Michigan Christmas Tree Pest Management Guide 2020

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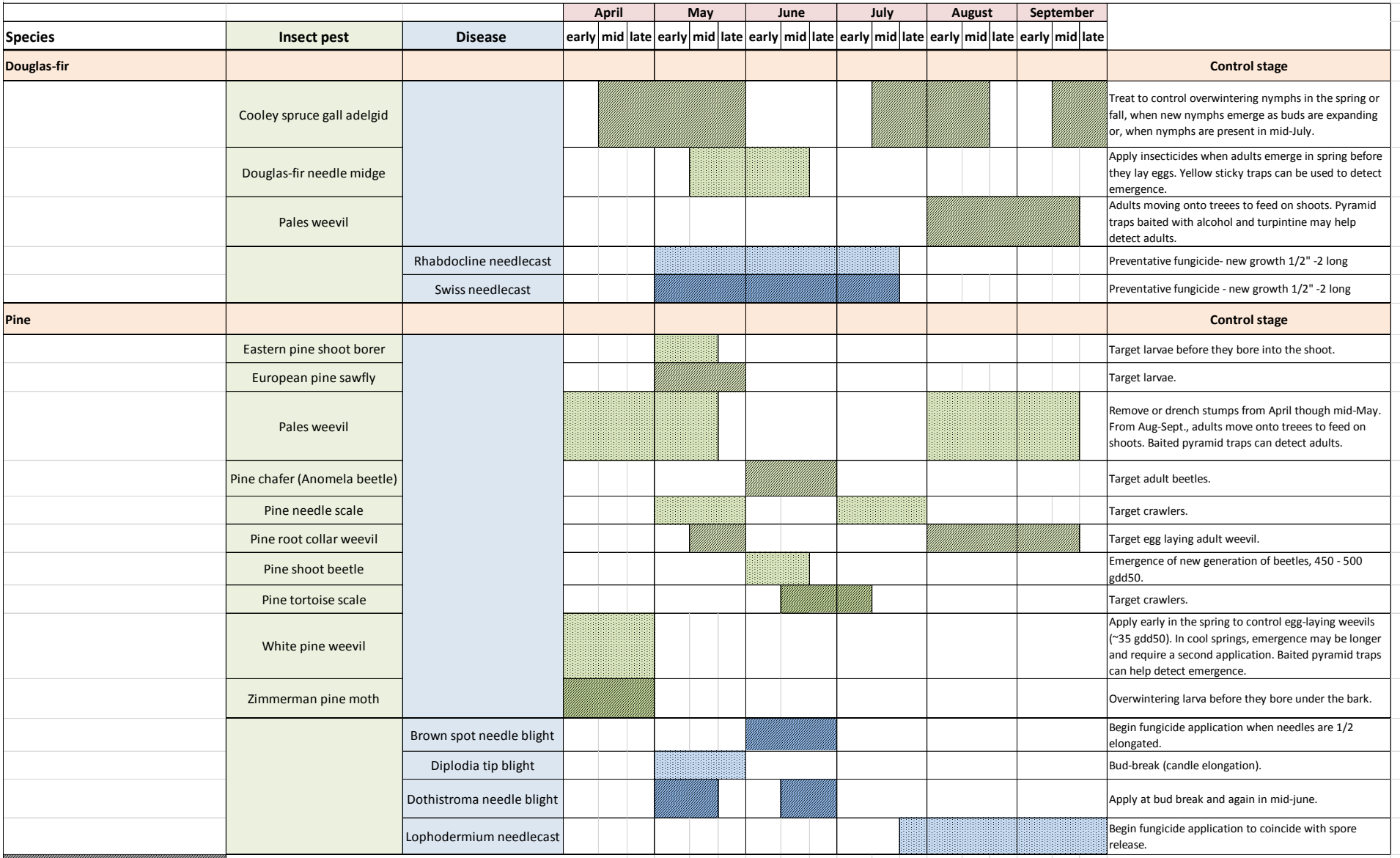
The information presented here does not supersede the label directions. To protect yourself, others and the environment, always read the label before applying any pesticide. Although efforts have been made to check the accuracy of information presented (December 2019), it is the responsibility of the 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

Reference to commercial products or trade names does not imply endorsement by Michigan State University Extension or bias against those not mentioned.

