

## Insecticides & Miticides for PA Christmas Tree Pests

PA Dept. of Agriculture, Bureau of Plant Industry

**ALWAYS READ THE PRODUCT LABEL. THE LABEL IS THE LAW. CONSULT THE LABEL TO TARGET THE MOST APPROPRIATE LIFE STAGE OF THE PEST.** For all pests, any recommendations for control are listed near the pest name. Any available PA Dept. of Agriculture Regulatory Horticulture pest circulars are listed near the pest name, in parentheses.

(Active Ingredient = Bio-rational Product)

### Active Ingredients

Adelgids (Cooley Spruce Gall, E. Spruce Gall, Pine Bark) (#51, 52, 84)

Plant Colorado Blue Spruce or Douglas-fir away from each other, which will decrease severity. Use horticultural oil or insecticidal soap if beneficial insects are present. Apply (dormant) horticultural oil to overwintering nymphs before new growth starts (early spring) or after first frost (late fall). Thorough coverage, including inner branches, is essential.

**Cooley Spruce Gall Adelgid (Douglas-fir):** Plant tolerant or resistant Douglas-fir varieties. In the spring, make the first application of a listed insecticide after nymphs and immature females begin to swell, but before white waxy threads are produced. Make a second listed insecticide application 7 to 10 days later, but before bud break. In the fall, apply a listed insecticide in late September or October to control exposed nymphs and immature females before overwintering.

**Cooley Spruce Gall Adelgid (Spruce):** Prune and destroy unopened green galls before nymphs emerge (mid-July). Apply a listed insecticide in mid-April, when adelgids are exposed (no waxy, white threads or eggs will be present). Apply a listed insecticide in late September to October, waiting until after the first frost to ensure nymphs have settled.

**Eastern Spruce Gall Adelgid:** Plant resistant varieties or non-hosts of this pest. Remove and destroy heavily infested trees in and around fields. Prune and destroy green galls before they open in late summer. Apply a listed insecticide from mid-September to October to control overwintering stage (preferred).

**Pine Bark Adelgid:** Do not plant Eastern White Pine near Austrian and Scotch Pine. If a few trees are infested, apply a stream of water to the tree trunk, blasting insects off. If a dormancy spray is missed, apply a listed insecticide with a spreader-sticker when adelgids are active (late April – May). A spreader-sticker helps to penetrate the waxy covering of the adelgid.

- Acephate
- Bifenthrin
- Carbaryl
- Chlorpyrifos
- Deltamethrin
- Dinotefuran
- Esfenvalerate
- Imidacloprid
- **Mineral Oil**
- Oxydemeton-methyl
- **Petroleum Oil**
- **Potassium Salts of Fatty Acids**
- **Soybean Oil (Food Grade)**
- Spirotetramat
- Thiamethoxam

Active IngredientsAphids (Balsam Twig, *Cinara* sp., Spotted Pine, W. Pine) (#98, 136)

Do not buy infested trees or nursery stock. Control over-wintering forms with a horticultural oil. Dormant oil kills aphids, but has a limited affect on overwintering eggs. Thorough spray coverage is essential for control.

**Balsam Twig Aphid:** *Plant species with delayed bud break (Firs). Pick and destroy young cones in the spring (time consuming, but pesticides don't reach inside cones). Apply a listed insecticide with a spreader-sticker after egg hatch, but before bud break (aphids protected by new growth). A spreader-sticker helps to penetrate the waxy covering of the aphid. Trees need a minimum of two years of normal growth to cover damaged foliage, so control this pest for several years before trees are to be marketed, ensuring a top-quality product.*

**White Pine Aphid:** *Application of a listed insecticide is only necessary when a large aphid population is present.*

- Abamectin
- Acephate
- Acetamiprid
- **Azadirachtin**
- ***Beauveria bassiana* ATCC 74040**
- ***Beauveria bassiana* Strain GHA**
- Bifenthrin
- Carbaryl
- Chlorpyrifos
- **Clarified Hydrophobic Extract of Neem Oil**
- Cyfluthrin
- Deltamethrin
- Diazinon
- Dimethoate
- Dinotefuran
- Esfenvalerate
- *Gamma*-cyhalothrin
- Imidacloprid
- Imidacloprid + Cyfluthrin
- *Lambda*-cyhalothrin
- Malathion
- Methiocarb
- **Mineral Oil**
- Naled
- Oxydemeton-methyl
- Permethrin
- **Petroleum Oil**
- **Petroleum Oil (Emulsified)**
- **Potassium Salts of Fatty Acids**
- Pymetrozine
- **Pyrethrins**
- Pyriproxyfen
- **Sorbitol Octanoate**
- **Soybean Oil (Food Grade)**
- Spirotetramat
- Thiamethoxam

