Vegetable Crop Update

A newsletter for commercial potato and vegetable growers prepared by the University of Wisconsin-Madison vegetable research and extension specialists

Extension
UNIVERSITY OF WISCONSIN–MADISON

No. 5 – June 16, 2024

In This Issue:

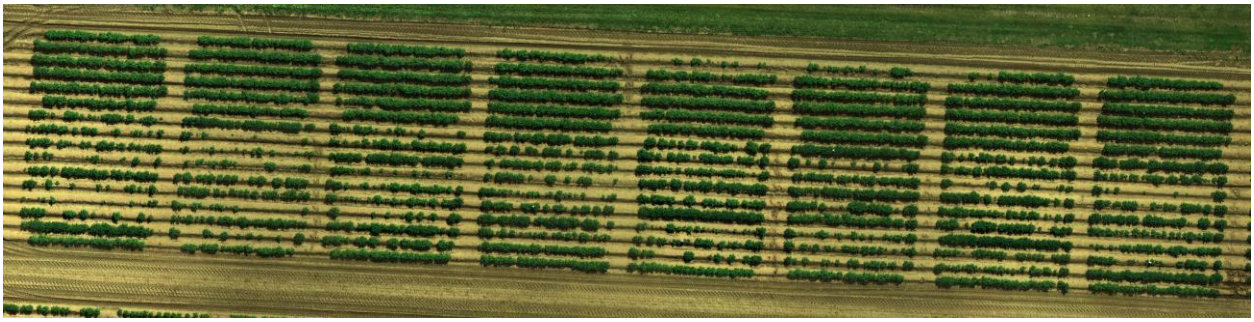
- Seed potato age and research updates
- Potato and vegetable disease forecasting updates
- Early blight spore collections
- Updates and management of potato leafhoppers, onion thrips, flea beetles, Colorado potato beetles (with detailed insecticide listing)

Calendar of Events:

July 11, 2024 – UW Agricultural Research Station Potato Field Day, Hancock, WI
July 18, 2024 – UW Langlade County Extension & WI Seed Potato Certification Program – Ag Research Station Field Day, Antigo, WI
July 31, 2024 – UW-Madison Rhinelander Agricultural Research Station Potato Breeding Farm Field Day, Rhinelander, WI (contact Becky Eddy)
December 3-5, 2024 – Midwest Food Producers Assoc. Processing Crops Conference, Kalahari Convention Center
January 13-14, 2025 – Wisconsin Agribusiness Classic, Alliant Energy Center, Madison, WI
February 4-6, 2025 – UW-Madison Div. of Extension & WPVGA Grower Education Conference & Industry Show, Stevens Point, WI

Yi Wang, Associate Professor & Extension Potato and Vegetable Production Specialist, UW-Madison, Dept. of Plant and Agroecosystem Sciences, 608-265-4781, Email: wang52@wisc.edu.

So far we have about 50% canopy cover on Russet Burbank potatoes (the six rows on the upper part of the aerial image), and the plants have started tuber initiation. This year I noted inconsistent emergence on some of the varieties that we included in our variety/nitrogen trial. We suspected the seeds might have some aging-related issues that impacted the emergence rate.



Physiological aging is influenced by two factors, genetics and environmental stresses. Since potatoes are grown from mother tuber, genetics is at the level of cultivars. Plants that die prematurely often have aged tubers. Late-season high soil temperature may stimulate premature sprouting in the field. However, the main cause of seed tuber aging is the temperature during storage. Higher storage temperatures are usually associated with greater aging (Figure below).

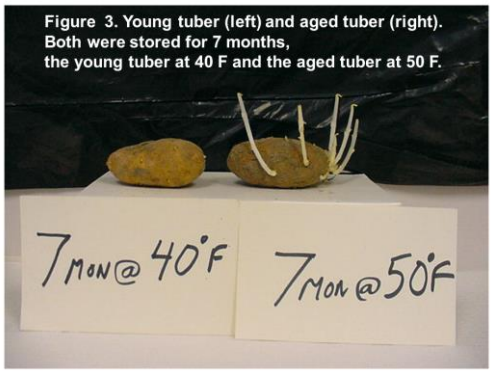


Figure 3. Young tuber (left) and aged tuber (right). Both were stored for 7 months, the young tuber at 40 F and the aged tuber at 50 F.

Photo on left cited from Pavlista, 2015.

Dormancy is a period during which sprouting will not occur even under optimal conditions. Toward the end of the growing season, abscisic acid (ABA), a sprout inhibitor, is produced by the vine and transported into the tubers. Dormancy is broken when the amount of abscisic acid in the tuber eyes decreases through metabolic breakdown to a level that allows the eyes to respond to conditions favoring sprouting. Young seed is characterized by one dominant eye that suppresses the sprouting of the other eyes (this physiological phenomenon is termed "apical dominance"). Older seed tubers (aged seed) are characterized by the loss of apical dominance among eyes.

