Insecticides & Miticides for PA Christmas Tree Pests

Pennsylvania Department of Agriculture, Bureau of Plant Industry

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

	Active Ingredients
Adelgids (Cooley Spruce Gall, Eastern 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 the first frost (late fall). Thorough coverage, including inner branches, is essential. ***Cooley Spruce Gall Adelgid:*** *Plant tolerant or resistant Douglas-fir varieties. In the spring, make an insecticide application after nymphs and immature females begin to swell, but before white waxy threads are produced. Make a second insecticide application seven to 10 days later, but before bud break. In the fall, make an insecticide application in late September or October to control exposed nymphs and immature females before overwintering.* ***Cooley Spruce Gall Adelgid:*** *Prune and destroy unopened galls before nymphs emerge (mid-July). Apply an insecticide in early April, when adelgids are exposed (no waxy, white threads or eggs will be present). Apply an 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 an insecticide from mid-September or October to control the 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 insecticide application is missed, apply an insecticide with a spreader-sticker when adelgids are active (late April to May). A spreader-sticker helps to penetrate the waxy covering of the adelgid.*	▪ Acephate ▪ Bifenthrin ▪ Carbaryl ▪ Chlorpyrifos ▪ Dinotefuran ▪ Esfenvalerate ▪ Imidacloprid ▪ Imidacloprid + Cyfluthrin ▪ **Mineral Oil** ▪ **Potassium Salts of Fatty Acids** ▪ Spirotetramat ▪ Thiamethoxam
Aphids (Balsam Twig, *Cinara spp.,* White 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. Regardless of which insecticide is used, thorough coverage is necessary for successful control. ***Balsam Twig Aphid:*** *Plant species with delayed bud break (e.g. Firs). Pick and destroy young cones in the spring (time consuming, but pesticides don't reach inside cones). Apply an 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.* ***Cinara spp. Aphid:*** *These aphids produce large amounts of honeydew, which attracts sooty mold. Cinara spp. attacks to seedlings sometimes result in the death of some plants. Cinara spp. builds up their populations during times of cool temperatures (i.e. spring and fall). Cinara spp. aphids are often found by looking for ants or bees that are searching tree foliage for honeydew. Cinara spp. can also be found by holding white paper under a branch and striking it with a stick. Several lady beetle and lacewing larvae specialize in feeding on aphids, in addition to several parasitic wasps. By reducing insecticide use, these biocontrols usually keep aphids under control.* ***White Pine Aphid:*** *Application of an insecticide is only necessary when a large aphid population is present.*	▪ Abamectin ▪ Acephate ▪ **Azadirachtin** ▪ ***Beauveria bassiana* Strain GHA** ▪ Bifenazate + Abamectin ▪ Bifenthrin ▪ Carbaryl ▪ Chlorpyrifos ▪ Chlorpyrifos + Gamma-cyhalothrin ▪ Chlorpyrifos + Lambda-cyhalothrin ▪ *Chromobacterium subtsugae* strain PRAA4-1 ▪ Cyfluthrin ▪ Dimethoate ▪ Dinotefuran ▪ Esfenvalerate ▪ Fipronil ▪ Gamma-cyhalothrin ▪ Imidacloprid ▪ Imidacloprid + Cyfluthrin ▪ Lambda-cyhalothrin ▪ Malathion ▪ **Mineral Oil** ▪ Naled ▪ Oxydemeton-methyl ▪ Piperonyl Butoxide + Pyrethrins ▪ **Potassium Salts of Fatty Acids** ▪ Pymetrozine ▪ **Soybean Oil (Food Grade)** ▪ Spirotetramat ▪ Thiamethoxam

