# 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. 3 – June 4, 2023**

***In This Issue:***

- Potato and vegetable disease model updates
- Potato early blight management options
- Natural control of insects, Two-spotted spider mites and mint bud mite, onion thrips, aphids, and Colorado potato beetle updates
- Colorado potato beetle management options

***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 27, 2023 –** WI Seed Potato Certification Program & WI Potato Coalition Early Generation Seed Potato Field Day, Lelah Starks Seed Potato Farm, Rhinelander, WI (subject to change)
**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
**February 6-8, 2024** – UW-Madison Div. of Extension & WPVGA Grower Education Conference & Industry Show, Stevens Point, WI

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**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 will come 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. We currently have our Grand Marsh, Hancock, Plover, and Antigo weather stations up and running. Data will soon be available in graphical and raw formats for each weather station at: https://vegpath.plantpath.wisc.edu/dsv/.

| | Planting Date | | 50% Emergence Date | Disease Severity Values (DSVs) *through 6/3/2023* | Potato Physiological Days (P-Days) *through 6/3/2023* |
|---|---|---|---|---|---|
| **Grand Marsh** | **Early** | Apr 5 | May 10 | 0 | 152 |
| | **Mid** | Apr 20 | May 15 | 0 | 119 |
| | **Late** | May 12 | May 25 | 0 | 67 |
| **Hancock** | **Early** | Apr 10 | May 17 | 0 | 111 |
| | **Mid** | Apr 22 | May 19 | 0 | 105 |
| | **Late** | May 14 | May 28 | 0 | 56 |

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|---|---|---|---|---|---|
| **Plover** | **Early** | Apr 14 | May 19 | 0 | 102 |
| | **Mid** | Apr 24 | May 20 | 0 | 97 |
| | **Late** | May 19 | May 29 | 0 | 48 |
| **Antigo** | **Early** | May 1 | May 28 | 0 | 53 |
| | **Mid** | May 15 | June 3 | 0 | 18 |
| | **Late** | TBD | 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

Potato early blight management is most successful when addressed preventatively. Cultivars vary in their susceptibility to this primarily foliar fungal disease caused by *Alternaria solani*, but all are susceptible. When the weather remains relatively warm and dry, early blight onset is slowed down and progress is hampered. Irrigation timing, when feasible to manage, can help to manage the length of leaf wetness. A list of fungicides for consideration once a foliar fungicide program is initiated (based on disease model tool of P-Day 300 or other indicator) is provided, below, and per the potato early blight management sections of the A3422. Please note that this list is not comprehensive nor does it provide specific recommendation.

| **Diseases managed** | **Active ingredient** | **Rate and fungicide name** | **Days to harvest** | **Comments** |
|---|---|---|---|---|
| **Early blight (*Alternaria solani*) and brown spot (*Alternaria alternata*)** | azoxystrobin | 6.0-15.5 fl oz Aframe, Equation, Quadris, Satori, Willowood Azoxy 2SC | 14 | Group 11 fungicide. Follow resistance management guidelines. *Note that much of the pathogen populations in Alternaria genus have resistance to Group 11 fungicides.* |
| | azoxystrobin + difenoconazole | 8-14 fl oz Quadris Top | 14 | Follow resistance management guidelines. |
| | difenoconazole | 5.5-7 fl oz Top MP | 14 | Follow resistance management guidelines. |
| | difenoconazole + tea tree oil | 4-8.5 fl oz Regev | 14 | Follow resistance management guidelines. |
| | fluazinam + difenoconazole | 12.5-14.5 fl oz Orbus | 14 | See label for fungicide resistance management guidelines. |
| | fluopyram | 6.5 fl oz Velum Prime | 7 | Use preventatively. Do not apply more than 43.6 fl oz/a/season. Do not make more than 2 |
| | fluopyram + penflufen | 13 fl oz Velum Rise | In furrow; one application per year | |
| | fluopyram + prothioconazole | 10 fl oz Luna Pro | 14 | |