Since the major factor in storage that accelerates tuber aging is temperature, people can manage to produce a desired tuber age at planting. Planting older seed of cultivars that tend to oversize such as 'Yukon Gold' may have advantages. It may improve uniformity and increase the number of marketable-sized tubers, especially for early markets. This may also be true for seed production in which a smaller tuber size profile might be preferred. Some cultivars such as 'Russet Norkotah' do not benefit from aging while others such as 'Yukon Gold' and 'Portage Russet' might, due to their tendency to oversize for their markets. Note that cultivars differ in the extent of their responses to aging.

To age seed, store it at 38°F, then before planting store for two to six weeks at 55–60°F. To hold young seed, store at 38°F and warm to 45°F just before cutting. Plant in soil that has about the same temperature as the tubers. Cutting tubers breaks apical dominance between eyes, thus releasing eyes to sprout. Because of this, sprout removal may result in more stems and smaller tubers.

Physiologically older aged seed emerges earlier, grows faster, yields higher early, and yields less later than physiologically young unaged seed. Because young seed emerges slower, there is a greater chance of seed decay and cankers (stem and stolon). Do not plant seeds right out of cold storage into soil as this will promote condensation of moisture on the seeds and promote decay. Planting young seeds in warmer soil can hasten its sprout emergence and growth. Warm seeds to 50–60°F for a few days and plant in soil slightly cooler. This will add some physiological age to the seed tuber or pieces. Seeds planted in sandy soil that warms rapidly tends to produce more stems and set more tubers. The result is smaller harvested tubers. Extra nitrogen starter fertilizer can partially overcome the effects associated with aging, as N can partially mimic young seed characteristics. Please note that later planting also tends to produce more stems per plant and lower final yield at harvest.

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Current P-Day (Early Blight) and Disease Severity Value (Late Blight) Accumulations will be posted at our website and available in the weekly newsletters. Thanks to Ben Bradford, UW-Madison Entomology for supporting this effort and providing a summary reference table: https://agweather.cals.wisc.edu/thermal-models/potato. A Potato Physiological Day or P-Day value of ≥300 indicates the threshold for early blight risk and triggers preventative fungicide application. A Disease Severity Value or DSV of ≥18 indicates the threshold for late blight risk and triggers preventative fungicide application. Data from the modeling source: https://agweather.cals.wisc.edu/vdifn are used to generate these risk values in the table below. I've estimated early, mid-, and late planting dates by region based on communications with stakeholders. These are intended to help in determining optimum times for preventative fungicide applications to limit early and late blight in Wisconsin.

	Planting Date		**50% Emergence Date**	**Disease Severity Values (DSVs)** *through 6/15/2024*	**Potato Physiological Days (P-Days)** *through 6/15/2024*
Spring Green	**Early**	Apr 3	May 9	9	291
	Mid	Apr 17	May 12	9	273
	Late	May 10	May 25	4	172
Arlington	**Early**	Apr 5	May 10	3	282
	Mid	Apr 20	May 15	3	251
	Late	May 12	May 25	1	172
Grand Marsh	**Early**	Apr 5	May 10	8	266
	Mid	Apr 20	May 15	8	237
	Late	May 12	May 25	1	164
Hancock	**Early**	Apr 10	May 17	9	219
	Mid	Apr 22	May 21	7	190
	Late	May 14	June 2	2	109
Plover	**Early**	Apr 14	May 18	8	214
	Mid	Apr 24	May 22	4	182
	Late	May 19	June 7	0	68
Antigo	**Early**	May 1	May 24	3	149
	Mid	May 15	June 1	5	106
	Late	June 1	June 15	TBD	TBD
Rhinelander	**Early**	May 7	May 25	1	143
	Mid	May 18	June 8	0	48
	Late	June 2	TBD	TBD	TBD

Late blight of potato/tomato. The usablight.org website (https://usablight.org/map/) indicates no reports of late blight from the US so far in 2024. The site is not comprehensive. We accumulated few to no Blitecast Disease Severity Values over the past week in WI.

Early blight of potato. P-Day values will continue to amass (up to ~10 per day) and develop conditions optimum for early blight disease caused by *Alternaria solani*. Earliest inoculum typically comes from within a field (small crop residue fragments can harbor the pathogen) and from nearby fields. Olee Hoi Lam, a PhD student working with early disease detection in potato with hyperspectral reflectance, is running several Rotorod air samplers in three of our potato research fields at the UW Hancock Agricultural Research Station. On Thursday of this past week, we collected conidia/spores which appear consistent with Alternaria species (pictures of conidia below). Sampling of the air at plant level in these fields will continue on an every-other-day basis. Once established, early blight continues to create new infections due to its polycyclic nature – meaning spores create foliar infection and the resulting lesion on the plant can then produce new spores for ongoing new infections in the field and beyond. Early season management of early blight in potato can mitigate the disease for the rest of the season.