This information was compiled by; Jill O'Donnell, with assistance from Lynnae Jess, Erin Lizotte, Dr. Dave Smitley, Dr. Deborah McCullough and Dr. Monique Sakalidis, Michigan State University.

SEASONAL PEST CALENDAR

Michigan Christmas Tree Pest Calendar



Species	Insect pest	Disease	April early	April mid	April late	May early	May mid	May late	June early	June mid	June late	July early	July mid	July late	August early	August mid	August late	September early	September mid	September 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 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 early	April mid	April late	May early	May mid	May late	June early	June mid	June late	July early	July mid	July late	August early	August mid	August late	September early	September mid	September 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*	shortly before egg hatch when bags are still small	early 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	150-300	acephate, azdirachtin, bifenthrin, chlorpyrifos, cyfluthrin, esfenvalerate, thiamothoxam	**27/30**
	galls apparent	550-700		
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**

*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 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 stem mothers present (control target)	60-100 100-140	abamectin, acephate, azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, dinotefuran, esfenvalerate, imidacloprid, insecticidal soap, horticulture oil, lambda-cyhalothrin, malathion, oxydemeton-methyl, 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** acephate, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, dinotefuran, esfenvalerate, horticulture oil, imidacloprid, insecticidal soap, lambda-cyhalothrin, oxydemeton-methyl, 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, oxydemeton-methyl, 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 2nd adults active	25-100 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 egg hatch, galls begin forming 2nd adults active	25-100 250-310 1500-1600	acephate, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, dinotefuran, esfenvalerate, horticulture oil, imidacloprid, insecticidal soap, oxydemeton-methyl, spirotetramat, thiamethoxam	**107/131**
elongated hemlock scale *Fiorinia externa*	dormant prior to bud break When crawlers are active, may take several applications due to staggered life cycle	mid-March to mid-April June-October	dormant oil acephate, azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, horticultural oil, imidacloprid, insecticidal soap, malathion, oxydemeton-methyl, 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 egg hatch adults active	50-220 900-1000 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 young caterpillars pupation	145-200 450 900-1200	acephate, azadirachtin, *Bacillus thuringiensis (Bt),* bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, diflubenzuron, emamectin benzoate, flubendiamide, insecticidal soap, lambda-cyhalothrin,	**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 large larvae feeding defoliation noticeable	300-350 650-700	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 2nd adults active	25-100 1200-1400	acephate, azadirachtin, bifenthrin, chlorpyrifos, cyfluthrin, diflubenzuron,	**86/106**
pine bark adelgid *Pineus strobi*		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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Insect	Life stage	GDD_{50} Months	Control Options	Page # Pest Manual* 1998/2014
pine chafer *Anomela oblivia*	1st adults active	450-600	azadirachtin, cyfluthrin, esfenvalerate, lambda-cyhalothrin	**64**
pine false webworm *Acantholyda erythrocephala*			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 1st generation - hyaline stage (control target) 2nd generation egg hatch 2nd generation - hyaline stage (control target)	250-400 400-500 1250-1350 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 2nd adults active	300-350 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 optimal control window	450-550 450-500	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 very early spring before eggs are laid to control the 1st generation of emerging adults.		acephate, azadirachtin, carbaryl, bifenthrin, kaolin, dinotefuran, lambda-cyhalothrin, malathion, oxydemeton-methyl, thiamethoxam	**45/51**
pine tortoise scale *Toumeyella parvicornis*	egg hatch begins; 1st crawlers egg hatch ends crawlers settling	400-500 1000-1200	acephate, azadirachtin, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, dinotefuran, horticultural oil, imidacloprid, insecticidal soap, lambda-cyhalothrin, malathion, oxydemeton-methyl, 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,oxydemeton-methyl, 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		bifenthrin, cyfluthrin, diflubenzuron, emamectin benzoate, methoxyfenozide, spinosad	**NA/83**
spruce gall midge *Mayetiola piceae*	adult emerge eggs hatch (control window)	70-100 130-145	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***

