

Vegetable Seed Crops

Pests of Cabbage and Mustard Grown for Seed

Craig Hollingsworth

Latest revision—March 2018

In all cases, follow the instructions on the pesticide label. The *PNW Insect Management Handbook* has no legal status, whereas the pesticide label is a legal document. Read the product label before making any pesticide applications.

Pesticides registered for pest control on a given vegetable crop can also be used for that vegetable's seed crop, unless prohibited. For pesticide recommendations in addition to those listed below, see the appropriate vegetable section in this handbook.

Important notice Several pesticides with 24c SLN (Special Local Need) registrations for use on seed crops lack legal tolerances established for pesticide residues that may be on the seed, screenings, or hay at harvest. Therefore, certain seed growers associations in Washington, Oregon, and Idaho have declared, through their respective state departments of agriculture, that the crop produced for seed in those states is a nonfood crop. This declaration means that none of the seed, screenings, hay, or sprouts produced from harvested seed will be available for human or animal consumption when these pesticides have been applied. The grower must notify the seed processing plant in writing of any seed treated with these pesticides. Processed seed must be labeled: "This seed was produced using one or more products for which the United States Environmental Protection Agency has not established pesticide residue tolerances. This seed, in whole, as sprouts, or in any form, may violate requirements of the Federal Food and Drug Administration, the Oregon Department of Agriculture and other regulatory agencies."

Note: Products are listed in alphabetical order and *not* in order of preference or superiority of pest control.

Cabbage and mustard seed—Aphid

Includes

Cabbage aphid (*Brevicoryne brassicae*)

Green peach aphid (*Myzus persicae*)

Turnip aphid (*Lipaphis erysimis*)

Pest description and crop damage Both species are gray, mealy plant lice that form colonies on foliage, on heads, or in buds.

Management—chemical control

- ◆ azadirachtin (Neemix 4.5) at 0.01 to 0.02 lb ai/a. PHI 0 days. Begin applications at first sign of infestation. Multiple applications and thorough coverage are necessary for effective control. This botanical pesticide acts slowly. Spray early, well before harvest, and check for effect. Some formulations are OMRI-listed for organic use.
- ◆ gamma cyhalothrin (Declare) at 0.01 to 0.015 lb ai/a. Do not apply more than 0.12 lb ai/a per season. Suppression only. PHI 1 day.

- ◆ pymetrozine (Fulfill) at 0.086 lb ai/a (2.75 oz/a) when aphids first appear. Do not apply more than 0.086 lb ai/a per application or more than 0.172 lb ai/a per crop per year. Allow a minimum of 7 days between applications. PHI 7 days. REI 12 hr. Pollinator protection: when crops or weeds are in bloom, apply between 6 pm and 7 pm.

See also:

Broccoli, Brussels sprout, cabbage, cauliflower—Aphid

Mustard greens—Aphid

Cabbage and mustard seed—Cabbage maggot

Delia brassicae

Pest description and crop damage White maggots that feed on roots and underground stems and weaken, lodge, and kill plants. Adult is a small gray fly that lays white, oblong eggs at plant bases.

Management—chemical control

- ◆ azadirachtin (Neemix 4.5) at 0.02 to 0.04 lb ai/a. PHI 0 days. Begin applications at first sign of infestation. Multiple applications and thorough coverage are necessary for effective control. This botanical pesticide acts slowly. Spray early, well before harvest, and check for effect. Some formulations are OMRI-listed for organic use.

See also:

Broccoli, Brussels sprout, cabbage, cauliflower—Cabbage maggot

Mustard greens—Cabbage maggot

Cabbage and mustard seed—Cabbage seedpod weevil

Ceutorhynchus assimilis

Pest description and crop damage Small, dark-gray snout beetles that congregate on blooms. Larvae feed on seeds inside pods.

Management—chemical control

- ◆ azadirachtin (Neemix 4.5) at 0.02 to 0.04 lb ai/a. PHI 0 days. Begin application at first sign of infestation. Multiple applications and thorough coverage are necessary for effective control. This botanical pesticide acts slowly. Spray early, well before harvest, and check for effect. Some formulations are OMRI-listed for organic use.

Cabbage and mustard seed—Diamondback moth

Plutella xylostella

Pest description and crop damage Small, pale yellowish green larvae with erect black hairs that eat holes in foliage. Adults are small gray or brown moths with white marks on forewings which form a diamond when wings are folded.

Management—chemical control

- ◆ azadirachtin (Neemix 4.5) at 0.02 to 0.04 lb ai/a. PHI 0 days. Begin applications at first sign of infestation. Multiple applications and thorough coverage are necessary for effective control. This botanical pesticide acts slowly. Spray early, well before harvest, and check for effect. Some formulations are OMRI-listed for organic use.
- ◆ gamma cyhalothrin (Declare) at 0.01 to 0.015 lb ai/a. Do not apply more than 0.12 lb ai/a per season. PHI 1 day.

See also:

Broccoli, Brussels sprout, cabbage, cauliflower—Cabbage maggot

Mustard greens—Cabbage maggot

Cabbage and mustard seed—Flea beetle

Includes cabbage flea beetle (*Phyllotreta cruciferae*)

Pest description and crop damage A small, shiny steel-blue jumping beetle that eats round holes in leaves of wild and cultivated crucifers. It is particularly serious on seedlings.

Management—chemical control

- ◆ azadirachtin (Neemix 4.5) at 0.02 to 0.04 lb ai/a. PHI 0 days. Begin applications at first sign of infestation. Multiple applications and thorough coverage are necessary for effective control. Some formulations are OMRI-listed for organic use.
- ◆ gamma cyhalothrin (Declare) at 0.01 to 0.015 lb ai/a. Do not apply more than 0.12 lb ai/a per season. PHI 1 day.

See also:

Broccoli, Brussels sprout, cabbage, cauliflower—Flea beetle
Mustard greens—Flea beetle

Cabbage and mustard seed—Imported cabbageworm

Pieris rapae

Pest description and crop damage Larvae are green and very hairy with a velvet-like appearance. Caterpillars are soft, velvety green with faint yellow stripes. Adult is a white butterfly with black spots.

Management—chemical control

- ◆ azadirachtin (Neemix 4.5) at 0.02 to 0.04 lb ai/a. PHI 0 days. Begin applications at first sign of infestation. Multiple applications and thorough coverage are necessary for effective control. Some formulations are OMRI-listed for organic use.
- ◆ gamma cyhalothrin (Declare) at 0.0075 to 0.0125 lb ai/a. Do not apply more than 0.12 lb ai/a per season. PHI 1 day.

See also:

Broccoli, Brussels sprout, cabbage, cauliflower—Imported cabbageworm
Mustard greens—Imported cabbageworm

Cabbage and mustard seed—Looper

Includes

Alfalfa looper (*Autographa californica*)
Cabbage looper (*Trichoplusia ni*)

Pest description and crop damage Larvae of both species are pale green with white lines on back and sides. They move in a looping manner and feed on foliage and other tender, above ground plant parts. Moth is gray-brown with a characteristic silvery spot on each forewing.

Management—chemical control

- ◆ azadirachtin (Neemix 4.5) at 0.02 to 0.04 lb ai/a. PHI 0 days. Begin applications at first sign of infestation. Multiple applications and thorough coverage are necessary for effective control. This botanical pesticide acts slowly. Spray early, well before harvest, and check for effect. Some formulations are OMRI-listed for organic use.
- ◆ gamma cyhalothrin (Declare) at 0.0075 to 0.025 lb ai/a. Do not apply more than 0.12 lb ai/a per season. PHI 1 day.

See also:

Broccoli, Brussels sprout, cabbage, cauliflower—Looper
Mustard greens—Armyworm and looper

Pests of Carrot Grown for Seed

Carrie H. Wohleb

Latest revision—March 2018

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Pesticides registered for pest control on a given vegetable crop can also be used for that vegetable's seed crop, unless prohibited. For pesticide recommendations in addition to those listed below, see the appropriate vegetable section in this handbook.

Important notice Several pesticides with 24c SLN (Special Local Need) registrations for use on seed crops lack legal tolerances established for pesticide residues that may be on the seed, screenings, or hay at harvest. Therefore, certain seed grower associations in Washington, Oregon, and Idaho have declared, through their respective state departments of agriculture, that the crop produced for seed in those states is a nonfood crop. This declaration means that none of the seed, screenings, hay, or sprouts produced from harvested seed will be available for human or animal consumption when these pesticides have been applied. The grower must notify the seed processing plant in writing of any seed treated with these pesticides. Processed seed must be labeled: "This seed was produced using one or more products for which the United States Environmental Protection Agency has not established pesticide residue tolerances. This seed, in whole, as sprouts, or in any form, may violate requirements of the Federal Food and Drug Administration, the Oregon Department of Agriculture and other regulatory agencies."

Note: Products are listed in alphabetical order and *not* in order of preference or superiority of pest control.

Carrot seed—Aphid

Includes

Green peach aphid (*Myzus persicae*)
Willow-carrot aphid (*Cavariella aegopodii*)

Pest description and crop damage The wingless form of the green peach aphid is yellowish green in color. The winged form has a black head and a distinct dark patch on the top of the abdomen. The wingless form of the willow-carrot aphid is pale green and oval-shaped. The winged form has a black head and thorax, with a pale green abdomen marked with dark bands on the top and sides. Green peach aphids and willow-carrot aphids are vectors of several important virus diseases in carrots.

Scouting and thresholds No treatment threshold has been determined for aphids on carrots grown for seed. Growers should inspect plant foliage and umbels for aphid activity. Also, look for evidence of predators. Treatment may be warranted if aphid populations increase drastically over time or if virus diseases vectored by aphids are of concern.

Management—chemical control

- ◆ acephate (Acephate 97UP, Orthene 97) at 1 lb/a (1.03 lb ai/a). REI 24 hr. Use of a buffering agent and anti-drift agent is suggested. This product is highly toxic to bees exposed to direct treatment

on blooming crops or weeds. Do not apply to blooming carrot seed crops during the pollination period. Do not spray if there is another seed field within half a mile that is being pollinated. Allow a minimum of 7 days between applications. Do not apply more than 2 lb/a (1.06 lb ai/a) per crop year. Do not apply through any type of irrigation system. No portion of treated plants can be used for food or feed. 24c SLNs: Acephate 97UP ID-090013 (expires 12/31/19), OR-090024 (expires 12/31/19); Orthene 97 OR-090025 (expires 12/31/20). Oregon and Idaho only for aphid control.

- ◆ bifenthrin (Bifenture EC, Brigade 2EC, Fanfare 2EC, Fanfare ES) at 3.9 to 6.4 fl oz/a (0.06 to 0.1 lb ai/a). REI 12 hr. Do not exceed three applications per crop year. Allow at least 21 days between applications. This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Use prebloom (allow 5 days before introducing pollinators) or after pollination. Extremely toxic to fish and aquatic invertebrates, so follow buffer zone restrictions on the label. Do not apply through chemigation. No portion of treated plants can be used for food or feed. 24c SLNs: Bifenture EC ID-080010 (expires 12/31/19), WA-070014 (expires 12/31/22); Fanfare 2EC ID-060024 (expires 12/31/18); Fanfare ES ID-130005 (expires 12/31/18). Idaho and Washington only.
- ◆ oxydemeton-methyl (MSR Spray Concentrate) at 1.5 to 2.0 pints/a (0.375 to 0.5 lb ai/a). REI 15 days. This product is toxic to bees exposed to direct treatment. Do not apply while bees are actively visiting the treatment area. Apply only with aerial or ground equipment. Use at least one gallon of water per acre. A second application may be made if necessary. Minimum of 14 days between applications. Do not apply within 21 days of harvest. Mechanical harvesting is required. No portion of the treated field may be used for human or animal consumption. Conditioners receiving seed in fields treated with this product must be informed, in writing, and provided a copy of the labeling. 24c SLNs: ID-010011 (expires 12/31/20). Idaho only.
- ◆ pymetrozine (Fulfill) at 2.75 oz/a (1.38 oz ai/a). PHI 14 days. REI 12 hr. This insecticide works primarily by ingestion, but also has some contact activity. Aphids stop feeding shortly after exposure, but may remain on the plant foliage until they die, which is usually within 2-7 days. This product has residual activity in the plant. Allow 7 days between applications. Do not exceed 5.5 oz/a (2.76 oz ai/a) per season. The addition of a penetrating type spray adjuvant is recommended. Do not apply through any type of irrigation system. Fulfill is toxic to bees exposed to direct application. Applications to blooming crops must be between late evening and early morning to coincide with minimal bee activity. No portion of treated plants can be used for food or feed. 24c SLNs: WA-000017 (expires 12/31/20). Washington only.

See also:

Carrot—Aphid

Carrot seed—Cutworm

Several species

Pest description and crop damage Dull gray, brown, or black caterpillars that may be striped or spotted. They are active at night and can be found in the soil by day. They cut off young plants at ground level or feed on foliage at night.

Management—chemical control

- ◆ bifenthrin (Bifenture EC, Brigade 2EC, Fanfare 2EC, Fanfare ES) at 3.9 to 6.4 fl oz/a (0.06 to 0.1 lb ai/a). REI 12 hr. Allow at least 21 days between applications. This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Use prebloom (allow 5 days before introducing pollinators) or after pollination. Do not exceed three applications per crop year. Extremely toxic to fish and aquatic invertebrates, so follow buffer zone restrictions on the label. Do not apply through chemigation. No portion of treated plants can be used for food or feed. 24c SLN: Bifenture EC WA-070014 (expires 12/31/22). Washington only for cutworm.
- ◆ chlorpyrifos (Lorsban Advanced) at 1 qt/a (0.94 lb ai/a). PHI 7 days. REI 24 hr. Do not make more than one application per year. Apply after carrots have started to bolt and when field counts or crop injury indicates that damaging pest populations are developing or present. This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Toxic to fish, aquatic invertebrates, small mammals and birds. Do not apply directly to water or to areas where surface water is present. Follow mandated buffer zone restrictions on the label. Do not apply through any type of irrigation system. No portion of treated plants can be used for food or feed. 24c SLNs: OR-090011 (expires 12/31/18), WA-090011 (expires 12/31/21). Oregon and Washington only.

