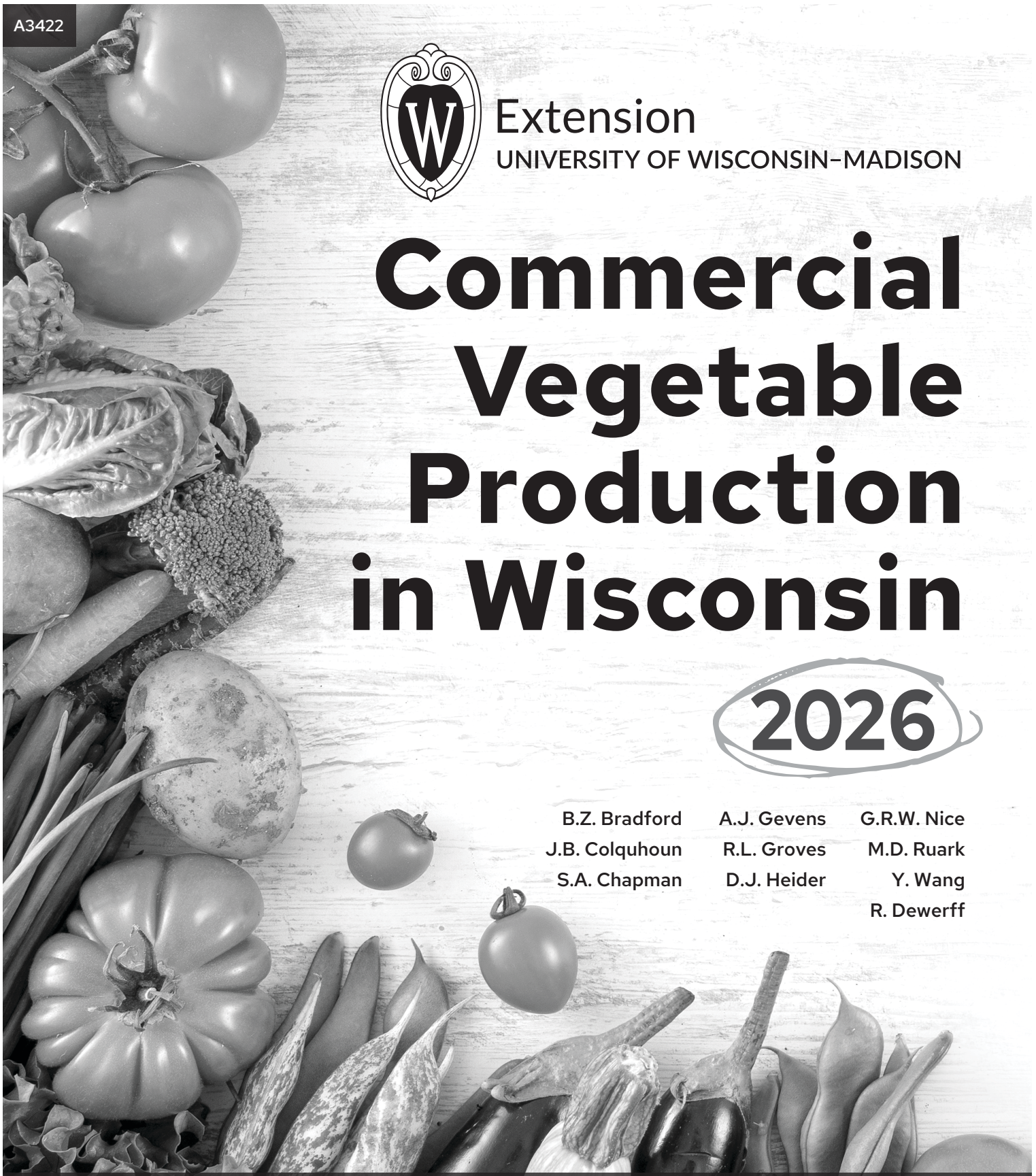
A3422

Extension
UNIVERSITY OF WISCONSIN–MADISON

Commercial Vegetable Production in Wisconsin

2026

B.Z. Bradford
J.B. Colquhoun
S.A. Chapman
A.J. Gevens
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M.D. Ruark
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R. Dewerff



ASPARAGUS • BEAN • CARROT • CELERY • COLE CROPS • CUCUMBER • EGGPLANT
HOPS • HORSERADISH • LEAFY GREENS • MELON • MINT • ONION • PEA • PEPPER
POTATO • PUMPKIN & SQUASH • SWEET CORN • TABLE BEET • TOMATO

Information current as of October 2025. Pesticide labels change often. This publication is not a substitute for the label. Always read the pesticide label prior to use.

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Contents

Best management practices for vegetable production 1
Irrigation management for vegetables 3
Insect identification 3
Natural enemies of insect and mite pests 7
Using blacklight traps and pheromone traps 13
Calculating degree days 14
Resistance management 15
Aster yellows index 16
Relative effectiveness and persistence of selected herbicides 16
Planning for next year—herbicide persistence and carryover 18
Pest management and pesticides 19
Crops
- Asparagus 36
- Bean: green, lima, navy, red kidney 43
- Carrot 65
- Celery 75
- Cole crops: broccoli, brussels sprouts, cabbage, cauliflower 83
- Cucumber 100
- Eggplant 123
- Hops 135
- Horseradish 147
- Leafy greens: lettuce, chicory, endive, escarole, and others 153
- Melon: muskmelon (cantaloupe), watermelon 164
- Mint 186
- Onion: dry bulb onion on high organic soils 193
- Pea 204
- Pepper 216
- Potato 226
- Pumpkin & squash 261
- Sweet corn 278
- Table beet 308
- Tomato 314

Insect key–immature stage 334
Insect key–adult stage 336
Abbreviations 339

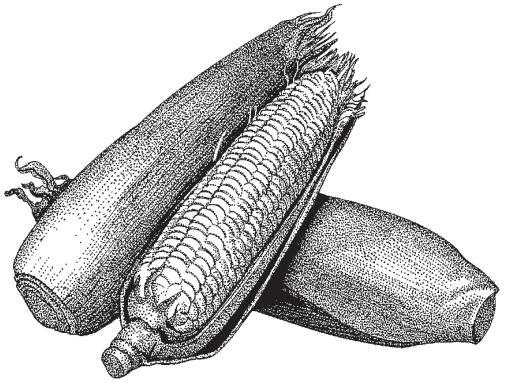
Pesticide information

Some pesticides containing the same active ingredients but having different trade names are marketed by more than one company. Also, some pesticides are produced in several formulations. Products mentioned in this publication are commonly used formulations of common pesticides. Other products and formulations may be equally good. Check labels on containers to determine whether the product is labeled for your intended use and to determine the amount of product to use per acre.

References to pesticides in this publication are for your convenience and are not an endorsement of one product over other similar products. You are responsible for using pesticides according to the manufacturer's current label directions. Follow directions exactly to protect the environment and people from pesticide exposure. Failure to do so violates the law.

Pesticides sometimes have restricted time periods for use, such as in a product recall or a use deadline. Always check pesticide registration status with the Wisconsin Department of Agriculture, Trade, and Consumer Protection.

To protect yourself, others, and the environment, always read the label before applying any pesticide.



Best management practices for vegetable production

Vegetable growers must use cultural practices that optimize yields, maximize returns and profits, and minimize environmental impacts. Maximum profits aren't always dependent on maximizing yields. For example, smaller yields of high-quality vegetables may generate a significantly higher profit than a large yield of marginal quality.

Common environmental problems that result from vegetable production include soil erosion from wind and water and groundwater contamination from pesticides and nitrates. Vegetable growers need to assume responsibility for protecting natural resources by reducing harmful impacts. Research has shown that using best management practices (BMPs) can reduce harmful impacts yet sustain profitable production.

BMPs are cultural practices that increase efficiency of inputs such as fertilizers (especially nitrogen and phosphorus), pesticides, and irrigation. By reducing inputs, growers lower their costs and the potential for fertilizer and pesticide leaching. The BMPs reviewed in this publication include crop rotation, tillage practices, fertility management, pest control, and irrigation management.

Crop rotation

Growing the same crop on the same land year after year is considered a poor practice that may lower crop productivity. The decrease in crop yield and quality may result from a buildup of certain crop pests and from changes in soil physical properties, such as compaction. Vegetable growers sometimes try to overcome this productivity loss by increasing fertilizer, pesticides, and irrigation, but increasing these inputs raises both costs and the potential for environmental problems.

Crop rotation is the cultural practice of growing a different crop each year on the same land. One goal of rotation is to avoid growing a given vegetable crop on the same land for at least 3 years. An example of a 2-year rotation program would be a cole crop (broccoli, cauliflower, or cabbage) in the first year, green beans or peas in the second year, and sweet corn in the third. The 3-year cycle could then be repeated.

Well-designed crop rotations help suppress pest problems and improve soil physical condition. Crop diversity effectively controls pests that have short survival periods and a narrow host range. Crop diversity and the resultant pesticide-use diversity also help to prevent the buildup of certain pest problems, particularly weed problems.

Adding organic matter from forage legumes or green manures rebuilds soil structure, adds nutrients (particularly nitrogen), and improves the soil's water and air balance. The result is more vigorous crop growth that can better resist pest and environmental stresses.

Potential crops to include in a rotation depend upon the individual grower's situation and will vary from grower to grower. Crop selection should follow these general guidelines:

- include both deep- and shallow-rooted crops;
- avoid crops with common disease or insect problems;
- use agronomic crops (field corn, oats, and soybeans) when possible; and
- include a forage legume (alfalfa, clover) when possible.

Finding the ideal rotation can be difficult. Production and marketing objectives, land availability, and financial conditions may dictate what rotations are feasible. More diversified and longer rotations can be effective in maintaining crop productivity while reducing production costs and the potential for harming the environment, particularly through groundwater contamination.

Tillage practices

Intensive soil tillage is often used in vegetable production. Depending on the crop, a given field may be subjected to as many as six different tillage operations in a growing season. Such intensive tillage can damage soil structure and increase compaction, especially when working on wet fields. Loss of soil structure increases the soil's susceptibility to wind and water erosion. Excessive tillage can also dry the soil's upper portions, causing poor germination, emergence, and early seedling growth.

Reducing tillage trips across the field protects the soil and reduces costs. Where possible, vegetable growers should try to implement conservation tillage (CT). This practice reduces tillage to maintain previous crop residue on the soil surface, which helps control soil erosion. However, CT can also increase problems with stand establishment, especially with processing vegetables, where a uniform stand is important. Previous crop residue can hinder the mechanical harvesting of vegetables. The effective use of CT requires a high level of management, and growers should begin by experimenting with CT on a small acreage of land.

Fertility management

The goals of effective fertility management are efficient use of soil and fertilizer-applied nutrients. Fertilizer programs should be designed to meet minimum crop needs. Excessive fertilizer applications must be avoided to maximize net returns. Excessive nitrogen and phosphorus applications must be avoided to minimize contamination of groundwater and surface water.

An efficient fertilizer program considers realistic yield goals to determine phosphate and potash needs. Fertilizing beyond realistic yield goals can reduce returns. Realistic yield goals are usually equal to the average yield for the past 5 years.

Base your fertilizer program on soil test results. These results will indicate the soil's potential for meeting the phosphorus and potassium needs of the crop, as well as some of the other nutrient needs. Only add fertilizer when the soil's nutrient supply fails to meet crop needs. In effect, the soil test results determine the fertilizer amount needed to meet yield goals. Adjust the fertilizer amounts to account for nutrient credits from previous crop residues or other nutrient additions such as manure.

Soil pH influences nutrient availability. Also, some crops are sensitive to different soil pH and development of certain diseases may be accelerated depending on the pH. Lime can be used to increase pH, but it must be added 6 to 18 months before planting crops that require the higher pH to be fully effective.

Fertilizer programs should also take into account fertilizer timing and placement. Generally, leachable fertilizer nutrients (especially nitrogen) should be applied just before the time of greatest crop need. Similarly, fertilizer placement should maximize uptake while minimizing leaching and tie-up by the soil. Row- and band-placed fertilizer often minimize soil tie-up while maintaining fertilizer availability. Some crops are sensitive to in-row nitrogen applications.

Finally, consider the fertilizer forms used. Some forms of fertilizer are less usable to crops, while in other cases the form may dictate specific placement or use considerations. For example, elemental sulfur is not available to crops until it is converted to the sulfate form (usually in 1 to 3 months).

The form of nitrogen fertilizer can be particularly important on sandy soils. Urea nitrogen is highly leachable as a neutral molecule. However, it is usually converted to the nonleachable ammonium form a few days after application. The ammonium is similarly converted to the highly leachable nitrate form over a 2- to 4-week period. In addition, urea nitrogen spread on the soil surface, without incorporation, can be lost by volatilization. Conversely, half the nitrogen in ammonium nitrate is immediately leachable, but this form is not lost by volatilization.

Some crops prefer specific forms of nitrogen. Potatoes, for example, show apparent losses in quality if supplied only with ammonium nitrogen. You must consider all the above factors if your fertilizer program is to become more efficient.

See Extension publication *Nutrient Application Guidelines for Field, Vegetable, and Fruit Crops in Wisconsin* (A2809) for additional information.

Integrated pest management

Effective pest management is essential in vegetable production because quality is as important as yield. Uncontrolled pest problems are a major cause of quality and yield losses in vegetables. To ensure profitable yields and quality, many vegetable growers tend to use more pesticides than are needed. Such excessive use leads to increased costs as well as an increased potential for environmental contamination.

Integrated pest management (IPM) is a BMP that can improve pest management efficiency, reduce pest management costs, and minimize dangers to the environment. IPM is a coordinated management strategy, using all suitable techniques to keep pest populations below economically damaging levels. IPM promotes the use of nonchemical control methods. These include using pest-resistant cultivars, well-designed crop rotations, pest-controlling tillage practices, adjusted planting and harvesting dates, exclusion with row covers, mulches, and plant spacing.

Unfortunately, not all pest problems can be controlled with nonchemical control methods. Chemical controls may be needed in order to achieve profitable yields and quality, but IPM ensures that pesticides are used only when necessary to prevent economic loss. Those using IPM monitor weather, crops, and pests in making pest control decisions.

Irrigation management for vegetables

A significant amount of Wisconsin's vegetable production is irrigated. Most of the irrigated vegetable production is on light sandy soils with shallow depths to groundwater. Such areas are sensitive to groundwater contamination by nitrates and pesticides. Excessive fertilizer (especially nitrogen) or pesticides and over-irrigation can increase groundwater contamination problems. Such overuse also adds costs from an increase in root and foliar diseases and unnecessary equipment operation.

Yield and quality losses occur when vegetables are subjected to moisture stresses. To avoid moisture stress, adequate amounts of water must be supplied to the crop throughout the growing season. Rainfall generally provides adequate moisture for vegetables grown on silt and clay loam soils. However, on sandy soils, a well-managed and efficient irrigation program must be used to avoid losses due to moisture stresses and overirrigation.

Efficient irrigation reduces costs and the potential for groundwater contamination problems. Effective scheduling (timing) of irrigation by using a program such as the Wisconsin Irrigation Scheduling Program (WISP; https://wisp.cals.wisc.edu) enhances irrigation efficiency.

Over-irrigation applies more water than the crop can use or the soil can hold. It is this excessive water that leaches nitrates or pesticides to the groundwater. Excessive or untimely rains also leach contaminants to groundwater. An effective irrigation scheduling program eliminates over-irrigation, so crop use of rain is maximized.

WISP uses estimates of crop water use to monitor soil moisture levels. The soil moisture status then determines the irrigation frequency and amount. WISP requires knowledge of four parameters for successful operation:

Allowable depletion (AD)—a measure of the soil's water storage. This is determined by soil type and crop rooting depth. A table is available that provides AD values for many crop/soil systems found in Wisconsin.

Rainfall—all rains must be accounted for in the WISP program. WISP now uses NOAA-derived rainfall values, but these can be manually altered if the user has a local rain gauge.

Irrigation—all irrigations must be recorded.

Evapotranspiration (ET)—a measure of crop water use. During the growing season, daily ET estimates are calculated for Wisconsin's major irrigated areas and are available online at https://agweather.cals.wisc.edu. Estimates should be adjusted to reflect the proportional canopy cover.

WISP uses the above parameters in a simple, checkbook-like accounting format to provide the needed information for making irrigation decisions. Specifically, WISP provides current soil moisture conditions that, in turn, determine the need for and amounts of irrigation. WISP also emphasizes the use of precipitation forecasts in making irrigation decisions. This approach ensures maximum flexibility in scheduling irrigations. Such flexibility is essential in Wisconsin, where weather patterns, particularly rainfall, are variable and changing. For more information about WISP, refer to Extension publication *Irrigation Management in Wisconsin—The Wisconsin Irrigation Scheduling Program (WISP)* (A3600) or visit https://wisp.cals.wisc.edu.

Insect identification

Aphids

Aphids are small 1/10–1/5 inch insects with two tailpipe projections (called *cornicles*) sticking out the abdomen. Both winged and non-winged forms can be found on plants. Large numbers cause plants to wilt and yellow. They also cause distorted and stunted plant growth. Most aphid species will go through numerous generations during the growing season. Aphids also transmit virus diseases to many plants. There are a number of important species in Wisconsin.

The **black bean aphid** is found in clusters on the undersides of succulent bean leaves. Large populations will cause yellowish foliage and poor growth of the crop. Because of the spotty nature of infestations in the field, a number of plants in several areas of the field should be examined. Check 15 consecutive plants (terminals only) in each site. Levels above 5 to 10% infested would indicate treatment is needed. Scout fields weekly.

Cabbage aphids are gray in color and live in closely packed groups. Heavy infestations cause leaves to curl and may prevent head formation. Aphid damage is most serious on young cabbage and in the seedbed. Once cabbage heads form, this insect is difficult to control.

Corn leaf aphids at first congregate on upper leaves and tassels, but later may be found over all parts of the plant. High numbers may occur on plants during ear filling, but this attack has little effect on yields. Treatment at this late stage will be of little or no benefit.

The **asparagus aphid** is a recent import from Europe that causes a brooming distorted growth of the ferns of asparagus.

It is bluish gray in color, and the cornicles aren't readily apparent. Normally only isolated plants are affected and can be spot treated.

The **green peach aphid** is the most destructive and insecticide-resistant aphid in Wisconsin. Many crops are attacked including greenhouse transplants of pepper, tomato, and cabbage, along with carrot, broccoli, brussels sprouts, lettuce, eggplant, potato, and table beet. Green peach aphids are 1/8 inch long, yellowish green, peach, or dirty red in color, and can be found on the undersides of leaves. This aphid is a very efficient vector of many virus diseases. Scouting is usually done by examining the undersides of leaves and looking for aphid activity.

In potatoes, remove 25 leaves per sample from the lower half of 25 different plants and sample at least 10 sites per field. Treat if more than 10 aphids are found per 100 leaves in seed fields or more than 30 per 100 leaves in table stock or processing potatoes.

Potato aphids are larger than green peach aphids and come in both red and green. They attack eggplant, tomato, and potato and are most often found on young, actively growing tissue. To sample for potato aphids, remove leaves from the terminal parts of 35 plants and count the number of aphids. Repeat in at least 10 locations per field. When aphid counts exceed 20 per 100 leaves in seed potato and 50 per 100 leaves in table or processing potatoes, control measures are suggested.

Melon aphid is a small dark aphid that can be found building up on the undersides of leaves of cucumber, squash, pumpkin, and melon. They can produce up to 10 generations per year and cause infested plants to yellow and wilt. Low numbers are most often controlled by natural enemies.

Armyworms

Armyworms are dark caterpillars measuring up to 2 inches long. They have a dark stripe running lengthwise on the side with a yellow stripe beneath. Dark and light stripes alternate along their back. Armyworms move up from grassy weeds within cornfields or migrate into cornfields from small grain or forage fields. They may hide in soil crevices and beneath clods by day. At night, they chew corn leaves and weaken plants.

Beetles

The **striped and spotted cucumber beetles** are 1/4-inch yellow-green beetles that become active in very early spring. Adults feed on developing fruit and foliage and, more importantly, transmit bacteria causing wilt disease. Small numbers of beetles can devastate a planting if they carry the disease, and they must be controlled before the disease appears. In the fall, adults of these beetles can chew holes in the developing fruit of vine crops such as cucumber, melon, pumpkin, and squash.

Flea beetles are frequently a pest of early plantings. These small, shiny black beetles jump when approached and chew small circular holes in leaves. This damage is insignificant on large potatoes and tomatoes, but young seedlings can be rapidly killed.

Young seedlings or transplants of cabbage, broccoli, table beet, tomato, eggplant, and all vine crops should be scouted on a weekly basis when they are young. If flea beetle activity is seen, an insecticide rescue treatment will be needed.

Common asparagus beetles are 1/5 inch long and orange, with a back showing white dots on a dark background. They overwinter as adults and emerge in April (earlier than the spotted asparagus beetle) and begin feeding and laying eggs on the spears. **Spotted asparagus beetle** adults may feed on spears but do not begin laying eggs until the plants have ferned out. When both species are present, both the spears and ferns can be heavily damaged.

Cabbage maggot

The adult **cabbage maggot** is a small gray fly that lays its eggs at the base of crop plants in the cabbage family. The small, cylindrical white eggs hatch into legless white maggots that feed on the roots. Seedling plants can be killed rapidly, while transplants tend to wilt and die slowly. Root crucifers such as radish and turnip show surface tunneling that is often accompanied by soft rots.

Chemical controls require either soil application to seed furrows or transplant drenches. However, these treatments last for only 4 to 5 days and must be applied when the adults are actively laying eggs.

The cabbage maggot has three generations in Wisconsin. The first emergence of adults from overwintering pupae is the largest and most damaging, therefore you want to plant after the pupae have emerged. This emergence and the egg-laying peak may be predicted accurately by keeping track of the degree days. Cabbage maggots do not develop below 43°F (developmental threshold). Peak emergence of first-generation cabbage maggots occurs when 300 degree days have accumulated. For more information, see "Calculating Degree Days" on page 14. If planting is necessary during the time of peak emergence, then insecticide treatments are recommended.

Colorado potato beetle

The Colorado potato beetle is the most distinctive pest of potatoes. Both the yellow-and-black striped adults and the brick-red humped larvae feed on the foliage. Feeding normally is initiated on the terminal growth and can be severe. Adults overwinter and move to emerging potatoes early in the spring (May). The adults lay bright yellow egg masses, and larvae feed for several weeks in the summer before pupating in the soil. Emerging adults then continue feeding throughout the season until no vines remain.

Common stalk borer

Eggs of this cutworm relative are laid in grassy weeds in September. In late May to July, the brown-and-white striped caterpillars migrate into fields and burrow into the stems of tomatoes, potatoes, beans, and other thick-stemmed plants. Once inside the stem, the insect cannot be controlled. Fall grass control will prevent egg laying and is the best control method for common stalk borer.

Corn rootworm

Rootworm larvae are white with black heads and grow 1/2 inch long. **Northern and western rootworm** larvae cannot be differentiated in the field. They feed on crown roots from June to August, causing corn to lodge and "gooseneck."

Rootworms are most serious in loam soils but are of little consequence in muck or non-irrigated sandy soils. The larvae are not a potential problem unless corn is planted on the same ground in a "rootworm area" for 2 or more years in succession. Annual crop rotation controls these insects, because eggs overwinter in the soil.

The adult beetle of the northern rootworm is yellow to green. The western species is yellow with three black strips. Because rootworm adults congregate in ear tips to feed on silks, large populations in August can impair corn pollination. If there are five or more beetles per plant (check silks), cornfields should be treated during the early silk period. This appraisal should be made prior to 75% silking.

Late-season corn borer and earworm treatments reduce adult rootworms and eggs. Other fields may receive an economic population of overwintering eggs if 0.75 or more adults per plant are present around mid-August.

Cutworms

These are the larval stage (caterpillar) of night-flying moths. They are whitish gray to brown worms, ranging from 1/2 to 2 inches long. They feed almost exclusively at night and hide in the soil during the day. All cutworms curl to a characteristic tight ball when exposed, making them easy to identify. Most cutworms cut plants off at or slightly below the soil surface, making recent transplants especially susceptible. Eventually, plants become too thick and tough for cutworms to feed. Adult females are attracted to tall grasses for egg laying, and cutworm numbers tend to be higher in weedy or trashy fields.

Almost all commercial vegetable crops such as asparagus, carrots, celery, onions, potatoes, and table beets can be attacked by cutworms. It is very difficult to predict when and where an infestation will spring up, and preplant insecticide treatments will not control heavy cutworm infestations. Scouting fields on a weekly basis is the best method for monitoring cutworm activity. If damaging populations are found, a "rescue" treatment will be needed. Bait formulations are the preferred treatment if conditions are dry, whereas both baits and sprays can be used when the cutworms are feeding at the soil surface.

Earworms

These smooth, varicolored caterpillars are up to 2 inches long and feed mostly on ear tips. Insecticide treatment is necessary for early market sweet corn and for late-season canning or market sweet corn (silking after August 15).

European corn borer

Corn borers are small white worms with black heads. In sweet corn, they hatch from egg masses on leaves and can grow to 1 inch. First-generation borers feed on whorl leaves during early summer, making small holes that show as the leaves grow. If uncontrolled, they also feed inside the stalk and ears. Second-generation borers invade ears and hide behind leaf sheaths. They also enter the stalk and ear shank as the shanks mature.

The best procedure for detecting damaging levels of egg-laying adult corn borers is to operate blacklight traps in a field and count trapped moths daily.

Hornworm

The tomato hornworm is a very large green worm (up to 3 inches) with a spine on the posterior end and white side stripes. The larva feeds on both foliage and fruit, and because each larva eats three to four times its weight in food daily, the damage appears dramatic. The adult stage of this insect is a gray hawk moth that is often mistaken for a hummingbird because it feeds on flowers. Because they are usually found in small numbers, hornworms rarely need control.

Leafhoppers

Potato leafhoppers are small (1/8 inch) wedge-shaped, bright green insects that blow up into the state every spring from the southern states. They may arrive anytime from late May to early July. Potato leafhoppers have a toxic saliva that causes injury to many plants. Leafhopper feeding will cause leaf edges to curl and turn yellow, and leaves may eventually brown and die. This "hopperburn" is most serious on potatoes, dry beans, and green beans. Fields should be scouted on a weekly basis to monitor for this pest.

Potato leafhoppers are best sampled with an insect sweep net. For potatoes, take 25 sweeps and carefully turn over 25 leaves per sample site. Select leaves from the middle portion of the plant. Use at least 10 sample sites per 100 acres. Control measures are recommended when a field averages one to two adult leafhoppers per sweep and there are more than 15 nymphs per 25 leaves, or if there are three or more adult leafhoppers per sweep and nymphs are present.

For green beans, take 25 sweeps per sample site with at least 10 sample sites per 100 acres. Nymphs are less mobile and are best scouted by leaf samples. Carefully turn over 25 leaves per sample site and count nymphs. Select leaves from the middle of the plant and sample at least 10 sites per 100 acres. If counts exceed one leafhopper per sweep and one nymph per 10 leaves, then control measures are recommended.

The **aster leafhopper** is an olive, wedge-shaped insect that is 1/6 inch long and has six black spots on the vertex of the head. This leafhopper also migrates from southern states and carries the pathogen that causes carrot (aster) yellows disease. Aster yellows can be a serious problem on carrot, lettuce, celery, onion, and potato. For most crops, it is important to control the disease before symptoms show in the field. For susceptible crops such as lettuce and celery, one or two insecticide applications per week may be needed from seedling stage until harvest. (For more information, see the "Aster Yellows Index" section on page 16.)

Onion maggots

Onion maggots are small whitish larvae found in the bulbs of onions. The adult is a grayish fly that resembles the cabbage maggot. Onion maggots are a problem after a series of cool, wet springs. The most effective way to control these insects is to apply an insecticide in the furrow when planting.

Plant bugs

Plant bugs are 1/4-inch tan to dark brown oval insects with piercing sucking mouthparts. They attack more than 50 different economic crops but are most damaging to strawberries, peppers, and all bean crops in Wisconsin. Feeding by these insects causes poor fruit set and gnarled fruit due to the toxic saliva they inject into the plant. They are highly mobile insects that overwinter in field debris. Large numbers of adult plant bugs migrate out of alfalfa fields when hay is cut.

For both potatoes and commercial beans, take 25 sweeps with an insect sweep net per sample site with at least 10 sample sites per 100 acres. When counts exceed one tarnish plant bug per sweep on a field average, control measures are recommended in potato and green bean.

Seed corn maggot

Seed corn maggot is by far the most serious pest of all beans. The white legless maggot burrows into the seed or seedling, causing very poor seed germination and emergence, and/or stems without leaves (snake heads). The adult is a small grayish fly that looks identical to the cabbage maggot. This insect overwinters in the pupal stage in the soil and becomes active early in the spring. Heaviest plant damage occurs during cool damp weather, in heavy organic soils, and after peak adult flights. There are five generations per year, but most severe damage occurs in May and June. Peak activity of each generation can be predicted using base 39°F degree days (360, 1,080, and 1,800 degree days for first, second, and third generations, respectively). But since damage is severe for each of the first three generations, it is seldom possible to avoid activity periods.

You can reduce damage by planting seeds during good germinating weather, using seed treated with insecticide, or sowing seed in higher than normal numbers. Planting seeds too early or directly into manure frequently increases problems with this insect. Other crops attacked include peas, corn, vine crops, and crucifers, but beans are the preferred host. For other hosts, damage is most severe when plants are planted before the recommended date or during cool springs.

Thrips

Thrips are small 1/25-inch insects that cause whitish scratches or brownish blotches on plant leaves. Hot, dry weather is correlated with severe thrips problems. Thrips attack cabbage and cause a brownish scarring in the head of processing cabbage. Thrips must be controlled before the plant heads out in order to assure proper coverage and control. In onions the injury looks similar to both ozone injury and some diseases. Use large-volume sprays (100 gal/a) with a wetting agent for thrips control. A second treatment 5 to 7 days later may be warranted.

White grubs

This insect, which is the larval stage of the June beetle, has up to a 3-year life cycle. Because the adults lay eggs in grassy sodded areas, fields located in plowed-down sodded areas are most susceptible. The characteristic C-shaped grubs feed on the roots of most plants. They are most damaging to root crops such as carrots or potatoes. Tilling the soil to expose the larvae during the spring and fall helps reduce numbers. Granular insecticides can be worked into the soil before planting in areas where damage is expected. Established weed-free fields should have few problems.

Wireworms

This insect is the larval stage of the click beetle and, like the white grub, lays eggs in grassy areas. Wireworms are also troublesome in low, poorly drained areas. Weed control is the best preventive measure. Control procedures for white grubs will also control wireworms. Potatoes and carrots are the most susceptible crops. Grassy or old sod fields will have high populations of wireworms. A soil insecticide should be worked in preplant in these fields.

Natural enemies of insect and mite pests

Biological control is the active utilization of beneficial living organisms to control pests. The beneficial organisms we use are usually referred to as "natural enemies" of the pests and are placed in three broad groups: predatory insects, parasitic insects, and insect pathogens. In the upper Midwest, literally hundreds of types of natural enemies occur naturally in the environments of agricultural crops, managed forests, and managed urban and suburban landscapes. These have a major impact on pest populations, and often result in pests being kept below damaging levels. When there is no human activity involved in managing these natural enemies, we refer to the results as "natural control" of the pests. Natural control is of major importance in pest management, but the benefits frequently go unrecognized because the natural enemies are often very small and their activity is easily overlooked.

To get the greatest benefit from both natural control and biological control, it is necessary to recognize natural enemies and understand their biological characteristics (such as life cycle, preferred host insects, and efficiency at controlling pests). Some natural enemies, such as lady beetles, are readily recognized in the adult stage by most people but may not be recognized in the egg, larval, or pupal stages. Other natural enemies, including most parasites, are much more difficult to recognize.

Although birds, mammals, frogs, and other higher animals can be important as natural enemies, they can rarely be effectively managed for biological control. These animals lie outside the scope of this discussion, which deals primarily with the predatory or parasitic insects of pest insects and mites.

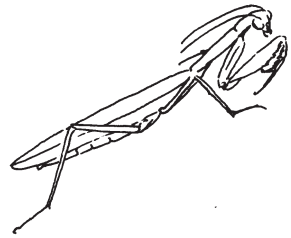
Predatory and parasitic insects

There is a very large number of different types of predatory and parasitic insects. A standard reference book about insects lists a total of 328 families. Between one third and one half of these families contain species that are predaceous or parasitic on other insects. Many of these families, however, are of little or no consequence to agriculture. For example, there are seven families of dragonflies. All species of dragonflies are predaceous on small insects, capturing them in flight, and are important regulators of population numbers of small insects such as gnats, midges, and mosquitoes. However, the diet of dragonflies does not usually contain a significant number of agricultural pests. Therefore, a smaller number of families consist of important natural enemies of agricultural pests, and these are the ones that will be covered here.

The praying mantids (Order Mantodea)

Praying mantids are all predatory on other insects. They have highly modified and strengthened front legs for capturing and subduing their prey, and they have chewing mouthparts. Large mantids can inflict a painful bite if handled. They all belong to the family Mantidae.

Family Mantidae: The praying mantids



Chinese mantid

Mantids are among the most recognizable of predaceous insects. They are often thought to be highly beneficial. However, they are opportunistic feeders, consuming whatever comes into their grasp, including other natural enemies, pollinators such as honeybees, and completely innocuous insects, as well as occasional pests. They are also cannibalistic and will readily consume each other.

Mantids are not native to areas of extreme winters and cannot naturally be found in Wisconsin. Those that are introduced, such as from commercial suppliers, will not survive northern winters.

Mantids have only one generation per year and overwinter as eggs in cases that contain from several dozen to several hundred eggs. It is in this form that they are distributed commercially. These purchased egg cases are distributed outdoors to hatch and populate the area through natural movements of the young. Because of their cannibalistic behavior and their rapid dispersal to avoid cannibalism, rarely can more than one or two be found in the vicinity of the original egg case. This, in combination with their indiscriminate predation on beneficial and innocuous insects as well as pests, renders them virtually useless as effective natural enemies of garden or crop pests.

The true bugs (Order Hemiptera)

All of the true bugs undergo simple metamorphosis, meaning that the immature stages (called *nymphs*) look like small, wingless versions of the adults. All have piercing-sucking mouthparts, meaning that they suck body fluids from their prey rather than chewing it up. Some Hemiptera are serious crop pests and others (such as bedbugs) are pests of human health and livestock. Some predatory Hemiptera can inflict a painful bite if mishandled, sometimes resulting in severe inflammation of the area surrounding the bite, which may persist for several days.

In all predatory Hemiptera, both the nymphs and the adults are predaceous and often can be found in the same general habitat feeding on similar types of insects, although the young nymphs usually require smaller prey. Some predaceous Hemiptera feed to a small extent on plants, sucking plant sap, but there are no indications that this causes plant damage.

Family Anthocoridae: The pirate bugs

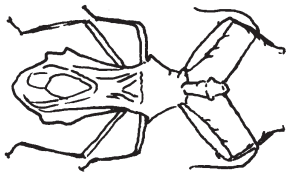
These are tiny insects, only 1–2 mm in size. Nymphs and adults feed on mites, small insects, and eggs. They are very common in many agricultural situations, especially where broad-spectrum insecticides are not routinely used, and are considered to be very beneficial general predators.



Minute pirate bug

Orius insidiosus, the minute pirate bug, is probably the most important species in our region. It is an important predator of thrips, aphids, and spider mites on many crops. It is also an important predator of insect eggs. It is considered to be one of the more important natural enemies of corn earworm and can destroy 50% or more of the eggs of this pest. Both the young and adults of *Orius* can consume 30 or more spider mites per day.

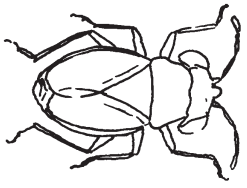
Family Reduviidae: The assassin bugs



Assassin bug

Some assassin bugs are parasitic bloodsuckers of mammals and have been implicated with the transmission of serious human illnesses. However, most species are highly beneficial predators of many serious crop pests. These are medium-sized bugs (up to about 1 inch long) and can subdue and kill medium-sized caterpillars and similar insects. They are generalist predators frequently found in gardens and fields.

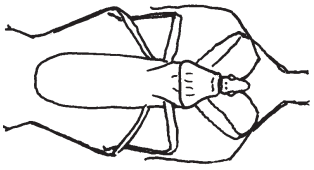
Family Lygaeidae: The seed bugs and bigeyed bugs



Geocoris

This family consists of both plant-feeding insects as well as predators. Many of the plant feeders feed specifically on fruits or seeds, hence the common name. The bigeyed bugs occur in the genus *Geocoris*. These are very beneficial predators that occur in many habitats and feed on many types of prey. *Geocoris punctipes* has been noted to feed on as many as 1,600 spider mites during the course of its nymphal development and an additional 80 mites per day as an adult. Bigeyed bugs are found in many agricultural situations, especially where broad-spectrum insecticide use is minimal, and in many non-crop situations.

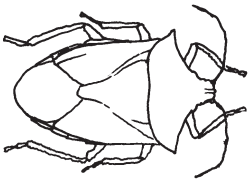
Family Nabidae: The damsel bugs



Damsel bug

This is a small family of general predators commonly found in many crop and garden situations. Adults are 1/3–1/2 inch in length and slender bodied. The tan-colored *Nabis ferus* is a common species in our region. It feeds on many types of insects, ranging from leafhoppers to small caterpillars. Some other species of damsel bugs are black in color.

Family Pentatomidae: The stinkbugs



Stinkbug

Stinkbugs are medium-sized insects with a broad, shield-shaped body. They are usually green or brown but are sometimes brightly colored. Many discharge a disagreeable odor, especially when handled, hence their common name. Many are plant feeders and some of these are serious pests on a variety of crops. However, some species, especially in the genera *Podisus* and *Perillus,* are important predators. *Podisus maculiventris* and *Perillus bioculatus* both feed on caterpillars and larvae of leaf-feeding beetles such as Colorado potato beetle and Mexican bean beetle. These are highly efficient predators capable of consuming many prey during the course of their development. *Podisus* has two generations per year, and each female can have 1,000 or more offspring. The eggs are laid in clusters on leaves. The young are small and round. The youngest nymphs of some predatory pentatomids may feed to a limited extent on leaf sap, but such feeding is not damaging.

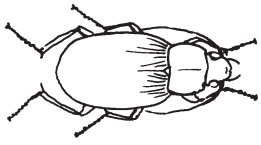
The beetles (Order Coleoptera)

The order Coleoptera is the largest group of insects in the world, constituting about 40% of all known insect species. There are about 30,000 species in the United States. The habits of this group vary considerably: many are aquatic, many are found in the soil, some are parasitic, and many are free living. Many are plant feeders and some are serious pests. Some feed on fungi or are scavengers. Many are predators of other insects.

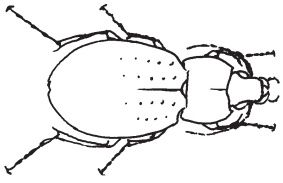
All beetles undergo complete metamorphosis, meaning that the immatures look nothing like the adults; instead they are wormlike or grublike. Depending on the species, larvae and adults may do similar or very different things. For example, both the adults and larvae of lady beetles are predatory, usually on the same types of prey. However, while blister beetle larvae are parasitic on grasshopper eggs and ground-nesting bees, the adults are generally plant feeders.

Approximately 40 families of beetles are known to have predatory or parasitic members. In some families, insect feeding may be only incidental, while in other families it is the rule. By far, the two families most important in crop protection are the predaceous ground beetles (family Carabidae) and the lady beetles (family Coccinellidae).

Family Carabidae: The ground beetles



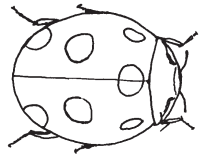
Chlaenius



Calosoma

Ground beetles vary in size from a few millimeters to over an inch in length. Most species are brown or black, but a few are metallic blue or green. There is generally one generation per year, but the adults of larger species are known to live 2 to 4 years. The larvae of some species may require more than 1 year to complete development. Carabids can be found in most agricultural and garden settings. Most species that have been studied are predaceous as both larvae and adults, although some are scavengers and a few feed on plants. The predatory species feed on insects found in or on the soil, earthworms, and similar small invertebrate animals. Many insects, even leaf-feeding insects, spend part of their life cycle in the soil or under leaf litter, especially to pass the pupal stage or to overwinter. Such insects often suffer a high degree of natural mortality at such times, and several studies have shown that ground beetles are important contributors to this natural mortality.

Family Coccinellidae: The lady beetles or ladybirds



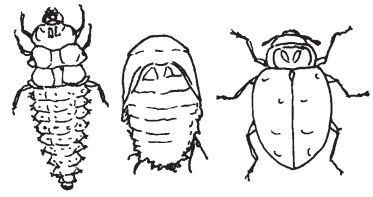
Lady beetle

Although frequently called *ladybugs*, these insects are not true bugs and therefore the other common names are preferred.

The lady beetles are a large group containing many important natural enemies. Although most are predaceous as both larvae and adults, a few are fungus feeders and a few feed on plants, including a couple of important pest species such as the Mexican bean beetle.

Predaceous lady beetles feed primarily on aphids, scale insects, mealybugs, and whiteflies. There are specialized lady beetles that limit their feeding to other prey groups, such as small caterpillars and leaf beetle larvae. Although most common species feed primarily on aphids and similar insects, other types of prey will occasionally be taken. Spider mites can be an important supplemental prey of many species of aphid-feeding coccinellids. Adult lady beetles also tend to feed on nectar and pollen taken from flowers.

Lady beetles overwinter in the adult beetle stage. Some species, such as our native convergent lady beetle, *Hippodamia convergens,* are known to congregate in enormous clusters. Other species overwinter singly or in small clusters. In spring they seek out the aphids or other hosts that will be both adult and larval food. Eggs are laid adjacent to the prey. Many deposit spindle-shaped eggs, laid on end on the leaf surface. Some species scatter individual eggs while other species lay in compact clusters of 10 to 20 or more. The eggs of the aphid-feeding species are usually yellow to orange in color, and 1.0 to 1.5 mm long. Eggs usually hatch in 3 to 7 days.



Larva *Pupa* *Adult*

Convergent lady beetle

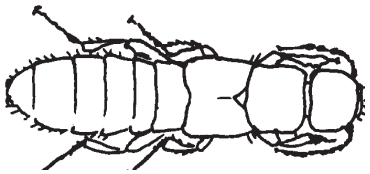
Lady beetle larvae are not as frequently recognized as are the adults, an unfortunate circumstance because they are just as important as the adults in natural control. The larvae of the aphid-feeding species are somewhat slender, with the body tapering to a point at the rear. Depending on species and stage of development, they will be 1/8 to 1/2 inch in length. The color is usually black or dark gray, but there usually are conspicuous, red, yellow, orange, or blue markings. The prominent legs are held to the side. The predators of mealybugs and scale insects may not be as conspicuous, as they are often covered in a white waxy coating similar to that of the prey insects. Larval lady beetles normally consume 500 to 1,000 aphids or similar prey during their growth.

If prey are abundant and temperatures warm, most lady beetle larvae complete development 2 to 4 weeks after egg hatch. When done feeding, the larvae

pupate in the same location. The pupal stage also is unrecognized by most people. The pupal period lasts about 1 week; the entire life cycle takes about 4 to 6 weeks. Generally, there are two to three generations per year, more in warmer areas with longer growing seasons.

There are many species of beneficial lady beetles in the north central United States, and only a few brief examples can be discussed here. The convergent lady beetle is one of the most common throughout the United States and is a very important predator of aphids and other pests. Recently, a large lady beetle from Europe was introduced into the United States for aphid control. *Coccinella septempunctata*, sometimes called *C-7* (derived from the scientific name), has rapidly become established and spread throughout much of the region. It is very noticeable because of its large size. The multicolored Asian lady beetle, *Harmonia axyridis*, is another introduced species. It is a specialized predator of aphids infesting trees such as fruit trees. It tends to congregate near buildings in the fall of the year and can sometimes be a bit of a nuisance. This is another reddish orange lady beetle, but the pattern and number of black dots of this species are variable; indeed, some have no black dots at all. Members of the genus *Stethorus* are only a few millimeters long and black in color, and therefore are not very conspicuous. As both larvae and adults, these are important predators of spider mites and are capable of consuming many mites during their lives. The twice-stabbed lady beetle is small and shiny black, with a bright red spot on either side of its body, hence the name. It is an important predator of scale insects and other pests. It is frequently seen in association with cottony maple scale and is undoubtedly important in control of this pest of silver maples.

Family Staphylindae: The rove beetles



Rove beetle

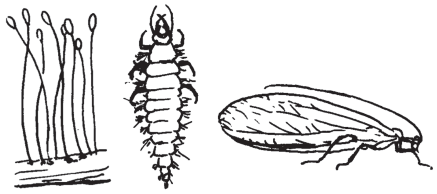
This is the largest family of North American beetles, with about 2,900 species. Most are quite small and of cryptic habits. Most are thought to be predaceous, although many are probably scavengers. Although these are small insects, usually less than 1/4 inch in length, they are quite recognizable because of their slender, usually black body, shortened front wings (elytra), and behavior of curling the tip of the abdomen upwards when disturbed or running.

Most rove beetles are found in association with soil or decaying organic matter. Many are predaceous or parasitic and undoubtedly help reduce populations of filth flies. Several occur in agricultural soils where they probably feed on a variety of types of prey. A few species can be found in vegetation where they feed on many types of small insects.

Lacewings, antlions, and others (Order Neuroptera)

The order Neuroptera contains several small families, most of which are predaceous or parasitic as larvae and predaceous as adults. Most families provide no appreciable benefit to agriculture, but two families of lacewings are quite important.

Family Chrysopidae: Green or common lacewings



Eggs *Larva* *Adult*

Green lacewing

Green lacewings are common throughout the United States and are frequently found in fields, orchards, and gardens. Both adults and larvae are important predators of aphids and other small insects. The adults, which are often attracted to lights at night, have pale green bodies about 1 inch long, large, clear, membranous wings with green veins and margins, and long hairlike antennae; the eyes are often golden and the body is slender and soft. The most commonly seen species are in the genus *Chrysoperla*.

The oval white or greenish eggs are readily recognized because each is attached to a slender, hairlike upright stalk, usually about 1/3 inch in length. Although most species lay their eggs singly, some lay their eggs in clusters. The eggs are usually laid on foliage near colonies of aphids or other prey. The eggs hatch into small, gray, slender larvae that are called *aphidlions*. These larvae have enlarged sickle-shaped mouthparts used to puncture the prey and suck out the internal fluids. The larva ultimately grows to about 1/2 inch in length and then spins a spherical silken cocoon, usually on the underside of a leaf, within which it pupates. The entire development period is about 1 month, and there can be from one to several generations per year, depending on species and location.

Green lacewings are highly beneficial insects found in many types of crop and garden situations. They are also raised in commercial insectaries and can be purchased for biological control. Usually it is the egg stage that is sold.

Family Hemerobiidae: Brown lacewings

These are similar to green lacewings in general appearance but are brown in color and are smaller. The eggs are not stalked as in green lacewings. Brown lacewings occur both in field and forest situations but are not as common in agriculture as are chrysopids. Both larvae and adults feed on aphids and other small, soft-bodied insects.

Flies, gnats, midges, and others (Order Diptera)

The flies constitute one of the largest groups of insects, and they are very diverse in their habits and habitats. Approximately 35 families are known to contain species that are predatory or parasitic on other insects. Some of these occur primarily in aquatic or semiaquatic environments where they feed on other insects in those areas, including mosquitoes, blackflies, and other public health or nuisance pests. Only those families that are commonly encountered or important in pest management are discussed here.

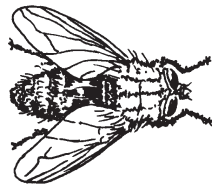
Family Syrphidae: The hoverflies



Syrphid fly

This is a large family of common insects. The adult flies are small to medium in size, with the body often striped yellow and black: some resemble bees or wasps. They are often seen on or hovering near flowers, and the adult flies feed exclusively on flower nectar and pollen. Although the biological habits of the larvae are quite diverse, many are predaceous on aphids, scale insects, and other insects. The aphid predators are quite common. These pale green to yellow maggots have a sluglike appearance, and the larger species become 1/2 inch long. Some studies indicate that larvae consume as many as 400 aphids during development. Some larvae pupate on the foliage near the feeding site, while others leave the plant and enter the soil to pupate. The puparium is often teardrop shaped. The life cycle takes 2 to 4 weeks to complete.

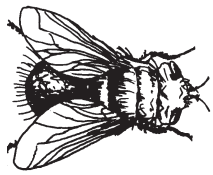
Family Sarcophagidae: The flesh flies



Flesh fly

This is a large family of medium to large flies. They somewhat resemble houseflies but are often gray-and-black striped and distinctly bristly. When they occur in numbers, they can be a significant nuisance because of their persistent droning and inclination to land on food and people. The larval habits are diverse, with some species breeding in carrion and others being parasitic on higher animals. Many species, however, are specialized parasites of other insects. Of the parasitic species, the largest group of hosts are the grasshoppers, and both nymphs and adults can be parasitized. Hosts of other sarcophagids include larval and adult bees (including honeybees and bumblebees), beetles, and caterpillars. One of the most common insect-parasitic sarcophagids in the northern United States attacks the forest tent caterpillar. During outbreaks of the host insect, this large fly occurs in abundance and is considered a nuisance by local residents. However, it provides significant control of the pest.

Family Tachinidae: The tachinid flies



Tachinid fly

This family is by far the largest and most important group of flies, with over 1,300 species in North America. All species are parasitic in the larval stage, and many are important natural enemies of major pests. Many species of tachinids have been introduced into North America from their native lands to suppress populations of alien pests. Tachinid flies are variable in color, size, and shape, but many resemble houseflies. They are usually housefly shaped and gray, black, or striped, often with many distinct abdominal bristles.

Tachinids are usually fairly host-specific, and, as a family, most frequently attack caterpillars and adult and larval beetles. Sawfly larvae, various types of true bugs, grasshoppers, and other types of insects are also attacked. Egg formation and oviposition varies considerably, with most species laying eggs on, in, or near the host. Many tachinids exhibit an unusual trait in which the eggs mature within the mother fly, which then lays eggs that immediately hatch. In some species, egg hatching actually occurs within the mother fly, and she gives birth to living young, a behavior called *larviposition*. Egg and larval development are rapid for most tachinids, and pupation often occurs within 4 to 14 days after oviposition. The pupal period generally lasts 1 to 2 weeks. Many species are capable of several generations per year, but others are restricted to only one generation, especially if their hosts have only a single generation. Most, if not all, tachinids are internal parasites within their hosts. Most species are solitary, but some have anywhere from two or three up to a dozen or more capable of developing from a single host.

Wasps, ants, and bees (Order Hymenoptera)

The order Hymenoptera is divided into two suborders. The smaller consists of the sawflies and horntails. Most of these are plant feeders, and many are serious pests of agricultural and horticultural plants and forest trees. The larger group consists of the bees, wasps, and ants. There are several families of bees, and all feed primarily on nectar and honey. The ants are in a single family (Formicidae) of diverse habits, but many species are predaceous on other insects, and some are very important in natural control. The wasps are a very diverse group of over 50 families, most of which feed entirely on other insects. The Hymenoptera is the second largest group of insects. Over 16,000 species are known from the United States and Canada; the majority of species are parasitic on other insects. Many of the parasitic species are very tiny and easily overlooked. These are commonly called *microhymenoptera*, and, because of their small size (as small as 0.5 mm, or 1/50 inch), many are as yet unknown to science.

As an order, the Hymenoptera are the most beneficial of all groups of insects. Bees provide honey and wax, and pollinate our crops. The parasitic wasps are the most important group of natural enemies of pest insects. Many different species have been transported around the world for control of alien pests, and several species are commercially available for the control of specific hosts.

All Hymenoptera undergo complete metamorphosis, having egg, larval, pupal, and adult stages. The most important natural enemies are the many families of parasitic wasps, or "parasites." In these the larval stage develops in and kills a single host insect. Some adult parasites also feed on insects, usually the same species which are host to the larval stage; this behavior is called *host feeding*. Although it may seem inefficient that each larva kills only one host insect, most females can lay many hundreds of eggs, resulting in the death of an equal number of host insects. By reproducing so rapidly, they efficiently overtake increasing host populations and therefore often are able to suppress pests below injury levels.

The behavior of parasitic Hymenoptera is quite complex. Many are highly selective to a single species of host insect or a narrow range of related hosts. The adult females often have highly developed means of locating the hosts that they will parasitize. This searching ability is important because it means that adult female wasps can locate and parasitize hosts at low host densities, another important factor in keeping pest populations low.

The hosts of the parasitic Hymenoptera are diverse and include almost all groups of terrestrial insects. The important agricultural groups such as caterpillars, beetles, sawflies, aphids, and scale insects are frequent hosts. Depending on the parasite species, virtually any host stage can be attacked: egg, nymph, larva, pupa, or adult.

Although we have thus far discussed primarily the parasitic wasps which, because of their small size are frequently overlooked, many of the larger wasps that are more frequently recognized because of their bright colors and ability to sting, also kill other insects. These larger wasps usually develop a cell of some sort for their larvae and provision these cells with food. In the predatory species the adults forage for insect prey to take back to the cell to feed the young. Many of the larger wasps are social insects, and some can have quite large colonies.

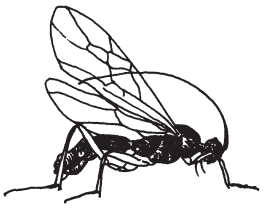
Family Ichneumonidae: Ichneumon wasps



Cryptus

This is one of the largest families of insects. All species are parasitic on other insects. As a group ichneumonid wasps are larger in size than many other parasitic wasps. They parasitize a variety of insects in several insect orders, but the Lepidoptera (moths and butterflies) and Coleoptera (beetles) contain the largest numbers of hosts. Many ichneumonid females have elongate, very noticeable ovipositors.

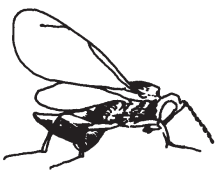
Family Braconidae: Braconid wasps



Rogas

Another large group and closely related to the ichneumonids, the braconids also are exclusively parasitic. Many are very important parasites of major agricultural pests, such as caterpillars, various beetles, aphids, fly maggots and other insects.

Superfamily Chalcidoidea: The chalcid wasps



Pteromalid

This is actually an assemblage of several specialized families. Most species are insect parasites, but a few, such as alfalfa seed chalcid, are plant pests. Most are quite tiny insects and attack fairly small hosts, including aphids, scale insects, fly larvae, leafminer larvae, small caterpillars, and many other types of insects. Some chalcids are so tiny they complete their entire life cycle in the egg stage of their host insect. This is true of all species of the families Mymaridae and Trichogrammatidae. Trichogramma species attack the eggs of many types of serious pests, especially caterpillars. Trichogramma are commercially mass produced and are widely used in biological control programs in Europe and Asia, and to a lesser degree in the United States.

Using blacklight traps and pheromone traps

Trapping is very important to any monitoring and pest management program. Blacklight traps use light to attract nocturnal insects while pheromone traps use "odors," or pheromones, to attract certain other insects. Blacklight traps are useful for monitoring European corn borer, armyworms, cutworms, and other nocturnal insects. Vegetable insects that can be monitored with pheromone traps include armyworms, black cutworm, cabbage looper, corn earworm, diamondback moth, and variegated cutworms.

Blacklight traps

Blacklight traps will help you determine when nocturnal moths are flying as well as their relative abundance. This information allows pest managers to determine the timing of peak periods of activity and subsequently, pest management activities. Blacklight traps are useful for monitoring pest populations; they are not designed to reduce pest populations. It is not necessary to locate a blacklight trap on every farm. Regional trapping information is available in several printed and electronic newsletters produced by DATCP and University of Wisconsin–Madison Division of Extension.

Trap location. Trap placement is important for assuring an accurate representation of the insects you are monitoring. For European corn borers, place traps in "action sites," grassy areas adjacent to cornfields where the adult corn borer moths congregate. The light should be positioned 3 to 4 feet above the ground over grassy vegetation. The traps should be no more than 300 feet from corn. The farther away from cornfields the traps are placed, the fewer moths that will be caught, although the catches will still show population trends. Trap placement relative to wind direction is not important. Locate traps at least 200 feet away from other sources of light such as post lamps or heavily traveled roads. When placing traps, you may wish to consider the potential for vandalism. Blacklights, as well as 12-volt batteries, if used, are attractive to vandals.

Trap efficiency. Several variables affect moth catches in blacklight traps. Inclement weather, such as cold temperatures, high winds, and rain, will reduce the number of moths caught. Keep in mind that if weather conditions are interfering with moth catches in light traps, those same conditions may also be affecting mating and egg laying. When the moon is full or nearly full, trap catches may be reduced due to the high amount of background light.

Light traps often don't detect low densities of moths. Therefore it is important to recognize that even though no moths are being caught, active moths may still be in the area.

Trap monitoring. Blacklight traps should be checked frequently—preferably every other day. Fresh specimens are much easier to identify as many of the identifying characteristics become obscure with age. If possible, check and empty traps prior to rain since water in the collection container will destroy the distinguishing characteristics on the wings. In general, moths smaller in size than the diamondback moth (wingspan less than 5/8 inch) and larger than hawk moths (wingspan greater than 3 inches) are not economically important and can be ignored when sorting through a trap catch. Placing a DDVP (dichlorvos) insecticide strip in the funnel portion of the collection container will kill the insects, making them easier to identify. To aid in moth identification, the UW–Madison Division of ExtensionIPM program has developed a color fact sheet entitled *Identifying Blacklight Trap Catches in the Upper Midwest*. It illustrates each of the economically important nocturnal moths and describes identifying characteristics. Single copies are available free from the University of Wisconsin IPM program, (608) 262-6429.

Pheromone traps

Insects secrete pheromones to alert other insects about information such as the sex of the insect, trail location, alarm, and grouping. Synthetically produced pheromones mimic the chemicals produced by insects and are used to lure specific insect species to specially-designed traps. At this time, over 60 different pheromones are commercially available to aid in pest monitoring. The most common vegetable pest monitored with a pheromone trap is the corn earworm. Diamondback moths can be monitored with pheromones as easily as the corn earworm. However, most growers haven't begun to utilize this very useful monitoring tool.

Trapping will take time and additional knowledge to implement. You must learn which type of trap to use, where and when to place the trap, which lure to use, how often to check the trap, and what trap catches mean. However, trapping will save you money in the long run by indicating whether you actually have an insect infestation and whether it is severe enough to require treatment. Trapping will also help you time your treatment efforts to the most susceptible life stage of the pest. By trapping the adult insects, you will realize you have a pest problem long before the damaging larvae are present.

Type of trap. It is important to use the appropriate lure specific to the pest you want to monitor as well as the correct trap. Pheromone traps may be sticky traps such as the delta or winged traps used to monitor gypsy moth and other tree or orchard pests. Some insects such as Japanese beetles and corn earworm moths require specifically-designed traps. For example, corn earworm moths must be trapped in a specialized wire mesh trap called a *Hartstack trap*.

Timing. Traps should be in place at least 2 weeks before the earliest known emergence of the insect in your area. Extension specialists can help you determine when to set out traps. Check traps at least twice a week. Once insects appear in the trap, monitor at least every other day so you don't miss population trends and peak emergences. Record the number of moths caught at each visit so you can compare trends at a later date if needed.

Location. Trap location is important. Ideally, every susceptible field should have a pheromone trap located in or near it. For example, if you are trapping corn earworm moths, you should have an earworm trap in every silking sweet corn field. Traps should be placed level with the crop canopy "upwind" at the field edge so that the pheromone can be dispersed through the field.

Storing lures. Lures, the plastic or rubber strips impregnated with the pheromone, should be kept in the freezer until ready to use. Do not expose lures to heat. Replace according to package directions. For example, earworm lures should be changed every 2 weeks. Because there will still be some pheromone left on the old lure, remove it from the field and dispose of it along with the packaging material for the new lure. Do not leave the used lure in the field as there is enough pheromone remaining to attract (and confuse) the moths.

For information on interpreting your trap catches, contact your county Extension office.

Calculating degree days

Temperature affects the rate of development of plants and insects. Cold weather slows development while warm weather accelerates it. For this reason, it is misleading to describe development in terms of calendar time alone. To monitor crop development and predict pest behavior, professional pest managers often use a system that takes into account the accumulation of heat with passing time. This system is based on degree days.

A degree day (DD) is a unit of measure that occurs for each degree above a base temperature during a 24-hour period. The base temperature is the temperature below which there is no plant or insect development. Specific insects have specific base temperatures. Begin recording degree day accumulations for Wisconsin on March 1.

To monitor plant and insect development using degree days, you can use one of several websites which track weather conditions and calculate accumulated degree days. For weather and degree day information, visit https://agweather.cals.wisc.edu. Weather data can be accessed from the Weather page, and degree days can be accessed from the Thermal Models page. This site also allows you to subscribe to daily weather, forecast, and degree day email updates for one or more locations in the upper Midwest from the Subscribers page. To view degree day accumulations or insect and disease risk models in an interactive map, visit https://agweather.cals.wisc.edu/vdifn. These websites use the single sine degree day calculation method, which is difficult to calculate manually but can produce more accurate degree day accumulations in the early part of the year when daily temperatures are near the base temperature.

If you wish to calculate degree days yourself, you will need a maximum/minimum thermometer to obtain the daily high and low temperatures. Calculate simple average degree days using the equations below.

(daily high + daily low) ÷ 2 = daily average temperature

daily average temperature – base temperature = degree day accumulation

Daily high: Use 86°F if the high temperature for the day is above 86°F.

Daily low: If below the base temperature, use the base temperature.

Example: Assume you have accumulated 200 degree days to date using a base temperature of 40°F. If yesterday's high temperature was 75°F and the low temperature was 60°F, then the daily average temperature would be 67.5°F [(75 + 60) ÷ 2]. To calculate the degree day accumulation, subtract the daily average from the base temperature for a total of 27.5DD (67.5 – 40). Add this number of degree days to date (27.5 + 200) for a new total of 227.5.

Resistance management

Whenever pesticides are used to control pest problems, there is potential for the development of pest populations that are resistant to the pesticides used. It is therefore important to use pesticides judiciously to prevent, or at least delay, the development of resistant pests.

Resistance management attempts to prevent, delay, or reverse the development of resistance. It is a complex task that involves more than just pesticides. You should incorporate the following practices into a resistance management program:

- **Use an integrated pest management program.** Combine all available control measures (chemical and non-chemical) into a practical pest management program.
- **Use pesticides only when needed.** A pest population can develop resistance to a pesticide only when you use that pesticide against it. Therefore, if you use the pesticide when you don't need to, you may unnecessarily increase the proportion of resistant individuals.

  Likewise, poor timing of a pesticide application can increase the risk of disease development. Fungicides and bactericides are generally more effective as protectants when applied before signs of pathogens (e.g., spore masses, bacterial ooze) are visible. If you apply the pesticide after such signs appear, more individuals will be exposed to the pesticide and there will be a greater chance that at least some of those individuals will be resistant to it. Such resistant individuals will then become predominant and control will be much more difficult to achieve.
- **Apply pesticides at the proper rate.** Using higher labeled pesticide rates to try to eradicate pests not only wastes money (because eradication is usually impossible) but also kills a larger proportion of susceptible pests. As a result, the proportion of resistant individuals among survivors will be even larger.
- **Use pesticides from different chemical families.** Try to do this whether you apply pesticides against a pest once or several times a year. This way, pests resistant to the first pesticide will be killed by the second. The pesticide table that follows includes resistance management information.

Aster yellows index

The incidence of aster yellows disease depends on three things—the crop being grown, the number of leafhoppers present, and the percentage of the leafhopper population carrying the disease (infectivity level). With this information, the grower can determine the aster yellows index for the crop and prevent needless insecticide applications.

The aster yellows index is an unbiased method for determining the allowable number of aster leafhoppers on susceptible crops for any aster leafhopper infectivity level. Insecticides are applied when the index exceeds the treatment threshold for that crop, rather than spraying on a strict calendar basis—such as twice a week. The aster yellows index depends on the number of aster leafhoppers collected in 100 sweeps with a sweep net and the percentage of the leafhoppers that carry the disease. Call the UW–Madison Entomology Department (608-262-6510) for information about the infectivity level. Compute the index using the following formula:

% infectivity in leafhoppers x (number of leafhoppers ÷ 100 sweeps) = aster yellows index

For example, if the leafhopper infectivity level was determined to be 2.5% and field sweeping showed there were 20 leafhoppers per 100 sweeps, then:

2.5% (infectivity rate) x 20 (number caught ÷ 100 sweeps) = 50 (aster yellows index)

The aster yellows index is computed to be 50.

The treatment threshold for carrots, celery, and lettuce with respect to their aster yellows index is:

Crop	Aster yellows index
Carrots	
Resistant	100
Intermediate	75
Susceptible	50
Celery	35
Lettuce	25

In using the aster yellows index computed above as an example, the index of 50 has equaled or exceeded the treatment levels for celery, lettuce, and susceptible carrots. However, intermediate and resistant carrots do not need treatment at this point and need to be resampled in 2 to 3 days.

See the resistance/susceptibility table in the Carrot section (page 64).

Significant variation in aster yellows resistance/susceptibility has sometimes occurred within a given cultivar between different seed lots from different companies. If there is concern about the occasional seed lot variation in yellows resistance, use the treatment threshold for the next lower category. For example, resistant carrots would be treated as intermediate resistance and intermediate resistance carrots would be treated as susceptible carrots. Susceptible carrots do not need to be treated more conservatively. The movement of cultivars to the next lower category changes a conservative treatment threshold to a very conservative treatment threshold.

Relative effectiveness and persistence of selected herbicides

The herbicide effectiveness ratings in the following table are based on Wisconsin field research or are compiled from similar ratings published by midwestern weed scientists. Because the performance of herbicides is affected by many variables, actual performance will vary.

Relative effectiveness of vegetable herbicides

Herbicide	Annual broadleaves						Annual grasses			Perennial grass
	Black nightshade	Lambsquarters	Pigweed	Purslane	Ragweed	Velvetleaf	Barnyard grass	Crabgrass	Foxtail	Quackgrass
Accent Q	N	P	**G***	—	P	F	**E***	P	**E***	**G***
Alachlor/Intrro	**E***	F	**G***	**G***	P	P	**E***	**E***	**E***	N
Alanap**	F	**E**	**G***	**G***	**E***	**G***	P	**G**	**G**	P
Anthem	**E***	**G**	**E***	**E***	**G***	**G**	**E***	**E***	**E***	N
Assure II/Targa	N	N	N	N	N	N	**E***	**E***	**E***	**E***
Atrazine	**G***	**E***	**E***	*	**G***	F*	P	P	P	P
Basagran	P	F	P	**E***	**G**	**E**	N	N	N	N
Bicep Lite II	**E***	**E***	**E***	*	**G***	F	**E***	**E***	**E***	P
Bullet/Lariat	**E***	**E***	**E**	*	**G***	F*	**E***	**E***	**E***	P
Cadet	P	**G***	**G***	—	P	**E***	N	N	N	N
Callisto	**E***	**E***	**G***	—	F	**G***	P	F	P	N
Caparol	—	**E***	**E***	**G***	**E***	—	**G***	**G***	**G***	P
Command	P	F	P	*	F	**G***	F	F	F*	P
Devrinol	P	**G***	**G***	**G***	P	P	**E***	**E***	**E**	P
Dual	**E***	F	**G***	**G**	P	P	**E***	**E***	**E***	N
Eptam/EPTC**	F*	**G***	**G***	*	F	**G**	**G**	**E***	**E***	F
Fusilade DX	N	N	N	N	N	N	**E***	**E***	**E***	**E**
G-Max Lite	**E***	**E***	**E***	*	**G***	F*	**E***	**E***	**E***	P
Goal	F	**G**	**G***	**G***	P	P	P	P	P	P
Impact	**G***	**E***	**E***	—	**G**	**E***	**G***	**G***	F	P
Laudis	**G***	**E***	**E***	N	**G***	**E***	**G***	**G***	**G***	P
Lorox	**G**	**E***	**E***	**E***	**E***	**G**	**G***	**G***	**G***	P
Lumax	**E***	**E***	**E***	—	**G**	**E***	**E***	**E***	**E***	P
Metribuzin	P	**E***	**E***	**G**	**E***	**E**	P	**G**	**G**	P
Option	**G***	**G***	**G***	—	F*	**G***	**G***	P	**E***	**G***
Outlook	**E***	F	**G***	**G**	P	P	**E***	**E***	**E***	N
Permit/Sandea	N	P	**G***	—	**G***	**E***	N	N	N	N
Poast/Poast Plus	N	N	N	N	N	N	**E***	**E***	**E***	**G***
Prefar	P	**G**	**G**	**G**	P	P	**E***	**E***	**E***	P
Princep	**E***	**E***	**E***	**E***	**E***	**E**	F*	F*	F*	P
Priority	**G***	**G***	**G***	—	**E***	**E***	N	N	N	N
Prowl	P	**G***	**G***	*	N	F	**G***	**E***	**E***	N
Pursuit	**E***	P	**E***	—	F	**G**	**G**	F	**G**	P
Pyramin	*	**G***	**G***	**G***	**G***	P	F	F	—	P
Raptor	**E***	F	**E***	—	F	**G**	**G**	F	**G**	P
Ro-Neet**	P	**G**	**G**	**G**	P	P	**E***	**E***	**E***	P
Sinbar	**E**	**E***	**G***	**E**	**E***	**E**	**E***	**E***	**E***	F
Sonalan	F	**G***	**G***	*	P	P	**E***	**E***	**E***	P
Spin-aid	—	**G***	P	**G***	**G***	F	P	P	P	P
Starane Ultra	F	P	P	**E**	**E***	**G***	N	N	N	N
Stinger	F	P	P	P	**G***	P	N	N	N	N
Treflan	P	**G***	**G***	**E***	P	P	**E***	**E***	**E***	P
Zemax	**E***	**E***	**E***	—	F	**G***	**E***	**E***	**E***	N

Abbreviations: E = excellent; G = good; F = fair; P = poor; N = none; — = data not available. Good and excellent ratings are set boldface.

*Manufacturer lists weed as controlled on label.

**This material has a relatively short half-life. It should provide initial control as described in the table but not season-long control.

Planning for next year—herbicide persistence and carryover

Residual herbicides are those that control weeds for some time after application. The advantage of a residual herbicide is the persistent weed control that increases the efficiency of weed management efforts. The disadvantage of a long-term residual herbicide is that it may persist longer than desired and injure or kill subsequent rotational crops. Herbicide persistence, or the time frame when an herbicide remains in the soil, varies greatly with climatic conditions, specific herbicide, soil type, and crop cultural practices. It is important to distinguish between herbicide persistence and herbicide activity. Some herbicides persist in soil for a long time but are not available for plant uptake and therefore are not active as herbicides. Herbicide persistence is difficult to predict, so it is important to understand the determining factors. Incorporating these factors into crop planning can reduce the risk of herbicide injury.

The most important step is to always read the herbicide label prior to use and follow the label exactly. It contains rotational crop restrictions, and the information may affect your choices of rotational crops.

Factors that affect herbicide persistence in soil

Herbicide persistence in soil and potential carryover are related to the herbicide's rate of degradation by microbial, chemical, or photo decomposition and its availability for plant uptake, which is determined by soil adsorption and leaching in soil water. These factors vary greatly by soil type and pH, climatic conditions between the time of herbicide application and re-cropping, and cropping practices. Understanding the variables that determine persistence can reduce the risk of crop injury from herbicide carryover.

Factors that affect herbicide availability in soil include:

Soil adsorption. Herbicides adsorbed to solids are not available for leaching, plant uptake, or microbial degradation. Therefore, adsorbed herbicides can persist until they are released from the soil surface. Some active ingredients in herbicides bind to soil so tightly that they persist nearly indefinitely and are not typically available for plant uptake.

Soil type is very important in determining potential adsorption. Organic matter and clay in soil increase soil adsorption because of their chemical reactivity and high number of binding sites. Negatively charged soil components attract and adsorb positively charged herbicides. Water in soil competes with herbicides for binding sites, and therefore, wet soils adsorb less herbicide than dry soils. Soil adsorption is greater in low pH soils as there are fewer positively charged particles to compete for the negatively charged binding sites. Additionally, herbicides that are highly soluble in water are not adsorbed well to soil.

Herbicide leaching. Herbicide leaching in soil water can move herbicides out of the tillage and root zone of subsequent crops. Herbicide leaching is greatest in coarse-textured, low organic matter soils. Highly soluble herbicides are prone to leaching.

Factors that affect the degradation rate of an herbicide include:

Microbial decomposition. Microbial decomposition accounts for a large portion of herbicide degradation in soil. Microbial organisms such as bacteria, fungi, and algae use herbicides as a food source. Microbes are herbicide-specific, and their population in the soil is related to the amount of herbicide available for consumption. Repeated use of an herbicide can lead to increased microbe populations and a shorter duration of effective weed control. Conditions that support high microbe populations favor rapid herbicide degradation.

Soil type is important for microbe populations. Organic matter in soil provides excellent habitat for microbes. The effect of soil pH on microbial degradation varies by microbe, but in general, the extremes in pH are less favorable for high microbe populations.

In general, climatic conditions that favor optimum plant growth also support microbe activity. Microbe activity is greatest when soil moisture ranges from 50 to 100% of field capacity. Given that the majority of herbicide degradation by microbes occurs in aerobic conditions (those with oxygen), microbe activity is minimal when soil moisture exceeds field capacity. Microbes are most active in warm soils (given adequate moisture). Microbial activity is negligible in cool soils (below approximately 40°F) or frozen soils.

Chemical decomposition. Chemical decomposition is important for some herbicides such as those in the sulfonylurea family (examples include rimsulfuron and halosulfuron). The majority of chemical decomposition occurs when herbicides react with soil water (called *hydrolysis*), which occurs most actively at lower soil pH and warm soil temperature.

Photo decomposition. Photo decomposition is important for a limited number of herbicides. These herbicides are broken down on the soil surface with energy from sunlight. Therefore, these herbicides are usually incorporated after application to prevent photo decomposition. Photo decomposition is important for herbicides such as trifluralin.

Strategies to avoid herbicide carryover

There are several strategies you can use to avoid herbicide carryover:

Apply labeled rates and follow rotational restrictions. Application of rates greater than those listed on the label can result in herbicide persistence. The rotational restrictions listed on the label are based on extensive field research. Many horticultural crops will often be included in the "all other crops" category. Some labels do not allow rotation to crops not listed on the label. Persistent herbicides can lead to illegal residue levels in rotational crops even when the risk for visual crop injury is minimal. Crop rotational restrictions for a particular herbicide can vary by application rate and timing, geography, and soil type and pH, so be sure to read the label thoroughly. When tank mixing herbicides, follow the crop rotation guidelines for the more restrictive label unless otherwise noted.

Keep future cropping plans in mind when planning herbicide programs. Avoid the use of long-residual herbicides when sensitive crops are included in the rotation.

Be aware of climatic conditions in the time between herbicide application and the next crop. Low moisture and temperature, in particular, can slow herbicide degradation and increase the risk for carryover.

Rotate herbicide mode of action to avoid buildup in soil. Although rare, repeated use of the same herbicide, or even same herbicide family in some cases, can lead to herbicide buildup in the soil.

Maintain healthy soil. Keep in mind: Soil conditions that favor plant growth also favor herbicide degradation. Maintain a moderate soil pH and organic matter for optimum herbicide degradation.

Pest management and pesticides

As an alternative to exclusive pesticide use, attention is being directed to the coordinated use of multiple tactics—an approach known as integrated pest management, or IPM (discussed on page 2).

Federal pesticide-use law

When Congress amended the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) in 1972, it included a mandate for the United States Environmental Protection Agency (EPA) to evaluate all new and existing pesticide products for potential harm they may cause. It also made it illegal to use, except as provided by FIFRA, any pesticide in a manner inconsistent with its labeling. Deviations from the label not recognized by FIFRA are a violation of the law.

The Food Quality Protection Act (FQPA) of 1996 strengthens the system that regulates pesticide residues on food. Recognizing that pesticide residues are present in more sources than just food, the FQPA sets limits on the total exposure from residues found in food, drinking water, and non-dietary sources (such as household, landscape, and pet uses). The more uses a particular pesticide has, the greater the chance its total exposure will be met and, thus, some or all of its uses canceled. If, during the pesticide registration process, the EPA finds a product to generally cause unreasonable adverse effects on the environment, including injury to the applicator, it will be classified as *restricted use*. Because restricted-use pesticides (RUPs) can be used only by certified applicators, the FIFRA amendments also call for each state to develop a program for training and certifying pesticide applicators. The certification program is designed to ensure that users of restricted-use products are properly qualified to handle and apply these materials safely and efficiently. A current list of restricted-use pesticides registered for use in Wisconsin may be downloaded from the Pesticide Applicator Training (PAT) website (https://fyi.extension.wisc.edu/pat/files/2018/02/RUP.pdf) under Tools > PAT Tools.

Wisconsin's training and certification program

In Wisconsin, responsibility for training lies with the University of Wisconsin–Madison Divison of Extension's Pesticide Applicator Training (PAT) program, while actual certification is the responsibility of the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP). The Wisconsin Pesticide Law requires that all commercial applicators for hire participate in the training and certification process and be licensed if they intend to use any pesticide in the state of Wisconsin, whether or not it is restricted use. All private applicators, those who apply pesticides to produce an agricultural commodity on property they or their employer owns or rents.

The selection, use, and potential risks of pesticides vary depending on the method of application and what it is you want to protect from pests. Therefore, there is a separate training manual and certification exam for 21 pest control categories, including categories for agricultural producers, the agricultural industry (10 categories), use in and around commercial and residential buildings (6 categories), use in right-of-way and surface waters (3 categories), and preserving wood. Certification is valid for 5 years, after which you can recertify by passing a new exam that is based on a revised training manual.

For more information about the Wisconsin PAT program, contact your county Extension agent or visit https://fyi.extension.wisc.edu/pat. For information on Wisconsin's licensing and certification program, visit https://datcp.wi.gov/Pages/Programs_Services/PesticidesFertilizersCertificationLicensing.aspx.

Wisconsin pesticide laws and regulations

Operating under the provisions of the Wisconsin Pesticide Law and Administrative Rule, Chapter ATCP 29 (Register, May 2013), DATCP has primary responsibility for pesticide use and control in the state. The Wisconsin Department of Natural Resources (DNR) has responsibility for pesticide use involving "waters of the state," the control of birds and mammals, and pesticide and container disposal. Wisconsin Emergency Management (WEM) has responsibility for helping communities evaluate their preparedness for responding to accidental releases of hazardous compounds, including pesticides, under Title III of the EPA's Superfund Amendments and Reauthorization Act (SARA). The Wisconsin Department of Transportation (WisDOT) has responsibility for regulating the transportation of pesticides listed as hazardous materials (shipping papers, vehicle placarding, etc.) and for issuing commercial driver's licenses. It is your responsibility to become familiar with all pertinent laws and regulations affecting pesticide use in Wisconsin. To see if a given pesticide is regulated by WisDOT, look in the Transportation section on the Safety Data Sheet (SDS) in question.

Pesticides and community right to know

To help communities evaluate their preparedness for responding to chemical spills, Congress passed the Emergency Planning and Community Right-to-Know Act (EPCRA). This law is part of a much larger legislation called the Superfund Amendments and Reauthorization Act (SARA) and is often referred to as Title III of SARA. Title III sets forth requirements for reporting of hazardous substances stored in the community and for developing an emergency response plan.

The first step in emergency planning is to know which chemicals can cause health problems and environmental damage if accidentally released. The EPA has prepared a list of such chemicals and calls them *extremely hazardous substances*. These substances are subject to emergency planning and the threshold planning quantity (TPQ), the smallest amount of a substance which must be reported. Some of the chemicals listed are commonly used in agricultural production (see table below).

A complete list of EPA's extremely hazardous substances is available from your county's Local Emergency Planning Committee (LEPC).

Any facility, including a farm, that produces, uses, or stores any of these substances in a quantity at or greater than their threshold planning quantity must notify WEM and their LEPC that it is subject to the emergency planning notification requirements of Title III of SARA.

In addition to emergency planning notification, agricultural service businesses with one or more employees are subject to two community right-to-know reporting requirements: submission of safety data sheets (SDS) and submission of Tier II inventory forms. Tier II forms request specific information on each hazardous chemical stored at or above its threshold.

Examples of agricultural chemicals subject to Title III of SARA

Active ingredient	Trade name	Threshold planning quantity (lb or gal of product)
anhydrous ammonia (fertilizer)	—	610 lb
azinphos-methyl	Guthion 50WP	20 lb
dimethoate	Dimethoate 4EC	125 gal
paraquat	Gramoxone SL	5 gal
phorate	Thimet 20G	50 lb
terbufos	Counter 20G	667 lb

Worker Protection Standard for agricultural pesticides

The federal Worker Protection Standard (WPS) for Agricultural Pesticides took effect January 1, 1995, and was reviewed in 2015. As of January 1, 2017, new WPS rules have gone into effect. The purpose of the WPS is to reduce the risk of employee exposure to pesticides. You are subject to the WPS if you have at least one nonfamily employee who is involved in the production of agricultural plants in a nursery, greenhouse, forest, or farming operation.

If you use pesticides on your property, as the employer you are expected to know and follow WPS. Some of the requirements are as follows:

- Display pesticide safety information in a central location.
- Train workers and handlers on general safety principles annually and keep those training records for two years.
- Provide personal protective clothing and equipment to employees.
- Provide a decontamination site (water, soap, towels, and coveralls).
- Provide transportation to an emergency medical facility for employees who are poisoned or injured by pesticide exposure.
- Provide notification to employees about pesticide applications (see next section).
- Make Safety Data Sheets available to workers and handlers.

For more information about the WPS and the training requirements for uncertified workers and handlers, download *How to Comply with the 2015 Revised Worker Protection Standard for Agricultural Pesticides* (http://pesticideresources.org/wps/htc/htcmanual.pdf). For WPS training materials, visit the the PERC website at http://pesticideresources.org.

Oral notification and posting

The WPS requires employers to give notice of pesticide applications to all workers who will be in a treated area or walk within 0.25 miles of a treated area during the pesticide application or during the restricted entry interval (described in the next section). Notification may be either oral warnings or posting of warning signs at entrances to treated sites; both are necessary if the label requires dual (oral and posting) notification. A current list of dual-notice pesticides registered for use in Wisconsin is available at https://fyi.extension.wisc.edu/pat/files/2018/02/Dual-Notice_Pesticides.pdf.

Wisconsin's Agriculture, Trade, and Consumer Protection (ATCP) 29 posting rule is designed to protect the general public as well as workers. Thus, it requires posting of areas treated with pesticides having a dual notification statement or, for nonagricultural pesticide applications, if the label prescribes a restricted entry interval for that particular application. Refer to *On-Farm Posting of Pesticide-Treated Sites in Wisconsin* for a flowchart guiding users through a series of questions to determine when posting of treated sites is needed, what warning sign to use, and where the sign should be located. Also covered are the separate posting requirements for chemigation treatments. This publication is available from your county Extension office or online at https://fyi.extension.wisc.edu/pat/files/2018/02/On-farm-posting-chart-2017.pdf.

Restricted entry interval

A restricted entry interval (REI) is the length of time that must expire after pesticide application before people can safely enter the treated site without using personal protective equipment and WPS handler training. Pesticide residues on a treated crop or in a treated area may pose a significant hazard to workers or others who enter the area after treatment. Therefore, nearly all pesticides affected by the WPS (see above) have an REI. Check the Agricultural Use Requirements section on the label for the specific REI for your product. These intervals must be strictly observed.

Pesticide toxicity

There are four common ways in which pesticides enter the human body: through the skin (dermal), the mouth (oral), the lungs (inhalation), and the eyes. Absorption through the skin is the most common route of exposure of agricultural workers.

Perhaps the greatest hazard for the applicator is in loading and mixing the pesticide concentrate, which presents a significant risk of exposure to the chemical in its most toxic form. Although hazards associated with the actual application are frequently much less severe, they can still be substantial, especially if there is significant drift or if appropriate precautions are ignored. A pesticide may be toxic as a result of exposure to a single dose (acute toxicity) or as a result of repeated exposures over time (chronic toxicity).

Acute toxicities are normally expressed as the amount of pesticide required to kill 50% of a population of test animals (usually rats or rabbits). For oral and dermal exposure, this is referred to as the LD_{50} or "lethal dose to 50%" in milligrams of toxicant per kilogram of body weight (mg/kg). For inhalation exposure, it is expressed as the LC_{50} or "lethal concentration to 50%" in parts per million (ppm) of toxicant in the total volume of air when the toxicant is a gas or vapor, and in milligrams per liter (mg/l) of air or water when the toxicant is a dust or mist. ***Pesticides with greater acute toxicities have lower LD_{50} and/or LC_{50} values; that is, it takes less of the chemical to kill 50% of the test population.***

Labels indicate the relative level of acute toxicity through signal words and symbols (see table below). The toxicity category is assigned based on the highest measured toxicity, be it oral, dermal, or inhalation; effects on the eyes and external injury to the skin are also considered.

In the event of human pesticide poisoning, the pesticide label is your first source of first-aid information. Always bear in mind, however, that first-aid response to pesticide exposure is not a substitute for professional medical help. Seek medical attention promptly and always be sure that the label or labeled container is given to the doctor. The product's Safety Data Sheet (SDS) is a more technical document than the label, and it often contains additional treatment instructions for the attending medical professional.

Poison Control Center (1-800-222-1222). You may call the Poison Control Center at any hour for information regarding proper treatment of pesticide

(continued on page 32)

Toxicity categories of pesticides

	Toxicity category			
Measure of toxicity	I High toxicity	II Moderate toxicity	III Slight toxicity	IV Low toxicity
Oral LD_{50} (mg/kg)	0–50	50–500	500–5,000	> 5,000
Dermal LD_{50} (mg/kg)	0–200	200–2,000	2,000–20,000	> 20,000
Inhalation LC_{50} gas/vapor (ppm) dust/mist (mg/l)	0–200 0–0.2	200–2,000 0.2–2	2,000–20,000 2–20	> 20,000 > 20
Eye effects	corrosive	irritation persists for 7 days	irritation reversible within 7 days	no irritation
Skin effects	corrosive	severe irritation	moderate irritation	mild irritation
Signal word	DANGER*	WARNING	CAUTION	CAUTION

Abbreviations: mg/kg = milligrams per kilogram; ppm = parts per million; mg/l = milligrams per liter; < = less than; > = greater than.

*Products assigned to Category I due to oral, inhalation, or dermal toxicity (as distinct from eye and local skin effects) also must have the word "poison" and the skull and crossbones symbol on the label.

Pesticide class and re-entry intervals of insecticides and fungicides

Active ingredient	Product	Manufacturer	Signal word	Notification	Resistance mgmt[a]		REI[b] (hours)
					Chemical group	Group code	
Insecticides							
abamectin	*Agri-Mek, *Epi-Mek	Syngenta	warning	oral	avermectin	6	12
abamectin + cyantraniliprole	*Minecto Pro	Syngenta	warning	oral	abamectin + anthranilic diamide	6 + 28	12
acephate	Acephate, Orthene	United Phos-phorous, Inc. (UPI), Valent	caution	oral	organophosphate	1B	24
acequinocyl	Kanemite 15 SC	Arysta LifeScience	caution	oral	acquinocyl	20B	12
acetamiprid	Assail	UPI	caution	oral	chloronicotinyl	4A	12
alpha-cypermethrin	*Fastac	BASF	danger	oral AND posted	synthetic pyrethroid	3	12
azadirachtin	Aza-Direct, Azatin XL Plus, Neemazad, Neemix, Trilogy	Gowan, several	caution	oral	triterpenoid	26	4–12
Bacillus thuringiensis subsp. *aizawai*	Agree, XenTari	several	caution	oral	microbial	11B1	4
Bacillus thuringiensis subsp. *kurstaki*	Biobit, Crymax, DiPel, Javelin, MVP	several	caution	oral	microbial	11B2	4
Bacillus thuringiensis subsp. *tenebrionis*	Raven	several	caution	oral	microbial	11C	12
beta-cyfluthrin	*Baythroid XL	Bayer CropScience	warning	oral	synthetic pyrethroid	3	12
bifenazate	Acramite	Chemtura	caution	oral	miticide	25	12
bifenthrin	*Bifenture, *Brigade, *Capture LFR, *Discipline, *Fifen, *Fanfare, *Skyraider, *Sniper, *Tailgunner, *Tundra	several	warning	oral	synthetic pyrethroid	3	12
bifenthrin + avermectin	*Athena	FMC	caution	oral	synthetic pyrethroid + avermectins	3A + 6	12
bifenthrin + chlorantraniliprole	*Elevest	FMC	warning	oral	synthetic pyrethroid + anthranilic diamide	3 + 28	12
bifenthrin + imidacloprid	*Brigadier	FMC	warning	oral	synthetic pyrethroid + neonicotinyl	3 + 4A	12

*Restricted-use pesticide.

(continued)

[a]To delay or prevent the development of resistance, select pesticides from different chemical groups. Newly approved pesticide labels bear the group code, a reference to the specific target site of the chemical. For more details, visit www.irac-online.org (insecticides), www.frac.info (fungicides), and www.plantprotection.org/HRAC/ (herbicides).

[b]REI = Restricted entry interval.

[c]PHI = Preharvest interval. A range of days to harvest indicates that there is variability between crops. Refer to the product label for specific information on the number of days to harvest for each crop.

[d]Chlorantraniliprole and rynaxypyr are the same active ingredient (ai). Do not exceed a total of 0.2 lb ai/a per season of products containing either of these two active ingredient names.

Pesticide class and re-entry intervals of insecticides and fungicides *(continued)*

Active ingredient	Product	Manufacturer	Signal word	Notification	Resistance mgmt[a]		REI[b] (hours)
					Chemical group	Group code	
Insecticides							
heat-killed *Burkholderia* spp, strain A396	Venerate	Marrone Bio Innovations	caution	oral	microbial	11	4
carbaryl	Adios, Sevin	Bayer CropScience	caution/ warning	oral	carbamate	1A	12 hr to 5 days
chlorantraniliprole[d]	Altacor, Coragen	DuPont	caution	oral	anthranilic diamide	28	4
Chromobacterium subtsugae strain PRAA4-1	Grandevo	Marrone Bio Innovations	caution	oral	microbial	11	4
clothianidin	Belay, Poncho 600	Valent, Bayer Crop-Science	caution	oral	neonicotinoid	4A	12
cyantraniliprole	Exirel, Verimark	DuPont	caution	oral	anthranilic diamide	28	12
cyfluthrin	*Tombstone, *Tombstone Helios	Loveland	danger	oral	synthetic pyrethroid	3A	12
cypermethrin	*Ammo, *UP-Cyde	FMC	caution/ warning	oral	synthetic pyrethroid	3	24
cyromazine	Trigard	Syngenta	caution	oral	insect growth regulator	17	12
deltamethrin	*Delta Gold	Agriliance	danger/ poison	oral	synthetic pyrethroid	3	12
diazinon	*Diazinon	many	caution	oral	organophosphate	1B	24
dicofol	Dicofol	Gowan	caution	oral	organochlorine	UN	12
dimethoate	Dimethoate	many	warning	oral AND posted	organophosphate	1B	48
dinotefuran	Scorpion, Venom	Gowan, Valent	caution	oral	neonicotinyl	4A	12
emamectin benzoate	*Proclaim	Syngenta	caution	oral AND posted	avermectin	6	48
endosulfan	Thiodan	Universal Crop Prot. Alliance	danger/ poison	oral	organochlorine	2A	24
esfenvalerate	*Asana	Valent	warning	oral	synthetic pyrethroid	3	12
ethoprop	*Mocap	Bayer CropScience	danger/ poison	oral AND posted	organophosphate	1B	48

*Restricted-use pesticide.

(continued)

Pesticide class and re-entry intervals of insecticides and fungicides *(continued)*

Active ingredient	Product	Manufacturer	Signal word	Notification	Resistance mgmt[a] Chemical group	Resistance mgmt[a] Group code	REI[b] (hours)
Insecticides							
etoxazole	Zeal	Valent	caution	oral	miticide	10B	12
fenpropathrin	*Danitol	Valent	warning	oral	synthetic pyrethroid	3	24
fenpyroximate	Fujimite	Nichino America	warning	oral	miticide	21	12
fipronil	*Regent	BASF	warning	oral	phenyl pyrazole	2B	0
flonicamid	Beleaf	FMC	caution	oral	selective feeding blocker	9C	12
flubendiamide	Belt, Synapse	Bayer CropScience	caution	oral	anthranilic diamide	28	12
flupyradifurone	Sivanto	Bayer CropScience	caution	oral	neonicotinyl	4D	4
gamma-cyhalothrin	*Proaxis	Pytech	caution	oral	synthetic pyrethroid	3	24
imidacloprid	Admire, Advise, Alias, AmTide, Gaucho, Imidacloprid, Macho, Malice, Montana, Nuprid, Pasada, Prey, Provado, Provoke, Sherpa, Widow, Wrangler	several	caution	oral	chloronicotinyl	4A	12
imidacloprid + beta-cyfluthrin	*Leverage 360	Bayer CropScience	warning	oral AND posted	synthetic pyrethroid + chloronicotynl	3 + 4A	12
indoxacarb	Avaunt	DuPont	caution	oral	oxadiazine	22	12
Isaria fumosorosea Apopka Strain 97	PFR-97 20WDG	Certis USA	caution	oral	microbial	118	4
lambda-cyhalothrin	*Lambda-Cy, *Warrior II	UPI, Syngenta	warning	oral	synthetic pyrethroid	3	24
lambda-cyhalothrin + chlorantraniliprole[d]	*Besiege, *Voliam Xpress	Syngenta	warning	oral AND posted	synthetic pyrethroid + anthranilic diamide	3 + 28	24
lambda-cyhalothrin + thiamethoxam	*Endigo ZC	Syngenta	warning	oral AND posted	synthetic pyrethroid + neonicotinyl	3 + 4A	24
malathion	Malathion	Gowan, Platte	caution	oral	organophosphate	1B	12
methomyl	*Lannate	DuPont	danger/ poison	oral	carbamate	1A	48
methoxyfenozide	Intrepid 2F	Dow AgroSciences	caution	oral	diacylhydrazine	18	4
naled	Dibrom	AMVAC	danger		organophosphate	1B	24
neem oil	Trilogy	Certis	caution	oral	unclassified	un-classified	4
novaluron	Rimon	Chemtura	warning	oral	benzoylurea	15	12
nucleopolyhedrovirus	Helicovex	Andermatt Biocontrol AG	caution	oral	virus	un-classified	4
oxamyl	*Vydate	DuPont	danger/ poison	oral	carbamate	1A	24

*Restricted-use pesticide.

(continued)

Pesticide class and re-entry intervals of insecticides and fungicides *(continued)*

Active ingredient	Product	Manufacturer	Signal word	Notification	Resistance mgmt[a]		REI[b] (hours)
					Chemical group	Group code	
Insecticides							
paraffin oil	JMS Stylet-Oil	JMS Flower Farms	caution	oral	unclassified	unclassified	4
permethrin	*Ambush, *Perm-UP, *Pounce	Syngenta, UPI	caution or warning	oral	synthetic pyrethroid	3	12
phorate	*Phorate, *Thimet	BASF	danger/ poison	oral AND posted	organophosphate	1B	48
phosmet	Imidan	Gowan	warning	oral	organophosphate	1B	24
potassium salts of fatty acids	M-Pede	Dow AgroSciences	warning	oral	insecticidal soap	—	12
pymetrozine	Fulfill	Syngenta	caution	oral	—	9B	12
pyrethrins	PyGanic	Valent	caution	oral	pyrethroid	3	12
spinetoram	Radiant	Dow AgroSciences	caution	oral	biological	5	4
spinosad	Entrust	Dow AgroSciences	caution	oral	biological	5	4
spirodiclofen	Envidor	Bayer CropScience	caution	oral	tetronic & tetramic acid derivatives	23	12
spiromesifen	Oberon 2 SC	Bayer CropScience	caution	oral	lipid biosynthesis inhibitor	23	12
spirotetramat	Movento	Bayer CropScience	caution	oral	lipid biosynthesis inhibitor	23	24
spirotetramat + pyriproxyfen	Senstar	Valent	warning	oral	lipid biosynthesis inhibitor + insect growth regulator	23 + 7C	24
sulfoxaflor	Transform WG	Dow AgroSciences	danger	oral	neonicotinyl	4C	24
sulfur (elemental)	Suffa	Drexel	caution	oral	unclassified	unclassified	24
tebufenozide	Confirm	Gowan	caution	oral	diacylhydrazine	18	4
tebupirimphos + cyfluthrin	*Aztec	AMVAC	warning	oral AND posted	organophosphate	1B	48
tefluthrin	*Force 3G	Syngenta, AMVAC	caution	oral	synthetic pyrethroid	3A	0
terbufos	*Counter 15G	AMVAC	danger	oral AND posted	organophosphate	1B	48
thiamethoxam	Actara WDG, Cruiser, Platinum	Syngenta	caution	oral	neonicotynl	4A	12
thiamethoxam + chlorantraniliprole[d]	Durivo, Voliam Flexi	Syngenta	caution	oral	neonicotinyl + anthranilic diamide	28	12
thiodicarb	Larvin	Bayer CropScience	warning	oral	carbamate	1A	12
tolfenpyrad	Torac	Nichino America	danger	oral	METI insecticide	21A	12

*Restricted-use pesticide.

(continued)

Pesticide class and re-entry intervals of insecticides and fungicides *(continued)*

Active ingredient	Product	Manufacturer	Signal word	Notification	Resistance mgmt[a]		REI[b] (hours)
					Chemical group	Group code	
Insecticides							
zeta-cypermethrin	*Mustang Maxx	FMC	caution	oral	synthetic pyrethroid	3	12
zeta-cypermethrin + bifenthrin	*Hero	FMC	caution	oral	synthetic pyrethroid	3A	12
zeta-cypermethrin + bifenthrin + imidacloprid	*Triple Crown	United Suppliers	warning	oral	synthetic pyrethroid + neonicotinyl	3A + 4A	12
Fungicides							
ametoctradin + dimethomorph	Zampro	BASF	caution	oral	QxI + cinnamic acid derivative	45 + 40	12
azoxystrobin	Dynasty, Equation, Quadris Flowable, Satori	Syngenta, Cheminova, Loveland	caution	oral	strobilurin	11	4
azoxystrobin + benzovindiflupyr	Elatus	Syngenta	caution	oral	strobilurin + carboxamide	11 + 7	12
azoxystrobin + chlorothalonil	Quadris Opti	Syngenta	warning	oral	strobilurin + substituted benzene	11 + M5	12
azoxystrobin + difenoconazole	Quadris Top	Syngenta	caution	oral	strobilurin + triazole	11 + 3	12
azoxystrobin + propiconazole	Quilt Xcel	Syngenta	warning	oral	strobilurin + triazole	11 + 3	12
azoxystrobin + Reynoutria sachalinensis	AZterknot	Vive Crop Protection	caution	oral	strobilurin + plant extract	11 + P5	—
boscalid	Endura	BASF	warning	oral	anilide	7	12
boscalid + pyraclostrobin	Pristine	BASF	caution	oral	anilide + strobilurin	7 + 11	12
captan	Captan	several	danger	oral	phthalimide	M4	4 days
chloropicrin	several	several	danger	oral	—	soil fumigant	—
chlorothalonil	Bravo, Echo, Equus, others	Syngenta, Sipcam, MANA, others	danger	oral	substituted benzenes	M5	12
chlorothalonil Zn	Bravo Zn, Echo Zn, Equus 500 Zn	Syngenta, Sipcam, MANA	warning	oral	substituted benzenes + zinc	M5	12
chlorothalonil + cymoxanil	Ariston	Sipcam	caution	oral	substituted benzenes + zinc + acetimide	M5 + 27	12
Coniothyrium minitans	Contans	Sipcam	caution	oral	biological	—	4
copper oxychloride + basic copper sulfate	C-O-C-S	Loveland	warning	oral	organometallic	M1	24
cyazofamid	Ranman	FMC	caution	oral	cyanoacetamide	21	12
cyflufenamid	Torino	Gowan	caution	oral	phenylacetamide	U6	4
cymoxanil	Curzate 60DF	DuPont	warning	oral	acetimide	27	12

*Restricted-use pesticide.

(continued)

Pesticide class and re-entry intervals of insecticides and fungicides *(continued)*

Active ingredient	Product	Manufacturer	Signal word	Notification	Resistance mgmt[a]		REI[b] (hours)
					Chemical group	Group code	
Fungicides							
cymoxanil + famoxadone	Tanos	DuPont	caution	oral	acetimide + strobilurin-like	27 + 11	12
cyprodinil + fludioxonil	Switch 62.5WG	Syngenta	caution	oral	anilinopyrimidine + phenylpyrrole	9 + 12	12
difenoconazole	Top MP	Syngenta	warning	oral	triazole	3	12
difenoconazole + cyprodinil	Inspire Super	Syngenta	caution	oral	triazole + anilinopyrimidine	3 + 9	12
dimethomorph	Forum	BASF	caution	oral	cinnamic acid derivative	40	12
ethaboxam	Elumin	Valent	caution	oral	benzamide	22	12
fenamidone	Reason 500 SC	Bayer CropScience	caution	oral	strobilurin-like	11	12
fixed copper	Kocide, Champ, others	DuPont, Nufarm Americas, others	caution	oral	organometallic	M1	48
fluazinam	Omega 500F	Syngenta	warning	oral	pyridinamine	29	48
fludioxonil	Cannonball WP	Syngenta	caution	oral	phenylpyrrole	12	12
	Maxim 4FS	Syngenta	caution	oral	phenylpyrrole	12	12
fluopicolide	Presidio	Valent	caution	oral	benzamide	43	12
fluopyram + penflufen	Velum Rise	Bayer Crop Science	caution	oral	benzanilide + benzanilide	7 + 7	12
fluopyram + pyrimethanil	Luna Tranquility	Bayer CropScience	caution	oral	benzanilide + anilinopyrimidine	7 + 9	12
fluopyram + trifloxystrobin	Luna Sensation	Bayer CropScience	caution	oral	benzanilide + strobilurin	7 + 11	12
fluoxastrobin	Aftershock, Evito 480 SC	Loveland, Arysta LifeScience	caution	oral	strobilurin	11	12
flutolanil	Moncut 70-DF	Gowan	caution	oral	benzanilide	7	12
flutolanil + mancozeb	MonCoat MZ	Gowan, Nichino	caution	oral	benzanilide + EBDC	7 + M3	24
flutriafol	Rhyme, Topguard	FMC, Cheminova	caution	oral	sterol inhibitor	3	12
fluxapyroxad + pyraclostrobin	Merivon, Priaxor	BASF	caution	oral	anilide + strobilurin	7 + 11	12
fosetyl-al	Aliette WDG	Bayer CropScience	caution	oral	phosphonate	33	12
iprodione	Iprodione, Rovral 4 Flowable	Arysta, Bayer Crop-Science, FMC	caution	oral	dicarboximide	2	24
isofetamid	Kenja	Summit Agro USA	caution	oral	benzanilide	7	12
kresoxim methyl	Sovran	Cheminova	caution	oral	strobilurin	11	12
mancozeb	Dithane, Manzate, Penncozeb	Dow AgroSciences, DuPont, UPI	caution	oral	EBDC	M3	24
mancozeb + chlorothalonil	Elixir	UPI	warning	oral	EBDC + substituted benzenes	M3 + M5	24

*Restricted-use pesticide.

(continued)

Pesticide class and re-entry intervals of insecticides and fungicides *(continued)*

Active ingredient	Product	Manufacturer	Signal word	Notification	Resistance mgmt[a] Chemical group	Resistance mgmt[a] Group code	REI[b] (hours)
Fungicides							
mandipropamid	Revus	Syngenta	caution	oral	mandelic acid amide	40	4
mandipropamid + difenoconazole	Revus Top	Syngenta	caution	oral	mandelic acid amide + triazole	40 + 3	12
mefenoxam	Apron XL	Syngenta	warning	oral	phenylamide	4	48
	Ridomil Gold GR	Syngenta	caution	oral	phenylamide	4	48
	Ridomil Gold SL	Syngenta	caution	oral	phenylamide	4	48
	Ultra Flourish	Nufarm Americas	warning	oral	phenylamide	4	48
mefenoxam + azoxystrobin	Quadris Ridomil Gold co-pack	Syngenta	caution	oral	phenylamide + strobilurin	4 + 11	0
	Uniform pre-mix	Syngenta	caution	oral	phenylamide + strobilurin	4 + 11	0
mefenoxam + chlorothalonil	Ridomil Gold Bravo SC	Syngenta	warning	oral	phenylamide + substituted benzenes	4 + M5	48
mefenoxam + copper hydroxide	Ridomil Gold Copper	Syngenta	danger	oral	phenylamide + organometallic	4 + M1	48
mefenoxam + fludioxonil	Apron MAXX RTA, RFC	Syngenta	caution	oral	phenylamide + phenylpyrrole	4 + 12	48
mefenoxam + mancozeb	Ridomil Gold MZ WG	Syngenta	caution	oral	phenylamide + EBDC	4 + M3	48
mefenoxam + PCNB	Ridomil Gold PC GR	Syngenta	warning	oral	phenylamide + substituted benzenes	4 + 14	48
mefentrifluconazole	Provysol	BASF	caution	oral	demethylation inhibitor (DMI)	3	12
metalaxyl	Allegiance FL	Bayer CropScience	warning	oral	phenylamide	4	24
	Metalaxyl 265 ST	Albaugh/Agri Star	warning	oral	phenylamide	4	24
	MetaStar 2E AG	LG International	warning	oral	phenylamide	4	48
	Sebring 318 FS, 480 FS	Nufarm Americas	warning	oral	phenylamide	4	24
metalaxyl + trifloxystrobin	Trilex 2000	Bayer CropScience	caution	oral	phenylamide + strobilurin	4 + 11	24
metam-potassium	*Sectagon-K54	NovaSource	danger	oral AND posted	fumigant	—	see label
metam-sodium	*Sectagon 42	NovaSource	danger	oral AND posted	fumigant	—	see label
	*Vapam	AMVAC	danger	oral AND posted	fumigant	—	see label
metconazole	Quash	Valent	caution	oral	triazole	3	12
metrafenone	Vivando	BASF	caution	oral	benzoprenone	U8	12
myclobutanil	Rally 40WSP	Dow AgroSciences	caution	oral	sterol inhibitor	3	24
Fungicides							

*Restricted-use pesticide.

(continued)

Pesticide class and re-entry intervals of insecticides and fungicides *(continued)*

Active ingredient	Product	Manufacturer	Signal word	Notification	Resistance mgmt[a]		REI[b] (hours)
					Chemical group	Group code	
Fungicides							
oxathiapiprolin + mandipropamid	Orondis Ultra	Syngenta	caution	oral	oxysterol + mandelic acid amide	49 + 40	4
PCNB	Blocker, PCNB 10% granules	AMVAC	caution	oral	substituted benzenes	14	12
penflufen + prothioconazole	Emesto Silver	Bayer CropScience	caution	oral	benzanilide + triazole	7 + 3	12
penthiopyrad	Fontelis	DuPont	caution	oral	benzanilide	7	12
	Vertisan	DuPont	caution	oral	benzanilide	7	12
phosphorous acid salts	Phostrol	Nufarm Americas	caution	oral	mono- and dibasic sodium, potassium, & ammonium phosphites	33	4
picoxystrobin	Aproach	DuPont	caution	oral	strobilurin	11	12
propamocarb hydrochloride	Previcur Flex	Bayer CropScience	caution	oral	carbamate	28	12
propiconazole	Bumper 41.8 EC, PropiMax EC, Tilt	MANA, Dow AgroSciences, Syngenta	warning	oral	triazole	3	12
prothioconazole	Proline 480SC	Bayer CropScience	caution	oral	triazole	3	12
prothioconazole + trifloxystrobin	Stratego YLD, Delaro 325 SC	Bayer CropScience	caution	oral	triazole + strobilurin	3 + 11	12
pyraclostrobin	Cabrio EG	BASF	caution	oral	strobilurin	11	12
	Headline SC	BASF	warning	oral	strobilurin	11	12
pyraclostrobin + metiram	Cabrio Plus	BASF	caution	oral	strobilurin + dithiocarbamate	11 + M3	24
pyrimethanil	Scala SC	Bayer CropScience	caution	oral	anilinopyrimidine	9	12
quinoxyfen	Quintec	Dow	caution	oral	quinoline	13	12
streptomycin sulfate	Agri-mycin 17	Nufarm Americas	caution	oral	antibiotic	25	12
sulfur	Kumulus, Micro Sulf, Microthiol Disperss	Wilbur-Ellis, Nufarm Americas, UPI	caution	oral	multi-site inorganic	M2	24
tebuconazole	Orius, Tebuzol 3.6F	MANA, UPI	caution	oral	triazole	3	12 19 days (sweet corn)
thiabendazole	Mertect 340F	Syngenta	caution	oral AND posted	benzimidazole	1	12
thiophanate-methyl	Topsin, Topsin M	MANA, Micro Flo, UPI	caution	oral	benzimidazole	1	12–72
thiram	Thiram	Chemtura, Taminco	caution	oral	dithiocarbamate	M3	24
TPTH (triphenyltin hydroxide)	*Agri Tin, *Super Tin 4L	Nufarm Americas, UPI	danger	oral AND posted	organometallic	30	48
trifloxystrobin	Flint	Bayer CropScience	caution	oral	strobilurin	11	12
	Gem	Bayer CropScience	caution	oral	strobilurin	11	12

*Restricted-use pesticide.

(continued)

Pesticide class and re-entry intervals of insecticides and fungicides *(continued)*

Active ingredient	Product	Manufacturer	Signal word	Notification	Resistance mgmt[a] Chemical group	Resistance mgmt[a] Group code	REI[b] (hours)
triflumizole	Procure 480SC	Chemtura	caution	oral	imidazole	3	12
zoxamide + chlorothalonil	Zing	Gowan	caution	oral	benzamide + substituted benzenes	22 + M5	12
zoxamide/mancozeb	Gavel 75DF	Gowan	caution	oral	benzamide/EBDC	22 + M3	48

*Restricted-use pesticide.

Herbicide common and product names, formulations, manufacturers, safety information, and mode of action

Active ingredient	Product	Formulation(s)	Manufacturer	Signal word	Resistance management[a] Mode of action	Resistance management[a] Group code	REI[b] (hrs)
2,4-D	2,4-D Amine	various	several	danger	growth regulator	4	48
	2,4-D Ester	various	several	caution	growth regulator	4	12
acetochlor + safener	several	6.4EC, 7EC	several	caution/ warning	shoot growth inhibitor	15	12
alachlor	*Intrro	4EC	Monsanto	danger	shoot growth inhibitor	15	12
	*Micro-Tech	4ME	Monsanto	caution	shoot growth inhibitor	15	12
atrazine	*several	90DF, 4L	several	caution	photosynthesis inhibitor (systemic)	5	12
bensulide	Prefar	4E	Gowan	caution		8	12
bentazon	Basagran	4S	Arysta	caution	photosynthesis inhibitor (contact)	6	48
bromoxynil	Buctril	4EC, 2EC	Bayer CropScience	warning	photosynthesis inhibitor (systemic)	6	12 hrs to 12 days
carfentrazone	Aim EC	2EW	FMC	caution	cell membrane disruptor	14	12
carfentrazone + halosulfuron	Priority	62.5DF	Tenkoz	caution		14 + 2	12
clethodim	Select Max	0.97EC	Valent	caution	lipid synthesis inhibitor	1	24
clomazone	Command	3ME	FMC/Helena	caution	pigment inhibitor	13	12–48
clopyralid	Stinger	3S	Dow AgroSciences	caution	growth regulator	4	12
cycloate	Ro-Neet	6E	Helm	caution	shoot growth inhibitor	8	12
dimethenamid-P	several	several	several	warning	shoot growth inhibitor	15	12
dimethenamid-P + atrazine	*G-Max Lite	2.25 + 2.75L	BASF	warning		15 + 5	12
EPTC	Eptam	7E, 20G	Gowan	warning/ caution	shoot growth inhibitor	8	12
ethalfluralin	Sonalan, Curbit	3EC, 10G	Dow AgroSciences, Loveland	danger	root growth inhibitor	3	24
fluazifop	Fusilade DX	2EC	Syngenta	caution	lipid synthesis inhibitor	1	12

*Restricted-use pesticide.

(continued)

[a] To delay or prevent the development of resistance, rotate among herbicides from different chemical groups. Newly approved labels bear the group code, a reference to the specific target site of the chemical. For more details, visit www.plantprotection.org/HRAC/.

[b] REI = Restricted entry interval.

Herbicide common and product names, formulations, manufacturers, safety information, and mode of action *(continued)*

Active ingredient	Product	Formulation(s)	Manufacturer	Signal word	Resistance management[a]		
					Mode of action	Group code	REI[b] (hrs)
flumioxazin	several	several	several	caution	cell membrane disruptor	14	12
fluroxypyr	Starane Ultra	2.8S	Dow AgroSciences	warning	growth regulator	4	24
fluthiacet	Cadet	0.91EC	FMC	warning	cell membrane disruptor	14	12
fomesafen	Reflex	2LC	Syngenta	danger	cell membrane disruptor	14	24
foramsulfuron + safener	Option	35DF	Bayer CropScience	caution	amino acid synthesis inhibitor (ALS)	2	12
glyphosate	several		several	caution	amino acid inhibitor	9	4–12
halosulfuron	Permit, Sandea	75DF	Gowan	caution	amino acid synthesis inhibitor (ALS)	2	12
imazamox	Raptor	1S	BASF	caution	amino acid synthesis inhibitor (ALS)	2	4
imazethapyr	Pursuit	2S	BASF	caution	amino acid synthesis inhibitor (ALS)	2	4
linuron	Lorox	50DF	NovaSource	caution	photosynthesis inhibitor (systemic)	7	24
MCPA	MCPA Amine	various	several	danger	growth regulator	4	48
	MCPA Ester	various	several	caution	growth regulator	4	12
MCPB	Thistrol	2S	NuFarm	warning	growth regulator	4	24
mesotrione	Callisto	4L	Syngenta	caution	pigment inhibitor	27	12
metribuzin	several	various	several	caution	photosynthesis inhibitor (systemic)	5	12
napropamide	Devrinol	50DF	United Phosphorus Inc. (UPI)	caution	shoot growth inhibitor	15	24
naptalam-sodium	Alanap-L	2L	Chemtura	warning	auxin transport inhibitor	19	48
nicosulfuron + safener	Accent Q	54.5DF	DuPont	caution	amino acid synthesis inhibitor (ALS)	2	4
oxyfluorfen	Goal	2XL	Dow AgroSciences	warning	cell membrane disrupter	14	24–48
	GoalTender	4L	Dow AgroSciences	caution	cell membrane disrupter	14	24–48
paraquat	*several	various	several	danger	cell membrane disrupter	22	12–24
pendimethalin	Prowl H_2O	3.8CS	BASF	caution	root growth inhibitor	3	24
prometryn	many	4L	many	caution	photosynthesis inhibitor (systemic)	5	12
quizalofop	Assure II/Targa	0.88EC	DuPont/Gowan	danger	ACCase inhibitor	1	12
rimsulfuron	Matrix/Solida	25DF	DuPont/Cheminova	caution	amino acid synthesis inhibitor	2	4
sethoxydim	Poast	1.5EC	BASF	warning	ACCase inhibitor	1	12
	Poast Plus	1EC	BASF	caution	ACCase inhibitor	1	12
simazine	Princep	90DF, 4L	Syngenta	caution	photosynthesis inhibitor (systemic)	5	12
s-metolachlor + safener	Dual II Magnum	7.64EC	Syngenta	caution	shoot growth inhibitor	15	24
s-metolachlor + atrazine + safener	*Bicep Lite II Magnum	3.33 + 2.67L	Syngenta	caution		15 + 5	24

*Restricted-use pesticide.

(continued)

Herbicide common and product names, formulations, manufacturers, safety information, and mode of action *(continued)*

Active ingredient	Product	Formulation(s)	Manufacturer	Signal word	Resistance management[a]		
					Mode of action	Group code	REI[b] (hrs)
s-metolachlor + mesotrione	Zemax	3.34 + 0.33L	Syngenta	caution		15 + 27	24
s-metolachlor + mesotrione + atrazine	*Lumax	2.68 + 0268 + 1L	Syngenta	caution		15 + 27 + 5	24
tembotrione + safener	Laudis	3.5L	Bayer CropScience	caution	pigment inhibitor	27	12
terbacil	Sinbar	80WP	NovaSource	caution	photosynthesis inhibitor (systemic)	5	12
topramazone	Impact	2.8L	AMVAC	caution	pigment inhibitor	27	12
trifluralin	Treflan	HFP	Dow AgroSciences	caution	root growth inhibitor	3	12

*Restricted-use pesticide.

(continued from page 21)

poisoning. While hospitals and other medical facilities may have some information, the Poison Control Center has the most complete and current files, and their personnel are specifically trained to deal with poison cases.

Most labels also list a phone number that you (or medical personnel) can call for specific information on poisoning (or other accidents) involving that particular product.

Pesticide safety

Before you handle pesticides, ***stop and read the label.*** Labels contain human safety precaution statements and list the specific personal protective clothing and equipment that you need to wear. Some of the following may be label requirements; others are commonsense guidelines that will help minimize pesticide exposure to you, your coworkers, and your family and neighbors.

- Wear a long-sleeved shirt, long pants, shoes, and socks when handling pesticides.
- Wear coveralls (fabric or chemical-resistant) over your work clothes for an added layer of protection.
- Unless the label states otherwise, always wear chemical-resistant gloves whenever you work with pesticides.
- Wear chemical-resistant footwear, gloves, eyewear, and a respirator (if the label requires one) when mixing, loading, or applying pesticides.
- If you wear fabric coveralls, also wear a chemical-resistant apron when mixing and loading pesticides.
- Stand in the crosswind when mixing or loading pesticides.
- Never apply pesticides when there is the likelihood of significant drift.
- Never leave a spray tank containing pesticide unattended.
- Do not allow back siphoning into the water source.
- Never eat, drink, or smoke when handling pesticides.
- Wash hands thoroughly after handling pesticides.
- If you splash pesticide on yourself, remove contaminated clothing immediately and wash yourself thoroughly.
- Wash contaminated clothes separately from other household laundry.
- Keep pesticides in original containers.
- Store and lock pesticides out of the reach of children.
- Observe restricted entry intervals on a treated crop or area.

Pesticide accidents

Pesticide spills. Regardless of the magnitude of a spill, the objectives of a proper response are the same—you must ***control*** the spill, you must ***contain*** it, and you must ***clean it up.*** A thorough knowledge of appropriate procedures will allow you to minimize the potential for adverse effects.

Spills of any compound need to be reported to the DNR. However, you do ***not*** need to report the spill if it is completely confined within an impervious secondary containment and the spilled amount can be recovered with no discharge to the environment. On the other hand, a spill of any amount is reportable if it occurred outside of secondary containment and it harmed, or threatens to harm, human health or the environment (e.g., back siphoning). The spill is exempt from the DNR reporting requirements if:

- you deem the spill will not harm, or threaten to harm, human health or the environment **AND**
- the amount spilled would cover less than 1 acre if applied at labeled rates **AND**
- if a SARA pesticide, it is less than the reportable quantity.

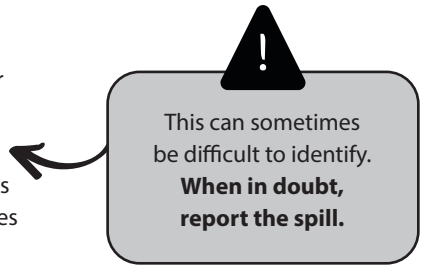
Reportable spills involving SARA substances (see "Pesticides and Community Right to Know" on page 20) are also to be reported to WEM and to your LEPC. To simplify emergency notification requirements to state agencies, call the 24-hour Wisconsin spill hotline (1-800-943-0003) whenever a spill of any compound occurs. Calling this hotline will not, however, remove your responsibility of notifying your LEPC.

Spills of some compounds may require that you notify federal authorities by calling the National Response Center (1-800-424-8802). Your call to the Wisconsin spill hotline should provide you with assistance in determining whether federal authorities need to be notified.

Pesticide fires. In the event of a fire, isolate the entire area and clear all personnel to a safe distance *upwind* from smoke and fumes. Always inform the fire department of the nature of the pesticides involved and of any specific information that may help them in fighting the fire and protecting themselves and others from injury. For information on cleanup and decontamination, contact WEM and the pesticide manufacturer(s).

Livestock poisoning. When you suspect animal poisoning by pesticides, first call your veterinarian. If the cause of poisoning cannot be determined, call DATCP's Animal Toxic Response Team Coordinator at 608-224-4539 (during office hours) or WEM at 1-800-943-0003 (after hours and on weekends).

Wildlife poisoning or water contamination. Contact the DNR district office. District offices are located in Eau Claire, Fitchburg, Green Bay, Milwaukee, Rhinelander, and Spooner.



Pesticides and endangered species

Endangered and threatened species are the most vulnerable plants and animals in our native natural communities. These species are either in danger of extinction or likely to become endangered in the foreseeable future. Starting in 2010, the EPA's Endangered Species Protection Program (ESPP) began implementing county-specific bulletins to provide applicators the information they need about pesticide use limitations in their county to better protect listed species and their habitat. The first product to carry a label statement directing users to view a bulletin is methoxyfenozide (Intrepid 2F), to protect the endangered Karner blue butterfly and Hine's emerald dragonfly. Please note that it may take several years for products with the new label to replace existing product in the channel trade. As always, pesticide users are to follow the label on the product they are using.

When using pesticides whose label statements instruct you to follow the measures contained in the ESPP Bulletin, you must either access the EPA's Bulletins Live! website or call their toll-free number (1-800-447-3813) within 6 months before using the product. The bulletin will show which counties or portions of counties are affected and the use limitations for that particular product. You must use the bulletin that is valid for the month and year in which you will apply the product.

Go to www.epa.gov/espp/ for general information on the ESPP and to access Bulletins Live! The DNR is responsible for implementing ESPP for our state. For more information about protected plants, animals, and natural communities in Wisconsin, see dnr.wi.gov/topic/endangeredresources/biodiversity.html.

Pesticide drift

It is impossible to totally eliminate pesticide drift. Drift occurs because of unforeseen wind variations and other factors, many of which are beyond the applicator's control. People living in areas subject to pesticide drift worry about the acute and chronic effects of exposure to pesticides. State rules governing pesticide drift attempt to strike a balance between the intended benefits of pesticide use and the potential risks to those exposed to pesticide drift.

According to state law, people living adjacent to land that is aerially sprayed with pesticides can request to be notified at least 24 hours before application. Beekeepers also are entitled to notification of applications that occur within a 1.5-mile radius of their honeybee colonies when reqested in writing annually. Both ground and aerial pesticide applications are subject to advance notification requirements to beekeepers who request such notification.

For ground applications, you can minimize drift by following these recommendations:

- Follow all label precautions for specific drift-reduction measures.
- Spray when wind speed is low.
- Use the maximum-size nozzle orifice without sacrificing pest control activity.
- Keep pressure at the lowest setting possible without distorting spray pattern and distribution.
- Use drift-control agents when permitted by product label.
- Consider using nozzles specifically designed to reduce drift.
- Leave an untreated border strip next to adjacent property.

For more information about drift—what it is, how it occurs, and drift management principles—ask for *Managing Pesticide Drift in Wisconsin: Field Sprayers* from your county Extension office or download it by going to https://fyi.extension.wisc.edu/pat/files/2017/09/driftdoc.pdf. This publication also describes the critical role the pesticide applicator plays in deciding whether to spray when arriving at the site.

Pesticides and groundwater

Trace amounts of pesticides are found in our nation's groundwater. To minimize further contamination, many pesticide labels contain precautionary statements either advising against or prohibiting use in areas vulnerable to groundwater contamination. A summary of these precautionary statements is included under "Remarks" for each pesticide in this publication.

To protect our state's water resources, Wisconsin's groundwater law (Act 310) created two guidelines to limit the presence of fertilizer and pesticides in groundwater: *enforcement standards* are maximum chemical levels allowed in groundwater, and *preventive action limits* are set at a percentage of the enforcement standard. When contamination approaches preventive action limits, the responsible party must implement corrective measures to prevent further contamination.

Through groundwater monitoring studies, the most commonly found pesticide is atrazine. Consequently, Wisconsin implemented Chapter ATCP 30 to help minimize further contamination of our groundwater by atrazine. Under this rule, statewide rate restrictions have been implemented and, in some geographic areas, the use of atrazine is prohibited.

Mixing and loading pesticides. Mixing and loading pesticides pose a high risk of point source contamination of ground and surface water because of the concentration, quantity, and type of pesticides that are usually handled at a mixing and loading site. To minimize this risk of environmental contamination, Wisconsin requires that certain mixing and loading sites have secondary containment.

Both private and commercial applicators are required to have a mixing and loading pad if more than 1,500 pounds of pesticide active ingredient are mixed or loaded at any one site in a calendar year or if mixing and loading occurs within 100 feet of a well or surface water. In-field mixing is exempt from the pad requirements provided mixing or loading at the site of application occurs 100 feet or more from a well or surface water.

Agricultural Chemical Cleanup Program. Cleanup of contaminated soil or contaminated groundwater is costly. The Agricultural Chemical Cleanup Program (ACCP) helps ease the financial burden for facilities and farms by reimbursing them for eligible costs associated with the cleanup of sites contaminated with pesticides or fertilizers. For more information, visit https://datcp.wi.gov/Pages/Programs_Services/ACCP.aspx.