	Active Ingredients
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 an insecticide shortly before 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. *kurstaki* strain ABTS-351** ▪ ***Bacillus thuringiensis* subspecies *kurstaki* strain EG7841** ▪ Bifenthrin ▪ Carbaryl ▪ Chlorpyrifos ▪ *Chromobacterium subtsugae* strain PRAA4-1 & spent fermentation media ▪ Cyfluthrin ▪ Diflubenzuron ▪ Dimethoate ▪ Flubendiamide ▪ Gamma-cyhalothrin ▪ Imidacloprid + Cyfluthrin ▪ Lambda-cyhalothrin ▪ Malathion ▪ Permethrin ▪ Piperonyl Butoxide + Pyrethrins ▪ **Spinosad** ▪ Tebufenozide
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 an 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.	▪ **Azadirachtin** ▪ Bifenthrin ▪ Carbaryl
Gypsy Moth Do not plant trees near hardwoods (e.g. oak, other preferred hosts). Apply an 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.	▪ Acephate ▪ **Azadirachtin** ▪ ***Bacillus thuringiensis* subsp. *kurstaki* strain ABTS-351** ▪ ***Bacillus thuringiensis* subspecies *kurstaki* strain EG7841** ▪ Bifenthrin ▪ Carbaryl ▪ Chlorpyrifos ▪ Chlorpyrifos + Gamma-cyhalothrin ▪ Chlorpyrifos + Lambda-cyhalothrin ▪ *Chromobacterium subtsugae* strain PRAA4-1 & spent fermentation media ▪ Cyfluthrin ▪ Diflubenzuron ▪ Flubendiamide ▪ Gamma-cyhalothrin ▪ Imidacloprid + Cyfluthrin ▪ Lambda-cyhalothrin ▪ Oxydemeton-methyl ▪ Phosmet ▪ Piperonyl Butoxide + Pyrethrins ▪ **Potassium Salts of Fatty Acids** ▪ **Spinosad** ▪ Tebufenozide

	Active Ingredients
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 an insecticide no later than a day after the first midge is collected in a trap. Make a second application in two weeks, if adults to continue to emerge.* ***Pine Needle Midge:*** *Once larvae are out, it is too late to apply controls for the current year. Application of an 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.*	▪ Acephate ▪ **Azadirachtin** ▪ Bifenthrin ▪ Chlorpyrifos ▪ Cyfluthrin ▪ Dimethoate ▪ Esfenvalerate ▪ Piperonyl Butoxide + Pyrethrins ▪ Thiamethoxam
Mites (#60, 69, 117, 118, 148, 190) Monitor populations regularly and apply miticides 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 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 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 miticide in early May and again in mid-September or whenever populations increase. Some insecticide applications (e.g. carbaryl, imidacloprid, some pyrethroids) for other pests may increase spider mite populations by destroying natural enemies. It is a good idea to apply a 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 seven to 10 days later to kill mites unaffected by the first application (unless prohibited by the label).*	▪ Abamectin ▪ Acephate ▪ Acequinocyl ▪ **Azadirachtin** ▪ Bifenazate + Abamectin ▪ Bifenthrin ▪ Carbaryl ▪ Chlorpyrifos ▪ *Chromobacterium subtsugae* strain PRAA4-1 & spent fermentation media ▪ Clofentezine ▪ Dimethoate ▪ Etoxazole ▪ Fenazaquin ▪ Fenpyroximate ▪ Hexythiazox ▪ Malathion ▪ **Mineral Oil** ▪ Oxydemeton-methyl ▪ **Petroleum Oil (Emulsified)** ▪ **Potassium Salts of Fatty Acids** ▪ Spirodiclofen ▪ Spiromesifen ▪ Spirotetramat
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 an insecticide when young larvae have infested at least 25% of the trees (spot treat). Additional applications of an insecticide may be needed more than once per season.	▪ Acephate ▪ **Azadirachtin** ▪ Bifenthrin ▪ Carbaryl ▪ Chlorpyrifos ▪ Chlorpyrifos + Gamma-cyhalothrin ▪ Chlorpyrifos + Lambda-cyhalothrin ▪ Cyfluthrin ▪ Diflubenzuron ▪ Esfenvalerate ▪ Gamma-cyhalothrin ▪ Imidacloprid ▪ Imidacloprid + Cyfluthrin ▪ Lambda-cyhalothrin ▪ Malathion ▪ **Mineral Oil** ▪ Phosmet ▪ **Potassium Salts of Fatty Acids** ▪ **Spinosad**