For custom values, please explore the UW Vegetable Disease and Insect Forecasting Network tool for P-Days and DSVs across the state (https://agweather.cals.wisc.edu/vdifn). This tool utilizes NOAA weather data. In using this tool, be sure to enter your model selections and parameters, then hit the blue submit button at the bottom of the parameter boxes. Once thresholds are met for risk of early blight and/or late blight, fungicides are recommended for optimum disease control. Fungicide details can be found in the 2024 Commercial Veg. Production in WI Extension Document A3422:
https://learningstore.extension.wisc.edu/products/commercial-vegetable-production-in-wisconsin

Vegetable Insect Update – Russell L. Groves, Professor and Department Chair, UW-Madison, Department of Entomology, 608-262-3229 (office), (608) 698-2434 (cell), e-mail rgroves@wisc.edu

Vegetable Entomology Webpage: https://vegento.russell.wisc.edu/

Potato leafhopper – (https://vegento.russell.wisc.edu/pests/potato-leafhopper/). Last week adult populations of Potato leafhopper (PLH) were increasing in several crops (alfalfa, green beans, hops and potatoes) and now nymphs (immature leafhoppers) can be expected in many parts of southern and central Wisconsin. Even very young nymphs can cause the toxic hopperburn condition after injection of their saliva during feeding. Leaf curling can be the first symptom of hopperburn followed by yellowing and then dead tissue (necrosis) along the leaf margins.

Healthy, vigorously growing plants withstand damage more effectively than stressed plants. Irrigation and cultural practices that favor the crop are recommended. Leafhopper infestations are

more likely to occur in crops planted adjacent to alfalfa fields, especially after alfalfa has been harvested and the insects are forced out of the field.

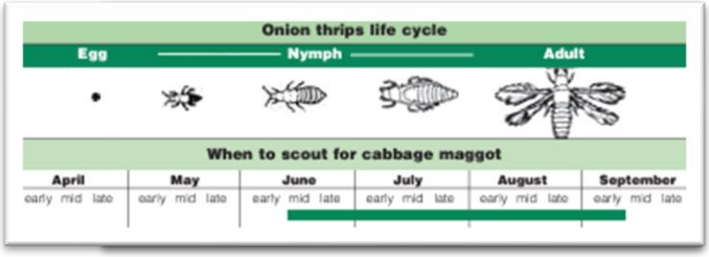
There are several predators, fungal pathogens and parasites that attack PLH, though none have been shown to be effective in controlling the insect. There is very little information available on varietal tolerances to leafhopper damage in hops. In potato we know that round-white 'chipping' and also red skin varieties have considerably more susceptibility to damage by PLH moreso than Russet types or yellow-flesh varieties. . In snap bean it has been demonstrated that Blue Lake cultivars are more susceptible to PLH damage than Tendercrop lines. Leaf hairiness has also been shown to deter leafhoppers in alfalfa.

Action threshold levels for vegetables

Crop	Nymphs	Adults
Seedling snap beans	1 every 10 leaves	1 adult per 2 sweeps
Larger snap beans	1 every 10 leaves	1 adult per sweep
Potatoes	2 ½ every 25 leaves	½-1 adult per sweep

Onion thrips (https://vegento.russell.wisc.edu/pests/onion-thrips/). Thrips are small 1/25-inch insects that cause whitish scratches 'silvering' 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 also attack the foliage of onion and must be controlled before significant damage results on leaves or cabbage heads in order to assure unaffected yields.

In onions the injury looks similar to both ozone injury and some diseases. Use larger volumes sprays (20+ gallons/acre) with a wetting agent for adequate coverage and good resulting thrips control. A second treatment 5 to 7 days later is often warranted when adults are present and laying eggs. Most of our foliar applied insecticides do not possess any ovicidal (egg-killing) effects, so a repeat application of the same mode-of-action insecticide is often warranted.



Yellow or white sticky traps (cards) may be used along field edges to monitor the initial migration of thrips into a field. Monitor plants weekly, and scout plants on field edges as thrips are more common at borders in the early part of the season. Depending upon the insecticide being used, it is appropriate to use the correct treatment threshold. When using spirotetramat (Movento HL), abamectin (Agri-Mek SC plus generics), cyclaniliprole (Harvanta 50SL), flupyradifurone (Sivanto Prime) or methomyl (Lannate SP or LV), use 1 immature (larval) thrips per onion leaf as the accepted threshold for chemical treatment. When using either spinetoram (Radiant SC) or cyantraniliprole (Exirel SC), use 1 immature (larval) thrips per onion leaf as the accepted threshold for chemical treatment.

