# Michigan Christmas Tree Pest Management Guide 2021

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**The information presented here does not supersede the label directions. To protect yourself, others and the environment, always read the label before applying any pesticide. Although efforts have been made to check the accuracy of information presented (January 2021), it is the responsibility of the person using is information to verify that it is correct by reading the corresponding pesticide label in its entirety before using the products.** The information presented here is intended as a guide for Michigan Christmas tree growers in selecting pesticides and is for educational purposes only. The efficacies of products listed may not been evaluated in Michigan. Labels can and do change. For current labels and MSDS information, visit one of the following free online databases: **greenbook.net, cdms.com, and agrian.com**

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# SEASONAL PEST CALENDAR

## Michigan Christmas Tree Pest Calendar

| Species | Insect pest | Disease | April | | | May | | | June | | | July | | | August | | | September | | | Control stage |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | early | mid | late | early | mid | late | early | mid | late | early | mid | late | early | mid | late | early | mid | late | |
| **Douglas-fir** | | | | | | | | | | | | | | | | | | | | | |
| | Cooley spruce gall adelgid | | | | | | | | | | | | | | | | | | | | Treat to control overwintering nymphs in the spring or fall, when new nymphs emerge as buds are expanding or, when nymphs are present in mid-July. |
| | Douglas-fir needle midge | | | | | | | | | | | | | | | | | | | | Apply insecticides when adults emerge in spring before they lay eggs. Yellow sticky traps can be used to detect emergence. |
| | Pales weevil | | | | | | | | | | | | | | | | | | | | Adults moving onto treees to feed on shoots. Pyramid traps baited with alcohol and turpintine may help detect adults. |
| | | Rhabdocline needlecast | | | | | | | | | | | | | | | | | | | Preventative fungicide- new growth 1/2" -2 long |
| | | Swiss needlecast | | | | | | | | | | | | | | | | | | | Preventative fungicide - new growth 1/2" -2 long |
| **Pine** | | | | | | | | | | | | | | | | | | | | | **Control stage** |
| | Eastern pine shoot borer | | | | | | | | | | | | | | | | | | | | Target larvae before they bore into the shoot. |
| | European pine sawfly | | | | | | | | | | | | | | | | | | | | Target larvae. |
| | Pales weevil | | | | | | | | | | | | | | | | | | | | Remove or drench stumps from April though mid-May. From Aug-Sept., adults move onto treees to feed on shoots. Baited pyramid traps can detect adults. |
| | Pine chafer (Anomela beetle) | | | | | | | | | | | | | | | | | | | | Target adult beetles. |
| | Pine needle scale | | | | | | | | | | | | | | | | | | | | Target crawlers. |
| | Pine root collar weevil | | | | | | | | | | | | | | | | | | | | Target egg laying adult weevil. |
| | Pine shoot beetle | | | | | | | | | | | | | | | | | | | | Emergence of new generation of beetles, 450 - 500 gdd50. |
| | Pine tortoise scale | | | | | | | | | | | | | | | | | | | | Target crawlers. |
| | White pine weevil | | | | | | | | | | | | | | | | | | | | Apply early in the spring to control egg-laying weevils (~35 gdd50). In cool springs, emergence may be longer and require a second application. Baited pyramid traps can help detect emergence. |
| | Zimmerman pine moth | | | | | | | | | | | | | | | | | | | | Overwintering larva before they bore under the bark. |
| | | Brown spot needle blight | | | | | | | | | | | | | | | | | | | Begin fungicide application when needles are 1/2 elongated. |
| | | Diplodia tip blight | | | | | | | | | | | | | | | | | | | Bud-break (candle elongation). |
| | | Dothistroma needle blight | | | | | | | | | | | | | | | | | | | Apply at bud break and again in mid-june. |
| | | Lophodermium needlecast | | | | | | | | | | | | | | | | | | | Begin fungicide application to coincide with spore release. |

Potential period of pest activity or presence, depending on weather.

Potential treatment window, depending on weather.

Scouting methods are: plants = inspect plants, deg day(gdd) = degree day models

Predictive (degree day) models available at enviroweather.msu.edu

# Michigan Christmas Tree Pest Calendar

| Species | Insect pest | Disease | April | | | May | | | June | | | July | | | August | | | September | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | early | mid | late | early | mid | late | early | mid | late | early | mid | late | early | mid | late | early | mid | late | |
| **Spruce** | | | | | | | | | | | | | | | | | | | | | **Control stage** |
| | Admes mite | | | | | | | | | | | | | | | | | | | | When larval and adult mites are active. |
| | Cooley spruce gall adelgid | | | | | | | | | | | | | | | | | | | | Time insecticide application to control overwintering nymphs in the spring or fall. |
| | Eastern spruce gall adelgid | | | | | | | | | | | | | | | | | | | | Time insecticide application to control overwintering nymphs in the spring or fall. |
| | Eriophyid mite | | | | | | | | | | | | | | | | | | | | When mites are actice, they are most active in the spring and fall. |
| | Spruce bud scale | | | | | | | | | | | | | | | | | | | | Time application for crawler emergence. |
| | Spruce spider mite | | | | | | | | | | | | | | | | | | | | When larval and adult mites are active. These are cool season mites which are most active in the spring and fall. |
| | Spruce gall midge | | | | | | | | | | | | | | | | | | | | Time applicaton for hatching larvae. Yellow sticky traps can be used to detect emergence. |
| | White pine weevil | | | | | | | | | | | | | | | | | | | | Apply early in the spring to control egg-laying weevils (~35 gdd50). In cool springs, emergence may be longer and require a second application. Baited pyramid traps can help detect emergence. |
| | | Diplodia tip blight | | | | | | | | | | | | | | | | | | | Preventative fungicide applied at budbreak. |
| | | Phomopsis tip blight/canker | | | | | | | | | | | | | | | | | | | First indication of budbreak then repeat application until the new shoots are fully developed. |
| | | Rhizosphaera/Stigmina needlecast | | | | | | | | | | | | | | | | | | | Preventative fungicide - new growth 1/2" -2" long, will require two to three applications. |
| **True fir (Fraser, balsam and concolor)** | | | | | | | | | | | | | | | | | | | | | **Control stage** |
| | Balsam Twig Aphid | | | | | | | | | | | | | | | | | | | | Apply insecticide after eggs have hatched but before the nypmphs become stem mothers, 100-140 gdd50. |
| | Eriophyid mites | | | | | | | | | | | | | | | | | | | | When mites are actice, they are most active in the spring and fall. |
| | Spruce spider mite | | | | | | | | | | | | | | | | | | | | Threshold will depend on when the trees will be going to market. Scout for immature and adult mites. Most active in the spring and fall. |
| | Spruce -fir looper | | | | | | | | | | | | | | | | | | | | Control caterpillars if they are present in large numbers. |
| | | Fir needle rust | | | | | | | | | | | | | | | | | | | Mow or control ferns with a herbicide in the plantation. |

Potential period of pest activity, presence, or treatment time depending on weather. Refer to the control stage column for more information.

Scouting methods are: plants = inspect plants, deg day(gdd) = degree day models

Predictive (degree day) models available at enviroweather.msu.edu

# INSECT PESTS

A diverse complex of insect pests affect nearly every part of the Christmas tree, from the terminal leader to the roots. Some insects affect multiple species while others are affect only one species. It is important to understand pest biology and pesticide activity as insecticides must be applied when the susceptible stage of the insect is present. Monitoring degree-day accumulation will help you estimate when insects are active. Degree-day accumulation is a way of keeping track of how quickly temperatures warm up in the spring, which greatly affects insect development. It is more accurate and reliable to base your scouting and control activities on accumulated degree-days than on the calendar. Accumulated degree-days are calculated weekly by Michigan State University and are available at www.enviroweather.msu.edu.

| Insect | Life stage | $GDD_{50}$ Months | Control Options | Page # Pest Manual* 1998/2014 |
|---|---|---|---|---|
| **Admes mite** *Eurytetranycus admes* | Eggs, larva or adults | Spring to fall | abamectin, bifenthrin, bifenazate, chlorpyrifos, clofentezine, cyflumetofen, etoxazole, fenazaquin, hexythiazox, horticutural oil, insecticidal soap, oxydemeton-methyl, peppermint and rosemary oil, propargite, spirodiclofen | **NA/28** |
| **ants** *Formica spp.* | | Spring to fall | bifenthrin, carbaryl, chlorpyrifos, spinosad (Seduce bait), thiamethoxam | **113/137** |
| **aphids** (*Cinara spp*., spotted and white pine aphid) | when aphids abundant | Spring to fall | abamectin, acephate, azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, dinotefuran, horticulture oil, imidacloprid, insecticidal soap, lambda-cyhalothrin, malathion, oxydemeton-methyl, peppermint and rosemary oil, pymetrozine, spirotetramat, thiamethoxam | **76/89** |
| **bagworm** *Thyridopteryx ephemeraeformis* | after eggs have hatched and larvae are small ( small bags can be seen on trees) | late May to mid June | acephate, azdirachtin, Bacillus thuringiensis subsp. Kurstaki stain ABTX-351 or EG7841, biefenthrin, carbaryl, chlorpyrifos, cyfluthrin, diflubenzuron, emamectin benzoate, flubendiamid, lambda-cyhalothrin, malathion, methoxyfenozide, permethrin, spinosad tebufenozide | **57/65** |
| **balsam gall midge** *Paradiplosis tumifex* | adults laying eggs<br>galls apparent | 150-300<br>550-700 | acephate, azdirachtin, bifenthrin, chlorpyrifos, cyfluthrin, esfenvalerate, thiamothoxam | **27/30** |
| **balsam fir sawfly** *Neodiprion abieties* | Treat if the larvae are abundant in early to midsummer | June-July | acephate, azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, diflubenzuron, esfenvalerate, horticulture oil, imidacloprid, insecticidal soap, malathion, phosmet, spinosad, thiamethoxam | **NA/66** |

