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 18, 2023

In This Issue:

- Potato and tomato early blight and late blight disease updates
- Cucurbit downy mildew updates
- Potato leafhopper, true armyworm, Colorado potato beetle, flea beetles, cole crop pests

Calendar of Events:

July 6, 2023 – UW Langlade County Extension & WI Seed Potato Certification Program – Ag Research Station Field Day, Antigo, WI
July 13, 2023 – UW Agricultural Research Station Potato Field Day, Hancock, WI (1-4:30PM)
July 20, 2023 – WI Seed Potato Certification Program & WI Potato Coalition Early Generation Seed Potato Field Day, Lelah Starks Seed Potato Farm, Rhinelander, WI (*new date!)*
November 28-30, 2023 – Midwest Food Producers Assoc. Processing Crops Conference, Kalahari Convention Center
January 9-11, 2024 – Wisconsin Agribusiness Classic, Alliant Energy Center, Madison, WI
January 21-23, 2024 – Wisconsin Fresh Fruit and Vegetable Growers Conference, Kalahari Resort, Wisconsin Dells, WI
January 25-26, 2024 – Organic Vegetable Production Conference, UW Madison Division of Extension (Online)
February 2-3, 2024 – Organic Vegetable Production Conference, UW Madison Division of Extension, Alliant Energy Center, Madison, WI
February 6-8, 2024 – UW-Madison Div. of Extension & WPVGA Grower Education Conference & Industry Show, Stevens Point, WI

Amanda Gevens, Chair, Professor & Extension Vegetable Pathologist, UW-Madison, Dept. of Plant Pathology, 608-575-3029, Email: gevens@wisc.edu, Lab Website: https://vegpath.plantpath.wisc.edu/

Early blight of potato/tomato. With the cooler weather of this past week, accumulations of P-days (recall these are influenced by heat) slowed a bit and on average we saw just roughly 40 P-days over the past week across the state of Wisconsin. No locations have yet reached the threshold of 300 for a recommended initiation of a preventative management program for early blight in potato. It is likely that during this coming week, southern Wisconsin earliest planted potato crops will reach threshold and require preventative fungicide treatments for management of early blight.

Late blight of potato/tomato. Accumulations of Blitecast DSVs have been low to non-existent. Of the locations that I highlight in the table, below, only Hancock has just a single DSV (accumulated on 6/13). Overall, the weather has been very dry, with temperatures a bit too hot to promote the pathogen prior to this recent cool period. Temperatures are forecasted to increase this week to nearly 90°F in some parts of the state. By next weekend, thunderstorms may bring precipitation and increased risk. The usablight.org website (https://usablight.org/map/) indicates no reports of late blight in potato or tomato from across the US in 2023. This website continues to provide a very useful mechanism for tracking this potentially destructive crop disease, but it's not comprehensive. To date, I've not heard of reports of late blight in susceptible crops in the upper midwestern states. With limited reports of the disease in 2022 (no reports in WI!), inoculum sources are limited/low and early pressure should be at a minimum. Fungicides for management of late blight in tomato and

potato crops are provided: https://learningstore.extension.wisc.edu/products/commercial-vegetable-production-in-wisconsin

Current P-Day (Early Blight) and Disease Severity Value (Late Blight) Accumulations. Many thanks to Ben Bradford, UW-Madison Entomology; Stephen Jordan, UW-Madison Plant Pathology; and our grower collaborator weather station hosts for supporting this disease management effort again in 2023. 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. Red text in table indicates threshold has been met or surpassed. TBD indicates that data are To Be Determined as time progresses. Weather data used in these calculations is from weather stations that are placed in potato fields in each of the four locations, as available. Data from an alternative modeling source: https://agweather.cals.wisc.edu/vdifn will be used to supplement as needed for missing data points and for additional locations (indicated with *). Data are available in graphical and raw formats for multiple locations at: https://vegpath.plantpath.wisc.edu/dsv/.

	Planting Date		50% Emergence Date	Disease Severity Values (DSVs) *through 6/17/2023*	Potato Physiological Days (P-Days) *through 6/17/2023*
Spring Green*	**Early**	Apr 3	May 9	0	277
	Mid	Apr 17	May 12	0	256
	Late	May 10	May 23	0	187
Arlington*	**Early**	Apr 5	May 10	0	271
	Mid	Apr 20	May 15	0	233
	Late	May12	May 25	0	173
Grand Marsh	**Early**	Apr 5	May 10	0	247
	Mid	Apr 20	May 15	0	213
	Late	May 12	May 25	0	161
Hancock	**Early**	Apr 10	May 17	1	209
	Mid	Apr 22	May 19	1	203
	Late	May 14	May 28	1	154
Plover	**Early**	Apr 14	May 19	0	199
	Mid	Apr 24	May 20	0	194
	Late	May 19	May 29	0	147
Antigo	**Early**	May 1	May 28	0	137
	Mid	May 15	June 3	0	94
	Late	June 7	TBD	TBD	TBD
Rhinelander*	**Early**	May 7	June 1	0	107
	Mid	May 18	June 5	0	72
	Late	June 9	TBD	TBD	TBD