See also:

Carrot—Cutworm and armyworm

Carrot seed—Lygus bug

Lygus spp.

Pest description and crop damage Adults are about 0.2 inch long, with a light yellow V on their back at the base of the wings. They vary from light brown to green. Lygus bugs use piercing-sucking mouthparts to feed on the umbels, which causes aborted buds, blossom drop, and shriveled seeds. Adults and late stage nymphs are the most injurious stages, but the smaller nymphs are easiest to control.

Scouting and thresholds Lygus bugs move into carrot fields in the late spring and early summer. During the prebloom period growers should scout for lygus bugs in the morning or evening. One lygus bug per umbel can result in economic damage in carrot seed crops.

Management—chemical control

- ◆ acephate (Acephate 97UP, Orthene 97) at 1 lb/a (1.03 lb ai/a). REI 24 hr. For suppression of lygus bugs. Use of a buffering agent and anti-drift agent is suggested. Allow a minimum of 7 days between applications. Do not apply more than 2 lb/a (1.06 lb ai/a) per crop year. Do not apply through any type of irrigation system. This product is highly toxic to bees exposed to direct treatment on blooming crops or weeds. Do not apply to blooming carrot seed crops during the pollination period. Do not spray if there is another seed field within a half mile that is being pollinated. No portion of treated plants can be used for food or feed. 24c SLNs: Acephate 97UP ID-090013 (expires 12/31/19), OR-090024 (expires 12/31/19); Orthene 97 OR-090025 (expires 12/31/20), WA-090021 (expires 12/31/18).

- ◆ azadirachtin (Aza-Direct, Neemix 4.5)—See label for rates. PHI 0 days. This is a botanical insecticide with ingestion and contact action that kills immature stages by interfering with molting; also reduces damage by repelling and deterring feeding. Apply at 7- to 10-day intervals, when pests first appear and are in the early nymph stage. Repeat applications break the life cycle of the pest. Some formulations are OMRI-listed for organic use.
- ◆ bifenthrin (Bifenture EC, Brigade 2EC, Fanfare 2EC, Fanfare ES) at 3.9 to 6.4 fl oz/a (0.06 to 0.1 lb ai/a). REI 12 hr. Allow at least 21 days between applications. This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Use prebloom (allow 5 days before introducing pollinators) or after pollination. Do not exceed three applications per crop year. Extremely toxic to fish and aquatic invertebrates, so follow buffer zone restrictions on the label. Do not apply through chemigation. No portion of treated plants can be used for food or feed. 24c SLNs: Bifenture EC ID-080010 (expires 12/31/19), WA-070014 (expires 12/31/22); Fanfare 2EC ID-060024 (expires 12/31/18); Fanfare ES ID-130005 (expires 12/31/18). Idaho and Washington only.
- ◆ chlorpyrifos (Lorsban Advanced) at 1 qt/a (0.94 lb ai/a). PHI 7 days. REI 24 hr. Apply after carrots have started to bolt and when field counts or crop injury indicates that damaging pest populations are developing or present. Do not make more than one application per year. This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Toxic to fish, aquatic invertebrates, small mammals and birds. Follow mandated buffer zone restrictions on the label. Do not apply through any type of irrigation system. No portion of treated plants can be used for food or feed. 24c SLN: OR-090011 (expires 12/31/18), WA-090011 (expires 12/31/21). Oregon and Washington only.
- ◆ gamma-cyhalothrin (Declare) at 0.01 to 0.015 lb ai/a. REI 24 hr. Do not exceed 0.06 lb ai/a per season. This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. The low rate may be applied from late evening to midnight during bloom. Do not apply at the 0.015 rate to blooming seed crops. Toxic to fish and aquatic invertebrates. Do not apply within 25 ft of an aquatic habitat, 150 ft if applied by air. Apply with ground or air equipment. Section 18 label allows application in Idaho and Oregon only.
- ◆ lambda-cyhalothrin (Paradigm VC, Silencer VXN, Warrior II with Zeon Technology) at 0.02 to 0.03 lb ai/a. REI 24 hr. Do not exceed 0.12 lb ai/a per season. This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. The low rate may be applied from late evening to midnight during bloom. Do not apply at the 0.03 rate to blooming seed crops. Toxic to fish and aquatic invertebrates. Do not apply within 25 ft of an aquatic habitat, 150 ft if applied by air. Do not apply through any type of irrigation system. No portion of treated plants can be used for food or feed. Section 18 labels for Paradigm VC and Silencer VXN allow applications in ID, OR, and WA only. 24c SLNs for Warrior II: OR-090017 (expires 12/31/19), WA-100002 (expires 12/31/20), ID-090011 (expires 12/31/19).
- ◆ naled (Dibrom 8E) at 1 to 1.5 pints/a (0.9 to 1.4 lb ai/a). REI 48 hr. Do not apply more than 3 pints/a (2.8 lb ai/a) per year. This product is highly toxic to bees exposed to direct treatment on blooming crops or weeds. Allow 48 hr after application before introducing bees for pollination. Do not apply if another seed crop within half a mile is being pollinated by honeybees. This product is toxic to fish, aquatic invertebrates, and wildlife. Do not apply directly to water. Do not apply by ground within 25 feet of bodies of water. Do not apply by air within 150 feet of bodies of water. Do not apply through any type of irrigation system. No portion of treated plants can be used for food or feed. 24c SLNs: OR-990032 (expires 12/31/20), WA-990028 (expires 12/31/18), ID-010017

(expires 12/31/19).

- ◆ novaluron (Rimon 0.83EC) at 9 to 12 fl oz/A (0.06 to 0.08 lb ai/a). PHI 14 days. REI 12 hr. Begin application when plant bugs appear and oviposition is initiated. Repeat at 7- to 14-day intervals. Rimon will not control adults. Do not apply more than 48 fl oz/a (0.3 lb ai/A) per season. Do not apply by air equipment within 250 ft of bodies of water. All applications must include a 25 ft vegetative buffer strip within the buffer zone to decrease runoff. This product may be applied through properly equipped chemigation systems. See label for instructions and restrictions on chemigation. 24c SLN: ID-100005 (expires 12/31/20). Idaho only.
- ◆ oxydemeton-methyl (MSR Spray Concentrate) at 1.5 to 2.0 pints/a (0.375 to 0.5 lb ai/a). REI 15 days. This product is toxic to bees exposed to direct treatment. Do not apply while bees are actively visiting the treatment area. Apply only with aerial or ground equipment. Use at least one gallon of water per acre. A second application may be made if necessary. Minimum of 14 days between applications. Do not apply within 21 days of harvest. Mechanical harvesting is required. No portion of the treated field may be used for human or animal consumption. Conditioners receiving seed in fields treated with this product must be informed, in writing, and provided a copy of the labeling. 24c SLN: ID-010011 (expires 12/31/20). Idaho only.

Carrot seed—Twospotted spider mite

Tetranychus urticae

Pest description and crop damage Tiny, spiderlike animals found on the underside of foliage and on plant terminals. Spider mites become a problem when air temperatures begin increasing in the summer. Dry, dusty conditions favor these pests. Mites feed on leaf surfaces. Yellowing and bronzing on the top side of the leaves indicates the presence of mite colonies on the underside. Lots of webbing and leaf desiccation indicate severe mite infestation.

Scouting and thresholds Sampling for mites requires close visual inspection. Shake plants over a white pail and look for tiny moving dots. A 10x hand lens helps. Mite populations can increase rapidly, so it is important to scout frequently.

Management—chemical control

- ◆ bifenthrin (Bifenture EC, Brigade 2EC, Fanfare 2EC, Fanfare ES) at 3.9 to 6.4 fl oz/a (0.06 to 0.1 lb ai/a). REI 12 hr. Allow at least 21 days between applications. Do not exceed three applications per crop year. This pesticide is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Use prebloom (allow 5 days before introducing pollinators) or after pollination. Extremely toxic to fish and aquatic invertebrates, so follow buffer zone restrictions on the label. Do not apply through chemigation. No portion of treated plants can be used for food or feed. 24c SLNs: Bifenture EC ID-080010 (expires 12/31/19), WA-070014 (expires 12/31/22); Fanfare 2EC ID-060024 (expires 12/31/18); Fanfare ES ID-130005 (expires 12/31/18). Idaho and Washington only.
- ◆ etoxazole (Zeal)—See SLN label for rates. REI 12 hr. Best results are achieved when mite populations are low. The product is predominantly an ovicide/larvicide and should be used early in the life cycle of mites. Do not make more than one application per season. Extremely toxic to aquatic invertebrates. Avoid drift and runoff to fish-bearing bodies of water. Ground application only. Do not apply through any type of irrigation system. No portion of treated plants can be used for food or feed. 24c SLNs: OR-090019 (expires 12/31/19), WA-090001 (expires 12/31/18), ID-090005 (expires 12/31/19).
- ◆ hexythiazox (Onager, Onager Optek) at 12 to 20 oz/a (0.09 to 0.156 lb ai/a) in at least 10 gal/a water. REI 12 hr. Apply prior to adult mite build up, this product does not control adult mites.

Do not apply by air in Washington. Do not apply through any type of irrigation system. Do not apply more than once per year. Rotation crop restrictions. This pesticide is toxic to fish and aquatic invertebrates. Do not use the product where impact on listed threatened or endangered species is likely. No portion of treated plants can be used for food or feed. 24c SLNs: Onager WA-040022 (expires 12/31/19), ID-080013 (expires 12/31/19); Onager Optek WA-170013 (expires 12/31/21). Washington and Idaho only.

- ◆ propargite (Comite) at 2 to 3 pints/a (1.6 to 2.5 lb ai/a). REI 2 days (Idaho allows 1 day reentry for hand weeding and thinning). Hand harvest prohibited for 13 days in Idaho and Oregon. Start applications as soon as mites appear. Complete coverage is necessary for effective control. Allow at least 14 days between applications. Do not make more than two applications per season. Do not apply through any type of irrigation system. This pesticide is toxic to fish and aquatic invertebrates and may cause reproductive effects in wildlife. Do not apply directly to water or areas where surface water is present. Do not apply by ground equipment within 50 feet or by aerial equipment within 75 feet of bodies of water. Hand harvest of carrots is prohibited for 13 days after application. Rotation crop restrictions. No portion of treated plants can be used for food or feed. 24c SLNs: ID-770005 (expires 12/31/18), OR-080017 (expires 12/31/18), WA-040019 (expires 12/31/19).

Pests of Corn Grown for Seed

Stuart Reitz

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In all cases, follow the instructions on the pesticide label. The *PNW Insect Management Handbook* has no legal status, whereas the pesticide label is a legal document. Read the product label before making any pesticide applications.

Notes: Modes of action are important criteria in selecting insecticides so as to prevent the development of resistance to insecticides. Rotate chemicals with a different mode-of-action group number, and do not use products with the same mode-of-action group number more than twice per season. For example, pyrethroids have a group number of 3A; chemicals with a 3A group number should be alternated with chemicals that have a group number other than 3A. For additional information, see <http://www.irac-online.org/>.

Products are listed in alphabetical order and *not* in order of preference or superiority of pest control. For all insecticides, use appropriate adjuvants and application methods for maximum efficacy.

Corn seed—Aphid

Includes

Bean aphid (*Aphis fabae*)
Bird-cherry oat aphid (*Rhopalosiphum padi*)
Corn leaf aphid (*Rhopalosiphum maidis*)
Green peach aphid (*Myzus persicae*)
Potato aphid (*Macrosiphum euphorbiae*)

Pest description and crop damage Aphids suck plant sap, causing leaf deformation and stunting of plants. They may become very abundant on leaves, especially in eastern Oregon. However, corn leaf aphids can cause damage while feeding within the whorl before large populations are found on exposed leaf surfaces. Therefore, begin to monitor for aphids before tasseling. Slowly unroll whorls to count aphids. Bird-cherry oat aphid is the dark gray-green species that has been most destructive on corn in recent years. The shiny black bean aphid has been less common for a number of years. Correct species identification is important for optimal control; however, there are no established economic thresholds for the PNW. The following guide provides easy-to-use diagnostics for key pest aphid species: <http://diagnostics.montana.edu/insects/topics/docs/AphidMtGuide.pdf>

Please contact your local extension office for assistance with identification.

