

Michigan Christmas Tree Pest Management Guide **2017**




The information presented here is intended as a guide for Michigan Christmas tree growers in selecting pesticides for use on trees grown in Michigan and is for educational purposes only. The efficacies of products listed may not have been evaluated in Michigan. Reference to commercial products or trade names does not imply endorsement by Michigan State University Extension or bias against those not mentioned. 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 (February 2017), it is the responsibility of the person using this information to verify that it is correct by reading the corresponding pesticide label in its entirety before using the product. Labels can and do change—greenbook.net, cdms.com, and agrian.com are free online databases for looking up label and MSDS information.

TABLE OF CONTENTS

SEASONAL PEST CALENDAR	3
INSECT PESTS.....	5
REGISTERED INSECTICIDES AND MITICIDES	10
DISEASES	16
REGISTERED FUNGICIDES	22


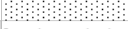
The information presented here is intended as a guide for Michigan Christmas tree growers in selecting pesticides for use on trees grown in Michigan and is for educational purposes only. The efficacies of products listed may not been evaluated in Michigan. Reference to commercial products or trade names does not imply endorsement by Michigan State University Extension or bias against those not mentioned. 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 (February 2017), it is the responsibility of the person using this information to verify that it is correct by reading the corresponding pesticide label in its entirety before using the product. Labels can and do change– greenbook.net, cdms.com, and agrian.com are free online databases for looking up label and MSDS information. Questions? Contact Jill O’Donnell at (231)779-9480 or odonne10@msu.edu.

MSU is an affirmative-action, equal-opportunity employer, committed to achieving excellence through a diverse workforce and inclusive culture that encourages all people to reach their full potential. Michigan State University Extension programs and materials are open to all without regard to race, color, national origin, gender, gender identity, religion, age, height, weight, disability, political beliefs, sexual orientation, marital status, family status or veteran status. Issued in furtherance of MSU Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Jeff Dwyer, Director, MSU Extension, East Lansing, MI 48824. This information is for educational purposes only. Reference to commercial products or trade names does not imply endorsement by MSU Extension or bias against those not mentioned.

 This material is based upon work supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under Agreement No. 2015-09785. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author and do not necessarily reflect the view of the U.S. Department of Agriculture.

WCAG 2.0 AA

SEASONAL PEST CALENDAR

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
Douglas-fir																		Control stage		
	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 trees to feed on shoots. Pyramid traps baited with alcohol and turpentine 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 through mid-May. From Aug-Sept., adults move onto trees to feed on shoots. Baited pyramid traps can detect adults.
	Pine chafer (Anomala 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 gdd 50). 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			Control stage
			early	mid	late	early	mid	late	early	mid	late	early	mid	late	early	mid	late	early	mid	late	
Spruce																					
	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 active, 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/Stigmima needecast																		Preventative fungicide - new growth 1/2" -2" long, will require two to three applications.	
True fir (Fraser, balsam and concolor)																					
	Balsam Twig Aphid																			Apply insecticide after eggs have hatched but before the nymphs become stem mothers, 100-140 gdd50.	
	Eriophyid mites																				When mites are active, 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 <i>Eurytetranychus admes</i>	Eggs, larva or adults	Spring to fall	abamectin, bifenthrin, bifenazate, chlorpyrifos, clofentezine, cyflumetofen, disulfoton, etoxazole, fenazaquin, hexythiazox, horticultural oil, insecticidal soap, oxydemeton-methyl, peppermint and rosemary oil, propargite, spirotetramat, spirotetramat, thiamethoxam	NA/28
Ants <i>Formica spp.</i>		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, disulfoton, horticulture oil, imidacloprid, insecticidal soap, lambda-cyhalothrin, malathion, oxydemeton-methyl, peppermint and rosemary oil, pymetrozine, spirotetramat, thiamethoxam	76/89
Bagworm <i>Thyridopteryx ephemeraeformis</i>	shortly before egg hatch when bags are still small	early to mid June	acephate, azadirachtin, Bacillus thuringiensis subsp. Kurstaki stain ABTX-351 or EG7841, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, diflubenzuron, emamectin benzoate, flubendiamid, lambda-cyhalothrin, malathion, methoxyfenozide, permethrin, spinosad, tebufenozide	57/65
Balsam gall midge <i>Paradiplosis tumifex</i>	adults laying eggs (control stage)	150-300	acephate, azadirachtin, bifenthrin, chlorpyrifos, cyfluthrin, esfenvalerate, thiamethoxam	27/30
	galls apparent	550-700	Scout for globe-like galls on the needles.	
Balsam fir sawfly <i>Neodiprion abietis</i>	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
Balsam shoot boring sawfly <i>Pleroneura brunneicornis</i>	Treat when larvae 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 <i>Mindarus abietis</i>	egg hatch	60-100	abamectin, acephate, azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, disulfoton, esfenvalerate, imidacloprid, insecticidal soap, horticulture oil, lambda-cyhalothrin, malathion, oxydemeton-methyl, peppermint and rosemary oil, pymetrozine, spirotetramat, thiamethoxam	29/32
	stem mothers present (control target)	100-140		

*Christmas Tree Pest Manual, Second Edition (MSU Extension Bulletin E-2676)/Christmas Tree Pest Manual, Third Edition, 2014