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| Insect | Life stage | $GDD_{50}$ Months | Control Options | Page # Pest Manual* 1998/2014 |
|---|---|---|---|---|
| **balsam shoot boring sawfly** *Pleroneura brunneicornis* | Treat when caterpillars are small and before much feeding injury occurs | | acephate, azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, diflubenzuron, esfenvalerate, horticulture oil, imidacloprid, insecticidal soap, malathion, phosmet, spinosad, thiamethoxam | **NA/90** |
| **balsam twig aphid** *Mindarus abietis* | egg hatch<br><br>stem mothers present (control target) | 60-100<br><br>100-140 | abamectin, acephate, azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, dinotefuran, esfenvalerate, imidacloprid, insecticidal soap, horticulture oil, lambda-cyhalothrin, malathion, peppermint and rosemary oil, pymetrozine, spirotetramat, thiamethoxam | **29/32** |
| **balsam wooly adelgid** *Adelges piceae* | First generation of crawlers | May-July | **Not Currently Found in Michigan**<br>acephate, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, dinotefuran, esfenvalerate, horticulture oil, imidacloprid, insecticidal soap, lambda-cyhalothrin, spirotetramat, thiamethoxam | **NA/91** |
| **conifer root aphid** *Prociphilus americanus* | | | imidacloprid | **NA/139** |
| **Cooley spruce gall adelgid** *Adelges cooleyi* | 1st adults active - *Spruce* | 25-120 | acephate, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, dinotefuran, esfenvalerate, horticulture oil, imidacloprid, insecticidal soap, spirotetramat, thiamethoxam | **106/128** |
| | 1st adults active - *Douglas-fir* | 90-180 | | |
| | 1st galls visible - *Spruce* | 200-310 | | |
| | 1st nymphs - *Douglas-fir* | 90-150 | | |
| | 2nd nymphs - *Douglas-fir* | 600-1000 | | |
| | 2nd adults active | 1500-1600 | | |
| **Douglas-fir needle midge** *Contarinia pseudotsuga* | Time application within a week after first adults are detected in traps. | 200-250 | acephate, azdirachtin, bifenthrin, chlorpyrifos, cyfluthrin, esfenvalerate, thiamothoxam | **NA/35** |
| **eastern pine shoot borer** *Eucosma gloriola* | 1st adults active | 75-200 | acephate, azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, diflubenzuron, esfenvalerate, imidacloprid, malathion, permethrin, phosmet, spinosad | **79/98** |
| **eastern pine weevil (formerly northern pine weevil)** *Pissodes nemorensis* | 1st adults active<br><br>2nd adults active | 25-100<br><br>1200-1400 | acephate, azadirachtin, bifenthrin, chlorpyrifos, cyfluthrin, diflubenzuron, esfenvalerate, lambda-cyhalothrin, oxydemeton-methyl. phosmet | **85/100** |

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| Insect | Life stage | $GDD_{50}$ Months | Control Options | Page # Pest Manual* 1998/2014 |
|---|---|---|---|---|
| **eastern spruce gall adelgid** *Adelges abietis* | 1st adults active<br><br>egg hatch, galls begin forming<br><br>2nd adults active | 25-100<br><br>250-310<br><br>1500-1600 | acephate, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, dinotefuran, esfenvalerate, horticulture oil, imidacloprid, insecticidal soap, spirotetramat, thiamethoxam | **107/131** |
| **elongated hemlock scale** *Fiorinia externa* | dormant prior to bud break<br><br>When crawlers are active, may take several applications due to staggered life cycle | mid-March to mid-April<br><br>June-October | dormant oil<br><br>acephate, azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, horticultural oil, imidacloprid, insecticidal soap, malathion, spirotetramat | **NA/39** |
| **eriophyid mites** *Setoptus and Nalepella spp.* | when mites are present | May - September | abamectin, carbaryl, fenazaquin, horticulture oil, spirodiclofen | **35/40** |
| **European pine sawfly** *Neodiprion sertifer* | 1st larvae | 100-195 | acephate, azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, diflubenzuron, dinotefuran, esfenvalerate, horticulture oil, imidacloprid, insecticidal soal, lambda-cyhalothrin, malathion, phosmet, spinosad, thiamethoxam | **58/67** |
| **European pine shoot moth** *Rhyacionia buoliana* | 1st larvae<br><br>egg hatch<br><br>adults active | 50-220<br><br>900-1000<br><br>700-800 | acephate, azadirachtim, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, diflubenzuron, esfenvalerate, malathion, methoxyfenozide, phosmet, tebufenozide | **80/101** |
| **grasshopper** *Melanoplus spp.* | Mid-summer | | acephate, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, esfenvalerate, kaolin | **59/69** |
| **gypsy moth** *Lymantria dispar* | egg hatch, 1st larvae<br><br>young caterpillars<br>pupation | 145-200<br><br>450<br>900-1200 | acephate, azadirachtin, Bacillus thuringiensis (Bt), bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, diflubenzuron, emamectin benzoate, flubendiamide, insecticidal soap, lambda-cyhalothrin, methoxyfenozide, phosmet, spinosad, tebufenozide | **60/70** |
| **introduced pine sawfly** *Diprion similis* | 1st larvae | 400-600 | acephate, azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, diflubenzuron, dinotefuran, esfenvalerate, imidacloprid, insecticidal soap, lambda-cyhalothrin, malathion, phosmet, spinosad, thiamethoxam | **62/72** |

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|---|---|---|---|---|
| **jack pine budworm** *Choristoneura pinus pinus* | young larvae feeding<br><br>large larvae feeding defoliation noticeable | 300-350<br><br>650-700 | acephate, azadirachtin, *Bacillus thuringiensis,* bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, diflubenzuron, esfenvalerate, flubendiamide, methoxyfenozide, spinosad, tebufenozide | **63/73** |
| **jack pine tip beetle** *Conopthorus resinosae* | shear off injured tips | summer to fall | Insecticides not needed & likely to be ineffective | **82/103** |
| **Japanese beetle** *Popillia japonica* | adult foliar feeding | 950-2150 | azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, kaolin, lambda-cyhalothrin, malathion, methoxyfenozide, permethrin, phosmet | |
| **Nantucket pine tip moth** *Rhyacionia frustrana* | young larvae | mid-May -mid June | acephate, azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, diflubenzuron, esfenvalerate, imidacloprid, lambda-cyhalothrin, malathion, methoxyfenozide, permethrin, sphosmet, spinosad | **84/105** |
| **northern pitch twig moth** *Retinia albicapitana* | clip flagged branches or break open blister and crush larvae | | Insecticides not needed & likely to be ineffective | **109/132** |
| **Pales weevil** *Hylobius pales* | 1st adults active<br>2nd adults active | 25-100<br>1200-1400 | acephate, azadirachtin, bifenthrin, chlorpyrifos, cyfluthrin, diflubenzuron, | **86/106** |
| **pine bark adelgid** *Pineus strobi* | spray trunk with dormant oil before growth starts in spring or in mid-May when insects are active | April - mid-May | bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, horticulture oil, imidacloprid, insecticidal soap, oxydemeton-methyl, spirotetramat, thiamethoxam | **117/142** |
| **pine bark beetle (pine engraver)** *Ips spp.* | | | azadirachtin, bifenthrin, carbaryl | **NA/153** |

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|---|---|---|---|---|
| **pine chafer** *Anomela oblivia* | 1st adults active | 450-600 | azadirachtin, cyfluthrin, esfenvalerate, lambda-cyhalothrin | **64** |
| **pine false webworm** *Acantholyda erythrocephala* | when larvae are feeding and building nests | late April to early June | Bacillius thuringiensus, lambda-cyhalothrin | **71/75** |
| **pine needle midge** *Contarinia baeri* | 1st adults active | 400-500 | acephate, azdirachtin, bifenthrin, chlorpyrifos, cyfluthrin, esfenvalerate, thiamothoxam | **65** |
| **pine needle scale** *Chionaspis pinifoliae* | 1st generation egg hatch<br>1st generation - hyaline stage (control target)<br>2nd generation egg hatch<br>2nd generation - hyaline stage (control target) | 250-400<br>400-500<br>1250-1350<br>1500 | acephate, azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, dinotefuran, horticultural oil, imidacloprid, insecticidal soap, lambda-cyhalothrin, malathion, oxydemeton-methyl, spirotetramat | **44/50** |
| **pine root collar weevil** *Hylobius radicis* | 1st adults active<br>2nd adults active | 300-350<br>1200-1400 | acephate, azadirachtin, bifenthrin, chlorpyrifos, cyfluthrin, diflubenzuron, esfenvalerate, lambda-cyhalothrin, oxydemeton-methyl. phosmet | **118/143** |
| **pine root tip weevil** *Hylobius rhizophagus* | | | cyfluthrin, lambda-cyhalothrin | **89/110** |
| **pine shoot beetle** *Tomicus piniperda* | new adults emerge, begin shoot feeding<br>optimal control window | 450-550<br>450-500 | bifenthrin, chlorpyrifos, cyfluthrin | **90/111** |
| **pine spittlebug** *Aphrophora parallela* | when 95% of spittle masses on pines are empty | late June to mid July | bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, esfenvalerate, lambda-cyhalothrin, spirotetramat | **92/113** |

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|---|---|---|---|---|
| **pine thrips** *Gnophothrips spp.* | Early in the spring before eggs are laid to control the 1st generation of emerging adults. | | acephate, abamectin, azadirachtin, carbaryl, bifenthrin, kaolin, dinotefuran, lambda-cyhalothrin, malathion, thiamethoxam | **45/51** |
| **pine tortoise scale** *Toumeyella parvicornis* | egg hatch begins; 1st crawlers<br><br>egg hatch ends<br><br>crawlers settling | 400-500<br><br>1000-1200 | acephate, azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, dinotefuran, horticultural oil, imidacloprid, insecticidal soap, lambda-cyhalothrin, malathion, spirotetramat | **93/114** |
| **pine tube moth** *Argyrotaenia pinatubana* | | | Insecticide rarely needed | **66/77** |
| **pine tussock moth** *Dasychira pinicola* | larvae feeding on foliage | late May to mid June | acephate, azadirachtin, Bacillus thuringiensis (Bt), bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, diflubenzuron, emamectin benzoate, flubendiamide, insecticidal soap, methoxyfenozide, phosmet, spinosad, tebufenozide | **67/78** |
| **pine webworm** *Pococera robustella* | | | lambda-cyhalothrin | **71/79** |
| **red-headed pine sawfly** *Neodiprion lecontei* | 1st larvae | 400-600 | acephate, azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, dinotefuran, esfenvalerate, imidacloprid, lambda-cyhalothrin, malathion, phosmet, spinosad, thiamethoxam | **68/80** |
| **Saratoga spittlebug** *Aphrophora saratogensis* | When all or nearly all (90%) spittlemasses on sweetfern plants are empty. Control sweetfern in plantation. | late June to mid-July | bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, esfenvalerate, lambda-cyhalothrin, spirotetramat | **95/115** |