Soil fumigant pesticides

Soil fumigants are used on a number of crops in Wisconsin, primarily on potatoes but also on strawberries, tobacco, and trees grown in nurseries. While fumigants are important and useful pesticides, they also pose some unique dangers because they are highly volatile and can move from the soil and the treatment site to the air. They can affect workers and, when vapors move off site, the general public.

Because of this danger, the Environmental Protection Agency (EPA) implemented a series of risk mitigation measures beginning in 2010. All the proposed extra protection measures were in place as of the 2012 growing season.

All soil fumigants are now registered as restricted-use pesticides. This means that **anyone,** whether a private applicator or a commercial applicator, **must** be certified to use and apply soil fumigants in Wisconsin. People wanting to use soil fumigants in the state must first become certified in a base category (e.g., *Field & Vegetable Crops* for commercial applicators; *General Farming, Greenhouse & Nursery* or *Fruit Crops* for private applicators) and then the supplemental subcategory, *Soil Fumigation*.

Some of the risk mitigation measures the EPA is now requiring on soil fumigant labels include buffer zones around an application area, written site-specific Fumigant Management Plans (FMP), emergency preparedness and community outreach education, lower application rates, more stringent respiratory protection, a minimum of 5 days for reentry, and others.

Some soil fumigant labels may have a requirement that applicators attend product-specific registrant training programs. However, in Wisconsin, applicators must be certified in a base category and in the soil fumigation subcategory as discussed above. Registrant training programs would be optional.

For more detailed information on the new mitigation measures, fact sheets, FMP templates, and more, see the EPA's Soil Fumigant Toolbox.

Calibrating pesticide equipment

Accurate and uniform pesticide application is fundamental to satisfactory pest control. Too frequently a grower does not know exactly how much pesticide has been used until the application is completed. This can lead to substantial monetary losses due to unnecessary pesticide and labor costs, unsatisfactory pest control resulting in reduced yields, and crop damage. Good pesticide application begins with accurate sprayer or granular applicator calibration. One method of calibration is contained in the *Training Manual for the Private Pesticide Applicator.* It also is found in the *Training Manual for the Commercial Applicator: Field and Vegetable Crops.* Both of these are available at https://patstore.wisc.edu/secure/default.asp.

Cleaning pesticide sprayers

Thorough sprayer cleaning is necessary when switching from pesticide application on one crop to the application of a different pesticide on another crop. This is especially important when the second crop is quite sensitive to the first pesticide. For example, residue of dicamba left in a sprayer may damage soybeans and other dicamba-sensitive crops during subsequent pesticide applications. No cleaning method is 100% foolproof, however. If you apply significant quantities of different types of pesticides, reserve one sprayer for herbicides only and another for insecticides and fungicides.

Check the label for specific cleaning instructions. If none are listed, follow these guidelines:

1. Park the sprayer on a wash pad; flush the tank, lines, and booms thoroughly with clean water; and apply the pesticide-contaminated rinsate to sites listed on label. Simpler still, mount a clean water source on your sprayer and flush the system while in the field.
2. Select the appropriate cleaning solution for the pesticide used:

   Hormone-type herbicides (e.g., 2,4-D, Banvel). Fill the sprayer with sufficient water to operate, adding 1 quart household ammonia for every 25 gallons of water. Circulate the ammonia solution through the sprayer system for 15 to 20 minutes and then discharge a small amount through the boom and nozzles. Let the solution stand for several hours, preferably overnight. (Please note: household ammonia will corrode aluminum sprayer parts.)

   Other herbicides, insecticides, and fungicides. Fill the sprayer with sufficient water to operate, adding 0.25 to 2 pounds powder detergent (liquid detergent may be substituted for powder at a rate to make a sudsy solution) for every 25 to 40 gallons of water. Circulate the detergent solution through the sprayer system for 5 to 10 minutes and then discharge a small amount through the boom and nozzles. Let the solution stand for several hours, preferably overnight.
3. Flush the solution out of the spray tank and through the boom.
4. Remove the nozzles, screens, and strainers and flush the system twice with clean water.
5. Scrub all accessible parts with a stiff bristle brush.

Preparing pesticide sprayers for storage

Before storing the sprayer at the end of the season:

1. Clean the sprayer per label instructions or as specified above.
2. Fill the sprayer with sufficient water to operate, adding 1 to 5 gallons of lightweight emulsifiable oil, depending upon the size of the tank. Circulate the oil/water solution through the sprayer system for 5 to 10 minutes.
3. Flush the solution out of the spray tank and through the boom; the oil will leave a protective coating on the inside of the tank, pump, and plumbing.
4. Remove the nozzles, screens, and strainers and place them in diesel fuel or kerosene to prevent corrosion. Cover the nozzle openings in the boom to prevent dirt from entering.
5. As an added precaution to protect pumps, pour 1 tablespoon of radiator rust-inhibitor antifreeze in each of the inlet and outlet ports. Rotate the pump several revolutions to completely coat the interior surfaces.

Pesticide disposal

It is the legal responsibility of all pesticide users to properly dispose of pesticide waste in an environmentally acceptable manner (it is illegal to bury or burn any pesticide containers in Wisconsin).

Some pesticides are considered "hazardous" by the EPA. Disposing waste or excess resulting from use of these pesticides comes under stringent regulations of the Resource Conservation Recovery Act (RCRA). This federal law and the accompanying state law (NR 600) regulate generators of hazardous waste—those who need to dispose of hazardous pesticides.

The simplest way to avoid becoming a hazardous-waste generator is to triple rinse all pesticide containers and apply rinsates to labeled sites. If you must generate hazardous waste, disposal procedures may differ depending on the volume of waste generated and its characteristics.

You can reduce the amount of pesticide waste (hazardous or not) by following these guidelines:

- Determine whether the pesticide you intend to use is considered hazardous by the EPA. A list of these pesticides is available from your DNR regional office. If listed, check for alternative pesticides that are not hazardous and will provide equivalent pest control.
- Mix only the amount of pesticide needed and calibrate equipment so all of the solution is applied.
- Attach a clean water supply to the sprayer unit so the tank can be rinsed and the rinsate applied to the labeled site while still in the field.
- Triple rinse all pesticide containers. Even if the pesticides were hazardous, a triple-rinsed container is not hazardous waste; you can dispose of it in a sanitary landfill.
- Don't mix hazardous waste with other pesticide waste, or the entire mixture will be considered hazardous.

Wisconsin Clean Sweep program. Wisconsin's Clean Sweep program, sponsored by DATCP and individual counties, offers a way to dispose of most kinds of pesticide waste, including liquids, dry formulations, and waste classified as hazardous. For details on when a site will be held in your area, check with your county Extension office or view the DATCP Clean Sweep interactive map at datcp.wi.gov/environment/clean_sweep/index.aspx. Wisconsin Clean Sweep offers grants for the collection and disposal of agricultural waste, household hazardous waste, and prescription drugs. However, not all municipalities collect all three types of waste at the same time, while some municipalities offer collection sites without use of Wisconsin Clean Sweep funds.

Recycling plastic pesticide containers. Your local recycling program might recycle plastic pesticide containers. First, be sure to clean the containers in accordance with the pesticide label. Once the containers are properly cleaned, contact your municipality to determine if it will recycle plastic pesticide containers. Each municipality decides whether or not it will accept plastic pesticide containers.

Be aware that Wisconsin law prohibits the burning of pesticide containers regardless of the label's directions.

Contact your pesticide supply dealer for additional container recycling options.

Asparagus

Permanent asparagus plantings in Wisconsin are usually started with year-old crowns. Direct seeding has had limited success in Wisconsin. Plug production of seedlings is also being done on a limited basis and will likely increase in future years as male hybrid seed becomes increasingly available.

Hybrid male cultivars cost more than the open-pollinated varieties, but yields are 1.5 to 2 times that of the traditional cultivars.

Planting

Field transplant production

Rows: 18–20 inches.

Seeds in row: 2 inches (1 inch deep). Use 4–5 lb seed/a. Each pound produces about 10,000 plants, enough for about an acre. (Sidedress with 75–100 lb/a ammonium nitrate about mid-June.) To speed germination, soak seeds in warm water (about 90˚F) for 4–5 days before planting. Add a few radish seeds to provide early plants to mark rows for cultivation. The following spring, lift and reset plants in a permanent location.

Indoor transplant production

You can also start seeds indoors around the first of March for transplanting the middle of May. This way you do not need to replant them the following year. Use the same spacing for transplants as recommended for 1-year-old crowns.

Permanent plantings from 1-year-old crowns or from transplants

Rows: 4–6 ft.

Crowns in row: 9–15 inches (6–8 inches deep). Cover the crowns or transplants with 2–3 inches of soil and gradually fill furrows as plants grow (see illustration). Poor stands result if plants are covered too deeply at the start. Ridge the soil moderately over the rows after the plants are well established.

Avoid planting asparagus in fields infested with perennial weeds such as Canada thistle, quackgrass, and field bindweed (creeping Jenny) or eliminate these weeds before planting.

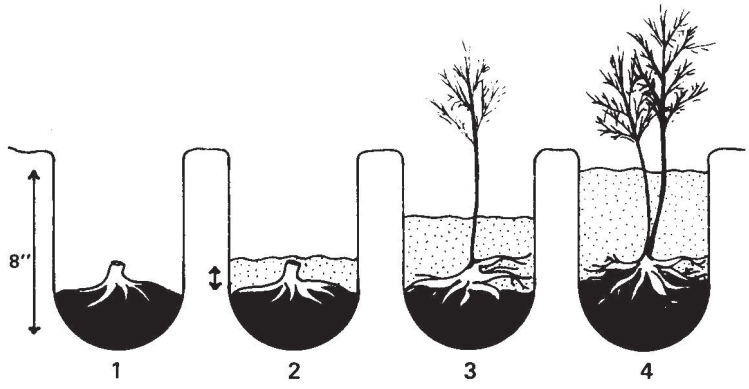
Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 6.0 on mineral soils and 5.6 on organic soils.

Fertilizer rates: Apply P_2O_5 and K_2O according to soil test recommendations before planting. Use annual nitrogen, P_2O_5, and K_2O recommendations in the following table each year asparagus is grown. Take credits for previous legume crops and manure.

Application: Broadcast and work in before spears begin to grow in early spring.

Nitrogen: On sandy soils, apply half of the nitrogen in early spring and the remaining half after the last harvest.



Set the plants upright in wide furrows, 6–8 inches deep, with the roots spread.

Cover with 2–3 inches of soil.

Gradually fill the furrow as the plants grow.

Annual nitrogen, phosphate, and potash recommendations for asparagus

Nitrogen		Phosphate and potash		
Organic matter (%)	**Amount to apply** (lb/a)	**Yield goal** (lb/a)	**Amount P_2O_5 to apply*** (lb/a)	**Amount K_2O to apply*** (lb/a)
<2	80	2,000–4,000	10	20
2.0–9.9	60			
10–20	40			
>20	20			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Disease control in asparagus

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cercospora leaf spot	mancozeb	2.0 lb Dithane M45, Dithane DF Rainshield	120	Only apply on asparagus ferns after spears have been harvested. Do not apply more than 8.0 lb ai/a per season.
Crown rot (*Phytophthora* spp.)	Mono- and di-basic sodium, potassium, and ammonium phosphite	2.5–5.0 pt Alude	—	Apply only to fully expanded asparagus ferns. Thorough coverage is required. Do not apply to senescing ferns.
	mefenoxam	2.0 pt Ultra Flourish	1	Do not apply more than 4 pt per acre per year.
		1.0 pt Ridomil Gold	1	Follow resistance management guidelines on label.
	mefenoxam + oxathiapiprolin	4.8–9.6 fl oz Orondis Gold 200	0	Follow use pattern and resistance management guidelines on label.
	metalaxyl	2.0 qt Metalaxyl 2E AG	1	Label provides use patterns for new plantings and cutting beds.
		2.0 qt MetaStar 2E	1	Label provides use patterns for new plantings and cutting beds.
Fusarium root rot	*Field choice is very important so that plant stress in subsequent years is avoided.*			
Purple spot (*Stemphylium vesicarium*)	azoxystrobin	6.0–15.5 fl oz Acadia, Aframe, AzoxyStar, Azoxyzone, Quadris, Satori, Willowood Azoxy 2SC	100	Do not apply more than 92.3 fl oz/a product per season. Do not make more than 1 application of azoxystrobin or other Group 11 fungicide before alternating to a fungicide with another mode of action.
	chlorothalonil	2.0–4.0 pt Bravo Weather Stik, Chloronil 720, Chlorothalonil 720, Echo 720, Equus 720 3.0–5.75 pt Echo Zn 1.8–3.6 lb Bravo Ultrex, Equus 90DF, Initiate 720	190	Do not apply more than 9.0 lb ai/a chlorothalonil per growing season. Post-harvest application only.
	trifloxystrobin	3.0–4.0 oz Flint	180	Do not apply more than 12.0 oz/a Flint per season. Do not make more than 3 applications of Flint or other Group 11 fungicides during the season.
Rust	chlorothalonil	2.0–4.0 pt Bravo Weather Stik, Chloronil 720, Chlorothalonil 720, Echo 720, Equus 720 3.0–5.75 pt Echo Zn 1.8–3.6 lb Bravo Ultrex, Equus 90DF, Initiate 720	190	Do not apply more than 9.0 lb ai/a chlorothalonil per growing season. Post-harvest application only.
	copper oxychloride + copper hydroxide	1.0–2.5 pt Badge SC	0	Use a spreader/sticker. Tank mix with another effective fungicide.
	mancozeb	1.5 qt Penncozeb 4FL 1.6 qt Dithane F-45, Manzate Flowable 2.0 lb Dithane DF Rainshield, Dithane M45, Koverall, Manzate Pro-Stick, Penncozeb 75DF, Penncozeb 80WP	180	Use rust-resistant varieties. Do not apply more than 6.0 lb ai/a per season. Apply only on ferns after spears have been harvested. Cut infected plants at ground level in late fall or winter and destroy infected debris.
	myclobutanil	5.0 oz Rally 40WSP	180	Do not apply to harvestable spears. Do not make more than 6 applications or exceed 30.0 oz/a Rally (0.75 lb ai/a) per year. Former product name was Nova.

*Restricted-use pesticide.

(continued)

Disease control in asparagus *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Rust *(cont.)*	sulfur	10.0–30.0 lb Kumulus, Micro Sulf, Microthiol Disperss	—	Use after cutting. Irrigate and cultivate before applying. Repeat at 7- to 10-day intervals through fern growth season. Foliar injury may be enhanced under high temperatures. Do not use in combination with oil.
	tebuconazole	4.0–6.0 fl oz AmTide TEBU 3.6F, Folicur 3.6 F, Monsoon, Onset 3.6L, Orius 3.6F, Tebucon, Tebuconazole 3.6F, Tebusha 3.6FL, Tebuzol 3.6F, Toledo, Willowood Teb 3.6SC	180	Postharvest application only. Do not make more than three foliar applications or exceed 18.0 fl oz/a per season.

*Restricted-use pesticide.

Insect control in asparagus

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Asparagus aphid	*Natural enemies will often eliminate this insect; spot treat when populations are increasing rapidly and biological control is ineffective. Treat when 5% of ferns show injury. New plantings tolerate less injury.*			
	0.047–0.1 lb acetamiprid	2.5–5.3 oz Assail 30SG	1	Do not exceed 0.2 lb ai/a per year. Thorough coverage is important to obtain optimum control.
	0.05–0.1 lb acetamiprid	1.1–2.3 oz Assail 70WP	1	
	azadirachtin	16.0–32.0 oz Aza-Direct 10.0–16.0 oz Azatin XL 5.0–7.0 oz Neemix 4.5	0	Apply at 7-day intervals when pests first appear. May apply every 3–4 days for heavy infestations.
	0.5 lb dimethoate	1.0 pt Dimethoate 400	180	Apply after the last harvest. Highly toxic to bees—do not apply when crop or nearby weeds are in bloom. Wait at least 14 days between treatments. Do not exceed 0.5 lb ai/a per treatment. Do not exceed 1.0 lb ai/a per season.
	0.938–1.25 lb malathion	1.5–2.0 pt (several brands) 57%EC	1	Re-entry interval of 12 hours. Wait at least 7 days between treatments. Do not exceed 1.25 lb ai/a (2.0 pt Malathion 57EC) per treatment. Do not exceed two applications per year.
	1–2% potassium salts of fatty acids	2.0 gal M-Pede/100 gal water	0	Primarily a contact spray. Apply every 7–14 days as needed.
	0.086 lb pymetrozine	2.75 oz Fulfill 50WDG	—	Apply after harvest.
	0.004–0.05 lb pyrethrin	1.0–12.0 fl oz Pyrenone 0.5EC	0	Primarily a contact spray.
	0.023–0.047 lb sulfoxaflor	0.75–1.5 oz Transform WG	post-harvest	Do not make applications less than 7 days apart. Do not make more than four applications per crop. Do not make more than two consecutive applications per crop. Do not apply more than a total of 8.5 oz of Transform WG (0.266 lb ai of sulfoxaflor) per acre per year.
Common and twelve-spotted asparagus beetles, Japanese beetle	1.0–2.0 lb carbaryl	1.0–2.0 qt Sevin XLR Plus	1	Do not apply to target crops or weeds in bloom. Do not apply more than a total of 3 qt/a before harvest of spears. Do not exceed 5 qt/a per year.

*Restricted-use pesticide.

(continued)

Insect control in asparagus *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Common and twelve-spotted asparagus beetles, Japanese beetle *(cont.)*	0.5 lb dimethoate	1.0 pt Dimethoate 400	180	Apply after the last harvest. Highly toxic to bees—do not apply when crop or nearby weeds are in bloom. Wait at least 14 days between treatments. Do not exceed 0.5 lb ai/a per treatment. Do not exceed 1.0 lb ai/a per season.
	0.938–1.25 lb malathion	1.5–2.0 pt (several brands) 57%EC	1	Re-entry interval of 12 hours. Wait at least 7 days between treatments. Do not exceed 1.25 lb ai/a (2.0 pt Malathion 57EC) per treatment. Do not exceed two applications per year.
	0.5–1.0 lb methomyl	1.5–3.0 pt *Lannate LV	1	Do not exceed 4.5 lb ai/a or 8 applications per crop.
	0.05–0.1 lb permethrin	2.0–4.0 oz *Permethrin 3.2EC	1	Do not exceed 16.0 oz/a per season. Minimum interval between applications is 7 days.
	0.031–0.063 lb spinetoram	4.0–8.0 oz Radiant SC	60	Do not exceed 24.0 oz/a Radiant (0.188 lb ai/a) or 3 applications per crop. Wait at least 4 days between treatments.
	spinosad	4.0–6.0 fl oz Entrust SC	60	Apply to ferns only. Do not make more than 3 applications per crop. Do not exceed 18.0 fl oz/a Entrust SC per season.
Cutworms	0.5–1.5 lb *Bacillus thuringiensis*	0.5–1.0 lb DiPel DF	0	
	2.0 lb carbaryl	Sevin bait (several formulations)	1	Apply when 5–10% of the plants show cutworm damage.
	chlorantraniliprole	3.5–7.5 fl oz Coragen	1	Do not make more than 4 applications per crop season and allow at least 3 days between applications. Do not apply more than 15.4 fl oz/a Coragen per season.
	0.45–0.9 lb methomyl	1.5–3.0 pt *Lannate LV 0.5–1.0 lb *Lannate SP	1	Do not exceed 4.5 lb ai/a or 8 applications.
	0.05–0.1 lb permethrin	2.0–4.0 oz *Permethrin 3.2EC	1	Do not exceed 16.0 oz/a per season. Minimum interval between applications is 7 days.

*Restricted-use pesticide.

Weed control in asparagus

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	1.0 lb clomazone	2.6 pt Command 3ME	14	Broadcast application to soil surface prior to spear emergence or after a clean harvest. Maximum of 2.6 pts Command 3ME in one application per year.
	0.19 lb flumioxazin	6.0 oz Chateau SW or Tuscany or 6.0 fl oz Tuscany SC		Apply only to dormant asparagus no less than 14 days before spears emerge. Application to nondormant asparagus may result in unacceptable crop injury. Postharvest applications may be made after final harvest and prior to fern emergence and must be sprinkler- or rainfall-incorporated with 0.5–0.75 inch of water.
	0.28-0.75 lb metribuzin + 0.14-0.38 lb sulfentrazone	16-43 fl oz/a Preview 2.1 SC	14	Apply as a broadcast treatment to crowns established for one or more years. Consult label for use rate which is dependent upon soil texture and organic matter. Do not use on soils classified as sand with less than 1% organic matter.

*Restricted-use pesticide.

(continued)

Weed control in asparagus *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds *(cont.)*	3.9 lb pendimethalin	up to 8.2 pt Prowl H_2O	14	Prowl H_2O may be applied in a single broadcast application up to 8.2 pt/a (maximum 2.4 pt/a on sandy soils) at least 14 days prior to first harvest or after final spear harvest and prior to spear emergence. Spray contacting emerged spears may result in severe injury.
	0.14-.38 lb sulfentrazone	4.5 - 12 fl oz/a Spartan 4F	14	Apply only to crowns established for one or more years in the spring before crop and weeds emerge. Rate is pH, organic matter and soil texture dependent - see label for details. Do not use on sands with less than 1% organic matter. Do not apply to frozen soils.
	trifluralin	several manufacturers		Apply to established asparagus as a single or split application, before new spears emerge or after harvest. Rate varies with soil texture. Follow recommended soil preparation, application, and incorporation procedures. Must be incorporated within 24 hours.
Annual broadleaves	0.09–0.24 lb mesotrione	3.0–7.7 fl oz Callisto		Callisto can be applied to asparagus as a spring application prior to spear emergence, as a postharvest application (after final harvest), or both. Do not exceed 7.7 fl oz/a Callisto per year or apply more than twice per year. For postharvest applications, use a directed spray to minimize contact with any standing asparagus spears or ferns to prevent crop injury. See label for rate and adjuvant recommendations based on weed and crop growth stage.
	0.8–1.6 lb terbacil (seeding year only)	1.0–2.0 lb Sinbar WDG		Plant seed 1.0–1.5 inches deep. Spread a band of activated charcoal over the seeding row and follow with a single application of Sinbar. Use the lower rate on coarser soils.
	1.2 lb terbacil	1.5 lb Sinbar WDG	5	Apply before spears and weeds emerge or to small weeds (less than 2 inches tall). Application may be made after clean cutting. Do not exceed 2.5 lb/a per year. Do not use on plants that are diseased or lacking in vigor as crop injury may result. Do not plant to any other crop within 2 years of application.
Annual grasses and broadleaves	linuron	Lorox DF (use and rate varies by soil type—see label)	1	Lorox DF is registered for use on newly planted asparagus and on established beds. Before treating a newly seeded bed, place a 1-inch band of activated charcoal (300 lb/a) directly over the seed. See label for crop height and weed size restrictions. Do not apply more than 4.0 lb/a per year in a maximum of 3 applications. Do not add surfactant to spray mix. Do not use on sand or loamy sand. Do not use on soils with less than 1% organic matter.
Nutsedge and some broadleaves	0.023–0.047 lb halosulfuron	0.5–1.5 oz Sandea	1	Sandea controls several broadleaf weeds and nutsedge. It will not control grasses. It may be applied as a postemergent broadcast treatment before or during the harvest season or as a postharvest directed spray using drop nozzles to direct the spray below the ferns. Spray contact with the fern may cause temporary yellowing. Wait to treat first-year transplants until at least 6 weeks after fern emergence. Do not exceed 2.0 oz/a per crop season in a maximum of two applications. Do not use soil- or foliar-applied organophosphate insecticides on asparagus that has been treated with Sandea or serious crop injury may occur. **Consult label for other important usage information, precautions.**

*Restricted-use pesticide.

(continued)

Weed control in asparagus *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Germinating annual weeds in established beds	0.8–3.2 lb diuron	0.8–3.2 qt Diuron 4L		Do not use on newly planted or seeded asparagus during the first growing season. If making two applications in one season, do not exceed 2.4 qt/a of Diuron per application. Moisture is needed to activate the herbicide. See label for specific application information and precautions.
	metribuzin	see label	14	Metribuzin is registered for a single preemergence application or a split application preemergence and postharvest. Do not exceed 2.0 lb ai/a per year. Do not apply to plants during the first growing season after setting crowns or to newly seeded beds. Apply in early spring before spears or ferns emerge. For split applications, apply half in early spring before spears or ferns emerge and half after the last harvest of spears but before ferns emerge.
	4.0 lb napropamide	8.0 lb Devrinol DF-XT 2.0 gal Devrinol 2-XT		Apply in early spring after disking but before weeds emerge. Do not apply to frozen ground or to ground with more than 10% organic matter. Incorporate or irrigate within 24 hours if no rainfall occurs. Treat only once per season.
Emerged broadleaves	2,4-D (see label for rate)	several manufacturers		Apply to actively growing weeds, usually in April or May. If spears are present, treat right after cutting. No more than two applications during the harvest season, and these should be at least 1 month apart. Contact by spray may cause malformed spears; cut and discard. Postharvest sprays require ground equipment using drop nozzles to avoid spraying the ferns. See label for worker re-entry and preharvest intervals.
	0.008–0.03 lb carfentrazone-ethyl	0.5–1.92 oz Aim EC	5	Apply as a broadcast application after harvest of asparagus spears for control of broadleaf weeds and new existing asparagus shoots. Adequate coverage is essential for good weed control. Do not apply more than 3.8 oz/a per season. Sequential applications must be at least 20 days apart. Consult label for surfactant options.
	0.25–0.5 lb dicamba	8.0–16.0 oz Clarity	24 hours	Apply after cutting, but at least 24 hours before next cutting to actively growing weeds. Multiple applications per season allowed, but do not exceed 16.0 oz/a per year.
	2.0–4.0 lb norflurazon	2.5–5.0 lb Solicam DF	14	Do not apply to asparagus in the first growing season. See label for correct application rate as determined by soil type. Before application, remove or incorporate crop debris. Rain or irrigation needed within 4 weeks of application for activation.
	0.375 lb quinclorac	12.6 fl oz Quinstar 4L		Make one broadcast application after the last harvest of the season and prior to first frost to control bindweed species. The addition of 2.0 pt/A crop oil concentrate may improve performance. Consult label for crop rotation restrictions.
Emerged grasses	0.068–0.12 lb clethodim	9.0–16.0 oz Select Max	1	Add non-ionic surfactant at a rate of 0.25% vol/vol. Wait at least 14 days before repeating treatment. Do not apply more than 64.0 oz/a per season.
	0.094–0.375 lb fluazifop-P-butyl	6.0–24.0 oz Fusilade DX	1	Make postemergence application to actively growing grasses; check label for size range and treatment rate. Always add either crop oil concentrate or non-ionic surfactant to final spray mix. Do not apply more than 48.0 oz/a per season.

*Restricted-use pesticide.

(continued)

Weed control in asparagus *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
	0.094–0.47 lb sethoxydim	0.5–2.5 pt Poast	1	Apply postemergence to actively growing grasses. Consult label for rate and adjuvant instructions for specific weeds. Apply no more than 5.0 pt/a of Poast per season. Do not apply if rain is expected within 1 hour.
Emerged weeds	glyphosate	several manufacturers and formulations	5	See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. Apply at least 1 week before the first spears emerge or apply as a spot treatment after cutting spears or after all spears have been removed. Do not spot treat more than 10% of the field. Direct contact with the crop will cause serious injury.
	*paraquat (rate varies by label)	several manufacturers, not all registered for this use	6	Application will kill emerged crop, so apply to dormant asparagus before emergence or after last harvest. Always add crop oil concentrate or non-ionic surfactant to spray mixture. Follow precautions on label.

*Restricted-use pesticide.

Bean: green, lima, navy, red kidney

Planting

Green bean

The between-row and in-row spacings for green beans depends on whether the conventional or close-row spacing system is being used.

Conventional rows are spaced 30–36 inches apart. The in-row spacing should result in a final plant stand of 7–9 plants/ft of row for irrigated fields and 6–8 plants/ft of row for non-irrigated fields.

Close-row systems have rows spaced 18–24 inches apart. In-row spacing should result in a final stand of 3–4 plants/ft for irrigated and non-irrigated fields. Carefully manage close-row spacings because such systems can increase the potential for white mold disease.

Seed: 75–90 lb/a; depends upon seed size, germination, row spacing. Plant seed 0.5–2.0 inches deep depending on soil conditions. Plant shallow if soil is cool and moist, but deeper in dry, warm sandy soils.

Lima bean

Rows: 18–36 inches. Rows narrower than 30 inches can increase the incidence of white mold. Wider rows allow cultivation and better air circulation, making them less prone to the disease.

Seed: Target stand density of 100,000 plants/a: for 30-inch rows, 5–6 plants/ft; for 18-inch rows, 2–3 plants/ft. Depends upon seed size, germination, row spacing.

Navy and red kidney bean

Rows: 28–32 inches.

Seed: Plant 2 inches apart and 1.0–1.5 inches deep in heavy soil and 2 inches in sandy soil. Use 75–100 lb/a of red kidney; 35–45 lb/a navy bean; depends on seed size, germination, row spacing.

Planting considerations (date, field selection)

Plant green beans from May 10–July 15. They prefer growing season temperatures of 60–70˚F and soil temperatures above 50˚F. Temperatures above 85˚F can result in poor pollination and "split set." Plant navy and red kidney beans June 1–June 9. Lima beans germinate best at soil temperatures of 65˚F. All bean seeds are subject to planter damage. Select planter plates to fit seed and reduce planter speed to minimize cracking of seed coat.

Grow on well-drained soils. Beans should follow corn on farms that use a corn-oats-forage rotation. Don't use atrazine on the crop preceding the beans; it may leave a soil residue that will injure the beans. Select fields without major weed problems. On sandy soil, plow under rye cover crops before they deplete soil moisture. Allow at least 2 years between bean crops because disease organisms may live in the soil or on plant residue.

Irrigation

Green and lima beans require a constant supply of moisture, especially during the blossom/pod-set period. Moisture stress during blossom/pod-set period may cause blossom and pod drop. This causes split pod set and reduces yields. An effective irrigation program can ensure high yields and high pod quality, particularly on sandy soils. Proper irrigation management should promote uniform germination and emergence, plant development, and harvest maturity—all are important in mechanical harvesting. If the WISP program is used to schedule irrigations, the AD value for green and lima beans on sands is 1.3 inches, and on silt loams the AD value is about 2.5 inches.

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 6.0 for dry beans. Green beans should be limed to 6.8 on mineral soils and 5.6 on organic soils to help avoid certain diseases.

Fertilizer rates: Apply P_2O_5 and K_2O according to soil test recommendations. Use annual nitrogen, P_2O_5, and K_2O recommendations in the following table. Take credits for previous legume crops and manure.

Application: Fertilizer may be applied broadcast or in a band 2 inches below seed and 2 inches to the side. Be sure seed does not contact fertilizer. Beans are salt-sensitive; contact with fertilizer can reduce germination.

Nitrogen (N): Apply broadcast or sidedress at trifoliate. Split applications on sandy soils. Check with processor for optimum N timing for each variety. On irrigated sands, apply the N in two applications to reduce leaching. In years with leaching due to excess rain, an extra 30–40 lb N/a may be needed on sandy soils. Research has shown that applications to green beans greater than 100–120 lb N/a resulted in yield reductions.

Magnesium: Correct deficiencies on acid soils with dolomitic limestone. If pH is above 6.5, use magnesium sulfate or potassium-magnesium sulfate to apply 10–20 lb/a of magnesium in row fertilizer.

Zinc: Deficiency may occur on sands or eroded soils. To correct, add 2–4 lb/a of zinc (as sulfate, oxide, or frits) to row fertilizer or broadcast 4–8 lb/a of zinc. Add 0.5–1.0 lb/a if using zinc chelates. You can also apply zinc in a foliar spray (1 lb/a Zn as sulfate or 0.15 lb/a Zn as chelate).

Annual nitrogen, phosphate, and potash recommendations for bean crops

Crop	Nitrogen: Organic matter (%)	Nitrogen: Amount to apply (lb/a)	Phosphate and potash: Yield goal	Amount P_2O_5 to apply* (lb/a)	Amount K_2O to apply* (lb/a)
Lima bean	<2	60	2,000–3,000 lb/a	20	40
	2.0–9.9	40	3,001–4,000 lb/a	30	60
	10–20	20	4,001–5,000 lb/a	40	80
	>20	10			
Navy & red kidney bean	<2	40	10–20 cwt/a	20	20
	2.0–9.9	30	21–30 cwt/a	30	40
	10–20	20	31–40 cwt/a	40	60
	>20	10			
Green bean	<2	60	1.5–2.5 ton/a	10	40
	2.0–9.9	40	2.6–3.5 ton/a	15	60
	10–20	20	3.6–4.5 ton/a	20	80
	>20	0	4.6–5.5 ton/a	25	100
			5.6–6.5 ton/a	30	120

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Disease control in bean—green, lima, navy, red kidney

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Angular leaf spot (Fungal pathogen: *Phaeoisariopsis griseola*)	*Practice a 2-year break between bean crops to permit decomposition of crop debris. Infested residue should be thoroughly incorporated into the soil to hasten decomposition.*			
Bacterial blights (brown spot, common blight, fuscous blight, and halo blight)	copper octanoate	0.5–2.0 gal Cueva	0	Do not apply more than 30 gal of product per acre per year.
	copper oxychloride + basic copper sulfate	2.0–4.0 lb C-O-C-S WDG	0	Rotating crops, deep-plowing debris, and planting disease-free seed are very effective controls.
	copper oxychloride + copper hydroxide	1.0–2.0 pt Badge SC 0.5–1.25 lb Badge X_2	0 0	
	copper hydroxide	0.66–2.0 pt Champ Formula 2 4.6F, Champ DP 1.0–3.0 lb Champion 77WP, Champ WG, Kentan DF 1.5–3.0 lb Kocide 101 77WP, Kocide DF 1.3–4.0 pt Kocide LF 0.67–2.0 pt Kocide 4.5 LF 0.75–2.25 lb Kocide 2000DF 0.5–1.25 lb Kocide 3000 0.67–4.0 pt Nu-Cop 3L	0 0 0 0 0 0 0 0	Apply at 7- to 14-day intervals when conditions are favorable for disease development. Not effective when disease pressure is severe.
	streptomycin sulfate	30,000 ppm (3%) solution streptomycin sulfate 62.5%	NA	Treat seed with streptomycin sulfate to help inactivate bacteria on the seed surface.

(continued)

Disease control in bean—green, lima, navy, red kidney *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Botrytis gray mold and Sclerotinia white mold	*Rotate bean fields with nonhost crops. Both fungi infect a broad range of crop and weed hosts. Plant on well-drained soil. In areas prone to disease, avoid excessive irrigation before and during the bloom period.*			
	boscalid	8.0–11.0 oz Endura 70 WDG	7 (succulent) 21 (dry)	Do not exceed two sprays and 22.0 oz/a of Endura per season.
	cyprodinil + fludioxonil	11.0–14.0 oz Switch 62.5WG	7	Do not use more than 56.0 oz/a per year. Application may be made by ground only. Apply prior to or at disease onset.
	fluazinam	0.5–0.85 pt Omega 500F	14 (edible podded & succulent beans) 30 (dry & lima beans)	Do not use more than 1.75 pt/a per year. Make first application at 10% bloom and again 7–10 days later as needed. Use higher rate for most severe disease pressure.
	fludioxonil	7.0 oz Cannonball WP	7	For white mold control, make first application at 10–20% bloom. Ground application only.
	iprodione	1.5–2.0 pt Iprodione 4L AG, Meteor, Nevado 4F, Rovral 4F	14	Apply spray at 10% bloom and again 5–7 days later or at 100% bloom, if necessary. Do not graze or feed treated vines to livestock.
	penthiopyrad *(edible podded & succulent shelled beans)*	*Botrytis:* 14.0–30.0 fl oz Fontelis *Sclerotinia white mold:* 16.0–30.0 fl oz Fontelis	0	Do not exceed 72.0 fl oz/a per season. Make no more than 2 sequential applications of Fontelis before changing to an effective fungicide with a different mode of action. For Botrytis management, make first application before disease development. For Sclerotinia management, make first application at beginning bloom and 7–10 days later or at full bloom.
	prothioconazole *(dried shelled peas, beans)*	5.7 fl oz Proline 480SC	7	Follow label for appropriate resistance management strategy. Not labeled for green beans. Labeled for soybean but rates vary for specific diseases.
	thiophanate-methyl *(green & dry beans)*	1.0–1.5 lb Topsin M WSB 20–30 fl oz Topsin 4.5FL (many generic formulations)	14 14	Apply spray at 25–50% bloom and again 7 days later at 100% bloom. Do not graze or feed treated vines to livestock.
		1.5–2.0 lb Topsin M WSB 30–40 fl oz Topsin 4.5FL (many generic formulations)	14 14	Apply once at 50–75% bloom. Do not graze or feed treated vines to livestock.
	thiophanate-methyl *(lima beans)*	1.0–2.0 lb Topsin M WSB (many generic formulations)	14	Begin application at 10–30% bloom. Do not exceed 4.0 lb/a product per season. Do not graze or feed treated vines to livestock.
	thiophanate-methyl + tebuconazole + azoxystrobin	25.0–30.0 fl oz Trevo Packed	14 (fresh) 28 (dry)	Fresh and dried except succulent shelled. Follow label guidelines for resistance management and crop specific strategies. 30.0 fl oz/acre for Sclerotinia white mold management.
Common mosaic virus and bean yellow mosaic virus	*Common mosaic is seed-borne. Yellow mosaic overwinters in perennial legumes and other hosts. Both are transmitted in the field by aphids. These virus diseases are not controlled by fungicides or seed treatments.*			
Pod tip rot (*Rhizoctonia* spp.)	myclobutanil	4.0–5.0 oz Rally 40WSP	0	Treat when pods begin to develop. Do not exceed 1.25 lb/a product per season. Allow at least 30 days following last application before planting new crops.

(continued)

Disease control in bean—green, lima, navy, red kidney *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Root rots (*Fusarium, Pythium, Rhizoctonia*)	*Rotate non-legume crops with beans, and use cover crops between plantings and over winter. When symptoms appear, timely irrigation can promote new feeder root development and produce an acceptable crop. Subsoiling 20–22 inches can promote deep rooting and improve yields. Wet soil conditions during emergence may increase root rot losses. Several seed treatments are available that may suppress root rots. Knowledge of the primary pathogen is useful in targeting a most appropriate treatment. Pythium is a water mold pathogen. Fusarium and Rhizoctonia are true fungi and may be managed uniquely.*			
	PCNB	*Rhizoctonia root and stem rot only:* 2.0–3.0 pt Blocker 4F	at-plant only	Apply 2.0–3.0 pt/a based on 36-inch row spacing. Avoid direct seed application.
Rust	*Bury all bean debris after harvest. If rust does not appear within 4 weeks of harvest, fungicides are unnecessary.*			
	chlorothalonil	1.3–3.0 pt Bravo Weather Stik, Echo 720, Equus 720 1.25–2.7 lb Bravo Ultrex 82.5WDG, Equus DF 1.125–2.5 lb Echo 90DF 2.0–4.25 pt Echo Zn	7 7 7 7	Do not apply more than 9.0 lb ai/a chlorothalonil per season. Do not graze treated areas or feed treated plant parts to livestock.
	myclobutanil	4.0–5.0 oz Rally 40WSP	0	Do not exceed 1.25 lb/a product (0.5 lb ai/a) per year. Observe a 30-day plantback interval between last application and planting new crops. (Formerly Nova.)
	prothioconazole	5.7 oz Proline 480SC	7	Follow label for appropriate resistance management strategy.
	tebuconazole	4.0–6.0 fl oz Folicur 3.6 F, Monsoon, Onset 3.6L, Orius 3.6F, Tebusha 3.6FL, TebuStar 3.6L, Tebuzol 3.6F, Toledo, Willowood Teb 3.6SC	7	Do not apply more than 24.0 fl oz/a per season of tebuconazole.
	thiophanate-methyl + tebuconazole + azoxystrobin	25.0–30.0 fl oz Trevo Packed	14 (fresh) 28 (dry)	Fresh and dried except succulent shelled. Follow label guidelines for resistance management and crop specific strategies. 30.0 fl oz/acre for Sclerotinia white mold management.
Rust, anthracnose, Alternaria leaf spot, Alternaria blight	azoxystrobin	6.2–15.4 fl oz Aframe, Equation SC, Quadris Flowable, Satori	0 (succulent) 14 (dry)	Quadris, Satori, Headline, and one of the components of Quilt belong to the Group 11 (strobilurin) fungicide category. Do not exceed more than 1 application of any of these products before alternating with a fungicide having a different mode of action. Do not exceed 4 foliar applications of strobilurin fungicides per crop per year. Do not exceed 1.44 qt/a Quadris or Satori, or 18.0 fl oz/a Headline per season. Do not use pyraclostrobin on lima beans. Do not feed bean forage or hay treated with these products earlier than 14 days after the last application.
	azoxystrobin + propiconazole	14.0 fl oz AzoxyStar, Cover XL, Quilt 10.5–14.0 fl oz Willowood AzoxyProp Xtra	7 (succulent) 14 (dry)	
	pyraclostrobin	6.0–9.0 fl oz Headline	7 (edible pod) 21 (dry)	
	azoxystrobin + chlorothalonil *(dry beans only)*	1.6–2.4 pt Quadris Opti	14	For use on beans to be harvested dry with pods removed. Quadris Opti belongs to Group 11 (strobilurin) and M fungicide categories. Do not apply more than one foliar spray of a Group 11 fungicide before alternating with a fungicide having a different mode of action. Do not exceed four foliar treatments of Group 11 fungicides per year. Do not apply more than 1.5 lb ai/a azoxystrobin or 6.0 lb ai/a chlorothalonil per year.

(continued)

Disease control in bean—green, lima, navy, red kidney *(continued)*

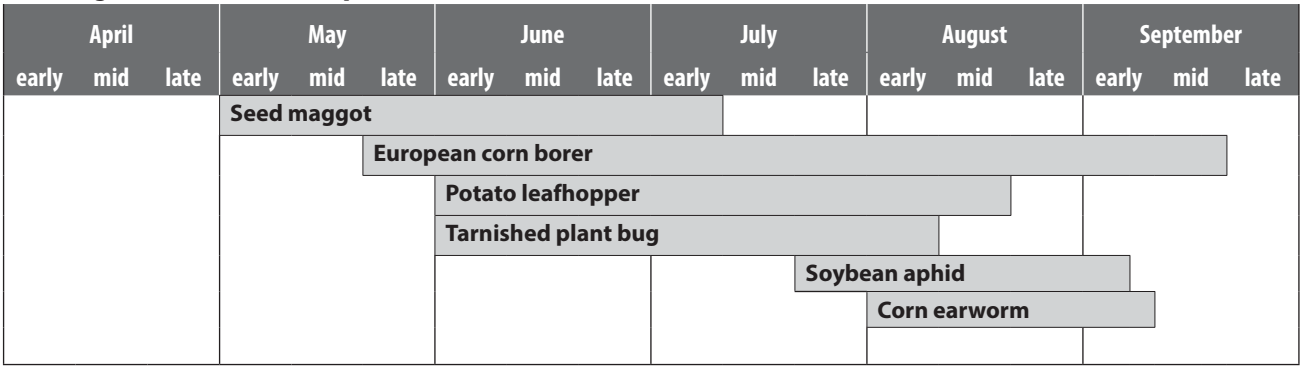
Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Rust, anthracnose, Alternaria leaf spot, Alternaria blight *(cont.)*	fluopyram + tebuconazole	8.0–12.8 fl oz Luna Experience	14	Refer to label for specific fungicide resistance management strategies.
	fluxapyroxad + pyraclostrobin	4.0–8.0 fl oz Priaxor	7	Use no more than 16.0 fl oz/a per year for resistance management consideration. White mold suppression at 6.0–8.0 fl oz rate. Apply before the start of disease development and continue every 7–14 days if needed. Labeled for edible podded legumes, snap bean, and peas.
	mefentrifluconazole	2.5–5.0 fl oz Provysol	21	Refer to label for specific fungicide resistance management strategies.
	mefentrifluconazole + pyraclostrobin	7.0–10.0 fl oz Veltyma	21	Refer to label for specific fungicide resistance management strategies.
	penthiopyrad	14.0–20.0 fl oz Vertisan	21	For shelled dry beans and peas only. Begin applications prior to disease development; continue at a 7- to 14-day interval. Use higher rates and shorter intervals when disease pressure is high.
	picoxystrobin	6.0–12.0 fl oz Aproach	14 (seed) 0 (vines & hay)	
	propiconazole	4.0 fl oz Tilt	7	Do not apply more than 12.0 fl oz/a per year for resistance management consideration. Apply when conditions are conducive for disease.
	pydiflumetofen + azoxystrobin + propiconazole	13.7 fl oz Miravis Neo	14	Refer to label for specific fungicide resistance management strategies.
Sclerotinia white mold	boscalid	8.0–11.0 oz Endura	7 (succulent) 21 (dry)	Do not make more than 2 applications per acre per year.
	Coniothyrium minitans	1.0–4.0 lb Contans WG	0	Apply postharvest to fields with white mold infection before incorporating crop debris or apply 3–4 months before disease onset. Immediately incorporate product into top 1–2 inches of soil. Do not plow before planting. This product is a biological mterial that should be kept cool before use. Intercept WG helps to reduce the soil-borne inoculum of Sclerotinia. The higher product rate is used when incorporation to a depth of greater than 2 inches occurs.
	fluxapyroxad + pyraclostrobin	6.0–8.0 fl oz Priaxor	7	Follow resistance management guidelines of the label.
	PCNB	*at-plant:* 4.0 pt Blocker 4F		Do not apply after pod formation.
	penthiopyrad	16.0–30.0 fl oz Fontelis	0	Do not exceed 72.0 fl oz/a per year. Do not make more than 2 sequential applications of Fontelis.
	pydiflumetofen + azoxystrobin + propiconazole	13.7 fl oz Miravis Neo	14	Only for use on dried shelled beans including kidney, lima, navy, and pinto bean. Suppression of white mold only.
	thiophanate methyl	30.0–40.0 fl oz Topsin 4.5FL	14	Do not apply more than 80.0 fl oz Topsin 4.5FL per year. Apply in conjunction with blooming status.

(continued)

Disease control in bean—green, lima, navy, red kidney *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Seed decay, rot, preemergence damping-off	azoxystrobin captan chloroneb fludioxonil mefenoxam metalaxyl pyraclostrobin thiram trifloxystrobin	Dynasty Maxim 4FS Apron, Ultra Flourish Allegiance, Sebring Stamina Signet Trilex		Most seed is treated with fungicide/insecticide. Do not use treated seed for food or feed. Multiple generic products are available for active ingredients listed without commercial product names.
	PCNB	*For root/stem rot (*Rhizoctonia solani*):* *at-plant:* 2.0–3.0 pt Blocker 4F		Use lower rate on lighter soils.
Virus complex (transmitted by aphids)	*A combination of cucumber mosaic virus and alfalfa mosaic virus can cause plant stunting, foliage mosaic, blossom abortion, misshapen and discolored pods, and significant yield reductions. The soybean aphid is the primary vector. Planting early to avoid high populations of the soybean aphid that appear in mid-July helps to reduce losses.*			

Scouting calendar for insect pests of beans



Insect control in bean—green, lima, navy, red kidney

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Bean aphid and soybean aphid	*Phorate and disulfoton treatments at planting will also control aphids (see leafhopper section for rates).*			
	0.487–0.974 lb acephate	0.5–1.0 lb Orthene 97 0.5–1.0 lb Acephate 97UP	1 (lima) 14 (dry)	Do not exceed 2.0 lb ai/a per season. Do not feed treated vines. Do not apply to green or succulent beans for use as a food crop.
	0.044–0.10 lb acetamiprid	1.0–2.3 oz Assail 70WP	7	Do not exceed 3 applications or 6.9 oz/a of product per crop season.
	0.047–0.10 lb acetamiprid	2.5–5.3 oz Assail 30 SG	7	Do not exceed 3 applications or 16.0 oz/a of product per crop season.
	alpha-cypermethrin	3.2–3.8 fl oz *Fastac	1 21 (dry)	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.025–0.10 lb bifenthrin	1.6–6.4 fl oz *Brigade 2EC	3	Do not apply more than 0.2 lb ai/a or 12.8 fl oz/a of product per season.

*Restricted-use pesticide.

(continued)

Insect control in bean—green, lima, navy, red kidney *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Bean aphid and soybean aphid *(cont.)*	0.098–0.167 lb bifenthrin + chlorantraniliprole	5.6–9.6 fl oz *Elevest	3	Make no more than 2 applications per acre per calendar year. Minimum interval between treatments is 3 days. Do not apply more than 19.2 fl oz *Elevest insect control or 0.2 lb ai of chlorantraniliprole and 0.2 lb ai of bifenthrin-containing products per acre per calendar year.
	0.06–0.086 lb bifenthrin + imidacloprid	3.8–5.5 fl oz *Brigadier	7	Do not apply more than 16.6 fl oz/a (0.26 lb ai/a) per season. No more than 0.2 lb ai/a bifenthrin and 0.13 lb ai/a imidacloprid are allowed per season.
	0.25–0.5 lb dimethoate	0.5–1.0 pt Dimethoate 400EC	0	Beans may be mechanically harvested on day of application. Highly toxic to bees—do not apply when crop or nearby weeds are in bloom. Wait at least 14 days between treatments. Do not exceed 0.5 lb ai/a per treatment. Do not exceed 1.0 lb ai/a per season. Re-entry interval is 48 hours.
	0.025–0.05 lb esfenvalerate	5.8–9.6 oz Asana	3 (green) 21 (dry)	Do not exceed 0.2 lb ai/a per season.
	flupyradifurone	7.0–10.5 fl oz Sivanto	7 21 (dry)	Foliar application. Apply when pests reach or exceed established thresholds. Do not apply more than 28.0 fl oz of Sivanto per acre per crop season.
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	7–21	Do not apply more than 0.96 pt/a (0.06 lb ai/a) per season. Do not graze treated area or feed vines to livestock. The 21-day PHI applies only to dried, shelled legumes.
	I. fumosorosea (20%)	1.0–2.0 lb PFR-97	1	Repeat applications at 3- to 10-day intervals over 2–3 weeks or as needed to maintain control. Frequent application may be required under dry conditions, during periods of increased pest buildup or reproduction, or rapid host plant growth.
	imidacloprid	1.6–3.2 fl oz Gaucho 600/100 lb seed	—	Green and lima beans only. Preplant commercial seed treatment. There is a 12-month rotational plantback restriction for crops not listed on label.
		7.0–10.5 fl oz Admire Pro	21	Apply in a narrow band centered on the plant row within 14 days of planting.
		3.5 fl oz Provado 1.6	7	Apply every 7 days as needed. Do not exceed 10.5 fl oz/a Provado per season and do not exceed a total of 0.5 lb ai/a imidacloprid per season (any formulation).
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	7	Do not apply more than 0.12 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	6.0–10.0 fl oz *Besiege	7 21 (dry)	Allow at least 5 days between applications. Do not apply more than 31.0 fl oz/a Besiege per season.
	1.0 lb naled	1.0 pt Dibrom 8E	1	Short-lasting residual contact insecticide.

*Restricted-use pesticide.

(continued)

Insect control in bean—green, lima, navy, red kidney *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Bean aphid and soybean aphid *(cont.)*	0.063–0.078 lb pyriproxyfen/ spirotetramat	8.0–10.0 fl oz Senstar	7	Do not apply more than 10 fl oz of Senstar Insecticide (0.078 lb spirotetramat and 0.027 lb pyriproxyfen) per acre per application. Do not make more than 2 applications per crop season. Do not apply more than 20 fl oz of Senstar Insecticide (0.156 lb spirotetramat and 0.055 lb pyriproxyfen) per acre per crop season. Minimum interval between applications is 14 days. Regardless of formulation do not apply more than 0.16 lb spirotetramat and 0.134 lb pyriproxyfen per acre per crop season. Do not allow livestock to graze treated areas. Do not use on legume vegetables varieties grown for livestock feed products.
	0.06–0.08 lb spirotetramat	2.0–2.5 fl oz Movento HL	1 (succulent) 7 (dry)	Do not apply more than 0.16 lb per calendar year of spirotetramat-containing products.
	0.023–0.047 lb sulfoxaflor	0.75–1.5 oz Transform WG	7	Do not apply more than a total of 8.5 oz of Transform WG (0.266 lb ai of sulfoxaflor) per acre per year.
	thiamethoxam	0.765–1.28 fl oz Cruiser 5FS/100 lb seed	—	Seed treatment only. There is a 120-day plantback restriction for crops not listed on the label.
	zeta-cypermethrin	3.2–4.0 oz *Mustang Maxx	1	Apply every 5 days as needed. Do not exceed 24.0 oz/a Mustang Maxx per season.
Bean leaf beetle	0.487–0.974 lb acephate	0.5–1.0 lb Orthene 97 0.5–1.0 lb Acephate 97UP	1 (lima) 14 (dry)	Do not exceed 2.0 lb ai/a per season. Do not feed treated vines. Do not apply to green or succulent beans for use as a food crop.
	alpha-cypermethrin	2.7–3.8 fl oz *Fastac	1 21 (dry)	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.0125–0.019 lb beta-cyfluthrin	1.6–2.4 fl oz *Baythroid XL	7	For dry beans only. Do not exceed 4 applications or 6.4 fl oz/a per year.
	0.033–0.10 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	3	Do not apply more than 0.2 lb ai/a or 12.8 fl oz/a of product per season.
	0.098–0.167 lb bifenthrin + chlorantraniliprole	5.6–9.6 fl oz *Elevest	3	Make no more than 2 applications per acre per calendar year. Minimum interval between treatments is 3 days. Do not apply more than 19.2 fl oz *Elevest insect control or 0.2 lb ai of chlorantraniliprole and 0.2 lb ai of bifenthrin-containing products per acre per calendar year.
	0.08–0.086 lb bifenthrin + imidacloprid	5.1–5.5 fl oz *Brigadier	7	Do not apply more than 16.6 fl oz/a (0.26 lb ai/a) per season. No more than 0.2 lb ai/a bifenthrin and 0.13 lb ai/a imidacloprid are allowed per season.
	0.5–1.0 lb carbaryl	0.5–1.0 qt Sevin XLR Plus	Consult label	Do not apply to target crops or weeds in bloom. Do not apply more than 6.0 qt/a per year.
	0.25–0.5 lb dimethoate	0.5–1.0 pt Dimethoate 400EC	0	Beans may be mechanically harvested on day of application. Highly toxic to bees—do not apply when crop or nearby weeds are in bloom. Wait at least 14 days between treatments. Do not exceed 0.5 lb ai/a per treatment. Do not exceed 1.0 lb ai/a per season. Re-entry interval is 48 hours.

*Restricted-use pesticide.

(continued)

Insect control in bean—green, lima, navy, red kidney *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Bean leaf beetle *(cont.)*	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	7–21	Do not apply more than 0.96 pt/a (0.06 lb ai/a) per season. Do not graze treated area or feed vines to livestock. The 21-day PHI applies only to dried, shelled legumes.
	imidacloprid	1.6–3.2 fl oz Gaucho 600/100 lb seed	—	Green and lima beans only. Apply as a commercial seed treatment before planting. There is a 12-month rotational plantback restriction for crops not listed on the label.
		16.0–24.0 fl oz Admire Pro	21	Apply in a narrow band centered on the plant row, 1–2 inches below the seed depth. Apply within 14 days before planting.
		3.5 fl oz Provado 1.6	7	Apply every 7 days as needed. Do not exceed 10.5 fl oz/a Provado per year.
	lambda-cyhalothrin + chlorantraniliprole	6.0–10.0 fl oz *Besiege	7 21 (dry)	Allow at least 5 days between applications. Do not apply more than 31.0 fl oz/a Besiege per season.
	thiamethoxam	0.765–1.28 fl oz Cruiser 5FS/100 lb seed	—	Seed treatment only. There is a 120-day plantback restriction for crops not listed on the label.
	zeta-cypermethrin	2.72–4.0 oz *Mustang Maxx	1	Apply every 5 days as needed. Do not exceed 24.0 oz/a Mustang Maxx per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 0.266 lb ai/a per season. Wait at least 5 days between applications.
Corn earworm	0.731–0.974 lb acephate	0.75-1.0 lb Orthene 97 0.75-1.0 lb Acephate 97UP	1 (lima) 14 (dry)	Do not exceed 2.0 lb ai/a per season. Do not feed treated vines. Do not apply to green or succulent beans for use as a food crop.
	alpha-cypermethrin	2.7–3.8 fl oz *Fastac	1 21 (dry)	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	azadirachtin	16.0–32.0 oz Aza-Direct 10.0–16.0 oz Azatin XL 4.0–10.0 oz Neemix 4.5	0	Apply at 7-day intervals as pests appear. May treat heavy infestations every 7–10 days.
	Bacillus thuringiensis subsp. *kurstaki*	1.0–2.0 lb Lepinox WDG	0	Treat early instar larvae before noticeable feeding damage occurs. Repeat as needed.
	0.0125–0.019 lb beta-cyfluthrin	1.6–2.4 fl oz *Baythroid XL	7	For dry beans only. Do not exceed 4 applications or 6.4 fl oz/a per year.
	0.033–0.10 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	3 (green) 14 (dry)	Do not apply more than 0.2 lb ai/a (12.8 fl oz formulated product) per season. Do not make applications less than 3 days apart for green bean or 7 days apart for dry bean.
	0.098–0.167 lb bifenthrin + chlorantraniliprole	5.6–9.6 fl oz *Elevest	3	Make no more than 2 applications per acre per calendar year. Minimum interval between treatments is 3 days. Do not apply more than 19.2 fl oz *Elevest insect control or 0.2 lb ai of chlorantraniliprole and 0.2 lb ai of bifenthrin-containing products per acre per calendar year.
	0.08–0.086 lb bifenthrin + imidacloprid	5.1–5.5 fl oz *Brigadier	7	Do not apply more than 16.6 fl oz/a (0.26 lb ai/a) per season. No more than 0.2 lb ai/a bifenthrin and 0.13 lb ai/a imidacloprid are allowed per season.
	0.5–1.5 lb carbaryl	0.5–1.5 qt Sevin XLR Plus	Consult label	Do not apply to target crops or weeds in bloom. Do not apply more than 6.0 qt/a per year.

*Restricted-use pesticide.

(continued)

Insect control in bean—green, lima, navy, red kidney *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Corn earworm *(cont.)*	chlorantraniliprole	3.5–7.5 fl oz Coragen	1	Do not make more than 4 applications per crop season and allow at least 3 days between applications. Do not apply more than 15.4 fl oz/a Coragen per season.
	0.065–0.133 lb cyantraniliprole	10.0–20.5 fl oz Exirel	1 (succulent) 7 (dry)	Applications of Exirel® to certain species of legume vegetables in this crop group may result in adverse crop response. Affected plants outgrow the effects in most cases. If the risk of adverse crop response to Exirel® cannot be accepted, do not apply it to legume vegetables. The crop safety of Exirel® in tank mixture has not been evaluated on this crop group. Minimum application interval between treatments is 5 days. For best performance, use with an effective adjuvant. Do not apply a total of more than 0.4 lb ai/a of cyazypyr or cyantraniliprole-containing products.
	0.086–0.133 lb cyantraniliprole + abamectin	7.5–10.0 fl oz *Minecto Pro	7	Minimum application interval of 7 days. Maximum annual rate of 20.0 fl oz/a per calendar year (0.18 lb ai/a of cyantraniliprole and 0.038 lb ai/a of abamectin). Do not apply more than 0.4 lb ai/a per calendar year of cyantraniliprole-containing products including all application types (seed treatment, soil, foliar). Do not apply more than 0.056 lb ai/a per calendar year of abamectin-containing products including all application types (seed treatment, soil, foliar).
	0.3–0.5 lb esfenvalerate	5.8–9.6 oz *Asana XL	3 (green) 21 (dry)	Do not exceed 0.2 lb ai/a per season. Do not allow livestock to graze treated bean fields. Do not harvest treated vines for livestock forage, fodder, or hay.
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	7–21	Do not apply more than 0.96 pt/a (0.06 lb ai/a) per season. Do not graze treated area or feed vines to livestock. The 21-day PHI applies only to dried, shelled legumes.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	7	Do not apply more than 0.12 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	6.0–10.0 fl oz *Besiege	7 21 (dry)	Allow at least 5 days between applications. Do not apply more than 31.0 fl oz/a Besiege per season.
	0.45–0.9 lb methomyl	1.5–3.0 pt *Lannate LV	Consult label	Repeat applications as necessary up to a total of 10 times per year but not more often than once every 5–7 days. Do not exceed 15.0 pt/a per year.
	0.031–0.063 lb spinetoram	4.0–8.0 oz Radiant SC	3	Do not apply more than 28.0 oz/a (0.219 lb ai/a) or exceed 4 applications per crop.
	spinosad	2.2–3.3 oz Blackhawk	3 28 (dry beans)	Apply when pests reach or exceed established thresholds. Do not apply more than 20.0 oz/a Blackhawk per crop season in succulent beans and 8.3 oz/a per crop season in dry beans. Do not exceed 6 applications in a year.
		3.0–6.0 fl oz Entrust SC	3	Use higher rates for larger larvae. Apply in adequate spray to get good coverage for best control. Do not exceed 0.45 lb ai/a per season.
	zeta-cypermethrin	2.72–4.0 oz *Mustang Maxx	1	Apply every 5 days as needed. Do not exceed 24.0 oz/a Mustang Maxx per season.

*Restricted-use pesticide.

(continued)

Insect control in bean—green, lima, navy, red kidney *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Corn earworm *(cont.)*	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 0.266 lb ai/a per season. Wait at least 5 days between applications.
Cutworms	*Spot treat when numbers exceed two larvae per foot of row.*			
	0.487–0.974 lb acephate	0.5–1.0 lb Orthene 97 0.5–1.0 lb Acephate 97UP	1 (lima) 14 (dry)	Do not exceed 2.0 lb ai/a per season. Do not feed treated vines. Do not apply to green or succulent beans for use as a food crop.
	alpha-cypermethrin	1.3–3.8 fl oz *Fastac	1 21 (dry)	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	azadirachtin	16.0–32.0 oz Aza-Direct 10.0–16.0 oz Azatin XL 4.0–10.0 oz Neemix 4.5	0	Apply at 7-day intervals when pests first appear. May treat heavy infestations every 7–10 days.
	0.0065–0.0125 lb beta-cyfluthrin	0.8–1.6 fl oz *Baythroid XL	7	For dry beans only. Do not exceed 4 applications or 6.4 fl oz/a per year.
	0.04–0.08 lb bifenthrin	3.4–6.8 oz *Capture LFR	—	Apply as a 5- to 7-inch band over an open furrow or in-furrow with the seed. Do not apply more than 0.1 lb/a Capture LFR per season as an at-plant application.
	0.084–0.167 lb bifenthrin + chlorantraniliprole	4.8–9.6 fl oz *Elevest	3	Make no more than 2 applications per acre per calendar year. Minimum interval between treatments is 3 days. Do not apply more than 19.2 fl oz *Elevest insect control or 0.2 lb ai of chlorantraniliprole and 0.2 lb ai of bifenthrin-containing products per acre per calendar year.
	0.08–0.086 lb bifenthrin + imidacloprid	5.1–5.5 fl oz *Brigadier	7	Do not apply more than 16.6 fl oz/a (0.26 lb ai/a) per season. No more than 0.2 lb ai/a bifenthrin and 0.13 lb ai/a imidacloprid are allowed per season.
	1.0–1.5 lb carbaryl	1.0–1.5 qt Sevin XLR Plus	Consult label	Repeat applications as necessary up to a total of 4 times per year but not more than once every 7 days. Use the higher rates for heavy populations and larger instars.
	chlorantraniliprole	3.5–7.5 fl oz Coragen	1	Do not make more than 4 applications per crop season and allow at least 3 days between applications. Do not apply more than 15.4 fl oz/a Coragen per season.
	0.3–0.5 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3 (green) 21 (dry)	Do not exceed 0.2 lb ai/a per season. Do not graze or feed treated vines to livestock. Do not harvest treated vines for livestock forage, fodder, or hay.
	0.0075–0.0125 lb gamma-cyhalothrin	1.92–3.20 oz *Proaxis	7–21	Do not apply more than 0.96 pt/a (0.06 lb ai/a) per season. Do not graze treated area or feed vines to livestock. The 21-day PHI applies only to dried, shelled legumes.
	0.015–0.025 lb lambda-cyhalothrin	0.96–1.6 fl oz *Warrior II	7	Do not apply more than 0.12 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	6.0–10.0 fl oz *Besiege	7 21 (dry)	Allow at least 5 days between applications. Do not apply more than 31.0 fl oz/a Besiege per season.
	zeta-cypermethrin	1.28–4.0 oz *Mustang Maxx	1	Apply every 5 days as needed. Do not exceed 24.0 oz/a Mustang Maxx per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 0.266 lb ai/a per season. Wait at least 5 days between applications.

*Restricted-use pesticide.

(continued)

Insect control in bean—green, lima, navy, red kidney *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
European corn borer	*Apply insecticide when beans are in the early bloom stage AND moth catches in nearby blacklight traps exceed 15 moths/night for first generation or 100 moths/night for second generation. Once moth catches drop, delay applications until beans are 1 inch long.*			
	0.731–0.974 lb acephate	0.75–1.0 lb Orthene 97 0.75–1.0 lb Acephate 97UP	1 (lima) 14 (dry)	Do not exceed 2.0 lb ai/a per season. Do not feed treated vines. Do not apply to green or succulent beans for use as a food crop.
	alpha-cypermethrin	2.7–3.8 fl oz *Fastac	1 21 (dry)	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	1.0–2.0 lb *Bacillus thuringiensis* subsp. *kurstaki*	Lepinox WDG	0	Treat early instar larvae before noticeable feeding damage occurs. Repeat as needed.
	0.019–0.025 lb beta-cyfluthrin	2.4–3.2 fl oz *Baythroid XL	7	For dry beans only. Do not exceed 4 applications or 6.4 fl oz/a per year.
	0.033–0.1 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	3 (green) 14 (dry)	Do not apply more than 0.2 lb ai/a (12.8 fl oz formulated product) per season. Do not make applications less than 3 days apart for green bean or 7 days apart for dry bean.
	0.098–0.167 lb bifenthrin + chlorantraniliprole	5.6–9.6 fl oz *Elevest	3	Make no more than 2 applications per acre per calendar year. Minimum interval between treatments is 3 days. Do not apply more than 19.2 fl oz *Elevest insect control or 0.2 lb ai of chlorantraniliprole and 0.2 lb ai of bifenthrin-containing products per acre per calendar year.
	0.08–0.086 lb bifenthrin + imidacloprid	5.1–5.5 fl oz *Brigadier	7	Do not apply more than 16.6 fl oz/a (0.26 lb ai/a) per season. No more than 0.2 lb ai/a bifenthrin and 0.13 lb ai/a imidacloprid allowed per season.
	1.0–1.5 lb carbaryl	1.0–1.5 qt Sevin XLR Plus	Consult label	Repeat applications as necessary up to a total of 4 times per year but not more than once every 7 days. Use the higher rates for heavy populations and larger instars.
	chlorantraniliprole	3.5–7.5 fl oz Coragen	1	Do not make more than 4 applications per crop season and allow at least 3 days between applications. Do not apply more than 15.4 fl oz/a Coragen per season.
	0.065–0.133 lb cyantraniliprole	10.0–20.5 fl oz Exirel	1 (succulent) 7 (dry)	Applications of Exirel® to certain species of legume vegetables in this crop group may result in adverse crop response. Affected plants outgrow the effects in most cases. If the risk of adverse crop response to Exirel® cannot be accepted, do not apply it to legume vegetables. The crop safety of Exirel® in tank mixture has not been evaluated on this crop group. Minimum application interval between treatments is 5 days. For best performance, use with an effective adjuvant. Do not apply a total of more than 0.4 lb ai/a of cyazypyr or cyantraniliprole-containing products.

*Restricted-use pesticide.

(continued)

Insect control in bean—green, lima, navy, red kidney *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
European corn borer *(cont.)*	0.086–0.133 lb cyantraniliprole + abamectin	7.5–10.0 fl oz *Minecto Pro	7	Minimum application interval of 7 days. Maximum annual rate of 20.0 fl oz/a per calendar year (0.18 lb ai/a of cyantraniliprole and 0.038 lb ai/a of abamectin). Do not apply more than 0.4 lb ai/a per calendar year of cyantraniliprole-containing products including all application types (seed treatment, soil, foliar). Do not apply more than 0.056 lb ai/a per calendar year of abamectin-containing products including all application types (seed treatment, soil, foliar).
	0.3–0.5 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3 (green) 21 (dry)	Do not exceed 0.2 lb ai/a per season. Do not graze or feed treated vines to livestock. Do not harvest treated vines for livestock forage, fodder, or hay.
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	7–21	Do not apply more than 0.96 pt/a (0.06 lb ai/a) per season. Do not graze treated area or feed vines to livestock. The 21-day PHI applies only to dried, shelled legumes.
	imidacloprid + beta-cyfluthrin	2.4–2.8 fl oz *Leverage 360	7	For dry beans only. Minimum interval between applications is 14 days and maximum allowable crop use per season is 6.4 fl oz/a.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	7	Do not apply more than 0.12 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	6.0–10.0 fl oz *Besiege	7 21 (dry)	Allow at least 5 days between applications. Do not apply more than 31.0 fl oz/a Besiege per season.
	0.45–0.9 lb methomyl	1.5–3.0 lb *Lannate LV	Consult label	Repeat applications as necessary up to a total of 10 times per year but not more than once every 3–4 days. Do not exceed 15.0 pt/a per year.
	0.023–0.063 lb spinetoram	3.0–8.0 oz Radiant SC	1	Do not apply more than 28.0 oz/a Radiant (0.219 lb ai/a) per crop and do not exceed 6 applications per year.
	spinosad	1.7–3.3 oz Blackhawk	3 28 (dry beans)	Apply when pests reach or exceed established thresholds. Do not apply more than 20.0 oz/a Blackhawk per crop season in succulent beans and 8.3 oz/a per crop season in dry beans. Do not exceed 6 applications in a year.
		3.0–6.0 fl oz Entrust SC	3	Use higher rates for larger larvae. Apply in adequate spray to get good coverage for best control. Do not exceed 0.45 lb ai/a per season. Do not use a buffering agent.
	zeta-cypermethrin	2.72–4.0 oz *Mustang Maxx	1	Apply every 5 days as needed. Do not exceed 24.0 oz/a Mustang Maxx per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 0.266 lb ai/a per season. Wait at least 5 days between applications.
Loopers and green cloverworm	*Treat when numbers exceed two to four larvae per foot of row.*			
	0.487–0.974 lb acephate	0.5–1.0 lb Orthene 97S 0.5–1.0 lb Acephate 97UP	1 (lima) 14 (dry)	Do not exceed 2.0 lb ai/a per season. Do not feed treated vines. Do not apply to green or succulent beans for use as a food crop.
	alpha-cypermethrin	2.7–3.8 fl oz *Fastac	1 21 (dry)	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	azadirachtin	16.0–32.0 oz Aza-Direct 10.0–16.0 oz Azatin XL 4.0–10.0 oz Neemix 4.5	0	Apply at 7-day intervals when pests first appear. May treat heavy infestations every 7–10 days.

*Restricted-use pesticide.

(continued)

Insect control in bean—green, lima, navy, red kidney *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Loopers and green cloverworm *(cont.)*	*Bacillus thuringiensis* subsp. *aizawai*	0.5–2.0 lb Ketch DF	0	Use lower rate for light infestations and small larvae; use higher rate for larger larvae and heavy pressure.
	Bacillus thuringiensis subsp. *kurstaki*	Biobit FC, WP	0	See label for rate.
		1.0–2.0 lb Lepinox WDG	0	Treat early instar larvae before noticeable feeding damage occurs. Repeat as needed.
	0.019–0.025 lb beta-cyfluthrin	2.4–3.2 fl oz *Baythroid XL	7	For dry beans only. Do not exceed 4 applications or 6.4 fl oz/a per year.
	0.033–0.10 lb bifenthrin	2.1–6.4 oz *Brigade 2EC	3 (green) 14 (dry)	Do not apply more than 0.2 lb ai/a (12.8 fl oz formulated product) per season. Do not make applications less than 3 days apart for green bean or 7 days apart for dry bean.
	0.084–0.167 lb bifenthrin + chlorantraniliprole	4.8–9.6 fl oz *Elevest	3	Make no more than 2 applications per acre per calendar year. Minimum interval between treatments is 3 days. Do not apply more than 19.2 fl oz *Elevest insect control or 0.2 lb ai of chlorantraniliprole and 0.2 lb ai of bifenthrin-containing products per acre per calendar year.
	0.08–0.086 lb bifenthrin + imidacloprid	5.1–5.5 fl oz *Brigadier	7	Do not apply more than 16.6 fl oz/a (0.26 lb ai/a) per season. No more than 0.2 lb/a bifenthrin and 0.13 lb/a imidacloprid are allowed per season.
	0.3–0.5 lb esfenvalerate	5.8–9.6 oz *Asana XL	3 (green) 21 (dry)	Do not exceed 0.2 lb ai/a per season. Do not allow livestock to graze treated bean fields. Do not harvest treated vines for livestock forage, fodder, or hay.
	0.0075–0.0125 lb gamma-cyhalothrin	1.92–3.20 oz *Proaxis	7–21	Do not apply more than 0.96 pt/a (0.06 lb ai/a) per season. Do not graze treated area or feed vines to livestock. The 21-day PHI applies only to dried, shelled legumes.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	7	Do not apply more than 0.12 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	6.0–10.0 fl oz *Besiege	7 21 (dry)	Allow at least 5 days between applications. Do not apply more than 31.0 fl oz/a Besiege per season.
	0.45–0.9 lb methomyl	1.5–3.0 lb *Lannate LV	Consult label	Repeat applications as necessary up to a total of 10 times per year but not more than once every 5–7 days. Do not exceed 15.0 pt/a per year.
	1.0–1.5 lb naled	1.0 pt Dibrom 8E	1	A short residual contact insecticide. Do not apply more than once every 7 days.
	0.031–0.063 lb spinetoram	4.0–8.0 oz Radiant SC	1	Do not apply more than 28.0 oz/a Radiant (0.219 lb ai/a) per crop and do not exceed 6 applications per year.
	spinosad	2.2–3.3 oz Blackhawk	3 28 (dry beans)	Apply when pests reach or exceed established thresholds. Do not apply more than 20.0 oz/a Blackhawk per crop season in succulent beans and 8.3 oz/a per crop season in dry beans. Do not exceed 6 applications in a year.
		4.0–6.0 fl oz Entrust SC	3	Use higher rates for larger larvae. Apply in adequate spray to get good coverage for best control. Do not exceed 0.45 lb ai/a per season. Do not use a buffering agent.
	zeta-cypermethrin	*cloverworms:* 2.72–4.0 oz *Mustang Maxx *loopers:* 3.2–4.0 oz *Mustang Maxx	1 1	Apply every 5 days as needed. Do not exceed 24.0 oz/a Mustang Maxx per season.

*Restricted-use pesticide.

(continued)

Insect control in bean—green, lima, navy, red kidney *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Loopers and green cloverworm *(cont.)*	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 0.266 lb ai/a per season. Wait at least 5 days between applications.
Potato leafhopper and plant bug	*Treat potato leafhoppers when they exceed an average of one adult/sweep or one nymph/10 leaves. If plants are younger than the two-true-leaf stage, reduce thresholds to one adult/two sweeps (nymphs will not be present yet). Treat tarnished plant bugs when they exceed an average of one bug/sweep.*			
	0.487–0.974 lb acephate	0.5–1.0 lb Orthene 97 0.5–1.0 lb Acephate 97UP	1 (lima) 14 (green)	Do not exceed 2.0 lb ai/a per season. Do not feed treated vines. Do not apply to green or succulent beans for use as a food crop.
	alpha-cypermethrin	2.7–3.8 fl oz *Fastac	1 21 (dry)	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	azadirachtin	16.0–32.0 oz Aza-Direct 10.0–16.0 oz Azatin XL 4.0–10.0 oz Neemix 4.5	0	Apply at 7-day intervals when pests first appear. May treat heavy infestations every 7–10 days.
	0.019–0.025 lb beta-cyfluthrin	2.4–3.2 fl oz *Baythroid XL	7	For dry beans only. Do not exceed 4 applications or 6.4 fl oz/a per year.
	0.025–0.10 lb bifenthrin	1.6–6.4 oz *Brigade 2EC	3 (green) 14 (dry)	Do not apply more than 0.2 lb ai/a (12.8 fl oz/a) per season. Do not make applications less than 3 days apart for green bean or 7 days apart for dry bean.
	0.084–0.167 lb bifenthrin + chlorantraniliprole	4.8–9.6 fl oz *Elevest	3	Make no more than 2 applications per acre per calendar year. Minimum interval between treatments is 3 days. Do not apply more than 19.2 fl oz *Elevest insect control or 0.2 lb ai of chlorantraniliprole and 0.2 lb ai of bifenthrin-containing products per acre per calendar year.
	0.06–0.086 lb bifenthrin + imidacloprid	3.8–5.5 fl oz *Brigadier	7	Do not apply more than 16.6 fl oz/a (0.26 lb ai/a) per season. No more than 0.2 lb ai/a bifenthrin and 0.13 lb ai/a imidacloprid are allowed per season.
	1.0 lb carbaryl	1.0 qt Sevin XLR Plus	Consult label	Repeat applications as necessary up to a total of 4 times per year but not more often than once every 7 days. Use higher rates for heavy populations and larger instars.
	0.25–0.5 lb dimethoate	0.5–1.0 pt Dimethoate 400EC	0	Beans may be mechanically harvested on day of application. Highly toxic to bees—do not apply when crop or nearby weeds are in bloom. Wait at least 14 days between treatments. Do not exceed 0.5 lb ai/a per treatment. Do not exceed 1.0 lb ai/a per season. Re-entry interval is 48 hours.
	1.0–2.0 lb disulfoton	*Di-Syston 8–15%	60	Place granules in a 7-inch band directly behind planter shoe in front of the press wheel at planting time only. Apply liquid in a water emulsion or with liquid fertilizer as a soil injection on each side of the seed furrow at planting. Do not apply directly on seed. Do not apply more than once per season. Do not feed vines or hay to livestock. If adequate rainfall does not occur within 10–14 days of treatment, irrigate to activate the product.
	0.015–0.5 lb esfenvalerate	2.9–9.6 fl oz *Asana XL	3 (green) 21 (dry)	Do not exceed 0.2 lb ai/a per season. Do not allow livestock to graze treated bean fields. Do not harvest treated vines for livestock forage, fodder, or hay.

*Restricted-use pesticide.

(continued)

Insect control in bean—green, lima, navy, red kidney *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Potato leafhopper and plant bug *(cont.)*	flupyradifurone	7.0–10.5 fl oz Sivanto	7 21 (dry)	Foliar application. Apply when pests reach or exceed established thresholds. Do not apply more than 28.0 fl oz of Sivanto per acre per crop season.
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	7–21	Do not apply more than 0.96 pt/a (0.06 lb ai/a) per season. Do not graze treated area or feed vines to livestock. The 21-day PHI applies only to dried, shelled legumes.
	imidacloprid	1.6–3.2 fl oz Gaucho 600/100 lb seed	—	Green and lima beans only. Apply as a commercial seed treatment before planting. There is a 12-month rotational plantback restriction for crops not listed on the label.
		16.0–24.0 fl oz Admire Pro	21	Apply in a narrow band centered on the plant row 1–2 inches below the seed depth. Apply within 14 days before planting.
		3.5 fl oz Provado 1.6	7	Apply every 7 days as needed. Do not exceed 10.5 fl oz/a Provado per year.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	7	Do not apply more than 0.12 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	6.0–10.0 fl oz *Besiege	7 21 (dry)	Allow at least 5 days between applications. Do not apply more than 31.0 fl oz/a Besiege per season.
	0.225–0.9 lb methomyl	0.75–3.0 pt *Lannate LV	Consult label	Repeat applications as necessary up to a total of 10 times per year but not more than once every 5–7 days. Do not exceed 15.0 pt/a per year.
	1.0 lb naled	1.0 pt Dibrom EC	1	A short residual contact insecticide. Do not apply more than once every 7 days.
	0.06–0.09 lb/1,000 ft row phorate	4.5–7.0 oz/1,000 ft row *Thimet 20-G	60	Minimum 30-inch row spacing. Apply granules in a band over the row at planting but do not contact seed. Do not graze or feed treated forage to livestock.
	0.047–0.071 lb sulfoxaflor	1.5–2.25 oz Transform WG	7	Do not apply more than a total of 8.5 oz of Transform WG (0.266 lb ai of sulfoxaflor) per acre per year.
	thiamethoxam	0.765–1.28 fl oz Cruiser 5FS/100 lb seed	—	Seed treatment only. There is a 120-day plantback restriction for crops not listed on the label.
	0.017–0.25 lb zeta-cypermethrin	2.72–4.0 oz *Mustang Maxx	1	Apply every 5 days as needed. Do not exceed 24.0 oz/a Mustang Maxx per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 0.266 lb ai/a per season. Wait at least 5 days between applications.
Seed corn maggot	*Plant during fly-free periods or use an insecticide at planting. First-generation adults emerge at 200 DD_{39} while second-generation adults emerge at 600 DD_{39}. Fields with fresh green manure are more attractive for egg laying.*			
	alpha-cypermethrin	2.7–3.8 fl oz *Fastac	1 21 (dry)	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.04–0.1 lb *Bacillus amyloliquefaciens* strain D747 + bifenthrin	3.4–8.5 fl oz *Ethos XB	—	Ethos is applied as a 5- to 7-inch band over the row on the soil surface, a 5- to 7-inch band over the open furrow (T-band), or in-furrow with the seed. Do not apply more than 0.1 lb bifenthrin active ingredient per acre per season including at-plant and foliar applications of other bifenthrin products.

*Restricted-use pesticide.

(continued)

Insect control in bean—green, lima, navy, red kidney *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Seed corn maggot *(cont.)*	0.04–0.08 lb bifenthrin	3.4–6.8 oz *Capture LFR	—	Apply as a 5- to 7-inch band over an open furrow or in-furrow with the seed. Do not apply more than 0.1 lb/a Capture LFR per season as an at-plant application.
	imidacloprid	1.6–3.2 fl oz Gaucho 600/100 lb seed	—	Green and lima beans only. Preplant commercial seed treatment. There is a 12-month rotational plantback restriction for crops not listed on label.
	0.06–0.09 lb/1,000 ft row phorate	4.5–7.0 oz/1,000 ft row *Thimet 20-G	60	Same as for leafhoppers above.
	thiamethoxam	0.765–1.28 fl oz Cruiser 5FS/100 lb seed	—	Seed treatment only. There is a 120-day plantback restriction for crops not listed on the label.
	0.017–0.25 lb zeta-cypermethrin	2.72–4.0 oz *Mustang Maxx	1	Apply every 5 days as needed. Do not exceed 24.0 oz/a Mustang Maxx per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 0.266 lb ai/a per season. Wait at least 5 days between applications.
Wire-worms	*Rotate with nonsusceptible crops to reduce wireworm populations.*			
	0.04–0.08 lb bifenthrin	3.4–6.8 oz *Capture LFR	—	Apply as a 5- to 7-inch band over an open furrow or in-furrow with the seed. Do not apply more than 0.1 lb/a Capture LFR per season as an at-plant application.
	3.0–4.0 lb diazinon	Diazinon G, WP, EC, D	—	Preplant broadcast incorporated, 4–8 inches.
	imidacloprid	1.6–3.2 fl oz Gaucho 600/100 lb seed	—	Green and lima beans only. Apply as a commercial seed treatment before planting. There is a 12-month rotational plantback restriction for crops not listed on the label.

*Restricted-use pesticide.

Weed control in bean—green, lima, navy, red kidney

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Weeds	*Till several times before planting to control early germinating weeds. After planting, but before beans emerge, kill emerging weeds with a rotary hoe or spike-toothed harrow. Cultivate beans at least twice before plants cover the middle of the row. Do not cultivate when plants are wet because this may spread disease. Several of the following herbicides can be tank mixed with each other or with liquid fertilizer for simultaneous application. Check specific herbicide labels for mixing directions and application details.*			
Annual weeds	0.15–0.25 lb clomazone	0.4–0.67 pt Command 3ME	45	Succulent snap beans only. For suppression and control of annual grasses and broadleaves, make a single preemergent soil application before seeding or after seeding but before crop emergence. Place seed or roots of transplants below the chemical barrier when planting. Strictly follow all precautions and restrictions on the label to minimize offsite movement and carryover. Read and understand the Vegetable Disclaimer section of the label; the end user of this product assumes all liability for failure to perform and any crop injury resulting from its use.
	dimethenamid–P	10.0–21.0 fl oz Outlook	70	Dry beans only. Consult label for variety-specific information and allowable rates depending on soil texture and organic matter. Outlook controls most annual grasses and pigweed and suppresses nightshade. It is weak on velvetleaf, lambsquarters, ragweed, and smartweed. Can cause stunting if wet, cold conditions occur during bean germination or emergence. Allowed application methods and timing vary by bean type. **Preplant-incorporated:** Apply to dry soil within 14 days before planting and blend into the top 1–2 inches of soil. Provides reasonable yellow nutsedge control at the highest rate recommended by soil type. **Preemergence:** Apply before or after planting but before weed emergence. Provides only limited control of yellow nutsedge. **Postemergence:** Although Outlook will not control emerged grasses, it can be applied to beans with 1–3 trifoliate leaves. Postemergence applications can speckle bean leaves.
	3.0–4.0 lb EPTC	3.5–4.5 pt Eptam 7E		Dry beans (consult label for allowable types) and succulent green beans only. Preplant-incorporated treatment controls most annual grasses and broadleaf weeds. Weak on smartweed and black nightshade. Incorporate 2–3 inches deep immediately after application. Can stunt beans if cool weather follows application. Do not exceed 3.5 pt/a Eptam 7E when treating green beans on sandy soils or on small white navy bean varieties. Ineffective on peat and muck soils.
	0.56–1.68 lb ethalfluralin	1.5–4.5 pt Sonalan HFP (dry beans) 1.5–2.0 pt (dry peas)		Dry beans and dry peas only. Preplant-incorporated treatment controls annual grasses and broadleaf weeds but is weak on wild mustard, smartweed, common ragweed, and velvetleaf. Some black nightshade suppression. Incorporate 2–3 inches deep within 2 days of application and before planting beans. May carry over in soil. Ineffective on peat or muck soils. Rate varies by soil type.
	0.048 lb flumioxazin	1.5 oz Chateau SW		May be applied only to dry beans prior to planting or within 2 days after planting and prior to dry bean emergence. Weather-related factors in combination with flumioxazin application may cause crop injury and/or delayed maturity. Consult label for additional information. Do not apply to dry beans after beans begin to crack or have emerged or severe injury may occur.

*Restricted-use pesticide.

(continued)

Weed control in bean—green, lima, navy, red kidney *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds *(cont.)*	fomesafen	Reflex (rate varies by location; check label)	30 (green) 45 (dry beans)	Dry and green beans only. Reflex is rate-restricted by location and prohibited from use in many areas of Wisconsin. Check label to determine if it can be used in your area. Preemergence or preplant surface application controls several broadleaf weeds.
	0.03 lb imazamox	4.0 oz Raptor		**Dry beans and dry peas:** Apply to dry beans with at least one fully expanded trifoliate leaf but before the bloom stage, and to dry peas with at least three pairs of leaves but before the bloom stage. Application may reduce crop growth, quality, and yield; cause temporary yellowing; and delay maturity. Raptor applications may be made with or without the addition of a fertilizer. A nitrogen-based fertilizer may improve weed control, but it will also increase the likelihood of crop damage. When nitrogen and/or crop oils are added to the mixture, include 6.0–16.0 oz/a Basagran or 12.0–24.0 oz/a Rezult to minimize injury. **For application to dry peas, always include Basagran or Rezult in the Raptor spray mixture, regardless of additives.** Only 1 application of Raptor may be made per crop season. Read the label for more specific directions, precautions, and restrictions. **Lima (succulent) and green beans:** Apply to lima beans between first- and second-trifoliate leaf stages or to green beans with at least one fully-expanded trifoliate but before bloom when weeds are less than 3 inches tall. Treatments made before the first-trifoliate leaf stage may cause temporary yellowing, stunt growth, and hurt crop quality and yield. Do not apply to beans during flowering. **Raptor must be applied as a tank mixture with Basagran** to minimize crop response. Using more than 16.0 oz/a of Basagran may reduce grass control. A non-ionic surfactant containing at least 80% active ingredient must be added at a rate of 1.0 qt/100 gal spray solution. Do not tank mix Raptor with any pesticides other than Basagran. Do not apply Raptor more than once per year.
	lima & dry beans: up to 0.0475 lb imazethapyr	up to 3.0 fl oz Pursuit	30 (succulent lima) 60 (dry beans)	Certain dry beans, lima, and green beans only. May reduce crop growth, quality, yield and/or delay maturity. Since maturity may be delayed, timing of harvest may need to be adjusted. **Do not apply Pursuit in the following situations:** —if cold and/or wet conditions are present or predicted to occur within 1 week of application; —by air or irrigation; —after July 31 for green beans; or —postemergence to lima and green beans. See label for specific instructions for postemergence application information for certain dry beans. Sensitive crops may be injured by this product; spray equipment should be thoroughly cleaned with water before being used to apply other products. **Follow rotational crop guidelines printed on the label or injury may result to subsequent crops.**
	green beans: 0.0238 lb imazethapyr	1.5 fl oz Pursuit	30 (green)	

*Restricted-use pesticide.

(continued)

Weed control in bean—green, lima, navy, red kidney *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds *(cont.)*	pendimethalin	2.4–3.6 pt Prowl 3.3EC 2.0–3.0 pt Prowl H_2O		Controls most annual grasses and certain broadleaf weeds. Rate varies depending on soil texture and organic matter. Make one preplant-incorporated application. Incorporate 1 inch deep using equipment capable of giving uniform incorporation. Incorporating in two passes gives better results.
	s-metolachlor	1.0–2.0 pt Dual II Magnum or Dual Magnum		Apply as a preplant treatment and shallowly incorporate or apply as a preemergence treatment. Controls most annual grasses and annual broadleaf weeds. Weak on velvetleaf, wild mustard, smartweed, and common lambsquarters. Preplant treatment gives reasonable yellow nutsedge control. Can delay maturity and reduce yields if wet, cold conditions occur after planting. Ineffective on peat or muck soils. Choose product rate for specific soil texture, organic matter classification and weed species expected.
	trifluralin	several manufacturers		Controls annual grasses and some broadleaf weeds, but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Rate varies depending on soil texture, organic matter, and type of bean planted. Incorporate 2–3 inches deep within 24 hours of application. See label for plantback restrictions. Ineffective on peat or muck soils.
Nutsedge and some broadleaves	0.023–0.047 lb halosulfuron	0.5–1.0 oz Sandea (rate varies by crop use and application timing—see label)	30	**Preemergence timing (dry beans, green beans, lima beans):** Apply after planting but prior to soil cracking. Use the lower rate on lighter texture soils with low organic matter. Apply uniformly with ground equipment in a minimum of 15 gal water/a. **Postemergence timing (dry beans, green beans, lima beans):** Apply to dry bean between the first- and third-trifoliate stage or to green and limas between the second- and fourth-trifoliate stage. Apply prior to flowering for all bean types. Use the lower rate on lighter texture soils with low organic matter. Directed sprays will limit crop injury. May be applied between rows. Avoid herbicide contact with the planted crop. See restrictions on the label if plastic is used on the planted row. Do not apply more than 1.0 oz/a Sandea per crop cycle (restricted to lesser amounts for some bean types—see label), and 2.0 oz/a Sandea per 12-month period. Use of soil or foliar-applied organophosphate insecticides on Sandea-treated crops may increase potential for and severity of crop injury. Consult label for important usage information and precautions.
Emerged weeds	glyphosate	several manufacturers and formulations available		See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. Glyphosate may be applied any time before crop emerges. Apply before seed germination in coarse sandy soils. If weeds have been mowed or tilled, do not treat until they have resumed active growth and reached the recommended stage on the label. Unless otherwise stated, allow 7 or more days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified.

*Restricted-use pesticide.

(continued)

Weed control in bean—green, lima, navy, red kidney *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged weeds *(cont.)*	*paraquat	several manufacturers and formulations available, not all are registered for this use		Prepare seedbed early to allow for maximum weed emergence. Application can be made as a banded or broadcast treatment before, during, or after planting, but before crop emergence. In preplant and preemergence (to the crop) uses, do not apply to soils lacking clay minerals, i.e. muck, pure sand. Use the higher rate for heavy weed infestations. Seeding should be performed with minimal soil disturbance. Always add crop oil concentrate or non-ionic surfactant to spray mixture. Follow precautions on label.
Emerged grasses	clethodim	several manufacturers and formulations	30	See label for specific bean types. Apply to actively growing grasses. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by the label. Do not apply if rain is expected within 1 hour. See label for tank mix instructions.
	clethodim	Select Max (see label for rate—varies by bean type)	30 (dry beans) 21 (succulent)	
	0.094–0.375 lb fluazifop-P-butyl	6.0–24.0 fl oz Fusilade DX	60	**Dry beans only.** Make postemergence application to actively growing grasses; check label for size range, treatment rate, and appropriate spray additive. Do not apply more than 24.0 fl oz/a Fusilade DX per application or more than a total of 48.0 fl oz/a Fusilade DX per season. Maintain a minimum of 14 days between applications.
	0.034–0.08 lb quizalofop	5.0–12.0 oz Assure II or Targa	15 (green) 30 (dry beans)	Apply to actively growing grasses. Check label for specific instruction regarding grasses controlled and application rates. Always add crop oil concentrate or a non-ionic surfactant. Rainfast 1 hour after application. Maximum annual use rate varies by formulation and bean type—see label.
	0.094–0.47 lb sethoxydim	0.5–2.5 pt Poast	15 (green) 30 (dry beans)	Make postemergence applications to actively growing grasses within the size ranges indicated on the label. Check the label for wild proso millet or rescue treatment rates and for information on quackgrass control. Do not exceed 4.0 pt/a Poast per crop season. Consult label for rate and adjuvant instructions for specific weeds. Do not cultivate 5 days prior to or within 7 days following application.
Emerged annual broadleaves	0.75–1.0 lb bentazon	several manufacturers and formulations	varies by label	Suggested as a postemergence spray when annual broadleaf weeds escape an earlier treatment. Controls velvetleaf, mustard, and purslane. Partial control of black nightshade, common lambsquarters, and redroot pigweed when applied in the very small seedling stage. Does not control grasses. Green beans are more sensitive to foliar burn than dry beans. Include 1.0–2.0 pt/a of crop oil concentrate in the spray mixture. Some oil concentrates cause excessive leaf burn, particularly during warm, humid weather. Apply when beans have at least the first trifoliate leaves expanded and annual broadleaf weeds are small and actively growing. Do not cultivate within 5 days before or 7 days after bentazon application. Must thoroughly cover weeds. Do not apply to beans under stress or if rainfall is expected within 4 hours of treatment.

*Restricted-use pesticide.

(continued)

Weed control in bean—green, lima, navy, red kidney *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged annual broadleaves *(cont.)*	fomesafen	Reflex (rate varies by location; check label)	30 (green beans) 45 (dry beans)	Dry and green beans only. Reflex is rate-restricted by location and prohibited from use in some areas of Wisconsin. Check label to determine if it can be used in your area. Apply postemergence broadcast to control broadleaves, including eastern black nightshade, pigweeds, common ragweed, and common purslane. See label for application timing based on crop and weed growth stage.
Preharvest and spot treatment of emerged weeds	glyphosate	several manufacturers and formulations available	varies by bean type	Certain dry beans only—see label. May be applied as an over-the-top broadcast spray to control labeled weeds before harvest. The crop should be in the hard dough stage (< 30% moisture). Only 1 application can be made per year. Do not combine spot treatment with a preharvest spray. Do not use if the crop is for seed or will be fed to livestock. Allow 30 days between treatment and replanting with any crop not listed on the herbicide label. Some formulations may also be used as a spot treatment for troublesome weeds such as Canada thistle or quackgrass. Any crop receiving spray in the treated area will be killed.
Dry bean and dry pea harvest aid	*paraquat	several manufacturers and formulations available	7	Treat when at least 80% of the pods are yellowing and mostly ripe, and no more than 40% (bush peas and beans) or 30% (vine peas and beans) of the leaves should be green. For vining beans or bush beans with lush growth, use a single application at the higher rate. Gramoxone Inteon may be applied as a split application, but do not make more than two or exceed a total of 2.0 pt/a. Add non-ionic surfactant at 1.0 qt/100 gallons spray mix. See label for precautions. Not all paraquat formulations are registered for this use.
	0.015–0.92 lb carfentrazone	1.0–6.1 oz Aim EC	0	Applications should be made when the crop is mature and the grain has begun to dry down. Use sufficient spray volume to provide complete foliage coverage. See label for adjuvant recommendations and maximum allowable use rates.

*Restricted-use pesticide.

Carrot

Planting

Mid-April to early June. Treat seed with thiram 75% WP to prevent damping-off. Choose deep, fertile soils and provide adequate drainage. Soils should not be subject to compaction or high water tables during growing season. Excess moisture can cause forked roots, reducing quality. If plow pans are a concern, deep rip below the seed row before planting.

Carrots are susceptible to wind damage when first emerging from the soil. You can protect young seedlings by spreading oat seed over the soil just after planting. When carrots are several inches tall, use a selective postemergence grass herbicide to kill the oats.

Rows: 15–30 inches; use 2–4 lb seed/a (1–2 lb seed/a for Chantenay). Carrots can be grown in raised beds. Beds should be 3–4 feet wide with 3–4 rows per bed.

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 5.6 or higher in organic soils and at least 5.8 in other soils.

Fertilizer rates: Apply P_2O_5 and K_2O according to soil test recommendations. Use annual nitrogen, P_2O_5, and K_2O recommendations listed in the table below. Take credits for previous legume crops and manure.

Application: Broadcast and work in before seeding. Where possible, avoid fall potash applications on organic soils.

Nitrogen: Apply preplant or sidedress. Split nitrogen into two or more applications on sandy soils.

Micronutrients: Carrots need moderate amounts of manganese, boron, and copper. Use soil and plant analyses to check for deficiencies of these nutrients. Foliar or banded micronutrient applications will likely be most effective on organic soils. Apply 1–3 lb Mn/a and 1–12 lb Cu/a, depending on soil and method of application.

Irrigation

Early irrigation helps establish stands in hot, dry weather and is particularly important in the seedling stage. Carrots should not be under moisture stress at any time. Be sure to moisten soil to rooting depth when irrigating.

Annual nitrogen, phosphate, and potash recommendations for carrot

Nitrogen		Phosphate and potash		
Organic matter (%)	**Amount to apply** (lb/a)	**Yield goal**	**Amount P_2O_5 to apply*** (lb/a)	**Amount K_2O to apply*** (lb/a)
<2	120	20–30 t/a	45	240
2.0–9.9	100			
10–20	80			
>20	40			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Resistance/susceptibility of some carrot cultivars to aster yellows & their action thresholds (aster yellows index)

Resistant cultivars (aster yellows index of 100)					
Amtou	Gold King	Nanton	Raoleta	Scarlet Nantes ST	Tahoe*
Bercaro*	Growers Choice	Nimrod	Revo*	Sierra*	Texsun*
Charger	GT 26 Dicer	PrimeCut 59	Rona*	Sirocco	Toudo
El Presidente	Hi Color 9	Prospector	Royal Chantenay	Six Pak	Triple Play
Enterprise	Impak	PY 60**	Scarlet Nantes	Spearhead	
Intermediate cultivars (aster yellows index of 75)					
Baby 657*	Cupar	Hipak*	Lucky B	Nuggeteer*	Spartan Winner*
Bolero	Cutlass*	Interceptor	Midas Touch	Pakmor	SugarSnax 54
Bradford	Flavor Pak*	Javelin*	Morecuts	Pioneer*	Thor*
Bremen	Florida	Karotan*	Nagadir	Prodigy	Triple Gold
Canada	Goldpak 28, G	King Midas*	Nanco	Prospector	Trophy 301
Casey	Harvestmore*	Lance*	Nikki	Sabre 78*	
Columbia	Heritage	Long Imperator 58	Noveno	Spartan Fancy	
Susceptible cultivars (aster yellows index of 50)					
Aristopak*	Carson	Fancipak*	Nandor*	Regina*	Sytan
Arrowhead	Clairon Corona	Fina*	Nantes	Scarla*	Tamino*
Belikumar*	Dandy	Flacaro*	Nantes ST	Spartan Bonus	Tip Top*
Bersky	Danver's Gold*	Flakkese	Nantes Superior	Spartan Bonus 80	Touche
Bonanza	Danvers 126	Giganta	Orlando Gold	Spartan Delite*	Woodland*
Candy Pak	Dessert Danvers*	Goldpak	Red Cored Chantenay	Super Sprite	
Caromba	Early Gold	Lucky's Gold		Sweet N Crisp*	

*Cultivars evaluated for 1 year only.

**In thick stands only.

Disease control in carrot

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Alternaria leaf blight and Cercospora leaf blight	azoxystrobin	*Alternaria:* 6.0–15.5 fl oz Aframe, AzoxyStar, Quadris Flowable, Satori, Willowood Azoxy 2SC *Cercospora:* 9.0–15.5 fl oz Aframe, AzoxyStar, Quadris Flowable, Satori, Willowood Azoxy 2SC	0 0	Quadris, Satori, Quadris Opti, Quilt, Cabrio, and Flint belong to the Group 11 (strobilurin) fungicide category. Do not exceed 1 application of these products before alternating to a fungicide with a different mode of action. Do not exceed 3 applications of Group 11 fungicides per crop per year. AzoxyStar can be applied at a rate up to 20.0 fl oz/a for Alternaria and Cercospora. Do not apply more than 55.0 fl oz/a Quilt per season.
	azoxystrobin + chlorothalonil	2.4 pt Quadris Opti	0	
	azoxystrobin + difenoconazole	12.0–14.0 fl oz Quadris Top	7	
	azoxystrobin + propiconazole	14.0 fl oz Cover XL, Quilt Xcel, Willowood AzoxyProp Xtra	14	
	pyraclostrobin	8.0–12.0 oz Cabrio EG	0	
	trifloxystrobin	2.0–3.0 oz Flint	7	

(continued)

Disease control in carrot *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Alternaria leaf blight and Cercospora leaf blight *(cont.)*	boscalid	4.5 oz Endura WDG	0	**For control of Alternaria leaf blight only.** Endura belongs to the Group 7 (anilide) fungicide category. Do not exceed 2 sequential applications of Endura before alternating to a labeled fungicide with a different mode of action. Do not exceed 5 applications per season. Do not exceed 22.5 oz/a Endura per season.
	boscalid + pyraclostrobin	8.0–10.5 oz Pristine WDG	0	Pristine belongs to Group 7 (anilide) and 11 (strobilurin) fungicide categories. Do not exceed 2 sequential applications of Pristine before alternating to a labeled fungicide with a different mode of action. Do not exceed 6 applications of Pristine or other Group 11 fungicide per season. Do not exceed 63.0 oz/a Pristine per season.
	chlorothalonil	1.5–2.0 pt Bravo Weather Stik, Echo 720, Equus 720 1.4–1.8 lb Bravo Ultrex 82.5WDG, Equus DF 1.25–1.63 lb Echo 90DF 2.25–2.75 pt Bravo Zn, Echo Zn, Equus 500 Zn	0 0 0 0	Apply at first sign of infection. Do not use tops for food or feed. Do not exceed 15.0 lb ai/a chlorothalonil per season.
	copper hydroxide	1.3 pt Champ Formula 2 4.6F 2 lb Kocide 101 77WP, DF 2.6 pt Kocide LF 2.4F 1.3 pt Kocide 4.5 LF 1.5–2.75 lb Kocide 2000 DF 0.75–1.5 lb Kocide 3000	0 0 0 0 0 0	
	cyprodinil + difenoconazole	16.0–20.0 fl oz Inspire Super	7	Follow label for fungicide resistance management strategies.
	cyprodinil + fludioxonil	11.0–14.0 oz Switch	7	**For control of Alternaria leaf blight only.** Ground application only. Do not apply more than 56.0 oz of Switch per crop per year.
	fluxapyroxad + pyraclostrobin	4.0–5.5 fl oz Merivon (Alternaria) 5.5 fl oz Merivon (Cercospora)	7	Do not make more than 3 applications per acre per year.
	fluopyram + pyrimethanil	8.0–11.2 fl oz Luna Tranquility	7	Follow resistance management guidelines.
	fluopyram + trifloxystrobin	5.8 fl oz Luna Sensation	7	Do not make more than 2 sequential applications of any Group 7 or Group 11 fungicide before rotating to an alternative fungicide group.
	iprodione	1.0–2.0 pt Iprodione 4L AG, Meteor, Nevado 4F, Rovral 4F	0	**For control of Alternaria leaf blight only.** Note label for rotational crop restrictions.
	penthiopyrad	16.0–30.0 fl oz Fontelis	0	Begin applications prior to disease development. Use higher rate and shorter spray interval when disease pressure is high. Make no more than 2 sequential applications before alternating to an effective fungicide with a different mode of action. Do not apply more than 61.0 fl oz/a per year.

(continued)

Disease control in carrot *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Alternaria leaf blight and Cercospora leaf blight *(cont.)*	propiconazole	4.0 fl oz AmTide Propiconazole 41.8% EC, Bumper 41.8 EC, Fitness, PropiMax EC, Tilt, Willowood Propicon 3.6EC	14	Do not apply more than 16.0 fl oz/a Bumper 41.8 EC per season.
		2.0 fl oz AmTide Propiconazole 41.8% EC, Bumper 41.8 EC, Fitness, PropiMax EC, Tilt *plus* 0.75 lb ai chlorothalonil, Willowood Propicon 3.6EC	14	
	pydiflumetofen + fludioxonil	6.8 fl oz Miravis Prime	7	Follow label for fungicide resistance management strategies.
	trifloxystrobin	1.9–2.9 fl oz Gem 500 SC	7	Do not make more than one foliar application before alternating to an effective fungicide with a different mode of action. Do not apply more than 11.5 fl oz/a per season. Do not make more than 4 applications/a per season of Gem or other strobilurin-containing fungicide.
Aster yellows	*Use an insecticide recommended for aster leafhopper. Treat from the seedling stage to 30 days before harvest. See treatment index for aster leafhopper.*			
Bacterial blight	*The best control is prevention. Use hot water treatment of seed at 122°F for 15 minutes. Fungicides containing copper may suppress disease progression and spread.*			
Cottony rot, watery soft rot, white mold *(Sclerotinia sclerotiorum)*	boscalid	7.0–8.0 oz Endura	0	Apply prior to or at first sign of disease to optimize efficacy.
	Coniothyrium minitans strain CON/M/91-08	1.0–4.0 lb Contans WG	0	Make broadcast application and incorporate Contans WG into top 2 inches of soil by implement or by irrigation.
	fluazinam	1.0 pt Omega 500F	7	Do not make more than 4 applications per crop cycle. Do not apply more than 4.0 pt per growing season. Apply in 30–50 gal water/a as a directed band spray over the crop.
	fludioxonil	16.0 fl oz/100 gal Scholar SC		Follow label for fungicide resistance management strategies.
	fluopyram + pyrimethanil	11.2 fl oz Luna Tranquility	7	Follow resistance management guidelines.
	fluopyram + trifloxystrobin	5.8 fl oz Luna Sensation	7	Apply at critical timing for disease control. do not make more than 4 applications per year.
	penthiopyrad	16.0–30.0 fl oz Fontelis	0	Begin applications prior to disease development. Use higher rate and shorter spray interval when disease pressure is high. Make no more than 2 sequential applications before alternating to an effective fungicide with a different mode of action. Do not apply more than 61.0 fl oz/a per year.
	pydiflumetofen + fludioxonil	6.8 fl oz Miravis Prime	7	Follow label for fungicide resistance management strategies.
Damping-off, Pythium root die-back, and seed rot	cyazofamid	6.0 fl oz Ranman	14	Do not use more than 30.0 fl oz per season. Do not use adjuvant when applying to carrots.
	fenamidone	8.2 fl oz Reason	14	Do not apply more than 24.6 fl oz per season. Do not make more than 1 application of Reason without alternating to a different resistance management group.

(continued)

Disease control in carrot *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Damping-off, Pythium root die-back, and seed rot *(cont.)*	fluopicolide	4.0 fl oz Presidio	7	Can be applied as an in-furrow treatment in 5–10 gal/a volume. Can be sidedressed in 20–40 gal/a spray mixture.
	mefenoxam	0.5–1.3 pt Ridomil Gold SL 2.0–4.0 pt Ultra Flourish	—	Preplant-incorporated or at-planting surface application. Rotate with less-susceptible crops. Use raised beds and precision seeding.
		0.32–0.64 fl oz Apron XL LS/100 lb seed	—	Follow manufacturer's directions. Do not use treated seed for feed or food.
		1.0–2.0 pt Orondis Gold	—	Preplant-incorporated or soil spray (band or broadcast). For Pythium root rot and Phytophthora root rot.
	metalaxyl	4.0–8.0 pt MetaStar 2E AG	—	Preplant-incorporated application or surface application at planting. Preplant to top 2 inches of soil.
		0.75 fl oz/100 lb seed Allegiance FL, Metalaxyl 265 ST 0.7 fl oz/100 lb seed Sebring 2.65 ST	—	Follow manufacturer's directions. Do not use treated seed for feed or food.
Rhizoctonia seedling infection and crown rot	azoxystrobin	0.4–0.8 fl oz Quadris Flowable/1,000 ft row	0	Follow manufacturer's directions.
Root-knot nematodes	heat-killed *Burkholderia* spp. strain A396 bionematicide	2.0 gal Majestene	0	Broadcast chemigation applications prior to planting or in-furrow at-plant applications. Soil must be wet for efficacy. Re-entry interval of 4 hours.
	metam-sodium	Vapam HL, Metam, Sectagon 42	—	Growing corn or sod for at least 3 years and then growing carrots for 1 year helps starve out root-knot larvae. Soil fumigation is effective but expensive on muck soils. Apply soil fumigants in the fall.
	oxamyl	1.0 gal Vydate L	14	Do not apply more than 20 pt Vydate L per acre per season. Minimum retreatment interval is 14 days.
	Paecilomyces lilacinus strain 251 bionematicide	4.0–9.0 lb MeloCon WG	—	Pre-plant or at-transplant application. Apply when soil temperatures are above 60°F at a 4-inch depth. Can apply up to 2 weeks prior to planting in a non-fumigated site.

Insect control in carrot

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids	*Treat when 25% of plants are infested.*			
	alpha-cypermethrin	3.2–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	azadirachtin	16.0–32.0 oz Aza-Direct 10.0–16.0 oz Azatin XL 4.0–10.0 oz Neemix 4.5	0	Apply at 7-day intervals when pests first appear. May treat heavy infestations every 7–10 days.

*Restricted-use pesticide.

(continued)

Insect control in carrot *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids *(cont.)*	0.08–0.1 lb bifenthrin	5.12–6.4 oz *Bifenture 2EC	21	Do not exceed 0.5 lb (32.0 fl oz formulated product) ai/a per season. Allow at least 7 days between applications.
	0.088–0.133 lb cyantraniliprole	13.5–20.5 fl oz Exirel	1	Minimum application interval between treatments is 5 days. Do not apply a total of more than 0.4 lb ai/a of cyazypyr or cyantraniliprole-containing products.
	0.018–0.028 lb deltamethrin	1.5–2.4 oz *Delta Gold	3	Apply every 3 days as needed.
	0.5 lb diazinon	1 pt Diazinon AG500 1 lb Diazinon 50WP	14	Do not exceed 5 applications per season. Allow at least 7 days between applications.
	0.062–0.089 lb flonicamid	2.0–2.8 oz Beleaf SG	0	Begin applications before aphid populations build. Do not exceed 2.8 oz/a Beleaf per application and do not exceed 8.4 oz/a (0.267 lb ai/a) per crop season.
	flupyradifurone	7.0–10.5 fl oz Sivanto	7	Foliar application. Apply when pests reach or exceed established thresholds. Do not apply more than 28.0 fl oz of Sivanto per acre per crop season.
	imidacloprid	0.31–0.74 fl oz Admire Pro/1,000 ft row 4.4–10.5 fl oz Admire Pro 3.5 fl oz Provado	21 21 7	Admire may only be applied once per season. Apply Provado every 5 days as needed. Do not exceed 3 applications per season. Maximum imidacloprid use per season is 0.5 lb ai/a from any formulation.
	imidacloprid + beta-cyfluthrin	2.4–2.8 fl oz *Leverage 360	7	Do not apply more than 8.3 fl oz/a per season and allow at least 7 days between applications.
	0.94–1.25 lb malathion	Malathion EC, WP, D	7	See label for rate.
	0.078 lb spirotetramat + 0.027 lb pyriproxifen	10.0 fl oz Senstar	7	Do not apply more than 10 fl oz of Senstar Insecticide (0.078 lb spirotetramat and 0.027 lb pyriproxyfen) per acre per application. Do not make more than 2 applications per crop season. Do not apply more than 20 fl oz of Senstar Insecticide (0.156 lb spirotetramat and 0.055 lb pyriproxyfen) per acre per crop season. Minimum interval between applications is 14 days. Regardless of formulation do not apply more than 0.16 lb spirotetramat and 0.109 lb pyriproxyfen per acre per crop season. Do not allow livestock to graze treated areas.

*Restricted-use pesticide.

(continued)

Insect control in carrot *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids *(cont.)*	0.023–0.047 lb sulfoxaflor	0.75–1.5 oz Transform WG	7	Do not make applications less than 7 days apart. Do not make more than four applications per crop. Do not make more than two consecutive applications per crop. Do not apply more than a total of 8.5 oz of Transform WG (0.266 lb ai of sulfoxaflor) per acre per year.
	thiamethoxam	1.5–3.0 oz Actara 25WDG	7	Apply before pests reach damaging levels. Use higher rate for heavy infestations. Do not exceed 8.0 oz/a per season.
		5.0–12.0 fl oz Platinum 2SC 1.07–4.01 oz Platinum 75 SG	0 0	Apply Platinum as an in-furrow spray or as a surface band at seeding. For surface-banded applications, irrigate within 24 hours to seeding depth using trickle or drip irrigation. Do not apply more than 12.0 fl oz Platinum 2SC or 4.01 oz Platinum 75SG per acre per crop season and apply sufficient water volume after application to ensure incorporation into the seed zone.
	0.02–0.025 lb zeta-cypermethrin	3.2–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	21	Do not apply more than 0.2 lb ai/a or exceed 2 applications per season.
Aster leafhopper	*For treatment thresholds, see "Aster Yellows Index" on page 16.*			
	alpha-cypermethrin	1.8–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.0125–0.022 lb beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Apply every 7 days; do not exceed 5 applications.
	1.0–2.0 lb carbaryl	1.0–2.0 qt Sevin XLR Plus	7	Do not apply within 7 days of harvest. Do not exceed 6.0 qt ai/a per crop season. Highly toxic to bees—do not apply when crop or nearby weeds are in bloom.
	0.018–0.028 lb deltamethrin	1.5–2.4 oz *Delta Gold	3	Apply every 3 days as needed.
	0.3–0.5 lb esfenvalerate	5.8–9.6 oz *Asana XL	7	Do not exceed 0.5 lb ai/a per season.
	flupyradifurone	7.0–10.5 fl oz Sivanto	7	Foliar application. Apply when pests reach or exceed established thresholds. Do not apply more than 28.0 fl oz of Sivanto per acre per crop season.
	imidacloprid + beta-cyfluthrin	2.4–2.8 fl oz *Leverage 360	7	Do not apply more than 8.3 fl oz/a per season and allow at least 7 days between applications.
	0.045–0.9 lb methomyl	1.5–3.0 pt *Lannate LV	1	Repeat applications as necessary up to a total of 10 times per year. Do not exceed 21.0 pt/a per year.

*Restricted-use pesticide.

(continued)

Insect control in carrot *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aster leafhopper *(cont.)*	0.023–0.086 lb sulfoxaflor	0.75–2.75 oz Transform WG	7	Do not make applications less than 7 days apart. Do not make more than four applications per crop. Do not make more than two consecutive applications per crop. Do not apply more than a total of 8.5 oz of Transform WG (0.266 lb ai of sulfoxaflor) per acre per year.
	thiamethoxam	1.5–3.0 oz Actara 25WDG	7	Apply before pests reach damaging levels. Use higher rate for heavy infestations. Do not exceed 8.0 oz/a per season.
		5.0–12.0 fl oz Platinum 2SC 1.07–4.01 oz Platinum 75SG	0 0	Apply Platinum as an in-furrow spray or as a surface band at seeding. For surface-banded applications, irrigate within 24 hours to seeding depth using trickle or drip irrigation. Do not apply more than 12.0 fl oz Platinum 2SC or 4.01 oz Platinum 75SG per acre per crop season and apply sufficient water volume after in-ground application to ensure incorporation into the seed zone.
	0.011–0.025 lb zeta-cypermethrin	1.76–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.
Black cutworms	*Spot treat when numbers exceed two larvae per foot of row.*			
	alpha-cypermethrin	1.3–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	azadirachtin	16.0–32.0 oz Aza-Direct 10.0–16.0 oz Azatin XL 4.0–10.0 oz Neemix 4.5	0	Apply at 7-day intervals when pests first appear. May treat heavy infestations every 7–10 days.
	0.0125–0.022 lb beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Apply every 7 days; do not exceed 5 applications.
	1.0–2.0 lb carbaryl	Sevin Bait	7	Broadcast bait formulation. See label for rate. Can only be used with mechanical harvest.
	0.3–0.5 lb esfenvalerate	5.8–9.6 oz *Asana XL	7	Do not exceed 0.5 lb ai/a per season.
	imidacloprid + beta-cyfluthrin	2.4–2.8 fl oz *Leverage 360	7	Do not apply more than 8.3 fl oz/a per season and allow at least 7 days between applications.
	0.008–0.025 lb zeta-cypermethrin	1.28–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.
	0.025–0.06 lb zeta-cypermethrin + bifenthrin	2.6–6.1 fl oz *Hero	21	Do not apply more than 0.2 lb ai/a or exceed 2 applications per season.
Carrot weevil	*Carrot weevil populations are easily managed by spraying every 3–5 days for 2 weeks once eggs are found.*			
	0.044 lb beta-cyfluthrin	2.8 fl oz *Baythroid XL	0	Apply every 7 days; do not exceed 5 applications.
	0.5 lb esfenvalerate	9.6 oz *Asana XL	7	Do not exceed 0.5 lb ai/a per season.
	imidacloprid + beta-cyfluthrin	2.4–2.8 fl oz *Leverage 360	7	Do not apply more than 8.3 fl oz/a per season and allow at least 7 days between applications.
	0.5–1.0 lb oxamyl	2.0–4.0 pt *Vydate L	14	Apply as directed spray. Do not apply more than 4.0 gal/a per season.

*Restricted-use pesticide.

(continued)

Insect control in carrot *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Seed corn maggot	imidacloprid	6.4 fl oz Gaucho 600	—	To provide early-season protection of seedlings as a commercial seed treatment.

*Restricted-use pesticide.

Weed control in carrot

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	1.0–2.0 lb prometryn	2.0–4.0 pt Caparol 4L	30	Caparol 4L can be applied preemergence and/or postemergence over the top to carrot. Apply up to 3 applications of Caparol 4L at the rate of 2.0–4.0 pt/a per application. Do not exceed one preemergence application at up to 4.0 pt/a and two postemergence applications each at up to 2.0 pt/a or one postemergence application at up to 4.0 pt/a per crop cycle. Maximum seasonal use varies by label. Make postemergence applications through the six-leaf stage of carrot development. See label for adjuvant instructions when making postemergence applications.
Annual broadleaves and some grasses	linuron	Lorox DF *(use and rate vary by soil type—see label)*	14	Use included on a Wisconsin Special Local Needs 24c label that currently expires on 12/31/2029 - check for new 24c label prior to use. Use restricted by soil type, organic matter, and depth to groundwater. See label for details.
	trifluralin	several manufacturers		Apply as a preplant soil-incorporated treatment only. Controls annual grasses and some broadleaf weeds, but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Rate varies depending on soil texture and organic matter. Must be incorporated within 24 hours. See label for plantback restrictions. Ineffective on peat or muck soils.
Annual grasses and some broadleaves	0.95 lb pendimethalin	2.0 pt Prowl H_2O	60	Apply preemergence as a broadcast treatment within 2 days after planting or at layby as a directed spray to the soil between rows. Emerged weeds will not be controlled. Do not allow the spray to contact carrot plants or injury may occur.
Emerged weeds	glyphosate	several manufacturers and formulations available		See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. Glyphosate may be applied any time before crop emerges. Apply before crop seed germination in coarse sandy soils. If weeds have been mowed or tilled, do not treat until they have resumed active growth and reached the recommended stage on the label. Unless otherwise stated, allow 7 or more days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified.

*Restricted-use pesticide.

(continued)

Weed control in carrot *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged weeds *(cont.)*	*paraquat	several manufacturers and formulations available, not all are registered for this use		Prepare seedbed early to allow for maximum weed emergence. Application can be made as a banded or broadcast treatment before, during, or after planting, but before crop emergence. In preplant and preemergence (to the crop) uses, do not apply to soils lacking clay minerals, i.e., muck, pure sand. Use the higher rate for heavy weed infestations. Minimize soil disturbance during seeding. Always add crop oil concentrate or non-ionic surfactant to spray mixture. Follow precautions on label.
Emerged grasses	0.068–0.12 lb clethodim	9.0–16.0 oz Select Max	30	Apply to actively growing grasses. Repeat treatments may be made at 14-day intervals up to the maximum annual use rate. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by label. Do not apply if rain is expected within 1 hour.
	clethodim	several manufacturers and formulations	30	
	0.094–0.375 lb fluazifop-P-butyl	6.0–24.0 oz Fusilade DX	45	Make postemergence applications when actively growing grasses are in the size ranges specified on the label. Always add one of the following to the finished spray volume: 1% crop oil concentrate or 0.25% non-ionic surfactant. Multiple applications may be made to control late germinating grasses but do not exceed 3.0 pt/a Fusilade DX in one crop season.
	0.094–0.47 lb sethoxydim	0.5–2.5 pt Poast	30	Apply postemergence to actively growing grasses. Consult label for rate and adjuvant instructions for specific weeds. Multiple applications may be made allowing 14 days between applications, but do not apply more than 5.0 pt/a of Poast per season. Do not apply if rain is expected within 1 hour.
Emerged annual broadleaves	metribuzin	see label	60	Postemergence applications may be made after carrots have formed five to six true leaves but before weeds are 1 inch in height or diameter. If needed, a second application may be made after an interval of at least 3 weeks but do not exceed 0.5 lb ai/a in one crop season. Check rotational restrictions prior to use. Excessive crop injury may occur if applications are made on very hot days, to drought-stressed carrots, or within 3 days after periods of cool, wet, or cloudy weather. Do not apply metribuzin within 3 days of any other chemical or when carrots are under stress. For carrots with unknown tolerance to metribuzin, treat a small area initially. See label for rotation restrictions.

*Restricted-use pesticide.

Celery

Planting

Plant treated seed in late April or transplants in mid-May. Avoid early planting that would expose young plants to temperatures below 55˚F for a week or more. This can cause "bolting" (seed stalk development). Choose deep, fertile soils and provide adequate drainage. Celery needs abundant available moisture during the growing season. Rotate celery with other vegetable crops but not with carrots.

Direct seedings

Rows: 18–40 inches.

Seeds in row: 2 inches apart, later thinned to 6–8 inches apart. Use 6–8 oz seed/a (1 oz seed produces 10,000 plants).

Transplants

Rows: 18–40 inches.

Plants in row: 6–8 inches. Set 30,000–45,000 plants/a.

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 5.6 or higher in organic soils and at least 6.0 in other soils.

Fertilizer rates: Apply P_2O_5 and K_2O according to soil test recommendations. Use annual nitrogen, P_2O_5, and K_2O recommendations in table below. Take credits for previous legume crops and manure.

Application: Broadcast and work in lime and fertilizer requirements before planting.

Nitrogen: Apply preplant or sidedress. At higher rates, split recommendations into two or more applications during the season.

Micronutrients: Celery has a high boron requirement and medium requirements for manganese and copper. Use soil and plant analyses to check for deficiencies of these nutrients. Apply 2–3 lb/a of boron with fertilizer each year if boron soil test is very low (VL) or low (L). Omit application if boron test is in the excessively high (EH) range. Apply 1–5 lb Mn/a or 1–12 lb Cu/a, depending on fertilizer source, soil, and method of application.