## Bagworm (#50)

*Remove and burn severely infested trees in and around fields. When practical, hand pick over-wintering bags before June. If chemical control is necessary, it is most effective when applied to young larvae. Apply a listed insecticide shortly after egg hatch, while bags are still tiny (early to mid-June). Make a second application 10 days later if necessary. Put out baited pheromone traps in August to trap male moths, reducing the number of male moths available for mating.*

- Acephate
- **Azadirachtin**
- ***Bacillus thuringiensis* subsp. *aizawai***
- ***Bacillus thuringiensis* subsp. *kurstaki***
- Bifenthrin
- Carbaryl
- Chlorpyrifos
- Deltamethrin
- Diazinon
- Diflubenzuron
- Dimethoate
- *Gamma*-cyhalothrin
- Imidacloprid + Cyfluthrin
- *Lambda*-cyhalothrin
- Malathion
- Oxydemeton-methyl
- Permethrin
- **Pyrethrins**
- **Spinosad**
- Tebufenozide

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**Active Ingredients**


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**Bark Beetles (#42, 151)**

Most bark beetles are secondary pests. Sanitation is important in reducing the effect of these pests. Remove potential breeding material (e.g. mature pines damaged by diseases, insects, etc). Remove and destroy dying or dead pines that may act as bark beetle reservoirs. Maintain tree vigor through proper fertilization and irrigation. Cut stumps as low as possible and eliminate slash piles. Treat stumps in early spring to prevent larval development. Application of a listed insecticide is only necessary for high-valued trees or balled-and-burlapped white pine during times of beetle flight. Contact your regional Plant Inspector for more information.

**Gypsy Moth**

Do not plant trees near hardwoods (e.g. oak, other preferred hosts). Apply a listed insecticide when larvae are less than one inch long (early to mid-May). Contact your regional Plant Inspector or local extension agent for specific recommendations.

**Midges (Douglas-fir Needle, Pine Needle) (#125)**

Insecticide applications are only effective on the adults.

**Douglas-fir Needle Midge:** Plant late bud breaking tree varieties to decrease midge damage. Remove old, overgrown, and heavily infested trees from field edges, as damage is severe on these trees. Make the first application of a listed insecticide no later than a day after the first midge is collected in the trap. Make a second application in two weeks, if adults continue to emerge.

**Pine Needle Midge:** Once larvae are out, it is too late to apply controls for the current year. Application of listed insecticide should be directed at the top third of the tree, when the needles are beginning to elongate. Damage from or presence of larvae indicates a possible need for application of controls the following year.

- **Azadirachtin**
  - Bifenthrin
  - Carbaryl
  - Chlorpyrifos
  - Gamma-cyhalothrin
  - Lambda-cyhalothrin
  - Oxydemeton-methyl
  - Permethrin
  - Acephate
  - **Azadirachtin**
  - Bifenthrin
  - **Bacillus thuringiensis subsp. aizawai**
  - **Bacillus thuringiensis subsp. kurstaki**
  - Bifenthrin
  - Carbaryl
  - Chlorpyrifos
  - Cyfluthrin
  - Deltamethrin
  - Diflubenzuron
  - Gamma-cyhalothrin
  - Imidacloprid + Cyfluthrin
  - Lambda-cyhalothrin
  - Oxydemeton-methyl
  - Permethrin
  - Phosmet
  - **Potassium Salts of Fatty Acids**
  - **Pyrethrins**
  - **Spinosad**
  - Tebufenozide
  - Acephate
  - **Azadirachtin**
  - Carbaryl
  - Chlorpyrifos
  - Dimethoate
  - Esfenvalerate
  - Lambda-cyhalothrin
  - **Pyrethrins**
  - Thiamethoxam
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## Active Ingredients

## Mites (#60, 69, 117, 118, 148, 190)

Monitor populations regularly and apply controls when increases are noted. Long periods of heavy rain can significantly reduce mite populations. Most Eriophyid and Spider Mites on conifers are "cool season" mites, with peak populations in the spring and fall. Apply (dormant) horticultural oil before bud break. Insecticidal soaps are effective, but require regular re-application (no residual activity). To avoid resistance, use a different class of miticide every third application.