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|---|---|---|---|---|
| **spruce budscale** *Physokermes piceae* | egg hatch, 1st crawlers | 700-1150 | acephate, azadirachtin, bifenthrin, buprofezin, carbaryl, chlorpyrifos, cyfluthrin, dinotefuran, horticultural oil, insecticidal soap, malathion, oxydemeton-methyl, spirotetramat | **99/119** |
| **spruce budworm** *Choristoneura fumiferana* | 1st larvae | 200-300 | acephate, *Bacillus thuringiensis,* bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, diflubenzuron, emamectin benzoate, esfenvalerate, flubendiamide, methoxyfenozide, spinosad, tebufenozide | **69/82** |
| **spruce-fir looper** *Macaria signaria* | larvae feeding on foliage | July - October | bifenthrin, cyfluthrin, diflubenzuron, emamectin benzoate, methoxyfenozide, spinosad | **NA/83** |
| **spruce gall midge** *Mayetiola piceae* | adult emerge<br>eggs hatch (control window) | 70-100<br>130-145 | acephate, azdirachtin, bifenthrin, chlorpyrifos, cyfluthrin, esfenvalerate, thiamothoxam | **NA/133** |
| **spruce needleminers** *Taniva albolineana, Epinotia nanana, Coleotchnites piceaella* | 1st larvae | 150-200 | bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, esfenvalerate, permethrin, spinosad | **70/84** |
| **spruce spider mite** *Oligonychus ununguis* | 1st egg hatch | 150-175 | abamectin, bifenthrin, bifenazate, chlorpyrifos, clofentezine, cyflumetofen, etoxazole, fenazaquin, hexythiazox, horticutural oil, insecticidal soap, oxydemeton-methyl, peppermint and rosemary oil, propargite, spirodiclofen | **51/59** |
| **striped pine scale** *Toumeyella pini (King)* | egg hatch | 750-800 | acephate, azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, dinotefuran, horticultural oil, imidacloprid, insecticidal soap, lambda-cyhalothrin, malathion, oxydemeton-methyl, spirotetramat | **93/114*** |

*Christmas Tree Pest Manual, Second Edition (MSU Extension Bulletin E2676)/Christmas Tree Pest Manual, Third Edition, 2014

| Insect | Life stage | $GDD_{50}$ Months | Control Options | Page # Pest Manual* 1998/2014 |
|---|---|---|---|---|
| **white grubs**<br>*Phyllophaga and Polyphylla spp.*<br>*Rhizotrogus majalis* | | | carbaryl, imidacloprid | **123/151** |
| **white pine weevil**<br>*Pissodes strobi* | 1st adults active<br><br>2nd adults active | 25-220<br><br>1200-1400 | acephate, azadirachtin, bifenthrin, chlorpyrifos, cyfluthrin, diflubenzuron, esfenvalerate, lambda-cyhalothrin, phosmet | **101/122** |
| **Zimmerman pine moth**<br>*Dioryctria zimmermani* | 1st larvae<br><br>adult flight | 25-100<br><br>1700 | acephate, bifenthrin, chlorpyrifos, cyfluthrin, diflubenzuron, lambda-cyhalothrin, methoxyfenozide | **126/156** |

*Christmas Tree Pest Manual, Second Edition (MSU Extension Bulletin E2676)/Christmas Tree Pest Manual, Third Edition, 2014

# REGISTERED INSECTICIDES AND MITICIDES

Read and follow all label instructions before using any pesticide product. Information derived from this publication does not constitute a label replacement or a recommendation. Before applying any pesticide, read and understand the entire pesticide label and any additional labeling related to the proposed use. The use of a pesticide in a manner not consistent with the label can lead to the injury of crops, humans, animals and the environment. Pesticides are good management tools for the control of pests on crops, but only when they are used in a safe, effective and prudent manner according to the label. Wherever possible, growers should rotate classes of insecticides and avoid using the same chemistry more than once per year, or better, once every other year. Note the resistance group number of each insecticides and avoid using chemistries from the same group.

| Active Ingredient | Insecticide & Formulation | EPA Reg# | Company | RUP | REI | IRAC Mode of Action(1) |
|---|---|---|---|---|---|---|
| **abamectin** | Ardent 0.15 EC | 100-896 | Syngenta | no | 12 hrs | **6 (Avermectins)** |
| | Avid 0.15 EC | 100-896 | Syngenta | no | 12 hrs | |
| | Lucid | 83100-5-83979 | Rotam North America, Inc. | no | 12 hrs | |
| | Minx 2 | 228-736 | Nufarm Americas, Inc. | no | 12 hrs | |
| | Reaper .15 EC** | 34704-923 | Loveland Products | yes | 12 hrs | |
| | Reaper Clearform** | 34704-1078 | Loveland Products | yes | 12 hrs | |
| **acephate** (some of these products may only be labeled on Douglas-fir) | Acephate 90 Prill | 66222-123 | ADAMA | no | 24 hrs | **1B (Organophosphates)** |
| | Acephate 90 WDG | 34704-1051 | Loveland Products, Inc. | no | 24 hrs | |
| | Acephate 97 UP | 70506-8 | United Phosphorus, Inc | no | 24 hrs | |
| | Bracket 97 | 70506-8-1381 | Winfield Solutions | no | 24 hrs | |
| | Orthene TTO 97 | 5481-8978 | Amvac Chemical Corp. | no | 24 hrs | |
| | Orthene TTO WSP | 5481-8971 | Amvac Chemical Corp. | no | 24 hrs | |
| | Tide Acephate 90 WDG | 84229-7 **(2020)** | Tide International USA, Inc. | no | 24 hrs | |
| **azadirachtin** | Aza-Direct* | 71908-1-10163 | Gowan Company | no | 4 hrs | **un (unknown)** |
| | Molt-X | 68539-11 | BioWorks, Inc. | no | 4 hrs | |
| **Bacillus thuringiensis, subsp. Kurstaki** | DiPel DF<br>DiPel PRO DF | 73049-39 | Valent USA | no | 4 hrs | **11A (Biopesticides)** |

| Active Ingredient | Insecticide & Formulation | EPA Reg# | Company | RUP | REI | IRAC Mode of Action(1) |
|---|---|---|---|---|---|---|
| **bifenthrin**** | Bifen 2 AG Gold | 83222-1 | Winfield United | yes | 12 hrs | **3A (Pyrethroids)** |
| | Bifenture EC | 70506-57 | United Phosphorus, In. | yes | 12 hrs | |
| | Bifenthrin 2 EC | 2749-556 **(2020)** | Aceto Agriculture Chemicals | yes | 12 hrs | |
| | Fanfare ES | 66222-236 | ADAMA | yes | 12 hrs | |
| | Onyx Pro | 279-4269 | FMC Professional Solution | yes | 12 hrs | |
| | Sniper/Sniper Heilos | 34704-858 | Loveland Products | yes | 12 hrs | |
| **bifenazate** | Acramite 4SC | 400-514 | Macdermid Agricultural Solutions | no | 12 hrs | **20D (Bifenazates)** |
| | Bifenamite 2SC | 42750-320 | Albaugh, Inc. | no | 12 hrs | |
| | Bizate 4SC | 34704-1116 | Loveland Products, Inc. | no | 12 hrs | |
| | Enervate 4SC | 91234-20 **(2020)** | Atticus LLC | no | 12 hrs | |
| | Floramite SC | 400-508-59807 | OHP,Inc. | no | 12 hrs | |
| | Vigilant 4SC | 400-514 | Macdermid Agicultural Solutions | no | 12 hrs | |
| **bifenazate and abamectin** | Sirocco | 400-582-59807 | OHP,Inc. | no | 12 hrs | **un/6 unknown/Abamectin** |
| **carbaryl** | Carbaryl 4L | 34704-447 | Loveland Products, Inc | no | 12 hrs | **1A (Carbamates)** |
| | Drexel Carbaryl 4L | 19713-49 | Drexel | no | 12 hrs | |
| | Sevin 4F | 61842-38 **(2020)** | Tessenderlo Kerley | no | 12 hrs | |
| | Sevin SL Carbaryl | 432-1227 | Bayer Environmental Science | no | 12 hrs | |
| | Sevin XLR Plus | 61842-37 | Tessenderlo Kerley | no | 12 hrs | |
| **chlorpyrifos** (continued on next page)** | Chlorpyrifos 4E AG | 66222-19 | ADAMA | yes | 24 hrs | **1B (Organophosphates)** |
| | Drexel Chlorpyrifos 4E AG | 19713-520 | Drexel | yes | 24 hrs | |
| | Govern 4E | 62719-220-55467 | TENKOZ, Inc. | yes | 24 hrs | |
| | Hatchet | 62719-220 | Dow AgroSciences | yes | 24 hrs | |
| | Lorsban Advanced | 62719-591 | Dow AgroSciences | yes | 24 hrs | |
| | Lorsban 4E | 62719-220 | Dow AgroSciences | yes | 24 hrs | |
| | Lorsban 75WG | 62719-301-10163 | Gowan | no | 24 hrs | |

| Active Ingredient | Insecticide & Formulation | EPA Reg# | Company | RUP | REI | IRAC Mode of Action(1) |
|---|---|---|---|---|---|---|
| **chlorpyrifos** (continued)** | Vulcan | 66222-233 | ADAMA | yes | 24 hrs | **1B (Organophosphates)** |
| | Warhawk | 34704-857 | Loveland | yes | 24 hrs | |
| | Warhawk Clearform | 34704-1077 | Loveland | yes | 24 hrs | |
| | Whirlwind | 62719-220-5905 | Helena | yes | 24 hrs | |
| | Yuma 4E | 62719-220-1381 | Winfield United | yes | 24 hrs | |
| **clofentezine** | Apollo SC | 66222-47 | ADAMA | no | 12 hrs | **10A (Clofentezine)** |
| **cyflumetofen** | Sultan Miticide | 7969-337 | BASF Ag Products | no | 12 hrs | **25 (Beta-ketonitrile Derivatives)** |
| **cyfluthrin**** | Baythroid XL | 264-840 EPA-SLN No. MI 060003 | Bayer CropScience | yes | 12 hrs | **3A (Pyrethroids)** |
| **diflubenzuron**** | Dimilin 25W | 400-465 | Macdermid Agricultural Solutions | yes | 12 hrs | **15 (Benzoylureas)** |
| **dinotefuran** | Safari 20 SG | 86203-11-59639 | Valent USA | no | 12 hrs | **4A (Neonicotinoids)** |
| **esfenvalerate**** | Asana XL | 59639-209 | Valent USA | yes | 12 hrs | **3A (Pyrethroids)** |
| | S-fenvalostar | 71532-21-91026 | LG Life Sciences | yes | 12 hrs | |
| | Zyrate | 71532-21-83979 | Rotam | yes | 12 hrs | |
| **etoxazole** | TetraSan 5 WDG | 59639-108 | Valent USA | no | 12 hrs | **10B (Etoxazole)** |
| **fenazaquin** | Magister SC | 10163-322 | Gowan | no | 12hrs | **21A (METI)** |
| | Magus Miticide | 10163-297 | Gowan | no | 12 hrs | |
| **hexythiazox** | Hexamite | 42750-311 | Albaugh Inc. | no | 12 hrs | **10A (Hexythiazox)** |
| | Hexygon DF | 10163-251 | Gowan | no | 12 hrs | |
| | Hexygon IQ | 10163-365 | Gowan | no | 12 hrs | |
| | Onager | 10163-277 | Gowan | no | 12 hrs | |
| | Onager Optek | 10163-337 | Gowan | no | 12 hrs | |
| | Savey 50DF | 10163-250 | Gowan | no | 12 hrs | |

