Pesticides for Use in Forest and Seed Tree Orchards Production in the North Central Region

Michigan State University Extension Service
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INTRODUCTION

Purpose of This Bulletin

This bulletin was developed to provide you with the latest available information on fungicide, insecticide or herbicide products available for pest management. Information included in the pesticide tables was acquired from product labels. This information should help you select an appropriate product for control of the target pest.

Stay Up-to-Date

Registration of pesticide products changes each year. Some products are removed from the market, new products are introduced, new uses are found for old products, or new restrictions are placed on their use. Check with your County Extension agent for updates that have occurred since the publication of this bulletin.

Always Read the Label

Always read the label of the pesticide to be sure that it is registered and appropriate for the target pest.

Note that some products require supplemental labels, which are available from your chemical supplier.

Many commonly used products are included in the list in this bulletin. However, other products may be registered and available for use in your state. Read the label and consult your County Extension office, Department of Natural Resources or Department of Agriculture if you have questions about the registration status of a pesticide product.

Selection of Products

Pesticides should be selected and applied to control specific pests. However, if there are two or more pests threatening the field or the trees, compare the recommendations for each pest and read the labels of the registered pesticides you are considering for use. In some cases, a single application can be used to control both pests.

Occasionally, collective names are used when referring to similar species. For example, "aphid pests" may include the giant pine aphid, powdery pine needle aphid, spotted pine aphid, white pine aphid, and others. All of these aphid species can be managed using the same insecticide.

IPM - Integrated Pest Management

Tree growers must deal with a great number of pests. The entire tree is vulnerable to attack including roots, stems, foliage, shoots and terminal leaders. Damage can range from complete mortality, to growth loss, to cosmetic damage that reduces the value of trees at market time.

Integrated Pest Management (or IPM), is the best approach to manage pests in nursery, Christmas tree or forest and seed orchard production. IPM is defined as using all available tools or tactics to prevent economically important damage from pests, without causing damage to the environment.

Pesticides are an important part of an IPM program, but should not be expected to cure all pest problems. Pesticide use is a corrective measure, designed to "control" a target pest.

However, effective long-term pest management must also include measures designed to prevent outbreaks of pests and to maintain tree health and vigor. Pesticide use should be incorporated into a year-long management program that includes the use of cultural controls, biological controls, frequent and regular pest scouting, accurate pest diagnosis, and evaluation of each pest management practice.

When using pesticides, growers should be conscious of factors such as timing, coverage and selection of the appropriate product. A good knowledge of the pest's life cycle, and selection of appropriate products and application equipment will improve coverage and the effectiveness of the control. The ability to recognize beneficial biocontrol insects, combined with cultural, sanitation or mechanical controls, may allow growers to delay or avoid treatment of a minor pest problem.

Contact your County Extension office to learn more about IPM and methods to integrate pesticide use with other pest management tools. For example, many publications and specialists can help you learn how to use good cultural practices to prevent damaging pest populations from occurring. Another example is the use of degree days to more accurately time insecticide application. Accurate timing can reduce the number of applications needed and increase the effectiveness of the spray. These practices may also help conserve beneficial insect predators or parasitoids. Sound IPM practices will pay off in the long run, both economically and environmentally.

SAFE USE OF PESTICIDES

Pesticide Name

The trade name (first letter capitalized; Lorsban, for example) is used when a pesticide is sold under only one well-known brand name. The accepted common name of a pesticide is used when it is sold under several brand names; chlorpyrifos, for example, has dozens of trade names (Lorsban is probably the most common). Some well-known brand names may be given in parentheses following the common name; carbaryl (Sevin).

Application Rates

The amount or rate of each formulation (the commercial mixture of toxicant and inert ingredients) used are given. Examine the label or contact your County Extension agent for more help in choosing appropriate rates for your situation. Use this information to help you select the safest pesticide for your application.

Abbreviations

We have tried to be consistent in the abbreviations used in the control recommendations. The abbreviations used are as follows:

Dry Measure

oz = ounces
lb = pound; 16 oz per lb

Liquid Measure

fl oz = fluid ounces
pt = pint; 16 fl oz per pt
qt = quart; 32 fl oz per qt,
2 pt per qt
gal = gallon; 128 fl oz per gal,
8 pt per gal,
4 qt per gal

Areas or Amounts Treated

sq ft = square foot, square feet
sq yd = square yard(s)
per acre (acre) = 43,560 square feet

Dry Formulations

The amount of active ingredient(s) in a dry formulation is given as a percentage in the formulation. For example, 50% WP indicates a wettable powder formulation containing 50 percent active ingredient.

B—bait; pesticide mixed with some attractant material that is applied without mixing with water.

D—dust; a finely ground pesticide intended for use without mixing with water.

G—granule; a coarse particle intended for use without mixing with water.

WP—wettable powder; a finely ground pesticide intended to be mixed with water for application.

SP—soluble powder; a finely ground pesticide to be dissolved in water for application.

Liquid Formulations

The amount of active ingredient in a liquid formulation is given as pounds active ingredient per gallon. This is usually cited with the ingredients statements on the label. For example, 3.2 lb/gal EC indicates an emulsifiable concentrate that contains 3.2 pounds active ingredient per gallon.

EC = emulsifiable (or soluble) concentrate: a solution of pesticide intended to be mixed with water for application.

F = flowable: a suspension of pesticide intended to be mixed with water for application.

ULV concentrate: ultra low-volume concentrate: a solution of pesticide intended to be applied by aircraft without mixing with water.

This section has been adopted, in part, and modified from *Chemical Control of Insects & Nematodes in Field & Forage Crops* (Extension Bulletin E-1582, October 1991) written by Douglas A. Landis, George W. Bird, Larry G. Olsen and Fred Warner, Department of Entomology and Pesticide Research Center, Michigan State University, and *Control & Management of Christmas Tree Insect Pests in Michigan* (Extension Bulletin E-2572, April 1995) written by Deborah McCullough and Tom Ellis, Department of Entomology, Michigan State University.

GUIDELINES FOR SAFE USE OF PESTICIDES

Selecting Pesticides

Always thoroughly read the label and the supplemental labeling material for any pesticide that you may consider using. Understand the label instructions and limitations. Make certain that your operation will use the pesticide only for the purposes listed and in the manner directed on the label. Select only those pesticides that are labeled for the crop you wish to use it on and the pest(s) you wish to control. To do otherwise will cost you in terms of effective and economical product performance, and may lead to an unacceptable risks to humans, the crop, and the surrounding environment.

Protecting Groundwater

Many people who live in rural areas get their drinking water from wells. Since well water is groundwater, it is easy to see why you should be concerned about keeping pesticides out of groundwater. There are several processes that determine the fate of pesticides and whether they will end up in your drinking supply.

Adsorption is the binding of chemicals to soil particles. The amount and persistence of pesticide adsorption varies with pesticide properties, soil moisture content, soil pH, and soil texture. Soils high in organic matter or clay are the most adsorptive; coarse, sandy soils are much less adsorptive. A soil-adsorbed pesticide is less likely to volatilize, leach or be degraded by microorganisms, but is also less available for intake by plants.

Volatilization occurs when a solid or liquid turns into a gas. Volatilization of pesticides increases with higher air temperature and air movement, higher temperature at the treated surface (soil, plant, etc.), low relative humidity, and when spray droplets are small. Pesticides also volatilize more readily from coarse-textured soils and from medium- to fine-textured soils with high moisture content. A pesticide in a gaseous state can be invisible and carried away from a treated area by air currents.

Runoff is the movement of pesticides in water across the soil surface. It occurs as water moves over a sloping surface, carrying pesticides either mixed in the water or bound to eroding soil. The amount of pesticide runoff depends on the grade or slope of an area, the erodibility and texture of the soil, the soil moisture content, the amount and timing of irrigation or rainfall, and properties of the pesticide.

Leaching also moves pesticides in water. In contrast to runoff, leaching occurs as water moves downward through the soil. Factors that influence leaching include whether the pesticide dissolves easily in water, soil structure and texture, and the amount and persistence of pesticide adsorption to soil particles.

Absorption is the process by which chemicals are taken up by plants. Once absorbed, most pesticides degrade within plants. However, some residues may persist inside the plant and may be released back into the environment as the plant tissues decay.

Crop removal can transfer pesticides. When treated crops are harvested, the pesticide residues are removed with them and transferred to a new location. After harvest, many agricultural commodities are washed or processed, which can remove or degrade much of the remaining residue. However, the wash water may now be contaminated and should be disposed of as a potential contaminant.

Microbial degradation occurs when microorganisms such as fungi and bacteria use a pesticide as a food source. Conditions that favor microbial growth include warm temperatures, favorable pH levels, adequate soil moisture, aeration (oxygen), and fertility. Adsorbed pesticides are more slowly degraded because they are less available to some microorganisms.

Chemical degradation is the breakdown of a pesticide by processes not involving a living organism. The adsorption of pesticides to the soil, soil pH levels, soil temperature and moisture all influence the rate and type of chemical reactions that occur. Many pesticides, especially the organophosphate insecticides, are susceptible to degradation by hydrolysis in high pH (alkaline) soils or spray mixes.

Photodegradation is the breakdown of pesticides by sunlight. To learn how to protect groundwater when applying pesticides, some basic information on groundwater is helpful. *Groundwater* is the water beneath the earth's surface occupying the saturated zone (the area where all the pores in the rock or soil are filled with water). It is stored in geological formations known as *aquifers*. Groundwater moves through aquifers and can be obtained at points of

natural discharge such as springs or streams, or by drilling a well into the aquifer.

The upper level of the saturated zone in the ground is called the *water table*. The water table depth below the soil surface fluctuates throughout the year, depending on the amount of water removed from the ground and the amount of water added by recharge and connected surface waters. Recharge is water that seeps through the soil from rain, melting snow, or irrigation. Surface waters are visible bodies of water such as lakes, rivers, and oceans.

Both surface water and groundwater are subject to contamination by *nonpoint source pollution*. This type of pollution generally results from land runoff, precipitation, acid rain, or percolation rather than from a discharge at a specific, single location (such as a single pipe or well head). Contamination from these single sites is known as *point source pollution.*

Keeping Pesticides Out of Groundwater

A pesticide that is not volatilized, absorbed by plants, bound to soil, or broken down can potentially move through the soil to groundwater. The movement of groundwater is often slow and difficult to predict. Substances that enter groundwater in one location can turn up years later in other locations. A major difficulty in dealing with groundwater contaminants is that the sources of pollution are not easily recognized. The problem is occurring underground, out of sight.