In addition to the potato field weather stations, we have the UW Vegetable Disease and Insect Forecasting Network tool to explore P-Days and DSVs across the state (https://agweather.cals.wisc.edu/vdifn). This tool utilizes NOAA weather data (stations are not situated within potato fields). 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 2023 Commercial Vegetable Production in Wisconsin Guide, Extension Document A3422, linked here: https://learningstore.extension.wisc.edu/products/commercial-vegetable-production-in-wisconsin

Cucurbit Downy Mildew. The Cucurbit Downy Mildew forecasting webpage (https://cdm.ipmpipe.org/) is not forecasting the movement of the pathogen, but the group is offering reporting of findings of cucurbit downy mildew. To date, the disease has been confirmed on cucumber in NJ; butternut squash and cucumber in SC; and watermelon, acorn/yellow summer squash, and cucumber in Georgia. These data suggest that there are both strain types of the pathogen active along the east coast. We should be watchful of all cucurbit crops. In past recent years, we have predominantly seen the cucumber strain types impacting cucurbits 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/). The potato leafhopper (PLH) is a serious annual pest of snap beans, hops, clover, alfalfa and potatoes. Damage caused by leafhoppers includes stunted plants, brown leaves and reduced plant vigor. Both adults and nymphs feed by inserting their mouth parts into the plant's vascular tissue and extracting sap. Damage results when the insect injects saliva containing toxic substances and creates physical damage during feeding, plugging the vascular tissue and permanently reducing the plant's photosynthetic efficiency.

Migratory populations of the PLH were slow to enter the state, but have now arrived in many portions of southern and central Wisconsin. Significant damage is attributed to feeding by the nymphs more so than the adults. For this reason, regularly scout potatoes, beans, hops and alfalfa now to ensure nymphal populations are not building in number. Leafhopper populations can build over successive weeks before any overt symptoms begin to show, and it is critical to gain control before they display the "hopperburn" symptomology. Snap beans and potatoes should be scouted regularly for PLH activity. Leafhoppers tend to migrate into other crops in early summer after alfalfa is cut and we are approaching the second cutting in many locations of the state. This is a key time to scout for early migrants in vegetable plantings.

True armyworm (https://vegento.russell.wisc.edu/pests/#leps). 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 corn fields or migrate into corn fields from small grain or forage fields. They may hide in soil crevices and beneath clods by day.

True Armyworm

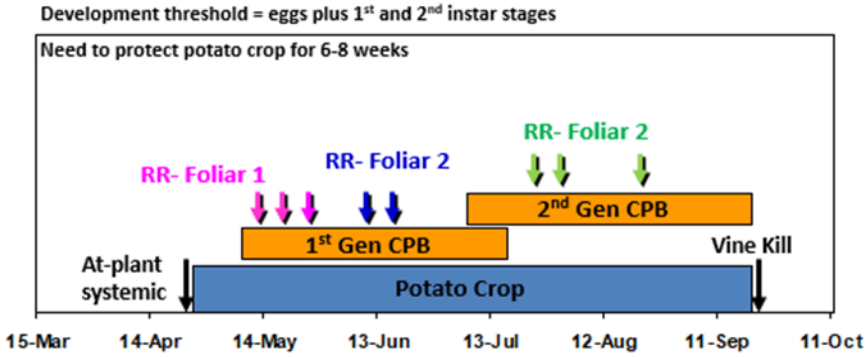
Photo courtesy WI DATCP (https://datcp.wi.gov/Pages/Programs_Services/TrueArmyworm.aspx)

Few armyworms overwinter in Wisconsin and are presumed to migrate into the state from the southern states in early spring. This year, significant populations have been observed statewide in grass pastures and areas where oviposition was highest. Upon arrival, armyworm moths are active during the evening, feeding on nectar, mating, and searching for oviposition sites. After completing six instars, larvae pupate just below the soil surface. Adults emerge in 1 to 2 weeks. A second generation will occur in late June or early July but the likelihood that these will cause significant defoliation in well-established sweet corn is low.