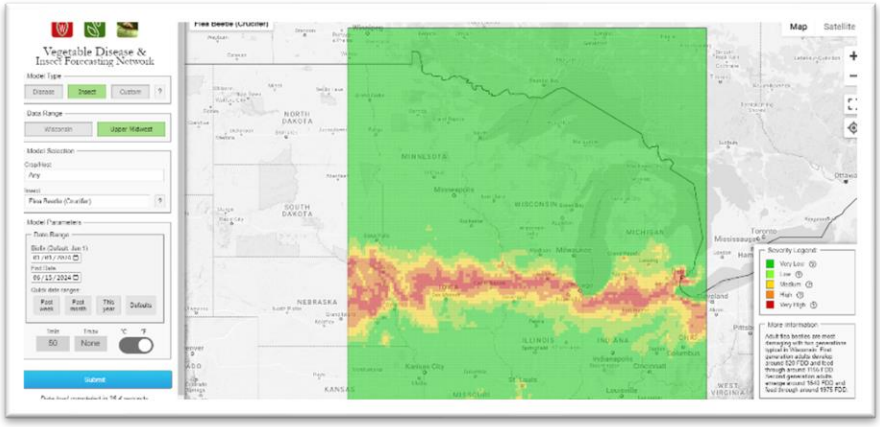
Flea beetles (several species) – (https://vegento.russell.wisc.edu/pests/flea-beetles/). Flea beetles continue to plague several producers, but first generation of many species should be coming to a close. These insects can especially be an issues as an early-season pest, but if good control is not achieved early they can continue their damage for longer than desired.

Several different species are commonly found on all members of the cole crop group, as well as spinach, beets, potatoes, and eggplant. There are several different species of flea beetle that pose problems early in the season when they are considered occasional pests. Host plants of many of the flea beetles are easily identified by their common names. For example, the crucifer flea beetle attacks cole crops and mustards while the eggplant flea beetle is commonly associated with eggplant.

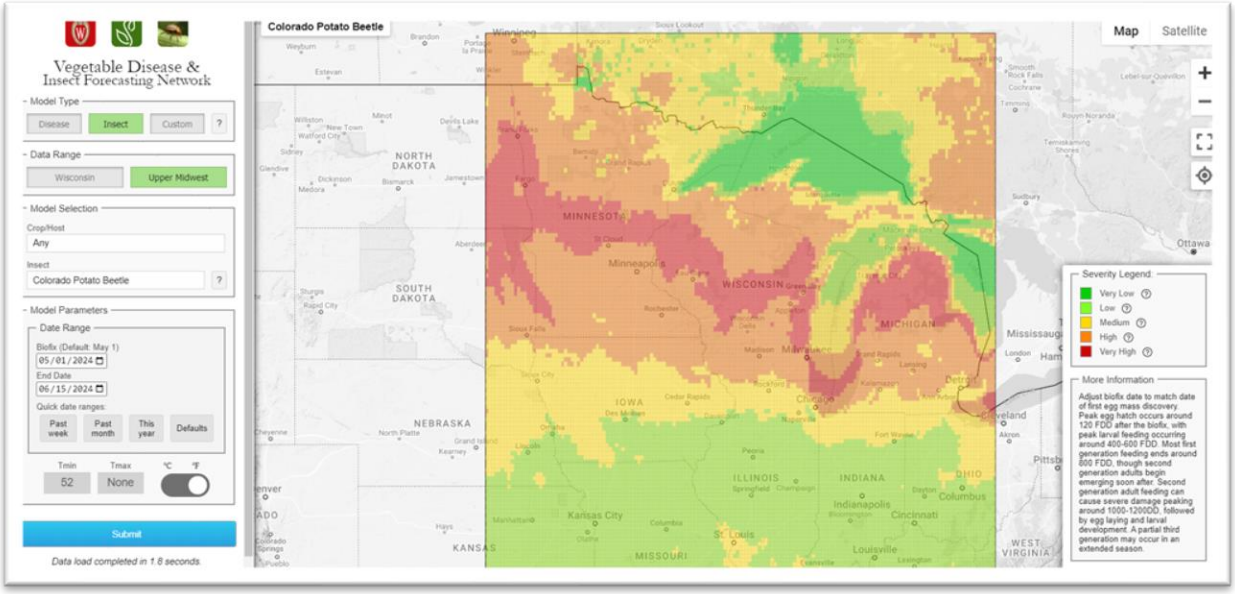
Table 1. Common Wisconsin flea beatles

Common name	Scientific name	Description	Host plants
Crucifer flea beetle	*Phyllotreta cruciferae*	greenish or bluish-black; 1/16" to 1/8"	cabbage and other crucifers including horseradish
Eggplant flea beetle	*Epitrix fuscula*	black; 1/16"	eggplant
Horseradish flea beetle	*Phyllotreta armoraciae*	black with yellow stripes; 1/8"	horseradish and other mustards
Pale-striped flea beetle	*Systena blanda*	dark brown with 2 broad white stripes down its back; 1/6"	potatoes, tomato, eggplant, pepper
Potato flea beetle	*Epitrix cucumeris*	dull black; 1/16"	potatoes, tomato, eggplant, pepper
Spinach flea beetle	*Disonycha xanthomeles*	greenish-black with a yellow thorax; 1/5"	spinach and beets
Striped flea beetle	*Phyllotreta striolata*	black with 2 crooked yellow strips running down its back; 1/12"	cabbage