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| | fluopyram + pyrimethanil | Early blight: 11.2 fl oz Luna Tranquility | 7 | sequential applications of any Group 7 or 9 fungicide before rotating with another mode of action. |
| | fluxapyroxad + pyraclostrobin | 4-8 fl oz Priaxor | 7 | Make no more than 3 applications/a/season. Apply no more than 24 fl oz/a/season. |
| | iprodione | 1-2 pt Meteor, Nevado 4F, Rovral | 14 | Use high specified rate under high disease pressure circumstances. Do not apply in less than 10 gal carrier water/acre. |
| | mefentrifluconazole | 3-5 fl oz Provysol | 7 | Do not apply more than 5 fl oz (0.13 lb) per acre/application. Do not make more than 3 applications at 5 fl oz or 5 applications at 3 fl oz per acre/year. |
| | metconazole | 2.5-4 oz Quash | 1 | Do not make more than 4 applications/season. Do not make more than 2 sequential applications. Do not apply more than 15 oz/a/season. |
| | picoxystrobin | 6-12 fl oz Approach | 3 | Follow label for resistance management. Also for white mold. |
| | penthiopyrad | 10-24 fl oz Vertisan | 7 | Do not exceed 72 fl oz/a/year. Make no more than 2 sequential applications before switching to different mode of action. |
| | pydiflumetofofen + fludioxonil | 9.2-11.4 fl oz Miravis Prime | 14 | Do not apply more than 2 applications/year by air. Do not apply more than 34.2 fl oz/acre/year. |
| | pyrimethanil | 7 fl oz Scala SC | 7 | Follow resistance management guidelines. |

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| **Early blight and late blight (*Phytophthora infestans*)** | azoxystrobin | 6-15.5 fl oz Aframe, Satori, Quadris, Equation | 14 | Evito, Gem, Headline, Quadris, Reason, and Tanos are Group 11 fungicides. Adhere to fungicide resistance mitigation requirements when using. Note: Group 11 fungicides are no longer optimal for early blight control due to high levels of pathogen resistance in the populations. Group 11 fungicides are good late blight preventatives when pressure is low. |
| | azoxystrobin + chlorothalonil | 1.6 pt Quadris Opti | 14 | |
| | azoxystrobin + difenoconzole | 8-14 fl oz Quadris Top | 14 | |
| | cymoxanil + famoxodone | *early blight:* 6 oz Tanos 50DF<br>*late blight:* 6-8 oz Tanos 50DF | 14 | |
| | fenamidone | 5.5-8.2 fl oz Reason 50 SC | 14 | |
| | fluoxatrobin | 2-3.8 fl oz Aftershock, Evito 480 SC | 7 | |
| | pyraclostrobin | *early blight:* 6-9 fl oz Headline SC, EC<br>*late blight:* 6-12 fl oz headline SC, EC | 3 | |
| | pyraclostrobin + metiram | 2.9 lb Cabrio Plus | 3 | |
| | *Bacillus mycoides* isolate J | 1-4.5 oz LifeGard WG | 0 | Maximum level of protection is induced within the plant at 3-5 days post application. Protection can last up to 18 days. |
| | boscalid | 2.5-4.5 Endura WDG | 10 | For control of early blight only. Endura belongs to Group 7 fungicide category. Do not exceed 2 sequential applications before alternating to a different mode of action. Do not exceed 20.5 oz/a/season. |
| | chlorothalonil | 1-1.5 pt Bravo Weather Stik, Echo 720, Equus 720<br>1.5-2.25 pt Bravo Zn, Equus 500 Zn<br>0.875-1.25 lb Echo 90DF, Echo Zn<br>0.9-1.36 lb Bravo Ultrex 82.5WDG, Equus DF | 7 | Note seasonal use limitations on label and in WI DATCP Special Registrations for Bravo and Echo products. |
| | chlorothalonil + cymoxanil | 2 pt Ariston | 14 | Apply preventatively when triggered by disease modeling tools. |