Insect	Life stage	GDD ₅₀ Months	Control Options	Page # Pest Manual* 1998/2014
Balsam wooly adelgid <i>Adelges piceae</i>	First generation of crawlers	May-July	acephate, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, esfenvalerate, horticulture oil, imidacloprid, insecticidal soap, lambda-cyhalothrin, oxydemeton-methyl, spirotetramat, thiamethoxam Not currently found in Michigan.	NA/91
Conifer root aphid <i>Prociphilus americanus</i>			imidacloprid	NA/139
Cooley spruce gall adelgid <i>Adelges cooleyi</i>	1st adults active - <i>Spruce</i>	25-120	acephate, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, esfenvalerate, horticulture oil, imidacloprid, insecticidal soap, oxydemeton-methyl, spirotetramat, thiamethoxam	106/128
	1st galls visible - <i>Spruce</i>	200-310	Galls can be pruned out.	
	2nd adults active	1500-1600	Time insecticide treatment after eggs have hatched to control overwintering nymphs.	
	1st adults active - <i>Douglas-fir</i>	90-180	Time insecticide treatment when nymphs/adults are present.	
	1st nymphs - <i>Douglas-fir</i>	90-150		
	2nd nymphs - <i>Douglas-fir</i>	600-1000		
Douglas-fir needle midge <i>Contarinia pseudotsuga</i>	Time application within a week after first adults are detected in traps.	200-250	acephate, azadirachtin, bifenthrin, chlorpyrifos, cyfluthrin, esfenvalerate, thiamethoxam	NA/35
Eastern pine shoot borer <i>Eucosma gloriola</i>	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) <i>Pissodes nemorensis</i>	1st adults active	25-100	acephate, azadirachtin, bifenthrin, chlorpyrifos, cyfluthrin, diflubenzuron, esfenvalerate, lambda-cyhalothrin, oxydemeton-methyl, phosmet	85/100
	2nd adults active	1200-1400		
Eastern spruce gall adelgid <i>Adelges abietis</i>	1st adults active	25-100	acephate, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, esfenvalerate, horticulture oil, imidacloprid, insecticidal soap, oxydemeton-methyl, spirotetramat, thiamethoxam	107/131
	egg hatch, galls begin forming	250-310	Time insecticide treatment after eggs have hatched to control overwintering nymphs.	
	2nd adults active	1500-1600		
Elongated hemlock scale <i>Fiorinia externa</i>	When crawlers are active, may take several applications due to staggered life cycle	June-October	acephate, azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, horticultural oil, imidacloprid, insecticidal soap, malathion, oxydemeton-methyl, spirotetramat	NA/39
Eriophyid mites <i>Setoptus and Nalepella spp.</i>	when mites are present	May - September	abamectin, carbaryl, fenazaquin, horticulture oil, spirodiclofen	35/40

*Christmas Tree Pest Manual, Second Edition (MSU Extension Bulletin E-2676)/Christmas Tree Pest Manual, Third Edition, 2014

Insect	Life stage	GDD ₅₀ Months	Control Options	Page # Pest Manual* 1998/2014
European pine sawfly <i>Neodiprion sertifer</i>	1st larvae	100-195	acephate, azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, diflubenzuron, esfenvalerate, horticulture oil, imidacloprid, insecticidal soap, lambda-cyhalothrin, malathion, phosmet, spinosad, thiamethoxam	58/67
European pine shoot moth <i>Rhyacionia buoliana</i>	1st larvae	50-220	acephate, azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, diflubenzuron, esfenvalerate, malathion, methoxyfenozide, phosmet, tebufenozide	80/101
Grasshopper <i>Melanoplus spp.</i>	Mid-summer		acephate, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, esfenvalerate, kaolin	59/69
Gypsy moth <i>Lymantria dispar</i>	egg hatch, 1st larvae	145-200	acephate, azadirachtin, <i>Bacillus thuringiensis (Bt)</i> , bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, diflubenzuron, emamectin benzoate, flubendiamide, insecticidal soap, lambda-cyhalothrin, methoxyfenozide, oxydemeton-methyl, phosmet, spinosad, tebufenozide Once pupa are present then the treatment window is closed.	60/70
	young caterpillars	450		
	pupation	900-1200		
Introduced pine sawfly <i>Diprion similis</i>	1st larvae	400-600	acephate, azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, diflubenzuron, esfenvalerate, imidacloprid, insecticidal soap, lambda-cyhalothrin, malathion, phosmet, spinosad, thiamethoxam	62/72
Jack pine budworm <i>Choristoneura pinus pinus</i>	young larvae feeding	300-350	acephate, azadirachtin, <i>Bacillus thuringiensis</i> , bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, diflubenzuron, esfenvalerate, flubendiamide, methoxyfenozide, spinosad, tebufenozide	63/73
	large larvae feeding defoliation noticeable	650-700		
Jack pine tip beetle <i>Conophthorus resinosae</i>	shear off injured tips	summer to fall	Insecticides not needed & likely to be ineffective	82/103
Japanese beetle <i>Popillia japonica</i>	adult foliar feeding	950-2150	azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, kaolin, lambda-cyhalothrin, malathion, methoxyfenozide, permethrin, phosmet	
Nantucket pine tip moth <i>Rhyacionia frustrana</i>	young larvae	mid-May -mid June	Not currently found in Michigan acephate, azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, diflubenzuron, esfenvalerate, imidacloprid, lambda-cyhalothrin, malathion, methoxyfenozide, permethrin, phosmet, spinosad	84/105
Northern pitch twig moth <i>Retinia albicapitana</i>	clip flagged branches or break open blister and crush larvae		Insecticides not needed & likely to be ineffective	109/132
Pales weevil <i>Hylobius pales</i>	1st adults active	25-100	acephate, azadirachtin, bifenthrin, chlorpyrifos, cyfluthrin, diflubenzuron, esfenvalerate, lambda-cyhalothrin, oxydemeton-methyl, phosmet	86/106
	2nd adults active	1200-1400		
Pine bark adelgid <i>Pineus strobi</i>		April - mid-May	bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, horticulture oil, imidacloprid, insecticidal soap, oxydemeton-methyl, spirotetramat, thiamethoxam	117/142