Adult flea beetles overwintered in the soil or beneath plant debris, so early season sanitation is/was critical. Adults have been laying eggs in the soil at the base of host plants in May and into early June. Eggs hatch in 7-14 days and larvae feed on various plant parts until fully grown. They pupate in earthen cells for 11-13 days before emerging as adults. In the adjacent screen shot from the Vegetable Disease and Insect Forecasting Network (VDIFN: https://agweather.cals.wisc.edu/vdifn), it is apparent that the emergence of the next generation of Crucifer flea beetles is soon to arrive in southern Wisconsin. Adult flea beetles are most damaging with two generations typical in Wisconsin. First generation adults develop around 820 FDD and feed through around 1155 FDD. Second generation adults emerge around 1640 FDD and feed through around 1975 FDD.



Colorado potato beetle (CPB) – (https://vegento.russell.wisc.edu/pests/colorado-potato-beetle/). Continue to scout populations of Colorado potato beetle (CPB) as the peak of larval feeding activity is midway across the state at this time. Producers in far northern Wisconsin are just beginning to consider foliar applications whereas producers in the southern quarter of the state are nearing the end of the first generation of larval feeding.



In each instance, the choice of insect control product can vary widely. Northern production areas are finishing perimeter treatments (e.g., indoxacarb) and insect growth regulators (e.g., novaluron), whereas southern locations in southern Wisconsin are now considering second generation options which will begin next week. Recall, there can be considerable variability in the predominant lifestages present, and this often results from planting date (later dates have younger larvae) and proximity to previous year potato (larger larvae in fields close to previous year potato). Continue to refer to the UW-Extension publication Commercial Vegetable Production in Wisconsin (A3422) for a list of registered insecticides and management recommendations and recommended products for control are listed in the attached below.

At-Plant Systemic Options

Trade name	Active ingredient	IRAC MoA Code	Spray pH<	Adjuvant	PHI	Rate	Adult	Egg Mass	Early Larvae (1st-2nd instar)	Late Larvae (3rd-4th instar)
Belay	clothianidin	4A	pH < 7	none (see notes)	0	12 fl oz	+	-	+++	++
Note: 1). consider soil surfactant to increase uniform movement in soil profile, 2.) season total maximum is only 0.2 lb a.i./ac for both soil-applied and foliar). Do not apply any Group 4A insecticides over the top of an at-plant application of Belay. Considerable resistance with CPB, very effective for potato leafhopper and colonizing aphids.										
Platinum 75SG	thiamethoxam	4A	pH < 7	none (see notes)	0	2.67 oz	+	-	+++	++
Note: 1). consider soil surfactant to increase uniform movement in soil profile, 2.) season total maximum varies by use pattern (soil-applied vs foliar). Can apply additional foliar applications of a Group 4A on an at-plant application. Considerable resistance with CPB, very effective for potato leafhopper and colonizing aphids.										
Admire Pro (generics)	imidacloprid	4A	pH < 7	none (see notes)	0	8.7 fl oz	+	-	+++	++
Note: 1). consider soil surfactant to increase uniform movement in soil profile, 2.) season total maximum varies by use pattern (soil-applied vs foliar). Can apply additional foliar applications of a Group 28 on an at-plant application. Considerable resistance with CPB, very effective for potato leafhopper and colonizing aphids.										
Verimark SC	cyantraniliprole	28	pH < 6.5	none (see notes)	0	13.5 fl oz	+	-	+++	++
Note: 1). consider soil surfactant to increase uniform movement in soil profile, 2.) season total maximum varies by use pattern (soil-applied vs foliar). Can apply additional foliar applications of a Group 28 on an at-plant application (not advisable!). Will provide only 45-60 days of control of CPB. Ineffective for potato leafhopper and mildly effective for aphids.										
Regent 4SC	fipronil	2B		none (see notes)	90	3.2 fl oz	-	-	-	-
Note: for use as an at-plant, distributed in-furrow application for the control of Asiatic garden beetle, other white grubs and wireworms.										