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| | copper hydroxide | 0.66-2.66 pt Champ Formula 2<br>0.67-2.67 pt Kocide 4.5LF<br>1.3-5.3 pt Kocide LF<br>0.5-1.75 Kocide 3000<br>0.75-3 lb Kocide 2000DF<br>1-4 lb Champion 77WP, Kocide 101, DF | 0 | Gives fair control of early blight and good control of late blight when applied preventatively. |
| | cymoxanil | 3.2 oz Curzate 60DF | 14 | Do not use Curzate alone. Always mix with another registered fungicide such as mancozeb or chlorothalonil. Do not apply more than 7 sprays/season. After 3 to four applications of Curzate, switch to another mode of action before applying any additional Curzate. High heat can reduce length of curative fungicide activity period from 3 days to 1 day. |
| | mancozeb | 0.4-1.6 qt Dithane F45 4F<br>0.5-2.0 lb Dithane M4, Penncozeb 80WP, Penncozeb 75DF<br>1-2 lb Dithane 75DF Rainshield NT, Koverall, Manzate 200 75DF | 3 | Do not exceed total of 11.2 lb/ai/a of EBDC per growing season. EBDCs include maneb, mancozeb, and metiram. |
| | mancozeb + chlorothalonil | 1.2-1.8 lb Elixir | 7 | Also controls black dot. Do not apply more than 18 lb product/acre/crop. |
| | mancozeb + mefenoxam | 2.5 lb Ridomil Gold MZ WG | 3 | Do not make more than 4 applications per year. Mefenoxam component can manage late blight and oomycete water rots when pathogen is susceptible. Generally, most US-23 clonal lineage types are still |

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| | | | | controllable with mefenoxam. |
| | mandipropamid + difenoconazole | 5.5-7 fl oz Revus Top | 14 | Make no more than 2 consecutive applications before switching to a non-Group 40/3 fungicide. Do not exceed 28 fl oz/a Revus Top per season. The addition of a spreading or penetrating type adjuvant such as a non-ionic surfactant is recommended. |
| | mefentrifluconazole + pyraclostrobin | 5-10 fl oz Veltyma | 7 | Follow label for resistance management strategies. Also registered for black dot. |
| | metiram | 1.5-2 lb Polyram 80DF | 14 | Do not exceed 14 lb/a Polyram 80DF per season. |
| | pyrimethanil | 7 fl oz Scala SC | 7 | Group 9 fungicide and controls only early blight. Use with broad spectrum fungicide for control of late blight. Use the 7 fl oz/a rate of Scala only in a tank mix with a broad spectrum fungicide. Alternating the tank-mix combination with a broad spectrum fungicide is a resistance management strategy. |
| | trifloxystrobin | *early blight:* 2.9-3.8 fl oz Gem 500 SC<br>*late blight:* 3.8 fl oz Gem 500 SCtank mixed with protectant fungicide | 7 | Follow resistance management strategies on fungicide label. |
| | triphenyltin hydroxide (TPTH) plus mancozeb or metiram | 3 fl oz Super Tin 4L *(restricted use fungicide)*<br>1.87 oz Super Tin 80WP *(restricted use fungicide)*<br>*Plus* one of the following:<br>1.5 lb Dithane M45 80WP, 75DF, WSP, | 7 | Combining TPTH with maneb, mancozeb, or metiram reduces foliage injury while providing improved control of early blight. Following use allowances for |

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| | | or 1.2 qt Manex F4 or 1.5 lb Penncozeb 80WP, 75DF or 1.5 lb Polyram 80DF | | EBDCs previously outlined. |
| | zoxamide + chlorothalonil | 32-34 fl oz Zing! | 7 | Do not make more than 2 sequential applications before alternating to another mode of action. |
| | zoxamide + mancozeb | 1.5-2 lb Gavel 75DF | 3 | Begin treatment before the onset of late blight. This product contains mancozeb, an EBDC. Follow allowances previously outlined. Do not make more than 6 applications per season or exceed 12.0 lb/acre of Gavel 75DF. |

https://learningstore.extension.wisc.edu/products/commercial-vegetable-production-in-wisconsin

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

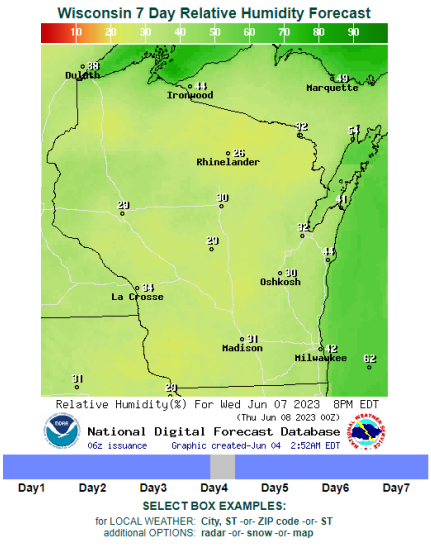
**Vegetable Entomology Webpage:** https://vegento.russell.wisc.edu/

**Natural Control of Insects** – (https://vegento.russell.wisc.edu/ipm/biological-control/). Natural, biological control represents one alternative to the use of insecticides. Biological control is the conscious exploitation of living beneficial organisms, called natural enemies, for the control of pests. Virtually all pests have natural enemies and appropriate management of natural enemies can effectively control many pests. The natural enemies of insects are a diverse group of organisms that includes predators, parasitic insects, nematodes, and various microorganisms.