*Christmas Tree Pest Manual, Second Edition (MSU Extension Bulletin E-2676)/Christmas Tree Pest Manual, Third Edition, 2014

Insect	Life stage	GDD ₅₀ Months	Control Options	Page # Pest Manual* 1998/2014
Pine bark beetle (pine engraver) <i>Ips spp.</i>	beetle flight periods		Treat only high value trees. azadirachtin, bifenthrin, carbaryl Note: Engraver beetles are a sign that trees are severely stressed.	NA/153
Pine chafer <i>Anomela obliqua</i>	1st adults active	450-600	azadirachtin, cyfluthrin, esfenvalerate, lambda-cyhalothrin	64
Pine false webworm <i>Acantholyda erythrocephala</i>			lambda-cyhalothrin	71/75
Pine needle midge <i>Contarinia baeri</i>	1st adults active	400-500	acephate, azadirachtin, bifenthrin, chlorpyrifos, cyfluthrin, esfenvalerate, thiamothoxam	65
Pine needle scale <i>Chionaspis pinifoliae</i>	1st generation egg hatch	250-400	acephate, azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, horticultural oil, imidacloprid, insecticidal soap, lambda-cyhalothrin, malathion, oxydemeton-methyl, spirotetramat	44/50
	1st generation - hyaline stage (control target)	400-500		
	2nd generation egg hatch	1250-1350		
	2nd generation - hyaline stage (control target)	1500		
Pine root collar weevil <i>Hylobius radialis</i>	1st adults active	300-350	acephate, azadirachtin, bifenthrin, chlorpyrifos, cyfluthrin, diflubenzuron, esfenvalerate, lambda-cyhalothrin, oxydemeton-methyl, phosmet	118/143
	2nd adults active	1200-1400		
Pine root tip weevil <i>Hylobius rhizophagus</i>			cyfluthrin, lambda-cyhalothrin	89/110
Pine shoot beetle <i>Tomicus piniperda</i>	new adults emerge	500-550	bifenthrin, chlorpyrifos, cyfluthrin	90/111
	begin shoot-feeding			
	optimal control window			
Pine spittlebug <i>Aphrophora parallela</i>	when 95% of spittle masses on pines are empty	late June to mid July	Treatment not usually required. bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, esfenvalerate, lambda-cyhalothrin, spirotetramat	92/113
Pine thrips <i>Gnaphothrips spp.</i>			acephate, azadirachtin, carbaryl, bifenthrin, kaolin, lambda-cyhalothrin, malathion, oxydemeton-methyl, thiamethoxam	45/51
Pine tortoise scale <i>Toumeyella parvicornis</i>	egg hatch begins; 1st crawlers	400-500	acephate, azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, horticultural oil, imidacloprid, insecticidal soap, lambda-cyhalothrin, malathion, oxydemeton-methyl, spirotetramat	93/114
	egg hatch ends crawlers settling	1000-1200		
Pine tube moth <i>Argyrotaenia pinatubana</i>			Insecticide rarely needed	66/77
Pine tussock moth <i>Dasychira pinicola</i>	larvae feeding on foliage	late May to mid June	acephate, azadirachtin, <i>Bacillus thuringiensis</i> (Bt), bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, diflubenzuron, emamectin benzoate, flubendiamide, insecticidal soap, methoxyfenozide, oxydemeton-methyl, phosmet, spinosad, tebufenozide	67/78

*Christmas Tree Pest Manual, Second Edition (MSU Extension Bulletin E-2676)/Christmas Tree Pest Manual, Third Edition, 2014