Management—chemical control

- ◆ abamectin + thiamethoxam (Avicta Duo, other formulations of Avicta that also contain fungicides)—Apply only for use in certified seed treatment facilities. Applied as a slurry to corn seed. Consult label. (Groups 6 and 4A*)
- ◆ alpha-cypermethrin (Fastac EC) at 0.017 to 0.025 lb ai/a. REI 12 hr. PHI 30 days. If crop residue is to be fed to livestock, PHI is 30 days grain & stover. Retreatment interval 3 days. Do not exceed 0.075 lb ai/a per season. Not for use on sweet corn seed. This product is highly toxic to bees and other pollinators exposed to

direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. (Group 3A)

- ◆ azadirachtin (Neemix 4.5) at 0.01 to 0.02 lb ai/a. PHI 0 days. REI 4 hr. Begin applications at first sign of infestation. Neemix is OMRI-listed for organic use. (Unidentified group)
- ◆ bifenthrin (Bifenthrin 2EC, numerous other products) at 0.033 to 0.1 lb ai/a. Do not exceed 0.3 lb/a. PHI 30 days. REI 12 hr. Bifenthrin is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Extremely toxic to fish and aquatic invertebrates. (Group 3A)
- ◆ bifenthrin/zeta-cypermethrin (Hero) at 0.04 to 0.1 lb ai/a. PHI 3 days for sweet corn seed. Do not graze livestock in treated areas or cut treated sweet corn seed crops for feed within 3 days of the last application. For non-sweet corn seed crops, there is a PHI of 30 days for crop residues harvested for stover; do not allow livestock to graze on crop residues for 30 days after treatment. REI 12 hr. Do not exceed 0.4 lb ai/a per season. Refer to product labels for application limits if multiple products containing zeta-cypermethrin are to be used in the same season. This product is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. (Group 3A)
- ◆ *Chromobacterium subsugae* (Grandevo) at 0.6 to 0.9 lb ai/a per 100 gal. PHI 0 days. REI 4 hr. Grandevo is OMRI-listed for organic use. (unidentified group)
- ◆ chlorpyrifos (numerous products) at 0.5 to 1 lb ai/a. PHI 21 days grain or ears. REI 24 hr. Apply postemergence as a broadcast or through overhead sprinklers. For aerial application, use at least 2 gal/a spray. Do not exceed 3 lb ai/a per season. Other chlorpyrifos formulations are registered for use on seed corn. Chlorpyrifos is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treatment area. (Group 1B)
- ◆ chlorpyrifos+gamma cyhalothrin (Cobalt) at 0.26 to 0.52 lb ai/a. Do not apply within 21 days before harvest of grain, ears, forage or fodder. REI 24 hr. Do not exceed 3 applications nor 2.5 lb/a per season. Refer to product labels for application limits if products containing gamma-cyhalothrin and products containing lambda-cyhalothrin are to be used in the same season. This product is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. (Group 1B and 3A)
- ◆ dimethoate (numerous products) at 0.33 to 0.5 lb ai/a. PHI 28 days. If crop residue is to be fed to livestock, PHI 14 days for forage; 28 days for grain. REI 48 hr. Do not exceed 0.5 lb ai/a per season. Not for use on sweet corn seed. This product is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Workers are prohibited from entering the treated area to perform detasseling tasks for 4 days in nonarid areas and for 15 days in outdoor areas where the average annual rainfall is less than 25 inches per year. (Group 1B)
- ◆ esfenvalerate (Asana XL; other products) at 0.03 to 0.05 lb ai/a. PHI 21 days. REI 12 hr. Do not exceed 0.25 lb ai/a per season. Esfenvalerate is highly toxic to bees exposed to direct treatment or

residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treatment area. Esfenvalerate is highly toxic to fish and aquatic invertebrates. (Group 3A)

- ◆ flupyradifurone (Sivanto 200 SL; Sivanto Prime) at 0.137 to 0.183 lb ai/a. PHI 21 days. REI 4 hr. Do not exceed 0.365 lb ai/a per season. Minimum interval between applications is 7 days. This pesticide is toxic to aquatic invertebrates. (Group 4D)
- ◆ methomyl (Lannate LV; other products) at 0.225 to 0.45 lb ai/a. PHI 21 days for ears or stover. REI 48 hr. Do not exceed 2.25 lb ai/a per season. This product is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. (Group 1A)
- ◆ zeta-cypermethrin (Mustang, Mustang Maxx) at 0.034 to 0.05 lb ai/a (Mustang) or 0.017 to 0.025 lb ai/a (Mustang Maxx). PHI 7 days. REI 12 hr. Do not exceed 0.2 lb ai/a per season (Mustang) or 0.1 lb ai/a per season (Mustang Maxx). Refer to product labels for application limits if multiple products containing zeta-cypermethrin are to be used in the same season. Degree of control will depend on the species present and plant-insect interactions. Mustang and Mustang Maxx are not for use on sweet corn seed. Zeta-cypermethrin is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. (Group 3A)

Corn seed—Corn earworm (sweet corn only)

Helicoverpa zea

Pest description and crop damage Eggs are laid on corn silks. Young caterpillars feed on silks and move into ear tips. Large older caterpillars are large green, brownish, or reddish worms that feed on silk and kernels of the ear. Caterpillar color can be highly variable even within a single field. Corn earworm must be controlled before larvae bore into corn ear.

Management—chemical control

- ◆ alpha-cypermethrin (Fastac EC) at 0.011 to 0.025 lb ai/a. REI 12 hr. If crop residue is to be fed to livestock, PHI is 30 days for grain & stover. Retreatment interval 3 days. Do not exceed 0.075 lb ai/a per season. This product is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. (Group 3A)
- ◆ azadirachtin (Neemix 4.5 and other products) at 0.02 to 0.04 lb ai/a. PHI 0 days. REI 4 hr. Begin applications at first sign of infestation. Some formulations are OMRI-listed for organic use. (unidentified group)
- ◆ beta-cyfluthrin (Baythroid XL) at 0.013 to 0.022 lb ai/a. If crop residues are to be used for fodder, there is a 21 day PHI. REI 12 hr. Do not exceed 0.088 lb ai/a per season. This product is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Extremely toxic to fish and aquatic invertebrates. (Group 3A)
- ◆ bifenthrin (Bifenthrin 2EC, numerous products) at 0.033 to 0.1 lb ai/a. PHI 30 days. REI 12 hr. Do not exceed 0.3 lb ai/a per season. Bifenthrin is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply bifenthrin or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Extremely toxic to fish and aquatic invertebrates. (Group 3A)

- ◆ bifenthrin/zeta-cypermethrin (Hero) at 0.04 to 0.1 lb ai/a. PHI 3 days. Do not graze livestock in treated areas or cut treated crops for feed within 3 days of the last application. REI 12 hr. Do not exceed 0.4 lb ai/a per season. Refer to product labels for application limits if multiple products containing zeta-cypermethrin are to be used in the same season. This product is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. (Group 3A)
- ◆ chlorpyrifos (numerous products) at 0.75 to 1 lb ai/a. If crop residue is to be fed to livestock, PHI 21 days grain or ears. REI 24 hr. Do not exceed 3 lb ai/a per season. Chlorpyrifos is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply chlorpyrifos or allow it to drift to blooming crops if bees are visiting the treatment area. (Group 1B)
- ◆ chlorpyrifos/gamma cyhalothrin (Cobalt) at 0.13 to 0.26 lb ai/a. Do not apply within 21 days before harvest of grain, ears, forage or fodder. REI 24 hr. Do not exceed 3 applications or 2.5 lb/a per season. This product is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. (Groups 1B and 3A)
- ◆ chlorantraniliprole (Coragen) at 0.045 to 0.065 lb ai/a. PHI 14 days. REI 4 hr. Do not exceed 0.2 lb ai/a or 4 applications per season. (Group 28)
- ◆ esfenvalerate (Asana XL; other products) at 0.03 to 0.05 lb ai/a. PHI 21 days. REI 12 hr. Do not exceed 0.25 lb ai/a per season. Esfenvalerate is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Esfenvalerate is highly toxic to fish and aquatic invertebrates. (Group 3A)
- ◆ flubendiamide (Belt SC) at 0.0625 to 0.094 lb ai/a. PHI 28 days. If crop residue is to be fed to livestock, PHI 28 days, grain or stover. REI 12 hr. Do not exceed 0.375 lb ai/a per season. (Group 28)
- ◆ lambda-cyhalothrin (numerous products) at 0.015 to 0.025 lb ai/a. PHI 21 days. If crop residues are to be used for livestock, PHI is 1 day for grazing, 21 days for fodder or silage. REI 24 hr. Apply no more than 0.12 lb ai/a per season. Refer to product labels for application limits if products containing gamma-cyhalothrin and products containing lambda-cyhalothrin are to be used in the same season. Highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply lambda-cyhalothrin or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Lambda-cyhalothrin is extremely toxic to fish and aquatic organisms and toxic to wildlife. (Group 3A)
- ◆ methomyl (Lannate LV; other products) at 0.225 to 0.45 lb ai/a. PHI 21 days for ears or stover. REI 48 hr. Do not exceed 2.25 lb ai/a per season. (Group 1A)
- ◆ spinetoram (Radiant SC) at 0.023 to 0.047 lb ai/a. PHI 1 day grain harvest. If crop residue is to be fed to livestock, PHI is 3 days for forage or fodder. REI 4 hr. Do not exceed 0.281 lb ai/a per season. Limit 6 applications. For corn earworm at silking, do not make applications less than 2 days apart, and do not make more than two consecutive applications of Group 5 insecticides. This product is toxic to bees exposed to treatment for 3 hours following treatment. Do not apply this pesticide to blooming, pollen-shedding or nectar-producing parts of plants if bees may forage on the plants during this time period. (Group 5)
- ◆ spinosad (Blackhawk, Entrust, Success, other products) at 0.047 to 0.094 lb ai/a. PHI 1 day. See individual product labels for forage and grain PHI. REI 4 hr. Do not exceed 0.45 lb ai/a per year (0.188 lb ai/a per year if used for livestock feed). Some formulations are OMRI-listed for organic use. For corn earworm at silking, applications may be made at 1- to 2-day intervals if necessary, but do not make more than two consecutive applications of a Group 5 insecticide. These products are toxic to bees exposed to treatment for 3 hours following treatment. Do not apply this pesticide to blooming, pollen-shedding or nectar-producing parts of plants if bees may forage on the plants during this time period. (Group 5)
- ◆ zeta-cypermethrin (Mustang, Mustang Maxx) at 0.022 to 0.05 lb ai/a (Mustang) or 0.011 to 0.025 lb ai/a (Mustang Maxx).. Do not apply within 7 Days of harvest of crop residues for stover or forage. REI 12 hr. Do not exceed 0.2 lb ai/a per season (Mustang) or 0.1 lb ai/a (Mustang Maxx). Mustang and Mustang Maxx are not for use on sweet corn seed. Zeta-cypermethrin is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. (Group 3A)

For additional information

<http://insect.pnwhandbooks.org/vegetable/vegetable-pests/common/vegetable-crop-pests-corn-earworm>

<http://horticulture.oregonstate.edu/content/corn-earworm>

Corn seed—Corn rootworm (larvae)

Diabrotica spp.

Pest description and crop damage Larvae feed on corn roots. They cause stunting and lodging and occasionally kill plants. Larvae are 0.5 inch long and pale yellow with yellow-brown heads.

Management—chemical control

- ◆ abamectin + thiamethoxam (Avicta Duo, other formulations of Avicta that also contain fungicides)—Only for use in certified seed treatment facilities. Applied as a slurry to corn seed. Consult label. (Groups 6 and 4A*)
- ◆ bifenthrin (Bifenthrin 2EC, numerous other products) at 0.0046 lb ai/1,000 linear ft at plant or 0.047 to 0.062 lb ai/a preplant. PHI 30 days. REI 12 hr. Bifenthrin is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply bifenthrin or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Extremely toxic to fish and aquatic invertebrates. Do not exceed 0.1 lb ai/a at plant. (Group 3A)
- ◆ bifenthrin/chlorethoxyfos (Smart Choice 5G) at 4.5 to 5 oz/1,000 ft row. REI 48 hr; 72 hours where annual rainfall is less than 25 inches. (Groups 4A and 1B)
- ◆ bifenthrin + indole-3-butyric acid (Empower II) at 0.005 to 0.006 lb ai/1,000 linear row ft. PHI 30 days. REI 24 hr. Do not exceed 0.1 lb ai/a at planting. Not for use on sweet corn seed. This product is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. (Group 3A)
- ◆ chlorpyrifos (numerous granular products and other formulations) at 0.075 lb ai/1,000 row ft. PHI 21 days grain or ears. REI 24 hr. Do not exceed 0.15 lb ai/1,000 row ft or 3 lb chlorpyrifos ai/a per season. Apply at planting as a band or at cultivation as a band or side dress. Chlorpyrifos is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. (Group 1B)

- ◆ gamma-cyhalothrin (Declare) at 0.0025 lb ai/1,000 row ft at plant. PHI 21 days. Do not allow livestock to graze in treated areas or harvest treated corn forage as food for meat or dairy animals within 1 day after last treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after the last treatment. REI 24 hr. Do not exceed 0.06 lb ai/a per season. Refer to product labels for application limits if products containing gamma-cyhalothrin and products containing lambda-cyhalothrin are to be used in the same season. This product is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Extremely toxic to fish and aquatic organisms and toxic to wildlife. (Group 3A)
- ◆ lambda-cyhalothrin (Warrior II; other products) at 0.005 lb ai/1,000 row ft (planting). PHI 21 days. If crop residues are to be used for livestock, PHI is 1 day for grazing, 21 days for fodder or silage. REI 24 hr. Apply no more than 0.12 lb ai/a per season. Refer to product labels for application limits if products containing gamma-cyhalothrin and products containing lambda-cyhalothrin are to be used in the same season. Highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply lambda-cyhalothrin or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Lambda-cyhalothrin is extremely toxic to fish and aquatic organisms and toxic to wildlife. (Group 3A)
- ◆ tefluthrin (Force 3G and other formulations) at 0.0075 to 0.0094 lb ai/1,000 row ft, T-banded or in-furrow at planting. Do not exceed one application per season. REI 48 hr. This product is highly toxic to fish and aquatic invertebrates. (Group 3A)
- ◆ terbufos (Counter 20G) at 0.056 to 0.075 lb ai/1,000 row ft. If crop residues are to be fed to livestock, PHI is 30 days for forage or grazing. REI 48 hr or 72 hr where average rainfall is less than 25 inches per year. Do not exceed 1.3 lb ai/a per season. Do not apply an ALS herbicide if Counter 20G has been applied at planting. Not for use on sweet corn seed. This product is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. (Group 1B)
- ◆ beta-cyfluthrin (Baythroid XL) at 0.013 to 0.022 lb ai/a. REI 12 hr. If crop residues are to be used for fodder, there is a 21 PHI; PHI is 0 days if used for forage. REI 12 hr. Do not exceed 0.088 lb ai/a per season. Retreatment interval 7 days. (Group 3A)
- ◆ bifenthrin (Bifenthrin 2EC; numerous other products) at 0.033 to 0.1 lb ai/a. PHI 30 days. REI 12 hr. Do not exceed 0.3 lb ai/a per season. Bifenthrin is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply bifenthrin or allow it to drift to blooming crops if bees are visiting the treatment area. (Group 3A)
- ◆ bifenthrin/zeta-cypermethrin (Hero) at 0.04 to 0.1 lb ai/a. PHI 3 days for sweet corn seed. Do not graze livestock in treated areas or cut treated sweet corn seed crops for feed within 3 days of the last application. For non-sweet corn seed crops, there is a PHI of 30 days for crop residues harvested for stover; do not allow livestock to graze on crop residues for 30 days after treatment. REI 12 hr. Do not exceed 0.4 lb ai/a per season. R (Group 3A)
- ◆ chlorpyrifos (Lorsban 4E; other formulations and products) at 0.05 to 1 lb ai/a. If crop residue is to be fed to livestock, PHI is 21 days for grain, ears, forage or fodder. REI 24 hr. Do not exceed 3 lb ai/a per season. (Group 1B)
- ◆ chlorpyrifos/gamma cyhalothrin (Cobalt) at 0.26 to 0.52 lb ai/a. Do not apply within 21 days before harvest of grain, ears, forage or fodder. REI 24 hr. Do not exceed 3 applications nor 2.5 lb/a per season. (Groups 1B and 3A)
- ◆ cyfluthrin (Tombstone) at 0.025 to 0.044 lb ai/a. PHI 21 days for grain or fodder. REI 12 hr. Do not exceed four applications or 0.175 lb ai/a per season. (Group 3A)
- ◆ dimethoate (numerous products) at 0.33 to 0.5 lb ai/a. PHI 14 days forage; 28 days grain; 14 days for forage if crop residues are to be fed to livestock. REI 48 hr. Do not exceed 0.5 lb ai/a per season. Not for use on sweet corn seed. (Group 1B)
- ◆ esfenvalerate (Asana XL; other products) at 0.03 to 0.05 lb ai/a. PHI 21 days. REI 12 hr. Do not exceed 0.25 lb ai/a per season. (Group 3A)
- ◆ lambda-cyhalothrin (Warrior II; other products) at 0.02 to 0.03 lb ai/a. PHI 21 days. If crop residues are to be used for livestock, PHI is 1 day for grazing, 21 days for fodder or silage. REI 24 hr. Apply no more than 0.12 lb ai/a per season. Refer to product labels for application limits if products containing gamma-cyhalothrin and products containing lambda-cyhalothrin are to be used in the same season. (Group 3A)
- ◆ methomyl (Lannate LV; other products) at 0.225 to 0.45 lb ai/a. PHI 21 days for ears or stover. REI 48 hr. Do not exceed 2.25 lb ai/a per season. (Group 1A)
- ◆ permethrin (numerous products) at 0.1 to 0.2 lb ai/a. Do not exceed 0.45 lb ai/a per season. If crop residues are to be used for livestock, do not apply less than 30 days prior to harvest of grain or fodder (stover). Forage may be harvested on the day of application. Not for use on sweet corn seed. (Group 3A)
- ◆ zeta-cypermethrin (Mustang, Mustang Maxx) at 0.034 to 0.05 lb ai/a (Mustang) or 0.017 to 0.025 lb ai/a (Mustang Maxx). PHI 7 days. REI 12 hr. Do not exceed 0.2 lb ai/a per season (Mustang) or 0.1 lb ai/a per season (Mustang Maxx). Refer to product labels for application limits if multiple products containing zeta-cypermethrin are to be used in the same season. Degree of control will depend on the species present and plant-insect interactions. Mustang and Mustang Maxx are not for use on sweet corn seed. Zeta-cypermethrin is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. (Group 3A)