| Active Ingredient | Insecticide & Formulation | EPA Reg# | Company | RUP | REI | IRAC Mode of Action(1) |
|---|---|---|---|---|---|---|
| **horticultural oil** | BioCover MLT | 34704-805 | Loveland Products, Inc | no | 4 hrs | **Oil – mineral or petroleum (Biopesticides)** |
| | Damoil | 19713-123 | Drexel | no | 4 hrs | |
| | Glacial Spray Fluid* | 34704-849 | Loveland Products | no | 4 hrs | |
| | Mite-E-Oil | 5905-302 | Helena Chemical | no | 4 hrs | |
| | Purespray Green | 69526-9 | Petro-Canada | no | 4 hrs | |
| | Purespray 10E | 69526-5 | Petro-Canada | no | 4 hrs | |
| | SuffOil-X* | 48813-1-68539 | BioWorks | no | 4 hrs | |
| | Tritek* | 48813-1 **(2020**) | Brandt Consolidated | no | 4 hrs | |
| | Ultra-Pure Oil Hort | 69526-5-499 | BASF | no | 4 hrs | |
| **imidacloprid (continued on next page)** | Admire Pro | 264-827 | Bayer CropScience | no | 12 hrs | **4A (Neonicotinoids)** |
| | Advise Four | 1381-219 | Winfield United | no | 12 hrs | |
| | Alias 4F | 66222-156 | ADAMA | no | 12 hrs | |
| | Imidashot DF | 70905-3 | Sulphur Mills Limited | no | 12 hrs | |
| | Macho 2.0 FL | 42750-110 | Albaugh, LLC/Agri Star | no | 12 hrs | |
| | Macho 4.0 | 42750-140 | Albaugh, LLC/Agri Star | no | 12 hrs | |
| | Malice 2F | 34704-893 | Loveland Products | no | 12 hrs | |
| | Malice 75 WSP | 34704-1009 | Loveland Products | no | 12 hrs | |
| | Midash Forte | 83529-6 | Sharda USA LLC | no | 12 hrs | |
| | Montana 2F | 83100-7-83979 | Rotam North America | no | 12 hrs | |
| | Montana 4F | 83100-21-83979 | Rotam North America | no | 12 hrs | |
| | Nuprid 2SC | 228-572 | Nufarm | no | 12 hrs | |
| | Nuprid 4.6F Pro | 228-527 | Nufarm | no | 12 hrs | |
| | Nuprid 4F MAX | 228-528 | Nufarm | no | 12 hrs | |
| | Prey 1.6 | 34704-894 | Loveland Products | no | 12 hrs | |
| | Provado 1.6F | 264-763 | Bayer CropScience | no | 12 hrs | |
| | Provoke | 89168-23-89391 | Innvictis | no | 12 hrs | |
| | Quali-Pro Imidacloprid 2F | 66222-203 | ADAMA | no | 12 hrs | |
| | Sherpa | 34704-983 | Loveland Products | no | 12 hrs | |
| | Widow | 34704-893 | Loveland Products | no | 12 hrs | |
| | Willowood Imidacloprid 4SC | 87290-26 | Willowood USA | no | 12 hrs | |

| Active Ingredient | Insecticide & Formulation | EPA Reg# | Company | RUP | REI | IRAC Mode of Action(1) |
|---|---|---|---|---|---|---|
| **imidacloprid (continued)** | Wrangler | 34704-931 | Loveland Products | no | 12 hrs | **4A (Neonicotinoids)** |
| **lambda-cyhalothrin**** | Grizzly Too | 100-1295-1381 | Winfield United | yes | 24 hrs | **3 (Pyrethroids)** |
| | Kendo | 74530-38 | Helm Agro | yes | 24 hrs | |
| | Kendo 22.8 CS | 74530-54 | Helm Agro | yes | 24 hrs | |
| | Lambda-Cy | 83222-42 | Winfield United | yes | 24 hrs | |
| | Lambda-Cy EC | 70506-121 | United Phosphorus, Inc. | yes | 24 hrs | |
| | LambdaStar 1 CS | 71532-25-91026 | LG Life Sciences | yes | 24 hrs | |
| | Lambda Star Plus | 71532-29-91026 | LG Life Sciences | yes | 24 hrs | |
| | Lambda-T | 100-1112-5905 | Helena Chemical | yes | 24 hrs | |
| | L-C Insecticide | 19713-572 | Drexel Chemical Co. | yes | 24 hrs | |
| | Lamcap II | 100-1295 | Syngenta Crop Protection | yes | 24 hrs | |
| | Nufarm Lambda-cyhalothrin 1 EC | 228-708 | Nufarm Ag Products | yes | 24 hrs | |
| | Paradigm | 66222-223-33270 **(2020)** | United Suppliers, Inc. | yes | 24 hrs | |
| | Province II | 100-1295-55467 | Tenkoz Inc. | yes | 24 hrs | |
| | Ravage | 89168-16-89391 | Innvictis Crop Care, LLC | yes | 24 hrs | |
| | Silencer | 66222-104 | ADAMA | yes | 24 hrs | |
| | Warrior II | 100-1295 | Syngenta Crop Protection | yes | 24 hrs | |
| | Willowood Lambda-Cy 1 EC | 87290-24 | Willowood USA | yes | 24 hrs | |
| **malathion** | Fyfanon 57% EC | 279-3607 | FMC Corporation | no | 12 hrs | **1B (Organophosphates** |
| | Malathion 5EC | 19713-217 | Drexel Chemical | no | 12 hrs | |
| | Malathion 8 Flowable | 10163-21 | Gowan | no | 12 hrs | |
| | Malathion 8 Aquamul | 34704-474 | Loveland Products | no | 12 hrs | |

| Active Ingredient | Insecticide & Formulation | EPA Reg# | Company | RUP | REI | IRAC Mode of Action(1) |
|---|---|---|---|---|---|---|
| **methoxyfenozide** | Intrepid 2F | 62719-442 | Dow AgroSciences | no | 4 hrs | **18 (Diacylhydrazines)** |
| | Invertid 2F | 34704-1107 | Loveland Products | no | 4 hrs | |
| | Troubadour 2F | 62719-442-5905 | Helena Chemical Co. | no | 4 hrs | |
| | Turn Style | 70506-332 | United Phosphorus, Inc. | no | 4 hrs | |
| **permethrin**** | Arctic 3.2 | 1381-187 | Winfield | Yes | 12 hrs | **3A (Pyrethroids)** |
| | PermaStar Ag. | 71532-15-91026 | LG Life Sciences | yes | 12 hrs | |
| | Perm-UP 25 DF | 70506-66 | United Phosphorus, Inc. | yes | 12 hrs | |
| | Pounce 25 WP | 279-3051 | FMC Professional Solutions | yes | 12 hrs | |
| **phosmet** | Imidan 70-W | 10163-169 | Gowan | no | 13 days | **1B (Organophosphates)** |
| **potassium salts of fatty acids** | M-Pede Insecticide* | 10163-324 | Gowan | no | 12 hrs | **insecticidal soap (Biopesticides)** |
| **pymetrozine** | Endeavor | 100-913 | Syngenta | no | 12 hrs | **9B (Pyridine azomethine derivatives)** |
| **spinosad** | Blackhawk Naturalyte | 62719-523 | Dow AgroSciences | no | 4 hrs | **5 (Spinosyns)** |
| | Conserve SC | 62719-291 | Dow AgroSciences | no | 4 hrs | |
| | Entrust * | 62719-282 | Dow AgroSciences | no | 4 hrs | |
| | Entrust SC * | 62719-621 | Dow AgroSciences | no | 4 hrs | |
| | Seduce (insect bait)* | 67702-25-70051 | Certis USA | no | 4 hrs | |
| | SpinTor 2SC | 62719-294 | Dow AgroSciences | no | 4 hrs | |
| **spirodiclofen** | Envidor 2SC Miticide | 264-831 | Bayer Cropscience | no | 12 hrs | **23 (Tetramic acids)** |
| **spirotetramat** | Movento | 264-1050 | Bayer Cropscience | no | 24 hrs | **23 (Tetramic acids)** |

| Active Ingredient | Insecticide & Formulation | EPA Reg# | Company | RUP | REI | IRAC Mode of Action(1) |
|---|---|---|---|---|---|---|
| **tebufenozide** | Confirm 2F | 8033-111-10163 | Gowan | no | 4 hrs | **18 (Diacylhydrazines)** |
| **thiamethoxam** | Flagship .22G | 100-960 | Syngenta | no | 12 hrs | **4A (Neonicotinoids)** |
| | Flagship 25WG | 100-955 | Syngenta | no | 12 hrs | |

*Organic Materials Review Institute (OMRI) Listed.

**RUP (Restricted Use Pesticide) - Products containing these active ingredients are classified as a restricted use pesticide and require the applicator to retain a pesticide applicator license.

**1** Insecticide Resistance Action Committee **(IRAC)** codes are used to distinguish the insecticide modes of action for resistance management.