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white grubs *Phyllophaga and Polyphylla spp.* *Rhizotrogus majalis*			carbaryl, imidacloprid	**123/151**
white pine weevil *Pissodes strobi*	1st adults active 2nd adults active	25-220 1200-1400	acephate, azadirachtin, bifenthrin, chlorpyrifos, cyfluthrin, diflubenzuron, esfenvalerate, lambda-cyhalothrin, oxydemeton-methyl, phosmet	**101/122**
Zimmerman pine moth *Dioryctria zimmermani*	1st larvae adult flight	25-100 1700	acephate, bifenthrin, chlorpyrifos, cyfluthrin, diflubenzuron, lambda-cyhalothrin, methoxyfenozide	**126/156**

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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	Tide International USA, Inc.	no	24 hrs	
azadirachtin	Aza-Direct*	71908-1-10163	Gowan Company	no	4 hrs	**un (unknown)**
	AzaGuard	70299-17	BioSafe Systems, LLC	no	4 hrs	
	Molt-X	68539-11	BioWorks, Inc.	no	4 hrs	

Active Ingredient	Insecticide & Formulation	EPA Reg#	Company	RUP	REI	IRAC Mode of Action(1)
Bacillus thuringiensis, subsp. Kurstaki	DiPel PRO DF	73049-39 **(2019)**	Valent USA	no	4 hrs	**11A (Biopesticides)**
bifenthrin**	Bifen 2 AG Gold	83222-1	Winfield United	yes	12 hrs	**3 (Pyrethroids)**
	Bifenture EC	70506-57	United Phosphorus, In.	yes	12 hrs	
	Fanfare ES	66222-236	ADAMA	yes	12 hrs	
	Onyx Pro	279-4269	FMC Professional Solution	yes	12 hrs	
	Sniper	34704-858	Loveland Products	yes	12 hrs	
bifenazate	Acramite 4SC	400-514	Macdermid Agricultural Solutions	no	12 hrs	**20D (Bifenazates)**
	Bizate 4SC	34704-1116	Loveland Products, Inc.	no	12 hrs	
	Enervate 4SC	91234-20	Atticus LLC	no	12 hrs	
	Floramite SC	400-508-59807	OHP,Inc.	no	12 hrs	**un (unknown)**
	Vigilant 4SC	400-514	Macdermid Agicultural Solutions	no	12 hrs	**20D (Bifenazates)**
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	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)**	Nufos 4E	67760-28 **(2019)**	Cheminova	yes	24 hrs	**1B (Organophosphates)**
	Vulcan	66222-233	ADAMA	yes	24 hrs	
	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)**
emamectin benzoate**	Enfold	100-1411 **(2019)**	Syngenta	yes	12 hrs	**6 (Avermectins)**
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	10163-297	Gowan	no	12 hrs	**21A (METI)**
	Magister SC	10163-322	Gowan	no	12hrs	
	Magus Miticide	10163-297	Gowan	no	12 hrs	

Active Ingredient	Insecticide & Formulation	EPA Reg#	Company	RUP	REI	IRAC Mode of Action(1)
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	
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	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	
	Mallet 75 WSP	228-588	Nufarm	no	12 hrs	
	Midash 2SC Ag Insecticide	83529-4 **(2019)**	Sharda USA LLC	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	

Active Ingredient	Insecticide & Formulation	EPA Reg#	Company	RUP	REI	IRAC Mode of Action(1)
imidacloprid (continued)	Nuprid 4F MAX	228-528	Nufarm	no	12 hrs	**4A (Neonicotinoids)**
	Pasada 1.6F	66222-228 **(2019)**	ADAMA	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 Alias 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	
	Wrangler	34704-931	Loveland Products	no	12 hrs	
kaolin	Surround WP*	61842-18	Tessenderlo Kerley	no	4 hrs	**(Biopesticides)**
lambda-cyhalothrin (continued on next page)**	Grizzly Too	100-1295-1381	Winfield United	yes	24 hrs	**3A (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	
	LC Insecticide	19713-572	Drexel Chemical Co.	yes	24 hrs	
	Lamcap	100-1112 **(2019)**	Syngenta Crop Protection	yes	24 hrs	
	Nufarm Lambda-cyhalothrin 1 EC	228-708	Nufarm Ag Products	yes	24 hrs	
	Paradigm	66222-223-33270	United Suppliers, Inc.	yes	24 hrs	