For additional information

Western Corn Rootworm in Eastern Oregon, Idaho, and Eastern Washington, PNW 622, <https://catalog.extension.oregonstate.edu/pnw662>

Corn seed—Corn rootworm (adult)

Diabrotica spp.

Pest description and crop damage Adults feed on corn silks, causing loss of seed yield by interfering with pollination.

Management—chemical control

Warning: Apply only if corn rootworm adults are at two adults per ear during green to brown silk stage. All of the following foliar spray insecticides applied to silking corn are toxic to bees and other pollinators. Apply late in the day or in the evening, when bee activity is minimal. Do not make applications or allow applications to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Products are also toxic to fish and aquatic invertebrates.

- ◆ alpha-cypermethrin (Fastac EC) at 0.017 to 0.025 lb ai/a. PHI 30 days. REI 12 hr. If crop residue is to be fed to livestock, PHI 30 days grain & stover; 60 days forage. Retreatment interval 3 days. Do not exceed 0.075 lb ai/a per season. Not for use on sweet corn seed. (Group 3A)

For additional information

Western Corn Rootworm in Eastern Oregon, Idaho, and Eastern Washington, PNW 622, <https://catalog.extension.oregonstate.edu/pnw662>

Corn seed—Cutworm

Includes

Black cutworm (*Agrotis ipsilon*)

Glassy cutworm (*Apamea devastator*)

Redbacked cutworm (*Euxoa ochrogaster*)

Pest description and crop damage Reddish, green, black, or dirty white worms that tunnel into the base of the plant, cut off seedlings, or feed on foliage.

Management—chemical control

- ◆ azadirachtin (Neemix 4.5) at 0.02 to 0.04 lb ai/a. PHI 0 days. REI 4 hr. Begin applications at first sign of infestation. Some formulations are OMRI-listed for organic use. (unidentified group)
- ◆ alpha-cypermethrin (Fastac EC) at 0.001 lb ai per 1,000 linear row ft as an in furrow or band treatment. Apply at 0.008 to 0.018 lb ai/a as a foliar treatment. REI 12 hr. PHI 30 days. If crop residue is to be fed to livestock, PHI 30 days grain & or stover. Retreatment interval 3 days. Do not exceed 0.075 lb ai/a per season. This product is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Not for use on sweet corn seed. (Group 3A)
- ◆ *Bacillus thuringiensis* (numerous products)—Use according to individual manufacturer’s label instructions. PHI 0 days. REI 4 hr. Most effective on small caterpillars, but use highest recommended rate for fully developed ones. A spreader-sticker may improve performance. Some formulations are OMRI-listed for organic use. (Group 11A)
- ◆ beta-cyfluthrin (Bathroid XL) at 0.007 to 0.013 lb ai/a. PHI 21 days. If crop residue is to be fed to livestock, 21 days for grain or fodder. Do not exceed four applications or 0.088 lb ai/a per season. REI 12 hr. Not for use on sweet corn seed. Highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. (Group 3A)
- ◆ bifenthrin (Bifenthrin 2EC, numerous products) at 0.033 to 0.1 lb ai/a. PHI 30 day. REI 12 hr. Do not exceed 0.3 lb ai/a per season. Bifenthrin is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Extremely toxic to fish and aquatic invertebrates. (Group 3A)
- ◆ bifenthrin (Bifenthrin 2EC, numerous products) at 0.0023 to 0.0046 lb ai/1,000 linear row ft at plant or 0.047 to 0.062 lb ai/a preplant. Use highest rate under heavy insect pressure. PHI 30 days. REI 12 hr. Do not exceed 0.1 lb ai/a at planting, 0.3 lb ai/a per season. Bifenthrin is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Extremely toxic to fish and aquatic invertebrates. (Group 3A)
- ◆ bifenthrin/chlorethoxyfos (Smart Choice 5G) at 4.5 to 5 oz/1,000 row ft. REI 48 hr; 72 hr where annual rainfall is less than 25 inches. This product is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. (Groups 3A and 1B)
- ◆ bifenthrin/indole-3-butyric acid (Empower II) at 0.002 to 0.006 lb ai/1,000 linear row ft. PHI 30 days. REI 24 hr. Do not exceed 0.1 lb ai/a at planting. Not for use on sweet corn seed. This product is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. (Group 3A)
- ◆ bifenthrin/zeta-cypermethrin (Hero) at 0.025 to 0.06 lb ai/a foliar or 0.04 to 0.1 lb ai/a at plant. PHI 3 days for sweet corn seed. Do not graze livestock in treated areas or cut treated sweet corn seed crops for feed within 3 days of the last application. For non-sweet corn seed crops, there is a PHI of 30 days for crop residues harvested for stover; do not allow livestock to graze on crop residues for 30 days after treatment. REI 12 hr. Do not exceed 0.4 lb ai/a per season. Refer to product labels for application limits if multiple products containing zeta-cypermethrin are to be used in the same season. This product is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. (Group 3A)
- ◆ chlorpyrifos (numerous products). Chlorpyrifos is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. (Group 1B)
 - ◇ Lorsban 15G and other granular formulations at 0.075 lb ai/1,000 ft T-band. PHI 21 days for grain and ears. REI 24 hr. Do not exceed 0.15 lb ai/1,000 ft of row or 3 lb chlorpyrifos ai/a per season.
 - ◇ Lorsban 4E other formulations at 0.5 to 1 lb ai/a. PHI 21 days grain or ears. REI 24 hr. Apply postemergence broadcast or through overhead irrigation. Do not exceed 3 lb chlorpyrifos ai/a per season.
- ◆ chlorpyrifos/gamma cyhalothrin (Cobalt) at 0.26 to 0.76 lb ai/a at plant. do not apply within 21 days before harvest of grain, ears, forage or fodder. REI 24 hr. This product is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. (Groups 1B and 3A)
- ◆ cyfluthrin (Tombstone) at 0.013 to 0.025 lb ai/a. PHI 21 days. If crop residue is to be fed to livestock, 21 days for grain or fodder. Do not exceed four applications or 0.175 lb ai/a per season. REI 12 hr. This product is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. (Group 3A)
- ◆ esfenvalerate (Asana XL; other products) at 0.03 to 0.05 lb ai/a or 0.0023 lb ai/1,000 row ft at plant. PHI 21 days. REI 12 hr. Do not exceed 0.25 lb ai/a per season. Esfenvalerate is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Esfenvalerate is highly toxic to fish and aquatic invertebrates. (Group 3A)
- ◆ gamma-cyhalothrin (Declare) at 0.0075 to 0.0125 lb ai/a applied as foliar or 0.0025 lb ai/a per 1,000 row ft. PHI 21 days. Do not allow livestock to graze in treated areas within 1 day after last treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after the last treatment. REI 24 hr. Do not exceed 0.06 lb ai/a per season. Refer to product labels for

application limits if products containing gamma-cyhalothrin and products containing lambda-cyhalothrin are to be used in the same season. This product is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Extremely toxic to fish and aquatic organisms and toxic to wildlife. (Group 3A)

- ◆ lambda-cyhalothrin (Warrior II) at 0.005 lb ai/a at plant or 0.015 to 0.025 lb ai/a foliar. PHI 21 days. If crop residues are to be used for livestock, PHI is 1 day for grazing, 21 days for fodder or silage. REI 24 hr. Apply no more than 0.12 lb ai/a per season. Refer to product labels for application limits if products containing gamma-cyhalothrin and products containing lambda-cyhalothrin are to be used in the same season. Highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply lambda-cyhalothrin or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Lambda-cyhalothrin is extremely toxic to fish and aquatic organisms and toxic to wildlife. (Group 3A)
- ◆ methomyl (Lannate LV; other products) at 0.45 lb ai/a. PHI 21 days for ears or stover. REI 48 hr. Do not exceed 2.25 lb ai/a per season. Methomyl is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops if bees are visiting the treatment area. (Group 1A)
- ◆ permethrin (numerous products) at 0.1 to 0.2 lb ai/a foliar or 0.1 to 0.2 lb ai/a preemergence broadcast. Do not exceed 0.45 lb ai/a per season. If crop residues are to be used for livestock, do not apply less than 30 days prior to harvest of grain or fodder (stover). Not for use on sweet corn seed. REI 12 hr. Do not exceed 0.45 lb ai/a per season. Use only prior to brown silk formation. Not for use on sweet corn seed. Permethrin is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops if bees are visiting the treatment area. Extremely toxic to aquatic organisms, (Group 3A)
- ◆ tefluthrin (Force 3G and other formulations) at 0.0056 to 0.0075 lb ai/1,000 row feet, T-banded or in-furrow at planting. Do not exceed one application per season. REI 48 hrs. This product is highly toxic to fish and aquatic invertebrates. (Group 3A)
- ◆ zeta-cypermethrin (Mustang, Mustang Maxx) at 0.002 lb ai/1,000 row ft (Mustang) or at 0.001 lb ai/1,000 row ft at planting (Mustang Maxx). Foliar treatment at 0.016 to 0.035 lb ai/a (Mustang) or 0.008 to 0.0175 lb ai/a at planting or at 0.016 to 0.035 lb ai/a foliar (Mustang, Mustang Maxx). Do not apply within 7 days of harvest of crop residues for stover. REI 12 hr. Do not exceed 0.2 lb ai/a per season (Mustang) or 0.1 lb ai/a per season (Mustang Maxx). Refer to product labels for application limits if multiple products containing zeta-cypermethrin are to be used in the same season. PHI 30 days. Not for use on sweet corn seed. These products are highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops if bees are visiting the treatment area. (Group 3A)

For additional information

http://content.libraries.wsu.edu/index.php/utills/getfile/collection/cahnrs-arch/id/289/filename/43918182432004_eb1892.pdf

Corn seed—Seedcorn maggot

Delia platura

Pest description and crop damage A small white maggot that attacks seed, germinating seeds, and seedlings. Seedlings that germinate usually die before maturation or are severely stunted. Seedcorn maggot-induced damage is facilitated by early planting dates, heavy cover crops, and cool-wet weather.