**Eriophyid Mites:** *Even if eggs have hatched, a thorough application of oil will control active mites. Apply a listed miticide labeled specifically for Rust or Eriophyid mites in mid-April to mid-May. Make a second application one to two weeks later, if necessary. Scout in the fall to see if a third application is needed.*

**Spruce Spider Mite:** *Apply a listed miticide in early May and again in mid-September or whenever populations increase. Some insecticide applications (carbaryl, imidacloprid, some pyrethroids) for other pests may increase spider mite populations by destroying natural enemies. It is a good idea to apply a listed miticide with the above-mentioned insecticides, but always consult the product label before mixing and applying. Control of spider mites depends on a thorough miticide application when mites are active. A second application may be needed 7 to 10 days later to kill mites unaffected by the first spray (unless prohibited by label).*

- Abamectin
- Acephate
- Acequinocyl
- **Azadirachtin**
- **Beauveria bassiana ATCC 74040**
- Bifenazate
- Bifenthrin
- Carbaryl
- Chlorpyrifos
- **Clarified Hydrophobic Extract of Neem Oil**
- Clofentezine
- Deltamethrin
- Diazinon
- Dimethoate
- Etoxazole
- Fenpropathrin
- Fenpyroximate
- Hexythiazox
- *Lambda-cyhalothrin*
- Malathion
- Methiocarb
- **Mineral Oil**
- Naled
- Oxydemeton-methyl
- **Petroleum Oil (Emulsified)**
- **Potassium Salts of Fatty Acids**
- **Sorbitol Octanoate**
- **Spinosad**
- Spirodiclofen
- Spiromesifen

## Sawflies (#54, 55)

*Plant non-pine species that are not susceptible to sawfly damage. Remove trees larger than marketable size to eliminate sawfly reservoirs. Prune and destroy infested branches of trees not ready for harvest if field infestation is small. Hand pick larvae and squash or place them in soapy water for a few days, if infestations are small. Apply a listed insecticide when young larvae have infested at least 25% of trees (spot treat). Additional applications of a listed insecticide may be needed more than once per season.*

- Acephate
- Acetamiprid
- **Azadirachtin**
- Bifenthrin
- Carbaryl
- Chlorpyrifos
- Cyfluthrin
- Deltamethrin
- Diflubenzuron
- Esfenvalerate
- *Gamma-cyhalothrin*
- Imidacloprid
- Imidacloprid + Cyfluthrin
- *Lambda-cyhalothrin*
- **Mineral Oil**
- Permethrin
- **Petroleum Oil (Emulsified)**
- Phosmet
- **Potassium Salts of Fatty Acids**
- **Spinosad**
- Thiamethoxam

## Active Ingredients

Scales (Cryptomeria, Elongate Hemlock, Pine Needle, Pine Tortoise, Spruce Bud, Striped Pine) (#32, 36, 87, 108, 178, 200)

Remove and destroy mature trees near or in fields that can serve as source of infestation. Scale control is directed toward the crawler stage. Avoid using broad-spectrum insecticides which kill natural predators.

**Cryptomeria Scale:** The first generation of crawlers emerge around mid-June, with second generation crawlers emerging in mid-August. Plant tree varieties that are less susceptible to infestations. Remove and destroy heavily infested trees before bud break. Wrap trees in a tarp when dragging them through the field, so other trees do not become infested. Clean mower blades and tractors when moving from infested to non-infested fields. Butt-prune infested trees to remove heavily infested, lower branches. Apply dormant oil in spring before bud break, ensuring thorough coverage of the underside of lower branches. For controlling first and second generation crawlers, apply a listed insecticide after crawlers are first seen, repeating applications every 7 to 10 days. Up to four sprays may be needed in one (growing) season. Look at infested branches for new scales after each spray to see if another spray is warranted. Check needles from two to three seasons back for crawlers.

**Elongate Hemlock Scale:** Plant tree species not susceptible to this pest. Apply a listed insecticide throughout the summer (mid-May to mid-September), 3 to 4 times over 12 weeks (3 sprays with 4 weeks between each spray OR 4 sprays with 3 weeks between each spray). Closely monitor trees the following year to determine scale survival.

**Pine Needle Scale:** Prune and destroy heavily infested branches. Do not mow or remove infested trees during crawler emergence, as it will spread crawlers. Sometimes natural predators can manage the infestation, but they are not reliable. Moderate success has been achieved using dormant oil in the early spring. Make a listed insecticide application targeting crawlers for 2-3 weeks, at 7-day intervals after the first crawler is seen (late May – early June). Monitor for the second generation in mid-July to early August.

**Pine Tortoise Scale:** Apply dormant oil in early spring, targeting overwintering females. Make two applications of a listed insecticide at 10- to 14-day intervals after egg hatch. Populations in Pennsylvania are high for a few years, followed by a few years of low populations, possibly due to natural enemy population cycles.