Active Ingredient	Insecticide & Formulation	EPA Reg#	Company	RUP	REI	IRAC Mode of Action(1)
lambda-cyhalothrin (continued)**	Province	100-1112-55467 **(2019)**	Tenkoz Inc.	yes	24 hrs	**3A (Pyrethroids)**
	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	Cheminova Malathion 57%	67760-40 **(2019)**	Cheminova	no	12 hrs	**1B (Organophosphates)**
	Fyfanon 57% EC	279-3607	FMC Corporation	no	12 hrs	
	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	
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	
peppermint and rosemary oil	Brandt Ecotec Plus*	48813-99999	Brandt Consolidated	no	0 **See label**	**Oil - plant based (Biopesticide)**
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	
	Perm-UP 3.2 EC	70506-9	United Phosphorus, Inc.	yes	12 hrs	
	Pounce 25 WP	279-3051	FMC Professional Solutions	yes	12 hrs	

Active Ingredient	Insecticide & Formulation	EPA Reg#	Company	RUP	REI	IRAC Mode of Action(1)
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)**
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.	**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 requires 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 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 *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	
	Viceroy 70 DF	61842-10-70506**(2019)**	12 hours	Conifer nurseries	United Phosphorus, Inc.	
azoxystrobin	Aframe	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/AgriStar	
	Azoxyzone	71532-35-91026	4 hours	Christmas trees	LG Life Sciences	
	Equation	67760-124 **(2019)**	4 hours	Christmas trees	Cheminova	
	Equation SC	67760-124 (**2019)**	4 hours	Christmas trees	Cheminova	
	Tetraban	33270-32	4 hours	Christmas trees	United Suppliers	
	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 label**	Bravo Ultrex	66222-277	12 hours*	Conifers (including Christmas trees)	ADAMA	**M5**
	Bravo Ultrex	50534-201-100	12 hours*	Conifers, pine, spruce, Douglas-fir	Syngenta Crop Protection, Inc.	
	Bravo Weather Stik	66222-276	12 hours*	Conifers, Christmas trees	ADAMA	
	Bravo Weather Stik	50534-188-100	12 hours*	Conifers, 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	12 hours *	Christmas trees, conifer, pines, spruces	Syngenta Crop Protection, Inc.	
	Chlorothalonil 720	19713-690	12 hours *	Conifers (including Christmas trees)	Drexel Chemical Co.	

Active Ingredient	Products	EPA Number	Re-Entry Interval	Crop	Manufacture	FRAC Code*
chlorothalonil* (continued on next page)	Daconil Weather Stik	50534-209-100	12 hours *	Conifers, Christmas trees, spruce pine, Douglas-fir	Syngenta Crop Protection, Inc.	**M5**
	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, 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, conifer nursery beds *** Do not use on blue spruce * 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 *** Do not use on blue spruce * 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 in nursery beds, 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.	
	Equus DF Quali-Pro Chlorothalonil DF	66222-149	12 hours*	Conifers, Christmas trees, nursery beds	ADAMA	
	Equus 720	66222-154	12 hours*	Conifers, Christmas tree, nursery beds	ADAMA	
	Equus 720 SST	5481-619	12 hours*	Conifers, Christmas tree, nursery beds	Amvac Chemical Corp.	
	Initiate 720	34704-881	12 hours *	Conifers (pines and spruce)	Loveland Products, Inc.	

