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

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In This Issue:

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

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

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 6/8/2024*	Potato Physiological Days (P-Days) *through 6/8/2024*
Spring Green	**Early**	Apr 3	May 9	9	221
	Mid	Apr 17	May 12	9	205
	Late	May 10	May 25	4	112
Arlington	**Early**	Apr 5	May 10	3	226
	Mid	Apr 20	May 15	3	195
	Late	May 12	May 25	1	116
Grand Marsh	**Early**	Apr 5	May 10	8	215
	Mid	Apr 20	May 15	8	186
	Late	May 12	May 25	1	112

Hancock	**Early**	Apr 10	May 17	9	169
	Mid	Apr 22	May 21	7	139
	Late	May 14	June 2	2	59
Plover	**Early**	Apr 14	May 18	8	163
	Mid	Apr 24	May 22	4	131
	Late	May 19	June 7	0	16
Antigo	**Early**	May 1	May 24	0	102
	Mid	May 15	June 1	5	61
	Late	June 1	TBD	TBD	TBD
Rhinelander	**Early**	May 7	May 25	1	101
	Mid	May 18	June 8	0	7
	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 comes from within field (small crop residue fragments can harbor the pathogen) and from nearby fields. 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 growing 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

Onion Botrytis leaf blight/leaf spot is a fungal disease of alliums caused by *Botrytis squamosa.* Picture of symptoms on the left is credited to Dr. Lindsay du Toit, Washington State University at bugwood.org. Symptoms first appear as small white spots on the leaf. These spots are oval-shaped, and sometimes are surrounded by a light green or silver halo that often appears water-soaked. Leaf tips will begin to dry and wither as the disease progresses, sometimes until the whole leaf dies back. Progressed infection can stunt bulb growth and reduce yield. Heavily infected fields often appear yellow.

Infection. Primary infection occurs from *B. squamosa* spores that overwinter in infected in-field plant debris, cull piles, stored bulbs, volunteer bulbs in-field, and in infected soil. Secondary infection can occur when conidia spores spread from moist, infected leaves. Favorable conditions for disease development include high relative humidity and rainfall, prolonged leaf wetness, and warm temperatures.

Disease Cycle. *Botrytis squamosa* overwinters as sclerotia in infected in-field plant debris, cull piles, stored bulbs, volunteer bulbs in the field, and infested soil. These sclerotia produce airborne conidia spores and ascospores (sexual spores) that travel to and infect onion leaves during periods of high moisture and low air movement. These same favorable conditions allow for secondary cycles of infection, where infected leaves produce more conidia, which spread to further infect the same leaf or others. Sclerotia are once again formed at the end of the season, and the disease cycle will continue the following season.

Cultural control. Cultural control strategies include scouting regularly to identify the presence of the disease early before it has had a chance to spread and cause significant damage. Disease spread can be limited by avoiding working in fields when plants are wet and disinfecting tools and machinery. The following practices can help mitigate the risk of this disease:

- Maintain proper spacing between plants
- Destroy cull piles
- Rogue volunteer plants
- Distance seed and commercial onion fields
- Destroy infested plant debris
- Rotate away from susceptible crops (Alliums) to reduce sclerotia in soil (3 years)

Chemical control. Use disease forecasting tools to properly time the most effective disease prevention sprays. For Wisconsin-specific fungicide information, refer to the Commercial Vegetable Production in Wisconsin (A3422), a guide available through the UW Extension Learning Store website. Or, for home garden fungicide recommendations, see Home Vegetable Garden Fungicides (D0062), a fact sheet available through the UW Plant Disease Diagnostic Clinic website. Always follow label directions carefully.

Predictive modeling. To view the predicted onion botrytis risk on any given day, visit the Vegetable Disease and Insect Forecasting Network (VDIFN) website. From the Disease tab, select the "Botrytis leaf blight" model. This BOTCAST model uses a cumulative disease severity index (CDSI) computed from gridded NOAA weather data to calculate the risk of onion botrytis development, which is displayed as a colored map overlay.

- Threshold 1: ($21 \leq CDSI < 31$) Warning threshold of "no spray applied unless rain predicted or overhead irrigation applied"
- Threshold 2: high risk of rapid disease development, apply initial spray as soon as possible
- $CDSI > 40$: extremely elevated risk

The start point should be set to the date of crop emergence. Click any grid point in VDIFN to get more detailed weather and disease progression information for that location.