Insect	Life stage	GDD ₅₀ Months	Control Options	Page # Pest Manual* 1998/2014
Pine webworm <i>Pococera robustella</i>			lambda-cyhalothrin	71/79
Red-headed pine sawfly <i>Neodiprion lecontei</i>	1st larvae	400-600	acephate, azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, esfenvalerate, imidacloprid, lambda-cyhalothrin, malathion, phosmet, spinosad, thiamethoxam	68/80
Saratoga spittlebug <i>Aphrophora saratogensis</i>	When all or nearly all (90%) spittlemasses on <u>sweetfern</u> plants are empty. Control sweetfern in plantation.	late June to mid-July	bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, esfenvalerate, lambda-cyhalothrin, spirotetramat Note: More of a problem on red and jack pines.	95/115
Spruce budscale <i>Physokermes piceae</i>	egg hatch, 1st crawlers	700-1150	acephate, azadirachtin, bifenthrin, buprofezin, carbaryl, chlorpyrifos, cyfluthrin, disulfoton, horticultural oil, insecticidal soap, malathion, oxydemeton-methyl, spirotetramat	99/119
Spruce budworm <i>Choristoneura fumiferana</i>	1st larvae	200-300	acephate, <i>Bacillus thuringiensis</i> , bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, diflubenzuron, emamectin benzoate, esfenvalerate, flubendiamide, methoxyfenozide, spinosad, tebufenozide	69/82
Spruce-fir looper <i>Macaria signaria</i>	larvae feeding on foliage		bifenthrin, cyfluthrin, diflubenzuron, emamectin benzoate, methoxyfenozide, spinosad	NA/83
Spruce gall midge <i>Mayetiola piceae</i>	adult emerge	70-100	acephate, azadirachtin, bifenthrin, chlorpyrifos, cyfluthrin, esfenvalerate, thiamethoxam	NA/133
	eggs hatch (control window)	130-145		
Spruce needleminers <i>Taniva albolineana, Epinotia nanana, Coleotechnites piceaella</i>	1st larvae	150-200	bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, esfenvalerate, permethrin, spinosad	70/84
Spruce spider mite <i>Oligonychus ununguis</i>	1st egg hatch	150-175	abamectin, bifenthrin, bifenazate, chlorpyrifos, clofentezine, cyflumetofen, disulfoton, etoxazole, fenazaquin, hexythiazox, horticultural oil, insecticidal soap, oxydemeton-methyl, peppermint and rosemary oil, propargite, spirotetramat	51/84
Striped pine scale <i>Toumeyella pini (King)</i>	egg hatch	750-800	acephate, azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, horticultural oil, imidacloprid, insecticidal soap, lambda-cyhalothrin, malathion, oxydemeton-methyl, spirotetramat	93/114*
White grubs <i>Phyllophaga and Polyphylla spp. Rhizotrogus majalis</i>			carbaryl, imidacloprid	123/151
White pine weevil <i>Pissodes strobi</i>	1st adults active	25-220	acephate, azadirachtin, bifenthrin, chlorpyrifos, cyfluthrin, diflubenzuron, esfenvalerate, lambda-cyhalothrin, oxydemeton-methyl, phosmet	101/122
	2nd adults active	1200-1400		
Zimmerman pine moth <i>Dioryctria zimmermani</i>	1st larvae	25-100	acephate, bifenthrin, chlorpyrifos, cyfluthrin, diflubenzuron, lambda-cyhalothrin, methoxyfenozide	126/156
	adult flight	1700		

*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	Mode of Action(1)
abamectin	Ardent 0.15 EC	100-896	Syngenta	no	12 hrs	6
	Avid 0.15 EC	100-896	Syngenta	no	12 hrs	
	Lucid	83100-5-83979	Rotam North America, Inc.	no	12 hrs	
	Minx	228-657	Nufarm	no	12 hrs	
	Nufarm Abamectin SPC0.15 EC	228-657	Nufarm	no	12 hrs	
	Phoenix Merlin	70506-276	United Phosphorus, 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	Makhteshim-Agan of North America, Inc	no	24 hrs	1B
	Acephate 90 WDG	34704-1051	Loveland Products, Inc.	no	24 hrs	
	Acephate 97	70506-8-55467	TENKOZ, Inc., 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	no	24 hrs	
	Orthene TTO WSP	5481-8971	Amvac	no	24 hrs	
	Tide Acephate	84229-7	Tide International	no	24 hrs	
azadirachtin	Aza-Direct*	71908-1-10163	Gowan	no	4 hrs	un

Active Ingredient	Insecticide & Formulation	EPA Reg#	Company	RUP	REI	Mode of Action(1)
azadirachtin	AzaGuard	70299-17	BioSafe Systems	no	4 hrs	un
	Ecozin Plus 1.2% ME*	5481-559	Amvac	no	4 hrs	
	Molt-X	68539-11	BioWorks, Inc.	no	4 hrs	
Bacillus thuringiensis, subsp. Kurstaki	DiPel ES	73049-17	Valent USA	no	4 hrs	11A
	DiPel PRO DF	73049-39	Valent USA	no	4 hrs	
bifenthrin**	Bifen 2 AG Gold	83222-1	Direct Ag Source	yes	12 hrs	3
	Sniper	34704-858	Loveland Products	yes	12 hrs	
bifenazate	Acramite 4SC	400-514	Chemtura	no	12 hrs	un
	Floramite SC	400-508-59807	OHP, Inc.	no	12 hrs	
bifenazate and abamectin	Sirocco	400-582-59807	OHP, Inc.	no	12 hrs	6/un
carbaryl	Carbaryl 4L	34704-447	Loveland products	no	12 hrs	1A
	Drexel Carbaryl 4L	19713-49 (2016)	Drexel	no	12 hrs	
	Sevin 4F	61842-38	Tessengerlo Kerley	no	12 hrs	
	Sevin SL Carbaryl	432-1227	Bayer CropScience	no	12 hrs	
	Sevin XLR Plus	61842-37	Tessengerlo Kerley	no	12 hrs	
chlorpyrifos** (continued on next page)	Chlorpyrifos 4E AG	66222-19	Makhteshim-Agan of North America, Inc	yes	24 hrs	1B
	Drexel Chlorpyrifos 4E AG	19713-520 (2016)	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	
	Nufos 4E	67760-28	Cheminova	yes	24 hrs	
	Quali-Pro Chlorpyrifos 4E	66222-19	Makhteshim-Agan of North America, Inc	yes	24 hrs	
	Vulcan	66222-233	Makhteshim-Agan of North America, Inc	yes	24 hrs	