	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 a 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 before 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 the spring before bud break, ensuring thorough coverage of the underside of lower branches. For controlling first and second generation crawlers, apply an insecticide after crawlers are first seen, repeating applications every seven to 10 days. Up to four applications may be needed in one (growing) season. Look at infested branches for new scales after each application to see if another application is warranted. Check needles from two to three seasons back for crawlers.* ***Elongate Hemlock Scale:*** *Plant tree species not susceptible to this pest. Apply an insecticide throughout the summer (mid-May to mid-September), three to four times over 12 weeks (three applications with four weeks between each application OR four applications with three weeks between each application). 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 an insecticide application targeting crawlers for two to three weeks, at seven-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 an 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 an insecticide at crawler emergence in the early summer (late June – early July). Examine foliage to see if a second application is warranted.*	▪ Acephate ▪ **Azadirachtin** ▪ Bifenthrin ▪ Carbaryl ▪ Chlorpyrifos ▪ Chlorpyrifos + Gamma-cyhalothrin ▪ Chlorpyrifos + Lambda-cyhalothrin ▪ Cyfluthrin ▪ Dimethoate ▪ Dinotefuran ▪ Gamma-cyhalothrin ▪ Imidacloprid ▪ Imidacloprid + Cyfluthrin ▪ Lambda-cyhalothrin ▪ Malathion ▪ **Mineral Oil** ▪ Oxydemeton-methyl ▪ **Petroleum Oil (Emulsified)** ▪ **Potassium Salts of Fatty Acids** ▪ Spirotetramat
Shoot & Tip Boring Moths (Eastern Pine Shoot Borer, European Pine Shoot Moth, Nantucket Pine Tip Moth) (#162, 183) ***Eastern Pine Shoot Borer:*** *Apply an 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 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 an insecticide at egg hatch or when overwintering larvae move to new shoots in the spring.* ***Nantucket Pine Tip 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 an insecticide two weeks after peak emergence. If no traps are available, apply an 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 ▪ Carbaryl ▪ Chlorpyrifos ▪ Cyfluthrin ▪ Diflubenzuron ▪ Dimethoate ▪ Esfenvalerate ▪ Imidacloprid ▪ Imidacloprid + Cyfluthrin ▪ Lambda-cyhalothrin ▪ Malathion ▪ Permethrin ▪ Phosmet ▪ Piperonyl Butoxide + Pyrethrins ▪ **Spinosad**

	Active Ingredients
Spittlebugs (Pine & 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 an 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.	▪ Bifenthrin ▪ Carbaryl ▪ Chlorpyrifos ▪ Chlorpyrifos + Gamma-cyhalothrin ▪ Chlorpyrifos + Lambda-cyhalothrin ▪ Cyfluthrin ▪ Esfenvalerate ▪ Gamma-cyhalothrin ▪ Imidacloprid + Cyfluthrin ▪ Lambda-cyhalothrin ▪ Naled ▪ Piperonyl Butoxide + Pyrethrins ▪ Spirotetramat
Weevils (Eastern Pine, Pales, Pine Root Collar, & White Pine) (#31, 47, 56, 111, 122, 154) Delay planting for two years where pines were recently harvested. Remove dying and dead trees in the early spring. Remove and destroy damaged or susceptible trees before planting. ***Eastern Pine Weevil:*** *Remove and destroy weak pines near field edges. Remove and destroy stumps. In the early spring, apply an insecticide to stumps from last year's harvested trees and surrounding soil to control ovipositing adults. Stumps more than two years old do not need to be treated. If severe damage is found, apply an insecticide to control adults feeding on seedlings/transplants and mature trees in the later summer. Follow the same controls for Pales Weevil.* ***Pales Weevil:*** *Remove and destroy stumps. In the early spring, apply an insecticide to stumps from last year's harvested trees. Stumps more than two years old do not need to be treated. In cases of high populations, apply an insecticide to mature trees in the spring (April – May) and again in August or September to kill actively feeding weevils. Apply an (foliar) insecticide in the 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 an insecticide are required for successful control of adults. Make a first application in mid-May (before egg lying), 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 an 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* Strain GHA** ▪ Bifenthrin ▪ Chlorpyrifos ▪ Chlorpyrifos + Gamma-cyhalothrin ▪ Chlorpyrifos + Lambda-cyhalothrin ▪ Diflubenzuron ▪ Dinotefuran ▪ Esfenvalerate ▪ Gamma-cyhalothrin ▪ Imidacloprid + Cyfluthrin ▪ Lambda-cyhalothrin ▪ Naled ▪ Oxydemeton-methyl ▪ Phosmet ▪ Piperonyl Butoxide + 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 an insecticide (drench) to the main trunk and branch bark when larvae are plentiful and attacking (early April – early May). Contact your regional Plant Inspector or local extension agent for more information.	▪ Acephate ▪ Bifenthrin ▪ Chlorpyrifos ▪ Diflubenzuron ▪ Dimethoate ▪ Naled