Currently in the Coloma area, for fields emerging on/around May 20, 16 disease severity values have accumulated. This brings us close to "Threshold 1" as described above.

Resources. Commercial Vegetable Production in Wisconsin (A3422) from the UW Extension Learning Store. This guide offers the latest recommendations for disease, insect, and weed management in Wisconsin's most common commercial vegetable crops. UW Plant Disease Diagnostics Clinic. The University of Wisconsin-Madison/Extension Plant Disease Diagnostics Clinic (PDDC) provides assistance in identifying plant diseases and provides educational information on plant diseases and their control.

June 9, 2024

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/). Populations of adult potato leafhopper (PLH) are now increasing in many parts of southern Wisconsin. Recall, these are annual pest of snap beans, hops, clover, alfalfa and potatoes. Both adults and nymphs feed by inserting their mouth parts into the plant's phloem and extracting sap and thereby injecting saliva containing toxic substances. It is the plant's response to the saliva (salivary proteins) that results in the observed damage.

Potato leafhopper (Empoasca fabae)
Photo: Penn State

Migratory populations of the PLH have now entered the southern portion of Wisconsin. For this reason, begin regular scouting of these crops now to ensure nymphal populations are not building in number. Leafhopper populations can build over successive weeks before any damage symptoms begin to show, and it is critical to gain control before they display the "hopperburn" symptomology. Leafhoppers tend to move into other crops in early summer after forage alfalfa had hay crops are cut and we are underway with second cutting in many locations of the state. This is a key time to scout for early migrants in vegetable plantings.

Cutworms (https://vegento.russell.wisc.edu/pests/#leps). Damage resulting from flights of cutworms are becoming apparent in select areas of southern Wisconsin. There are a variety cutworm moths and associated larvae that can feed on and damage newly emerged vegetable crops. The caterpillars (worms) are active, nocturnal feeders, clipping many seedlings at or below the soil line in a single night. They prefer crops sown as seed (rather than transplants); susceptible crops include beets, carrots, cucumber, leafy greens, melons, peas, potato, pumpkin, snap beans, squash, and sweet corn. If not controlled, these pests can destroy large areas in short periods of time once they have reached later larval stages.


Cutworm larvae (from top): Sandhill cutworm, variegated cutworm, black cutworm, dingy cutworm, claybacked cutworm
Common cutworm larvae
Photo: Alabama Extension

Not all cutworms overwinter in Wisconsin and are presumed to migrate into the state from the southern states in early spring. This year populations have been observed near grassy field corners and areas where moths began laying eggs. Newly hatched larvae feed on leaves but are unable to chew entirely through, creating a "window pane" effect. As they mature, large infestations of cutworms can completely kill plants as larvae begin cutting plant stems.

Economic treatment thresholds for black cutworms have been developed for the following crops:
i) Snap bean= 2 larvae/ row foot; ii) Potatoes= 4 larvae/row foot; iii) Sweet Corn= >5% of plants damaged; iv) Leafy greens= <3% of the stand affected.

Cucumber beetles. – (https://vegento.russell.wisc.edu/pests/cucumber-beetles/). Striped and spotted cucumber beetles will now begin to infest many of our cucurbit crops planted over the past 3 weeks. Spotted cucumber beetle (aka southern corn rootworm) can cause damage in vine crops, but the striped beetle is more common and damaging in Wisconsin. Feeding from larvae and adults causes direct damage to roots, leaves, flowers, and fruits.

Adult striped cucumber beetle can vector the bacteria, *Erwinia tracheiphila*. Cucumbers and melons are particularly susceptible to bacterial wilt, and damage from this can be severe. Only the striped cucumber beetle overwinters in Wisconsin. They emerge in mid- to late May and lay eggs in the soil at the base of cucurbits. Spotted beetles migrate to northern locations in early to mid-July. This late arrival generally seldom makes them a serious problem.

Striped cucumber beetle (Acalymma vitatum)
Photo: Ralph C. Baslow

Spotted cucumber beetle (Diabrotica undecim-punctata)
Photo: 'Pollinator' on Wikipedia

Plants infected with bacterial wilt will not recover. Therefore, it is important to control the beetles early in the season to prevent spread of the disease. Scout fields for adult beetles 2-3 times per week early in the season and weekly thereafter. Particular attention is needed in field edges where beetles congregate. The treatment threshold for cucumber beetles is 1 beetle per plant in melons, cucumber, Hubbard and Butternut squash, and younger pumpkins and 5 adults per plant in watermelon, other varieties of squash and older pumpkins. Beetle populations in excess of 20 per plant may transmit the bacterial wilt before insecticides have a chance to control the beetles.