# DISEASES

As we continually gain insight into pesticide and pest interactions, we have the opportunity to greatly improve the efficacy of our management practices. In order to optimize environmental and economic sustainability we have to understand the lifecycles of the pathogens in our Christmas tree fields and also the pesticides used to treat them. Monitoring temperature and wetting events is another critical part of managing disease and can assist in estimating when pathogens are likely present and able to cause infection. Real time and historical weather data and pest models are available via Michigan State University (MSU) at the Enviroweather website found at www.enviroweather.msu.edu.

| Disease | Pathogen | Cultural control | Chemical control | Comments | Reference page[1] (2nd/3rd) |
|---|---|---|---|---|---|
| **Armillaria Root Rot** *Armillaria spp.* | All species | Choose a site that is well suited to the growth needs of the desired species. If possible, avoid planting on cutover sites, especially those that were red pine, Douglas-fir and other Christmas tree species. If possible, remove stumps and large roots before planting. Maintain healthy, vigorous trees. | *Trichoderma asperellum* | Efficacy has not been evaluated in Christmas tree fields in Michigan where Armillaria natively occurs. *Trichoderma asperellum* is a biological fungicide for use in nursery plantings mix, bareroot dip, when transplanting ornamentals or a soil drench to protect plants from root pathogens. | **114/138** |
| **Balsam Fir Needle Rust** *Uredinopsis spp. and Milesina spp.* | Balsam fir Concolor fir potentially Fraser fir | Control is usually not necessary because weather conditions and competition from other fungi keep the damage below serious levels. However, in Christmas tree plantations, disease can cause economic loss. | triadimefon | Some formulations containing triadimefon may be registered but keep in mind that these products are best used preventatively. Apply at bud break and 10-14 day intervals. The necessity for control will depend on the level of diseases. If disease incidence is high, mow or use a registered herbicide to control ferns, which are the source of spores, this will reduce disease in subsequent years. **Do not use triadimefon on *Abies concolor.*** | **26/42** |
| **Broom Rust of Fir** *Melampsorella caryophyllacearum* | Balsam fir Concolor fir Fraser fir | Remove diseased trees through selective thinning. Infected branches can be pruned from high value trees. Inspect nursery crop and survey new planting areas for broom rust in native balsam or fir trees. | myclobutanil ziram | Typically, removing infected branches or trees will eliminate the problem. To break the life-cycle and control the spread of this disease, eradicating the chickweed is essential. Commercial growers should look for chickweed in the groundcover, between the rows and throughout the planting so it can be controlled where necessary. | **77/93** |

| Disease | Pathogen | Cultural control | Chemical control | Comments | Reference page[1] (2nd/3rd) |
|---|---|---|---|---|---|
| **Brown Spot Needle Blight** *Mycosphaerella dearnessii* | Scotch pine | Cultural -Remove severely diseased trees and treat surrounding area with fungicides. Promote good air circulation through pruning and weed control. Shear healthy trees before infected tree. Pruning tools should be sterilized between trees. Avoid shearing infected trees when the foliage is wet. Do not leave live branches on the stumps of harvested trees. | chlorothalonil copper hydroxide copper sulfate mancozeb thiophanate-methyl | Make first application when needles are 1/2 elongated and the second application about 2-3 weeks later. Repeat after heavy rains and at two-week intervals as long as needed. Short-needled varieties are very susceptible. If a few trees are diseased remove and destroy those trees to prevent further spread of the disease. | **31/34** |
| **Charcoal Rot** *Macrophomina phaseolina* | Fraser fir Spruce | Charcoal rot is a disease that occurs when plants are under heat and drought stresses. Irrigate trees where available to help reduce drought stress. Avoid planting soybeans as a rotational crop. | | At this point, no information is available on the effectiveness of fungicides for control of this disease. | **NA** |
| **Cyclaneusma Needlecast** *Cyclaneusma minus* | Scotch pine | Usually does not warrant control efforts. In problem plantations, control weeds and maintain tree spacing to maximize air movement. | chlorothalonil copper hydroxide copper sulfate mancozeb | Many fungicides have shown activity protecting needles from infection. The long and unpredictable infection periods require multiple applications throughout the growing season to control this disease. In some cases, these applications have achieved control but do not improve the tree grade or density of the foliage. Pines typically hold1-2 years of growth and other factors controlling needle retention may cause heavy needle casting in the fall regardless of levels of infection. | **32/35** |
| **Cytospora (Leucostoma) Canker** *Leucostoma kunzei* | Spruce, especially Colorado blue and Norway | Remove infected branches. Do not prune or shear infected trees during wet weather. Maintain tree vigor and do not plant trees on marginal sites. Avoid wounding the trees. Harvest as quickly as possible. | | At this point, there are no effective chemical controls for Leucostoma canker (Cytospora canker). | **83/104** |
| **Diplodia Shoot Blight and Canker** *Sphaeropsis sapinea* | Austrian pine Red pine Scotch pine Occasionally-Colorado blue spruce and Douglas-fir | Do not allow water stress, maintain tree vigor, and prevent injury through insect control. Do not shear infected trees during wet weather. Prune out infected branches and sanitize pruning tools between cuts. | azoxystrobin mancozeb* myclobutanil thiophanate-methyl triadimefon | Diplodia tip blight can be controlled with one to three applications of an effective fungicide. Time your application at bud break (candle elongation). Repeat 10-14 days later, just before needles emerge from sheath. Repeat again 10-14 days after needle emergence. | **98/96** |

| Disease | Pathogen | Cultural control | Chemical control | Comments | Reference page[1] (2nd/3rd) |
|---|---|---|---|---|---|
| **Dothistroma Needle Blight** *Mycosphaerella pini* | Austrian pine Potentially Scotch pine | Provide for air circulation around the tree by decreasing planting density and controlling weeds that block air movement. Do not plant in low lying or cooler areas with susceptible pine. | chlorothalonil copper sulfate copper hydroxide | Two fungicide applications are recommended to control Dothistroma. Apply at bud break to protect the previous year's needles and one in mid-June to protect the current year's needles. Some have reported controlling Dothistroma with one application in June. | **33/36** |
| **Gall Rust (Pine/pine or Western)** *Endocronartium harknessii* | Scotch pine | Remove branch galls and heavily galled trees before May 1 (before they produce spores). Purchase clean planting stock. Replant infested sites with non-host species. | triadimefon mancozeb | In research trials fungicide application provided fair to poor control. Repeat mancozeb applications after heavy rains and at two-week intervals as long as needed. | **108/130** |
| **Interior Needle Blight** *Mycosphaerella spp., Phaeocryptopus nudus, Phyllosticta abietina, Toxosporium spp., Rhizosphaera spp* | Grand fir Noble fir | Use practices that increase air circulation (e.g. weed control), decreasing needle wetness is beneficial. Do not interplant the next rotation before the current rotation of trees has been completely harvested. | chlorothalonil | Applications of fungicides to new growth on affected Christmas trees during spring has increased the percentage of healthy older green needles. Make the initial application when shoots are 1 1/2 to 2 1/2 inches long, followed by an additional application about 3 to 4 weeks later if conditions are variable for disease development. Applications are not needed in the harvest year, especially for clear-cut operations. | |
| **Isthmiella Needlecast** *Isthmiella faullii* | Balsam fir Concolor fir Fraser fir | Promote good air movement by controlling weeds and pruning lower branches. Shear healthy trees first and disinfect tools often. Do not shear during wet weather. Space trees adequately and do not interplant rotations. Plant clean nursery stock. | mancozeb* | Time fungicide application to protect current needles during spores released from infected needles during rainy periods in June - August. | **NA/44** |
| **Lirula Needlecast** *Lirula nervata and Lirula mirabilis* | Balsam fir Concolor fir Fraser fir | Promote good air movement by controlling weeds and pruning lower branches. Shear healthy trees first and disinfect tools often. Do not shear during wet weather. Space trees adequately and do not interplant rotations. Plant clean nursery stock. | | At this point, no information is available on the effectiveness of fungicides for control of this disease. | **38/44** |

| Disease | Pathogen | Cultural control | Chemical control | Comments | Reference page[1] (2nd/3rd) |
|---|---|---|---|---|---|
| **Lophodermium Needlecast** *Lophodermium seditiosum* | Austrian pine Eastern white pine Red pine Scotch pine | Choose seed sources that are less susceptible and disease free nursery stock. Avoid prolonged periods of moisture and promote good air circulation by irrigating in the morning, controlling weeds and pruning lower branches. Shear healthy trees first and disinfect tools often. Do not shear during wet weather. Do not leave live branches on cut stumps. | azoxystrobin chlorothalonil mancozeb triadimefon | The most important time to protect trees is in August and September. Begin application to coincide with spore release beginning the end of July and through September. For most plantations, two applications, one about August 1 and the other about September 1 will give adequate control. If the weather in the late fall is unusually wet an additional application may be required. If using mancozeb, repeat after heavy rains and at two-week intervals as long as needed. | **40/46** |
| **Phomopsis twig blight and canker** *Phomopsis spp.* | Colorado blue spruce Occasionally - White spruce Norway spruce | Cultural management of plant vigor can help reduce damage caused by plant pathogens, because wounds, water stress and the presence of other pest play important roles in plant susceptibility to infection and disease development. Remove diseased branches and trees as soon as possible. | mancozeb* thiophanate-methyl | Apply fungicides to protect spruce during maximum susceptibility. Fungicide should be timed to protect the new growth from infection and suppress the development of existing infection sites. Applications of protectant fungicides should start at the bud break and continue at 3-week intervals until new shoots are fully developed and hardened off. | **NA/108** |
| **Phytophthora Root Rot** *Phytophthora cactorum, P. citricola, P. cryptogea, and P. nicotiana among other species* | Various species of the fungus Phytophthora are present throughout the U.S. and are known to infect fir, spruce, and pine trees. | Do no plant on heavy soil or poorly drained sites. Prevent introduction of Phytophthora by inspecting stock before planting and clean equipment and tools regularly to prevent movement. | aluminum tris fluopicolide mefenoxam metalaxyl potassium salts of phosphorous acid potassium phosphite | Fungicides will not overcome poorly drained sites. Applications of systemic fungicides are used in nurseries. Use in Christmas tree plantations may not be practical or economical. Mefenoxam can be used as a dip, drench or foliar treatment. For best metalaxyl efficacy, 1/2 - 1 inch of irrigation or rainfall is required within 24 hours after application. | **116/142** |
| **Pine Needle Rust** *Coleosporium asterum* | Red pine Scotch pine | Avoid planting on sites with poor air circulation. Kill weeds, aster and goldenrod prior to planting. | | Remove goldenrod and aster before August in and around infected plantations by mowing or applying an herbicide. | **42/48** |

| Disease | Pathogen | Cultural control | Chemical control | Comments | Reference page[1] (2nd/3rd) |
|---|---|---|---|---|---|
| **Rhabdocline Needlecast** *Rhabdocline pseudotsugae* | Douglas-fir | Plant disease-resistant seed sources of Douglas-fir such as Shuswap. Remove severely affected to prevent disease buildup by May 1. Improve air circulation through plant spacing and weed control. Remove and destroy infected trees from plantations. Avoid using Rocky Mountain seed sources and purchase disease free nursery stock. Do not shear during wet weather. Shear healthy trees first and sanitize tools often. Do not leave live branches on the stumps of harvested trees. | chlorothalonil mancozeb copper hydroxide copper sulfate thiophanate methyl | Start applying fungicides when trees are 4-5 years away from harvest. Since trees do not break bud at the same time, apply when first buds break, a second spray one week later, and a third spray two weeks after the second. A fourth application may be required three weeks after the third application if wet weather persists. | **46/53** |
| **Rhizosphaera Needlecast** *Rhizosphaera kalkhoffii* | Colorado Blue Spruce Occasionally-White spruce | Remove severely affected trees early in the rotation to prevent disease buildup. Provide adequate space between trees to increase air movement. Do not leave live branches on the stumps of harvested trees or shear during wet weather. Shear healthy trees first and disinfect tools often. | chlorothalonil copper hydroxide copper sulfate mancozeb* | Phytotoxicity can occur when spraying chlorothalonil on spruce at higher rates and with air-blast sprayers. Begin application when the new growth is 1/2 to 2" long. Make additional applications at 3–4-week intervals until conditions no longer favor disease development. For control to be successful it may take 2-3 years of yearly fungicide applications. | **48/55** |
| **Scleroderris Canker** *Gremmeniella abietina* | All pines Occasionally-Spruces Firs Douglas-fir | Remove infected branches. Do not shear during wet weather and sterilize tools often. Shear healthy trees first. | chlorothalonil | Begin application when the new growth is 1/2 to 2" long. Make additional applications at 3–4-week intervals until conditions no longer favor disease development. | **97/117** |
| **Sirococcus Tip Blight** *Sirococcus spp.* | Red pine Scotch pines Colorado blue spruce, rarely White spruce | Remove and destroy heavily infected trees. Do not shear during wet weather. | azoxystrobin chlorothalonil triadimefon | Begin application when the new growth is 1/2 to 2" long. Make additional applications at 3–4-week intervals until conditions no longer favor disease development. | **NA/118** |