Insecticide & Miticide Information

Visit Penn State's Christmas Trees website (for scouting reports, manual information, etc.): http://ento.psu.edu/extension/christmas-trees

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.

CONIFERS KNOWN TO BE SENSITIVE TO DORMANT OILS INCLUDE DOUGLAS-FIR AND SPRUCE. BE SURE NOT TO APPLY OIL ON GLAUCOUS, OR BLUE, VARIETIES OF CONIFERS BECAUSE THE BLUE COLOR WILL BE REMOVED AND MAY NOT RETURN FOR TWO OR THREE YEARS. GENETIC VARIABILITY MAY AFFECT INDIVIDUAL PLANTS DIFFERENTLY, EVEN IF THE VARIETY IS KNOWN TO BE TOLERANT TO OIL. WHEN TEMPERATURES ARE BELOW FREEZING, OIL CAN CAUSE PHYTOTOXICITY. UNDER THESE CONDITIONS, THE OIL AND WATER CANNOT STAY MIXED AND THE WATER FREEZES, ALLOWING OIL DROPLETS TO ACCUMULATE. WHEN THAWING DOES OCCUR, THE WATER WILL EVAPORATE, CONCENTRATING THE OIL ON PLANT SURFACES. OIL CAN ALSO CAUSE PHYTOTOXICITY WHEN TEMPERATURES ARE ABOVE 90° F. BURNING IS ALSO A CONCERN ON THE SUNNY SIDE OF THE TREES OR DURING TIMES OF DROUGHT.

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 = Bio-rational Product
Active Ingredient | Chemical Class | IRAC # | Trade Names = Bio-rational Product
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 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 pest management programs. Using different classes of pesticides slows the development of resistance in the target 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, FRAC/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	Avermectins, Milbemycins	6	▪ ABBA CS (Control Solutions, Inc.); ▪ RReaper 0.15 EC (Loveland Products, Inc.); ▪ Quali-Pro Abamectin 0.15 EC (Makhteshim Agan of North America, Inc.); ▪ Minx, Nufarm Abamectin SPC 0.15 EC Insecticide (Nufarm Americas Inc.); ▪ Lucid (Rotam North America, Inc.); ▪ Ardent 0.15EC, Avid 0.15EC (Syngenta Crop Protection, Inc.); ▪ Timectin 0.15 EC T&O Insecticide/Miticide (Tide International USA, Inc.); ▪ Phoenix Merlin (United Phosphorus, Inc.)