Active Ingredient	Insecticide & Formulation	EPA Reg#	Company	RUP	REI	Mode of Action(1)
chlorpyrifos**	Warhawk	34704-857	Loveland	yes	24 hrs	1B
	Warhawk Clearform	34704-1077	Loveland	yes	24 hrs	
	Whirlwind	62719-220-5905 (2015)	Helena	yes	24 hrs	
	Yuma 4E	62719-220-1381	Winfield Solutions LLC	yes	24 hrs	
clofentezine	Apollo SC	66222-47	Makhteshim-Agan of North America, Inc	no	12 hrs	10A
cyflumetofen	Sultan Miticide	7969-337	BASF Ag Products	no	12 hrs	25
cyfluthrin**	Baythroid XL	264-840 EPA-SLN No. MI 060003	Bayer CropScience	yes	12 hrs	3
diflubenzuron**	Dimilin 25W	400-465	Chemtura Corp.	yes	12 hrs	15
emamectin benzoate**	Enfold	100-1411	Syngenta	yes	12 hrs	6
esfenvalerate**	Asana XL	352-515 (2016)	DuPont	yes	12 hrs	3
	Asana XL	59639-209 (2016)	Valent	yes	12 hrs	
	S-fenvalostar	71532-21-73006	LG Life Sciences	yes	12 hrs	
	Zyrate	71532-21-83979	Rotam	yes	12 hrs	
etoxazole	TetraSan 5 WDG	59639-108 (2016)	Valent USA	no	12 hrs	10B
fenazaquin	Magister	10163-297	Gowan	no	12 hrs	21A
	Magus Miticide	10163-297	Gowan	no	12 hrs	
flubendiamide	Belt SC	264-1025	Bayer CropScience	no	12 hrs	28
hexythiazox	Hexygon DF	10163-251	Gowan	no	12 hrs	10A
	Onager	10163-277	Gowan	no	12 hrs	
	Savey 50DF	10163-250	Gowan	no	12 hrs	

Active Ingredient	Insecticide & Formulation	EPA Reg#	Company	RUP	REI	Mode of Action(1)
horticultural oil	Damoil	19713-123 (2016)	Drexel	no	4 hrs	oil/mineral
	Glacial Spray Fluid*	34704-849	Loveland	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	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
	Advise 2FL	1381-205	Winfield Solutions	no	12 hrs	
	Alias 2F	66222-203	Makhteshim-Agan of North America, Inc	no	12 hrs	
	Alias 4F	66222-156	Makhteshim-Agan of North America, Inc	no	12 hrs	
	AmTide Imidacloprid 2F	83851-12	AmTide, LLC	no	12 hrs	
	AmTide Imidacloprid 4F	83851-20	AmTide, LLC	no	12 hrs	
	Couraze 2F	67760-91	Cheminova	no	12 hrs	
	Couraze 4	67760-116	Cheminova	no	12 hrs	
	Couraze 4F	67760-97	Cheminova	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	
	Mallet 75 WSP	228-588	Nufarm	no	12 hrs	
	Midash Forte	83529-6	Sharda USA LLC	no	12 hrs	
	Montana 2F	83100-7- 83979 (2015)	Rotam North America	no	12 hrs	
	Montana 4F	83100-21- 83979 (2015)	Rotam North America	no	12 hrs	
	Nuprid 1.6 F	228-488	Nufarm	no	12 hrs	

Active Ingredient	Insecticide & Formulation	EPA Reg#	Company	RUP	REI	Mode of Action(1)
imidacloprid	Nuprid 2F	228-484	Nufarm	no	12 hrs	4A
	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	
	Pasada 1.6F	66222-228	Makhteshim-Agan of North America, Inc	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	
	Sherpa	34704-983	Loveland Products	no	12 hrs	
	Widow	34704-893	Loveland Products	no	12 hrs	
	Wrangler	34704-931	Loveland Products	no	12 hrs	
kaolin	Surround*	61842-18	Tessengerlo	no	4 hrs	un
lambda-cyhalothrin	Lambda-T	100-1112-5905	Helena Chemical	yes	24 hrs	3
malathion	Cheminova Malathion 57% Low Voc	67760-119	Cheminova	no	12 hrs	1B
	Cheminova Malathion 57%	67760-40	Cheminova	no	12 hrs	
	Drexel Malathion 5EC	19713-217 (2016)	Drexel Chemical	no	12 hrs	
	Malathion 8 Flowable	10163-21	Gowan	no	12 hrs	
	Malathion 8 Aquamul	34704-474	Loveland Products	no	12 hrs	
methoxyfenozide	Intrepid 2F	62719-442	Dow AgroSciences	no	4 hrs	18
oxydemeton-methyl**	MSR Spray Concentrate	10163-220	Gowan	yes	18 days	1B
peppermint and rosemary oil	Ecotec*	48813-99999	Brandt Consolidated	no		un
permethrin**	Ambush 25W	5481-502 (2016)	Amvac	yes	12 hrs	3
phosmet	Imidan 70-W	10163-169	Gowan	no	13 days	1B
potassium salts of fatty acids	M-Pede Insecticide*	10163-324	Gowan	no	12 hrs	insecticidal soap