**Spruce Bud Scale:** Current and historical status of low populations warrants no control. If control would be necessary, target the crawler stage with a thorough coverage of a horticultural oil or insecticidal soap. This scale is commonly attacked by small, parasitic wasps.

**Striped Pine Scale:** Remove and destroy severely infested trees before bud break. Apply (dormant) horticultural oil in the fall or spring before bud break. Apply a listed insecticide at crawler emergence in the early summer. Examine foliage to see if a second spray is warranted.

Shoot & Tip Boring Moths (Eastern Pine Shoot Borer, European Pine Shoot Moth, Nantucket Pine Tip Moth) (#162, 183)

**Eastern Pine Shoot Borer:** Apply a listed insecticide in May to kill larvae before they bore into shoots. Most larvae have left shoots when damage is apparent, making insecticides ineffective. Adults emerge from mid-April through June.

**European Pine Shoot Moth:** Larvae should be controlled during the first two weeks of April, as they migrate to new shoots. Pines can also be treated in late June or early July, after egg hatch. Shear trees after mid-July to remove eggs or larvae from the tips of new shoots. Shoots with mature larvae should be destroyed before adult emergence (mid-June). They cannot survive cold temperatures, with -20°F and below being lethal. Dry weather and poor soil conditions cause populations to increase. Apply a listed insecticide at egg hatch or when overwintering larvae move to new shoots in the spring.

**Nantucket Tip Pine Moth:** Controls should be targeted at young larvae before they conceal themselves. Accurate identification is essential, as damage resembles other shoot-boring insects and shoot blight diseases. Control small infestations in small fields by pruning and destroying infested tips. Use pheromone traps to determine adult emergence in the spring. Apply a listed insecticide two weeks after peak emergence. If no traps are available, apply a listed insecticide in mid-May to late June, making a second application in mid-July to late August. A third generation is possible in southeastern Pennsylvania during long, dry summers.

- Acephate
- **Azadirachtin**
- Bifenthrin
- Buprofezin
- Carbaryl
- Chlorpyrifos
- Dimethoate
- Dinotefuran
- Gamma-cyhalothrin
- Imidacloprid
- Lambda-cyhalothrin
- **Mineral Oil**
- Oxydemeton-methyl
- **Petroleum Oil (Emulsified)**
- **Potassium Salts of Fatty Acids**
- **Sorbitol Octanoate**
- Spirotetramat
- Thiamethoxam

- Acephate
- **Azadirachtin**
- Bifenthrin
- Carbaryl
- Chlorpyrifos
- Cyfluthrin
- Deltamethrin
- Diazinon
- Diflubenzuron
- Dimethoate
- Esfenvalerate
- Gamma-cyhalothrin
- Imidacloprid
- Imidacloprid + Cyfluthrin
- Lambda-cyhalothrin
- Malathion
- Oxydemeton-methyl
- Permethrin
- Phosmet
- **Pyrethrins**
- **Spinosad**
- Tebufenozide

## Active Ingredients

## Spittlebugs (Pine &amp; Saratoga) (#150)

*Thinning stands may help to increase tree vigor. Eggs can be destroyed through shearing and by removing and destroying dead branches. Replant Scotch Pine with more resistant conifers (e.g. Douglas-fir, fir, spruce). Apply a listed insecticide in late June to mid-July when 95% of the spittlebug masses are empty. Damage is usually more aesthetic than economic. Controlling Pine Spittlebug will also decrease problems associated with Diplodia Tip Blight.*

- Azadirachtin
- Bifenthrin
- Carbaryl
- Chlorpyrifos
- Cyfluthrin
- Esfenvalerate
- Gamma-cyhalothrin
- Imidacloprid + cyfluthrin
- Lambda-cyhalothrin
- Naled
- Pyrethrins

## Weevils (Eastern Pine, Pales, Pine Root Collar, &amp; White Pine) (#31, 47, 56, 111, 122 154)

Delay planting for two years where pines were recently harvested. Remove and destroy stumps. In early spring, apply a listed insecticide to stumps from last year's harvested trees. Stumps more than two years old do not need to be treated. Remove dying and dead trees in early spring. Remove and destroy damaged or susceptible trees before planting.