It is very difficult to clean contaminated groundwater. The best solution is to prevent contamination in the first place. The following pesticide application practices can reduce the potential for surface and groundwater contamination.

Use integrated pest management programs—Keep pesticide use to a minimum by combining chemical control with other pest management practices.

Consider the geology of your area—Be aware of the water table depth and the permeability of the geological layers between the surface soil and groundwater. Sinkholes can be especially troublesome because they allow surface water to quickly reach groundwater.

Select pesticides carefully—Pesticides that are highly soluble, relatively stable, and not readily adsorbed to soil tend to be the most likely to leach. Read labels carefully and consult a specialist from a County Extension office, or your chemical dealer, if necessary. The tables in this bulletin will also help you choose the best pesticide for your use.

Follow label directions—The label carries crucial information about the proper rate, timing, and placement of the pesticide

Calibrate accurately—Calibrate equipment carefully and often to avoid over or under application.

Measure accurately—Carefully measure concentrates before they are placed into the spray tank. Do not "add a little extra" to ensure the pesticide will do a better job.

Avoid back-siphoning—The end of the fill hose should remain above the water level in the spray tank at all times to prevent back-siphoning of chemicals into the water supply. Use an anti-backflow device when siphoning water directly from a well, pond, or stream.

Consider weather and irrigation—If you suspect heavy rain will occur, delay applying pesticides. Control the quantity of irrigation to minimize potential pesticide leaching and runoff.

Avoid spills—But when spills occur, contain and clean them up quickly with an absorbent material such as cat litter.

Mix on an impervious pad—Mix and load pesticides on an impervious pad if possible, where spills can be contained and cleaned up. If mixing is done in the field, change the location of the mixing area regularly.

Dispose of wastes properly—Obey laws regulating the disposal of pesticide wastes. Triple rinse containers. Pour the rinsewater into the spray tank for use in treating the site or the crop.

Store and mix pesticides away from water sources such as well, ponds, and springs.

Protect Nontarget Organisms

Bees and other pollinating insects are essential for successful production of tree fruits, small fruits, most seed crops and certain vegetables. Many insecticides are highly toxic to pollinating honeybees and wild bees. Be aware of how bee poisonings can occur from applying pesticides and how to prevent them. Take the following precautions to reduce the chance of bee poisoning:

- Do not apply insecticides that are toxic to bees if the site contains a crop or weeds which are in bloom. Mow cover crops and weeds to remove the blooms before spraying.

- Select insecticides that are least harmful to bees, and select the safest formulation. Dusts are more hazardous to bees than sprays. Wettable powders are more hazardous than emulsifiable concentrates or water soluble formulations. Granular insecticide formulations are generally the least hazardous to bees. Microencapsulated insecticides are extremely hazardous because the minute capsules can be carried back to the hive.

- Reduce drift during application. Use drift control materials whenever possible.

- Time pesticide applications carefully. Evening applications are less hazardous than early morning; both are safer than midday applications.

- Do not treat near hives. Bees may need to be moved or covered before using insecticides near colonies.

The best way to avoid injury of **beneficial insects and microorganisms** is to minimize insecticide use. Use selective insecticides whenever possible and apply only when necessary as part of a total pest management program.

Pesticides can be harmful to all kinds of vertebrates such as **fish and wildlife**. Most recognizable are the direct effects from acute poisoning. Fish kills can result from water pollution by a pesticide (usually insecticides). Pesticides can enter water via drift, surface runoff, soil erosion, and leaching.

Bird kills from insecticides can occur when birds ingest the toxicant in granules, baits, or treated seed; drink or use contaminated water; or feed on insecticide-contaminated prey.

Pesticide Emergency Preparedness

At the time that the pesticide is purchased, ask the chemical dealer for a complete specimen label of the product you bought. This label and labeling information packet is an exact duplicate of the label information that is affixed to and/or must accompany the pesticide container. Use the specimen label material as a reference during any pesticide emergency. Bring the specimen label material along with any person who has become poisoned and needs medical attention.

Closely follow all the warning statements outlined in the PRECAUTIONARY STATEMENTS section on the pesticide label. Be certain that you use all protective clothing and equipment as specified by the label. Make certain all persons involved in the operation of the farm know and can carry out the STATEMENT OF PRACTICAL TREATMENT that is given on the front panel of all pesticide labels.

Transporting Pesticides

Have agricultural chemicals delivered by your dealer directly to your pesticide storage facility if possible. Transporting pesticides, especially large quantities, can involve a high degree of assumed liability by the grower. Department of Transportation shipping rules must also be followed for transporting large quantities of pesticides, including proper placarding of the vehicle, liability insurance, special handling requirements, etc.

Storing Pesticides

Pesticides must be stored in a facility that will protect them from temperature extremes, high humidity, and direct sunlight. The storage facility should be heated, dry and well ventilated. It should be designed for easy containment and cleanup of pesticide spills and made of materials that will not absorb any pesticide material that leaks out of a container. Store only pesticides in such a facility and always store them in their original containers. Do not store any feed, seed, food, or fertilizer with pesticides. Do not store any protective clothing or equipment in the pesticide storage facility. Try to store herbicides separate from insecticides and fungicides because volatile materials will cross-contaminate other materials. Keep the facility locked at all times when not in use to prevent animals, children, and irresponsible adults from entering and becoming poisoned. Post the facility as a PESTICIDE STORAGE FACILITY to warn others that the area is off limits. Always read and follow the STORAGE AND DISPOSAL section of all pesticide labels. For further information on proper storage, and plans for constructing a facility, consult Midwest Plan Service 37 and MSU Bulletin E-2335.

Handling and Mixing Pesticides

Always wear protective clothing and equipment when handling, mixing, and applying pesticides and during the clean up of application equipment. Protective clothing should include full coverage clothing, chemical resistant gloves and boots, eye protection, hard hat, and a MSHA/NOISH approved respirator

with a chemical absorbent material appropriate for the pesticide being used.

Mix pesticides downwind and below eye level. Avoid excessive splashing and sloshing. If pesticides are spilled on you, wash them off immediately with lots of water and change clothing. Resume spraying only after cleaning up any spills. Try to use closed handling/mixing systems when appropriate.

Mix only what is required for the area to be sprayed according to label directions. Avoid mixing excessive amounts. To do otherwise will create a hazardous waste which is difficult and expensive to dispose of. Keep unauthorized persons out of the areas when you handle pesticides.

Applying Pesticides

Prior to any application, the equipment used must be thoroughly checked for sound operation and accurately calibrated. Poor maintenance and calibration practices will lead to excessive residues on the crop and could harm humans, animals, crops and the environment. Inspect the application equipment during use to prevent the unintentional release of chemicals. If the equipment needs repair, stop the application operation and fix the problem before completing the spray job. Spray only the label directed rate to the target area.

Do not spray on days when the wind is greater than 10 miles per hour and/or weather conditions (e.g., inversions) are conducive to pesticide drift away from the target area. Make every effort to AVOID PESTICIDE DRIFT.

Warn all unauthorized persons to get out of the target area during the pesticide application. Warn occupants of properties abutting the target area when such precautions are specified by the label of the pesticide being used.

Handling and Disposing of Pesticide Containers

All pesticide containers are considered HAZARDOUS WASTE unless they are triple rinsed and the rinsate is used as additional dilution in the spray mixture. After triple rinsing all emptied pesticide containers, perforate both ends so that the container cannot be reused. All metal and plastic triple rinsed containers should be offered for recycling. If this option is not available, dispose of them in a state licensed sanitary landfill. Dispose of all paper containers in a sanitary landfill or municipal waste incinerator. Do not bury or burn any pesticide containers. Do not reuse any empty pesticide containers for any purpose.

Cleaning of Pesticide Application Equipment

Follow all specific label directions for cleaning application equipment. If such instructions are not given on the pesticide label, then triple rinse the entire inside of the application equipment, spraying the rinsate on a labeled site not exceeding labeled rates. Wash off the outside of the equipment in the target area. Only after rinsing the equipment out with fresh water should you clean the spray system with an appropriate cleaning solution. Do not spray any cleaning solution onto any crop; dispose of the cleaning solution as you would any municipal waste. Follow the equipment manufacturer's guidelines for routine and year-end cleaning and maintenance.

Unused and Unwanted Pesticides

Unused and unwanted pesticides are considered HAZARDOUS WASTE by both federal and state regulations. To be exempt from the stringent requirements for the disposal of hazardous pesticide waste, make every effort to purchase the exact amount of pesticides that will be needed during the growing season. Take extreme care in the calibration and application of any pesticide so that leftovers are not generated at the end of the job. Use any pesticide containing rinsates and unused pesticides exactly according to label USE directions. If these procedures cannot be met, contact the Department of Natural Resources Hazardous Waste Division for instructions on the legal disposal of pesticide waste.

Worker Protection Standard

New federal rules for farm worker protection, issued during 1992, require farmers to provide additional training and notification to farm workers to prevent accidental or occupational exposure to pesticides. Farmers should contact Extension agents to learn the details of this standard and availabilty of training materials for education of workers and handlers.

Read and follow the label instructions on **Restricted Entry Intervals (REI)** for every pesticide used. Some pesticide labels require both oral warning and posted signs to notify workers of pesticide applications. If the label doesn't require both forms of notification, notify workers either orally or by posting warning signs at entrances to treated areas. When using posted signs, post 24 hours or less before the pesticide application and remove signs within three days after the end of the restricted entry interval. Keep workers out during the entire time the signs are posted (except for early-entry

workers wearing the proper personal protective equipment).

Record Keeping

The 1990 Farm Bill requires that all applicators who apply restricted use pesticides (RUP) keep records and maintain them for two years. Records to be kept include:

1. brand or product name, formulation, and the EPA registration number of the RUP that was applied;

2. total amount and the rate of application of the RUP;

3. address or location, the size of area treated, the target pest, and the crop, commodity or stored product to which the RUP was applied;

4. month, day and year on which the RUP application occurred; and

5. name, address, and certification number (if applicable) of the certified applicator who applied or supervised the application of the RUP.

As of October 1992, a Drift Management Plan was required. The purpose of the plan is to show that reasonable care has been taken by the grower to prevent drift of pesticides during application

Be sure to properly record all pesticide applications. Your County Extension office can help provide forms and suggestions for record keeping systems. Penalties are up to $500 for the first violation and up to $1000 for subsequent violations. Provisions for protecting the identity of individual producers are included in the law. Although, at the time of this printing, no state agency have been designated to enforce this new rule in some states, accurate records should be kept for efficient farm management.