Management—chemical control

- ◆ abamectin + thiamethoxam (Avicta Duo, other formulations of Avicta that also contain fungicides)—Only for use in certified seed treatment facilities. Applied as a slurry to corn seed. Consult label. (Groups 6 and 4A*)
- ◆ beta-cyfluthrin (Baythroid XL) at 0.12 to 0.16 fl oz/1,000 row ft or 2.0 to 2.8 fl oz/a. Total mix volume should be applied in the open furrow ahead of the closing wheels. If crop residues are to be used for fodder, there is a 21 day PHI for grain or fodder (stover). REI 12 hr. Do not exceed 0.088 lb ai/a per season. Not for use on sweet corn seed. This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops if bees are visiting the treatment area. (Group 3A)
- ◆ bifenthrin (Bifenthrin 2EC, numerous products) at 0.0023 to 0.0046 lb ai/1,000 row ft at plant or 0.047 to 0.062 lb ai/a preplant. Extremely toxic to fish and aquatic invertebrates. Highly toxic to bees. PHI 30 days. REI 24 hr. Do not exceed 0.1 lb ai/a at plant. Bifenthrin is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops if bees are visiting the treatment area. Extremely toxic to fish and aquatic invertebrates. (Group 3A)
- ◆ bifenthrin/chlorethoxyfos (Smart Choice 5G) at 4.5 to 5 oz/1,000 row ft. REI 48 hr; 72 hr where annual rainfall is less than 25 inches. Smart Choice 5G must be applied with the SMARTBOX system. This product is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. This product also is toxic to mammals, birds, fish, and aquatic invertebrates. (Groups 3A and 1B)
- ◆ bifenthrin/zeta-cypermethrin (Hero) at 0.04 to 0.1 lb ai/a at plant. PHI 3 days for sweet corn seed. Do not graze livestock in treated areas or cut treated sweet corn seed crops for feed within 3 days of the last application. For non-sweet corn seed crops, there is a PHI of 30 days for crop residues harvested for stover; do not allow livestock to graze on crop residues for 30 days after treatment. REI 12 hr. Do not exceed 0.4 lb ai/a per season. (Group 3A)
- ◆ bifenthrin/indole-3-butyric acid (Group 3A) (Empower II) at 0.002 to 0.006 lb ai/1,000 row ft. PHI 30 days. REI 24 hr. Do not exceed 0.1 lb ai/a at plant. Not for use on sweet corn seed. (Group 3A)
- ◆ chlorpyrifos (numerous products) at 0.075 lb ai/1,000 ft of row at planting. PHI 21 days for grain and ears. REI 24 hr. Do not exceed 0.15 lb ai/1,000 row ft or 3 lb ai/a per season. Apply as an in-furrow treatment at planting. Apply only once per season as a soil treatment. Chlorpyrifos is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. (Group 1B)
- ◆ chlorpyrifos/gamma cyhalothrin (Cobalt) at 0.26 to 0.76 lb ai/a at planting. Do not apply within 21 days before harvest of grain, ears, forage or fodder. REI 24 hr. This product is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. (Groups 1B and 3A)

- ◆ cyfluthrin (Tombstone) at 0.12 to 0.16 fl oz/1,000 row ft or 2.0 to 2.8 fl oz/a. Total mix volume should be applied in the open furrow ahead of the closing wheels. PHI 21 days for grain or fodder. REI 12 hr. Do not exceed 0.175 lb ai/a per season. (Group 3A)
- ◆ gamma-cyhalothrin (Declare) at 0.0025 lb ai/1,000 ft of row. PHI 21 days. Do not allow livestock to graze in treated areas within 1 day after last treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after the last treatment. REI 24 hr. Do not exceed 0.06 lb ai/a per season. Refer to product labels for application limits if products containing gamma-cyhalothrin and products containing lambda-cyhalothrin are to be used in the same season. This product is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Extremely toxic to fish and aquatic organisms and toxic to wildlife. (Group 3A)
- ◆ lambda-cyhalothrin (Warrior II; other products) at 0.005 lb ai/1,000 row ft. PHI 21 days. If crop residues are to be used for livestock, PHI is 1 day for grazing, 21 days for fodder or silage. REI 24 hr. Apply no more than 0.12 lb ai/a per season. Refer to product labels for application limits if products containing gamma-cyhalothrin and products containing lambda-cyhalothrin are to be used in the same season. Highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply lambda-cyhalothrin or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Lambda-cyhalothrin is extremely toxic to fish and aquatic organisms and toxic to wildlife. (Group 3A)
- ◆ permethrin (numerous products) at 0.1 to 0.2 lb ai/a preemergence broadcast. Not for use on sweet corn seed. If crop residues are to be used for livestock, do not apply less than 30 days prior to harvest of grain or fodder (stover). REI 12 hr. Do not exceed 0.45 lb ai/a per season. Permethrin is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops if bees are visiting the treatment area. Extremely toxic to aquatic organisms, (Group 3A)
- ◆ tefluthrin (Force 3G and other formulations) at 0.0075 to 0.0094 lb ai/1,000 row ft, T-banded or in-furrow at planting. Do not exceed one application per season. REI 48 hr. This product is highly toxic to fish and aquatic invertebrates. (Group 3A)
- ◆ terbufos (Counter 20G) at 0.056 to 0.075 lb ai/1,000 row ft. PHI 30 days forage or graze. REI 48 hr or 72 hr where average rainfall is less than 25 inches per year. Do not exceed 1.3 lb ai/a per season. Do not apply an ALS herbicide if Counter 20G has been applied at planting. Not for use on sweet corn seed. (Group 1B)
- ◆ thiamethoxam (Cruiser 5FS, Cruiser Extreme)—Commercial seed treatments only. See label instructions. This product is toxic to wildlife and highly toxic to aquatic invertebrates. Thiamethoxam is highly toxic to bees exposed to direct treatment, and effects may be possible as a result of exposure to translocated residues in blooming crops. (Group 4A)

For more information

<http://insect.pnwhandbooks.org/vegetable/vegetable-pests/common/vegetable-crop-pests-seedcorn-maggot>

Corn seed—Slug

Various species

Pest description and crop damage Snails and slugs are nocturnal and generally feed during the night damaging many varieties of plants and plant seedlings. They inhabit damp, moist areas around decaying refuse, organic matter, and hide at the base of growing plants. Their presence can be detected by the shiny trails left on the soil surface. Damage is to new seedlings and primarily to hay grown west of the Cascades.

Management – chemical control

- ◆ metaldehyde baits (Trail’s End LG large granules)—PHI 0 days. REI 12 hr. Broadcast bait should be applied to the soil over hot spots in the field. Do not apply to edible plant parts or allow contamination. Do not apply to dry soil. For best results, apply soon after rain or irrigation, and apply in the evenings when slugs are most active. Rain and irrigation water following application will deactivate baits. See specific product label for rates.

See also:

Slug Control

For additional information

http://ohioline.osu.edu/ent-fact/pdf/ENT_20_14.pdf

Corn seed—Mite

Includes

Banks grass mite (*Oligonychus pratensis*)

Twospotted spider mite (*Tetranychus urticae*)

Pest description and crop damage Tiny, spiderlike animals, on underside of leaves, that cause yellowing or silvering of leaves. They feed on plant juices and may contribute to early maturity and poor quality of corn. Mite infestations typically are first observed near field edges or where plants are stressed. Mite populations can build rapidly during hot, dry weather. Monitor mite populations carefully if synthetic pyrethroids (Group 3A insecticides) are used for mites or other pests as these insecticides may flare outbreaks of mites. Because twospotted spider mite populations are often more resistant to miticides/insecticides than are Banks grass mite populations, it is essential to determine which species are present in a field before treatment.

Management—chemical control

- ◆ bifenthrin (Bifenthrin 2EC; other products) at 0.08 to 0.1 lb ai/a. PHI 30 days. REI 12 hr. Do not apply more than 0.3 lb ai/a per season. ULV application is prohibited. Do not apply if heavy rain is imminent. Bifenthrin is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops if bees are visiting the treatment area. Extremely toxic to fish and aquatic invertebrates. (Group 3A)
- ◆ bifenthrin/zeta-cypermethrin (Hero) at 0.1 lb ai/a. PHI 3 days for sweet corn seed. Do not graze livestock in treated areas or cut treated sweet corn seed crops for feed within 3 days of the last application. For non-sweet corn seed crops, there is a PHI of 30 days for crop residues harvested for stover; do not allow livestock to graze on crop residues for 30 days after treatment. REI 12 hr. Do not exceed 0.4 lb ai/a per season. This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops if bees are visiting the treatment area. (Group 3A)
- ◆ etoxazole (Zeal) at 0.045 to 0.135 lb ai/a. PHI 21 days. REI 12 hr. Apply before or at tassel stage. Retreatment interval 14 days. Make no more than two applications per season and do not exceed 0.27 lb ai/a per season. Not for use on sweet corn seed. (Group 10B)

- ◆ propargite (Comite) at 1.64 to 2.4 lb/ ai/a. PHI 30 days. REI 13 days, or 2 days if wearing personal protective equipment. Comite is most effective when applications are made when mite populations are low and plants are small enough to allow thorough coverage. It is best to use Comite is pH 7 or lower. To minimize risk of phytotoxicity, make applications when foliage is dry. One application only per season. (Group 12C)

For additional information

<http://extension.colostate.edu/topic-areas/insects/spider-mites-in-corn-5-555/>.

Corn seed—Western bean cutworm

Striacosta albicosta

Pest description and crop damage Large brown caterpillars that feed on foliage and burrow into ears. Female moths lay egg masses on corn foliage. The caterpillars will move from plant to plant, and individuals from a single egg mass may infest nearby plants within a six- to 10 foot circle.

Management—chemical control

Treat when egg masses or larvae are present.

- ◆ alpha-cypermethrin (Fastac EC) at 0.011 to 0.025 lb ai/a. REI 12 hr. PHI 30 days. If crop residue is to be fed to livestock, PHI is 30 days for grain or stover. Retreatment interval 3 days. Do not exceed 0.075 lb ai/a per season. This product is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Not for use on sweet corn seed. (Group 3A)
- ◆ beta-cyfluthrin (Baythroid XL) at 0.013 to 0.022 lb ai/a. If crop residues are to be used for fodder (stover), there is a 21 day PHI. REI 12 hr. Do not exceed four applications or 0.088 lb ai/a per season. This product is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. (Group 3A)
- ◆ bifenthrin (Bifenthrin 2EC; other products) at 0.0046 lb ai/1,000 row ft at plant or 0.047 to 0.062 lb ai/a preplant. PHI 30 days. REI 12 hr. Do not apply more than 0.3 lb ai/a per season. Do not apply if heavy rain is imminent. This product is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Extremely toxic to fish and aquatic invertebrates. (Group 3A)
- ◆ bifenthrin (Bifenthrin 2EC; other products) at 0.033 to 0.1 lb ai/a. PHI is 30 days. REI 12 hr. Do not exceed 0.3 lb ai/a per season. Bifenthrin is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops if bees are visiting the treatment area. Extremely toxic to fish and aquatic invertebrates. (Group 3A)
- ◆ bifenthrin/zeta+cypermethrin (Hero) at 0.025 to 0.06 lb ai/a foliar or 0.04 to 0.1 lb ai/a at plant. PHI 3 days for sweet corn seed. Do not graze livestock in treated areas or cut treated sweet corn seed crops for feed within 3 days of the last application. For non-sweet corn seed crops, there is a PHI of 30 days for crop residues harvested for stover; do not allow livestock to graze on crop residues for 30 days after treatment. REI 12 hr. Do not exceed 0.4 lb ai/a per season. Refer to product labels for application limits if multiple products containing zeta-cypermethrin are to be used in the same season. Highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. (Group 3A)
- ◆ *Chromobacterium subsugae* (Grandevo) at 0.6 to 0.9 lb ai/a per 100 gal. PHI 0 days. REI 4 hr. (Unidentified group)
- ◆ chlorpyrifos (numerous products) at 0.5 to 1 lb/ ai/a. PHI 21 days grain or ears. Apply at cultivation at base of plant on both sides of row just ahead of cultivator shovels and cover brace roots with soil. Do not exceed 3 lb ai/a per season. REI 24 hr. Chlorpyrifos is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. (Group 1B)
- ◆ chlorpyrifos/gamma cyhalothrin (Cobalt) at 0.26 to 0.52 lb ai/a. Do not apply within 21 days before harvest of grain, ears, forage or fodder. REI 24 hr. Do not exceed 3 applications nor 2.5 lb/a per season. Refer to product labels for application limits if products containing gamma-cyhalothrin and products containing lambda-cyhalothrin are to be used in the same season. Chlorpyrifos is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. (Groups 1B and 3A)
- ◆ cyfluthrin (Tombstone) at 0.025 to 0.044 lb ai/a. PHI 21 days for grain or fodder. Do not exceed four applications or 0.175 lb ai/a per season. REI 12 hr. Highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. (Group 3A)
- ◆ esfenvalerate (Asana XL; other products) at 0.015 to 0.03 lb ai/a. PHI 21 days. REI 12 hr. Do not exceed 0.25 lb ai/a per season. Esfenvalerate is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply esfenvalerate or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Esfenvalerate is highly toxic to fish and aquatic invertebrates. (Group 3A)
- ◆ flubendiamide (Belt SC) at 0.0625 to 0.094 lb ai/a. PHI 28 days. If crop residue is to be fed to livestock, PHI 28 days grain or stover. REI 12 hr. Do not exceed 0.375 lb ai/a per season. (Group 28)
- ◆ lambda-cyhalothrin (Warrior II; other products) at 0.015 to 0.025 lb ai/a. PHI 21 days. If crop residues are to be used for livestock, PHI is 1 day for grazing, 21 days for fodder or silage. REI 24 hr. Apply no more than 0.12 lb ai/a per season. Refer to product labels for application limits if products containing gamma-cyhalothrin and products containing lambda-cyhalothrin are to be used in the same season. Highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply lambda-cyhalothrin or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. Lambda-cyhalothrin is extremely toxic to fish and aquatic organisms and toxic to wildlife. (Group 3A)
- ◆ methoxyfenozide (Intrepid 2F) at 0.06 to 0.25 lb ai/a. PHI 21 days. Do not exceed 1 lb ai/a per season. REI 4 hr. (Group 18)
- ◆ permethrin (numerous products) at 0.05 to 0.1 lb ai/a. Not for use on sweet corn seed. If crop residues are to be used for livestock, do not apply less than 30 days prior to harvest of grain or fodder (stover). Not for use on sweet corn seed. REI 12 hr. Do not exceed 0.45 lb ai/a per season. Permethrin is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops if bees are visiting the treatment area. Extremely toxic to aquatic organisms, (Group 3A)