Annual nitrogen, phosphate, and potash recommendations for celery

Nitrogen		Phosphate and potash		
Organic matter (%)	Amount to apply (lb/a)	Yield goal	Amount P_2O_5 to apply* (lb/a)	Amount K_2O to apply* (lb/a)
<2	140	25–35 t/a	100	300
2.0–9.9	120			
10–20	100			
>20	50			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Disease control in celery

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Anthracnose *(Colletotrichum acutatum)*	azoxystrobin	6.0–15.5 fl oz Quadris Aframe	0	Begin treatment prior to disease development. Follow resistance management guidelines per label. Start with disease-free transplants.
	pyraclostrobin	12.0–16.0 oz Cabrio	0	
Aster yellows	*Control aster leafhopper. See "Aster Yellows Index" on page 16.*			
Basal stalk rot *(Rhizoctonia)*	azoxystrobin + chlorothalonil	2.4–3.7 pt Quadris Opti	7	Quadris Opti contains Group 11 (strobilurin) and M5 fungicides. Do not apply more than two sequential foliar applications of these materials before alternating with a fungicide with a different mode of action. Do not exceed four foliar applications and 3.0 gal/a Quadris Opti per season.

(continued)

Disease control in celery *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Basal stalk rot *(cont.)*	chlorothalonil *(7-day spray schedule)*	2.0–3.0 pt Bravo Weather Stik, Echo 720, Equus 720 1.8–2.7 lb Bravo Ultrex 82.5WDG, Equus DF 1.7–2.4 lb Echo 90DF	7 7 7	Spray before infection occurs. Rotate celery with non-susceptible crops. Do not exceed 18.0 lb ai/a chlorothalonil per season.
Bacterial blight *(Pseudo-monas)*	copper hydroxide	1.3 pt Champ Formula 2 4.6F, Kocide 4.5 LF 2.3 pt Kocide LF 2.4F 1.5 lb Kocide 2000 DF 0.75–1.5 lb Kocide 3000 2.0 lb Champion 77WP, Kocide 101 77WP, Kocide DF	0 0 0 0 0	Use a 2- to 3-year crop rotation and hot water seed treatment (118˚F for 30 minutes) to control bacterial diseases. Spray during wet periods and when disease is anticipated.
Cercospora (early blight), **Septoria** (late blight), **Alternaria** (Alternaria leaf spot)	*Hot water seed treatment will eliminate Septoria spores on the seed.*			
	azoxystrobin	9.0–15.5 fl oz Aframe, AzoxyStar, Quadris Flowable, Satori, Willowood Azoxy 2SC	0	Quadris, Satori, Quilt, Cabrio, and Flint are Group 11 (strobilurin) fungicides; Quadris Opti contains Group 11 and M5 fungicides. To prevent disease resistance, do not apply more than 1 application of these products before alternating with a fungicide having a different mode of action. Do not exceed 3 applications of strobilurin fungicides per crop per year. Do not exceed 2.88 qt/a Quadris or Satori, 3.0 gal/a Quadris Opti, 64.0 oz/a Cabrio, or 12.0 oz/a Flint per season.
	azoxystrobin + chlorothalonil	2.4–3.7 pt Quadris Opti	7	
	azoxystrobin + propiconazole	14.0 fl oz Quilt Xcel	14	
	pyraclostrobin	12.0–16.0 oz Cabrio EG	0	
	trifloxystrobin	2.0–3.0 oz Flint	7	
	azoxystrobin + propiconazole	14.0 fl oz Quilt, Willowood AzoxyProp Xtra	14	Do not apply more than 56.0 fl oz/a per season of Quilt.
	boscalid	*Alternaria control:* 4.5–9.0 oz Endura	0	Do not make more than 2 applications of Endura per season. Use higher rate when disease pressure is high.
	boscalid + pyraclostrobin	10.0–15.0 oz Pristine	0	Make no more than 2 applications per season. Follow resistance management guidelines.
	chlorothalonil *(3- to 5-day spray schedule)*	1.5–2.0 pt Bravo Weather Stik, Echo 720, Equus 720 1.4–1.8 lb Bravo Ultrex 82.5WDG, Equus DF 0.9–1.25 lb Echo 90DF 1.5–2.125 pt Echo Zn, Equus 500 Zn	7 7 7 7	Start sprays when transplants are set in the field. Do not exceed 18.0 lb ai/a chlorothalonil per season.
	chlorothalonil *(7-day spray schedule)*	2.0–3.0 pt Bravo Weather Stik, Echo 720, Equus 720 1.8–2.7 lb Bravo Ultrex 82.5WDG, Equus DF 1.6–2.5 lb Echo 90DF 3.0–4.25 pt Echo Zn, Equus 500 Zn	7 7 7 7	Start sprays when transplants are set in the field. Do not exceed 18.0 lb ai/a chlorothalonil per season.
	cyprodinil + fludioxonil	11.0–14.0 oz Switch 62.5WG	0	Do not apply more than 56.0 oz/a product per year. After 2 applications, alternate with another fungicide with a different mode of action.
	chlorothalonil *(seedbed)*	1.5–2.0 pt/100 gal Bravo Weather Stik, Echo 720, Equus 720 1.4–1.8 lb/100 gal Bravo Ultrex 82.5WDG, Equus DF		For seedbeds, apply 125 gal of spray suspension weekly or as needed for control.

(continued)

Disease control in celery *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cercospora, Septoria, Alternaria *(cont.)*	fenamidone	5.5–8.2 fl oz Reason 500 SC	2	Do not apply more than 24.6 fl oz/a per season. Do not make more than 1 application of Reason without alternating to an effective fungicide with a different mode of action.
	fluopyram + trifloxystrobin	4.0–5.8 fl oz Luna Sensation	7	Follow resistance management guidelines on label.
	fluoxastrobin	5.7 fl oz Aftershock, Evito 480 SC	3	Alternate every QoI fungicide application with at least 1 application of another effective fungicide with a different mode of action.
	flutriafol + azoxystrobin	6.0–8.0 fl oz TopGuard EQ	7	Follow resistance management guidelines on label.
	fluxapyroxad + pyraclostrobin	4.0–11.0 fl oz Merivon Xemium	1	Do not make more than 3 applications per acre per year.
	penthiopyrad	14.0–24.0 fl oz Fontelis	3	Do not apply more than 2 sequential applications of Fontelis before alternating to an effective fungicide with a different mode of action. Do not exceed 72.0 fl oz/a per year.
	propiconazole	4.0 fl oz AmTide Propiconazole 41.8% EC, Bumper 41.8 EC, Fitness, Propicure 3.6F, PropiMax EC, Topaz, Willowood Propicon 3.6EC	14	Do not exceed 16.0 fl oz/a per season. Apply when conditions exist for disease development.
		4.0 fl oz Tilt 41.8% EC	14	Do not apply more than 16.0 fl oz/a in 4 applications per season. Consult the label for crop rotation (plantback) restrictions.
	pydiflumetofen + fludioxonil	9.2–13.4 fl oz Miravis Prime	0	Follow resistance management guidelines on label.
	trifloxystrobin	2.0–3.0 oz Flint, Gem 500 SC	7	Do not apply more than 12.0 oz/a per season. Do not apply more than four times per season.
Damping-off	mefenoxam	1.0–2.0 pt Ridomil Gold SL 2.0–4.0 pt Ultra Flourish	— —	Preplant-incorporated application or surface application at planting. Preplant to top 2 inches of soil.
		0.085–0.64 fl oz Apron XL/100 lb seed	—	Follow manufacturer's directions. Do not use treated seed for feed or food.
	mefenoxam + azoxystrobin	0.34 fl oz Uniform/1,000 ft row	—	Preplant application as an in-furrow spray in a minimum of 5 gal of water per acre at planting.
	metalaxyl	4.0–8.0 pt MetaStar 2E AG	—	Preplant-incorporated application or surface application at planting. Preplant to top 2 inches of soil.
		0.7 fl oz/100 lb seed Sebring 2.65 ST 0.75 fl oz/100 lb seed Allegiance FL, Metalaxyl 265 ST	— —	Follow manufacturer's directions. Do not use treated seed for feed or food.
	metam-sodium	Vapam HL, Metam, Sectagon 42		Use disease-free soil. Use steam or chemicals to sterilize contaminated soil.
Rhizoctonia root rot	azoxystrobin	0.4–0.8 fl oz Quadris Flowable/1,000 ft row	0	Use at planting. Follow manufacturer's directions.

Insect control in celery

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids	0.038–0.075 lb acetamiprid	2.0–4.0 oz Assail 30SG	7	Begin treatment when thresholds are reached. Apply every 7 days as needed. Do not exceed 5 applications or 0.375 lb ai/a per season.
	0.035–0.075 lb acetamiprid	0.8–1.2 oz Assail 70WP	7	
	0.088–0.133 lb cyantraniliprole	13.5–20.5 fl oz Exirel	1	Minimum application interval between treatments is 5 days. Do not apply a total of more than 0.4 lb ai/a of cyazypyr or cyantraniliprole-containing products.
	0.088 lb cyantraniliprole + 0.019 lb abamectin	10.0 fl oz *Minecto Pro	7	Minimum application interval of 7 days. Maximum annual rate of 20.0 fl oz/a per calendar year (0.18 lb ai/a of cyantraniliprole and 0.038 lb ai/a of abamectin). Do not apply more than 0.4 lb ai/a per calendar year of cyantraniliprole-containing products including all application types (seed treatment, soil, foliar). Do not apply more than 0.056 lb ai/a per calendar year of abamectin-containing products including all application types (seed treatment, soil, foliar).
	0.062–0.089 lb flonicamid	2.0–2.8 oz Beleaf SG	0	Begin applications before aphid populations build. Do not exceed 2.8 oz/a Beleaf per application and do not apply more than 8.4 oz/a (0.267 lb ai/a) per season.
	flupyradifurone	10.5–12.0 fl oz Sivanto	1	Foliar application. Apply when pests reach or exceed established thresholds. Do not apply more than 28.0 fl oz of Sivanto per acre per crop season.
	0.25–0.37 lb imidacloprid	7.0–10.5 fl oz AdmirePro 4.6F 16.0–24.0 fl oz (several formulations) 2F	21	Apply via chemigation into the root zone, as an in-furrow spray at-planting on or below the seed, or as a post-seeding or transplant drench.
	0.06–0.08 lb spirotetramat	4.0–5.0 fl oz Movento	1	Do not apply more than 10.0 fl oz/a Movento (0.16 lb ai/a) per season.
	0.063–0.078 lb spirotetramat + 0.022–0.027 lb pyriproxifen	8.0–10.0 fl oz/a Senstar	14	Do not apply more than 10 fl oz of Senstar Insecticide (0.078 lb spirotetramat and 0.027 lb pyriproxyfen) per acre per application. Do not make more than 2 applications per crop season. Do not apply more than 20 fl oz of Senstar Insecticide (0.156 lb spirotetramat and 0.055 lb pyriproxyfen) per acre per crop season. Minimum interval between applications is 14 days. Regardless of formulation do not apply more than 0.16 lb spirotetramat and 0.134 lb pyriproxyfen per acre per crop season.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.

*Restricted-use pesticide.

(continued)

Insect control in celery *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids *(cont.)*	0.17–0.21 lb tolfenpyrad	17.0–21.0 fl oz Torac	1	Do not apply until at least 14 days after emergence or after transplanting to allow time for root establishment. This period of time should be extended if conditions at time of emergence or transplanting are not favorable to crop growth. Apply by ground only, using a minimum of 20 gallons of water per acre. Do not apply more than 42.0 fl oz (0.42 lb ai) per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow at least 14 days between applications. Do not make more than 4 applications per year.
	0.014–0.025 lb zeta-cypermethrin	2.24–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.
Aster leafhopper	*Treat celery when the aster yellows index reaches 35. (See "Aster Yellows Index" on page 16 for calculations.)*			
	0.033–0.10 lb bifenthrin	2.1–6.4 oz *Brigade 2EC	7	Do not exceed 0.5 lb (32.0 fl oz formulated product) ai/a per season. Wait at least 7 days between applications.
	0.25–0.37 lb imidacloprid	7.0–10.5 fl oz AdmirePro 4.6F 16.0–24.0 fl oz (several formulations) 2F	21	Apply via chemigation into the root zone, as an in-furrow spray at-planting on or below the seed, or as a post-seeding or transplant drench.
	0.045–0.9 lb methomyl	1.5–3.0 pt *Lannate LV	7	Repeat applications as necessary up to a total of 8 times per crop. Do not exceed 21.0 pt/a per year.
	0.05–0.2 lb permethrin	2.0–8.0 oz *Permethrin 3.2EC	1	Do not exceed 40.0 oz ai/a per season.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	0.014–0.025 lb zeta-cypermethrin	2.24–4.0 oz *Mustang Maxx	1	Do not exceed 0.15 lb ai/a. Apply every 7 days as needed. Use higher rate for heavy infestations.
Cutworms	*If more than 4 weeks before harvest, treat if you see eggs or larvae. Within 4 weeks of harvest, preventively treat approximately weekly.*			
	0.03–0.045 lb flubendiamide	2.0–3.0 oz Synapse WG	1	Do not apply more than 3.0 oz/a (0.045 lb ai/a) in a 7-day period or exceed 9.0 oz/a per season.
	0.1–0.2 lb permethrin	4.0–8.0 oz *Permethrin 3.2EC	1	Do not exceed 40.0 oz ai/a per season.
	0.014–0.025 lb zeta-cypermethrin	2.24–4.0 oz *Mustang Maxx	1	Do not exceed 0.15 lb ai/a. Apply every 7 days as needed. Use higher rate for heavy infestations.
Leafminers	0.009–0.019 lb abamectin	8.0–16.0 fl oz *Agri-Mek 0.15EC	7	
	chlorantraniliprole	3.5–7.5 fl oz Coragen	1	Do not make more than 4 applications per crop season and allow at least 3 days between applications. Do not apply more than 15.4 fl oz/a Coragen per season.
	0.049–0.088 lb cyantraniliprole + 0.01–0.019 lb abamectin	5.5–10.0 fl oz *Minecto Pro	7	Minimum application interval of 7 days. Maximum annual rate of 20.0 fl oz/a per calendar year (0.18 lb ai/a of cyantraniliprole and 0.038 lb ai/a of abamectin). Do not apply more than 0.4 lb ai/a per calendar year of cyantraniliprole-containing products including all application types (seed treatment, soil, foliar). Do not apply more than 0.056 lb ai/a per calendar year of abamectin-containing products including all application types (seed treatment, soil, foliar).

*Restricted-use pesticide.

(continued)

Insect control in celery *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Leafminers *(cont.)*	0.12 lb cyromazine	2.66 oz Trigard 75WP	7	
	0.045–0.268 lb dinotefuran	*foliar:* 1.0–3.0 oz Venom 70SG *soil:* 5.0–6.0 oz Venom 70SG	7 —	Use only one application method. See product label for application directions. **Foliar applications:** Do not exceed 4.5 oz/a per year. **Soil applications:** Do not follow soil application with foliar treatment of any other neonicotinoid insecticide. Do not exceed 6.0 oz/a per season.
	0.05–0.13 lb dinotefuran *(foliar)*	2.0–5.25 oz Scorpion 35SL	1	Can repeat at 7-day intervals. Do not apply more than 10.5 oz per year. Use only one application method.
	0.23–0.27 lb dinotefuran *(soil)*	9.0–10.5 oz Scorpion 35SL	21	Do not apply more than 21.0 oz per year. Use only one application method.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	0.063–0.078 lb spirotetramat + 0.022–0.027 lb pyriproxifen	8.0–10.0 fl oz Senstar	14	Do not apply more than 10 fl oz of Senstar Insecticide (0.078 lb spirotetramat and 0.027 lb pyriproxyfen) per acre per application. Do not make more than 2 applications per crop season. Do not apply more than 20 fl oz of Senstar Insecticide (0.156 lb spirotetramat and 0.055 lb pyriproxyfen) per acre per crop season. Minimum interval between applications is 14 days. Regardless of formulation do not apply more than 0.16 lb spirotetramat and 0.134 lb pyriproxyfen per acre per crop season.
Loopers	*If more than 4 weeks before harvest, treat if you find two or more larvae per 100 plants; within 4 weeks of harvest, preventative cutworm treatments should provide control.*			
	0.974 lb acephate	1.0 lb Orthene 97 1.0 lb Acephate 97UP	21	Do not use tops for food or feed. Do not apply more than 2.0 lb ai/a per season.
	Bacillus thuringiensis subsp. *kurstaki*	1.0–2.0 lb Lepinox WDG	0	Treat early instar larvae before noticeable feeding damage occurs. Repeat treatment as needed.
		Biobit, Cutlass WP, DiPel DF, Javelin WG	0	See label for rate.
	beta-cyfluthrin	2.4–3.2 fl oz *Baythroid XL	0	Maximum Baythroid XL allowed per 7-day interval is 3.2 fl oz/a and season total allowed per crop season is 12.8 fl oz/a.
	chlorantraniliprole	3.5–7.5 fl oz Coragen	1	Do not make more than 4 applications per crop season and allow at least 3 days between applications. Do not apply more than 15.4 fl oz/a Coragen per season.
	0.066–0.088 lb cyantraniliprole + 0.014–0.019 lb abamectin	7.5–10.0 fl oz *Minecto Pro	7	Minimum application interval of 7 days. Maximum annual rate of 20.0 fl oz/a per calendar year (0.18 lb ai/a of cyantraniliprole and 0.038 lb ai/a of abamectin). Do not apply more than 0.4 lb ai/a per calendar year of cyantraniliprole-containing products including all application types (seed treatment, soil, foliar). Do not apply more than 0.056 lb ai/a per calendar year of abamectin-containing products including all application types (seed treatment, soil, foliar).

*Restricted-use pesticide.

(continued)

Insect control in celery *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Loopers *(cont.)*	0.0075–0.015 lb emamectin benzoate	3.2–4.8 oz *Proclaim	7	Apply when larvae first appear. Use higher rate for larger larvae or severe outbreaks. Do not exceed 28.8 oz/a per season. Highly toxic to bees.
	0.03–0.045 lb flubendiamide	2.0–3.0 oz Synapse WG	1	Do not apply more than 3.0 oz/a (0.045 lb ai/a) in a 7-day period or exceed 9.0 oz/a per season.
	0.9 lb methomyl	3.0 pt *Lannate LV	7	Repeat treatment as necessary up to 8 times per crop. Do not exceed 21 pt ai/a per year.
	0.06–0.16 lb methoxyfenozide	10.0 oz Intrepid 2F	1	Apply 4.0–8.0 oz only for early applications use higher rates for heavy infestations. Do not exceed 64.0 oz/a.
	0.05–0.2 lb permethrin	2.0–8.0 oz *Permethrin 3.2EC	1	Do not exceed 40.0 oz ai/a per season.
	0.039–0.078 lb spinetoram	5.0–10.0 fl oz Radiant SC	1	Do not apply more than 34.0 fl oz/a or make more than 6 applications per year. Do not exceed 2 consecutive applications.
	spinosad	3.0–6.0 fl oz Entrust SC	1	Use higher rate for larger larvae. Apply in adequate spray volume to get good coverage for best control. Do not exceed 0.45 lb ai/a per season. Do not apply to seedlings grown for transplant.
	0.6–0.75 lb thiodicarb	24.0–30.0 fl oz Larvin F	14	Do not exceed 1.5 lb ai/a per season.
	0.02–0.025 lb zeta-cypermethrin	3.2–4.0 oz *Mustang Maxx	1	Do not exceed 0.15 lb ai/a. Apply every 7 days as needed. Use higher rate for heavy infestations.
Tarnished plant bug	*For plants shorter than 4 inches, treat if you find at least 20 insects per 20 plants. For plants taller than 4 inches, treat if you find four or more plant bugs per 20 plants if there are more than 3 weeks until harvest; within 3 weeks of harvest, treat if you find two insects per 20 plants.*			
	1.0–2.0 lb carbaryl	1.0–2.0 qt Sevin XLR Plus	7	Do not apply within 7 days of harvest. Do not exceed 6.0 qt ai/a per year. Do not apply when crop or nearby weeds are in bloom.
	0.062–0.089 lb flonicamid	2.0–2.8 oz Beleaf SG	0	Begin applications before aphid populations build. Do not exceed 2.8 oz/a Beleaf per application and do not apply more than 8.4 oz/a (0.267 lb ai/a) per season.

*Restricted-use pesticide.

Weed control in celery

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	0.095 lb flumioxazin	3.0 oz Chateau SW or Tuscany or 3.0 fl oz Tuscany SC		May be applied pretransplant or between 3 and 7 days following transplanting. Do not use an adjuvant or apply as part of a tank mix. Do not apply more than 3.0 oz/a per application or growing season.
	linuron	Lorox DF *(use and rate vary by soil type—see label)*	45	Make a single post-transplant application after celery is established but less than 8 inches tall. Apply before broadleaf weeds are 6 inches tall or grassy weeds exceed 2 inches. Do not tank mix with surfactants, fertilizer, or other pesticide. Do not use on sand or loamy sand. Do not use on soils with less than 1% organic matter.
	1.9 lb pendimethalin	4.0 pt Prowl H_2O	60	Apply postemergence one or more days after transplanting. Celery must have established roots and plants regained full turgidity before application. Do not apply more than 4.0 pts of Prowl H_2O per acre in a single application or 8.0 pts per acre in a year. Sequential applications must be separated by a minimum of 21 days.

(continued)

Weed control in celery *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds *(cont.)*	prometryn	Caparol 4L *(use and rate vary—see label)*	40	May be applied to direct-seeded or transplanted celery either preemergence or postemergence (but not both) per crop. A split postemergence application may be made in transplanted celery only, not to exceed a seasonal maximum of 4.0 pt/a. When applying postemergence, do not tank mix with other pesticides. Apply before weeds are 2 inches tall. Use only on fine-textured soils. Do not disturb the soil following treatment.
	0.11 lb pyroxasulfone	3.25 fl oz Zidua SC		Apply 1–6 days following transplant after bed has settled to ensure good row closure. Only apply to transplanted celery grown on muck or peaty soils with greater than 20% organic matter. Before applying to celery, verify the selectivity of Zidua on your variety to avoid potential injury.
	trifluralin	several manufacturers		May be applied before, during, or immediately after direct-seeding or transplanting celery. Controls annual grasses and some broadleaves, but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Rate varies with soil texture and organic matter. Follow recommended soil preparation, application, and incorporation procedures. Must be incorporated within 24 hours. See label for plantback restrictions. Ineffective on peat or muck soils.
Annual grasses	5.0–6.0 lb bensulide	5.0–6.0 qt Prefar 4E		Apply before planting and incorporate 1–2 inches deep to avoid loss due to volatilization. Use on mineral soils only.
Emerged weeds	glyphosate	several manufacturers and formulations		See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. Glyphosate may be applied any time before crop emerges. Apply before crop seed germination in coarse sandy soils. If weeds have been mowed or tilled, do not treat until they have resumed active growth and reached the recommended stage on the label. Unless otherwise stated, allow 7 or more days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified.
Emerged grasses	0.068–0.12 lb clethodim	9.0–16.0 oz Select Max	30	Apply to actively growing grasses. Repeat treatments may be made at 14-day intervals up to the maximum annual use rate. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by label. Do not apply if rain is expected within 1 hour.
	clethodim	several manufacturers and formulations	30	
	0.094-0.25 lb fluazifop-p-butyl	6.0-16.0 fl oz Fusilade DX	14	Make postemergence application to actively growing grasses; check label for size range, treatement rate, and appropriate spray additive. Do not apply more than 16.0 fl oz/a Fusilade DX per application or more than a total of 32.0 fl oz/a Fusilade DX per season. Maintain a minimum of 14 days between applications.
	0.094–0.28 lb sethoxydim	0.5–1.5 pt Poast	30	Make postemergence applications to actively growing grasses within the size ranges indicated on the label. Check the label for early and rescue treatment rates. Do not apply more than 3.0 pt/a Poast in one crop season. Consult label for rate and adjuvant instructions for specific weeds. Check the label for additional precautions and restrictions.

Cole crops: broccoli, brussels sprouts, cabbage, cauliflower

Cauliflower is relatively difficult to grow compared to cabbage. Failure to head properly and poor curd quality are common problems. Curds need to be protected from sunlight to ensure good color and quality. For success, cauliflower needs a fertile, moist soil relatively high in organic matter and nitrogen. Good soil drainage and a cool, humid climate are essential. If producing cauliflower on a light-textured soil, it must be irrigated to keep moisture continuously available to the crop. Broccoli and brussels sprouts are not as exacting in their requirements as cauliflower and, therefore, can be produced over a wider range of soil and climatic conditions. Cabbage is the most easily grown of the cole crops. It is adaptable but does best under a temperate climate, ample moisture, and good fertility with a relatively high nitrogen supply.

Planting

From mid-April through mid-June. Cole crops grow best on well-drained, fertile, loam soils with adequate organic matter. Sandy loams are better for early crops. Harrow to control weeds. Do not overwork seedbed.

Transplants

Plant spacing	Between rows (in.)	Between plants (in.)
Broccoli and cauliflower	18–36	12–24
Brussels sprouts	24–30	12–18
Cabbage	24–36	12–24

Transplants: 8,300–29,000/a; depends upon row spacing, variety, soil fertility, pest control methods, irrigation, crop use, and harvesting.

Direct seeding

Plant no deeper than 1/2 inch. Use size-graded seed and select size to fit planter.

Single seeding

Plant single seed 3–4 inches apart. After emergence, remove excess plants by thinning.

Cluster seeding

Plant three seeds per cluster, spacing seed 2 inches apart. Thin to remove all but one plant per cluster. Thin when plants are 2 inches high.

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 6.0 or higher on mineral soils and 5.6 on organic soils.

Fertilizer rates: Determine fertilizer needs by soil test. Use annual nitrogen, P_2O_5, and K_2O recommendations in table on next page. Take credits for previous legume crops and manure.

Application: Broadcast and work in fertilizer before planting.

Nitrogen: Apply preplant or sidedress early in growing season. On sandy soils, split the nitrogen into two or more applications during the season. Excessive nitrogen can promote tipburn occurrence in susceptible cabbage varieties.

Micronutrients: Cole crops have relatively high or medium boron requirements and medium requirements for copper and manganese. Use soil and plant analyses to check for deficiencies of these nutrients. If boron soil test is very low (VL) or low (L), apply 2–3 lb/a of boron with fertilizer each year cauliflower is grown and 1–2 lb/a of boron for each broccoli, cabbage, or brussels sprouts crop. Omit these applications if the boron soil test is in the excessively high (EH) range. Apply 1–3 lb Mn/a or 1–12 lb Cu/a, depending on soil and application method.

Annual nitrogen, phosphate, and potash recommendations for cole crops

Crop	Nitrogen: Organic matter (%)	Nitrogen: Amount to apply (lb/a)	Phosphate and potash: Yield goal (t/a)	Phosphate and potash: Amount P_2O_5 to apply* (lb/a)	Phosphate and potash: Amount K_2O to apply* (lb/a)
Broccoli	<2	100	4–6	10	20
	2.0–9.9	80			
	10–20	60			
	>20	25			
Brussels sprouts	<2	100	4–6	15	45
	2.0–9.9	80			
	10–20	60			
	>20	25			
Cabbage	<2	180	8–12	15	70
	2.0–9.9	140	12.1–20	25	115
	10–20	100	20.1–30	40	180
	>20	40	30.1–40		
Cauliflower	<2	120	6–8	20	50
	2.0–9.9	100			
	10–20	80			
	>20	40			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Disease control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Alternaria leaf spot	azoxystrobin	6.0–15.5 fl oz Aframe, AzoxyStar, Equation, Quadris Flowable, Satori, Willowood Azoxy 2SC	0	Equation, Quadris, Satori, and Cabrio belong to the Group 11 (strobilurin) fungicide category. Do not exceed 1 application of any of these products before alternating with a fungicide having a different mode of action. Do not exceed 3 applications of strobilurin fungicides per crop per year. Do not exceed 1.44 qt/a Equation, Quadris Flowable, or Satori, or 64.0 oz/a Cabrio per crop per season.
	pyraclostrobin	12.0–16.0 oz Cabrio EG	0	
	azoxystrobin + difenoconazole	12.0–14.0 fl oz Quadris Top	1	Do not apply more than 56.0 fl oz/a per year. Make no more than 1 application before alternating to a non-strobilurin fungicide. Follow resistance management guidelines.
	azoxystrobin + flutriafol	5.0–8.0 fl oz TopGuard EQ	7	See label for fungicide resistance management strategies.
	boscalid	6.0–9.0 oz Endura WDG	0	Endura belongs to the Group 7 fungicide category. Do not exceed 1 application of Endura before alternating to a labeled fungicide with a different mode of action. Do not exceed 2 applications or 18.0 oz/a Endura per season.
	cyprodinil + difenoconazole	16.0–20.0 fl oz Inspire Super	7	Begin application prior to disease onset. Apply on a 7- to 10-day interval. Make no more than 2 sequential applications before alternating to a fungicide with a different mode of action.

(continued)

Disease control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Alternaria leaf spot *(cont.)*	cyprodinil + fludioxonil	11.0–14.0 Switch 62.5WG	7	Do not apply more than 56.0 fl oz/a per year. Make no more than 2 applications before alternating to an effective fungicide with a different mode of action. Follow resistance management guidelines.
	fludioxonil	5.5–7.0 fl oz Spirato GHN	7	See label for fungicide resistance management strategies.
	fludioxonil + pydiflumetofen	11.4 fl oz Miravis Prime	7	See label for fungicide resistance management strategies.
	flutriafol	5.0–7.0 fl oz Rhyme	7	Do not apply more than 4 applications per year. Re-entry interval of 12 hours. Follow resistance management guidelines.
	fluxapyroxad + pyraclostrobin	6.0–8.2 fl oz Priaxor Xemium	3	Make no more than 3 applications per season. Follow resistance management guidelines.
	mancozeb	2.0 lb Dithane M45	7	Do not apply more than 12.0 lb/a product. Minimum re-treatment period is 7 days. For broccoli and cabbage.
	penthiopyrad	14.0–30.0 fl oz Fontelis	0	Do not apply more than 2 sequential applications of Fontelis before alternating to an effective fungicide with a different mode of action. Do not exceed 72.0 fl oz/a per year.
	trifloxystrobin	3.0–3.8 fl oz Flint Extra	0	See label for fungicide resistance management strategies.
	triflumizole	6.0–8.0 fl oz Procure 480SC	1	Do not apply more than 18.0 fl oz/a Procure per season. Use higher rates for higher disease pressure.
Alternaria leaf spot and downy mildew	chlorothalonil	1.5 pt Bravo Weather Stik, Echo 720, Equus 720 1.4 lb Bravo Ultrex 82.5WDG, Equus DF 1.25 lb Echo 90DF	7 7 7	Apply as foliar spray when conditions favor disease. Do not apply more than 11.7 pt/a (8.8 lb ai/a) during one season.
	fenamidone	5.5–8.2 fl oz Reason (rate for downy mildew)	2	Do not apply more than 24.6 fl oz per season. Do not use Reason more than one time before alternating to a fungicide of a different resistance management group.
	fluopyram + trifloxystrobin	5.0–7.6 fl oz Luna Sensation	0	Follow label for resistance management strategies.
	mancozeb	1.6–2.1 lb Koverall, Manzate Pro-Stick 2.0 lb Dithane M45	7 7	Do not apply more than 12.8 lb/a. For broccoli and cabbage.
	mefenoxam/ chlorothalonil	1.5 lb Ridomil Gold Bravo	7	Consult the label for crop rotation restrictions before using this product. You may make up to 4 applications of Ridomil Gold Bravo per crop per season.
Black rot (bacterial), **blackleg** (fungal)	❑ *Use seed grown in western United States.* ❑ *Use hot water seed treatment (details below).* ❑ *Use plant bed sanitation.* ❑ *Do not use compost from diseased plants or manure from animals that have eaten diseased plants.* ❑ *Use care in purchase and handling of plants.* ❑ *Rotate crops (3-year rotation).* ❑ *Select black-rot resistant cultivars.* ❑ *Use disease-free soil or treat soil with an approved soil fumigant.* Hot water seed treatment: *Place the seed in a mesh bag and dip it into water heated to 122˚F. Treat cauliflower and broccoli seed for 20 minutes; treat cabbage and brussels sprouts seeds for 25 minutes. Transfer the bag to cold water immediately to cool the seed. There will be some reduction in the germination rate of treated seed. You may wish to sow additional seed to compensate.*			
	fixed coppers	various: Champ WG, Champ Formula 2, Kocide 2000, Kocide 3000	0	Spraying with copper fungicides can be expected to reduce spread in field. However, in some instances application may cause black spots on outer leaves.

(continued)

Disease control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Clubroot	cyazofamid	*transplant soil drench:* 12.9–25.75 fl oz/100 gal Ranman *soil incorporation:* 20.0 fl oz Ranman	0	Do not apply more than 39.5 fl oz/a Ranman per year. See label for specific transplant and soil incorporation specifications.
	fluazinam	*transplant:* 6.45 fl oz/100 gal Omega 500F *soil incorporation:* 2.6 pt Omega 500F	20 (leafy greens) 50 (cabbage, broccoli)	**Transplant:** Soil drench immediately after transplanting. Apply Omega in transplant water. **Soil incorporation:** Apply in a 9-inch band along the planting row and incorporate 6–8 inches. This product may cause a delay in the start of harvest by up to 8 days, cause stunting, and shorten the length of harvest with no impact on final yield.
	PCNB	2.0–6.0 lb PCNB 75% WP/100 gal transplant water; use 0.5–0.75 pt/plant		Add hydrated lime in spring to reach a soil pH of 7.2. PCNB may also be applied as a band or broadcast.
		3.0 pt/100 gal water, 5.87 gal/a/apply in 25 gal of water/a Blocker 4F	—	May be applied as a transplant solution, banded application, or broadcast application.
Downy mildew *(see also* **Alternaria leaf spot and downy mildew)**	ametoctradin + dimethomorph	14.0 fl oz Zampro	0	Do not make more than 3 applications per season.
	dimethomorph	6.0 oz Forum	0 (leafy greens) 7 (cabbage, broccoli)	Must be applied as a tank mix with another fungicide that has a different mode of action. Do not exceed 30.0 oz/a per growing season.
	fluopicolide	3.0–4.0 fl oz Presidio	2	Tank mix with another labeled fungicide of a different mode of action on the target pathogen to manage resistance.
	mandipropamid	8.0 fl oz Revus	1	Do not apply more than 2 consecutive applications of this product before switching to another effective non–Group 40 fungicide. Do not exceed 32.0 fl oz/a of product per season.
	mono- and dipotassium salts of phosphorous acid	1.25 qt in 25 gal water/a to 2.5 qt in 250 gal water/a Alude 2.5–5.0 pt Phostrol	0	Apply at 1- to 3-week intervals. Use higher rates and shorter intervals when disease pressure increases.
	oxathiapiprolin	2.0–4.8 fl oz Orondis Ultra A	0	Make no more than 2 sequential applications before rotating to a fungicide with a different mode of action. Do not exceed 19.2 fl oz/a per year. Begin foliar applications prior to disease development and continue on a 5- to 14-day interval.
Internal tipburn	*Avoid overfertilizing, especially with nitrogen. Plant tolerant or resistant cultivars. If you find tipburn, harvest crop before full maturity to reduce losses.*			
Pythium damping-off	mefenoxam	0.085–0.64 fl oz Apron XL/100 lb seed	—	If a seed treatment is utilized, do not apply this active ingredient again as an in-furrow, at-plant treatment.
		0.25–0.50 pt Ridomil Gold SL 0.5–1.0 pt Ultra Flourish	— —	Preplant-incorporated application or surface application at planting. Incorporate in top 2 inches. For banded applications, a 7-inch band is recommended.
	metalaxyl	0.75–1.5 fl oz Acquire/100 lb seed 0.75 fl oz Allegiance-FL/100 lb seed 0.5–1.0 fl oz Sebring 480 FS/100 lb seed	— — —	Label includes most cole crops, including cabbage, broccoli, brussels sprouts, and cauliflower.

(continued)

Disease control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Pythium damping-off *(cont.)*		4.0–8.0 pt MetaStar 2E	—	Broadcast, soil-incorporated, or banded applications.
Rhizoctonia basal stem and root rot, wirestem	azoxystrobin	0.4–0.8 fl oz Quadris Flowable/1,000 ft row	0	Use at planting. Follow manufacturer's directions.
	flutolanil	1.1 lb Moncut		Make 1 application per acre to the row of planting as an in-furrow treatment or as a directed spray at the base of transplants. Use a minimum of 3 gal of spray volume per acre.
	PCNB	15.0–20.0 lb Blocker 75% WP in 50 gal water/a or 1.0 level tablespoon/gal water/50 sq ft of seedbed 2.8–3.75 gal Blocker 4F in 50 gal water/a		Broadcast drench application.
Seed rot	*Maintain a disease-free plant bed and use sanitation measures listed for black rot.*			

Insect control

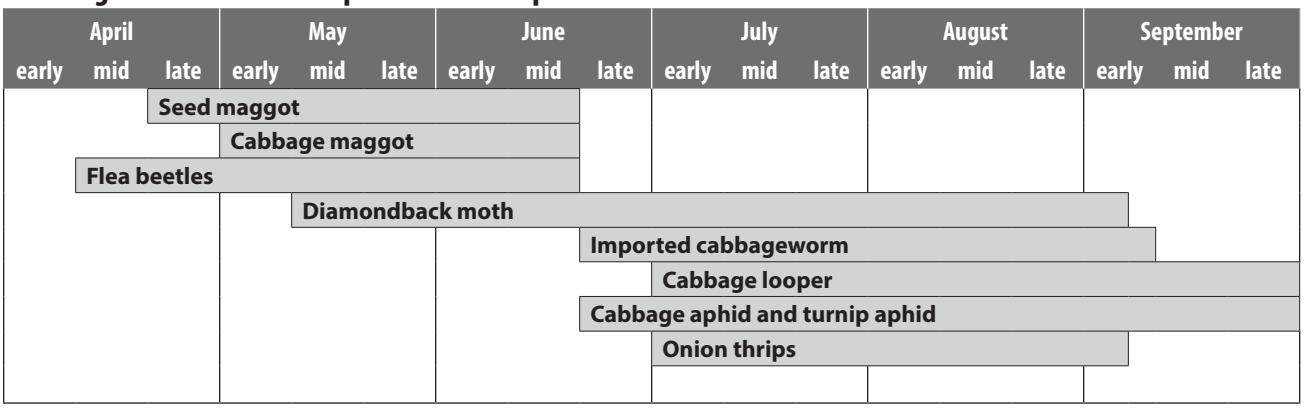
Caterpillars cause varying amounts of damage depending on the maturity of the plant, so thresholds change as the crop grows through the different developmental stages (see following table). The three caterpillars—imported cabbage worm, cabbage looper, and diamondback moth larvae—are considered together as a single caterpillar complex. Weekly crop scouting and treatment based on larval infestation threshold levels provides the most effective management of this pest complex. To monitor, walk along a W-shaped path through the field and examine randomly-selected plants every few yards; examine 25–50 plants, depending on the field size, and record the percentage of infestation. A plant is infested if the eggs or caterpillars of any species are present.

Treatment thresholds for the caterpillar complex on major cole crops

Crop	Growth stage	Threshold (% infestation)
Cabbage	Seedbed	10
	Transplant to cupping	30
	Cupping to early head	20
	Mature head	10
Broccoli	Seedbed	10
	Transplant to first flower	50
	Flower bud to harvest	10
Cauliflower	Seedbed	10
	Transplant to first curd	50
	Curd present	10

Note: Diamondback moths have developed resistance to insecticides and Bt in areas of the southern United States. Be cautious when using transplants from the South, which may harbor this insect. Bt resistance has been found only in southern Florida so far.

Scouting calendar for insect pests of cole crops



Insect control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest**	Remarks and suggestions
Cabbage aphid	*Natural enemies will often eliminate this insect, especially if* Bacillus thuringiensis *(which does not kill beneficial insects) is used for caterpillar control. Treat broccoli and cauliflower before heading if there are more than 100 aphids per plant; after heading, treat if there are more than 5 aphids per plant. Treat cabbage if 1–2% of the plants are infested.*			
	0.038–0.075 lb acetamiprid	2.0–4.0 oz Assail 30SG	7	Begin treatment when thresholds are reached. Apply every 7 days as needed. Do not exceed 5 applications or 0.375 lb ai/a per season.
	0.035–0.075 lb acetamiprid	0.8–1.2 oz Assail 70WP	7	
	alpha-cypermethrin	3.2–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	azadirachtin	16.0–32.0 oz Aza-Direct 10.0–16.0 oz Azatin XL 4.0–10.0 oz Neemix 4.5	0	Apply at 7-day intervals when pests first appear. May treat heavy infestations every 7–10 days.
	0.033–0.10 lb bifenthrin	2.1–6.4 oz *Brigade 2EC	7	Do not exceed 0.5 lb (32.0 fl oz formulated product) ai/a per season. Wait at least 7 days between applications.
	0.06–0.095 lb bifenthrin + imidacloprid	3.8–6.1 fl oz *Brigadier	7	Do not apply more than 30.72 fl oz/a (0.48 lb ai/a) per season. A total of 0.24 lb ai/a imidacloprid and 0.5 lb ai/a bifenthrin allowed per season.
	clothianidin	*foliar:* 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		soil: 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a sidedress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.

*Restricted-use pesticide.

(continued)

**Where ranges are given, check product label for specific number of days between insecticide application and harvest of a particular crop.

Insect control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest**	Remarks and suggestions
Cabbage aphid *(cont.)*	0.088–0.176 lb cyantraniliprole *(soil)*	6.75–13.5 fl oz Verimark	—	Do not apply more than 13.5 fl oz/a Verimark per crop per season. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6. Minimum application interval between foliar sprays is 5 days.
	0.088–0.133 lb cyantraniliprole *(foliar)*	13.5–20.5 fl oz Exirel	1	
	0.25–0.5 lb diazinon	several formulations	5–14	
	0.045–0.268 lb dinotefuran	*foliar:* 1.0–4.0 oz Venom 70SG *soil:* 5.0–6.0 oz Venom 70SG	21	Do not follow applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 12.0 oz/a per season using soil applications. See product label for application directions.
	0.2–0.3 lb fenpropathrin	10.66–16.0 fl oz *Danitol 2.4EC	7	For use on brussels sprouts and cauliflower only. Treat when pests first appear. May repeat every 7 days as needed. Do not exceed 0.8 lb ai/a per season.
	0.062–0.089 lb flonicamid	2.0–2.8 oz Beleaf SG	0	Begin applications before aphid populations build. Do not exceed 2.8 oz/a Beleaf per application and do not apply more than 8.4 oz/a (0.267 lb ai/a) per season.
	flupyradifurone	7.0–12.0 fl oz Sivanto	1	Apply when pests reach or exceed established thresholds. Do not apply more than 28.0 fl oz of Sivanto per acre per crop season.
	0.0075–0.015 lb gamma-cyhalothrin	1.92–3.84 oz *Proaxis	1	For suppression only. Apply every 5 days as needed. Do not exceed 1.92 pt/a (0.12 lb ai/a) per season.
	imidacloprid	4.4–10.5 fl oz Admire Pro 3.75 fl oz Provado F	21 7–21	Also controls whitefly. Soil application. Apply Admire in a narrow band centered on the row. Treat within 14 days before planting. Apply Provado every 5 days as needed. Do not exceed 18.75 fl oz/a Provado per season and do not apply more than a total of 0.5 lb/a imidacloprid in any formulation.
	imidacloprid + beta-cyfluthrin	3.0 fl oz *Leverage 360	7	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	For suppression only. Do not use on brussels sprouts, kale, collards, chard, or mustard.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	3	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.24 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 7 days between applications.
	0.32–1.0 lb malathion	Malathion EC, WP, D	3–7	See label for rate.

*Restricted-use pesticide.

(continued)

**Where ranges are given, check product label for specific number of days between insecticide application and harvest of a particular crop.

Insect control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest**	Remarks and suggestions
Cabbage aphid *(cont.)*	1.0 lb naled	1.0 pt Dibrom 8E	1	Not for use on kale, collards, chard, or mustard.
	0.023 lb pymetrozine	2.75 oz Fulfill 50WDG	7	
	0.06–0.08 lb spirotetramat	4.0–5.0 fl oz Movento 2SC	7	Do not exceed 10.0 fl oz/a per season.
	0.047–0.078 lb spirotetramat + 0.016–0.027 lb pyriproxifen	6.0–10.0 fl oz/a Senstar	7	Do not apply more than 10 fl oz of Senstar Insecticide (0.078 lb spirotetramat and 0.027 lb pyriproxyfen) per acre per application. Do not make more than 2 applications per crop season. Do not apply more than 20 fl oz of Senstar Insecticide (0.156 lb spirotetramat and 0.055 lb pyriproxyfen) per acre per crop season. Minimum interval between applications is 14 days. Regardless of formulation do not apply more than 0.16 lb spirotetramat and 0.134 lb pyriproxyfen per acre per crop season.
	thiamethoxam	1.5–3.0 oz Actara 25WDG 5.0–11.0 fl oz Platinum 2SC 1.66–3.67 oz Platinum 75SG	5 30 30	Do not follow applications of Platinum with foliar applications of any other neonicotinoid insecticide. Platinum may be applied to direct seeded crops in-furrow at the seeding or transplant depth, or as a narrow surface band above the seedling and followed by irrigation. Do not apply more than 11.0 oz of Actara 25WDG or Platinum 2SC and no more than 3.67 oz Platinum 75SG per acre per crop season and apply sufficient water volume after in-ground application to ensure incorporation into the seed zone. Actara is applied as a foliar spray.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	0.17–0.21 lb tolfenpyrad	17.0–21.0 fl oz Torac	1	Do not apply until at least 14 days after emergence or after transplanting to allow time for root establishment. This period of time should be extended if conditions at time of emergence or transplanting are not favorable to crop growth. Apply by ground only, using a minimum of 20 gallons of water per acre. Do not apply more than 42.0 fl oz (0.42 lb ai) per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow at least 14 days between applications. Do not make more than 4 applications per year.
	zeta-cypermethrin	3.2–4.0 oz *Mustang Maxx	1	Apply every 7 days as needed. Use a minimum of 15 gal/a of finished spray. Do not exceed 24.0 oz/a Mustang Maxx per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	7	Do not apply more than 0.45 lb ai/a per season. Wait at least 7 days between applications.

*Restricted-use pesticide. *(continued)*

**Where ranges are given, check product label for specific number of days between insecticide application and harvest of a particular crop.

Insect control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest**	Remarks and suggestions
Cabbage maggot	0.04–0.08 lb bifenthrin	3.4–6.8 oz *Capture LFR	—	Apply as a 5- to 7-inch band over an open furrow or in-furrow with the seed. Do not apply more than 0.1 lb/a Capture LFR per season as an at-plant application.
	0.13–0.176 lb cyantraniliprole *(soil)*	10.0–13.5 fl oz Verimark	—	Do not apply more than 13.5 fl oz/a Verimark per crop per season. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6.
	0.125–0.25 lb diazinon	several formulations		Apply in transplant water. See label for rate.
	2.0–3.0 lb diazinon	several formulations		See label for rate. Broadcast and incorporate 3–4 inches deep before planting.
	imidacloprid + beta-cyfluthrin	3.0 fl oz *Leverage 360	7	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.
Caterpillar pests (imported cabbageworm, cabbage looper, diamondback moth larvae)	*Apply insecticides only when thresholds are exceeded (see treatment threshold table on page 86).*			
	0.974 lb acephate	1.0 lb Orthene 97	14	Do not exceed 2.0 lb ai/a per season. Do not feed trimmings to livestock or allow animals to graze treated areas.
	0.075 lb acetamiprid	4.0 oz Assail 30SG 1.7 oz Assail 70WP	7	To suppress diamondback moth.
	alpha-cypermethrin	3.2–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	Bacillus thuringiensis subsp. *aizawai*	1.0–2.0 lb Agree 0.5–1.5 lb Xentari	0	Use lower rate for light infestations and small larvae; use higher rate for heavy infestations and larger larvae.
	Bacillus thuringiensis subsp. *kurstaki*	Biobit, Cutlass, DiPel, Javelin, MVP, Thuricide, and others	0	Rates vary with formulation, check the label. Most effective against young larvae; use other insecticides if larvae are large. Does not kill beneficial insects.
		1.0–2.0 lb Lepinox WDG	0	Treat early instar larvae before noticeable feeding damage occurs. Repeat as needed.
	beta-cyfluthrin	1.6–3.2 fl oz *Baythroid XL	0	Maximum Baythroid XL allowed per 7-day interval is 3.2 fl oz/a and season total allowed per crop season is 12.8 fl oz/a.
	0.033–0.10 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	7	Do not exceed 0.5 lb (32.0 fl oz formulated product) ai/a per season. Wait at least 7 days between applications.
	0.06–0.095 lb bifenthrin + imidacloprid	3.8–6.1 fl oz *Brigadier	7	Do not apply more than 30.72 fl oz/a (0.48 lb ai/a) per season. A total of 0.24 lb ai/a imidacloprid and 0.5 lb ai/a bifenthrin allowed per season.
	chlorantraniliprole	3.5–7.5 fl oz Coragen	3	Do not make more than 4 applications per crop season and allow at least 3 days between applications. Do not apply more than 15.4 fl oz/a Coragen per season.
	0.065–0.13 lb cyantraniliprole *(soil)*	5.0–10.0 fl oz Verimark	—	Do not apply more than 13.5 fl oz/a Verimark per crop per season. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6. Minimum application interval between foliar sprays is 5 days.
	0.045–0.088 lb cyantraniliprole *(foliar)*	7.0–13.5 fl oz Exirel	1	

*Restricted-use pesticide.

(continued)

**Where ranges are given, check product label for specific number of days between insecticide application and harvest of a particular crop.

Insect control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest**	Remarks and suggestions
Caterpillar pests *(cont.)*	0.05–0.1 lb cypermethrin	2.5–5.0 fl oz *Ammo 2.5EC 1–2 bags *Ammo WSB	1	Cabbage only.
	0.0075–0.015 lb emamectin benzoate	2.4–4.8 oz *Proclaim	7	Use higher rate for loopers or larger larvae. Apply when larvae first appear and repeat as necessary for control. Do not exceed 28.8 oz/a per season. Highly toxic to bees.
	0.3–0.5 lb esfenvalerate	5.8–9.6 oz *Asana XL	3	Do not exceed 0.4 lb ai/a per season.
	0.2–0.3 lb fenpropathrin	10.66–16.0 fl oz *Danitol 2.4EC	7	Do not exceed 2.66 pt/a (42.7 oz/a) per season. Apply in spray volume of 25 to 50 gal/a. Adding non-ionic surfactant may improve control.
	0.03–0.045 lb flubendiamide	2.0–3.0 oz Synapse WG	1	Do not apply more than 3.0 oz/a (0.045 lb ai/a) in a 7-day period or more than 9.0 oz/a per season.
	flubendiamide + buprofezin	11.0–13.0 fl oz Vetica	1	Do not apply more than 38.0 fl oz/a per season and allow at least 7 days between applications. Do not make more than 2 applications per crop season.
	0.0075–0.015 lb gamma-cyhalothrin	1.92–3.84 oz *Proaxis	1	Apply every 5 days as needed. Use the high rate for diamondback moth. Do not exceed 1.92 pt/a (0.12 lb ai/a) per season.
	imidacloprid + beta-cyfluthrin	3.0 fl oz *Leverage 360	7	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.
	0.045–0.065 lb indoxacarb	2.5–3.5 oz Avaunt	3	Treat when populations reach threshold levels. For diamondback moth control, use higher rate. May repeat every 3 days as needed. Do not exceed 14.0 oz/a per crop.
	0.015–0.02 lb lambda-cyhalothrin	0.96–1.6 fl oz *Warrior II	4	Apply every 5 days as needed. Use 0.02–0.03 lb ai/a for diamondback moth larvae.
	lambda-cyhalothrin + chlorantraniliprole	5.0–8.0 fl oz *Voliam Xpress	3	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.24 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 7 days between applications.
	0.225–0.9 lb methomyl	1.5–3.0 pt *Lannate LV	Consult label	Consult label for specifics on various cole crops.
	0.06–0.16 lb methoxyfenozide	*early season:* 4.0–8.0 fl oz Intrepid 2F *mid- to late season:* 8.0–16.0 fl oz Intrepid 2F	1 1	Will not control diamondback moth. Do not exceed 64.0 fl oz/a per season. Use the higher rates with higher populations or when spray coverage is difficult. See label for use restrictions in some Wisconsin counties.
	0.039–0.078 lb novaluron	6.0–12.0 fl oz Rimon 0.83EC	7	Apply when the majority of the population has hatched up to the second instar larvae stage. Use higher rates and volumes when larvae are large, when populations are at least double the threshold amount, and when the foliage canopy is dense. Do not apply more than three times per crop per season or more than 24.0 oz/a per season.

*Restricted-use pesticide. *(continued)*

**Where ranges are given, check product label for specific number of days between insecticide application and harvest of a particular crop.

Insect control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest**	Remarks and suggestions
Caterpillar pests *(cont.)*	0.05–0.2 lb permethrin	2.0–8.0 oz *Permethrin 3.2EC	1	Consult label.
	0.039–0.078 lb spinetoram	5.0–10.0 oz Radiant SC	1	Do not apply more than 34.0 oz/a Radiant (0.266 lb ai/a) per crop and do not exceed 6 applications per year.
	spinosad	1.5–10.0 fl oz Entrust SC	1	See product label for specific rates. Use higher rates for larger larvae. Apply in adequate spray to get good coverage for best control. Do not exceed 0.45 lb ai/a per season. Do not use a buffering agent.
	0.09–0.12 lb tebufenozide	6.0–8.0 fl oz Confirm	7	Apply per label directions every 10–14 days as needed. Do not exceed 8.0 oz/a per application or 56.0 oz/a per season. There is a 1- to 12-month plantback restriction depending on the crop.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	0.4–1.0 lb thiodicarb	16.0–40.0 fl oz Larvin 3.2	7	Do not exceed 4.0 lb ai/a per season for broccoli, cabbage, and cauliflower only. There is a 30-day plantback restriction.
	0.17–0.21 lb tolfenpyrad	17.0–21.0 fl oz Torac	1	Do not apply until at least 14 days after emergence or after transplanting to allow time for root establishment. This period of time should be extended if conditions at time of emergence or transplanting are not favorable to crop growth. Apply by ground only, using a minimum of 20 gallons of water per acre. Do not apply more than 42.0 fl oz (0.42 lb ai) per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow at least 14 days between applications. Do not make more than 4 applications per year.
	0.014–0.025 lb zeta-cypermethrin	2.24–4.0 oz *Mustang Maxx	1	Use higher rates for cabbage looper. Apply every 7 days as needed. Use a minimum of 15 gal/a of finished spray. Do not exceed 24.0 oz/a Mustang Maxx per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	7	Do not apply more than 0.45 lb ai/a per season. Wait at least 7 days between applications.
Flea beetles	alpha-cypermethrin	2.2–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	beta-cyfluthrin	1.6–3.2 fl oz *Baythroid XL	0	Maximum Baythroid XL allowed per 7-day interval is 3.2 fl oz/a and season total allowed per crop season is 12.8 fl oz/a.
	0.033–0.10 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	7	Do not exceed 0.5 lb (32.0 fl oz formulated product) ai/a per season. Wait at least 7 days between applications.
	0.5–1.0 lb carbaryl	0.5–1.0 qt Sevin XLR Plus	3	Do not apply within 3 days of harvest. Do not exceed 6.0 qt ai/a per year. Do not apply when crop or nearby weeds are in bloom.

*Restricted-use pesticide. *(continued)*

**Where ranges are given, check product label for specific number of days between insecticide application and harvest of a particular crop.

Insect control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest**	Remarks and suggestions
Flea beetles *(cont.)*	clothianidin	*foliar:* 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		soil: 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a sidedress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
	0.088–0.176 lb cyantraniliprole *(soil)*	6.75–13.5 fl oz Verimark	—	Do not apply more than 13.5 fl oz/a Verimark per crop per season. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6. Minimum application interval between foliar sprays is 5 days.
	0.088–0.133 lb cyantraniliprole *(foliar)*	13.5–20.5 fl oz Exirel	1	
	0.045–0.268 lb dinotefuran	*foliar:* 1.0–4.0 oz Venom 70SG *soil:* 5.0–6.0 oz Venom 70SG	1 21	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not exceed 12.0 oz/a per season using soil applications. See product label for application directions.
	0.3–0.5 lb esfenvalerate	5.8–9.6 oz *Asana XL	3	Do not exceed 0.4 lb ai/a per season.
	0.0075–0.015 lb gamma-cyhalothrin	1.92–3.84 oz *Proaxis	1	Apply every 5 days as needed. Do not exceed 1.92 pt/a (0.12 lb ai/a) per season.
	imidacloprid + beta-cyfluthrin	3.0 fl oz *Leverage 360	7	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Apply every 5 days as needed. Do not exceed 0.96 pt/a per season.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	3	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.24 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 7 days between applications.
	0.1–0.2 lb permethrin	4.0–8.0 oz *Permethrin 3.2EC	1	Cabbage only. Consult label.
	thiamethoxam	1.5–3.0 oz Actara 25WDG 5.0–11.0 fl oz Platinum 2SC 1.66–3.67 oz Platinum 75SG	5 30 30	Do not follow applications of Platinum with foliar applications of any other neonicotinoid insecticide. Platinum may be applied to direct-seeded crops in-furrow at seeding or transplant depth, or as a narrow surface band above the seedling and followed by irrigation. Do not apply more than 11.0 oz of Actara 25WDG or Platinum 2SC and no more than 3.67 oz Platinum 75SG per acre per crop season and apply sufficient water volume after in-ground application to ensure incorporation into the seed zone. Actara is applied as a foliar spray.

*Restricted-use pesticide. *(continued)*

**Where ranges are given, check product label for specific number of days between insecticide application and harvest of a particular crop.

Insect control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest**	Remarks and suggestions
Flea beetles *(cont.)*	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	0.4–0.8 lb thiodicarb	16.0–32.0 fl oz Larvin F	7–14	Do not exceed 4.0 lb ai/a per season for broccoli, cabbage, and cauliflower only. Do not exceed 1.5 lb ai/a per season for greens.
	0.088–0.133 lb tolfenpyrad	13.5–20.5 fl oz Torac	1	Do not apply until at least 14 days after emergence or after transplanting to allow time for root establishment. This period of time should be extended if conditions at time of emergence or transplanting are not favorable to crop growth. Apply by ground only, using a minimum of 20 gallons of water per acre. Do not apply more than 42.0 fl oz (0.42 lb ai) per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow at least 14 days between applications. Do not make more than 4 applications per year.
	0.14–0.25 lb zeta-cypermethrin	2.24–4.0 oz *Mustang Maxx	1	Apply every 7 days as needed. Use a minimum of 15 gal/a of finished spray. Do not exceed 24.0 oz/a Mustang Maxx per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	7	Do not apply more than 0.45 lb ai/a per season. Wait at least 7 days between applications.
Onion thrips	*Thrips attack only cabbage and brussels sprouts. Plant resistant cabbage varieties to avoid the problem.*			
	acetamiprid	4.0 oz Assail 30 SG	7	Apply as part of a resistance management program for control of immature thrips.
	alpha-cypermethrin	3.2–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.06–0.095 lb bifenthrin + imidacloprid	3.8–6.1 fl oz *Brigadier	7	Do not apply more than 30.72 fl oz/a (0.48 lb ai/a) per season. A total of 0.24 lb ai/a imidacloprid and 0.5 lb ai/a bifenthrin allowed per season.
	0.13–0.176 lb cyantraniliprole *(soil)*	10.0–13.5 fl oz Verimark	—	Do not apply more than 13.5 fl oz/a Verimark per crop per season. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6. Minimum application interval between foliar sprays is 5 days.
	0.088–0.133 lb cyantraniliprole *(foliar)*	13.5–20.5 fl oz Exirel	1	
	0.05–0.1 lb cypermethrin	2.5–5.0 fl oz *Ammo 2.5EC	1	Apply when thrips enter cabbage head. There is a 30-day plantback restriction.
	0.0075–0.015 lb gamma-cyhalothrin	1.92–3.84 oz *Proaxis	1	For suppression only. Apply every 5 days as needed beginning when thrips enter cabbage head. Do not exceed 1.92 pt/a (0.12 lb ai/a) per season.
	imidacloprid + beta-cyfluthrin	3.0 fl oz *Leverage 360	7	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Apply every 5 days as needed. Do not exceed 0.96 pt/a per season. For suppression only. Apply when thrips enter cabbage head.

*Restricted-use pesticide.

(continued)

**Where ranges are given, check product label for specific number of days between insecticide application and harvest of a particular crop.

Insect control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest**	Remarks and suggestions
Onion thrips *(cont.)*	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	3	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.24 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season. For suppression only.
	lambda-cyhalothrin + thiamethoxam	4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 7 days between applications.
	0.039–0.078 lb novaluron	6.0–12.0 fl oz Rimon 0.83EC	7	For suppression only. Apply when thrips first appear and when they begin to enter the cabbage head. Reapply at 7- to 14-day intervals to protect new growth. Do not apply more than three times per crop per season or more than 24.0 oz/a per season.
	0.004–0.05 lb pyrethrin	1.0–12.0 fl oz Pyrenone	0	Apply as needed.
	0.047–0.078 lb spinetoram	6.0–10.0 fl oz Radiant SC	1	Do not apply more than 30.0 fl oz/a or make more than 5 applications per year. Do not exceed 2 consecutive applications.
	spinosad	4.0–10.0 fl oz Entrust SC	1	Apply when thrips first appear. Do not make more than 3 applications to a single generation or within a 30-day period.
	thiamethoxam	3.0–5.5 oz Actara 25WDG 5.0–11.0 fl oz Platinum 2SC 1.66–3.67 oz Platinum 75SG	0–7 30 30	Do not follow applications of Platinum with foliar applications of any other neonicotinoid insecticide. Platinum may be applied to direct-seeded crops in-furrow at seeding or transplant depth, or as a narrow surface band above the seedling and followed by irrigation. Do not apply more than 11.0 oz of Actara 25WDG or Platinum 2SC and no more than 3.67 oz Platinum 75SG per acre per crop season and apply sufficient water volume after in-ground application to ensure incorporation into the seed zone. Actara is applied as a foliar spray.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	0.21 lb tolfenpyrad	21.0 fl oz Torac	1	Do not apply until at least 14 days after emergence or after transplanting to allow time for root establishment. This period of time should be extended if conditions at time of emergence or transplanting are not favorable to crop growth. Apply by ground only, using a minimum of 20 gallons of water per acre. Do not apply more than 42.0 fl oz (0.42 lb ai) per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow at least 14 days between applications. Do not make more than 4 applications per year.

*Restricted-use pesticide.

(continued)

**Where ranges are given, check product label for specific number of days between insecticide application and harvest of a particular crop.

Insect control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest**	Remarks and suggestions
Onion thrips *(cont.)*	0.2–0.25 lb zeta-cypermethrin	3.2–4.0 oz *Mustang Maxx	1	Apply when thrips enter cabbage head. Treat every 7 days as needed. Use a minimum of 15 gal/a of finished spray. Do not exceed 24.0 oz/a Mustang Maxx per season.
	0.1 lb zeta-cypermethrin + bifenthrin	10.3 fl oz *Hero	7	Do not apply more than 0.45 lb ai/a per season. Wait at least 7 days between applications.
Onion thrips (larvae)	0.047–0.078 lb spirotetramat + 0.016–0.027 lb pyriproxifen	6.0–10.0 fl oz/a Senstar	7	Do not apply more than 10 fl oz of Senstar Insecticide (0.078 lb spirotetramat and 0.027 lb pyriproxyfen) per acre per application. Do not make more than 2 applications per crop season. Do not apply more than 20 fl oz of Senstar Insecticide (0.156 lb spirotetramat and 0.055 lb pyriproxyfen) per acre per crop season. Minimum interval between applications is 14 days. Regardless of formulation do not apply more than 0.16 lb spirotetramat and 0.134 lb pyriproxyfen per acre per crop season.

*Restricted-use pesticide.

** Where ranges are given, check product label for specific number of days between insecticide application and harvest of a particular crop.

Weed control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	clomazone	rate varies by label and cole crop	see label	Allowable cole crops, rates and instructions vary by label. Strictly follow all precautions and restrictions on the label to minimize offsite movement and carryover. Read the vegetable disclaimer section of the label—the end user assumes all liability for failure to perform and crop injury.
	1.0 lb napropamide	2.0 lb Devrinol DF-XT 2.0 qt Devrinol 2-XT		Apply and shallowly incorporate before planting or apply after seeding or transplanting and sprinkler irrigate within 24 hours. Use lower rate on light soil. Do not use on soil with more than 10% organic matter.
	0.475–1.0 lb pendimethalin	1.0–2.1 pt Prowl H_2O	60 (broccoli) 70 (other cole crops)	Prowl H_2O may only be applied as a postemergence-directed spray between the rows to broccoli, brussels sprouts, cabbage, and cauliflower. Apply postemergence-directed to two- to four-leaf transplants at 1–3 days after transplanting or to the two- to four-leaf stage of direct-seeded plants. Do not spray foliage or stems because crop injury will occur.
		1.0–2.1 pt Satellite Hydrocap	60 (broccoli) 70 (other cole crops)	Satellite Hydrocap may be applied broadcast or banded to the soil surface at pretransplant time, as a broadcast postemergence foliar spray, or as a postemergence directed spray to 2–4 leaf transplants at 1–3 days after transplanting or to the 2–4 leaf stage of direct-seeded brassica head and stem vegetables.

*Restricted-use pesticide.

(continued)

Weed control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds *(cont.)*	trifluralin	several manufacturers		Apply before transplanting. Trifluralin is also registered at lower rates for direct-seeded cole crops. Controls annual grasses and some broadleaves, but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Rate varies with soil texture and organic matter. Follow recommended soil preparation, application, and incorporation procedures. Must be incorporated within 24 hours. See label for plantback restrictions. Ineffective on peat and muck soils.
Annual grasses	5.0–6.0 lb bensulide	5.0–6.0 qt Prefar 4E		Apply before planting. Incorporate 1–2 inches deep to avoid loss due to volatilization. Use on mineral soils only.
Annual broadleaves	0.25–0.5 lb oxyfluorfen	1.0–2.0 pt Goal 2XL 0.5–1.0 pt GoalTender		For use on transplanted broccoli, cabbage, and cauliflower only. Apply after final tillage but before transplanting. Do not use on direct-seeded cole crops. Use low rate on coarse-textured soils with less than 1% organic matter. If plants contact treated soil, some foliar burn may occur but plants generally outgrow symptoms rapidly. For wider-spectrum weed control, use Goal following preplant-incorporated Treflan. Do not apply if an acetanilide herbicide such as Dual Magnum has been applied during the current growing season.
Annual grasses and some broadleaves	0.07–0.375 lb sulfentrazone	2.25–12.0 fl oz Spartan 4F		For transplanted processing cabbage only. May be surface-applied in spring before transplanting. It may also be preplant incorporated or applied as a preemergent treatment. When used as a preemergent treatment, Spartan should be applied before transplanting. Banded application to row middles may be made within 72 hours after transplanting. Rate is based on soil texture and organic matter. Do not apply more than 12.0 oz/a per 12-month period.
Emerged weeds	glyphosate	several manufacturers and formulations		See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. Glyphosate may be applied any time before crop emerges. Apply before crop germination in coarse sandy soils. If weeds have been mowed or tilled, wait until they have resumed active growth and reached the recommended stage on the label. Allow 7 or more days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified.
	*paraquat	several manufacturers and formulations, not all are registered for this use		Prepare seedbed early to allow for maximum weed emergence. Band or broadcast apply before, during, or after planting, but before crop emergence. In preplant and preemergence (to the crop) uses, do not apply to soils lacking clay minerals (i.e., muck, pure sand). Use the higher rate for heavy weed infestations. Seed and transplant with minimal soil disturbance. Always add crop oil concentrate or non-ionic surfactant to spray mixture. Follow precautions on label.

*Restricted-use pesticide.

(continued)

Weed control in cole crops—broccoli, brussels sprouts, cabbage, and cauliflower *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged broadleaves	0.094–0.187 lb clopyralid	several manufacturers and formulations	30	Controls many broadleaf weeds including common ragweed, nightshade species, and galinsoga. Suppresses Canada thistle and annual sowthistle. Do not exceed 0.5 pt/a per year. Note rotational crop interval restrictions before use. Consult label for allowable brassica leafy vegetables.
Emerged grasses	0.068–0.12 lb clethodim	9.0–16.0 oz Select Max	30	Apply to actively growing grasses. Repeat treatments may be made at 14-day intervals up to the maximum annual use rate. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by product label. Do not apply if rain is expected within 1 hour.
	clethodim	several manufacturers and formulations	30	
	0.094–0.375 lb fluazifop-P-butyl	6.0–24.0 oz Fusilade DX	14	Make postemergence application to actively growing grasses; check label for size range and treatment rate. Always add either crop oil concentrate or non-ionic surfactant to final spray mix. Do not apply more than 48.0 oz/a per season.
	0.094–0.28 lb sethoxydim	0.5–1.5 pt Poast	30	Make postemergence applications to actively growing grasses within the size ranges indicated on the label. Check the label for wild proso millet or rescue treatment rates. Do not apply more than 3.0 pt/a Poast in one crop season. Consult label for rate and adjuvant instructions for specific weeds. Check the label for additional precautions and restrictions.

*Restricted-use pesticide.

Cucumber

Planting

Pickling cucumbers

Hand-harvested plantings: Rows—36–60 inches; **plants in row** —12–24 inches apart (narrower row spacings), 9–15 inches apart (wider row spacings). The resulting plant population will be 7,000–25,000 plants/a depending on variety.

Machine-harvested plantings: Rows—18–28 inches; **seed**—4–6 inches. The resulting plant population will be 50,000–90,000 plants/a.

Slicing cucumbers

Rows: 48–72 inches.

Plants in row: 12–24 inches apart.

Plant seed 0.75–1.5 inches deep, depending on soil type and moisture. Reduce planting depth on heavier soils or when soils are cool and moist at planting.

If hand harvesting, plant seeds with corn or bean planter and use appropriate cucumber plates. For machine harvesting, use precision planting to eliminate thinning.

Cucumbers will grow on a wide variety of soils if they are well drained and have a high fertility level. To use machine harvesting, the fields must be level and stone-free. Avoid excessive tillage, which can cause moisture loss, soil compaction, and crusting.

Cucumbers are a warm season crop and require growing temperatures of 60–75°F. They will not tolerate frost, so avoid fields that have frost pockets. Temperatures above 90°F or below 60°F slow growth. Good seed germination requires soil temperatures of 55–95°F. Because of these requirements, do not plant seed in northern Wisconsin before June 1.

Irrigation

Cucumbers require a constant supply of moisture, especially during blossom and fruit development. Silt and clay soils have a relatively high moisture-holding capacity, so normal rainfall is usually adequate for cucumber production on these soils. Sandy soils do not hold much moisture and irrigation is essential for profitable cucumber production. If the WISP scheduling program is used, the AD value for sands is 1.0 inch. The AD value for silt loams is 2.5 inches.

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 5.8 on mineral soils and 5.6 on organic soils.

Fertilizer rates: Apply P_2O_5 and K_2O according to soil test recommendations. Use annual nitrogen, P_2O_5, and K_2O recommendations in table below. Take credits for previous legume crops and manure.

Application: For hand-harvested plantings, apply fertilizer in a band 2 inches below the seed at planting. For destructive, machine-harvested plantings, fertilizer can be planter applied or broadcast and worked in before planting.

Nitrogen: Split nitrogen recommendation into two or more applications during the season. Make the first application when plants have two to three true leaves. Make a second application when vines begin to fill the rows. For hand harvest, apply 15–20 lb N/a at 10–14 day intervals after harvest has begun. These applications can be made through the irrigation system.

Pollinating

Hand-harvested acreage: Typically, the natural bee population provides adequate pollination.

Machine-harvested acreage: Supplement the natural bee population by adding one colony (40,000–60,000 bees)/a in the field at blossoming time. (Note: many beekeepers provide pollinating services.)

Disease control

Many cucumber cultivars are resistant to several important diseases including angular leaf spot, anthracnose, cucumber mosaic virus, downy mildew, powdery mildew, and scab. Use resistant varieties and disease-free seed. Practice a 3- to 4-year rotation. Planting cultivars with multiple disease resistance minimizes the need for fungicide and bactericides on this crop.

Annual nitrogen, phosphate, and potash recommendations for cucumber

Nitrogen		Phosphate and potash		
Organic matter (%)	Amount to apply (lb/a)	Yield goal (bu/a)	Amount P_2O_5 to apply* (lb/a)	Amount K_2O to apply* (lb/a)
<2	100	300–400	10	25
2.0–9.9	80			
10–20	60			
>20	30			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Disease control in cucumber

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Alternaria leaf blight	azoxystrobin	11.0–15.4 fl oz Aframe, Equation, Quadris Flowable, Satori	1	Equation, Quadris, Satori, Reason, and Cabrio belong to the Group 11 (strobilurin) fungicide category. Quadris Opti contains a combination of Group 11 and M5 fungicides. Tanos contains a combination of Group 11 and Group 27 fungicides. Do not exceed 1 application of any of these products before alternating with a fungicide having a different mode of action. Do not exceed 4 applications of strobilurin fungicides per crop per year. Do not exceed 92.3 fl oz/a Equation, Quadris, or Satori; 1.0 lb ai/a Quadris Opti; 32.0 oz/a Tanos; 22.0 fl oz/a Reason; or 64.0 oz/a Cabrio per season. Tanos must be tank mixed with a contact fungicide such as mancozeb, chlorothalonil, or a copper-containing fungicide. Following the last application of Reason 500 SC, do not rotate to wheat for 30 days; for all other crops, wait 1 year before rotating.
	azoxystrobin + chlorothalonil	3.2 pt Quadris Opti	1	
	azoxystrobin + difenoconazole	12.0–14.0 fl oz Quadris Top	1	
	famoxadone + cymoxanil	8.0 oz Tanos	3	
	fenamidone	5.5 fl oz Reason 500 SC	14	
	pyraclostrobin	12.0–16.0 oz Cabrio EG	0	
	boscalid	6.5 oz Endura	0	Do not apply more than 26.0 oz/a Endura per year. Do not make more than 4 applications per year.
	boscalid + pyraclostrobin	12.5–18.5 oz Pristine WDG	0	Pristine belongs to Groups 7 and 11 fungicide categories. Do not exceed 1 application of Pristine before alternating to a labeled fungicide with a different mode of action. Do not exceed 4 applications of Pristine or any other Group 7 or 11 fungicides per season. Do not exceed 74.0 oz/a Pristine per season.
	chlorothalonil	2.0–3.0 pt Bravo Weather Stik, Equus 720 1.8–2.7 lb Bravo Ultrex 82.5WDG, Equus DF 2.25–2.75 pt Bravo Zn, Echo Zn, Equus 500 Zn	0 0 7	Apply when conditions favor disease. Do not apply more than 15.75 lb ai/a of chlorothalonil products per year.
	chlorothalonil + cymoxanil	1.9–3.0 pt Ariston	3	Begin application when conditions are favorable for disease. Be aware of potential for phytotoxicity on watermelon.
	chlorothalonil + zoxamide	36.0 fl oz Zing	0	Do not make more than 2 sequential applications before alternating with a fungicide that has a different mode of action.
	cyprodinil + difenoconazole	16.0–20.0 fl oz Inspire Super	7	Do not apply more than 80.0 fl oz/a per year. Make no more than 2 sequential applications before alternating to an effective fungicide with a different mode of action.
	cyprodinil + fludioxonil	11.0–14.0 oz Switch 62.5WG	1	Do not apply more than 56.0 fl oz/a per year. Make no more than 2 sequential applications before alternating to an effective fungicide with a different mode of action.
	difenoconazole + benzovindiflupyr	10.5–13.5 fl oz Aprovia Top	0	Follow resistance management guidelines. Do not apply more than 53.6 fl oz per acre per year.
	fludioxonil	5.5–7.0 fl oz Spirato GHN	1	Follow label for resistance management strategies.
	fluopyram + tebuconazole	6.0–17.0 fl oz Luna Experience	7	Do not apply more than 34.0 fl oz per acre per season.
	fluopyram + trifloxystrobin	7.6 fl oz Luna Sensation	0	Do not apply more than 27.1 fl oz of Luna Sensation per acre per year.

(continued)

Disease control in cucumber *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Alternaria leaf blight *(cont.)*	fluoxastrobin	3.0–5.7 fl oz Aftershock, Evito 480 SC	1	Begin application preventively. Use higher rates when disease pressure is high. Do not tank mix with insecticides that are EC-based.
	fluxapyroxad + pyraclostrobin	4.0–5.5 fl oz Merivon	0	Make no more than 3 applications per season. Follow resistance management guidelines.
	hydrogen dioxide	1:100–1:2000 dilution rate OxiDate	0	Root and cutting dip treatment, soil drench, and seed treatments are registered. See label for application details. Follow tank-mixing instructions on label; some incompatibility issues exist. Cucurbit section of label for further details among crop grouping. Allowable for use in organic systems.
	mancozeb *(Cercospora leaf spot)*	1.2–2.4 qt Penncozeb 4FL 1.6–2.4 qt Dithane F-45, Manzate Flowable 2.0–3.0 lb Dithane DF Rainshield, Koverall, Manzate Pro-Stick 1.5–3.0 lb Penncozeb 75DF, 80WP	5 5 5 5	Consult label for seasonal product limits.
	mancozeb + copper hydroxide	2.0–3.0 lb ManKocide	5	Do not make more than 8 applications per year. Some cantaloupe varieties may have sensitivity to ManKocide.
	penthiopyrad	12.0–16.0 fl oz Fontelis	1	Make no more than 2 sequential applications before alternating to an effective fungicide with a different mode of action. Do not exceed 67.0 fl oz/a per year. Can be used on greenhouse-grown cucumbers. See label for specific instructions on greenhouse rates.
	pydiflumetofen + fludioxonil	9.2–11.4 fl oz Miravis Prime	1	Do not make more than 2 sequential applications of Miravis Prime before alternating to a fungicide outside of the Classes 7 or 12.
	tetraconazole	8.0 fl oz Mettle 125ME	0	Make no more than 5 applications per season per crop. Make no more than 2 sequential applications of Mettle before alternating to another fungicide with a different mode of action.
	zoxamide + mancozeb	1.5–2.0 lb Gavel 75DF	5	Do not exceed 8 applications or apply more than 16.0 lb/a product (10.67 lb ai/a mancozeb and 1.33 lb ai/a zoxamide) per season.
Angular leaf spot *(Pseudo-monas)*	fixed copper	1.3 pt Champ Formula 2 1.5–3.0 lb Champion 77WP 1.5–2.0 lb Kocide 77WP, DF 2.0–2.3 pt Kocide LF 2.4F 1.0–2.25 lb Kocide 2000 DF 0.5–1.25 lb Kocide 3000	0 0 0 0 0 0	Use disease-free seed and rotate crops. Many cultivars are resistant to this disease. If needed, begin applications before fruit appear. Copper sprays are most effective when applied immediately after a rain or wind storm has damaged foliage.
	mancozeb + copper hydroxide	2.0–3.0 lb ManKocide	5	Do not make more than 8 applications per year. Some cantaloupe varieties may have sensitivity to ManKocide.

(continued)

Disease control in cucumber *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Anthracnose	azoxystrobin	11.0–15.5 fl oz Aframe, Equation, Quadris Flowable, Satori	1	See remarks for these products in the Alternaria leaf blight listing. Make no more than 1 application of a strobilurin-containing fungicide before alternating to another fungicide with a different mode of action.
	azoxystrobin + chlorothalonil	3.2 pt Quadris Opti	1	
	azoxystrobin + difenoconazole	12.0–14.0 fl oz Quadris Top	1	
	cymoxanil + famoxadone	8.0 oz Tanos	3	
	pyraclostrobin	12.0–16.0 oz Cabrio EG	0	
	azoxystrobin + benzovindiflupyr	0.6–0.8 oz/5,000 sq ft Mural (for treatment in greenhouses for plant resale)	0	Allowable growing environments include greenhouses, enclosed structures, and fields for the purpose of plant resale to consumer.
	boscalid + pyraclostrobin	18.5 oz Pristine WDG	0	Pristine belongs to Groups 7 and 11 fungicide categories. Do not exceed 2 sequential applications of Pristine before alternating to a labeled fungicide with a different mode of action. Do not exceed 4 applications of Pristine or of any other Group 7 or 11 fungicides per season. Do not exceed 74.0 oz/a Pristine per season.
	chlorothalonil	1.5–2.0 pt Bravo Weather Stik, Echo 720, Equus 720 1.4–1.8 lb Bravo Ultrex 82.5WDG, Equus DF 1.3–1.6 lb Echo 90DF	0 0 0	Apply when conditions favor disease.
	chlorothalonil + zoxamide	31.0 fl oz Zing	0	Do not make more than 2 sequential applications before alternating with a fungicide that has a different mode of action.
	cyprodinil + difenoconazole	16.0–20.0 fl oz Inspire Super	7	Do not apply more than 80.0 fl oz/a per year. Make no more than 2 sequential applications before alternating to an effective fungicide with a different mode of action.
	difenoconazole + benzovindiflupyr	10.5–13.5 fl oz Aprovia Top	0	Follow resistance management guidelines. Do not apply more than 53.6 fl oz per acre per year.
	fluopyram + tebuconazole	10.0–17.0 fl oz Luna Experience	7	Do not apply more than 34.0 fl oz per acre per season.
	fluopyram + trifloxystrobin	7.6 fl oz Luna Sensation	0	Do not apply more than 27.1 fl oz of Luna Sensation per acre per year.
	fluoxastrobin	3.0–5.7 fl oz Aftershock, Evito 480 SC	1	Begin application preventively. Use higher rates when disease pressure is high. Do not tank mix with insecticides that are EC-based.
	fluxapyroxad + pyraclostrobin	5.5 fl oz Merivon	0	Make no more than 3 applications per season. Follow resistance management guidelines.
	hydrogen dioxide	1:100–1:2000 dilution rate OxiDate	0	Root and cutting dip treatment, soil drench, and seed treatments are registered. See label for application details. Follow tank-mixing instructions on label; some incompatibility issues exist. See cucurbit section of label for further details among crop grouping. Allowable for use in organic systems.

(continued)

Disease control in cucumber *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Anthracnose *(cont.)*	mancozeb	1.2–2.4 qt Penncozeb 4FL 1.6–2.4 qt Dithane F-45, Manzate Flowable 1.5–3.0 lb Penncozeb 75DF, 80WP 2.0–3.0 lb Dithane DF Rainshield, Koverall, Manzate Pro-Stick	5 5 5 5	Do not apply more than 24.0 lb/a per year. Consult label for seasonal product limitations.
	thiophanate-methyl	10.0 fl oz Topsin 4.5FL 0.5 lb Topsin M 70W, 70WDG, Topsin M WSB 0.2–0.4 lb Thiophanate methyl 85 WDG	0	Apply when disease first appears and repeat if needed every 7–14 days.
Bacterial wilt *(Erwinia)*	*Eliminate the cucumber beetles that carry this pathogen (see Insect Control table).*			
Belly rot	azoxystrobin	11.0–15.5 fl oz Equation, Quadris Flowable, Satori	1	See remarks for Equation, Quadris, Satori, and Cabrio in the Alternaria leaf blight listing. For belly rot control, the first application should be made at the one- to three-leaf crop stage with a second application just prior to vine tip or 10–14 days later.
	azoxystrobin + difenoconazole	12.0–14.0 fl oz Quadris Top	1	
	pyraclostrobin	12.0–16.0 oz Cabrio EG	0	
	difenoconazole + benzovindiflupyr	10.5–13.5 fl oz Aprovia Top	0	Follow resistance management guidelines. Do not apply more than 53.6 fl oz per acre per year.
	fluopyram + tebuconzaole	10.0–17.0 fl oz Luna Experience	7	Do not apply more than 34.0 fl oz/acre/season.
	fluopyram + trifloxystrobin	7.6 fl oz Luna Sensation	0	Do not apply more than 27.1 fl oz of Luna Sensation per acre per year.
	fluoxastrobin	3.0–5.7 fl oz Aftershock, Evito 480 SC	1	Begin application preventively. Use higher rates when disease pressure is high. Do not tank mix with insecticides that are EC-based.
Black rot	*See fungicide treatments recommended for anthracnose.* fixed copper			Use certified disease-free seed. Destroy infected plant refuse.
Downy mildew	ametoctradin + dimethomorph	14.0 fl oz Zampro	0	The addition of a spreading/penetrating adjuvant is recommended. Use prior to disease development.
	azoxystrobin + chlorothalonil	3.2 pt Quadris Opti	1	See remarks for this product in Alternaria leaf blight section.
	cymoxanil + famoxadone	8.0 oz Tanos 50DF	3	See remarks for this product in Alternaria leaf blight section.
	boscalid + pyraclostrobin	12.5–18.5 Pristine WDG	0	Pristine belongs to Groups 7 and 11 fungicide categories. Do not exceed 1 application of Pristine before alternating to a labeled fungicide with a different mode of action. Do not exceed 4 applications of Pristine or other Group 7 or Group 11 fungicides per season. Do not exceed 74.0 oz/a Pristine per season.
	chlorothalonil + cymoxanil	3.0 pt Ariston	3	Begin application when conditions are favorable for disease. Be aware of potential phytotoxicity on watermelon.
	chlorothalonil + zoxamide	36.0 fl oz Zing	0	Do not make more than 2 sequential applications before alternating with a fungicide that has a different mode of action.

(continued)

Disease control in cucumber *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Downy mildew *(cont.)*	cyazofamid	2.1–2.75 fl oz Ranman	0	Ranman belongs to Group 21 fungicide category. Do not apply more than six sprays of Ranman per crop. Alternate Ranman sprays with a fungicide having a different mode of action. Do not apply more than 16.5 fl oz/a per year.
	cymoxanil	3.2–5.0 oz Curzate	3	Use only in combination with a protectant fungicide such as mancozeb, copper hydroxide, or chlorothalonil. Make no more than 9 applications of Curzate in 1 year.
	dimethomorph	6.0 fl oz Forum	0	Do not exceed 30.0 fl oz/a or 5 applications per season. Do not make more than 2 sequential applications before alternating to another effective fungicide with a different mode of action for at least 1 application.
	ethaboxam	8.0 fl oz Elumin	2	Do not make more than 2 applications per year. Do not apply sequentially.
	fenamidone	5.5 fl oz Reason 500 SC	14	Begin applications when conditions favor disease.
	fixed copper	1.5–3.0 lb Champion 77WP 1.3 pt Champ Formula 2 1.5–2.0 lb Kocide 77WP 1.5–2.0 lb Kocide DF 2.6 pt Kocide LF 2.4F 1.0–2.25 lb Kocide 2000 DF 0.5–1.25 lb Kocide 3000	0 0 0 0 0 0 0	Use disease-free seed and rotate crops. Begin applications before fruit form at less than 7-day intervals. After a rain and wind storm, make two or 3 applications as soon as possible after the storm at 2- to 3-day intervals.
	fluazinam	12.0–24.0 fl oz Lektivar 40SC	7	Follow label for resistance management strategies.
	fluopicolide	3.0–4.0 fl oz Presidio Fungicide	2	Tank mix this product with another labeled non–Group 43 fungicide. Label recommends a 10-day spray interval. In 2015 field trials at Michigan State University, Presidio and Previcur Flex did not control downy mildew. Resistant pathogen strains are likely occurring in the Upper Midwest, rendering these two fungicides inefficient in downy mildew control.
	fluoxastrobin	3.0–5.7 fl oz Aftershock, Evito 480 SC	1	Begin application preventively. Use higher rates when disease pressure is high. Do not tank mix with insecticides that are EC-based.
	fosetyl-al	2.0–5.0 lb Aliette WDG, Linebacker WDG	12 hr	Begin applications when conditions favor disease development (high moisture and moderate temperatures). Repeat at 7- to 14-day intervals. Do not exceed 7 applications per season.
	hydrogen dioxide	1:100–1:2000 dilution rate OxiDate	0	Root and cutting dip treatment, soil drench, and seed treatments are registered. See label for application details. Follow tank-mixing instructions on label; some incompatibility issues exist. See cucurbit section of label for further details among crop grouping. Allowable for use in organic systems.

(continued)

Disease control in cucumber *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Downy mildew *(cont.)*	mancozeb	1.6–2.4 qt Dithane F-45 2.0–3.0 lb Dithane DF Rainshield 2.0–3.0 lb Koverall 1.6–2.4 qt Manzate Flowable 2.0–3.0 lb Koverall, Manzate Pro-Stick 1.2–2.4 qt Penncozeb 4FL 1.5–3.0 lb Penncozeb 75DF, 80WP	5 5 5 5 5 5 5	Do not apply more than 24.0 lb/a per year. Consult label for seasonal product limitations.
	mancozeb + copper hydroxide	2.0–3.0 lb ManKocide	5	Do not make more than 8 applications per year.
	mandipropamid	8.0 fl oz Revus	0	Make no more than 1 application before switching to another effective non–Group 40 fungicide.
	mefenoxam + chlorothalonil	2.5 pt Ridomil Gold Bravo SC	0	Initiate application prior to disease onset. Apply a full rate of protectant fungicide between applications of Ridomil Gold Bravo (14-day interval). Avoid applications when the crop begins to senesce.
	oxathiapiprolin	2.0–4.8 fl oz Orondis Opti A, Orondis Ultra A	0	Make no more than 2 sequential applications before rotating to a fungicide with a different mode of action. Do not exceed 19.2 fl oz/a per year. Begin foliar applications prior to disease development and continue on a 5- to 14-day interval.
	phosphorous acid, mono- and dibasic sodium, potassium, and ammonium salts	2.5–5.0 pt Phostrol	0	Do not exceed 7 applications per season.
	potassium phosphite	1.0–3.0 qt Fosphite/100 gal water	0	Do not apply to plants that are stressed due to heat or moisture. Do not apply when leaf wetness periods of more than 4 hours are expected. Do not apply at less than 3-day intervals.
	propamocarb hydrochloride	1.2 pt Previcur Flex 0.6–1.2 pt Previcur Flex + tank-mix partner	2	Do not apply more than 6.0 pt/a Previcur Flex per season. Most effective when applied preventively. In 2015 field trials at Michigan State University, Presidio and Previcur Flex did not control downy mildew. Resistant pathogen strains are likely occurring in the Upper Midwest, rendering these two fungicides inefficient in downy mildew control.
	pyraclostrobin	8.0–12.0 oz Cabrio EG	0	See remarks for this product in Alternaria leaf blight section.
	trifloxystrobin	4.0 oz Flint	0	Do not make more than 4 applications per crop per year of Flint. Do not make subsequent applications of Flint. Alternate fungicide modes of action to limit development of resistance.
	zoxamide + mancozeb	1.5–2.0 lb Gavel 75DF	5	Do not exceed 8 applications or apply more than 16.0 lb/a product (10.67 lb ai/a mancozeb or 1.33 lb ai/a zoxamide) per season.
Fusarium wilt	*The only practical control is to grow wilt-resistant varieties. Rotate with crops other than melons.*			

(continued)

Disease control in cucumber *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Mosaic	*Plant resistant varieties. When possible, control by isolation from the following plants: burdock, catnip, china aster, chrysanthemum, wild cucumber, geranium, gladiolus, wild ground cherry, horse nettle, hyacinth, jimsonweed, larkspur, lily, marigold, milkweed, morning glory, nasturtium, petunia, phlox, pokeweed, salvia, snapdragon, lowering spurge, tulip, white cockle, and zinnia. Control aphids that spread the disease (see Insect Control table).*			
Phytophthora blight or crown rot *(Phytophthora capsici)*	ametoctradin + dimethomorph	14.0 fl oz Zampro	0	The addition of a spreading or penetrating adjuvant is recommended. Use prior to disease development.
	cyazofamid	2.75 fl oz Ranman 400SC	0	Do not apply more than six sprays or 16.5 fl oz/a per year. Alternate Ranman (Group 21) sprays with a fungicide having a different mode of action. Crops not listed on the label should not be planted within 30 days after the last application.
	dimethomorph	6.0 fl oz Forum	0	Do not exceed 30.0 fl oz/a or 5 applications per season. Do not make more than 2 sequential applications of Forum before alternating to another effective fungicide with a different mode of action for at least 1 application.
	ethaboxam	8.0 fl oz Elumin	2	Do not make more than 2 applications per year. Do not apply sequentially.
	famoxadone + cymoxanil	8.0–10.0 oz Tanos	3	Do not make more than 1 application before alternating with a fungicide having a different mode of action. Do not exceed 4 applications of Tanos or other Group 11 fungicides per season and do not alternate Tanos with other Group 11 fungicides. Do not exceed 32.0 oz/a Tanos per crop per season. Tanos is helpful for suppressing Phytophthora blight, but it must be tank mixed with a contact fungicide such as mancozeb, chlorothalonil, or a copper-containing fungicide.
	fluazinam	12.0–24.0 fl oz Lektivar 40SC	7	Follow label for resistance management strategies.
	fluopicolide	3.0–4.0 fl oz Presidio Fungicide	2	Tank mix this product with another labeled non–Group 43 fungicide. Label recommends a 10-day spray interval.
	fosetyl-al	2.0–5.0 lb Aliette WDG, Linebacker WDG	12 hr	Begin applications when conditions favor disease development (high moisture and moderate temperatures). Repeat at 7- to 14-day intervals. Do not exceed 7 applications per season.
	hydrogen dioxide	1:100–1:2000 dilution rate OxiDate	0	Root and cutting dip treatment, soil drench, and seed treatments are registered. See label for application details. Follow tank-mixing instructions on label; some incompatibility issues exist. See cucurbit section of label for further details among crop grouping. Allowable for use in organic systems.
	mandipropamid	8.0 fl oz Revus	0	Do not exceed 1 application before switching to another effective non–Group 40 fungicide.

(continued)

Disease control in cucumber *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Phytophthora blight or crown rot *(cont.)*	oxathiapiprolin	2.0–4.8 fl oz Orondis Opti A, Orondis Ultra A 2.4–19.2 fl oz Orondis Gold 200	0	For foliar application of Orondis Ultra A, begin foliar applications prior to disease development and continue on a 3- to 14-day interval. For pickle fruit protection, apply with a copper fungicide starting at 1-inch fruit on 3- to 5-day intervals. For soil-applied Orondis Gold 200, apply at-planting, in-furrow, by drip, or in transplant water. Do not follow soil applications of Orondis Gold 200 with foliar applications of Orondis Ultra A.
	phosphorous acid, mono- and dibasic sodium, potassium, and ammonium salts	2.5–5.0 pt Phostrol	0	Do not exceed 7 applications per season.
	potassium phosphite	1.0–3.0 qt Fosphite/100 gal water	0	Do not apply to plants that are stressed due to heat or moisture. Do not apply when leaf wetness periods of more than 4 hours are expected. Do not apply at less than 3-day intervals.
	zoxamide + mancozeb	1.5–2.0 lb Gavel 75DF	5	Do not exceed 8 applications or apply more than 16.0 lb/a product (10.67 lb ai/a mancozeb or 1.33 lb ai/a zoxamide) per season.
Powdery mildew	azoxystrobin	11.0–15.5 fl oz Aframe, Equation, Quadris Flowable, Satori	1	Equation, Quadris, Satori, Cabrio, and Flint are Group 11 (strobilurin) fungicides. Do not exceed 1 application of any of these products before alternating with a fungicide having a different mode of action. Do not make more than 4 applications of Group 11 fungicides or exceed 1.92 qt/a Equation, Quadris, or Satori; 8.0 oz/a Flint; or 64.0 oz/a Cabrio per crop per season. Do not tank mix any of these products with additives or adjuvants. See labels for listing of products that should not be tank mixed with these materials.
	pyraclostrobin	12.0–16.0 oz Cabrio EG	0	
	trifloxystrobin	1.5–2.0 oz Flint	0	
	boscalid + pyraclostrobin	12.5–18.5 oz Pristine WDG	0	Pristine belongs to Group 7 and 11 fungicide categories. Do not exceed 2 sequential applications of Pristine before alternating to a fungicide with a different mode of action. Do not exceed 4 applications of Pristine or other Group 7 or Group 11 fungicides per season. Do not exceed 74.0 oz/a Pristine per season.
	chlorothalonil + tebuconazole	1.1–1.6 pt Muscle ADV	7	Do not apply if plants are undergoing heat or drought stress. Effective against gummy stem blight at rate of 2.1 pt/a.
	clarified hydrophobic extract of neem oil	0.5–1.0% Trilogy in 25–100 gal water *or* 2.0 pt in at least 5 gal water/a	0	Do not apply more than 2 gal of Trilogy/a. OMRI-approved.
	cyflufenamid	3.4 oz Torino	0	Do not make more than 2 applications/a per year. Do not exceed a total of 6.8 oz/a per year.
	cyprodinil + difenoconazole	16.0–20.0 fl oz Inspire Super	7	Do not apply more than 80.0 fl oz/a per year. Make no more than 2 sequential applications before alternating to an effective fungicide with a different mode of action.

(continued)

Disease control in cucumber *(continued)*

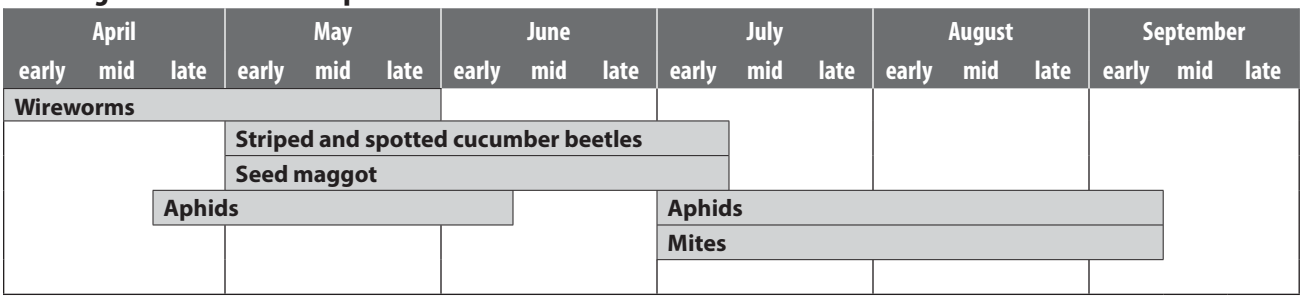
Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Powdery mildew *(cont.)*	cyprodinil + fludioxonil	11.0–14.0 oz Switch 62.5WG	1	Do not apply more than 56.0 fl oz/a per year. Make no more than 2 sequential applications before alternating to an effective fungicide with a different mode of action.
	difenoconazole + benzovindiflupyr	10.5–13.5 fl oz Aprovia Top	0	Follow resistance management guidelines. Do not apply more than 53.6 fl oz per acre per year.
	fludioxonil	5.5–7.0 fl oz Spirato GHN	1	Follow label for resistance management strategies.
	fluopyram	6.5–6.84 fl oz Velum Prime	0	For powdery mildew and nematode suppression. Follow resistance management guidelines.
	fluopyram + prothioconazole	13.6 fl oz Propulse	7	Also labeled for Fusarium and Gummy Stem Blight. Hand harvesting is prohibited.
	fluopyram + trifloxystrobin	4.0–7.6 fl oz Luna Sensation	0	Do not apply more than 27.1 fl oz of Luna Sensation per acre per year.
	fluoxastrobin	3.0–5.7 fl oz Aftershock, Evito	1	Being application preventively. Use higher rates when disease pressure is high.
	flutianil	6.0–8.0 fl oz Gatten	0	Follow label for resistance management strategies.
	flutriafol	10.0–14.0 fl oz Topguard 5.0–7.0 fl oz Rhyme	0	Do not make more than 4 applications per year. Also provides control of gummy stem blight.
	hydrogen dioxide	1:100–1:2000 dilution rate OxiDate	0	Root and cutting dip treatment, soil drench, and seed treatments are registered. See label for application details. Follow tank-mixing instructions on label; some incompatibility issues exist. See cucurbit section of label for further details among crop grouping. Allowable for use in organic systems.
	kresoxim methyl	3.2–4.8 oz Sovran	0	Do not apply more than 19.2 oz/a per season. Begin application prior to onset of disease.
	metrafenone	15.4 fl oz Vivando	0	Do not make more than 3 applications per year. Do not mix with oils.
	myclobutanil	2.5–5.0 oz Rally 40WSP	0	Do not exceed 1.5 lb/a product (0.6 lb ai/a) per year. Observe a 30-day plantback interval between last application and planting new crops. Resistance has been noted in several WI locations.
	neem oil	0.5–1.0% Trilogy in 25–100 gal water	0	Has fungicide and miticide benefits. Organic (OMRI) approved. Reapply every 7–21 days.
	potassium phosphite	1.0–3.0 qt Fosphite/100 gal water	0	Do not apply to plants that are stressed due to heat or moisture. Do not apply when leaf wetness periods of more than 4 hours are expected. Do not apply at less than 3-day intervals.
	prothioconazole	5.7 fl oz Proline 480 SC	7	Also labeled for Fusarium and Gummy Stem Blight. Follow label for resistance management strategies.
	pydiflumetofen + fludioxonil	9.2–11.4 fl oz Miravis Prime	1	Make no more than 2 sequential applications before alternating to a fungicide outside of Classes 7 or 12.
	pyriofenone	4.0–5.0 fl oz Prolivo 300SC	0	Follow label for resistance management strategies.

(continued)

Disease control in cucumber *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Powdery mildew *(cont.)*	sulfur	various, depending on product and formulation	0	Do not apply sulfur to sensitive crops. Do not apply during high temperatures. Do not use within 2 weeks of an oil treatment. When grown for processing, consult processor prior to use.
	tebuconazole	4.0–6.0 fl oz Folicur 3.6 F, Monsoon, Orius 3.6F, Tebusha 3.6FL, TebuStar 3.6L, Tebuzol 3.6F, Toledo	7	Do not exceed 24.0 fl oz per season. Most effective when applied preventively.
	tetraconazole	8.0 fl oz Mettle 125ME	0	Make no more than 5 applications per season per crop. Make no more than 2 sequential applications before alternating to an effective fungicide with a different mode of action.
	thiophanate-methyl	0.5 lb Topsin M 70W, Topsin M WSB	0	Apply when disease first appears and repeat if needed every 7–14 days.
		10 fl oz Topsin 4.5FL	0	
		0.2–0.4 lb Thiophanate methyl 85WDG	0	
	triflumizole	4.0–8.0 oz Procure 50WS, Procure 480SC	0	Do not apply more than 40.0 oz of Procure per season. See product label for plantback restrictions for leafy vegetables (30 days), root vegetables (60 days) and all other crops (1 yr).
Seed rot and damping-off	captan	0.5–1.0 teaspoon Captan 50% WP/lb of dry seed	—	Use disease-free soil. Water plants in morning. Chemical listed is seed treatment. Do not use treated seed for feed or food.
	fludioxonil	0.08–0.16 fl oz/100 lb seed Dyna-Shield, Maxim 4FS, Spirato	—	Follow manufacturer's directions. Not for feed or food.
	mefenoxam	1.0–2.0 pt Ridomil Gold SL	—	Preplant-incorporated application or surface application at planting. Preplant to top 2 inches of soil.
		2.0–4.0 pt Ultra Flourish	—	
		0.085–0.64 fl oz Apron XL/100 lb seed	—	Follow manufacturer's directions. Do not use treated seed for feed or food.
	mefenoxam + azoxystrobin	0.34 fl oz Uniform/1,000 ft row	—	Apply Uniform as an in-furrow spray in a minimum of 5 gal of water per acre at planting.
	metalaxyl	4.0–8.0 pt MetaStar 2E AG	—	Preplant-incorporated application or surface application at planting. Preplant to top 2 inches of soil.
		0.7 fl oz Sebring 2.65 ST/100 lb seed	—	Follow manufacturer's directions. Do not use treated seed for feed or food.
		0.75 fl oz/100 lb seed Acquire, Allegiance FL, Metalaxyl 265 ST	—	
	thiram	0.75 teaspoon Thiram 50%WP/lb seed	—	Use disease-free soil. Water plants in morning. Chemical listed is seed treatment. Do not use treated seed for feed or food.

Scouting calendar for insect pests in cucumber



Insect control in cucumber

(Note: Heavy applications and certain formulations may be phytotoxic to cucumbers.)

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Bean aphid and soybean aphid	0.047– 0.075 lb acetamiprid	2.5–4.0 oz Assail 30SG	0	For any of the pests listed, use the high rate within the listed rate range under heavy pest pressure. Do not make more than 5 applications per calendar year. Do not apply more than once every 5 days. Do not exceed a total of 0.5 lb acetamiprid active ingredient (26.5 oz of Assail 30SG) per acre per calendar year including any pretransplant applications of acetamiprid (maximum pretransplant application rate of acetamiprid is 0.15 lb ai/a).
	alpha-cypermethrin	3.4–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.088 lb cyantraniliprole + 0.019 lb abamectin	10.0 fl oz *Minecto Pro	7	Minimum application interval of 7 days. Maximum annual rate of 20.0 fl oz/a per calendar year (0.18 lb ai/a of cyantraniliprole and 0.038 lb ai/a of abamectin). Do not apply more than 0.4 lb ai/a per calendar year of cyantraniliprole-containing products including all application types (seed treatment, soil, foliar). Do not apply more than 0.056 lb ai/a per calendar year of abamectin-containing products including all application types (seed treatment, soil, foliar).
	flupyradifurone	*foliar:* 7.0–12.0 fl oz Sivanto *soil:* 21.0–28.0 fl oz Sivanto	1 21	Apply when pests reach or exceed established thresholds. Do not apply more than 28.0 fl oz of Sivanto per acre per crop season.
	I. fumosorosea (20%)	1.0–2.0 lb PFR-97	1	Repeat applications at 3- to 10-day intervals over 2–3 weeks or as needed to maintain control. Frequent application may be required under dry conditions, during periods of increased pest buildup or reproduction, or rapid host plant growth.
	lambda-cyhalothrin + chlorantraniliprole	9.0 fl oz *Voliam Xpress	1	Allow at least 5 days between applications. Do not apply more than 31.0 fl oz/a Voliam Xpress per season.
	spirotetramat	4.0–5.0 fl oz Movento	1 (edible) 7 (dry)	Do not apply more than 10.0 fl oz/a per season and allow at least 7 days between applications.
	0.023 lb sulfoxaflor	0.75 oz Transform WG	1	Do not make applications less than 7 days apart. Do not make more than four applications per crop. Do not make more than two consecutive applications per crop. Do not apply more than a total of 8.5 oz of Transform WG (0.266 lb ai of sulfoxaflor) per acre per year.

*Restricted-use pesticide.

(continued)

Insect control in cucumber *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Bean aphid and soybean aphid *(cont.)*	0.17–0.21 lb tolfenpyrad	17.0–21.0 fl oz Torac	1	Do not apply until at least 14 days after emergence or after transplanting to allow time for root establishment. This period of time should be extended if conditions at time of emergence or transplanting are not favorable to crop growth. Apply by ground only, using a minimum of 20 gallons of water per acre. Do not apply more than 42.0 fl oz (0.42 lb ai) per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow at least 14 days between applications. Do not make more than 4 applications per year.
Cucumber beetles (striped, spotted)	*Treat when there are more than 4–5 adults per 50 plants. Cucumber beetles are vectors of bacterial wilt. High beetle populations (more than 20 per plant) may overwhelm the ability of the insecticide to control beetles quickly enough to stop the transmission of the wilt-causing bacterium.*			
	0.047–0.075 lb acetamiprid	2.5–4.0 oz Assail 30SG	0	Begin treatment when thresholds are reached. Apply every 5 days as needed. Do not exceed 5 applications or 0.5 lb ai/a per season.
	0.05–0.075 lb acetamiprid	1.1–1.7 oz Assail 70WP	0	
	alpha-cypermethrin	3.0–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.019–0.022 lb beta-cyfluthrin	2.4–2.8 fl oz *Baythroid XL	0	Apply every 7 days as needed. Do not exceed 11.2 fl oz/a.
	0.04–0.10 lb bifenthrin	2.6–6.4 fl oz *Brigade 2EC	3	Do not exceed 0.3 lb (19.2 fl oz formulated product) ai/a per season. Do not make more than 2 applications after bloom. Wait 7 days between applications.
	0.08–0.10 lb bifenthrin	6.8–8.5 fl oz *Capture LFR	21	Do not apply more than 0.1 lb ai/a per season as an at-plant application. Do not apply more than 0.5 lb ai/a per season including other bifenthrin products (e.g., Brigade 2EC).
	bifenthrin + zeta-cypermethrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
	1.0 lb carbaryl	1.0 qt Sevin XLR Plus	3	Repeat applications as necessary up to 6 times per year but not more than once every 7 days. Observe plant response precautions. Do not apply when crop or nearby weeds are in bloom.
	clothianidin	*foliar:* 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		soil: 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a sidedress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
	0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold	3	Apply every 3 days as needed. Do not exceed 14.4 fl oz/a per season.
	0.132–0.179 lb dinotefuran	3.0–4.0 oz Venom 70SG	1	Do not exceed 6.0 oz/a Venom per season.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Do not exceed 0.25 lb ai/a per season.
	0.2–0.3 lb fenpropathrin	10.66–16.0 oz *Danitol 2.4EC	7	Do not exceed 2.66 pt/a per season.

*Restricted-use pesticide.

(continued)

Insect control in cucumber *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cucumber beetles *(cont.)*	0.25–0.375 lb imidacloprid	7.0–10.5 fl oz Admire Pro	21	Apply in a narrow band centered on plant row within 14 days before planting or as an in-furrow treatment during planting. Do not exceed 0.38 lb ai/a per year.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	3	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.24 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.9–1.75 lb malathion	several formulations	1	
	0.45–0.9 lb methomyl	1.5–3.0 pt *Lannate LV	Consult label	Repeat applications as necessary up to 12 times per crop. Do not exceed 18.0 pt/a per year.
	0.5–1.0 lb oxamyl	2.0–4.0 pt *Vydate L	1	Make first application 2–4 weeks after planting. Repeat 2–3 weeks later.
	0.1–0.2 lb permethrin	4.0–8.0 oz *Permethrin 3.2EC	0	Do not exceed 48.0 oz ai/a per season. Wait at least 7 days between treatments.
	thiamethoxam	3.0–5.5 oz Actara 25WDG 5.0–11.0 fl oz Platinum 2SC 1.66–3.67 oz Platinum 75SG	5 30 30	Do not follow applications of Platinum with foliar applications of any other neonicotinoid insecticide. Platinum may be applied to direct-seeded crops in-furrow at seeding or transplant depth or as a narrow surface band above the seedling and followed by irrigation. Do not apply more than 11.0 oz of Actara 25WDG or Platinum 2SC and no more than 3.67 oz Platinum 75SG per acre per crop season and apply sufficient water volume after in-ground application to ensure incorporation into the seed zone. Actara is applied as a foliar spray.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	0.21 lb tolfenpyrad	21.0 fl oz Torac	1	Do not apply until at least 14 days after emergence or after transplanting to allow time for root establishment. This period of time should be extended if conditions at time of emergence or transplanting are not favorable to crop growth. Apply by ground only, using a minimum of 20 gallons of water per acre. Do not apply more than 42.0 fl oz (0.42 lb ai) per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow at least 14 days between applications. Do not make more than 4 applications per year.
	0.018–0.025 lb zeta-cypermethrin	2.8–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.

*Restricted-use pesticide.

(continued)

Insect control in cucumber *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cutworms, cabbage looper	alpha-cypermethrin	1.4–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.0065–0.0125 lb beta-cyfluthrin	0.8–1.6 fl oz *Baythroid XL	0	Apply every 7 days as needed. Do not exceed 11.2 fl oz/a.
	bifenthrin	2.6–6.4 fl oz *Brigade 2EC	3	Apply before insects reach threshold levels. May repeat applications after 7 days, but do not make more than 2 applications after bloom. Do not exceed 0.3 lb ai/a per season.
		3.4–6.8 fl oz *Capture LFR	21	Do not apply more than 0.1 lb ai/a per season as an at-plant application. Do not apply more than 0.3 lb ai/a per season including other bifenthrin products (e.g., Brigade 2EC).
	bifenthrin + zeta-cypermethrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
	1.0 lb carbaryl	Sevin Bait	1	See label for rate. Broadcast when cutworms are present in damaging numbers.
	chlorantraniliprole	3.5–7.5 fl oz Coragen	1	Do not make more than 4 applications per crop season and allow at least 3 days between applications. Do not apply more than 15.4 fl oz/a Coragen per season.
	0.088–0.176 lb cyantraniliprole *(soil)*	6.75–13.5 fl oz Verimark	1	Do not apply more than 13.5 fl oz/a Verimark per crop per season. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6. Minimum application interval between foliar sprays is 5 days.
	0.065–0.11 lb cyantraniliprole *(foliar)*	10.0–17.0 fl oz Exirel	1	
	0.15–0.2 lb cyantraniliprole + abamectin	7.5–10.0 fl oz *Minecto Pro	7	Do not apply more than 0.4 lb per calendar year of cyantraniliprole-containing products, or more than 0.056 lb per calendar year of abamectin-containing products.
	0.012–0.028 lb deltamethrin	1.0–2.4 fl oz *Delta Gold	3	Apply every 3 days as needed. Do not exceed 14.4 fl oz/a per season.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Do not exceed 0.25 lb ai/a per season.
	0.03–0.045 lb flubendiamide	2.0–3.0 oz Synapse WG	1	Do not exceed 3.0 oz/a (0.045 lb ai/a) in a 7-day period or 9.0 oz/a per season.
	flubendiamide + buprofezin	12.0–17.0 fl oz Vetica	7	Do not apply more than 38.0 fl oz/a per season and allow at least 7 days between applications. Do not make more than 3 applications per crop season.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	3	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.24 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.

*Restricted-use pesticide.

(continued)

Insect control in cucumber *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cutworms, cabbage looper *(cont.)*	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.1–0.2 lb permethrin	4.0–8.0 oz *Permethrin 3.2EC	0	Do not exceed 48.0 oz ai/a per season. Wait at least 7 days between applications.
	0.008–0.025 lb zeta-cypermethrin	1.28–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.
Melon aphid	0.047–0.075 lb acetamiprid	2.5–4.0 oz Assail 30SG	0	Begin treatment when thresholds are reached. Apply every 5 days as needed. Do not exceed 5 applications or 0.5 lb ai/a per season.
	0.05–0.075 lb acetamiprid	1.1–1.7 oz Assail 70WP	0	
	alpha-cypermethrin	3.4–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.04–0.10 lb bifenthrin	2.6–6.4 fl oz *Brigade 2EC	3	Apply before insects reach threshold levels. May repeat applications after 7 days, but do not make more than 2 applications after bloom. Do not exceed 0.3 lb ai/a per season.
	bifenthrin + zeta-cypermethrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
	clothianidin	*foliar:* 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		soil: 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a sidedress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
	0.088–0.176 lb cyantraniliprole *(soil)*	6.75–13.5 fl oz Verimark	1	Do not apply more than 13.5 fl oz/a Verimark per crop per season. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6. Minimum application interval between foliar sprays is 5 days.
	0.088–0.133 lb cyantraniliprole *(foliar)*	13.5–20.5 fl oz Exirel	1	
	0.2 lb cyantraniliprole + abamectin	10.0 fl oz *Minecto Pro	7	Do not apply more than 0.4 lb per calendar year of cyantraniliprole-containing products, or more than 0.056 lb per calendar year of abamectin-containing products.
	0.25–0.75 lb diazinon	several formulations	3	Apply as soon as aphids are noticed. Apply no more than 5 applications per season.

*Restricted-use pesticide.

(continued)

Insect control in cucumber *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Melon aphid *(cont.)*	0.045–0.268 lb dinotefuran	*foliar:* 1.0–4.0 oz Venom 70SG *soil:* 5.0–6.0 oz Venom 70SG	1 21	Do not follow soil applications with foliar applications of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 12.0 oz/a per season using soil applications. See product label for application directions.
	0.05–0.18 lb dinotefuran *(foliar)*	2.0–7.0 oz Scorpion 35SL	1	Can repeat at 7-day intervals. Do not apply more than 10.5 oz per year. Use only one application method.
	0.23–0.27 lb dinotefuran *(soil)*	9.0–10.5 oz Scorpion 35SL	21	Do not apply more than 21.0 oz per year. Use only one application method.
	0.062–0.089 lb flonicamid	2.0–2.8 oz Beleaf SG	0	Begin applications before aphid populations build. Do not exceed 2.8 oz/a Beleaf per application and do not apply more than 8.4 oz/a (0.267 lb ai/a) per season.
	flupyradifurone	*foliar:* 10.5–14.0 fl oz Sivanto *soil:* 21.0–28.0 fl oz Sivanto	1 21	Apply when pests reach or exceed established thresholds. Do not apply more than 28.0 fl oz of Sivanto per acre per crop season.
	I. fumosorosea (20%)	1.0–2.0 lb PFR-97	1	Repeat applications at 3- to 10-day intervals over 2–3 weeks or as needed to maintain control. Frequent application may be required under dry conditions, during periods of increased pest buildup or reproduction, or rapid host plant growth.
	0.25–0.38 lb imidacloprid	7.0–10.5 fl oz Admire Pro	21	Apply in a narrow band centered on plant row within 14 days before planting or as an in-furrow treatment during planting. Do not exceed 0.38 lb ai/a per year.
	0.03 lb lambda-cyhalothrin	1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days. For suppression only.
	lambda-cyhalothrin + chlorantraniliprole	9.0 fl oz *Voliam Xpress	1	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.18 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	1.0–2.0 lb malathion	several formulations	1	Do not apply before vining or to wet plants.
	0.45–0.9 lb methomyl	1.5–3.0 pt *Lannate LV		Repeat applications as necessary up to 12 times per crop. Do not exceed 18.0 pt ai/a per season.
	0.86 lb pymetrozine	2.75 oz Fulfill	14	Controls melon and green peach aphids. Treat when aphids first appear. May repeat in 7 days. Do not exceed 5.5 oz/a per season or more than 2 applications per crop.
	0.023 lb sulfoxaflor	0.75 oz Transform WG	1	Do not make applications less than 7 days apart. Do not make more than four applications per crop. Do not make more than two consecu-tive applications per crop. Do not apply more than a total of 8.5 oz of Transform WG (0.266 lb ai of sulfoxaflor) per acre per year.

*Restricted-use pesticide.

(continued)

Insect control in cucumber *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Melon aphid *(cont.)*	thiamethoxam	1.5–3.0 oz Actara 25WDG 5.0–11.0 fl oz Platinum 2SC 1.66–3.67 oz Platinum 75SG	0 30 30	Do not follow applications of Platinum with foliar applications of any other neonicotinoid insecticide. Platinum may be applied to direct-seeded crops in-furrow at the seeding or transplant depth or as a narrow surface band above the seedling and followed by irrigation. Do not apply more than 11.0 oz of Actara 25WDG or Platinum 2SC and no more than 3.67 oz Platinum 75SG per acre per crop season and apply sufficient water volume after in-ground application to ensure incorporation into the seed zone. Actara is applied as a foliar spray.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	0.17–0.21 lb tolfenpyrad	17.0–21.0 fl oz Torac	1	Do not apply until at least 14 days after emergence or after transplanting to allow time for root establishment. This period of time should be extended if conditions at time of emergence or transplanting are not favorable to crop growth. Apply by ground only, using a minimum of 20 gallons of water per acre. Do not apply more than 42.0 fl oz (0.42 lb ai) per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow at least 14 days between applications. Do not make more than 4 applications per year.
	0.02–0.025 lb zeta-cypermethrin	3.2–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.
Seed corn maggot	0.04–0.08 lb bifenthrin	3.4–6.8 oz *Capture LFR		Apply as a 5- to 7-inch band over an open furrow or in-furrow with the seed. Do not apply more than 0.1 lb/a Capture LFR per season as an at-plant application.
	0.13–0.176 lb cyantraniliprole *(soil)*	10.0–13.5 fl oz Verimark	1	Do not apply more than 13.5 fl oz/a Verimark per crop per season. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6.
Spider mite	0.938–1.88 lb abamectin	8.0–16.0 fl oz *Agri-Mek 0.15EC	7	May repeat after 7 days, but do not make more than two sequential treatments or exceed 5.64 lb ai/a per year.
	0.375–0.5 lb bifenazate	0.75–1.0 lb Acramite 50WS	1	Do not exceed 1 application per season.
	0.08–0.10 lb bifenthrin	5.12–6.4 fl oz *Brigade 2EC	3	Apply before insects reach threshold levels. May repeat applications after 7 days, but do not make more than 2 applications after bloom. Do not exceed 0.3 lb ai/a per season.
	bifenthrin + zeta-cypermethrin	10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
	0.11–0.2 lb cyantraniliprole + abamectin	5.5–10.0 fl oz *Minecto Pro	7	Do not apply more than 0.4 lb per calendar year of cyantraniliprole-containing products, or more than 0.056 lb per calendar year of abamectin-containing products

*Restricted-use pesticide.

(continued)

Insect control in cucumber *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Spider mite *(cont.)*	0.625 lb dicofol	20.0 oz Dicofol 4E	2	Do not make more than 1 application per season. Do not use in mixtures with other materials.
	0.2 lb fenpropathrin	10.0–66.0 fl oz *Danitol 2.4EC	7	Treat when mites first appear and repeat every 7 days as needed. Do not exceed 0.8 lb ai/a per season.
	0.1 lb fenpyroximate	2.0 pt Portal	1	Do not apply more than 4.0 pt per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow 14 days between applications.
	I. fumosorosea (20%)	1.0–2.0 lb PFR-97	1	Repeat applications at 3- to 10-day intervals over 2–3 weeks or as needed to maintain control. Frequent application may be required under dry conditions, during periods of increased pest buildup or reproduction, or rapid host plant growth.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	1.5–2.0 lb malathion	several formulations	1	Do not apply before vining or to wet plants.
	0.11–0.13 lb spiromesifen	7.0–8.5 fl oz Oberon 2 SC	7	Apply every 7 days as needed. Do not exceed 25.5 fl oz/a per season.
Squash bug	*Check undersides of leaves for squash bug eggs laid in neat rows. Eggs hatch within 1–2 weeks. Treat when squash bugs are young; they are difficult to control as older nymphs or adults. Destroy crop residue in fall to reduce overwinter survival of this pest.*			
	0.10 lb acetamiprid	5.3 oz Assail 30SG 2.3 oz Assail 70WP	0 0	Begin treatment when thresholds are reached. Apply every 5 days as needed. Do not exceed 5 applications or 0.5 lb ai/a per season.
	alpha-cypermethrin	3.0–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.04–0.10 lb bifenthrin	2.6–6.4 fl oz *Brigade 2EC	3	Apply before insects reach threshold levels. May repeat applications after 7 days, but do not make more than 2 applications after bloom. Do not exceed 0.3 lb ai/a per season.
	1.0 lb carbaryl	1 qt Sevin XLR Plus	3	Repeat applications as necessary up to 6 times per year but not more than once every 7 days. Do not apply when crop or nearby weeds are in bloom.
	bifenthrin + zeta-cypermethrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
	clothianidin	*foliar:* 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		soil: 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a sidedress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.

*Restricted-use pesticide.

(continued)

Insect control in cucumber *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Squash bug *(cont.)*	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Do not exceed 0.25 lb ai/a per season.
	flupyradifurone	*foliar:* 10.5–14.0 fl oz Sivanto *soil:* 21.0–28.0 fl oz Sivanto	1 21	Apply when pests reach or exceed established thresholds. Do not apply more than 28.0 fl oz of Sivanto per acre per crop season.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	1	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.24 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.2 lb permethrin	8.0 oz *Permethrin 3.2EC	0	Do not exceed 48.0 oz ai/a per season. Wait at least 7 days between applications.
	0.018–0.025 lb zeta-cypermethrin	2.8–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.
Squash vine borer	*Treat when adults are observed (900 DD_{50} or when chicory is in bloom), especially when runners are less than 2 feet long. Larvae boring in the main stem can kill the entire plant, while loss of a runner or two when the plant is larger will not cause economic damage. Look for sawdust-like excrement coming from holes in the stems, and open the stems to confirm the presence of squash vine borer larvae. Repeat applications at 5- to 7-day intervals throughout the 3-week egg-laying period.*			
	0.10 lb acetamiprid	5.3 oz Assail 30SG 2.3 oz Assail 70WP	0 0	Begin treatment when thresholds are reached. Apply every 5 days as needed. Do not exceed 5 applications or 0.5 lb ai/a per season.
	alpha-cypermethrin	3.0–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.04–0.10 lb bifenthrin	2.6–6.4 fl oz *Brigade 2EC	3	Apply before insects reach threshold levels. May repeat applications after 7 days, but do not make more than 2 applications after bloom. Do not exceed 0.3 lb ai/a per season.
	bifenthrin + zeta-cypermethrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Do not exceed 0.25 lb ai/a per season.
	flubendiamide + buprofezin	12.0–17.0 fl oz Vetica	7	Do not apply more than 38.0 fl oz/a per season and allow at least 7 days between applications. Do not make more than 3 applications per crop season.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	1	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.24 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.

*Restricted-use pesticide.

(continued)

Insect control in cucumber *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Squash vine borer *(cont.)*	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.1–0.2 lb permethrin	4.0–8.0 oz *Permethrin 3.2EC	0	Do not exceed 48.0 oz ai/a per season. Wait at least 7 days between applications.
	0.018–0.025 lb zeta-cypermethrin	2.8–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.

*Restricted-use pesticide.