**Eastern Pine Weevil:** *Remove and destroy weak pines near field edges. Treat freshly cut stumps and surrounding soil with a listed insecticide to control ovipositing adults in early spring. If severe damage is found, apply a listed insecticide to control adults feeding on seedlings/transplants and mature trees in late summer. Follow the same controls for Pales Weevil.*

**Pales Weevil:** *In cases of high populations, apply a listed insecticide to mature trees in the spring (April – May) and again in August or September to kill actively feeding weevils. Apply a listed (foliar) insecticide in late summer.*

**Pine Root Collar Weevil:** *Do not interplant Scotch Pine with other pines. Prevent attack by planting new fields a minimum of one mile away from known infestations. Plant resistant Scotch pine varieties in small, single-species blocks, only interplanting with fir, spruce, and deciduous trees. Reduce populations and the risk of infestation by butt-pruning at least 12 inches, removing leaf litter from under the tree, and removing one to two inches of soil to create an undesirable setting for ovipositing adults. Two drench applications of a listed insecticide are required for successful control of adults. Make a first application in mid-May (before egg laying), with a second application in mid-August to mid-September (newly, emerging adults).*

**White Pine Weevil:** *Prune damaged leaders as soon as wilting (shepherd's crook) is seen, but before adults emerge (mid-July). Leaders need to be pruned until to healthy, green wood is reached. Do not use damaged leaders to train new ones. Apply a listed insecticide to the top third of the tree, when the first weevil is found in a trap or on a tree (late March – early April). Delaying insecticide applications will result in poor control. Only make insecticide applications when temperatures are forecasted to be above 50°F for a few days. A second application is warranted only if heavy feeding by adults is seen.*

- Acephate
- Azadirachtin
- **Beauveria bassiana ATCC 74040**
- **Beauveria bassiana Strain GHA**
- Bifenthrin
- Chlorpyrifos
- Diflubenzuron
- Dinotefuran
- Esfenvalerate
- Gamma-cyhalothrin
- Indoxacarb
- Lambda-cyhalothrin
- Naled
- Oxydemeton-methyl
- Permethrin
- Phosmet
- Pyrethrins

## Zimmerman Pine Moth (#192)

*Fir Coneworm, a relative to Zimmerman Pine Moth, may be a possible pest in Pennsylvania. Avoid planting trees too deep, which may lead to health issues. Remove and destroy heavily damaged trees, before adults emerge (early July). Mechanical damage to trunks may increase risk of attack. Prune and destroy injured shoots. Apply a listed insecticide (drench) to the main trunk and branch bark when larvae are plentiful and attacking (in early April to early May). Contact your regional Plant Inspector or local extension agent for more information.*

- Acephate
- Bifenthrin
- Chlorpyrifos
- Diflubenzuron
- Dimethoate
- Endosulfan
- Naled
- Permethrin
- Tebufenozide

## Insecticide & Miticide Information

Call **1-800-PENN IPM** (736-6476) for Christmas tree pest scouting reports (April through June; special report in early August)

Penn State Christmas trees website: <http://ento.psu.edu/extension/christmas-trees>

To view chemical labels, go to: <http://www.cdms.net/LabelsMsds/LMDefault.aspx?t=>

### DISCLAIMER

**ALWAYS READ THE PESTICIDE LABEL TO DETERMINE SPECIFIC USES AND RATES BEFORE MIXING AND APPLYING THE COMPOUND. IF ANY QUESTIONS ARISE, CONTACT THE DEALER OR MANUFACTURER. IT IS ILLEGAL TO APPLY ANY PESTICIDE IN EXCESS OF LABELED RATES. LABELED USES MAY VARY FOR EACH FORMULATION OF THE SAME CHEMICAL. PURCHASE THE FORMULATION INTENDED FOR YOUR PARTICULAR USE.**

Where trade names are used, no discrimination is intended and no endorsement by the Pennsylvania Department of Agriculture is implied. There has been no attempt to rank chemicals in order of effectiveness. Every effort has been made to provide correct and up-to-date control suggestions. However, pesticide labels change constantly and human errors are possible. It is the applicator's responsibility to read the label before using any pesticide. Controls on this sheet supersede those given on sheets from previous years.

### Document Key

**Active Ingredient | Chemical Class | IRAC # | Trade Names** = Bio-rational Product

**L** = Need Special Local Needs Label

**R** = RESTRICTED USE PESTICIDE

### IRAC Codes

The Insecticide Resistance Action Committee (IRAC) is a group whose members are companies manufacturing insecticides and acaricides and operating in the areas of crop protection, plant biotechnology, and/or public health. The mission of IRAC is to (a) aid communication and education on insecticide and acaricide resistance and (b) promote the development of resistance management strategies in crop protection and vector control to maintain efficiency and support sustainable agriculture and improved public health. The IRAC has developed a mode of action classification based upon known ways in which different products act. For more information, please visit <http://www.irac-online.org>.