Colorado potato beetle (CPB) – (https://vegento.russell.wisc.edu/pests/colorado-potato-beetle/). Continue to scout populations of CPB adults especially as nearly all potato plants have emerged in central Wisconsin. In southern Wisconsin, adults continue to colonize much of the field and nearly all egg masses have hatched into 1st instar larval stages. Later larval stages (3rd and 4th instar) are now common in southern locations, whereas mostly early instar larvae are present in portions of the state north of Hwy 10. In each instance, the choice of insect control product can vary widely. Northern production areas can still use perimeter treatments (e.g., indoxacarb) and insect growth regulators (e.g., novaluron, whereas central and southern locations will not benefit as much from these treatments at this time if they have just begun treatments. 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).

Egg masses and early instar larvae of the Colorado potato beetle

For most CPB chemical management tools, timing application occurs with the appearance of first instar larvae in the field. Early instar larvae are the most susceptible life stage for chemical management, applications should be timed with the midpoint of egg hatch. The first application should be followed up in 5-7 days with a second application of the same compound depending on the formulation and label restrictions. Refer to the UW-Extension publication Commercial Vegetable Production in Wisconsin (A3422) for a list of registered insecticides and management recommendations.

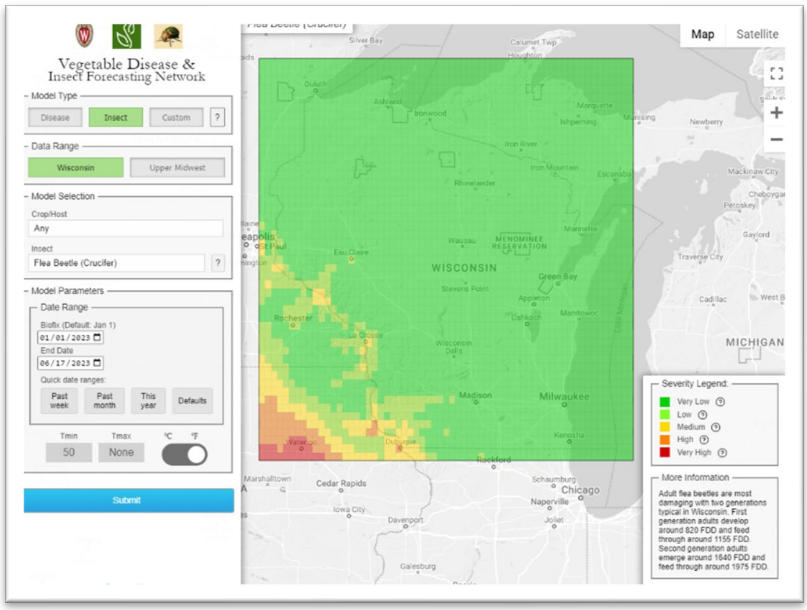


Applications of novaluron (Rimon) tolfenpyrad (Torac), spinetoram (Radiant, Delegate), or abamectin (Agri-Mek) should be applied when nearly 50-75% of egg masses have hatched, and a few 2nd instar larvae are present from the earliest hatched egg masses. This milestone has been reached in many fields in central Wisconsin, with few egg masses being deposited given that many overwintered adults are disappearing due to mortality. These 1st generation larvicides often require 2-3 subsequent re-applications spaced on a 7-10 day interval to achieve sufficient control of this damaging generation. In northern Wisconsin, CPB adults are still colonizing fields, and mating and egg laying is underway along field perimeters. With warm and dry daytime high and low temperatures forecast for the coming week, populations will move fast so don't delay! Careful scouting will reveal the exact timing! Recommended products for control are listed below.

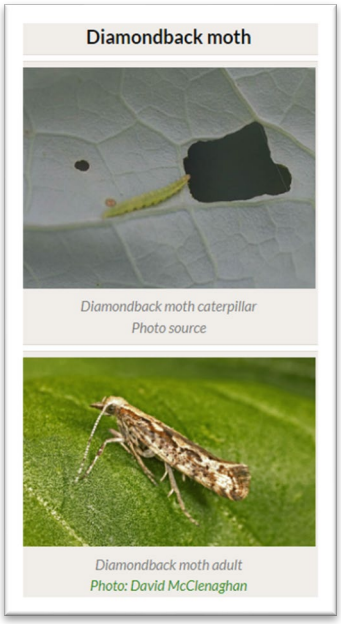
Flea beetles. – (https://vegento.russell.wisc.edu/pests/flea-beetles/). The damage associated with feeding flea beetles is increasing, and these are commonly found on all members of the cole crop group (kale, brussels sprouts, cabbage, etc.), potato, and spinach, beets, and early planted eggplant. There are several different species of flea beetles that can feed and damage crops in the early season. The crucifer flea beetle attacks cole crops and mustards while the eggplant flea beetle is commonly associated with eggplant. Similarly, the potato flea beetle most often attacks potato, but can be found on other nightshade plants (pepper, tomato, solanaceous weeds). Common Wisconsin flea beetles include the crucifer, eggplant, horseradish, pale-striped, potato, spinach, and striped flea beetles. Management options are recommended when flea beetle populations exceed established threshold levels, particularly early in the season. When choosing to control flea beetles, take care not to disrupt early populations of natural enemies that are also emerging currently. Synthetic pyrethroids comprise the majority of options currently, as well as pyrethrum (e.g., Pyganic, Azera, etc.) for organics. Spinosad-containing compounds (organics and conventional) can also work to limit some species of flea beetles to include potato, eggplant and crucifer flea beetles. Floating row covers can prevent adults from feeding on leaves and laying eggs on the crop. If used, row covers should be set up just before the crop emerges. Heavy rains and overhead watering can deter adult flea beetle feeding, and this is partially why damage has been accumulating (no rain).