Weed control in cucumber

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	0.15–0.38 lb clomazone	0.4–1.0 pt Command 3ME	30	For suppression and control of annual grasses and broadleaves, make a single preemergent soil application after seeding and before crop emergence or prior to transplanting. Place seed or roots of transplants below the chemical barrier when planting. Strictly follow all precautions and restrictions on the label to minimize offsite movement and carryover. Read and understand the vegetable disclaimer section of the label—the end user assumes all liability for failure to perform and crop injury resulting from its use.
	1.1–1.7 lb ethalfluralin	3.0–4.5 pt Curbit 3EC		Make a single broadcast application within 2 days after seeding. Rate varies with soil texture and organic matter. A shallow cultivation or ½ inch of water is needed to activate the herbicide. Heavy rain following application or shallow seeding may result in crop injury. Do not incorporate prior to planting or use under plastic mulch, broadcast over transplants, or apply through irrigation. Do not use on soils with more than 10% organic matter.
	0.4–1.2 lb ethalfluralin + 0.125–0.375 lb clomazone	2.0–6.0 pt Strategy	45	Use only as a postplant surface-applied herbicide. Make 1 application before crop and weeds emerge or apply as a banded spray between rows following crop emergence or transplanting. Strategy requires rainfall, irrigation, or a shallow cultivation within 2–5 days after application for activation. Because of the potential for offsite movement and severe crop injury, strictly follow all precautions and restrictions on the label.

*Restricted-use pesticide.

(continued)

Weed control in cucumber *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds *(cont.)*	trifluralin	several manufacturers	30	Direct-spray between rows when plants have reached the three- to four-leaf stage. Set incorporation equipment to move treated soil around the base of plants. Controls annual grasses and some broadleaf weeds, but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Rate varies with soil texture and organic matter. Follow recommended soil preparation, application, and incorporation procedures. Must be incorporated within 24 hours. See label for plantback restrictions. Ineffective on peat and muck soils.
Annual grasses	5.0–6.0 lb bensulide	5.0–6.0 qt Prefar 4E		Apply preplant or preemergence. Follow application instructions on label. Use on mineral soils only.
Nutsedge and some broadleaves	0.023–0.047 lb halosulfuron	0.5–1.0 oz Sandea	14	Sandea controls several broadleaf weeds and nutsedge. It will not control grasses. Sandea has both pre- and postemergence activity and can be used under plastic mulch. Do not exceed 2 applications per crop cycle or 2.0 oz/a per 12-month period. See label for organophosphate insecticide restrictions. **Consult label for rate, application timing, and other important usage information and precautions.**
Emerged weeds	glyphosate	several manufacturers and formulations		See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. Some formulations require a wait of 3 days between application and seeding. Crop contact will result in severe injury or death. If weeds have been mowed or tilled, do not treat until they have resumed active growth and reached the recommended stage on the label. Unless otherwise stated, allow 7 or more days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified.

*Restricted-use pesticide.

(continued)

Weed control in cucumber *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged weeds *(cont.)*	*paraquat	several manufacturers and formulations, not all are registered for this use		Prepare seedbed early to allow for maximum weed emergence. Application can be made as a banded or broadcast treatment before, during, or after planting, but before crop emergence. In preplant and preemergence (to the crop) uses, do not apply to soils lacking clay minerals (i.e., muck, pure sand). Use the higher rate for heavy weed infestations. Seeding should be performed with minimal soil disturbance. Always add crop oil concentrate or non-ionic surfactant to spray mixture. Follow precautions on label.
Emerged grasses	0.068–0.12 lb clethodim	9.0–16.0 oz Select Max	14	Apply to actively growing grasses. Repeat treatments may be made at 14-day intervals up to the maximum annual use rate. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by product label. Do not apply if rain is expected within 1 hour.
	clethodim	several manufacturers and formulations	14	
	0.094–0.28 lb sethoxydim	0.5–1.5 pt Poast	3	Make postemergence applications to actively growing grasses within the size ranges indicated on the label. Check the label for wild proso millet or rescue treatment rates. Do not apply more than 3.0 pt/a Poast in one crop season. Consult label for rate and adjuvant instructions for specific weeds. Check the label for additional precautions and restrictions.

*Restricted-use pesticide.

Eggplant

Planting

Choose well-drained, moderately fertile, sandy loam soils. Seeds germinate best at soil temperatures of 75–90°F. Set medium-sized, vigorous 6- to 8-week-old plants outside about June 1, or after danger of frost and chilling. Before transplanting, harden the plants by holding them at 60–65°F for a few days or place them in covered beds outside the greenhouse. To lessen the shock from transplanting, use a starter solution high in phosphorus.

Rows: 24–48 inches.

Plants in row: 18–30 inches apart. Use 2.0 oz seed/a. (1.0 oz produces 2,500 plants.)

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 6.6–6.9.

Fertilizer rates: Apply 60–100 lb N/a, 60 lb P_2O_5/a, and 60 lb K_2O/a. Take credits for previous legume crops and manure.

Application: Broadcast and work in before planting.

Nitrogen: On sandy soils, use the higher nitrogen rate and split the recommendation into two or more applications during the season, preferably at 2–3 week intervals.

Disease control in eggplant

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Alternaria blight, anthracnose, and Phomopsis fruit rot	boscalid	2.5–3.5 oz Endura	0	Do not make more than 6 applications of Endura per season. Do not apply more than 21.0 oz Endura/a per season.
	cyprodinil + fludioxonil	11.0–14.0 oz Switch 62.5WG	0	Do not apply more than 56.0 oz/a product per plot of land per year. After 2 applications, alternate with another fungicide with a different mode of action for 2 applications.
	difenoconazole + cyprodinil	16.0–20.0 fl oz Inspire Super	0	Begin applications prior to disease development. Do not apply more than 47.0 fl oz/a Inspire Super per season.
	fenamidone	*Alternaria:* 5.5–8.2 fl oz Reason 500 SC	14	Do not apply more than 24.6 fl oz/a per year. Do not apply more than one time before alternating to an effective fungicide with a different mode of action.
	fixed copper	2.0 lb Champion 77WP 1.33 pt Champ Formula 2 Flowable 2.0 lb Kocide 77WP, DF 1.5 lb Kocide 2000 DF 0.75–1.5 lb Kocide 3000	0 0 0 0 0	Rotate with crops other than eggplant, tomato, or pepper; use disease-free seed; and grow resistant varieties. Florida Market and Florida Beauty are resistant to Phomopsis fruit rot, though they are very late for Wisconsin. Begin applications prior to disease onset.
	fluoxastrobin	3.8–5.7 fl oz Evito 480 SC *Alternaria:* 2.0–5.7 fl oz Aftershock	3	For optimum results, apply preventively. Alternate every application with an effective fungicide of a different mode of action. Do not apply to fruiting vegetables grown in the greenhouse. Maximum of 4 applications/a per year.

(continued)

Disease control in eggplant *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Alternaria blight, anthracnose, and Phomopsis fruit rot *(cont.)*	fluxapyroxad + pyraclostrobin	4.0–8.0 fl oz Priaxor	7	Do not use more than 24.0 fl oz/a per year. Do not apply more than three times/a per year. See label for specific tank-mix restrictions, which include no tank mixes with EC (emulsifiable concentrates) or solvent-based formulations.
	penthiopyrad	10.0–24.0 fl oz Fontelis (24.0 fl oz rate for anthracnose suppression)	0	Do not exceed 72.0 fl oz/a per year. Labeled for use on greenhouse-grown fruiting vegetables. See label for rate and application details.
	pyraclostrobin	8.0–12.0 oz Cabrio EG	0	Begin application prior to disease onset. Use higher rate and shorter interval when disease pressure is high.
	tebuconazole	8.0 fl oz Tebuzol 3.6F, Toledo, Willowood Teb 3.6SC	7	Only controls early blight (Alternaria). Follow resistance management guidelines.
	tetraconazole	6.0–8.0 fl oz Mettle 125ME	0	Do not apply more than 16 fl oz per acre per year. Follow resistance management guidelines.
	trifloxystrobin	*Alternaria:* 2.0–3.0 oz Flint *Anthracnose:* 3.0–4.0 oz Flint	3	Do not apply more than 16.0 oz/a per season. Alternate fungicide modes of action. Tank mix with a protective fungicide.
Anthracnose	azoxystrobin	6.0–15.5 fl oz Aframe, AzoxyStar, Equation, Quadris Flowable, Satori, Willowood Azoxy 2SC	0	Equation, Quadris, and Satori, and Cabrio belong to the Group 11 (strobilurin) category of fungicides. Do not exceed 1 application of a strobilurin product before alternating with a fungicide having a different mode of action. Do not exceed 4 applications of strobilurin fungicides per crop per acre per year. Do not exceed 1.92 qt/a Equation, Quadris, or Satori, or 96.0 oz/a Cabrio per season.
	azoxystrobin + difenoconazole	8.0–14.0 fl oz Quadris Top	0	
	azoxystrobin + benzovindiflupyr	0.6–0.8 oz/5,000 sq ft Mural (for treatment in greenhouses for plant resale)	0	Allowable growing environments include greenhouses, enclosed structures, and fields for the purpose of plant resale to consumer.
	chlorothalonil	1.5 pt Echo 720, Equus 720 SST	3	Begin application when disease is anticipated.
		1.4 lb Bravo Ultrex	3	Do not use more than 10.9 lb Bravo Ultrex/a per year.
		1.5 pt Bravo Weather Stik	3	Do not apply more than 12.0 pt/a per season.
	chlorothalonil + cymoxanil	2.0–2.44 pt Ariston	3	Apply when conditions favor disease.
	difenoconazole + benzovindiflupyr	10.5–13.5 fl oz Aprovia Top	0	Follow resistance management guidelines. Do not apply more than 53.6 fl oz per acre per year.
	fluopyram + trifloxystrobin	7.6 fl oz Luna Sensation	3	Do not make more than 5 applications per year.
	flutriafol	14.0 fl oz Topguard	0	For management of Anthracnose and Cercospora. Follow resistance management guidelines.
	tetraconazole	6.0–8.0 fl oz Mettle 125ME	0	Do not apply more than 16 fl oz per acre per year. Follow resistance management guidelines.

(continued)

Disease control in eggplant *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Phytophthora blight, ripe rot	ametoctradin + dimethomorph	14.0 fl oz Zampro	4	Do not apply more than 42.0 fl oz per season. Begin application prior to disease development.
	cyazofamid	2.75 fl oz Ranman	0	Should be tank mixed with a surfactant when disease is severe. Do not apply more than 16.5 fl oz/a per year.
	dimethomorph	6.0 oz Forum	0	Disease suppression only. Tank mix with another fungicide active against Phytophthora blight and having a different mode of activity. Do not make more than 2 sequential applications of Forum before alternating to another effective fungicide. Do not make more than 5 applications per season or apply more than 32.0 oz/a per season. (Formerly Acrobat.)
	ethaboxam	8.0 fl oz Elumin	2	Can be applied in drip irrigation system. Follow resistance management guidelines.
	fenamidone	8.2 fl oz Reason 500 SC	14	Do not apply more than 24.6 fl oz/a per year. Do not apply more than one time before alternating to an effective fungicide with a different mode of action.
	fluazinam	1.0–1.5 pt Omega 500F	30	Initial application may be made as a soil drench at transplanting at 1.5 pt/a. Do not apply more than 9.0 pt/a per growing season.
	fluopicolide	3.0–4.0 fl oz Presidio	2	Tank mix with another fungicide having different mode of action must be used for resistance management.
	mandipropamid	8.0 fl oz Revus	1	Begin management with an initial treatment at transplanting with a fungicide registered for this use. Apply Revus as a foliar application with a copper-containing fungicide at first sign of disease.
	oxathiapiprolin	2.0–4.8 fl oz Orondis Opti A, Orondis Ultra A	0	Make no more than 2 sequential applications before rotating to a fungicide with a different mode of action. Do not exceed 4.8 fl oz/a per treatment, or 19.2 fl oz/a per year. Begin foliar applications prior to disease development and continue on a 5- to 14-day interval. Do not use foliar Orondis Ultra A if you have already used Orondis Gold 200 soil treatments.
	pyraclostrobin	8.0–16.0 oz Cabrio EG	0	Begin application prior to disease onset. Use higher rate and shorter interval when disease pressure is high.
	trifloxystrobin	4.0 oz Flint	3	Do not apply more than 16.0 oz/a per season. Alternate fungicide modes of action.
Seed rot and damping-off	azoxystrobin	*Rhizoctonia seedling rot:* 0.4–0.8 fl oz Quadris Flowable/1,000 ft row	—	See general information on labels for soilborne and seedling disease control.
	mefenoxam	1.0–2.0 pt Ridomil Gold SL	—	Preplant-incorporated application or surface application at planting. Preplant to top 2 inches of soil.
		0.085–0.64 fl oz Apron XL/100 lb seed	—	Follow manufacturer's directions. Do not use treated seed for feed or food.

(continued)

Disease control in eggplant *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Seed rot and damping-off *(cont.)*	metalaxyl	4.0–8.0 pt MetaStar 2E AG	—	Preplant-incorporated application or surface application at planting. Preplant to top 2 inches of soil.
		0.75 fl oz/100 lb seed Allegiance FL, Metalaxyl 265 ST	—	Follow manufacturer's directions. Do not use treated seed for feed or food.
Verticillium wilt	metam-sodium	Vapam HL, Metam, Sectagon 42		Use long rotations with non-susceptible crops and eradicate weeds. Plant in well-drained soils. Steam sterilization can also be used.

Insect control in eggplant

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids	0.038–0.075 lb acetamiprid	2.0–4.0 oz Assail 30SG	7	Begin treatment when thresholds are reached. Apply every 7 days as needed. Do not exceed 5 applications or 0.375 lb ai/a per season.
	0.035–0.075 lb acetamiprid	0.8–1.7 oz Assail 70WP	7	
	0.06–0.15 lb bifenthrin + imidacloprid	3.9–9.85 fl oz *Brigadier	7	Do not apply more than 25.6 fl oz/a (0.4 lb ai/a) per season. No more than 0.2 lb ai/a bifenthrin and 0.24 lb ai/a imidacloprid are allowed per season.
	0.088–0.176 lb cyantraniliprole *(soil)*	6.75–13.5 fl oz Verimark	1	Do not apply more than 13.5 fl oz/a Verimark per crop per season. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6.
	0.088–0.133 lb cyantraniliprole *(foliar)*	13.5–20.5 fl oz Exirel	1	Minimum application interval between treatments is 5 days. Scarlet eggplant: For best performance, use with an effective adjuvant. Do not apply a total of more than 0.4 lb ai/a of cyazypyr or cyantraniliprole-containing products.
	0.2 lb cyantraniliprole + abamectin	10.0 fl oz *Minecto Pro	7	Do not apply more than 0.4 lb per calendar year of cyantraniliprole-containing products, or more than 0.056 lb per calendar year of abamectin-containing products.
	0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold	1	Apply every 5 days as needed. Do not exceed 14.4 fl oz/a.
	0.045–0.268 lb dinotefuran	*foliar:* 1.0–4.0 oz Venom 70SG *soil:* 5.0–6.0 oz Venom 70SG	1 21	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 6.0 oz/a per year using foliar applications, or 12.0 oz/a per season using soil applications. See product label for application directions.
	0.05–0.18 lb dinotefuran *(foliar)*	2.0–7.0 oz Scorpion 35SL	1	Can repeat at 7-day intervals. Do not apply more than 10.5 oz per year. Use only one application method.
	0.23–0.27 lb dinotefuran *(soil)*	9.0–10.5 oz Scorpion 35SL	21	Do not apply more than 21.0 oz per year. Use only one application method.

*Restricted-use pesticide.

(continued)

Insect control in eggplant *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids *(cont.)*	0.062–0.089 lb flonicamid	2.0–2.8 oz Beleaf SG	0	Begin applications before aphid populations build. Do not exceed 2.8 oz/a Beleaf per application and do not apply more than 8.4 oz/a (0.267 lb ai/a) per season.
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	5	For suppression of aphids only. Apply every 5 days as needed. Do not apply more than 2.88 pt/a (0.18 lb ai/a) per season.
	0.25–0.38 lb imidacloprid	7.0–10.5 fl oz Admire Pro	21	Systemic at planting.
		3.75 fl oz Provado 1.6	0	Foliar spray. Do not exceed 18.75 fl oz/a Provado per season.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	5	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.36 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season. For suppression only.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	5	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.63–1.0 lb malathion	several formulations	3	
	0.225-0.90 lb methomyl	0.25–1.0 lb *Lannate SP 0.75–3.0 pt *Lannate LV	5	Do not exceed 4.5 lb ai/a per season.
	pymetrozine	2.75 oz Fulfill WDG	14	Treat when aphids first appear. Controls potato and green peach aphids. May repeat application in 7 days. Do not exceed 5.5 oz/a per season or 2 applications per crop.
	0.06–0.08 lb spirotetramat	4.0–5.0 fl oz Movento	1	Do not apply more than 10.0 fl oz/a (0.16 lb ai/a) per season.
	0.063–0.078 lb spirotetramat + 0.022–0.027 lb pyriproxifen	8.0–10.0 fl oz Senstar	1	Do not apply more than 10 fl oz of Senstar Insecticide (0.078 lb spirotetramat and 0.027 lb pyriproxyfen) per acre per application. Do not make more than 2 applications per crop season. Do not apply more than 20 fl oz of Senstar Insecticide (0.156 lb spirotetramat and 0.055 lb pyriproxyfen) per acre per crop season. Minimum interval between applications is 14 days. Regardless of formulation do not apply more than 0.16 lb spirotetramat and 0.108 lb pyriproxyfen per acre per crop season.
	0.023–0.031 lb sulfoxaflor	0.75–1.0 oz Transform WG	1	Do not make applications less than 7 days apart. Do not make more than four applications per crop. Do not make more than two consecutive applications per crop. Do not apply more than a total of 8.5 oz of Transform WG (0.266 lb ai of sulfoxaflor) per acre per year.

*Restricted-use pesticide.

(continued)

Insect control in eggplant *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids *(cont.)*	thiamethoxam	2.0–3.0 oz Actara 25WDG 5.0–11.0 fl oz Platinum 2SC 1.66–3.67 oz Platinum 75SG	0 30 30	Do not apply more than 11.0 oz of Actara 25WDG or Platinum 2SC and no more than 3.67 oz Platinum 75SG per acre per crop season and apply sufficient water volume after in-ground application to ensure incorporation into the seed zone. Actara is applied as a foliar spray.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	0.17–0.21 lb tolfenpyrad	17.0–21.0 fl oz Torac	1	Do not apply until at least 14 days after emergence or after transplanting to allow time for root establishment. This period of time should be extended if conditions at time of emergence or transplanting are not favorable to crop growth. Apply by ground only, using a minimum of 20 gallons of water per acre. Do not apply more than 42.0 fl oz (0.42 lb ai) per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow at least 14 days between applications. Do not make more than 4 applications per year.
	zeta-cypermethrin	3.2–4.0 oz *Mustang Maxx	1	Apply every 7 days as needed. Use higher rate for heavy infestations. Do not exceed 24.0 oz/a Mustang Maxx per season.
Colorado potato beetle	*When plants are smaller than 6 inches, treat if you find two small larvae or one large larvae or adult per plant. For plants taller than 6 inches, treat if you find four small larvae or two large larvae or adults per plant.*			
	0.009–0.019 lb abamectin	8.0–16.0 fl oz *Agri-Mek 0.15EC	7	Begin treatments at thresholds. Use high rates for resistance management.
	0.028–0.047 lb acetamiprid	1.5–2.5 oz Assail 30SG	7	Begin treatment when thresholds are reached. Apply every 7 days as needed. Do not exceed 5 applications or 0.3 lb ai/a per season.
	0.025–0.05 lb acetamiprid	0.6–1.1 oz Assail 70WP	7	
	Bacillus thuringiensis subsp. *tenebrionis*	1.0–3.0 qt Novador	0	Make initial spray when small larvae are first observed.
	3.0–6.0 qt *Bacillus thuringiensis* subsp. *tenebrionis*	3.0–6.0 qt Trident	1	Use 3.0–6.0 quarts of Trident per acre, in a minimum spray volume of 20 gallons of water per acre. Use the 3.0 qt per acre rate only when light populations of larvae of uniform age/size are present.
	0.033–0.10 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	7	Apply every 7 days as needed. Do not exceed 0.2 lb ai/a per season.
	0.08–0.15 lb bifenthrin + imidacloprid	5.1–9.85 fl oz *Brigadier	7	Do not apply more than 25.6 fl oz/a (0.4 lb ai/a) per season. No more than 0.2 lb ai/a bifenthrin and 0.24 lb ai/a imidacloprid are allowed per season.
	1.0–2.0 lb carbaryl	1.0–2.0 qt Sevin XLR Plus	3	Repeat applications as necessary up to a total of 7 times per year but not more than once every 7 days.Do not exceed 8.0 qt per crop per year. Do not apply when crop or nearby weeds are in bloom.
	chlorantraniliprole	3.5–7.5 fl oz Coragen	1	Do not make more than 4 applications per crop season and allow at least 3 days between applications. Do not apply more than 15.4 fl oz/a Coragen per season.

*Restricted-use pesticide.

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Insect control in eggplant *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Colorado potato beetle *(cont.)*	0.065–0.130 lb cyantraniliprole *(drip, chemigation, or soil injection only)*	5.0–10.0 fl oz Verimark	1	Do not apply more than 13.5 fl oz/a Verimark per crop per season. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6. Minimum application interval between foliar sprays is 5 days.
	0.045–0.088 lb cyantraniliprole *(foliar)*	7.0–13.5 fl oz Exirel	1	
	0.11–0.2 lb cyantraniliprole + abamectin	5.5–10.0 fl oz *Minecto Pro	7	Do not apply more than 0.4 lb per calendar year of cyantraniliprole-containing products, or more than 0.056 lb per calendar year of abamectin-containing products.
	0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold	1	Apply every 5 days as needed. Do not exceed 14.4 fl oz/a.
	0.045–0.268 lb dinotefuran	*foliar:* 1.0–4.0 oz Venom 70SG *soil:* 5.0–6.0 oz Venom 70SG	1 21	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 12.0 oz/a per season using soil applications. See product label for application directions.
	0.05–0.18 lb dinotefuran *(foliar)*	2.0–7.0 oz Scorpion 35SL	1	Can repeat at 7-day intervals. Do not apply more than 10.5 oz per year. Use only one application method.
	0.23–0.27 lb dinotefuran *(soil)*	9.0–10.5 oz Scorpion 35SL	21	Do not apply more than 21.0 oz per year. Use only one application method.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	7	Do not exceed 0.35 lb ai/a per season.
	0.137–0.183 lb flupyradifurone	10.5–14.0 fl oz Sivanto 200SL	1	Minimum interval between applications is 7 days. Minimum application volumes is 10 gal/a for ground, and 2 gal/a for aerial. Maximum Sivanto 200SL allowed per year is 28.0 fl oz/a (0.365 lb ai/a).
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	5	Apply every 5 days as needed. Do not apply more than 2.88 pt/a (0.18 lb ai/a) per season.
	0.25–0.38 lb imidacloprid	7.0–10.5 fl oz Admire Pro	21	Systemic at planting.
		3.75 fl oz Provado 1.6	0	Foliar spray.
	imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	7	Minimum interval between applications is 7 days and maximum allowable crop use per season is 15.4 fl oz/a.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	5	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.36 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	5	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.15 lb permethrin	6.0 oz *Permethrin 3.2EC	3	Do not exceed 24.0 oz ai/a per season. Wait 7 days between applications

*Restricted-use pesticide.

(continued)

Insect control in eggplant *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Colorado potato beetle *(cont.)*	0.039–0.078 lb spinetoram	5.0–10.0 oz Radiant SC	1	Do not apply more than 34.0 oz/a Radiant (0.266 lb ai/a) per crop and do not exceed 6 applications per year.
	spinosad	3.0–10.0 fl oz Entrust SC	1	Use higher rate for larger insects. Do not exceed 0.45 lb ai/a per season. Do not use a buffering agent. Spray thoroughly for control.
	thiamethoxam	2.0–3.0 oz Actara 25WDG 5.0–11.0 fl oz Platinum 2SC 1.66–3.67 oz Platinum 75SG	0 30 30	Do not apply more than 11.0 oz of Actara 25WDG or Platinum 2SC and no more than 3.67 oz Platinum 75SG per acre per crop season and apply sufficient water volume after in-ground application to ensure incorporation into the seed zone. Actara is applied as a foliar spray.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	0.14–0.21 lb tolfenpyrad	14.0–21.0 fl oz Torac	1	Do not apply until at least 14 days after emergence or after transplanting to allow time for root establishment. This period of time should be extended if conditions at time of emergence or transplanting are not favorable to crop growth. Apply by ground only, using a minimum of 20 gallons of water per acre. Do not apply more than 42.0 fl oz (0.42 lb ai) per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow at least 14 days between applications. Do not make more than 4 applications per year.
	zeta-cypermethrin	2.24–4.0 oz *Mustang Maxx	1	Apply every 7 days as needed. Use higher rate for heavy infestations. Do not exceed 24.0 oz/a Mustang Maxx per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	7	Do not apply more than 0.266 lb ai/a per season. Wait at least 7 days between applications.
European corn borer	beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Maximum Baythroid XL allowed per 7-day interval is 2.8 fl oz/a and season total allowed per crop season is 16.8 fl oz/a.
	0.08–0.15 lb bifenthrin + imidacloprid	5.1–9.85 fl oz *Brigadier	7	Do not apply more than 25.6 fl oz/a (0.4 lb ai/a) per season. No more than 0.2 lb ai/a bifenthrin and 0.24 lb ai/a imidacloprid are allowed per season.
	chlorantraniliprole	3.5–7.5 fl oz Coragen	1	Do not make more than 4 applications per crop season and allow at least 3 days between applications. Do not apply more than 15.4 fl oz/a Coragen per season.
	0.130 lb cyantraniliprole *(drip, chemigation, or soil injection only)*	10.0 fl oz Verimark	1	Do not apply more than 13.5 fl oz/a Verimark per crop per season. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6. Minimum application interval between foliar sprays is 5 days.
	0.045–0.088 lb cyantraniliprole *(foliar)*	7.0–13.5 fl oz Exirel	1	
	0.11–0.2 lb cyantraniliprole + abamectin	5.5–10.0 fl oz *Minecto Pro	7	Do not apply more than 0.4 lb per calendar year of cyantraniliprole-containing products, or more than 0.056 lb per calendar year of abamectin-containing products.

*Restricted-use pesticide.

(continued)

Insect control in eggplant *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
European corn borer *(cont.)*	0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold	1	Apply every 5 days as needed. Do not exceed 14.4 fl oz/a.
	0.03–0.045 lb flubendiamide	2.0–3.0 oz Synapse WG	1	Do not exceed 3.0 oz/a (0.045 lb ai/a) in a 7-day period or 9.0 oz/a per season.
	imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	7	Minimum interval between applications is 7 days and maximum allowable crop use per season is 15.4 fl oz/a.
	0.065–0.11 lb indoxacarb	3.5–6.0 oz Avaunt	7	Do not exceed 0.26 lb ai/a per season.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	5	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.36 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	5	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.063–0.25 lb methoxyfenozide	4.0–16.0 fl oz Intrepid 2F	1	Will not control Colorado potato beetle. Do not exceed 64.0 fl oz/a per season. Use higher rate with higher populations or when spray coverage is difficult. See label for use restrictions in some Wisconsin counties.
	0.039–0.078 lb spinetoram	5.0–10.0 oz Radiant SC	1	Do not apply more than 34.0 oz/a Radiant (0.266 lb ai/a) per crop and do not exceed 6 applications per year.
	spinosad	3.0–10.0 fl oz Entrust SC	1	Use higher rate for larger insects. Do not exceed 0.45 lb ai/a per season. Do not use a buffering agent. Spray thoroughly for control.
	0.21 lb tolfenpyrad	21.0 fl oz Torac	1	Do not apply until at least 14 days after emergence or after transplanting to allow time for root establishment. This period of time should be extended if conditions at time of emergence or transplanting are not favorable to crop growth. Apply by ground only, using a minimum of 20 gallons of water per acre. Do not apply more than 42.0 fl oz (0.42 lb ai) per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow at least 14 days between applications. Do not make more than 4 applications per year.
	0.014–0.025 lb zeta-cypermethrin	2.24–4.0 oz *Mustang Maxx	1	Apply every 7 days as needed. Use higher rate for heavy infestations. Do not exceed 24.0 oz/a Mustang Maxx per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	7	Do not apply more than 0.266 lb ai/a per season. Wait at least 7 days between applications.

*Restricted-use pesticide.

(continued)

Insect control in eggplant *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Flea beetles (striped, spotted)	*When eggplants are less than 3 inches tall, treat if you find two beetles per plant. At a plant height of 3–6 inches, treat if there are four beetles per plant. For plants taller than 6 inches, treat if you find eight or more beetles per plant.*			
	beta-cyfluthrin	2.8 fl oz *Baythroid XL	0	Maximum Baythroid XL allowed per 7-day interval is 2.8 fl oz/a and season total allowed per crop season is 16.8 fl oz/a.
	0.03–0.05 lb bifenthrin	5.8–9.6 oz *Brigade 2EC	7	Do not exceed 0.35 lb ai/a per season. Apply when insects are observed or when insect damage is observed. Repeat applications at 7–10 day intervals to achieve control.
	0.08–0.15 lb bifenthrin + imidacloprid	5.1–9.85 fl oz *Brigadier	7	Do not apply more than 25.6 fl oz/a (0.4 lb ai/a) per season. No more than 0.2 lb ai/a bifenthrin and 0.24 lb ai/a imidacloprid are allowed per season.
	0.5–1.0 lb carbaryl	0.5–1.0 qt Sevin XLR Plus	3	Repeat applications as necessary up to a total of 7 times per year but not more than once every 7 days.Do not exceed 8.0 qt per crop per year. Do not apply when crop or nearby weeds are in bloom.
	0.088–0.176 lb cyantraniliprole *(soil)*	6.75–13.5 fl oz Verimark	1	Do not apply more than 13.5 fl oz/a Verimark per crop per season. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6.
	0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold	1	Apply every 5 days as needed. Do not exceed 14.4 fl oz/a.
	0.045–0.268 lb dinotefuran	*foliar:* 1.0–4.0 oz Venom 70SG *soil:* 5.0–6.0 oz Venom 70SG	1 21	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 12.0 oz/a per season using soil applications. See product label for application directions.
	0.05–0.18 lb dinotefuran *(foliar)*	2.0–7.0 oz Scorpion 35SL	1	Can repeat at 7-day intervals. Do not apply more than 10.5 oz per year. Use only one application method.
	0.23–0.27 lb dinotefuran *(soil)*	9.0–10.5 oz Scorpion 35SL	21	Do not apply more than 21.0 oz per year. Use only one application method.
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	5	Apply every 5 days as needed. Do not apply more than 2.88 pt/a (0.18 lb ai/a) per season.
	imidacloprid	7.0–10.5 fl oz Admire Pro	21	Systemic at planting.
	imidacloprid + beta-cyfluthrin	4.1 fl oz *Leverage 360	7	Minimum interval between applications is 7 days and maximum allowable crop use per season is 15.4 fl oz/a.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	5	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.36 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season. For suppression only.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	5	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.

*Restricted-use pesticide.

(continued)

Insect control in eggplant *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Flea beetles *(cont.)*	0.15 lb permethrin	6.0 oz *Permethrin 3.2EC	3	Do not apply more than 24.0 oz/a per season. Wait at least 7 days between applications.
	thiamethoxam	2.0–3.0 oz Actara 25WDG 5.0–11.0 fl oz Platinum 2SC 1.66–3.67 oz Platinum 75SG	0 30 30	Do not apply more than 11.0 oz of Actara 25WDG or Platinum 2SC and no more than 3.67 oz Platinum 75SG per acre per crop season and apply sufficient water volume after in-ground application to ensure incorporation into the seed zone. Actara is applied as a foliar spray.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	0.17–0.21 lb tolfenpyrad	17.0–21.0 fl oz Torac	1	Apply by ground only, using a minimum of 20 gallons of water per acre. Do not apply by air on fruiting vegetables. Do not apply more than 42.0 fluid ounces (0.42 lb ai) per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow at least 14 days between applications. Do not make more than 4 applications per year.
	0.014–0.025 lb zeta-cypermethrin	2.24–4.0 oz *Mustang Maxx	1	Apply every 7 days as needed. Use higher rate for heavy infestations. Do not exceed 24.0 oz/a Mustang Maxx per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	7	Do not apply more than 0.266 lb ai/a per season. Wait at least 7 days between applications.

*Restricted-use pesticide.

Weed control in eggplant

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	*transplants only:* 1.0–2.0 lb napropamide	2.0–4.0 lb Devrinol DF-XT 2.0–4.0 qt Devrinol 2-XT		Apply to weed-free soil before transplanting. Incorporate 1–2 inches. Use the lower rate on coarse, sandy soils. Carryover the following year may affect sensitive crops, especially small grains.
	0.48–1.43 lb pendimethalin	1.0–3.0 pt Prowl H_2O	70	Apply as a broadcast preplant-incorporated or as a broadcast surface application before transplanting, or as a post- directed application to transplanted or established direct-seeded eggplant. Do not apply postemergence over the top of eggplant foliage. Rate varies by soil type. Do not exceed 3.0 pt/a per season or allow treated soil to come in contact with transplants.
	trifluralin	several manufacturers		Apply before transplanting or as a directed spray to the soil between rows after transplanting. Tolerance of eggplant to trifluralin is marginal. Controls annual grasses and some broadleaf weeds, but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Rate varies with soil texture and organic matter. Follow recommended soil preparation, application, and incorporation procedures. Incorporate within 24 hours. See label for plantback restrictions. Ineffective on peat and muck soils.

*Restricted-use pesticide.

(continued)

Weed control in eggplant *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual grasses	5.0–6.0 lb bensulide	5.0–6.0 qt Prefar 4E		Apply before planting and incorporate 1–2 inches deep to avoid loss due to volatilization. Use on mineral soils only.
Nutsedge and some broad-leaves	0.023–0.047 lb halosulfuron	0.5–1.0 oz Sandea	30	Sandea controls several broadleaf weeds and nutsedge. It will not control grasses. Sandea may be applied between rows of direct-seeded or transplanted eggplant as a directed or shielded spray. Avoid contact of the spray with the crop. If plastic was used on the planted row, adjust equipment to keep application off the plastic. Do not apply more than 2.0 oz/a per crop cycle or 12-month period. Soil or foliar applications of organophosphate insecticides to Sandea-treated crops may increase potential for and severity of crop injury. **Consult label for additional usage information and other precautions.**
Emerged weeds	glyphosate	several manufacturers and formulations		See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. Some formulations require a wait of 3 days between application and planting. Contact with the crop will result in severe injury or death. If weeds have been mowed or tilled, do not treat until they have resumed active growth and reached the recommended stage on the label. Unless otherwise stated, allow 7 or more days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified.
	*paraquat	several manufacturers and formulations, not all are registered for this use		Prepare seedbed early to allow for maximum weed emergence. Application can be made as a banded or broadcast treatment before, during, or after planting, but before crop emergence. In preplant and preemergence (to the crop) uses, do not apply to soils lacking clay minerals (i.e., muck, pure sand). Use the higher rate for heavy weed infestations. Seeding and transplanting should be performed with minimal soil disturbance. Up to three directed/shielded treatments may be made per season using precision equipment to prevent spray contact with the crop. Always add crop oil concentrate or non-ionic surfactant to spray mixture. Follow precautions on label.
Emerged grasses	0.068–0.12 lb clethodim	9.0–16.0 oz Select Max	20	Apply to actively growing grasses. Repeat treatments may be made at 14-day intervals up to the maximum annual use rate. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by product label. Do not apply if rain is expected within 1 hour.
	clethodim	several manufacturers and formulations	20	
	0.094–0.28 lb sethoxydim	0.5–1.5 pt Poast	20	Make postemergence applications to actively growing grasses within the size ranges indicated on the label. Check the label for early and rescue treatment rates as well as additional precautions and restrictions. Do not exceed 4.5 pt/a Poast per season. Consult label for rate and adjuvant instructions for specific weeds.

*Restricted-use pesticide.

Hops

Hops are grown for their aromatic cones, which are used to enhance bitterness and flavor in beer. Though Wisconsin was the number one hops producer in the U.S. in the mid-1860s, production declined in subsequent years due to pest and disease challenges in addition to market factors. With the rising popularity of regional craft brews and locally sourced ingredients, production is again on the rise; a recent UW–Madison Division of Extension poll indicated close to 300 acres of hops grown currently with considerable expansion on the horizon.

Planting and cultivation

Hops are grown as a vegetatively propagated perennial on elaborate trellis systems. In Wisconsin, hop trellis height commonly ranges from 16–20 feet, though the optimal height has not been empirically established for the region. New yards can be started with rhizomes or, more commonly, small plantlets generated from softwood cuttings. Individual plants are spaced 30–36 inches apart with approximately 12 feet between rows.

Training of the hop bines occurs in the spring when shoots are 12–24 inches long. Two to four shoots are selected and wound in a clockwise direction around each string. In some cases a second round of training may be necessary if there are insufficient shoots the first time through.

Established plants will produce many more shoots than required for training and these are removed, most commonly with chemical desiccants, after the trained bines have developed sufficient woody tissue. This removal may occur several times during the growing season. Any male plants accidentally introduced to the hop yard should be removed as to prevent fertilization and the formation of seeds in female cones, as this is undesirable to brewers.

While hop plants may start producing cones in their first year, peak production is generally not reached until the third year. Harvest is generally not recommended in the first 1–2 years of yard establishment in order to allow sufficient development of the root system and ensure maximum yields in subsequent years.

Irrigation

Supplemental irrigation systems are common in most commercial hop yards in Wisconsin. Typically, these are drip systems with emitters suspended approximately 12 inches from the ground.

Nutrient management guidelines

See Extension publication *Nutrient Application Guidelines for Field, Vegetable, and Fruit Crops in Wisconsin* (A2809) for hop fertility information. The publication can be downloaded for free by visiting learningstore.extension.wisc.edu and entering A2809 in the search box.

Harvest

While harvest timing is largely dependent on variety, the Wisconsin harvest season generally spans from mid-August through mid-September. Harvest timing is also influenced by the chemical properties of ripening cones. Growers frequently utilize testing services to determine peak ripeness. Most hops in the state are mechanically harvested, as hand harvesting is intensely laborious. Typically, the bines are cut by hand and transported to the harvester, use of which may be arranged with another grower if not owned. A small percentage of fresh, so-called "wet" hops are used immediately after harvest for brewing, but the majority are dried, pelletized, and frozen for storage and later use.

Forward contributed by Michelle Marks, graduate research assistant, UW–Madison Plant Pathology.

Disease control in hops

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Downy mildew (*Pseudoperonospora humili*)	ametoctradin + dimethomorph	11.0–14.0 fl oz Zampro	7	Do not apply more than 40.0 fl oz/a per season. Make no more than 3 applications per season. Do not make more than 2 sequential applications before alternating to a labeled fungicide with a different mode of action.
	Bacillus pumilis strain QST 2808	2.0–4.0 qt/100 gal spray volume of Sonata	0	Use when conditions favor disease and apply at 7- to 14-day intervals as needed. OMRI approved.
	basic copper sulfate	1.0–1.25 lb Cuprofix Ultra 40 Disperss	14	Apply after pruning but before training. Apply again as needed on a 10-day basis after training.
	copper ammonium complex	2.0 qt Copper Count N	14	Apply after pruning but before training. Apply again as needed on a 10-day basis after training.
	copper hydroxide	1.33 lb Champ Dry Prill 1.33 lb Champ Formula 2 Flowable 1.06 lb Champ WG 0.75–1.5 lb Kocide 3000 1.5 lb Kocide 2000 2.0 lb Kentan DF 1.33–2.67 pt NuCop 3L	14	Apply after pruning but before training. Apply again as needed on a 10-day basis after training.
	copper octanoate	0.5–2.0 gal Cueva in 100 gal water	0	Apply soon after training vines.
	copper oxychloride + basic copper sulfate	4.0–6.0 lb C-O-C-S WDG	14	Apply soon after training vines.
	copper oxychloride + copper hydroxide	1.8 pts Badge SC 0.75 lb Badge X_2	14	Treat after pruning but before training.
	cuprous oxide	2.0 lb Nordox	14	Apply after pruning but before training. Apply again as needed on a 10-day basis after training.
	cyazofamid	2.1–2.75 fl oz Ranman	3	Apply prior to or at first sign of disease. Follow resistance management guidelines. Rainfast.
	cyflufenamid	6.0–8.0 oz Torino	6	Do not make more than 2 applications per year. Treat at first sign of disease.
	cymoxanil	3.2 oz Curzate DF	7	Apply with a protectant fungicide such as copper hydroxide. Rainfast in 2 hours.
	dimethomorph	6.0 fl oz Forum	7	Do not make more than 3 applications per season. Addition of an adjuvant to spray mix is recommended. Good antisporulant. Rainfast.
	famoxadone + cymoxanil	8.0 oz Tanos	7	Use with a tank-mix partner. Apply preventatively and on a 6- to 8-day spray schedule. Follow resistance management guidelines. Excellent curative activity. Good leaf protectant. Rainfast.
	fluopyram + trifloxystrobin	7.6 fl oz Luna Sensation	14	Suppression of downy mildew only. Do not exceed 4 applications per year.

(continued)

Disease control in hops *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Downy mildew (*Pseudoperonospora humili*) *(cont.)*	fosetyl-al	2.5 lb Aliette 5.0 lb/100 gal spray volume Linebacker	24	Do not tank mix with coppers. Initiate application when weather conditions favor disease (warm and humid). Avoid mixing with foliar fertilizers or surfactants.
	mandipropamid	8.0 fl oz Revus	7	A non-ionic surfactant is recommended with use of this product. Follow resistance management guidelines.
	mefenoxam	0.5 pt Ridomil Gold SL	45	Label allows drench and foliar applications. Follow resistance management guidelines. Can be highly effective and is a two-way systemic. However, downy mildew pathogen may have resistance.
	monopotassium phosphate and monopotassium phosphite	2.0–4.0 qt Phorcephite 1.0–3.0 qt in 20 gal of water Rampart	0	Apply when conditions favor disease when shoots are 6–12 inches high, after training at 5–6 ft tall, about 3 weeks after second application, and during bloom.
	mono- and dipotassium salts of phosphorous acid	1.0–3.0 qt in 20 gal water Confine Extra 1.0–3.0 qt/100 gal water Fosphite 1.0–2.0 qt/a in a spray volume of 25 gal water Fungi-phite 2.0–4.0 pt Helena Prophyt 2.5 pt Phostrol	0	Apply at 2- to 3-week intervals. Do not apply at an interval less than 3 days. Apply when conditions favor disease when shoots are 6–12 inches high, after training at 5–6 ft tall, about 3 weeks after second application, and during bloom.
	potassium bicarbonate	2.5–5.0 lb/100 gal spray volume Armicarb 100	0	Do not exceed mix rate of 5.0 lb/100 gal of water. Do not store unused portion of spray for more than 12 hours prior to use.
	pyraclostrobin + boscalid	14.0 oz/100 gal spray volume Pristine	14	Use preventatively and apply at 14- to 21-day intervals as needed. Follow resistance management guidelines.
	extract of *Reynoutria sachalinensis*	1.0–4.0 qt Regalia	0	Use preventatively and apply at 7-day intervals as needed. **Emergence to wire-touch:** 1.0–2.0 qt recommended. **Wire-touch through harvest:** 2.0–4.0 qt. OMRI approved. Has some contact fungicidal activity.
Powdery mildew (*Podosphaera macularis* and *humili*)	*Bacillus pumilis* strain QST 2808	2.0–4.0 qt/100 gal spray volume of Sonata	0	Use when conditions favor disease and apply at 7- to 14-day intervals as needed. OMRI approved.
	Bacillus subtilis strain QST 713	4.0–6.0 qt/100 gal spray volume of Serenade ASO 2.0–3.0 lb/100 gal spray volume of Serenade MAX	0	Use when conditions favor disease and apply at 7-day intervals as needed. OMRI approved.
	copper octanoate	0.5–2.0 gal Cueva in 100 gal water	0	Apply soon after training vines.
	cyflufenamid	6.0–8.0 oz Torino	6	Do not exceed 2 applications per year. Treat at first sign of disease.
	fluopyram	6.5–6.84 fl oz Velum Prime	7	Follow resistance management guidelines.
	fluopyram + tebuconazole	8.0–17.0 fl oz Luna Experience	14	Do not apply more than 34.0 fl oz of Luna Experience per acre per year.

(continued)

Disease control in hops *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Powdery mildew (*Podosphaera macularis* and *humili*) *(cont.)*	fluopyram + trifloxystrobin	3.0–7.6 fl oz Luna Sensation	14	Suppression of downy mildew only. Do not exceed 4 applications per year.
	flutriafol	5.0–7.0 fl oz Rhyme	7	Do not apply more than 4 applications per year. Do not apply more than 28.0 fl oz/a per year.
	metrafenone	15.4 fl oz Vivando	3	Do not make more than 2 applications of Vivando per year. Do not mix with horticultural oils.
	mono- and dipotassium salts of phosphorous acid	1.0–3.0 qt/100 gal water Phosphite 1.0–3.0 qt in 20 gal of water Rampart	0	Apply at 2- to 3-week intervals. Do not apply at an interval less than 3 days.
	myclobutanil	2.0–10.0 oz Rally	14	**Emergence to training label rate:** 2.0–4.0 oz. **Training to wire:** 4.0–6.0 oz. **Wire to 14-day prior to harvest:** 6.0–10.0 oz. Follow resistance management guidelines. (Former product name was Nova.)
	neem oil	0.5%–1.0% in 25–100 gal water spray volume of Trilogy	0	Use when conditions favor disease and apply at a 7- to 14-day intervals as needed. OMRI approved. Also a miticide/insecticide.
	potassium bicarbonate	2.5–5.0 lb/100 gal spray volume Armicarb 100 2.5–5.0 lb Kaligreen	0	Do not exceed mix rate of 5.0 lb/100 gal of water. Do not store unused portion of spray for more than 12 hours prior to use. Apply when weather conditions favor disease and repeat on a 7- to 10-day basis.
	pyraclostrobin + boscalid	14.0 oz/100 gal spray volume Pristine	14	Use preventatively and apply at 14- to 21-day intervals as needed. Follow resistance management guidelines.
	quinoxyfen	4.0–8.2 fl oz Quintec	21	Follow resistance management guidelines, including "Do not apply more than 4 times per season." Minimum spray interval is 7 days.
	extract of *Reynoutria sachalinensis*	1.0–4.0 qt Regalia	0	Use preventatively and apply at 7-day intervals as needed. **Emergence to wire-touch:** 1.0–2.0 qt recommended. **Wire-touch through harvest:** 2.0–4.0 qt. OMRI approved. Some contact fungicidal activity.
	sodium bicarbonate	4.0 oz/10 gal water spray volume Milstop	0	Begin application when weather favors disease and apply at 1- to 2-week intervals. Tighten intervals when disease pressure heightens.
	sulfur	4.0–6.0 lb Thiolux	see label	Do not apply after flowering, and grower should verify with processor before use. Do not use within 2 weeks of oil spray. Sulfur is fungitoxic in its vapor phase and therefore is effective only when air temperatures promote volatilization. Sulfur volatilizes above 65°F but becomes phytotoxic above 95°F. Using it above 85°F is not recommended. See label for details on rates and reentry intervals. Kumulus and Microthiol Disperss are labeled for spider mite control in hop.
	tebuconazole	4.0–8.0 fl oz Monsoon, ONSET 3.6L, Orius 3.6F, Tebustar 3.6L, Tebuzol 3.6F, Toledo 3.6F	14	Apply at 10- to 14-day intervals. Follow resistance management guidelines.
	trifloxystrobin	1.0 oz with every 15–30 gal spray volume Flint	14	Apply preventatively for best results. Apply on a 10- to 14-day interval. Follow resistance management guidelines.
	triflumizole	12.0 fl oz Procure 480SC, Trionic 4SC	7	Use prior to or at disease onset for best results and reapply on a 14-day schedule.

OMRI-approved products are typically acceptable by organic certifiers. Several copper formulations may be approved for organic use, but this status can change. Check with your organic certifying agency prior to selection of fungicides for the production season.

Insect control in hops

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids	azadirachtin	Azatin 0, Ecozin Plus 1.2% ME	0	Kills only immature stages (larvae or nymphs) of insects. Treated larvae may die as pupae. Consult label for rates and insect-specific use instructions.
		1.0–2.0 pt Aza-Direct	0	See label for remarks and suggestions.
		Molt-X, Neemix 4.5	0	See label for rates, remarks, and suggestions.
	azadirachtin + pyrethins	1.0–3.5 pt Azera	0	Do not apply more than 10 times per season. Do not reapply within 3 days except under extreme pest pressure.
	beta-cyfluthrin	3.2 fl oz *Baythroid XL	7	Do not apply more than 3.2 fl oz/a in a 14-day interval or 16.0 fl oz per crop season.
	bifenthrin	*Bifen 2 AG Gold; *Bifenthrin 2EC; *Bifenture EC; *Brigade 2EC; *Fanfare 2EC, EC, ES; *Sniper; *Sniper Helios; *Tundra EC, *Bifender FC, *Brigade WSB	14	See label for rates, remarks, and suggestions. Do not exceed 0.1 lb ai per application or exceed 0.3 lb ai/a per season. Consult label for specific use recommendations for each product. Highly toxic to bees.
	bifenthrin + avermectin	10.0–17.0 fl oz *Athena	28	Do not apply more than 17.0 fl oz/a. Do not apply more than 34.0 fl oz/a per growing season.
	bifenthrin + imidacloprid	*Swagger, *Brigadier, *Skyraider, *Tempest	28	See label for rates. Do not apply more than 0.3 lb ai/a of bifenthrin-containing products or 0.30 lb ai of imidacloprid-containing products per year. Highly toxic to bees.
	Chromobacterium subtsugae	2.0–3.0 lb Grandevo	0	See label for remarks and suggestions.
	cyfluthrin	3.2 fl oz *Tombstone, *Tombstone Helios	7	Do not apply more than 3.2 fl oz per 14-day interval or 16.0 fl oz/a per crop season.
	flonicamid	1.7–2.8 fl oz Beleaf 50 SG	10	Do not apply more than 8.4 fl oz per season. Allow a minimum of 7 days between applications.
	flupyradifurone	7.0–10.5 fl oz Sivanto 200 SL 7.0–14.0 fl oz Sivanto Prime	21	Do not exceed 10.5 fl oz/a of Sivanto 200 SL per year. Do not exceed 28.0 fl oz/a Sivanto Prime per year.
	imidacloprid *(foliar)*	Admire Pro Malice 75 WSP Advise Four, Alias 4F, Midash Forte, Nuprid 4F, Provoke, Wrangler Macho 2.0 FL, Macho 4.0, Nuprid 2SC Pasada 1.6F, Prey 1.6, Sherpa	Varies by formulation	See label for rates, remarks, and suggestions. Highly toxic to bees.
	imidacloprid *(soil)*	Admire Pro, Nuprid 4.6F Advise Four, Alias 4F, Midash Forte, Nuprid 4F, Provoke, Wrangler Macho 2.0 FL, Macho 4.0, Alias 2F, Malice 2F, Montana 2F, Montana 4F, Nuprid 2SC, Widow	60	See label for rates, remarks, and suggestions.

*Restricted-use pesticide.

(continued)

Insect control in hops *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids *(cont.)*	imidacloprid + beta-cyfluthrin	3.2 fl oz *Leverage 360	28	Do not apply more than 16.0 fl oz/a of Leverage 360 insectide per year. Seasonal use rates are also dependent on applications of cyfluthrin and beta-cyfluthrin. Highly toxic to bees.
	malathion	Malathion (various manufacturers and formulations)	Consult label	See label for rates, remarks, and suggestions.
	mineral oil	1.0–2.0 gal PureSpray Green in at least 50 gal water, Damoil		Discontinue use at burr development.
		1.0–2.0 gal SuffOil-X/100 gal water	0	See label for remarks and suggestions.
	naled	1.0 pt *Dibrom 8 Emulsive	7	See label for remarks and suggestions.
	neem oil (clarified hydrophobic extract)	Trilogy		Can be used up to day of harvest.
	potassium salts of fatty acids	M-Pede, Des-X	0	See label for remarks and suggestions.
	pymetrozine	4.0–6.0 oz Fulfill	14	Do not apply more than 6.0 oz/a per application. Do not make more than 3 applications per crop per season. Do not exceed a total of 18.0 oz/a per crop per season.
	spirotetramat	5.0–6.0 fl oz Movento	7	Maximum Movento allowed per 12-month period is 12.5 fl oz/a. Minimum interval between applications is 14 days.
	thiamethoxam	8.0 fl oz Platinum 2.67 fl oz Platinum 75 SG	65	Do not exceed a maximum of 0.125 lb ai/a of thiamethoxam-containing products per growing season.
Army-worms	azadirachtin	4.0–16.0 fl oz Azatin 0	0	Kills only immature stages (larvae or nymphs) of insects. Treated larvae may die as pupae. Consult label for insect-specific use instructions.
		1.0–2.0 pt Aza-Direct	0	See label for remarks and suggestions.
	azadirachtin + pyrethins	1.0–3.5 pt Azera	0	Do not apply more than 10 times per season. Do not reapply within 3 days except under extreme pest pressure.
	Bacillus thuringiensis	Biobit HP, DiPel DF, XenTari	0	See label for rates, remarks, and suggestions.
	bifenthrin	*Bifen 2 AG Gold; *Bifenthrin 2EC; *Bifenture EC; *Brigade 2EC; *Fanfare 2EC, EC, ES; *Sniper; *Sniper Helios; *Tundra EC *Brigade WSB *Bifender FC	14	Do not exceed 0.1 lb ai per application or exceed 0.3 lb ai/a per season. Consult label for rates and specific use recommendations for each product.
	bifenthrin + avermectin	10.0–17.0 fl oz *Athena	28	Do not apply more than 17.0 fl oz/a. Do not apply more than 34.0 fl oz/a per growing season.
	bifenthrin + imidacloprid	*Swagger *Brigadier, *Skyraider, *Tempest	28	See label for remarks and suggestions. Do not apply more than 0.3 lb ai/a of bifenthrin-containing products or 0.30 lb ai of imidacloprid-containing products per year.

*Restricted-use pesticide.

(continued)

Insect control in hops *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Army-worms *(cont.)*	heat-killed *Burkholderia* spp.	1.0–4.0 qt Venerate XC	0	See label for remarks and suggestions.
	Chromobacterium subtsugae	1.0–3.0 lb Grandevo	0	See label for remarks and suggestions.
	naled	1.0 pt *Dibrom 8 Emulsive	7	See label for remarks and suggestions.
	spinosad	4.0–6.0 fl oz Entrust SC 1.25–2.0 fl oz Entrust Naturalyte	1	Do not apply more than a total of 0.47 lb ai of spinosad per acre per crop. Do not make more than 5 applications per calendar year.
	spinetoram	2.5–4.0 oz Delegate WG	1	Do not apply more than a total of 19.5 oz of Delegate per acre per year. Do not make more than 3 applications per calendar year.
Cutworms	azadirachtin	4.0–16.0 fl oz Azatin 0	0	Kills only immature stages (larvae or nymphs) of insects. Treated larvae may die as pupae. Consult label for insect-specific use instructions.
		1.0–2.0 pt Aza-Direct	0	See label for remarks and suggestions.
	azadirachtin + pyrethrins	1.0–3.5 pt Azera	0	Do not apply more than 10 times per season. Do not reapply within 3 days except under extreme pest pressure.
	bifenthrin	*Bifen 2 AG Gold; *Bifenthrin 2EC; *Bifenture EC; *Brigade 2EC; *Fanfare EC, ES; *Sniper; *Sniper Helios; *Tundra EC *Brigade WSB *Bifender FC	14	Do not exceed 0.1 lb ai per application or exceed 0.3 lb ai/a per season. Consult label for rates and specific use recommendations for each product.
	bifenthrin + avermectin	10.0–17.0 fl oz *Athena	28	Do not apply more than 17.0 fl oz/a. Do not apply more than 34.0 fl oz/a per growing season.
	bifenthrin + imidacloprid	*Swagger *Brigadier, *Skyraider, *Tempest	28	See label for rates, remarks, and suggestions. Do not apply more than 0.3 lb ai/a of bifenthrin-containing products or 0.30 lb ai of imidacloprid-containing products per year. Highly toxic to bees.
	spinetoram	2.5–4.0 oz Delegate WG	1	Do not apply more than a total of 19.5 oz of Delegate per acre per year. Do not make more than 3 applications per calendar year.
Flea beetles	azadirachtin + pyrethrins	1.0–3.5 pt Azera	0	Do not apply more than 10 times per season. Do not reapply within 3 days except under extreme pest pressure.
	beta-cyfluthrin	3.2 fl oz *Baythroid XL	7	Do not apply more than 3.2 fl oz/a in a 14-day interval or 16.0 fl oz per crop season.
	cyfluthrin	3.2 fl oz *Tombstone, *Tombstone Helios	7	Do not apply more than 3.2 fl oz per 14-day interval or 16.0 fl oz/a per crop season.
	imidacloprid + beta-cyfluthrin	3.2 fl oz *Leverage 360	28	See label for remarks and suggestions. Hazardous to bees.

*Restricted-use pesticide.

(continued)

Insect control in hops *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Leafhoppers	azadirachtin	4.0–16.0 fl oz Azatin 0 15.0–30.0 oz Ecozin Plus 1.2% ME	0	Kills only immature stages (nymphs) of insects. Treated larvae may die as pupae. Consult label for insect-specific use instructions.
		1.0–2.0 pt Aza-Direct	0	See label for remarks and suggestions.
		8.0–15.0 fl oz Molt-X	0	See label for remarks and suggestions.
	azadirachtin + pyrethrins	1.0–3.5 pt Azera	0	Do not apply more than 10 times per season. Do not reapply within 3 days except under extreme pest pressure.
	bifenthrin + imidacloprid	*Swagger *Brigadier, *Tempest	28	See label for rates, remarks, and suggestions. Do not apply more than 0.3 lb ai/a of bifenthrin-containing products or 0.30 lb ai of imidacloprid-containing products per year. Highly toxic to bees.
	potassium salts of fatty acids	M-Pede, Des-X	0	See label for remarks and suggestions.
Lepidopterous (moth and butterfly) caterpillars	**This is a large category of insects. Read the individual insecticide label to make sure your specific species is included.**			
	azadirachtin	4.0–16.0 fl oz Azatin 0 15.0–30.0 oz Ecozin Plus 1.2% ME	0	Kills only immature stages (larvae or nymphs) of insects. Treated larvae may die as pupae. Consult label for insect-specific use instructions.
		1.0–2.0 pt Aza-Direct	0	See label for remarks and suggestions.
		8.0–15.0 fl oz Molt-X	0	See label for remarks and suggestions.
	azadirachtin + pyrethins	1.0–3.5 pt Azera	0	Do not apply more than 10 times per season. Do not apply within 3 days except under extreme pest pressure.
	Bacillus thuringiensis	Javelin WG Deliver	0	See label for remarks and suggestions.
	bifenthrin	*Bifen 2 AG Gold; *Bifenthrin 2EC; *Bifenture EC; *Brigade 2EC; *Fanfare EC, ES; *Sniper; *Sniper Helios; *Tundra EC *Bifender FC *Brigade WSB	14	Do not exceed 0.1 lb ai per application or exceed 0.3 lb ai/a per season. Consult label for rates and specific use recommendations for each product.
	bifenthrin + avermectin	10.0–17.0 fl oz *Athena	28	Do not apply more than 17.0 fl oz/a. Do not apply more than 34.0 fl oz/a per growing season.
	bifenthrin + imidacloprid	*Swagger *Brigadier, *Skyraider, *Tempest	28	See label for rates, remarks, and suggestions. Do not apply more than 0.3 lb ai/a of bifenthrin-containing products or 0.30 lb ai of imidacloprid-containing products per year. Highly toxic to bees.
	spinetoram	2.5–4.0 oz Delegate WG	1	Do not apply more than a total of 19.5 oz of Delegate per acre per year. Do not make more than 3 applications per calendar year.
Loopers	azadirachtin	4.0–16.0 fl oz Azatin 0	0	Kills only immature stages (larvae or nymphs) of insects. Treated larvae may die as pupae. Consult label for insect-specific use instructions.
		1.0–2.0 pt Aza-Direct	0	See label for remarks and suggestions.
	azadirachtin + pyrethins	1.0–3.5 pt Azera	0	Do not apply more than 10 times per season. Do not reapply within 3 days except under extreme pest pressure.

*Restricted-use pesticide.

(continued)

Insect control in hops *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Loopers *(cont.)*	*Bacillus thuringiensis*	Biobit HP, DiPel DF, XenTari	0	See label for remarks and suggestions.
	beta-cyfluthrin	3.2 fl oz *Baythroid XL	7	Do not apply more than 3.2 fl oz/a in a 14-day interval or 16.0 fl oz per crop season.
	bifenthrin	*Bifen 2 AG Gold; *Bifenthrin 2EC; *Bifenture EC; *Brigade 2EC; *Fanfare EC, ES; *Sniper; *Sniper Helios; *Tundra EC *Bifender FC *Brigade WSB	14	Do not exceed 0.1 lb ai per application or exceed 0.3 lb ai/a per season. Consult label for rates and specific use recommendations for each product.
	bifenthrin + avermectin	10.0–17.0 fl oz *Athena	28	Do not apply more than 17.0 fl oz/a. Do not apply more than 34.0 fl oz/a per growing season.
	bifenthrin + imidacloprid	*Swagger *Brigadier, *Skyraider, *Tempest	28	See label for rates, remarks, and suggestions. Do not apply more than 0.3 lb ai/a of bifenthrin-containing products or 0.30 lb ai of imidacloprid-containing products per year. Highly toxic to bees.
	heat-killed *Burkholderia* spp.	1.0–4.0 qt Venerate XC	0	See label for remarks and suggestions.
	Chromobacterium subtsugae	1.0–3.0 lb Grandevo	0	See label for remarks and suggestions.
	cyfluthrin	3.2 fl oz *Tombstone, *Tombstone Helios	7	Do not apply more than 3.2 fl oz per 14-day interval or 16.0 fl oz/a per crop season.
	imidacloprid + beta-cyfluthrin	3.2 fl oz *Leverage 360	28	Do not apply more than 16.0 fl oz/a of Leverage 360 insectide per year. Seasonal use rates are also dependent on applications of cyfluthrin and beta-cyfluthrin. Hazardous to bees.
	spinosad	4.0–6.0 fl oz Entrust SC 1.25–2.0 fl oz Entrust Naturalyte	1	Do not apply more than a total of 0.47 lb ai of spinosad per acre per crop. Do not make more than 5 applications per calendar year.
	spinetoram	2.5–4.0 oz Delegate WG	1	Do not apply more than a total of 19.5 oz of Delegate per acre per year. Do not make more than 3 applications per calendar year.
Slugs	sodium ferric EDTA	10.0–40.0 lb IronFist	0	Use higher rates when slug infestations are high.
Two-spotted spider mite	abamectin	*Agri-Mek SC *Abba Ultra *Abacus, *Abba 0.15, *Reaper 0.15 EC, *Reaper Advance, *Reaper ClearForm, *Tide Timectin	28	See label for rates, remarks, and suggestions.
	acequinocyl	31.0 fl oz Kanemite 15 SC	7	Do not apply more than 62.0 fl oz of Kanemite 15 SC per year. Do not make more than 2 applications per season.
	bifenazate	0.75–1.5 lb Acramite 50WS	14	Do not make more than 1 application per season.
	bifenthrin	*Bifen 2 AG Gold; *Bifenthrin 2EC; *Bifenture EC; *Brigade 2EC; *Fanfare EC, ES; *Sniper; *Tailgunner; *Tundra EC *Bifender FC *Brigade WSB	14	Do not exceed 0.1 lb ai per application or exceed 0.3 lb ai/a per season. Consult label for rates and specific use recommendations for each product.

*Restricted-use pesticide.

(continued)

Insect control in hops *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Two-spotted spider mite *(cont.)*	bifenthrin + avermectin	10.0–17.0 fl oz *Athena	28	Do not apply more than 17.0 fl oz/a. Do not apply more than 34.0 fl oz/a per growing season.
	bifenthrin + imidacloprid	*Swagger *Brigadier, *Skyraider, *Tempest	28	See label for rates, remarks, and suggestions. Do not apply more than 0.3 lb ai/a of bifenthrin-containing products or 0.30 lb ai of imidacloprid-containing products per year. Highly toxic to bees.
	Chromobacterium subtsugae	2.0–3.0 lb Grandevo	0	See label for remarks and suggestions.
	etoxazole	3.0–4.0 fl oz Zeal	7	Do not make more than 1 application per season. Do not apply more than 4.0 oz/a per season.
	fenpyroximate	2.0–3.0 pt Portal XLO	15	Do not apply more than 3.0 pints of product per acre per growing season.
	malathion	Malathion (various manufacturers and formulations)	Consult label	See label for remarks and suggestions.
	mineral oil	1.0–2.0 gal PureSpray Green in at least 50 gal water 1.0–2.0 gal in 100 gal water Damoil, Glacial Spray Fluid, Omni Supreme Spray, Ultra-Pure Oil		Discontinue at burr development.
		1.0–2.0 gal SuffOil-X/100 gal water	0	See label for remarks and suggestions.
	neem oil (clarified hydrophobic extract)	1.0–2.0% Trilogy		Can be used up to day of harvest.
	paraffin oil	1.0–2.0 gal JMS Stylet-Oil/100 gal water		Discontinue sprays at burr development.
	potassium salts of fatty acids	M-Pede, Des-X	0	See label for remarks and suggestions.
	spirodiclofen	18.0–24.7 fl oz Envidor 2 SC	14	Do not apply more than 1 application per year. Do not apply more than 24.7 fl oz/a per year.
	spirotetramat	5.0–6.0 fl oz Movento	7	Maximum Movento allowed per 12-month period is 12.5 fl oz/a. Minimum interval between applications is 14 days.
	sulfur (elemental)	0.3–7.5 gal Suffa	not listed	See label for remarks and suggestions.

*Restricted-use pesticide.

Weed control in hops

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	0.56–0.98 lb dimethenamid-P	12.0–21.0 fl oz Outlook	60	May be used in first year or on established hops. Apply preemergence to weeds when hops are in the dormant or early vegetative stages of growth. Contact with hop foliage or cones may cause injury. The label recommends testing Outlook on a small portion of the target crop to confirm safety in the local soil type.
	0.045-0.065 lb indaziflam	3.5–5.0 fl oz Alion	14	Rate is dependent upon soil type and organic matter—consult label. Only use in established plantings at least one year after planting. Apply as an early spring dormant application and/or as a fall dormant application after harvest. Do not use on hops grown on sand. Do not allow applications to contact green stems or foliage as unacceptable injury will occur.
	0.5–1.0 lb isoxaben	16.0–31.0 fl oz Trellis SC		Apply Trellis SC prior to crop and weed emergence in a minimum carrier of 20 GPA. Irrigation or rainfall of at least 0.5 inch within 21 days is required for activation. Do not apply more than twice per crop year (harvest to harvest) up to a maximum of 31 fl oz per crop year. Do not apply Trellis SC to newly planted hops until soil has settled and no cracks are present.
	2.0–4.0 lb norflurazon	2.5–5.0 lb Solicam DF	60	Controls several broadleaves and grasses. Apply as a directed spray. Wait at least 6 months after planting hops before applying. Apply to clean soil surface either in fall after tillage or in spring. Use lower rate on coarse soils and higher rate on fine soils.
	1.05–4.0 lb pendimethalin	1.1–4.2 qt Prowl H_2O	90	Apply as broadcast or banded treatment (including post-emergence directed) to first-year or established hops. Do not apply over the top of vines with leaves or cones. Do not exceed 4.2 qts/a per year in a single or sequential applications.
	0.5–0.75 lb trifluralin	several manufacturers		Controls several annual grasses and a few broadleaf weeds. Apply and incorporate 1–2 inches when crop is dormant. Do not spray over hop crowns. Will not control emerged weeds. Rate varies by soil texture.
	0.19 lb flumioxazin	6.0 oz Chateau SW or Tuscany or 6.0 fl oz Tuscany SC	30	Controls several broadleaf weeds and some annual grasses. **Sucker control:** Apply as a directed spray after hops are at least 6 ft tall. Direct spray to the lower 2 ft of hops. **PRE weed control:** Apply to dormant hops November through February as a 1–1.5 ft band to each side of the hop row. Do not apply with an adjuvant or allow spray to contact green stems (unless for sucker control), foliage, flowers, or cones, or unacceptable injury may occur.
Emerged broadleaves	0.5 lb acid equivalent 2,4-D	several manufacturers	28	Make directed applications to row middles for control of small broadleaf weeds. Up to 3 applications per season are allowed with at least 30 days between applications. Avoid drift—do not allow spray to contact hop foliage or apical buds.
	0.045 lb bicyclopyrone	3.5 fl oz/a Optogen	30	Apply post directed including either NIS or COC. The addition of AMS in addition to an adjuvant will also improve weed control consistency. Using a hooded or shielded sprayer will minimize the potential for crop injury. Apply to very small weeds (label is <2 inch, but even smaller is better). Optogen is usually used in a tank mix with another labeled herbicide to improve weed control.

*Restricted-use pesticide.

(continued)

Weed control in hops *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged broadleaves *(cont.)*	0.125-0.25 lb clopyralid	⅓–⅔ pt Spur	30	Apply in 10–20 GPA. For Canada thistle control apply after a majority of basal leaves have emerged but prior to thistle bud stage. Some minor leaf cupping may occur to lower leaves and suckers if spray contacts the hop plants. Do not exceed 2 broadcast applications or ⅔ pt/a per crop per year. Pending state registration for 2026 - be sure to check for updates prior to use.
	0.004–0.0053 lb pyraflufen-ethyl	3.0–4.0 fl oz Venue or 1.5–1.9 fl oz Venue Max	30	Apply in a minimum of 20 GPA to target small broadleaf weeds and sucker growth. COC adjuvant is label recommended at 1–2% v/v. For sucker control direct application to the lower 12–18 inches of hop plants and extend out to approximately 20–40 inches from each side of the row. Do not exceed 2 applications per year.
Emerged grasses	0.068–0.12 lb clethodim	9.0–16.0 oz Select Max	21	Controls most annual grasses and several perennial grasses, but not broadleaves. Apply to actively growing grasses, including appropriate adjuvant as directed by the label. Rate depends on targeted grass species. Wait at least 14 days between applications and do not exceed total seasonal maximum use rates.
	0.125 lb clethodim	several manufacturers	21	Controls most annual grasses and several perennial grasses, but not broadleaves. Apply to actively growing grasses, including appropriate adjuvant as directed by the label. Rate depends on targeted grass species. Wait at least 14 days between applications and do not exceed total seasonal maximum use rates.
Emerged weeds	0.03 lb carfentrazone-ethyl	2.0 oz Aim EC	7	For sucker management and control of some young, actively growing broadleaf weeds. **Sucker control:** Apply to the bottom 1.5 ft of the hop plant and to the sucker mat that extends from the base of the plant to 1.5–2 ft into the row. See label for adjuvant requirements. **POST weed control:** Weeds need to be newly emerged and actively growing. Apply using shielded or hooded sprayers. Avoid upward spray drift to new hop growth. Avoid applications until newly trained hops have developed sufficient barking and are high enough up the string to avoid contact with the apical bud. Allow 14 days between applications and do not exceed 7.6 fl oz/a per season.
	0.59–1.0 lb glufosinate	32.0–55.0 fl oz Rely 280	25	For postemergent control of weeds present between hop rows and/or for control of hop sucker growth, apply as a directed spray to the lower portion of the hop plant. Do not apply to hops less than 6 feet tall, and then only apply to the lower 18 inches of hops. Do not apply to hop suckers prior to training hops. See label for maximum seasonal rates and applications.
	glyphosate	several manufacturers and formulations	14	Apply to actively growing weeds as a row middle, shielded, wiper, directed, or spot treatment application. Glyphosate will injure or kill hops. Do not allow contact of spray with green hop stems or foliage.

*Restricted-use pesticide.

Horseradish

Horseradish is usually grown commercially as an annual in Wisconsin. One-year-old secondary roots are selected and detached from primary roots at harvest for planting the following year. When grown as a perennial, the main roots are harvested, and secondary roots broken off during harvest will provide root material for the next year's crop.

In Wisconsin, horseradish is grown on sands, sandy loams, and organic soils. Such soils should be well drained and stone free. Irrigation is recommended for profitable horseradish production on very sandy soils.

Planting

Rows: 30–36 inches.

Plants in row: 12–18 inches apart.

Use set roots that are 1/4–1/2 inch thick and 12–14 inches long. Lay roots flat in shallow furrows with the crown end resting slightly higher than the basal end. Cover the sets with 2–4 inches of soil, then firm the soil using a roller.

After the plant is established, lift the crown end slightly to break off the new secondary roots from the upper portion. The remaining secondary roots at the basal end will nourish the set and young plant. Removing the secondary crown roots allows enlargement of the set root, yielding high-quality primary roots.

Lime and fertilizer

Lime: Use dolomitic lime to maintain a pH of 6.8.

Fertilizer rates: On sands/sandy loams with a pH of 6.5 or higher, the soil test value for phosphorous should be in the range of 60 ppm. The potassium soil test should be in the range of 140 ppm. Use annual nitrogen, P_2O_5, and K_2O recommendations listed in the table below.

Application: Broadcast lime and fertilizer and work in before planting. Sidedress annual applications at planting.

Nitrogen: On irrigated sands, apply 25% of the nitrogen at planting. Apply the remainder in at least two applications after crop emergence. Split applications reduce the potential for nitrate leaching.

Micronutrients: Irrigated sands may require additional sulfur and boron.

Annual nitrogen, phosphate, and potash recommendations for horseradish

Nitrogen		Phosphate and potash		
Organic matter (%)	**Amount to apply** (lb/a)	**Yield goal** (t/a)	**Amount P_2O_5 to apply*** (lb/a)	**Amount K_2O to apply*** (lb/a)
<2	160	6	50	160
2.0–9.9	120			
10–20	100			
>20	75			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Disease control in horseradish

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Alternaria leaf spot and white rust	azoxystrobin	6.0–15.5 fl oz Aframe, Quadris Flowable, Satori, Willowood Azoxy 2SC 6.0–20.0 fl oz AzoxyStar	0 0	Quadris, Satori, and Cabrio belong to the Group 11 (strobilurin) category of fungicides. Do not exceed 1 application of any of these products before alternating with a fungicide having a different mode of action. Do not exceed 3 applications of strobilurin fungicides per year. Do not exceed 123.0 fl oz/a per season Quadris or 48.0 oz/a Cabrio per season.
	pyraclostrobin	*Alternaria:* 8.0–12.0 oz Cabrio EG *white rust:* 8.0–16.0 oz Cabrio EG	0	
	boscalid	4.5 oz Endura	0	Do not make more than 5 applications per season. Do not apply more than 22.5 oz/a Endura per season.
	cyprodinil + fludioxonil	11.0–14.0 oz Switch 62.5WG	7	Ground application only. Do not apply more than 56.0 oz/a per season.
	fluopyram + pyrimethanil	8.0–11.2 fl oz Luna Tranquility	7	For Alternaria and Botrytis management.
	fluopyram + trifloxystrobin	5.0–5.8 fl oz Luna Sensation	7	Follow resistance management guidelines.
	fluxapyroxad + pyraclostrobin	4.0–5.5 fl oz Merivon	7	Also manages powdery mildew and Cercospora. Do not make more than 3 applications per acre per year.
	penthiopyrad	16.0–30.0 fl oz Fontelis	0	Do not apply more than 61.0 fl oz/a per year. Do not apply more than two times before alternating to an effective fungicide wtih a different mode of action.
	trifloxystrobin	2.0–3.0 oz Flint 1.9–2.9 fl oz Gem 500 SC	7	Do not apply more than 12.0 oz/a per year of Flint. Alternate fungicide modes of action for resistance management. Do not apply more than 11.5 fl oz/a per season of Gem 500 SC. Do not graze or feed foliage of treated crops.
Pythium and Phytophthora root rot	azoxystrobin	0.4–0.8 fl oz Quadris/1,000 ft row		For soilborne/seedling disease control, see general information section on label.
	fenamidone	8.2 fl oz Reason 500 SC	14	Do not apply more than 24.6 fl oz/a per year. Do not apply more than one time before alternating to an effective fungicide wtih a different mode of action.
	fluopicolide	3.0–4.0 fl oz Presidio	7	Tank mix with another effective, labeled fungicide of another mode of action for resistance management. Recommended spray interval is 10 days.
	mefenoxam	1.0–2.0 pt Ridomil Gold SL	—	Preplant-incorporated application or surface application at planting. Preplant to top 2 inches of soil.
	mefenoxam + azoxystrobin	0.34 fl oz Uniform/1,000 ft row	—	For Pythium damping-off and root rots. Also manages Rhizoctonia seedling blight. Apply Uniform as an in-furrow spray in minimum of 5 gal water per acre spray volume.
	metalaxyl	0.75 fl oz/100 lb seed Allegiance FL, Metalaxyl 265 ST	—	Follow manufacturer's directions. Do not use treated seed for feed or food.
Verticillium wilt root rot pathogens	metam-sodium	50.0 gal Vapam HL, Metam, Sectagon 42		Knife into plow layer of soil at a rate of 50.0 gal/a or on sandy soils only apply through the irrigation system in 0.6–1.0 inches of water in the fall. An approved backflow prevention valve must be used when applying fumigant through irrigation system. Do not apply if significant rainfall is forecast in the next 24 hours. Fields must be monitored during and after application. Soil temperature must be below 75°F. Fumigant cannot be applied through an irrigation system within 1/4 mile of an institution such as a hospital, school, or prison.

Insect control in horseradish[a]

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids	alpha-cypermethrin	3.2–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.088–0.133 lb cyantraniliprole	13.0–20.5 fl oz Exirel	1	Minimum application interval between treatments is 5 days. For best performance, use with an effective adjuvant. Do not apply a total of more than 0.4 lb ai/a of cyazypyr or cyantraniliprole-containing products.
	flupyradifurone	7.0–10.5 fl oz Sivanto 200SL	1	Minimum interval between applications is 7 days. Minimum application volumes is 10 gal/a for ground, and 2 gal/a for aerial. Maximum Sivanto 200SL allowed per year is 28.0 fl oz/a (0.365 lb ai/a).
	imidacloprid	0.31–0.74 fl oz Admire Pro/1,000 ft row 4.4–10.5 fl oz Admire Pro 3.5 fl oz Provado	21 21 7	Admire may only be applied once per season. Apply Provado every 5 days as needed. Do not exceed 3 applications per season. Maximum imidacloprid use per season is 0.5 lb ai/a from any formulation.
	0.94–1.25 lb malathion	several formulations	7	Consult label for rates and remarks.
	0.45 lb methomyl	1.5 pt *Lannate LV	65	Repeat application as necessary up to 4 times per crop. Do not exceed 6.0 pt ai/a per season.
	0.023–0.047 lb sulfoxaflor	0.75–1.5 oz Transform WG	7	Do not make applications less than 7 days apart. Do not make more than four applications per crop. Do not make more than two consecutive applications per crop. Do not apply more than a total of 8.5 oz of Transform WG (0.266 lb ai of sulfoxaflor) per acre per year.
	thiamethoxam	1.5–3.0 oz Actara 25WDG 5.0–12.0 fl oz Platinum 2SC 1.7–4.01 oz Platinum 75SG	7 30 30	Do not apply more than 12.0 oz of Actara 25WDG or Platinum 2SC and no more than 4.01 oz Platinum 75SG per acre per crop season and apply sufficient water volume after in-ground application to ensure incorporation into the seed zone. Actara is applied as a foliar spray.
	0.02–0.025 lb zeta-cypermethrin	3.2–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	21	Do not apply more than 0.2 lb ai/a per season. Do not make more than 2 applications per season.
Beet leafhopper	alpha-cypermethrin	1.8–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	flupyradifurone	7.0–10.5 fl oz Sivanto	7	Foliar application. Apply when pests reach or exceed established thresholds. Do not apply more than 28.0 fl oz of Sivanto per acre per crop season.
	imidacloprid	0.31–0.74 fl oz Admire Pro/1,000 ft row 4.4–10.5 fl oz Admire Pro 3.5 fl oz Provado	21 21 7	Admire may only be applied once per season. Apply Provado every 5 days as needed. Do not exceed 3 applications per season. Maximum imidacloprid use per season is 0.5 lb ai/a from any formulation.
	thiamethoxam	1.5–3.0 oz Actara 25WDG 5.0–12.0 fl oz Platinum 2SC 1.7–4.01 oz Platinum 75SG	7 30 30	Do not apply more than 12.0 oz of Actara 25WDG or Platinum 2SC and no more than 4.01 oz Platinum 75SG per acre per crop season and apply sufficient water volume after in-ground application to ensure incorporation into the seed zone. Actara is applied as a foliar spray.
	0.011–0.025 lb zeta-cypermethrin	1.76–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season

*Restricted-use pesticide.

(continued)

[a]Adapted from Illinois pest control recommendations.

Insect control in horseradish[a] *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Diamond-back moth (DBM)	*Bacillus thuringiensis* subsp. *kurstaki*	Cutlass, DiPel, Javelin, and others	0	Rates vary with formulation; check the label. Must be eaten by caterpillars to be effective. Thorough coverage is necessary; some labels recommend wetting agents.
		1.0–2.0 lb Lepinox WDG	0	Treat early instar larvae before noticeable feeding damage occurs. Repeat as needed.
	0.5–1.5 lb *Bacillus thuringiensis* subsp. *tenebrionis*	Xentari		Treat early instar larvae before noticeable feeding damage occurs. Must be eaten to be effective. Thorough coverage is necessary. Repeat as needed.
	imidacloprid	0.31–0.74 fl oz Admire Pro/1,000 ft row 4.4–10.5 fl oz Admire Pro 3.5 fl oz Provado	21 21 7	Admire may only be applied once per season. Apply Provado every 5 days as needed. Do not exceed 3 applications per season. Maximum imidacloprid use per season is 0.5 lb ai/a from any formulation.
Flea beetles	*Treat only if you find large populations early in the season.*			
	alpha-cypermethrin	1.8–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.5–1.0 lb carbaryl	0.5–1.0 qt Sevin XLR Plus	7	Repeat applications as necessary up to a total of 6 times per year but not more than once every 7 days. Do not exceed 6.0 qt per crop per year. Do not apply when crop or nearby weeds are in bloom.
	0.088–0.133 lb cyantraniliprole	13.0–20.5 fl oz Exirel	1	Minimum application interval between treatments is 5 days. For best performance, use with an effective adjuvant. Do not apply a total of more than 0.4 lb ai/a of cyazypyr or cyantraniliprole-containing products.
	imidacloprid	0.31–0.74 fl oz Admire Pro/1,000 ft row 4.4–10.5 fl oz Admire Pro 3.5 fl oz Provado	21 21 7	Admire may only be applied once per season. Apply Provado every 5 days as needed. Do not exceed 3 applications per season. Maximum imidacloprid use per season is 0.5 lb ai/a from any formulation.
	0.046–0.063 lb spinetoram	6.0–8.0 oz Radiant SC	3	For suppression only. Do not apply more than 28.0 oz/a Radiant (0.219 lb ai) per crop and do not exceed 3 applications per year.
	thiamethoxam	1.5–3.0 oz Actara 25WDG 5.0–12.0 fl oz Platinum 2SC 1.7–4.01 oz Platinum 75SG	7 30 30	Do not apply more than 12.0 oz of Actara 25WDG or Platinum 2SC and no more than 4.01 oz Platinum 75SG per acre per crop season and apply sufficient water volume after in-ground application to ensure incorporation into the seed zone. Apply Platinum 2SC as an in-furrow spray or as a narrow surface band above the seedling and followed by irrigation. Actara is applied as a foliar spray.
	0.011–0.025 lb zeta-cypermethrin	1.76–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	21	Do not apply more than 0.2 lb ai/a per season. Do not make more than 2 applications per season.

*Restricted-use pesticide.

(continued)

[a]Adapted from Illinois pest control recommendations.

Insect control in horseradish[a] *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Imported crucifer weevil	*Crop rotation, destroying volunteers, use of insecticide dips for sets, and foliar insecticide sprays will help reduce weevil populations.*			
	0.1% solution permethrin	*Ambush (several formulations)	30	At planting. Soak sets 30 minutes and air dry before planting to kill eggs and larvae.
	0.15 lb permethrin	6.0 oz *Permethrin 3.2EC	30	Do not apply more than 18.0 oz/a per season. Wait at least 10 days between applications.
	0.011–0.025 lb zeta-cypermethrin	1.76–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.

*Restricted-use pesticide.

[a]Adapted from Illinois pest control recommendations.

Weed control in horseradish

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	0.56–0.98 lb dimethenamid-P	12.0–21.0 fl oz Outlook	40	Apply only when horseradish is between the two-leaf and eight-leaf stage. Outlook will not control emerged weeds. Injury may occur when cool weather follows application. Use rate varies by soil type.
	up to 1.5 lb linuron	up to 3.0 lb Lorox DF		Make a single broadcast application after planting or during dormancy, but before leaves emerge in spring. Allow an irrigation or rainfall of 1/2 inch prior to application after planting. Use lower rates on lighter soils. Do not use on sand or loamy sand. Do not use on soils with less than 1% organic matter.
	s-metolachlor	1.0–1.33 pt Dual Magnum or Dual II Magnum		Apply once after planting but before weed or crop emergence. Use lower rates on relatively coarse-textured soils and higher rates on fine-textured soils.
Annual broadleaves	0.033–0.045 lb bicyclopyrone	2.6-3.5 fl oz/a Optogen		Apply 2.6 fl oz/a preemergence following planting and at least 3 days prior to emergence or apply 3.5 fl oz/a post directed including either NIS or COC. The addition of AMS in addition to an adjuvant will also improve weed control consistency. Using a hooded or shielded sprayer will minimize the potential for crop injury. Apply to very small weeds (label is <2 inch, but even smaller is better). Optogen is usually used in a tank mix with another labeled herbicide to improve weed control. Not recommended to be used on muck soil.
	0.5 lb oxyfluorfen	2.0 pt Goal 2XL 1.0 pt GoalTender		Controls common lambsquarters, redroot pigweed, common purslane, shepherd's purse, and Pennsylvania smartweed. Apply after planting but before emergence of crop or annual weeds. Use flat fan nozzles in a minimum of 20 gal/a of water. For maximum activity, soil surface should be smooth and free of weed and crop residue. Avoid disturbing the soil surface after application for as long as weed control is desired. Cultural practices that redistribute or disturb the soil surface will decrease herbicidal activity. Rainfall or irrigation of 1/4 inch after application is necessary for herbicide activation. Do not apply through irrigation. Do not use when horseradish plantings are weak or stressed.

(continued)

Weed control in horseradish *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual grasses and some broadleaves	0.07–0.25 lb sulfentrazone	2.25–8.0 oz Spartan 4F		Broadcast applications can be made in the fall, in the spring before planting, or after planting up to 5 days before crop emergence. Banded applications to row middles are permitted following crop emergence. Use rate is based on soil texture and organic matter. Do not exceed maximum annual use rate. See label for weeds controlled and other precautions.
Emerged weeds	glyphosate	several manufacturers and formulations		See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. May be applied at any time before the crop emerges. Apply before crop germination/growth on coarse sandy soils. Do not treat mowed or tilled weeds until they have resumed active growth and reached the recommended stage on the label. Unless otherwise stated, allow at least 7 days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified.
Emerged grasses	0.068–0.12 lb clethodim	9.0–16.0 oz Select Max	30	Apply to actively growing grasses. Repeat treatments may be made at 14-day intervals up to the maximum annual use rate. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by product label. Do not apply if rain is expected within 1 hour.
	clethodim	several manufacturers and formulations	30	
	0.094–0.47 lb sethoxydim	0.5–2.5 pt Poast	60	Make postemergence applications to actively growing grasses within the size ranges indicated on the label. Check the label for wild proso millet or rescue treatment rate and for information on quackgrass control. Do not exceed 2.5 pt per application or 5 pt/a per season. Consult label for rate and adjuvant instructions for specific weeds. Do not cultivate within 5 days before or 7 days after application.

Leafy greens: lettuce, chicory, endive, escarole, and others

Planting

Make successive plantings from April to mid-July. Irrigate after seeding in dry weather. Choose deep, fertile soils with an abundance of available moisture during the growing season. Rotate leafy greens with other vegetable crops. Break up fresh leafy greens residue and allow it to dry for several days before plowing or working the residue into the soil. Crisphead-lettuce types are difficult to grow in Wisconsin. Some varieties will not germinate in warm soils (above 40–50°F).

Rows: 12–36 inches.

Plants in row: 2–12 inches. Use 0.5–1.0 lb seed/a (use only mosaic-free seed).

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 5.6 or higher in organic soils and at least 5.8 in other soils.

Fertilizer rates: Apply P_2O_5 and K_2O according to soil test recommendations. Use annual nitrogen, P_2O_5, and K_2O recommendations in table below. Take credits for previous legume crops and manure.

Application: Broadcast and work in before planting. For most efficient use of nitrogen, split the recommendation into two or more applications during the season.

Micronutrients: Leafy greens need relatively high amounts of manganese, molybdenum, and copper. Use soil and plant analyses to check for deficiencies of these nutrients.

Annual nitrogen, phosphate, and potash recommendations for leafy greens

Nitrogen		Phosphate and potash		
Organic matter (%)	**Amount to apply** (lb/a)	**Yield goal** (t/a)	**Amount P_2O_5 to apply*** (lb/a)	**Amount K_2O to apply*** (lb/a)
<2	120	15–20	40	160
2.0–9.9	100			
10–20	60			
>20	40			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Disease control in leafy greens

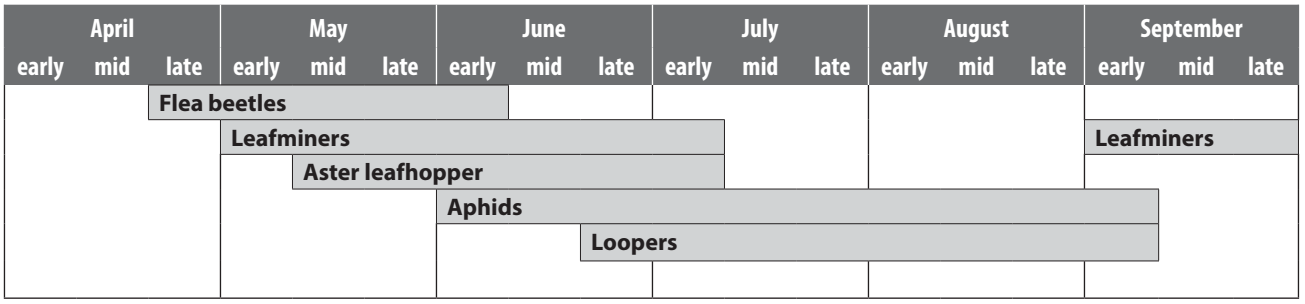
Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aster yellows	*Control aster leafhopper (see Insect Control table); also see "Aster Yellows Index" section on page 16.*			
Bottom rot *(Rhizoctonia)* **and drop** *(Sclerotinia)*	*Use long rotations with resistant crops such as corn, grasses, or small grains. Good weed control is important because these disease pathogens attack a wide range of plants. Maintain good soil fertility—healthy plants will be more resistant to disease. Also improve soil aeration at the base of plants by pairing the rows on raised beds and thinning plants to allow optimum growth. Chop debris with Rotobeater or flail-type machine. This will encourage rapid breakdown of plant materials and reduce potential of pathogens overwintering.*			
	azoxystrobin	*Rhizoctonia:* 0.4–0.8 fl oz Aframe, AzoxyStar, Quadris, Willowood Azoxy2SC/1,000 ft row	0	Do not apply more than 92.3 fl oz/a per season. See label for details on use for soilborne disease control.
	boscalid	8.0–11.0 oz Endura	14	Do not apply more than 22.0 oz/a per year. Only 2 applications can be made per season.
	Coniothyrium minitans strain CON/M/91-08	*drop caused by Sclerotinia:* 2.0 lb Contans WG	0	Incorporate in top 2 inches of soil by light mechanical incorporation or by irrigation. See label for specific application program post lettuce thinning. Approved for use on certified organic farms.
	cyprodinil + fludioxonil	*drop caused by Sclerotinia:* 11.0–14.0 oz Switch 62.5WG	0	Do not apply more than 56.0 oz/a per year. For lettuce, make first application at thinning and 2 weeks later.
	fludioxonil	*drop caused by Sclerotinia:* 7.0 oz Cannonball WP	0	Do not apply more than 28.0 oz/a per year. Do not apply more than two times before alternating to an effective fungicide with a different mode of action.
	fluopyram + trifloxystrobin	7.6 fl oz Luna Sensation	0	Days to Harvest is 0 for foliar broadcast uses. Follow resistance management guidelines.
	fluxapyroxad + pyraclostrobin	8.0–11.0 fl oz Merivon	1	Follow resistance management guidelines on label.
	iprodione	1.5–2.0 pt Iprodione 4L AG, Nevado 4F, Rovral 4FL	14	Lettuce only. Spray at the three-leaf stage and again 10 days later. Use a tractor-mounted boom with hollow cone or flat fan nozzles. Direct spray to the base of plants.
	isofetamid	12.3 fl oz Kenja 400SC	14	Do not make more than 2 sequential applications of Kenja or other group 7 fungicides before rotating to a different mode of action.
	penthiopyrad	*drop caused by Sclerotinia:* 16.0–24.0 fl oz Fontelis	3	Do not apply more than 72.0 fl oz/a per year. Do not apply more than two times before alternating to an effective fungicide with a different mode of action.
Damping-off *(Pythium)*	*Avoid growing lettuce on wet, poorly drained soil.*			
	mefenoxam	1.0–2.0 pt Ridomil Gold SL 1.0–2.0 lb Ridomil Gold WSP		Lettuce and endive only. Preplant-incorporated application or surface application after planting.
	propamocarb hydrochloride	2.0 pt Previcur Flex	2	Do not apply more than 8.0 pt/a per season. Apply when conditions become favorable for disease. Can be applied in transplant water, through drip irrigation, or directed nozzles to lower plant parts and surrounding soil.
Downy mildew	ametoctradin + dimethomorph	14.0 fl oz Zampro	0	Apply with a spreading/penetrating adjuvant. Do not make more than 3 applications/a per year.
	azoxystrobin	12.0–15.5 fl oz Aframe, AzoxyStar, Quadris, Satori, Willowood Azoxy 2SC	0	Do not apply more than 92.3 fl oz/a per season.

(continued)

Disease control in leafy greens *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Downy mildew *(cont.)*	cyazofamid	2.75 fl oz Ranman	0	Do not apply more than 16.5 fl oz/a per growing season.
	cymoxanil	3.2–5.0 oz Curzate	3	Use high rate for severe disease pressure and for spinach downy mildew. Do not apply more than 30.0 oz/a per year.
	cymoxanil + famoxadone	8.0–10.0 oz Tanos	1	Must be tank mixed with an appropriate contact fungicide such as chlorothalonil, mancozeb, or copper. Do not make more than 1 application without alternating to an effective fungicide with a different mode of action.
	dimethomorph	6.0 fl oz Forum	0	Do not make more than 5 applications per season. Do not exceed 30.0 fl oz per season.
	fenamidone	5.5–8.2 fl oz Reason 500 SC	2	Do not apply more than 24.6 oz/a per year. Do not make more than 1 application without alternating to an effective fungicide with a different mode of action.
	fixed copper	1.0–2.0 lb Champion 77WP 0.6–1.3 pt Champ Formula 2 Flowable	0 0	Lettuce, endive, and escarole only.
	fluopicolide	3.0–4.0 fl oz Presidio	2	Lettuce, chicory, endive, and escarole. May be applied through sprinkler or drip irrigation system. Tank mix with another fungicide having different mode of action for resistance management.
	fosetyl-al	2.0–5.0 lb Aliette WDG, Linebacker WDG	3	Lettuce, arugula, celery, cress, endive, spinach, Swiss chard, fennel, escarole, and chicory only.
	mancozeb	1.2–1.6 qt Dithane F-45 1.6–2.1 lb Manzate Pro-Stick, Penncozeb (lettuce) 2.0 lb Dithane M45, Koverall	10	Begin application prior to disease development. Minimum re-treatment interval is 7 days.
	mandipropamid	8.0 fl oz Revus	1	Lettuce and endive. Make no more than 2 consecutive applications before switching to another effective non–Group 40 fungicide. The addition of an adjuvant is recommended.
	oxathiapiprolin	2.0–4.8 fl oz Orondis Ultra A (for *Bremia lactucae*) 2.4–4.8 fl oz Orondis Ultra A (for *Peronospora farinosa*)	0	Make no more than 2 sequential applications before rotating to a fungicide with a different mode of action. Do not exceed 19.2 fl oz/a per year. Begin foliar applications prior to disease development and continue on a 3- to 14-day interval.
	propamocarb hydrochloride	2.0 pt Previcur Flex *or* 1.33–2.0 pt Previcur Flex with tank-mix partner	2	Do not apply more than 8.0 pt/a per season. Apply when conditions become favorable for disease.
	pyraclostrobin	12.0–16.0 oz Cabrio EG	0	Do not apply more than 64.0 oz/a per year. Do not apply more than two times before alternating to an effective fungicide with a different mode of action.
Lettuce mosaic	*Use seed certified mosaic free.*			
Root rot	*Thoroughly work old plant refuse into the soil. Only grow one lettuce crop per season on a field.*			

Scouting calendar for insect pests of leafy greens



Insect control in leafy greens

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids	*Treat seedlings if one or more aphids per plant; treat established plants if 10 or more aphids per plant.*			
	0.974 lb acephate	1.0 lb Orthene 97	21	Head lettuce only. Do not exceed 2.0 lb ai/a per season. Do not feed trimmings. Do not allow livestock to graze treated areas.
	0.038–0.075 lb acetamiprid	2.0–4.0 oz Assail 30SG	7	Begin treatment when thresholds are reached. Apply every 7 days as needed. Do not exceed 5 applications or 0.375 lb ai/a per season.
	0.035–0.075 lb acetamiprid	0.8–1.7 oz Assail 70WP	7	
	alpha-cypermethrin	2.2–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.033–0.10 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	7	Apply to head lettuce every 7 days as needed. Do not exceed 0.5 lb ai/a per season.
	0.066–0.095 lb bifenthrin + imidacloprid	4.24–6.1 fl oz *Brigadier	7	Do not apply more than 30.72 fl oz/a (0.48 lb ai/a) per season. No more than 0.5 lb ai/a bifenthrin and 0.24 lb ai/a imidacloprid are allowed per season.
	clothianidin	*foliar:* 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		soil: 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a side-dress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
	0.088–0.176 lb cyantraniliprole *(soil)*	6.75–13.5 fl oz Verimark	—	Do not apply more than 13.5 fl oz/a Verimark per crop per season. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6. Minimum application interval between foliar sprays is 5 days. Do not use adjuvants in foliar tank mix with spinach.
	0.088–0.133 lb cyantraniliprole *(foliar)*	13.5–20.5 fl oz Exirel	1	
	0.2 lb cyantraniliprole + abamectin	10.0 fl oz *Minecto Pro	7	Do not apply more than 0.4 lb per calendar year of cyantraniliprole-containing products, or more than 0.056 lb per calendar year of abamectin-containing products.

*Restricted-use pesticide.

(continued)

Insect control in leafy greens *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids *(cont.)*	0.25–0.5 lb diazinon	several formulations	14	
	0.062–0.089 lb flonicamid	2.0–2.8 oz Beleaf SG	0	Begin applications before aphid populations build. Do not exceed 2.8 oz/a Beleaf per application and do not apply more than 8.4 oz/a (0.267 lb ai/a) per season.
	flupyradifurone	10.5–12.0 fl oz Sivanto	1	Foliar application. Apply when pests reach or exceed established thresholds. Do not apply more than 28.0 fl oz of Sivanto per acre per crop season.
	I. fumosorosea (20%)	1.0–2.0 lb PFR-97	1	Repeat applications at 3- to 10-day intervals over 2–3 weeks or as needed to maintain control. Frequent application may be required under dry conditions, during periods of increased pest buildup or reproduction, or rapid host plant growth.
	imidacloprid	4.4–10.5 fl oz Admire Pro	21	Systemic at planting. Do not exceed 24.0 fl oz/a Admire per season.
		3.75 fl oz Provado F	7	Foliar spray. Apply before populations become damaging. Do not exceed 18.75 fl oz/a Provado per season.
	imidacloprid + beta-cyfluthrin	3.0 fl oz *Leverage 360	7	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not apply more than 0.3 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	1	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.3 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	1.25–1.9 lb malathion	several formulations	7–14	Apply twice a week. Check label for crop.
	0.1–0.2 lb permethrin	4.0–8.0 oz *Permethrin 3.2EC	1	Consult label.
	0.086 lb pymetrozine	2.75 oz Fulfill 50WDG	0	Apply before aphids reach damaging levels. Do not exceed 5.5 oz/a per season.
	0.06–0.08 lb spirotetramat	4.0–5.0 fl oz Movento	1	Do not apply more than 10.0 fl oz/a (0.16 lb ai/a) per season.
	0.063–0.078 lb spirotetramat + 0.022–0.027 lb pyriproxifen	8.0–10.0 fl oz Senstar	14	Do not apply more than 10 fl oz of Senstar Insecticide (0.078 lb spirotetramat and 0.027 lb pyriproxyfen) per acre per application. Do not make more than 2 applications per crop season. Do not apply more than 20 fl oz of Senstar Insecticide (0.156 lb spirotetramat and 0.055 lb pyriproxyfen) per acre per crop season. Do not apply within 14 days of harvest. Minimum interval between applications is 14 days. Regardless of formulation do not apply more than 0.16 lb spirotetramat and 0.134 lb pyriproxyfen per acre per crop season.
	thiamethoxam	1.5–3.0 oz Actara 25WDG 5.0–11.0 fl oz Platinum 2SC 1.66–3.67 oz Platinum 75SG	7 30 30	Do not apply more than 11.0 oz of Actara 25WDG or Platinum 2SC and no more than 3.67 oz Platinum 75SG per acre per crop season and apply sufficient water volume after in-ground application to ensure incorporation into the seed zone. Actara is applied as a foliar spray.

*Restricted-use pesticide.

(continued)

Insect control in leafy greens *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids *(cont.)*	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	0.17–0.21 lb tolfenpyrad	17.0–21.0 fl oz Torac	1	Do not apply until at least 14 days after emergence or after transplanting to allow time for root establishment. This period of time should be extended if conditions at time of emergence or transplanting are not favorable to crop growth. Apply by ground only, using a minimum of 20 gallons of water per acre. Do not apply more than 42.0 fluid ounces (0.42 lb ai) per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow at least 14 days between applications. Do not make more than 4 applications per year.
	0.014–0.025 lb zeta-cypermethrin	2.24–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.
Aster leafhopper and tarnished plant bug	0.487–0.974 lb acephate	0.5–1.0 lb Orthene 97	21	Head lettuce only. Do not exceed 2.0 lb ai/a per season. Do not feed trimmings. Do not allow livestock to graze treated areas.
	alpha-cypermethrin	2.2–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	leafhopper: 0.033–0.10 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	7	Apply to head lettuce every 7 days as needed. Do not exceed 0.5 lb ai/a per season.
	tarnished plant bug: 0.08–0.10 lb bifenthrin	5.12–6.4 fl oz *Brigade 2EC	7	
	0.066–0.095 lb bifenthrin + imidacloprid	4.24–6.1 fl oz *Brigadier	7	Do not apply more than 30.72 fl oz/a (0.48 lb ai/a) per season. No more than 0.5 lb ai/a bifenthrin and 0.24 lb ai/a imidacloprid are allowed per season.
	1.0–2.0 lb carbaryl	1.0–2.0 qt Sevin XLR Plus	14	Repeat applications as necessary up to 5 times per year but not more than once every 7 days. Do not exceed 6.0 qt per crop per year. Do not apply when crop or nearby weeds are in bloom.
	clothianidin	*foliar:* 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		soil: 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a side-dress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
	0.25 lb dimethoate	0.5 pt Dimethoate EC	7 (head) 14 (leaf)	Apply weekly as needed.
	flubendiamide + buprofezin	12.0–17.0 fl oz Vetica	7	Do not apply more than 38.0 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 3 applications per crop season.
	imidacloprid + beta-cyfluthrin	3.0 fl oz *Leverage 360	7	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.

*Restricted-use pesticide.

(continued)

Insect control in leafy greens *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aster leafhopper and tarnished plant bug *(cont.)*	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not apply more than 0.3 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	1	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.3 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	0.45–0.9 lb methomyl	1.5–3.0 pt *Lannate LV	Consult label	Head and leaf lettuce only. Consult label for specific restrictions.
	0.05–0.2 lb permethrin	2.0–8.0 oz *Permethrin 3.2EC	1	Consult label for specific restrictions.
	zeta-cypermethrin	2.24–4.0 fl oz *Mustang Maxx	1	Apply every 7 days as needed. Do not exceed 24.0 oz/a Mustang Maxx per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	7	Do not apply more than 0.45 lb ai/a per season. Wait at least 7 days between applications.
Leafhoppers only	alpha-cypermethrin	2.2–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.066–0.095 lb bifenthrin + imidacloprid	4.24–6.1 fl oz *Brigadier	7	Do not apply more than 30.72 fl oz/a (0.48 lb ai/a) per season. No more than 0.5 lb ai/a bifenthrin and 0.24 lb ai/a imidacloprid are allowed per season.
	clothianidin	*foliar:* 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		soil: 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a side-dress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
	0.05–0.1 lb cypermethrin	2.5–5.0 fl oz *Ammo EC	5	Apply no more than 0.6 lb ai/a per season.
	0.045–0.268 lb dinotefuran	*foliar:* 1.0–4.0 oz Venom 70SG *soil:* 5.0–6.0 oz Venom 70SG	1 21	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 12.0 oz/a per season using soil applications. See product label for application directions.
	0.05–0.13 lb dinotefuran *(foliar)*	2.0–5.25 oz Scorpion 35SL	1	Can repeat at 7-day intervals. Do not apply more than 10.5 oz per year. Use only one application method.
	0.23–0.27 lb dinotefuran *(soil)*	9.0–10.5 oz Scorpion 35SL	21	Do not apply more than 21.0 oz per year. Use only one application method.
	flubendiamide + buprofezin	12.0–17.0 fl oz Vetica	7	Do not apply more than 38.0 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 3 applications per crop season.
	flupyradifurone	7.0–10.5 fl oz Sivanto	1	Foliar application. Apply when pests reach or exceed established thresholds. Do not apply more than 28.0 fl oz of Sivanto per acre per crop season.
	imidacloprid	4.4–10.5 fl oz Admire Pro	21	Systemic at planting. Do not exceed 24.0 fl oz/a Admire per season.

*Restricted-use pesticide.

(continued)

Insect control in leafy greens *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Leafhoppers only *(cont.)*	imidacloprid + beta-cyfluthrin	3.0 fl oz *Leverage 360	7	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not apply more than 0.3 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	1	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.3 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	0.25–0.5 lb malathion	several formulations	7–14	Apply twice a week.
	0.05–0.2 lb permethrin	2.0–8.0 oz *Permethrin 3.2EC	1	Consult label for crop specifics.
	thiamethoxam	1.5–3.0 oz Actara 25WDG 5.0–11.0 fl oz Platinum 2SC 1.66–3.67 oz Platinum 75SG	7 30 30	Do not follow applications of Platinum 2SC with foliar applications of any other neonicotinoid insecticide. Platinum 2SC may be applied to direct seeded crops in-furrow at seeding or transplant depth, or as a narrow surface band above the seedling and followed by irrigation. Do not apply more than 11.0 oz of Actara 25WDG or Platinum 2SC and no more than 3.67 oz Platinum 75SG per acre per crop season and apply sufficient water volume after in-ground application to ensure incorporation into the seed zone. Actara is applied as a foliar spray.
	0.14–0.21 lb tolfenpyrad	14.0–21.0 fl oz Torac	1	Do not apply until at least 14 days after emergence or after transplanting to allow time for root establishment. This period of time should be extended if conditions at time of emergence or transplanting are not favorable to crop growth. Apply by ground only, using a minimum of 20 gallons of water per acre. Do not apply more than 42.0 fluid ounces (0.42 lb ai) per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow at least 14 days between applications. Do not make more than 4 applications per year.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	7	Do not apply more than 0.45 lb ai/a per season. Wait at least 7 days between applications.
Loopers	*For damage-free produce in mass-harvested crops, treat when 5% of the plants are infested. If selectively harvesting only healthy plants, more damage can be tolerated; treat when 15% of plants are infested.*			
	0.974 lb acephate	1.0 lb Orthene 97	21	Head lettuce only. Do not exceed 2.0 lb ai/a per season. Do not feed trimmings. Do not allow livestock to graze treated areas.
	alpha-cypermethrin	2.2–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	Bacillus thuringiensis	Biobit FL, WP; Cutlass; DiPel 2DF; Javelin; MVP	0	Rates vary with formulation; check the label.
	1.0–2.0 lb *Bacillus thuringiensis* subsp. *kurstaki*	1.0–2.0 lb Lepinox WDG	0	Treat early instar larvae before noticeable feeding damage occurs. Repeat as needed.
	0.033–0.10 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	7	Apply to head lettuce every 7 days as needed. Do not exceed 0.5 lb ai/a per season.

*Restricted-use pesticide.

(continued)

Insect control in leafy greens *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Loopers *(cont.)*	0.066–0.095 lb bifenthrin + imidacloprid	4.24–6.1 fl oz *Brigadier	7	Do not apply more than 30.72 fl oz/a (0.48 lb ai/a) per season. No more than 0.5 lb ai/a bifenthrin and 0.24 lb ai/a imidacloprid are allowed per season.
	chlorantraniliprole	3.5–7.5 fl oz Coragen	1	Do not make more than 4 applications per crop season and allow at least 3 days between applications. Do not apply more than 15.4 fl oz/a Coragen per season.
	0.088–0.176 lb cyantraniliprole *(soil)*	6.75–13.5 fl oz Verimark	—	Do not apply more than 13.5 fl oz/a Verimark per crop per season. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6. Minimum application interval between foliar sprays is 5 days. Do not use adjuvants in foliar tank mix with spinach.
	0.065–0.11 lb cyantraniliprole *(foliar)*	10.0–17.0 fl oz Exirel	1	
	0.15–0.2 lb cyantraniliprole + abamectin	7.5–10.0 fl oz *Minecto Pro	7	Do not apply more than 0.4 lb per calendar year of cyantraniliprole-containing products, or more than 0.056 lb per calendar year of abamectin-containing products.
	0.025–0.1 lb cypermethrin	*Ammo WSB, EC	5	Do not exceed 0.6 lb ai/a per season.
	0.0075–0.015 lb emamectin benzoate	3.2–4.8 oz *Proclaim	7	Apply when larvae first appear. Use higher rate for larger larvae or severe outbreaks. Do not exceed 28.8 oz ai/a per season. Highly toxic to bees.
	0.03–0.045 lb flubendiamide	2.0–3.0 oz Synapse WG	1	Do not exceed 3.0 oz/a (0.045 lb ai/a) in a 7-day period or more than 9.0 oz/a per season.
	flubendiamide + buprofezin	12.0–17.0 fl oz Vetica	7	Do not apply more than 38.0 fl oz/a per season and allow at least 7 days between applications. Do not make more than 3 applications per crop season.
	imidacloprid + beta-cyfluthrin	3.0 fl oz *Leverage 360	7	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.
	0.045–0.065 lb indocaxarb	2.5–3.5 oz Avaunt	3	For use on head and leaf lettuces only. Apply when insect populations reach threshold levels. Do not exceed 0.25 lb ai/a per crop.
	0.015–0.025 lb lambda-cyhalothrin	0.96–1.6 fl oz *Warrior II	4	Do not apply more than 0.3 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	5.0–8.0 fl oz *Voliam Xpress	1	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.3 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	1.25–1.9 lb malathion	several formulations	7–14	
	0.45–0.9 lb methomyl	1.5–3.0 pt *Lannate LV		Repeat application as necessary up to 12 times per crop. Do not exceed 18.0 pt/a per crop.
	0.06–0.16 lb methoxyfenozide	*early season:* 4.0–8.0 fl oz Intrepid 2F *mid- to late season:* 8.0–16.0 fl oz Intrepid 2F	1 1	Do not exceed 64.0 fl oz/a per season. Use the higher rates with higher populations or when spray coverage is difficult. See label for use restrictions in some Wisconsin counties.
	0.05–0.2 lb permethrin	2.0–8.0 oz *Permethrin 3.2EC	1	Consult label for crop specifics.

*Restricted-use pesticide.

(continued)

Insect control in leafy greens *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Loopers *(cont.)*	0.039–0.078 lb spinetoram	5.0–10.0 oz Radiant SC	1	Do not apply more than 34.0 oz/a Radiant (0.266 lb ai/a) per crop and do not exceed 6 applications per year.
	spinosad	3.0–6.0 fl oz Entrust SC	1	Use higher rate for larger larvae. Apply in adequate spray volume to get good coverage for best control. Do not exceed 0.45 lb ai/a per season. Do not apply to seedlings grown for transplant.
	0.09–0.12 lb tebufenozide	6.0–8.0 fl oz Confirm 2F	7	Apply per label directions every 10–14 days as needed. Do not exceed 56.0 oz/season or 8.0 oz/application. There is a 1- to 12-month plantback restriction depending on the crop.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	zeta-cypermethrin	2.24–4.0 fl oz *Mustang Maxx EC	1	Apply every 7 days as needed. Do not exceed 24.0 oz/a Mustang Maxx per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	7	Do not apply more than 0.45 lb ai/a per season. Wait at least 7 days between applications.

*Restricted-use pesticide.

Weed control in leafy greens (See label for specific crop species.)

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	0.475–1.0 lb pendimethalin	up to 2.1 pt Satellite Hydrocap	21	Apply Satellite Hydrocap as a broadcast foliar spray to either direct seeded or transplanted leafy brassica greens (consult label for allowable greens) at the 4–5 leaf stage.
	0.5–2.0 lb *pronamide	1.25–5.0 pt Kerb SC	Varies with rate applied	Rate depends on soil texture and method of irrigation. Not recommended for high organic (muck) soils. Application can be made before or after planting, but prior to emergence of weeds. Only the SC formulation is labeled for use on leaf lettuce. See label for rate restrictions for use on certain varieties of crisp lettuce or endive, escarole, or radicchio greens. Kerb should be incorporated mechanically or with rainfall or irrigation within 2–3 days of application.
	trifluralin	several manufacturers		See label for allowable leafy greens and rates. Controls annual grasses and some broadleaf weeds, but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Rate varies with soil texture and organic matter. Follow recommended soil preparation, application, and incorporation procedures. Must be incorporated within 24 hours. See label for plantback restrictions. Ineffective on peat and muck soils.

*Restricted-use pesticide.

(continued)

Weed control in leafy greens *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual broad-leaves	0.094–0.187 lb clopyralid	rate varies by type of leafy green	21 (spinach) 30 (brassica leafy greens)	Apply to spinach in the two- to five-leaf growth stage, making 1–2 broadcast applications per crop year, not to exceed annual seasonal maximum (see label for details). Some leaf curling may be observed.
	0.49–0.98 lb *phenmedipham	3.0–6.0 pt Spin-Aid	21	Processing spinach only. Apply when spinach is at the four-leaf stage or later. Consult label for split application rates and environmental conditions that may cause injury.
Annual grasses	5.0–6.0 lb bensulide	5.0–6.0 qt Prefar 4E		See label for allowable leafy greens. Apply before planting. Incorporate 1–2 inches deep to avoid loss due to volatilization. Use on mineral soils only.
Emerged weeds	glyphosate	several manufacturers and formulations		See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. Glyphosate may be applied anytime before crop emerges. Apply before crop seed germination in coarse sandy soils. If weeds have been mowed or tilled, do not treat until they have resumed active growth and reached the recommended stage on the label. Unless otherwise stated, allow 7 or more days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified.
	*paraquat	several manufacturers and formulations, not all are registered for this use		Prepare seedbed early to allow for maximum weed emergence. Application can be made as a banded or broadcast treatment before, during, or after planting, but before crop emergence. In preplant and preemergence (to the crop) uses, do not apply to soils lacking clay minerals (i.e., muck, pure sand). Use the higher rate for heavy weed infestations. Seeding and transplanting should be performed with minimal soil disturbance. Always add crop oil concentrate or non-ionic surfactant to spray mixture. Follow precautions on label.
Emerged grasses	0.068–0.12 lb clethodim	9.0–16.0 oz Select Max	14	Apply to actively growing grasses. Repeat treatments may be made at 14-day intervals up to the maximum annual use rate. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by product label. Do not apply if rain is expected within 1 hour.
	clethodim	several manufacturers and formulations		
	0.094–0.375 lb fluazifop-p-butyl	6.0–24.0 fl oz Fusilade DX	14	Make postemergence application to actively growing grasses; check label for size range, treatment rate, and appropriate spray additive. Do not apply more than 24.0 fl oz/a Fusilade DX per application or more than a total of 48.0 fl oz/a Fusilade DX per season. Maintain a minimum of 14 days between applications.
	0.094–0.28 lb sethoxydim	0.5–1.5 pt Poast	30 (head lettuce) 15 (leaf lettuce, endive, escarole)	Make postemergence applications to actively growing grasses within the size ranges indicated on the label. Check the label for early and rescue treatment rates. Do not apply more than 3.0 pt/a Poast in one crop season. Consult label for rate and adjuvant instructions for specific weeds. Do not use on chicory.

*Restricted-use pesticide.

Melon: muskmelon (cantaloupe), watermelon

Planting

Melons need a long growing season of relatively high temperatures (averaging 70–80°F) for optimal growth. Vine crops are susceptible to frost, and seeds will not germinate in soils colder than 60°F. Planting generally begins around May 10 in southern Wisconsin and June 1 in northern Wisconsin.

Use tillage practices that create a level, firm seedbed with adequate moisture for germination. Melons grown on sandy soil will need irrigation.

Muskmelon

Rows: 60–84 inches.

Plants in row: 8–12 inches apart.

Watermelon

Rows: 60–96 inches.

Plants in row: 36–96 inches apart.

Transplants can and often should be used to start plantings. Vine crops are sensitive to transplanting and should be seeded in individual containers about 3–4 weeks before putting in the field. Move plants to the field starting around May 20 in southern Wisconsin and June 1 in northern counties. Vine crops do well when grown on black plastic mulch or under floating row covers in spring and early summer.

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 5.8 on mineral soils and 5.6 on organic soils.

Fertilizer rates: Apply P_2O_5 and K_2O according to soil test recommendations. Use annual nitrogen, P_2O_5, and K_2O recommendations in the table below. Take credits for previous legume crops and manure.

Application: Broadcast lime and fertilizer and work into the soil before planting. Apply fertilizer at planting time in a band 2 inches to the side and 2 inches below seed level.

Nitrogen: Split nitrogen recommendation into two or more applications during the season. Make the first application when plants have two or more true leaves. Make a second application when vines begin to fill the rows. Subsequent applications (15–20 lb N/a each) can be made at 10- to 14-day intervals after harvest has started.

Annual nitrogen, phosphate, and potash recommendations for melon

Nitrogen		Phosphate and potash		
Organic matter (%)	**Amount to apply** (lb/a)	**Yield goal** (t/a)	**Amount P_2O_5 to apply*** (lb/a)	**Amount K_2O to apply*** (lb/a)
<2	100	8–10	40	145
2.0–9.9	80			
10–20	60			
>20	30			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Disease management

Try to grow crop under ideal conditions for fertility, soil texture, soil moisture, and pH. Use disease-free seed. Avoid fruit injury. Rotate crops with non-cucurbits and eradicate cucurbit weeds. Follow a 7-day fungicide spray schedule, starting before the disease occurs. Apply the selected fungicide in at least 50 gal water/a when using ground equipment or in 5–10 gal water/a with aerial application.

Disease control in melon—muskmelon, watermelon

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Alternaria leaf blight	azoxystrobin	10.0–15.5 fl oz Equation, Quadris Flowable, Satori 11.0–15.5 fl oz Aframe	1 1	Equation, Quadris, Satori, Reason, and Cabrio belong to the Group 11 (strobilurin) fungicide category. Quadris Opti contains Groups 11 and M5 fungicides. Tanos contains Groups 11 and 27 fungicides. Do not exceed 1 application of any of these products before alternating with a fungicide having a different mode of action. Do not exceed 4 applications of strobilurin fungicides per crop per year.
	azoxystrobin + chlorothalonil	3.2 pt Quadris Opti	1	
	azoxystrobin + difenoconazole	12.0–14.0 fl oz Quadris Top	1	
	cymoxanil + famoxadone	8.0 oz Tanos 50DF	3	
	fenamidone	5.5 fl oz Reason 500 SC	14	
	pyraclostrobin	12.0–16.0 oz Cabrio EG	0	
	boscalid	6.5 oz Endura	0	Do not apply more than 26.0 oz/a Endura per year. Do not make more than 4 applications per year.
	boscalid + pyraclostrobin	12.5–18.5 oz Pristine WDG	0	Pristine belongs to Groups 7 and 11 fungicide categories. Do not exceed 1 application of Pristine before alternating to a labeled fungicide with a different mode of action and not belonging to Groups 7 or 11. Do not exceed 4 applications of Pristine or other Group 7 or Group 11 fungicides per season. Do not exceed 74.0 oz/a Pristine per season.
	chlorothalonil	2.0–3.0 pt Bravo Weather Stik, Equus 720 1.8–2.7 lb Bravo Ultrex 82.5WDG, Equus DF	0 0	Consult label directions, especially for use on watermelons. Application can result in sunburn on surface of fruit.
	cyprodinil + difenoconazole	16.0–20.0 fl oz Inspire Super	7	Do not apply more than 80.0 fl oz/a per year. Make no more than 2 sequential applications before alternating to an effective fungicide with a different mode of action.
	cyprodinil + fludioxonil	11.0–14.0 oz Switch 62.5WG	1	Do not apply more than 56.0 fl oz/a per year. Make no more than 2 sequential applications before alternating to an effective fungicide with a different mode of action.
	fluopyram + tebuconazole	8.0–17.0 fl oz Luna Experience	7	Do not apply with aerial application equipment. Follow resistance management guidelines.
	fluopyram + trifloxystrobin	7.6 fl oz Luna Sensation	0	For watermelon only. A mild yellowing on leaf margins may be noted with Luna Sensation. Follow resistance management guidelines.

(continued)

Disease control in melon—muskmelon, watermelon *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Alternaria leaf blight *(cont.)*	fluoxastrobin	3.0–5.7 fl oz Evito 480 SC	1	Begin application preventively. Use higher rates when disease pressure is high. Do not tank mix with insecticides that are EC-based.
	fluxapyroxad + pyraclostrobin	4.0–5.5 fl oz Merivon	0	Do not make more than 3 applications per acre per season.
	hydrogen dioxide	1:100–1:2000 dilution rate OxiDate	0	Root and cutting dip treatment, soil drench, and seed treatments are registered. See label for application details. Follow tank-mixing instructions on label; some incompatibility issues exist. See cucurbit section of label for further details among crop grouping. Allowable for use in organic systems.
	mancozeb	1.2–2.4 qt Penncozeb 4FL 1.6–2.4 qt Dithane F-45, Manzate Flowable 2.0–3.0 lb Dithane DF Rainshield, Manzate Pro-Stick, Penncozeb 75DF, Penncozeb 80WP	5 5 5	Consult label for seasonal product limits. Apply when conditions favor disease. Use higher rates and shorter intervals when disease pressure is high.
	mancozeb + copper hydroxide	2.0–3.0 lb ManKocide	5	Do not make more than 8 applications/a per year. Follow seasonal limits for EBDC usage.
	penthiopyrad	12.0–16.0 fl oz Fontelis	1	Make no more than 2 sequential applications before alternating to an effective fungicide with a different mode of action. Do not exceed 67.0 fl oz/a per year. Can be used on greenhouse-grown cucumbers. See label for specific instructions on greenhouse rates.
	pydiflumetofen + fludioxonil	9.2–11.4 fl oz Miravis Prime	1	Make no more than 2 sequential applications before alternating to a fungicide outside of the Classes 7 or 12.
	tetraconazole	8.0 fl oz Mettle 125ME	0	Make no more than 5 applications per season per crop. Make no more than 2 sequential applications before alternating to an effective fungicide from another Class.
	zoxamide + chlorothalonil	36.0 fl oz Zing	0	Do not make more than 2 sequential applications before alternating to a fungicide of a different mode of action.
	zoxamide + mancozeb	1.5–2.0 lb Gavel 75DF	5	Do not exceed 8 applications or apply more than 16.0 lb/a Gavel (10.67 lb ai/a mancozeb and 1.33 lb ai/a zoxamide) per season.