Active Ingredient	Chemical Class	IRAC #	Trade Names
acephate	Organophosphates	1B	▪ Orthene Turf, Tree & Ornamental WSP (AMVAC Chemical Corporation); ▪ ACE-jet (Arborjet, Inc.); ▪ Acephate 90 WDG (Arysta LifeScience North America, LLC); ▪ Acephate 90 WDG (Loveland Products, Inc.); ▪ Acephate 90 Prill (Makhteshim Agan of North America, Inc.); ▪ Lepitect, Lepitect Infusible (Rainbow Treecare Scientific Advancements); ▪ Tenkoz Acephate 97 Insecticide (Tenkoz, Inc.); ▪ Tide Acephate 90 WDG (Tide International USA, Inc.); ▪ Acephate 75 WSP, Acephate 97UP (United Phosphorus, Inc.); ▪ Bracket 90 WDG, Bracket 97 (Winfield Solutions, LLC)
acequinocyl	Acequinocyl	20B	▪ Shuttle 15 SC (Arysta LifeScience North America, LLC); ▪ SHUTTLE O (OHP, Inc.)
azadirachtin	Azadirachtin	UN	▪ AMAZIN PLUS 1.2% ME, ECOZIN PLUS 1.2% ME (AMVAC Chemical Corporation); ▪ Azatin XL (OHP, Inc.); ▪ AzaMax AG 0.6 (Parry America Inc.)
Bacillus thuringiensis subsp. *kurstaki* strain ABTS-351			▪ Biobit HP, DiPel ES, DiPel PRO DF (Valent BioSciences Corporation)
Bacillus thuringiensis subsp. *kurstaki* strain EG7841			▪ Crymax (Certis USA, L.L.C.)
Beauveria bassiana Strain GHA			▪ BotaniGard 22WP, BotaniGard ES, Mycotrol O (Laverlam International Corporation)
bifenazate + abamectin	Bifenazate + Avermectins, Milbemycins	UN + 6	▪ Sirocco (OHP, Inc.)
bifenthrin	Pyrethroids	3A	▪ [R]Aceto Bifenthrin 2 EC (Aceto Agricultural Chemicals Corporation); ▪ [R]Bifen 2 AG Gold (Direct Ag Source, LLC); ▪ [R]OnyxPro, [R]Talstar Select Insecticide (FMC Corporation); ▪ [R]REVEAL (Innvictis Crop Care LLC); ▪ [R]Sniper (Loveland Products, Inc.); ▪ [R]Quali-Pro Bifenthrin Golf & Nursery 7.9F (Makhteshim Agan of North America, Inc.); ▪ [R]Menace GC 7.9% Flowable (Nufarm Americas Inc.); ▪ [R]Bifen 25% EC (Tacoma Ag, LLC); ▪ [R]Phoenix Firebird Pro, [R]UP-Star Lawn & Nursery Insecticide/Miticide (United Phosphorus, Inc.)
carbaryl	Carbamates	1A	▪ Sevin brand RP4 Carbaryl Insecticide (Bayer CropScience LP); ▪ Sevin SL (Bayer Environmental Science); ▪ Carbaryl 4L (Drexel Chemical Company); ▪ LESCO Sevin SL Carbaryl Insecticide (John Deere Landscapes); ▪ Carbaryl 4L (Loveland Products, Inc.); ▪ PROKoZ Sevin SL (PROKoZ, Inc.); ▪ SEVIN brand 4F Carbaryl Insecticide, SEVIN brand XLR PLUS Carbaryl Insecticide (Tessenderlo Kerley, Inc.)