Endangered Species Act

To minimize the adverse impact of pesticides on endangered species, the EPA has initiated **The Endangered Species Act**. Every implicated pesticide will have an endangered species warning statement regarding use of the product within the geographic area when endangered species restrictions apply. Users must obtain a county-specific endangered species bulletin from their local County Extension office, which will identify the specific area where use restrictions apply. Application of listed pesticides in the identified geographic areas in that county will be restricted or prohibited.

SARA Title III Emergency Planning and Community Right to Know Act

The Community Right to Know law, under SARA Title III, requires farmers to notify their State Emergency Response Commission (SERC), Local Emergency Planning Committee (LEPC) and local fire department that they store extremely hazardous materials. Check with the state Department of Natural Resources or County Extension office to receive a list of EPA established _extremely hazardous substances_ and their planning threshold quantities.

The SERC, LEPC and local fire chief may request maps of your storage facility and detailed lists of materials you store.

This law also requires that, in the event of a spill, the SERC, LEPC and National Response Commission be notified. The reportable quantities for spills is much less than for storage and can be obtained from the above sources. Your County Extension office may be able to assist you in preparing an emergency response plan for your farm.

Farmers are protected from nuisance law suits under the Right to Farm law if you follow acceptable management practices. These practices are completed for pesticides and nearly ready for fertilizers. Contact your local County Extension office, Department of Natural Resources or regional Department of Agriculture Office to obtain copies.

MAJOR DISEASE PESTS

TREE SPECIES	DISEASE
Douglas fir	Rhabdocline needlecast, Swiss needlecast
Balsam fir	Lirula needlecast
Black, white, blue and Norway spruce	Spruce needle rust
Blue and white spruce	Rhizosphaera needlecast
All spruce	Lirula needlecast, Cytospora canker
Scotch pine	Brown spot needlecast, Lophodermium needlecast, Cyclaneusma needlecast, pine needle rust, gall rust, Sphaeropsis (Diplodia) shoot blight
Red pine	Lophodermium needlecast, Cyclaneusma needlecast, pine needle rust, Sphaeropsis (Diplodia) shoot blight
Austrian pine	Dothistroma needlecast, Sphaeropsis (Diplodia) shoot blight
White pine	White pine blister rust

DISEASE DIAGNOSIS CHART

Pest and Host(s)	Symptoms	Time Present[1]	When to Treat[2]
Rhabdocline Needlecast	2-year-old needles yellowish brown to red-brown	March-May	Benomyl(Benlate)-Apply initially in early May. Repeat at 4 wk. intervals.
Douglas Fir	Shedding of 2-year-old needles	May-mid-July	Chlorothalonil or Copper Hydroxide - Apply at budbreak and repeat at 3-4 wk. intervals until needles are fully elongated & conditions no longer favor disease development.
	Fruiting bodies (pale orange) on 2-year-old needles	May-July	Chlorothalonil-Make one application in spring when the new shoot growth is 1/2-2 in. in length. Make additional applications at 3-4 wk. intervals until conditions no longer favor disease development.
	2-year-old needles with yellow spots	September-November	
Swiss Needlecast	Fuzzy black fruiting bodies in stomata of 1 and 2-year-old needles	April-June	Benomyl(Benlate) -Apply initially in early May. Repeat at 4 wk. intervals.
Douglas fir	Brown 2 and 3-year-old needles on lower branches	July-August	Chlorothalonil-Make one application in spring when the new shoot growth is 1/2-2 in. in length. Additional applications can be made at 3-4 wk. intervals depending on the product formulation and rate/A used in first application & environmental conditions. Mancozeb(Dithane)- Begin application in spring or early summer before infection occurs. Repeat after heavy rains and at 2 week intervals as long as needed.
	Fruiting bodies on current year's needles	September-October	
Lirula Needlecast	Scattered, buff-colored 1, 2 and 3-year-old needles. More common on lower branches.	May - October	NA[3]
Balsam fir	Infected needles may persist on twigs until the end of the 3rd growing season.		
	*In rare cases, a few current year's needles may be buff-colored.	July - December	
Rhizosphaera Needlecast	Fuzzy black fruiting bodies in stomata of 1 and 2-year-old needles	April-June	Chlorothalonil-Make first application in spring when new shoot growth is 1/2-2 in. in length. Make additional applications at 3-4 week intervals until conditions no longer favor disease development.
Blue and white spruce	Purplish-brown 2 and 3-year-old needles on lower branches	July-September	
	Fruiting bodies on current and 1-year-old needles	August-September	

Disease Diagnosis Chart (continued)

Pest and Host(s)	Symptoms	Time Present[1]	When to Treat[2]
Spruce Needle Rust Black, white, blue and Norway spruce	Whitish blisters filled with yellow spores on the underside of current year's needles Shedding of current year's needles	July-September August-early November	NA[3]
Lirula Needlecast Most common on Black Hills spruce but can be present on many species of spruce	1-year-old needles purplish-brown 2-year-old needles reddish-brown or brown with black spots and black lines. 3-year-old needles grayish-tan. Infected needles may persist on twig or be cast.	July-October June - December	NA[3]
Mycosphaerella (Scirrhia) Brown Spot Needlecast Scotch pine	1-year-old needles absent or falling off. These needles will be brown or green with reddish-brown spots. Most common on lower branches. Current year's needles brown or green with reddish-brown spots. Most common on lower branches.	May-July August-November	Mancozeb(Dithane) - Begin application in the spring or early summer before infection occurs. Repeat after heavy rains and at 2 wk. intervals as long as needed. Chlorothalonil or Chlorothalonil/ Triadimefon(Reach)- See directions for Rhizosphaera Needlecast
Lophodermium Needlecast Red and Scotch pine	Brown spots on 1-year-old needles 1-year-old needles turning brown. Most common on the bottom branches. 1-year-old needles defoliated on lower branches Black, football-shaped fruiting bodies on dead needles	March-April May-mid July June-August July - October	Mancozeb(Dithane)- See directions for Brown Spot Ferbam(Carbamate WDG)- Begin application in spring or early summer before infection occurs. Repeat after heavy rains and every 10-14 days Chlorothalonil or Chlorothalonil/ Triadimefon(Reach)- **Check below for instructions for North Central and Northeastern states.** Begin application in spring prior to budbreak. Repeat applications at approximately 6-8 wk. intervals, until spore release ceases in late fall. During drought periods, applications may be suspended, then resumed upon next occurrence of needle wetness. Chlorothalonil or Chlorothalonil/ Triadimefon(Reach)- **North Central and Northeast states**: Begin applications in mid-July to early August before infection occurs. Make additional applications until conditions no longer favor disease development.

Disease Diagnosis Chart (continued)

Pest and Host(s)	Symptoms	Time Present[1]	When to Treat[2]
Cyclaneusma Needlecast Scotch pine	Light green spots on 2 & 3-year-old needles. Yellow 2 & 3-year-old needles with dark bands. White waxy fruiting bodies on brown 2 and 3-year-old needles. Defoliation of 2 & 3-year-old needles anywhere on the tree.	September - October October - May	Chlorothalonil or Chlorothalonil/ Triadimefon(Reach)- Apply in spring prior to budbreak. Repeat applications at approximately 6-8 wk. intervals, until spore release ceases in late fall. During drought periods, applications may be suspended, then resumed upon next occurrence of needle wetness.
Dothistroma Needlecast Austrian pine	Current year's needles with dead needle tips and green bases	October-December	Copper(Tenn-Cop 5E)- Make 1st application as needles begin to emerge from needle sheaths and repeat 3-4 wks. later. Repeat monthly through September.
Pine Needle Rust Scotch and Red pine	Frosty-orange droplets on 1 & 2-year-old needles Orange blisters erupting from 1 & 2-year-old needles on lower branches	April-early June May-mid July	NA[3]
Gall Rust Scotch pine	Globe or spindle-shaped galls present on trunk or branches Galls erupt with whitish blisters and orange spores	Entire season April-mid June	Bayleton or Chlorothalonil/ Triadimefon(Reach)- Begin application when needles break through fascicle sheath. Make additional applications at 2-3 wk. intervals until the galls of previously infected trees become pale to white in color. Mancozeb(Dithane)- See directions for Brown Spot
White Pine Blister Rust White pine	Cream colored blisters Patches of brown bark with yellow borders. Spindle shaped swellings. Resin flow on trunk.	May-mid June Entire season	NA[3] CopperTenn-Cop 5E- Make 1st application when buds open & repeat at weekly intervals until the needles break through the needle sheaths.
Sphaeropsis (Diplodia) Shoot Blight Red, Scotch & Austrian pine	Curling of terminal and lateral shoots. Shoots not hollow.	May-August	Benomyl- Apply at bud break. Repeat 10-14 days later, just before needles emerge from sheath; repeat again in 10-14 days after needles emerge.
Cytospora Canker Spruces, occasionally fir and pine	Sunken areas on the branches or stems associated with heavy pitch flow	Entire season	NA[3]

[1] The information for the time of year symptoms occur is based on observations and research conducted in Minnesota, Michigan and Wisconsin.

[2] Products listed more than once have different recommendations for different formulations. Consult the pesticide table and product labels to determine which products are labeled for use at the times listed.

[3] No disease management product information available.