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

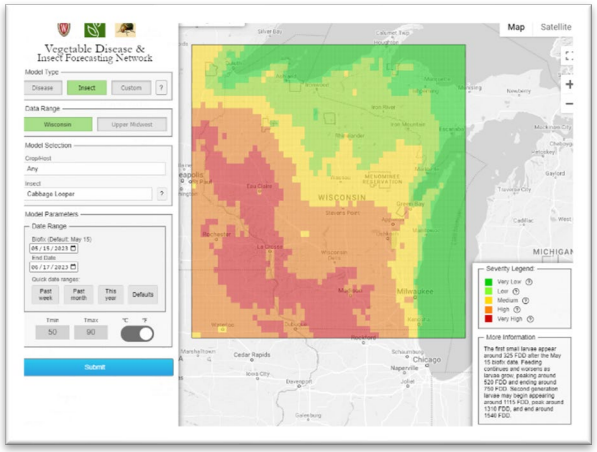


Cole crop pests: Cabbage looper, Diamondback moth and Imported cabbageworm – (https://vegento.russell.wisc.edu/pests/caterpillar-pests-of-cole-crops/). Imported cabbageworms (also known as cabbage whites or small whites), cabbage loopers and diamondback moths are the three most significant caterpillar pests of Wisconsin cole crops, with the imported cabbage worm being the most significant. The first generation of the imported cabbageworm has already been surpassed and now second generation moths are emerging in southern Wisconsin. Adult populations will continue to develop throughout the remainder of the state over the coming week, and egg deposition on cole crops will continue. Imported cabbageworm adults, commonly referred to as the white cabbage butterfly, are white butterflies whereas the larvae appear as velvety green worms up to 1 inch long with a faint yellow stripe running down the back.



Diamondback moths (DBM) have also completed a full generation in most portions of the state, and these typically arrive on infested transplants from southern locations. Diamondback moths overwinter as adults and can therefore be an early season pest if they successfully overwinter. Cold winters increase mortality; however, our past Wisconsin winter was very mild for many insects and survivorship of DBM was quite high. In early spring, females lay eggs on weeds in the mustard family, and later they move into susceptible cole crops. After completing four larval stages they spin white silken cocoons on the underside of leaves in the lower portion of the plant. There are typically 3 to 5 generations of diamondback moths per year in Wisconsin.

Cabbage loopers are now increasing in southern portions of Wisconsin as they enter the state from southern locations where overwintering success was also quite high. The cabbage looper often feeds between veins on the underside of lower leaves. Large loopers will make larger holes in the foliage and can burrow through 3 to 6 layers of tightly wrapped head leaves in cabbage. A good indicator of the presence of loopers and imported cabbageworms is fresh frass (droppings) on leaves. Scout fields weekly throughout the remainder of the season for damage. Check plants carefully, even if no feeding damage is apparent, to look for eggs that will hatch into small caterpillars in just a few days. Examine the lower leaves of the plant for the larvae of each pest. Although feeding damage and fecal material are signs of activity, it is better to rely on larvae counts to determine the level of infestation. Caterpillars cause varying amounts of damage depending on the plant's maturity, so the need for treatment changes as the crop grows.



Peak flight activity for 1st generation of cabbage looper in the upper Midwest. First generation peak (and subsequent risk) is illustrated across central and southern Wisconsin. (Source: https://agweather.cals.wisc.edu/vdifn).

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	clothianadin	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 CPB 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	-	+++	++	++

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)
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 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). Ground application advised.										
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). Ground-application advised. 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). Ground-application advised. 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). Ground-application advised. 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). Ground-application advised. Only two successive applications of Radiant or Delegate allowed in succession per crop season.										

2nd generation CPB 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 (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).										

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)
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.										
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.										

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)
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	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 may increase the efficiency of adult control. Apply only two successive applications, spaced 5 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.										