Non-chemical control is possible in small plantings by covering the plants with floating row covers. Be sure to uncover flowering plants to allow bees to enter and pollinate the plants. Rotating crops with grain, tomatoes, or a cover crop or using perimeter trap crops can delay infestations. If a trap crop is used, exercise care that the trap crop will not act as a reservoir for bacterial wilt. If bacterial wilt infections have already occurred, remove the diseased plants immediately to prevent the spread of the disease while insects are present.

Aster leafhopper (https://vegento.russell.wisc.edu/pests/aster-leafhopper/). The aster leafhopper is a serious pest of many crops in the upper Midwest because of its ability to spread aster yellows disease. Aster yellows is untreatable and the only solution is to remove infected plants and treat for the leafhopper if numbers are too great. Both the insect and the disease can attack a broad range of plants, including vegetables, field crops, flowers, and weeds. Infected flowers, particularly those in the aster family (Compositae), are severely disfigured by the disease, destroying both their visual appeal and their economic value.

Leafhoppers prefer lettuce, carrots, celery, and small grains for feeding and breeding, while other crops such as potatoes and onions provide a temporary source of food and refuge. Only adults use these temporary sites; immature leafhoppers fail to develop on these plants. All plants are susceptible to aster yellows infection.

Migratory populations of the aster leafhopper have arrived in Wisconsin over the past 3 weeks and, similar to other migratory pests mentioned (e.g. cutworm, potato leafhopper) are associated with the recent storm events that have brought southern winds into the state in advance of the fronts. Adult leafhoppers that migrate into the state can be infected with the bacterium that causes the disease.

Begin scouting for aster leafhoppers in early spring when plants are newly sprouted and continue scouting weekly throughout the end of July. Yellow sticky cards may be placed in the field to determine when the first migrants arrive. Once leafhoppers are observed, you'll need to estimate the size of the population using an insect net to sweep the area. Take 100 sweeps per sample site and sample at least four areas. Established thresholds for treatment vary by crop susceptibility, but are generally: i) susceptible

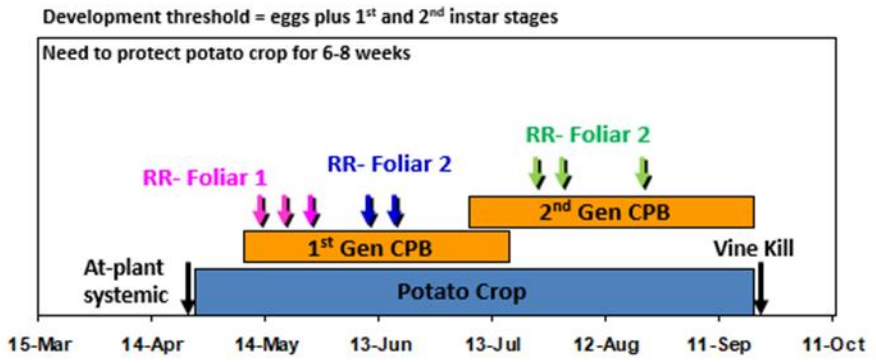
Aster leafhopper
Photo: P. Beauzay, NDSU

carrot varieties: 20 adult ALH/100 sweeps; ii) resistant carrot varieties: 40 adult ALH/100 sweeps; iii) onion, 15 adult ALH/100 sweeps; iv) celery: 10 adult ALH/100 sweeps. Consult A3422 (Commercial Vegetable Production in Wisconsin), to get a listing of carrot varieties considered susceptible and resistant.

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, adult colonization is slowing in many fields and less than 25% of egg masses remain unhatched. Later larval stages (2nd and 3rd instar) are now common in southern locations, whereas mostly early instar larvae are present in portions of the state north of Hwy 23. 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. 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, and applications should be timed with the midpoint of egg hatch. The first application should be followed up in 7-10 days later 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 ledprona (Calantha), 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 will be reached in the coming week in many fields in central Wisconsin, with several egg masses continuing to be being deposited as overwintered adults continue to be active in many fields in the Central Sands. These 1st generation larvicides often require 2-3 subsequent re-applications spaced on a 7-10 day interval to achieve sufficient control. In northern Wisconsin, CPB adults are still colonizing fields, and mating and egg laying are just 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.

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 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