### Classification of Pesticides Listed under Each Pest

Knowledge of pesticide classification has become increasingly important in Christmas tree pest management programs. Using different classes of pesticides slows the development of resistance in the targeted pest, thus extending the useful life of chemicals, a worthwhile goal for all growers. It is important to rotate classes or different types of chemicals, not just brand names.

### Class of Chemicals and Active Ingredients

The following table is arranged by active ingredients and linked to their respective chemical class, IRAC codes, and all trade names currently registered in Pennsylvania. **AS ALWAYS, READ AND FOLLOW ALL LABEL INSTRUCTIONS BEFORE USING ANY PESTICIDE PRODUCT. NEVER USE ANY PESTICIDE IN A MANNER INCONSISTENT WITH THE US EPA APPROVED LABELING!**

Active Ingredient	Chemical Class	IRAC #	Trade Names
abamectin	Avermectin, Milbemycins	6	Minx (Cleary Chemical Corporation); Quali-Pro Abamectin 0.15 EC (Makhteshim Agan of North America, Inc); Abamectin SPC 0.15 EC (Nufarm Americas Inc); Lucid (Rotam North America, Inc); Ardent 0.15EC, Avid 0.15EC (Syngenta Crop Protection, Inc); Timectin 0.15 EC T&O (Tide International USA, Inc)
acephate	Organophosphates	1B	Orthene Turf, Tree & Ornamental WSP (AMVAC Chemical Corporation); ACE-jet (ARBORJET, Inc); Acephate 90 Soluble, Acephate 90 WDG (Arysta LifeScience North America, LLC); Acephate 90 WDG (Loveland Products, Inc); Acephate 90 Prill (Makhteshim Agan of North America, Inc); Avatar (Phoenix Environmental Care, LLC); Lepitect, Lepitect Infusible (Rainbow Treecare Scientific Advancements); Tenkoz Acephate 97 (Tenkoz, Inc); Tide Acephate 90WDG (Tide International USA, Inc); Acephate 97UP (United Phosphorus, Inc); Bracket 97 (Winfield Solutions, LLC)
acequinocyl	Acequinocyl	20B	Shuttle 15 SC (Arysta LifeScience North America, LLC); Shuttle O (OHP, Inc)
acetamiprid	Neonicotinoids	4A	TriStar 30 SG (Cleary Chemical Corporation)