Active Ingredient	Chemical Class	IRAC #	Trade Names
chlorpyrifos	Organophosphates	1B	▪ [R]Nufos 4E (Cheminova, Inc.); ▪ [R]Dursban 50W, [R]Hatchet, [R]Lorsban Advanced, [R]Lorsban-4E (Dow AgroSciences LLC); ▪ [R]Chlorpyrifos 4E-AG (Drexel Chemical Company); ▪ [R]Pilot 4E (Gharda Chemicals Limited); ▪ Lorsban 75WG (Gowan Company); ▪ [R]Whirlwind (Helena Chemical Company); ▪ [R]Warhawk (Loveland Products, Inc.); ▪ [R]Chlorpyrifos 4E AG, [R]Quali-Pro Chlorpyrifos 4E, [R]Vulcan (Makhteshim Agan of North America, Inc.); ▪ [R]Govern 4E (Tenkoz, Inc.); ▪ [R]Yuma 4E (Winfield Solutions, LLC)
chlorpyrifos + gamma-cyhalothrin	Organophosphates + Pyrethroids	1B + 3A	▪ [R]BOLTON (Cheminova, Inc.)
chlorpyrifos + lambda-cyhalothrin	Organophosphates + Pyrethroids	1B + 3A	▪ [R]Cobalt Advanced (Dow AgroSciences LLC)
Chromobacterium subtsugae strain PRAA4-1 & spent fermentation media			▪ GRANDEVO PTO (Engage Agro USA LLC); ▪ MBI-203 EP BIOINSECTICIDE (Marrone Bio Innovations, Inc.)
clofentezine	Clofentezine	10A	▪ Apollo SC (Makhteshim Agan of North America, Inc.)
cyfluthrin	Pyrethroids	3A	▪ Decathlon 20 WP (OHP, Inc.)
diflubenzuron	Benzoylureas	15	▪ [R]Dimilin 25W, [R]Dimilin 4L (Chemtura Corporation)
dimethoate	Organophosphates	1B	▪ Dimethoate 4E (Arysta LifeScience North America, LLC); ▪ DIMETHOATE 4E (Cheminova, Inc.); ▪ Dimethoate 4EC (Drexel Chemical Company); ▪ Dimethoate 400 (Loveland Products, Inc.); ▪ Dimate 4E Insecticide (Winfield Solutions, LLC)
dinotefuran	Neonicotinoids	4A	▪ Safari 20 SG (Valent U.S.A. Corporation)
esfenvalerate	Pyrethroids	3A	▪ [R]DuPont ASANA XL (E.I. du Pont de Nemours & Company); ▪ [R]S-FenvaloStar (LG International (America), Inc.)
etoxazole	Etoxazole	10A	▪ TetraSan 5 WDG (Valent U.S.A. Corporation)
fenazaquin	METI Acaricides & Insecticides	21A	▪ MAGISTER, MAGUS (Gowan Company)
fenpyroximate	METI Acaricides & Insecticides	21A	▪ Akari 5SC Miticide/Insecticide (SePRO Corporation)
fipronil	Phenylpyrazoles (Fiproles)	2A	▪ PTM Insecticide (BASF Corporation)
flubendiamide	Diamides	28	▪ BELT SC Insecticide (Bayer CropScience LP)
gamma-cyhalothrin	Pyrethroids	3A	▪ [R]DECLARE (Cheminova, Inc.)
hexythiazox	Hexythiazox	10A	▪ Hexygon DF, Onager Miticide, Savey 50 DF (Gowan Company)
imidacloprid	Neonicotinoids	4A	▪ IMA-jet (Arborjet, Inc.); ▪ Provado 1.6 Flowable Insecticide (Bayer CropScience LP); ▪ SilvaShield Forestry Tablets (Bayer Environmental Science); ▪ Couraze 1.6F, Couraze 2F (Cheminova, Inc.); ▪ Malice 75 WSP, Prey 1.6 Insecticide, SHERPA Insecticide (Loveland Products, Inc.); ▪ Pasada 1.6F (Makhteshim Agan of North America, Inc.); ▪ ArmorTech IMD 75 Insecticide, Mallet 75 WSP Insecticide, Nuprid 2SC (Nufarm Americas Inc.); ▪ Discus Tablets (OHP, Inc.); ▪ Advise 2FL (Winfield Solutions, LLC)
imidacloprid + cyfluthrin	Neonicotinoids + Pyrethroids	4A + 3A	▪ Discus (OHP, Inc.)