(continued)

Disease control in melon—muskmelon, watermelon *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Anthracnose	azoxystrobin	10.0–15.5 fl oz Equation, Quadris Flowable, Satori 11.0–15.5 fl oz Aframe	1 1	See remarks for Equation, Quadris, Satori, Tanos, and Cabrio in Alternaria leaf blight section. If disease pressure is high, use the shortest interval and highest rate.
	azoxystrobin + chlorothalonil	3.2 pt Quadris Opti	1	
	azoxystrobin + difenoconazole	12.0–14.0 fl oz Quadris Top	1	
	cymoxanil + famoxadone	8.0 oz Tanos 50DF	3	
	pyraclostrobin	12.0–16.0 oz Cabrio EG	0	
	azoxystrobin + benzovindi-flupyr	0.6–0.8 oz/5,000 sq ft Mural (for treatment in greenhouses for plant resale)	0	Allowable growing environments include greenhouses, enclosed structures, and fields for the purpose of plant resale to consumer.
	boscalid + pyraclostrobin	18.5 oz Pristine WDG	0	Pristine belongs to Group 7 and 11 fungicide categories. Do not exceed 1 application of Pristine before alternating to a labeled fungicide with a different mode of action. Do not exceed 4 applications of Pristine or other Group 7 or Group 11 fungicides per season. Do not exceed 74.0 oz/a Pristine per season.
	chlorothalonil	1.5–2.0 pt Bravo Weather Stik, Echo 720 1.4–1.8 lb Bravo Ultrex 82.5WDG 1.25–1.625 lb Echo 90DF	0 0 0	Apply when conditions are favorable for disease onset. Do not apply chlorothalonil to watermelon when any of the following conditions are present: 1) intense heat and sunlight; 2) drought conditions; 3) poor vine canopy; 4) other conditions favoring sunburn.
	cyprodinil + difenoconazole	16.0–20.0 fl oz Inspire Super	7	Do not apply more than 80.0 fl oz/a per year. Make no more than 2 sequential applications before alternating to an effective fungicide with a different mode of action.
	difenoconazole + benzovindif-lupyr	10.5–13.5 fl oz Aprovia Top	0	Follow resistance management guidelines. Do not apply more than 53.6 fl oz per acre per year.
	fluopyram + tebuconazole	17.0 fl oz Luna Experience	7	Do not apply with aerial application equipment. Follow resistance management guidelines.
	fluopyram + trifloxystrobin	7.6 fl oz Luna Sensation	0	For watermelon only. A mild yellowing on leaf margins may be noted with Luna Sensation. Follow resistance management guidelines.
	fluoxastrobin	3.0–5.7 fl oz Evito 480 SC	1	Begin application preventively. Use higher rates when disease pressure is high. Do not tank mix with insecticides that are EC-based.
	fluxapyroxad + pyraclostrobin	5.5 fl oz Merivon	0	Do not make more than 3 applications per acre per season.
	hydrogen dioxide	1:100–1:2000 dilution rate OxiDate	0	Root and cutting dip treatment, soil drench, and seed treatments are registered. See label for application details. Follow tank-mixing instructions on label; some incompatibility issues exist. See cucurbit section of label for further details among crop grouping. Allowable for use in organic systems.

(continued)

Disease control in melon—muskmelon, watermelon *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Anthracnose *(cont.)*	mancozeb	1.2–2.4 qt Penncozeb 4FL 1.6–2.4 qt Dithane F-45, Manzate Flowable 2.0–3.0 lb Dithane DF Rainshield, Koverall, Manzate Pro-Stick, Penncozeb 75DF, Penncozeb 80WP	5 5 5	Do not apply more than 24.0 lb/a per year. Consult label for seasonal product limitations.
	mancozeb + copper hydroxide	2.0–3.0 lb ManKocide	5	Do not make more than 8 applications/a per year. Follow label allowance guidelines for EBDC usage.
	tetraconazole	8.0 fl oz Mettle 125ME	0	Make no more than 5 applications per season per crop. Make no more than 2 sequential applications before alternating to an effective fungicide with a different mode of action.
	thiophanate methyl	0.5 lb Topsin M 70W, Topsin M WSB 10.0 fl oz Topsin 4.5FL	0	Apply when disease first appears and repeat if needed every 7–14 days. See label for resistance management guidelines. Do not apply more than 60.0 fl oz of product/a per year.
	zoxamide + chlorothalonil	36.0 fl oz Zing	0	Do not make more than 2 sequential applications before alternating to a fungicide of a different mode of action.
Bacterial wilt *(Erwinia)*	*Eliminate the cucumber beetles that carry this pathogen (see Insect Control table).*			
Black rot	*See fungicide treatments recommended for anthracnose.* fixed copper			Use certified disease-free seed. Destroy infected plant refuse.
Downy mildew	ametoctradin + dimethomorph	14.0 fl oz Zampro	0	Begin application prior to disease development and continue on a 5- to 7-day interval. Make no more than 3 applications/a per season.
	azoxystrobin + chlorothalonil	3.2 pt Quadris Opti	1	See remarks for this product in Alternaria leaf blight section.
	boscalid + pyraclostrobin	12.5–18.5 oz Pristine WDG	0	Pristine belongs to Groups 7 and 11 fungicide categories. Do not exceed 1 application of Pristine before alternating to a labeled fungicide with a different mode of action. Do not exceed 4 applications of Pristine or other Group 7 or Group 11 fungicides per season. Do not exceed 74.0 oz/a Pristine per season.
	chlorothalonil	1.4–1.8 lb Bravo Ultrex	0	Do not apply more than 19.1 lb/a.
	chlorothalonil + cymoxanil	3.0 pt Ariston	3	Be cautious when applying to mature watermelons as treatment may result in sunburn on upper surface of fruit.
	cyazofamid	2.1–2.75 fl oz Ranman	0	Ranman belongs to Group 21 fungicide category. Do not apply more than six sprays of Ranman per crop. Alternate Ranman sprays with a fungicide having a different mode of action. Do not apply more than 16.5 fl oz/a per year.
	cymoxanil	3.2–5.0 oz Curzate	3	Use only with a protectant as a tank mix partner, such as chlorothalonil, mancozeb, or copper hydroxide. Do not make more than 9 applications per year.

(continued)

Disease control in melon—muskmelon, watermelon *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Downy mildew *(cont.)*	dimethomorph	6.0 fl oz Forum	0	Do not exceed 30.0 fl oz/a per growing season. Do not make more than 5 applications per season. Do not make more than 2 sequential applications of Forum before alternating to another effective fungicide with a different mode of action for at least one application.
	ethaboxam	8.0 fl oz Elumin	2	Follow resistance management guidelines.
	famoxadone + cymoxanil	8.0 oz Tanos	3	Do not make more than 1 application of Tanos before alternating with a fungicide having a different mode of action. Do not make more than 4 applications of Tanos or other Group 11 fungicides per season. Do not exceed 32.0 oz/a Tanos per crop per season. Tanos is helpful for suppressing Phytophthora blight. Tanos must be tank mixed with a contact fungicide such as mancozeb, chlorothalonil, or copper-containing fungicide.
	fenamidone	5.5 fl oz Reason 500 SC	14	Do not apply more than 22.0 fl oz Reason 500 SC (0.71 lb ai/a per year).
	fixed copper	1.0–1.3 pt Champ Formula 2 2.6 pt Kocide LF 2.4F 0.5–1.25 lb Kocide 3000 1.0–2.25 lb Kocide 2000 DF 1.5–2.0 lb Kocide 101 77WP, Kocide DF 1.5–3.0 lb Champion 77WP	0 0 0 0 0 0	Use disease-free seed and rotate crops. Begin applications before fruit form at less than 7-day intervals. After a rain and wind storm, make two or 3 applications as soon as possible after the storm at 2- to 3-day intervals.
	fluazinam	0.75–1.5 pt Omega 500F	30	Do not apply more than 9.0 pt/a per year. Has a long PHI for cucurbits.
	fluopicolide	3.0–4.0 fl oz Presidio	2	Tank mix this product with another labeled non–Group 43 fungicide. May be applied through irrigation.
	fosetyl-al	2.0–5.0 lb Aliette WDG, Linebacker WDG	12 hr	Begin applications when conditions favor disease development (high moisture and moderate temperatures). Repeat at 7- to 14-day intervals. Do not exceed 7 applications per season.
	hydrogen dioxide	1:100–1:2000 dilution rate OxiDate	0	Root and cutting dip treatment, soil drench, and seed treatments are registered. See label for application details. Follow tank-mixing instructions on label; some incompatibility issues exist. See cucurbit section of label for further details among crop grouping. Allowable for use in organic systems.
	mancozeb	1.2–2.4 qt Penncozeb 4FL 1.6–2.4 qt Dithane F-45, Manzate Flowable 2.0–3.0 lb Dithane DF Rainshield, Koverall, Manzate Pro-Stick, Penncozeb 75DF, Penncozeb 80WP	5 5 5	Do not apply more than 24.0 lb/a per year. Consult label for seasonal product limitations.

(continued)

Disease control in melon—muskmelon, watermelon *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Downy mildew *(cont.)*	mancozeb + copper hydroxide	2.0–3.0 lb ManKocide	5	Do not make more than 8 applications per year. Some cantaloupe varieties may exhibit sensitivity to ManKocide application.
	mandipropamid	8.0 fl oz Revus	0	Do not exceed 1 application before switching to another effective non–Group 40 fungicide. Must be applied with an adjuvant.
	mefenoxam	2.5 pt Ridomil Gold Bravo SC	0	Use caution when applying to watermelon. Do not exceed 15.75 lb ai/a of chlorothalonil products or 1.0 lb ai soil-applied or 0.5 lb ai folliar-applied mefenoxam.
	mefenoxam + mancozeb	2.5 lb Ridomil Gold MZ	5	A maximum of 10.0 lb Ridomil Gold MZ may be applied per crop per season. Follow season allowance guidelines for EBDC usage.
	oxathiapiprolin	2.0–4.8 fl oz Orondis Opti A, Orondis Ultra A	0	Make no more than 2 sequential applications before rotating to a fungicide with a different mode of action. Do not exceed 19.2 fl oz/a per year. Begin foliar applications prior to disease development. Do not use Orondis Ultra A as a foliar application if you have already used Orondis Gold 200 on the soil at time of planting.
	phosphorous acid, mono- and dibasic sodium, potassium, and ammonium salts	2.5–5.0 pt Phostrol 1.0–3.0 qt Confine Extra, K-Phite/20 gal water	0	Do not exceed 7 applications per season.
	potassium phosphite	1.0–3.0 qt Fosphite, Rampart/100 gal water 1.25 qt Alude/40 gal water 1.0–2.0 qt Fungi-Phite/30 gal water 2.0–4.0 pt ProPhyt	0	Do not apply to plants that are stressed due to heat or moisture. Do not apply when leaf wetness periods of more than 4 hours are expected. Do not apply at less than 3-day intervals.
	potassium phosphite + tebuconazole	4.0 pt Viathon	7	Do not apply more than 12.0 pt/a per year. Apply prior to disease onset. For watermelon only.
	propamocarb hydrochloride	1.2 pt Previcur Flex OR 0.6–1.2 pt Previcur Flex *plus* tank-mix partner	2	Use as a foliar spray in a preventive program. Begin applications when conditions are favorable for disease, but before infection. Continue at 7- to 14-day intervals until the threat of disease is over. When applying at intervals longer than 7 days, alternate with an application of a contact fungicide midway between applications. Do not apply more than 6.0 pt/a Previcur Flex per season.
	pyraclostrobrin	8.0–12.0 oz Cabrio EG		Do not exceed 4 applications of strobilurin fungicides per crop per year.
	trifloxystrobin	4.0 oz Flint	0	Begin application prior to disease onset. Follow resistance management guidelines as per the label.

(continued)

Disease control in melon—muskmelon, watermelon *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Downy mildew *(cont.)*	zoxamide + chlorothalonil	36.0 fl oz Zing	0	Do not make more than 2 sequential applications before alternating to a fungicide of a different mode of action.
	zoxamide + mancozeb	1.5–2.0 lb Gavel 75DF	5	Do not exceed 8 applications or apply more than 16 lb/a product (10.67 lb ai mancozeb or 1.33 lb zoxamide) per season.
Fusarium wilt	*The only practical control is to grow wilt-resistant varieties. A lone crop rotation with crops other than melons can be beneficial.*			
Mosaic	*Plant resistant varieties. When possible, control by isolation from the following plants: burdock, catnip, china aster, chrysanthemum, wild cucumber, geranium, gladiolus, wild ground cherry, horse nettle, hyacinth, jimsonweed, larkspur, lily, marigold, milkweed, morning glory, nasturtium, petunia, phlox, pokeweed, salvia, snapdragon, flowering spurge, tulip, white cockle, and zinnia. Control aphids that spread the disease (see Insect Control table).*			
Phytophthora blight or crown rot *(Phytophthora capsici)*	ametoctradin + dimethomorph	14.0 fl oz Zampro	0	Begin application prior to disease development and continue on a 5- to 7-day interval. Make no more than 3 applications/a per season.
	cyazofamid	2.75 fl oz Ranman 400SC	0	Do not apply more than six sprays or 16.5 fl oz/a of Ranman per year. Alternate Ranman (Group 21) sprays with a fungicide having a different mode of action. Crops not listed on the label should not be planted within 30 days after the last application.
	dimethomorph	6.0 fl oz Forum	0	Do not exceed 30.0 fl oz/a per growing season. Do not make more than 5 applications per season. Do not make more than 2 sequential applications of Forum before alternating to another effective fungicide with a different mode of action for at least one application.
	ethaboxam	8.0 fl oz Elumin	2	Follow resistance management guidelines.
	famoxadone + cymoxanil	8.0–10.0 oz Tanos	3	Do not make more than 1 application of Tanos before alternating with a fungicide having a different mode of action. Do not make more than 4 applications of Tanos or other Group 11 fungicides per season. Do not exceed 32.0 oz/a Tanos per crop per season. Tanos is helpful for suppressing Phytophthora blight. Tanos must be tank mixed with a contact fungicide such as mancozeb, chlorothalonil, or copper-containing fungicide.
	fluopicolide	3.0–4.0 fl oz Presidio	2	Tank mix this product with another labeled non–Group 43 fungicide. May be applied through irrigation.
	fosetyl-al	2.0–5.0 lb Aliette WDG, Linebacker WDG	12 hr	Begin applications when conditions favor disease development (high moisture and moderate temperatures). Repeat at 7- to 14-day intervals. Do not exceed 7 applications per season.
	hydrogen dioxide	1:100–1:2000 dilution rate OxiDate	0	Root and cutting dip treatment, soil drench, and seed treatments are registered. See label for application details. Follow tank-mixing instructions on label; some incompatibility issues exist. See cucurbit section of label for further details among crop grouping. Allowable for use in organic systems.

(continued)

Disease control in melon—muskmelon, watermelon *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Phytophthora blight or crown rot *(cont.)*	mandipropamid	8.0 fl oz Revus	0	Do not exceed 1 application before switching to another effective non–Group 40 fungicide. An adjuvant must be applied with Revus.
	oxathiapiprolin	2.0–4.8 fl oz Orondis Opti A, Orondis Ultra A 2.4–19.2 fl oz Orondis Gold 200	0	Make no more than 2 sequential applications before rotating to a fungicide with a different mode of action. Do not exceed 19.2 fl oz/a per year. Begin foliar applications prior to disease development. Do not use Orondis Ultra A as a foliar application if you have already used Orondis Gold 200 on the soil at time of planting. Soil applications of Orondis Gold 200 are to be applied at-plant, in-furrow, or by drip irrigation treatment only.
	phosphorous acid, mono- and dibasic sodium, potassium, and ammonium salts	2.5–5.0 pt Phostrol 1.0–3.0 qt Confine Extra in 20 gal water	0	Do not exceed 7 applications per season.
	potassium phosphite	1.0–3.0 qt Fosphite, Rampart/100 gal water 1.0–2.0 qt Fungi-Phite/30 gal water 1.25 qt Alude/40 gal water 2.0–4.0 pt ProPhyt	0	Do not apply to plants that are stressed due to heat or moisture. Do not apply when leaf wetness periods of more than 4 hours are expected. Do not apply at less than 3-day intervals.
	zoxamide + mancozeb	1.5–2.0 lb Gavel 75DF	5	Do not exceed 8 applications or apply more than 16.0 lb/a Gavel (10.67 lb ai/a mancozeb or 1.33 lb ai/a zoxamide) per season.
Powdery mildew	azoxystrobin	10.0–15.5 fl oz Quadris Flowable, Satori 11.0–15.5 fl oz Aframe	1 1	Quadris, Satori, Cabrio, and Flint belong to the Group 11 (strobilurin) fungicide category. Quadris Opti contains a combination of Group 11 and Group M fungicides. Do not exceed 1 application of any of these products before alternating with a fungicide having a different mode of action. Do not exceed 4 applications of strobilurin fungicides per crop per year. Do not exceed 1.92 qt/a Quadris or Satori, 64.0 oz/a Cabrio, 8.0 oz/a Flint, or 2.0 gal/a Quadris Opti per season. Do not tank mix Quadris, Satori, Cabrio, Flint, or Quadris Opti with additives or adjuvants.
	azoxystrobin + chlorothalonil	3.2 pt Quadris Opti	1	
	pyraclostrobin	12.0–16.0 oz Cabrio EG	0	
	trifloxystrobin	1.5–2.0 oz Flint	0	
	boscalid + pyraclostrobin	12.5–18.5 oz Pristine WDG	0	Pristine belongs to Group 7 and 11 fungicide categories. Do not exceed 1 application of Pristine before alternating to a labeled fungicide with a different mode of action. Do not exceed 4 applications of Pristine or other Group 7 or Group 11 fungicides per season. Do not exceed 74.0 oz/a Pristine per season.
	chlorothalonil	1.8–2.7 lb Bravo Ultrex	0	Apply when conditions favor disease. See further instruction in the anthracnose section.

(continued)

Disease control in melon—muskmelon, watermelon *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Powdery mildew *(cont.)*	chlorothalonil + tebuconazole	1.1–1.6 pt Muscle ADV	7	Do not apply to heat- or drought-stressed plants. Follow resistance management guidelines.
	clarified hydrophobic extract of neem oil	0.5–1.0% Trilogy in 25–100 gal water *or* 2.0 pt in at least 5 gal water/a	0	Do not apply more than 2 gal/a of Trilogy. OMRI-approved.
	cyflufenamid	3.4 oz Torino	0	Do not make more than 2 applications/a per year. Do not exceed a total of 6.8 oz/a per year.
	cyprodinil + difenoconazole	16.0–20.0 fl oz Inspire Super	7	Do not apply more than 80.0 fl oz/a per year. Make no more than 2 sequential applications before alternating to an effective fungicide with a different mode of action.
	cyprodinil + fludioxonil	11.0–14.0 oz Switch 62.5WG	1	Do not apply more than 56.0 fl oz/a per year. Make no more than 2 sequential applications before alternating to an effective fungicide wtih a different mode of action.
	difenoconazole + benzovindiflupyr	10.5–13.5 fl oz Aprovia Top	0	Follow resistance management guidelines. Do not apply more than 53.6 fl oz per acre per year.
	fluopyram	6.5–6.84 fl oz Velum Prime	0	Also provides nematode control. Can be applied through drip irrigation.
	fluopyram + tebuconazole	6.0–17.0 fl oz Luna Experience	7	Do not apply with aerial application equipment. Follow resistance management guidelines.
	fluopyram + trifloxystrobin	4.0–7.6 fl oz Luna Sensation	0	For watermelon only. A mild yellowing on leaf margins may be noted with Luna Sensation. Follow resistance management guidelines.
	flutriafol	5.0–7.0 fl oz Rhyme 10.0–14.0 fl oz Topguard	0	Do not make more than 4 applications per acre per year. Follow resistance management guidelines. Not for muskmelon.
	fluxapyroxad + pyraclostrobin	4.0–5.5 fl oz Merivon	0	Do not apply more than 3 applications per acre per season.
	hydrogen dioxide	1:100–1:2000 dilution rate OxiDate	0	Root and cutting dip treatment, soil drench, and seed treatments are registered. See label for application details. Follow tank-mixing instructions on label; some incompatibility issues exist. See cucurbit section of label for further details among crop grouping. Allowable for use in organic systems.
	kresoxim methyl	3.2–4.8 oz Sovran	0	Not labeled for use in the greenhouse. This is a Group 11 strobilurin fungicide. Do not make more than 4 applications of Sovran or other strobilurin fungicides per acre per year.
	metrafenone	15.4 fl oz Vivando	0	Follow resistance management guidelines.
	myclobutanil	2.5–5.0 oz Rally 40WSP	0	Do not exceed 1.5 lb/a product (0.6 lb ai/a) per year. Observe a 30-day plantback interval between last application and planting new crops.
	neem oil	1% solution Trilogy	0	Thorough coverage is essential for good disease control. Also provides control of some insect crop pests.
	potassium bicarbonate	2.4–5.0 lb Kaligreen	0	Use higher rate when environmental conditions favor disease and pressure is high. Begin application at first sign of disease.

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Disease control in melon—muskmelon, watermelon *(continued)*

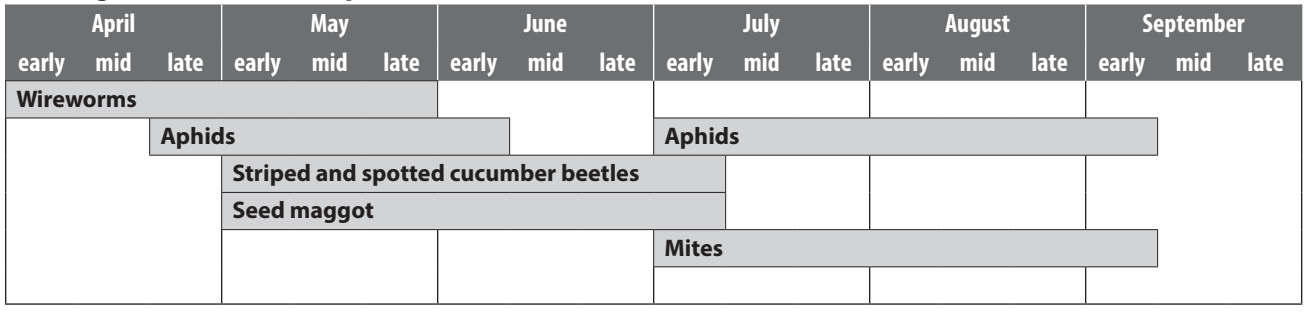
Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Powdery mildew *(cont.)*	potassium phosphite	1.0–3.0 qt Fosphite, Rampart/100 gal water 1.0–2.0 qt Fungi-Phite/20 gal water 1.25 qt Alude/40 gal water 2.0–4.0 pt ProPhyt	0	Do not apply to plants that are stressed due to heat or moisture. Do not apply when leaf wetness periods of more than 4 hours are expected. Do not apply at less than 3-day intervals.
	potassium phosphite + tebuconazole	2.0–3.0 pt Viathon	7	Apply prior to disease onset. Apply no more than 12.0 pt/a per year. For use on watermelon only.
	pydiflumetofen + fludioxonil	9.2–11.4 fl oz Miravis Prime	1	Do not make more than 2 sequential applications of Miravis Prime before alternating to a fungicide outside of the Classes 7 or 12.
	quinoxyfen	4.0–6.0 fl oz Quintec	3	Do not apply more than 24.0 fl oz/a per year. Do not apply more than 2 consecutive applications before alternating to an effective fungicide with a different mode of action.
	sulfur	2.0–4.0 lb Micro Sulf 5.0–10.0 lb Microthiol Disperss	0	Do not apply with oils or when temperatures are 90°F or higher. Phytotoxicity can occur.
	tebuconazole	4.0–6.0 fl oz Folicur 3.6 F, Monsoon, Onset 3.6L, Orius 3.6F, Tebusha 3.6FL, TebuStar 3.6L, Tebuzol 3.6F, Toledo	7	Do not exceed 24.0 fl oz/a per season.
	tetraconazole	8.0 fl oz Mettle 125ME	0	Make no more than 5 applications per season per crop. Make no more than 2 sequential applications before alternating to an effective fungicide with a different mode of action.
	thiophanate methyl	0.5 lb Topsin M 70W, Topsin M WSB 10.0 fl oz Topsin 4.5FL 0.2–0.4 lb Thiophanate methyl 85WDG	0	Apply when disease first appears and repeat if needed every 7–14 days.
	trifloxystrobin	1.5–2.0 oz Flint	0	Begin application prior to disease onset. Follow resistance management guidelines on label.
	triflumizole	4.0–8.0 oz Procure 50WS, Procure 480SC	0	Do not apply more than 40.0 oz/a Procure per season. See product label for plantback restrictions for leafy vegetables (30 days), root vegetables (60 days) and all other crops (1 yr). For greenhouse melon production, 4.0–8.0 fl oz in 100 gal water.
Seed rot and damping-off	azoxystrobin	0.1–0.38 fl oz Dynasty/100 lb seed	—	Follow manufacturer's directions. Not intended for food or feed source.
	captan	0.5–1.0 teaspoon Captan 50% WP/lb of dry seed	—	Use disease-free soil. Water plants in morning. Chemicals listed are seed treatments. Do not use treated seed for feed or food.
	fludioxonil	0.08–0.16 fl oz Dyna-Shield, Maxim 4FS, Spirato 480 FS	—	Follow manufacturer's directions. Not intended for food or feed source.

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Disease control in melon—muskmelon, watermelon *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Seed rot and damping-off *(cont.)*	mefenoxam	1.0–2.0 pt Ridomil Gold SL 2.0–4.0 pt Ultra Flourish	— —	Preplant-incorporated application or surface application at planting. Preplant to top 2 inches of soil.
		0.085–0.64 fl oz Apron XL/100 lb seed	—	Follow manufacturer's directions. Do not use treated seed for feed or food.
	mefenoxam + azoxystrobin	0.34 fl oz Uniform/1,000 ft row	—	Apply Uniform as an in-furrow spray in a minimum of 5 gal of water per acre at planting.
	metalaxyl	4.0–8.0 pt MetaStar 2E AG	—	Preplant-incorporated application or surface application at planting. Preplant to top 2 inches of soil.
		0.7 fl oz/100 lb seed Sebring 2.65 ST 0.75 fl oz/100 lb seed Allegiance FL, Metalaxyl 265 ST	— —	Follow manufacturer's directions. Do not use treated seed for feed or food.
	thiram	0.75 teaspoon Thiram 50% WP/lb seed	—	Use disease-free soil. Water plants in morning. Chemicals listed are seed treatments. Do not use treated seed for feed or food.

Scouting calendar for insect pests of melon



Insect control in melon—muskmelon, watermelon

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids	0.023 lb sulfoxaflor	0.75 oz Transform WG	1	Do not make applications less than 7 days apart. Do not make more than four applications per crop. Do not make more than two consecutive applications per crop. Do not apply more than a total of 8.5 oz of Transform WG (0.266 lb ai of sulfoxaflor) per acre per year.

*Restricted-use pesticide.

(continued)

Insect control in melon—muskmelon, watermelon *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Bean aphid and soybean aphid	alpha-cypermethrin	3.4–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	flupyradifurone	*foliar:* 7.0–12.0 fl oz Sivanto *soil:* 21.0–28.0 fl oz Sivanto	1 21	Apply when pests reach or exceed established thresholds. Do not apply more than 28.0 fl oz of Sivanto per acre per crop season.
	I. fumosorosea (20%)	1.0–2.0 lb PFR-97	1	Repeat applications at 3- to 10-day intervals over 2–3 weeks or as needed to maintain control. Frequent application may be required under dry conditions, during periods of increased pest buildup or reproduction, or rapid host plant growth.
	lambda-cyhalothrin + chlorantraniliprole	9.0 fl oz *Voliam Xpress	1	Allow at least 5 days between applications. Do not apply more than 31.0 fl oz/a Voliam Xpress per season.
	spirotetramat	4.0–5.0 fl oz Movento	1 (edible) 7 (dry)	Do not apply more than 10.0 fl oz/a per season and allow at least 7 days between applications.
Caterpillar pests (cutworms, cabbage looper, diamond-back moth)	0.0065–0.0125 lb beta-cyfluthrin	0.8–1.6 fl oz *Baythroid XL	0	Apply every 7 days as needed. Do not exceed 11.2 fl oz/a.
	0.04–1.0 lb bifenthrin	2.6–6.4 oz *Brigade 2EC	7	Apply every 7 days as needed. Do not exceed 0.3 lb (19.2 fl oz formulated product) ai/a per season. Do not make more than 2 applications after bloom. Wait at least 7 days between applications.
	bifenthrin + zeta-cypermethrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
	1.0 lb carbaryl	Sevin Bait (several formulations)	1	Broadcast when cutworms are present in damaging numbers.
	chlorantraniliprole	3.5–7.5 fl oz Coragen	1	Do not make more than 4 applications per crop season and allow at least 3 days between applications. Do not apply more than 15.4 fl oz/a Coragen per season.
	0.088–0.176 lb cyantraniliprole *(soil)*	6.75–13.5 fl oz Verimark	1	Do not apply more than 13.5 fl oz/a Verimark per crop per season. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6. Minimum application interval between foliar sprays is 5 days.
	0.065–0.11 lb cyantraniliprole *(foliar)*	10.0–17.0 fl oz Exirel	1	
	0.15–0.2 lb cyantraniliprole + abamectin	5.5–10.0 fl oz *Minecto Pro	7	Do not apply more than 0.4 lb per calendar year of cyantraniliprole-containing products, or more than 0.056 lb per calendar year of abamectin-containing products.
	0.012–0.028 lb deltamethrin	1.0–2.4 fl oz *Delta Gold	3	Apply every 3 days as needed. Do not exceed 14.4 fl oz/a per season.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Use as a rescue treatment when worms are present.
	0.03–0.045 lb flubendiamide	2.0–3.0 oz Synapse WG	1	Do not apply more than 3.0 oz/a (0.045 lb ai/a) in a 7-day period or more than 9.0 oz/a per season.
	flubendiamide + buprofezin	12.0–17.0 fl oz Vetica	7	Do not apply more than 38.0 fl oz/a per season and allow at least 7 days between applications. Do not make more than 3 applications per crop season.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.

*Restricted-use pesticide.

(continued)

Insect control in melon—muskmelon, watermelon *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Caterpillar pests *(cont.)*	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	1	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.18 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.1–0.2 lb permethrin	4.0–8.0 oz *Permethrin 3.2EC	0	Consult label for crop specifics.
	spiromesifen	7.0–8.5 fl oz Oberon 2 SC	7	Apply every 7 days as needed. Do not exceed 25.5 fl oz/a per season.
	0.01–0.025 lb zeta-cypermethrin	1.28–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.
Cucumber beetles (striped, spotted)	*Treat when there are more than four to five adults per 50 plants.*			
	0.047–0.10 lb acetamiprid	2.5–5.3 oz Assail 30SG	0	Begin treatment when thresholds are reached. Apply every 5 days as needed. Do not exceed 5 applications or 0.5 lb ai/a per season.
	0.05–0.10 lb acetamiprid	1.1–2.3 oz Assail 70WP	0	
	alpha-cypermethrin	3.0–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.019–0.022 lb beta-cyfluthrin	2.4–2.8 fl oz *Baythroid XL	0	Apply every 7 days as needed. Do not exceed 11.2 fl oz/a.
	0.033–0.10 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	7	Do not exceed 0.5 lb ai/a or 5 applications per season. Wait at least 7 days between treatments.
		6.8–8.5 fl oz *Capture LFR	16	Do not exceed 0.1 lb ai/a as an at-plant application; do not exceed 0.5 lb ai/a per season of all bifenthrin products.
	bifenthrin + zeta-cypermethrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
	1.0 lb carbaryl	1.0 qt Sevin XLR Plus	3	Repeat applications as necessary up to a total of 6 times per year but not more than once every 7 days. Do not exceed 6.0 qt per crop per year. Do not apply when crop or nearby weeds are in bloom.
	clothianidin	*foliar:* 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		soil: 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a sidedress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
	0.018–0.024 lb deltamethrin	1.5–2.4 fl oz *Delta Gold	3	Apply every 3 days as needed. Do not exceed 14.4 fl oz/a per season.
	0.05–0.18 lb dinotefuran *(foliar)*	2.0–7.0 oz Scorpion 35SL	1	Can repeat at 7-day intervals. Do not apply more than 10.5 oz per year.
	0.132–0.179 lb dinotefuran	3.0–4.0 oz Venom 70SG	1	Do not apply more than 62.0 oz/a per season.

*Restricted-use pesticide.

(continued)

Insect control in melon—muskmelon, watermelon *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cucumber beetles *(cont.)*	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Do not exceed 0.25 lb ai/a per year.
	0.2–0.3 lb fenpropathrin	10.66–16.0 oz *Danitol 2.4EC	7	Do not exceed 2.66 pt/a per season.
	imidacloprid	7.0–10.5 fl oz Admire Pro	21	Apply in a narrow band centered on plant row within 14 days before planting or as an in-furrow treatment during planting. Do not exceed 0.38 lb ai/a per year.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	1	Do not exceeed a total of 31.0 fl oz/a of Voliam Xpress or 0.18 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.94–1.9 lb malathion	several formulations	1	Do not apply before vining or to wet plants.
	0.45–0.9 lb methomyl	1.5–3.0 pt *Lannate LV	Consult label	Repeat application as necessary up to 12 times per crop. Do not exceed 18.0 pt/a per crop.
	0.5–1.0 lb oxamyl	2.0–4.0 pt *Vydate L	1	Make first application 2–4 weeks after planting. Repeat 2–3 weeks later.
	0.1–0.2 lb permethrin	4.0–8.0 oz *Permethrin 3.2EC	0	Consult label for crop specifics.
	thiamethoxam	3.0–5.5 oz Actara 25WDG 5.0–11.0 fl oz Platinum 2SC 1.66–3.67 oz Platinum 75SG	0 30 30	Do not follow applications of Platinum 2SC with foliar applications of any other neonicotinoid insecticide. Platinum may be applied to direct seeded crops in-furrow at seeding or transplant depth, or as a narrow surface band above the seedling and followed by irrigation. Do not apply more than 11.0 oz of Actara 25WDG or Platinum 2SC and no more than 3.67 oz Platinum 75SG per acre per crop season and apply sufficient water volume after in-ground application to ensure incorporation into the seed zone. Actara is applied as a foliar spray.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	0.02–0.025 lb zeta-cypermethrin	2.8–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.
Melon aphid	0.047–0.075 lb acetamiprid	2.5–4.0 oz Assail 30SG	0	Begin treatment when thresholds are reached. Apply every 5 days as needed. Do not exceed 5 applications or 0.5 lb ai/a per season.
	0.05–0.075 lb acetamiprid	1.1–1.7 oz Assail 70WP	0	
	alpha-cypermethrin	3.4–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.04–0.10 lb bifenthrin	2.6–6.4 fl oz *Brigade 2EC	3	Apply every 7 days as needed. Do not exceed 0.3 lb ai/a per season. Do not make more than 2 applications after bloom.
	bifenthrin + zeta-cypermethrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.

*Restricted-use pesticide.

(continued)

Insect control in melon—muskmelon, watermelon *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Melon aphid *(cont.)*	clothianidin	*foliar:* 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		soil: 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a sidedress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
	0.088–0.176 lb cyantraniliprole *(soil)*	6.75–13.5 fl oz Verimark	1	Do not apply more than 13.5 fl oz/a Verimark per crop per season. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6. Minimum application interval between foliar sprays is 5 days.
	0.088–0.133 lb cyantraniliprole *(foliar)*	13.5–20.5 fl oz Exirel	1	
	0.2 lb cyantraniliprole + abamectin	10.0 fl oz *Minecto Pro	7	Do not apply more than 0.4 lb per calendar year of cyantraniliprole-containing products, or more than 0.056 lb per calendar year of abamectin-containing products.
	0.25–0.75 lb diazinon	several formulations	3	Apply as soon as aphids are noticed.
	0.5 lb dimethoate	1.0 pt Dimethoate 400EC	3	Wait at least 7 days between treatments. Do not exceed 0.5 lb ai/a per treatment. Do not exceed 1.0 lb ai/a per year. Re-entry interval is 48 hours.
	.025–0.50 lb dimethoate *(watermelon)*	0.5–1.0 pt Dimethoate 400EC	3	
	0.045–0.268 lb dinotefuran	*foliar:* 1.0–4.0 oz Venom 70SG *soil:* 5.0–6.0 oz Venom 70SG	1 21	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 12.0 oz/a per season using soil applications. See product label for application directions.
	0.05–0.18 lb dinotefuran *(foliar)*	2.0–7.0 oz Scorpion 35SL	1	Can repeat at 7-day intervals. Do not apply more than 10.5 oz per year. Use only one application method.
	0.23–0.27 lb dinotefuran *(soil)*	9.0–10.5 oz Scorpion 35SL	21	Do not apply more than 21.0 oz per year. Use only one application method.
	0.062–0.089 lb flonicamid	2.0–2.8 oz Beleaf SG	0	Begin applications before aphid populations build. Do not exceed 2.8 oz/a Beleaf per application and do not apply more than 8.4 oz/a (0.267 lb ai/a) per season.
	flupyradifurone	*foliar:* 10.5–14.0 fl oz Sivanto *soil:* 21.0–28.0 fl oz Sivanto	1 21	Apply when pests reach or exceed established thresholds. Do not apply more than 28.0 fl oz of Sivanto per acre per crop season.
	I. fumosorosea (20%)	1.0–2.0 lb PFR-97	1	Repeat applications at 3- to 10-day intervals over 2–3 weeks or as needed to maintain control. Frequent application may be required under dry conditions, during periods of increased pest buildup or reproduction, or rapid host plant growth.
	imidacloprid	7.0–10.5 fl oz Admire Pro	21	Apply in a narrow band centered on plant row within 14 days before planting or as an in-furrow treatment during planting. Do not exceed 0.38 lb ai/a per year.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.

*Restricted-use pesticide.

(continued)

Insect control in melon—muskmelon, watermelon *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Melon aphid *(cont.)*	lambda-cyhalothrin + chlorantraniliprole	9.0 fl oz *Voliam Xpress	1	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.18 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	1.0–2.0 lb malathion	several formulations	1	Do not apply before vining or to wet plants.
	0.45–0.9 lb methomyl	1.5–3.0 pt *Lannate LV	Consult label	Repeat application as necessary up to 12 times per crop. Do not exceed 18.0 pt/a per crop.
	pymetrozine	2.75 oz Fulfill 50WDG	14	Controls melon and green peach aphids. Treat when aphids first appear. May repeat in 7 days. Do not exceed 5.5 oz/a per season or more than 2 applications per crop.
	thiamethoxam	2.0–3.0 oz Actara 25WDG 5.0–11.0 fl oz Platinum 2SC 1.66–3.67 oz Platinum 75SG	0 30 30	Do not apply more than 11.0 oz of Actara 25WDG or Platinum 2SC and no more than 3.67 oz Platinum 75SG per acre per crop season and apply sufficient water volume after in-ground application to ensure incorporation into the seed zone. Actara is applied as a foliar spray.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	0.02–0.025 lb zeta-cypermethrin	3.2–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.
Seed corn maggot	0.04–0.08 lb bifenthrin	3.4–6.8 oz *Capture LFR		Apply as a 5- to 7-inch band over an open furrow or in-furrow with the seed. Do not exceed 0.1 lb/a per season as an at-plant application.
	0.13–0.176 lb cyantraniliprole *(soil)*	10.0–13.5 fl oz Verimark	1	Do not apply more than 13.5 fl oz/a Verimark per crop per season. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6.
	0.01–0.025 lb zeta-cypermethrin	1.28–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.
Spider mite	0.938–1.88 lb abamectin	8.0–16.0 fl oz *Agri-Mek 0.15EC	7	May repeat after 7 days, but do not make more than two sequential treatments or exceed 5.64 lb ai/a per year.
	bifenazate	0.75–1.0 lb Acramite 50WS	3	Do not exceed 1 application per season.
	0.08–0.10 lb bifenthrin	5.12–6.4 fl oz *Brigade 2EC	3	Apply before insects reach threshold levels. May repeat applications after 7 days, but do not make more than 2 applications after bloom. Do not exceed 0.3 lb ai/a per season.
	bifenthrin + zeta-cypermethrin	10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.

*Restricted-use pesticide.

(continued)

Insect control in melon—muskmelon, watermelon *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Spider mite *(cont.)*	0.11–0.2 lb cyantraniliprole + abamectin	5.5–10.0 fl oz *Minecto Pro	7	Do not apply more than 0.4 lb per calendar year of cyantraniliprole-containing products, or more than 0.056 lb per calendar year of abamectin-containing products.
	0.09–0.14 lb etoxazole	2.0–3.0 oz Zeal	7	Do not make more than 1 application of Zeal or exceed 0.14 lb ai/a per season.
	0.2 lb fenpropathrin	10.66 fl oz *Danitol 2.4EC	7	Treat when mites first appear and repeat every 7 days as needed. Do not exceed 0.8 lb ai/a per season.
	0.1 lb fenpyroximate	2.0 pt Portal	1	Do not apply more than 4.0 pt per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow 14 days between applications.
	I. fumosorosea (20%)	1.0–2.0 lb PFR-97	1	Repeat applications at 3- to 10-day intervals over 2–3 weeks or as needed to maintain control. Frequent application may be required under dry conditions, during periods of increased pest buildup or reproduction, or rapid host plant growth.
	lambda-cyhalothrin + thiamethoxam	4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	spiromesifen	7.0–8.5 fl oz Oberon 2 SC	7	Apply every 7 days as needed. Do not exceed 25.5 fl oz/a per season.
Squash bug	*Check undersides of leaves for squash bug eggs laid in neat rows. Eggs hatch within 1–2 weeks. Treat when squash bugs are young; they are difficult to control as older nymphs or adults. Destroy crop residue in fall to reduce overwinter survival of this pest.*			
	0.10 lb acetamiprid	5.3 oz Assail 30SG 2.3 oz Assail 70WP	0 0	Begin treatment when thresholds are reached. Apply every 5 days as needed. Do not exceed 5 applications or 0.5 lb ai/a per season.
	alpha-cypermethrin	3.0–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.04–0.10 lb bifenthrin	2.6–6.4 fl oz *Brigade 2EC	3	Apply every 7 days as needed. Do not exceed 0.3 lb ai/a per season. Do not make more than 2 applications after bloom.
	bifenthrin + zeta-cypermethrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
	1.0 lb carbaryl	1.0 qt Sevin XLR Plus	3	Repeat applications as necessary up to a total of 6 times per year but not more than once every 7 days. Do not exceed 6.0 qt per crop per year. Do not apply when crop or nearby weeds are in bloom.
	clothianidin	*foliar:* 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		soil: 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a sidedress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Do not exceed 0.25 lb ai/a per year.

*Restricted-use pesticide.

(continued)

Insect control in melon—muskmelon, watermelon *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Squash bug *(cont.)*	0.05–0.18 lb dinotefuran	2.0–7.0 oz Scorpion 35SL	1	Can repeat at 7-day intervals. Do not apply more than 10.5 oz per year.
	0.132–0.179 lb dinotefuran	3.0–4.0 oz Venom 70SG	1	Do not apply more than 6.0 oz/a per season.
	flupyradifurone	*foliar:* 10.5–14.0 fl oz Sivanto *soil:* 21.0–28.0 fl oz Sivanto	1 21	Apply when pests reach or exceed established thresholds. Do not apply more than 28.0 fl oz of Sivanto per acre per crop season.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	1	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.18 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.2 lb permethrin	8.0 oz *Permethrin 3.2EC	0	Consult label for crop specifics.
	0.02–0.025 lb zeta-cypermethrin	2.8–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.
Squash vine borer	*Treat when adults are observed (900 DD_{50} or when chicory is in bloom), especially when runners are less than 2 feet long. Larvae boring in the main stem can kill the entire plant, while loss of a runner or two when the plant is larger will not cause economic damage. Look for sawdust-like excrement coming from holes in the stems, and open the stems to confirm the presence of squash vine borer larvae. Repeat applications at 5- to 7-day intervals throughout the 3-week egg-laying period.*			
	0.10 lb acetamiprid	5.3 oz Assail 30SG 2.3 oz Assail 70WP	0 0	Begin treatment when thresholds are reached. Apply every 5 days as needed. Do not exceed 5 applications or 0.5 lb ai/a per season.
	alpha-cypermethrin	3.0–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.04–0.10 lb bifenthrin	2.6–6.4 fl oz *Brigade 2EC	3	Apply every 7 days as needed. Do not exceed 0.3 lb ai/a per season. Do not make more than 2 applications after bloom.
	bifenthrin + zeta-cypermethrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Do not exceed 0.25 lb ai/a per season.
	flubendiamide + buprofezin	12.0–17.0 fl oz Vetica	7	Do not apply more than 38.0 fl oz/a per season and allow at least 7 days between applications. Do not make more than 3 applications per crop season.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.

*Restricted-use pesticide.

(continued)

Insect control in melon—muskmelon, watermelon *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Squash vine borer *(cont.)*	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	1	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.18 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.1–0.2 lb permethrin	4.0–8.0 oz *Permethrin 3.2EC	0	Consult label for crop specifics.
	0.02–0.025 lb zeta-cypermethrin	2.8–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.

*Restricted-use pesticide.

Weed control in melon—muskmelon, watermelon

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	0.15–0.25 lb clomazone	0.4–0.67 pt Command 3ME		For suppression and control of annual grasses and broadleaves, make a single preemergent soil application after seeding and before crop emergence or prior to transplanting. Place seed or roots of transplants below the chemical barrier when planting. Strictly follow all precautions and restrictions on the label to minimize offsite movement and carryover. Read and understand the vegetable disclaimer section of the label—the end user assumes all liability for failure to perform and crop injury resulting from its use.
	1.1–1.7 lb ethalfluralin	3.0–4.5 pt Curbit 3EC		Make a single broadcast application within 2 days after seeding. Rate varies with soil texture and organic matter. A shallow cultivation or 1/2-inch of water is needed to activate the herbicide. Heavy rain following application or shallow seeding may result in crop injury. Do not incorporate prior to planting, use under plastic mulch, broadcast over transplants, or apply through irrigation. Do not use on soils with more than 10% organic matter.
	0.4–1.2 lb ethalfluralin + 0.125–0.375 lb clomazone	2.0–6.0 pt Strategy	45	Use only as a postplant surface-applied herbicide. Make one application before crop and weeds emerge or apply as a banded spray between rows following crop emergence or transplanting. Do not make broadcast applications to transplants or use under plastic mulch. Strategy requires rainfall, irrigation, or a shallow cultivation within 2–5 days after application for activation. Because of the potential for offsite movement and severe crop injury, strictly follow all precautions and restrictions on the label.
	1.0 lb pendimethalin	2.1 pt Prowl H_2O	35	Apply as a shielded spray between the rows, avoiding 6 inches on either side of row middles. May be applied sequentially up to 4.2 pt/a per season. Consult label for additional information on plastic culture and other limitations.

*Restricted-use pesticide.

(continued)

Weed control in melon—muskmelon, watermelon *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds *(cont.)*	0.1–0.2 lb terbacil	2.0–4.0 oz Sinbar WDG	70	Watermelon only. Apply preemergence to seeded watermelon or prior to planting transplants. If using plastic mulch, Sinbar may be applied preemergence under plastic, to row middles, or broadcast over the plastic prior to hole punching or transplanting. See label for additional instructions.
	trifluralin	several manufacturers	60 (watermelon) 30 (all other cucurbits)	Direct spray between rows when plants have reached the three- to four-leaf stage. Set incorporation equipment to move treated soil around the base of plants. Controls annual grasses and some broadleaf weeds, but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Rate varies with soil texture and organic matter. Follow recommended soil preparation, application, and incorporation procedures. Must be incorporated within 24 hours. See label for plantback restrictions. Ineffective on peat and muck soils.
Annual grasses	5.0–6.0 lb bensulide	5.0–6.0 qt Prefar 4E		Apply preplant or preemergence. Follow application and applicable incorporation instructions on label. Use on mineral soils only.
Nutsedge and some broad-leaves	0.023–0.047 lb halosulfuron	0.5–1.0 oz Sandea (Rate varies by melon type, application type, and timing. See label for appropriate rate.)	57	Sandea controls several broadleaf weeds and nutsedge. It will not control grasses. Sandea has both pre- and postemergence activity and can be used under plastic mulch. Broadcast application to watermelon should not exceed 0.75 oz/a Sandea. Do not exceed 2 applications or apply more than 2.0 oz/a per 12-month period. Soil or foliar applications of organophosphate insecticides to Sandea-treated crops may cause severe crop injury. **Consult label for application timing, maximum Sandea use per crop cycle, and other important usage information and precautions.**
	0.19–0.3 lb imazosulfuron	4.0–6.4 oz League	48	For use in cantaloupe and watermelon. Apply to well established melons (at least 5 inches wide) as a row middle application only. Effective on yellow nutsedge and several annual weeds, but ineffective on nightshades and weeds with ALS inhibitor resistance. See label for additional restrictions.

*Restricted-use pesticide.

(continued)

Weed control in melon—muskmelon, watermelon *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged weeds	glyphosate	several manufacturers and formulations		See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. Some formulations require a wait of 3 days between application and seeding. Crop contact will result in severe injury or death. If weeds have been mowed or tilled, do not treat until they have resumed active growth and reached the recommended stage on the label. Unless otherwise stated, allow 7 or more days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified.
	*paraquat	several manufacturers and formulations, not all are registered for this use		Prepare seedbed early to allow for maximum weed emergence. Application can be made as a banded or broadcast treatment before, during, or after planting, but before crop emergence. In preplant and preemergence (to the crop) uses, do not apply to soils lacking clay minerals (i.e., muck, pure sand). Use the higher rate for heavy weed infestations. Seeding and transplanting should be performed with minimal soil disturbance. Always add crop oil concentrate or non-ionic surfactant to spray mixture. Follow precautions on label.
Emerged grasses	0.068–0.12 lb clethodim	9.0–16.0 oz Select Max	14	Apply to actively growing grasses. Repeat treatments may be made at 14-day intervals up to the maximum annual use rate. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by product label. Do not apply if rain is expected within 1 hour.
	clethodim	several manufacturers and formulations	14	
	0.094–0.28 lb sethoxydim	0.5–1.5 pt Poast	3 (cantaloupe) 14 (all other melons)	Make postemergence applications to actively growing vgrasses within the size ranges indicated on the label. Check the label for wild proso millet or rescue treatment rates. Do not apply more than 3.0 pt/a Poast in one crop season. Consult label for rate and adjuvant instructions for specific weeds. Check the label for additional precautions and restrictions.

*Restricted-use pesticide.

Mint

Wisconsin mint is grown on high organic or muck soils with high water tables or on fine-textured soils. Since mint is a shallow-rooted crop, irrigation is desirable.

Planting

Mint is grown as a vegetatively propagated perennial. New fields are planted in the spring with stolons dug from an existing planting known to be free of pathogens and perennial weeds with a digger similar to a potato digger. First-year plantings are known as "row mint," as the stolons are planted in rows with special planters. One acre of well-established mint will usually yield enough stolons to plant 10–15 acres. Given good growing conditions, the stolons quickly spread, covering the entire field with plants. This solid stand, called "meadow mint," contributes to the spread of disease and some perennial weed problems but is important in helping control soil erosion and annual weeds. Weeds, insects, and diseases can reduce quality and yield.

Mint is usually plowed shallow after the first killing frost to protect the crop from winterkill and to help control pests that might otherwise overwinter on the mint stubble. To maintain profitable production, short rotations of 3 years of mint should be followed by 3 years of another crop.

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 5.6 or higher on organic soils and 5.8 on mineral soils.

Fertilizer rates: Apply 50 lb/a phosphate and 200 lb/a potash when soil tests P and K are in the optimum range. Optimum nitrogen rates may vary between soils, organic nutrients, and locations. Apply 100–150 lb N/a on mineral soils or 50–80 lb N/a on organic soils depending on muck depth, quality, and length of time the field has been farmed. At least some of the nitrogen should be applied prior to the rapid growth phase in May.

Application: Broadcast applications are commonly used.

Micronutrients: Mint has relatively low micronutrient requirements. It is unlikely that this crop will respond to micronutrient additions.

Harvest

Mint harvest in Wisconsin generally begins about mid-July. Mint fields are usually cut before the plants reach 10% of full bloom. Harvesting at a later growth stage can result in lower quality oil and lower yields. The cut hay is left in windrows for 24–36 hours, until mint leaves begin to dry. If the hay gets too dry, the leaves will shatter during pickup, reducing yield. If too green when collected, the hay will require more time and energy to distill. Rain while the cut hay is still in the field can result in significant yield loss due to leaf loss and oil washed from the plants. The mint is chopped directly into custom-built distilling tubs. A typical mint tub holds hay from 0.75 to 1.25 acres of land. The hay is carried from the field in the distillation tubs to the mint still. There, steam is applied to the mint through a series of tubes located in the bottom of the tub. Boiler size, for supplying the steam, depends on the number of tubs that will be distilled at one time. As a general rule, 100 horsepower is required for each tub. The vaporized oil passes through a condenser where the oil and water condense for collection in the receiver. The temperature of the condensate leaving the condenser should be maintained at 110°F. The lighter oil floats on top of the water in the receiver and is periodically drained off into clean barrels. The distillation process takes about 1 hour per tub, depending on tub size, condition of the hay, and steam pressure. Improper distillation can result in yield loss, lower oil quality, and increased energy costs.

Annual nitrogen, phosphate, and potash recommendations for mint

Nitrogen		Phosphate and potash		
Organic matter (%)	**Amount to apply** (lb/a)	**Yield goal** (lb/a)	**Amount P_2O_5 to apply*** (lb/a)	**Amount K_2O to apply*** (lb/a)
<2	120	35–55 (oil)	50	200
2.0–9.9	100			
10–20	80			
>20	50			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Disease control in mint

Disease	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Mint stolon decay	*Early spring tillage hastens soil warming, which creates unfavorable conditions for disease development. Clipping the regrowth before plowdown in the fall reduces later losses to stolon decay. Application of fungicides for control is not feasible at this time.*			
Rust, powdery mildew	azoxystrobin	6.0–15.5 fl oz Aframe, AzoxyStar, Equation, Quadris Flowable, Satori, Willowood Azoxy 2SC	7	Equation, Quadris Flowable, Satori, Quilt, and Headline belong to the Group 11 (strobilurin) fungicide category. Do not apply more than one foliar spray of any strobilurin product before alternating with a fungicide having a different mode of action. Do not exceed 3 applications of strobilurin fungicides per year. Do not exceed 1.44 qt/a Quadris or Satori, or 48.0 fl oz/a Headline per season.
	azoxystrobin + propiconazole	14.0 fl oz Quilt, Willowood AzoxyProp Xtra	30	
	pyraclostrobin	9.0–12.0 fl oz Headline	14	
	chlorothalonil	1.2 lb Bravo Ultrex 82.5WDG, Equus DF 1.38 pt Bravo Weather Stik, Echo 720, Equus 720 1.2 lb Echo 90DF	80 80 80	Do not feed fresh or extracted mint hay from treated fields to livestock. Plow in the fall to bury leaf and stem tissue.
	myclobutanil	4.0–5.0 oz Rally 40WSP	30	Treat in early spring when plants break dormancy and continue applications on a 14- to 21-day schedule. Do not apply more than 15.0 oz/a product (0.375 lb ai/a) per season.
	propiconazole	4.0 fl oz AmTide Propiconazole 41.8% EC, Bumper ES, Fitness, Propicure 3.6F, PropiMax EC, Shar-Shield PPZ, Tide Propiconazole 41.8% EC, Tilt, Topaz, Willowood Propicon 3.6EC	30	Do not apply more than 78.0 fl oz/a per season.
Verticillium wilt	*Ideally, mint plantings should be kept in production for no longer than 4–6 years. Rotate to nonsusceptible crops for as long as possible between mint crops. The following cultivars are listed in order of increasing susceptibility: Native Spearmint, Scotch Spearmint, Murray Mitcham and Todd Mitcham Peppermint, and Black Mitcham Peppermint.*			

Insect control in mint

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Armyworms, cutworms, and loopers	*Many species of armyworms, cutworms, and loopers may occur together in the field. Small larvae may be collected in sweep net samples. Estimate larger instars by inspecting the soil surface (one square foot) after vigorously shaking the foliage in the area. Use the total number of all foliage-feeding worms to determine if treatment is necessary. Thresholds vary from 1.5 to 3.0 larvae/sq ft.*			
	0.974 lb acephate	1.0 lb Orthene 97 1.0 lb Acephate 97UP	14	Do not exceed 2.0 lb ai/a per season. Do not feed trimmings. Do not allow livestock to graze treated areas.
	0.5–2.0 lb *Bacillus thuringiensis* subsp. *aizawai*	XenTari	0	Treat when larvae are young. Use another type of product to control older larvae.
	Bacillus thuringiensis subsp. *kurstaki*	Biobit WP, DiPel DF, Gut Buster BT, Javelin WG	0	See label for rate. Treat when larvae are young.
	1.0–2.0 lb *Bacillus thuringiensis* subsp. *kurstaki*	Lepinox WDG	0	Treat early instar larvae before noticeable feeding damage occurs. Repeat as needed.

*Restricted-use pesticide.

(continued)

Insect control in mint *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Armyworms, cutworms, and loopers *(cont.)*	chlorantraniliprole	3.5–7.5 fl oz Coragen	3	Do not make more than 4 applications per crop season and allow at least 14 days between applications. Do not apply more than 15.4 fl oz/a Coragen per season.
	0.065 lb indoxacarb	3.5 oz Avaunt 30DG	7	The minimum interval between applications is 5 days. Do not apply more than 24.0 oz/a Avaunt (0.44 lb ai/a) per crop.
	3.0 lb methomyl	3.0 pt *Lannate LV	14	Do not exceed 6.0 pt ai/a per crop. Repeat application as necessary up to 4 times per crop.
	pyrethrin	1.0–2.0 pt Pyrenone E.C.	0	
	0.031–0.093 lb spinetoram	4.0–12.0 oz Radiant SC	7	Do not apply more than 60.5 oz/a Radiant (0.48 lb ai/a) per crop and do not make more than 4 applications per crop. Must wait at least 4 days before repeating applications.
	spinosad	4.0–10.0 fl oz Entrust SC	7	Apply when small larvae appear. Treat larger larvae at higher rate or re-treat. Do not exceed 29.0 oz/a or 4 applications per year.
***Floridotarsonemus* mite**	*Determine mite populations from bud samples. Examine at least 20 buds per field at several sites throughout the field. Open each bud and examine a single leaf surface with a 10–15X hand lens. Count the number of adult (brown) mites. Treatment is recommended if there is an average of more than one mite per bud.*			
	0.1 lb fenpyroximate	1.0–2.0 pt Portal	1	Do not apply more than 4.0 pt per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow 14 days between applications.
	2.25 lb propargite	Omite 6E, Comite	14	Apply in large volume of water and high pressure for good penetration. Apply up to 2 applications at 7- to 10-day intervals.
Mint aphid	*No treatment thresholds have been established, but relative populations can be estimated from sweep net samples taken when sampling for other pests. Damage occurs only when aphids are so numerous that leaves are coated with honeydew.*			
	0.974 lb acephate	1.0 lb Orthene 97 1.0 lb Acephate 97UP	14	Do not exceed 2.0 lb ai/a per season. Do not feed trimmings. Do not allow livestock to graze treated areas.
	1.0 lb acephate	Orthene 97	14	Do not apply more than 2.66 lb/a.
	0.625–0.938 lb malathion	1.0–1.5 pt (several brands) 57%EC	7	Re-entry interval of 12 hours. Wait at least 7 days between treatments. Do not exceed 0.94 lb ai/a (1.5 pt Malathion 57EC) per treatment. Do not exceed 3 applications per year.
	pyrethrin	1.0–2.0 pt Pyrenone E.C.	0	May be combined with other insecticides.
	thiamethoxam	1.5–3.0 oz Actara 25WDG	7	Apply every 14 days as needed. Do not exceed 8.0 oz/a per season.
Mint flea beetle	*Direct control measures at adults since no materials are registered for larval control. Adults emerge in late July (1100 DD, soil temperature at 6-inch depth, 40°F base) and begin laying eggs 2 weeks later. Treat before egg laying when adults are present if the following thresholds are exceeded: (1) larval damage—stunting, purpling in June—is visible; (2) no larval damage is visible, but more than 25 adults/100 sweeps are collected in standing mint; or (3) fewer than 25 adults/100 sweeps are present in standing mint, but more than 25/100 sweeps are collected from stubble after harvest.*			
	0.625–0.938 lb malathion	1.0–1.5 pt (several brands) 57%EC	7	Re-entry interval of 12 hours. Wait at least 7 days between treatments. Do not exceed 0.94 lb ai/a (1.5 pt Malathion 57EC) per treatment. Do not exceed 3 applications per year.
	0.675-0.9 lb methomyl	2.25–3.0 pt *Lannate LV	14	Do not exceed 6.0 pt ai/a per crop. Repeat application as necessary up to 4 times per crop.
	thiamethoxam	1.5–3.0 oz Actara 25WDG	7	Apply every 14 days as needed. Do not exceed 8.0 oz/a per season.

*Restricted-use pesticide.

(continued)

Insect control in mint *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Two-spotted spider mite	*Determine mite populations from leaf samples. Examine a total of 45 leaves (15 leaves each from the bottom, middle, and top of the canopy) at several locations throughout the field. For each 30 acres, monitor 15 individual field sites. Classify the leaves as "infested" (5 or more mites) or "uninfested" (fewer than 5 mites). Treat if 18 or more of the leaves in the 45-leaf sample at each site are "infested."*			
	0.009–0.014 lb abamectin	8.0–12.0 oz *Agri-Mek 0.15EC	28	Treat when mites first appear and have exceeded thresholds.
	0.375–0.75 lb bifenazate	0.75–1.5 lb Acramite 50WS	7	Apply Acramite in at least 50 gallons of water to ensure uniform coverage and canopy penetration. Do not apply more than once per year.
	0.438–0.625 lb dicofol	1.75–2.5 pt Dicofol 4E	30	Do not make more than 1 application of Dicofol per crop per year.
	0.05–0.1 lb fenpyroximate	1.0–2.0 pt Fujimite 5EC	1	Apply Fujimite in 25–50 gallons of water to ensure uniform coverage and canopy penetration. Do not exceed 2.0 pt/a per year.
	1.5–2.25 lb propargite	Omite 6E, Comite	14	Do not apply more than twice per year. Most effective when temperatures are above 70°F.

*Restricted-use pesticide.

Weed control in mint

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	0.5 lb clomazone	1.3 pt Command 3ME	84	For suppression and control of annual grasses and broadleaves, make a single broadcast application to the soil before weeds emerge and before mint plants begin any new growth. Strictly follow all precautions and restrictions on the label to minimize offsite movement and carryover. **Read and understand the vegetable disclaimer section of the label—**the end user assumes all liability for failure to perform and crop injury resulting from use of this product.
	0.128 lb flumioxazin	4.0 oz Chateau SW or Tuscany or 4.0 fl oz Tuscany SC	80	Do not apply more than 4 oz of Chateau SW per acre or a total of 8 oz per year. Minimum time interval between sequential applications varies by label. Apply only to dormant, established meadow mint. See label for adjuvant recommendations.
	4.0 lb napropamide	8.0 lb Devrinol DF-XT 2.0 gal Devrinol 2-XT		Apply to a weed-free soil surface. Application to established crops should be after one growing season. Application to newly planted crops may be made immediately after planting. Do not exceed 8 lb/a per crop cycle.
	0.71–1.9 lb pendimethalin	1.5–4.0 pt Prowl H_2O (based on soil texture—see label)	90	Make a single application to dormant established mint before weed emergence. Do not apply to mint during the first year of establishment or to mint that has broken dormancy.
	0.102 lb pyroxasulfone + 0.007 lb carfentrazone-ethyl	3.5 fl oz/a Anthem Flex	5	Apply in a single application to dormant mint only. Do not apply to newly planted mint. Application to mint that is near dormancy break can result in crop injury. Do not apply to soils with less than 1% organic matter or soils classified as sand.

*Restricted-use pesticide.

(continued)

Weed control in mint *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds *(cont.)*	0.14–0.375 lb sulfentrazone	4.5–12.0 oz Spartan 4F		Apply Spartan to dormant mint following cultivation and before mint emergence. Rate is based on soil texture and organic matter. Split applications may be used for preemergent sequential control of winter and summer annuals. May be applied before crop emergence to newly planted mint, but application should be reduced 25%. Do not apply more than 12.0 oz/a per 12-month period. Rainfall or irrigation after application is required for herbicide activation. See label for weeds controlled and other precautions.
	labeled rates: 0.8–1.6 lb terbacil *recommended rates (see note in* Remarks*):* 0.125–0.25 lb terbacil	*labeled rates:* 1.0–2.0 lb Sinbar WDG *recommended rates (see note in* Remarks*):* 0.16–0.3 lb Sinbar WDG	60	Preemergence: Apply before weeds and mint emerge, after last cultivation. Postemergence: Apply before broadleaves are 2 inches tall and before grasses are 1 inch tall. Do not exceed 2.0 lb/a per season. Do not plant to crops other than mint within 2 years after last application. **Note:** *Wisconsin recommends using less than 0.5 lb/a of Sinbar per year due to its long residual activity. Low rates may give inadequate weed control.*
	trifluralin	several manufacturers		Controls annual grasses and some broadleaf weeds, but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Rate varies depending on soil texture and organic matter. Follow recommended soil preparation, application, and incorporation procedures. Must be incorporated. See the label for plantback restrictions. Ineffective on peat and muck soils.
Germinating annuals	1.0–1.5 lb oxyfluorfen	4.0–6.0 pt Goal 2XL 2.0–3.0 pt GoalTender		Apply Goal only to mint grown on muck soils with at least 20% organic matter. Make one preemergence application in the spring after the last tillage operation before new mint growth emerges. May cause temporary stunting of mint. See label for application timing in new mint.
Emerged weeds	0.008–0.03 lb carfentrazone	0.5–1.92 fl oz Aim EC	5	Apply Aim EC as a broadcast application before mint breaks dormancy for control of existing broadleaf weeds. Good coverage is essential. Do not apply to actively growing crop. See label for adjuvant requirements.
	glyphosate	several manufacturers and formulations	7	See manufacturer's label to assure that the formulation is labeled for spot treatment in mint. Use handheld equipment to direct the spray solution. The spray will kill all plants it contacts. Do not treat more than 1/10 of any acre at any time. Treatment may be repeated at 30-day intervals.
	*paraquat *(rate varies by label)*	several manufacturers and formulations		Apply to dormant mint before emergence. May be mixed with Sinbar. Always add crop oil concentrate or non-ionic surfactant to spray mixture. Follow precautions on the label.

*Restricted-use pesticide.

(continued)

Weed control in mint *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged grasses	0.068–0.24 lb clethodim	9.0–32.0 oz Select Max	21	Apply to actively growing grasses. Repeat treatments may be made at 14-day intervals up to the maximum annual use rate. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by product label. Do not apply if rain is expected within 1 hour.
	clethodim	several manufacturers and formulations	21	
	0.034–0.08 lb quizalofop	5.0–12.0 oz Assure II or Targa	30	Apply postemergence to actively growing grasses. Add COC or NIS to spray mixture. Do not make more than 2 applications per season. Wait a minimum of 24 hours following application before applying a post broadleaf herbicide. Do not apply Assure II or Targa following a post broadleaf herbicide until grass plants begin to develop new leaves. See label for maximum annual use rate.
	0.094–0.47 lb sethoxydim	0.5–2.5 pt Poast	20	Apply postemergence to actively growing grasses. Consult label for rate and adjuvant instructions for specific weeds. Do not apply more than 5.0 pt/a Poast or make more than 2 applications per season. Do not apply if rain is expected within 1 hour.
Emerged annual broadleaves, some perennials	1.0–2.0 lb bentazon	several manufacturers and formulations	varies by label	Apply early postemergence when weeds are small and actively growing. May cause leaf burn under some conditions, but the mint will generally outgrow this condition within 10 days.
	0.125–0.38 lb acid equivalent clopyralid	several manufacturers and formulations	45	Controls specific annual and perennial weeds. Apply early postemergence to actively growing annuals before they send up a flower stalk. For Canada thistle, apply when most basal leaves are formed but before bud stage. May cause temporary injury, but should not reduce oil yields. Read label carefully for follow crop restrictions. Do not make aerial applications.
	0.25–0.5 lb acid equivalent MCPB	1.0–2.0 pt/a Thistrol	40	Apply postemergence for suppression of field bindweed and several broadleaf weeds. Do not apply after mint exceeds 6 inches in height or oil yield may be reduced. Mint may be discolored or twisted following application. Fall applications may be made for control of winter annual weeds. Do not use this product if minor crop injury is unacceptable.
Emerged annual broadleaves	0.25–0.38 lb bromoxynil	*labeled rates:* 1.0–1.5 pt bromoxynil 2EC formulation *recommended rates (see note in* Remarks*):* 2.0–4.0 oz bromoxynil 2EC formulation	70	Apply postemergence to actively growing weed seedlings before weeds have more than four leaves, are 2 inches in height, or are 1 inch in diameter, whichever comes first. See label for list of susceptible weeds. Do not apply in spring or to newly planted mint. Bromoxynil can cause temporary stunting and discoloration of the mint. Bromoxynil may cause unacceptable injury if temperatures exceed 70°F following application, if mint is under stress, or if mint has been treated with Sinbar. Do not apply more than 6.0 pt/a bromoxynil 2EC per season or by aerial application. Under Wisconsin conditions, using the label rate may result in unacceptable mint injury. Previous experience suggests that 2.0–4.0 oz/a bromoxynil 2EC may be more appropriate.
	0.94 lb pyridate	24.0 fl oz Tough 5EC	49	Apply broadcast postemergent to mint and small actively growing weeds at 24.0 fl oz/a per application. Two applications at 24.0 fl oz/a can be made. Always add an appropriate adjuvant to the spray tank (see the spray additives section on the label).

*Restricted-use pesticide.

(continued)

Weed control in mint *(continued)*

*Restricted-use pesticide.

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged annual broadleaves *(cont.)*	0.02-0.04 lb salflufenacil	1.0 - 2.0 fl oz/a Sharpen		Apply only to dormant established (at least one year after planting) mint for postemergence broadleaf control. Applicatinon to mint near dormancy break will result in crop injury. See label for adjuvant requirement details. Maximum of 2 applications and a total of 2.0 oz/A per cropping season.

Onion: dry bulb onion on high organic soils

Planting

Plant seeds, transplants, or "sets" in April to early May. Choose deep, fertile soils and provide adequate drainage. Rotate onions with other vegetable crops. Onions work well in rotation with potatoes or carrots.

In the field

Rows: Direct-seeded onions are usually planted in paired rows, 16–24 inches apart.

Plants in row: 6–12/ft (120,000–160,000 seeds/a). For transplants, set 4–6 inches apart (60,000–100,000 plants/a).

In beds

Rows: 6–9 inches with 6–8 rows/bed.

Plants in row: 6–12/ft.

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 5.4 or higher in organic soils and at least 5.6 in other soils.

Fertilizer rates: Apply P_2O_5 and K_2O according to soil test recommendations. Use annual nitrogen, P_2O_5, and K_2O recommendations in table below. Take credits for previous legume crops and manure.

Application: Broadcast and work in before planting. For most efficient use of nitrogen, split recommended rate into two or more applications during the season.

Micronutrients: Onions need relatively high amounts of manganese, copper, zinc, and molybdenum. Use soil and plant analyses to check for deficiencies of these nutrients. Specific recommendations vary with fertilizer sources, soil, and method of application.

Annual nitrogen, phosphate, and potash recommendations for onion

Nitrogen		Phosphate and potash		
Organic matter (%)	**Amount to apply** (lb/a)	**Yield goal** (cwt/a)	**Amount P_2O_5 to apply*** (lb/a)	**Amount K_2O to apply*** (lb/a)
<2	150	400–600	60	130
2.0–9.9	140			
10–20	130			
>20	120			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Disease control in onion

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Bacterial blight	copper hydroxide	0.67–1.0 pt Champ Formula II Flowable 0.75–1.5 lb Kocide 3000 1.5 lb Kocide 2000	0	Can aid in limiting spread of bacterial pathogens of onion. May cause phytotoxicity if rate is high, low sprayer volumes are used, and/or temperatures are high.
Downy mildew	acibenzolar-S-methyl	0.75–1.0 oz Actigard 50WG		For suppression of downy mildew. Do not apply on stressed plants. Can aid in virus and bacterial disease suppression.
	ametoctradin + dimethomorph	14.0 fl oz Zampro	0	Use no more than 42.0 fl oz/a per season. Do not make more than 2 sequential applications before alternating to a fungicide with a different mode of action.
	azoxystrobin	9.0–15.5 fl oz Quadris Flowable	0	Quadris and Cabrio belong to the Group 11 (strobilurin) fungicide category. Do not exceed 1 application of any of these products before alternating with a fungicide having a different mode of action. Do not exceed 4 applications of strobilurin fungicides per year.
	pyraclostrobin	12.0 oz Cabrio EG	7	
	azoxystrobin + chlorothalonil	2.4–3.7 pt Quadris Opti	14	Do not apply more than one foliar application without alternating to a fungicide with a different mode of action. See label for specifications on tank mixing.
	boscalid + pyraclostrobin	18.5 oz Coronet, Pristine WDG	7	Disease suppression only. Pristine belongs to Groups 7 and 11 fungicide categories. Do not exceed 1 application of Pristine before alternating to a labeled fungicide with a different mode of action. Do not exceed 4 applications of Pristine or other Group 11 fungicide per season. Do not exceed 111.0 oz/a Pristine per season.
	cymoxanil + famoxadone	8.0 oz Tanos	3	Alternate applications with fungicides of different modes of action for fungicide resistance management. Do not apply more than 84.0 oz/a per season Tanos.
	dimethomorph	6.0 oz Forum	0	Tank mix Forum with another fungicide active against downy mildew and having a different mode of action. Do not make more than 2 sequential applications of Forum before alternating to another effective fungicide. Do not make more than 5 applications or use more than 30.0 oz/a per season.
	fluazinam	1.0 pt Omega	7	Do not make more than 6 applications/a per year. Do not use with an adjuvant.
	fluopicolide	3.0–4.0 fl oz Presidio	2	Tank mix with a fungicide of a different mode of action for fungicide resistance management.
	fluxapyroxad + pyraclostrobin	8.0–11.0 fl oz Merivon Xemium (suppression only)	7	Make no more than 3 applications per crop per season.
	fosetyl-al	2.0–3.0 lb Aliette WDG, Linebacker WDG	7	Begin applications when conditions favor disease development (high moisture and moderate temperatures). Repeat at 7- to 14-day intervals. If disease is already present, treat at 3.0 lb/a and repeat at 7-day intervals. Do not exceed seven sprays per year.
	mancozeb	1.6–2.4 qt Penncozeb 4FL 2.4 qt Dithane F-45, Manzate Flowable 2.0–3.0 lb Penncozeb 75DF, Penncozeb 80WP 3.0 lb Dithane DF Rainshield, Koverall, Manzate Pro-Stick	7 7 7 7	Consult labels for seasonal product limits. Do not apply to exposed bulbs. Spray every 7–10 days depending on weather conditions.

(continued)

Disease control in onion *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Downy mildew *(cont.)*	mancozeb + zoxamide	1.5–2.0 lb Gavel 75 DF	7	Do not apply to exposed bulbs. Do not make more than 8 applications/a per season.
	mandipropamid	8.0 fl oz Revus	7	Do not make more than 2 consecutive applications before switching to another effective non–Group 40 fungicide. Do not exceed 32.0 fl oz/a of product per season.
	mefenoxam	2.5 lb Ridomil Gold Bravo	7 (dry bulb) 14 (green)	Spray at 14-day intervals when conditions are favorable for disease, alternating sprays with other protective fungicides. Limit of 4 applications on dry bulb onions and 3 applications on green onions.
		2.5 lb Ridomil Gold MZ	7 (dry bulb)	Spray at 14-day intervals when conditions are favorable for disease, alternating sprays with other protective fungicides. Use up to 4 applications on dry bulb onions.
	oxathiapiprolin	2.0–4.8 fl oz Orondis Ultra A	0	Make no more than 2 sequential applications before rotating to a fungicide with a different mode of action. Do not exceed 19.2 fl oz/a per year. Begin foliar applications prior to disease development and continue on a 5- to 10-day interval. Do not use Orondis Ultra A as a foliar application if you have already used Orondis Gold 200 on the soil at time of planting.
	phosphoric acid salts	2.0 qt Alude/100 gal water	0	Apply preventively and on a regular basis to manage disease.
		1.0–2.0 qt Fungi-Phite/30 gal water		Do not make more than 6 applications/a per year.
		1.0–4.0 qt K-Phite/20 gal water		
		2.5–3.75 pt Phostrol		Do not make more than 7 applications/a per season.
	potassium phosphite	1.0–3.0 qt Fosphite/100 gal water	0	Do not apply at intervals less than 3 days. Do not apply to heat- or moisture-stressed plants.
		4.0 pt ProPhyt		Make no more than 7 applications/a per year. Apply in 20.0–50.0 gal water.
	potassium phosphite + tebuconazole	2.0–3.0 pt Viathon	7	Apply preventively. Apply no more than 6.0 pt/a per season.
Fusarium basal rot	*Plant resistant varieties such as Fusario 24, Nugget, Hickory, and Nutmeg. Harvestmore has some tolerance to basal rot.*			
Leaf blight *(Botrytis)* **and purple blotch** *(Alternaria)*	azoxystrobin + chlorothalonil	1.6–3.2 pt Quadris Opti	14	Do not apply more than one foliar application without alternating to a fungicide with a different mode of action. See label for specifications on tank mixing.
	azoxystrobin + difenoconazole	12.0–14.0 fl oz Quadris Top	7	Quadris Top and Cabrio belong to the Group 11 (strobilurin) fungicide category. Do not exceed 1 application of Group 11 products before alternating with a fungicide having a different mode of action. Do not exceed 4 applications of strobilurin fungicides per year. Do not exceed 56.0 fl oz Quadris Top (dry bulb) and 72.0 oz/a Cabrio per season.
	pyraclostrobin	8.0–12.0 oz Cabrio EG	7	
	boscalid	6.8 oz Endura WDG	7	Endura belongs to the Group 7 (anilide) fungicide category. Do not exceed 2 sequential applications of Endura before alternating to a labeled fungicide with a different mode of action. Do not exceed 6 applications per season. Do not exceed 41.0 oz/a Endura per season. Note comments on Pristine below.

(continued)

Disease control in onion *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Leaf blight and purple blotch *(cont.)*	boscalid + pyraclostrobin	10.5–18.5 oz Pristine WDG	7	Pristine belongs to Groups 7 and 11 fungicide categories. Do not exceed 2 sequential applications of Pristine before alternating to a labeled fungicide with a different mode of action. Do not exceed 4 applications of Pristine or other Group 11 fungicide per season. Do not exceed 111.0 oz/a Pristine per season.
	chlorothalonil	1.0–3.0 pt Bravo Weather Stik, Echo 720, Equus 720 1.5–4.25 pt Bravo Zn, Echo Zn, Equus 500 Zn 0.875–1.625 lb Echo 90DF 0.9–2.7 lb Bravo Ultrex 82.5WDG, Equus DF	7 7 7 7	Do not exceed 15.0 lb ai/a chlorothalonil per season. Spray every 7–10 days during the growing season (more frequently during periods favoring the disease). You can alternate chlorothalonil with mancozeb. Do not use on Sweet Spanish onions. Excessive use can reduce yields.
	cyprodinil	10.0 oz Vangard WG	7	Do not apply more than 28.0 oz/a per plot per year of Vangard. Do not exceed 2 sequential applications of Vangard before alternating to a labeled fungicide with a different mode of action.
	cyprodinil + fludioxonil	11.0–14.0 oz Switch 62.5WG	7	Do not exceed 56.0 oz product per year per acre. Do not plant rotational crops other than strawberries or onions for 12 months following the last application.
	difenoconazole + cyprodinil	16.0–20.0 fl oz Inspire Super		For bulb onions, do not apply within 7 days of harvest. For green onions, do not apply within 14 days of harvest.
	fluazinam	1.0 pt Omega	7	Do not make more than 6 applications/a per year. Do not use with an adjuvant.
	fluxapyroxad + pyraclostrobin	5.5–11.0 fl oz Merivon Xemium	7	Make no more than 3 applications per crop per season. Also provides suppression of downy mildew. Controls Stemphylium and Botrytis at higher rates.
	iprodione	1.5 pt Iprodione 4L AG, Meteor, Nevado 4F, Rovral 4F	7	Spray every 7 days during the growing season (more often during periods favoring the disease).
	mancozeb	1.6–2.4 qt Penncozeb 4FL 2.4 qt Dithane F-45, Manzate Flowable 2.0–3.0 lb Penncozeb 75DF, Penncozeb 80WP 3.0 lb Dithane DF Rainshield, Manzate Pro-Stick	7 7 7 7	Consult labels for seasonal product limits. Do not apply to exposed bulbs. Spray every 7–10 days depending on weather conditions. Mancozeb will also control downy mildew.
	penthiopyrad	16.0–24.0 fl oz Fontelis	3	Do not apply more than 72.0 fl oz/a per season. Make no more than 2 sequential applications before alternating to a fungicide with a different mode of action.
	pyrimethanil	18.0 fl oz Scala SC alone 9.0–18.0 fl oz Scala SC in tank mix	7	Scala belongs to the Group 9 fungicide category. Use the 9.0 fl oz rate of Scala in a tank mix with a broad-spectrum fungicide. Alternating the tank mix combination with a broad-spectrum fungicide is a resistance management strategy.
	zoxamide + mancozeb	1.5–2.0 lb Gavel 75 DF	7	Do not apply to exposed bulbs. Do not make more than 8 applications/a per year.
Neck rot	*Plant varieties that mature properly so neck tissues dry before storage; undercut and windrow onions until inside neck tissues are dry before topping and storing. Forced heated air at 93–95°F for 5 days at the beginning of the storage period may help.*			

(continued)

Disease control in onion *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Pink root	*Long rotation with unrelated crops and use good crop management to promote healthy plant growth.*			
Purple blotch	azoxystrobin	6.0–12.0 fl oz Aframe, Quadris Flowable, Satori	0	Quadris, Satori, and Cabrio belong to the strobilurin group of fungicides. Do not exceed 1 application of these products before alternating with a fungicide having a different mode of action. Do not exceed 4 applications of strobilurin fungicides per year. Do not exceed 2.88 qt/a Quadris or Satori, or 72.0 oz/a Cabrio per season.
	pyraclostrobin	8.0–12.0 oz Cabrio EG	7	
	azoxystrobin + propiconazole	14.0–27.5 fl oz Quilt	14 (dry bulb) 0 (green)	Do not apply more than 55.3 fl oz/a per season of Quilt.
	cymoxanil + famoxadone	8.0 oz Tanos	3	Alternate applications with fungicides of different modes of action for fungicide resistance management. Do not apply more than 84.0 oz/a per season Tanos.
	difenoconazole + benzovindiflupyr	10.5 fl oz Aprovia Top	7	Do not make more than 2 sequential applications before alternating to a fungicide with an alternative mode of action (not Groups 7 or 3). Do not exceed 4 total applications per season.
	propiconazole	4.0–8.0 fl oz AmTide Propiconazole 41.8% EC, Bumper 41.8 EC, Fitness, Propicure 3.6F, PropiMax EC, Tilt, Topaz *or* 2.0–4.0 fl oz AmTide Propiconazole 41.8% EC, Bumper 41.8 EC, Fitness, Propicure 3.6F, PropiMax EC, Tilt, Topaz, with tank-mix partner	0 (green onions) 14 (dry bulb)	Do not apply more than 16.0 fl oz/a per season. Use a wetting agent for optimum control.
	tebuconazole	4.0–6.0 fl oz Folicur 3.6 F, Monsoon, Onset 3.6L, Orius 3.6F, Tebusha 3.6FL, TebuStar 3.6L, Tebuzol, Toledo	7	Do not exceed 12.0 fl oz/a per season. To optimize result, apply preventively.
Purple blotch and downy mildew	azoxystrobin + propiconazole	*purple blotch:* 14.0–21.0 fl oz Quilt Xcel *downy mildew:* 17.5–26.0 fl oz Quilt Xcel	0 (green onions) 14 (dry bulb onions)	Do not apply more than 56.0 fl oz/a of Quilt Xcel per crop. Mixing with products formulated as an EC may result in phytotoxicity.
	chlorothalonil + cymoxanil	*dry bulb:* 1.6–2.4 pt Ariston	7	For enhanced control of purple blotch, tank mix with chlorothalonil.
		bunching & green onions: 2.0–2.4 pt Ariston	14	
	copper hydroxide	1.3 pt Champ Formula 2 2.6 pt Kocide LF 2.4F 0.75–1.5 lb Kocide 3000 2.0 lb Kocide 101 77WP, DF	0 0 0 0	May be useful to reduce losses to bacterial infections during periods of wet weather.
	fenamidone	5.5 fl oz Reason 500 SC	7	Reason belongs to the Group 11 (strobilurin) fungicide category. Do not exceed 1 application of any strobilurin products before alternating with a fungicide having a different mode of action. Do not exceed 4 applications of strobilurin fungicides per year. Do not exceed 22.0 fl oz/a Reason per season. Allow 30 days after the last application before rotating to wheat and 1 year for all other crops.

(continued)

Disease control in onion *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Purple blotch and downy mildew *(cont.)*	fluxapyroxad + pyraclostrobin	5.5–11.0 fl oz Merivon Xemium	7	Do not make more than 3 applications per crop per season.
	mancozeb + copper hydroxide	2.5 lb ManKocide	7	Do not apply to exposed bulbs. For best disease management results, apply preventively every 7 days.
	potassium phosphite	4.0 pt ProPhyt	0	Apply preventively in 20.0-50.0 gal water/a at 7- to 14-day intervals. Make no more than 7 applications per season.
	potassium phosphite + tebuconazole	2.0–3.0 pt Viathon	7	Use preventively. Follow resistance management guidelines.
	zoxamide + chlorothalonil	30.0 fl oz Zing	7	Also controls Botrytis. Do not allow spray to contact bulbs. Do not make more than 8 applications per acre per year.
Smut	carboxin/thiram	Pro-Gro seed treatment		While there is no Wisconsin label for treating seed, it is legal to purchase and plant pretreated seed.
	mancozeb	2.4 qt Dithane F-45, Manzate Flowable, Penncozeb 4FL 3.0 lb Dithane DF Rainshield, Manzate Pro-Stick, Penncozeb 75DF, Penncozeb 80WP	7 7	Apply as a furrow drench when planting seeds. Use 75–125 gal water/a.
Stemphylium	azoxystrobin	6.0–12.0 fl oz Equation SC, Trevo	0	Apply preventively when conditions favor infection. Do not apply more than 92.3 fl oz/a per season.
	azoxystrobin + difenoconazole	12.0–14.0 fl oz Quadris Top	7	For dry bulb onions do not apply more lthan 56.0 fl oz/a per season of Quadris Top. For green onions do not apply more than 42.0 fl oz /a per season.
	boscalid + pyraclostrobin	10.5–18.5 oz Pristine	7	Do not make more than 6 applications per year. Do not apply more than 111.0 oz/a per year.
	cyprodinil + difenoconazole	16.0–20.0 fl oz Inspire Super	14 (green onions) 7 (bulb onions)	Begin applications prior to disease onset. Follow resistance management guidelines.
	cyprodinil + fludioxonil	11.0–14.0 oz Switch 62.5WG		Follow resistance management guidelines.
	difenoconazole + benzovindiflupyr	10.5 fl oz Aprovia Top	7	Do not make more than 2 sequential applications before alternating to a fungicide with an alternative mode of action (not Groups 7 or 3). Do not exceed 4 total applications per season.
	fluopyram + pyrimethanil	16.0–27.0 fl oz Luna Tranquility	7	Apply at critical times for disease control, prior to disease onset or crop damage.
	fluopyram + tebuconazole	12.8 fl oz Luna Experience	7	Do not apply more than 25.6 fl oz/a per year. Follow resistance management guidelines.
	fluxapyroxad + pyraclostrobin	5.5–11.0 fl oz Merivon	7	Make no more than 3 applications per season.
	iprodione	1.5 pt Meteor, Nevado 4F, Rovral 4F	7	Do not make more than 5 applications per season.
	penthiopyrad	16.0–24.0 fl oz Fontelis	3	Make no more than 2 sequential applications before switching to a fungicide of a different mode of action.
Tipburn	*This is not a disease but a condition that can result from high concentrations of ozone in the air—often associated with thunderstorms. It can also be the result of drought stress or insect pressures.*			

Scouting calendar for insect pests of onion

April			May			June			July			August			September		
early	mid	late	early	mid	late	early	mid	late	early	mid	late	early	mid	late	early	mid	late
				Onion maggots					Onion maggots					Onion maggots			
								Onion thrips									

Insect control in onion

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Maggot	*A preventive treatment at planting is usually necessary; foliar treatments to suppress adults are usually not successful. Continuous planting of onions on the same ground increases onion maggot problems. Rotate with other crops to reduce populations. Destroy cull piles and crop debris to prevent onion maggot buildup.*			
	cyromazine	6.6 lb Trigard OMC, 75%OMC/100 lb seed	60	Section 18 registration. Seed treatment in California only. Trigard has limited activity against seed corn maggot.
	2.0–4.0 lb diazinon[a]	several formulations		Apply diazinon in furrow. Use minimum of 40 gal drench/a. Direct seeded; bulb onions only.
Maggot—foliar treatments	0.5 lb diazinon[a]	several formulations	10	
	0.0075–0.0125 lb gamma-cyhalothrin	1.92–3.84 oz *Proaxis	14	Apply every 5 days as needed. Do not apply more than 1.92 pt/a (0.12 lb ai/a) per season.
	0.015–0.025 lb lambda-cyhalothrin	0.96–1.6 fl oz *Warrior II	14	Do not exceed 0.24 lb ai/a per season. Do not feed treated foliage to animals.
	0.1–0.3 lb permethrin	4.0–12.0 oz *Permethrin 3.2EC	7	Consult label for crop specifics.
	spinosad	3.0–6.0 fl oz Entrust SC	1	Apply to small larvae. Do not exceed 29.0 fl oz/a Entrust SC or 5 applications per year.
Maggot—foliar treatments *(cont.)*	zeta-cypermethrin	2.24–4.0 oz *Mustang Maxx	7	Apply every 7 days as needed. Use higher rates as populations escalate to avoid rescue treatments. Do not exceed 20.0 oz/a Mustang Maxx per year.
Thrips	*Treat when there are seven or more thrips per plant. Tolerant varieties such as El Charo, Snow White, Vega, White Keeper, and Zapotec can handle more than 45 thrips per plant. Direct the spray down the center of the plants. Thrips populations in other states have shown resistance to several organophosphate insecticides; spray only when necessary and alternate two or more materials each season to minimize potential for resistance.*			
	abamectin	8.0–16.0 fl oz *Agri-Mek 0.15 EC, *Epi-Mek 0.15 EC	30	Add a non-ionic type activator or wetting agent and do not use a binder sticker. Apply when pests reach or exceed established thresholds. Do not apply more than 48.0 fl oz/a Agri-Mek 0.15 EC or Epi-Mek 0.15 EC per crop season and allow at least 7 days between applications.
		1.75–3.5 fl oz *Agri-Mek SC	30	To avoid illegal residues, Agri-Mek SC **must** be mixed with a non-ionic activator type wetting agent and do not use a binder sticker. Apply when pests reach or exceed established thresholds. Do not apply more than 10.25 fl oz/a Agri-Mek SC per crop season and allow at least 7 days between applications.

*Restricted-use pesticide.

(continued)

[a]Some onion maggots in other midwestern states have shown resistance to diazinon. Use a different insecticide if satisfactory control has not been obtained in recent years.

Insect control in onion *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Thrips *(cont.)*	0.094–0.15 lb acetamiprid	5.0–8.0 oz Assail 30SG 2.1–3.4 oz Assail 70WP	7 7	Begin treatment when thresholds are reached. Apply every 7 days as needed. Do not exceed 4 applications or 0.6 lb ai/a per season.
	0.088–0.133 lb cyantraniliprole *(soil)*	13.5–20.5 fl oz Verimark	—	Minimum application interval between treatments is 5 days. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6.
	0.14–0.2 lb cyantraniliprole + abamectin	7.0–10.0 fl oz *Minecto Pro	7	Do not apply more than 0.4 lb per calendar year of cyantraniliprole-containing products, or more than 0.056 lb per calendar year of abamectin-containing products.
	0.04–0.10 lb cypermethrin	2.0–5.0 fl oz *Ammo EC	7	
	0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold	1	Apply every 5 days as needed. Do not exceed 9.6 fl oz/a per season.
	0.5 lb diazinon[a]	several formulations	14	Do not exceed 3 applications per season.
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	14	Apply every 5 days as needed. Do not apply more than 2.88 pt/a (0.18 lb ai/a) per season.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	14	Do not exceed 0.24 lb ai/a per season. Do not feed treated foliage to animals.
	1.0–1.6 lb malathion	several formulations	3–7	
	0.9 lb methomyl	3.0 pt *Lannate LV	7	Do not exceed 6.0 pt ai/a per crop. Repeat application as necessary up to 4 times per crop.
	0.25–0.5 lb methyl parathion	0.5–1.0 pt *Methyl Parathion, EC	15	Do not apply when onions bloom.
	0.25–0.5 lb oxamyl	1.0–2.0 pt *Vydate L	14	Vydate L has a 24c label for thrips and suppression of aster leafhopper as a foliar spray. Higher rates may be applied at planting for stubby root nematode control.
	0.15–0.3 lb permethrin	6.0–12.0 oz *Permethrin 3.2EC	1	Do not exceed 40.0 oz ai/a per season.
	0.047–0.078 lb spinetoram	6.0–10.0 oz Radiant SC	1	Do not apply more than 30.0 oz/a Radiant (0.234 lb ai/a) per crop and do not make more than 5 applications per crop.
	spinosad	4.0–8.0 fl oz Entrust SC	1	Treat every 4 days as needed. Do not exceed 29.0 fl oz per year.
	0.08 lb spirotetramat	2.5 fl oz Movento HL	3	Do not apply more than 0.16 lb per calendar year of spirotetramat-containing products.
	0.24 lb tolfenpyrad	24.0 fl oz Torac	7	For ground applications, apply using a minimum of 20 gallons of water per acre. For aerial applications, apply using a minimum of 5 gallons of water per acre. See Chemigation statement in Application Directions. Do not apply more than 72.0 fl oz (0.73 lb ai) per acre per year. Allow at least 7 days between applications. Do not make more than 3 applications per year.
	zeta-cypermethrin	2.88–4.0 oz *Mustang Maxx	7	Apply every 7 days as needed. Use higher rates as populations escalate to avoid rescue treatments. Do not exceed 20.0 oz/a Mustang Maxx per year.

*Restricted-use pesticide.

[a]Some onion maggots in other midwestern states have shown resistance to diazinon. Use a different insecticide if satisfactory control has not been obtained in recent years.

Weed control in dry bulb onion

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	0.033-0.045 lb bicyclopyrone	2.6-3.5 fl oz/a Optogen	45	Apply 2.6 fl oz/a preemergence to onion on muck soils only (will injure onions on mineral soil) or apply 3.5 fl oz/a post directed/row-middles including either NIS or COC. The addition of AMS in addition to an adjuvant will also improve weed control consistency. Avoid contact with onion foliage or injury will occur. Apply to very small weeds (label is <2 inch, but even smaller is better). Optogen is usually used in a tank mix with another labeled herbicide to improve weed control.
	0.25–0.375 lb bromoxynil	1.0–1.5 pt bromoxynil 2EC		Preemergence use restricted to muck soils only. Apply at least 3–4 days prior to emergence. Rainfall or irrigation within 2 days following preemergence application or 3 days prior to crop emergence may result in unacceptable crop injury—do not irrigate during this time. Maximum use amount per season varies by label.
	0.56–0.98 lb dimethenamid-P	*coarse soils:* 12.0–18.0 fl oz Outlook *medium- and fine-textured soils:* 14.0–21.0 fl oz Outlook	30	For use in direct seeded and transplanted dry bulb onions. Apply only after onion has reached the two-true-leaf stage. Applications to transplants should be delayed several days until soil has settled around the plants. Do not exceed 21.0 fl oz/a in a growing season and allow at least 14 days between applications.
Annual weeds *(cont.)*	ethalfluralin	Sonalan HFP		Rate varies by soil type and direct seeding vs. transplanting - see label for details. Incorporate with rainfall or no more than 0.25 inch of irrigation within 48 hours of application for direct seeded onion and with shallow incorporation into preformed beds prior to transplanting. For direct seeded onion, apply delayed preeermgence in the loop stage when 75% of the onion radicles have developed. Do not make postemergent applications.
	0.5–1.0 lb ethofumesate	*preemergence, coarse soils:* 1.0 pt Ethotron SC or Nortron SC *preemergence, medium and fine soils:* 2.0 pt Ethotron SC or Nortron SC *postemergence:* 1.0 pt Ethotron SC or Nortron SC	30	Controls selected broadleaf and grass weeds and suppresses yellow and purple nutsedge in dry bulb onions. Maximum number of applications and seasonal use rate varies by application timing and soil type. Do not use on muck or peat soils.
	0.06 lb flumioxazin	2.0 oz Chateau SW or 2.0 fl oz Tuscany SC	45	Apply to transplanted dry bulb onions between the two- and six-leaf stage, or to seeded dry bulb onion between the three- and six-leaf stage. Do not apply more than 2.0 oz/a Chateau SW per application or more than 3.0 oz/a per season. Do not make a sequential application within 14 days of the first application. Do not apply with any type of adjuvant. Consult label for additional instructions on micro-rate application, soil limitations, and tank-mix limitations.

*Restricted-use pesticide.

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Weed control in dry bulb onion *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds *(cont.)*	0.25–0.5 lb oxyfluorfen	1.0–2.0 pt Goal 2XL 0.5–1.0 pt GoalTender	45	**Pretransplant application:** Transplanted onions only. Apply as a broadcast or band application after completion of tillage operations and prior to transplanting. If less than 0.5 lb ai/a oxyfluorfen is used pretransplant, postemergence applications may be made, up to the seasonal maximum of 0.5 lb ai/a oxyfluorfen. **Post-transplant:** An application of up to 0.5 lb ai/a oxyfluorfen may be made within 2 days of transplanting. If less than 0.5 lb ai/a oxyfluorfen is applied, a second application can be made 2 or more weeks after transplanting. Do not exceed a seasonal maximum of 0.5 lb ai/a oxyfluorfen.
	0.09 lb pyroxasulfone	2.75 fl oz Zidua SC	60	Zidua SC may be applied in a single postemergence application to direct seeded or transplanted onions that have 2–6 true leaves. Consult label for warnings of possible crop response.
	trifluralin	several manufacturers	60	Spray and incorporate between onion rows. Avoid covering onions with treated soil during incorporation as injury may occur. Do not apply as a preplant or preemergence treatment. Controls annual grasses and some broadleaf weeds, but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Rate varies with soil texture and organic matter. Follow recommended soil preparation, application, and incorporation procedures. Must be incorporated within 24 hours. See label for plantback restrictions. Ineffective on peat and muck soils.
Annual grasses	5.0–6.0 lb bensulide	5.0–6.0 qt Prefar 4E		Apply preplant or preemergence. Application instructions on label. Use on mineral soils only.
Annual grasses and some broad-leaves	glyphosate	several manufacturers and formulations		See label to assure that the formulation is labeled for this crop and for specific instructions. Crop contact will result in severe injury or death. If weeds have been mowed or tilled, do not treat until they have resumed active growth and reached the recommended stage on the label. Unless otherwise stated, allow 7 or more days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified.
	*paraquat *(rate varies by label)*	several manufacturers and formulations, not all are registered for this use	60	Treat when a maximum number of grasses and broadleaves have emerged, but before the crop has emerged. In preplant and preemergence (to the crop) uses, do not apply to soils lacking clay minerals (i.e., muck, pure sand). Always add crop oil concentrate or non-ionic surfactant to the spray mixture. Follow precautions on the label.
	0.71–1.9 lb pendimethalin	1.5–4.0 pt Prowl H_2O	45	For use in direct-seeded and transplanted dry bulb onions. Rate depends on soil texture, classification, organic matter and herbicide formulation. May be applied sequentially on muck soils. See label for additional instructions and restrictions.
	0.74–2.0 lb pendimethalin	1.8–4.8 pt Prowl 3.3 EC	45	
Emerged grasses	0.068–0.24 lb clethodim	9.0–32.0 oz Select Max	45	Make postemergence applications when actively growing grasses are in the size ranges specified on the label. Do not apply more than 0.5 lb ai/a clethodim in one crop season. Include appropriate surfactant as required by product label. Requires a 1-hour rain-free period.
	clethodim	several manufacturers and formulations	45	

*Restricted-use pesticide.

(continued)

Weed control in dry bulb onion *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged grasses *(cont.)*	0.094–0.375 lb fluazifop-P-butyl	6.0-24.0 oz Fusilade DX	45	Make postemergence applications to actively growing grasses in the size ranges specified on the label. Always add to the spray volume 1% crop oil concentrate or 0.25% non-ionic surfactant. Multiple applications may be made to control late germinating grasses, but do not exceed 3.0 pt/a Fusilade DX per crop season.
	0.094–0.28 lb sethoxydim	0.5–1.5 pt Poast	30	Make postemergence applications to actively growing grasses. Check label grass size ranges and wild proso millet or rescue treatment rates. Do not exceed 4.5 pt/a Poast per crop season. Consult label for rate and adjuvant instructions for specific weeds.
Emerged annual broad-leaves	0.25–0.375 lb bromoxynil	1.0–1.5 pt bromoxynil 2EC		Apply when onions are in the two- to five-true-leaf stage and weeds are less than 2 inches tall—younger or older onions may be injured. Do not exceed 1.5 pt/a bromoxynil 2EC per growing season. Apply in at least 50 gal water/a to avoid crop injury; do not add surfactant. Apply when soil and onion leaves are dry. Do not treat onions damaged by insects or blowing sand.
	0.12 lb fluroxypyr	0.35 pt Starane Ultra	42	Broadcast application may be made to dry bulb onions from the 2 true leaf through the 6 true leaf stage. Do not apply more than 0.35 pt of Starane Ultra per acre in a single application or 0.7 pt per acre per crop season. Sequential applications must be separated by a minimum of 10 days. Do not make more than two applications per season. The use of adjuvants is not recommended. Crop injury such as but not limited to leaf twisting may occur with some onion cultivars when Starane Ultra is applied as a broadcast treatment, especially when applications are made to larger dry bulb onions.
	dry bulb onions only: 0.12 lb oxyfluorfen	0.5 pt Goal 2XL 0.25 pt GoalTender	45	For seeded onions, apply postemergence when onions have at least two true leaves and weeds are in the two- to four-leaf stage. Do not exceed 0.5 lb ai/a oxyfluorfen per season. Do not apply when onion plants are stressed. Do not mix with pesticides, oils, surfactants, or fertilizers. Check the label for application to transplanted onions.

*Restricted-use pesticide.

Pea

Peas grow best in cool, moist early spring weather. To avoid all peas maturing at once, planting dates and varieties are chosen on the basis of degree days (DD). The base temperature used in computing degree days is 40°F. The number of degree days needed for a variety to reach the processing stage is fairly constant. Within a variety, temperature records are commonly used to predict the maturation or harvest date. Because of the large difference in spring and summer temperatures, several days separation at planting time may be required to separate harvests by only 1 or 2 days. Planting dates are determined using growing degree day requirements for maturation and on historical weather records.

Select fields with uniform fertility, soil type, slope, and drainage. Silt loams, sandy loams, or clay loams are best. High organic matter improves tilth and makes soil less droughty. Peas grown on sands and mucks require careful irrigation management.

Peas need adequate soil moisture but too much or too little reduces yield. Inadequate drainage starves the root zone of oxygen so that normal root respiration cannot occur, nitrogen-fixing bacteria cannot function efficiently, and root rot organisms become more destructive.

Peas typically follow corn in a rotation. Other crops such as small grains and hay also work well. The usual sequence is corn, peas, small grain, hay. Rotations with potatoes do not work well unless soil pH is above 6.6. Peas are sometimes grown in a double crop system. Green beans, soybeans, or silage corn may be planted after the peas are harvested. Double cropping can increase risks from diseases and insects.

Frequent pea culture increases disease and insect problems, especially common root rot. To avoid buildup of these problems, peas should not be grown on the same field more than once every 4 or 5 years.

Peas do not compete well with weeds. The best time to control weeds is before planting. Canada thistles are particularly troublesome because their buds are hard to remove from shelled peas and greatly reduce the pea grade. Choose fields without major weed problems. Check that previous herbicides will not damage peas, since some chemicals persist in the soil.

Planting

The best yields can be expected from the earliest planted peas. Till seedbed 4–5 inches deep, but do not work the soil too fine, or crusting will cause problems in emergence. Grain drills are generally used to plant peas. Seeding rates vary depending on cultivar. Plant seeds 2 inches deep in firm moist soil to promote fast, uniform germination and seedling emergence. Plant shallower if soil is heavy or very moist. Plant deeper (but no more than 3 inches) on light soils or if soil is dry or cloddy.

Good yields require adequate stands. Full stands of strong vigorous plants provide needed competition against weeds and make full use of soil moisture and nutrients. The problem is more apt to be one of too few plants rather than too many.

Early and light-vined varieties, such as Alsweet, should have at least 672,000 plants/a (nine plants/ft in 7-inch rows). Later varieties need a minimum population of 500,000 plants/a (six plants/ft in 7-inch rows). There are indications that populations higher than these minimums may be profitable. Base seeding rates on the final plant population desired. Large seeds require heavier rates than small seeds. Poor germinating seeds or unfavorable conditions at planting require heavier rates.

Seed treatment

Most pea seeds for commercial production are treated with a fungicide and dyed to make them stand out. The fungicide coating helps protect seed and seedling from soil fungi until emergence. Treated seeds are poisonous and must not be used for food or feed.

Seed inoculation

Peas in association with the proper nitrogen-fixing bacteria can fix their own nitrogen from the air, therefore it may be beneficial to inoculate the seeds before planting. This is especially important if peas have not been grown in that field for more than 5 years.

Lime and fertilizer

Determine fertilizer and lime needs with a soil test.

Lime: Adjust pH to 6.0 or higher on mineral soils and 5.6 on organic soils for maximum yields.

Fertilizer rates: Apply annual nitrogen, P_2O_5, and K_2O rates shown in the table below. Take credits for previous legume crops and manure.

Application: Broadcast and work in lime and fertilizer before planting. Small amounts of fertilizer (up to 200 lb/a) can be applied with the drill at planting time. Additional required fertilizer should be broadcast and incorporated before planting. Drill-applied fertilizer should be placed 2 inches to the side and slightly below the seed. Starter fertilizer is especially important for early peas on cool, wet soils because nitrogen-fixing bacteria are less active.

Annual nitrogen, phosphate, and potash recommendations for peas

Nitrogen		Phosphate and potash		
Organic matter (%)	Amount to apply (lb/a)	Yield goal (lb/a)	Amount P_2O_5 to apply* (lb/a)	Amount K_2O to apply* (lb/a)
<2	40	1,000–2,500	10	15
2.0–9.9	30	2,501–4,000	15	30
10–20	20	4,001–6,000	25	45
>20	0			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Disease control in pea

Disease	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Ascochyta blight	*Use clean, disease-free seed and a 3-year rotation.*			
	azoxystrobin	6.0–15.5 fl oz Aframe, AzoxyStar, Quadris Flowable, Satori, Willowood Azoxy 2SC	0	Quadris, Satori, and Headline belong to the strobilurin group of fungicides. Do not exceed 1 application of any of these products before alternating with a fungicide having a different mode of action. Do not exceed 2 applications of strobilurin fungicides per crop per year. Do not exceed 2.88 qt/a Quadris or Satori, or 18.0 fl oz/a Headline per crop per season.
	pyraclostrobin	6.0–9.0 fl oz Headline SC	7	
	boscalid	8.0–11.0 oz Endura	21 (dried beans) 7 (succulent)	Use no more than 22.0 oz/a per season. Apply at beginning of flowering and again at full bloom for maximum efficacy. Do not make more than 2 applications/a per season.
	fluxapyroxad + pyraclostrobin	4.0–8.0 fl oz Priaxor	7	See label and follow instructions for limitations in tank mixing to avoid crop injury. Do not apply more than 16.0 fl oz/a per season.
	penthiopyrad	14.0–30.0 fl oz Fontelis	0	Do not exceed 72.0 fl oz/a per season. Do not make more than 2 sequential applications without alternating to a fungicide with a different mode of action.
Bacterial blight ("syringae" blight)	Use clean, disease-free seed. Avoid planting after green and lima beans. Don't over-irrigate. Copper-containing fungicides may aid in limiting bacterial disease spread.			
Common root rot *(Aphanomyces)*	*There are no disease-resistant cultivars. Rotations with non-legumes slow the buildup of disease problems. A test from the UW-Madison Dept. of Plant Pathology predicts the potential for root rot. Trifluralin herbicide gives some protection against Aphanomyces root rot.*			
Downy mildew *(Peronospora viciae)*	phosphoric acid salts, potassium phosphites	1.0–3.0 qt in 20 gal water/a Confine Extra, Fosphite, Fungi-Phite, K-Phite, Rampart	0	Apply at 2- to 3-week intervals. Also registered for control of Pythium and Phytophthora.
		3.0–4.0 pt ProPhyt	0	Start application at flowering and reapply at 7-day intervals or as conditions dictate.
		4.0 pt Phostrol	0	Apply at 7-day intervals starting prior to disease onset.
Fusarium near wilt	*Cultivars resistant to near wilt are the only effective control.*			

(continued)

Disease control in pea *(continued)*

Disease	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Fusarium root rot	*Avoid close cropping of peas. Plant peas in a 4-year rotation with other crops.*			
Fusarium wilt	*Use resistant varieties.*			
Powdery mildew	8.0–10.0 lb wettable sulfur in 100 gal water or dust on 325 mesh dusting sulfur			Use mildew-resistant varieties. Begin applications at first sign of mildew. Do not apply when plants are wet or when temperatures are above 85°F.
Rhizoctonia root rot	azoxystrobin	0.40–0.80 fl oz Quadris Flowable/ 1,000 ft row	0	Use at planting. Follow manufacturer's directions.
Seed rot, root rot, and damping-off	captan thiram	varies by manufacturer		Seed treatment only. Follow manufacturer's instructions. Combination fungicides and insecticides are available. If using inoculum, apply just before planting. Plant disease-free seed.
	fludioxonil	0.08–0.16 fl oz/100 lb seed Dyna-Shield, Maxim 4FS, Spirato 480FS		
	fludioxonil + mefenoxam	1.5 fl oz/100 lb seed Apron MAXX RFC 0.016 fl oz/100 lb seed Apron XL 0.167–0.334 fl oz/100 lb seed Maxim XL		
	fluxapyroxad	0.24–0.47 fl oz Systiva		
	mefenoxam	0.5–1.0 pt Ridomil Gold SL 1.0–2.0 pt Ultra Flourish		
	metalaxyl	0.75 fl oz/100 lb seed Acquire, Metalaxyl 265 ST 2.0 oz/100 lb seed Allegiance 0.1–0.375 fl oz/100 lb seed MetaStar ST 0.75–1.5 fl oz/100 lb seed Sebring 318 FS 0.5–1.0 fl oz/100 lb seed Sebring 480 FS		
	pyraclostrobin	0.4–1.5 fl oz/100 lb seed Stamina		
	trifloxystrobin + metalaxyl	1.0 oz/100 lb seed Trilex 2000		
Virus diseases	*Virus diseases such as enation virus, mosaic seed-borne virus, mosaic pea streak virus, and pea stunt are spread by aphids. Good aphid control is the most effective control measure.*			

Scouting calendar for insect pests of peas

April			May			June			July			August			September		
early	mid	late	early	mid	late	early	mid	late	early	mid	late	early	mid	late	early	mid	late
			Aphids														
			Caterpillar contaminants														

Insect control in pea[a]

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Alfalfa caterpillar	*Treat if you find one caterpillar per 25 sweeps.*			
	alpha-cypermethrin	2.7–3.8 fl oz *Fastac CS, *Fastac EC	1 (succulent shelled or edible-podded peas)	Do not apply more than 11.4 fl oz (0.075 lb ai)/a per season.
	Bacillus thuringiensis subsp. *kurstaki*	Various manufacturers and formulations	Consult label	Consult label. Treat early instar larvae before noticeable feeding damage occurs. Repeat as needed.
	bifenthrin	2.1–6.4 fl oz *Brigade 2EC (several other manufacturers)	3	Do not exceed 12.8 oz/a (0.2 lb ai/a) per season.
	bifenthrin + imidacloprid	5.6 fl oz *Brigadier	7	Do not apply more than 16.64 fl oz/a per season. Do not apply more than 0.13 lb ai/a of imidacloprid or 0.20 lb ai/a of bifenthrin per season. Highly toxic to bees.
	0.098–0.167 lb bifenthrin + chlorantraniliprole	5.6–9.6 fl oz *Elevest	3	Make no more than 2 applications per acre per calendar year. Minimum interval between treatments is 3 days. Do not apply more than 19.2 fl oz *Elevest insect control or 0.2 lb ai of chlorantraniliprole and 0.2 lb ai of bifenthrin-containing products per acre per calendar year.
	esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Do not exceed 0.1 lb ai/a per season. Do not feed treated forage to livestock.
	flubendiamide	2.0–3.0 fl oz Belt SC	1	Do not apply more than 6.0 fl oz/a (0.188 ai/a) per crop season.
	gamma-cyhalothrin	2.56–3.84 fl oz *Proaxis (several other manufacturers)	7	Do not apply more than 0.96 pt/a (0.06 lb ai/a) per season.
	lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II (several other manufacturers)	7	Do not exceed 7.68 fl oz/a (0.12 lb ai/a) per season.
	lambda-cyhalothrin + chlorantraniliprole	6.0–10.0 fl oz *Besiege	7	Do not exceed a total of 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole-containing products per acre per year.
	methomyl	*Lannate LV, *Lannate SP (rates vary by formulation)	1 (succulent) 5 (forage) 14 (hay)	See label for remarks.

*Restricted-use pesticide.

(continued)

[a] EPA-approved insecticides for pea insects. Usually honeybees do not work pea blossoms, but weed blossoms in the field or in the fencerow might attract bees. Avoid using Sevin sprays if bee yards are located within 2.0–2.5 miles of pea fields. Apply insecticides in the evening to avoid excessive kill of foraging bees.

Insect control in pea[a] *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Alfalfa caterpillar *(cont.)*	zeta-cypermethrin	2.72–4.0 oz *Mustang Maxx	1	Wait at least 5 days between applications. Do not exceed 24.0 oz/a (0.15 lb ai/a) per season.
	zeta-cypermethrin + bifenthrin	*Hero, *Hero EW (rates vary by formulation)	3	Do not apply more than 0.266 lb ai/a per season. Wait at least 5 days between applications.
	zeta-cypermethrin + bifenthrin + imidacloprid	4.5 fl oz *Triple Crown	7	Do not apply more than 13.1 fl oz/a per season.
Aphids	*Treatment is recommended if you find one aphid per small pod or 10 per sweep.*			
	acetamiprid	2.5–5.3 oz Assail 30 SG 1.0–2.3 oz Assail 70WP	7	Do not make more than 3 applications per season. Do not exceed a total of 0.3 lb ai of acetamiprid-containing products/a per growing season.
	alpha-cypermethrin	3.2–3.8 fl oz *Fastac CS, *Fastac EC	1 (succulent shelled or edible-podded peas)	Do not apply more than 11.4 fl oz (0.075 lb ai)/a per season. Aphid control may be variable depending on species present and host-plant relationships.
	azadirachtin	Aza-Direct, Neemix 4.5	0	See label for rate. Suppression and adult feeding deterrence. Apply every 7–10 days.
	bifenthrin	2.1–6.4 fl oz *Brigade 2EC (several other manufacturers)	3	Do not exceed 12.8 fl oz/a (0.2 lb ai/a) per season.
	bifenthrin + imidacloprid	3.8–5.6 fl oz *Brigadier	7	Do not apply more than 16.64 fl oz/a per season. Do not apply more than 0.13 lb ai/a of imidacloprid or 0.20 lb ai/a of bifenthrin per season. Highly toxic to bees.
	0.098–0.167 lb bifenthrin + chlorantraniliprole	5.6–9.6 fl oz *Elevest	3	Make no more than 2 applications per acre per calendar year. Minimum interval between treatments is 3 days. Do not apply more than 19.2 fl oz *Elevest insect control or 0.2 lb ai of chlorantraniliprole and 0.2 lb ai of bifenthrin-containing products per acre per calendar year.
	dimethoate	several formulations	consult label	Consult label. Highly toxic to bees.
	esfenvalerate	2.9–5.8 fl oz *Asana XL	3	Foliar treatment. Do not exceed 0.1 lb ai/a per season. Do not feed treated forage to livestock.
	fenpropathrin	10.66 fl oz *Danitol 2.4 EC	7	Do not exceed 2.66 pts (42.66 fl oz)/a per season.
	gamma-cyhalothrin	2.56–3.84 fl oz *Proaxis (several manufacturers)	7	Do not apply more than 0.96 pt/a (0.06 lb ai/a) per season. See resistance statement under "General Use Precautions and Restrictions" on label.
	lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II (several other manufacturers)	7	Do not exceed 7.68 fl oz/a (0.12 lb ai/a) per season.
	lambda-cyhalothrin + chlorantraniliprole	6.0–10.0 fl oz *Besiege	7	Refer to resistance management section of label. Do not exceed a total of 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole-containing products per acre per year.
	methomyl	*Lannate LV, *Lannate SP (rates vary by formulation)	1 (succulent) 5 (forage) 14 (hay)	See label for remarks.

*Restricted-use pesticide.

(continued)

[a] EPA-approved insecticides for pea insects. Usually honeybees do not work pea blossoms, but weed blossoms in the field or in the fencerow might attract bees. Avoid using Sevin sprays if bee yards are located within 2.0–2.5 miles of pea fields. Apply insecticides in the evening to avoid excessive kill of foraging bees.

Insect control in pea[a] *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids *(cont.)*	spirotetramat	4.0–5.0 fl oz Movento 2.0–2.5 fl oz Movento HL	1 (succulent) 7 (dried)	Do not apply more than 0.16 lb ai/a per season.
	thiamethoxam	1.28 fl oz Cruiser 5FS/100 lb seed	—	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
	zeta-cypermethrin	3.2–4.0 oz *Mustang Maxx	1	Wait at least 5 days between applications. Do not exceed 24.0 oz/a (0.15 lb ai/a) per season.
	zeta-cypermethrin + bifenthrin	*Hero, *Hero EW (rates vary by formulation)		Do not apply more than 0.266 lb ai/a per season. Wait at least 5 days between applications.
Armyworms	alpha-cypermethrin	2.7–3.8 fl oz *Fastac CS, *Fastac EC	1 (succulent shelled or edible-podded peas)	Do not apply more than 11.4 fl oz (0.075 lb ai)/a per season.
	azadirachtin	Aza-Direct, Neemix 4.5	0	See label for rate. Suppression and adult feeding deterrence. Apply every 7–10 days.
	Bacillus thuringiensis subsp. *kurstaki*	Various manufacturers and formulations	Consult label	Consult label. Treat early instar larvae before noticeable feeding damage occurs. Repeat as needed.
	0.0875 lb bifenthrin + imidacloprid	5.6 fl oz *Brigadier	7	Do not apply more than 16.64 fl oz/a per season. Do not apply more than 0.13 lb ai/a of imidacloprid or 0.20 lb ai/a of bifenthrin per season. Highly toxic to bees.
	esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Foliar treatment. Do not exceed 0.1 lb ai/a per season. Do not feed treated forage to livestock.
	fenpropathrin	10.66 fl oz *Danitol 2.4 EC	7	Do not exceed 2.66 pts (42.66 fl oz)/a per season.
	flubendiamide	2.0–3.0 fl oz Belt SC	1	Do not apply more than 6.0 fl oz/a (0.188 ai/a) per crop season.
	gamma-cyhalothrin	2.56–3.84 fl oz *Proaxis (several manufacturers)	7	Use higher rates for large larvae. Do not apply more than 0.96 pt/a (0.06 lb ai/a) per season. Use higher rates for large larvae.
	lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II (several other manufacturers)	7	Use higher rates for large larvae. Do not exceed 7.68 fl oz/a (0.12 lb ai/a) per season.
	lambda-cyhalothrin + chlorantraniliprole	6.0–10.0 fl oz *Besiege	7	Use higher rates within the listed rate range for large larvae. Do not exceed a total of 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole-containing products per acre per year.
	methomyl	*Lannate LV, *Lannate SP (rates vary by formulation)	1 (succulent) 5 (forage) 14 (hay)	See label for remarks.
	methoxyfenozide	4.0–16.0 fl oz Intrepid 2F	7	Do not apply more than 64.0 fl oz/a per year.
	spinetoram	4.0–8.0 fl oz Radiant SC	3	Do not use for yellow-striped armyworm. Do not make more than 6 applications per crop. Do not exceed 0.219 lb ai/a per season. Wait at least 4 days between applications.

*Restricted-use pesticide.

(continued)

[a] EPA-approved insecticides for pea insects. Usually honeybees do not work pea blossoms, but weed blossoms in the field or in the fencerow might attract bees. Avoid using Sevin sprays if bee yards are located within 2.0–2.5 miles of pea fields. Apply insecticides in the evening to avoid excessive kill of foraging bees.

Insect control in pea[a] *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Armyworms *(cont.)*	spinosad	Blackhawk, Entrust SC, Entrust Naturalyte (rates vary by formulation)	3 (succulent peas)	Scout with enough regularity to monitor the population size. Heavy infestations may require repeat applications, but follow resistance management guidelines. Do not make more than 2 applications of Group 5 insecticides (spinetoram and spinosad). For succulent peas, do not apply more than a total of 0.45 lb ai of spinosad (20.0 fl oz of Blackhawk or 29.0 fl oz of Entrust SC) per acre per season.
	zeta-cypermethrin	2.72–4.0 oz *Mustang Maxx	1	Wait at least 5 days between applications. Do not exceed 24.0 oz/a (0.15 lb ai/a) per season.
	zeta-cypermethrin + bifenthrin	*Hero, *Hero EW (rates vary by formulation)	3	Do not apply more than 0.266 lb ai/a per season. Wait at least 5 days between applications.
	zeta-cypermethrin + bifenthrin + imidacloprid	4.5 fl oz *Triple Crown	7	Do not apply more than 13.1 fl oz/a per season.
Cutworms	alpha-cypermethrin	1.3–3.8 fl oz *Fastac CS, *Fastac EC	1 (succulent shelled or edible-podded peas)	Do not apply more than 11.4 fl oz (0.075 lb ai)/a per season.
	azadirachtin	Aza-Direct, Neemix 4.5	0	See label for rate. Suppression and adult feeding deterrence. Apply every 7–10 days.
	Bacillus thuringiensis subsp. *kurstaki*	Various manufacturers and formulations	Consult label	Consult label. Treat early instar larvae before noticeable feeding damage occurs. Repeat as needed.
	bifenthrin	2.1–6.4 fl oz *Brigade 2EC (several other manufacturers)	3	Do not exceed 12.8 oz/a (0.2 lb ai/a) per season.
	bifenthrin + imidacloprid	5.6 fl oz *Brigadier	7	Do not apply more than 16.64 fl oz/a per season. Do not apply more than 0.13 lb ai/a of imidacloprid or 0.20 lb ai/a of bifenthrin per season. Highly toxic to bees.
	0.084–0.167 lb bifenthrin + chlorantraniliprole	4.8–9.6 fl oz *Elevest	3	Make no more than 2 applications per acre per calendar year. Minimum interval between treatments is 3 days. Do not apply more than 19.2 fl oz *Elevest insect control or 0.2 lb ai of chlorantraniliprole and 0.2 lb ai of bifenthrin-containing products per acre per calendar year.
	0.047–0.098 chlorantraniliprole	1.2–2.5 fl oz Vantacor	1	Do not apply more than 5.1 fl oz Vantacor or 0.2 lb ai of chlorantraniliprole or chlorantraniliprole-containing products per acre per year.
	esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Foliar treatment. Do not exceed 0.1 lb ai/a per season. Do not feed treated forage to livestock.
	fenpropathrin	10.66 fl oz *Danitol	7	Do not exceed 2.66 pt (42.66 fl oz) per acre per season. Climbing cutworms only.
	flubendiamide	2.0–3.0 fl oz Belt SC	1	Do not apply more than 6.0 fl oz/a (0.188 ai/a) per crop season.
	gamma-cyhalothrin	1.92–3.20 fl oz *Proaxis (several manufacturers)	7	Do not apply more than 0.96 pt/a (0.06 lb ai/a) per season.

*Restricted-use pesticide.

(continued)

[a] EPA-approved insecticides for pea insects. Usually honeybees do not work pea blossoms, but weed blossoms in the field or in the fencerow might attract bees. Avoid using Sevin sprays if bee yards are located within 2.0–2.5 miles of pea fields. Apply insecticides in the evening to avoid excessive kill of foraging bees.

Insect control in pea[a] *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cutworms *(cont.)*	lambda-cyhalothrin	0.96–1.6 fl oz *Warrior II (several other manufacturers)	7	Do not exceed 7.68 fl oz/a (0.12 lb ai/a) per season.
	lambda-cyhalothrin + chlorantraniliprole	5.0–8.0 fl oz *Besiege	7	Do not exceed a total of 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole-containing products per acre per year.
	zeta-cypermethrin	1.28–4.0 oz *Mustang Maxx	1	Wait at least 5 days between applications. Do not exceed 24.0 oz/a (0.15 lb ai/a) per season.
	zeta-cypermethrin + bifenthrin	*Hero, *Hero EW (rates vary by formulation)	3	Do not apply more than 0.266 lb ai/a per season. Wait at least 5 days between applications.
	zeta-cypermethrin + bifenthrin + imidacloprid	3.5–4.5 fl oz *Triple Crown	7	Do not apply more than 13.1 fl oz/a per season.
Loopers	*Treat if you find one looper per 25 sweeps.*			
	alpha-cypermethrin	3.2–3.8 fl oz *Fastac	1 (succulent shelled or edible-podded peas) 21 (dried shelled peas)	Do not apply more than 11.4 fl oz (0.075 lb ai)/a per season.
	azadirachtin	Aza-Direct, Neemix 4.5	0	See label for rate. Suppression and adult feeding deterrence. Apply every 7–10 days.
	Bacillus thuringiensis subsp. *kurstaki*	Various manufacturers and formulations	Consult label	Consult label. Treat early instar larvae before noticeable feeding damage occurs. Repeat as needed.