MAJOR INSECT PESTS

TREE SPECIES	PEST SPECIES
All conifers	Allegheny mound ant, aphids, bark beetles, grasshoppers, gypsy moth, mites.
All firs	Allegheny mound ant, aphids, bagworm, bark beetles, grasshoppers, gypsy moth, mites, pales weevil, spruce budworm.
Balsam fir	Allegheny mound ant, aphids, bagworm, balsam gall midge, grasshoppers, gypsy moth, mites, pales weevil, spruce budworm.
Douglas fir	Allegheny mound ant, aphids, bagworm, bark beetles, Cooley spruce gall adelgid, eastern pine shoot borer, grasshoppers, gypsy moth, mites, pales weevil, spruce budworm, white pine weevil.
Eastern red cedar	Aphids, mites, pine needle scale.
Fraser fir	Allegheny mound ant, aphids, bagworm, balsam gall midge, bark beetles, grasshoppers, gypsy moth, mites, pales weevil, spruce budworm.
Scotch pine	Adana tip moth, aphids, European pine shoot moth, European pine sawfly, introduced pine sawfly, mites, jack pine budworm, jack pine tip beetle, Nantucket pine tip moth, northern pine weevil, northern pitch twig moth, pine bark adelgid, pine chafer, pine needle midge, pine root collar weevil, pine shoot beetle, pine tortoise scale, pine thrips,redheaded pine sawfly, Zimmerman pine moth.
White pine	Aphids, European pine sawfly, introduced pine sawfly, northern pine weevil, mites, pine bark adelgid, pine chafer, pine needle midge, pine shoot beetle, Zimmerman pine moth.
Other pines (Austrian, Jack, Red)	Adana tip moth, aphids, European pine sawfly, European pine shoot moth, introduced pine sawfly, jack pine budworm, jack pine tip beetle, Nantucket pine tip moth, mites, northern pine weevil, northern pitch twig moth, pine chafer, pine bark adelgid, pine needle midge, pine root collar weevil, pine shoot beetle, pine thrips, pine tortoise scale, redheaded pine sawfly, Zimmerman pine moth.
All spruce	Aphids, eastern spruce gall adelgid, mites, pales weevil, spruce budworm, spruce needle miner.
Blue spruce	Aphids, Cooley spruce gall adelgid, eastern spruce gall adelgid, mites, pales weevil, spruce budworm, spruce needle miner.
Engleman spruce	Aphids, Cooley spruce gall adelgid, eastern spruce gall adelgid, mites, pales weevil, spruce budworm, spruce needle miner.
Norway spruce	Aphids, eastern spruce gall adelgid, mites, pales weevil, spruce budworm, spruce bud scale, spruce needle miner.
Sitka spruce	Aphids, Cooley spruce gall adelgid, eastern spruce gall adelgid, mites, pales weevil, spruce budworm, spruce needle miner.
White spruce	Aphids, eastern pine shoot borer, eastern spruce gall adelgid, mites, pales weevil, spruce budworm, spruce needle miner.

INSECT PEST IDENTIFICATION

INSECT	TREE SPECIES	SYMPTOMS	TIME PRESENT[1]	WHEN TO TREAT[1]
Adana Tip Moth	Austrian, Red and Scotch Pine	Stunted, dying or dead shoots	Larvae begin feeding in late April-early May	Spray in mid- to late April to control larvae at base as they hatch from eggs; repeat in May if needed.
Allegheny Mound Ant	All Conifers	Dead or dying tree	Spring to Fall	Treat mounds between April and October when activity is observed. For best results mix insecticide into upper 2-3 inches of mound just before rain.
Anomala Beetle (Pine Chafer)	All Pines	Scorched appearance, broken or brown needles, adults present		Late June to control feeding adults.
Aphids	All Conifers	Discolored foliage, honey-dew, sooty or glittering foliage	Spring-Summer	Variable, depending on species, weather and natural enemies. Monitor for a few days to determine if predators will control aphids.
Bagworm	All Firs and Spruces, Eastern White Pine	Defoliation, brown bags with needle particles, flagging	Larvae become active in late May	
Balsam Gall Midge	Balsam and Fraser Fir	Thin canopy, premature needle drop, small galls at base of needle		Spray when needles are roughly 1.5 inches long
Balsam Twig Aphid	All Firs, Spruces Juniper	Twisted, curled needles, honeydew and sooty mold		

Insect Pest Identification Table (continued)

INSECT	TREE SPECIES	SYMPTOMS	TIME PRESENT[1]	WHEN TO TREAT[1]
Bark Beetles	All Conifers	Galleries and tunnels under bark; boring dust or pitch tubes often seen on stem	Summer	
Cooley Spruce Gall Adelgid	White, Blue, Engleman and Sitka Spruce; Douglas Fir	Spruce: pineapple-shaped galls on tips of new shoots; Douglas-Fir: Yellow spots on bent needles and cottony balls on underside of needles		Early-late April or May and again in early Fall if needed
Eastern Pine Shoot Borer	Douglas Fir, all Pines; White Spruce	Dead or discolored shoots; terminal leaders clearly broken at base, exit hole on damaged shoots		Treat before young larvae bore into shoots, usually occurs in mid-May
Eastern Spruce Gall Adelgid	All Spruces	Small pineapple-shaped ball at base of new shoot		Treat in April when buds begin to swell; repeat in September after galls open if necessary
Eriophyid Mite	All Firs and Pines	Yellow, stippled needles; tips of needles may turn brown, twist and hook	Early April; overlapping generations throughout growing season	Spray in early May and repeat in 10 days
European Pine Shoot Moth	Pines-especially Scotch, Austrian and Red	Stunted shoots, usually dead before expansion; hard yellowish pitch mass over buds in mid- to late summer; caterpillar overwinters in buds, under pitch		Spray when newly hatched larvae are moving to new shoots; usually early to late April
Grasshopper	All Conifers	Ragged needles and scarred bark on twigs, branches or seedlings	Mid-Summer	Spray in August or September

Insect Pest Identification Table (continued)

INSECT	TREE SPECIES	SYMPTOMS	TIME PRESENT[1]	WHEN TO TREAT[1]
Gypsy Moth	All Conifers	Presence of egg masses is critical; defoliation causes ragged foliage		Bt can be used when caterpillars are 1 inch or less. Spray with registered insecticide before pupation. Consult Dept. of Agriculture for current regulations.
Introduced Pine Sawfly	See Pine Sawflies			
Jack Pine Budworm	Jack and Scotch Pine	Defoliation, dry clipped needles webbed to shoots		
Jack Pine Tip Beetle	Pines, particularly Scotch and Red Pines	Yellow or red shoot tips; small glob of pitch at base of damage	Injured tips can be found throughout summer	This insect is not known to cause economic damage and should not require treatment.
Nantucket Pine Tip Moth	Pines, particularly Austrian, Red and Scotch	Deformed shoot tips; dead or dying needles at end of shoots; mined	Spring to early summer	Treat in mid-May to mid-June to control young larvae. A second generation may require treatment in mid-July to late August.
Northern Pine Weevil	All Pines; sometimes Spruces	Flagging and browning of new shoots; small circular wounds at base of damage		Spray stumps in April. Use foliar spray to kill feeding adults in late April and late August-September
Northern Pitch Twig Moth	Pines, particularly Scotch	Small, hollow pitch blister in crotch of shoots	Blisters can be seen throughout the year	
Pales Weevil	Pines, particularly Scotch and Eastern White, Douglas-Fir; some Spruces	Flagging and browning of shoots; patches of exposed bark at base of dead shoots, often exuding pitch		Spray stumps in April. Use foliar spray to kill feeding adults in late April and late August-September

Insect Pest Identification Table (continued)

INSECT	TREE SPECIES	SYMPTOMS	TIME PRESENT[1]	WHEN TO TREAT[1]
Pine Bark Adelgid	Eastern White Pine and occasionally Scotch and Austrian Pine	Discolored, stunted or dying tree; clumps of white, wooly, waxy material on stem and large branches	Blue-green nymphs appear in early May	Spray in mid-April to mid-May when nymphs are active. Trees can also be sprayed in summer; 2-3 applications at 1 week intervals may be needed.
Pine Needle Midge	Pines, particularly Scotch and Red	Bending or drooping of needles; brown bent needles in upper canopy; loss of injured needles causing thin crowns; bright orange larvae feeding at base of needles		Treat in mid-May to early June.
Pine Needle Scale	All Pines, all Spruces and Douglas-Fir	White, elongated scales on needles; discolored needles with white "flecks"		Sprays only effective when crawlers are present. First generation crawlers usually coincide with lilac bloom.
Pine Root Collar Weevil	All Pines, particularly Scotch and Red	Foliage fades to yellow, then red; black pitch on root collar and surrounding soil; larval feeding galleries in root collar and large roots		Soak root collar area in early summer to kill adults and developing larvae.
Pine Sawflies	All Pines, particularly Scotch	Defoliation; dried tufts of skeletonized needles	Spring to late Summer	Varies depending on species and weather.
Pine Shoot Beetle	All Pines	Shoots with 3/16 inch circular holes; often with round glob of pitch; shoots bent and often brown above boring hole; boring dust or feeding galleries may be observed on recently cut trees, stumps, other brood material	Adults breed in February or March. Adults begin to shoot feed in early June and continue through October	Destroy brood material and trap logs by May 15; treat foliage in early June when new adults begin to shoot feed.

Insect Pest Identification Table (continued)

INSECT	TREE SPECIES	SYMPTOMS	TIME PRESENT[1]	WHEN TO TREAT[1]
Pine Tortoise Scale	All Pines, particularly Scotch, Red and Austrian	Reddish-brown helmet shaped scales on woody tissue; discolored needles; black sooty mold on needles		Spray trees when crawlers are active.
Redheaded Pine Sawfly	See Pine Sawflies			
Spider Mites	All Conifers	Stippled or yellow mottled needles; webbing and fine frass on needles; presence of dark colored mites	Early and later summer usually peak periods	Rap a branch over a white piece of paper to determine if mites are present. Two or three sprays at 7 to 10 day intervals may be needed if populations are high.
Spruce Bud Scale	Spruce and Balsam Fir	Red or dark globular "bumps" on twigs; honeydew and sooty mold on twigs and needles		Treat in July when crawlers are active.
Spruce Budworm	Spruce and Balsam Fir	Defoliated shoot tips; browning of clipped and webbed needles		Spray insecticide in May when larvae first appear. A second spray 7 to 10 days later may be needed if populations are high.
Spruce Needle Miner	All Spruces	Clusters of reddish-brown needles webbed together; needles hollow with tiny holes at the base		Spray in mid- to late July when larvae are hatching. Consider a second spray 10 to 14 days later.
White Grub	All Conifers, but particularly Pines	Dead or dying seedlines; fibrous roots absent on dead seedlings	Late Spring	Late Spring to early Summer when insects become active.
White Pine Weevil	Spruces, Pines and occasionally Douglas-Fir	Round feeding wounds and fresh tree pitch on terminal leader in early spring; terminal leader wilts and dies in mid-summer, forming a characteristic shepards' crook; top 2-3 years of growth may be killed each year		Spray early in Spring to kill adult weevils before oviposition.