| Disease | Pathogen | Cultural control | Chemical control | Comments | Reference page[1] (2nd/3rd) |
|---|---|---|---|---|---|
| **Spruce Needle Rust** *Chrysomyxa spp.* | Colorado blue spruce Black spruce White spruce Occasionally-Norway spruce. | Control is not typically warranted because disease rarely occurs in consecutive seasons. Remove and destroy alternate hosts near to plantation. Plant resistant species of spruce, such as Norway or Black Hills. White spruce is moderately resistant, but black and Colorado blue spruce are extremely susceptible. | | At this point, no information is available on the effectiveness of fungicides for control of this disease. Avoid planting spruce near swamps that contain Labrador tea and leather leaf. | **50/58** |
| **Stigmina Needlecast** *Stigmina lautii* | Colorado Blue spruce Serbian spruce White spruce | Promote good air movement through weed control and pruning lower branches. Do not leave live branches on the stumps of harvested trees. Do not shear during wet weather. Shear healthy trees first and sanitize tools often. The Christmas Tree Pest Manual page referenced is for Rhizosphaera needlecast that is believed to be comparable to Stigmina needlecast. | chlorothalonil copper hydroxide mancozeb | Products that control Rhizosphaera needlecast should also control of Stigmina. Begin application when the new growth is 1/2 to 2" long. Make additional applications at 3–4-week intervals until conditions no longer favor disease development. Research in North Dakota indicates that fungicide applications may need to be applied yearly to be successful. | **48/55** |
| **Swiss Needlecast** *Phaeocryptopus gäumanni* | Douglas-fir | Remove severely affected trees early in the rotation to prevent disease buildup or older trees in fencerows. Improve air circulation in fields. To increase air movement, provide adequate space between trees, control weeds and prune lower branches. Do not shear in wet weather and sterilize tools often. Do not leave live branches on stumps of harvested trees. | azoxystrobin chlorothalonil mancozeb thiophanate-methyl | Begin applying fungicides for control beginning 3 years before you plan to harvest the trees. Needle infection occurs shortly after bud break, so you will want to time your application to protect these new needles from infection. Begin application when the new growth is 1/2 to 2" long. Make additional applications at 3–4-week intervals until conditions no longer favor disease development. Labels list a single application at a higher rate. Remember when treating it is better to be on the early side than too late. Repeat mancozeb applications after heavy rains and at two-week intervals as long as needed. | **52/60** |
| **Weir's cushion rust** *Chrysomyxa weirii* | Colorado blue spruce Engelmann spruce White spruce | Remove severely affected trees early in the rotation to prevent disease buildup or older trees in fencerows. Provide adequate space between trees to increase air movement around lower branches allowing the foliage to dry quicker. | chlorothalonil | Begin when bud break is about 10% complete. Two more applications should be made at 7 to 10-day intervals. | **NA/58** |

| Disease | Pathogen | Cultural control | Chemical control | Comments | Reference page[1] (2nd/3rd) |
|---|---|---|---|---|---|
| **White Pine Blister Rust** *Cronartium ribicola* | White pine | Remove and destroy alternate hosts (gooseberry or currant) in or near the plantation before August. When shearing Christmas trees, prune off all brown branches that have cankers to prevent the fungus from entering the trunk and killing the tree. Destroy and remove trees with trunk cankers. | | At this point, no information is available on the effectiveness of fungicides for control of this disease. Remove and destroy alternate hosts (gooseberry or currant) in or near the plantation before August. | **100/120** |

[1]Christmas Tree Pest Manual, Second and Third Edition (Michigan State University Extension Bulletin E-2676).
*Not all mancozeb products are labeled for the listed disease or tree species, check the label.

# REGISTERED FUNGICIDES

Read and follow all label instructions before using any pesticide product. Information derived from this publication does not constitute a label replacement or a recommendation. Before applying any pesticide, read and understand the entire pesticide label and any additional labeling related to the proposed use. The use of a pesticide in a manner not consistent with the label can lead to the injury of crops, humans, animals and the environment. **FRAC Code is a number and/or letter combination assigned by the fungicide resistance action committee (FRAC) to group together active ingredients which demonstrate potential for cross-resistance. Fungicides with the same FRAC code are at risk for cross-resistance because they have the same target site.**

| Active Ingredient | Products | EPA Number | Re-Entry Interval | Crop | Manufacture | FRAC Code* |
|---|---|---|---|---|---|---|
| **aluminum tris** | Aliette WDG | 432-890 | 12 hours | Conifer nurseries | Bayer Environmental Science | **33** |
| | Quali-Pro Fosetyl-Al 80 WDG | 66222-161 | 12 hours | Conifer nurseries | ADAMA | |
| **azoxystrobin** | Abound<br>Aframe<br>Quadris Flowable | 100-1098 | 4 hours | Christmas trees | Syngenta Crop Protection | **11** |
| | Armortech Zoxy 2 SC | 87290-44-86064 | 4 hours | Christmas trees | United Turf Alliance | |
| | Azoxystar | 42750-261 | 4 hours | Christmas trees | Albaugh, LLC | |
| | Azoxyzone | 71532-35-91026 | 4 hours | Christmas trees | LG Life Sciences | |
| | Tetraban | 33270-32 | 4 hours | Christmas trees | United Suppliers Inc. | |
| **chlorothalonil** **Special Eye Irritation Provision** - after REI expires, for the next 6.5 days entry is permitted when safety measures are provided. **See label** | Bravo Ultrex | 66222-277 | 12 hours** | Conifers (including Christmas trees) | ADAMA | **M5** |
| | Bravo Ultrex | 50534-201-100 | 12 hours** | Conifers (including Christmas trees) | Syngenta Crop Protection, Inc. | |
| | Bravo Weather Stik | 66222-276 | 12 hours** | Conifers (including Christmas trees) | ADAMA | |
| | Bravo Weather Stik | 50534-188-100 | 12 hours** | Conifers (including Christmas trees) | Syngenta Crop Protection, Inc. | |
| | Cercos | 60063-5 | !2 hours** | Conifer - nursery beds, Christmas trees | Sipcam Agro USA, Inc. | |
| | Chloronil 720 | 50534-188-100 **(2020)** | 12 hours ** | Conifers (including Christmas trees) | Syngenta Crop Protection, Inc. | |
| | Chlorothalonil 720 | 19713-690 | 12 hours ** | Conifers (including Christmas trees) | Drexel Chemical Co. | |
| | Daconil Weather Stik | 50534-209-100 | 12 hours ** | Conifers, nursery beds, Christmas trees ***Do not apply to blue spruce** | Syngenta Crop Protection, Inc. | |
| | Daconil Zn | 50534-211-100 | 12 hours ** | Conifers, Christmas trees, Douglas-fir, conifer nursery beds | Syngenta Crop Protection, Inc. | |

| Active Ingredient | Products | EPA Number | Re-Entry Interval | Crop | Manufacture | FRAC Code* |
|---|---|---|---|---|---|---|
| **chlorothalonil (continued on next page)**<br><br>****Special Eye Irritation Provision** - after REI expires, for the next 6.5 days entry is permitted when safety measures are provided. **See label** | | | | *** Do not apply to blue spruce**<br>*** Do not apply with high pressure spray equipment.** | | **M5** |
| | Daconil Ultrex Turf Care | 50534-202-100 | 12 hours ** | Conifers, Christmas trees, conifer nursery beds *****<br>**Do not use on blue spruce**<br>*** Do not apply with high pressure spray equipment.** | Syngenta Crop Protection, Inc. | |
| | Docket DF | 50534-202-100 | 12 hours ** | Conifers, Christmas trees, conifer nursery beds *****<br>**Do not use on blue spruce**<br>*** Do not apply with high pressure spray equipment.** | Syngenta Crop Protection, Inc. | |
| | Docket WS Flowable | 50534-209-100 | 12 hours ** | Conifers, Christmas trees, conifer nursery beds<br>*** Do not use on blue spruce**<br>*** Do not apply with high pressure spray equipment.** | Syngenta Crop Protection, Inc. | |
| | Echo 90DF | 60063-10 | 12 hours** | Conifers | Sipcam Agro USA, Inc. | |
| | Echo ZN | 60063-4 | 12 hours** | Conifers | Sipcam Agro USA, Inc. | |
| | Echo 720 | 60063-7 | 12 hours** | Conifers (pines and spruce) | Sipcam Agro USA, Inc. | |
| | Echo Ultimate Turf and Ornamental | 60063-3 | 12 hours** | Conifers (including Christmas trees) | Sipcam Agro USA, Inc. | |
| | Ensign 720 | 34704-966 | 12 hours** | Conifers, Christmas tree, nursery beds | Loveland Products, Inc. | |
| | Ensign 82.5% | 34704-965 | 12 hours** | Conifers, Christmas tree, nursery beds | Loveland Products, Inc. | |
| | Ensign 90DF | 34704-878 | 12 hours** | Conifers | Loveland Products, Inc. | |
| | Equus DF<br>Quali-Pro Chlorothalonil DF | 66222-149 | 12 hours** | Conifers, pines, spruce | ADAMA | |
| | Equus 720 | 66222-154 **(2020)** | 12 hours** | Conifers, pine, spruce | ADAMA | |
| | Equus 720 SST | 5481-619 | 12 hours** | Conifers, pine, spruce | Amvac Chemical Corp. | |
| | Initiate 720 Flowable | 34704-881 | 12 hours** | Conifers (including Christmas trees, nursery beds) | Loveland Products, Inc. | |
| | Initiate ZN | 34704-1050 | 12 hours** | Conifers (including Christmas trees, nursery beds) | Loveland Products, Inc | |
| | Pegasus 6L | 70506-262 | 12 hours** | Conifers, conifer nursery beds, Christmas trees | United Phosphorus, Inc. | |