Active Ingredient	Chemical Class	IRAC #	Trade Names
lambda-cyhalothrin	Pyrethroids	3A	▪ [R]CropSmart Lambda-Cy (CropSmart, LLC); ▪ [R]Cavalry (GROWMARK, Inc.); ▪ [R]Lambda-T (Helena Chemical Company); ▪ [R]Kendo 22.8 CS, [R]Kendo Insecticide (Helm Agro US, Inc.); ▪ [R]RAVAGE (Innvictis Crop Care LLC); ▪ [R]LambdaStar 1 CS, [R]LambdaStar Insecticide (LG International (America), Inc.); ▪ [R]Paradigm, [R]Silencer (Makhteshim Agan of North America, Inc.); ▪ [R]Nufarm Lambda-Cyhalothrin 1 EC Insecticide (Nufarm Americas Inc.); ▪ [R]Lambda Select (Select Source, LLC); ▪ [R]Lamcap, [R]Warrior II with Zeon Technology, [R]Warrior Insecticide with Zeon Technology (Syngenta Crop Protection, Inc.); ▪ [R]PROVINCE Insecticide (Tenkoz, Inc.); ▪ [R]Lambda-Cy EC Insecticide-RUP (United Phosphorus, Inc.); ▪ [R]Willowood Lambda-Cy 1EC (Willowood, LLC); ▪ [R]Grizzly Z (Winfield Solutions, LLC)
malathion	Organophosphates	1B	▪ Malathion 57% (Control Solutions, Inc.); ▪ Malathion 5EC (Drexel Chemical Company); ▪ PRENTOX 5 LB MALATHION SPRAY (Envincio, LLC) ▪ Malathion 8 Flowable (Gowan Company)
mineral oil			▪ SuffOil-X (BioWorks, Inc.); ▪ TriTek (Brandt Consolidated, Inc.); ▪ Damoil (Drexel Chemical Company); ▪ Mite-E-Oil, Omni Supreme Spray (Helena Chemical Company); ▪ PureSpray 10E, PureSpray Green (Petro-Canada Lubricants, Inc.); ▪ RTSA Horticultural Oil (Rainbow Treecare Scientific Advancements)
naled	Organophosphates	1B	▪ [R]DIBROM 8 Emulsive (AMVAC Chemical Corporation)
oxydemeton-methyl	Organophosphates	1B	▪ [R]MSR Spray Concentrate (Gowan Company)
permethrin	Pyrethroids	3A	▪ [R]AMBUSH Insecticide, [R]AMBUSH 25W Insecticide (AMVAC Chemical Corporation); ▪ [R]Pounce 25 WP (FMC Corporation); ▪ [R]PermaStar AG (LG International (America), Inc.); ▪ [R]PERMETHRIN (Loveland Products, Inc.); ▪ Tenkoz Permethrin 3.2EC (Tenkoz, Inc.); ▪ [R]Perm-Up 25DF, [R]PERM-UP 3.2EC (United Phosphorus, Inc.); ▪ [R]ARCTIC 3.2 EC (Winfield Solutions, LLC)
petroleum oil (emulsified)			▪ Ultra-Pure Oil (BASF Corporation)
phosmet	Organophosphates	1B	▪ Imidan 70-W (Gowan Company)
piperonyl butoxide + pyrethrins	Pyrethroids	3A	▪ Pyreth-It Formula 2 Pyrethrum Insecticide (BASF Corporation); ▪ Prentox Pyronyl Crop Spray (Envincio, LLC); ▪ EverGreen Crop Protection EC 60-6 (McLaughlin Gormley King Company)
potassium salts of fatty acids			▪ DES-X INSECTICIDAL SOAP CONCENTRATE (Certis USA, LLC); ▪ M-Pede (Gowan Company)

Active Ingredient	Chemical Class	IRAC #	Trade Names
pymetrozine	Pymetrozine	9B	▪ Endeavor (Syngenta Crop Protection, Inc.)
soybean oil (food grade)			▪ Golden Pest Spray Oil (Stoller Enterprises, Inc.)
spinosad	Spinosyns	5	▪ Blackhawk, Conserve SC, Entrust, Entrust SC, SpinTor 2SC, Success (Dow AgroSciences LLC)
spirodiclofen	Tetronic & Tetramic Acid Derivatives	23	▪ Envidor 2 SC Miticide (Bayer CropScience LP)
spiromesifen	Tetronic & Tetramic Acid Derivatives	23	▪ JUDO (OHP, Inc.)
spirotetramat	Tetronic & Tetramic Acid Derivatives	23	▪ MOVENTO (Bayer CropScience LP); ▪ KONTOS (OHP, Inc.)
tebufenozide	Diacylhydrazines	18	▪ Confirm 2F (Gowan Company)
thiamethoxam	Neonicotinoids	4A	▪ Flagship 0.22G, Flagship 25WG (Syngenta Crop Protection, Inc.)