Insect Pest Identification Table (continued)

INSECT	TREE SPECIES	SYMPTOMS	TIME PRESENT[1]	WHEN TO TREAT[1]
Zimmerman Pine Moth	All Pines, especially Scotch and Austrian; rarely Spruce and Douglas-Fir	Pitch mass on stem, at branch whorl or on shoots near terminal leader; dead, broken tops. Large globular pitch mass often mixed with reddish frass on stem or large branches; patches of dead foliage in canopy; broken tops		Spray stems and large branches in early to mid-April before larval activity begins.

[1] Information on timing is based on observations and research conducted in Michigan.

PESTICIDES REGISTERED FOR USE IN FOREST AND SEED ORCHARDS BY STATE

FUNGICIDES

Code: Y=Yes registered, NO=Not registered for use, SLN=Special Local Needs Label, SUP=Supplemental Label. A blank box indicates that registration status of the product was unknown at the time of publication. Consult state regulatory agency for more information.

Trade Name and Active Ingredient	IA	IL	IN	MI	MN	MO	WI
Acme Bordeaux Mixture (PBI/Gordon)	Y	Y	Y	Y	Y	Y	Y
Alamo (Ciba-Geigy)	Y	Y	Y	Y	Y	Y	Y
Blue Shield DF (Helena Chem Corp/Cuproquim Corp.)	NO	NO	Y	Y	Y	NO	NO
Bravo 720, Ultex, 90DG, & 500 (ISK Biosciences)	Y	Y	Y	Y	Y	Y	Y
Bravo W-75 (ISK Biosciences)	Y	Y	Y	Y	NO	Y	Y
Carbamate WDG (FMC)		Y	Y	Y	Y		Y
Daconil Ultrex, 2787 F, & 2787 WDG (Isk Biosciences)	Y	Y	Y	Y	Y	Y	Y
Echo 90DF (Sostram Corp)	Y	Y	Y	Y	Y	Y	Y
Echo 720 (Sostram)	NO	Y	Y	Y	Y	Y	Y
Evade Flowable (Platte Chem. Co)	NO	NO	NO	NO	Y	NO	Y
Kocide LF & Kocide 101 & Kocide DF (Griffin Corp)	Y	Y	Y	N	Y	Y	Y
Reach (Isk Biosciences)	NO	Y	Y	Y	NO	Y	Y
Subdue 2E (Ciba-Geigy)	Y	Y	Y	Y	Y	Y	Y
Syllit 65W (United Agri Products/Platte)	Y	Y	Y	Y	Y	Y	Y
Terranil 90DF & 6L (Riverside/Terra Corp.)	Y	Y	Y	Y	Y	Y	Y
Thalonil 90 DF, 90DF WSP & 4L (Riverside/Terra Corp.)	Y	Y	Y	Y	Y	NO	Y

INSECTICIDES

Trade Name and Active Ingredient	IA	IL	IN	MI	MN	MO	WI
Ambush (Zeneca)	Y	Y	Y	Y	Y	Y	Y
Asana XL (DuPont)				Y			Y
Astro (FMC Corp.)		Y	Y	Y	Y		Y
Azinphos-M 50 W (Gowan Co)	NO	Y	Y	Y	Y	Y	NO
Azinphos-M 50 WSB (Gowan Co)	Y	Y	Y	Y	Y	NO	Y
Azinphosmethyl 50W (Micro Flo Co)		Y	Y	Y	NO		NO
Carbaryl 4L (Drexel)		NO	Y	Y	Y		NO
Carbaryl 80S (Drexel)		NO	NO	NO	NO		NO
Clean Crop Carbaryl 50 WP & 4L (Platte Chem co.)	Y	Y	Y	Y	Y	Y	Y
Clean Crop Dimethoate 2.67 EC (Platte Chem. Co.)	Y	Y	Y	Y	Y	Y	Y
Clean Crop Malathion ULV Conc. Platte Chem. Co.	NO	Y	NO	Y	Y	Y	Y
Condor, (Ecogen)	Y	Y	Y	Y	Y	NO	NO
Dibrom 8 Emulsive (Valent USA Corp)	Y	Y	Y	Y	Y	Y	Y
Dimilin 4L (Uniroyal Chem)	Y	Y	Y	Y	Y	NO	Y
Dimilin 25W (Uniroyal Chem)	Y	Y	Y	Y	Y	Y	Y
DiPel 4L & 2X (Abbott Labs)	Y	Y	Y	Y	Y	Y	Y
Dipel 6AF* (Abbott Labs)	NO	Y	NO	Y	Y	NO	Y
Foray 48B Flowable Concentrate (Novo Nordisk)	Y	Y	Y	Y	Y	Y	Y
Foray 76B Flowable* Concentrate (Novo Nordisk)	NO	NO	NO	Y	NO	NO	Y
Furadan 4F (FMC Corp)		Y	Y	Y	Y		Y
Guthion 2L (Bayer Corp.)	NO	NO	NO	NO	NO	Y	NO
Guthion 2S (Bayer Corp.)	Y	Y	Y	Y	Y	Y	Y
Guthion 3F (Bayer Corp.)	Y	Y	Y	Y	Y	Y	Y
Guthion Solupak 50% WP (Bayer Corp.)	Y	Y	Y	Y	Y	Y	Y

Forest and Seed Orchard Insecticides - continued

Trade Name and Active Ingredient	IA	IL	IN	MI	MN	MO	WI
Imidan 50 WP, 70-WSB & 70 WP (Gowan)	Y	Y	Y	Y	Y	Y	Y
Imidan 50-WSB (Gowan)	NO	NO	NO	Y	Y	NO	NO
Mavrik (Sandoz Agro)	Y	Y	Y	Y	Y	Y	Y
Methoxychlor 2EC (Drexel)		NO	NO	NO	NO		NO
Methoxychlor 4L (Drexel)		NO	NO	NO	NO		NO
Methyl Parathion 4E (Drexel)		NO	NO	NO	NO		NO
Omite-CR (Uniroyal Chem. Co)	NO	Y	NO	Y	NO	NO	NO
Orthene 75WSP (Valent)	Y	Y	Y	Y	Y	Y	Y
Pentac Aquaflow (Sandoz Agro)	Y	Y	Y	Y	Y	Y	Y
Pounce 3.2 EC (FMC Corp.)		Y	Y	Y	Y		Y
Pounce 25 WP (FMC Corp.)		Y	Y	Y	Y		Y
Pounce WSB (FMC Corp.)		Y	Y	Y	Y		Y
Raptor (American Cyanamid Co.)	Y	Y	Y	Y	Y	Y	Y
Sevin 4-Oil ULV (Rhone-Poulenc)		NO	Y	Y	Y		Y
Sniper 50 PVA, (Platte Chem. Co.)	NO	NO	Y	Y	NO	NO	Y
Talstar 10 WP, (FMC)	NO	SLN	NO	SLN	NO	NO	NO
Talstar 10WP (FMC)	NO			Y		NO	NO
Thuricide 32LV (Sandoz Agro)	NO	NO	NO	Y	NO	NO	NO
Thuricide 48LV & 64V (Sandoz Agro)	NO	NO	NO	Y	NO	NO	Y

FOREST AND SEED ORCHARD PESTICIDES

Fungicides

Fungicide Trade Name and Active Ingredient	Signal Word	Diseases Controlled	Rate	Application Directions	Comments and Site Registration
Acme Bordeaux Mixture, Copper Sulfate and Lime (PBI/Gordon Corp.)	Danger	Anthracnose, leaf spot and elm leaf curl (Sycamore, linden, maple, oak, tulip tree, and elm). Twig blight (Yew). Cedar apple rust (Cedar). Needlecast (Blue spruce) and Sphaeropsis blight (Diplodia Pine). Coryneum blight (Cypress, juniper and arborvitae).	Mix 8 tbl of product/1 gal water (8-8-100). Mix 6 tbl of product/1 gal water (4-4-100).	Begin applications when leaves begin to unfold in the spring to protect the plant before infection begins. Spray for full coverage. Apply in early spring Apply during July-August Apply in spring and fall.	Registered on "Trees and Ornamentals"; other trees and ornamentals are listed.
Alamo, Propiconazole (Ciba-Geigy)	Warning	Oak wilt Dutch elm disease.	Use 6 ml Alamo/1 inch DBH in up to 1 L water (preventative). Increase to 10 ml for therapeutic treatment.	Inject into flare roots in sufficient water for distribution throughout the vascular system of the tree. Treat oak after June 15.	Registered for use on oak and elms. See label for details concerning tree preparation and measurements.
Blue Shield DF Cupric Hydroxide (Cuproquim Corp.)	Danger	Anthracose (Sycamore). Bacterial blight (Walnuts).	2 to 3 lb/100 gal. 8 to 12.5 lb/A.	Make 1st application at bud crack and 2nd application 7 to 14 days later at 10% leaf expansion. Make 1st application at early pre-bloom prior to or when catkins are partially expanded. Make additional applications during bloom and early nutlet stage or as needed.	Sycamore and Walnut not listed as ornamentals.

Fungicide Trade Name and Active Ingredient	Signal Word	Diseases Controlled	Rate	Application Directions	Comments and Site Registration
Bravo 90 DG and Daconil 2787 WDG, (ISK Biosciences) or Terranil 90DF and Thalonil 90 DF (Riverside/ Terra Corp.) or Echo 90DF (Sostram) A.I. Chlorothalonil	Danger	Swiss needlecast.	2.25 to 4.50 lb/A.	Single application technique: Make one application in the spring when new shoot growth is 1/2 to 2 inches in length.	Registered for use in conifer forest stands. Daconil 2787 WDG is not registered for single application method of Swiss needlecast.
		Scleroderris canker (pines) and Swiss needlecast (Douglas fir).	1.13 to 2.25 lb/A.	Make the first application in spring when new shoot growth is 1/2 to 2 inches in length. Make additional applications at 3 to 4 wk intervals until conditions no longer favor disease development.	
		Sirococcus tip blight.	1.75 to 3.0 lb/A.		
		Rhizosphaera needlecast (spruces), Scirrhia brown spot (pines)	4.5 lb/A.		
		Cyclaneusma and Lophodermium needlecasts (pines).	2.25 to 4.5 lb/A.	Apply in early spring prior to budbreak. Repeat applications at approximately 6 to 8 wk intervals, until spore release ceases in late fall. Apply monthly during periods of frequent rainfall. During drought periods, applications may be suspended, then resumed upon the next occurrence of needle wetness.	
		Rhabdocline needlecast (Douglas fir).	.13 to 2.25 lb/A.	Apply at budbreak and repeat at 3 to 4 wk intervals until needles are fully elongated and conditions no longer favor disease development. In plantations of mixed provenance, or when irregular budbreak occurs, apply weekly until all trees have broken bud, then every 3 to 4 wks as specified above.	
Bravo 500 and Daconil 2787 (ISK Biosciences) or	Warning	Swiss needlcast.	4 to 8 pt/A.	Single application technique: Make one application in the spring when new shoot growth is 1/2 to 2 inches in length.	Registered for use in conifer forest stands. Except, Thalonil 4L is registered on "Ornamentals and Conifers".