| Active Ingredient | Products | EPA Number | Re-Entry Interval | Crop | Manufacture | FRAC Code* |
|---|---|---|---|---|---|---|
| **chlorothalonil (continued) **Special Eye Irritation Provision** | Pegasus DFX | 70506-272 | 12 hours** | Conifers, conifer nursery beds, Christmas trees | United Phosphorus, Inc. | **M5** |
| | Pegasus HPX | 70506-273 | 12 hours** | Conifers, conifer nursery beds, Christmas trees | United Phosphorus, Inc. | |
| | Praiz | 9779-320 | 12 hours** | Conifers (pine and spruce) | Winfield Solutions | |
| | Vabro | 9779-320-33270 | 12 hours** | Conifers (pine and spruce) | United Suppliers Inc. | |
| **copper hydroxide** | Champ Formula 2 Flowable | 55146-64 | 48 hours | Conifers-Christmas tree plantings, silviculture nurseries - Douglas fir, Fir, Pine & Spruce | Nufarm Agricultural Products | **M1** |
| | ChampION | 55146-115 | 48 hours | Conifers-Christmas tree plantings, silviculture nurseries - Douglas fir, Fir, Pine & Spruce | NuFarm Agricultural Products | |
| | CuPRO 5000 | 80289-2-67690 | 48 hours | Conifers-Christmas tree plantings, silviculture nurseries- Douglas fir, Fir, Pine & Spruce | Sepro Corporation | |
| | Kocide 2000-O | 91411-10-70051 | 48 hours | Conifers-Christmas tree plantings, silviculture nurseries- Douglas fir, Fir, Pine & Spruce | Certis, USA | |
| | Kocide 3000 | 91411-2-70051 | 48 hours | Conifers-Christmas tree plantings, silviculture nurseries - Douglas fir, Fir, Pine & Spruce | Certis, USA | |
| | Kocide HCu | 91411-12-70051 | 48 hours | Conifers-Christmas tree plantings, silviculture nurseries - Douglas fir, Fir, Pine & Spruce | Certis, USA | |
| | Kentan DF | 80289-2 | 48 hours | Conifers-Christmas tree plantings, silviculture nurseries, Douglas fir, Fir, Pine & Spruce | Isagro USA, Inc. | |
| | Nu-Cop 30 HB | 42750-281 | 48 hours | Conifers-Christmas tree plantings, silviculture nurseries, Douglas fir, Fir, Pine & Spruce | Albaugh, LLC/AgriStar | |
| | Nu-Cop XLR | 42750-217 | 48 hours | Conifers-Christmas tree plantings, silviculture nurseries, Douglas fir, Fir, Pine & Spruce | Albaugh, LLC/AgriStar | |

| Active Ingredient | Products | EPA Number | Re-Entry Interval | Crop | Manufacture | FRAC Code* |
|---|---|---|---|---|---|---|
| **copper oxychloride and copper hydroxide** | Badge SC | 80289-3-10163 | 48 hours | Conifers-Christmas tree plantings, silviculture nurseries, Douglas fir, Fir, Pine & Spruce | Gowan Company | **M1** |
| | Badge X2 | 80289-12 80289-12-10163 | 48 hours | Conifers-Christmas tree plantings, silviculture nurseries, Douglas fir, Fir, Pine & Spruce | Isagro USA Inc. Gowan Company | |
| **copper sulfate** | Cuprofix Ultra 40 Dispersible | 70506-201 | 48 hours | Douglas-fir, Fir, Pine and Spruce | United Phosphorus, Inc | **M1** |
| | Cuproxat Flowable | 35935-3 **(2020)** | 48 hours | Conifers-Christmas tree plantings, silviculture nurseries, Douglas fir, Fir, Pine & Spruce | Nufarm Limited | |
| **fluopicolide** | Adorn | 59639-141 | 12 hours | Conifers, Christmas trees | Valent USA, LLC | **43** |
| **mancozeb** | Dithane DF Rainshield | 62719-402 | 24 hours | Christmas tree (conifer), Douglas-fir | Dow AgroSciences | **M3** |
| | Dithane 75DF Rainshield | 62719-402 | 24 hours | Conifers, Christmas trees, Fraser fir, Douglas-fir, Scotch pine, Austrian pine | Dow AgroSciences | |
| | Dithane F-45 | 62719-396 | 24 hours | Conifer (Christmas trees), Douglas-fir | Dow AgroSciences | |
| | Dithane M-45 | 62719-387 | 24 hours | Christmas trees(conifer), Douglas-fir | Dow AgroSciences | |
| | Fore 80WP | 62719-388 | 24 hours | Conifers, Christmas trees, Fraser fir, Douglas-fir, Scotch pine, Austrian pine | Dow AgroSciences | |
| | Koverall | 279-3580 | 24 hours | Conifers (Christmas trees), Fraser fir, Douglas-fir, Scots Pine | FMC Agricultural Products | |
| | Manzate MAX | 70506-194 | 24 hours | Christmas trees, Douglas-fir | United Phosphorus, Inc. | |
| | Manzate ProStick T&O | 70506-234 | 24 hours | Christmas trees- fir, spruce, pine | United Phosphorus, Inc. | |
| | Omni Mancozeb 75WDG | 89333-1-5905 | 24 hours | Christmas trees – fir, spruce, pine, Douglas-fir | Helena Agri-Enterprise, LLC | |
| | PenncoZeb 75DF | 70506-185 | 24 hours | Christmas trees (conifer), Douglas-fir | United Phosphorus, Inc. | |
| | PenncoZeb 80WP | 70506-183 | 24 hours | Christmas trees(conifer), Douglas-fir | United Phosphorus, Inc. | |
| | Protect DF | 1001-77 **(2020)** | 24 hours | Christmas trees, conifer, fir, Douglas-fir, pine, spruce | Cleary Chemical Corporation | |
| | Roper DF Rainshield | 34704-1063 | 24 hours | Christmas trees (conifer), Douglas-fir | Loveland Products | |

| Active Ingredient | Products | EPA Number | Re-Entry Interval | Crop | Manufacture | FRAC Code* |
|---|---|---|---|---|---|---|
| **mefenoxam** | Subdue GR | 100-794 | 48 hours | Conifers in nurseries (including Christmas trees) | Syngenta Crop Protection | **4** |
| | Subdue MAXX | 100-796 | 48 hours | Conifers in nurseries (including Christmas trees) | Syngenta Crop Protection | |
| **metalaxyl** | MetaStar 2E | 71532-5-91026 | 48 hours | Conifers in nurseries and plantations (including Christmas trees) | LG Life Science America | **4** |
| **mono- & di-potassium salts of phosphorous acid** | Alude Systemic Fungicide | 55146-83 | 4 hours | Conifers in nurseries, plantations, (including Christmas trees) | NuFarm Limited | **33** |
| | Fosphite | 68573-2 | 4 hours | Conifers in nurseries, plantations, (including Christmas Trees, pines) | JH Biotech, Inc. | |
| | KPHITE 7LP | 73806-1 | 4 hours | Conifers in nurseries, plantations, (including Christmas Trees, pines) | Plant Food Systems | |
| | Quanta | 5905-566 | 4 hours | Conifers, nurseries, plantations, (including Christmas trees) | Helena Chemical Company | |
| | Rampart<br>Rampart T&O | 34704-924 | 4 hours | Conifers in nurseries, plantations, including Christmas trees, pines) | Loveland Products | |
| **myclobutanil** | Eagle 20EW | 62719-463 | 24 hours | Christmas trees, Douglas fir | Dow AgroSciences | **3** |
| **thiophanate-methyl (continued on next page)** | Incognito 4.5 F<br>Quali-Pro TM 45 | 66222-134 | 12 hours | Conifers -Pine (Austrian, Scots), Christmas trees, Douglas-fir | ADAMA | **1** |
| | Incognito 85 WDG<br>Quali-Pro TM 85 WDG | 66222-145 | 12 hours | Conifers - Pine (Austrian, Scots), Christmas trees, Douglas-fir | ADAMA | |
| | Nufarm T-Methyl 4.5F | 228-652 | 12 hours | Conifers - Pine (Austrian, Red, Scots), Christmas trees, Douglas-fir, conifer seedling treatment | Nufarm Americas, Inc. | |
| | Nufarm T-Methyl SPC 4.5F | 228-626 | 12 hours | Conifers - Pine (Austrian, Red, Scots), Christmas trees, Douglas-fir, conifer seedling treatment | Nufarm Americas, Inc. | |
| | NuFarm T-Methyl 70W WSB | 228-655 | 12 hours | Conifers, Pine (Austrian, Scots), Christmas trees, Douglas-fir | Nufarm Americas, Inc. | |
| | Omni T-Methyl 4.5 | 5905-608 | 12 hours | Conifer spp. (Pines) Austrian Pine, Christmas Trees, Scots Pine, Douglas-fir | Helena Chemical | |
| | T-Methyl 4.5 ST | 42750-295 | 12 hours | Conifer spp. (Pines) Austrian Pine, Christmas Trees, Scots Pine, Douglas-fir | Albaugh Inc. | |

| Active Ingredient | Products | EPA Number | Re-Entry Interval | Crop | Manufacture | FRAC Code* |
|---|---|---|---|---|---|---|
| **Thiophanate-methyl (continued)** | Topsin 4.5FL | 8033-122-70506 | 12 hours | Conifers - pine (Austrian, Scots), Christmas trees, Douglas-fir | United Phosphorus, Inc. | **1** |
| | Topsin M WSB | 8033-125-70506 | 12 hours | Conifers, pine (Austrian, Scots), Christmas trees, Douglas-fir | United Phosphorus, Inc. | |
| **triadimefon** | Bayleton Flo | 432-1445 | 12 hours | Christmas trees (except Concolor), Pine Seedlings | Bayer Environmental Science | **3** |
| | Bayleton 50 Turf & Ornamental | 432-1360 | 12 hours | Christmas trees (except Concolor), Pine Seedlings | Bayer Environmental Science | |
| **Trichoderma asperellum** | Tenet WP | 80289-9 | 1 hour | Evergreen/conifer and Christmas trees (fir, pine, spruce) | Isagro/Sipcam Advan | **NC** |
| **ziram** | Ziram 76DF | 70506-173 | 48 hours | Conifer pine seedlings, Douglas-fir Christmas trees | United Phosphorus, Inc. | **M3** |

*__FRAC Code__ is a number and/or letter combination assigned by the fungicide resistance action committee (FRAC) to group together active ingredients which demonstrate potential for cross-resistance. Fungicides with the same FRAC code are at risk for cross-resistance because they have the same target site.