Active Ingredient	Insecticide & Formulation	EPA Reg#	Company	RUP	REI	Mode of Action(1)
propargite**	Omite 30 WS	400-427	Chemtura	yes	14 days	12C
pymetrozine	Endeavor	100-913	Syngenta	no	12 hrs	9B
spinosad	Blackhawk Naturalyte	62719-523	Dow AgroSciences	no	4 hrs	5
	Conserve SC	62719-291	Dow AgroSciences	no	4 hrs	
	Entrust *	62719-282	Dow AgroSciences	no	4 hrs	
	Entrust EC *	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	
	Success Naturalyte	62719-523	Dow AgroSciences	no	4 hrs	
spiroadiclofen	Envidor 2SC Miticide	264-831	Bayer Cropscience	no	12 hrs	23
spirotetramat	Movento	264-1050	Bayer Cropscience	no	24 hrs	23
tebufenozide	Confirm 2F	8033-111-10163	Gowan	no	4 hrs	18
thiamethoxam	Flagship .22G	100-960	Syngenta	no	12 hrs	4A
	Flagship 25WG	100-955	Syngenta	no	12 hrs	

*Organic Materials Review Institute (OMRI) Listed.

**Restricted Use Pesticide(s)

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 <i>Armillaria spp.</i>	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.	<i>Trichoderma asperellum</i>	Efficacy has not been evaluated in Christmas tree fields in Michigan where <i>Armillaria</i> natively occurs. <i>Trichoderma asperellum</i> 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 <i>Uredinopsis spp.</i> and <i>Milesina spp.</i>	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 <i>Abies concolor</i>.	26/42
Broom Rust of Fir <i>Melampsorella caryophyllacearum</i>	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 <i>Mycosphaerella dearnessii</i>	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 weeks later. Repeat after heavy rains and at two week intervals as long as needed.	31/34
Charcoal Rot <i>Macrophomina phaseolina</i>	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 <i>Cyclaneusma minus</i>	Scotch pine	Usually doesn't 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 requires multiple applications throughout the growing season to control this disease. In some cases, these application have achieved control but do not improve the tree grade or density of the foliage. Pines typically hold 1-2 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 <i>Leucostoma kunzei</i>	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 <i>Sphaeropsis sapinea</i>	Austrian pine Red pine Scotch pine Occasionally- Colorado blue spruce and Douglas-fir	Do not allow water stress and 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 <i>Mycosphaerella pini</i>	Austrian pine Potentially Scotch pine	Provide for air circulation around the tree by decreasing planting density and controlling weeds which 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) <i>Endocronartium harknessii</i>	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 <i>Mycosphaerella spp.</i> , <i>Phaeocryptopus nudus</i> , <i>Phyllosticta abietina</i> , <i>Toxosporium spp.</i> , <i>Rhizosphaera spp.</i>	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 harvest year, especially for clear-cut operations.	
Isthmiella Needlecast <i>Isthmiella faullii</i>	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 <i>Lirula nervata</i> and <i>Lirula mirabilis</i>	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 <i>Lophodermium seditiosum</i>	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 <i>Phomopsis spp.</i>	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 <i>Phytophthora cactorum, P. citricola, P. cryptogea, and P. nicotiana among other species</i>	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 <i>Coleosporium asterum</i>	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 <i>Rhabdocline pseudotsugae</i>	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 east-side and 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 <i>Rhizosphaera kalkhoffii</i>	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 airblast 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 <i>Gremmeniella abietina</i>	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 <i>Sirococcus spp.</i>	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
Spruce Needle Rust <i>Chrysomyxa spp.</i>	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

Disease	Pathogen	Cultural control	Chemical control	Comments	Reference page ¹ (2nd/3rd)
Stigmina Needlecast <i>Stigmina lautii</i>	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 which 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 <i>Phaeocryptopus gäumanni</i>	Douglas-fir	Remove severely affected trees early in the rotation to prevent disease buildup or older trees in fence rows. 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 <i>Chrysomyxa weirii</i>	Colorado blue spruce Engelmann spruce White spruce	Remove severely affected trees early in the rotation to prevent disease buildup or older trees in fence rows. 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
White Pine Blister Rust <i>Cronartium ribicola</i>	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

¹Christmas 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.