Fungicide Trade Name and Active Ingredient	Signal Word	Diseases Controlled	Rate	Application Directions	Comments and Site Registration
Bravo 500 (continued) Thalonil 4L (Riverside/Terra) or Evade Flowable, (Platte Chem. Co) A.I. Chlorothalonil		Scleroderris canker (pines), Swiss needlecast, and Rhabdocline needlecast.	2 to 4 pt/A.	Make the first application in spring when new shoot growth is 1/2 to 2 inches in length. Make additional applications at 3 to 4 wk intervals until conditions no longer favor disease development.	Rhabdocline needlecast (Douglas fir) is associated with these directions on Thalonil 4L and Evade Flowable labels. Rhabdocline needlecast is not on the Echo 500 label. See below for Rhabdocline needlcast instructions associated with Bravo 500 and Daconil 2787.
		Sirococcus tip blight.	3 to 5 pt.		
		Rhizosphaera needlecast (spruces), Scirrhia brown spot (pines).	8 pt.		
		Rhabdocline needlecast (Douglas fir).	2 to 4 pt/A.	Apply at budbreak and repeat at 3 to 4 wk intervals until needles are fully elongated and conditions no longer favor disease development. In plantations of mixed provenance, or when irregular budbreak occurs, apply weekly until all trees have broken bud, then every 3 to 4 wk as specified above.	Different directions on Thalonil 4L and Evade Flowable labels. These directions are for Bravo 500 and Daconil 2787 only.
		Cyclaneusma and Lophodermium needlecasts (pines).	4 to 8 pt/A.	Apply in early spring prior to budbreak. Repeat applications at approximately 6 to 8 wk intervals, until spore release ceases in late fall. Apply monthly during periods of frequent rainfall. During drought periods, application may be suspended, then resumed on the next occurence of needle wetness.	Cyclaneusma is not on Evade or Thalonil 4L labels. See separate instructions and rate for Lophodermium needlecast. Cyclaneusma and Lophodermium needlecasts not on Echo 500 label.
		Lophodermium needlecast	2 to 4 pt/A.	NC and NE states: begin applications in mid-July to early August before infection occurs. Make additional applications until conditions no longer favor disease development.	Only on Thalonil 4L and Evade Flowable labels.

Fungicide Trade Name and Active Ingredient	Signal Word	Diseases Controlled	Rate	Application Directions	Comments and Site Registration
Bravo 720, Bravo W-75 and Bravo Weather Stik (ISK Biosciences) or Terranil 6L (Riverside/Terra) or Echo 720 (Sostram) A.I. Chlorothalonil	Warning	Swiss needlecast.	2.75 to 5.5 pt/A.	Single application technique: make one application in spring when new shoot growth is 1/2 to 2 inches in length. Make first application in spring when new shoot growth is 1/2 to 2 inches in length. Make additional applications at 3 to 4 wk intervals until conditions no longer favor disease development.	Registered for use in conifer forest stands (except Thalonil 6L). Registered for use on Conifers. Forest stands mentioned in Swiss needlecast description.
		Scleroderris canker (pines) and Swiss needlecast.	1.5 to 2.75 pt/A.		
		Sirococcus tip blight.	2 to 3.5 pt/A.		
		Rhizosphaera needlecast (spruces), Scirrhia brown spot (pines).	5.5 pt/A.		
		Cyclaneusma and Lophodermium needlecasts (pines).	2.75 to 5.5 pt/A.	Apply in early spring prior to budbreak. Repeat applications at approximately 6 to 8 wk intervals, until spore release ceases in late fall. Apply monthly during periods of frequent rainfall. During drought periods application may be suspended, then resumed upon the next occurence of needle wetness.	Not on the Bravo W-75 label.
		Lophodermium needlecast.	1.5 to 2.75 lb.	NC and NE states: Begin applications in mid-July to early August before the infection occurs. Make additional applications at 3 to 4 wk intervals until conditions no longer favor disease development.	Only on Bravo W-75 label.
Bravo 720 (continued)		Rhabdocline needlecast (Douglas fir).	1.5 to 2.75 pt.	Apply at budbreak and repeat at 3 to 4 wk intervals until needles are fully elongated and conditions no longer favor disease development. In plantations of mixed provenance, or when irregular budbreak occurs, apply weekly until all trees have broken bud, then every 3 to 4 wk as specified above.	Not on Bravo W-75 label.

Fungicide Trade Name and Active Ingredient	Signal Word	Diseases Controlled	Rate	Application Directions	Comments and Site Registration
Bravo Ultrex and Daconil Ultrex, Chlorothalonil (Isk Biosciences)	Danger	Swiss Needlecast.	2.5 to 5.0 lb/A.	Single application technique: Make one application in the spring when new shoot growth is 1/2 to 2 inches in length.	Registered for use in conifer forest stands.
		Scleroderris canker (pines), Swiss needlecast.	1.25 to 2.5 lb/A.	Make the first application in spring when new shoot growth is 1/2 to 2 inches in length. Make additional applications at 3 to 4 wk intervals until the conditions no longer favor disease development.	
		Sirococcus tip blight	1.8 to 3.2 lb/A.		
		Rhizosphaera needlecast (spruces), Scirrhia brown spot (pines).	5.0 lb/A.		
		Cyclaneusma and Lophodermium needlecasts (pines).	2.5 to 5.0 lb/A.	Apply in early spring prior to budbreak. Repeat applications at approximately 6 to 8 wk intervals, until spore release ceases in late fall. During drought periods, applications may be suspended, then resumed on next occurrence of needle wetness.	
		Rhabdocline needlecast (Douglas Fir).	1.4 to 2.5 lb/A.	Apply at budbreak and repeat at 3 to 4 wk intervals until needles are fully elongated and conditions no longer favor disease development. In plantations of mixed provenance, or when irregular budbreak occurs, apply weekly until all trees have broken bud, then every 3 to 4 wk as specified above.	

Forest and Seed Orchard Pesticides - Fungicides (continued)

Fungicide Trade Name and Active Ingredient	Signal Word	Diseases Controlled	Rate	Application Directions	Comments and Site Registration
Carbamate WDG, Ferbam (FMC)	Caution	Spruce cone rust. Southern Cone Rust (*Cronartium stroblinum*)	2 lb/100 gal water Use 2 lb plus 4 to 8 oz of spreader sticker.	Apply 1 wk before and after pollination. Spray to run off. Begin at time of flowing when strobili are emerging from bud scales. Repeat at 5 day intervals until conelet stage. Direct spray to flower-bearing portions of tree crowns.	Spruce Slash and long leaf pine
Kocide LF, Kocide 101and Kocide DF, Copper Hydroxide (Griffin Corp)	Caution	Rhabdocline Needlecast (Douglas fir). Anthranose (Sycamore).	4 pt/A (Kocide LF) 2 lb/A (Kocide 101and Kocide DF). 4 to 6 pt/A (Kocide LF) 2 to 3 lb/A (Kocide 101and Kocide DF.	Begin applications at bud break and repeat at 3 to 4 wk intervals. See label for tank mix information. Apply as a full coverage spray in 100 gal water or sufficient volume. Make first application at bud crack, second application 7 to 10 days later at 10% leaf expansion.	Registered for use Miscellaneous - Douglas fir and Sycamore.
Reach, Chlorothalonil and Triadimefon (Isk Biosciences)	Danger	Stem gall rusts and fusiform rusts on pine. Also provides control of other pine diseases such as: Scleroderris canker, Sirococcus tip blight, Scirrhia brown spot, Cyclaneusma and Lophodermium needlecasts.	8 pt/A.	Apply in sufficient water to obtain uniform coverage. Begin application when needles break through fascicle sheath. Make additional applications at 2 to 3 wk intervals until galls of previously infected trees become pale to white in color. Refer to Bravo and Daconil 2787 for instructions concerning additional pine disease.	Registered for use on conifers. Maximum of 32 pt/A REACH may be used per growing season.
Subdue 2E, Metalaxyl (Ciba-Geigy)	Warning	Phytophthora root rot.	Apply 1.25 to 2.5 gal of product/A in a minimum of 50 gal of water.	Directed soil spray early in spring before growth starts and in the fall before the ground freezes. Do not apply as a foliar spray. Apply 0.5 to 1 inch of water after application if rain is not expected for 3 days.	Registered for use in "Conifers grown in nurseries and plantations including Christmas trees". Does not mention forests.
Syllit 65W, Dodine (United Agri. Products)	Danger	Anthracnose (Leaf Blight).	4 lb/A.	Apply when leaves first unfold. Repeat application at 10 to 14 d intervals.	

Forest and Seed Orchard Pesticides - Fungicides (continued)

Fungicide Trade Name and Active Ingredient	Signal Word	Diseases Controlled	Rate	Application Directions	Comments and Site Registration
Thalonil 90DF WSP, Chlorothalonil (Riverside/Terra)	See label.	Swiss needlecast.	0.25 to 0.5 acre/ one packet.	Same as Thalonil 90 DF.	Registered for use in conifer forest stands.
		Scleroderris canker (pines), and Swiss needlecast.	0.5 to 1 acre/one packet.	Same as Thalonil 90 DF.	
		Sirococcus tip blight.	2/5 to 3/4 A/one packet.		
		Rhizosphaera needlecast (spruces), Scirrhia brown spot (pines).	0.25 A/one packet.		
		Cyclaneusma and Lophodermium needlecasts (pines).	0.25 to 0.50 A/one packet.	Same as Thalonil 90 DF.	
		Rhabdocline needlecast (Douglas fir).	0.5 to 1 acre/one packet.	Same as Thalonil 90 DF.	