- ◆ spinetoram (Radiant SC) at 0.023 to 0.047 lb ai/a. PHI 1 day grain harvest. If crop residue is to be fed to livestock, PHI is 3 days for forage or fodder. REI 4 hr. Do not exceed 0.281 lb ai/a per season. Limit 6 applications per season, and do not make more than two consecutive applications of Group 5 insecticides. (Group 5)
- ◆ spinosad (Blackhawk, Success, Entrust, Success) at 0.047 to 0.094 lb ai/a. PHI 1 day. If crop residue is to be fed to livestock, PHI 3 days for forage or fodder (Blackhawk); 28 days for fodder (Entrust and Success). REI 4 hr. Do not apply more than 0.45 lb ai/a per year. Some formulations, such as Entrust, are OMRI-listed for organic use. (Group 5)
- ◆ zeta-cypermethrin (Mustang, Mustang Maxx) at 0.022 to 0.05 lb ai/a (Mustang) or 0.011 to 0.025 lb ai/a (Mustang Maxx). Do not apply within 7 days of harvest of crop residues for stover. REI 12 hr. Do not exceed 0.2 lb ai/a per season (Mustang) or 0.1 lb ai/a per season (Mustang Maxx). Refer to product labels for application limits if multiple products containing zeta-cypermethrin are to be used in the same season. For control before larvae bore into the plant stalk or ear. Mustang and Mustang Maxx are not for use on sweet corn seed. Zeta-cypermethrin is highly toxic to bees and other pollinators exposed to direct treatment or residues on blooming crops or weeds. Do not apply zeta-cypermethrin or allow it to drift to blooming crops or weeds if bees or other pollinating insects are foraging in the treatment area. (Group 3A)
- ◆ bifenthrin/indole-3-butyric acid (Empower II) at 0.002 to 0.006 lb ai/1,000 row ft. PHI 30 days. REI 24 hr. Do not exceed 0.1 lb ai/a at plant. Not for use on sweet corn seed. (Group 3A)
- ◆ chlorpyrifos (numerous products) at 0.075 lb ai/1,000 row ft at planting. PHI 21 days for grain and ears. REI 24 hr. Do not exceed 0.15 lb ai/1,000 ft of row or 3 lb ai/a per season. (Group 1B)
- ◆ chlorpyrifos/gamma cyhalothrin (Cobalt) at 0.26 to 0.76 lb ai/a at plant. Do not apply within 21 days before harvest of grain, ears, forage or fodder. REI 24 hr. Refer to product labels for application limits if products containing gamma-cyhalothrin and products containing lambda-cyhalothrin are to be used in the same season. (Groups 1B and 3A)
- ◆ cyfluthrin (Tombstone) at 0.12 to 0.16 fl oz/1,000 row ft or 2.0 to 2.8 fl oz/a. Total mix volume should be applied in the open furrow ahead of the closing wheels. If crop residue is to be used for livestock, there is a 21 day PHI for grain or fodder. REI 12 hr. Do not exceed 0.175 lb ai/a per season. (Group 3A)
- ◆ lambda-cyhalothrin (Warrior II, other products) at 0.005 lb ai/1,000 row ft. PHI 21 days. If crop residues are to be used for livestock, PHI is 1 day for grazing, 21 days for fodder (stover). REI 24 hr. Apply no more than 0.12 lb ai/a per season. Refer to product labels for application limits if products containing gamma-cyhalothrin and products containing lambda-cyhalothrin are to be used in the same season. (Group 3A)
- ◆ permethrin (numerous products) at 0.1 to 0.2 lb ai/a preemergent broadcast. If crop residues are to be used for livestock, do not apply less than 30 days prior to harvest of grain or fodder (stover). REI 12 hr. Do not apply more than 0.45 lb ai/a per season. Not for use on sweet corn seed. (Group 3A)
- ◆ tefluthrin (Force 3G and other formulations) at 0.0075 to 0.0094 lb ai/1,000 row ft, T-banded or in-furrow at planting. Do not exceed one application per season. REI 48 hrs. This product is highly toxic to fish and aquatic invertebrates. (Group 3A)
- ◆ terbufos (Counter 20G) at 0.056 to 0.075 lb ai/1,000 row ft. If crop residue is to be fed to livestock, PHI is 30 days forage or grazing. REI 48 hr or 72 hr where average rainfall is less than 25 inches per year. Do not exceed 1.3 lb ai/a per season. Not for use on sweet corn seed. (Group 1B)
- ◆ thiamethoxam (Cruiser 5FS, Cruiser Extreme)—For use in commercial seed treatment facilities only. See label for instructions. (Group 4A)

For additional information

<http://extension.colostate.edu/topic-areas/insects/western-bean-cutworm-characteristics-and-management-in-corn-and-dry-beans-5-538/>.

Corn seed—Wireworm

Ctenicera spp. and *Limoniuss* spp.

Pest description and crop damage Slender shiny brown to yellow grubs with hard bodies. Wireworms are the larvae of click beetles. Wireworms live in the soil where they may feed on corn seeds or the roots of young plants. Damage typically occurs during the early stages of crop development.

See also:

Potato, Irish—Wireworm.

Warning: The following insecticides are hazardous to bees. Do not apply these products or allow them to drift to blooming crops if bees are visiting the treatment area.

Management—chemical control

- ◆ abamectin+thiamethoxam (Avicta Duo, other formulations of Avicta that also contain fungicides)—Only for use in certified seed treatment facilities. Applied as a slurry to corn seed. Consult label. (Groups 6 and 4A)
- ◆ beta-cyfluthrin (Baythroid XL) at 0.12 to 0.16 fl oz/1,000 row ft or 2.0 to 2.8 fl oz/a. Total mix volume should be applied in the open furrow ahead of the closing wheels. PHI 21 days. If crop residues are to be used for livestock, there is a 21 day PHI for fodder (stover). REI 12 hr. Do not exceed 0.088 lb ai/a per season. (Group 3A)
- ◆ bifenthrin (Bifenthrin 2EC, numerous products) at 0.0023 to 0.0046 lb ai/1,000 row ft at plant or 0.047 to 0.062 lb ai/a preplant. PHI 30 days. REI 12 hr. Bifenthrin is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Extremely toxic to fish and aquatic invertebrates. Do not exceed 0.1 lb ai/a at plant. (Group 3A)
- ◆ bifenthrin/chlorethoxyfos (Smart Choice 5G) at 4.5 to 5 oz/1,000 row ft. REI 48 hr. (Groups 3A and 1B)

For additional information

<http://www.ipm.ucdavis.edu/PMG/r113300211.html>

PNW 607, Wireworm: Biology and Nonchemical Management in Potatoes in the Pacific Northwest, <https://catalog.extension.oregonstate.edu/pnw607>

Pests of Lettuce Grown for Seed

Scott B. Lukas

Latest revision—March 2018

In all cases, follow the instructions on the pesticide label. The *PNW Insect Management Handbook* has no legal status, whereas the pesticide label is a legal document. Read the product label before making any pesticide applications.

Pesticides registered for pest control on a given vegetable crop can also be used for that vegetable's seed crop, unless prohibited. For pesticide recommendations in addition to those listed below, see the appropriate vegetable section in this handbook.

Important notice Several pesticides with 24c SLN (Special Local Need) registrations for use on seed crops lack legal tolerances established for pesticide residues that may be on the seed, screenings, or hay at harvest. Therefore, certain seed grower associations in Washington, Oregon, and Idaho have declared, through their respective state departments of agriculture, that the crop produced for seed in those states is a nonfood crop. This declaration means that none of the seed, screenings, hay, or sprouts produced from harvested seed will be available for human or animal consumption when these pesticides have been applied. The grower must notify the seed processing plant in writing of any seed treated with these pesticides. Processed seed must be labeled as follows: "This seed was produced using one or more products for which the United States Environmental Protection Agency has not established pesticide residue tolerances. This seed, in whole, as sprouts, or in any form, may violate requirements of the Federal Food and Drug Administration, the Oregon Department of Agriculture and other regulatory agencies."

Note: Products are listed in alphabetical order and *not* in order of preference or superiority of pest control.

Lettuce seed—Aphid

Includes

Green peach aphid (*Myzus persicae*)
Lettuce aphid (*Nasonovia ribis-nigri*)

Pest description and crop damage Small yellowish, soft-body insect. Aphids suck plant sap from foliage causing a yellowing or wilting of the plant and sticky "honeydew" exudates.

Management—chemical control

Begin applications at first sign of infestation. Multiple applications with thorough coverage are necessary for effective control.

- ◆ azadirachtin (Neemix 4.5) at 5 to 7 fl oz /a (0.015 to 0.021 lb ai/a). PHI 0 days. REI 4 hr. Suppression and adult feeding deterrence. Apply every 7 to 10 days as needed. Some formulations are OMRI-listed for organic production.
- ◆ pymetrozine (Fulfill) at 2.75 oz/a product (0.086 lb ai/a). PHI 14 days. REI 12 hr. Do not exceed 5.5 oz/a product per season. Apply when aphids first appear, before populations build to damaging levels. Two applications may be needed to control persistent aphid populations. Allow at least 7 days between applications. SLN WA-000017 (expires 12/31/20). Washington only. In Washington, when crops or broadleaf weeds are blooming, apply between late evening and early morning only (between 6PM and 7AM).

Lettuce seed—Armyworm and looper

Includes

Armyworms

Armyworm (*Pseudaletia unipuncta*)
Beet armyworm (*Spodoptera exigua*)

Loopers

Alfalfa looper (*Autographa californica*)
Cabbage looper (*Trichoplusia ni*)

Pest description and crop damage Loopers are green, smooth-skinned, and usually have a narrow stripe along each side. Looper caterpillars can be distinguished from other common caterpillars by their distinctive looping movement, in which they arch the middle portion of their body to bring the hind legs forward to meet the front legs. Larvae feed on leaves, causing ragged-edged holes in the leaf and on the leaf margins. They can cause severe defoliation. Adults are brownish moths with distinctive figures on the front wings.

Management—chemical control

Begin applications at first sign of infestation. Multiple applications with thorough coverage are necessary for effective control.

Armyworms

- ◆ azadirachtin (Neemix 4.5) at 4 to 16 fl oz/a (0.012 to 0.049 lb ai/a). PHI 0 days. REI 4 hr. This botanical pesticide acts slowly. Spray early—well before harvest—and check for effect. Apply every 7 to 10 days as needed. Some formulations are OMRI-listed for organic production.

Loopers

- ◆ azadirachtin (Neemix 4.5) at 7 to 16 fl oz/a (0.021 to 0.049 lb ai/a). REI 4 hr. PHI 0 days. This botanical pesticide acts slowly. Spray early—well before harvest—and check for effect. Apply every 7 to 10 days as needed. Some formulations are OMRI-listed for organic production.

Lettuce seed—Slug

Includes

Gray field slug (*Deroceras reticulatum*)
Greenhouse slug (*Milax gagates*)
Marsh slug (*Deroceras laeve*)
Red slug (*Arion* spp.)
Reticulated slug (*Prophysaon andersoni*)
Spotted garden slug (*Limax maximus*)

Pest description and crop damage Slugs are active above ground primarily at night, and also during mild, wet periods at any time of year. Very little activity takes place in cold, freezing, or extremely hot weather. During the day, slugs usually stay in the soil or in crevices or cracks in order to protect themselves from dehydration and predators. Slug damage can be distinguished easily by the presence of slime trails. Slug damage tends to be heaviest along field margins. Weedy or grassy borders serve as excellent habitat for slugs.

Management—chemical control

Fall baiting usually is recommended for unirrigated crops. Apply bait after the first rain showers, when slugs become surface active. Bait applied immediately after the first fall rains kills a large population in the field.

- ◆ metaldehyde baits

See also:

Slug Control

Lettuce seed—Wireworm

Limonius spp.

Pest description and crop damage Wireworms are the soil-dwelling larvae of click beetles. Adult click beetles are slender, and tan to nearly black. Larvae are hard, segmented, and dark yellow or brown. Wireworms injure seedlings by feeding on roots or boring into stems. Damage is more common in spring planted crops where the soil has a high organic content, such as fields that recently have been in or adjacent to alfalfa, pasture, or uncontrolled weeds.

Management—chemical control

- ◆ azadirachtin (Neemix 4.5) at 10 to 12 fl oz/a (0.031 to 0.037 lb ai/a). PHI 0 days. REI 4 hr. This botanical pesticide acts slowly. Apply every 7 to 10 days as needed. Some formulations are OMRI-listed for organic production.

See also:

Potato, Irish—Wireworm

Onion seed—Maggot

Includes

Bean seed maggot (*Delia florilega*)
Onion maggot (*Delia antiqua*)
Seedcorn maggot (*Delia platura*)

Pest description and crop damage Adult is a fly, with a gray body and black legs, less than 0.25 inch long. Larvae are legless, blunt, white maggots that feed on seeds and reduce onion stands. They sometimes damage bulbs of mature plants.

Management—chemical control

- ◆ azadirachtin (Neemix 4.5) at 10 to 12 fl oz/a (0.031 to 0.037 lb ai/a). PHI 0 days. REI 4 hr. In most cases, apply at high rate. Effective on larval or immature stages only. This botanical pesticide acts slowly. Spray early and check for effect. Repeat in 7 to 10 days as needed. Some formulations are OMRI-listed for organic production.

Onion seed—Thrips

Includes

Onion thrips (*Thrips tabaci*)
Western flower thrips (*Frankliniella occidentalis*)

Pest description and crop damage Adults are small, slender, feather-wing insects. They are yellow to light brown and about 0.06 inch long. The young are wingless. They feed on foliage, reduce plant vigor, and may kill tops.

Management—chemical control

Onion thrips are not damaging once seed heads have formed. Western flower thrips, which feed on pollen without damaging seed, often are most prevalent in the flower heads. It rarely is justified to treat for thrips beyond the initial early application.

- ◆ azadirachtin (Neemix 4.5) at 10 to 12 fl oz/a (0.031 to 0.037 lb ai/a). PHI 0 days. REI 4 hr. In most cases, apply at high rate. This botanical pesticide acts slowly. Repeat in 7 to 10 days as needed. Spray early and check for effects. Some formulations are OMRI-listed for organic production.
- ◆ spirotetramat (Movento) at 5 fl oz/a (0.08 lb ai/a). Apply no more than 10 fl oz/a (0.16 lb ai/a) per crop season with a minimum treatment interval of 7 days. For onions, leeks, and chives grown for seed production, do not apply 4 months prior to bloom, during bloom or until after petal fall.

Pests of Onion Grown for Seed

Scott B. Lukas

Latest revision—March 2018

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Pesticides registered for pest control on a given vegetable crop can also be used for that vegetable's seed crop, unless prohibited. For pesticide recommendations in addition to those listed below, see the appropriate vegetable section in this handbook.