1st generation Colorado potato beetle materials

Trade name	Active ingredient	IRAC MoA Code	Spray pH<	Adjuvant	PHI	Rate	Adult	Egg Mass	Early Larvae (1st-2nd instar)	Late Larvae (3rd-4th instar)
Rimon 0.83EC	novaluron	15	pH < 6.5	NIS (0.25-0.5% V:V)	14	9,8,7 fl oz 10,8,8 fl oz	-	+++	++	++
Initiate applications when egg deposition first appears in outer rows (0-48rows) of the field. Initial foliar application (9.0 fl oz/ac) can be applied as a 'ring' application, treating only the outer-most rows of the field. Subsequently, apply 2nd foliar application (8.0 fl oz/ac) over entire field one week later. Continue to scout field and consider a 3rd foliar application (7.0 fl oz/ac) 7 days after prior application. Continue to scout the field, if an additional application is necessary, apply a final application (8.0 fl oz) to the interior of the field, not initially treated during the ring application. Must be applied										

Trade name	Active ingredient	IRAC MoA Code	Spray pH<	Adjuvant	PHI	Rate	Adult	Egg Mass	Early Larvae (1st-2nd instar)	Late Larvae (3rd-4th instar)
with an adjuvant (NIS), and consider application outside of mid-day hours (10:00 - 16:00 h). Slightly acidify tank mix prior to application (pH < 6.5). Caution when tank-mixing this product with fungicides containing proprietary stickers (e.g., WeatherStik). Both ground and aerial application are appropriate.										
Agri-Mek SC	abamectin	6	pH < 6.5	NIS (0.5% V:V)	14	3.0-3.25 fl oz	+	-	+++	++
Initiate applications when 50-75% egg hatch has occurred, and 1st instar larvae are present on outer-most field rows. Initial foliar application (3.25 fl oz/ac) can be applied to the entire field. Subsequently, apply 2nd foliar application (3.0 fl oz/ac) over entire field one week later. Continue to scout field and consider a 3rd foliar application 7 days after previous application with another larvicide that is effective on later stage larvae (e.g., Radiant @ 8 fl oz/ac). Must be applied with an adjuvant (NIS), and consider application outside of mid-day hours (10:00 - 16:00 h). Slightly acidify tank mix prior to application (pH < 6.5). Caution when tank-mixing this product with fungicides containing proprietary stickers (e.g., WeatherStik). Both ground and aerial application are appropriate. Only two successive applications of Agri-Mek SC allowed per crop season.										
Torac	tolfenpyrad	21A	pH = 6.5	NIS (0.5% V: V)	14	14-21 fl oz	++	++	+++	++
Initiate applications when 50-75% egg hatch has occurred, and 1st instar larvae are present on outer-most field rows. Initial foliar application (21.0 fl oz/ac) can be applied to the entire field. Subsequently, apply 2nd foliar application (21.0 fl oz/ac) over entire field two weeks later. Continue to scout field and consider a 3rd foliar application with another larvicide that is effective on later stage larvae as needed. Must be applied with an adjuvant (NIS), and consider application outside of mid-day hours (10:00 - 16:00 h). Slightly acidify tank mix prior to application (pH < 6.5). Both ground and aerial application are appropriate. Only two successive applications of Torac allowed per crop season.										
Blackhawk 36WDG	spinosad	5	pH = 7	NIS (0.125 - 0.25% V:V)	7	3.0-3.3 oz	+	-	+++	+++
Initiate applications when 50-75% egg hatch has occurred, and 1st instar larvae are present on outer-most field rows. Initial foliar application (3.3 oz/ac) can be applied to the entire field. Subsequently, apply 2nd foliar application (3.0 oz/ac) over entire field one week later. Continue to scout field and consider a 3rd foliar application 7 days after previous application with another larvicide that is effective on later stage larvae (e.g., Agri-Mek SC @ 3.25 fl oz/ac). Can be applied with an adjuvant (NIS), and consider application outside of mid-day hours (10:00 - 16:00 h). Neutral tank pH is appropriate for this application (pH = 7.0). Both ground and aerial application are appropriate. Only two successive applications of Blackhawk allowed in succession per crop season.										
Radiant SC / Delegate WG	spinetoram	5	pH = 7	NIS (0.125 - 0.25% V:V)	7	Radiant 6.5-8.0 fl oz/A, Delegate 2.5 – 4.0 oz/A	++	-	+++	+++
Initiate applications when 50-75% egg hatch has occurred, and 1st instar larvae are present on outer-most field rows. Initial foliar application (8.0 oz/ac) can be applied to the entire field. Subsequently, apply 2nd foliar application (6.5 oz/ac) over entire field one week later. Continue to scout field and consider a 3rd foliar application 7 days after previous application with another larvicide that is effective on later stage larvae (e.g., Agri-Mek SC @ 3.25 fl oz/ac). Can be applied with an adjuvant (NIS) and consider application outside of mid-day hours (10:00 - 16:00 h). Neutral tank pH is appropriate for this application (pH = 7.0). Both ground and aerial application are appropriate. Only two successive applications of Radiant or Delegate allowed in succession per crop season.										