Insecticides

Insecticide	Signal Word	Registered for use on:	Insects Controlled	Amount	Time /method of Application	Comments
Ambush, Permethrin (Zeneca)	Warning Restricted	Pine seed orchards	Coneworms, Seed bugs.	13 fl oz/100 gal water for high volume sprayers. 68 fl oz/100 gals water for low volume sprayers.	Same as Pounce.	See label for webbing coneworm and aerial application rates.
Asana XL, Esfenvalerate (DuPont)	Warning, restricted	Conifer seed orchards	Nantucket pine tip moth, Balsam woolly adelgid, Balsam tip aphid, Redheaded pine sawfly, Pine conelet bug, European pine sawfly, Pine needle midge, Spruce budworm, as well as others. Pales Weevil Northern Pine Weevil. Coneworms, Seedbugs and Seed Chalid.	Use 5.8 to 9.6 fl oz product/100 gal (high volume sprayer). 5.8 to 9.6 fl oz product/100 gal (high volume sprayer). 9.6 fl oz/100 gal water (High volume sprayer).	Apply as needed to maintain control. Spray sufficient gallonage to obtain good coverage of entire trees. Spray stumps. Dilute in kerosene instead of water. See label for specific instuctions.	See label for aerial and low volumn sprayer rates.
Astro, Permethrin (FMC Corp.)	Caution	Pine Seed Orchards	Coneworms, Seed bugs, Nantucket Pine Tip Moth.	4 to 8 fl oz/100 gals or 4 to 8 fl oz/A (broadcast).	Same as Pounce. except make repeat applications every 5 to 7 days as needed.	Same as Pounce.
Azinphosmethyl 50W Agri. insecticide, Azinphos methyl (Micro Flo Co)	Danger Restricted	Ornamentals: Forest and Shade trees	Aphids, certain scales, lace bugs, leafhoppers, mites and thrips. Brown soft scale and putnam scale.	0.75 to 1 lb/A. 2 lb/A.	Spray all foliage surfaces including the undersides of leaves for complete coverage.	Apply in 100 gal water.

Forest and Seed Orchard Pesticides - Insecticides (continued)

Insecticide	Signal Word	Registered for use on:	Insects Controlled	Amount	Time /method of Application	Comments
Azinphosmethyl 50W Agri. insecticide (continued)			Black pine leaf scale, European elm scale.	1.5 to 2 lb/A.		
			Cone midge, cone moth.	4 to 8 lb/A.	Time application to coincide with moth flight when cones are open for poll.	
			European pine shoot moth and Nantucket pine tip moth.	0.75 to 1.5 lb/A.	Time application to coincide with moth flight	Apply in sufficient water for good coverage.
Carbaryl 80S, Carbaryl (Drexel)	Warning	Forest insect control	Gypsy moth, fall and spring cankerworm, saddled prominent, elm spanworm and forest tent caterpillar.	Use 1.25 lb/A.	Apply when larvae are in early instars. Use hydralic mist blower or aircraft.	Same as Carbaryl 50 WP.
Clean Crop Carbaryl 4L, (Platte Chem Co.) or Carbaryl 4L (Drexel)	Caution	Same as Carbaryl 50 WP.	Same as Carbaryl 50 WP. Plus the addition of elm bark beetle, Ips engraver beetle and others*.	Use 1 qt of product in water to obtain 100 gal of solution.	Same as Carbaryl 50 WP Scale control, also treat trunks, stems and twigs	Same as Carbaryl 50 WP.
Clean Crop Carbaryl 80 WDG, Carbaryl (Platte Chem Co.)	Warning			Use 1.25 lb of product in water to obtain 100 gal of solution.		

* See label for increased rate and separate application directions.

Insecticide	Signal Word	Registered for use on:	Insects Controlled	Amount	Time /method of Application	Comments
Clean Crop Carbaryl 50 WP, Carbaryl (Platte Chem co.)		Tree and Ornamental Insect Control: Forest	Elm leaf beetle, bagworms, Cooley and Eastern spruce gall, gypsy moth, canker-worms, spruce bud-worm, pine spittle-bug, pitch pine tip moth, sawflies and scale insects, others.	Use 2 lb product in 100 gal water/A for dilute spray. For concentrate-spray ground applications, use sufficient water for thorough coverage.	Apply dilute sprays to obtain thorough coverage of upper and lower leaf surfaces. For optimum worm control, treat when in early instars.	Addition of a sticker may improve residual control.
Clean Crop Dimethoate 2.67 EC, Dimethoate (Platte Chem. Co.)	Warning	Douglas Fir, (not listed as a Christmas tree or ornamental)	Fir cone midge.	Apply 0.75 gal in 100 gal water. Make thorough coverage applications when cones are closed and pendant.	Use hydraulic or back-pack sprayer.	Systemic
Clean Crop Malathion ULV Conc., Malathion Platte Chem. Co.	Caution	Douglas fir, true fir, Spruce Hemlock Pines Larch	Spruce budworm. Hemlock looper. European pine sawfly. Saratoga spittlebug. Larch casebearer.	13 fl oz/A. 8 fl oz/A. 10 fl oz/A. 8 fl oz/A.	Apply when highest % of larvae are 5th instar. Apply when most larvae are 3-4th instar. Apply when most larvae are 1-2nd instar. Apply when 95% of the population become adults. Apply in spring when larvae begin feeding on new foliage.	Registered for use on Forest Insects. Do not allow spray to contact ferns, hickory and maples as injury may result. Do not apply to stressed elm trees.
Condor, *Bacillus thuringiensis* subsp. *kurstaki* (Ecogen)	Warning	Forest	Gypsy moth, elm spanworm, spruce budworm, browntail moth, Douglas fir tussock moth, pine butterfly, bagworms, tent caterpillar, spring and fall cankerworm, fall webworm, as well as other pests.	Use 0.66 to 1.66 qt/A (ground and aerial application). When using hand-held equipment, use 2 tsp/1gal water or 1 qt/100 gal spray solution. Spray to wet, but not to runoff.	Similar to Foray 48B. For ground application use at least 20 gal water/A. For aerial application use at least 5 gal water/A.	Do not use in a tank mix with chlorothalonil based fungicides.

Insecticide	Signal Word	Registered for use on:	Insects Controlled	Amount	Time /method of Application	Comments
Dibrom 8 Emulsive, Naled (Valent USA Corp)	Danger	Forest and Shade use: conifers (pine, fir, Spruce etc.). Broadleaf trees (elm, black walnut, oak etc.).	Conifers: spruce budworm, aphids, Zimmerman moth, spittlebugs etc. Broadleaf trees: aphids, spring and fall cankerworm, etc.	1 pt/100 gal water/A.	Use when infestation is evident, repeat as necessary. Ground use only.	
Dimilin 4L and Dimilin 25W Insect growth regulator (Uniroyal Chem)	Caution	Forests and forest plantings (Dimilin 4L) and forest plantings . (Dimilin 25W).	Gypsy moth. Forest tent caterpillar. Nantucket pine tip moth. Tussock moth. Terminal weevils of pine and spruce (Pissodes sp., white pine weevil).	0.5 to 2 fl oz/A (Dimilin 4L) 1 to 4 oz/A (Dimilin 25W). 1 to 4 fl oz/A (Dimilin 4L) 2 to 8 oz/A (Dimilin 25W). 2 fl oz/A (Dimilin 4L) 4 oz/A (Dimilin 25W). 2 to 4 fl oz/A (Dimilin 4L) 4 to 8 oz/A (Dimilin 25W). 2 to 4 fl oz/A (Dimilin 4L) 4 to 8 oz/A (Dimilin 25W).	Early instar (1st-3rd) preferred, but prior to leaf expansion. Early instar or when 75% of pupal cases are empty. Early instar. Treat adults in spring as snow leaves.	Do not exceed 2 fl oz (Dimilin 4L) or 4 oz (Dimilin 25W) per acre per season for gypsy moth or Nantucket pine tip moth. Do not exceed 4 fl oz (Dimilin 4L) or 8 oz (Dimilin 25W) per acre per season for terminal weevil, forest tent caterpillar or tussock moth. See label for use in gypsy moth programs.
DiPel 4L and DiPel 2X *Bacillus thuringiensis* subsp. *kurstaki* (Abbott Labs)	Caution	Forests	Gypsy moth, spruce budworm. Bagworm, elm spanworm, tent caterpillars. Spring and fall cankerworm.	2 to 4 pt/A (4L) 0.5 to 1.5 lb/A (2X). 1 to 2 pt/A (4L) 0.5 to 1.5 lb/A (2X). 0.5 to 1 pt/A (4L) 0.5 to 1.5 lb/A (2X).	Rates are for aerial application. Use up to 10 gal water (Dipel 4L). Use in 1 to 5 gal water (DiPel 2X).	Many other insects listed on labels. See label for ground application rates.

Forest and Seed Orchard Pesticides - Insecticides (continued)

Insecticide	Signal Word	Registered for use on:	Insects Controlled	Amount	Time /method of Application	Comments
Dipel 6AF, *Bacillus thuringiensis* subsp. *kurstaki* (Abbott Labs)	Caution	Forests	Gypsy moth, Asian gypsy moth, eastern spruce budworm. Bagworm. Elm spanworm, Forest tent caterpillars. Eastern tent caterpillar. Spring and fall cankerworm.	21 to 128 oz/A. 21 to 43 oz/A. 21 to 64 oz/A. 43 to 64 oz/A. 21 to 64 oz/A (6AF)	Rates are for aerial application. Use up to 10 gal water. Treat when larvae are young and actively feeding. Use the higher label rate under heavy pest pressures.	Many other insects listed on label. * Dipel 6AF label has restrictions on the use of treated plants.
Foray 48B Flowable Concentrate and Foray 76B Flowable* Concentrate, *Bacillus thuringiensis* subsp. *kurstaki* (Novo Nordisk)	Caution	Forests. Foray 48B also registered for use in seed orchards	Gypsy moth and Asian Gypsy moth, Elm Spanworm. Spruce budworm, browntail moth, Douglas fir tussock moth, coneworm. Tussock moths, pine butterfly, bagworms, leafrollers, and tent caterpillar. Other pests listed. Redhumped caterpillars, spring and fall cankerworm, fall webworm.	1.3 to 6.7 pt/A (Foray 48B), 13.5 to 67.5 oz/A (Foray 76B). 1.3 to 5.0 pt/A (Foray 48B), 13.5 to 50.5 oz/A (Foray 76B). 1.2 to 7.0 pt/A (Foray 48B), 10.0 to 27.0 oz/A (Foray 76B). 0.7 to 1.3 pt/A (Foray 48B), 7.0 to 13.5 oz/A (Foray 76B).	Use higher rates on more advanced stages of larvae or when densities are high. After ingestion, larvae stop feeding within hours and die 2 to 5 days later. Best results are expected when applied to dry foliage.	Product contains both the spores and crystalline proteins produced by the *B.t.* bacterium.
Furadan 4F, Carbofuran (FMC Corp)	Danger Restricted	Pine seedlings in pine plantations	Pales weevil and pitch-eating weevil.	Add 1.6 oz of Furdan 4F to 0.5 gal water. Mix. Add 2 lb clay.	Apply slurry to roots of pine seedling prior to transplanting.	Treats the roots of 150-200 seedlings.