## Protecting Pollinators

David Smitley, Professor of Entomology, Michigan State University

**Why are some people concerned about bees and other pollinators?**

Beekeepers in Europe and North American have faced some difficult problems in the last 10 years, including a parasite of bees called the Varroa mite, increased exposure to systemic pesticides appearing in nectar and pollen, and loss of foraging habitat. Colony Collapse Disorder is no longer considered an important threat to honey bees. Research has shown it to be a syndrome caused a combination of several things, poor food sources, bee diseases and pesticides. Overall, beekeepers were losing an average of 30% or more of their colonies each winter due to Varroa mite and other stresses including pesticides.

**What are neonicotinoid insecticides?**

Neonicotinoids are a group of insecticides with a chemical structure that is similar to nicotine. They have been used extensively in agriculture and in yard and garden products. The five-neonicotinoid active ingredients are acetamiprid, clothianidin, dinotefuran, imidacloprid and thiamethoxam. They are more selective (e.g. they have greater toxicity to insects than to mammals) and less harmful to wildlife than most of the older classes of insecticides. The problem is that neonicotinoids are highly toxic to bees. In addition, they are systemic and can move into nectar and pollen, especially if they are applied as a soil systemic, or are sprayed over open flowers. Flowering weeds or flowering trees and shrubs in or near agricultural fields where neonicotinoid insecticides are applied as a seed-coat treatment, or where synthetic pyrethroid insecticides are sprayed, are lethal to honey bees, native bees and other pollinators.

**What can I do to protect bees and other pollinators?**

Christmas trees are wind pollinated, but bees may frequent flowering plants or weeds in the field or roadways. The diversity and abundance of bees and other pollinators is also a good indicator of the diversity and abundance of predators and parasitoids. Therefore, production practices that encourage bees also encourage natural enemies and biological control.

• When applying insecticides or miticides choose ones that are the least toxic to bees and other natural enemies. Look for the 'bee box' on pesticide labels.

• Consider spot treatments for highly localized pest problems.

• Time pesticide application either before dawn or after dusk when bees are foraging less.

• Horticultural oil and insecticidal soap can also be used on cool mornings (< 50° F), after sunset, or at any time that bees are not present because the spray residue is not toxic to bees.

• Consider establishing no spray zones that can act as a refuge for bees.

· Avoid using neonicotinoid insecticides as a seed-coat treatment, granular treatment or soil drench anywhere that flowering weeds grow, or where the roots of flowering ground covers, shrubs and trees grow, because they are absorbed through the roots, move systemically through the entire plant.

· Avoid spray drift onto flowering weeds, shrubs, or trees growing along the edges of Christmas tree fields.

**If beekeepers are in the area or if growers want to encourage bees and natural enemies:**

• Encourage as many wildflower, flowering weeds, and flowering brambles and shrubs as possible. The more flowers all season long, the better it is for bees.

• Avoid spraying any type of insecticide or miticide when the ground cover in Christmas tree fields has flowers. Some fungicides have also been found to suppress the immune response of bees. Even if only the trees are sprayed, the drift onto flowers in the ground cover will be highly toxic to bees. This can be prevented by mowing the groundcover strips between rows one day or less before spraying. That will remove the flowers before the spray. A week later when new flowers form there should be no problem for the bees because the new flowers will not have any pesticide residue.

• If Christmas tree fields are bordered by linden trees or any other flowering tree that is highly attractive to bees, avoid spraying when the trees are in bloom. For lindens, this will be for about a 2-week period in mid- June.

• Notify local beekeepers when Christmas trees are sprayed. This not a requirement, only a courtesy. The beekeepers already know that sprayed 0rchards or Christmas tree fields with flowering weeds could be a problem for their bees.

## Enviroweather: Tools for Pest, Disease and Production Management

Keith Mason - Enviroweather Coordinator MSU Department of Geography, Environment and Spatial Sciences


Do you need current weather information for your farm? Would you like to know when to schedule management activities for pests and diseases? Enviroweather can help.

Enviroweather is an online resource that provides Michigan growers, farm managers and crop consultants access to local weather information and a suite of weather-based tools available to help manage a variety of crops. These tools include summaries of weather conditions, models that predict pest, disease and crop development and water-use tools.

The Enviroweather program is pleased to unveil a test version of our newly redesigned website. The new site went live in August 2020 and can be accessed directly at this web address: alpha.enviroweather.msu.edu. Users will also find multiple places to reach the new site on our current website (enviroweather.msu.edu). This arrangement will allow users to switch back and forth between website versions as needed, and we hope this will make it easier to become familiar with the layout and functions of new website.

Please keep in mind this is a test version, so you should expect to see some subtle changes in the website over time as we continue to develop some

features. We are still in the process of adding some of our models to the new website, so models and applications that are not yet developed for the new site will link to models on the current website. Both of these websites will remain accessible during this test phase, which will likely extend through the 2021 growing season. Eventually the old site will be decommissioned and the new site will be directly accessed through the original web address (enviroweather.msu.edu).

The new Enviroweather platform features multiple changes that are designed to satisfy critical needs and make improvements previously identified from user surveys. The new design will be easier to use than the current website, and it will be geared toward viewing on smartphones and tablets. One major change will allow a user to create an account and save preferences on a dashboard. This will provide faster access to the crop and pest models and weather information that is most important for each user's production operations. The new site also includes a feature where a user can create "Custom Sites" that can be used to distinguish different sections of a farm that may need different management strategies.

As with any new technology, it may take a little time to get used to a new way of doing things. To help with this, user guides are available through the Information link on the menu bar near the top of the page. In addition, each model or tool on the website has a "Description" tab that contains additional information on running and interpreting the model to help with decision making.

Enviroweather will host several webinars during the fall of 2020 and continue through the winter and spring of 2021. These training webinars will demonstrate how to set up an account and a dashboard, save preferences and help users navigate the new website. Announcements for these will come through MSU Extension News, so if you haven't done so already, be sure to sign up for MSUE News e-newsletters for the crops and other topics that are most relevant for you.

As always, Enviroweather welcomes your feedback, and the new website includes a straight-forward way to share your comments and ask questions about the new platform. The Feedback Form is available under "Information" on the menu bar. In addition, you can always contact Enviroweather Program Coordinator, Keith Mason at masonk@msu.edu or 517-355-3897 for assistance with the tools and features on either website.

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enviroweather.msu.edu

## Mite Management – Avoiding resistance

Dave Smitley, Michigan State University

In many types of intense agricultural systems spider mites tend to develop resistance to insecticides and miticides, sometimes to the point where hardly any products are effective (like in greenhouse production). In Christmas tree production insecticide-resistance can become a problem if insecticides are used frequently.

Spider mites may develop resistance to any of the recommended products listed if they are sprayed frequently for several years. In addition, it is possible for resistant spider mites to move into Christmas tree farms from nearby orchards and they can be brought-in on infested plant material. It is well-known that most populations of spider mites are completely resistant to carbaryl (Sevin, etc.). The chemical group most susceptible to resistance problems is the synthetic pyrethroids. If spider mites become resistant, an application of a synthetic pyrethroid may cause an outbreak of spider mites by eliminating predator mites and other predators that keep spider mites under control. However, spider mites can become resistant to any pesticide if it is used frequently.

The bottom-line is to scout frequently so you know how well your miticides work and to be prepared to switch to a different product if it is not working. The following table can help you choose the best product and to rotate. Alternatively, if you are not using insecticides or miticides, you are unlikely to see any problems with spider mites.

## Pesticide Efficacy for Mite Control and Relative Impact on Predatory Mites

| Chemical class | Compound (*active ingredient*) | Life stage target[1] | Efficacy | Residual control | Toxicity to predatory mites[2] |
|---|---|---|---|---|---|
| Pyrethroids | Asana XL, S-fenvalostar (*esfenvalerate*), OnyxPro, Sniper (*bifenthrine*), Baythroid XL (*cyfluthrin*) | Motiles | Good | 4-6 weeks | H |
| Organophosphates | Chlorpyrifos 4E AG, Govern 4E, Hatchet, Lorsban Advanced, Lorsban 4E, Lorsban 75WG, Nufos 4E, Quali-Pro Chlorpyrifos 4E, Warhawk, Whirlwind, Yuma 4E Insecticide, Vulcan (*chlorpyrifos*) | Motiles | Fair | 4-6 weeks | H |
| Avermectins[3] | Avid 0.15EC, Ardent 0.15EC, Lucid Ornamental, Nufarm Abamectin,Minx, Quali-Pro Abamectin 0.15EC, Timectin 0.15EC T&O (*abamectin*) | Motiles | Good | 3-4 weeks | M |
| Neonicitinoids | Admire Pro, Couraze 2F, Couraze 4F, Mallet 75WSP, Nuprid 1.6F, Pasada 1.6F, Prey, Provado 1.6F, Sherpa, Widow, Wrangler (*imidacloprid*) | | Poor | | M |
| Tetronic acids | Envidor 2SC Mitecide (*spirodiclofan*) | Eggs, Motiles | Good | 6-8 weeks | S |
| Thiazoles[3] | Savey 50DF, Onager, Hexygon DF (*hexythiazox*) | Eggs, Larvae | Good | 6-8 weeks+ | S |
| Carbazates | Acramite 4SC, Floramite SC, Sirocco (*bifenazate*) | Eggs, Motiles | Good | 4 Weeks | M |
| Sulfite esters | Omite (*propargite*) | Motiles | Good | 3-4 weeks | S |
| Horticultural oils[4] | Damoil (*mineral oil*), Purespray 10E, Purespray Green (*petroleum oil*) | Eggs, Motiles | Good | 2-6 Weeks | S |
| Quinolines | Shuttle (*acequinocyl*) | Eggs, Motiles | Good | 3-4 Weeks | M |
| Quinazolines | Magister, Magus (*fenazaquin*) | Motiles | Good | 6-8 Weeks+ | M |
| Pyridazinone | Sanmite (*pyridaben*) | Eggs, Motiles | Good | 3-4 Weeks | M |
| Insect growth inhibitors | Apollo SC (clofentazine)[5] | Eggs, Larvae, Nymphs | Good | 3-4 Weeks | S |
| Insect growth regulators | TetraSan (*etoxazole*) | Eggs, Larvae, Nymphs | Good | 4 Weeks | M |

1. Motile forms include mite larvae, nymph and adult stages.

2. S-relatively safe to mite predators, M-moderatly toxic, H-highly toxic.

3. Avermectin, thiazole, and tetronic acid miticides are slower acting so growers should not be surprised if mites appear alive following application, it may take 7-10 days to see complete mortality.

4. Horticultural oils can cause phytotoxicity, particularly when used in the summer, and can lighten the blue coloring in blue spruce trees . A 1% concentration of a highly refined horticultural oil is usually a safe rate to spray anytime of the year, but a 2% or higher concentration may damage bloom on glaucous varieties of spruce, and cause other undesirable symptoms.

5. The Apollo label should be read and followed carefully to ensure proper use and slow the development of insecticide resistance.