Trade name	Active ingredient	IRAC MoA Code	Spray pH<	Adjuvant	PHI	Rate	Adult	Egg Mass	Early Larvae (1st-2nd instar)	Late Larvae (3rd-4th instar)
Calantha	ledprona	35	pH < 6.5	NIS (0.125 - 0.25% V:V)	0	16.0 fl oz	++	-	+++	++
Initiate applications when 50-75% egg hatch has occurred, and 1st instar larvae are present on outer-most field rows. Initial foliar application (16.0 fl oz/ac) can be applied to the field perimeter and all subsequent applications (16.0 fl oz/ac) can occur over the entire field one week later. Continue to scout field and consider a 3rd or 4th foliar application 7 days after previous application as needed through only the 1st generation of CPB. Do not use Calantha on 2nd generation if used earlier in the same year. Can be applied with an adjuvant (NIS). Both ground and aerial application are appropriate. No more than four successive applications of Calantha are allowed in succession per crop season.										

2nd generation Colorado potato beetle materials

Trade name	Active ingredient	IRAC MoA Code	Spray pH<	Adjuvant	PHI	Rate	Adult	Egg Mass	Early Larvae (1st-2nd instar)	Late Larvae (3rd-4th instar)
Coragen 1.67SC / Vantacor 5SC	chlorantraniliprole	28	pH < 6.5	MSO (0.25-0.5 % V:V)	14	variable and formulation dependent (fl oz/A)	++	++	+++	+++
Initiate applications after the emergence of the 2nd generation of CPB, and when defoliation estimates have reached or exceeded 5-10%. Initial foliar application (7.5 fl oz/ac, Coragen) can be applied to the entire field. Subsequently, apply 2nd foliar application (5.5 fl oz/ac, Coragen) over entire field one week later. Continue to scout field and consider a 3rd foliar application 7-10 days later only if populations continue to defoliate. Should be applied with an adjuvant (MSO) and acidify tank pH (pH < 6.5). Ground-application advised. Up to 4 successive applications of Coragen allowed in succession per crop season for control of the Colorado potato beetle. Do not apply a Group 28 material if a Group 28 material was applied in 1st generation, or as an at-plant systemic (e.g., Verimark).										
Exirel 0.83SC	cyantraniliprole	28	pH < 6.5	MSO (0.25-0.5 % V:V)	7	5.0-13.5 fl oz	++	++	+++	+++
Initiate applications after the emergence of the 2nd generation of CPB, and when defoliation estimates have reached or exceeded 5-10%. Initial foliar application (13.5 fl oz/ac) can be applied to the entire field. Subsequently, apply 2nd foliar application (10 fl oz/ac) over entire field one week later. Continue to scout field and consider a 3rd foliar application 7-10 days later only if populations continue to defoliate. Should be applied with an adjuvant (MSO) and acidify tank pH (pH < 6.5). Ground-application advised. Only two successive applications of Exirel allowed in succession per crop season for control of the Colorado potato beetle. Do not apply a Group 28 material if a Group 28 material was applied in 1st generation, or as an at-plant systemic (e.g., Verimark).										
Minecto Pro	abamectin + cyantraniliprole	6 + 28	pH < 6.5	MSO (0.25-0.5 % V:V)	14	5.5-10 fl oz	++	++	+++	+++
Initiate applications after the emergence of the 2nd generation of CPB, and when defoliation estimates have reached or exceeded 5-10%. Initial foliar application (10 fl oz/ac) can be applied to the entire field. Subsequently, apply 2nd foliar application (7.5 fl oz/ac) over entire field one week later. Continue to scout field and consider a 3rd foliar application 7-10 days later only if populations continue to defoliate. Should be applied with an adjuvant										