<b>Active Ingredient</b>	<b>Chemical Class</b>	<b>IRAC #</b>	<b>Trade Names</b>
azadirachtin	Azadirachtin	UN	Amazin Plus 1.2% ME, Ecozin Plus 1.2% ME (AMVAC Chemical Corporation); Azatin XL (OHP, Inc); Ornazin 3% EC (SePRO Corporation)
<i>Bacillus thuringiensis</i> subsp. <i>aizawai</i>	Microbials	11	XenTari (Valent BioSciences Corporation)
<i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i>	Microbials	11	Crymax, Javelin WG (Certis USA, LLC); Biobit HP, DiPel ES, DiPel Pro DF (Valent BioSciences Corporation)
<i>Beauveria bassiana</i> ATCC 74040			Naturalis L (OHP, Inc)
<i>Beauveria bassiana</i> strain GHA			BotaniGard 22WP, BotaniGard ES, Mycotrol O (Laverlam International Corporation)
bifenazate	Bifenazate	UN	Floramite SC (Chemtura Corporation)
bifenthrin	Pyrethroids	3A	Wisdom Nursery Granular (AMVAC Chemical Corporation); <sup>R</sup> OynxPro, Talstar N Granular, <sup>R</sup> Talstar Select (FMC Corporation); <sup>R</sup> Quali-Pro Bifenthrin Golf & Nursery 7.9F (Makhteshim Agan of North America, Inc); <sup>R</sup> Menace GC 7.9% Flowable (Nufarm Americas Inc); <sup>R</sup> Firebird Pro (Phoenix Environmental Care, LLC); UP-Star Nursery Granular, <sup>R</sup> UP-Star SC (United Phosphorus, Inc)
buprofezin	Buprofezin	16	Talus 40SC (Nichino America, Inc); Talus 40SC, Talus 70DF (SePRO Corporation)
carbaryl	Carbamates	1A	Sevin 4F, Sevin RP4, Sevin XLR Plus (Bayer CropScience LP); Sevin 80 WSP, Sevin SL (Bayer Environmental Science); Carbaryl 4L, Carbaryl 80S (Drexel Chemical Company); Carbaryl 4L (Loveland Products, Inc)
chlorpyrifos	Organophosphates	1B	<sup>R</sup> Nufos 4E (Cheminova, Inc); <sup>R</sup> Dursban 50W, <sup>R</sup> Hatchet, <sup>R</sup> Lorsban-4E, <sup>R</sup> Lorsban Advanced (Dow AgroSciences LLC); <sup>R</sup> Chlorpyrifos 4E-AG (Drexel Chemical Company); Lorsban 75WG (Gowan Company); <sup>R</sup> Whirlwind (Helena Chemical Company); <sup>R</sup> Warhawk (Loveland Products, Inc); <sup>R</sup> Chlorpyrifos 4E AG, <sup>R</sup> Quali-Pro Chlorpyrifos 4E (Makhteshim Agan of North America, Inc); <sup>R</sup> Govern 4E (Tenkoz, Inc); <sup>R</sup> Yuma 4E (Winfield Solutions, LLC)
clarified hydrophobic extract of neem oil			Triact 70 (OHP, Inc)
clofentezine	Clofentezine, Hexythiazox, Diflovidazin	10A	Apollo SC (Makhteshim Agan of North America, Inc); Ovation SC (Scotts-Sierra Crop Protection Company)
cyfluthrin	Pyrethroids	3A	Decathlon 20 WP (OHP, Inc)
deltamethrin	Pyrethroids	3A	<sup>R</sup> DeltaGard GC 5 SC (Bayer Environmental Science)
diazinon	Organophosphates	1B	<sup>R</sup> Diazinon AG600 WBC (Loveland Products, Inc); <sup>R</sup> Diazinon 50W, <sup>R</sup> Diazinon AG500 (Makhteshim Agan of North America, Inc)
diflubenzuron	Benzoylureas	15	<sup>R</sup> Dimilin 25W, <sup>R</sup> Dimilin 4L (Chemtura Corporation)
dimethoate	Organophosphates	1B	Dimethoate 267, <sup>L</sup> Dimethoate 4E (Arysta LifeScience North America, LLC); Dimethoate 4E (Cheminova, Inc); Dimethoate 4EC (Drexel Chemical Company); Dimethoate 400 (Loveland Products, Inc); Dimate 4E (Winfield Solutions, LLC)
dinotefuran	Neonicotinoids	4A	<sup>L</sup> Safari 20 SG (Valent USA Corporation)
endosulfan	Cyclodiene Organochlorines	2A	<sup>R</sup> Thionex 3EC (Makhteshim Agan of North America, Inc)
esfenvalerate	Pyrethroids	3A	<sup>R</sup> Asana XL (E.I. du Pont de Nemours & Company); <sup>R</sup> S-FenvaloStar (LG International (America), Inc); <sup>R</sup> Adjourn, <sup>R</sup> Silencer (Makhteshim Agan of North America, Inc)
etoxazole	Etoxazole	10B	<sup>L</sup> TetraSan 5 WDG (Valent USA Corporation)
fenpropathrin	Pyrethroids	3A	<sup>R</sup> Tame 2.4 EC Spray (Valent USA Corporation)
fenpyroximate	METI Acaricides & Insecticides	21A	Akari 5SC (SePRO Corporation)