*Foray 76B label states restrictions on the use of treated plants.

Forest and Seed Orchard Pesticides - Insecticides (continued)

Insecticide	Signal Word	Registered for use on:	Insects Controlled	Amount	Time /method of Application	Comments
Guthion 2L or Guthion 2S or Guthion 3F or Guthion Solupak 50% WP (Bayer Corp.)	Danger Restricted	Southern pine seed orchards	Coneworm and Seedworm.	6 pt/100 gal water (Guthion 2L/2S). _____ 4 pt/100 gal water (Guthion 3F). _____ 4 lb/100 gal water (Guthion 3F).	Apply 1st application within 30d following conelet closure. Apply 3 to 5 more times at least 30 days apart. Use 5 to 10 gal solution /tree.	Directions are for high volume sprayer. See label for low volume spray directions. Apply no more than 6 applications/season (Guthion 2S).
Imidan 50- WSB and Imidan 50 WP, and Imidan 70 WSB and Imidan 70 WP Phosmet (Gowan)	Warning	Pine Seedlings (White, slash and loblolly)	Pales weevil (*Hylobius pales*) and pitch eating weevil (*Pachylobius picivorus*).	Use 67 lb/100 gal solution (Imidan 50 WP and Imidan 50 WSB). Use 48 lb/100 gal solution (Imidan 70 WP and Imidan 70 WSB).	Use as a 4% top dip, dipping down to and including root collar only. Swish in solution for 10-15 seconds.	5 gal solution should be enough to treat 10,000 seedlings.
Mavrik , Fluvalinate (Sandoz Agro)	Caution	Conifers, including Christmas trees	Insecticide and miticide. Aphids, thrips, mites, leaf-feeding caterpillars etc.	Apply 4.0 to 10.0 fl oz/100 gal water.	Use higher rates when pest pressures are heavy.	Avoid breathing spray mist. Certain persons are sensitive to Mavrik, see label for additional cautions.
Methoxychlor 2EC and Methoxychlor 4L (Drexel) ai. Methoxy-chlor	Caution	Forest trees	Gypsy moth, Eastern tent caterpillar, Elm leaf beetle, Japanese beetle, tussock moth, forest tent caterpillar, as well as others. _____ Elm bark beetle. _____ Elm leafhopper.	Use a 6% spray solution for mist blower. In conventional sprayer use 1 to 2 qt product/100 gal water (2EC) and 0.5 to 1 qt/100 gal water (4L). _____ 12% spray solution (mistblower) 2% spray solution (conventional sprayer). _____ 6% solution (convention sprayer). check label	 _____ Apply before elm flowers or leaves sprout. Repeat at 7 to 14 day intervals. _____ Apply when elm leaves are fully grown.	 _____ See label for repeat applications

Insecticide	Signal Word	Registered for use on:	Insects Controlled	Amount	Time /method of Application	Comments
Methyl Parathion 4E, Parathion (Drexel)	Danger Restricted	Pine Forests	Nantucket Pine tip moth, European pine shoot moth.	Apply 2 pt/A in 5 to 50 gal water.		
MVP, Delta endotoxin of *Bacillus thuringiensis* variety *kurstaki* (Mycogen Corp)	Caution	Forests, landscape trees, Nursery trees and Shrubs	Armyworms, fruittree leafroller, jack pine budworm, loopers, Mimosa webworm, omnivorous leafroller, pine butterfly, tent caterpillar, blackheaded budworm, Fall webworm, Tortrix.	Use 1 to 4 qt/A depending on infestation level. For mist blowers, mix specific amount in 10 gal water. See label for aerial and conventional ground application directions.	Target newly hatched larvae before they cause extensive damage and before larvae tunnel into plant.	Product must be ingested by target pests.
Omite-CR, Propargite (Uniroyal Chem. Co)	Danger	Conifers (plantation use)	Spider mites. Southern red mite	3 to 7.5 lb/A. 1 lb/A/100 gal water	100 gal spray solution/A (ground application) or 10 gal spray solution/A (aerial application). Spray to wet.	Higher or lower gallonage can be used. Total number sprays/yr is 3.
Orthene 75WSP, Acephate (Valent)	Caution	Fence rows	Grasshoppers.	5.25 oz/A. Apply in 1 to 5 gal water by air, or in 10 to 20 gal water (ground).	Apply early-mid season. Use higher volumes when spraying heavier foliage.	
Pentac Aquaflow, Decachlor bis (Sandoz Agro)	Warning	Conifers, including Christmas trees	Miticide against most phytophagous species including two-spotted, European red, and broad mites.	Apply 0.1 fl oz (2/3 tsp) per gal (0.75 ml per liter).	Mix well before spraying. Throughly wet both upper and lower leaf surfaces.	
Pounce 3.2 EC or Pounce 25 WP or Pounce WSB Permethrin ai. (FMC Corp.)	Caution Restricted Warning Restricted	Pine seed orchards	Coneworms, Seed bugs.	Use 8 fl oz /100 gal water (3.2 EC form). Use 13 fl oz/100 gal water (25 WP formulation). Use 2 bags/100 gal water (WSB formulation).	Make 1st application within 30 days of female flower closure. Repeat application at 4 wk intervals. Use 5 to 10 gal solution/tree. Rates for high volume sprayer.	See label for webbing coneworm. See label for low volume sprayer and aerial application rates.

Insecticide	Signal Word	Registered for use on:	Insects Controlled	Amount	Time /method of Application	Comments
Raptor, *Bacillus thuringiensis* subsp. *kurstaki* (American Cyanamid Co.)	Caution	Forests	Gypsy moth. Spruce budworm. Forest tent caterpillar. Elm spanworm Eastern tent caterpillars saddle prominent caterpillar, spring and fall cankerworm.	1.25 to 5.4 pt/A. 1.25 to 4.0 pt/A. 0.75 to 2.0 pt/A. 0.75 to 1.25 pt/A.	Use 0.5 to 10 gal water /A (aerial applications). Use 100 gal water/A for ground applications using a hydraulic sprayer, and 10 gal water/A for mist blowers.	Other insects are also listed on the label.
Sevin 4-Oil ULV, Carbaryl (Rhone-Poulenc)	Caution	Forest insect control	Gypsy moth, fall and spring cankerworm, saddled prominent, forest tent caterpillar, elm spanworm, oak leafroller complex and Japanese beetle. Spruce budworm. Douglas-fir tussock moth.	Use 1 qt/A. Use 0.5 to 1 qt/A. Use 2 qt/A.	Apply when larvae are in early instars and leaves at least 1/3 grown, or when Japanese beetles are present Apply when the majority of the larvae are 3rd-6th instars. Use when larvae 1st and 2nd instrars.	
Sniper 50 PVA, (Platte Chem. Co.) or Azinphos-M 50 W (Gowan Co) or Azinphos-M 50 WSB (Gowan Co) Azinphos methyl ai.	Danger Restricted	Southern Pine seed orchards	Coneworm, seed worm.	Use 4 lb/100 gal water. Rates for hydraulic type sprayer - full coverage spray.	Same as Pounce for coneworms	See label for low volume sprayer application rates.

Forest and Seed Orchard Pesticides - Insecticides (continued)

Insecticide	Signal Word	Registered for use on:	Insects Controlled	Amount	Time /method of Application	Comments
Talstar 10WP, Bifenthrin (FMC)	Warning	Pine Seed Orchard	Aphids, armyworm, bagworms, black vine weevil adults, brown soft scale, broad mite, fall webworm, flea beetle, lacebugs, leafhoppers, leaf-feeding caterpillars, loopers, pine needle scale crawlers, Pine tip moths, Plant bugs (including Lygus spp.), San Jose Scale crawlers, whiteflies as well as other insects.	6.4 to 32 oz Talstar 10 WP/100 gal water or acre	Bagworm control: Applications should be made in mid-late June when larvae hatch and are young. Spray the larvae directly. Scale crawlers and twig borers: treat trunks, stems and twigs in addition to plant foliage.	Special Local Needs use in some states. Do not exceed 0.5 lb ai/A/season (MI). Can also be applied as a concentrate in sufficient spray volume/acre to provide good coverage or by air. Do not apply by ground within 25 feet or by air with 75 ft of lakes, reservoirs and rivers etc. See label for details.
			Beet Armyworm, European red mite, spider mites, twig borers, thrips, and leafrollers.	9.6 to 32 oz. Talstar 10 WP/100 gal water or acre.		
			Japanese Beetle, Leafminers, Pear Psylla, Pecan leaf scorch mite.	16 to 32 oz. Talstar 10 WP/100 gal water or acre.		

Forest and Seed Orchard Pesticides - Insecticides (continued)

Insecticide	Signal Word	Registered for use on:	Insects Controlled	Amount	Time /method of Application	Comments
Thuricide 32LV and Thuricide 48LV and Thuricide 64LV *Bacillus thuringiensis* subsp. *kurstaki* ai. (Sandoz Agro)	Caution	Forest Pests	Gypsy moth.	32 to 160 oz/A (32LV), 22 to 106 oz/A (48LV) 16 to 80 oz/A (64LV).	Use 100 gal water/A for ground application using a hydraulic sprayer, and 10 gal water/A for mist blowers. Thuricide 32LV, aerial application, use at least 0.5 gal water /A. Thuricide 48LV and 64LV, aerial application, use alone or dilute with water. Use spray volumes of 32-128 oz/A.	Many other insects are also listed on the label. For specific timing see label. Apply to dry foliage.
			Spruce budworm.	24 to 160 oz/A (32LV), 16 to 106 oz/A (48LV) 12 to 80 oz/A (64LV).		
			Elm spanworm, Jack pine budworm, tent caterpillar, bagworms, sp. and fall canker-worm.	16 to 64 oz/A (32LV), 11 to 44 oz/A (48LV) 8 to 32 oz/A (64LV).		
			Fall webworm.	8 to 32 oz/A (32LV), 5 to 22 oz/A (48LV) 12 to 48 oz/A (64LV).		