Note: Products are listed in alphabetical order and *not* in order of preference or superiority of pest control.

Onion seed—Armyworm and cutworm

Beet armyworm (*Spodoptera exigua*)
Bertha armyworm (*Mamestra configurata*)
Western yellowstriped armyworm (*Spodoptera praefica*)
Black cutworm (*Agrotis ipsilon*)
Variegated cutworm (*Peridroma saucia*)

Pest description and crop damage Dark or various-color moth larvae that damage roots and bulbs by feeding.

Management—chemical control

- ◆ azadirachtin (Neemix 4.5) at 4 to 16 fl oz/a (0.012 to 0.049 lb ai/a). PHI 0 days. REI 4 hr. In most cases, apply at high rate. Effective on larval or immature stages only. This botanical pesticide acts slowly. Repeat in 7 to 10 days as needed. Spray early and check for effect. Some formulations are OMRI-listed for organic production.

Pests of Radish Grown for Seed

Carrie H. Wohleb

Latest revision—March 2018

In all cases, follow the instructions on the pesticide label. The *PNW Insect Management Handbook* has no legal status, whereas the pesticide label is a legal document. Read the product label before making any pesticide applications.

Pesticides registered for pest control on a given vegetable crop can also be used for that vegetable's seed crop, unless prohibited. For pesticide recommendations in addition to those listed below, see the appropriate vegetable section in this handbook.

Important notice Several pesticides with 24c SLN (Special Local Need) registrations for use on seed crops lack legal tolerances established for pesticide residues that may be on the seed, screenings, or hay at harvest. Therefore, certain seed grower associations in Washington, Oregon, and Idaho have declared, through their respective state departments of agriculture, that the crop produced for seed in those states is a nonfood crop. This declaration means that none of the seed, screenings, hay, or sprouts produced from harvested seed will be available for human or animal consumption when these pesticides have been applied. The grower must notify the seed processing plant in writing of any seed treated with these pesticides. Processed seed must be labeled: "This seed was produced using one or more products for which the United States Environmental Protection Agency has not established pesticide residue tolerances. This seed, in whole, as sprouts, or in any form, may violate requirements of the Federal Food and Drug Administration, the Oregon Department of Agriculture and other regulatory agencies."

Note: Products are listed in alphabetical order and *not* in order of preference or superiority of pest control.

Radish seed—Aphid

Includes:

Cabbage aphid (*Brevicoryne brassicae*)
Green peach aphid (*Myzus persicae*)
Turnip aphid (*Hydaphis pseudobrassicae*)

Pest description and crop damage Cabbage and turnip aphids species are gray and adults are covered with a bluish-white waxy powder. They form colonies on foliage, on or in buds, or in flowers. High populations reduce seed set, cause seed pods to abort, cause premature plant death, and interfere with harvest operations.

Management—chemical control

◆ acephate (Orthene 97) at 1 lb/a (1 lb ai/a). REI 24 hr. Allow a minimum of 7 days between applications. Do not exceed 2 lb/a (2 lb ai/a) per year. Do not apply through any type of irrigation system. This product is highly toxic to bees exposed to direct treatment of residues on blooming crops or weeds. Do not apply to blooming radish seed during pollination. Bee colonies used for pollination should be removed from the field being treated prior to the application. Notify beekeepers pollinating crops within .25 mile of the field to be treated at least 48 hr prior to the application. Do not use on daikon radish. No portion of treated plants can be used for food or feed. 24c SLNs: Orthene 97 WA-050015 (expires 12/31/19). Washington only.

◆ pymetrozine (Fulfill) at 2.75 oz/a (1.38 oz ai/a). PHI 14 days. REI 12 hr. This insecticide works primarily by ingestion, but also has some contact activity. Aphids stop feeding shortly after exposure, but may remain on the plant foliage until they die, which is usually within 2-7 days. This product has residual activity in the plant. Do not exceed 5.5 oz/a (2.75 oz ai/a) per season. The addition of a penetrating type spray adjuvant is recommended. Do not apply through any type of irrigation system. Allow at least 7 days between applications. Fulfill is toxic to bees exposed to direct application. Application to blooming crops must be between late evening and early morning to coincide with minimal bee activity. No portion of treated plants can be used for food or feed. 24c SLNs: WA-000017 (expires 12/31/20). Washington only.

See also:

Radish—Aphid

Radish seed—Cabbage looper

Trichoplusia ni

Pest description and crop damage Pale green larvae with white stripes on back and sides. They move in a looping manner.

Management—chemical control

◆ acephate (Orthene 97) at 1 lb/a (1 lb ai/a). REI 24 hr. Allow a minimum of 7 days between applications. Do not exceed 2 lb/a (2 lb ai/a) per year. Do not apply through any type of irrigation system. This product is highly toxic to bees exposed to direct treatment of residues on blooming crops or weeds. Do not apply to blooming radish seed during pollination. Bee colonies used for pollination should be removed from the field being treated prior to the application. Notify beekeepers pollinating crops within .25 mile of the field to be treated at least 48 hr prior to the application. Do not use on daikon radish. No portion of treated plants can be used for food or feed. 24c SLNs: Orthene 97 WA-050015 (expires 12/31/19). Washington only.

See also:

Radish—Looper

Radish seed—Cabbage maggot

Delia brassicae

Pest description and crop damage White maggots that feed on roots and underground stems and weaken, lodge, and kill plants. Adult is a small gray fly that lays white eggs at plant bases.

Management—chemical control

◆ cyantraniliprole (Verimark) at 10.0 to 13.5 fl oz/a as a soil at planting application (in-furrow spray, surface band, soil shank injection, transplant tray drench) no earlier than 72 hours prior to planting. REI 4 hr. The pH of the application solution should be between 4 and 6. Do not apply more than 0.4 lbs ai/a. This product is toxic to aquatic invertebrates and oysters. Do not apply directly to water. Drift and runoff may be hazardous to aquatic organisms in water adjacent to use sites. No portion of treated plants can be used for food or feed. 24c SLN: OR-170004 (expires 12/31/22). Oregon only.

See also:

Radish—Cabbage maggot

Radish seed—Cabbage seedpod weevil

Ceutorhynchus assimilis

Pest description and crop damage Small, dark gray snout beetles that congregate on blooms. Larvae feed on seeds inside pods.

Management—chemical control

- ◆ azadirachtin (Aza-Direct, Neemix 4.5)—See label for rates. PHI 0 days. This is a botanical insecticide with ingestion and contact action that kills larvae by interfering with molting; also reduces damage by repelling and deterring feeding. Repeat in 7- to 10- day intervals beginning at the first sign of infestation when pests are immature. Repeated applications break the life cycle of the pest. Some formulations are OMRI-listed for organic use.
- ◆ cyantraniliprole (Exirel) at 13.5 to 20.5 fl oz/a. REI 12 hr. Make a second application if weevil adults continue to reach treatment threshold 7 to 10 days after first application. Do not apply more than 0.4 lbs ai/a. This product is toxic to aquatic invertebrates and oysters. Do not apply directly to water. Drift and runoff may be hazardous to aquatic organisms in water adjacent to use sites. The product is highly toxic to bees exposed to direct treatment on blooming crops or weeds. Do not apply this product while bees are foraging. The beekeeper providing pollination services must be notified at least 48 hr prior to application so that the bees can be removed or covered prior to spraying. No portion of treated plants can be used for food or feed. 24c SLN: OR-160011 (expires 12/31/18). Oregon only.

Radish seed—Cutworm

Various species

Pest description and crop damage Dull gray, brown, or black caterpillars. They are active at night and can be found in the soil by day. They cut off young plants at ground level, or feed on foliage, buds, and bloom of older plants.

Management—chemical control

- ◆ chlorpyrifos (Lorsban Advanced) at 1 quart/a (0.94 lb ai/a). PHI 7 days. REI 24 hr. Do not make more than one application per year. This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Evening or night time applications when foragers are not present reduce exposure hazards. Do not apply to radishes in bloom. Toxic to fish, aquatic invertebrates, small mammals and birds. Do not apply directly to water or to areas where surface water is present. Follow mandated buffer zone restrictions on the label. Do not apply through any type of irrigation system. No portion of treated plants can be used for food or feed. 24c SLNs: OR-090012 (expires 12/31/18). Oregon only.

See also:

Radish—Armyworm and cutworm

Radish seed—Diamondback moth

Plutella xylostella

Pest description and crop damage Diamondback larvae are about 0.31 inch when fully grown. The larval body is wider in the middle and tapers at both ends, with two legs (prolegs) on the last segment forming a distinctive V-shape at the rear end. They feed mostly on outer or more mature leaves of older plants, chewing out small holes, or at growing points of young plants. They also feed on floral stalks and flower buds. Adult moths are small, slender, and grayish brown. Male moths display three diamond-shaped markings on their back.

Management—chemical control

- ◆ acephate (Orthene 97) at 1 lb/a (1 lb ai/a). REI 24 hr. Allow a minimum of 7 days between applications. Do not exceed 2 lb/a (2 lb ai/a) per year. Do not apply through any type of irrigation

system. This product is highly toxic to bees exposed to direct treatment of residues on blooming crops or weeds. Do not apply to blooming radish seed during pollination. Bee colonies used for pollination should be removed from the field being treated prior to the application. Notify beekeepers pollinating crops within .25 mile of the field to be treated at least 48 hr prior to the application. Do not use on daikon radish. No portion of treated plants can be used for food or feed. 24c SLNs: Orthene 97 WA-050015 (expires 12/31/19). Washington only.

See also:

Radish—Diamondback moth

Radish seed—Imported cabbageworm

Pieris rapae

Pest description and crop damage Larvae are green and very hairy, with an almost velvet-like appearance. Older larvae may be up to 1 inch long. They often have one faint yellow-orange stripe down their backs and broken stripes along the sides.

Management—chemical control

- ◆ acephate (Orthene 97) at 1 lb/a (1 lb ai/a). REI 24 hr. Allow a minimum of 7 days between applications. Do not exceed 2 lb/a (2 lb ai/a) per year. Do not apply through any type of irrigation system. This product is highly toxic to bees exposed to direct treatment of residues on blooming crops or weeds. Do not apply to blooming radish seed during pollination. Bee colonies used for pollination should be removed from the field being treated prior to the application. Notify beekeepers pollinating crops within .25 mile of the field to be treated at least 48 hr prior to the application. Do not use on daikon radish. No portion of treated plants can be used for food or feed. 24c SLNs: Orthene 97 WA-050015 (expires 12/31/19). Washington only.
- ◆ azadirachtin (Aza-Direct, Neemix 4.5)—See label for rates. PHI 0 days. This is a botanical insecticide with ingestion and contact action that kills larvae by interfering with molting; also reduces damage by repelling and deterring feeding. Repeat in 7- to 10- day intervals beginning at the first sign of infestation when pests are immature. Repeated applications break the life cycle of the pest. Some formulations are OMRI-listed for organic use.
- ◆ zeta-cypermethrin (Mustang) at 1.9 to 4.3 fl oz/a (0.016 to 0.05 lb ai/a). PHI 7 days. REI 12 hr. Do not exceed 25.8 fl oz/a (0.3 lb ai/a) per season. This product is highly toxic to bees exposed to direct treatment on blooming crops or weeds. Toxic to fish and aquatic organisms. Do not apply by ground within 25 feet of bodies of water. Do not apply by ULV aerial application within 450 feet or by non-ULV aerial application within 150 feet of bodies of water. Maintain a minimum 10-ft wide vegetative filter strip between the field and down gradient aquatic habitat.

Radish seed—Leafhopper

Beet leafhopper (*Circulifer tenellus*)

Pest description and crop damage Beet leafhoppers transmit a phytoplasma, the beet leafhopper transmitted virescence agent (BLTVA), to radish crops in the arid regions of the Pacific Northwest. BLTVA-infected radish seed plants tend to bolt prematurely, and the flower parts can be malformed.

Management—chemical control

- ◆ azadirachtin (Aza-Direct, Neemix 4.5)—This is a botanical insecticide with ingestion and contact action that kills immature pests by interfering with molting; also reduces damage by repelling and deterring feeding. Repeat in 7- to 10- day intervals beginning at the first sign of infestation when pests are immature. Repeated applications break the life cycle of the pest. Some formulations are OMRI-listed for organic use.

- ◆ carbaryl (Sevin 4F) at 0.5 to 1 quarts/a (0.5 to 1 lb ai/a) as foliar treatment. PHI 7 days. REI 12 hr. Repeat applications as necessary up to a total of 6 times per year but not more often than once every 7 days. This product is highly toxic to bees exposed to direct treatment or residues on crops or weeds in bloom. Do not apply this product to target crops or weeds in bloom.
- ◆ thiamethoxam (Actara) at 1.5 to 3.0 oz/a (0.023 to 0.047 lb ai/a) foliar application. PHI 7 days. REI 12 hr. Retreatment interval 7 days. Do not exceed a total of 4.0 oz/a (0.063 lb ai/a) per season. This product is highly toxic to bees exposed to direct treatment on blooming crops or weeds.
- ◆ thiamethoxam (Platinum) at 5.0 to 6.5 fl oz/a (0.078 to 0.1 lb ai/a) soil application. REI 12 hr. Apply at seeding or within 24 hours of seeding. Do not exceed 6.5 fl oz/a (0.1 lb ai/a) per season of Platinum or 0.063 lb ai/a per season of thiamethoxam-containing products. This product is highly toxic to bees exposed to direct treatment on blooming crops or weeds.
- ◆ zeta-cypermethrin (Mustang) at 1.9 to 4.3 fl oz/a (0.016 to 0.05 lb ai/a). PHI 7 days. REI 12 hr. Do not exceed 25.8 fl oz/a (0.3 lb ai/a) per season. This product is highly toxic to bees exposed to direct treatment on blooming crops or weeds. Toxic to fish and aquatic organisms. Do not apply by ground within 25 feet of bodies of water. Do not apply by ULV aerial application within 450 feet or by non-ULV aerial application within 150 feet of bodies of water. Maintain a minimum 10-ft wide vegetative filter strip between the field and down gradient aquatic habitat.

Radish seed—Lygus bug

Lygus spp.