<b>Active Ingredient</b>	<b>Chemical Class</b>	<b>IRAC #</b>	<b>Trade Names</b>
<i>gamma</i> -cyhalothrin	Pyrethroids	3A	<sup>R</sup> Declare (Cheminova, Inc); <sup>R</sup> Proaxis (Loveland Products, Inc)
hexythiazox	Clofentezine, Hexythiazox, Diflovidazin	10A	Hexygon DF, <sup>L</sup> Onager, Savey 50 DF (Gowan Company)
imidacloprid	Neonicotinoids	4A	IMA-jet (ARBORJET, Inc); Provado 1.6 (Bayer CropScience LP); Couraze 1.6F (Cheminova, Inc); Prey 1.6, Sherpa (Loveland Products, Inc); Pasada 1.6F (Makhteshim Agan of North America, Inc); Nuprid 2SC (Nufarm Americas Inc); Xytect Infusible (Rainbow Treecare Scientific Advancements); Advise 2FL (Winfield Solutions, LLC)
imidacloprid + cyfluthrin	Neonicotinoids; Pyrethroids	4A; 3A	Discus (OHP, Inc)
indoxacarb	Indoxacarb	22	<sup>L</sup> Avaunt (E.I. du Pont de Nemours & Co)
<i>lambda</i> -cyhalothrin	Pyrethroids	3A	<sup>R</sup> CropSmart Lambda-Cy (CropSmart, LLC); <sup>R</sup> Cavalry (Growmark, Inc); <sup>R</sup> Lambda-T (Helena Chemical Company); <sup>R</sup> Kendo (Helm Agro US, Inc); <sup>R</sup> LambdaStar, <sup>R</sup> LambdaStar 1 CS (LG International (America), Inc); <sup>R</sup> Silencer (Makhteshim Agan of North America, Inc); <sup>R</sup> Kaiso 24WG, <sup>R</sup> Lambda-Cyhalothrin 1 EC (Nufarm Americas Inc); <sup>R</sup> Scimitar GC, <sup>R</sup> Warrior, <sup>R</sup> Warrior II (Syngenta Crop Protection, Inc); <sup>R</sup> Province (Tenkoz, Inc); <sup>R</sup> Lambda-Cy EC Insecticide-RUP (United Phosphorus, Inc); <sup>R</sup> Grizzly Z, <sup>R</sup> Taiga Z (Winfield Solutions, LLC)
malathion	Organophosphates	1B	Malathion 5 EC (Arysta LifeScience North America, LLC); Malathion 5EC (Drexel Chemical Company); 5 LB. Malathion Spray (Prentiss Incorporated); Malathion 5 (Winfield Solutions, LLC)
methiocarb	Carbamates	1A	<sup>R</sup> Mesuroil 75-W (Gowan Company)
mineral oil			Damoil (Drexel Chemical Company); Glacial Spray Fluid (Loveland Products, Inc); RTSA Horticultural Oil (Rainbow Treecare Scientific Advancements)
naled	Organophosphates	1B	<sup>R</sup> Dibrom 8 Emulsive (AMVAC Chemical Corporation)
oxydemeton-methyl	Organophosphates	1B	<sup>R</sup> MSR Spray Concentrate (Gowan Company); <sup>R</sup> Harpoon (Tree Tech Microinjection Systems)
permethrin	Pyrethroids	3A	<sup>R</sup> Ambush, <sup>R</sup> Ambush 25W (AMVAC Chemical Corporation); <sup>R</sup> Permethrin 3.2 AG (Arysta LifeScience North America, LLC); <sup>R</sup> Pounce 25 WP (FMC Corporation); <sup>R</sup> PermaStar AG (LG International (America), Inc); <sup>R</sup> Permethrin (Loveland Products, Inc); <sup>R</sup> Tenkoz Permethrin 3.2EC (Tenkoz, Inc); <sup>R</sup> Perm-UP 25DF, <sup>RL</sup> Perm-UP 3.2 EC (United Phosphorous, Inc); <sup>R</sup> Arctic 3.2 EC (Winfield Solutions, LLC)
petroleum oil (emulsified)			SuffOil-X (BioWorks, Inc); Saf-T-Side (Brandt Consolidated, Inc); PureSpray Green, PureSpray Spray Oil 10E (Petro-Canada)
phosmet	Organophosphates	1B	Imidan 70-W (Gowan Company)
potassium salts of fatty acids	Insecticidal Soaps		Des-X (Certis USA, LLC); M-Pede (Dow AgroSciences LLC)
pymetrozine	Pymetrozine	9B	Endeavor (Syngenta Crop Protection, Inc)
pyrethrins	Pyrethroids	3A	Pyreth-It Formula 2 (BASF Corporation); Pyrenone Crop Spray (Bayer Environmental Science); EverGreen Crop Protection EC 60-6, PyGanic Crop Protection EC 1.4 <sub>II</sub> , PyGanic Crop Protection EC 5.0 <sub>II</sub> (McLaughlin Gormley King Company); Pyronyl Crop Spray (Prentiss Incorporated)
pyriproxyfen	Pyriproxyfen	7C	Distance (Valent USA Corporation)
sorbitol octanoate			SorbiShield 90 (Natural Forces, LLC)
soybean oil (food grade)			Golden Pest Spray Oil (Stoller Enterprises, Inc)

<b>Active Ingredient</b>	<b>Chemical Class</b>	<b>IRAC #</b>	<b>Trade Names</b>
spinosad	Spinosyns	5	Blackhawk, Conserve SC, Entrust, SpinTor 2SC, Success (Dow AgroSciences LLC)
spirodiclofen	Tetronic & Tetramic Acid Derivatives	23	Envidor 2 SC (Bayer CropScience LP)
spiromesifen	Tetronic & Tetramic Acid Derivatives	23	Judo (OHP, Inc)
spirotetramat	Tetronic & Tetramic Acid Derivatives	23	Movento (Bayer CropScience LP)
tebufenozide	Diacylhydrazines	18	Confirm 2F, Mimic 2LV (Dow AgroSciences LLC)
thiamethoxam	Neonicotinoids	4A	Flagship 0.22G, Flagship 25WG (Syngenta Crop Protection, Inc)