Active Ingredient	Products	EPA Number	Re-Entry Interval	Crop	Manufacture	FRAC Code*
chlorothalonil* (continued)	Initiate ZN	34704-1050	12 hours*	Conifers (pine and spruce)	Loveland Products, Inc	**M5**
	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.	
	Praiz	9779-320	12 hours*	Conifers (pine and spruce)	Winfield United	
	Vabro	9779-320-33270	12 hours*	Conifers (pine and spruce)	United Suppliers	
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	
	Kocide 2000-O	91411-10-70051	48 hours	Conifers-Christmas tree plantings, silviculture nurseries- Douglas fir, Fir, Pine & Spruce	Certis, USA	
	Kocide 2000	352-656 **(2019)**	48 hours	Conifers-Christmas tree plantings, silviculture nurseries, Douglas fir, Fir, Pine & Spruce	Dupont Crop Protection	
	Kocide 3000	91411-2-70051	48 hours	Conifers-Christmas tree plantings, silviculture nurseries - Douglas fir, Fir, Pine & Spruce	Certis, USA	
	Kocide 3000	352-662 **(2019)**	48 hours	Conifers-Christmas tree plantings, silviculture nurseries, Douglas fir, Fir, Pine & Spruce	DuPont Crop Protection	
	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 – Douglas-fir, Fir, Pine and Spruce	Albaugh, LLC/AgriStar	
	Nu-Cop XLR	42750-217	48 hours	Conifers – Douglas-fir, Fir, Pine and Spruce	Albaugh, LLC/AgriStar	
copper oxychloride and copper hydroxide	Badge SC	80289-3-10163	48 hours	Conifers Douglas-fir Fir Pine and Spruce	Gowan Company	**M1**
	Badge X2	80289-12 80289-12-10163	48 hours	Conifers Douglas-fir Fir Pine and Spruce	Isagro USA Inc. Gowan Company	

Active Ingredient	Products	EPA Number	Re-Entry Interval	Crop	Manufacture	FRAC Code*
copper sulfate	Cuprofix Ultra 40 Dispersible	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 Limited	
fluopicolide	Adorn	59639-141	12 hours	Conifers, Christmas trees	Valent	**43**
kaolin	Surround WP	61842-18	4 hours	Christmas Trees	Tessenderlo Kerley,	
mancozeb	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	Conifer (Christmas trees), Douglas-fir	Dow AgroSciences	
	Dithane M-45	62719-387	24 hours	Conifer (Christmas trees), Douglas-fir	Dow AgroSciences	
	Fore 80WP	62719-388	24 hours	Conifers, Christmas trees, Fraser fir, Douglas-fir, Scotch pine, Austrian pine	Dow AgroSciences	
	Fortuna 75 WDG	89333-1 **(2019)**	24 hours	Christmas trees, fir, spruce, pine, Douglas-fir	Agria Canada Inc	
	Koverall	67760-110 **(2019)**	24 hours	Christmas trees, Douglas-fir	Cheminova, Inc	
	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.	
	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.	
	Protect DF	1001-77	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	
mefenoxam	Subdue GR	100-794	48 hours	Conifers in nurseries and plantations (including Christmas trees)	Syngenta Crop Protection	**4**
	Subdue MAXX	100-796	48 hours	Conifers in nurseries and plantations (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**

Active Ingredient	Products	EPA Number	Re-Entry Interval	Crop	Manufacture	FRAC Code*
mono- & di-potassium salts of phosphorous acid	Alude Systemic Fungicide	55146-83	4 hours	Conifers, nurseries, plantations, forests, Christmas trees	NuFarm Limited	**33**
	Fosphite	68573-2	4 hours	Conifers, nurseries, plantations, forests, Christmas Trees, Pines	JH Biotech, Inc.	
	KPHITE 7LP	73806-1 (2019)	4 hours	Conifers, nurseries, plantations, forests, Christmas Trees, Pines	Plant Food Systems	
	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	ADAMA	**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	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.	
	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 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	Conifers, 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**

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, exposure to pesticides 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 have been 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 with mammals) and less harmful to mammals and wildlife than most of the older classes of insecticides. The potential problem for bees 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.

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 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 orchards or Christmas tree fields with flowering weeds could be a problem for their bees.

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.