*Restricted-use pesticide.

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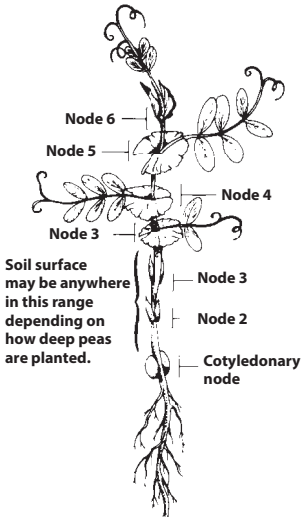
[a] EPA-approved insecticides for pea insects. Usually honeybees do not work pea blossoms, but weed blossoms in the field or in the fencerow might attract bees. Avoid using Sevin sprays if bee yards are located within 2.0–2.5 miles of pea fields. Apply insecticides in the evening to avoid excessive kill of foraging bees.

Weed control

Postemergence herbicides need to be applied at the correct stage of growth to avoid injury and prevent yield losses. Correctly counting leaves or nodes on pea plants is critical in timing herbicide applications.

To count nodes, refer to the drawing of the pea plant. The point where the cotyledons (seed) are attached to the plant is the cotyledonary node. The root forms below this node and the stem above. The two nodes above this point produce incomplete or stipular leaves. These leaves can be above or below the soil surface and can be difficult to detect.

Count the first two nodes above the cotyledonary node as one and two. The third node has normal stipules and usually a leaf with two leaflets. The rest of the nodes produce normal stipules and a leaf with four leaflets. The uppermost node from which a leaf extends is the last developed node to be counted. Within the folded stipules of this node are the growing point of the pea plant and stipules and leaves of still more nodes.



Insect control in pea[a] *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Loopers *(cont.)*	bifenthrin	2.1–6.4 fl oz *Brigade 2EC (several other manufacturers)	3	Do not exceed 12.8 fl oz/a (0.2 ai/a) per season.
	bifenthrin + imidacloprid	5.6 fl oz *Brigadier	7	Do not apply more than 16.64 fl oz/a per season. Do not apply more than 0.13 lb ai/a of imidacloprid or 0.20 lb ai/a of bifenthrin per season. Highly toxic to bees.
	0.098–0.167 lb bifenthrin + chlorantraniliprole	5.6–9.6 fl oz *Elevest	3	Make no more than 2 applications per acre per calendar year. Minimum interval between treatments is 3 days. Do not apply more than 19.2 fl oz *Elevest insect control or 0.2 lb ai of chlorantraniliprole and 0.2 lb ai of bifenthrin-containing products per acre per calendar year.
	esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Foliar treatment. Do not exceed 0.1 lb ai/a per season. Do not feed treated forage to livestock.
	fenpropathrin	10.66 fl oz *Danitol 2.4 EC	7	Do not exceed 2.66 pts (42.66 fl oz)/a per season.
	flubendiamide	2.0–3.0 fl oz Belt SC	1	Do not apply more than 6.0 fl oz/a (0.188 ai/a) per crop season.
	gamma-cyhalothrin	2.56–3.84 fl oz *Proaxis (several manufacturers)	7	Do not exceed 0.96 pt/a (0.06 lb ai/a) per season.
	lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II (several other manufacturers)	7	Do not exceed 7.68 fl oz/a (0.12 lb ai/a) per season.
	lambda-cyhalothrin + chlorantraniliprole	6.0–10.0 fl oz *Besiege	1	Do not exceed a total of 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole-containing products per acre per year.
	methomyl	*Lannate LV, *Lannate SP (rates vary by formulation)	1 (succulent) 5 (forage) 14 (hay)	See label for remarks.
	spinetoram	4.0–8.0 fl oz Radiant SC	3	Do not make more than 6 applications per crop. Do not exceed 0.219 lb ai/a per season. Wait at least 4 days between applications.
	spinosad	Blackhawk, Entrust SC, Entrust Naturalyte (rates vary by formulation)	3 (succulent peas)	Follow resistance management guidelines. Consult label for seasonal use rates.
	zeta-cypermethrin	3.2–4.0 oz *Mustang Maxx	1	Wait at least 5 days between applications. Do not exceed 24.0 oz/a (0.15 lb ai/a) per season.
	zeta-cypermethrin + bifenthrin	*Hero, *Hero EW (rates vary by formulation)	3	Do not apply more than 0.266 lb ai/a per season. Wait at least 5 days between applications.
	0.061–0.079 lb zeta-cypermethrin + bifenthrin + imidacloprid	4.5 fl oz *Triple Crown	7	Do not apply more than 13.1 fl oz/a per season.
Seed maggot	thiamethoxam	1.28 fl oz Cruiser 5FS/100 lb seed	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.

*Restricted-use pesticide.

[a] EPA-approved insecticides for pea insects. Usually honeybees do not work pea blossoms, but weed blossoms in the field or in the fencerow might attract bees. Avoid using Sevin sprays if bee yards are located within 2.0–2.5 miles of pea fields. Apply insecticides in the evening to avoid excessive kill of foraging bees.

Weed control in pea

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annuals	0.5 lb clomazone	1.3 pt Command 3ME		Command provides fair control of annual grasses and several broadleaf weeds but is weak on pigweed and black nightshade. Command is ineffective on peat and muck soils. The 3ME formulation is labeled for preemergence applications. Off-site movement through drift or vapors can cause bleaching of sensitive plants and must be avoided. Label includes significant buffer restrictions near senstive sites, such as towns, housing, greenhouses, nurseries, and sensitive plants. Do not apply if wind exceeds 10 mph. Treated pea vines cannot be fed to livestock.
	0.047 lb imazethapyr	3.0 fl oz Pursuit	30	Apply as a preplant treatment within 7 days of planting and incorporate 1–2 inches deep or as a preemergence treatment within 3 days after planting. Ineffective on peat or muck soils. Or apply postemergence when weeds are less than 2 inches tall and after peas are at least 3 inches tall but prior to five nodes before flowering. Include 2 pt/100 gal of non-ionic surfactant in the final spray mixture. Do not use crop oil as an adjuvant. Pursuit controls several annual broadleaf weeds, including black nightshade, and some annual grasses. It can stunt peas if cool and/or wet weather follows treatment. The use of trifluralin prior to Pursuit application may increase the likelihood and severity of crop injury. Treated pea vines cannot be fed to livestock.
	0.5–1.0 lb linuron	1.0–2.0 lb Lorox	60	Depending on rate, Lorox will provide fair to good control of most annual grasses; fair control of cocklebur and black nightshade; and good to excellent control of giant and common ragweed, lambsquarters, velvetleaf, pigweeds, and smartweeds. Apply Lorox after planting but before crop or weeds emerge, and do not disturb the soil after application as poor weed control and increased risk of crop injury will occur. Do not make more than 1 application per year. Do not apply to sand or loamy sand soil types. Do not apply on soils with less than 1% organic matter. Sufficient rainfall to move the herbicide into the root zone of germinating weeds is needed for best performance. Lorox can also be tank mixed with other herbicides labeled in Pea to improve weed control, but follow directions for the most restrictive herbicide.
	0.71–1.43 lb pendimethalin	1.5–3.0 pt Prowl H_2O		Preplant-incorporated treatment controls annual grasses, lambsquarters, and pigweed but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Incorporate 1–2 inches deep. Can delay maturity of early-maturing pea cultivars. Pea injury is more severe on wet soils. Ineffective on peat or muck soils. Crops that allow preplant-incorporated pendimethalin use can be double cropped after peas. Treated pea vines cannot be fed to livestock.
	0.74–1.49 lb pendimethalin	1.8–3.6 pt Prowl 3.3EC or registered equivalent		
	s-metolachlor	1.0–2.0 pt Dual II Magnum or Dual Magnum		Apply preemergence for good to excellent control of foxtails and other annual grasses, good control of black nightshade and pigweed, and partial control of nutsedge. Does not control most other broadleaf weeds. If soils are cold and wet during pea germination and emergence, s-metolachlor may delay maturity and/or reduce yield. Pea vines can be cut for hay 120 days after preemergence application. Ineffective on peat or muck soils.

(continued)

Weed control in pea *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annuals *(cont.)*	0.017 lb saflufenacil	0.75 fl oz Sharpen		Sharpen may be applied preplant-incorporated or preemergence for residual suppression of select broadleaf weeds such as black nightshade, common lambsquarters, redroot pigweed, and velvetleaf. Check with your seed supplier for information regarding sensitive varieties. Sharpen may be preplant-incorporated up to 1 week prior to planting, but do not incorporate deeper than 3 inches. It can be applied preemergence up to 3 days after planting but prior to cracking stage (emergence) or severe crop injury may result. Also, make sure peas were planted at least ½-inch deep and soil conditions allowed furrows to close properly. Do not apply if cold and/or wet soil conditions are present or predicted within 1 week of application, and do not apply with any other products containing Group 14/Group E herbicides within 30 days. Do not feed or graze as forage for 65 days.
	0.017 lb saflufenacil + 0.047 lb imazethapyr	1.5 oz OpTill		OpTill is a combination of Sharpen and Pursuit. It will control a broad spectrum of annual broadleaf and grassy weeds. Check the label for specifics. It may be applied preplant up to 30 days prior to planting but is more reliable if applied not more than 14 days prior to planting. OpTill may be preplant-incorporated up to 1 week prior to planting. Do not incorporate more than 3 inches deep. Preemergence applications may be made up to 3 days after planting but before emergence. Do not apply if crop is cracking. Some varieties may be sensitive to OpTill—check with your seed supplier prior to use. OpTill may be used in burndown applications as a tank mix with products containing glyphosate. Check labels for tank mix directions. Check product labels for additional cropping and plantback restrictions.
	trifluralin	several manufacturers		Preplant-incorporated treatment controls annual grasses, lambsquarters, and pigweed but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Incorporate 2–3 inches deep within 24 hours of application. Can delay maturity of early-maturing pea cultivars. Pea injury is more severe on wet soils. Ineffective on peat or muck soils.
Emerged annual broad-leaves	0.75–1.0 lb bentazon	several manufacturers and formulations	10	Excellent control of velvetleaf and wild mustard. Partial control of black nightshade, common lambsquarters, and redroot pigweed when applied to very small seedlings. Some burndown of yellow nutsedge and Canada thistle. Does not control grasses. Apply when broadleaf weeds are small and actively growing, but only after three pairs of pea leaves (usually four nodes) are present. Good coverage is essential for maximum control. Do not spray when peas are in bloom or when stressed by root rot. Rain or irrigation within 4 hours reduces effectiveness.
	0.023 lb imazamox	3.0 fl oz Raptor		Controls eastern black and hairy nightshade, wild mustard, field pennycress, shepherd's purse, and pigweed. Apply before weeds exceed 3 inches in height. Peas must be at least 3 inches tall, but five nodes before flowering. Add 0.25% non-ionic surfactant to the spray mixture. Weed control can be improved by adding 2.5% of liquid nitrogen fertilizer (28%) or 12–15 lb of ammonium sulfate per 100 gal of mix. Suppression of annual grasses will be increased if 1% crop oil concentrate is used instead of surfactant. When using crop oil concentrate or nitrogen fertilizer as an adjuvant, always add 6.0–16.0 oz/a of Basagran to reduce crop injury. Rain or irrigation within 1 hour will reduce control.

(continued)

Weed control in pea *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged annual broad-leaves *(cont.)*	0.5–1.5 lb acid equivalent MCPB	2.0–6.0 pt Thistrol		Controls many annual broadleaf weeds and inhibits Canada thistle flower bud formation. Weak on smartweed, mustards, and black nightshade. Lower rate controls only young weeds less than 3 inches tall. Rate increases with thistle size and growth stage. Apply no later than three nodes before pea flowering. Usually delays pea maturity 1–4 days. Do not apply when soils are waterlogged or during drought. Do not apply if temperatures are over 90°F. Treated pea vines cannot be fed to livestock.
Emerged annual grasses	0.068–0.12 lb clethodim	9.0–16.0 oz Select Max	21	Apply to actively growing grasses before peas bloom but no later than 21 days before harvest. Include appropriate surfactant as directed by label. Do not apply more than once per season.
	clethodim	several manufacturers and formulations	21	
	0.034–0.083 lb quizalofop	5.0–12.0 oz Assure II or Targa	30	Controls most annual and perennial grasses but does not control broadleaves. Apply 5.0–8.0 oz/a for wild proso millet, 7.0–8.0 oz/a for foxtails, 8.0–10.0 oz/a for crabgrass, 9.0–10.0 oz/a for woolly cupgrass, and 10.0–12.0 oz/a for quackgrass. To avoid antagonizing activity, apply broadleaf herbicides either 7 days before or 24 hours after Assure II or Targa. Include non-ionic surfactant or crop oil concentrate according to label directions. Rainfall within 1 hour reduces effectiveness. Treated pea vines cannot be fed to livestock.
	0.094–0.48 lb sethoxydim	0.5–2.5 pt Poast	15	Controls most annual and perennial grasses but does not control broadleaf weeds or sedges. Thoroughly cover weeds. Adjuvants required for control; see label for rate and adjuvant instructions for specific weeds. Do not exceed 4.0 pt/a per season. Rainfall within 1 hour reduces effectiveness.
Emerged weeds	*paraquat	several manufacturers and formulations available, not all are registered for this use		Prepare seedbed early to allow for maximum weed emergence. Application can be made as a banded or broadcast treatment before, during, or after planting, but before crop emergence. In preplant and preemergence (to the crop) uses, do not apply to soils lacking clay minerals, i.e. muck, pure sand. Use the higher rate for heavy weed infestations. Seeding should be performed with minimal soil disturbance. Always add crop oil concentrate or non-ionic surfactant to spray mixture. Follow precautions on label.
Perennial weeds	glyphosate	several manufacturers and formulations		See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. Some formulations require a wait of 3 days between application and planting. Crop contact will result in severe injury or death. If weeds have been mowed or tilled, do not treat until they have resumed active growth and reached the recommended stage on the label. Unless otherwise stated, allow 7 or more days before tilling treated fields.

Pepper

Planting

Transplants

Rows: 18–36 inches.

Plants in row: 18–24 inches. Use 24 lb/a seed (1 oz produces 215 plants).

Set transplants May 20–June 1 in the southern half of Wisconsin and 7–10 days later in the northern counties after danger of frost is past. Plants stop growing below 55°F. Poor fruit set may occur below 60°F or above 75°F.

Transplants should be 6–8 weeks old, vigorous, slightly hardened (held at 60–65°F several days), stocky, dark green, and without disease or insect injury. Handle transplants carefully. Use a starter solution high in nitrogen and phosphorus as transplants are set out.

Irrigation

Irrigation is essential on sandy soils and may help on heavier soils during prolonged dry periods. Approximately 1.0–1.5 inches of water is needed every 5–7 days. If maximum daily temperatures exceed 85°F, more frequent irrigation may be necessary.

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 6.0 on mineral soils and 5.6 on organic soils.

Fertilizer rates: Apply P_2O_5 and K_2O according to soil test recommendations. Use annual nitrogen, P_2O_5, and K_2O recommendations in the table below. Take credits for previous legume crops and manure.

Application: Broadcast recommended fertilizer and plow or disk under before setting transplants.

Nitrogen: Apply preplant or sidedress. Split nitrogen into two or 3 applications, especially on sandy soils.

Annual nitrogen, phosphate, and potash recommendations for peppers

Nitrogen		Phosphate and potash		
Organic matter (%)	Amount to apply (lb/a)	Yield goal (t/a)	Amount P_2O_5 to apply* (lb/a)	Amount K_2O to apply* (lb/a)
<2	100	8–10	10	50
2.0–9.9	80			
10–20	60			
>20	30			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Disease control in pepper

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Anthracnose (*Colletotrichum* spp.)	azoxystrobin	6.0–15.5 fl oz Aframe, AzoxyStar, Equation, Quadris, Satori, Willowood Azoxy 2SC	0	Do not apply more than 61.5 fl oz/a per season. Do not make more than 1 application without alternating to a fungicide with a different mode of action.
	azoxystrobin + benzovindiflupyr	0.6–0.8 oz/5,000 sq ft Mural	0	For transplants grown in greenhouses and high tunnels for sale. Manages multiple diseases.
	azoxystrobin + difenoconazole	8.0–14.0 fl oz Quadris Top	0	Do not apply more than 55.3 fl oz/a per season. Do not make more than 2 consecutive applications before alternating to a fungicide with a different mode of action.

(continued)

Disease control in pepper *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Anthracnose *(cont.)*	chlorothalonil	1.5 pt Bravo Weather Stik, Chloronil 720, Echo 720, Equus 720	3	Do not apply more than 12.0 pt/a per season.
	chlorothalonil + cymoxanil	2.0–2.44 pt Ariston	3	Initiate application prior to disease onset and apply at 7-day intervals or as disease pressure dictates.
	difenoconazole + benzovindiflupyr	10.5–13.5 fl oz Aprovia Top	0	Do not make more than 2 sequential applications before alternating to a fungicide with an alternative mode of action (not Groups 3 or 7).
	difenoconazole + cyprodinil	16.0–20.0 fl oz Inspire Super	0	Apply no more than a total of 47.0 fl oz product/a per year. Follow resistance management guidelines.
	fluopyram + trifloxystrobin	7.6 fl oz Luna Sensation	3	Follow resistance management guidelines.
	flutriafol	14.0 fl oz Topguard	0	Do not make more than 4 applications per field per year.
	fluxapyroxad + pyraclostrobin	4.0–8.0 fl oz Priaxor	7	See label and follow instructions for limitations in tank mixing to avoid crop injury. Do not apply more than 24.0 fl oz/a per season.
	mancozeb	1.6–3.2 lb Manzate Pro-Stick 3.0 lb Koverall	7	Minimum re-treatment interval is 7 days.
	mancozeb + copper hydroxide	2.0–3.0 lb ManKocide	7	Do not apply more than 39.0 lb/a per year.
	penthiopyrad	24.0 fl oz Fontelis	0	Make no more than 2 sequential applications before switching to a fungicide with a different mode of action.
	pyraclostrobin	8.0–12.0 oz Cabrio	0	Do not apply more than 96.0 fl oz/a per season. The use of adjuvants may enhance efficacy of this product. Do not make more than 1 application before alternating to a fungicide with a different mode of action.
	tetraconazole	6.0–8.0 fl oz Mettle 125ME	0	Do not apply more than 16.0 fl oz per acre of Mettle 125ME per year.
	trifloxystrobin	3.0–4.0 oz Flint 3.0–3.8 fl oz Gem	3	Follow resistance management guidelines as per labels.
Bacterial spot	*Plant cultivars with resistance to bacterial spot. Several cultivars have field tolerance to races of the pathogen. A hot water seed treatment will help prevent bacterial spot. Place the seed in a mesh bag and dip it into water heated to 122°F; treat for 25 minutes. Immediately transfer the bag to cold water to cool the seed. There will be some reduction in the germination rate of treated seed. You may wish to sow additional seed to compensate.*			
	copper ammonium complex	1.5–3.0 qt Copper-Count-N	0	Spray every 7 days.
	copper hydroxide	1.3–2.0 pt Champ Formula 2 2.6–4.0 pt Kocide LF 2.4F 0.75–1.25 lb Kocide 3000 1.5–2.25 lb Kocide 2000 DF 2.0–3.0 lb Champion 77WP, Kocide DF	0 0 0 0 0	
	copper sulfate	0.75–2.0 lb Cuprofix Ultra 40 Disperss	0	
	streptomycin sulfate	200 ppm solution of 21.2% streptomycin sulfate		Spray every 4–5 days in the plant bed, but do not use after transplanting.

(continued)

Disease control in pepper *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Botrytis leaf mold *(Botrytis cinerea)*	chlorothalonil	1.5 pt Bravo Weather Stik, Chloronil 720	3	Do not apply more than 12.0 pt/a per season.
	pydiflumetofen + fludioxonil	11.4 fl oz Miravis Prime (suppression)	0	Do not make more than 2 sequential applications before alternating to a fungicide with an alternative mode of action (not Groups 7 or 12).
Cercospora leaf spot (*Cercospora* spp.)	chlorothalonil	1.5 pt Bravo Weather Stik, Chloronil 720	3	Do not apply more than 12.0 pt/a per season.
	difenoconazole + benzovindiflupyr	10.5–13.5 fl oz Aprovia Top	0	Do not make more than 2 sequential applications before alternating to a fungicide with an alternative mode of action (not Groups 3 or 7).
Damping-off, crown rot	azoxystrobin	0.10–0.38 fl oz/100 lb seed Dynasty	—	For seed or soil-borne fungi causing decay.
	fludioxonil	0.08–0.16 fl oz/100 lb seed Dyna-Shield, Maxim 4FS, Spirato 480 FS	—	Follow manufacturer's directions. Not for feed or food.
	mefenoxam	1.0 pt Ridomil Gold SL 2.0 pt Ultra Flourish	—	Preplant-incorporated application or surface application at planting. Preplant to top 2 inches of soil.
		0.085–0.64 fl oz Apron XL/ 100 lb seed	—	Follow manufacturer's directions. Do not use treated seed for feed or food.
	metalaxyl	4.0–8.0 pt MetaStar 2E AG	—	Preplant-incorporated application or surface application at planting. Preplant to top 2 inches of soil.
		0.75–1.5 fl oz/100 lb seed Acquire 0.7 fl oz/100 lb seed Sebring 2.65 ST 0.75 fl oz/100 lb seed Allegiance FL, Metalaxyl 265 ST	—	Follow manufacturer's directions. Do not use treated seed for feed or food.
	propamocarb hydrochloride	1.2 pt Previcur Flex	5	Do not apply more than 6.0 pt/a per season. Can be applied to lower portions of plants and soil by directed nozzles. Can be applied through drip irrigation or transplant water.
Phytophthora blight, ripe rot	ametoctradin + dimethomorph	14.0 fl oz Zampro	4	Do not apply more than 42.0 fl oz/a per season. Do not make more than 3 applications per season.
	cyazofamid	2.75 fl oz Ranman	0	Do not make more than 6 applications/a per year. Do not apply more than 16.5 fl oz/a per year.
	cymoxanil + famoxadone	8.0–10.0 oz Tanos 50DF	3	Disease suppression only. Do not make more than 1 application of Tanos before alternating with a fungicide having a different mode of action. Do not exceed 72.0 oz/a Tanos per season.
	dimethomorph	6.0 oz Forum	0	Disease suppression only. Tank mix Forum with another fungicide active against Phytophthora blight and having a different mode of activity. Do not make more than 2 sequential applications of Forum before alternating to another effective fungicide. Do not exceed 5 applications per season or 30.0 oz/a per season.
	ethaboxam	8.0 fl oz Elumin	2	Can be applied through drip irrigation. Follow resistance management guidelines.

(continued)

Disease control in pepper *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Phytophthora blight, ripe rot *(cont.)*	fenamidone	8.2 fl oz Reason 500 SC	14	Do not apply more than 24.6 fl oz/a per year. Do not make more than 1 application before alternating to a fungicide with a different mode of action (non–Group 11, non-strobilurin).
	fluazinam	1.0–1.5 pt Omega 500F	30	Do not apply more than 9.0 pt/a per year. Can be applied through drip irrigation.
	fluopicolide	3.0–4.0 fl oz Presidio	2	Tank mix this product with another labeled non–Group 43 fungicide.
	mancozeb + copper hydroxide	2.0–3.0 lb ManKocide	7	Do not apply more than 39.0 lb/a per year.
	mandipropamid	8.0 fl oz Revus	1	Apply as a foliar spray in a mixture with a copper-based fungicide. Alternate with another effective non–Group 40 fungicide.
	oxathiapiprolin	*foliar:* 2.0–4.8 fl oz Orondis Opti A, Orondis Ultra A *soil, at-plant:* 2.4–19.2 fl oz Orondis Gold 200	0	Make no more than 2 sequential applications before rotating to a fungicide with a different mode of action. Do not exceed 19.2 fl oz/a per year. Begin foliar applications prior to disease development. Do not use Orondis Ultra A as a foliar application if you have already used Orondis Gold 200 on the soil at time of planting.
	phosphorous acid salts	1.0–3.0 qt/100 gal water Fosphite, Rampart 1.0–4.0 qt/20 gal water K-Phite	0	Apply prior to disease onset and do not apply at less than 3-day intervals.
	potassium phosphite	6.0 pt ProPhyt	0	Drench application is also registered at 4.0 pt/100 gal water to transplants.
Powdery mildew *(Leveillula taurica)*	chlorothalonil	1.5 pt Bravo Weather Stik, Chloronil 720	3	Do not apply more than 12.0 pt/a per season.
	cyflufenamid	3.4 oz Torino	0	Make no more than 3 applications of Torino per acre per year.
	difenoconazole + benzovindiflupyr	10.5–13.5 fl oz Aprovia Top	0	Make no more than 2 sequential applications before alternating to a fungicide of a different mode of action (not Groups 3 or 7).
	tetraconazole	6.0–8.0 fl oz Mettle 125ME	0	Do not apply more than 16.0 fl oz/a of Mettle 125ME per year.
Virus diseases (alfalfa mosaic, cucumber mosaic, tobacco mosaic, potato viruses X & Y, tobacco etch)	*Be sure transplants are free from virus infections. Plant peppers far from potatoes, tomatoes, squash, cucumbers, melons, alfalfa. Eliminate all perennial weed hosts within 150 ft of field. Plant varieties resistant to tobacco mosaic virus.*			

Insect control in pepper

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids	0.063–0.078 lb spirotetramat + 0.022–0.027 lb pyriproxifen	8.0–10.0 fl oz Senstar	1	Do not apply more than 10 fl oz of Senstar Insecticide (0.078 lb spirotetramat and 0.027 lb pyriproxyfen) per acre per application. Do not make more than 2 applications per crop season. Do not apply more than 20 fl oz of Senstar Insecticide (0.156 lb spirotetramat and 0.055 lb pyriproxyfen) per acre per crop season. Minimum interval between applications is 14 days. Regardless of formulation do not apply more than 0.16 lb spirotetramat and 0.108 lb pyriproxyfen per acre per crop season.
	0.023–0.31 lb sulfoxaflor	0.75–1.0 oz Transform WG	1	Do not make applications less than 7 days apart. Do not make more than four applications per crop. Do not make more than two consecutive applications per crop. Do not apply more than a total of 8.5 oz of Transform WG (0.266 lb ai of sulfoxaflor) per acre per year.
	0.17–0.21 lb tolfenpyrad	17.0–21.0 fl oz Torac	1	Do not apply until at least 14 days after emergence or after transplanting to allow time for root establishment. This period of time should be extended if conditions at time of emergence or transplanting are not favorable to crop growth. Apply by ground only, using a minimum of 20 gallons of water per acre. Do not apply more than 42.0 fluid ounces (0.42 lb ai) per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow at least 14 days between applications. Do not make more than 4 applications per year.
European corn borer	*Treat when eggs or larvae are observed OR when female European corn borer moths in nearby blacklight traps exceed four per night on three consecutive nights when peppers are forming. Repeat applications at 5- to 7-day intervals while moth flights continue or until harvest.*			
	0.24–0.97 lb acephate	0.25–1.0 lb Orthene 97	7	Sweet bell peppers only. Do not exceed 2.66 lb ai/a per season.
	0.5–1.0 lb acephate	12.0–16.0 oz Acephate 97UP	7	Sweet bell peppers only. Do not apply more than 2.66 lb/a of formulated product per season.
	0.094–0.15 lb acetamiprid	0.75–1.0 lb Orthene 97 0.75–1.0 lb Acephate 97UP	7	Sweet bell peppers only. Do not exceed 2.0 lb ai/a per season.
	alpha-cypermethrin	2.2–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	Bacillus thuringiensis subsp. *kurstaki*	1.0–2.0 lb Lepinox WDG	0	Treat early instar larvae before noticeable feeding damage occurs. Repeat as needed.
	0.0125–0.022 lb beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	7	Do not use when peppers are grown for seed. Ground applications only. Do not exceed 16.8 fl oz/a Baythroid XL per season. Allow 7 days between applications.
	0.033–0.1 lb bifenthrin	2.1–6.4 fl oz *Brigade 2EC	7	Apply every 7 days as needed. Do not exceed 12.8 fl oz/a (0.2 lb ai/a) per season.
	1.0–2.0 lb carbaryl	1.0–2.0 qt Sevin XLR Plus	3	Repeat applications as necessary up to a total of 7 times per year but not more than once every 7 days. Do not exceed 8.0 qt per crop per year. Do not apply when crop or nearby weeds are in bloom.
	chlorantraniliprole	3.5–7.5 fl oz Coragen	1	Do not make more than 4 applications per crop season and allow at least 3 days between applications. Do not apply more than 15.4 fl oz/a Coragen per season.

*Restricted-use pesticide.

(continued)

Insect control in pepper *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
European corn borer *(cont.)*	0.130 lb cyantraniliprole *(drip, chemigation, or soil injection only)*	10.0 fl oz Verimark	1	Do not apply more than 13.5 fl oz/a Verimark per crop per season. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6. Minimum application interval between foliar sprays is 5 days.
	0.045–0.088 lb cyantraniliprole *(foliar)*	7.0–13.5 fl oz Exirel	1	
	0.11–0.2 lb cyantraniliprole + abamectin	5.5–10.0 fl oz *Minecto Pro	7	Do not apply more than 0.4 lb per calendar year of cyantraniliprole-containing products, or more than 0.056 lb per calendar year of abamectin-containing products.
	0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold	1	Apply every 5 days as needed. Do not exceed 14.4 fl oz/a.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana L	7	Do not exceed 0.35 lb ai/season.
	0.03–0.045 lb flubendiamide	2.0–3.0 oz Synapse WG	1	Do not exceed 3.0 oz (0.045 lb ai/a) in a 7-day period or 9.0 oz/a per season.
	flubendiamide + buprofezin	12.0–17.0 fl oz Vetica	1	Do not apply more than 38.0 fl oz/a per season and allow at least 7 days between applications. Do not make more than 3 applications per crop season.
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	5	Apply every 5 days as needed. Do not apply more than 2.88 pt/a (0.18 lb ai/a) per season.
	imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	7	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.
	0.065 lb indoxacarb	3.5 oz Avaunt 30DG	3	Wait at least 5 days between applications. Do not exceed 24.0 oz/a Avaunt (0.44 lb ai/a) per crop.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Reapply at intervals of 5 days or more. Do not exceed 0.18 lb ai/a per year.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	5	Do not exceed a total of 31.0 fl oz/a of Voliam Xpress or 0.36 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	5	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.06–0.16 lb methoxyfenozide	*early season:* 4.0–8.0 fl oz Intrepid 2F *mid- to late season:* 8.0–16.0 fl oz Intrepid 2F	1 1	Will not control flea beetles. Do not exceed 64.0 fl oz/a per season. Use the higher rates with higher populations or when spray coverage is difficult. See label for use restrictions in some Wisconsin counties.
	0.2 lb permethrin	8.0 oz *Permethrin 3.2EC	3	Sweet bell peppers only. See label for rate. Do not exceed 32.0 oz/a per season.
	0.039–0.078 lb spinetoram	5.0–10.0 oz Radiant SC	1	Do not apply more than 34.0 oz/a Radiant (0.266 lb ai/a) per crop and do not exceed 4 applications per year.
	spinosad	3.0–6.0 fl oz Entrust SC	1	Use higher rate for larger insects. Apply adequate spray to get good coverage for best control. Do not exceed 0.45 lb ai/a per season. Do not use a buffering agent.
	0.09–0.12 lb tebufenozide	6.0–16.0 fl oz Confirm 2F	7	Apply at first sign of feeding or when populations exceed threshold levels. Do not exceed 64.0 fl oz per season. There is a 1–12 month plantback restriction depending on the crop.

*Restricted-use pesticide.

(continued)

Insect control in pepper *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
European corn borer *(cont.)*	zeta-cypermethrin	2.24–4.0 oz *Mustang Max	1	Apply every 7 days as needed. Use higher rate for heavy infestations. Do not exceed 24.0 oz/a Mustang Maxx per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	7	Do not apply more than 0.266 lb ai/a per season. Wait at least 7 days between applications.
Green peach aphid	0.487–0.974 lb acephate (sweet bell)	0.5–1.0 lb (sweet bell) 0.5 lb (non-bell) Orthene 97	7	**Sweet bell peppers:** Do not exceed 2.0 lb ai/a per season. **Non-bell peppers:** Do not exceed 1.0 lb ai/a per season.
	0.487 lb acephate (non-bell)	0.5–1.0 lb (sweet bell) 0.5 lb (non-bell) Acephate 97UP	7	
	0.038–0.075 lb acetamiprid	2.0–4.0 oz Assail 30SG	7	Begin treatment when thresholds are reached. Apply every 7 days as needed. Do not exceed 5 applications or 0.375 lb ai/a per season.
	0.035–0.075 lb acetamiprid	0.8–1.7 oz Assail 70WP	7	
	alpha-cypermethrin	3.2–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.06–0.15 lb bifenthrin + imidacloprid	3.8–9.8 fl oz *Brigadier	7	Do not apply more than 25.6 fl oz/a (0.4 lb ai/a) per season. No more than 0.2 lb ai/a bifenthrin and 0.24 lb ai/a imidacloprid are allowed per season.
	clothianidin	*foliar:* 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		soil: 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a sidedress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
	0.088–0.176 lb cyantraniliprole *(soil)*	6.75–13.5 fl oz Verimark	1	Do not apply more than 13.5 fl oz/a Verimark per crop per season. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6. Minimum application interval between foliar sprays is 5 days.
	0.088–0.133 lb cyantraniliprole *(foliar)*	13.5–20.5 fl oz Exirel	1	
	0.2 lb cyantraniliprole + abamectin	10.0 fl oz *Minecto Pro	7	Do not apply more than 0.4 lb per calendar year of cyantraniliprole-containing products, or more than 0.056 lb per calendar year of abamectin-containing products.
	0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold	1	Apply every 5 days as needed. Do not exceed 14.4 fl oz/a.
	0.25–0.33 lb dimethoate	0.5–0.6 pt Dimethoate 400EC	0	Peppers may be mechanically harvested on day of application. Highly toxic to bees—do not apply when crop or nearby weeds are in bloom. Wait at least 7 days between treatments. Do not exceed 0.33 lb ai/a per treatment. Do not exceed 1.65 lb ai/a per year. Re-entry interval is 48 hours.
	0.045–0.268 lb dinotefuran	*foliar:* 1.0–4.0 oz Venom 70SG *soil:* 5.0–6.0 oz Venom 70SG	1 21	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 6.0 oz/a per year using foliar applications, or 12.0 oz/a per season using soil applications. See product label for application directions.

*Restricted-use pesticide.

(continued)

Insect control in pepper *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Green peach aphid *(cont.)*	0.062–0.089 lb flonicamid	2.0–2.8 oz Beleaf SG	0	Begin applications before aphid populations build. Do not exceed 2.8 oz/a Beleaf per application and do not apply more than 8.4 oz/a (0.267 lb ai/a) per season.
	flupyradifurone	*foliar:* 7.0–12.0 fl oz Sivanto *soil:* 21.0–28.0 fl oz Sivanto	1 45	Apply when pests reach or exceed established thresholds. Do not apply more than 28.0 fl oz of Sivanto per acre per crop season.
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	5	Apply every 5 days as needed. Do not apply more than 2.88 pt/a (0.18 lb ai/a) per season.
	imidacloprid	7.0–14.0 fl oz Admire Pro	21	Systemic at planting. Do not exceed 32.0 fl oz/a Admire per season.
	0.05 lb imidacloprid	3.75 fl oz Provado 1.6	0	Foliar spray. Do not exceed 18.75 fl oz/a Provado per season.
	imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	7	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Reapply at intervals of 5 days or more. Do not exceed 0.18 lb ai/a per year.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	5	Do not exceed a total of 31.0 fl oz/a of Voliam Xpress or 0.36 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	5	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.625–1.5 lb malathion	several formulations	3	
	0.45–0.90 lb methomyl	1.5–3.0 pt *Lannate LV	3	Repeat application as necessary up to 8 times per crop. Do not exceed 12.0 pt/a per crop.
	0.5–1.0 lb oxamyl	2.0–4.0 pt *Vydate L	7	Sweet bell peppers only. Repeat at 1- to 2-week intervals or as needed.
	pymetrozine	2.75 oz Fulfill 50WDG	14	May be used on bell, chili, cooking, and pimento peppers. Controls melon and green peach aphids. Treat when aphids first appear. May repeat in 7 days. Do not exceed 5.5 oz/a per season or more than 2 applications per crop.
	0.06–0.08 lb spirotetramat	4.0–5.0 fl oz Movento	1	Do not apply more than 10.0 fl oz/a (0.16 lb ai/a) per season.
	thiamethoxam	2.0–3.0 oz Actara 25WDG 5.0–11.0 fl oz Platinum 2SC 1.66–3.67 oz Platinum 75SG	0 30 30	Do not apply more than 11.0 oz of Actara 25WDG or Platinum 2SC and no more than 3.67 oz Platinum 75SG per acre per crop season and apply sufficient water volume after in-ground application to ensure incorporation into the seed zone. Actara is applied as a foliar spray.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	zeta-cypermethrin	3.2–4.0 oz *Mustang Maxx	1	Apply every 7 days as needed. Use higher rate for heavy infestations. Do not exceed 24.0 oz/a Mustang Maxx per season.

*Restricted-use pesticide.

Weed control in pepper

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
All weeds	*Even where you use herbicides, shallow cultivation will help control weeds. Cultivate as needed when weeds are less than 2–3 inches tall.*			
Annual weeds	0.25–1.0 lb clomazone	0.67–2.67 pt Command 3ME		Do not use on banana peppers. For suppression and control of annual grasses and broadleaves, make a single preemergent soil application before seeding or transplanting, or after seeding but prior to crop emergence. Place seed or roots of transplants below the chemical barrier when planting. Strictly follow all precautions and restrictions on the label to minimize offsite movement and carryover. Read and understand the vegetable disclaimer section of the label—the end user of this product assumes all liability for failure to perform and crop injury resulting from its use.
	1.0–2.0 lb napropamide	2.0–4.0 lb Devrinol DF-XT 2.0–4.0 qt Devrinol 2-XT		Apply before planting to weed-free soil surface. Incorporate 1–2 inches deep the same day. Can be applied to direct-seeded or transplanted peppers.
	0.48–1.43 lb pendimethalin	1.0–3.0 pt Prowl H_2O	70	Apply as a broadcast preplant-incorporated or as a broadcast surface application before transplanting, or as a post directed application to transplanted or established direct-seeded peppers. Do not apply postemergence over the top of or to pepper foliage. Rate varies by soil type. Do not exceed 3.0 pt/a per season or allow treated soil to come in contact with transplants.
	trifluralin	several manufacturers		Apply and incorporate prior to transplanting. Controls annual grasses and some broadleaf weeds, but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Rate varies with soil texture and organic matter. Follow recommended soil preparation, application, and incorporation procedures. Must be incorporated within 24 hours. See label for plantback restrictions. Ineffective on peat and muck soils.
Annual grasses	5.0–6.0 lb bensulide	5.0–6.0 qt Prefar 4E		Apply preplant or preemergence. Follow application and applicable incorporation instructions on label. Use on mineral soils only.
Nutsedge and some broad-leaves	0.023–0.047 lb halosulfuron	0.5–1.0 oz Sandea	30	Sandea controls several broadleaf weeds and nutsedge. It will not control grasses. Sandea may be applied between rows of direct-seeded or transplanted peppers as a directed or shielded spray. Avoid contact of the spray with the crop. If plastic was used on the planted row, adjust equipment to keep application off the plastic. Do not apply more than 2.0 oz/a per crop cycle or 12-month period. Soil or foliar applications of organophosphate insecticides to Sandea-treated crops may cause severe crop injury. **Consult label for additional usage information and other precautions.**
	0.19–0.3 lb imazosulfuron	4.0–6.4 oz League	21	For use in bell and non-bell peppers. Apply to well established peppers (at least 10 inches in height) as a row middle or directed under the row application only. Effective on yellow nutsedge and several annual weeds, but ineffective on nightshades and weeds with ALS inhibitor resistance. See label for additional restrictions.

*Restricted-use pesticide.

(continued)

Weed control in pepper *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged weeds	glyphosate	several manufacturers and formulations		See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. Some formulations require a wait of 3 days between application and planting. Crop contact will result in severe injury or death. If weeds have been mowed or tilled, do not treat until they have resumed active growth and reached the recommended stage on the label. Unless otherwise stated, allow 7 or more days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified.
	*paraquat	several manufacturers and formulations, not all are registered for this use		Prepare seedbed early to allow for maximum weed emergence. Application can be made as a banded or broadcast treatment before, during, or after planting but before crop emergence. In preplant and preemergence (to the crop) uses, do not apply to soils lacking clay minerals (i.e., muck, pure sand). Use the higher rate for heavy weed infestations. Seeding and transplanting should be performed with minimal soil disturbance. Up to three directed/shielded treatments may be made per season using precision equipment to prevent spray contact with the crop. Always add crop oil concentrate or non-ionic surfactant to spray mixture. Follow precautions on label.
Emerged grasses	0.068–0.12 lb clethodim	9.0–16.0 oz Select Max	20	Apply to actively growing grasses. Repeat treatments may be made at 14-day intervals up to the maximum annual use rate. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by product label. Do not apply if rain is expected within 1 hour.
	clethodim	several manufacturers and formulations	20	
	0.094–0.28 lb sethoxydim	0.5–1.5 pt Poast	7	Make postemergence applications to actively growing grasses within the size ranges indicated on the label. Check the label for wild proso millet and rescue treatment rates. Do not apply more than 4.5 pt/a of Poast in one crop season. Consult label for rate and adjuvant instructions for specific weeds. Do not treat bell peppers during hot, humid weather or unacceptable leaf injury may occur. Check the label for additional precautions and restrictions.

*Restricted-use pesticide.

Potato

State law pertaining to seed potatoes in Wisconsin

As of January 1, 2018, Wisconsin law requires growers of more than 5 acres of potatoes to plant certified seed. Seed can be certified by the UW Plant Pathology Seed Certification Program or a parallel program. For more information, see WI State Statute Plant Industry 94.36.

Planting

Choose fertile, well-drained sands, sandy loams, or silt loams for best production. Prepare a deep, loose seedbed using minimum tillage. Deep tillage may be beneficial in soils with compacted layers resistant to rooting. Deep tillage should be done at an angle to planting operations to ensure straight rows. Potatoes should be planted from early April through early May on sandy soils, and from mid-April through early June in northern Wisconsin. Potatoes can be planted from late April through early July on muck soils depending on soil moisture conditions and intended market.

Potatoes should be planted when soil temperatures are similar to the pulp temperature of the seed piece (50–55°F). Temperature differences of more than 10°F between soil and seed pieces can lead to condensation on seed piece surfaces, leading to decay. A preplant irrigation is often recommended for two reasons. First, soil moisture should be about 70–80% field capacity to allow for some rainfall. Soil moisture should be acceptable to support the developing roots after planting to reach emergence. Second, a preplant irrigation can break down clods and clumps for better planting. When seed pieces are planted in dry soils and then irrigated or rained upon, they're more vulnerable to decay. Sandy soils dry relatively quickly, especially when tilled and in windy conditions.

Rows: 30–36 inches.

Seed piece spacing in row: 8–16 inches apart, depending on variety and market goals. Seed pieces should be blocky and weigh 1.5–2.0 oz; use 12–24 cwt/a, depending on variety and spacing. Plant 2–6 inches deep. Little potatoes typically require smaller seed spacing at 4 inches.

Seed-piece treatment

Condition seed potatoes prior to planting. Seed potatoes should be warmed slowly to 50-55°F for several days before handling and cutting to minimize bruising. After cutting, store seed at 50-55°F for at least 3 days with good air circulation and high relative humidity to promote wound healing. The treatment of cut and whole seed pieces with a fungicide may help to reduce seed piece decay as well as tuber-borne and soil-borne problems caused by fungi. Fungicides registered for seed application have gradually shifted from dust formulations to liquid formulations for human safety reasons. Current fungicide active ingredients with seed-treatment registrations include: difenoconazole, fenamidone, fludioxonil, flutolanil, mancozeb, mandipropamid, penflufen, prothioconazole, sedaxane, thiabendazole, and thiophanate methyl. Mancozeb's seed application use pattern is likely to be removed in the coming years due to the outcome of the Environmental Protection Agency's review in 2024. As always, check pesticide labels prior to use.

Hilling

Potatoes are generally grown in hills that are 15–20 inches across and 6–8 inches tall. Hilling prevents tubers from being exposed to sunlight and greening of tuber ends. Hilling is done at planting and again shortly after plants emerge. Delaying hilling too long after emergence for one or two times can prune roots, which stresses plants and could lead to disease infection.

Irrigation

Potatoes require a constant supply of water, especially during tuber formation and growth. With some varieties, such as Russet Burbank, moisture stress not only reduces yields but can significantly lower tuber quality. To ensure good yields and tuber quality most potatoes are irrigated. If the WISP scheduling program is used, the AD for irrigated sands is 0.7 inch. The AD for silt loams is 1.5 inches. These low AD values reflect the shallow rooting system of potatoes. Research and grower experience has shown that frequent irrigation of small amounts is best. See "Irrigation Management for Vegetables" on page 3.

Lime and fertilizer

Lime: Maintain a pH of 5.2 for scab-susceptible potatoes on organic and mineral soils, 5.6 for scab-resistant varieties on organic soils, and 6.0. for scab-resistant varieties on mineral soils.

Fertilizer rates: Recommended rates are shown in the following tables. Apply amounts recommended by soil test by banding starter fertilizer with the planter (not exceeding 800 lb/a on sands) and broadcasting the remainder before seeding. Recent research on medium-textured, acid soils in northeastern Wisconsin shows response to 120–150 lb/a P_2O_5 even on soils testing more than 100 ppm soil test phosphorous (P). Sandy soils showed few responses when soil test P was higher than 75 ppm. Potassium should be broadcast in spring on highly leachable sandy and organic soils. Some row-placed starter fertilizer (30-30-30) is recommended even when soils test in the EH range.

Nitrogen: On sandy soils, apply 25–50% of the supplemental nitrogen (N) at emergence and the remainder at tuberization, or apply it in multiple split applications. During years with high precipitation, multiple split applications via fertigation improve yield and quality, and during years with normal to low precipitation, splitting N applications at emergence

and at tuberization consistently produces high-yielding, high-quality potatoes. Excessive N splitting may increase the percentage of cull potatoes. Late N can be applied up to 60 days after emergence or the first week of August. Applications after this do not improve yield or quality and may delay crop maturity. On medium to heavily textured soils, there is no advantage to splitting applications. When potatoes follow a legume crop, reduce the N recommendation by 40–190 lb/a (see table on following page). Take appropriate credits if manure has been used. For help determining credits, see Extension publication *Credit What You Spread—and Reap the Profits* (A3580). Broadcasting or applying N with the irrigation water, especially early in the season, results in less efficient N use because most water moves downward in the furrows, therefore the N bypasses the plant roots and leaches into groundwater bodies causing contamination. Petiole nitrate (NO_3) levels can help determine the need for split N applications. The table below provides optimum petiole NO_3–N levels for several varieties and stages of growth. If levels are below optimum and the crop has at least 45 days to vine kill, apply 30–50 lb N/a. If you will be monitoring N levels through petiole NO_3–N testing, early season supplemental N rates can be reduced by 25–30%. Additional N may be applied when needed through fertigation.

Secondary nutrients and micronutrients: Calcium, magnesium, sulfur, and micronutrients should only be added when the need is clearly indicated by soil test, plant analysis, or confirmed deficiency symptoms. Row magnesium (10 lb Mg/a) is recommended where soil test potassium (K) exceeds 140 lb/a.

Optimum petiole nitrate-nitrogen levels for several varieties at different growth stages

	Dry weight basis (% NO_3–N)			Sap basis (ppm NO_3–N)		
Stage of growth (days after emergence)	Norkotah Norland Atlantic Kennebec	Shepody R. Burbank Snowden	Superior	Norkotah Norland Atlantic Kennebec	Shepody R. Burbank Snowden	Superior
30	2.5–2.8	2.0–2.3	2.3–2.5	1900–2100	1600–1800	1800–1900
40	2.3–2.5	1.7–2.2	2.0–2.3	1800–2000	1600–1700	1600–1800
50	1.8–2.3	1.2–1.6	1.5–1.9	1400–1800	1000–1300	1200–1500
60	1.3–1.9	0.8–1.1	0.9–1.2	1100–1500	700–900	500–1000
70	0.8–1.1	0.5–0.8	0.4–0.6	700–900	500–700	400–600

Annual nitrogen, phosphate, and potash recommendations for potato[a]

	Amount nitrogen to apply (lb/a)				Phosphate and potash[b]	
	Organic matter %					
Yield goal (cwt/a)	<2	2.0–9.9	10–20	>20	Amount P_2O_5 to apply (lb/a)	Amount K_2O to apply (lb/a)
250–350	145	120	100	60	10	50
351–450	180	155	130	75		
451–550	220	180	150	85		
551–650	250	210	175	95		

[a] The nutrient application rates include starter fertilizer and are the total amount of nutrient to apply.

[b] Amounts shown are for optimum (O) soil test levels. Apply half the listed rate plus 30 lb/a for soils testing high (H). If soils test excessively high (EH), apply only 30 lb/a. If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Nitrogen replacement credits for previous legume crops

Legume	Credit—sandy soils	Credit—non-sandy soils
Forages[a]		
Alfalfa		
poor stands (<1.5 plants/sq ft)	80 lb/a	130 lb/a
fair stands (1.5–4.0 plants/sq ft)	110 lb/a	160 lb/a
good stands (>4.0 plants/sq ft)	140 lb/a	190 lb/a
Red clover or trefoil	Use 80% of alfalfa credit	Use 80% of alfalfa credit
Soybeans	No credit	40 lb/a
Vegetable legumes	No credit	20 lb/a where residue remains on field
Green manure crops		
Sweet clover	30–60 lb/a	80–120 lb/a
Alfalfa	10–50 lb/a	60–100 lb/a
Red clover	0–30 lb/a	50–80 lb/a

[a] If harvesting forage crops after September 10, reduce credit by 40 lb/a.

Color enhancement for red potatoes

Properly timed applications of 2,4-D enhance color in red potatoes, aid in storage retention of color, improve skin appearance, increase tuber set, and improve tuber size uniformity. Crop response may vary depending on variety, stress factor, and local conditions. For example, Dark Red Norland has minimal response to 2,4-D while Red Norland turns darker and holds its color. Make first application when potatoes are in the pre-bud stage (about 7–10 inches high) and make a second application about 10–14 days later. Allow 45 days to harvest. **Only certain 2,4-D products are labeled for this use in Wisconsin.**

Tuber shape

The shape of potato tubers can be improved with the application of maleic hydrazide (Royal MH-30). While maleic hydrazide may reduce total yield, it should increase the marketable yield. Apply at least 2 weeks before vine desiccation. However, typical applications are made around the first week of August, when tubers are 1.5–2.0 inches in diameter. Optimal timing will vary depending on variety. Avoid making applications during hot, dry weather to minimize the potential for phytotoxicity.

Potato vine killing

Diquat (multiple trade names) with a suggested surfactant kills potato vines adequately. Apply at least 7 days before harvest. Three weeks between vine killing and harvest is recommended for good skin set. Where vine growth is dense, make a second application at the same rate. Allow a minimum of 5 days between applications. Do not apply Diquat to drought-stressed potatoes. Do not feed vines treated with Diquat to livestock.

Vida (pyraflufen ethyl) is labeled for vine desiccation in Wisconsin. When applied to potatoes in the early stages of senescence, it will hasten desiccation of potato vines and foliage as well as burn down late-season broadleaf weeds. Make one or two applications of 2.0–5.5 oz/a in 20–50 gal/a. Do not apply within 7 days of harvest. Vines are typically dried within 14 days after the first treatment. Two applications are allowed, but do not exceed 11.0 oz/a per crop season. Use an approved agricultural buffering agent buffering to pH 5.0 or less if using Vida in a water source of pH 5.0 or greater. Always buffer the water source before adding Vida to the spray tank.

Rely 280 (glufosinate-ammonium) is a nonselective, broad-spectrum herbicide labeled as a potato desiccant. Make a single application of 21.0 fl oz/a in 20–100 gallons of water with ground equipment. Where the crop canopy is dense, use higher spray volumes for best results. Wait at least 9 days following application before harvesting. Do not use on potatoes grown for seed stock. See label for rotation restrictions.

Aim EC can be used alone or in combination with other herbicides (if allowed by the tank-mix partner label) to desiccate potatoes. Apply Aim EC as a broadcast spray at a rate of 3.2–5.8 oz/a product (0.05–0.09 lb ai/a) with an appropriate spray adjuvant in a spray volume sufficient for complete potato foliage coverage. Thorough coverage is essential. Aim can be applied to potato foliage in the later stages of senescence. If plants are still actively growing, two applications may be required to adequately kill leaves and stems. Wait 7–14 days after the first application before making a second treatment. Allow at least 7 days before harvest. See the Aim EC label for specific application and adjuvant instructions and restrictions.

Harvest

To reduce the chances of tuber infection by early and late blight fungi, do not begin digging until vines are dead either from a vine burner, a chemical vine killer, or frost. Vines should be killed 14–21 days before harvest. (Do not use TPTH fungicides within 21 days of harvest.) This interval allows proper maturity and skin set. Allowing tubers to remain in the soil for several weeks after vines are dead increases the risk of silver scurf, a disease that affects the visual appearance and storability of infected tubers.

Avoid bruising or injuring tubers during harvesting, grading, packaging, and storing. Tuber breakdown organisms generally start where there is an entry point caused by bruising or other mechanical damage.

Proper operation of windrowing and harvesting equipment will minimize tuber damage, especially bruising. Harvester chain and boom drops should be 6 inches or less. Harvester blade angle should cause potatoes to flow onto primary chain. Adjust ground and chain speeds to keep chains as full of potatoes as possible without rollback. All loads of potatoes should be covered during transport from field to grading–storing locations. Do not walk on potatoes when covering them with the tarp.

Early-maturing potatoes should not be harvested in hot, windy conditions because of increased potential for breakdown. For late-maturing varieties, harvest when soil temperatures are 45–65°F. Colder temperatures increase both blackspot bruises and shatter bruises, but the type of bruising damage also depends on tuber hydration level. Higher hydration leads to more shatter bruises and dehydration causes more blackspot bruises. Temperatures higher than 65°F are considered undesirable because they increase the risk of tuber decay in storage.

Storage

Storage management

Do not store injured, diseased, or immature potatoes. Do not wash potatoes before storage unless they are sound and disease-free. All washed potatoes must be completely dried before storage. When loading bins, allow several feet between the top of the pile and ceiling for adequate air circulation.

Before storage

Remove old refuse and potatoes from storage. Spray inside surfaces of storage with a quaternary ammonium compound or another disinfectant. Except for seed storage, rinse surfaces with clean water after ammonium treatment.

Make sure ventilation system is in proper operation and that insulation and vapor barriers are properly maintained. One week before storage, open doors at night and close them during the day to cool the storage space. Operate air systems and humidifiers in preparation for harvest. The floors can be watered to build up humidity.

Storage operation

Storage operation is divided into three stages: curing, holding, and removal.

1) Curing. Curing promotes suberization (healing of bruises, cuts, and skinned surfaces). Curing takes place over 2–4 weeks immediately after harvest. Cure potatoes at 50–55°F and a relative humidity of >90°F. Tubers that are stressed from disease or are excessively wet can be cured at 85% relative humidity, but the lower humidity levels will increase the potential for pressure bruising.

2) Holding. Long-term storage temperatures are based on intended use: 38–40°F for seed and table stocks, 42–47°F for frozen and dehydration stocks and for cultivars used for both table and processing, 50°F for chipping stock and potatoes stored 3 months or less.

Slowly lower storage temperature 1°F per 5–7 days, to prevent reducing sugar accumulation. Relative humidity should be 90–95% unless potatoes are damaged by rot, frost, or late blight. Ventilating airflow rates of 0.5–0.8 cfm/cwt should prevent excessive moisture loss and pressure bruising.

Monitor temperatures. Temperatures at the top of the pile should be 1.0–1.5°F higher than the temperature at the bottom of the pile. If temperatures are the same, too much air is moving through the pile.

Monitor relative humidity. At high relative humidities, a drop in outside temperature can cause condensation at the ceiling. This can wet the potatoes and increase the potential for tuber breakdown by soft rot bacteria.

Long-term storage of potatoes will require use of a sprout inhibitor. Sprout inhibitors can be applied either in the field (MH-30 during the growing season) or in storage (such as CPIC) after curing has been completed.

3) Removal. Before removing potatoes, storage should be warmed to 55–65°F for 2–3 weeks. This is essential for reconditioning potatoes for quality chips and french fries. Warming also reduces the possibility of tuber injury. Cold tubers are easily bruised.

Disease control—late blight

Late blight appears periodically in Wisconsin when cool, wet conditions prevail and the disease inoculum is present. From 1996 to 2002, the US-8 genotype was the only pathogen genotype observed in Wisconsin. In recent years, newer genotypes US-22, US-23, and US-24 have emerged. While US-23 has become the pre-dominant strain across the U.S., we have reported US-8 sporadically in 2014–2017. US-22 and US-23 can be controlled with mefenoxam-containing fungicides at this time. Mefenoxam does not control the US-8 or US-24 genotypes. Protective fungicides (including chlorothalonil, mancozeb, metiram, fixed coppers, and triphenyltin hydroxide) used before infection give much better control of late blight and also control early blight. Because several genotypes of the late blight pathogen currently exist in the United States, we urge growers observing late blight on seed potatoes or in production fields to submit samples for genotype analysis to the Vegetable Pathology Laboratory, Department of Plant Pathology, 693 Russell Laboratories, UW–Madison, Madison, WI 53706, phone 608-575-3029. Knowing the genotype of the late blight pathogen helps with long-term management.

Research has shown that temperature, relative humidity, and rainfall or irrigation play an important role in determining when or if late blight appears, and the timing of influxes in airborne spores of the early blight fungus. A computer program, Blitecast, is available from UW–Madison Division of Extension to warn growers of the potential development of late blight. The program recommends a schedule of fungicide applications to prevent or control disease. For further details, contact the Department of Plant Pathology, UW–Madison, Madison, WI 53706.

Late blight is also regulated by DATCP in Wisconsin. State Statute 94.02 codifies management of this disease to protect economic interests of growers and associated industries.

Disease control in potato

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Black dot	azoxystrobin	6.0–15.5 fl oz Aframe, Equation, Quadris Flowable, Satori, Willowood Azoxy 2SC	14	Quadris and Headline belong to the Group 11 (strobilurin) fungicide category. Quadris Opti contains a combination of Group 11 and Group M fungicides. Do not exceed 1 application of a Group 11 fungicide before alternating with a fungicide having a different mode of action.
	azoxystrobin + chlorothalonil	1.6 pt Quadris Opti	14	
	azoxystrobin + difenoconazole	8.0–14.0 fl oz Quadris Top	14	
	pyraclostrobin	6.0–9.0 fl oz Headline SC, EC	3	
	azoxystrobin + benzovindiflupyr	0.34–0.5 oz Elatus/1,000 ft row	14	Make an in-furrow application at planting. Apply the spray in a narrow band over the seed piece. Do not apply more than 9.5 oz/a as a banded application.
	azoxystrobin + extract of Reynoutria sachalinensis	0.5-0.9 fl oz/1000 linear row ft of AZterknot; 7.4 -24.3 fl oz/acre AZterknot	14	AZterknot can be applied in-furrow, at-plant for black dot, silver scurf, and black scurf management, and for foliar disease control in management of black dot, early blight, late blight, and powdery mildew. Follow resistance management guidelines on the lab as Akterknot contains azoxystrobin (FRAC 11) which has a high risk for development of resistance in the target pathogen populations.
	chlorothalonil	1.0–1.5 pt Bravo Weather Stik, Echo 720, Equus 720 1.5–2.25 pt Bravo Zn, Equus 500 Zn 0.875–1.25 lb Echo 90DF, Echo Zn 0.9–1.36 lb Bravo Ultrex 82.5WDG, Equus DF	7 7 7 7	Note seasonal use limitations on label. Current labeling for annual use of chlorothalonil products in Wisconsin allows 11.2 lb ai/a Equus products and 16.0 lb ai/a Bravo products (Ultrex, WeatherStik, Zn) (special WI registration expires 12/31/17, however a renewal is in process—please check DATCP special registrations listings) and 16.0 lb ai/a Echo products (Zn, 720, 90DF) (special WI registration expires 12/31/20).
	chlorothalonil + cymoxanil	2.0 pt Ariston	14	Apply at 7- to 14-day intervals. Use shorter interval when plants are rapidly growing and disease conditions are severe.
	cymoxanil + famoxadone	6.0–8.0 oz Tanos	14	Manages several other diseases. Follow resistance management guidelines. For suppression.
	difenoconazole	5.5–7.0 fl oz Top MP	14	Follow resistance management guidelines.
	fenamidone	5.5–8.2 fl oz Reason	14	Manages several other diseases. Follow resistance management guidelines. For suppression.
	fluopyram + penflufen	13.0 fl oz Velum Rise	in-furrow, at-plant treat-ment	Provides black dot suppression, along with suppression of Rhizoctonia diseases, early blight, white mold, and early dying. Track use of fluopyram and penflufen as they may be components of other in-season foliar-applied fungicides for disease control in potato.
	fluopyram + pyrimethanil	11.2 fl oz Luna Tranquility (for suppression)	7	Begin fungicide applications preventively. Do not apply more than 43.6 fl oz/a per season. Do not make more than 2 sequential applications of any Group 7 or 9 fungicide before rotating with a fungicide from a different group.
	fluoxastrobin	0.16–0.24 fl oz/1,000 ft row Aftershock, Evito 480 SC 6.1–9.2 fl oz/a Tepera	7	Follow resistance management guidelines.

*Restricted-use pesticide.

(continued)

Disease control in potato *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Black dot *(cont.)*	flutolanil	0.71–1.1 lb Moncut 70-DF	in-furrow, at-plant treat-ment	Direct spray uniformly around and over seed piece in a 4- to 8-inch band prior to covering with soil.
	fluxapyroxad + pyraclostrobin	4.0–8.0 fl oz Priaxor	7	Make no more than 3 applications/a per season. Apply no more than 24.0 fl oz/a per season.
	mancozeb	0.4–1.6 qt Dithane F45 4F 0.5–2.0 lb Dithane M45, Penncozeb 80WP, Penncozeb 75DF 1.0–2.0 lb Dithane 75DF Rainshield NT, Koverall, Manzate 200 75DF	3 3 3	Do not exceed a total of 11.2 lb ai/a EBDC per growing season. EBDC materials include maneb, mancozeb, and metiram.
	mefentrifluconazole	3.0–5.0 fl oz Provysol	7	Do not apply more than 5.0 fl oz (0.13 lb) per acre per application. Do not make more than 3 applications at 5.0 fl oz or 5 applications at 3.0 fl oz per acre per year.
	metconazole	2.5–4.0 oz Quash	1	Do not make more than 4 applications per season. Do not make more than 2 sequential applications. Do not apply more than 16.0 oz/a per season.
	penthiopyrad	10.0–24.0 fl oz Vertisan	7	Do not exceed 72.0 fl oz/a per year. Make no more than 2 sequential applications of Vertisan before switching to a fungicide with a different mode of action.
	prothioconazole + trifloxystrobin	8.0-11.4 fl oz Delaro 325 SC	14	Both fungicides prothioconazole FRAC 3 and trifloxystrobin FRAC 11 have a risk for the development of resistance in their target pathogens. Follow guidelines on the label for total allowable use per acre per year to manage resistance.
	pydiflumetofen + fludioxonil	9.2–11.4 fl oz Miravis Prime	14	Suppression of black dot only. Do not apply more than 2 applications per year by air. Do not apply more than 34.2 fl oz per acre per year.
	pyraclostrobin + metiram	2.0–2.9 lb Cabrio Plus	3	Do not make more than 2 sequential applications before alternating to a non–Group 11 or M3 fungicide.
	zoxamide + chlorothalonil	32.0–34.0 fl oz Zing	7	Do not make more than 2 sequential applications before alternating to another mode of action.
Black leg	*Bacillus amyloliquefaciens* strain D747	0.125–1.0 lb Double Nickel 55		Soil drench or apply as a foliar treatment depending upon disease management considerations.
	0.5% calcium or sodium hypochlorite	Hilex Clorox 1 gal Lysol 50%/10 gal water		Disinfect machinery, warehouse, planters, and seed cutters.
	copper hydroxide	1.0–3.0 qt Previsto		Apply higher rate if conditions favor disease.
	formaldehyde	4 cups 40% solution/10 gal water		
	phenol	1–3% solution		
	streptomycin	100 ppm Agri-Mycin 17, Harbour		Can provide some suppression of blackleg symptom development. Soak cut seed pieces in this treatment for several minutes.

*Restricted-use pesticide.

(continued)

Disease control in potato *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Common scab *(Streptomyces scabies)*	*Cultural practices aid in overall common scab management. Maintain adequate field moisure during tuberization and adjust pH to less than 5.2. Select varieties with resistance. Early-season stress can promote scab.*			
	chloropicrin	varies by product	see label	Soil fumigation processes require special certification and management plans with the WI Department of Agriculture, Trade, and Consumer Protection.
	PCNB (pentachloro-nitrobenzene)	5.2–10.4 fl oz Blocker 4F		Do not exceed 5.0 lb of active ingredient per acre in any one season.
Early blight *(Alternaria solani)* **and brown spot** *(Alternaria alternata)*	azoxystrobin	6.0–15.5 fl oz Aframe, Equation, Quadris Flowable, Satori, Willowood Azoxy 2SC	14	Quadris and Headline belong to the Group 11 (strobilurin) fungicide category. Quadris Opti contains a combination of Group 11 and Group M fungicides. Do not exceed 1 application of a Group 11 fungicide before alternating with a fungicide having a different mode of action.
	azoxystrobin + difenoconazole	8.0–14.0 fl oz Quadris Top	14	Follow resistance management guidelines.
	difenoconazole	5.5–7.0 fl oz Top MP	14	Do not apply more than 28.0 fl oz/a per season. Special label with Omega for broad spectrum disease control.
	fluopyram	6.5 fl oz Velum Prime	7	Begin fungicide applications preventively. Do not apply more than 43.6 fl oz/a per season. Do not make more than 2 sequential applications of any Group 7 or 9 fungicide before rotating with a fungicide from a different group.
	fluopyram + pyrimethanil	*early blight:* 11.2 fl oz Luna Tranquility	7	
	fluopyram + penflufen	13.0 fl oz Velum Rise	in-furrow, at-plant treat-ment	Provides black dot suppression, along with suppression of Rhizoctonia diseases, early blight, white mold, and early dying. Track use of fluopyram and penflufen as they may be components of other in-season foliar-applied fungicides for disease control in potato.
	fluxapyroxad + pyraclostrobin	4.0–8.0 fl oz Priaxor	7	Make no more than 3 applications/a per season. Apply no more than 24.0 fl oz/a per season.
	mefentrifluconazole	3.0–5.0 fl oz Provysol	7	Do not apply more than 5.0 fl oz (0.13 lb) per acre per application. Do not make more than 3 applications at 5.0 fl oz or 5 applications at 3.0 fl oz per acre per year.
	metconazole	2.5–4.0 oz Quash	1	Do not make more than 4 applications per season. Do not make more than 2 sequential applications. Do not apply more than 16.0 oz/a per season.
	picoxystrobin	6.0–12.0 fl oz Aproach	3	Follow label for fungicide resistance management strategies. Also labeled for white mold.
	penthiopyrad	10.0–24.0 fl oz Vertisan	7	Do not exceed 72.0 fl oz/a per year. Make no more than 2 sequential applications of Vertisan before switching to a fungicide with a different mode of action.
	prothioconazole + trifloxystrobin	8.0-11.4 fl oz Delaro 325 SC	14	Both fungicides prothioconazole FRAC 3 and trifloxystrobin FRAC 11 have a risk for the development of resistance in their target pathogens. Follow guidelines on the label for total allowable use per acre per year to manage resistance.
	pydiflumetofen + fludioxonil	9.2–11.4 fl oz Miravis Prime	14	Do not apply more than 2 applications per year by air. Do not apply more than 34.2 fl oz per acre per year.
	pyrimethanil	7.0 fl oz Scala SC	7	Follow resistance management guidelines.

*Restricted-use pesticide.

(continued)

Disease control in potato *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Early blight and late blight	azoxystrobin	6.0–15.5 fl oz Aframe, Equation, Quadris Flowable, Satori	14	Evito, Gem, Headline, Quadris, Reason, and Tanos belong to the Group 11 (strobilurin) fungicide category. Quadris Opti contains a combination of Groups 11 and M5 fungicides. Do not exceed 1 application of any of these products before alternating with a fungicide having a different mode of action. Tanos must be tank mixed with a contact fungicide having a different mode of action. Following the final application of Reason 500 SC, wait 30 days before rotating to wheat; wait 1 year before rotating to all other crops. Use higher rates and shorter intervals when disease pressure is severe.
	azoxystrobin + chlorothalonil	1.6 pt Quadris Opti	14	
	azoxystrobin + difenoconazole	8.0–14.0 fl oz Quadris Top	14	
	cymoxanil + famoxadone	*early blight:* 6.0 oz Tanos 50DF *late blight:* 6.0–8.0 oz Tanos 50DF	14 14	
	fenamidone	5.5–8.2 fl oz Reason 500 SC	14	
	fluoxastrobin	2.0–3.8 fl oz Aftershock, Evito 480 SC	7	
	pyraclostrobin	*early blight:* 6.0–9.0 fl oz Headline SC, EC *late blight:* 6.0–12.0 fl oz Headline SC, EC	3 3	
	pyraclostrobin + metiram	2.9 lb Cabrio Plus	3	
	azoxystrobin + extract of Reynoutria sachalinensis	0.5-0.9 fl oz/1000 linear row ft of AZterknot; 7.4 -24.3 fl oz/acre AZterknot	14	AZterknot can be applied in-furrow, at-plant for black dot, silver scurf, and black scurf management, and for foliar disease control in management of black dot, early blight, late blight, and powdery mildew. Follow resistance management guidelines on the lab as Akterknot contains azoxystrobin (FRAC 11) which has a high risk for development of resistance in the target pathogen populations.
	Bacillus mycoides isolate J	1.0–4.5 oz LifeGard WG	0	Maximum level of protection is induced within the plant at 3–5 days post application. Protection can last up to 18 days.
	boscalid	2.5–4.5 oz Endura WDG	10	For control of early blight only. Endura belongs to the Group 7 fungicide category. Do not exceed 2 sequential applications of Endura before alternating to a labeled fungicide with a different mode of action. Do not exceed 4 applications per season. Do not exceed 20.5 oz/a Endura per season.
	chlorothalonil	1.0–1.5 pt Bravo Weather Stik, Echo 720, Equus 720 1.5–2.25 pt Bravo Zn, Equus 500 Zn 0.875–1.25 lb Echo 90DF, Echo Zn 0.9–1.36 lb Bravo Ultrex 82.5WDG, Equus DF	7 7 7 7	Note seasonal use limitations on label. Current labeling for annual use of chlorothalonil products in Wisconsin allows 11.2 lb ai/a Equus products and 16.0 lb ai/a Bravo products (Ultrex, WeatherStik, Zn) (special WI registration expires 12/31/17, however a renewal is in process—please check DATCP special registrations listings) and 16.0 lb ai/a Echo products (Zn, 720, 90DF) (special WI registration expires 12/31/20).

*Restricted-use pesticide.

(continued)

Disease control in potato *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Early blight and late blight *(cont.)*	chlorothalonil + cymoxanil	2.0 pt Ariston	14	Apply preventively when triggered by disease forecasting tools such as Blitecast and P-Days.
	copper hydroxide	0.66–2.66 pt Champ Formula 2 0.67–2.67 pt Kocide 4.5 LF 1.3–5.3 pt Kocide LF 0.5–1.75 lb Kocide 3000 0.75–3.0 lb Kocide 2000 DF 1.0–4.0 lb Champion 77WP; Kocide 101, DF	0 0 0 0 0 0	Gives fair control of early blight and good control of late blight. Can be tank mixed with maneb, mancozeb, or chlorothalonil for broad-spectrum disease control. Tank mixing with insecticides such as Monitor may reduce effectiveness of the insecticide.
	cymoxanil	3.2 oz Curzate 60DF	14	Do not use Curzate 60DF alone; always mix with another registered protectant fungicide such as mancozeb, chlorothalonil, triphenyltin hydroxide, or metiram. Do not apply more than 7 sprays per season. After three to 4 applications of Curzate 60DF, switch to another fungicide program for one to two sprays before applying additional sprays of Curzate 60DF. Very warm day and night temperatures hastens curative activity to 1 day rather than normal 2–3 days.
	mancozeb	0.4–1.6 qt Dithane F45 4F 0.5–2.0 lb Dithane M45, Penncozeb 80WP, Penncozeb 75DF 1.0–2.0 lb Dithane 75DF Rainshield NT, Koverall, Manzate 200 75DF	3 3 3	Do not exceed a total of 11.2 lb ai/a EBDC per growing season. EBDC materials include maneb, mancozeb, and metiram.
	mancozeb + chlorothalonil	1.2–1.8 lb Elixir	7	Also controls black dot. Do not apply more than 18.0 lb product/a per crop.
	mandipropamid/ difenoconazole	5.5–7.0 fl oz Revus Top	14	Make no more than 2 consecutive applications before switching to a non-Group 40/3 fungicide. Do not exceed 28.0 fl oz/a Revus Top per season. The addition of a spreading/penetrating type adjuvant, such as non-ionic surfactant, is recommended.
	mefentrifluconazole + pyraclostrobin	5.0–10.0 fl oz Veltyma	7	Follow label for resistance management strategies. Also registered for black dot.
	metiram	1.5–2.0 lb Polyram 80 DF	14	Do not exceed 14.0 lb/a Polyram 80 DF per season.
	pyrimethanil	7.0 fl oz Scala SC in combination with broad spectrum fungicide	7	Scala belongs to the Group 9 fungicide category and controls only early blight. If used alone, Scala does not control late blight. Use the 7.0 fl oz/a rate of Scala only in a tank mix with a broad-spectrum fungicide. Alternating the tank-mix combination with a broad-spectrum fungicide is a resistance management strategy.
	trifloxystrobin	*early blight:* 2.9–3.8 fl oz Gem 500 SC *late blight:* 3.8 fl oz Gem 500 SC tank mixed with a registered protectant fungicide	7 7	

*Restricted-use pesticide.

(continued)

Disease control in potato *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Early blight and late blight *(cont.)*	triphenyltin hydroxide (TPTH)	4.0–6.0 fl oz *Super Tin 4L 2.5–3.75 oz *Agri Tin 80WP, *Super Tin 80WP	7 7	Do not exceed 18.0 fl oz/a Super Tin 4L, 11.25 oz/a Super Tin 80WP, or 11.5 oz/a Agri Tin 80WP per season. Combination of TPTH fungicides with MH-30 and some emulsifiable concentrate insecticides can cause serious crop injury. High rates may injure foliage of sensitive varieties such as Superior and Norland. Observe 24-hour field re-entry period as specified on label. Note label information regarding mixing, loading, and application.
	triphenyltin hydroxide (TPTH) plus mancozeb or metiram	3.0 fl oz *Super Tin 4L *or* 1.87 oz *Super Tin 80WP *or* 1.87 oz *Agri Tin 80WP *plus* one *of the following:* 1.5 lb Dithane M45 80WP, 75DF, WSP *or* 1.2 qt Manex F4 *or* 1.5 lb Manzate 200 75DF *or* 1.5 lb Penncozeb 80WP, 75DF *or* 1.5 lb Polyram 80DF	7 7 7	Combining TPTH with maneb, mancozeb, or metiram reduces foliage injury while providing improved control of early blight. See comments on TPTH above. Do not exceed a total of 11.2 lb ai/a EBDC per growing season. EBDC materials include maneb, mancozeb, and metiram.
	zoxamide + chlorothalonil	32.0–34.0 fl oz Zing	7	Do not make more than 2 sequential applications before alternating to another mode of action.
	zoxamide + mancozeb	1.5–2.0 lb Gavel 75DFp	3	Begin treatment before the onset of late blight. This product contains mancozeb, an active ingredient of EBDC. If using other EBDC-containing fungicides, do not exceed 11.2 lb ai/a EBDC per growing season. Do not make more than 6 applications per season or exceed 12.0 lb/a of Gavel 75DF.
Early dying complex	*A soil test to determine the presence of Verticillium and/or nematodes is recommended prior to treatment since other agents that are not controlled by soil fumigation may cause early senescence of a potato crop. If Verticillium propagules, root lesion nematodes, or root knot nematodes are present in significant numbers, treatment with a soil fumigant may provide acceptable disease control.*			
	fluopyram + penflufen	13.0 fl oz Velum Rise	in-furrow, at-plant treatment	Provides black dot suppression, along with suppression of Rhizoctonia diseases, early blight, white mold, and early dying. Track use of fluopyram and penflufen as they may be components of other in-season foliar-applied fungicides for disease control in potato.
	metam-sodium	50 gal Vapam HL, Metam, Sectagon 42		Knife into plow layer of soil at a rate of 50.0 gal/a or on sandy soils only apply through the irrigation system in 0.6–1.0 inch water in the fall. An approved backflow prevention valve must be used when applying fumigant through irrigation system. Do not apply if significant rainfall is forecast in the next 24 hours. Fields must be monitored during and after application. Soil temperature must be below 75°F. Treatment should not be applied immediately following a potato crop. Potato vine debris should be decomposed at the time of fumigant application for best results. A 2- to 3-year rotation between potato crops is recommended. Fumigant cannot be applied through an irrigation system within 1/4 mile of an institution such as a hospital, school, or prison.

*Restricted-use pesticide.

(continued)

Disease control in potato *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Fusarium	azoxystrobin + fludioxonil + difenoconazole	1.0 fl oz Stadium/2,000 lb tubers	—	Postharvest treatment only. Do not use on seed potatoes or seed pieces. Do not make more than one postharvest application to the tubers.
	cymoxanil + mancozeb + thiophanate-methyl	0.75 lb Evolve/100 lb seed pieces	seed treatment	Thoroughly cover seed pieces with treatment mixture.
	fludioxonil	0.08–0.16 fl oz Maxim 4FS or Spirato 480 FS/100 lb seed potatoes	seed treatment	If applied to potatoes being grown for seed, either a labeled rate of mancozeb or an in-furrow application of Quadris (azoxystrobin) at 0.40 fl oz/1,000 ft row must be applied after Maxim 4FS or Spirato 480 FS.
	fludioxonil + mancozeb	0.5 lb Maxim MZ/100 lb seed pieces	seed treatment	Apply using equipment that ensures uniform and thorough coverage of each seed piece.
	flutolanil + mancozeb	0.75–1.0 lb MonCoat MZ/100 lb cut seed pieces	seed treatment	Apply immediately after seed cutting for thorough coverage of dust to the cut seed piece surfaces.
	mancozeb	1.0 lb Potato Seed Treater PS or Macozeb 6% Firbark/100 lb whole or cut seed pieces	seed treatment	Plant as soon as possible after treatment. Provides some control of late blight on cut seed.
	penflufen + prothioconazole	0.31 fl oz Emesto Silver/100 lb seed pieces	seed dressing applied at-plant	Do not apply more than 2.5 fl oz of slurry treatment/100 lb seed pieces. Application of an inert absorbent ingredient is recommended to improve suberization.
	thiabendazole	0.42 fl oz Mertect 340-F/2000 lb of tuber		Mist unwashed tubers entering storage with 0.42 fl oz Mertect 340-F per 2000 lb of tubers in sufficient water for complete coverage. Additional treatment may be made before shipping by misting the tubers at the same rate or dipping the tubers for 20 seconds in a solution containing 0.42 fl oz of Mertect per gallon of water. Do not treat seed potatoes after cutting.
	thiophanate-methyl + mancozeb	0.75–1.0 lb Tops MZ/100 lb cut seed pieces	seed treatment	Thoroughly cover seed pieces with fungicide dust. Can also limit late blight spread on cut seed.
Late blight	ametoctradin + dimethomorph	11.0–14.0 fl oz Zampro	4	Begin treatment prior to disease development. Do not make more than 3 applications of Zampro per season.
	cyazofamid	1.4–2.75 fl oz Ranman 400SC	7	Do not apply more than 10 sprays or 27.5 fl oz/a per year. Alternate Ranman (Group 21) sprays with a fungicide having a different mode of action. Crops not listed on the label should not be planted within 30 days after the last application.
	cymoxanil + mancozeb + thiophanate-methyl	0.75 lb Evolve/100 lb seed pieces	seed treatment	Thoroughly cover seed pieces with treatment mixture.
	dimethomorph	6.0 oz Forum	4	Begin treatment before the onset of late blight. Forum should be used as a tank mix with other protectant fungicides, but do not mix with mefenoxam or metalaxyl. Adjust rates and timing according to late blight conditions. Do not exceed 30.0 oz/a of product per season. Consult the label for rotational crop restrictions. May be used after vine kill for control of late blight tuber infection.

*Restricted-use pesticide.

(continued)

Disease control in potato *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Late blight *(cont.)*	fluazinam	5.5 fl oz Omega 500F	14	Application should begin prior to onset of disease. Do not apply more than 3.5 pt/a per season. Tank mix with other fungicides such as chlorothalonil, maneb, or mancozeb. REI = 4 days for high-exposure activities.
	fludioxonil + mancozeb	0.5 lb Maxim MZ/100 lb seed pieces	seed treatment	Apply using equipment that ensures uniform and thorough coverage of each seed piece.
	flutolanil + mancozeb	0.75–1.0 lb MonCoat MZ/100 lb cut seed pieces	seed treatment	Apply immediately after seed cutting for thorough coverage of dust to the cut seed piece surfaces.
	mancozeb	5.5-8.0 fl oz/acre Orondis Ultra	14	Oxathiapiprolin (FRAC 49) and mandipropamid (FRAC 40) both have risk for the development of fungicide resistance in the target pathogen. As such, carefully track total usage of these fungicides and follow label for management. Both active ingredients target oomycete plant pathogens.
	oxathiapiprolin	1.6–4.8 fl oz Orondis Opti A, Orondis Ultra A	5	Begin foliar applications prior to disease development and continue on a 5- to 14-day interval. Do not exceed 27.2 fl oz/a per year.
	oxathiapiprolin + mandipropamid			
	propamocarb hydrochloride	0.7–1.2 pt Previcur Flex	14	Begin treatment before the onset of late blight. Tank mix with other fungicides such as chlorothalonil, maneb, or mancozeb. Adjust rates and timing according to late blight conditions. Do not exceed 6 pt/a of Previcur Flex per season.
Powdery scab	fluazinam	1.5–3.0 pt Omega 500F	14	Apply in-furrow for control of powdery scab. Special Local Needs Registration (11/16/16–12/31/20).
Rhizoctonia	azoxystrobin	0.4–0.8 fl oz Quadris Flowable/1,000 ft row	—	Apply in-furrow at planting.
	azoxystrobin + benzovindiflupyr	0.34–0.5 oz Elatus/1,000 ft row	14	Do not apply more than 9.5 oz per year of Elatus. Band over the seed piece.
	fludioxonil	0.08–0.16 fl oz Maxim 4FS/100 lb seed potatoes	seed treatment	If applied to potatoes being grown for seed, either a labeled rate of mancozeb or an in-furrow application of Quadris (azoxystrobin) at 0.40 fl oz/1,000 ft row must be applied after Maxim 4FS.
	fludioxonil + mancozeb	0.5 lb Maxim MZ/100 lb seed pieces	seed treatment	Apply using equipment that ensures uniform and thorough coverage of each seed piece.
	flutolanil	0.71–1.1 lb Moncut 70-DF	in-furrow, at-plant treat-ment	Direct spray uniformly around and over seed piece in a 4- to 8-inch band prior to covering with soil.
	flutolanil + mancozeb	0.75–1.0 lb MonCoat MZ/100 lb cut seed pieces	seed treatment	Apply immediately after seed cutting for thorough coverage of dust to the cut seed piece surfaces.
	PCNB (pentachloro-nitrobenzene)	1.65 lb Blocker 10 G/1,000 ft row	45	Direct 8.5-inch band into the furrow over the seed and cover as part of the hilling operation at planting. Received label for common scab control in 2014.

*Restricted-use pesticide.

(continued)

Disease control in potato *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Rhizoctonia *(cont.)*	penthiopyrad	10.0–24.0 fl oz Vertisan	7	Do not exceed 72.0 fl oz/a per year. Make no more than 2 sequential applications of Vertisan before switching to a fungicide with a different mode of action.
	pyraclostrobin	0.4–0.8 fl oz Headline SC/1,000 ft row	—	Apply in-furrow at planting.
	Reynoutria sachalinensis extract	1.0–4.0 qt or 2.2–8.8 fl oz/1,000 ft row Regalia Rx Biofungicide	0	Improves plant health and induces the defense system of treated plants.
	thiophanate-methyl + mancozeb	0.75–1.0 lb Tops MZ/100 lb cut seed pieces	seed treatment	Thoroughly cover seed with fungicide dust. Can also limit late blight spread on cut seed.
Root lesion and root knot nematodes	metam-sodium	Vapam HL, Metam, Sectagon 42		Generally double mineral soil rates for muck soils. More effective when soils are warmer than 55°F. A minimum of 3 weeks is necessary between fumigation and planting to prevent phytotoxicity.
Silver scurf *(Helminthosporium solani)* **and black scurf** *(Rhizoctonia solani)*	azoxystrobin	0.4–0.8 fl oz Quadris Flowable/1,000 ft row	0	Apply at planting just before covering seed pieces with soil. Application of Quadris at planting does not appear to control early blight or late blight on the foliage later in the season. Do not exceed 2.88 qt/a Quadris per season.
	azoxystrobin + benzovindiflupyr	0.34–0.5 oz Elatus/1,000 ft row	14	Do not apply more than 9.5 oz per year of Elatus. Band over the seed piece.
	azoxystrobin + fludioxonil + difenoconazole	*silver scurf:* *postharvest only:* 1.0 fl oz/2,000 lb tubers	—	Do not use on seed potatoes or seed pieces. Do not make more than one postharvest application to the tubers.
	cymoxanil + mancozeb + thiophanate-methyl	0.75 lb Evolve/100 lb seed pieces	seed treatment	Thoroughly cover seed pieces with treatment mixture.
	fludioxonil	0.08–0.16 fl oz Maxim 4FS/100 lb seed potatoes	seed treatment	If applied to potatoes being grown for seed, either a labeled rate of mancozeb or an in-furrow application of Quadris (azoxystrobin) at 0.40 fl oz/1,000 ft row must be applied after Maxim 4FS.
	fludioxonil + mancozeb	0.5 lb Maxim MZ/100 lb seed pieces	seed treatment	Apply using equipment that ensures uniform and thorough coverage of each seed piece.
	flutolanil + mancozeb	0.75–1.0 lb MonCoat MZ/100 lb cut seed pieces	seed treatment	Apply immediately after seed cutting for thorough coverage of dust to the cut seed piece surfaces.
	penflufen + prothioconazole	0.31 fl oz Emesto Silver/100 lb seed pieces	seed dressing applied at-plant	Do not apply more than 2.5 fl oz of slurry treatment/100 lb seed pieces. Application of an inert absorbent ingredient is recommended to improve suberization.
Tuber rot, pythium leak, and pink rot	cyazofamid	*at planting:* 0.42 fl oz Ranman/1,000 ft row (6.1 fl oz/a on 36-inch row spacing) *lay-by hilling:* 2.75 fl oz Ranman		Do not use reduced rates as incomplete control can promote resistance.
	ethaboxam	8.0 fl oz Elumin	2	Follow resistance management guidelines.
	fluopicolide	4.0 fl oz Presidio	7	For pink rot control. Can be applied in-furrow in 5–10 gal/a spray mixture OR can be applied as a sidedress in 20–40 gal/a spray mixture.

*Restricted-use pesticide.

(continued)

Disease control in potato *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Tuber rot, pythium leak, and pink rot *(cont.)*	mefenoxam	0.42 oz Ridomil Gold SL/1,000 ft row at planting 0.84 fl oz Ultra Flourish/1,000 ft row at planting	—	Mix Ridomil Gold SL or Ultra Flourish in a minimum of 3 gal/a of water and apply in a 6- to 8-inch band over the potato seed piece at planting.
	mefenoxam + chlorothalonil	2.5 pt Ridomil Gold Bravo	14	A total of up to 3 applications at 14-day intervals may be made beginning at flowering. May also provide control of late blight if caused by a sensitive genotype.
	mefenoxam + copper hydroxide	2.0 lb Ridomil Gold Copper	14	
	mefenoxam + mancozeb	2.5 lb Ridomil Gold MZ	3	
	phosphorous acid	*foliar:* 2.5–10.0 pt Phostrol *in-furrow:* 3.75–10.0 pt Phostrol *postharvest:* 0.1 gal Phostrol in 0.5 gal water/2,000 lb tubers *russet varieties only:* 12.0–16.0 fl oz Confine Extra in 0.5 gal water/2,000 lb tubers	0	For control of pink rot, late blight, and Pythium leak. First foliar treatment should begin at tuber initiation at the 10 pt/a rate, followed by a second and third application timed 2 weeks apart. Use adequate spray mixture volumes when applying to avoid phytotoxicity. In-furrow application aids in control of pink rot, late blight, and Pythium leak. Postharvest application can limit advancement and spread of pink rot, late blight, and Pythium leak. Use adequate spray mixture volumes when applying to avoid tuber damage.
White mold *(Sclerotinia sclerotiorum)*	*Bacillus mycoides* isolate J	1.0–4.5 oz LifeGard WG	0	Maximum level of protection is induced within the plant at 3–5 days post application. Protection can last up to 18 days.
	boscalid	5.5–10.0 oz Endura WDG	30	Endura belongs to the Group 7 fungicide category. Do not exceed 2 sequential applications of Endura before alternating to a labeled fungicide with a different mode of action. Do not exceed 2 applications per season for white mold control. Do not exceed 20.5 oz/a Endura per season.
	Coniothyrium minitans	0.75–1.5 oz/1,000 sq ft Contans		Preplant or postharvest soil incorporation to reduce viability of pathogen sclerotia in soil. Can make up to 8 applications/a per season. This is a biological fungicide with specific activity only against white mold.
	fluazinam	5.5–8.0 fl oz Omega 500F	14	Application should begin prior to onset of disease. Do not apply more than 3.5 pt/a per season. Tank mix with other fungicides such as chlorothalonil, maneb, or mancozeb.
	fluopyram	6.5 fl oz Velum Prime		Provides nematode, white mold, and early blight control. Follow resistance management guildelines.
	fluopyram + penflufen	13.0 fl oz Velum Rise	in-furrow, at-plant treatment	Provides black dot suppression, along with suppression of Rhizoctonia diseases, early blight, white mold, and early dying. Track use of fluopyram and penflufen as they may be components of other in-season foliar-applied fungicides for disease control in potato.

*Restricted-use pesticide.

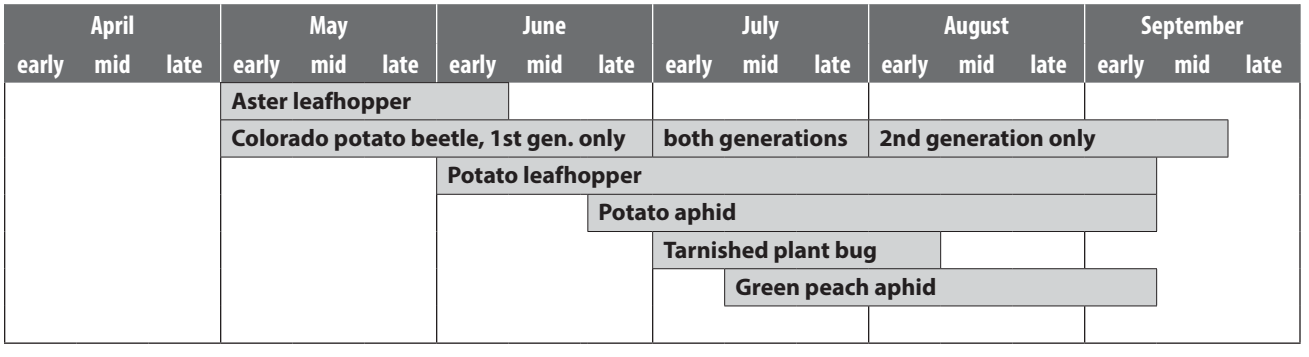
(continued)

Disease control in potato *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
White mold *(cont.)*	iprodione	2.0 lb Rovral 50WP 2.0 pt Rovral 4F, Iprodione 4L, Nevado 4F	14 14	Treat when warm, wet weather conditions favor disease development. Up to 4 applications at 7- to 10-day intervals may be made. Note crop rotation information on label. All crops on the Rovral label may be grown after treated potatoes. Root crops, cereal grains, soybeans, and tomatoes may be grown the year following treated potatoes.
	metconazole	4.0 oz Quash	1	Make first application prior to infection at row closure and 14 days later if conditions promote disease. Do not make more than 4 applications per season. Do not make more than 2 sequential applications. Do not apply more than 16.0 oz/a per season.
	picoxystrobin	6.0–12.0 fl oz Aproach	3	Follow label for fungicide resistance management strategies. Also labeled for early blight.
	prothioconazole + trifloxystrobin	8.0-11.4 fl oz Delaro 325 SC	14	Both fungicides prothioconazole FRAC 3 and trifloxystrobin FRAC 11 have a risk for the development of resistance in their target pathogens. Follow guidelines on the label for total allowable use per acre per year to manage resistance.
	pydiflumetofen + fludioxonil	11.4 fl oz Miravis Prime	14	Apply at or before row closure followed by a second application 14 days later. Do not apply more than 34.2 fl oz/a per year. Apply in a minimum volume of 10 gal/a for adequate coverage.
	thiophanate-methyl	1.0–1.5 lb Topsin M WSB, 70 WP 20.0–30.0 fl oz Topsin 4.5FL	21 21	Make first application just before row closure. Subsequent applications may be made at 7- to 14-day intervals if conditions warrant. Application at peak bloom provides best control. Do not apply more than 4.0 lb/a Topsin M WSB or 80.0 fl oz/a Topsin 4.5FL per season.

*Restricted-use pesticide.

Scouting calendar for insect pests of potato



Insect control in potato

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
General insect control with soil-applied systemic	*Aphid, leafhopper, flea beetle, Colorado potato beetle:*			
	0.1–0.2 lb clothianidin	7.2–12.0 fl oz Belay	—	Apply specified rate in sufficient carrier volume to ensure uniform coverage and incorporate into soil using either (1) narrow-band application centered over the plant row, (2) direct, in-furrow spray on the seed pieces, or (3) sidedress to both sides of the row or as directed spray at ground-cracking over the row. Cover immediately with soil.
	0.088–0.176 lb cyantraniliprole *(soil)*	6.75–13.5 fl oz Verimark	—	Do not apply more than 13.5 fl oz/a Verimark per crop per season. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6.
	0.2–0.3 lb imidacloprid	5.7–8.7 fl oz Admire Pro8	21	Apply as band below seed furrow within 7 days before planting or spray in furrow at planting. Use higher rate on muck soils or for seed production. Do not exceed 8.7 fl oz/a per season.
	Aphid, leafhopper, flea beetle, and suppression of Colorado potato beetle:			
	broadcast rate: 2.0–3.0 lb phorate *banded rate:* heavy soil—0.22 lb/1,000 ft row light soil—0.14 lb/1,000 ft row	*banded rate:* heavy soil—17.3 oz *Thimet 20G, *Phorate 20G light soil—11.3 oz *Thimet 20G, *Phorate 20G	90	Apply as band in furrow at planting *or* apply sidedress postemergence at hilling; do not use both. Use the lower rate only on sandy soils and for all emergence applications.
	thiamethoxam	5.0–8.0 fl oz Platinum 2SC 1.66–2.67 oz Platinum 75SG	30 30	Do not apply more than 8.0 fl oz of Platinum 2SC and no more than 2.67 oz Platinum 75SG per acre per crop season and apply sufficient water volume after in-ground application to ensure incorporation into the seed zone.
Seed piece treatment	*Use a seed dusting metering applicator to assure thorough coverage. Plant seed pieces as soon as possible after treatment.*			
	clothianidin	0.4–0.6 fl oz Belay/100 lb cut seed pieces	—	Apply as a diluted spray to ensure uniform coverage over whole or cut seed pieces. Liquid fungicides can be applied with Belay. If using a dust formulation of fungicide, apply Belay first, then the dust application. Plant seed as soon as possible after treatment. Do not use treated seed pieces as food, feed, or fodder. Do not apply a neonicotinoid (MoA Class 4) compound following Belay seed treatment.
	imidacloprid + thiophanate-methyl + zinc + manganese	0.75–1.0 lb Tops-MZ-Gaucho/100 lb cut seed pieces		Regardless of the type of application, do not exceed 0.31 lb ai/a imidacloprid (Admire or Provado) per year. There is a 12-month rotational plantback interval for all crops except those registered.
Aphids	0.063–0.078 lb spirotetramat + 0.022–0.027 lb pyriproxifen	8.0–10.0 fl oz Senstar	7	Do not apply more than 10 fl oz of Senstar Insecticide (0.078 lb spirotetramat and 0.027 lb pyriproxyfen) per acre per application. Do not make more than 2 applications per crop season. Do not apply more than 20 fl oz (0.156 lb spirotetramat and 0.055 lb pyriproxyfen) of Senstar Insecticide per acre per crop season. Minimum interval between applications is 14 days. Regardless of formulation do not apply more than 0.16 lb spirotetramat and 0.108 lb pyriproxyfen per acre per crop season. Do not allow livestock to graze treated areas.

*Restricted-use pesticide.

(continued)

Insect control in potato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids *(cont.)*	0.17–0.21 lb tolfenpyrad	17.0–21.0 fl oz Torac	1	Apply by ground only, using a minimum of 20 gallons of water per acre. Do not apply by air on fruiting vegetables. Do not apply more than 42.0 fluid ounces (0.42 lb ai) per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow at least 14 days between applications. Do not make more than 4 applications per year.
Colorado potato beetle	*Historically, the need for control was based upon percent defoliation observed in the canopy of potato at different growth stages. If you are using an active ingredient that is effective across all developmental stages of the insect (eggs, larvae, pupa, adults), then defoliation thresholds may still be useful. Few foliar-applied, broad-spectrum products remain effective for the control of Colorado potato beetle in this way, however. A high proportion of populations are resistant to the synthetic pyrethroids, carbamates, organophosphates, chlorinated hydrocarbons, and the neonicotinoids.* • *Pre-flowering plants (e.g., 6–8 inches tall) can withstand 20–30% defoliation with no economic loss.* • *Flowering plants can withstand only 5–10% defoliation with no economic loss.* • *Post-flowering plants (e.g., tuberization) can withstand <10% defoliation with no economic loss.* *Current, reduced-risk insecticides have only limited effectiveness against very specific stages of the Colorado potato beetle and should be applied when the majority of individuals in a population have reached this stage. The specific stages of Colorado potato beetle development can be predicted based upon an accumulation of degree days using a base temperature of 52°F. Following are the specific DD_{52} accumulations necessary for specific stages of development:* • *Eggs 120* • *1st instar larvae 185* • *2nd instar larvae 240* • *3rd instar larvae 300* • *4th instar larvae 400* • *Pupae 675* *When the appropriate life stages are prevalent in fields, apply 2–3 successive applications of reduced-risk compounds, spaced 7–10 days apart, to target vulnerable stages of Colorado potato beetles, primarily 1st and 2nd instar stages. Active ingredients that fit in this category include abamectin, acetamiprid, chlorantraniliprole, cyantraniliprole, novaluron, spinetoram, and spinosad. For the second generation of Colorado potato beetle, which occurs primarily in July and August, use compounds including chlorantraniliprole and cyantraniliprole that possess a broader spectrum of activity against several of the life stages of the insect.* *Also use perimeter, or spot treatments, on early season colonizing adult insects that invade fields along outside edges.*			
	abamectin	8.0–16.0 fl oz Agrimek	14	Target first-generation larvae.
	0.028–0.075 lb acetamiprid 0.025–0.075 lb acetamiprid	1.5–4.0 oz Assail 30SG 0.6–1.7 oz Assail 70WP	7 7	Begin treatment when thresholds are reached. Apply every 7 days as needed. Do not exceed 4 applications or 0.3 lb ai/a per season.
	alpha-cypermethrin	3.2–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	Bacillus thuringiensis subsp. *tenebrionis*	Raven	0	Make initial spray when you first observe eggs and small larvae. Rates vary with formulation.
	3.0–6.0 qt *Bacillus thuringiensis* subsp. *tenebrionis*	3.0–6.0 qt Trident	1	Use 3.0–6.0 quarts of Trident per acre, in a minimum spray volume of 20 gallons of water per acre. Use the 3.0 qt per acre rate only when light populations of larvae of uniform age/size are present.
	0.0125–0.022 lb beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Apply every 5 days as needed. Do not exceed 6 applications per year. Do not exceed 0.125 lb ai/a cyfluthrin including Baythroid and Leverage 360.
	0.075–0.096 lb bifenthrin + imidacloprid	4.8–6.14 fl oz *Brigadier	21	Do not apply more than 25.6 fl oz/a (0.4 lb ai/a) per season. No more than 0.5 lb ai/a bifenthrin and 0.2 lb ai/a imidacloprid are allowed per season.

*Restricted-use pesticide.

(continued)

Insect control in potato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Colorado potato beetle *(cont.)*	0.098–0.167 lb bifenthrin + chlorantraniliprole	5.6–9.6 fl oz *Elevest	21	Make no more than 2 applications per acre per calendar year. Minimum interval between treatments is 21 days. Do not apply more than 28.8 fl oz *Elevest insect control or 0.2 lb ai of chlorantraniliprole and 0.5 lb ai of bifenthrin-containing products per acre per calendar year.
	chlorantraniliprole	3.5–7.5 fl oz Coragen	14	Do not make more than 4 applications per crop season and allow at least 3 days between applications. Do not apply more than 15.4 fl oz/a Coragen per season.
	0.03–0.05 lb clothianidin	1.9–2.8 fl oz Belay	14	Do not exceed 3 applications of Belay. Allow at least 7 days between applications. Do not make a foliar application of Belay following an at-plant application of a neonicotinoid (MoA Class 4) compound.
	0.088–0.133 lb cyantraniliprole	5.0–13.5 fl oz Exirel	7	Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. Minimum reapplication interval is 5 days.
	0.11–0.2 lb cyantraniliprole + abamectin	5.5–10.0 fl oz *Minecto Pro	7	Do not apply more than 0.4 lb per calendar year of cyantraniliprole-containing products, or more than 0.056 lb per calendar year of abamectin-containing products.
	0.12–0.24 lb cyromazine	2.66–5.32 oz Trigard 75WP	7	Do not apply more than 1.0 lb/a Trigard per crop. Repeat applications 7 days apart.
	0.018–0.028 lb deltamethrin	1.5–2.4 oz *Delta Gold	3	Apply every 3 days as needed.
	0.05–0.33 lb dinotefuran	*foliar:* 1.0–1.5 oz Venom 70SG *soil:* 6.5–7.5 oz Venom 70SG	7 —	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 4.5 oz/a per year using foliar applications, or 7.5 oz/a per season using soil applications. See product label for application directions.
	0.05–0.07 lb dinotefuran *(foliar)*	2.0–2.75 oz Scorpion 35SL	7	Can repeat at 14-day intervals. Do not apply more than 7.75 oz per year. Use only one application method.
	0.28–0.33 lb dinotefuran *(soil)*	11.0–13.0 oz Scorpion 35SL		Do not apply more than 13.0 oz per year. Apply either as a preplant, preemergence, or at ground crack. Do not follow soil applications with foliar applications; use only one application method.
	0.025–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	7	Do not exceed 0.35 lb ai/a per season. CPB has developed resistance in some areas.
	flupyradifurone	10.5–14.0 fl oz Sivanto	7	Foliar application. Apply when pests reach or exceed established thresholds. Do not apply more than 28.0 fl oz of Sivanto per acre per crop season.
	0.047 lb imidacloprid	3.75 fl oz Provado 1.6	7	Foliar application: Use ground equipment only. Allow at least 7 days between applications. Regardless of the type of application, do not exceed 0.31 lb ai/a imidacloprid (Admire, Leverage 360, or Provado) per year. **There is a 12-month rotational plantback interval for all crops except those registered.**
	imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	0	Do not apply more than 15.4 fl oz/a per season and allow at least 7 days between applications.

*Restricted-use pesticide.

(continued)

Insect control in potato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Colorado potato beetle *(cont.)*	0.11 lb indoxacarb	6.0 oz Avaunt 30 DG	7	Wait at least 5 days between applications. Do not apply more than 24.0 oz/a Avaunt (0.44 lb ai/a) per crop. In areas where Colorado potato beetles are resistant to other insecticides, addition of piperonyl butoxide (PBO) as a tank mix with Avaunt may be required. Adult beetles will cease to feed following exposure to Avaunt but may not die for several days.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	7	Do not apply more than 0.12 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege	14	Do not apply more than 27.0 fl oz/a Besiege per season and allow at least 7 days between applications.
	0.017–0.03 lb lambda-cyhalothrin + thiamethoxam	3.5–4.5 fl oz *Endigo ZC	14	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Do not exceed 10.0 fl oz/a Endigo ZC, or 0.12 lb ai/a of products containing lambda-cyhalothrin or 0.094 lb ai/a of products containing thiamethoxam.
	0.067 lb ledprona	16.0 fl oz Calantha	1	Apply two to a maximum of four (2-4) successive applications to control a single generation. Initiate applications when 10-50% egg hatch has occurred. Do not apply more than 4 successive applications per season. Make applications 7 days apart. Do not apply more than a total of 64 fl oz of Calantha (0.268 lb ai of ledprona) per acre per year.
	0.058–0.078 lb novaluron	9.0–12.0 fl oz Rimon 0.83EC	14	Apply when population is between egg hatch and second instar. Use higher rates for larger larvae. Do not apply more than twice to a single generation of Colorado potato beetles and do not apply to successive generations. Do not apply more than 24.0 oz/a per season.
	0.5–1.0 lb oxamyl	2.0–4.0 pt *Vydate L	7	Treat first-generation larvae. Use low rates for light infestation; higher rates for severe infestation.
	0.1–0.2 lb permethrin	4.0–8.0 oz *Permethrin 3.2EC	14	Do not exceed 32.0 oz/a per year.
	1.0 lb phosmet	1.33 lb Imidan WP	7	Use only on potatoes to be machine harvested.
	9.6–11.5 lb sodium aluminofluoride	10.0–12.0 lb Prokil Cryolite 96, Kryocide	0	Treat beginning at 20% egg hatch at a minimum of 7-day intervals. Do not exceed 96.0 lb per season. Mortality does not occur for 2–4 days. Does not affect beneficial insects. Cryolite can be abrasive to equipment; check the label.
	0.047–0.094 lb spinetoram	6.0–8.0 oz Radiant SC	7	Do not apply more than 32.0 oz/a Radiant (0.25 lb ai/a) per crop and do not make more than 4 applications per crop.
	spinosad	1.7–3.3 oz Blackhawk	3	Apply when pests reach or exceed established thresholds. Do not make more than two successive applications of a Group 5 material and do not apply more than 14.4 oz/a Blackhawk per crop season in potato. Do not exceed 4 applications in a year.
		3.0–10.0 fl oz Entrust SC	7	Target application for eggs at hatching and small larvae. Use higher rates for heavier infestations and for older larvae. Do not apply more than 21.0 fl oz/a per crop.

*Restricted-use pesticide.

(continued)

Insect control in potato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Colorado potato beetle *(cont.)*	thiamethoxam	1.5–3.0 oz Actara 25WDG	14	Apply before pests reach damaging levels. Allow at least 7 days between applications. Do not exceed 3.0 oz/a per season.
		0.11–0.16 fl oz Cruiser 5FS/100 lb seed pieces	0–30	Use rate chart on label to select proper application rate. Do not exceed 0.125 lb ai/a.
	0.047 lb thiamethoxam + chlorantraniliprole	4.0 oz Voliam Flexi	14	Do not exceed a total of 8.0 fl oz/a Voliam Flexi or 0.094 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per growing season.
	0.14–0.21 lb tolfenpyrad	14.0–21.0 fl oz Torac	1	Apply by ground only, using a minimum of 20 gallons of water per acre. Do not apply by air on fruiting vegetables. Do not apply more than 42.0 fluid ounces (0.42 lb ai) per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow at least 14 days between applications. Do not make more than 4 applications per year.
	0.02–0.025 lb zeta-cypermethrin	3.2–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season. May provide inadequate control in areas where CPB are resistant to other synthetic pyrethroids.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	21	Do not exceed 0.2 lb ai/a per season or make more than 2 applications per season.
Cutworms, loopers	*Before July 25 treat when counts exceed four per row foot; after July 25 treat when counts exceed eight per row foot. Use spot treatments if infestations are patchy.*			
	alpha-cypermethrin	1.3–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	Bacillus thuringiensis subsp. *kurstaki*	Agree, Biobit, DiPel	0	Rates vary with formulations for loopers.
	1.0–2.0 lb *Bacillus thuringiensis* subsp. *kurstaki*	1.0–2.0 lb Lepinox WDG	0	Treat early instar larvae before noticeable feeding damage occurs. Repeat as needed.
	0.0125–0.022 lb beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Apply every 5 days as needed. Do not exceed 6 applications per year.
	0.098–0.167 lb bifenthrin + chlorantraniliprole	5.6–9.6 fl oz *Elevest	21	Make no more than 2 applications per acre per calendar year. Minimum interval between treatments is 21 days. Do not apply more than 28.8 fl oz *Elevest insect control or 0.2 lb ai of chlorantraniliprole and 0.5 lb ai of bifenthrin-containing products per acre per calendar year.
	1.0–2.0 lb carbaryl	1.0–2.0 qt Sevin XLR Plus	7	Repeat applications as necessary up to a total of 6 times per year but not more than once every 7 days. Do not exceed 6.0 qt per crop per year. Do not apply when crop or nearby weeds are in bloom.
	chlorantraniliprole	3.5–7.5 fl oz Coragen	14	Do not make more than 4 applications per crop season and allow at least 3 days between applications. Do not apply more than 15.4 fl oz/a Coragen per season.
	0.012–0.028 lb deltamethrin	1.0–2.4 oz *Delta Gold	3	Apply every 3 days as needed.
	0.025–0.05 lb esfenvalerate	2.8–9.6 fl oz *Asana XL	7	Do not exceed 0.35 lb ai/a per season.

*Restricted-use pesticide.

(continued)

Insect control in potato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cutworms, loopers *(cont.)*	imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	0	Do not apply more than 15.4 fl oz/a per season and allow at least 7 days between applications.
	0.015–0.025 lb lambda-cyhalothrin	0.96–1.6 fl oz *Warrior II	7	Do not apply more than 0.12 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	5.0–8.0 fl oz *Besiege	14	Do not apply more than 27.0 fl oz/a Besiege per season and allow at least 7 days between applications.
	0.017–0.03 lb lambda-cyhalothrin + thiamethoxam	2.5–4.5 fl oz *Endigo ZC	14	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Do not exceed 10.0 fl oz/a Endigo ZC, or 0.12 lb ai/a of products containing lambda-cyhalothrin or 0.094 lb ai/a of products containing thiamethoxam.
	0.058–0.078 lb novaluron	9.0–12.0 fl oz Rimon 0.83EC	14	Apply when population is between egg hatch and second instar. Use higher rates for larger larvae. Do not make more than 2 applications or exceed 24.0 oz/a per season.
	0.1–0.2 lb permethrin	4.0–8.0 oz *Permethrin 3.2EC	14	Do not exceed 32.0 oz ai/a per year.
	0.047–0.094 lb spinetoram	6.0–8.0 oz Radiant SC	7	Do not apply more than 32.0 oz/a Radiant (0.25 lb ai/a) per crop and do not exceed 4 applications per crop.
	spinosad	1.7–3.5 oz Blackhawk	3	Apply when pests reach or exceed established thresholds. Do not make more than two successive applications of a Group 5 material and do not apply more than 14.4 oz/a Blackhawk per crop season in potato. Do not exceed 4 applications in a year.
		4.5–10.0 fl oz Entrust SC	7	Target application for eggs at hatching and small larvae. Use higher rates for heavier infestations and for older larvae. Do not apply more than 21.0 fl oz/a per crop.
	0.047 lb thiamethoxam + chlorantraniliprole	4.0 oz Voliam Flexi	14	Do not exceed a total of 8.0 fl oz/a Voliam Flexi or 0.094 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per growing season.
	0.21 lb tolfenpyrad	21.0 fl oz Torac	1	Do not apply until at least 14 days after emergence or after transplanting to allow time for root establishment. This period of time should be extended if conditions at time of emergence or transplanting are not favorable to crop growth. Apply by ground only, using a minimum of 20 gallons of water per acre. Do not apply more than 42.0 fluid ounces (0.42 lb ai) per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow at least 14 days between applications. Do not make more than 4 applications per year.
	0.01–0.025 lb zeta-cypermethrin	1.76–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	21	Do not exceed 0.2 lb ai/a per season or make more than 2 applications per season.
European corn borer	0.047–0.075 lb acetamiprid	2.5–4.0 oz Assail 30SG	7	Begin treatment when thresholds are reached. Apply every 7 days as needed. Do not make more than 4 applications or exceed 0.3 lb ai/a per season.
	0.05–0.075 lb acetamiprid	1.1–1.7 oz Assail 70WP	7	

*Restricted-use pesticide.

(continued)

Insect control in potato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
European corn borer *(cont.)*	alpha-cypermethrin	1.8–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	1.0–2.0 lb *Bacillus thuringiensis* subsp. *kurstaki*	1.0–2.0 lb Lepinox WDG	0	Treat early instar larvae before noticeable feeding damage occurs. Repeat as needed.
	0.0125–0.022 lb beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Apply every 5 days as needed. Do not exceed 6 applications per year.
	0.098–0.167 lb bifenthrin + chlorantraniliprole	5.6–9.6 fl oz *Elevest	21	Make no more than 2 applications per acre per calendar year. Minimum interval between treatments is 21 days. Do not apply more than 28.8 fl oz *Elevest insect control or 0.2 lb ai of chlorantraniliprole and 0.5 lb ai of bifenthrin-containing products per acre per calendar year.
	1.0–2.0 lb carbaryl	1.0–2.0 qt Sevin XLR Plus	7	Repeat applications as necessary up to a total of 6 times per year but not more than once every 7 days. Do not exceed 6.0 qt per crop per year. Do not apply when crop or nearby weeds are in bloom.
	chlorantraniliprole	3.5–7.5 fl oz Coragen	14	Do not make more than 4 applications per crop season and allow at least 3 days between applications. Do not apply more than 15.4 fl oz/a Coragen per season.
	0.044–0.088 lb cyantraniliprole *(overhead irrigation only)*	7.0–13.5 fl oz Verimark	—	Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. Minimum reapplication interval is 5 days.
	0.11–0.2 lb cyantraniliprole + abamectin	5.5–10.0 fl oz *Minecto Pro	7	Do not apply more than 0.4 lb per calendar year of cyantraniliprole-containing products, or more than 0.056 lb per calendar year of abamectin-containing products.
	0.018–0.028 lb deltamethrin	1.5–2.4 oz *Delta Gold	3	Apply every 3 days as needed.
	0.3–0.5 lb esfenvalerate	5.8–9.6 oz *Asana XL	7	Do not exceed 0.35 lb ai/a per season.
	imidacloprid + beta-cyfluthrin	2.8 fl oz *Leverage 360	7	Minimum interval between applications is 7 days and maximum allowable crop use per season is 12.8 fl oz/a.
	0.065–0.11 lb indoxacarb	3.5–6.0 oz Avaunt	7	Do not exceed 0.26 lb ai/a per season.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	7	Do not apply more than 0.12 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege	14	Do not apply more than 27.0 fl oz/a Besiege per season and allow at least 7 days between applications.
	0.02–0.027 lb lambda-cyhalothrin + thiamethoxam	3.0–4.0 fl oz *Endigo ZC	14	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Do not exceed 10.0 fl oz/a Endigo ZC, or 0.12 lb ai/a of products containing lambda-cyhalothrin or 0.094 lb ai/a of products containing thiamethoxam.
	0.1–0.2 lb permethrin	4.0–8.0 oz *Permethrin 3.2EC	14	Do not exceed 32.0 oz/a per year.

*Restricted-use pesticide.

(continued)

Insect control in potato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
European corn borer *(cont.)*	0.047–0.094 lb spinetoram	6.0–8.0 oz Radiant SC	7	Do not apply more than 32.0 oz/a Radiant (0.25 lb ai/a) per crop and do not exceed 4 applications per crop.
	spinosad	1.7–3.3 oz Blackhawk	3	Apply when pests reach or exceed established thresholds. Do not make more than two successive applications of a Group 5 material and do not apply more than 14.4 oz/a Blackhawk per crop season in potato. Do not exceed 4 applications in a year.
		3.0–10.0 fl oz Entrust SC	7	Target application for eggs at hatching and small larvae. Use higher rates for heavier infestations and for older larvae. Do not make more than 2 applications per generation. Do not apply more than 21.0 fl oz/a per crop.
	0.047 lb thiamethoxam + chlorantraniliprole	4.0 oz Voliam Flexi	14	Do not exceed a total of 8.0 fl oz/a Voliam Flexi or 0.094 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per growing season.
	0.21 lb tolfenpyrad	21.0 fl oz Torac	1	Do not apply until at least 14 days after emergence or after transplanting to allow time for root establishment. This period of time should be extended if conditions at time of emergence or transplanting are not favorable to crop growth. Apply by ground only, using a minimum of 20 gallons of water per acre. Do not apply more than 42.0 fluid ounces (0.42 lb ai) per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow at least 14 days between applications. Do not make more than 4 applications per year.
	0.01–0.025 lb zeta-cypermethrin	1.76–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	21	Do not exceed 0.2 lb ai/a per season or make more than 2 applications per season.
Grass-hoppers	*Treat when defoliation exceeds 10%.*			
	alpha-cypermethrin	3.2–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.068–0.167 lb bifenthrin + chlorantraniliprole	3.9–9.6 fl oz *Elevest	21	Make no more than 2 applications per acre per calendar year. Minimum interval between treatments is 21 days. Do not apply more than 28.8 fl oz *Elevest insect control or 0.2 lb ai of chlorantraniliprole and 0.5 lb ai of bifenthrin-containing products per acre per calendar year.
	2.0 lb carbaryl	Sevin Bait	0	Broadcast. See label for rate.
	chlorantraniliprole	2.0–5.0 fl oz Coragen	14	Do not make more than 4 applications per crop season and allow at least 3 days between applications. Do not apply more than 15.4 fl oz/a Coragen per season.
	0.25–0.5 lb dimethoate	0.5–1.0 pt Dimethoate EC	0	
	0.2–0.5 lb esfenvalerate	3.9–9.6 oz *Asana XL	7	Do not exceed 0.35 lb ai/a per season.
	imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	0	Do not apply more than 15.4 fl oz/a per season and allow at least 7 days between applications.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	7	Do not apply more than 0.12 lb ai/a per season. Do not feed treated foliage to animals.

*Restricted-use pesticide.

(continued)

Insect control in potato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Grasshoppers *(cont.)*	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege	14	Allow at least 7 days between applications. Do not apply more than 27.0 fl oz/a Besiege per season.
Green peach aphid, potato aphid	*Control when green peach aphids exceed one per 10 leaves for seed production or three aphids per 10 leaves for table stock.*			
	0.047–0.075 lb acetamiprid 0.044–0.075 lb acetamiprid	2.5–4.0 oz Assail 30SG 1.0–1.7 oz Assail 70WP	7 7	Begin treatment when thresholds are reached. Apply every 7 days as needed. Do not exceed 4 applications or 0.3 lb ai/a per season.
	alpha-cypermethrin	3.2–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.022 lb beta-cyfluthrin	2.8 fl oz *Baythroid XL	0	Maximum Baythroid XL allowed per 7-day interval is 2.8 fl oz/a and season total allowed per crop season is 16.8 fl oz/a.
	0.075–0.096 lb bifenthrin + imidacloprid	4.8–6.14 fl oz *Brigadier	21	Do not apply more than 25.6 fl oz/a (0.4 lb ai/a) per season. No more than 0.5 lb ai/a bifenthrin and 0.2 lb ai/a imidacloprid are allowed per season.
	0.03–0.05 lb clothianidin	1.9–2.8 fl oz Belay	14	Do not exceed 3 applications of Belay. Allow at least 7 days between applications. Do not make a foliar application of Belay following an at-plant application of a neonicotinoid (MoA Class 4) compound.
	0.088–0.134 lb cyantraniliprole *(overhead irrigation only)*	13.5–20.5 fl oz Verimark	—	Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. Minimum reapplication interval is 5 days.
	0.2 lb cyantraniliprole + abamectin	10.0 fl oz *Minecto Pro	7	Do not apply more than 0.4 lb per calendar year of cyantraniliprole-containing products, or more than 0.056 lb per calendar year of abamectin-containing products.
	0.018–0.028 lb deltamethrin	1.5–2.4 oz *Delta Gold	3	Apply every 3 days as needed.
	0.25–0.5 lb diazinon	several formulations	35	Repeat applications as necessary. Allow at least 7 days between applications. Do not use on potatoes that will be hand harvested. Limit of 5 applications per season.
	0.25–0.5 lb dimethoate	0.5–1.0 pt Dimethoate 400EC	0	Potatoes may be mechanically harvested on day of application. Highly toxic to bees—do not apply when crop or nearby weeds are in bloom. Wait at least 7 days between treatments. Do not exceed 0.5 lb ai/a per treatment. Do not exceed 1.0 lb ai/a per year. Re-entry interval is 48 hours.
	0.025–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	7	For potato aphid only. Do not exceed 0.35 lb ai/a per season.
	0.062–0.089 lb flonicamid	2.0–2.8 oz Beleaf 50SG	7	Thorough coverage is required for optimal control. Do not apply more than 2.8 oz/a Beleaf 50SG (0.089 lb ai/a) per treatment and do not exceed 8.4 oz/a (0.267 lbai/a) per season. Allow at least 7 days between applications; rapidly growing plants often require re-treatment. Limit of 3 applications per year.
	flupyradifurone	7.0–10.5 fl oz Sivanto	7	Foliar application. Apply when pests reach or exceed established thresholds. Do not apply more than 28.0 fl oz of Sivanto per acre per crop season.

*Restricted-use pesticide.

(continued)

Insect control in potato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Green peach aphid, potato aphid *(cont.)*	*I. fumosorosea* (20%)	1.0–2.0 lb PFR-97	1	Repeat applications at 3- to 10-day intervals over 2–3 weeks or as needed to maintain control. Frequent application may be required under dry conditions, during periods of increased pest buildup or reproduction, or rapid host plant growth.
	0.047 lb imidacloprid	3.75 fl oz Provado 1.6F	7	Foliar application: Use ground equipment only. Allow at least 7 days between applications. Regardless of the type of application, do not exceed 0.31 lb ai/a imidacloprid (Admire or Provado) per year. There is a 12-month rotational plantback interval for all crops except those registered.
	imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	0	Do not apply more than 15.4 fl oz/a per season and allow at least 7 days between applications.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	7	Do not apply more than 0.12 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege	14	Do not apply more than 27.0 fl oz/a Besiege per season and allow at least 7 days between applications.
	0.027–0.03 lb lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	14	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Do not exceed 10.0 fl oz/a Endigo ZC, or 0.12 lb ai/a of products containing lambda-cyhalothrin or 0.094 lb ai/a of products containing thiamethoxam.
	0.6–0.9 lb malathion	several formulations	0	Short residual.
	0.45–0.90 lb methomyl	1.5–3.0 pt *Lannate LV	6	Repeat application as necessary up to 10 times per crop. Do not exceed 15.0 pt/a per crop.
	0.5–1.0 lb oxamyl	2.0–4.0 pt *Vydate L	7	Foliar application. Do not exceed 6 applications per season.
	0.1–0.2 lb permethrin	4.0–8.0 oz *Permethrin 3.2EC	14	Do not exceed 32.0 oz/a per year.
	pymetrozine	2.75 oz Fulfill 50WDG	14	Apply according to label directions when aphids first appear. May repeat treatment in 7 days. Do not exceed 2 applications per crop or 5.5 oz ai/a per season. May be applied through chemigation.
	0.06–0.08 lb spirotetramat	2.0–2.5 fl oz Movento HL	7	Do not apply more than 0.16 lb per calendar year of spirotetramat-containing products.
	0.023–0.047 lb sulfoxaflor	0.75–1.5 oz Transform WG	7	Do not apply more than a total of 8.5 oz of Transform WG (0.266 lb ai of sulfoxaflor) per acre per year.
	thiamethoxam	3.0 oz Actara 25WDG	14	Apply every 7–10 days as needed. Do not exceed 6.0 oz/a per season.
		0.11–0.16 fl oz Cruiser 5FS/100 lb seed pieces	0–30	Use rate chart on label to select proper application rate. Do not exceed 0.125 lb ai/a.
	0.047 lb thiamethoxam + chlorantraniliprole	4.0 oz Voliam Flexi	14	Do not exceed a total of 8.0 fl oz/a Voliam Flexi or 0.094 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per growing season.
	0.02–0.025 lb zeta-cypermethrin	3.2–4.0 oz *Mustang Maxx	1	Apply Mustang Maxx only after populations have exceeded thresholds and do not exceed 24.0 oz/a per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	21	Do not exceed 0.2 lb ai/a per season or make more than 2 applications per season.