Although biological control will not control all pests all the time, it can be a key component of integrated pest management if conditions prevail that support biological control. Biological control will rarely eradicate pest populations, but under the correct environmental conditions will keep them at tolerable levels at which they cause no measurable harm.

In the late spring and early summer in the upper Midwest region, there are many types of natural enemies (microorganisms) that occur naturally in the cooler and wetter springtime environments within agricultural crops. These have a major, but often unrecognized and under-appreciated impact on pest populations and can result in pests being kept below damaging levels until the environmental conditions change in mid to late summer that release the pest from control by these natural enemies.

For many leaf-infesting and sap-feeding insects, there are often fungal, viral and bacterial pathogens of insects that slow the development of early season populations. Examples include *Beauveria bassiana*, *Metarhizium* spp, *Cordyceps* spp (made famous recently by HBO), nuclear polyhedrosis virus, granulosis virus, *Burkholderia* spp, and *Chromobacterium* spp. Some of these microorganisms have even been developed and formulated as biological pesticides. Important to remember, these organisms are naturally endemic and under the right circumstances can really provide value. Our plant protection strategies can always consider ways to limit the impacts upon these organisms, and encourage their grow and persistence (irrigation, limit broad spectrum fungicides, reduce use of metal-containing compounds including Cu, Zn, Mn, etc.).




**Unfortunately**, we are starting the production season with environmental conditions that do NOT favor these natural microorganisms. Over much of late May and early June, we have experienced above average temperatures, very little precipitation, combined with abnormally low relative humidity (RH). This combination of conditions has resulted in very little natural control of early season, soft-bodied insects. As a result, we are observing rapidly increasing populations of leaf-feeding insects and mites that rarely occur at damaging levels at this time of the season. These include flower thrips and onion thrips, two-spotted spider mites, and several aphid species. Combined with an abnormally mild winter throughout much of Wisconsin that increased their overwintering survivorship, these arthropod pests are increasing rapidly in many crops.

Scouts should pay special attention to the developing crop while this weather prevails. The 7-10 day forecast does call for some slightly lower day and night time temperatures, but forecast precipitation and RH estimates are predicted to remain low (https://graphical.weather.gov/sectors/wisconsin.php).

**Two-spotted spider mites and Mint bud mite** – (https://vegento.russell.wisc.edu/pests/mint-bud-mite/). Two spotted spider mites overwinter in field margins and sheltered areas where permanent hosts are available. Spider mites attack a wide variety of plants, including potato, corn, soybeans, alfalfa, and other vegetables. A generation typically takes 5-20 days but is dependent on temperature. Development is more rapid when temperatures are over 80°F. Females produce approximately 100 eggs each, and populations can increase 70-fold in as little as 6 days during the summer.

Photo 2. Twospotted spider mite injury on soybean. Photo by Whitney Cranshaw, Colorado State University, Bugwood.org.

Two spotted spider mites typically reach crops from overwintering hosts using silk threads to move with the wind. Most often, two spotted spider mites aggregate at field edges, especially if there are weeds surrounding the border. Eventually, they may disperse with the wind to develop a field-wide infestation.

The mint bud mite, Tarsonemus sp., is a highly destructive pest of Midwestern peppermint. Mint bud infestations are typically associated with older stands of peppermint and can result in dramatic reductions in the yield of essential oils. Symptoms, which first appear in mid-season, consist of shortened terminal internodes, curling of new leaves and a twisting or puckering of apical buds. This collection of symptoms is commonly referred to as "squirrelly mint".

This mite overwinters underground on mint stolons or on plowed down mint debris in the adult female stage. Adult female mites emerge from the soil in early to mid-May (depending on spring temperatures) and begin depositing eggs in terminal buds soon after emergence. Cool temperatures early in the season typically slow development and rapid population increases are not seen until late May or early June.