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-AI 80 WDG	66222-161	12 hours	Conifer nurseries	Makhteshim Agan of North America, Inc.	
	Viceroy 70 DF	61842-10-70506	12 hours	Conifer nurseries	United Phosphorus, Inc.	
azoxystrobin	Aframe	100-1098	4 hours	Christmas trees	Syngenta Crop Protection	11
	Abound	100-1098	4 hours	Christmas trees	Syngenta Crop Protection	
	Quadris Flowable	100-1098	4 hours	Christmas trees	Syngenta Crop Protection	
chlorothalonil* Special Eye Irritation Provision - for the next 6.5 days entry is permitted when safety measures are provided. See below	Bravo Ultrex	50534-201-100	12 hours*	Conifers, pine, spruce, Douglas-fir	Syngenta Crop Protection, Inc.	M5
	Bravo Weather Stik	50534-188-100	12 hours*	Conifers, Christmas trees	Syngenta Crop Protection, Inc.	
	Chloronil 720	50534-188-100	12 hours *	Christmas trees, conifer, pines, spruces	Syngenta Crop Protection, Inc.	
	Chlorothalonil 720 Flowable Fungicide Chlorothalonil 720 SC	66330-362 (2016)	12 hours *	Conifers, pine. spruce	Arysta LifeScience	
	Daconil Weather Stik	50534-209-100	12 hours *	Conifers, Christmas trees, spruce pine, Douglas-fir	Syngenta Crop Protection, Inc.	
	Daconil Zn	50534-211-100	12 hours *	Conifers, Christmas trees, Douglas-fir, conifer nursery beds * Do not use on blue spruce * Do not apply with high pressure spray equipment.	Syngenta Crop Protection, Inc.	
	Daconil Ultrex Turf Care	50534-202-100	12 hours *	Conifers, Christmas trees, Douglas-fir, conifer nursery beds * Do not use on blue spruce * Do not apply with high pressure spray equipment.	Syngenta Crop Protection, Inc.	
	Docket DF	50534-202-100	12 hours *	Conifers, Christmas trees, Douglas-fir, conifer nursery beds * Do not use on blue spruce * Do not apply with high pressure spray equipment.	Syngenta Crop Protection, Inc.	

Active Ingredient	Products	EPA Number	Re-Entry Interval	Crop	Manufacture	FRAC Code*
chlorothalonil*	Docket WS Flowable	50534-209-100	12 hours *	conifers, spruce, Douglas-fir, pines	Syngenta Crop Protection, Inc.	M5
	Echo 90DF	60063-10	12 hours*	conifers, spruce, Douglas-fir, pines	Sipcam Agro USA, Inc.	
	Echo ZN	60063-4	12 hours*	conifers, spruce, Douglas-fir, pines	Sipcam Agro USA, Inc.	
	Echo 720	60063-7	12 hours *	Conifers	Sipcam Agro USA, Inc.	
	Echo Ultimate Turf and Ornamental	60063-3	12 hours *	Conifers	Sipcam Agro USA, Inc.	
	Ensign 720	34704-966	12 hours *	Conifers, pine, spruce, Douglas-fir	Loveland Products, Inc.	
	Ensign 82.5%	34704-965	12 hours *	Conifer, Pine, spruce, Douglas-fir	Loveland Products, Inc.	
	Equus DF Quali-Pro Chlorothalonil DF	66222-149	12 hours*	conifers, Christmas trees, pines, spruces	Makhteshim Agan of North America, Inc.	
	Equus 500 ZN Quali-Pro Chlorothalonil ZN	66222-150 66222-150	12 hours *	Douglas Fir, Conifers, Pines, Spruce	Makhteshim Agan of North America, Inc.	
	Equus 720	66222-154	12 hours	Christmas trees-Conifers, Douglas-fir, Pines, Spruce	Makhteshim Agan of North America, Inc.	
	Initiate 720	34704-881	12 hours *	Douglas-Fir, Conifers, Pine, Spruce	Loveland Products, Inc.	
	Legend	1001-85	12 hours *	Douglas-Fir, Conifers, Pine, Spruce	Cleary Chemical LLC	
	Pegasus 6L	70506-262	12 hours*	Conifers	United Phosphorus, Inc	
	Pegasus DFX	70506-272	12 hours*	Conifers	United Phosphorus, Inc	
	Pegasus HPX	70506-273	12 hours*	Conifers	United Phosphorus, Inc	
copper hydroxide	Champ Formula 2 Flowable	55146-64	48 hours	Conifers-Douglas fir, Fir, Pine & Spruce	Nufarm Agricultural Products	M1
	Kocide 2000	91411-1-70051	48 hours	Conifers-Douglas-fir, Fir, Pine, Spruce	Certis, USA	
	Kocide 3000	91411-2-70051				
copper sulfate	Cuprefix Ultra 40 Disperss	70506-201	48 hours	Douglas-fir, Fir, Pine and Spruce	United Phosphorus, Inc	M1
	Cuproxat Flowable	35935-3	48 hours	Douglas fir, Fir, Pine & Spruce	Nufarm Speciality Products	
fluopicolide	Adorn	59639-141 (2016)	12 hours	Conifers, Christmas trees	Valent	43
kaolin	Surround WP	61842-18	4 hours	Christmas Trees	Tessengerlo Kerley, Inc. (NovaSource)	
mancozeb (continued on next page)	Dithane 75DF Rainshield	62719-402	24 hours	conifers, Christmas trees, Fraser fir, Douglas-fir, Scotch pine, Austrian pine	Dow AgroSciences	M3
	Dithane F-45	62719-396	24 hours	Christmas trees, conifer, Douglas-fir	Dow AgroSciences	