*Restricted-use pesticide.

(continued)

Insect control in potato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Potato flea beetle	0.028–0.047 lb acetamiprid	1.5-2.5 oz Assail 30SG	7	Begin treatment when thresholds are reached. Apply every 7 days as needed. Do not exceed 4 applications or 0.3 lb ai/a per season.
	0.025–0.05 lb acetamiprid	0.6-1.1 oz Assail 70WP	7	
	alpha-cypermethrin	1.8–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.0125–0.022 lb beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Apply every 5 days as needed. Do not exceed 6 applications per year.
	0.075–0.096 lb bifenthrin + imidacloprid	4.8–6.14 fl oz *Brigadier	21	Do not apply more than 25.6 fl oz/a (0.4 lb ai/a) per season. No more than 0.5 lb ai/a bifenthrin and 0.2 lb ai/a imidacloprid are allowed per season.
	0.098–0.167 lb bifenthrin + chlorantraniliprole	5.6–9.6 fl oz *Elevest	21	Make no more than 2 applications per acre per calendar year. Minimum interval between treatments is 21 days. Do not apply more than 28.8 fl oz *Elevest insect control or 0.2 lb ai of chlorantraniliprole and 0.5 lb ai of bifenthrin-containing products per acre per calendar year.
	0.5–1.0 lb carbaryl	0.5–1.0 qt Sevin XLR Plus	7	Repeat applications as necessary up to a total of 6 times per year but not more than once every 7 days. Do not exceed 6.0 qt per crop per year. Do not apply when crop or nearby weeds are in bloom.
	0.03–0.05 lb clothianidin	1.9–2.8 fl oz Belay	14	Do not exceed 3 applications of Belay. Allow at least 7 days between treatments. Do not make a foliar application of Belay following an at-plant application of a neonicotinoid (MoA Class 4) compound.
	0.088–0.134 lb cyantraniliprole *(overhead irrigation only)*	13.5–20.5 fl oz Verimark	—	Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. Minimum reapplication interval is 5 days.
	0.2 lb cyantraniliprole + abamectin	10.0 fl oz *Minecto Pro	7	Do not apply more than 0.4 lb per calendar year of cyantraniliprole-containing products, or more than 0.056 lb per calendar year of abamectin-containing products.
	0.018–0.028 lb deltamethrin	1.5–2.4 oz *Delta Gold	3	Apply every 3 days as needed.
	0.25–0.5 lb diazinon	several formulations	35	Repeat applications as necessary. Allow at least 7 days between applications. Do not use on potatoes that will be hand harvested.
	0.05–0.33 lb dinotefuran	*foliar:* 1.0–1.5 oz Venom 70SG	7	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 4.5 oz/a per year using foliar applications, or 7.5 oz/a per season using soil applications. See product label for directions.
		soil: 6.5–7.5 oz Venom 70SG	—	
	0.05–0.07 lb dinotefuran *(foliar)*	2.0–2.75 oz Scorpion 35SL	7	Can repeat at 14-day intervals. Do not apply more than 7.75 oz per year. Use only one application method.
	0.28–0.33 lb dinotefuran *(soil)*	11.0–13.0 oz Scorpion 35SL		Do not apply more than 13.0 oz per year. Apply either as a preplant, preemergence, or at ground crack. Do not follow soil applications with foliar applications; use only one application method.

*Restricted-use pesticide.

(continued)

Insect control in potato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Potato flea beetle *(cont.)*	0.025–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	7	Do not exceed 0.35 lb ai/a per season.
	0.047 lb imidacloprid	3.75 fl oz Provado 1.6F	7	Use ground equipment only. Allow at least 7 days between applications. Regardless of the type of application, do not exceed 0.31 lb ai/a imidacloprid (Admire, Leverage 360, or Provado) per year. **There is a 12-month rotational plantback interval for all crops except those registered.**
	imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	0	Do not apply more than 15.4 fl oz/a per season and allow at least 7 days between applications.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	7	Do not apply more than 0.12 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege	14	Do not apply more than 27.0 fl oz/a Besiege per season and allow at least 7 days between applications.
	0.017–0.03 lb lambda-cyhalothrin + thiamethoxam	2.5–4.5 fl oz *Endigo ZC	14	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Do not exceed 10.0 fl oz/a Endigo ZC, or 0.12 lb ai/a of products containing lambda-cyhalothrin or 0.094 lb ai/a of products containing thiamethoxam.
	0.05–0.2 lb permethrin	*Ambush, *Pounce	14	Several formulations; see label for rate. Do not exceed 1.6 lb ai/a per season.
	spinosad	1.7–3.3 oz Blackhawk	3	Apply when pests reach or exceed established thresholds. Do not make more than two successive applications of a Group 5 material and do not apply more than 14.4 oz/a Blackhawk per crop season in potato. Do not exceed 4 applications in a year.
	0.17–0.21 lb tolfenpyrad	17.0–21.0 fl oz Torac	1	Apply by ground only, using a minimum of 20 gallons of water per acre. Do not apply by air on fruiting vegetables. Do not apply more than 42.0 fluid ounces (0.42 lb ai) per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow at least 14 days between applications. Do not make more than 4 applications per year.
	thiamethoxam	0.11–0.16 fl oz Cruiser 5FS/100 lb seed pieces	0–30	Use rate chart on label to select proper application rate. Do not exceed 0.125 lb ai/a.
		1.5–3.0 oz Actara 25WDG	14	Apply when pests reach or exceed established thresholds. Do not apply more than 6.0 oz of Actara 25WDG per acre per crop season. Actara is applied as a foliar spray.
	0.047 lb thiamethoxam + chlorantraniliprole	4.0 oz Voliam Flexi	14	Do not exceed a total of 8.0 fl oz/a Voliam Flexi or 0.094 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per growing season.
	0.01–0.025 lb zeta-cypermethrin	1.76–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	21	Do not exceed 0.2 lb ai/a per season or make more than 2 applications per season.
Potato leafhopper	*Sample nymphs and adults. Do not treat if fewer than 0.5 adults per sweep unless there are more than 2.5 nymphs per 25 leaves. If 0.5–1.0 adults per sweep, treat if they remain at the same level for 10–14 days or if nymphs are present. If 1.0–1.5 adults per sweep, treat within 5–7 days or immediately if nymphs are present. If more than 1.5 adults per sweep, treat immediately.*			

*Restricted-use pesticide.

(continued)

Insect control in potato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Potato leafhopper *(cont.)*	0.028–0.075 lb acetamiprid	1.5–4.0 oz Assail 30SG	7	Begin treatment when thresholds are reached. Apply every 7 days as needed. Do not exceed 4 applications or 0.3 lb ai/a per season.
	0.025–0.075 lb acetamiprid	0.6–1.7 oz Assail 70WP	7	
	alpha-cypermethrin	3.2–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.0125–0.022 lb beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Apply every 5 days as needed. Do not exceed 6 applications per year.
	0.075–0.096 lb bifenthrin + imidacloprid	4.8–6.14 fl oz *Brigadier	21	Do not apply more than 25.6 fl oz/a (0.4 lb ai/a) per season. No more than 0.5 lb ai/a bifenthrin and 0.2 lb ai/a imidacloprid are allowed per season.
	0.5–1.0 lb carbaryl	0.5–1.0 qt Sevin XLR Plus	0	Repeat applications as necessary up to a total of 6 times per year but not more than once every 7 days. Do not exceed 6.0 qt per crop per year. Do not apply when crop or nearby weeds are in bloom.
	0.03–0.05 lb clothianidin	1.9–2.8 fl oz Belay	14	Do not exceed 3 applications of Belay. Allow at least 7 days between treatments. Do not make a foliar application of Belay following an at-plant application of a neonicotinoid (MoA Class 4) compound.
	0.018–0.028 lb deltamethrin	1.5–2.4 oz *Delta Gold	3	Apply every 3 days as needed.
	0.25–0.5 lb dimethoate	0.5–1.0 pt Dimethoate 400EC	0	Potatoes may be mechanically harvested on day of application. Highly toxic to bees—do not apply when crop or nearby weeds are in bloom. Wait at least 7 days between treatments. Do not exceed 0.5 lb ai/a per treatment. Do not exceed 1.0 lb ai/a per year. Re-entry interval is 48 hours.
	0.05–0.33 lb dinotefuran	*foliar:* 1.0–1.5 oz Venom 70SG	7	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 4.5 oz/a per year using foliar applications, or 7.5 oz/a per season using soil applications. See product label for directions.
		soil: 6.5–7.5 oz Venom 70SG	—	
	0.05–0.07 lb dinotefuran *(foliar)*	2.0–2.75 oz Scorpion 35SL	7	Can repeat at 14-day intervals. Do not apply more than 7.75 oz per year. Use only one application method.
	0.28–0.33 lb dinotefuran *(soil)*	11.0–13.0 oz Scorpion 35SL		Do not apply more than 13.0 oz per year. Apply either as a preplant, preemergence, or at ground crack. Do not follow soil applications with foliar applications; use only one application method.
	0.015–0.05 lb esfenvalerate	2.9–9.6 fl oz *Asana XL	7	Do not exceed 0.35 lb ai/a per season.
	flupyradifurone	7.0–10.5 fl oz Sivanto	7	Foliar application. Apply when pests reach or exceed established thresholds. Do not apply more than 28.0 fl oz of Sivanto per acre per crop season.

*Restricted-use pesticide.

(continued)

Insect control in potato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Potato leafhopper *(cont.)*	0.047 lb imidacloprid	3.75 fl oz Provado 1.6F	7	Foliar application: Use ground equipment only. Allow at least 7 days between applications. Regardless of the type of application, do not exceed 0.31 lb ai/a imidacloprid (Admire or Provado) per year. **There is a 12-month rotational plantback interval for all crops except those registered.**
	imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	0	Do not apply more than 15.4 fl oz/a per season and allow at least 7 days between applications.
	0.015–0.025 lb lambda-cyhalothrin	0.96–1.6 fl oz *Warrior II	7	Do not apply more than 0.12 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	5.0–8.0 fl oz *Besiege	14	Allow at least 7 days between applications. Do not apply more than 27.0 fl oz/a Besiege per season.
	0.017–0.03 lb lambda-cyhalothrin + thiamethoxam	2.5–4.5 fl oz *Endigo ZC	14	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Do not exceed 10.0 fl oz/a Endigo ZC, or 0.12 lb ai/a of products containing lambda-cyhalothrin or 0.094 lb ai/a of products containing thiamethoxam.
	0.6–0.9 lb malathion	several formulations	0	Short residual will protect beneficial insects.
	0.45–0.9 lb methomyl	1.5–3.0 pt *Lannate LV	6	Repeat applications as necessary up to 10 times per crop. Do not exceed 15.0 pt/a per crop.
	0.1–0.2 lb permethrin	4.0–8.0 oz *Permethrin 3.2EC	14	Do not exceed 32.0 oz/a per year.
	1.0 lb phosmet	1.33 lb Imidan WP	7	Use only on potatoes to be machine harvested.
	0.047–0.71 lb sulfoxaflor	1.50–2.25 oz Transform WG	7	Do not make applications less than 14 days apart. Do not make more than four applications per crop. Do not make more than two consecutive applications per crop. Do not apply more than a total of 8.5 oz of Transform WG (0.266 lb ai of sulfoxaflor) per acre per year.
	thiamethoxam	1.5–3.0 oz Actara 25WDG	14	Apply every 7–10 days as needed. Do not exceed 6.0 oz/a per season.
		0.11–0.16 fl oz Cruiser 5FS/100 lb seed pieces	0–30	Use rate chart on label to select proper application rate. Do not exceed 0.125 lb ai/a.
	0.047 lb thiamethoxam + chlorantraniliprole	4.0 oz Voliam Flexi	14	Do not exceed a total of 8.0 fl oz/a Voliam Flexi or 0.094 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per growing season.
	0.14–0.21 lb tolfenpyrad	14.0–21.0 fl oz Torac	1	Apply by ground only, using a minimum of 20 gallons of water per acre. Do not apply by air on fruiting vegetables. Do not apply more than 42.0 fluid ounces (0.42 lb ai) per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow at least 14 days between applications. Do not make more than 4 applications per year.
	0.01–0.025 lb zeta-cypermethrin	1.76–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	21	Do not exceed 0.2 lb ai/a per season or make more than 2 applications per season.
Tarnished plant bug	*Treat when insect sweep net counts exceed an average of 1 bug/sweep.*			
	alpha-cypermethrin	3.2–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.0125–0.022 lb beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Apply every 5 days as needed. Do not exceed 6 applications per year.

*Restricted-use pesticide.

(continued)

Insect control in potato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Tarnished plant bug *(cont.)*	1.0–2.0 lb carbaryl	1.0–2.0 qt Sevin XLR Plus	7	Repeat applications as necessary up to a total of 6 times per year but not more than once every 7 days. Do not exceed 6.0 qt per crop per year. Do not apply when crop or nearby weeds are in bloom.
	0.018–0.028 lb deltamethrin	1.5–2.4 oz *Delta Gold	3	Apply every 3 days as needed.
	0.025–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	7	Do not exceed 12 applications per season.
	imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	0	Do not apply more than 15.4 fl oz/a per season and allow at least 7 days between applications.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	7	Do not apply more than 0.12 lb ai/a per season. Do not feed treated foliage to animals.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege	14	Do not apply more than 27.0 fl oz/a Besiege per season and allow at least 7 days between applications.
	0.02–0.027 lb lambda-cyhalothrin + thiamethoxam	3.0–4.0 fl oz *Endigo ZC	14	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Do not exceed 10.0 fl oz/a Endigo ZC, or 0.12 lb ai/a of products containing lambda-cyhalothrin or 0.094 lb ai/a of products containing thiamethoxam.
	0.1–0.2 lb permethrin	4.0–8.0 oz *Permethrin 3.2EC	14	Do not exceed 32.0 oz/a per year.
	0.01–0.025 lb zeta-cypermethrin	1.76–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.
	0.1 lb zeta-cypermethrin + bifenthrin	10.3 fl oz *Hero	21	Do not exceed 0.2 lb ai/a per season or make more than 2 applications per season.
Two-spotted spider mite	0.125–0.25 lb bifenazate	16.0–24.0 oz Acramite 4SC	14	Apply in at least 50 gallons of water to ensure uniform coverage and canopy penetration. Do not apply more than once per year.
	0.11–0.2 lb cyantraniliprole + abamectin	5.5–10.0 fl oz *Minecto Pro	7	Do not apply more than 0.4 lb per calendar year of cyantraniliprole-containing products, or more than 0.056 lb per calendar year of abamectin-containing products.
	I. fumosorosea (20%)	1.0–2.0 lb PFR-97	1	Repeat applications at 3- to 10-day intervals over 2–3 weeks or as needed to maintain control. Frequent application may be required under dry conditions, during periods of increased pest buildup or reproduction, or rapid host plant growth.

*Restricted-use pesticide.

(continued)

Insect control in potato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Two-spotted spider mite *(cont.)*	0.06–0.08 lb spirotetramat	2.0–2.5 fl oz Movento HL	7	Do not apply more than 0.16 lb per calendar year of spirotetramat-containing products.
Wireworms (soil treatments)	0.15–0.3 lb *Bacillus amyloliquefaciens* strain D747 + bifenthrin	12.75–25.5 fl oz *Ethos XB		Ethos is applied as incorporated treatments as a soil-incorporated broadcast, directed bed spray, or a T-band spray into the planting furrow. Do not apply more than 0.5 lb bifenthrin active ingredient per acre per season, including at-plant and foliar applications of other bifenthrin products.
	bifenthrin	*at-plant:* 19.2 oz *Brigade 2EC *lay-by:* 3.2–9.6 oz *Brigade 2EC		Apply as an in-furrow spray or T-band spray at planting. May be applied as a lay-by treatment as a banded spray over the drilled area.
		12.75–25.5 oz *Capture LFR	34 (at-plant) 35 (lay-by)	Do not exceed 0.3 lb ai/a per season as an at-plant application. Do not apply more than 0.5 lb ai/a per season including other bifenthrin products.
	4–6 lb ethoprop	2.1 lb/1,000 ft row *Mocap EC		Band in row at planting.
		40.0–60.0 lb *Mocap G		Preplant broadcast if severe infestation is likely.
	0.09–0.1 lb fipronil	2.9–3.2 oz Regent 4SC	90	Make only one in-furrow treatment. Apply as a 5- to 7-inch-wide band and cover thoroughly. See label for plantback restrictions.
	banded rate: *heavy soil*: 0.22 lb/1,000 ft row phorate *light soil*: 0.14 lb/1,000 ft row phorate	*heavy soil:* 17.3 oz *Thimet 20G, *Phorate 20G *light soil:* 11.3 oz *Thimet 20G, *Phorate 20G	90	Apply as fertilizer band treatment at planting.

*Restricted-use pesticide.

Weed control

Control potato weeds with timely cultivation and use of herbicides. Many herbicide application options exist, including preplant, drag-off, preemergence, and postemergence applications. If you hill early, spray-hill and hill-spray options are also available. Hill-spray refers to applying the herbicide immediately after hilling when potatoes are beginning to emerge. Any preemergence herbicide can be used. Spray-hill refers to application made at cracking but before emergence. Application is made at cracking and followed immediately by hilling. Herbicides requiring incorporation can be used in this option.

Relative effectiveness of potato herbicides

Target species	Dual pre	Eptam pre	Linuron pre	Matrix pre, post	Metribuzin pre, post	Poast post	Prowl pre	Treflan pre
Annual broadleaf weeds								
Black nightshade	**E***	F*	**G**	P	P	N	P	P
Carpetweed	—	—*	—*	—	**E**[a]	N	—	—*
Lady's thumb	P	F	**E**	F	**E**	N	—	P
Lambsquarters	F	**G***	**E***	F*	**E***	N	**G***	**G***
Pigweed, redroot	**G***	**G***	**E***	**E***	**E***	N	**G***	**G***
Pigweed, prostrate	—	**G***	—	**E***	—[a]	N	**G***	**G***
Purslane, common	**G**	—*	**E***	F*	**G**[b]	N	—*	**E***
Ragweed, common	F	F	**E***	F*	**E***	N	P	P
Shepherd's purse	—	—*	—	**E***	—[a]	N	—	—

Smartweed, Pennsylvania	F	F	**E***	F*	**E***	N	P	P
Velvetleaf	P	**G**	**G**	F*	**E***	N	P	P
Wild buckwheat	P	F	F	F	—	N	—	P
Annual grasses								
Barnyard grass	**E***	F*	**G***	**E***	P	**E**	**G***	**E***
Crabgrass, large	**E***	**E***	**G***	F*	**G**	**E**	**E***	**E***
Foxtail, green	**E***	**E***	**G***	**E***	**G***	**E**	**E***	**E***
Sandbur	F	—*	—	—	P	**E**	**G***	—*
Witchgrass	—*	**E***	F	—	P	**E**	**E***	**E**
Perennial grass								
Quackgrass	P	F	P	**G***	P	**G***	P	P

*Weeds listed as controlled on the herbicide's label.

Abbreviations: E = excellent; G = good; F = fair; P = poor; N = none; — = data not available; pre = preemergence treatment, post = postemergence treatment. Good and excellent ratings are set boldface.

Note: Because the performance of herbicides is affected by many variables, these ratings can only indicate the relative effectiveness. The actual performance may be better or worse than indicated in the chart.

[a] Metribuzin label lists carpetweed, jimsonweed, wild mustard, prostrate pigweed, and shepherd's purse as controlled by preemergence sprays only.

[b] Metribuzin label states preemergence treatment will suppress purslane.

Weed control in potato (See preceding table of relative effectiveness of potato herbicides.)

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	0.56–0.98 lb dimethenamid-P	*coarse soils:* 12.0–18.0 fl oz Outlook *medium- and fine-textured soils:* 14.0–21.0 fl oz Outlook	40	Make preemergence applications after drag-off or after hilling, but before weeds emerge. In cold and wet conditions, Outlook may delay emergence or stunt potatoes.
	fomesafen	Reflex	70	Reflex is prohibited from use in many areas of Wisconsin and is rate-restricted by location. Check label to determine if it can be used in your area and for use instructions.
	0.08–0.11 lb pyroxasulfone	2.5–3.25 fl oz Zidua SC		Apply to potato after planting, drag off, or hilling but prior to crop or weed emergence. In all applications ensure the seed piece and sprout/vegetation are covered by at least 2 inches of soil. Rate varies by soil texture—see label for details. Before applying to potato, verify with your local seed supplier that the variety is tolerant of Zidua.
	0.102 lb pyroxasulfone + 0.008 lb carfentrazone-ethyl	3.5 fl oz/a Anthem Flex		Apply preemergence after planting and/or hilling and prior to weed emergence. Potato vegetation must be covered by at least 2 inches of soil at application. Potato growth may be suppressed if extended periods of saturated soil occur during potato emergence. Do not apply to soils with less than 1% organic matter.
Annual grasses and some broadleaves	EPTC	Eptam 7E or registered equivalent	30	Rate varies by application timing—see label for details. May be applied and incorporated with various methods before or at planting, or postemergence. Superior may suffer early season stunting if the crop is stressed.
	0.5–1.0 lb ethalfluralin	1.33–2.67 pt Sonalan HFP		Broadcast apply and incorporate Sonalan HFP after planting but prior to crop emergence. If rain or irrigation does not incorporate within 2 days after application, mechanically incorporate. Maximum rate on coarse soils is 2.0 pt/a. Consult label for rates on other soil textures.

*Restricted-use pesticide.

(continued)

Weed control in potato *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual grasses and some broadleaves *(cont.)*	0.71–1.43 lb pendimethalin	1.5–3.0 pt Prowl H_2O		Make one preemergence application after potatoes are planted but before weeds or crop emerge. Use rate is based on soil texture. Pendimethalin is most effective if adequate rainfall or irrigation occurs within 1 week of treatment. Incorporate if moisture is inadequate. May also be applied postemergence from crop emergence to 6-inch stage and through chemigation. Do not make applications to potatoes under stress from cold/wet or hot/dry weather.
	0.74–1.49 lb pendimethalin	1.8–3.6 pt Prowl 3.3EC		
	s-metolachlor	1.0–2.0 pt Dual Magnum or Dual II Magnum		Make preemergence applications after drag-off or after hilling but before weeds emerge. Use rates vary with soil organic matter and formulation. PHI varies with type of application, so read the label carefully. Do not use on peat or muck soils. If cool wet soil conditions occur after treatment, Dual may delay maturity or reduce yield of early-maturing varieties.
	trifluralin	several manufacturers		Treat after planting but before emergence, following dragoff or after potatoes have fully emerged. May also be applied through chemigation. Controls annual grasses and some broadleaf weeds, but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Rate varies with soil texture and organic matter. Follow recommended soil preparation, application, and incorporation procedures. May injure potatoes if improperly incorporated. Must be incorporated within 24 hours. See label for plantback restrictions. Ineffective on peat and muck soils.
Annual broadleaves and some grasses	0.047 lb flumioxazin	1.5 oz Tuscany		Apply after hilling and before potato emergence when at least 2 inches of settled soil covers any potato vegetative growth. Do not apply more than 1.5 oz/a in a single application or more than 1.5 oz/a in a year. Cool temperatures or heavy rain at potato emergence may result in stunting or delayed maturity in treated fields.
	linuron	Linuron *(use and rate vary by soil type—see label)*		Linex 4L use included on a Wisconsin Special Local Needs 24c label that expires 12/31/25. Consult WDATCP special pesticide registrations website prior to using to confirm if a new 24c label has been approved. Special local needs label addresses restricted soil types, organic matter, and depth to groundwater. See label for details. Apply delayed preemergence after planting but just before potatoes emerge. Linuron can be applied in a hill-spray operation. Apply before grasses are 2 inches tall and broadleaf weeds are 6 inches tall, preferably just before or when weed seedlings emerge. If weeds are present, add 1 pt surfactant/25 gal spray mixture. In irrigated areas, apply linuron to moist soil and follow with sprinkler irrigation or rainfall within 2 weeks. Do not incorporate. More effective on annual broadleaf weeds than grasses.

*Restricted-use pesticide.

(continued)

Weed control in potato *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual broadleaves and some grasses *(cont.)*	metribuzin	See label—rate and use instructions vary.	60	Apply delayed preemergence after drag-off or hilling. Do not incorporate. Early postemergence applications are labeled for russet-type or white-skinned varieties that are not early maturing. Can be applied with sprinkler irrigation systems. Do not apply within 3 days after periods of cool, wet, or cloudy weather, or to weeds taller than 1 inch. Postemergence metribuzin treatment is not recommended for red-skinned varieties or Atlantic, Shepody, Chip Bell, Bellchip, or Centennial. Preemergence application to these varieties may also cause injury. Split applications (preemergence and early postemergence) at reduced rates are often effective and reduce potential for leaching. See label for rotation restrictions.
	0.19-0.51 lb metribuzin + 0.10-0.25 lb sulfentrazone	11-29 fl oz/a Preview 2.1 SC		Apply pre-emergence after planting and prior to potato emergence. Consult label for use rate which varies based on soil texture and organic matter. Do not use on soils classified as sand with less than 1% organic matter. Irrigation with water having a pH greater than 7.5 could result in adverse crop response.
Annual weeds and some perennial weeds	0.15–0.3 lb imazosulfuron	3.2–6.4 oz League	45	May be applied preemergence, postemergence or sequentially. Do not apply more than 6.4 oz of League Herbicide per acre per year in a maximum of 2 applications per year. Effective on yellow nutsedge and several annual weeds, but ineffective on nightshades and weeds with ALS inhibitor resistance. See label for additional restrictions.
	0.0156–0.02 lb rimsulfuron	1.0–1.5 oz Matrix	30	Apply 1.0–1.5 oz/a immediately after hilling or dragoff, or postemergence to young, actively growing weeds. Depending on soil type, rainfall or irrigation of 1/3 to 1 inch is needed within 5 days after application for activation. For postemergence applications, allow at least 4 hours drying time after application. Sequential applications are allowed up to a total of 2.5 oz/a. Check the label for crop rotation guidelines. Do not use on potatoes grown for seed if grown from microtubers or transplants.
Emerged weeds	glyphosate	several manufacturers and formulations		See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. Glyphosate may be applied any time before crop emerges. Apply before crop germination in coarse sandy soils. If weeds have been mowed or tilled, wait until they resume active growth and reach the recommended stage on the label. Unless otherwise stated, allow 7 or more days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified.
	*paraquat *(rate varies by label)*	several manufacturers and formulations, not all are registered for this use		Make application up to cracking. Always add crop oil concentrate or non-ionic surfactant to spray mixture. Follow precautions on label. In preplant and preemergence (to the crop) uses, do not apply to soils lacking clay minerals (i.e., muck, pure sand).
Emerged grasses	0.068–0.24 lb clethodim	9.0–32.0 oz Select Max	30	Apply to actively growing grasses. Repeat treatments may be made at 14-day intervals up to the maximum annual use rate. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by product label. Do not apply if rain is expected within 1 hour.
	clethodim	several manufacturers and formulations	30	

*Restricted-use pesticide.

(continued)

Weed control in potato *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
	0.19–0.48 lb sethoxydim	1.0–2.5 pt Poast	30	Make applications to actively growing grasses within the size ranges indicated on the label. Check the label for wild proso millet and rescue treatment rates. Do not exceed 5 pt/a Poast in one crop season. Consult label for rate and adjuvant instructions for specific weeds. Specific tank-mix restrictions for potato included on label, including longer preharvest intervals.

*Restricted-use pesticide.

Pumpkin & squash

Planting

Most commercial growers start pumpkin and squash from seed. Delay planting until danger of frost is past and soils have warmed to at least 60°F. Planting generally begins around May 10 in southern Wisconsin and June 1 in northern Wisconsin. Pumpkin and squash are sensitive to transplanting. Plants are typically started in individual containers 3–4 weeks before transplanting in the field—May 20 in southern Wisconsin and June 1 in northern counties. Using too small a container or allowing the plants to grow too large before transplanting can impair root growth in the field.

Bush types

Rows: 24–48 inches.

Plants in row: 36–60 inches apart.

Vine types

Rows: 36–96 inches.

Plants in row: 36–60 inches apart.

Pollination

Pumpkins and squash have male and female flowers that are pollinated by insects, typically bees. To protect pollinators, insecticide applications should not be made during the day while they are active.

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 6.0 on mineral soils and 5.6 on organic soils.

Fertilizer rates: Apply P_2O_5 and K_2O according to soil test recommendations. Use annual nitrogen, P_2O_5, and K_2O recommendations in the table below. Increase the rates shown below by 20% for high-yielding pumpkins. Take credits for previous legume crops and manure.

Application: Broadcast lime and fertilizer and work into the soil before planting. Apply fertilizer at planting time in a band 2 inches to the side and 2 inches below seed level.

Nitrogen: Split nitrogen recommendation into two or more applications during the season. Make the first application when plants have two or more true leaves. Make a second application when vines begin to fill the rows. Subsequent applications (15–20 lb N/a each) can be made at 10- to 14-day intervals after harvest has started. Excess nitrogen can delay maturity and result in green pumpkins.

Annual nitrogen, phosphate, and potash recommendations for pumpkin and squash

	Nitrogen		Phosphate and potash		
Crop	Organic matter (%)	Amount to apply (lb/a)	Yield goal (t/a)	Amount P_2O_5 to apply* (lb/a)	Amount K_2O to apply* (lb/a)
Pumpkin	<2	100	15–20	50	110
	2.0–9.9	80			
	10–20	60			
	>20	30			
Squash	<2	80	12–16	40	90
	2.0–9.9	60			
	10–20	40			
	>20	20			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Disease control in pumpkin and squash

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Angular leaf spot *(Pseudomonas)*	copper hydroxide	1.33 pt Champ Formula 2 Flowable	0	Do not apply more than 14.4 pt product per year.
	fixed copper	1.5–2.0 qt Copper-Count-N 1.0–2.25 lb Kocide 2000 DF 0.5–1.25 lb Kocide 3000	0 0 0	Use disease-free seed and rotate crops.
Anthracnose and other foliar diseases (see label)	azoxystrobin	11.0–15.5 fl oz Aframe, AzoxyStar, Equation, Quadris Flowable	1	Equation, Quadris, and Cabrio belong to the Group 11 (strobilurin) category of fungicides; Quadris Opti contains Groups 11 and M5 fungicides; and Tanos contains Groups 11 and 27 fungicides. Do not exceed 1 application of any of these products before alternating with a fungicide having a different mode of action. Do not exceed 4 applications of strobilurin fungicides per year. Do not exceed 1.92 qt/a Quadris or Equation, 2.0 gal/a Quadris Opti, 32.0 oz/a Tanos, or 64.0 oz/a Cabrio per season.
	azoxystrobin + chlorothalonil	3.2 pt Quadris Opti	1	
	azoxystrobin + difenoconazole	12.0–14.0 fl oz Quadris Top	1	
	famoxadone + cymoxanil	8.0 oz Tanos	3	
	fluoxastrobin	3.0–5.7 fl oz Aftershock, Evito	1	Tanos must be tank mixed with a contact fungicide such as mancozeb, chlorothalonil, or a copper-containing fungicide. Do not tank mix Quadris, Equation, Quadris Opti, or Cabrio with additives or adjuvants.
	pyraclostrobin	12.0–16.0 oz Cabrio EG	0	
	boscalid + pyraclostrobin	12.5–18.5 oz Pristine WDG	0	Pristine belongs to Groups 7 (anilide) and 11 (strobilurin) fungicide categories. Do not exceed 1 application of Pristine before alternating to a labeled fungicide with a different mode of action not in Group 7 or 11. Do not exceed 4 applications of Pristine or other Group 7 or Group 11 fungicides per season. Do not exceed 74.0 oz/a Pristine per season.
	chlorothalonil	*Anthracnose:* 1.5–2.0 pt Bravo Weather Stik, Echo 720, Equus 720 1.4–1.8 lb Bravo Ultrex 82.5WDG, Equus DF 1.3–1.6 lb Echo 90DF 2.25–2.75 pt Bravo Zn, Echo Zn, Equus 500 Zn *Alternaria:* 2.0–3.0 pt Bravo Weather Stik, Echo 720, Equus 720 1.8–2.7 pt Bravo Ultrex WDG, Equus DF 1.6–2.5 lb Echo 90DF 2.75–4.25 pt Bravo Zn, Echo Zn, Equus 500 Zn	 0 0 0 0 0 0 0 0	Use in sufficient water to obtain adequate coverage. Begin application when plants are in first true leaf stage or when conditions are favorable for disease development.
	chlorothalonil + cymoxanil	1.9–3.0 pt Ariston	3	Apply before infection and repeat at 7-day intervals.
	cyprodinil + difenoconazole	16.0–20.0 fl oz Inspire Super	7	Apply no more than 80.0 fl oz/a per season. Make no more than 2 sequential applications before alternating to a fungicide with a different mode of action.
	difenoconazole + benzovindiflupyr	10.5–13.5 fl oz Aprovia Top	0	Do not apply to greenhouse peppers. Do not apply more than 53.6 oz per year.

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Disease control in pumpkin and squash *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Anthracnose and other foliar diseases *(cont.)*	fenamidone	5.5 fl oz Reason 500 SC	14	**For Alternaria leaf blight only.** Reason belongs to the Group 11 (strobilurin) fungicide category. Do not exceed 1 application of Reason or other Group 11 materials before alternating with a fungicide having a different mode of action. Do not exceed 4 applications of Group 11 fungicides per year. Do not exceed 22.0 fl oz/a Reason per season. Following the last application of Reason 500 SC, wait 30 days before planting wheat and 1 year for all other crops.
	fluopyram + trifloxystrobin	7.6 fl oz Luna Sensation	0	Make no more than 4 applications per year. Do not apply more than 27.1 fl oz/a per season.
	fluoxastrobin	*Alternaria:* 3.0–5.7 fl oz Evito 480 SC	1	Begin application preventively. Use higher rates when disease pressure is high.
	fluxapyroxad + pyraclostrobin	4.0–5.5 fl oz Merivon	0	Make no more than 3 applications per acre per year. Follow resistance management guidelines.
	hydrogen dioxide	1:100–1:2000 dilution OxiDate	0	See label for specific cucurbit application instructions. Can be used on certified organic operations.
	mancozeb	1.6–2.4 qt Dithane F-45, Manzate Flowable, Penncozeb 4FL 1.5–3.0 lb Penncozeb 75DF, Penncozeb 80WP 2.0–3.0 lb Dithane DF Rainshield, Dithane M45, Koverall, Manzate Pro-Stick	5 5 5	For use on summer squash only. Consult label for seasonal product use limits. Spray every 5–10 days depending on disease and weather pressures.
	thiophanate methyl	0.2–0.4 lb Thiophanate methyl 85WDG 0.5 lb Topsin M 70WSB	0	
	zoxamide + chlorothalonil	36.0 fl oz Zing	0	For downy mildew management. Follow resistance management guidelines.
Bacterial wilt *(Erwinia)*	*Control the cucumber beetles that carry this pathogen (see Insect Control table).*			
Black rot *(Didymella)*	*See chemical recommendations for anthracnose. Use disease-free seed and practice long rotations with crops other than cucurbits. Destroy infected plant refuse at the end of the growing season. Handle storage squash and pumpkins carefully to avoid scratches or injuries to the rind.*			
Downy mildew *(Pseudoperonospora cubensis)* **and Phytophthora blight or crown rot** *(Phytophthora capsici)*	ametoctradin + dimethomorph	14.0 fl oz Zampro	0	Make no more than 2 sequential applications before alternating to a different mode of action. Do not apply more than 42.0 fl oz/a Zampro per season.
	cyazofamid	2.75 fl oz Ranman 400SC	0	Do not apply more than six sprays or 16.5 fl oz/a per year. Alternate Ranman (Group 21) sprays with a fungicide having a different mode of action. Crops not listed on the label should not be planted within 30 days after the last application.
	cymoxanil	*downy mildew:* 3.2–5.0 oz Curzate 60DF	3	Apply no more than 30.0 oz per 12-month period. Use Curzate only in combination with a labeled rate of a protectant fungicide such as products containing mancozeb, copper hydroxide, or chlorothalonil.

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Disease control in pumpkin and squash *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Downy mildew and Phytophthora blight or crown rot *(cont.)*	dimethomorph	6.0 oz Forum	0	Do not exceed 30.0 oz/a or 5 applications per season. Do not make more than 2 sequential applications of Forum before alternating to another effective fungicide with a different mode of action for at least 1 application.
	ethaboxam	8.0 fl oz Elumin	2	Do not apply more than 16.0 fl oz per acre per year. Do not apply sequentially.
	famoxadone + cymoxanil	*downy mildew:* 8.0 oz Tanos *Phytophthora:* 8.0–10.0 oz Tanos	3 3	Do not make more than 1 application of Tanos before alternating with a fungicide having a different mode of action. Do not make more than 4 applications of Tanos or other Group 11 fungicides per season and do not alternate Tanos with other Group 11 fungicides. Do not exceed 32.0 oz/a Tanos per crop per season. Tanos is helpful for suppressing Phytophthora blight. Tanos must be tank mixed with a contact fungicide such as mancozeb, chlorothalonil, or a copper-containing fungicide.
	fluazinam	0.75–1.5 pt Omega 500F	7	Do not exceed 4 applications of Omega 500F at a rate of 1.5 pt/a.
	fluopicolide	3.0–4.0 fl oz Presidio	2	Tank mix this product with another labeled non–Group 43 fungicide.
	fosetyl-al	2.5–5.0 lb Aliette WDG, Linebacker	12 hr	Begin applications when conditions favor disease. The lower rates of Aliette WDG (2.0–3.0 lb) can be used when tank mixed with another fungicide (other than copper) labeled for downy mildew control.
	mandipropamid	8.0 fl oz Revus	0	Make no more than 1 application before switching to another effective non–Group 40 fungicide.
	oxathiapiprolin	2.0–4.8 fl oz Orondis Opti A, Orondis Ultra A *Phytophthora crown and fruit rot only:* 2.4–19.2 fl oz Orondis Gold 200	0	Make no more than 2 sequential applications before rotating to a fungicide with a different mode of action. Do not exceed 19.2 fl oz/a per year. Begin foliar applications prior to disease development. Do not use Orondis Ultra A as a foliar application if you have already used Orondis Gold 200 on the soil at time of planting. Soil applications of Orondis Gold 200 are to be applied at-plant, in-furrow, or by drip irrigation treatment only.
	phosphorous acid, mono- and dibasic sodium, potassium, and ammonium salts	2.5–5.0 pt Phostrol	0	Do not exceed 7 applications/a per season. Begin applications when conditions favor disease.
	potassium phosphite	1.0–3.0 qt Fosphite/100 gal water	0	Do not apply at intervals less than 3 days. Do not apply to heat- or moisture-stressed plants.
	propamocarb hydrochloride	1.2 pt Previcur Flex or 0.6–1.2 pt Previcur Flex *plus* tank-mix partner (protectant)	2	Do not apply more than 6 pt/a Previcur Flex per season.
	zoxamide + chlorothalonil	36.0 fl oz Zing	0	For downy mildew management. Follow resistance management guidelines.

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Disease control in pumpkin and squash *(continued)*

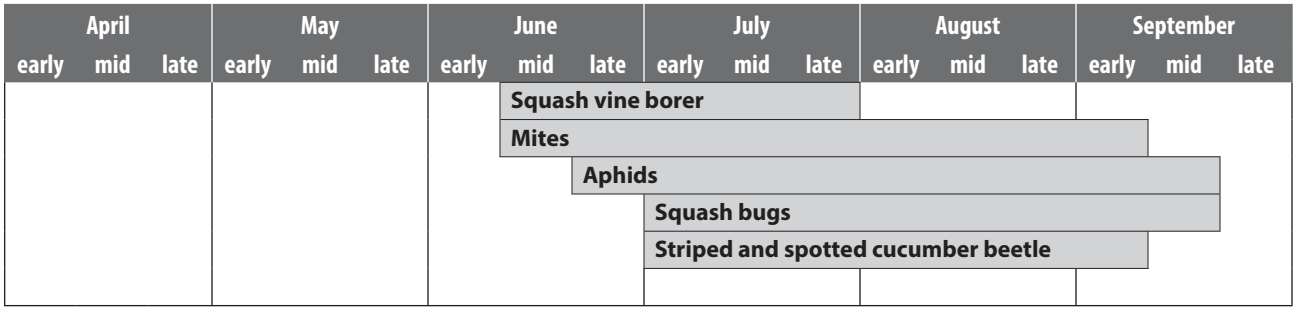
Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Downy mildew and Phytophthora blight or crown rot *(cont.)*	zoxamide + mancozeb	1.5–2.0 lb Gavel 75DF	5	For use on squash and pumpkin. Do not exceed 8 applications or apply more than 16.0 lb/a product (10.67 lb mancozeb or 1.33 lb zoxamide) per season.
Mosaic	*Plant resistant varieties.*			
Powdery mildew	azoxystrobin	11.0–15.5 fl oz Aframe, AzoxyStar, Equation, Quadris Flowable, Satori	1	Equation, Quadris, Cabrio, and Flint belong to the Group 11 (strobilurin) category of fungicides. Quadris Opti contains a combination of Groups 11 and M5 fungicides. Do not exceed 1 application of any of these products before alternating with a fungicide having a different mode of action. Do not exceed 4 applications of strobilurin fungicides per year. Do not exceed 64.0 oz/a Cabrio, 8.0 oz/a Flint, 1.92 qt/a Quadris or Equation, or 2 gal/a Quadris Opti per season. Do not tank mix Cabrio, Flint, Quadris, Equation, or Quadris Opti with additives or adjuvants.
	azoxystrobin + chlorothalonil	3.2 pt Quadris Opti	1	
	pyraclostrobin	12.0–16.0 oz Cabrio EG	0	
	trifloxystrobin	1.5–2.0 oz Flint	0	
	boscalid + pyraclostrobin	12.5–18.5 oz Pristine WDG	0	Pristine belongs to Group 7 and Group 11 (strobilurin) fungicide categories. Do not exceed 2 sequential applications before alternating to a labeled fungicide with a different mode of action. Do not exceed 4 applications of Pristine or other Group 7 or 11 fungicides per season. Limit of 74.0 oz/a per season.
	clarified hydrophobic extract of neem oil	0.5–1.0% Trilogy in 25–100 gal water *or* 2.0 pt in at least 5 gal water	0	Do not apply more than 2 gal of Trilogy/a. OMRI-approved.
	cyflufenamid	3.4 oz Torino	0	Do not make more than 2 applications per year. Do not apply more than once every 7 days. Do not exceed total of 6.8 oz/a product per year.
	cyprodinil + fludioxonil	11.0–14.0 oz Switch 62.5WG	1	Do not apply more than 56.0 oz/a Switch per season. After 2 applications, alternate with a fungicide with a different mode of action for 2 applications.
	difenoconazole + benzovindiflupyr	10.5–13.5 fl oz Aprovia Top	0	Do not apply to greenhouse peppers. Do not apply more than 53.6 oz per year.
	fluopyram	6.5–6.84 fl oz Velum Prime	0	Also labeled for nematode suppression. Do not apply more than 13.7 fl oz of Velum Prime per acre per year. Fluopyram usage should be considered as total of soil and foliar applications (no more than 0.446 lb fluopyram).
	fluopyram + tebuconazole	6.0–17.0 fl oz Luna Experience	7	A mild yellowing on leaf margins is sometimes noted following application.
	fluopyram + trifloxystrobin	4.0–7.6 fl oz Luna Sensation	0	Do not apply more than 27.1 fl oz/a per season.
	flutriafol	10.0–14.0 fl oz Topguard	0	Follow resistance management guidelines.
	kresoxim-methyl	3.2–4.8 oz Sovran	0	Do not exceed 19.2 oz/a per season. Consult label for comments on adjuvant usage.
	metrafenone	15.4 fl oz Vivando	0	Make no more than 3 applications per year.
	myclobutanil	2.5–5.0 oz Rally 40WSP	0	Do not exceed 1.5 lb/a product (0.6 lb ai/a) per year. Observe a 30-day plantback interval between the last application and planting new crops. (Formerly Nova.) Resistance has been noted in WI.

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Disease control in pumpkin and squash *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Powdery mildew *(cont.)*	neem oil	0.5–1.0% Trilogy in 25–100 gal water	0	Has fungicide and miticide benefits. Organic (OMRI) approved.
	penthiopyrad	12.0–16.0 fl oz Fontelis	1	For disease control in greenhouse cucurbits, use at a rate range of 0.375–0.5 fl oz per gallon of spray per 1,360 sq ft. These rates equal field rates of 12.0–16.0 fl oz/a. Make no more than 2 sequential applications before switching to a fungicide with a different mode of action. Do not apply more than 67.0 fl oz/a per year.
	potassium bicarbonate	2.5–5.0 lb Kaligreen	1	Use higher rates when disease pressure is high. Apply at first sign of disease for best results.
	quinoxyfen	4.0–6.0 fl oz Quintec	3	Do not apply more than 32.0 fl oz Quintec per calendar year. Under certain environmental conditions, Quintec may cause leaf spotting or chlorosis. If symptoms occur after applying Quintec, discontinue use.
	sulfur	various, depending on product and formulation	0	Do not apply to sensitive crops. Do not apply during hot weather. Do not use within 2 weeks of an oil treatment. Consult with processor prior to use.
	tebuconazole	4.0–6.0 fl oz Folicur 3.6 F, Monsoon, Onset 3.6L, Orius 3.6F, Tebusha 3.6FL, TebuStar 3.6L, Tebuzol 3.6F, Toledo	7	Do not exceed 24.0 fl oz/a per season.
	thiophanate methyl	0.5 lb Topsin M 70W, Topsin M WSB 10.0 fl oz Topsin 4.5FL 0.2–0.4 lb Thiophanate methyl WDG	0 0	Apply when disease first appears and repeat if needed every 7–14 days.
	triflumizole	4.0–8.0 oz Procure 50WS 4.0–8.0 fl oz Procure 480 SC	0	Do not exceed 40.0 oz/a of Procure 50WS or 40.0 fl oz/a of Procure 480 SC per season. See product label for plantback restrictions for leafy vegetables (30 days), root vegetables (60 days), and all other crops (1 yr).
Seed rot and damping-off	captan thiram			Plant seed that has been pretreated with Captan or Thiram.

Scouting calendar for insect pests of pumpkin and squash



Insect control in pumpkin and squash

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Bean aphid and soybean aphid	alpha-cypermethrin	3.4–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.088 lb cyantraniliprole + 0.019 lb abamectin	10.0 fl oz *Minecto Pro	7	Minimum application interval of 7 days. Maximum annual rate of 20.0 fl oz/a per calendar year (0.18 lb ai/a of cyantraniliprole and 0.038 lb ai/a of abamectin). Do not apply more than 0.4 lb ai/a per calendar year of cyantraniliprole-containing products including all application types (seed treatment, soil, foliar). Do not apply more than 0.056 lb ai/a per calendar year of abamectin-containing products including all application types (seed treatment, soil, foliar).
	flupyradifurone	*foliar:* 7.0–12.0 fl oz Sivanto *soil:* 21.0–28.0 fl oz Sivanto	1 21	Apply when pests reach or exceed established thresholds. Do not apply more than 28.0 fl oz of Sivanto per acre per crop season.
	I. fumosorosea (20%)	1.0–2.0 lb PFR-97	1	Repeat applications at 3- to 10-day intervals over 2–3 weeks or as needed to maintain control. Frequent application may be required under dry conditions, during periods of increased pest buildup or reproduction, or rapid host plant growth.
	lambda-cyhalothrin + chlorantraniliprole	9.0 fl oz *Voliam Xpress	1	Allow at least 5 days between applications. Do not apply more than 31.0 fl oz/a Voliam Xpress per season.
	spirotetramat	4.0–5.0 fl oz Movento	1 (edible) 7 (dry)	Do not apply more than 10.0 fl oz/a per season and allow at least 7 days between applications.
	0.023 lb sulfoxaflor	0.75 oz Transform WG	1	Do not make applications less than 7 days apart. Do not make more than four applications per crop. Do not make more than two consecutive applications per crop. Do not apply more than a total of 8.5 oz of Transform WG (0.266 lb ai of sulfoxaflor) per acre per year.
	0.17–0.21 lb tolfenpyrad	17.0–21.0 fl oz Torac	1	Apply by ground only, using a minimum of 20 gallons of water per acre. Do not apply by air on curcurbits. Do not apply more than 42.0 fluid ounces (0.42 lb ai) per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow at least 14 days between applications. Do not make more than 4 applications per year.
Cucumber beetle (striped, spotted)	*Treat when there are more than four to five adults per 50 plants. If the plants are not touching within the row, treatment is justified if the field averages more than five beetles per plant.*			
	0.047–0.1 lb acetamiprid 0.05–0.1 lb acetamiprid	2.5–5.3 oz Assail 30SG 1.1–2.3 oz Assail 70WP	0 0	Begin treatment when thresholds are reached. Apply every 5 days as needed. Do not exceed 5 applications or 0.5 lb ai/a per season.
	alpha-cypermethrin	3.0–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.

*Restricted-use pesticide.

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Insect control in pumpkin and squash *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cucumber beetle *(cont.)*	beta-cyfluthrin	2.4–2.8 fl oz *Baythroid XL	0	Maximum Baythroid XL allowed per 7-day interval is 2.8 fl oz/a and season total allowed per crop season is 16.8 fl oz/a.
	bifenthrin	2.6–6.4 fl oz *Brigade 2EC	3	Treat every 7 days as needed. Do not exceed 0.3 lb ai/a per season. Do not make more than 2 applications after bloom.
		6.8–8.5 fl oz *Capture LFR	21	Do not exceed 0.1 lb ai/a as an at-plant application; do not exceed 0.3 lb ai/a per season of all bifenthrin products.
	bifenthrin + zeta-cypermethrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
	1.0 lb carbaryl	1.0 qt Sevin XLR Plus	3	Repeat applications as necessary up to a total of 6 times per year but not more than once every 7 days. Do not exceed 6.0 qt per crop per year. Do not apply when crop or nearby weeds are in bloom.
	clothianidin	*foliar:* 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		soil: 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a sidedress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
	0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold	3	Apply every 3 days as needed. Do not exceed 14.4 fl oz/a per season.
	0.045–0.268 lb dinotefuran	*foliar:* 1.0–4.0 oz Venom 70SG *soil:* 5.0–6.0 oz Venom 70SG	1 21	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 6.0 oz/a per year using foliar applications, or 12.0 oz/a per season using soil applications. See product label for application directions.
	0.2–0.3 lb fenpropathrin	10.66–16.0 oz *Danitol 2.4EC	7	Do not exceed 2.66 pt/a Danitol (0.8 lb ai/a) per season. Control may be improved by the addition of a non-ionic surfactant.
	imidacloprid	7.0–10.5 fl oz Admire Pro	21	Apply in a narrow band centered on plant row within 14 days before planting or as an in-furrow treatment during planting. Do not exceed 0.38 lb ai/a per season.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	1	Do not exceed a total of 31.0 fl oz/a of Voliam Xpress or 0.18 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per season.

*Restricted-use pesticide.

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Insect control in pumpkin and squash *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cucumber beetle *(cont.)*	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.9–1.75 lb malathion	several formulations	3 (pumpkin) 1 (squash)	Do not apply before vining or to wet plants.
	0.45–0.9 lb methomyl	1.5–3.0 pt *Lannate LV		Squash only. Repeat application as necessary up to 12 times per crop. Do not exceed 18.0 pt/a per crop.
	0.1–0.2 lb permethrin	4.0–8.0 oz *Permethrin 3.2EC	0	Do not apply more than 48.0 oz/a per year.
	thiamethoxam	3.0–5.5 oz Actara 25WDG 5.0–11.0 fl oz Platinum 2SC 1.66–3.67 oz Platinum 75SG	0 30 30	Do not apply more than 11.0 oz of Actara 25WDG or Platinum 2SC and no more than 3.67 oz Platinum 75SG per acre per crop season and apply sufficient water volume after in-ground application to ensure incorporation into the seed zone. Actara is applied as a foliar spray.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of products containing thiamethoxam or 0.2 lb ai/a of products containing chlorantraniliprole per season.
	0.21 lb tolfenpyrad	21.0 fl oz Torac	1	Apply by ground only, using a minimum of 20 gallons of water per acre. Do not apply by air on curcurbits. Do not apply more than 42.0 fluid ounces (0.42 lb ai) per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow at least 14 days between applications. Do not make more than 4 applications per year.
	0.02–0.025 lb zeta-cypermethrin	2.8–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.
Cutworms and loopers	alpha-cypermethrin	1.4–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	beta-cyfluthrin	0.8–2.4 fl oz *Baythroid XL	0	Maximum Baythroid XL allowed per 7-day interval is 2.8 fl oz/a and season total allowed per crop season is 16.8 fl oz/a.
	bifenthrin	2.6–6.4 fl oz *Brigade 2EC	3	Treat every 7 days as needed. Do not exceed 0.3 lb ai/a per season. Do not make more than 2 applications after bloom.
		6.8–8.5 fl oz *Capture LFR	21	Do not exceed 0.1 lb ai/a as an at-plant application; do not exceed 0.3 lb ai/a per season of all bifenthrin products.
	bifenthrin + zeta-cypermethrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
	1.0 lb carbaryl	Sevin Bait (several formulations)	0	Broadcast when cutworms are present in damaging numbers.

*Restricted-use pesticide.

(continued)

Insect control in pumpkin and squash *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cutworms and loopers *(cont.)*	chlorantraniliprole	3.5–7.5 fl oz Coragen	1	Do not make more than 4 applications per crop season and allow at least 3 days between applications. Do not apply more than 15.4 fl oz/a Coragen per season.
	0.088–0.176 lb cyantraniliprole *(soil)*	6.75–13.5 fl oz Verimark	1	Do not apply more than 13.5 fl oz/a Verimark per crop per season. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6. Minimum application interval between foliar sprays is 5 days.
	0.065–0.11 lb cyantraniliprole *(foliar)*	10.0–17.0 fl oz Exirel	1	
	0.15–0.2 lb cyantraniliprole + abamectin	7.5–10.0 fl oz *Minecto Pro	7	Do not apply more than 0.4 lb per calendar year of cyantraniliprole-containing products, or more than 0.056 lb per calendar year of abamectin-containing products.
	0.012–0.028 lb deltamethrin	1.0–2.4 fl oz *Delta Gold	3	Apply every 3 days as needed. Do not exceed 14.4 fl oz/a per season.
	0.05–0.18 lb dinotefuran *(foliar)*	2.0–7.0 oz Scorpion SL	1	Can repeat at 7-day intervals. Do not apply more than 10.5 oz per year.
	0.132–0.179 lb dinotefuran	3.0–4.0 oz Venom 70SG	1	Do not apply more than 6.0 oz/a per year using foliar applications. See product label for application directions.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Spray when cutworms are present in damaging numbers.
	0.03–0.045 lb flubendiamide	2.0–3.0 oz Synapse WG	1	Do not apply more than 3.0 oz/a (0.045 lb ai/a) in a 7-day period or 9.0 oz/a per season.
	flubendiamide + buprofezin	12.0–17.0 fl oz Vetica	7	Do not apply more than 38.0 fl oz/a per season and allow at least 7 days between applications. Do not make more than 3 applications per crop season.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	1	Do not exceed a total of 31.0 fl oz/a of Voliam Xpress or 0.18 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.1–0.2 lb permethrin	4.0–8.0 oz *Permethrin 3.2EC	0	Do not apply more than 48.0 oz/a per year.
	0.01–0.025 lb zeta-cypermethrin	1.28–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.
Melon aphid	0.047–0.075 lb acetamiprid	2.5–4.0 oz Assail 30SG	0	Begin treatment when thresholds are reached. Apply every 5 days as needed. Do not exceed 5 applications or 0.5 lb ai/a per season.
	0.05–0.075 lb acetamiprid	1.1–1.7 oz Assail 70WP	0	

*Restricted-use pesticide.

(continued)

Insect control in pumpkin and squash *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Melon aphid *(cont.)*	alpha-cypermethrin	3.4–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.04–0.10 lb bifenthrin	2.6–6.4 fl oz *Brigade 2EC	3	Treat every 7 days as needed. Do not exceed 0.3 lb ai/a per season. Do not make more than 2 applications after bloom.
	bifenthrin + zeta-cypermethrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
	clothianidin	*foliar:* 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		soil: 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a sidedress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
	0.088–0.176 lb cyantraniliprole *(soil)*	6.75–13.5 fl oz Verimark	1	Do not apply more than 13.5 fl oz/a Verimark per crop per season. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6. Minimum application interval between foliar sprays is 5 days.
	0.088–0.133 lb cyantraniliprole *(foliar)*	13.5–20.5 fl oz Exirel	1	
	0.2 lb cyantraniliprole + abamectin	10.0 fl oz *Minecto Pro	7	Do not apply more than 0.4 lb per calendar year of cyantraniliprole-containing products, or more than 0.056 lb per calendar year of abamectin-containing products.
	0.25–0.75 lb diazinon	several formulations	3 (winter squash) 7 (summer squash)	Apply as soon as aphids are noticed.
	0.062–0.089 lb flonicamid	2.0–2.8 oz Beleaf SG	0	Begin applications before aphid populations build. Do not exceed 2.8 oz/a Beleaf per application and do not apply more than 8.4 oz/a (0.267 lb ai/a) per season.
	flupyradifurone	*foliar:* 10.5–14.0 fl oz Sivanto *soil:* 21.0–28.0 fl oz Sivanto	1 21	Apply when pests reach or exceed established thresholds. Do not apply more than 28.0 fl oz of Sivanto per acre per crop season.
	I. fumosorosea (20%)	1.0–2.0 lb PFR-97	1	Repeat applications at 3- to 10-day intervals over 2–3 weeks or as needed to maintain control. Frequent application may be required under dry conditions, during periods of increased pest buildup or reproduction, or rapid host plant growth.

*Restricted-use pesticide.

(continued)

Insect control in pumpkin and squash *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Melon aphid *(cont.)*	imidacloprid	7.0–10.5 fl oz Admire Pro	21	Apply in a narrow band centered on plant row within 14 days before planting or as an in-furrow treatment during planting. Do not exceed 0.38 lb ai/a per season.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.
	lambda-cyhalothrin + chlorantraniliprole	9.0 fl oz *Voliam Xpress	1	Do not exceed a total of 31.0 fl oz/a of Voliam Xpress or 0.18 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	1.0–2.0 lb malathion	several formulations	3 (pumpkin) 1 (squash)	Do not apply before vining or when plants are wet.
	pymetrozine	2.75 oz Fulfill 50WDG	14	Controls melon and green peach aphids. Treat when aphids first appear. May repeat in 7 days. Do not exceed 5.5 oz/a per season or more than 2 applications per crop.
	thiamethoxam	1.5–3.0 oz Actara 25WDG 5.0–11.0 fl oz Platinum 2SC 1.66–3.67 oz Platinum 75SG	0 30 30	Do not apply more than 11.0 oz of Actara 25WDG or Platinum 2SC and no more than 3.67 oz Platinum 75SG per acre per crop season and apply sufficient water volume after in-ground application to ensure incorporation into the seed zone. Actara is applied as a foliar spray.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of products containing thiamethoxam or 0.2 lb ai/a of products containing chlorantraniliprole per season.
	0.17–0.21 lb tolfenpyrad	0.17–21.0 fl oz Torac	1	Apply by ground only, using a minimum of 20 gallons of water per acre. Do not apply by air on curcurbits. Do not apply more than 42.0 fluid ounces (0.42 lb ai) per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow at least 14 days between applications. Do not make more than 4 applications per year.
	0.02–0.025 lb zeta-cypermethrin	2.8–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.
Seed corn maggot	0.04–0.08 lb bifenthrin	3.4–6.8 oz *Capture LFR	—	Apply as a 5- to 7-inch band over an open furrow or in-furrow with the seed. Do not apply more than 0.1 lb/a Capture LFR per season as an at-plant application.
	0.13–0.176 lb cyantraniliprole *(soil)*	10.0–13.5 fl oz Verimark	1	Do not apply more than 13.5 fl oz/a Verimark per crop per season. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6.

*Restricted-use pesticide.

(continued)

Insect control in pumpkin and squash *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Spider mite	0.938–1.88 lb abamectin	8.0–16.0 fl oz *Agri-Mek 0.15EC	7	May repeat after 7 days, but do not make more than two sequential treatments or exceed 5.64 lb ai/a per year.
	bifenazate	0.75–1.0 lb Acramite 50WS	3	Limit of 1 application per season.
	0.08–0.10 lb bifenthrin	5.12–6.4 fl oz *Brigade 2EC	3	Apply before insects reach threshold levels. May repeat after 7 days. Do not apply more than twice after bloom or exceed 0.3 lb ai/a per season.
	bifenthrin + zeta-cypermethrin	10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
	0.11–0.2 lb cyantraniliprole + abamectin	5.5–10.0 fl oz *Minecto Pro	7	Do not apply more than 0.4 lb per calendar year of cyantraniliprole-containing products, or more than 0.056 lb per calendar year of abamectin-containing products.
	0.2 lb fenpropathrin	10.0–66.0 fl oz *Danitol 2.4EC	7	Treat when mites first appear and repeat every 7 days as needed. Do not exceed 0.8 lb ai/a per season.
	I. fumosorosea (20%)	1.0–2.0 lb PFR-97	1	Repeat applications at 3- to 10-day intervals over 2–3 weeks or as needed to maintain control. Frequent application may be required under dry conditions, during periods of increased pest buildup or reproduction, or rapid host plant growth.
	lambda-cyhalothrin + thiamethoxam	4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	1.5–2.0 lb malathion	several formulations	3 (pumpkin) 1 (squash)	Do not apply before vining or to wet plants.
	spiromesifen	7.0–8.5 fl oz Oberon 2 SC	7	Apply every 7 days as needed. Do not exceed 25.5 fl oz/a per season.
Squash bug	*Check undersides of leaves for squash bug eggs laid in neat rows. Eggs hatch within 1–2 weeks. Treat when squash bugs are young; they are difficult to control as older nymphs or adults. At early flowering, treat if you find more than one egg mass per plant. Destroy crop residue in fall to reduce overwinter survival of this pest.*			
	0.10 lb acetamiprid	5.3 oz Assail 30SG 2.3 oz Assail 70WP	0 0	Begin treatment when thresholds are reached. Apply every 5 days as needed. Do not exceed 5 applications or 0.5 lb ai/a per season.
	alpha-cypermethrin	3.0–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.04–0.10 lb bifenthrin	2.6–6.4 fl oz *Brigade 2EC	3	Treat every 7 days as needed. Do not exceed 0.3 lb ai/a per season. Do not make more than 2 applications after bloom.
	bifenthrin + zeta-cypermethrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.

*Restricted-use pesticide.

(continued)

Insect control in pumpkin and squash *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Squash bug *(cont.)*	1.0 lb carbaryl	1.0 qt Sevin XLR Plus	3	Repeat applications as necessary up to a total of 6 times per year but not more than once every 7 days. Do not exceed 6.0 qt per crop per year. Do not apply when crop or nearby weeds are in bloom.
	clothianidin	*foliar:* 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		soil: 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a sidedress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
	0.05–0.18 lb dinotefuran *(foliar)*	2.0–7.0 oz Scorpion 35SL	1	Can repeat at 7-day intervals. Do not apply more than 10.5 oz per year.
	0.132–0.179 lb dinotefuran	3.0–4.0 oz Venom 70SG	1	Do not exceed 6.0 oz/a per year using foliar applications. See label for application directions.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Do not exceed 0.25 lb ai/a per year.
	flupyradifurone	*foliar:* 10.5–14.0 fl oz Sivanto *soil:* 21.0–28.0 fl oz Sivanto	1 21	Apply when pests reach or exceed established thresholds. Do not apply more than 28.0 fl oz of Sivanto per acre per crop season.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	1	Do not exceed a total of 31.0 fl oz/a of Voliam Xpress or 0.18 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.1–0.2 lb permethrin	4.0–8.0 oz *Permethrin 3.2EC	0	Do not exceed 48.0 oz/a per year.
	0.02–0.025 lb zeta-cypermethrin	2.8–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.
Squash vine borer	*Treat when adults are observed (around 900DD$_{50}$), especially when runners are less than 2 feet long. Larvae boring in the main stem can kill the entire plant, while loss of a runner or two when the plant is larger will not cause economic damage. Look for sawdust-like excrement coming from holes in the stems, and open the stems to confirm the presence of squash vine borer larvae. Repeat applications at 5- to 7-day intervals throughout the 3-week egg-laying period. Once larvae are inside the vine, little can be done to control this pest.*			

*Restricted-use pesticide.

(continued)

Insect control in pumpkin and squash *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Squash vine borer *(cont.)*	0.10 lb acetamiprid	5.3 oz Assail 30SG	0	Begin treatment when thresholds are reached. Apply every 5 days as needed. Do not exceed 5 applications or 0.5 lb ai/a per season.
		2.3 oz Assail 70WP	0	
	alpha-cypermethrin	3.0–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.04–0.10 lb bifenthrin	2.6–6.4 fl oz *Brigade 2EC	3	Treat every 7 days as needed. Do not exceed 0.3 lb ai/a per season. Do not make more than 2 applications after bloom.
	bifenthrin + zeta-cypermethrin	4.0–10.3 fl oz *Hero	3	Do not apply more than 10.3 fl oz/a per season and allow at least 7 days between applications. Do not apply more than 41.2 fl oz of product/a per crop season.
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	3	Do not exceed 0.25 lb ai/a per season
	flubendiamide + buprofezin	12.0–17.0 fl oz Vetica	7	Do not apply more than 38.0 fl oz/a per season and allow at least 7 days between applications. Do not make more than 3 applications per crop season.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Reapply at intervals of 5 or more days.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	1	Do not exceed a total of 31.0 fl oz/a of Voliam Xpress or 0.18 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	1	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.1–0.2 lb permethrin	4.0–8.0 oz *Permethrin 3.2EC	0	Do not exceed 48.0 oz/a per year.
	0.02–0.025 lb zeta-cypermethrin	2.8–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.

*Restricted-use pesticide.

Weed control in pumpkin and squash

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	0.25–0.75 lb clomazone	*pumpkins and winter squash:* 0.67–2.0 pt Command 3ME	45	Pumpkin (processed only), winter squash, and summer squash only. For suppression and control of annual grasses and broadleaves, make a single preemergent soil application before seeding or transplanting. Place seed or roots of transplants below the chemical barrier when planting. Consult variety restrictions on label. Strictly follow all precautions and restrictions on the label to minimize offsite movement and carryover. Read and understand the vegetable disclaimer section of the label—the end user of this product assumes all liability for failure to perform and crop injury resulting from its use.
		summer squash: 0.67–1.33 pt Command 3ME	30	

*Restricted-use pesticide.

(continued)

Weed control in pumpkin and squash *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds *(cont.)*	1.1–1.7 lb ethalfluralin	3.0–4.5 pt Curbit EC		Make a single broadcast application within 2 days after seeding. Rate varies with soil texture and organic matter. A shallow cultivation or 1/2 inch of water is needed for activation. Heavy rain following application or seeding may result in crop injury. Do not incorporate prior to planting, use under plastic mulch, broadcast over transplants, or apply through irrigation. Do not use on soils with more than 10% organic matter.
	0.4–1.2 lb ethalfluralin + 0.125–0.375 lb clomazone	2.0–6.0 pt Strategy	45	Use only as a postplant surface-applied herbicide before weed emergence. Rate varies by squash type. Make 1 application before crop emergence or apply as a banded spray between rows following emergence or transplanting. Do not make broadcast applications to transplants or use under plastic mulch. Rainfall, irrigation, or a shallow cultivation 2–5 days after application required for activation. Because of the potential for offsite movement and severe crop injury, strictly follow all precautions and restrictions listed on the label.
	s-metolachlor	1.0–1.33 pt Dual Magnum or Dual II Magnum	30	Apply as an inter-row or inter-hill application in pumpkin only. Leave 1 foot of untreated area over the row, or 6 inches to each side of the planted hill and/or any emerged pumpkin foliage. Broadcast sprays over the planted row or hill, and applications made directly to crop foliage will increase the risk of stand loss, delayed maturity, and yield loss. Rate depends on soil type.
Annual grasses	5.0–6.0 lb bensulide	5.0–6.0 qt Prefar 4E		Apply before planting and incorporate 1–2 inches deep to avoid losses due to volatilization. Use on mineral soils only.
Nutsedge and some broad-leaves	0.023–0.047 lb halosulfuron	0.5–1.0 oz Sandea (rate varies by crop use and application timing—see label)	30	Sandea controls several broadleaf weeds and nutsedge. It will not control grasses. Sandea has both pre- and postemergence activity. Broadcast applications to non-processing crops should not exceed 0.75 oz/a Sandea. Application of Sandea to summer squash is limited to directed spray to row middles, avoiding contact with the crop. Do not exceed 2 applications or apply more than 2.0 oz per 12-month period. Soil or foliar applications of organophosphate insecticides to Sandea-treated crops may cause severe crop injury. **Consult label for rate, maximum Sandea use per crop cycle, application timing, and other important usage information and precautions.**
Emerged weeds	glyphosate	several manufacturers and formulations		See label to assure that the formulation is labeled for this crop and for specific instructions. Some formulations require a wait of 3 days between application and planting. Crop contact will result in severe injury or death. If weeds have been mowed or tilled, do not treat until they have resumed active growth and reached the recommended stage on the label. Unless otherwise stated, allow 7 or more days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified.

*Restricted-use pesticide.

(continued)

Weed control in pumpkin and squash *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged weeds *(cont.)*	*paraquat	several manufacturers and formulations—not all are registered for this use		Prepare seedbed early to allow for maximum weed emergence. Application can be made as a banded or broadcast treatment before, during, or after planting but before crop emergence. In preplant and preemergence (to the crop) uses, do not apply to soils lacking clay minerals (i.e., muck, pure sand). Use the higher rate for heavy weed infestations. Seeding and transplanting should be performed with minimal soil disturbance. Always add crop oil concentrate or nonionic surfactant to spray mixture. Follow precautions on label.
Emerged grasses	0.068–0.12 lb clethodim	9.0–16.0 oz Select Max	14	Apply to actively growing grasses. Repeat treatments may be made at 14-day intervals up to the maximum annual use rate. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by product label. Do not apply if rain is expected within 1 hour.
	clethodim	several manufacturers and formulations	14	
	0.094–0.28 lb sethoxydim	0.5–1.5 pt Poast	14	Make postemergence applications to actively growing grasses at the sizes indicated on the label. Check the label for wild proso millet or rescue treatment rates as well as precautions and restrictions. Do not exceed 3.0 pt/a Poast per season. Consult label for rate and adjuvant instructions for specific weeds.

*Restricted-use pesticide.

Sweet corn

Since sweet corn is harvested in the immature or milk stage, it requires a shorter growing season than other types of corn. Nonetheless, it is a warm weather crop. Average temperatures of 65–70°F, with a minimum of 50°F, are required during June, July, and August. On the other hand, high temperatures above 80°F hasten maturity and often result in inferior quality. Temperature also greatly affects the length of time that sweet corn kernels remain sweet and tender. At high temperatures, they pass the best eating stage quickly.

The relationship of growth and maturity to temperature may be expressed more accurately in terms of degree days than calendar days. Since sweet corn does not grow at temperatures below 50°F, daily degree days are computed by subtracting 50°F from the average daily temperature. Scheduling of planting and harvest for nearly 75% of the processing sweet corn in the nation is based on degree days computed by this method or modifications. For more information, see "Calculating Degree Days" on page 14.

Sweet corn does best where annual rainfall is 30 inches or more, and April through September rainfall is 20 inches or more. The crop is especially susceptible to lack of moisture and to hot dry winds during the reproductive period. After the appearance of tassels the plants need rain every week. For this reason supplemental irrigation is increasingly important in the production of processing sweet corn. The water added may increase snapped weight by 0.5 t/a per inch of irrigation water, resulting in yields of 10–12 t/a in the humid North Central states.

Most sweet corn varieties were based on the sugary gene and had yellow kernels. Sugary hybrids have between 10% and 15% sugar at harvest time. Recently, new hybrids based on other genes have become available. The most important of these new gene types are the supersweet types based on the *shrunken-2* gene and the SE types based on the *sugary enhancer* gene. Botv of these genes result in elevated sugar levels of 25–35% at harvest. The supersweet types also convert sugar to starch more slowly resulting in a longer harvest period and longer shelf life. However, the pericarp of the supersweets will toughen with increased maturity resulting in decreased quality just as it does in the other types.

White kernel and bicolor (yellow and white kernels) hybrids are also becoming increasingly common. While the kernel color does not affect taste they may be of interest to consumers due to their attractiveness or novelty.

Supersweets must be isolated from sugary enhancer and sugary hybrids. To obtain the best results, sugary enhancer hybrids should be isolated from sugary hybrids and white hybrids should be isolated from bicolor and yellow. Isolation may be either in space or time. Different gene types should be grown at least 100 feet apart or they should flower at least 10 days apart.

Planting

Rows: 30–40 inches.

Plants in row: 7–20 inches (depends on row width and acre population).

For maximum yields, there should be 16,000–20,000 plants/a. Thus, actual seeding rates must be 18,000–22,000 plants/a—12–16 lb/a seed depending upon the grade or seed size for sugary hybrids. Supersweet seed is lighter and therefore only 5–8 lb/a seed is required.

Plant sweet corn for processing during May and June. Market gardeners may plant on light soils in mid-April. Supersweets are more sensitive to cold soils and should be planted when the soil temperature is over 60°F.

Uniform plant growth and maturity is important for processing sweet corn plantings since fields must be harvested at one time for market and processing. Plant uniform-size seed using a dependable planter with plates designed for that specific seed grade.

A deep firm seedbed free of clods, trash, and surface irregularities is necessary for uniform germination, good stands, and uniform maturity. You can fall plow moderately heavy soils that are unlikely to erode and leave them rough over the winter to permit earlier spring planting. You should plow light soils early in the spring.

Plow under stubble or green manure crops that precede sweet corn, and disk the soil 3–4 weeks before planting. Disk as many times as necessary to prepare a uniform seedbed and keep weeds under control. However, a crust can form if you work the soil too much.

In heavy soils, do not plant seed deeper than 1 inch. On sandy loams, plant seed 1.5 inches deep, and plant seed 2 inches deep on light sandy soils. Deeper planting may interfere with germination and prevent emergence if packing and crusting follow hard rains. In case of packing or crusting, use a rotary hoe to break the crust.

To extend the length of harvest, you can use successive plantings of the same hybrid at intervals of a week or less; or plant early-, medium-, and late-maturing hybrids at the same time. Late plantings of early varieties usually are less productive than early plantings of late varieties. If you plant different hybrids that will be used for processing, they should have a similar ear and similar kernel type and color because of overlap at harvest. Late plantings often have more serious problems with diseases and insects.

Continuous corn production in the same field increases the danger of corn rootworm damage. To avoid this problem, rotate crops. You can rotate sweet corn with other vegetable processing crops such as green beans, lima beans, peas, and cabbage. You can use early hybrids in multiple cropping systems following canning peas.

Irrigation

Sweet corn is sensitive to the moisture supply, especially during the 10 days before silking and the 20 days between silking and harvest. Irrigation rates depend upon soil type, temperature, relative humidity, and rainfall. Apply 2–3 inches of water when needed.

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 6.0 or higher on mineral soils and 5.6 on organic soils.

Fertilizer rates: Apply fertilizer according to soil test recommendations. Use annual nitrogen, P_2O_5, and K_2O recommendations in the table below. Take credits for previous legume crops and manure. Sowing 1.5–2.0 bu/a of rye or wheat after the corn harvest in late August or September may help capture some mobile soil nutrients.

Application: Broadcast lime and fertilizer and disc or plow under before seeding. Apply fertilizer to the side and below the seed.

Nitrogen: Apply sidedress or split the rate into two or 3 applications during the growing season on sandy soils. You can apply nitrogen through the irrigation system.

Micronutrients: If the soil test is low or very low for zinc, apply 2–4 lb Zn/a with the starter fertilizer.

Annual nitrogen, phosphate, and potash recommendations for sweet corn

Nitrogen		Phosphate and potash		
Organic matter (%)	**Amount to apply** (lb/a)	**Yield goal** (t/a)	**Amount P_2O_5 to apply*** (lb/a)	**Amount K_2O to apply*** (lb/a)
<2	150	2.0–4.0	10	20
2.0–9.9	130	4.1–6.0	15	30
10–20	110	6.1–8.0	25	40
>20	70	8.1–10.0	30	55

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Disease control in sweet corn

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Anthracnose	*Rotate crops or use deep-incorporation of debris from previous year's corn crop.*			
Leaf rust, foliar diseases (gray leaf spot, northern corn leaf blight, and northern corn leaf spot)	azoxystrobin	*leaf rust:* 6.0–9.0 fl oz Quadris Flowable, Satori *other foliar diseases:* 6.0–15.5 fl oz Quadris Flowable, Satori	7	Headline, Quadris, and Satori belong to the Group 11 (strobilurin) fungicide category. Avaris, Quilt, and Stratego contain Group 11 and Group 3 fungicides. Do not exceed 1 application of Headline, Quadris, Satori, Quilt, or Stratego before alternating to a labeled fungicide with a different mode of action. The number of applications using Group 11 fungicides should not exceed half of the total fungicide applications per season. Treat when disease first appears; continue fungicide applications on a 7- to 14-day interval if conditions favorable for disease development persist.
	azoxystrobin + propiconazole	*leaf rust, gray leaf spot, eyespot:* 10.5–14.0 fl oz Avaris, Quilt 10.5–14.0 fl oz Quilt Excel *other foliar diseases:* 7.0–14.0 fl oz Avaris, Quilt	14 14	
	prothioconazole + triflozystrobin	4.0–5.0 fl oz Stratego YLD	14 (fodder) 0 (forage & ears)	
	pyraclostrobin	6.0–12.0 fl oz Headline	7	
	azoxystrobin + benzovindiflupyr	5.0–7.3 oz Elatus	7	Begin applications prior to disease onset. Make no more than 2 applications before alternating to a non–Group 7 or 11 fungicide.
	azoxystrobin + tebuconazole	9.0–12.9 fl oz Custodia	7	Do not use adjuvants or crop oil after V8 stage of plant growth. For best results, tank mix with the lowest labeled rate of a spray surfactant and obtain sufficient coverage.
	benzovindiflupyr	4.0 fl oz Trivapro A		The addition of a spreading/penetrating adjuvant is recommended.
	chlorothalonil	0.75–2.0 pt Bravo Weather Stik, Echo 720, Equus 720 0.7–1.8 lb Bravo Ultrex 82.5WDG, Equus DF 1.25–1.625 lb Echo 90DF	14 (fresh market only) 14 (fresh market only) 14 (fresh market only)	Plant tolerant or resistant varieties. Early detection is critical for fungicide use. Early plantings are less susceptible to these diseases. Do not exceed 9.0 lb ai/a chlorothalonil per season. Spray at 4- to 7-day intervals when symptoms first appear. Do not graze treated fields or use treated corn for livestock feed.
	fluopyram + prothioconazole	13.6 fl oz Propulse	0	Make no more than 2 applications per crop per season.
	fluoxastrobin	2.0–3.8 fl oz Aftershock, Evito 480 SC	30	Do not apply more than 11.4 fl oz/a per year. Maximum of 2 applications per season, with a minimum interval of 7 days between applications.
	fluoxastrobin + tebuconazole	4.0–9.0 fl oz Evito T	7	Begin applications preventively. Follow resistance management protocols as per the label.

(continued)

Disease control in sweet corn *(continued)*

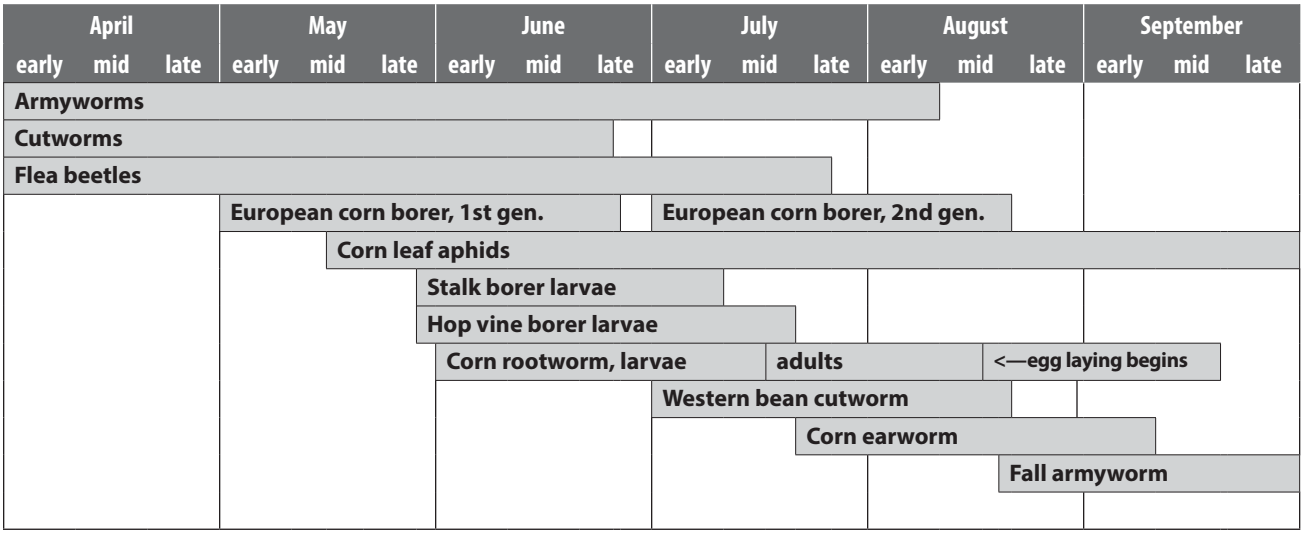
Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Leaf rust, foliar diseases *(cont.)*	fluxapyroxad + pyraclostrobin	4.0–8.0 fl oz Priaxor	7 (for sweet corn only)	Do not apply more than 16.0 fl oz/a per season. Do not make more than 2 consecutive applications of Priaxor before alternating to a labeled fungicide with a different mode of action.
	mancozeb	0.8–1.2 qt Penncozeb 4FL 1.2 qt Dithane F-45 1.0–1.5 lb Penncozeb 80WP, Penncozeb 75DF 1.5 lb Dithane DF Rainshield, Koverall, Manzate 200 75DF	7 7 7 7	Consult label for product use limits. Spray every 5–10 days depending on disease and weather pressures. Do not feed treated forage to livestock.
	penthiopyrad	10.0–24.0 fl oz Vertisan	7 (grain and stover harvest) 0 (grazing or forage)	Make no more than 2 sequential applications before switching to a fungicide with a different mode of action. Do not exceed 48.0 fl oz/a per year.
	picoxystrobin	3.0–12.0 fl oz Aproach (rates increase for crop growth stages; see label)	7	Do not exceed 36.0 fl oz per acre per crop. Make no more than 2 sequential applications before alternating to a fungicide with a different mode of action.
	propiconazole	*eye spot, gray leaf spot, rusts:* 4.0 fl oz AmTide Propiconazole 41.8% EC, Bumper 41.8 EC, Propicure 3.6F, PropiMax EC, Tilt, Topaz *Helminthosporium leaf blights, northern corn leaf blight, northern corn leaf spot, southern corn leaf blight:* 2.0–4.0 fl oz AmTide Propiconazole 41.8% EC, Bumper 41.8 EC, Propicure 3.6F, PropiMax EC, Tilt, Topaz	14 14	Apply when disease first appears and continue at 7- to 14-day intervals. Do not apply more than 16.0 fl oz/a per season. Do not harvest sweet corn for forage within 14 days of application.
	propiconazole + trifloxystrobin	10.0 fl oz Stratego	14	Follow resistance management guidelines.
	pyraclostrobin + metconazole	10.0–14.4 fl oz Headline AMP	7	Make no more than 4 applications per season. Do not apply more than 57.6 fl oz/a per season.
	tebuconazole	4.0–6.0 fl oz Folicur 3.6 F, Monsoon, Onset 3.6L, Orius 3.6F, TebuStar 3.6L, Tebusha 3.6FL, Tebuzol, Toledo	7	Do not exceed 24.0 fl oz/a per season. Restricted entry interval is 19 days. May be applied up to 7 days before the harvest of ears or forage, and 49 days before the harvest of fodder.
Maize dwarf mosaic	*Plant tolerant or resistant varieties. Early plantings generally are less susceptible to this disease.*			
Seed rot and damping-off	captan fludioxonil ipconazole sedaxane thiram tolclofos-methyl Trilex (metalaxyl + trifloxystrobin)			Seed corn should always be treated with a fungicide. Follow manufacturer's directions for rate and use. Do not use treated seed for feed or food.

(continued)

Disease control in sweet corn *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Smut	*There is no satisfactory control for smut. Later, larger-growing varieties tend to have less infection than early, small varieties. Avoid excessive nitrogen or manure. Not poisonous to livestock or people.*			
White line mosaic	*Occurs more in soils that have high moisture content. Varieties resistant to this virus have not been identified.*			

Scouting calendar for insect pests of sweet corn



Spray schedule for corn earworm (CEW) based on nightly trap catches of moths

CEW moths per night		
in blacklight trap	in pheromone trap*	Treatment
<5	<10	No treatment needed.
5–24	10–99	Treat vulnerable corn (row tassel to 100% silk) with an effective CEW insecticide, reapplying every 2–5 days until brown silks appear.
25–100	100–500	Treat silking corn until brown silk. Corn should be treated on a 2- to 3-day schedule as long as trap catches remain high.
>100	>500	Treat silking corn with most effective CEW insecticide until brown silk. Corn should be treated on a 1- to 2-day schedule as long as trap catches remain high.

Adapted from Foster and Flood (eds.), *Vegetable Insect Management* (Willoughby, OH: Meister Publishing, 2005).

*Pheromone traps and lures for CEW can be ordered at Great Lakes IPM: www.greatlakesipm.com.

Spray schedule for European corn borer (ECB) based on blacklight trap catches of moths

ECB moths trapped per night	Treatment
<10	No treatment needed. Moths probably not laying enough eggs to justify a treatment program, but keep monitoring silking sweet corn for egg laying. Be aware that catches may increase in near future.
10–100 for 3 consecutive nights	Moths are laying eggs. Sweet corn is in a vulnerable stage (pre-row tassel to brown silk). Treat with insecticide. If you are catching female ECB moths in blacklight trap, eggs are already in the field.
>100	This is a reinfestation flight. Moths are laying high numbers of eggs in the field. If sweet corn is in vulnerable stage, apply an insecticide, even if previously treated. Repeat treatment every 5–7 days (depending on temperature) until brown silk.

Adapted from Foster and Flood (eds.), *Vegetable Insect Management* (Willoughby, OH: Meister Publishing, 2005); and R. Foster, *Managing Insects in Commercially Grown Sweet Corn* (Purdue Extension Publication E-98-W, 2008).

Insect control in sweet corn

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids	*Corn leaf aphids can occur in large numbers on tassels of sweet corn plants. Treat fields if field is less than 50% pollinated and at least 50% of the plants are infested with at least 50 aphids per plant.*			
	acetamiprid	Assail, several formulations (see label for rate)	1–7 (dependent on rate)	Do not exceed a total of 0.21 lb ai (11.2 oz)/a per growing season.
	alpha-cypermethrin	2.8–3.8 fl oz *Fastac CS, *Fastac EC	3	Do not apply more than 11.4 fl oz (0.075 lb ai)/a per season.
	bifenthrin	2.1–6.4 fl oz *Brigade 2EC	1	Do not exceed 12.8 fl oz/a (0.2 lb ai/a) per season. Do not graze or use treated crops for feed within 1 day of last application.
	.084–0.167 lb bifenthrin + chlorantraniliprole	4.8–9.6 fl oz *Elevest	1	Make no more than 2 applications per acre per calendar year. Minimum interval between treatments is 1 day. Do not apply more than a total of 0.2 lb ai/a of chlorantraniliprole and 0.2 lb ai/a of bifenthrin per year. This total includes applications of *Elevest insect control and other chlorantraniliprole or bifenthrin-containing products.
	0.25–0.5 mg clothianidin/ kernel	1.13–2.26 fl oz Poncho 600/80,000 seeds	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
	0.25–0.50 mg clothianidin/seed, *Bacillus firmus*	1.35–2.7 fl oz Poncho/ VOTiVO/80,000 seeds	seed treatment	Purchase treated seed from seed dealer or seed treatment representative. Also used for nematode management. Pretest for compatibility with other seed treatments. Do not use treated seed for food, feed, or oil production.
	esfenvalerate	5.8–9.6 fl oz *Asana XL	1	Do not exceed 0.5 lb ai/a per season.
	flupyradifurone	7.0–14.0 fl oz Sivanto Prime 7.0–10.5 oz fl oz Sivanto 200 SL	7	Do not apply more than 0.365 lb flupyradifurone per acre per calendar year on cereal grains regardless of product or formulation.
	imidacloprid	3.2–6.4 fl oz Gaucho 600/100 lb seed	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
	methomyl	*Lannate LV, *Lannate SP (rates vary by formulations)	0 (ears) 3 (forage) 21 (stover)	Certain hybrids are susceptible to methomyl injury. Treat a small area to determine crop safety before full spraying. Allow at least 1 day between treatments.
	sulfoxaflor	0.75–1.5 oz *Transform WG	7	Do not apply more than 3.0 oz of Transform WG (0.09 lb ai of sulfoxaflor) per acre per year.
	zeta-cypermethrin	2.8–4.0 oz *Mustang Maxx	3	Do not exceed 24.0 fl oz/a Mustang Maxx (0.15 lb ai/a) per season. Aphid control may be variable depending on species present and host-plant relationships.
	zeta-cypermethrin + bifenthrin	*Hero, *Hero EW (rates vary by formulation)	3	Refer to maximum usage tables when applying more than one product containing zeta-cypermethrin and/or bifenthrin.
Armyworms	*Treat when there are two or more armyworms per plant on 25% of plants or there is one per plant on 75% of the plants and armyworms are 3/4 inch or smaller in length.*			
	alpha-cypermethrin	2.8–3.8 fl oz *Fastac CS, *Fastac EC	3	Do not apply more than 11.4 fl oz (0.075 lb ai)/a per season.

*Restricted-use pesticide.

(continued)

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Armyworms *(cont.)*	*Bacillus thuringiensis*	Agree WG, Biobit, DiPel, Javelin, others	0	See label for rate.
	beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	For control of first and second instar larvae. Do not exceed 28.0 fl oz/a (0.22 lb ai/a) per season.
	bifenthrin	2.1–6.4 fl oz *Brigade 2EC	1	Do not exceed 12.8 fl oz/a (0.2 lb ai/a) per season. Do not graze or use treated crops for feed within 1 day of last application.
		0.23–0.92 fl oz/1,000 ft row *Capture 3RIVE 3D		Do not apply more than 0.2 lb ai/a per season.
	0.098–0.167 lb bifenthrin + chlorantraniliprole	5.6–9.6 fl oz *Elevest	1	Make no more than 2 applications per acre per calendar year. Minimum interval between treatments is 1 day. Do not apply more than a total of 0.2 lb ai/a of chlorantraniliprole and 0.2 lb ai/a of bifenthrin per year. This total includes applications of *Elevest insect control and other chlorantraniliprole or bifenthrin-containing products.
	carbaryl	1.0–2.0 qt Sevin XLR Plus	2 (ears) 14 (forage) 48 (fodder)	Highly toxic to bees; see label for details. Do not exceed 16.0 qt/a per season. Hand harvesting is prohibited.
	chlorantraniliprole	3.5–7.5 fl oz Coragen	1	Do not make more than 4 applications per crop season and allow at least 1 day between applications. Do not apply more than 15.4 fl oz/a Coragen per season.
		1.2–2.5 fl oz Vantacor	1	Do not apply more than 5.1 fl oz Vantacor or 0.2 lb/a per calendar year of chlorantraniliprole-containing products including all application types (seed treatment, soil, foliar).
	deltamethrin	1.5–2.4 fl oz *Delta Gold 1.5EC	1 (ear, grazing) 21 (stover)	Apply to early instar larvae. Do not exceed 38.4 fl oz/a (0.45 lb ai/a) per season. See label for grazing and feed restrictions.
	esfenvalerate	5.8–9.6 fl oz *Asana XL	1	Do not exceed 0.5 lb ai/a per season.
	flubendiamide	2.0–3.0 fl oz Belt SC	1 (ear)	Do not apply more than 12.0 fl oz/a (0.375 lb ai/a) per crop season. See label for grazing and forage restrictions.
	lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	1	Use higher rates for large larvae. Do not apply more than 0.48 lb ai/a per crop. See label for grazing and forage feed restrictions.
	lambda-cyhalothrin + chlorantraniliprole	6.0–10.0 fl oz *Besiege	1	Use higher rates within the listed rate range for large larvae. Do not apply more than 31.0 fl oz of Besiege or 0.48 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole-containing products per acre per year. See label for grazing and forage restrictions.
	methomyl	*Lannate LV, *Lannate SP (rates vary by formulation)	0 (ears) 3 (forage) 21 (stover)	Certain hybrids are susceptible to methomyl injury. Treat a small area to determine crop safety before full-scale spraying. Allow at least 1 day between treatments.

*Restricted-use pesticide.

(continued)

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Armyworms *(cont.)*	methoxyfenozide	4.0–16.0 fl oz Intrepid 2F	3 (ears, green chop) 21 (fodder)	For heavy infestations, reapply at 5- to 10-day intervals. Do not exceed 16.0 fl oz/a per application or 64.0 fl oz/a (1.0 lb ai/a) per season.
	novaluron	6.0–12.0 fl oz Rimon 0.83EC	1	Do not apply more than 60.0 fl oz/a per season.
	permethrin	several formulations	1	Several formulations; see label for rate.
	spinetoram	3.0–6.0 fl oz Radiant SC	1 (ear) 3 (forage, fodder)	Do not make more than 6 applications per crop or exceed 0.281 lb ai/a per season. Wait at least 4 days between treatments.
	spinosad	Blackhawk Entrust SC, other formulations available	1 (grain) 7 (forage) 28 (fodder)	Consult label.
	zeta-cypermethrin	2.8–4.0 oz *Mustang Maxx	3	Do not exceed 24.0 oz/a Mustang Maxx (0.15 lb ai/a) per season.
	zeta-cypermethrin + bifenthrin	*Hero, *Hero EW (rates vary by formulation)	3	Refer to maximum usage tables when applying more than one product containing zeta-cypermethrin and/or bifenthrin.
Corn earworm	*Treat as soon as silks begin to appear and pheromone trap catches indicate threshold levels have been exceeded. Check traps at least every other day when moths are present. Refer to spray schedule above for timing recommendations. Make ground application in 25 gal of water/a with at least 100 psi. Direct nozzles at silks from each side of the row. Make aerial applications in 4–5 gal water/a.*			
	alpha-cypermethrin	2.8–3.8 fl oz *Fastac CS, *Fastac EC	3	Do not apply more than 11.4 fl oz (0.075 lb ai)/a per season.
	azadirachtin	Neemix 4.5 (see label for rates)	0	Consult label.
	Bacillus thuringiensis (various formulations)	Agree WG, Biobit, DiPel, Javelin, others (see label rates)	0	See label for control suggestions.
	beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Application must be made before larvae bore into plants. Do not exceed 28.0 fl oz/a (0.22 lb ai/a) per season.
	bifenthrin	2.1–6.4 fl oz *Brigade 2EC	1	Do not exceed 12.8 fl oz/a (0.2 lb ai/a) per season. Do not graze or use treated crops for feed within 1 day of last application.
	0.098–0.167 lb bifenthrin + chlorantraniliprole	5.6–9.6 fl oz *Elevest	1	Make no more than 2 applications per acre per calendar year. Minimum interval between treatments is 1 day. Do not apply more than a total of 0.2 lb ai/a of chlorantraniliprole and 0.2 lb ai/a of bifenthrin per year. This total includes applications of *Elevest insect control and other chlorantraniliprole or bifenthrin-containing products.
	carbaryl	1.0–2.0 qt Sevin XLR Plus	2 (ears) 14 (forage) 48 (fodder)	Highly toxic to bees; see label for details. Do not exceed 16.0 qt/a per season. Hand harvesting is prohibited.
	chlorantraniliprole	3.5–7.5 fl oz Coragen	1	Do not make more than 4 applications per crop season and allow at least 1 day between applications. Do not apply more than 15.4 fl oz/a Coragen per season.

*Restricted-use pesticide.

(continued)

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Corn earworm *(cont.)*		1.2–2.5 fl oz Vantacor	1	Do not apply more than 5.1 fl oz Vantacor or 0.2 lb/a per calendar year of chlorantraniliprole-containing products including all application types (seed treatment, soil, foliar).
	deltamethrin	1.5–2.4 fl oz *Delta Gold 1.5EC	1 (ear, grazing) 21 (stover)	Apply to early instar before larvae bore into plants. Apply as needed from tassel emergence to silk dry down. Do not exceed 38.4 fl oz/a (0.45 lb ai/a) per season. See label for grazing and feed restrictions.
	esfenvalerate	5.8–9.6 fl oz *Asana XL	1	Do not exceed 0.5 lb ai/a per season.
	flubendiamide	2.0–3.0 fl oz Belt SC	1	Do not apply more than 12.0 fl oz ai/a (0.375 lb ai/a) per crop per season. Consult label for grazing and forage restrictions.
	gamma-cyhalothrin	2.56–3.84 oz *Proaxis	1	Do not apply more than 3.84 pt/a (0.24 lb ai/a) per season. See label for grazing and forage feed restrictions.
		1.02–1.54 fl oz *Declare	1	Do not apply more than 1.54 pt/a per crop. See label for grazing and forage feed restrictions.
	Helicoverpa armigera nucleopolyhedrovirus	0.5–2.5 fl oz Helicovex	0	Shake container well before use. Keep tank agitated during spraying. Spray as soon as possible after mixing; do not allow the spray mix to stand overnight. See label for applications frequency.
	indoxacarb	2.5–3.5 fl oz Avaunt	3 (ear)	Consult label.
	lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	1	Do not apply more than 0.48 lb ai/a per crop. See label for grazing and forage feed restrictions.
	lambda-cyhalothrin + chlorantraniliprole	6.0–10.0 fl oz *Besiege	1	Do not apply more than 31.0 fl oz of Besiege or 0.48 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole-containing products per acre per year. See label for grazing and forage restrictions.
	methomyl	*Lannate LV, *Lannate SP (rates vary by formulation)	0 (ears) 3 (forage) 21 (stover)	Certain hybrids are susceptible to methomyl injury. Treat a small area to determine crop safety before full-scale spraying. Allow at least 1 day between treatments.
	novaluron	6.0–12.0 fl oz Rimon 0.83EC	1	Do not apply more than 60.0 fl oz/a per season.
	nuclear polyhedrosis insecticidal virus	4.0–10.0 fl oz Gemstar LC	0	Re-treatment may be required at 2- to 3-day intervals.
	permethrin	consult label	1	Several formulations; see label for rate.
	spinetoram	3.0–6.0 fl oz Radiant SC	1 (food) 3 (forage, fodder)	Do not make more than 6 applications per crop. Do not exceed 0.281 lb ai/a per season. Wait at least 2 days between treatments at silking.
	spinosad	Blackhawk Entrust SC other formulations available	1 (grain) 7 (forage) 28 (fodder)	Consult label.

*Restricted-use pesticide.

(continued)

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Corn earworm *(cont.)*	zeta-cypermethrin	2.8–4.0 oz *Mustang Maxx	3	Do not exceed 24.0 oz/a Mustang Maxx (0.15 lb ai/a) per season.
	zeta-cypermethrin + bifenthrin	*Hero, *Hero EW (rates vary by formulation)	3	Refer to maximum usage tables when applying more than one product containing zeta-cypermethrin and/or bifenthrin.
Corn flea beetle	*These tiny (less than 1/16 inch), black beetles transmit the bacterial disease Stewart's wilt. The pathogen overwinters in beetles, plant residue, and soil. During mild winters, enough flea beetles may survive in Wisconsin to lead to significant incidence of Stewart's wilt in the southern tier or two of counties.* *To predict disease risk—and the need to scout for beetles—add the monthly average temperatures for December, January, and February. Scout seedling corn intensively if the total is greater than 90°F. Treatment may be warranted if you find an average of six or more beetles per 100 plants. Beetles readily jump from plants when disturbed.*			
	acetamiprid	Assail, several formulations (see label for rate)	1–7 (dependent on rate)	Do not exceed a total of 0.21 lb ai (11.2 oz)/a per growing season.
	alpha-cypermethrin	2.2–3.8 fl oz *Fastac CS, *Fastac EC	3	Do not apply more than 11.4 fl oz (0.075 lb ai)/a per season.
	beta-cyfluthrin	0.8–1.6 fl oz *Baythroid XL	0	Do not exceed 28.0 fl oz/a (0.22 ai/a) per season.
	bifenthrin	2.1–6.4 fl oz *Brigade 2EC	1	Do not exceed 12.8 fl oz/a (0.2 lb ai/a) per season. Do not graze or use crops for feed within 1 day of last treatment.
	0.084–0.167 lb bifenthrin + chlorantraniliprole	4.8–9.6 fl oz *Elevest	1	Make no more than 2 applications per acre per calendar year. Minimum interval between treatments is 1 day. Do not apply more than a total of 0.2 lb ai/a of chlorantraniliprole and 0.2 lb ai/a of bifenthrin per year. This total includes applications of *Elevest insect control and other chlorantraniliprole or bifenthrin-containing products.
	carbaryl	1.0–2.0 qt Sevin XLR Plus	2 (ears) 14 (forage) 48 (fodder)	Highly toxic to bees; see label for details on protecting them. Do not exceed 16.0 qt/a per season. Hand harvesting is prohibited.
	0.25–0.50 mg clothianidin/kernel	1.13–2.26 fl oz Poncho 600/80,000 seeds	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
	0.25–0.50 mg clothianidin/seed, *Bacillus firmus*	1.35–2.7 fl oz Poncho/ VOTiVO/80,000 seeds	seed treatment	Purchase treated seed from seed dealer or seed treatment representative. Also used for nematode management. Pretest for compatibility with other seed treatments. Do not use treated seed for food, feed, or oil production.
	deltamethrin	1.0–1.5 fl oz *Delta Gold 1.5EC	1 (ear, grazing) 21 (stover)	Do not exceed 38.4 fl oz/a per season. See label for grazing and feed restrictions.
	esfenvalerate	5.8–9.6 fl oz *Asana XL	1	Do not exceed 0.5 lb ai/a per season.
	gamma-cyhalothrin	2.56–3.84 oz *Proaxis	1	Do not apply more than 3.84 pt/a (0.24 lb ai/a) per season. See label for grazing and forage use restrictions.
		1.02–1.54 fl oz *Declare	1	Do not apply more than 1.54 pt/a per crop. See label for grazing and forage use restrictions.

*Restricted-use pesticide.

(continued)

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Corn flea beetle *(cont.)*	imidacloprid	6.4 fl oz Gaucho 600/100 lb seed	seed treatment	Purchase treated seed from seed dealer or seed treatment representative.
	lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	1	Do not exceed 0.48 lb ai/a per season. See label for grazing and forage feed restrictions.
	lambda-cyhalothrin + chlorantraniliprole	6.0–10.0 fl oz *Besiege	1	Do not apply more than 31.0 fl oz of Besiege or 0.48 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole-containing products per acre per year. See label for grazing and forage restrictions.
	methomyl	*Lannate LV, *Lannate SP (rates vary by formulations)	0 (ears) 3 (forage) 21 (stover)	Certain hybrids are susceptible to methomyl injury. Treat a small area to determine crop safety before full spraying. Allow at least 1 day between treatments.
	0.25–0.80 mg thiamethoxam/kernel	Cruiser	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
	zeta-cypermethrin	2.24–4.0 fl oz *Mustang Maxx	3	Do not exceed 24.0 oz/a Mustang Maxx (0.15 lb ai/a) per season.
	zeta-cypermethrin + bifenthrin	*Hero, *Hero EW (rates vary by formulation)	3	Do not exceed 0.266 lb ai/a per season. Refer to maximum usage tables when applying more than one product containing zeta-cypermethrin and/or bifenthrin.
Cutworms	*Treat when 5% of plants are cut.*			
	alpha-cypermethrin	2.2–3.8 fl oz *Fastac CS, *Fastac EC	3	Do not apply more than 11.4 fl oz (0.075 lb ai)/a per season.
	azadirachtin	Neemix 4.5 (see label for rates)	0	Consult label.
	Bacillus thuringiensis	Agree WG, Biobit, DiPel, Javelin, others	0	See label for rate.
	beta-cyfluthrin	0.8–1.6 fl oz *Baythroid XL	0	Do not exceed 28.0 fl oz/a (0.22 lb ai/a) per season.
	bifenthrin	0.2–0.78 fl oz *Capture LFR/1,000 ft row		Apply as a 5- to 7-inch T-band. Do not apply more than 0.2 lb ai/a per season as an at-plant application.
		*Capture 3RIVE 3D		Do not apply more than 0.2 lb ai (16.0 fl oz product) per acre per season as an at-plant application.
		2.1–6.4 fl oz *Brigade 2EC	1	Do not exceed 12.8 fl oz/a (0.2 lb ai/a) per season. Do not graze or use treated crops for feed within 1 day of last application.
	0.084–0.167 lb bifenthrin + chlorantraniliprole	4.8–9.6 fl oz *Elevest	1	Make no more than 2 applications per acre per calendar year. Minimum interval between treatments is 1 day. Do not apply more than a total of 0.2 lb ai/a of chlorantraniliprole and 0.2 lb ai/a of bifenthrin per year. This total includes applications of *Elevest insect control and other chlorantraniliprole or bifenthrin-containing products.
	carbaryl	2.0 qt Sevin XLR Plus	2 (ears) 14 (forage) 48 (fodder)	Highly toxic to bees; see label for details. Do not exceed 16.0 qt/a per season. Hand harvesting is prohibited.

*Restricted-use pesticide.

(continued)

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cutworms *(cont.)*	chlorantraniliprole	3.5–7.5 fl oz Coragen	1	Do not make more than 4 applications per crop season and allow at least 1 day between applications. Do not apply more than 15.4 fl oz/a Coragen per season.
		1.2–2.5 fl oz Vantacor	1	Do not apply more than 5.1 fl oz Vantacor or 0.2 lb/a per calendar year of chlorantraniliprole-containing products including all application types (seed treatment, soil, foliar).
	chlorethoxyfos + bifenthrin	*SmartChoice 5G, HC (rate varies by formulation)	at-plant only	Do not apply as a surface band.
		0.44–0.72 fl oz *Index/1,000 ft row	at-plant only	Do not make more than 1 application per year. In-furrow application only. There is a 30-day rotational plantback interval for all crops other than corn.
	0.25–0.50 mg clothianidin/kernel	1.13–2.26 fl oz Poncho 600/80,000 seeds	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
	0.25–0.50 mg clothianidin/seed, *Bacillus firmus*	1.35–2.7 fl oz Poncho/ VOTiVO/80,000 seeds	seed treatment	Purchase treated seed from seed dealer or seed treatment representative. Also used for nematode management. Pretest for compatibility with other seed treatments. Do not use treated seed for food, feed, or oil production.
	deltamethrin	1.0–1.5 fl oz *Delta Gold 1.5EC	1 (ear, grazing) 21 (stover)	Do not exceed 38.4 fl oz/a (0.45 lb ai/a) per season. See label for grazing and feed restrictions.
	esfenvalerate	5.8–9.6 fl oz *Asana XL	1	Broadcast spray. Do not exceed 0.5 lb ai/a per season.
	flubendiamide	2.0–3.0 fl oz Belt SC	1	Do not apply more than 12.0 fl oz ai/a (0.375 lb ai/a) per crop per season. Consult label for grazing and forage restrictions.
	gamma-cyhalothrin	2.56–3.84 oz *Proaxis	1	Do not apply more than 3.84 pt/a (0.24 lb ai/a) per season. See label for grazing and forage use restrictions.
		1.02–1.54 fl oz *Declare	1	Do not apply more than 1.54 pt/a per crop. See label for grazing and forage use restrictions.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	1	Do not apply more than 0.48 lb ai/a per crop. See label for grazing and forage feed restrictions.
	lambda-cyhalothrin + chlorantraniliprole	6.0–10.0 fl oz *Besiege	1	Do not apply more than 31.0 fl oz of Besiege or 0.48 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole-containing products per acre per year. See label for grazing and forage restrictions.
	permethrin	consult label	1	Several formulations; see label for rate. Broadcast spray.
	tefluthrin	4.0–5.0 oz *Force 3G/1,000 ft row 0.46–5.7 fl oz *Force Evo/1,000 ft row		Apply in 7-inch band or seed furrow.

*Restricted-use pesticide.

(continued)

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cutworms *(cont.)*	thiamethoxam	Cruiser (see label for rate)	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
	zeta-cypermethrin	2.24–4.0 fl oz *Mustang Maxx	3	Do not exceed 24.0 oz/a Mustang Maxx (0.15 lb ai/a) per season.
	zeta-cypermethrin + bifenthrin	*Hero, *Hero EW (rates vary by formulation)	3	Refer to maximum usage tables when applying more than one product containing zeta-cypermethrin and/or bifenthrin.
European corn borer	*Scout every 5–7 days and sample at least five consecutive plants in 10 areas of a field. Treat if there is an average of one egg mass per 10 plants. Check traps at least every 2–3 days when moths are present. Refer to the spray schedule table above for treatment frequency based on trap catches.*			
	alpha-cypermethrin	2.8–3.8 fl oz *Fastac CS, *Fastac EC	3	Do not apply more than 11.4 fl oz (0.075 lb ai)/a per season.
	Bacillus thuringiensis (various formulations)	Agree WG, Biobit, DiPel, Javelin, others (see label rates)	0	First generation larvae. Larvae must be actively feeding on treated, exposed plant surfaces. Thorough spray coverage is needed. Repeat as needed every 3–14 days, depending on plant growth rate, moth activity, rainfall, and other factors.
	beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Application must be made before larvae bore into plants. Do not exceed 28.0 fl oz/a (0.22 lb ai/a) per season.
	bifenthrin	2.1–6.4 fl oz *Brigade 2EC	1	Do not exceed 12.8 fl oz/a (0.2 lb ai/a) per season. Do not graze or use crops for feed within 1 day of last treatment.
	0.098–0.167 lb bifenthrin + chlorantraniliprole	5.6–9.6 fl oz *Elevest	1	Make no more than 2 applications per acre per calendar year. Minimum interval between treatments is 1 day. Do not apply more than a total of 0.2 lb ai/a of chlorantraniliprole and 0.2 lb ai/a of bifenthrin per year. This total includes applications of *Elevest insect control and other chlorantraniliprole or bifenthrin-containing products.
	carbaryl	1.5–2.0 qt Sevin XLR Plus	2 (ears) 14 (forage) 48 (fodder)	Highly toxic to bees; see label for details. Do not exceed 16.0 qt/a per season. Hand harvesting is prohibited.
	chlorantraniliprole	3.5–7.5 fl oz Coragen	1	Do not make more than 4 applications per crop season and allow at least 1 day between applications. Do not apply more than 15.4 fl oz/a Coragen per season.
		1.2–2.5 fl oz Vantacor	1	Do not apply more than 5.1 fl oz Vantacor or 0.2 lb/a per calendar year of chlorantraniliprole-containing products including all application types (seed treatment, soil, foliar).
	deltamethrin	1.5–2.4 fl oz *Delta Gold 1.5EC	1 (ear, grazing) 21 (stover)	Application must be made before larvae bore into plants. Do not exceed 38.4 fl oz/a (0.45 lb ai/a) per season. See label for grazing and feed restrictions.
	esfenvalerate	5.8–9.6 fl oz *Asana XL	1	Do not exceed 0.5 lb ai/a per season.
	flubendiamide	2.0–3.0 fl oz Belt SC	1	Do not apply more than 12.0 fl oz ai/a (0.375 lb ai/a) per crop per season. Consult label for grazing and forage restrictions.

*Restricted-use pesticide.

(continued)

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
European corn borer *(cont.)*	gamma-cyhalothrin	2.56–3.84 oz *Proaxis	1	Do not apply more than 3.84 pt/a (0.24 lb ai/a) per season. See label for grazing and forage feed restrictions.
		1.02–1.54 fl oz *Declare	1	Do not apply more than 1.54 pt/a per crop. See label for grazing and forage feed restrictions.
	indoxacarb	2.5–3.5 fl oz Avaunt	3 (ear)	Consult label.
	lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	1	Do not apply more than 0.48 lb ai/a per crop. See label for grazing and forage feed restrictions.
	lambda-cyhalothrin + chlorantraniliprole	6.0–10.0 fl oz *Besiege	1	Do not apply more than 31.0 fl oz of Besiege or 0.48 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole-containing products per acre per year. See label for grazing and forage restrictions.
	methomyl	*Lannate LV, *Lannate SP	0 (ears) 3 (forage) 21 (stover)	Certain hybrids are susceptible to methomyl injury. Treat a small area to determine crop safety before full-scale spraying. Allow at least 1 day between treatments.
	methoxyfenozide	4.0–16.0 fl oz Intrepid 2F	3 (ears, green chop) 21 (fodder)	For early season (first-generation) infestations, direct application at the whorl. For mid- and late-season (second-generation) infestations, broadcast over the row. Do not exceed 16.0 fl oz/a per application or 64.0 fl oz/a (1.0 lb ai/a) per season.
	novaluron	6.0–12.0 fl oz Rimon 0.83EC	1	Do not apply more than 60.0 fl oz/a per season.
	permethrin	consult label	1	Several formulations; see label for rate.
	spinetoram	3.0–6.0 fl oz Radiant SC	1 (food) 3 (forage, fodder)	Do not make more than 6 applications per crop. Do not exceed 0.281 lb ai/a per season. Wait at least 4 days between treatments.
	spinosad	Blackhawk Entrust SC other formulations available	1 (grain) 7 (forage) 28 (fodder)	Consult label.
	zeta-cypermethrin	2.8–4.0 oz *Mustang Maxx	3	Do not exceed 24.0 oz/a Mustang Maxx (0.15 lb ai/a) per season.
	zeta-cypermethrin + bifenthrin	*Hero, *Hero EW (rates vary by formulation)	3	Refer to maximum usage tables when applying more than one product containing zeta-cypermethrin and/or bifenthrin.
Grasshoppers	*Treat fencerows adjacent to cornfields to prevent injury.*			
	alpha-cypermethrin	2.8–3.8 fl oz *Fastac CS, *Fastac EC	3	Do not apply more than 11.4 fl oz (0.075 lb ai)/a per season.
	azadirachtin	Neemix 4.5 (see label for rates)	0	Consult label.
	beta-cyfluthrin	2.0–2.8 fl oz *Baythroid XL	0	Do not exceed 28.0 fl oz/a (0.22 lb ai/a) per season.
	bifenthrin	2.1–6.4 fl oz *Brigade 2EC	1	Do not exceed 12.8 fl oz/a (0.2 lb ai/a) per season. Do not graze or use treated crops for feed within 1 day of last application.

*Restricted-use pesticide.

(continued)

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Grasshoppers *(cont.)*	0.084–0.167 lb bifenthrin + chlorantraniliprole	4.8–9.6 fl oz *Elevest	1	Make no more than 2 applications per acre per calendar year. Minimum interval between treatments is 1 day. Do not apply more than a total of 0.2 lb ai/a of chlorantraniliprole and 0.2 lb ai/a of bifenthrin per year. This total includes applications of *Elevest insect control and other chlorantraniliprole or bifenthrin-containing products.
	chlorantraniliprole	2.0–5.0 fl oz Coragen	1	Do not make more than 4 applications per crop season and allow at least 1 day between applications. Do not apply more than 15.4 fl oz/a Coragen or 0.2 lb/a of chlorantraniliprole-containing products per season.
		0.7–1.7 fl oz Vantacor	1	Do not apply more than 5.1 fl oz Vantacor or 0.2 lb/a per calendar year of chlorantraniliprole-containing products including all application types (seed treatment, soil, foliar).
	deltamethrin	1.0–1.5 fl oz *Delta Gold 1.5EC	1 (ear, grazing) 21 (stover)	Do not exceed 38.4 fl oz/a per season. See label for grazing and feed restrictions.
	esfenvalerate	5.8–9.6 fl oz *Asana XL	1	Do not exceed 0.5 lb ai/a per season.
	gamma-cyhalothrin	2.56–3.84 oz *Proaxis	1	Do not apply more than 3.84 pt/a (0.24 lb ai/a) per season. See label for grazing and forage use restrictions.
		1.02–1.54 fl oz *Declare	1	Do not apply more than 1.54 pt/a per crop. See label for grazing and forage use restrictions.
	lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	1	Do not exceed 0.48 lb ai/a. See label for grazing and forage feed restrictions.
	lambda-cyhalothrin + chlorantraniliprole	6.0–10.0 fl oz *Besiege	1	Do not apply more than 31.0 fl oz of Besiege or 0.48 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole-containing products per acre per year. See label for grazing and forage restrictions.
	novaluron	6.0–12.0 fl oz Rimon 0.83EC	1	Nymphs only. Do not apply more than 60.0 fl oz/a per season.
	zeta-cypermethrin	2.8–4.0 fl oz *Mustang Maxx	3	Do not exceed 24.0 oz/a Mustang Maxx (0.15 lb ai/a) per season.
	zeta-cypermethrin + bifenthrin	*Hero, *Hero EW (rates vary by formulation)	3	Refer to maximum usage tables when applying more than one product containing zeta-cypermethrin and/or bifenthrin.
Rootworm larvae	*Corn rootworm larvae are a potential problem in sweet corn following other corn crops. Female corn rootworm beetles lay eggs in corn fields from mid- to late-August. Late-planted corn is more attractive to adults. Eggs oviposited in August will overwinter in the soil and hatch the following spring. Treatments at planting are most effective. Postemergence treatments, when available, do not provide consistent control.*			
	bifenthrin	0.39–0.98 fl oz/1,000 ft row *Capture LFR		Apply as a 5- to 7-inch T-band. Do not apply more than 0.2 lb ai/a per season as an at-plant application.
		0.30 fl oz/1,000 ft row *Brigade 2EC	30	Apply as a 5- to 7-inch T-band. Do not apply more than 0.1 lb ai/a per season as an at-plant application.

*Restricted-use pesticide.

(continued)

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Rootworm larvae *(cont.)*	bifenthrin	0.46–0.92 fl oz/1,000 ft row *Capture 3RIVE 3D		Do not apply more than 0.2 lb ai/a per season.
	chlorethoxyfos + bifenthrin	0.65–0.72 fl oz *Index/1,000 ft row	at-plant only	Do not make more than 1 application per year. In-furrow application only. There is a 30-day rotational plantback interval for all crops other than corn.
		*SmartChoice 5G, HC (rate varies by formulation)	at-plant only	Do not apply as a surface band.
	phorate	*Thimet (rate varies by formulation)	30	Apply in a 7-inch band. Do not use in furrow.
	tebupirimphos + cyfluthrin	*Aztec 2.1 G, *Aztec 4.67 G, *Aztec HC (consult label for rate)		Apply in 7-inch band or seed furrow. Within 20 yards of aquatic areas, make in-furrow applications only.
	tefluthrin	*Force 3G, *Force 6.5G, *Force 10G HL, *Force Evo		Rates vary by formulation. Apply in 7-inch band or seed furrow.
	terbufos	*Counter 20G (consult label for rate)	60	If application is made at planting, do not apply postemergence or at cultivation. **Do not use** ALS-inhibiting herbicides if using Counter at planting.
	thiamethoxam	Cruiser (see label for rate)	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
Rootworm beetle	*Treat if five or more beetles per plant (check silks) before 75% silking, and silks are being pruned to within 1/2 inch of the husk.*			
	acetamiprid	Assail, several formulations (see label for rate)	1–7 (dependent on rate)	Do not exceed a total of 0.21 lb ai (11.2 oz)/a per growing season.
	alpha-cypermethrin	2.2–3.8 fl oz *Fastac CS, *Fastac EC	3	Do not apply more than 11.4 fl oz (0.075 lb ai)/a per season.
	beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Do not exceed 28.0 fl oz/a (0.22 lb ai/a) per season.
	bifenthrin	2.1–6.4 fl oz *Brigade 2EC	1	Do not exceed 12.8 fl oz/a (0.2 lb ai/a) per season. Do not graze or use crops for feed within 1 day of last treatment.
	0.084–0.167 lb bifenthrin + chlorantraniliprole	4.8–9.6 fl oz *Elevest	1	Make no more than 2 applications per acre per calendar year. Minimum interval between treatments is 1 day. Do not apply more than a total of 0.2 lb ai/a of chlorantraniliprole and 0.2 lb ai/a of bifenthrin per year. This total includes applications of *Elevest insect control and other chlorantraniliprole or bifenthrin-containing products.
	carbaryl	1.0–2.0 qt Sevin XLR Plus	2 (ears) 14 (forage) 48 (fodder)	Highly toxic to bees; see label for details. Do not exceed 16.0 qt/a per season. Hand harvesting is prohibited.
	deltamethrin	1.5–2.4 fl oz *Delta Gold 1.5EC	1 (ear, grazing) 21 (stover)	Do not exceed 38.4 fl oz/a (0.45 lb ai/a) per season. See label for grazing and feed restrictions.
	esfenvalerate	5.8–9.6 fl oz *Asana XL	1	Do not exceed 0.5 lb ai/a per season.
	gamma-cyhalothrin	2.56–3.84 oz *Proaxis	1	Do not exceed 3.84 pt/a (0.24 lb ai/a) per season. See label for grazing and forage use restrictions.
		1.02–1.54 fl oz *Declare	1	Do not apply more than 1.54 pt/a per crop. See label for grazing and forage use restrictions.

*Restricted-use pesticide.

(continued)

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Rootworm beetle *(cont.)*	lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	1	Do not exceed 0.48 lb ai/a. See label for grazing and forage feed restrictions.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Besiege	1	Do not apply more than 31.0 fl oz of Besiege or 0.48 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole-containing products per acre per year.
	methomyl	*Lannate LV, *Lannate SP	0 (ears) 3 (forage) 21 (stover)	Certain hybrids are susceptible to methomyl injury. Treat a small area to determine crop safety before full-scale spraying. Allow at least 1 day between treatments.
	permethrin	consult label	1	Several formulations; see label for rate.
	zeta-cypermethrin	2.24–4.0 fl oz *Mustang Maxx	3	Do not exceed 24.0 oz/a Mustang Maxx (0.15 lb ai/a) per season.
	zeta-cypermethrin + bifenthrin	*Hero, *Hero EW (rates vary by formulation)	3	Refer to maximum usage tables when applying more than one product containing zeta-cypermethrin and/or bifenthrin.
Sap (picnic) beetles	acetamiprid	Assail, several formulations (see label for rate)	1–7 (dependent on rate)	Do not exceed a total of 0.21 lb ai (11.2 oz)/a per growing season.
	alpha-cypermethrin	2.2–3.8 fl oz *Fastac CS, *Fastac EC	3	Do not apply more than 11.4 fl oz (0.075 lb ai)/a per season.
	bifenthrin	2.1–6.4 fl oz *Brigade 2EC	1	Do not exceed 12.8 fl oz/a (0.2 lb ai/a) per season. Do not graze or use treated crops for feed within 1 day of last application.
	0.084–0.167 lb bifenthrin + chlorantraniliprole	4.8–9.6 fl oz *Elevest	1	Make no more than 2 applications per acre per calendar year. Minimum interval between treatments is 1 day. Do not apply more than a total of 0.2 lb ai/a of chlorantraniliprole and 0.2 lb ai/a of bifenthrin per year. This total includes applications of *Elevest insect control and other chlorantraniliprole or bifenthrin-containing products.
	carbaryl	1.0–2.0 qt Sevin XLR Plus	2 (ears) 14 (forage) 48 (fodder)	Highly toxic to bees; see label for details. Do not exceed 16.0 qt/a per season.
	esfenvalerate	5.8–9.6 fl oz *Asana XL	1	Do not exceed 0.5 lb ai/a per season.
	gamma-cyhalothrin	2.56–3.84 oz *Proaxis	1	Do not apply more than 3.84 pt/a (0.24 lb ai/a) per season. See label for grazing and forage use restrictions.
		1.02–1.54 fl oz *Declare	1	Do not apply more than 1.54 pt/a per crop. See label for grazing and forage use restrictions.
	lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	1	Do not exceed 0.48 lb ai/a. See label for grazing and forage feed restrictions.
	lambda-cyhalothrin + chlorantraniliprole	6.0–10.0 fl oz *Besiege	1	Do not apply more than 31.0 fl oz of Besiege or 0.48 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole-containing products per acre per year. See label for grazing and forage restrictions.

*Restricted-use pesticide.