Trade name	Active ingredient	IRAC MoA Code	Spray pH<	Adjuvant	PHI	Rate	Adult	Egg Mass	Early Larvae (1st-2nd instar)	Late Larvae (3rd-4th instar)
(MSO) and acidify tank pH (pH < 6.5). Ground-application advised. Only two successive applications of Minecto Pro allowed in succession per crop season for control of the Colorado potato beetle. Do not apply a Group 28 material if a Group 28 material was applied in 1st generation, or as an at-plant systemic (e.g., Verimark).										
Besiege	chlorantraniliprole + lambda-cyhalothrin	28 + 3	pH < 6.5	MSO (0.25-0.5 % V:V)	14	6.0-9.0 fl oz	++	++	+++	+++
Initiate applications after the emergence of the 2nd generation of CPB, and when defoliation estimates have reached or exceeded 5-10%. Initial foliar application (9.0 fl oz/ac) can be applied to the entire field. Subsequently, apply 2nd foliar application (7.0 fl oz/ac) over entire field one week later. Continue to scout field and consider a 3rd foliar application 7-10 days later only if populations continue to defoliate. Should be applied with an adjuvant (MSO) and acidify tank pH (pH < 6.5). Ground-application advised. Three successive applications of Besiege are allowed in succession per crop season for control of the Colorado potato beetle. Do not apply a Group 28 material if a Group 28 material was applied in 1st generation, or as an at-plant systemic (e.g., Verimark).										
Elevest	chlorantraniliprole + bifenthrin	28 + 3	pH < 6.5	MSO (0.125 – 0.25% V:V)	21	5.6-9.6 fl oz/A	++	++	+++	+++
Initiate applications after the emergence of the 2nd generation of CPB, and when defoliation estimates have reached or exceeded 5-10%. Initial foliar application (9.6 fl oz/ac) can be applied to the entire field. Subsequently, apply 2nd foliar application (7.5 fl oz/ac) over entire field one week later. Should be applied with an adjuvant (MSO) and acidify tank pH (pH < 6.5). Ground-application advised. Two successive applications of Elevest are allowed in succession per crop season for control of the Colorado potato beetle. Do not apply a Group 28 material if a Group 28 material was applied in 1st generation, or as an at-plant systemic (e.g., Verimark).										
Voliam Flexi	chlorantranilprole + thiamethoxam	28+4A	pH < 6.5	MSO (0.25-0.5 % V:V)	14	4.0 fl oz	++	++	+++	+++
Initiate applications after the emergence of the 2nd generation of CPB, and when defoliation estimates have reached or exceeded 5-10%. Initial foliar application (4.0 fl oz/ac) can be applied to the entire field. Subsequently, apply 2nd foliar application (3.5 fl oz/ac) over entire field one week later. Continue to scout field and consider a 3rd foliar application 7-10 days later only if populations continue to defoliate. Should be applied with an adjuvant (MSO) and acidify tank pH (pH < 6.5). Ground-application advised. Only two successive applications of Voliam Flexi are allowed in succession per crop season for control of the Colorado potato beetle. Do not apply a Group 28 material if a Group 28 material was applied in 1st generation, or as an at-plant systemic (e.g., Verimark).										

Other options

Trade name	Active ingredient	IRAC MoA Code	Spray pH<	Adjuvant	PHI	Rate	Adult	Egg Mass	Early Larvae (1st-2nd instar	Late Larvae (3rd-4th instar)
Admire Pro (foliar)	imidacloprid	4A	pH < 7	none (see notes)	7	1.3 fl oz	+	-	++	+
Apply Admire Pro as a foliar insecticide for control of late-season potato leafhopper and aphids where no Group 4A insecticide was used as an at-plant insecticide starter.										

Trade name	Active ingredient	IRAC MoA Code	Spray pH<	Adjuvant	PHI	Rate	Adult	Egg Mass	Early Larvae (1st-2nd instar	Late Larvae (3rd-4th instar)
Actara 25WG (foliar)	thiamethoxam	4A	pH < 7	none (see notes)	14	1.5-3.0 oz	+	-	++	+
Apply Actara 25WG as a foliar insecticide for control of late-season potato leafhopper and aphids where no Group 4A insecticide was used as an at-plant insecticide starter.										
Assail 30SG (foliar)	acetamiprid	4A	pH < 7	NIS (0.25-0.5 % V:V)	7	1.5-4.0 oz	+	-	++	+
Apply Assail 30SG as a foliar insecticide for control of late-season potato leafhopper and aphids where no Group 4A insecticide was used as an at-plant insecticide starter.										
Venom	dinotefuran	4A	pH < 7	none (see notes)	7	1.0-1.5 oz	+	-	++	+
Apply Venom as a foliar insecticide for control of late-season potato leafhopper and aphids where no Group 4A insecticide was used as an at-plant insecticide starter.										
Avaunt eVo	indoxacarb	22	pH < 7	NIS (0.25% V:V)	7	3.5-6.0 fl oz	+++	-	-	-
Apply Avaunt insecticide targeting only adult Colorado potato beetle. Applications can be tank mixed with Rimon 0.83EC during early season applications to kill adults, alternatively a tank mix application can be applied during later 2nd generations to target adults only. The addition of piperonyl butoxide (PBO) is necessary to increase the efficiency of adult control. Use a formulation of PBO that contains > 90% active ingredient. Apply only two successive applications, spaced 5-7 days apart.										
Brigade 2EC	bifenthrin	3A	N/A	N/A	21	2.1-6.4 fl oz	+	-	-	-
Apply Brigade insecticide targeting only adult Colorado potato beetle. Applications can be applied during later 2nd generations to target adults only. The addition of piperonyl butoxide may increase the efficiency of adult control. Apply only two successive applications, spaced 5-7 days apart.										
Imidan 70W	phosmet	1B	pH < 6.5	N/A	7	1.33	+	-	+	-
DO NOT Re-enter fields within 5 days (5-day REI)! Apply Imidan insecticide targeting only adult Colorado potato beetle. Applications can be applied during later 2nd generations to target adults only. Apply successive applications spaced no less than 10 days apart.										

Definitions:

- PHI: Post-harvest interval (time that must elapse after last application and before any harvesting of the crop, given in hours)
- Activity icons: (-) no activity, (+) very little activity, (++) moderate activity, (+++) excellent activity