However, the bud mite is extremely responsive to changes in temperature, so a warm and dry spring may result in an earlier and more rapid build-up of mites. During periods of moderate to warm temperatures, 70F to 85F, mites can complete a generation is as little as a week, laying an average of one egg per day. Field studies have indicated that under optimum conditions the number of bud mites can double in under a week.

**Onion thrips** – (https://vegento.russell.wisc.edu/pests/onion-thrips/). Onion thrips overwinter in legume and grain fields and along weedy field edges. Females can reproduce without mating and lay eggs beneath the leaf's surface. Eggs hatch after 5-10 days, and nymphs are fully grown within 15-30 days. Thrips produce 5-8 generations per year, and outbreaks are most likely to occur in hot, dry weather. Sampling should be initiated 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. 1-3 thrips per onion leaf or approximately 5-10 per plant is a widely accepted threshold for chemical treatment, and especially at this early time of the season.

Left: onion thrips (Thrips tabaci)
Right: western flower thrips (Frankliniella occidentalis)
Photo: Alton N. Sparks, Jr.

**Aphids** – (https://vegento.russell.wisc.edu/pests/aphids/). Aphids, also known as plant lice, are soft-bodied, sucking insects. They feed on plant sap and excrete a sugary honeydew that attracts ants and creates the conditions for sooty mold, a type of fungus (saprophytic) that feeds on decaying organic matter. There are several aphid species, all belonging to the insect family *Aphididae*, that can attack any type of vegetation. Aphids that pose the most serious problem to Wisconsin vegetable production include the green peach, melon, and potato aphids.

It is difficult to generalize the life cycle of all aphids because of the diversity of their life habits, which can range from single to multiple hosts. Aphids overwinter as eggs on a perennial host. In spring, the eggs hatch and the aphids migrate onto their summer host when it becomes available. The female aphids can then reproduce without mating and will hold the eggs in their bodies to give birth to live young. Look for "hot spots" of aphid activity scattered throughout the field. Because of the spotty nature of infestations, look for aphids on a number of plants in several areas. Examine the terminals of 15 consecutive plants and rate the plants as infested or uninfested. Given the huge reproductive potential of aphids, an infestation level of 5%-10% indicates a potentially damaging infestation. Repeat checks at weekly intervals to determine the need to treat as long as conditions prevail for their increase.

Green peach aphid (*Myzus persicae*)

Photo: Scott Bauer

**Appearance:** Yellowish-green with 3 dark lines on their backs

**Host plants:** Beet, celery, cole crops, cucurbits, lettuce, pepper, potato, spinach, tomato

**Winter hosts:** Cherry and peach

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

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

Melon aphid (*Aphis gossypii*)


Photo: Univ. of Tennessee

**Appearance:** Pale yellow to brown or nearly black with black cornicles

**Host plants:** Asparagus, bean, beet, celery, cucurbits, okra, spinach

**Winter hosts:** Many

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

**Colorado potato beetle (CPB) –** (https://vegento.russell.wisc.edu/pests/colorado-potato-beetle/). The current and forecast weather remains very conducive for continued emergence of adult CPB in southern and central Wisconsin. Egg masses are becoming very prevalent on outside field edges and producers thinking about initial perimeter spray applications should be prepared to spray in the coming week. We recommend the insect growth regulator, novaluron (Rimon® 0.83EC), together with a tank mix of indoxacarb (Avaunt® eVo 30DG).

***Week 1: Spray field edges*** ***Week 2-3: Spray entire field*** ***Week 4: Spray field interior***

In the

illustration above, Week 1 represents the initial perimeter application which should contain a tank mix of Rimon® 0.83EC (8.0 fl oz/acre) together with Avaunt® eVo 30DG (6.0 oz/acre). This tank mix should also contain a 6.0 fl oz/acre addition of piperonyl butoxide (e.g., Exponent) to synergize the indoxacarb component. Additional applications of Rimon, or another appropriate 1st generation CPB material, can follow in weeks 2-4.

## 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 | - | +++ | ++ | ++ |
| *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 | + | - | +++ | ++ |

| 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 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 <* | | | | | | | | | | |

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|
| *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).* | | | | | | | | | | |
| **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.* | | | | | | | | | | |
| **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.* | | | | | | | | | | |

**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