(continued)

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Sap (picnic) beetles *(cont.)*	methomyl	*Lannate LV, *Lannate SP (rates vary by formulation)	0 (ears) 3 (forage) 21 (stover)	Certain hybrids are susceptible to methomyl injury. Treat a small area to determine crop safety before full-scale spraying. Allow at least 1 day between treatments.
	novaluron	6.0–12.0 fl oz Rimon 0.83EC	1	Apply when adults first appear and prior to egg hatch. Do not apply more than 60.0 fl oz/a per season.
	zeta-cypermethrin	2.24–4.0 fl oz *Mustang Maxx	3	Do not exceed 24.0 oz/a Mustang Maxx (0.15 lb ai/a) per season.
	zeta-cypermethrin + bifenthrin	*Hero, *Hero EW (rates vary by formulation)	3	Refer to maximum usage tables when applying more than one product containing zeta-cypermethrin and/or bifenthrin.
Seed maggots	beta-cyfluthrin	2.0–2.8 oz *Baythroid XL/1,000 ft row	0	Do not exceed 28.0 fl oz/a (0.22 lb ai/a) per season.
	bifenthrin	0.2–0.78 fl oz/1,000 ft row *Capture LFR		Apply as a 5- to 7-inch T-band. Do not apply more than 0.2 lb ai/a per season as an at-plant application.
		0.15–0.30 fl oz/1,000 ft row (several formulations available)	30	Apply as a 5- to 7-inch band treatment over open seed furrow.
	0.05–0.2 lb bifenthrin	0.23–0.92 fl oz/1,000 ft row *Capture 3RIVE 3D		Do not apply more than 0.2 lb ai/a per season.
	chlorethoxyfos + bifenthrin	0.44–0.72 fl oz *Index/1,000 ft row	at-plant only	Do not make more than 1 application per year. In-furrow application only. There is a 30-day rotational plantback interval for all crops other than corn.
		*SmartChoice 5G, HC (rate varies by formulation)	at-plant only	Do not apply as a surface band.
	0.25–0.50 mg clothianidin/kernel	1.13–2.26 fl oz Poncho 600/80,000 seeds	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
	0.25–0.50 mg clothianidin/seed, *Bacillus firmus*	1.35–2.7 fl oz Poncho/VOTiVO/80,000 seeds	seed treatment	Purchase treated seed from seed dealer or seed treatment representative. Also used for nematode management. Pretest for compatibility with other seed treatments. Do not use treated seed for food, feed, or oil production.
	imidacloprid	1.6–6.4 fl oz Gaucho 600/100 lb seed	seed treatment	Purchase treated seed from seed dealer or seed treatment representative.
	phorate	*Thimet (rate varies by formulation)	30	Apply in 7-inch band over the row. Do not use in-furrow application.
	tebupirimphos + cyfluthrin	*Aztec 2.1 G, *Aztec 4.67 G, *Aztec HC (consult label for rate)		Apply in 7-inch band or seed furrow. Within 20 yards of aquatic areas, make in-furrow applications only.
	tefluthrin	4.0–5.0 oz *Force 3G/1,000 ft row 1.28–2.3 oz *Force 6.5G/1,000 ft row 0.46–0.57 oz *Force Evo/1,000 ft row		Apply in 7-inch band or seed furrow.

*Restricted-use pesticide.

(continued)

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Seed maggots *(cont.)*	terbufos	*Counter 15G, *Counter 20G (consult label for rate)	60	If application is made at planting, do not apply postemergence or at cultivation. ALS-inhibiting herbicides **should not** be used if Counter has been applied to corn at the time of planting.
	thiamethoxam	Cruiser 5FS (see label for rate)	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
Stalk borers	*Small corn is most susceptible to injury. Control is most effective when larvae are small and before wilted plants are common. Begin scouting border rows at 1300–1400 degree days (DD). The* Wisconsin Crop Manager *newsletter and DATCP's* Pest Survey Bulletin *provide degree day information (base 41°F) during the stalk borer season. Iowa State University studies indicate that 10% of the larvae move into corn from adjacent host weeds by 1400 DD and 50% will have migrated by 1700 DD. Larvae originating within the field from last year's weed patches will damage corn earlier. Map weedy areas during fall harvest so that you can check them the following year, starting at about 900–1000 DD.*			
	beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Application must be made before larvae bore into the plant. Do not exceed 28.0 fl oz/a (0.22 lb ai/a) per season.
	bifenthrin	0.23–0.92 fl oz/1,000 ft row *Capture 3RIVE 3D		Do not apply more than 0.2 lb ai/a per season.
		2.2–6.4 fl oz *Brigade 2EC	1	Do not exceed 12.8 fl oz/a (0.2 lb ai/a) per season. Do not graze or feed within 1 day of last treatment.
	0.098–0.167 lb bifenthrin + chlorantraniliprole	5.6–9.6 fl oz *Elevest	1	Make no more than 2 applications per acre per calendar year. Minimum interval between treatments is 1 day. Do not apply more than a total of 0.2 lb ai/a of chlorantraniliprole and 0.2 lb ai/a of bifenthrin per year. This total includes applications of *Elevest insect control and other chlorantraniliprole or bifenthrin-containing products.
	deltamethrin	1.5–2.4 fl oz *Delta Gold 1.5EC	1 (ear, grazing) 21 (stover)	Apply to early instar larvae before they bore into stalks. Do not exceed 38.4 fl oz/a (0.45 lb ai/a) per season. See label for grazing and feed restrictions.
	esfenvalerate	5.8–9.6 fl oz *Asana XL	1	Do not exceed 0.5 lb ai/a per season.
	flubendiamide	2.0–3.0 fl oz Belt SC	1	Do not apply more than 12.0 fl oz ai/a (0.375 lb ai/a) per crop per season. Consult label for grazing and forage restrictions.
	gamma-cyhalothrin	2.56–3.84 oz *Proaxis	1	Do not exceed 3.84 pt/a (0.24 lb ai/a) per season. See label for grazing and forage use restrictions.
		1.02–1.54 fl oz *Declare	1	Do not apply more than 1.54 pt/a per crop. See label for grazing and forage use restrictions.
	lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	1	Use higher rates for large larvae. Do not apply more than 0.48 lb ai/a per crop. See label for grazing and forage feed restrictions.
	lambda-cyhalothrin + chlorantraniliprole	6.0–10.0 fl oz *Besiege	1	Do not apply more than 31.0 fl oz of Besiege or 0.48 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole-containing products per acre per year. See label for grazing and forage restrictions.
	permethrin	consult label	1	See label for rate.

*Restricted-use pesticide.

(continued)

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Stalk borers *(cont.)*	zeta-cypermethrin + bifenthrin	*Hero, *Hero EW (rates vary by formulation)	3	Refer to maximum usage tables when applying more than one product containing zeta-cypermethrin and/or bifenthrin.
Two-spotted spider mite	bifenthrin	5.12–6.4 fl oz *Brigade	1	Do not apply more than 0.20 lb of active ingredient (12.8 fl oz product) per acre per season.
	0.134–0.0167 lb bifenthrin + chlorantraniliprole	7.7–9.6 fl oz *Elevest	1	Make no more than 2 applications per acre per calendar year. Minimum interval between treatments is 1 day. Do not apply more than a total of 0.2 lb ai/a of chlorantraniliprole and 0.2 lb ai/a of bifenthrin per year. This total includes applications of *Elevest insect control and other chlorantraniliprole or bifenthrin-containing products.
	spiromesifen	Oberon 2 SC, Oberon 4 SC (rates vary by formulation)	5 (ear, green forage, silage) 30 (stover)	Consult labels for plantback restrictions and rate restrictions.
	zeta-cypermethrin + bifenthrin	*Hero, *Hero EW (rates vary by formulation)	3	Refer to maximum usage tables when applying more than one product containing zeta-cypermethrin and/or bifenthrin.
Western bean cutworm	*Western bean cutworm (WBC) moth flight begins late June to early July, depending on location and temperatures. Pheromone traps should be in place throughout Wisconsin by July 1 each year to detect first moth emergence in your area.* *WBC pheromone traps placed at or near sweet corn fields is the best indicator of when to start scouting. Begin scouting as soon as first moth is captured in pheromone trap. Alternatively, using the WBC phenology model, begin scouting sweet corn no later than 1,320 degree-days (Base 50F) when 25% of moth population will be in flight. Egg laying will peak at 50% emergence (1,422 degree-days).* *Scout sweet corn for WBC egg masses and small larvae BEFORE larvae enter the ear. Sample five areas throughout field, 20 plants at each location, for a representative 100-plant sample. Continue to scout sweet corn fields throughout moth flight until trap captures diminish. There is one generation per year, and only one moth flight.* *Treatment threshold for sweet corn is 4% field infestation with egg masses and/or small larvae.* *For more information on WBC pheromone trapping and scouting in-season, please refer to the* Wisconsin Crop Manager *newsletter (ipcm.wisc.edu/wcm) and the* Wisconsin Pest Bulletin *(pestbulletin.wi.gov).*			
	Bacillus thuringiensis	Agree WG, Biobit, DiPel, Javelin, others (see label for rates)	0	Treat when plants first exhibit feeding signs in the whorl or leaves. If mature worms or heavy populations are present, a contact insecticide should be used to enhance control.
	beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Do not exceed 28.0 fl oz/a (0.22 lb ai/a) per season.
	bifenthrin	2.1–6.4 fl oz *Brigade 2EC	1	Do not exceed 12.8 fl oz/a (0.2 lb ai/a) per season.
	0.084–0.167 lb bifenthrin + chlorantraniliprole	4.8–9.6 fl oz *Elevest	1	Make no more than 2 applications per acre per calendar year. Minimum interval between treatments is 1 day. Do not apply more than a total of 0.2 lb ai/a of chlorantraniliprole and 0.2 lb ai/a of bifenthrin per year. This total includes applications of *Elevest insect control and other chlorantraniliprole or bifenthrin-containing products.
	carbaryl	2.0 qt. Sevin XLR Plus	2 (ears)	Highly toxic to bees; see label for details. Do not exceed 16.0 qt/a per season. Hand harvesting is prohibited.

*Restricted-use pesticide.

(continued)

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Western bean cutworm *(cont.)*	chlorantraniliprole	3.5–7.5 fl oz Coragen	1	Do not make more than 4 applications per crop season and allow at least 1 day between applications. Do not apply more than 15.4 fl oz/a Coragen or 0.2 lb/a of chlorantraniliprole-containing products per season.
		1.2–2.5 fl oz Vantacor	1	Do not apply more than 5.1 fl oz Vantacor or 0.2 lb/a per calendar year of chlorantraniliprole-containing products including all application types (seed treatment, soil, foliar).
	esfenvalerate	2.9–5.8 fl oz *Asana XL	1	Do not exceed 0.5 lb ai/a per season.
	flubendiamide	2.0–3.0 fl oz Belt SC	1	Do not apply more than 12.0 fl oz ai/a (0.375 lb ai/a) per crop per season. Consult label for grazing and forage restrictions.
	gamma-cyhalothrin	2.56–3.84 fl oz *Proaxis	1	Do not apply more than 3.84 pt/a (0.24 lb ai/a) per season. See label for grazing and forage use restrictions.
		1.02–1.54 fl oz *Declare	1	Do not apply more than 1.54 pt/a per crop. See label for grazing and forage use restrictions.
	lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	1	Do not apply more than 0.48 lb ai/a per crop.
	lambda-cyhalothrin + chlorantraniliprole	6.0–10.0 fl oz *Besiege	1	Do not apply more than 31.0 fl oz of Besiege or 0.48 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole-containing products per acre per year. See label for grazing and forage use restrictions.
	methoxyfenozide	4.0–16.0 fl oz Intrepid 2F	3 (ears, green chop) 21 (fodder)	Do not exceed 16.0 fl oz/a per application or 64.0 fl oz/a (1.0 lb ai/a) per season.
	spinetoram	3.0–6.0 fl oz Radiant SC	1 (ear) 3 (forage, fodder)	Do not make more than 6 applications per crop or exceed 0.281 lb ai/a per season. Wait at least 4 days between treatments.
	spinosad	Blackhawk Entrust SC other formulations available	1 (grain) 7 (forage) 28 (fodder)	Consult label.
	zeta-cypermethrin + bifenthrin	*Hero, *Hero EW (rates vary by formulation)	3	Refer to maximum usage tables when applying more than one product containing zeta-cypermethrin and/or bifenthrin.
White grubs	bifenthrin	0.15–0.30 fl oz/1,000 ft row (several formulations available)	30	Apply as a 5- to 7-inch band treatment over open seed furrow. Do not apply more than 0.10 lb ai/a per season as an at-plant application.
		0.23–0.92 fl oz/1,000 ft row *Capture 3RIVE 3D		Do not apply more than 0.2 lb ai/a per season.
	0.04–0.08 lb bifenthrin	0.2–0.78 fl oz/1,000 ft row *Capture LFR	30	Apply as a 5- to 7-inch T-band treatment over open seed furrow. Do not apply more than 0.20 lb ai/a per season as an at-plant application.

*Restricted-use pesticide.

(continued)

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
White grubs *(cont.)*	chlorethoxyfos + bifenthrin	0.44–0.72 fl oz *Index/1,000 ft row	at-plant only	Do not make more than 1 application per year. In-furrow application only. There is a 30-day rotational plantback interval for all crops other than corn.
		*SmartChoice 5G, HC (rate varies by formulation)	at-plant only	Do not apply as a surface band.
	0.25–0.50 mg clothianidin/kernel	1.13–2.26 fl oz Poncho 600/80,000 seeds	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
	0.25–0.50 mg clothianidin/seed, *Bacillus firmus*	1.35–2.7 fl oz Poncho/ VOTiVO/80,000 seeds	seed treatment	Purchase treated seed from seed dealer or seed treatment representative. Also used for nematode management. Pretest for compatibility with other seed treatments. Do not use treated seed for food, feed, or oil production.
	phorate	*Thimet (rate varies by formulation)	30	Apply in 7-inch band over the row. Do not use in furrow application.
	tebupirimphos + cyfluthrin	*Aztec 2.1 G, *Aztec 4.67 G, *Aztec HC (consult label for rate)		Apply in 7-inch band over the row. Do not use in furrow application.
	tefluthrin	4.0–5.0 oz *Force 3G/1,000 ft row 1.28–2.3 oz *Force 6.5G/1,000 ft row 0.46–0.57 oz *Force Evo/1,000 ft row		Apply in 7-inch band or seed furrow. Use 0.57 fl oz Force CS per 1,000 feet of row for heavy infestations. For best wireworm and/or white grub control, apply the liquid as an in-furrow treatment.
	terbufos	*Counter 15G, *Counter 20G (consult label for rate)	60	If application is made at planting, do not apply postemergence or at cultivation. ALS-inhibiting herbicides **should not** be used if Counter has been applied to corn at the time of planting.
	0.25–0.80 mg thiamethoxam/kernel	Cruiser 5FS	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
Wireworms	beta-cyfluthrin	2.0–2.8 oz/1,000 ft row *Baythroid XL	0	Apply in 7-inch band or in seed furrow. Do not exceed 28.0 fl oz/a (0.22 lb ai/a) per season.
	bifenthrin	0.30 fl oz/1,000 ft row *Brigade 2EC	30	Apply as a 5- to 7-inch T-band. Do not apply more than 0.1 ai/a per season as an at-plant application.
		0.2–0.78 fl oz/1,000 ft row *Capture LFR	30	Apply as a 5- to 7-inch T-band treatment over open seed furrow. Do not apply more than 0.2 lb ai/a per season.
		0.23–0.92 fl oz/1,000 ft row *Capture 3RIVE 3D		Do not apply more than 0.2 lb ai/a per season.
	chlorethoxyfos + bifenthrin	0.44–0.72 fl oz *Index/1,000 ft row	at-plant only	Do not make more than 1 application per year. In-furrow application only. There is a 30-day rotational plantback interval for all crops other than corn.
		*SmartChoice 5G, HC (rate varies by formulation)	at-plant only	Do not apply as a surface band.
	0.25–0.50 mg clothianidin/kernel	1.13–2.26 fl oz Poncho 600/80,000 seeds	seed treatment	Purchase treated seed from seed dealer or seed treatment representative.

*Restricted-use pesticide.

(continued)

Insect control in sweet corn *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Wireworms *(cont.)*	0.25–0.50 mg clothianidin/seed, *Bacillus firmus*	1.35–2.7 fl oz Poncho/ VOTiVO/80,000 seeds	seed treatment	Purchase treated seed from seed dealer or seed treatment representative. Also used for nematode management. Pretest for compatibility with other seed treatments. Do not use treated seed for food, feed, or oil production.
	imidacloprid	0.8–6.4 fl oz Gaucho 600/100 lb seed	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.
	phorate	*Thimet (rate varies by formulation)	30	Apply in 7-inch band over the row. Do not use in furrow application.
	tebupirimphos + cyfluthrin	*Aztec 2.1 G, *Aztec 4.67 G, *Aztec HC (consult label for rate)		Apply in 7-inch band or seed furrow. Within 20 yards of aquatic areas, make in-furrow applications only.
	tefluthrin	4.0–5.0 oz *Force 3G/1,000 ft row 1.28–2.3 oz *Force 6.5G/1,000 ft row 0.46–0.57 oz *Force Evo/1,000 ft row		Apply in 7-inch band or seed furrow. Use 0.57 fl oz Force CS per 1,000 feet of row for heavy infestations. For best wireworm and/or white grub control, apply the liquid as an in-furrow treatment.
	terbufos	*Counter 15G, *Counter 20G (consult label for rate)		If application is made at planting, do not apply postemergence or at cultivation. ALS-inhibiting herbicides **should not** be used if Counwter has been applied to corn at the time of planting.
	0.25–0.80 mg thiamethoxam/kernel	Cruiser 5FS	seed treatment	Early season protection. Purchase treated seed from seed dealer or seed treatment representative.

*Restricted-use pesticide.

Weed control

Due to concern about groundwater contamination, Wisconsin has enacted atrazine rate restrictions based on surface soil texture, prior atrazine use, and geographic location relative to atrazine detections in groundwater. Wisconsin's Atrazine Rule (ATCP 30) imposes a 0.75–1.5 lb/a rate limit on atrazine use statewide. An exception is allowed for growers who find it necessary to use atrazine postemergence to "rescue" seed or sweet corn from weed competition. This exception applies only to seed and sweet corn and the total amount of atrazine used at planting and postemergence may not exceed 1.5 lb/a on coarse soils and 2.0 lb/a on medium or fine soil. In addition, atrazine use is prohibited in extensive areas of Dane County and the entire Lower Wisconsin River valley extending downstream from the Highway 60 bridge at Prairie du Sac to the confluence of the Wisconsin and Mississippi Rivers. Localized areas of Adams, Brown, Calumet, Chippewa, Columbia, Dodge, Eau Claire, Grant, Green, Green Lake, Iowa, Jackson, Juneau, Lafayette, Manitowoc, Marathon, Marinette, Marquette, Monroe, Outagamie, Pierce, Portage, Richland, Rock, St. Croix, Sauk, Trempealeau, Vernon, Walworth, Waupaca, Waushara, Winnebago, and Wood Counties have a total prohibition on atrazine use. Contact your county Extension office for detailed maps of atrazine prohibition areas or visit https://datcp.wi.gov/Pages/Programs_Services/Atrazine.aspx.

The following table lists atrazine active ingredient rate limits for various management situations in Wisconsin. Be certain to reduce the use rates of atrazine and atrazine-containing products according to the Wisconsin Atrazine Rule. Wisconsin ATCP 30 also specifies that atrazine can be applied only from April 1 through July 31. It also prohibits atrazine application through irrigation systems and prohibits irrigation for 2 years after atrazine application unless such irrigation is practiced via an irrigation scheduling program that does not allow the water content of the soil in the crop root zone to exceed field moisture capacity.

Atrazine active ingredient rate limits

	Statewide atrazine limits (lb ai/a)	
Surface soil texture	Atrazine used last year	No atrazine used last year
Coarse	0.75	0.75
Medium and fine	1.0	1.5

State and federal rules have also established setbacks for mixing, loading, and applying atrazine and atrazine-containing herbicides. Heed the following guidelines to minimize ground and surface water contamination by atrazine.

- No mixing or loading within 100 feet of wells, sinkholes, streams, lakes, or reservoirs unless such mixing or loading occurs over a spill containment pad constructed in compliance with Wisconsin ATCP 29. (Note: In Wisconsin, this rule applies for all pesticides. Federal rules require a 50-foot setback for atrazine only.)
- No application within 50 feet of a well or sinkhole or within 200 feet of the shoreline of natural or impounded lakes or reservoirs.
- No application within 66 feet of where field runoff enters streams (perennial or intermittent) and rivers.

Weed control in sweet corn

Weed	Active ingredient	Rate/a of commercial product	Remarks and suggestions
Annual weeds (soil-applied herbicides)	*Even where you use herbicides, shallow cultivation will help control weeds. Cultivate while both weeds and sweet corn are small. Do not cultivate when sweet corn is more than 24 inches tall or you may prune roots.*		
	acetochlor + safener	1.25–3.0 pt Harness 1.25–3.0 pt Surpass NXT (or equivalent)	Acetochlor provides good to excellent control of foxtails, crabgrass, and fall panicum, but will only suppress wild proso millet and has no effect on quackgrass. It controls nightshade and pigweed, suppresses lambsquarters, but several other broadleaf weeds escape control. See label for use restrictions when depth to ground water is less than 30 feet. **Preplant-incorporated:** Apply to dry soil within 2 weeks before planting and incorporate into the top 1–2 inches of soil. **Preemergence:** Apply after planting but before weed emergence.
	*acetochlor + atrazine + safener	1.8–2.3 qt Harness Xtra 1.8–2.7 qt Keystone LA NXT (or equivalent)	These premixes provide good to excellent control of foxtails, crabgrass, fall panicum, and several annual broadleaf weeds, but will only suppress wild proso millet and have no effect on quackgrass. Some velvetleaf may escape. See label for use restrictions when depth to ground water is less than 30 feet. **Preplant-incorporated:** Apply to dry soil within 2 weeks before planting and incorporate into the top 1–2 inches of soil. **Preemergence:** Apply after planting but before weed emergence.
	*atrazine	1.5–3.0 pt Atrazine 4L (or equivalent)	Many annual broadleaf weeds are controlled but permissible rates are generally inadequate for annual grass control except on very coarse-textured, low organic matter soils and when combined with rotary hoeing and/or row cultivation. Atrazine can be tank mixed with Dual II Magnum, Outlook, or Prowl to improve control of annual grasses. Triazine-resistant velvetleaf, common lambsquarters, smooth pigweed, and kochia are not controlled. **Preplant-incorporated:** Work into soil within the 2 weeks before planting. Ineffective on peat or muck soils. **Preemergence:** Apply after planting but before annual weeds emerge. Ineffective on peat or muck soils.
	dimethenamid-P	10.0–21.0 fl oz Outlook 6.0	Outlook provides good to excellent control of foxtails, crabgrass, and fall panicum but will only suppress wild proso millet and has no effect on quackgrass. It also does not control velvetleaf and several other broadleaf weeds. **Preplant-incorporated:** Apply to dry soil within 14 days before planting and blend into the top 1–2 inches of soil. Provides reasonable yellow nutsedge control at the highest rate recommended by soil type. **Preemergence:** Apply after planting but before weed emergence. Provides only limited control of yellow nutsedge. **Postemergence:** Although Outlook will not control emerged grasses, it can be applied to sweet corn up to 12 inches tall in single or sequential treatments. Do not harvest within 50 days or feed to livestock within 40 days after application.

*Restricted-use pesticide.

(continued)

Weed control in sweet corn *(continued)*

Weed	Active ingredient	Rate/a of commercial product	Remarks and suggestions
Annual weeds (soil-applied herbicides) *(cont.)*	dimethenamid-P + saflufenacil	10 fl oz Verdict	Provides residual control of many annual grass and broadleaf weeds. The addition of atrazine will improve control of large-seeded broadleaves. Will also provide control of small (<4 inches), emerged broadleaf weeds. If weeds are present (burndown scenario), add MSO (1% v/v) plus either AMS or UAN. Preplant-incorporated: Apply within two weeks of planting and blend into the top 1-2 inches of soil. Preplant surface applications made more than two weeks before planting are not advised. Preemergence: Apply after planting but before sweet corn emerges. For use on processing sweet corn only. Do not use on fresh market varieties. Do not apply on coarse textured soils with less than 3% organic matter.
	mesotrione	6.0–7.7 oz Callisto	**Preemergence:** Controls many annual broadleaf weeds including lambsquarters, nightshade, pigweed, common ragweed, and velvetleaf, but not annual grasses. Callisto can be tank mixed with a preemergence grass herbicide for annual grass control. If tank mixed with a herbicide containing atrazine, the Callisto rate can be reduced to 5.0–6.0 oz/a. To avoid injury, do not apply with emulsifiable concentrate grass herbicides after corn has spiked. Do not apply if wind speed exceeds 10 mph.
	pendimethalin	*% organic matter:* less than 1.5%: 2.0–3.0 pt Prowl H_2O more than 1.5%: 3.0–4.0 pt Prowl H_2O	**Preemergence:** Apply after planting and before weeds emerge. Do not soil incorporate. Provides excellent control of foxtails, crabgrass, and fall panicum, but has no effect on quackgrass, ragweeds, and mustards. Do not use on peat or muck soils. Plant sweet corn at least 1.5 inches deep. **Postemergence:** Will not control emerged grasses, but it can be applied postemergence for residual grass control before sweet corn reaches 24 inches tall or the 8-collar stage.
	pyroxasulfone	2.5-6.5 fl oz Zidua SC depending on soil type and timing	Pyroxasulfone provides residual control of annual grasses and small-seeded broadleaf weeds. Will not control emerged weeds. Preplant-incorporated: Apply within two weeks of planting and blend into the top 1-2 inches of soil. Preplant surface applications are not advised. Preemergence: Apply after planting but before weeds or sweet corn emerge. Postemergence: Apply to corn at spiking up to the V8 growth stage. Do not harvest sweet corn ears for 37 days after application.
	pyroxasulfone + fluthiacet	5.0–13.0 fl oz Anthem depending on soil type and timing	Anthem can be used early preplant, preemergence, and early postemergence to control many annual grass and small seeded broadleaf weeds. Can be applied preplant, preplant-incorporated, preemergence, or postemergence. Rates vary by soil type, organic matter, and use timing. Do not harvest ears or harvest for forage until 40 days after application.

*Restricted-use pesticide.

(continued)

Weed control in sweet corn *(continued)*

Weed	Active ingredient	Rate/a of commercial product	Remarks and suggestions
Annual weeds (soil-applied herbicides) *(cont.)*	S-metolachlor + mesotrione + pyroxasulfone + bicyclopryone	% organic matter: <3%: 2.1 qt Storen; ≥3%: 2.4 qt Storen	Provides excellent residual control of many annual broadleaf and grass species. Will also provide control of small (<3 inches), emerged broadleaf weeds. Add NIS or COC if weeds are present (burndown scenario). AMS or UAN may also be added to improve consistency of control. Preplant: Apply within 4 weeks of planting. Preemergence: Apply after planting but before sweet corn emerges. Do not apply postemergence or severe injury may occur. Do not use on coarse textured soils. Not recommended for soils with 10% or more organic matter.
	S-metolachlor + mesotrione	% organic matter: <3%: 2 qt Coyote ≥3%: 2.4 qt Coyote	Premix of S-metolachlor and mesotrione for residual control of annual broadleaf and grass weeds. Will also provide control of small (<3 inches), emerged broadleaf weeds. Add NIS or COC if weeds are present (burndown scenario). AMS or UAN may also be added to improve consistency of control. Preplant: Apply within 2 weeks of planting. Preemergence: Apply after planting but before sweet corn emerges. Do not apply postemergence or severe injury may occur.
	s-metolachlor + safener	1.0–2.0 pt Dual II Magnum	S-metolachlor provides good to excellent control of foxtails, crabgrass, and fall panicum but will only suppress wild proso millet and has no effect on quackgrass. It does not control velvetleaf and several other annual broadleaf weeds. Ineffective on peat or muck soils. **Preplant-incorporated:** Apply within 2 weeks before planting and blend into the top 2 inches. Treatment at 2.0 pt/a will control yellow nutsedge. Allowable rate depends on soil texture and organic matter. **Preemergence:** Apply after planting but before weeds or sweet corn emerge. Offers limited control of yellow nutsedge. **Postemergence:** Although s-metolachlor will not control emerged grasses, it can be applied on sweet corn up to 40 inches tall for residual grass control. Do not harvest ears for 30 days after application.
	*s-metolachlor + atrazine + safener	0.9–2.2 qt Bicep Lite II	Provides good to excellent control of foxtails, crabgrass, fall panicum, and several broadleaf weeds, but will only suppress wild proso millet and has little effect on quackgrass. Some velvetleaf may escape. Ineffective on peat or muck soils. **Preplant-incorporated:** Apply within the 2 weeks before planting and blend into top 2 inches of soil. Gives reasonable nutsedge control at the higher rate. **Preemergence:** Apply after planting but before weeds emerge. Provides limited control of yellow nutsedge. **Early postemergence:** Apply before weeds reach the two-leaf stage and before sweet corn is 5 inches tall. Best results when rain occurs 5–7 days after this application.
	*s-metolachlor + atrazine + mesotrione + bicyclopyrone	2.5–3.0 qt Acuron	Apply early preplant up to 28 days prior to planting or preemergence to the soil surface as a broadcast or banded application. Do not apply postemergence to sweet corn. Use the lower rate on soils with less than 3% organic matter. Not effective on soils with greater than 10% organic matter.

*Restricted-use pesticide.

(continued)

Weed control in sweet corn *(continued)*

Weed	Active ingredient	Rate/a of commercial product	Remarks and suggestions
Annual weeds (soil-applied herbicides) *(cont.)*	s-metolachlor + mesotrione + bicyclopyrone	2.0–2.25 qt Acuron Flexi	Apply early preplant up to 28 days prior to planting or preemergence to the soil surface as a broadcast or banded application. Do not apply postemergence to sweet corn. Use the lower rate on soils with less than 3% organic matter. Not effective on soils with greater than 10% organic matter.
	*s-metolachlor + mesotrione + atrazine + safener	2.7–3.25 qt Lumax EZ	Lumax provides good to excellent control of foxtails, crabgrass, fall panicum, and most annual broadleaf weeds, but will only suppress wild proso millet and has no effect on quackgrass. The mesotrione in this premix improves velvetleaf control compared to Bicep Lite II Magnum or similar premixes. Do not apply if wind speed exceeds 10 mph. **Preplant:** Apply up to 14 days before planting. **Preemergence:** Apply after planting but before sweet corn and grass weeds emerge.
	salflufenacil	2.0 oz Sharpen	Only use on processing varieties. Do not use on sweet corn grown for fresh market or seed. Sharpen may be applied preplant surface, preplant incorporated, or preemergence for broadleaf weed control as part of a planned two-pass weed control program. Do not apply after corn emergence or when an organophosphate or carbamate insecticide has been applied or is planned or severe crop injury will occur.
	simazine	Princep 4L (or equivalent)	Princep controls many annual broadleaf weeds, but grasses will only be controlled at higher rates. Quackgrass will not be controlled. Rate varies by soil type and application timing; see label. **Preplant-incorporated:** Apply within 2 weeks before planting and blend into the top 2 inches. **Preemergence:** Apply after planting but before sweet corn and weeds emerge. Princep requires more rainfall than atrazine to make it effective. Preplant-incorporated applications will be more effective in dry springs.
Emerged annual broadleaves	*atrazine	1.5–3.0 pt Atrazine 4L (or equivalent) *plus* 2.0 pt oil concentrate	**Early postemergence:** Use after earlier annual grass control treatment before redroot pigweed and common lambsquarters are 6 inches tall and before all other broadleaf weeds reach 4 inches but before corn is more than 12 inches tall. Check Wisconsin atrazine rate limits before using this treatment. Triazine-resistant velvetleaf, common lambsquarters, smooth pigweed, and kochia are not controlled.
	bentazon	Basagran	**Postemergence:** Apply when broadleaf weeds are small. If velvetleaf is the primary problem, substitute UAN or spray grade ammonium sulfate for the oil concentrate. Consult label for allowable adjuvants and rates. If both velvetleaf and common lambsquarters and/or common ragweed are a problem, include both oil concentrate and nitrogen solution or ammonium sulfate. Use sufficient spray volume to ensure adequate coverage. Rain within 4 hours reduces effectiveness. Also provides good control of yellow nutsedge; treat when 6–8 inches tall.
	carfentrazone	0.5-1 fl oz Aim EC plus 0.25% NIS	Provides excellent burndown control of velvetleaf. Also effective on many other broadleaf weed species (consult label). Aim EC should not be mixed with COC or other EC herbicide formulations to avoid severe crop injury. Postemergence: Apply broadcast to sweet corn up to the V8 growth stage. Can apply up to V14 sweet corn if using drop nozzles. Broadcast applications may result in leaf speckling and necrosis. Severity will depend on environmental conditions, adjuvants, and tank-mix partners. To minimize application into the whorl, make sure spray nozzles are at least 18 inches above the crop canopy. Drop nozzles or other directed sprayers can also be used.

*Restricted-use pesticide.

(continued)

Weed control in sweet corn *(continued)*

Weed	Active ingredient	Rate/a of commercial product	Remarks and suggestions
Emerged annual broadleaves *(cont.)*	clopyralid	0.33–0.66 pt Stinger or 0.2-0.4 pt Stinger HL	**Postemergence:** Stinger has good activity on weeds in the legume and sunflower families, including Canada thistle, common and giant ragweed, and cocklebur. For Canada thistle, apply when most plants have emerged and are 6–8 inches tall but before the pre-bud stage. For annual weeds, apply before weeds exceed the five-leaf stage. Apply before sweet corn exceeds 18 inches in height as a broadcast or directed spray in 10–20 gal/a. Stinger may be tank mixed with other herbicides labeled for use on sweet corn. Rain within 6 hours reduces effectiveness. Do not harvest ears or forage within 30 days after application, or stover within 60 days.
	fluroxypyr	0.4 pt Starane Ultra	**Postemergence:** Starane controls cocklebur, ragweeds, velvetleaf, hemp dogbane, and suppresses volunteer potato. It is poor on lambsquarters and pigweed when used alone. Starane can be tank mixed with atrazine to control these and other broadleaf weeds. Apply before annual weeds are 8 inches tall. Apply to sweet corn through the four-leaf collar stage in broadcast or directed spray in 10–20 gal/a. Drop nozzle applications can be made after this stage. Rain within 1 hour reduces effectiveness. Apply at least 31 days before harvesting ears or feeding forage to livestock.
	fluthiacet	0.6–0.9 oz Cadet *plus* 0.25% non-ionic surfactant or 1.0–2.0 pt/a crop oil concentrate	**Postemergence:** Cadet is primarily a velvetleaf herbicide with little residual activity. It may be applied from the 2-collar stage to 48 inches tall or prior to tasseling corn, whichever occurs first. Cadet provides excellent control of velvetleaf up to 36 inches tall, but is only labeled to control small lambsquarters, waterhemp, and pigweed at the 0.9 oz/a rate. It may cause temporary spotting of corn leaves. It is an option when targeting velvetleaf alone or to improve the control of other broadleaf herbicides. Cadet has contact activity and requires a minimum of 15 gallons per acre spray volume and 20 psi spray pressure. It can be mixed with other grass or broadleaf herbicides. Do not apply if wind speed exceeds 10 mph. Do not harvest sweet corn until 40 days after application.
	halosulfuron	0.67–1.0 oz Permit or Sandea	Apply over the top or with drop nozzles up to 30 days prior to harvest. If susceptible weeds are present at application the addition of NIS will enhance weed control. Treat nutsedge in the three- to five-leaf stage and broadleaf weeds 1–3 inches in height. Do not use on Jubilee sweet corn. Not all varieties have been tested for sensitivity to halosulfuron.
	mesotrione	3.0 oz Callisto *plus* 0.25% non-ionic surfactant	**Postemergence:** Callisto controls many annual broadleaf weeds, but will not control most grasses. Callisto may cause bleaching of sweet corn leaves, but the injury generally does not affect sweet corn growth. Sweet corn varieties vary in tolerance to Callisto. To minimize the risk of injury, non-ionic surfactant is the recommended adjuvant. Crop oil concentrate at 1% may be used, but the risk of injury increases. Do not add ammonium sulfate or a liquid nitrogen fertilizer. Because less-active adjuvants are used in sweet corn versus field corn, broadleaf weeds should be sprayed before 5 inches tall. Tank mixing 0.25 lb/a atrazine with Callisto is synergistic and will compensate for the less-active adjuvants in general and will specifically improve common ragweed control. Callisto plus atrazine must be applied before the sweet corn exceeds 12 inches. Callisto alone must be applied before sweet corn exceeds 30 inches or the V8 stage. Rain within 1 hour may reduce effectiveness. Do not apply Callisto if Counter was applied. Do not apply if wind speed exceeds 10 mph.

*Restricted-use pesticide.

(continued)

Weed control in sweet corn *(continued)*

Weed	Active ingredient	Rate/a of commercial product	Remarks and suggestions
Emerged annual broadleaves *(cont.)*	tembotrione + safener	3.0 oz Laudis *plus* 1% methylated seed oil (preferred) or 1% crop oil concentrate *plus* 1.5 qt 28% nitrogen solution or 1.5 lb ammonium sulfate	**Postemergence:** Laudis controls many annual broadleaf weeds including lambsquarters, nightshade, pigweed, ragweeds, and velvetleaf, as well as several annual grasses including large crabgrass, giant and yellow foxtail, and wild proso millet. Broadleaf weeds should be treated before they are 6-inches tall. Grass weed heights are shorter and vary by species. Tank mixing with 0.5 lb/a atrazine is synergistic and will improve control of broadleaf weeds and will control larger grass weeds. Laudis can be applied to sweet corn up to the 7-collar growth stage, except for atrazine tank mixtures which must be applied before corn exceeds 12 inches. Most hybrids have excellent tolerance to Laudis; however, a few hybrids, like Merit, are highly sensitive and will be killed. Rain within 1 hour may reduce effectiveness.
	tolpyralate	1-1.35 fl oz Shieldex 400SC plus 0.5-1% MSO plus AMS or UAN	Provides control of small (<5 inch) emerged broadleaf and grass weed species. The addition of atrazine will improve burndown and broaden the postemergence efficacy of Shieldex. Postemergence: Apply to sweet corn up to 20 inches tall or the V6 growth stage, whichever is more restrictive. Do not apply within 35 days of sweet corn harvest.
	topramezone	0.75–2.0 oz Impact	Apply postemergence to actively growing weeds at least 45 days prior to corn harvest. Both an adjuvant and nitrogen fertilizer are required to achieve optimum weed control—refer to the label for allowable types and rates. Where allowed, the addition of atrazine in a tank mix with Impact will improve weed control.
Emerged annual grasses	nicosulfuron + safener	0.9 oz/a Accent Q *plus* 1.0% oil concentrate or 0.25% surfactant *plus* 2.0 qt 28% nitrogen fertilizer or 2.0 lb ammonium sulfate	**Postemergence:** Apply broadcast to processing or fresh-market sweet corn up to 12 inches tall or with drop nozzles to sweet corn up to 18 inches tall. Do not treat if sweet corn has 6 or more collars (V6 stage). Accent Q may injure certain sweet corn hybrids. Contact a DuPont representative for hybrid tolerance information. Accent Q will kill highly sensitive hybrids. Apply before foxtails, barnyardgrass, fall panicum, and wild proso millet exceed 4 inches or quackgrass exceeds 10 inches. Accent Q will not control crabgrass. Rain within 4 hours reduces effectiveness. Do not cultivate 10 days before or 7 days after application. Accent Q can be tank mixed with atrazine. Do not apply Accent Q if Counter has been used. Accent Q's interaction with other organophosphate soil insecticides may cause unacceptable injury. Do not apply an organophosphate insecticide within 7 days before or 3 days after applying Accent Q.
	sethoxydim	0.5–1.5 pt Poast *plus* 1.0 qt/a crop oil concentrate	**Poast can only be applied to Poast-protected sweet corn; other hybrids will be severely injured.** **Postemergence:** Poast will control annual grass weeds and suppress quackgrass. Apply Poast at 0.75 pt/a to control wild proso millet up to 10 inches tall, 1.5 pt/a for crabgrass up to 6 inches tall and foxtails up to 8 inches tall, and 2.25 pt/a for quackgrass when 8 inches tall. The addition of 2.5 lb/a ammonium sulfate or 2–4 qt/a 28% nitrogen solution may improve control of certain grass weeds. Poast applications can be made until before pollen shed. Up to 2 applications can be made at an interval of 10 days. Rain within 1 hour may reduce effectiveness. Sweet corn can be harvested 30 days after application.

*Restricted-use pesticide.

(continued)

Weed control in sweet corn *(continued)*

Weed	Active ingredient	Rate/a of commercial product	Remarks and suggestions
Emerged annual and perennial broadleaves	2,4-D	rate varies by formulation—consult label	Sweet corn may be injured by 2,4-D; use only when essential. Do not cultivate for 8–10 days to allow sweet corn to recover from stalk brittleness. Smartweeds and wild buckwheat are tolerant to 2,4–D, especially the amine form. Do not harvest ears within 45 days after application. **Broadcast early postemergence:** Apply when sweet corn is 4–6 inches tall. Use the lower rate in hot, humid weather. **Drop nozzle postemergence:** Apply when sweet corn is at least 8 inches tall. Direct spray toward base of sweet corn.
Directed applications	*paraquat	1.0–2.0 pt *Gramoxone SL 2.0	Apply as directed spray when corn is at least 10 inches tall and before weeds reach 6 inches tall. Corn plants shorter than 10 inches may be injured beyond recovery. Add 1 qt of non-ionic surfactant per 100 gal of final spray mixture. Arrange nozzles to spray no higher than the lower 3 inches of corn stalks to provide maximum weed contact with minimum corn contact. Do not spray over the top of corn. Do not mix this herbicide with liquid fertilizer for simultaneous application. For improved control of broadleaf annual weeds include 1–2 pt/a of the atrazine 4L formulation or an equivalent in the spray mixture. Use Gramoxone only when there is enough height difference between the corn and weeds to thoroughly spray the weed foliage without contacting the upper corn leaves by spray or drift. Such contact may cause crop injury. This treatment provides excellent annual weed control and temporary burn on the topgrowth of perennial weeds. However, an earlier herbicide treatment, rotary hoeing, or row cultivation is usually necessary to establish the proper height differential between corn and weeds.

*Restricted-use pesticide.

Table beet

Planting

Plant in well-drained soil that is high in organic matter. Use minimum tillage to maintain good soil structure. Crusting seriously reduces seedling emergence. Rotating crops will help prevent damping-off.

Rows: 12–30 inches; 15–20 plants/ft of row.

Seed: 10–15 lb/a.

Table beets can be planted in paired rows 14 inches apart with 1.5 inches between paired rows. Use size-graded seed of monogerm varieties or multigerm varieties spaced 1 inch apart in each paired row. Smaller seed sizes of multigerm varieties are recommended, since a relatively higher percentage of the "seedballs" will contain a single germ as compared to the larger seed sizes. Use 16–20 lb/a of seed. Plant seed no deeper than 0.5–0.75 inch in moist soil.

Lime and fertilizer

Lime: Use dolomitic limestone to maintain a pH of 6.0 on mineral soils and 5.6 on organic soils.

Fertilizer rates: Apply P_2O_5 and K_2O according to soil test recommendations before planting. Annual nitrogen, P_2O_5, and K_2O recommendations are shown in the table below. Take credits for previous legume crops and manure.

Application: Broadcast fertilizer or apply in a band 2 inches to the side of the row and 2 inches below seed depth.

Nitrogen: Apply before planting or sidedress early in the growing season. On sandy soils, split the nitrogen into two or 3 applications over the growing season.

Boron: Apply 2–3 lb/a of boron with broadcast fertilizer before planting if boron soil test is very low (VL) or low (L). Omit application if boron soil test is in the excessively high (EH) range. During extended periods of dry weather, make foliar applications of boron (see *black spot* in Disease Control table).

Annual nitrogen, phosphate, and potash recommendations for table beet

Nitrogen		Phosphate and potash		
Organic matter (%)	**Amount to apply** (lb/a)	**Yield goal** (t/a)	**Amount P_2O_5 to apply*** (lb/a)	**Amount K_2O to apply*** (lb/a)
<2	120	5.0–10.0	10	30
2.0–9.9	100	10.1–15.0	15	50
10–20	80	15.1–20.0	25	70
>20	30			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Disease control in table beet

Disease	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphanomyces root rot	*Poor soil structure and compaction contribute to this problem. Well-drained soil in good tilth and rotation aid in control. Grass sod, cover crops, and plant residue (especially corn stubble) improve soil structure.*			
Black spot (boron deficiency)	*More of a problem on calcareous soils having a high pH and when periods of dry weather occur during the growing season.*			
	18.0–20.0 lb borax	8.0–12.0 lb Solubor		Apply at planting. Also make 2 applications 2–4 weeks apart, beginning before midseason (spray with 10.0–20.0 lb borax or 6.0–11.0 lb Solubor/100 gal water per acre).
Botrytis leaf spot (*Botrytis cinerea*), **leaf blight/leaf spot** (*Alternaria* spp.), **Septoria leaf spot** (*Septoria* spp.)	fluopyram + pyrimethanil	8.0–11.2 fl oz Luna Tranquility	7	Follow resistance management guidelines.
	fluopyram + trifloxystrobin	5.8 fl oz Luna Sensation	7	Follow resistance management guidelines.
	fluxapyroxad + pyraclostrobin	4.0–5.5 fl oz Merivon Xemium (*Alternaria*)	7	Make no more than 3 applications per crop per season. Do not apply more than 2 sequential applications before applying a fungicide that is not in Groups 7 or 11.
Cercospora leaf spot	azoxystrobin	9.0–15.5 fl oz Aframe, AzoxyStar, Quadris Flowable, Satori	0	Quadris, Satori, Cabrio, and Flint belong to the strobilurin group of fungicides. Do not exceed 1 application from this group before alternating with a fungicide that has a different mode of action. Do not exceed 4 applications of strobilurin fungicide per crop per year.
	pyraclostrobin	8.0–12.0 oz Cabrio EG	0	
	trifloxystrobin	2.0–3.0 oz Flint	7	
	Bacillus mycoides isolate J	1.0–4.5 oz LifeGard WG	0	May limit size and bulking of table meets. OMRI approved.
	copper hydroxide	1.33–2.66 pt Champ Formula 2 Flowable	0	Apply when conditions favor disease. Do not apply more than 21.6 pt/a per year.
	copper hydroxide copper sulfate	2.0–5.0 lb Kocide 101 77WP, DF 1.5–3.74 Kocide 2000 DF 0.75–2.0 lb Kocide 3000 1.3–3.3 pt Kocide 4.5 LF 2.0–4.0 lb Basic Copper Sulfate	0 0 0 0 0	Spray weekly at first sign of infection. Follow a 3-year rotation between table beet crops.
	fluxapyroxad + pyraclostrobin	5.5 fl oz Merivon Xemium	7	Make no more than 3 applications per crop per season. Do not apply more than 2 sequential applications before applying a fungicide that is not in Groups 7 or 11.
	penthiopyrad	16.0–30.0 fl oz Fontelis	0	Make no more than 2 sequential applications before switching to a fungicide with a different mode of action. Do not exceed 61.0 fl oz/a per year.
	propiconazole	3.0–4.0 fl oz Bumper 41.8 EC, Topaz 3.0–4.0 fl oz Tilt, Topaz	14 14	Do not apply more than 12.0 fl oz of Bumper 41.8 EC/a per season or 16.0 fl oz of Tilt/a per season.
	tebuconazole	3.0–7.2 fl oz Monsoon, Orius 3.6F, Tebuzol 3.6, Toledo	7	Do not exceed 28.8 fl oz/a per season. Begin applications as soon as crop and/or environmental conditions become favorable for disease.
	trifloxystrobin	1.9–2.9 fl oz Gem 500 SC	7	Do not make more than 4 applications per year per season. Use higher rates when disease pressure is greater.
		2.0–3.0 oz Flint	7	Apply preventively and follow resistance management guidelines as per the label.
Pythium damping-off	mefenoxam	1.0–2.0 pt Ridomil Gold SL 2.0–4.0 pt Ultra Flourish		Preplant-incorporated application or surface application at planting. Preplant to top 2 inches of soil.

(continued)

Disease control in table beet *(continued)*

Disease	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Pythium damping-off *(cont.)*		0.085–0.64 fl oz Apron XL/100 lb seed		Follow manufacturer's directions. Do not use treated seed for feed or food.
	metalaxyl	4.0–8.0 pt MetaStar 2E AG		Preplant-incorporated application or surface application at planting. Preplant to top 2 inches of soil.
		0.7 fl oz/100 lb seed Sebring 2.65 ST 0.75 fl oz/100 lb seed Allegiance FL, Metalaxyl 265 ST		Follow manufacturer's directions. Do not use treated seed for feed or food.
Rhizoctonia dry rot and seed rot	*Control black spot. Remove the crop promptly from the field; chop and work old plant refuse into the soil.*			
	thiram captan			Follow manufacturer's directions. Do not use treated seed for feed or food.
	azoxystrobin	0.4–0.8 fl oz Quadris Flowable/1,000 ft row	0	Use at planting. Follow manufacturer's directions.

Insect control in table beet

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids	alpha-cypermethrin	3.2–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	azadirachtin	16.0–32.0 oz Aza–Direct 10.0–16.0 oz Azatin XL 4.0–10.0 oz Neemix 4.5	0	Apply at 7-day intervals when pests first appear. May apply every 7–10 days for heavy infestations.
	0.012–0.028 lb deltamethrin	1.5–2.4 oz *Delta Gold	3	Apply every 3 days as needed.
	0.25–0.5 lb dimethoate	0.5–1.0 pt Dimethoate 400EC	0	Beets may be mechanically harvested on day of application. Highly toxic to bees—do not apply when crop or nearby weeds are in bloom. Wait at least 7 days between treatments. Do not exceed 0.5 lb ai/a per treatment. Do not exceed 1.0 lb ai/a per year. Re-entry interval is 48 hours.
	flupyradifurone	7.0–10.5 fl oz Sivanto	7	Foliar application. Apply when pests reach or exceed established thresholds. Do not apply more than 28.0 fl oz of Sivanto per acre per crop season.
	imidacloprid	0.31–0.74 fl oz Admire Pro/1,000 ft row 4.4–10.5 fl oz Admire Pro 3.5 fl oz Provado	21 21 7	Admire may only be applied once per season. Apply Provado every 5 days as needed. Do not exceed 3 applications per season. Maximum imidacloprid use per season is 0.5 lb ai/a from any formulation.
	thiamethoxam	1.5–3.0 oz Actara 25WDG 5.0–12.0 fl oz Platinum 2SC 1.66–4.01 oz Platinum 75SG	7 30 30	Do not apply more than 12.0 oz of Actara 25WDG or Platinum 2SC and no more than 4.01 oz Platinum 75SG per acre per crop season and apply sufficient water volume after in-ground application to ensure incorporation into the seed zone. Actara is applied as a foliar spray.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	21	Do not apply more than 0.2 lb ai/a or exceed 2 applications per season.

*Restricted-use pesticide.

(continued)

Insect control in table beet *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cutworms	alpha-cypermethrin	1.3–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	azadirachtin	16.0–32.0 oz Aza–Direct 10.0–16.0 oz Azatin XL 4.0–10.0 oz Neemix 4.5	0	Apply at 7-day intervals when pests first appear. May apply every 7–10 days for heavy infestations.
	1.0 lb carbaryl	1.0 qt Sevin XLR Plus	3	Repeat applications as necessary up to a total of 6 times per year but not more than once every 7 days. Do not exceed 6.0 qt per crop per year. Do not apply when crop or nearby weeds are in bloom.
	2.0–4.0 lb diazinon	several formulations	14	Preplant broadcast application. Work into top 2–6 inches of soil before planting.
	0.45 lb methomyl	1.5 pt *Lannate LV	Consult label	Repeat application as necessary up to 12 times per crop. Do not exceed 18.0 pt/a per crop.
	0.05 lb zeta-cypermethrin	4.3 oz *Mustang Maxx	50	Apply at planting to the soil surface in a 5- to 7-inch band or broadcast in a minimum of 3–5 gal/a. Do not exceed 0.15 lb ai/a per season.
	0.025–0.06 lb zeta-cypermethrin + bifenthrin	2.6–6.1 fl oz *Hero	21	Do not apply more than 0.2 lb ai/a or exceed 2 applications per season.
Flea beetles	*Treat when flea beetles are so numerous on small plants that feeding is causing stand reduction.*			
	alpha-cypermethrin	1.8–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.5–1.0 lb carbaryl	0.5–1.0 qt Sevin XLR Plus	7	Repeat applications as necessary up to a total of 6 times per year but not more than once every 7 days. Do not exceed 6.0 qt per crop per year. Do not apply when crop or nearby weeds are in bloom.
	0.018–0.028 lb deltamethrin	*Delta Gold	3	Apply every 3 days as needed.
	imidacloprid	0.7–1.7 fl oz Admire Pro/1,000 ft row 7.0–10.0 fl oz Admire Pro 3.5 fl oz Provado	21 21 7	Admire may only be applied once per season. Apply Provado every 5 days as needed. Do not exceed 3 applications per season. Maximum imidacloprid use per season is 0.5 lb ai/a from any formulation.
	thiamethoxam	1.5–3.0 oz Actara 25WDG 5.0–12.0 fl oz Platinum 2SC 1.66–4.01 oz Platinum 75SG	7 30 30	Do not apply more than 8.0 oz of Actara 25WDG or Platinum 2SC and no more than 4.01 oz Platinum 75SG per acre per crop season and apply sufficient water volume after in-ground application to ensure incorporation into the seed zone. Actara is applied as a foliar spray.
	0.028–0.05 lb zeta-cypermethrin	2.4–4.3 oz *Mustang Maxx	50	Do not exceed 0.15 lb ai/a per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	21	Do not apply more than 0.2 lb ai/a or exceed 2 applications per season.
Leafminers	*Plants past the eight-leaf stage can compensate for damage caused by average leafminer populations.*			
	0.25–0.5 lb diazinon	several formulations	14	Will not control organophosphate-resistant leafminers.

*Restricted-use pesticide.

(continued)

Insect control in table beet *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Leafminers *(cont.)*	0.25–0.5 lb dimethoate	0.5–1.0 pt Dimethoate 400EC	7	Beets may be mechanically harvested on day of application. Highly toxic to bees—do not apply when crop or nearby weeds are in bloom. Wait at least 7 days between treatments. Do not exceed 0.5 lb ai/a per treatment. Do not exceed 1.0 lb ai/a per year. Re-entry interval is 48 hours.
	0.047–0.062 lb spinetoram	6.0–8.0 fl oz Radiant SC	7	Do not apply more than 32.0 fl oz/a or make more than 4 applications per year. Do not exceed 2 consecutive applications.
	spinosad	4.5–10.0 fl oz Entrust SC	3	Apply to small larvae or at egg hatch. Do not exceed 4 applications a crop year. Do not exceed 21.0 fl oz/a Entrust SC per season.
	0.028–0.05 lb zeta-cypermethrin	2.4–4.3 oz *Mustang Maxx	50	Do not exceed 0.15 lb ai/a per season.

*Restricted-use pesticide.

Weed control in table beet

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual grasses and some broadleaf weeds	3.0–4.0 lb cycloate	0.5–0.66 gal Ro-Neet 6E		Rate varies by soil type. Apply before planting and incorporate immediately, preferably by double disking. (Use on mineral soils only.)
	1.88 lb ethofumesate	60.0 fl oz Nortron SC or Ethotron SC		Apply alone or in a tank mix preemergence at time of planting or shortly after, but before weed germination. Where table beets are grown in beds, apply after bedding and incorporate. Do not exceed a total of 96 fl oz/a Nortron SC in a single growing season. Do not use on muck or peat soils.
Annual broadleaves	0.24–0.49 lb *phenmedipham	1.5–3.0 pt Spin-Aid	60	Controls small annual broadleaves but not redroot pigweed. Apply when beets are at the two-leaf stage or later. Multiple applications are allowed. Consult label for application rates and environmental conditions that may cause injury.
Emerged broadleaves	0.094–0.187 lb clopyralid	Several manufacturers and formulations	30	Effective on common ragweed and eastern black, cutleaf, and hairy nightshade. Apply to table beet in the two- to eight-leaf stage of crop growth. Do not apply more than twice per crop year and do not exceed a total of 0.5 pt/a.
	0.164–0.328 lb ethofumesate	5.25–10.5 fl oz Nortron SC or Ethotron SC		Apply postemergence for enhanced weed control. Use lower rates for table beets with two to four leaves; apply at 10.5 fl oz/a rate for table beets with six to eight leaves.
	0.016 lb triflusulfuron methyl	0.5 oz UpBeet	30	Apply postemergence to small weeds when table beets are in the two- to four-leaf stage. Additional applications may be made at the four- to six-leaf stage and the six- to eight-leaf stage. Combined applications must not exceed 1.5 oz/a UpBeet per growing season.

*Restricted-use pesticide.

(continued)

Weed control in table beet *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Emerged weeds	glyphosate	several manufacturers and formulations		See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. Glyphosate may be applied any time before crop emerges. Apply before crop seed germination in coarse sandy soils. If weeds have been mowed or tilled, do not treat until they have resumed active growth and reached the recommended stage on the label. Unless otherwise stated, allow 7 or more days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified.
Emerged grasses	0.068–0.12 lb clethodim	9.0–16.0 oz Select Max	30	Apply to actively growing grasses. Repeat treatments may be made at 14-day intervals up to seasonal maximum. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by label. Do not apply if rain is expected within 1 hour.
	clethodim	several manufacturers and formulations	30	
	0.164–0.328 lb ethofumesate	5.25–10.5 fl oz Nortron SC or Ethotron SC		Apply postemergence for enhanced weed control. Use lower rates for table beets with two to four leaves; apply at 10.5 fl oz/a rate for table beets with six to eight leaves.
	0.094–0.47 lb sethoxydim	0.5–2.5 pt Poast	60	Make postemergence applications to actively growing grasses within the size ranges indicated on the label. Check the label for wild proso millet or rescue treatment rate and for information on quackgrass control. Do not exceed 2.5 pt per application or 5.0 pt/a per season. Always add 2.0 pt/a of crop oil concentrate. Do not cultivate within 5 days before or 7 days after treatment.

*Restricted-use pesticide.

Tomato

Planting

Don't grow tomatoes in the same spot 2 years in succession. Rotate them with other crops—but not pepper, eggplant, or potato. Prepare bed 7–8 inches deep. The bed should be smoothed and free of weeds. Wisconsin's growing season is too short to allow direct planting of tomato seed. Instead, seed should be planted indoors around March 25 and transferred to a cold frame or hotbed May 1. Transplant after all danger of frost—about May 20–25 in southern Wisconsin and after June 1 in northern Wisconsin. Cultivate or hoe to control weeds. Do not cultivate after vines cover the ground. To avoid spreading plant diseases, do not hoe or cultivate when plants are wet. Alternatively, plastic mulch can be used to suppress weeds in the row. In addition, mulches increase tomato yield as compared to plants grown in bare soil.

Should plants be staked, caged, or left to sprawl? If cultivars are indeterminate (the terminal bud is vegetative), they should be caged or staked. If they are determinate (the terminal bud is a flower bud), you can cage them or let them sprawl. Each method has advantages and disadvantages.

Staked plants give a slightly earlier harvest, are cleaner, have somewhat larger fruit and are easier to harvest. However, extra labor is needed for weekly pruning and tying; fruit is more prone to cracking and sunscald; and more plants are needed to give the same yield.

Caged plants give higher quality, cleaner, and more abundant fruit compared to ordinary ground-type culture. They ripen later but are less susceptible to sunscald than staked plants. Caged plants do not need to be pruned.

Ground plants are the easiest to care for. However, they occupy the most space and fruit quality is compromised, especially for fruit touching the soil.

Pruned and staked

Rows: 36–48 inches.

Plants in row: 12–24 inches apart.

Caged

Rows: 36–48 inches.

Plants in row: 36 inches apart.

Use 10–12 ft^2 per plant for early varieties; use 15–20 ft^2 per plant for late or main crop varieties. Set 8-week-old plants 5–7 inches deep. Trench-in plants with long stems. Water plants several hours before they are set to ensure that a "ball" of soil adheres to the roots at transplanting.

Lime and fertilizer

Lime: Apply aglime to maintain a pH of 6.0 on mineral soils and 5.6 on organic soils.

Fertilizer rates: Apply P_2O_5 and K_2O according to soil test recommendations. Use annual nitrogen, P_2O_5, and K_2O recommendations in table below. Take credits for previous legume crops and manure. Adequate K_2O fertilization is important for prevention of gray wall.

Application: Broadcast lime, P_2O_5, and K_2O and work into soil before planting.

Nitrogen: On heavier soils, broadcast and incorporate with fertilizer before planting. On sandy soils, apply 20–40 lb N/a before setting plants and sidedress the balance of the nitrogen recommended in one or more applications after the first fruits set. Overapplication of nitrogen can lead to excess vegetative growth, delaying maturity and reducing yield.

Micronutrients: Tomato has relatively high requirements for most micronutrients. Use plant analysis to confirm if these nutrients may be in short supply.

Annual nitrogen, phosphate, and potash recommendations for tomato

Nitrogen		Phosphate and potash		
Organic matter (%)	**Amount to apply** (lb/a)	**Yield goal** (t/a)	**Amount P_2O_5 to apply*** (lb/a)	**Amount K_2O to apply*** (lb/a)
<2	140	20–25	40	180
2.0–9.9	120			
10–20	100			
>20	50			

*Amounts shown are for optimum (O) soil test levels. Apply 50% of this rate if soil test is high (H) and omit if soil test is excessively high (EH). If soil test is low (L) or very low (VL), increase rates according to soil test recommendations.

Disease control in tomato

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Bacterial spot	*A hot water seed treatment will help prevent bacterial spot. Place the seed in a mesh bag and dip it into water heated to 122°F. Treat seed for 25 minutes. Immediately transfer the bag to cold water to cool the seed. There will be some reduction in the germination rate of treated seed. You may wish to sow additional seed to compensate.*			
	fixed copper	3.0–4.0 lb Tri-Basic Copper Sulfate 2.0 qt Top Cop Tri-Basic 2.0–4.0 lb Kocide 77WP 2.0–4.0 lb Champion 77WP 1.3–2.6 pt Champ Formula 2 4.6F 2.0–4.0 lb Kocide DF 2.6–5.3 pt Kocide LF 2.4F 1.5 lb Kocide 2000 DF 0.75–1.75 lb Kocide 3000	0 0 0 0 0 0 0 0 0	Use disease-free plants. Only certified disease-free transplants should be used. Spray every 7 days in the plant bed and continue to spray in the field. Before transplanting, examine transplants carefully for bacterial spot lesions on the leaves and stems, especially when using southern-grown transplants.
	streptomycin sulfate	200 ppm streptomycin	0	Spray every 4–5 days in the seedbed up to transplanting.
Blossom-end rot	*Maintain uniform moisture supply by mulching and irrigating. Avoid excessive use of ammonia nitrogen and highly soluble potassium salts. Also work a superphosphate fertilizer or hydrated lime into the soil before planting. Do not cultivate too close to plants.*			
Botrytis (gray mold)	*Cultural management in greenhouses: keep ventilators partly open while the outside temperature is at least 45°F. This practice reduces relative humidity and the duration of periods favorable to spread of the fungus.*			
Early blight and Botrytis (gray mold)	azoxystrobin + benzovindiflupyr	0.6 oz/5,000 sq ft Mural	0	Only apply to tomato transplants intended for resale to consumers.
	boscalid	*early blight:* 2.5–3.5 oz Endura *Botrytis (gray mold):* 9.0–12.5 oz Endura	0	Endura belongs to the Group 7 fungicide category. If used alone, Endura does not control late blight. Use only in a tank mix with a broad-spectrum fungicide. Do not make more than 2 sequential applications of Endura before switching to a fungicide having a different mode of action. Do not make more than 6 applications of Endura per growing season. Do not exceed 21.0 oz/a per season when treating for early blight or 25.0 oz/a per season when treating for gray mold.
	difenoconazole + benzovindiflupyr	10.5–13.5 fl oz Aprovia Top	0	Do not apply more than 53.6 oz per year.
	fluopyram + pyrimethanil	11.2 fl oz Luna Tranquility	1	Follow resistance management guidelines.
	fluopyram + trifloxystrobin	5.0–7.6 fl oz Luna Sensation	3	Follow resistance management guidelines.
	pydiflumetofen + fludioxonil	9.2–11.4 fl oz Miravis Prime	0	Not for greenhouse application on vegetable crops. Do not apply more than 2 applications per acre per season at the maximum rate.

(continued)

Disease control in tomato *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Early blight and Botrytis *(cont.)*	pyrimethanil	7.0 fl oz Scala SC in combination with a broad-spectrum fungicide	1	Scala SC belongs to the Group 9 fungicide category. Use only in a tank mix with a broad-spectrum fungicide. Alternating the tank-mix combination with a broad-spectrum fungicide is a resistance management strategy. Scala SC can be used in a well-ventilated plastic tunnel house or glass house. Ventilate for at least 2 hours after application.
	tetraconazole	6.0–8.0 fl oz Mettle 125ME	0	Do not make more than 2 sequential applications.
Fruit anthracnose	*See Septoria leaf blight for chemical recommendations. When conditions are favorable for fruit anthracnose, use higher label rates of chlorothalonil formulations.*			
Fusarium and Verticillium wilts	*Plant only wilt-resistant varieties and follow a rotation that does not include wilt-susceptible crops.*			
	metam-sodium	Vapam HL		
Late blight	ametoctradin + dimethomorph	14.0 fl oz Zampro	4	Do not apply more than 2 sequential applications of Zampro. Alternate to a fungicide with a different mode of action. Also targets *Phytophthora capsici* (crown and fruit rot).
	cyazofamid	2.1–2.75 fl oz Ranman 400SC	0	Do not apply more than six sprays or 16.5 fl oz/a per year. Alternate Ranman (Group 21) sprays with a fungicide having a different mode of action. Crops not listed on the label should not be planted within 30 days after the last application.
	cymoxanil	3.2–5.0 oz Curzate 60DF	3	If late blight is present, use the 5.0 oz rate. Use only in combination with a labeled rate of a protectant fungicide, such as mancozeb, chlorothalonil, or copper hydroxide.
	dimethomorph	6.0 oz Forum	0	Begin treatment before the onset of late blight. Apply every 7–10 days; when cool, wet conditions are conducive for disease or when late blight has been detected in a field or nearby, apply every 5–7 days. Forum must be used in a tank mix with other protectant fungicides other than mefenoxam or metalaxyl. Do not exceed 30.0 oz/a Forum per season.
	fixed copper	2.6–4.0 pt Kocide LF 2.4F 0.75–1.75 lb Kocide 3000 1.5 lb Kocide 2000 DF 2.0–3.0 lb Kocide 101, DF 3.0–4.0 lb Tri-Basic Copper Sulfate	0 0 0 0 0	Begin treatment before symptoms appear.
	fluopicolide	3.0–4.0 fl oz Presidio	2	Tank mix this product with another labeled non–Group 43 fungicide.
	mandipropamid	5.5–8.0 fl oz Revus	1	Do not apply more than 32.0 fl oz/a per season. Begin application prior to disease onset. The addition of a spreading/penetrating adjuvant is recommended.
	mandipropamid/ difenoconazole	5.5–7.0 fl oz Revus Top	1	Make no more than 2 consecutive applications before switching to another non–Group 40/3 fungicide. Do not exceed 28.0 fl oz/a Revus Top per season.

(continued)

Disease control in tomato *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Late blight *(cont.)*	oxathiapiprolin	2.0–4.8 fl oz Orondis Opti A, Orondis Ultra A 2.4–19.2 fl oz Orondis Gold 200	0	Begin foliar applications prior to disease development. Do not exceed 4.8 fl oz/a per treatment, or 19.2 fl oz/a per year. Do not use Orondis Ultra A as a foliar application if you have already used Orondis Gold 200 on the soil at time of planting. Soil applications of Orondis Gold 200 are to be applied at-plant, in-furrow, or by drip irrigation treatment only.vo
	potassium phosphite	1.0–3.0 qt Fosphite/100 gal water	0	Do not apply Fosphite at intervals less than 3 days. Do not apply to plants that are heat- or moisture-stressed.
	propamocarb hydrochloride	0.7–1.5 pt Previcur Flex	5	Begin treatment before the onset of late blight. Tank mix with other fungicides such as chlorothalonil, maneb, or mancozeb. Adjust rates and timing according to late blight conditions. Do not exceed 7.5 pt/a Previcur Flex per growing season.
Leaf mold (Fulvia blight)	*Leaf mold is a very common foliar disease of tomato grown in greenhouses or high tunnels. Varietal resistance can aid in management. Plant spacing for airflow and dry foliage is important.*			
	fixed copper	3.0–4.0 lb Tri-Basic Copper Sulfate 2.0 qt Top Cop Tri-Basic 2.0–4.0 lb Kocide 77WP 2.0–4.0 lb Champion 77WP 1.3–2.6 pt Champ Formula 2 4.6F 2.0–4.0 lb Kocide DF 2.6–5.3 pt Kocide LF 2.4F 1.5 lb Kocide 2000 DF 0.75–1.75 lb Kocide 3000	0 0 0 0 0 0 0 0 0	Use disease-free plants. Only certified disease-free transplants should be used. Spray every 7 days in the plant bed and continue to spray in the field. Before transplanting, examine transplants carefully for bacterial spot lesions on the leaves and stems, especially when using southern-grown transplants.
	azoxystrobin + difenoconazole	8..0 fl oz Quadris Top	0	Follow resistance management guidelines.
	difenoconazole + benzovindiflupyr	10.5–13.5 fl oz Aprovia Top	0	Do not apply more than 53.6 oz per year.
	difenoconazole + cyprodinil	16.0–20.0 fl oz Inspire Super	0	Follow resistance management guidelines. Label doesn't limit greenhouse use.
	famoxadone + cymoxanil	6.0–8.0 oz Tanos	3	Follow resistance management guidelines. Label does not limit greenhouse use.
	mancozeb	1.2–1.6 qt Dithane DF Rainshield, Dithane F-45 1.5–3.0 lb Dithane M45 0.75–1.0 lb Koverall 0.75–1.5 lb Manzate Pro-Stick	3	Do not apply more than 11.2 qt per acre per crop. Can be used in greenhouse or high tunnel.
Seed rot, root rot, and damping-off	captan thiram			Plant seed treated with Captan or Thiram fungicide.
	fosetyl-al	2.5–5.0 lb Aliette, Linebacker	14	Do not exceed 20.0 lb product/a per season. Do not apply in less than 10.0 gal/a application volume. Apply at two- to four-leaf stage for direct-seeded tomatoes or immediately after transplanting to the field.

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Disease control in tomato *(continued)*

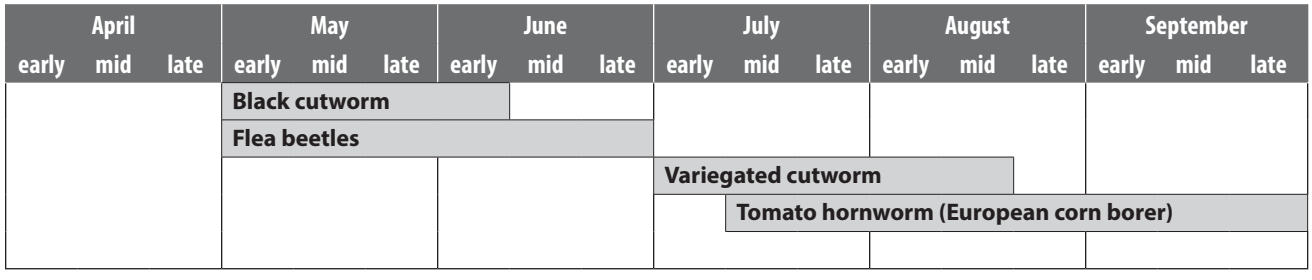
Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Septoria leaf blight, early blight, and late blight	azoxystrobin	6.2 fl oz Aframe, Equation, Quadris Flowable, Satori	14	Equation, Quadris, Satori, Tanos, Reason, and Evito belong to the Group 11 (strobilurin) fungicide category. Quadris Opti contains a combination of Groups 11 and M5 fungicides. Do not exceed 1 application of any of these Group 11 products before alternating with a fungicide having a different mode of action. Do not exceed 4 applications of Evito or 6 applications of other Group 11 fungicides per year. Do not exceed 22.8 fl oz/a Evito; 1.0 qt/a Equation, Quadris, or Satori; 1.0 gal/a Quadris Opti, 24.6 fl oz/a Reason, or 72.0 oz/a Tanos per season. Following the last application of Reason 500 SC, wait 30 days before rotating to wheat and 1 year for all other crops. Do not apply Equation, Quadris, Satori, or Tanos with an adjuvant. Do not apply Equation, Quadris, Satori, or Tanos until 21 days after transplanting or 35 days after seeding. Do not apply Equation, Quadris, Satori, or Tanos within 6 days before or after a postemergence application of metribuzan herbicide. Tanos must be tank mixed with a contact fungicide having a different mode of action.
	azoxystrobin + chlorothalonil	1.6 pt Quadris Opti	0	
	azoxystrobin + difenoconazole	8.0–14.0 fl oz Quadris Top	0	
	cymoxanil + famoxadone	*early blight:* 6.0–8.0 oz Tanos 50DF	3	
		late blight, fruit anthracnose: 8.0 oz Tanos 50DF	3	
	fenamidone	5.5–8.2 fl oz Reason 500 SC	14	
	fluoxastrobin	3.8–5.7 fl oz Evito 480 SC, Aftershock	3	
	chlorothalonil	1.3–1.8 lb Bravo Ultrex 82.5WDG, Equus DF	0	Begin spraying when the first fruit clusters start to develop and continue on a 7-day schedule throughout the season. Do not exceed 15.1 lb ai/a chlorothalonil per season. Adjust spray intervals when conditions favor disease development.
		1.375–2.0 pt Bravo Weather Stik, Echo 720, Equus 720	0	
		1.2–1.7 lb Echo 90DF	0	
		2.0–3.0 pt Echo Zn	0	
		2.0–2.75 pt Bravo Zn	0	
		1.9–2.8 pt Equus 500 Zn	0	
	chlorothalonil + cymoxanil	1.9–3.0 pt Ariston	3	Apply before infection but when conditions occur to favor disease.
	cyprodinil + difenoconazole	*Septoria leaf blight, early blight:* 16.0–20.0 fl oz Inspire Super	0	Also targets leaf mold (*Fulvia fulvum*) common in high tunnels and greenhouses. Do not apply more than 47.0 fl oz/a season. Do not use on varieties of tomatoes in which mature fruit are less than 2 inches (such as cherry or grape).
	cyprodinil + fludioxonil	*early blight:* 11.0–14.0 oz Switch 62.5WG	0	Do not apply more than 56.0 oz/a per year. Do not apply to small tomatoes such as cherry- or grape-type tomatoes in the greenhouse.
	fluxapyroxad + pyraclostrobin	4.0–8.0 fl oz Priaxor	7	Do not mix Priaxor with emulsifiable concentrate (EC) formulation or solvent-based formulation products, or crop oil concentrate, methylated seed oil, organosilicone, or MSO/OS blended adjuvant products. Do not make more than 2 applications before alternating to a fungicide with a different mode of action.
	hydrogen dioxide	1:100–1:2000 OxiDate dilution rate	0	Can be used on certified organic farms. Multiple use patterns for tomato. See label for details.

(continued)

Disease control in tomato *(continued)*

Disease	Active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Septoria leaf blight, early blight, and late blight *(cont.)*	mancozeb	0.6–2.4 qt Penncozeb 4FL, Manzate Flowable 1.2–2.4 qt Dithane F-45 0.75–1.5 lb Koverall 0.75–3.0 lb Penncozeb 75DF, 80WP 1.0–2.0 lb Manzate Pro-Stick 1.5–3.0 lb Dithane DF Rainshield	5 5 5 5 3 5	Consult label for product use limits. Spray every 5–10 days depending on disease and weather pressures.
	penthiopyrad	10.0–24.0 fl oz Fontelis	0	Make no more than 2 sequential applications before switching to a fungicide with a different mode of action. Do not exceed 72.0 fl oz/a per year.
	pyraclostrobin	*early blight, fruit anthracnose, Septoria leaf blight:* 8.0–12.0 oz Cabrio EG *late blight:* 8.0–16.0 oz Cabrio EG	0 0	
	trifloxystrobin	*Septoria suppression:* 3.0–3.8 fl oz Gem 500 SC 3.0–4.0 oz Flint *late blight:* 3.8 fl oz Gem 500 SC 4.0 oz Flint and tank mix with 75% of labeled rate of a protectant fungicide	3	Do not apply more than 16.0 oz/a per season. Do not apply more than 5 applications/a per season. Alternate every Group 11 application with at least one application from a different group.
	zoxamide + chlorothalonil	36.0 fl oz Zing	5	Follow resistance management guidelines.
	zoxamide + mancozeb	1.5–2.0 lb Gavel 75DF	5	Do not make more than 4 applications or apply more than 8.0 lb/a product (5.33 lb ai mancozeb or 0.66 lb zoxamide) per season. See label for other diseases controlled.
Soil rot	*Avoid by staking or mulching plants.*			
Walnut wilt	*Symptoms are similar to Fusarium wilt. Plant tomatoes at a distance from the base of black walnut trees that is greater than the tree height.*			
White mold *(Sclerotinia sclerotiorum)*	*Coniothyrium minitans*	1.0–4.0 lb Contans WG	0	Broadcast apply into top 2 inches of soil and incorporate with light mechanical incorporation or irrigation. See label for additional use patterns. Can be used in greenhouses and high-tunnel structures.

Scouting calendar for insect pests of tomato



Insect control in tomato

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids	0.038–0.075 lb acetamiprid	2.0–4.0 oz Assail 30SG	7	Begin treatment when thresholds are reached. Apply every 7 days as needed. Do not exceed 4 applications or 0.3 lb ai/a per season.
	0.035–0.075 lb acetamiprid	0.8–1.7 oz Assail 70WP	7	
	alpha-cypermethrin	3.2–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.025–0.044 lb beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Ground applications only.
	0.033–0.08 lb bifenthrin	2.1–5.2 fl oz *Brigade 2EC	1	Do not exceed 4 applications per season.
	0.06–0.15 lb bifenthrin + imidacloprid	3.8–9.85 fl oz *Brigadier	1	Do not apply more than 30.72 fl oz/a (0.48 lb ai/a) per season. No more than 0.32 lb ai/a bifenthrin and 0.24 lb ai/a imidacloprid are allowed per season.
	clothianidin	*foliar:* 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		soil: 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a sidedress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
	0.088–0.176 lb cyantraniliprole *(soil)*	6.75–13.5 fl oz Verimark	1	Do not apply more than 13.5 fl oz/a Verimark per crop per season. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6. Minimum application interval between foliar sprays is 5 days.
	0.088–0.133 lb cyantraniliprole *(foliar)*	13.5–20.5 fl oz Exirel	1	
	0.2 lb cyantraniliprole + abamectin	10.0 fl oz *Minecto Pro	7	Do not apply more than 0.4 lb per calendar year of cyantraniliprole-containing products, or more than 0.056 lb per calendar year of abamectin-containing products.
	0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold	1	Apply every 5 days as needed. Do not exceed 14.4 fl oz/a Delta Gold.
	0.045–0.268 lb dinotefuran	*foliar:* 1.0–4.0 oz Venom 70SG	1	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 6.0 oz/a per year using foliar applications, or 12.0 oz/a per season using soil applications. See product label for application directions. Do not apply to tomatoes less than 2 inches tall.
		soil: 5.0–6.0 oz Venom 70SG	21	
	0.05–0.18 lb dinotefuran *(foliar)*	2.0–7.0 oz Scorpion 35SL	1	Can repeat at 7-day intervals. Do not apply more than 10.5 oz per year. Use only one application method.
	0.23–0.27 lb dinotefuran *(soil)*	9.0–10.5 oz Scorpion 35SL	21	Do not apply more than 21.0 oz per year. Use only one application method.
	0.25–0.5 lb dimethoate	0.5–1.0 pt Dimethoate EC	7	
	0.2 lb fenpropathrin	10.67 oz *Danitol 2.4EC	3	Do not exceed 2.66 pt/a Danitol (0.8 lb ai/a) per season. Control may be improved by the addition of a non-ionic surfactant.

*Restricted-use pesticide.

(continued)

Insect control in tomato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids *(cont.)*	0.062–0.089 lb flonicamid	2.0–2.8 oz Beleaf SG	0	Begin applications before aphid populations build. Do not exceed 2.8 oz/a per application or 8.4 oz/a (0.267 lb ai/a) per season.
	flupyradifurone	*foliar:* 7.0–12.0 fl oz Sivanto *soil:* 21.0–28.0 fl oz Sivanto	1 45	Apply when pests reach or exceed established thresholds. Do not apply more than 28.0 fl oz of Sivanto per acre per crop season.
	imidacloprid	7.0–10.5 fl oz Admire Pro	21	Systemic at planting. Do not exceed 24.0 fl oz/a Admire per season.
	0.05 lb imidacloprid	Provado 1.6	0	Foliar spray. Also controls whitefly. Do not exceed 18.75 fl oz/a Provado per season.
	imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	0	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Reapply at intervals of 5 days or more. Do not exceed 0.18 lb ai/a per year.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	5	Do not exceed a total of 31.0 fl oz/a of Voliam Xpress or 0.36 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	5	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.9–1.5 lb malathion	several formulations	1	
	0.45–0.9 lb methomyl	1.5–3.0 pt *Lannate LV	1	Repeat application as necessary up to 16 times per crop. Do not exceed 21.0 pt/a per crop.
	pymetrozine	2.75 oz Fulfill 50WDG	14	Controls melon and green peach aphids. Treat when aphids first appear. May repeat in 7 days. Do not exceed 5.5 oz/a per season or more than 2 applications per crop.
	0.06–0.08 spirotetramat	4.0–5.0 Movento	1	Do not apply more than 10.0 fl oz/a (0.16 lb ai/a) per season.
	0.063–0.078 lb spirotetramat + 0.022–0.027 lb pyriproxifen	8.0–10.0 fl oz Senstar	1	Do not apply more than 10 fl oz of Senstar Insecticide (0.078 lb spirotetramat and 0.027 lb pyriproxyfen) per acre per application. Do not make more than 2 applications per crop season. Do not apply more than 20 fl oz of Senstar Insecticide (0.156 lb spirotetramat and 0.055 lb pyriproxyfen) per acre per crop season. Do not apply within 1 day of harvest. Minimum interval between applications is 14 days. Regardless of formulation do not apply more than 0.16 lb spirotetramat and 0.108 lb pyriproxyfen per acre per crop season.
	0.023–0.031 lb sulfoxaflor	0.75–1.0 oz Transform WG	7	Do not make applications less than 7 days apart. Do not make more than four applications per crop. Do not make more than two consecutive applications per crop. Do not apply more than a total of 8.5 oz of Transform WG (0.266 lb ai of sulfoxaflor) per acre per year. Do not apply this product at any time between 3 days prior to bloom and until after petal fall.

*Restricted-use pesticide.

(continued)

Insect control in tomato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Aphids *(cont.)*	thiamethoxam	2.0–3.0 oz Actara 25WDG 5.0–11.0 fl oz Platinum 2SC 1.66–3.67 oz Platinum 75SG	0 30 30	Do not apply more than 11.0 oz of Actara 25WDG or Platinum 2SC and no more than 3.67 oz Platinum 75SG per acre per crop season and apply sufficient water volume after in-ground application to ensure incorporation into the seed zone. Actara is applied as a foliar spray.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	0.17–0.21 lb tolfenpyrad	0.17–21.0 fl oz Torac	1	Apply by ground only, using a minimum of 20 gallons of water per acre. Do not apply by air on fruiting vegetables. Do not apply more than 42.0 fluid ounces (0.42 lb ai) per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow at least 14 days between applications. Do not make more than 4 applications per year. than 2 applications per crop cycle. Allow at least 14 days between applications. Do not make more than 4 applications per year.
	zeta-cypermethrin	3.2–4.0 oz *Mustang Maxx	1	Apply every 7 days as needed. Use higher rate for heavy infestations. Do not exceed 24.0 oz/a Mustang Maxx per season.
Colorado potato beetle	0.01–0.19 lb abamectin	1.75–3.5 fl oz *Agri-Mek	7	Minimum application interval is 7 days. Maximum annual rate is 10.25 fl oz Agri-Mek SC per acre per calendar year. Do not exceed 0.056 lb ai/a per calendar year of abamectin-containing products including all application types (seed treatment, soil, foliar). Do not apply more than 2 sequential applications of Agri-Mek SC or any other foliar-applied abamectin-containing product.
	0.28–0.047 lb acetamiprid 0.025–0.05 lb acetamiprid	1.5–2.5 oz Assail 30SG 0.6–1.1 oz Assail 70WP	7 7	Begin treatment when thresholds are reached. Apply every 7 days as needed. Do not exceed 5 applicatons or 0.3 lb ai/a per season.
	3.0–6.0 qt *Bacillus thuringiensis* subsp. *tenebrionis*	3.0–6.0 qt Trident	1	Use 3.0–6.0 quarts of Trident per acre, in a minimum spray volume of 20 gallons of water per acre. Use the 3.0 qt per acre rate only when light populations of larvae of uniform age/size are present.
	0.06–0.15 lb bifenthrin + imidacloprid	3.8–9.85 fl oz *Brigadier	7	Do not apply more than 25.6 fl oz/a (0.4 lb ai/a) per season. No more than 0.2 lb ai/a bifenthrin and 0.24 lb ai/a imidacloprid are allowed per season.
	1.0–2.0 lb carbaryl	1.0–2.0 qt Sevin XLR Plus	3	Repeat applications as necessary up to a total of 7 times per year but not more than once every 7 days. Do not exceed 8.0 qt per crop per year. Do not apply when crop or nearby weeds are in bloom.
	0.045–0.098 lb chlorantraniliprole	3.5–7.5 fl oz Coragen	1	Do not make more than 4 applications per crop season and allow at least 3 days between applications. Do not apply more than 15.4 fl oz/a per season.

*Restricted-use pesticide.

(continued)

Insect control in tomato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Colorado potato beetle *(cont.)*	0.065–0.130 lb cyantraniliprole *(drip, chemigation, or soil injection only)*	5.0–10.0 fl oz Verimark	1	Do not apply more than 13.5 fl oz/a Verimark per crop per season. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6.
	0.045–0.088 lb cyantraniliprole *(foliar)*	7.0–13.5 fl oz Exirel	1	Minimum application interval between treatments is 5 days. For best performance, use with an effective adjuvant. Do not apply a total of more than 0.4 lb ai/A of cyazypyr or cyantraniliprole-containing products.
	0.049–0.088 lb cyantraniliprole + 0.010–0.019 lb abamectin	5.5–10.0 fl oz *Minecto Pro	7	Minimum application interval of 7 days. Maximum annual rate of 20.0 fl oz/a per calendar year (0.18 lb ai/a of cyantraniliprole and 0.038 lb ai/a of abamectin). Do not apply more than 0.4 lb ai/a per calendar year of cyantraniliprole-containing products including all application types (seed treatment, soil, foliar). Do not apply more than 0.056 lb ai/a per calendar year of abamectin-containing products including all application types (seed treatment, soil, foliar).
	0.018–0.028 lb deltamethrin	1.2–204 fl oz *Delta Gold	1	Apply every 5 days as needed. Do not exceed 14.4 fl oz/a.
	0.045–0.328 lb dinotefuran	*foliar:* 1.0–4.0 oz Venom 70SG *soil:* 5.0–7.5 oz Venom 70SG	1 21	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 12.0 oz/a per season using soil applications. See product label for application directions.
	0.05–0.18 lb dinotefuran *(foliar)*	2.0–7.0 oz Scorpion 35SL	1	Can repeat at 7–day intervals. Do not apply more than 10.5 oz per year. Use only one application directions.
	0.23–0.27 lb dinotefuran *(soil)*	9.0–10.5 oz Scorpion 35SL	21	Do not apply more than 21.0 oz per year. Use only on application method
	0.03–0.05 lb esfenvalerate	5.8–9.6 fl oz *Asana XL	7	Do not exceed 0.35 lb ai/a per season.
	0.137–0.183 lb flupyradifurone	10.5–14.0 fl oz Sivanto 200SL	1	Minimum interval between applications is 7 days. Minimum application volume is 10 gal/a for ground, and 2 gal/a for aerial. Maximum Sivanto 200SL allowed per year is 28.0 fl oz/a (0.365 lb ai/a).
	0.01–0.015 lb gamma–cyhalothrin	2.56–3.84 oz *Proaxis	5	Apply every 5 days as needed. Do not apply more than 2.88 pt/a (0.18 lb ai/a) per season.
	0.25–0.38 lb imidacloprid	7.0–10.5 oz Admire Pro	21	Systemic at planting.
	0.047–0.080 lb imidacloprid	1.3–2.2 fl oz Admire Pro	0	Minimum interval between applications is 5 days. Maximum Admire Pro allowed per crop season is 6.7 fl oz/a (0.24 lb ai/a).
	0.048–0.078 lb imidacloprid	3.8–6.2 oz Provado 1.6	0	Foliar spray
	imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	0	Minimal interval between applications is 7 days and maximum allowable crop use per season is 15.4 fl oz/a.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz/a *Warrior II	4	Do not exceed 0.18 lb ai/a per season. Minimum interval between applications is 5 days.

*Restricted-use pesticide.

(continued)

Insect control in tomato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Colorado potato beetle *(cont.)*	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	5	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.36 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	lambda cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	5	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.05–2.0 lb permethrin	2.0–8.0 fl oz *Permethrin 3.2EC	0	Do not apply more than 24.0 oz per acre per season.
	0.039–0.078 lb spinetoram	5.0–10.0 oz Radiant SC	1	Do not apply more than 34.0 oz/a (0.266 lb ai/a) per crop and do not exceed 6 applications per year.
	0.047–0.094 lb spinosad	3.0–6.0 oz Entrust SC	1	Do not make applications less than 4 days apart. Do not apply more than a total of 29.0 fl oz of Entrust SC (0.45 lb spinosad) per acre per crop for all methods of application, including foliar, soil, and seed treatment uses. Do not make more than 6 applications per calendar year.
	thiamethoxam	2.0–3.0 oz Actara 25WDG 5.0–11.0 fl oz Platinum 2SC 1.66–3.67 oz Platinum 75SG	0 30 30	Do not apply more than 11.0 oz of Actara 25WDG or Platinum 2SC and no more than 3.67 oz Platinum 75SG per acre per crop season and apply sufficient water volume after in-ground application to ensure incorporation into the seed zone. Actara is applied as a foliar spray.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	0.14–0.21 lb tolfenpyrad	0.14–21.0 fl oz Torac	1	Apply by ground only, using a minimum of 20 gallons of water per acre. Do not apply by air on fruiting vegetables. Do not apply more than 42.0 fluid ounces (0.42 lb ai) per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow at least 14 days between applications. Do not make more than 4 applications per year.
	0.014–0.025 lb zeta-cypermethrin	2.24–4.0 oz *Mustang Maxx	1	Apply every 7 days as needed. Use higher rate for heavy infestations. Do not exceed 24.0 oz/a Mustang Maxx per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 oz *Hero	7	Do not apply more than 0.266 lb ai/a per season. Wait at least 7 days between applications.
Cutworms and loopers	*Treat when larvae exceed one per 10 plants.*			
	alpha-cypermethrin	2.2–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	0.033–0.044 lb beta-cyfluthrin	2.1–2.8 fl oz *Baythroid XL	0	Ground applications only. Apply every 7 days as needed. Do not apply more than 16.8 fl oz/a of Baythroid per season.
	bifenthrin	2.1–5.2 fl oz *Brigade 2EC	1	Do not exceed 4 applications per season.
		3.4–6.8 fl oz *Capture LFR	33	Do not exceed 0.1 lb ai/a as an at-plant application; do not exceed 0.32 lb ai/a per season of all bifenthrin products.

*Restricted-use pesticide.

(continued)

Insect control in tomato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Cutworms and loopers *(cont.)*	0.04–0.15 lb bifenthrin + imidacloprid	5.1–9.85 fl oz *Brigadier	1	Do not apply more than 30.72 fl oz/a (0.48 lb ai/a) per season. No more than 0.32 lb ai/a bifenthrin and 0.24 lb ai/a imidacloprid are allowed per season.
	1.0–2.0 lb carbaryl	Sevin (several formulations)	0	Broadcast bait formulation. Can only be used with mechanical harvest.
	chlorantraniliprole	3.5–7.5 fl oz Coragen	1	Do not make more than 4 applications per crop season and allow at least 5 days between applications. Do not apply more than 15.4 fl oz/a Coragen per season.
	0.088–0.176 lb cyantraniliprole *(soil)*	6.75–13.5 fl oz Verimark	1	Do not apply more than 13.5 fl oz/a Verimark per crop per season. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6.
	0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold	1	Apply every 5 days as needed. Do not exceed 14.4 fl oz/a Delta Gold.
	0.0075–0.015 lb emamectin benzoate	2.4–4.8 oz *Proclaim	7	
	0.3–0.5 lb esfenvalerate	5.8–9.6 oz *Asana XL	1	Do not apply more than 0.4 lb ai/acre per season.
	0.2 lb fenpropathrin	10.67 oz *Danitol 2.4EC	3	Do not exceed 2.66 pt/a Danitol (0.8 lb ai/a) per season. Control may be improved by the addition of a non-ionic surfactant.
	0.03–0.045 lb flubendiamide	2.0–3.0 oz Synapse WG	1	Do not apply more than 3.0 oz/a (0.045 lb ai/a) in a 7-day period or more than 9.0 oz/a per season.
	flubendiamide + buprofezin	12.0–17.0 fl oz Vetica	1	Do not apply more than 38.0 fl oz/a per season and allow at least 7 days between applications. Do not make more than 3 applications per crop season.
	imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	0	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.
	0.015–0.025 lb lambda-cyhalothrin	0.96–1.6 fl oz *Warrior II	4	Do not exceed 0.36 lb ai/a per season. Reapply at intervals of 5 or more days.
	lambda-cyhalothrin + chlorantraniliprole	5.0–8.0 fl oz *Voliam Xpress	5	Do not exceed 31.0 fl oz/a of Voliam Xpress or 0.36 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per growing season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	5	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.06–0.16 lb methoxyfenozide	4.0–10.0 fl oz Intrepid 2F	1	Do not exceed 64.0 fl oz/a per season. Use the higher rates with higher populations or when spray coverage is difficult. See label for use restrictions in some Wisconsin counties.
	0.039–0.063 lb spinetoram	5.0–8.0 oz Radiant SC	7	Do not apply more than 34.0 oz/a Radiant (0.266 lb ai/a) or make more than 6 applications per season.
	spinosad	3.0–6.0 fl oz Entrust SC	1	Use higher rate for larger insects. Do not exceed 0.45 lb ai/a per season. Do not use a buffering agent. Spray thoroughly for control.

*Restricted-use pesticide.

(continued)

Insect control in tomato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
	tebufenozide	6.0–16.0 fl oz Confirm 2F	7	Apply per label directions when populations reach threshold levels. Do not exceed 64.0 fl oz ai/a per season. There is a 1–12 month plantback restriction depending on crop.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season.
	0.01–0.025 lb zeta-cypermethrin	2.24–4.0 oz *Mustang Maxx	1	Apply at thresholds and do not exceed 24.0 oz/a Mustang Maxx per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	1	Do not apply more than 0.42 lb ai/a per season. Wait at least 10 days between applications.
Flea beetles	*Treat when numbers exceed two beetles per 10 leaves.*			
	alpha-cypermethrin	2.2–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	beta-cyfluthrin	2.8 fl oz *Baythroid XL	0	Maximum Baythroid XL allowed per 7-day interval is 2.8 fl oz/a and season total allowed per crop season is 16.8 fl oz/a.
	bifenthrin	2.1–5.2 fl oz *Brigade 2EC	1	Do not exceed 4 applications per season.
		3.4–6.8 fl oz *Capture LFR	33	Do not exceed 0.1 lb ai/a as an at-plant application; do not exceed 0.32 lb ai/a per season of all bifenthrin products.
	0.04–0.15 lb bifenthrin + imidacloprid	5.1–9.85 fl oz *Brigadier	1	Do not apply more than 30.72 fl oz/a (0.48 lb ai/a) per season. No more than 0.32 lb ai/a bifenthrin and 0.24 lb ai/a imidacloprid are allowed per season.
	0.5–1.0 lb carbaryl	0.5–1.0 qt Sevin XLR Plus	3	Repeat applications as necessary up to a total of 7 times per year but not more than once every 7 days. Do not exceed 8.0 qt per crop per year. Do not apply when crop or nearby weeds are in bloom.
	clothianidin	*foliar:* 3.0–4.0 fl oz Belay	21	Do not apply more than 12.0 fl oz/a per season and allow at least 7 days between applications.
		soil: 9.0–12.0 fl oz Belay	—	Do not apply more than 12.0 fl oz/a per season. Apply as a narrow band centered on the plant row; as an in-furrow spray at planting; as a sidedress to both sides of the row; as a transplant water drench; or as chemigation into root zone through drip, trickle or micro-sprinkler, or similar equipment.
	0.088–0.176 lb cyantraniliprole *(soil)*	6.75–13.5 fl oz Verimark	1	Do not apply more than 13.5 fl oz/a Verimark per crop per season. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6.

*Restricted-use pesticide.

(continued)

Insect control in tomato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Flea beetles *(cont.)*	0.018–0.028 lb deltamethrin	1.5–2.4 fl oz *Delta Gold	1	Apply every 5 days as needed. Do not exceed 14.4 fl oz/a Delta Gold.
	0.045–0.268 lb dinotefuran	*foliar:* 1.0–4.0 oz Venom 70SG *soil:* 5.0–6.0 oz Venom 70SG	1 21	Do not follow soil applications with foliar application of any other neonicotinoid insecticide. Use only one application method. Do not apply more than 6.0 oz/a per year using foliar applications, or 12.0 oz/a per season using soil applications. See product label for application directions. Do not apply to tomatoes less than 2 inches tall.
	0.05–0.18 lb dinotefuran *(foliar)*	2.0–7.0 oz Scorpion 35SL	1	Can repeat at 7-day intervals. Do not apply more than 10.5 oz per year. Use only one application method. Do not apply to tomatoes less than 2 inches tall.
	0.23–0.27 lb dinotefuran *(soil)*	9.0–10.5 oz Scorpion 35SL	21	Do not apply more than 21.0 oz per year. Use only one application method. Do not apply to tomatoes less than 2 inches tall.
	0.3–0.5 lb esfenvalerate	5.8–9.6 oz *Asana XL	1	Do not apply more than 0.5 lb ai/acre per season.
	0.01–0.015 lb gamma-cyhalothrin	2.56–3.84 oz *Proaxis	5	Apply every 5 days as needed. Do not apply more than 2.88 pt/a (0.18 lb ai/a) per season.
	imidacloprid	7.0–10.5 fl oz Admire Pro	21	Systemic at planting.
	imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	0	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.
	0.02–0.03 lb lambda-cyhalothrin	1.28–1.92 fl oz *Warrior II	4	Reapply at intervals of 5 days or more. Do not exceed 0.36 lb ai/a per year.
	lambda-cyhalothrin + chlorantraniliprole	6.0–9.0 fl oz *Voliam Xpress	5	Do not exceed a total of 31.0 fl oz/a of Voliam Xpress or 0.36 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	5	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	thiamethoxam	2.0–3.0 oz Actara 25WDG 5.0–11.0 fl oz Platinum 2SC 1.66–3.67 oz Platinum 75SG	0 30 30	Do not apply more than 11.0 oz of Actara 25WDG or Platinum 2SC and no more than 3.67 oz Platinum 75SG per acre per crop season and apply sufficient water volume after in-ground application to ensure incorporation into the seed zone. Actara is applied as a foliar spray.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chloran-traniliprole-containing products per season.
	0.01–0.025 lb zeta-cypermethrin	2.24–4.0 oz *Mustang Maxx	1	Apply every 7 days as needed. Use higher rate for heay infestations. Do not exceed 24.0 oz/a Mustang Maxx per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	1	Do not apply more than 0.42 lb ai/a per season. Wait at least 10 days between applications.

*Restricted-use pesticide.

(continued)

Insect control in tomato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Hornworm and tomato fruitworm	*Treat when there is an average of at least two hornworms per plant.*			
	alpha-cypermethrin	2.2–3.8 fl oz *Fastac	1	Apply when pests reach or exceed established thresholds. Do not apply more than 11.4 fl oz of Fastac per acre per crop season.
	Bacillus thuringiensis	DiPel DF, Javelin, MVP	0	Rates vary with formulation. Apply when larvae are small.
	Bacillus thuringiensis subsp. *kurstaki*	1.0–2.0 lb Lepinox WDG	0	Treat early instar larvae before noticeable feeding damage occurs. Repeat as needed.
	0.025–0.044 lb beta-cyfluthrin	1.6–2.8 fl oz *Baythroid XL	0	Ground applications only. Apply every 7 days as needed. Do not apply more than 16.8 fl oz/a of Baythroid XL per season.
	0.033–0.08 lb bifenthrin	2.1–5.2 fl oz *Brigade 2EC	1	Do not exceed 4 applications per season.
	0.04–0.15 lb bifenthrin + imidacloprid	5.1–9.85 fl oz *Brigadier	1	Do not apply more than 30.72 fl oz/a (0.48 lb ai/a) per season. No more than 0.32 lb ai/a bifenthrin and 0.24 lb ai/a imidacloprid are allowed per season.
	1.0–2.0 lb carbaryl	1.0–2.0 qt Sevin XLR Plus	3	Repeat applications as necessary up to a total of 7 times per year but not more than once every 7 days. Do not exceed 8.0 qt per crop per year. Do not apply when crop or nearby weeds are in bloom.
	chlorantraniliprole	3.5–7.5 fl oz Coragen	1	Do not make more than 4 applications per crop season and allow at least 5 days between applications. Do not apply more than 15.4 fl oz/a Coragen per season.
	0.065–0.130 lb cyantraniliprole *(soil)*	5.0–10.0 fl oz Verimark	1	Do not apply more than 13.5 fl oz/a Verimark per crop per season. Do not apply more than 0.4 lb ai/a cyantraniliprole-containing products per crop whether applied as soil or foliar applications. The pH of the application solution should be adjusted to between pH 4 and 6. Minimum application interval between foliar sprays is 5 days.
	0.045–0.088 lb cyantraniliprole *(foliar)*	7.0–13.5 fl oz Exirel	1	
	0.11–0.2 lb cyantraniliprole + abamectin	5.5–10.0 fl oz *Minecto Pro	7	Do not apply more than 0.4 lb per calendar year of cyantraniliprole-containing products, or more than 0.056 lb per calendar year of abamectin-containing products.
	0.012–0.028 lb deltamethrin	1.0–2.4 fl oz *Delta Gold	1	Apply every 5 days as needed. Do not exceed 14.4 fl oz/a Delta Gold.
	0.0075–0.015 lb emamectin benzoate	2.4–4.8 oz *Proclaim	7	
	0.015–0.05 lb esfenvalerate	2.9–9.6 fl oz *Asana XL	1	Do not exceed 0.5 lb ai/a per season.
	0.2 lb fenpropathrin	10.67 oz Danitol 2.4EC	3	Do not exceed 2.66 pt/a Danitol (0.8 lb ai/a) per season. Control may be improved by the addition of a non-ionic surfactant.
	0.03–0.045 lb flubendiamide	2.0–3.0 oz Synapse WG	1	Do not apply more than 3.0 oz/a (0.045 lb ai/a) in a 7-day period or more than 9.0 oz/a per season.
	flubendiamide + buprofezin	12.0–17.0 fl oz Vetica	1	Do not apply more than 38.0 fl oz/a per season and allow at least 7 days between applications. Do not make more than 3 applications per crop season.

*Restricted-use pesticide.

(continued)

Insect control in tomato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Hornworm and tomato fruitworm *(cont.)*	0.0075–0.0125 lb gamma-cyhalothrin	1.92–3.20 oz *Proaxis	5	Apply every 5 days as needed. Do not apply more than 2.88 pt/a (0.18 lb ai/a) per season.
	imidacloprid + beta-cyfluthrin	3.8–4.1 fl oz *Leverage 360	0	Do not apply more than 12.8 fl oz/a per season and allow at least 7 days between applications.
	0.045–0.065 lb indoxacarb	2.5–3.5 oz Avaunt	3	Apply when insect populations reach threshold levels. May repeat treatment every 5 days. Do not apply more than 0.26 lb ai/a per crop. Apply higher rate for tomato fruitworm control.
	0.015–0.025 lb lambda-cyhalothrin	0.96–1.6 fl oz *Warrior II	4	Reapply at intervals of 5 days or more. Do not exceed 0.36 lb ai/a per year.
	lambda-cyhalothrin + chlorantraniliprole	5.0–8.0 fl oz *Voliam Xpress	5	Do not exceed a total of 31.0 fl oz/a of Voliam Xpress or 0.36 lb ai/a of products containing lambda-cyhalothrin or 0.2 lb ai/a of products containing chlorantraniliprole per season.
	lambda-cyhalothrin + thiamethoxam	4.0–4.5 fl oz *Endigo ZC	5	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	0.45–0.9 lb methomyl	1.5–3.0 pt *Lannate LV	1	Repeat application as necessary up to 16 times per crop. Do not exceed 21.0 pt/a per crop.
	0.16–0.25 lb methoxyfenozide	10.0–16.0 fl oz Intrepid 2F	1	Do not exceed 64.0 fl oz/a per season. Use the higher rates with higher populations or when spray coverage is difficult. See label for use restrictions in some Wisconsin counties. May only provide partial control of fruitworms in heavy infestations.
	0.05–0.2 lb permethrin	2.0–8.0 oz *Permethrin 3.2EC	0	Do not apply more than 24.0 oz/a per year.
	0.039–0.063 lb spinetoram	5.0–8.0 oz Radiant SC	7	Do not apply more than 34.0 oz/a Radiant (0.266 lb ai/a) per crop and do not make more than 6 applications per crop.
	spinosad	3.0–6.0 fl oz Entrust SC	1	Use higher rate for larger insects. Apply adequate spray to get good coverage for best control. Do not exceed 0.45 lb ai/a per season Do not use a buffering agent.
	0.09–0.25 lb tebufenozide	6.0–16.0 fl oz Confirm 2F	7	Apply per label directions when populations reach threshold levels. Do not exceed 64.0 fl oz ai/a per season. There is a 1–12 month plantback restriction depending on crop.
	0.198–0.257 lb thiamethoxam + chlorantraniliprole	10.0–13.0 fl oz Durivo	30	Do not exceed a total of 13.0 fl oz/a Durivo (0.257 lb ai/a) per growing season. Do not exceed 0.172 lb ai/a of thiamethoxam-containing products or 0.2 lb ai/a of chloran-traniliprole-containing products per season.
	0.01–0.025 lb zeta-cypermethrin	2.24–4.0 oz *Mustang Maxx	1	Apply every 7 days as needed. Use higher rate for heay infestations. Do not exceed 24.0 oz/a Mustang Maxx per season.
	0.04–0.1 lb zeta-cypermethrin + bifenthrin	4.0–10.3 fl oz *Hero	1	Do not apply more than 0.42 lb ai/a per season. Wait at least 10 days between applications.
Spider mite	0.938–1.88 lb abamectin	8.0–16.0 fl oz *Agri-Mek 0.15EC	7	May repeat after 7 days, but do not make more than two sequential treatments or exceed 5.64 lb ai/a per year.
	bifenazate	0.75–1.0 lb Acramite 50WS	3	Limit one application per season.

*Restricted-use pesticide.

(continued)

Insect control in tomato *(continued)*

Insect	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Spider mite *(cont.)*	0.033–0.08 lb bifenthrin	2.1–5.2 fl oz *Brigade 2EC	1	Do not exceed 4 applications per season.
	0.11–0.2 lb cyantraniliprole + abamectin	5.5–10.0 fl oz *Minecto Pro	7	Do not apply more than 0.4 lb per calendar year of cyantraniliprole-containing products, or more than 0.056 lb per calendar year of abamectin-containing products.
	0.2 lb fenpropathrin	10.66 fl oz Danitol 2.4EC	3	Treat when mites first appear and repeat every 7 days as needed. Do not exceed 0.8 lb ai/a per season.
	0.1 lb fenpyroximate	2.0 pt Portal	1	Do not apply more than 4.0 pt per acre per crop cycle. Do not make more than 2 applications per crop cycle. Allow 14 days between applications.
	lambda-cyhalothrin + thiamethoxam	4.5 fl oz *Endigo ZC	5	Apply when pests reach or exceed established thresholds. Do not apply more than 19.0 fl oz/a Endigo ZC per crop season and allow at least 5 days between applications.
	1.5–2.0 lb malathion	several formulations	1–5	
	spiromesifen	7.0–8.5 fl oz Oberon 2 SC	7	Apply every 7 days as needed. Do not exceed 25.5 fl oz/a per season.
	0.1 lb zeta-cypermethrin + bifenthrin	10.3 fl oz *Hero	1	Do not apply more than 0.42 lb ai/a per season. Wait at least 10 days between applications.

*Restricted-use pesticide.

Weed control in tomato

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds	0.14-0.45 lb metribuzin + 0.07-0.23 lb sulfentrazone	8-26 fl oz/a Preview 2.1 SC		Apply only to transplanted tomato as a preplant incorporated application prior to transplanting, placing the roots of the transplants below the herbicide incorporation zone to prevent injury. Consult label for use rate which is dependent upon soil texture and organic matter. Do not use on soils classified as sand with less than 1% organic matter.
Annual weeds	0.48–1.43 lb pendimethalin	1.0–3.0 pt Prowl H_2O	21	Apply as a broadcast preplant-incorporated application, or as a broadcast preplant surface application before transplanting, or as a post-directed application to transplanted or established direct-seeded tomatoes. Do not apply postemergence over the top of or to foliage of tomatoes. Use rate varies by soil type. Do not apply more than 3.0 pt/a per season. Do not allow treated soil to come in contact with the transplant area.
	s-metolachlor	1.0–2.0 pt Dual Magnum or Dual II Magnum	varies	**Transplanted tomatoes:** Apply as a preplant-incorporated, preplant before transplanting, or post-directed following the first settling rain or irrigation. Dual Magnum may also be used under plastic mulch or to treat row middles in bedded tomatoes. Dual Magnum will not control emerged weeds. Adjust rate according to soil texture and expected weed pressure. Do not apply to cultivars with unknown tolerance. Preharvest interval varies with application rate. Consult label for specific rate-dependent preharvest intervals. See label for additional directions and precautions.

*Restricted-use pesticide.

(continued)

Weed control in tomato *(continued)*

Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Annual weeds *(cont.)*	0.07–0.25 lb sulfentrazone	2.25–8.0 oz Spartan 4F		Pre-transplant broadcast or banded applications to transplanted tomatoes only. Use rate is based on soil texture and organic matter. Do not apply to soils classified as sand with less than 1% organic matter.
Annual grasses and some broadleaves	1.0–2.0 lb napropamide	2.0–4.0 lb Devrinol DF-XT 2.0–4.0 qt Devrinol 2-XT		Apply before planting to a weed-free soil surface. Incorporate 1–2 inches deep the same day. Napropamide can be applied to direct-seeded or transplanted tomatoes.
	trifluralin	several manufacturers		For transplants, apply and incorporate before transplanting or apply post-plant as a directed spray to the soil between the rows and beneath plants and incorporate. On direct-seeded tomatoes, apply as a directed spray between rows and under plants at thinning. May cause early stunting of tomatoes, especially under poor growing conditions. Controls annual grasses and some broadleaf weeds, but is weak on wild mustard, smartweed, common ragweed, velvetleaf, and black nightshade. Rate varies with soil texture and organic matter. Follow recommended soil preparation application, and incorporation procedures. Must be incorporated within 24 hours. See label for plantback restrictions. Ineffective on peat and muck soils.
Annual broadleaves and some grasses	metribuzin	*preplant-incorporated*	7	Incorporate 2–4 inches deep before transplanting.
		postemergence broadcast	7	For postemergence broadcast spray to established tomatoes, apply before weeds are 1 inch tall. Minimum of 14 days between applications. Do not treat seeded tomatoes until they have five to six leaves. Do not apply until transplants have recovered from transplant shock and new growth is evident. Do not apply within 3 days after cool, wet, or cloudy weather, or injury may result. Do not apply within 24 hours of other chemical treatments.
		postemergence directed	7	Use postemergence directed spray application on fields with a history of severe weed pressure or fields infested with hard-to-kill weeds. Use in limited trials on new varieties. If making multiple applications, do not exceed the maximum annual rate. See label for additional precautions on this use.
Annual weeds and some perennial weeds	0.0156–0.624 lb rimsulfuron	*preemergence:* 2.0–4.0 oz Matrix *postemergence:* 1.0–2.0 oz Matrix	45 45	Requires rainfall or irrigation for activation; see label for timing and amount. For postemergence applications, use 1.0–2.0 oz/a product to control young, actively growing weeds. See label for adjuvant instructions. Do not exceed 4.0 oz/a per season.
Nutsedge and some broadleaves	0.023–0.047 lb halosulfuron	0.5–1.0 oz Sandea (rate varies by crop use and application timing—see label)	30	Sandea controls several broadleaf weeds and nutsedge, but no grasses. Sandea has both pre- and postemergence activity and can be used under plastic mulch. A broadcast postemergent treatment can be sprayed 14 days after transplanting but before first bloom, or directed between rows of a seeded or transplanted crop at any time. If plastic is used on the planted row, adjust equipment to keep spray off the plastic. Do not exceed two applications or apply more than 2.0 oz/a per crop cycle or 12-month period. Soil or foliar applications of organophosphate insecticides to Sandea-treated crops may cause severe crop injury. **Consult label for additional usage information and other precautions.**

*Restricted-use pesticide.

(continued)

Weed control in tomato *(continued)*

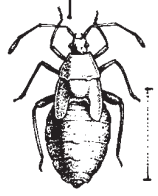
Weed	Rate/a of active ingredient	Rate/a of commercial product	Days to harvest	Remarks and suggestions
Nutsedge and some broadleaves *(cont.)*	0.19–0.3 lb imazosulfuron	4.0–6.4 oz League	21	May be applied pre-transplant, postemergence, or as a directed spray. Do not apply more than 6.4 oz of League Herbicide per acre per year in a single application. Effective on yellow nutsedge and several annual weeds, but ineffective on nightshades and weeds with ALS inhibitor resistance. See label for additional restrictions.
Emerged weeds	glyphosate	several manufacturers and formulations		See manufacturer's label to assure that the formulation is labeled for this crop and for specific instructions. Some formulations require a wait of 3 days between application and planting. If allowed, glyphosate may be applied any time before crop emerges. If preemergence application is allowed, apply before crop seed germination in coarse sandy soils. If weeds have been mowed or tilled, do not treat until they have resumed active growth and reached the recommended stage on the label. Unless otherwise stated, allow 7 or more days before tilling treated fields. Do not tank mix with soil-residual herbicides unless otherwise specified. Do not make hooded or shielded applications to row middles.
	*paraquat	several manufacturers and formulations—not all are registered for this use	30	Prepare seedbed early to allow for maximum weed emergence. Application can be made as a banded or broadcast treatment before, during, or after planting, but before crop emergence. In preplant and pre-emergence (to the crop) uses, do not apply to soils lacking clay minerals (i.e., muck, pure sand). Use the higher rate for heavy weed infestations. Seeding and transplanting should be performed with minimal soil disturbance. Up to three directed/shielded treatments may be made per season using precision equipment to prevent spray contact with the crop. Always add crop oil concentrate or non-ionic surfactant to spray mixture. Follow precautions on label.
Emerged grasses	0.068–0.24 lb clethodim	9.0–32.0 oz Select Max	20	Apply to actively growing grasses. Repeat treatments may be made at 14-day intervals up to the maximum annual use rate. Do not cultivate grasses within 7 days before or after application. Include appropriate surfactant as required by product label. Do not apply if rain is expected within 1 hour.
	clethodim	several manufacturers and formulations	20	
	0.094–0.28 lb sethoxydim	0.5–1.5 pt Poast	20	Make postemergence applications to actively growing grasses within the size ranges indicated on the label. Check the label for other (wild proso millet, rescue) treatment rates. Do not apply more than 4.5 pt/a Poast in one crop season. Consult label for rate and adjuvant instructions for specific weeds. Follow precautions on label, including tank mix restrictions.

*Restricted-use pesticide.

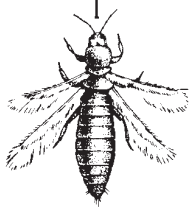
Immature key

Nymphs
Not worm shaped (without wings).

No tail pipe extending from rear of body.



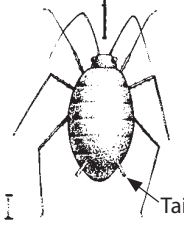
Squash bug and leaf-footed bug
½ inch long. Oblong, greenish-brown body often has two black spots on abdomen.



Onion thrips
Thrips about the size and shape of the exclamation mark "!"; yellow to brown in color.



Leafhopper
⅛-inch, green, wedge-shaped nymph. Like adults but smaller.



Plant lice (aphids)
Tail pipes extending from rear of body.

6 true legs (3 pairs), prolegs present; caterpillars.



White grub
Fat, soft, C-shaped, white grubworms.

Green, brown, or black larvae without horn at rear of body.

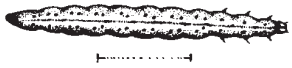


Hornworms
Red or black horn at rear of body.

4 pairs of prolegs.



Cabbage looper
2 pairs of prolegs. Light-green larvae up to 1½ inches long, body makes a looping motion while moving.



Diamond moth caterpillar
3 pairs of prolegs. Light-green, cigar-shaped larvae less than ¾ inch long.



European corn borer
Without cross stripes; not brown at each end; flesh-colored caterpillars up to 1 inch long with small donut-shaped brown spots over the body.



Common stalk borer
Brown and white stripes run lengthwise on body. Yellow head. Bores into stems of many vegetables.

* Beneficial insect

Worm-shaped larvae.



True legs | Prolegs

6 true legs (3 pair), no prolegs.

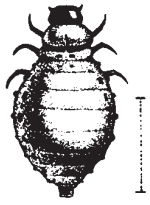
Found in soil.



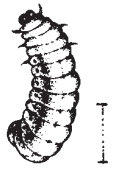
Wireworm
Slender, white or brown, hard-shelled worms.

Found on leaves.

Smooth-skinned larvae.



Colorado potato beetle larva
Reddish-brown, hump-backed, smooth-skinned grubs.



Asparagus beetle
Dark-gray, slug-like larvae with soft, plump, non-hairy skin; black head and legs.

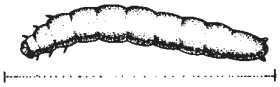
Without cross stripes; not brown at each end; without donut-shaped spots.



Cutworms
Gray, brown, white, or black; smooth skinned. Markings indistinct. Curl up in C-shape when disturbed.

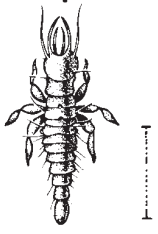


Corn earworm
Light-green to nearly black larvae up to 2 inches long with coarse black hairs and alternating light and dark stripes running lengthwise on body.

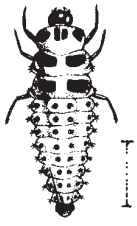


Imported cabbage worm
Leaf-green, velvety-skinned larvae, up to 1¼ inch long.

Larval skin with warts or spines.



Lacewing*
Spindle-shaped larvae with long sharp-pointed jaws.



Lady beetle*
Carrot shaped. Flattened, gradually tapering body with a warty back; does not have long sharp-pointed jaws; colored with patches of blue, black, and orange.

No legs present.

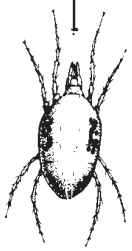


Root maggot
½ inch long or less, white transparent body, tapered at one end.

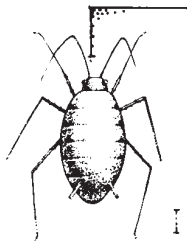


Slugs
"Snail-like," gray to brown, up to 1 inch long. Leave shiny trails on leaf surface.

Adult key

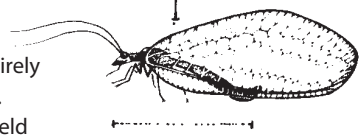


Spider mites
Barely visible—about the size of a period. Adults have 8 legs.



Aphids
⅛–1⁄10 inch long, small, soft bodied, 2 tail pipes, usually no wings, pear-shaped bodies.

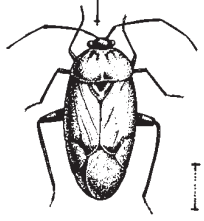
Wings overlap on back; base of front wing may be leathery. Not hard shelled.



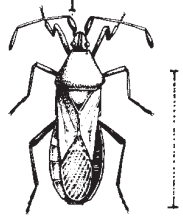
Lacewing*
Front wings entirely membrane-like. Finely netted, held tent-like over body. Green in color. Hair-like antenna.



Leafhopper
⅛ inch long, wedge shaped. Hop when disturbed.



Plant bug
¼ inch long, actively fly.



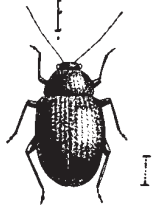
Squash bug
1 inch long, dark brown.

Antenna longer than length of head and thorax.

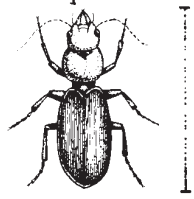
Usually entirely one color—black, brown, blue, or green.



Asparagus beetle
Metallic blue to back, orange to yellow marking.



Flea beetle
About ⅛–¼ inch long.



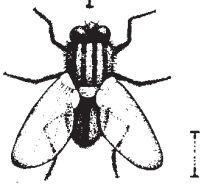
Ground beetle*
¼ inch or longer.

* Beneficial insect

Larger than a period; adults have 6 legs.

Wings present; no tail pipes.

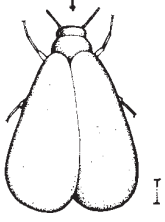
2 pairs of wings present.



True flies and root maggot adults
Only 1 pair of wings present.

Beetles
Front wings entirely hard shelled, meeting down the middle in straight line.

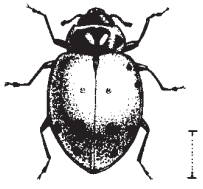
White fly
Tiny (⅛-inch), moth-like insects. Wings covered with whitish dust. Wings overlap when resting.



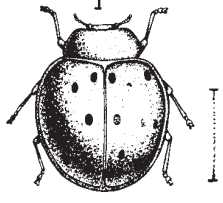


Moths and butterflies
Wings covered with fine powder-like scales. Various sizes.

Antenna shorter than length of head and thorax.



Lady beetle*
Usually yellow, orange, or red beetles; usually with one or more spots per front wing—but not 8.

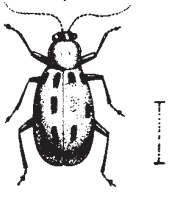


Mexican bean beetle
Yellow to copper brown; 8 black spots on each front wing.



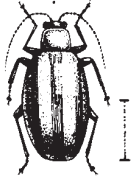
Picnic beetle
Dark brown-black with 4 orange-yellow spots on back.

Spots or stripes on front wings.

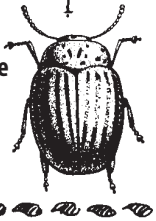


Spotted cucumber beetle
Yellow green with 6 black spots on each front wing.

Front wings with stripes.



Striped cucumber beetle
Yellow with 2 black stripes on each front wing; elongate body.



Colorado potato beetle
Yellow with 4 black stripes on each front wing; fat, round body.

Abbreviations

a = acre
AD = allowable depletion
ae = acid equivalent
ai = active ingredient
BMP = best management practices
bu = bushel
Ca = calcium
cfm = cubic feet per minute
CS = capsule suspension
CT = conservation tillage
Cu = copper
cwt = hundredweight (100 lb)
D = dust
DD = degree day
DF = dry flowable
DG = dispersible granule
DS = dry soluble
E or EC = emulsifiable concentrate
ET = evapotranspiration
F = flowable
FC = flowable concentrate
fl oz = fluid ounce
ft = foot
G = granular
gal = gallon
IPM = integrated pest management
K_2O = potash
K = potassium
kg = kilogram
L = liquid
lb = pound
LC = liquid concentrate
LS = liquid sprayable
M or ME = microencapsulated
mg = milligram
Mg = magnesium
Mn = manganese
N = nitrogen
NO_3 = nitrate
oz = ounce
P_2O_5 = phosphate
P = phosphorus
PAT = Pesticide Applicator Training
pH = a measure of acidity and alkalinity
PHI = preharvest interval
ppm = parts per million
psi = pounds per square inch
pt = pint
qt = quart
REI = restricted entry interval
RUP = restricted-use pesticide
S = sulfur
SC = soluble concentrate
SP = soluble powder
sq ft = square feet
t = ton
TPQ = threshold planning quantity
ULV = ultra low volume
W or WP = wettable powder
WDG = water dispersible granule
WSB = water-soluble bag
WSP = water-soluble pouch
Zn = zinc

Related websites

Pesticide labels
www.cdms.net

Pesticide resistance management
fungicides: www.frac.info
insecticides: www.irac-online.org
herbicides: www.hracglobal.com

Vegetable diseases
https://vegpath.plantpath.wisc.edu

Vegetable insects
https://vegento.russell.wisc.edu

Specialty crops
https://specialtycrops.wisc.edu

BioIPM Workbooks
https://ipcm.wisc.edu/downloads/guides

Wisconsin Pest Bulletin
http://datcpservices.wisconsin.gov/pb/index.jsp



Extension
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