Pest description and crop damage Adults are 0.18 inch long and have a light yellow V on the back. Lygus bugs pierce buds and suck sap, injuring both vegetative and reproductive buds. Damage includes blasted buds, blossom drop, and shriveled seed.

Management—chemical control

- ◆ gamma-cyhalothrin (Declare) at 0.01 to 0.015 lb ai/a. REI 24 hr. Do not exceed 0.06 lb ai/a per season. This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. The low rate may be applied from late evening to midnight during bloom. Do not apply at the 0.015 rate to blooming seed crops. Do not apply to daikon radish. Toxic to fish and aquatic invertebrates. Do not apply within 25 ft of an aquatic habitat, 150 ft if applied by air. Apply with ground or air equipment. Section 18 label allows application in Oregon only.
- ◆ lambda-cyhalothrin (Warrior II) at 1.28 to 1.92 fl oz/a (0.02 to 0.03 lb ai/a). REI 1 day. Do not apply more than 0.48 pints/a (0.12 lb ai/a) per season. This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. The low rate may be applied from late evening to midnight during bloom. Do not apply the 0.03 lb ai/a rate during bloom. Toxic to fish and aquatic invertebrates. Do not apply within 25 ft of an aquatic habitat, 150 ft if applied by air. 24c SLN: OR-090017 (expires 12/31/18). Oregon only.

Radish seed—Slug

Several species

Pest description and crop damage Mollusks that feed on foliage and leave slime trails.

Management—chemical control

- ◆ metaldehyde baits

See also:

Slug Control

Radish seed—Wireworm

Limonius spp. and *Ctenicera* spp.

Pest description and crop damage Brown, shiny, jointed larvae of click beetles. Larvae are from 0.33 to 0.5 inch long. They inhabit soil for 2 to 5 years during maturation, feeding on plant roots and lower stems.

Management—chemical control

See also:

Radish—Wireworm

Pests of Rutabaga and Turnip Grown for Seed

Carrie H. Wohleb

Latest revision—March 2018

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Note: Products are listed in alphabetical order and *not* in order of preference or superiority of pest control.

Rutabaga and turnip seed—Aphid

Cabbage aphid (*Brevicoryne brassicae*)

Turnip aphid (*Hyadaphis pseudobrassicae*)

Pest description and crop damage Both species are gray mealy plant lice that form colonies on foliage.

Management—chemical control

- ◆ pymetrozine (Fulfill) at 2.75 oz/a (0.086 lb ai/a). PHI 14 days. REI 12 hr. This insecticide works primarily by ingestion, but also has some contact activity. Aphids stop feeding shortly after exposure, but may remain on the plant foliage until they die, which is usually within 2-7 days. This product has residual activity in the plant. Do not exceed 5.5 oz/a (0.17 lb ai/a) per season. The addition of a penetrating type spray adjuvant is recommended. Do not apply through any type of irrigation system. Allow at least 7 days between applications. Fulfill is toxic to bees exposed to direct application. Application to blooming crops must be between late evening and early morning to coincide with minimal bee activity. No portion of treated plants can be used for food or feed. 24c SLN: WA-000017 (expires 12/31/20). Washington only.

See also:

Turnip (roots and tops) and rutabaga—Aphid

Rutabaga and turnip seed—Cabbage maggot

Delia brassicae

Pest description and crop damage Larvae are legless white maggots that feed on roots.

Management—chemical control

- ◆ cyantraniliprole (Verimark) at 10.0 to 13.5 fl oz/a as a soil at planting application (in-furrow spray, surface band, soil shank injection, transplant tray drench) no earlier than 72 hours prior to planting. REI 4 hr. The pH of the application solution should be between 4 and 6. Do not apply more than 0.4 lbs ai/a. This product is toxic to aquatic invertebrates and oysters. Do not apply directly to water. Drift and runoff may be hazardous to aquatic organisms in water adjacent to use sites. No portion of treated plants can be used for food or feed. 24c SLN: OR-170004 (expires 12/31/22). Oregon only.

See also:

Turnip (roots and tops) and rutabaga—Cabbage maggot

Rutabaga and turnip seed—Cabbage seedpod weevil

Ceutorhynchus assimilis

Pest description and crop damage Small, dark gray snout beetles congregate on blooms. Larvae feed on seeds inside pods.

Management—chemical control

- ◆ cyantraniliprole (Exirel) at 13.5 to 20.5 fl oz/a. REI 12 hr. Make a second application if weevil adults continue to reach treatment threshold 7 to 10 days after first application. Do not apply more than 0.4 lb ai/a. This product is toxic to aquatic invertebrates and oysters. Do not apply directly to water. Drift and runoff may be hazardous to aquatic organisms in water adjacent to use sites. The product is highly toxic to bees exposed to direct treatment on blooming crops or weeds. Do not apply this product while bees are foraging. The beekeeper providing pollination services must be notified at least 48 hr prior to application so that the bees can be removed or covered prior to spraying. No portion of treated plants can be used for food or feed. 24c SLN OR-160011 (expires 12/31/18). Oregon only.

Pests of Spinach Grown for Seed

Craig Hollingsworth

Latest revision—March 2018

In all cases, follow the instructions on the pesticide label. The *PNW Insect Management Handbook* has no legal status, whereas the pesticide label is a legal document. Read the product label before making any pesticide applications.

Pesticides registered for pest control on a given vegetable crop can also be used for that vegetable's seed crop, unless prohibited. For pesticide recommendations in addition to those listed below, see the appropriate vegetable section in this handbook.

Important notice Several pesticides with 24c SLN (Special Local Need) registrations for use on seed crops lack legal tolerances established for pesticide residues that may be on the seed, screenings, or hay at harvest. Therefore, certain seed growers associations in Washington, Oregon, and Idaho have declared, through their respective state departments of agriculture, that the crop produced for seed in those states is a nonfood crop. This declaration means that none of the seed, screenings, hay, or sprouts produced from harvested seed will be available for human or animal consumption when these pesticides have been applied. The grower must notify the seed processing plant in writing of any seed treated with these pesticides. Processed seed must be labeled: "This seed was produced using one or more products for which the United States Environmental Protection Agency has not established pesticide residue tolerances. This seed, in whole, as sprouts, or in any form, may violate requirements of the Federal Food and Drug Administration, the Oregon Department of Agriculture and other regulatory agencies."

Note: Products are listed in alphabetical order and *not* in order of preference or superiority of pest control.

Spinach seed—Aphid

Bean aphid (*Aphis fabae*)

Green peach aphid (*Myzus persicae*)

Melon aphid (*Aphid gossypii*)

Pest description and crop damage Bean aphids are black and colonize foliage. Green peach aphids are yellowish pink to pale green with a large, distinct blotch on top of the abdomen. Melon aphids are small and yellowish to dull green; pale forms have dark mottlings.

Management—chemical control

- ◆ azadirachtin (Neemix) at 0.049 lb ai/a. PHI 0 days. Some formulations are OMRI-listed for organic use.
- ◆ pymetrozine (Fulfill) at 0.086 lb ai/a (2.75 oz/a) when aphids first appear. Do not apply more than 0.086 lb ai/a per application or more than 0.172 lb ai/a per crop per year. Allow a minimum of 7 days between applications. PHI 14 days. REI 12 hr. Pollinator protection: when crops or weeds are in bloom, apply between 6 pm and 7 pm.

See also:

Spinach—Aphid

Spinach seed—Collembola (Springtail)

Primarily *Onychiurus pseudarmatus*

Pest description and crop damage Small, white, slow-moving, soil-dwelling insects that feed on germinating seeds or roots of small plants, causing reduced stands and loss of vigor in surviving plants. They usually are in localized or irregular spots in the field.

Management—chemical control

See also:

Spinach—Collembola (Springtail)

Spinach seed—European cranefly

Tipula paludosa

Pest description and crop damage Small, gray-brown, worm-like larvae that develop a tough skin and are commonly called leatherjackets. They feed on clover and a number of vegetables.

Management—chemical control

- ◆ azadirachtin (Neemix) at 0.017 lb ai/a. PHI 0 days. Some formulations are OMRI-listed for organic use.

See also:

Spinach—European cranefly

Spinach seed—Looper

Includes alfalfa looper (*Autographa californica*)

Pest description and crop damage Mottled gray moth, 1.5 inches, with silver markings on forewings. Worms are slender (1 inch) and dark olive-green with a paler head marked with three light stripes.

Management—chemical control

- ◆ azadirachtin (Neemix) at 0.049 lb ai/a. PHI 0 days. Some formulations are OMRI-listed for organic use.

See also:

Spinach—Alfalfa looper

Spinach seed—Twospotted spider mite

Tetranychus urticae

Pest description and crop damage Adult mites are about 0.06 inch long, have four pairs of legs, are greenish to pink or cream color, and have various-sized black spots on the body. Under warm conditions, spider mites move rapidly within the colony area. Damaged leaves become somewhat stippled on the upper surface and may turn brown or bronze with heavy damage. The undersurface of leaves may have a grayish cast due to webbing. Wilting, leaf deformity, tissue death, and abscission all may take place.

Biology and life history Spider mites have four stages of development: the oval, somewhat translucent egg; a six-leg translucent larval stage; an eight-leg nymph stage; and the eight-leg adult stage. A resting or quiescent stage occurs at the end of the larval and nymph stages. A generation may pass in as few as 5 to 7 days in midsummer, or in a month during cool periods. There are numerous overlapping generations each year.

Management—chemical control

- ◆ propargite (Comite) at 1.64 to 2.46 lb ai/a. Maximum of two applications per season. REI 9 days. Retreatment interval 14 days. Toxic to fish. Resistance Group 12c. SLN 24c WA-040019 (expires 12/31/2019). WA only.

Pests of Table Beet Grown for Seed

Edward John Bechinski

Latest revision—March 2018

In all cases, follow the instructions on the pesticide label. The *PNW Insect Management Handbook* has no legal status, whereas the pesticide label is a legal document. Read the product label before making any pesticide applications.

Pesticides registered for pest control on a given vegetable crop can also be used for that vegetable's seed crop, unless prohibited. For pesticide recommendations in addition to those listed below, see the appropriate vegetable section in this handbook.

Important notice Several pesticides with 24c SLN (Special Local Need) registrations for use on seed crops lack legal tolerances established for pesticide residues that may be on the seed, screenings, or hay at harvest. Therefore, certain seed grower associations in Washington, Oregon, and Idaho have declared, through their respective state departments of agriculture, that the crop produced for seed in those states is a nonfood crop. This declaration means that none of the seed, screenings, hay, or sprouts produced from harvested seed will be available for human or animal consumption when these pesticides have been applied. The grower must notify the seed processing plant in writing of any seed treated with these pesticides. Processed seed must be labeled: "This seed was produced using one or more products for which the United States Environmental Protection Agency has not established pesticide residue tolerances. This seed, in whole, as sprouts, or in any form, may violate requirements of the Federal Food and Drug Administration, the Oregon Department of Agriculture and other regulatory agencies."

Note: Products are listed in alphabetical order and *not* in order of preference or superiority of pest control.

Table beet seed—Aphid

Includes green peach aphid (*Myzus persicae*)

Pest description and crop damage The green peach aphid is yellowish green and teardrop-shaped. Its most important damage is as a vector of virus diseases rather than by feeding injury through sucking sap.

Management—chemical control

- ◆ pymetrozine (Fulfill) at 0.086 lb ai/a (2.75 oz/a product) as foliar treatment when aphids first appear. A second application may be made no sooner than 7 days after the initial treatment to control persistent infestations. Pymetrozine is a selective aphicide that works primarily by ingestion but does have some contact activity. Treated aphids stop feeding shortly after exposure but do not die for 2 to 7 days. Toxic to bees. No portion of treated plants can be used for food or feed. PHI 14 days. 24c SLN WA-000017 (expires 12/31/2020). Washington only.

Table beet seed—Garden symphylan

Scutigera immaculata

Pest description and crop damage Active, fragile, centipede-like, soilborne relative of insects, white, 0.25 inch long, with 12 or more pair of legs. Garden symphylan primarily damage beets early in the season by feeding on germinating seed or on small roots of seedling plants. Symphylan occur in unpredictably spotty infestations and are generally considered minor pests.

Management—chemical control

No formal economic thresholds exist for insecticide treatment decisions. No effective postemergence “rescue” treatments exist for symphylan in sugar beet seed fields.

- ◆ chlorpyrifos (Lorsban Advanced)—Restricted to one of the following types of uses: either one pre-plant broadcast application at 1.88 lb ai/a (2 qt/a product) and incorporated into the top 2 to 4 inches of soil; or one at-planting/transplanting application at 0.94 lb ai/a (1 qt/a product) as 5-to 7-inch band over row and incorporated into the top 2 to 4 inches of soil. 24c SLN OR-090007 (expires 12/31/2018). Oregon only.

Table beet seed—Slug

Various species

Management—chemical control

- ◆ iron phosphate (Leaf Life Sluggo Snail and Slug Bait) at 0.20 to 0.44 lb ai/a (20 to 44 lb product/a).
- ◆ metaldehyde—
 - ◇ Deadline M-Ps Mini Pellets broadcast at 0.2 to 0.8 lb ai/a (5 to 20 lb product/a); 24c SLN OR-140008 (expires 12/31/2019). Oregon only.
 - ◇ Metarex Slug and Snail Bait broadcast at 0.2 to 0.8 lb ai/a (5 to 20 lb product/a); 24c SLN OR-140005 (expires 12/31/2019). Oregon only.
 - ◇ Slugger 4.0 Slug & Snail Bait or Wilco Blue 4.0 Slug & Snail Bait broadcast at 0.2 to 0.8 lb ai/a (5 to 20 lb product/a); 24c SLN OR-140004 (expires 12/31/2019). Oregon only.

Table beet seed—Twospotted spider mite

Tetranychus urticae

Management—chemical control

- ◆ propargite (Comite) at 1.6375 to 2.45625 lb ai/a (2 to 3 pints/a product) in 25 to 40 gal/a spray solution (ground application) or at least 10 gal/a spray solution (aerial application). Complete coverage of both upper and lower leaf surfaces is necessary for effective control; 24c SLN WA-040019 (expires 12/31/2019). Washington only.