Active Ingredient	Products	EPA Number	Re-Entry Interval	Crop	Manufacture	FRAC Code*
mancozeb	Dithane M-45	62719-387	24 hours	Christmas trees, conifer, Douglas-fir	Dow AgroSciences	M3
	Fore 80WP	62719-388	24 hours	conifers, Christmas trees, Fraser fir, Douglas-fir, Scotch pine, Austrian pine	Dow AgroSciences	
	Koverall	67760-110	24 hours	Christmas trees, Douglas-fir	Cheminova, Inc	
	Manzate MAX	70506-194	24 hours	Christmas trees, Douglas-fir	United Phosphorus, Inc.	
	Manzate Pro-Stick	70506-234	24 hours	Christmas trees, fir, spruce and pine	United Phosphorus, Inc.	
	PenncoZeb 75DF	70506-185	24 hours	Christmas trees, Douglas-fir	United Phosphorus, Inc.	
	PenncoZeb 80WP	70506-183	24 hours	Christmas trees, Douglas Fir	United Phosphorus, Inc.	
	Phoenix Wingman 4L	70506-287	24 hours	Conifers (Christmas trees), Fir (Abies), Douglas fir, Fraser fir, pine, Austrian pine, Scotch pine, spruce	United Phosphorus, Inc.	
	Protect DF	1001-77	24 hours	Christmas trees, fir, Douglas-fir, pine spruce	Cleary Chemical Corporation	
	Roper DF Rainshield	34704-1063	24 hours	Christmas trees (conifer), Douglas-fir	Loveland Products	
mefenoxam	Subdue GR	100-794	48 hours	Conifers in nurseries and plantations (including Christmas trees)	Sygenta Crop Protection	4
	Subdue MAXX	100-796	48 hours	Conifers in nurseries and plantations (including Christmas trees)	Sygenta Crop Protection	
metalaxyl	MetaStar 2E	71532-5-91026	48 hours	Conifers in nurseries and plantations (including Christmas trees)	LG Life Science America	4
	Phoenix Vireo MEC	70506-275	48 hours	Conifers in nurseries and plantations (including Christmas trees)	United Phosphorus, Inc.	
mono- & di-potassium salts of phosphorous acid (continued on next page)	Alude Systemic Fungicide	71962-1-1001	4 hours	Conifers, nurseries, plantations, forests, Christmas trees	Cleary Chemical Corporation	33
	Fosphite	68573-2	4 hours	Conifers, nurseries, plantations, forests, Christmas Trees, Pines	JH Biotech, Inc.	
	KPHITE 7LP	73806-1	4 hours	Conifers, nurseries, plantations, forests, Christmas Trees, Pines	Plant Food Systems	
	Phoenix Jetphiter	70506-291	4 hours	Conifers in commercial nurseries, plantations, forestry, Christmas trees	United Phosphorus, Inc.	

Active Ingredient	Products	EPA Number	Re-Entry Interval	Crop	Manufacture	FRAC Code*
mono- & di-potassium salts of phosphorous acid	Quanta	5905-566	4 hours	Conifers, nurseries, plantations, forests, Christmas trees	Helena Chemical Company	33
	Rampart Rampart T&O	34704-924	4 hours	Conifers, nurseries, plantations, forests, Christmas trees	Loveland Products	
myclobutanil	Eagle 20EW	62719-463	24 hours	Christmas trees, Douglas fir	Dow AgroSciences	3
thiophanate-methyl	Incognito 4.5 F Quali-Pro TM 45	66222-134	12 hours	Conifers -Pine (Austrian, Red, Scots), Christmas trees, Douglas-fir, Conifer seedling treatment	Makhteshim Agan of North America, Inc.	1
	Incognito 85 WDG Quali-Pro TM 85 WDG	66222-145	12 hours	Conifers - Pine (Austrian, Red, Scots), Christmas trees, Douglas-fir, Conifer seedling treatment	Makhteshim Agan of North America, Inc.	
	Nufarm T-Methyl 4.5F Nufarm T-Methyl SPC 4.5F	228-652 228-626	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.	
	T-Methyl 4.5	87373-10-83520	12 hours	Conifers - pine (Austrian, Scots), Christmas trees, Douglas-fir	Tacoma Ag	
	Topsin 4.5FL	8033-122-70506	12 hours	Conifers - pine (Austrian, Scots), Christmas trees, Douglas-fir	United Phosphorus, Inc.	
	Topsin M WSB	8033-125-70506	12 hours	Conifers, pine (Austrian, Scots), Christmas trees, Douglas-fir	United Phosphorus, Inc.	
triadimefon	Bayleton 50% Dry Flowable	264-737-5481 (2016)	12 hours	Christmas trees (except Concolor), Pine Seedlings	Amvac Chemical	3
	Bayleton Flo	432-1445	12 hours	Christmas trees (except Concolor), Pine Seedlings	Bayer CropScience	
	Bayleton Turf & Ornamental	432-1360	12 hours	Christmas trees (except Concolor), Pine Seedlings	Bayer CropScience	
Trichoderma asperellum	Tenet WP	80289-9	1 hour	Conifers, Christmas trees, fir, pine, spruce	Isagro/Sipcam Advan	3
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.