Virginia Cooperative Extension Service

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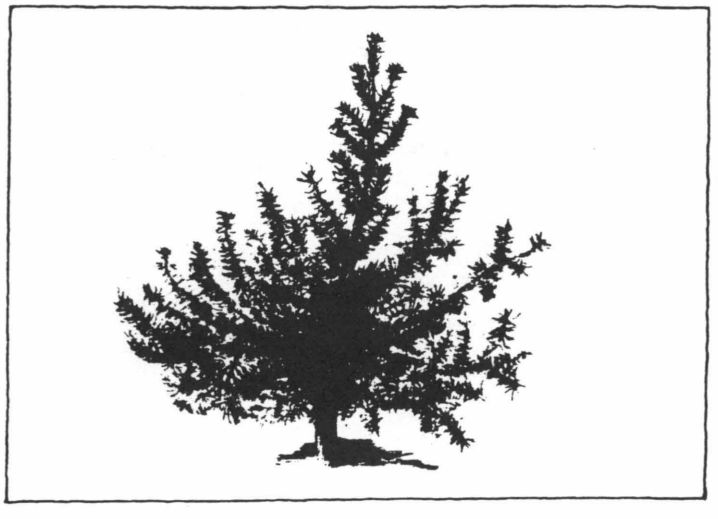
Pest Management Guide

for

Forest, Christmas Tree, Aquatic, Right-of-way and Non-Crop Areas



Virginia Tech and Virginia State - Virginia's Land Grant Universities

Produced by the Department of Entomology and the Department of Plant Pathology, Physiology and Weed Science, VA Tech. Coordinator: J. M. Luna, Department of Entomology

Keys to the Proper Use of Pesticides

1. Read the label on each pesticide container before each use. Follow the printed instructions to the letter; heed all cautions and warnings; note precautions about residues.

2. Store pesticides in the containers in which you bought them. Put them where children and animals cannot get to them -- preferably locked-up and away from food, feed, seed and other materials that may become harmful if contaminated.

3. Dispose of empty pesticide containers in the manner specified on their labels.

SEE YOUR DOCTOR IF SYMPTOMS OF ILLNESS OCCUR DURING OR AFTER USE OF PESTICIDES

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Virginia Cooperative Extension Service
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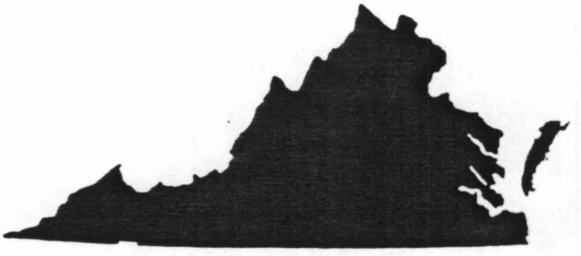
PEST MANAGEMENT GUIDES FOR VIRGINIA -- 1988-89



Contents:

Control Recommendations for Insects of Forest Trees

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In addition to the major pests of forest trees, there are many kinds of insects that live in forests without occurring in damaging numbers. However, a few may develop occasionally into serious local infestations. Since both major and occasional pests tend to be cyclic and often scattered, ongoing surveys and monitoring by trained foresters are an essential part of forest pest management. Early detection of pests is essential to prevention of economic losses due to serious outbreaks.

Sound forest management practices are basic to effective integrated pest management. Proper site selection, stand density control, stand and tree vigor, and proper sanitation are among the most important. Under poor management and inadequate protection practices, salvage operations may be the only recourse. Pesticide applications may be utilized for prevention of potential insect population buildup and suppression of outbreaks that threaten the vigor as well as survival of trees.

Technical assistance is available from the Virginia Division of Forestry, VDC&ED, and the U.S. Forest Service, as well as the Virginia Cooperative Extension Service. State and federal forestry agencies may provide control services on a cost-sharing basis as well as survey and detection programs in cooperation with public and private forest land owners. Control programs for new, introduced, or as yet not established pests such as gypsy moth are conducted by the Bureau of Plant Protection and Pesticide Regulation of the Virginia Department of Agriculture and Consumer Services with cooperation of the Animal and Plant Health Inspection Service and the Forest Service, USDA; and the Virginia Division of Forestry; and Virginia Cooperative Extension Service, VPI&SU.

INSECT	HOSTS	CONTROL	REMARKS
ADELGIDS			
balsam woolly adelgid	Fraser, balsam fir	lindane 20% EC, 3 qts./100 gal. or 6 Tblsp./3 gal. water Pydrin 2.4 EC, 1/3-2/3 teasp /gal. water	Spray bark and foliage to runoff. Treat in June or when found May to October. If infested plants are few and scattered, rogue and burn, and spray trees in a 20-foot diameter circle around rogued trees.
hemlock woolly adelgid	eastern hemlock	diazinon 48% EC 3 pts./100 gal. or 3 Tblsp./3 gal. water	Spray bark and especially twigs to runoff. Treat in mid-late June and/or in September.
APHIDS			
	various hardwoods	malathion 57% EC 1.5 pts./100 gal. or 1.5 Tblsp./3 gal. water diazinon 48% EC 1 pt/100 gal. or 1 Tblsp./3 gal. water	Thorough coverage of foliage for leaf-feeding aphids or twigs and branches for bark feeding aphids. Treat when aphids are first seen, May occur throughout season.
	various conifers	malathion 57% EC 1.5 10 gal. or 1.5 Tblsp./3 gal. water diazinon 48% EC 1 pt/100 gal. water of 1 Tblsp./3 gal. water dimethoate 23.4% EC 2 qts./100 gal. water or 4 Tblsp./3 gal. water	Thorough coverage of new shoots, twigs, and branches. Treat when first seen. May occur throughout season. Pydrin registered for balsam fir.
BARK BEETLES IPS engraver beetles, Southern pine beetle, Turpentine beetle	pines	For high value trees to prevent infestation, use lindane 20% EC at 1/2% (1 gal./40 gal. water) or Dursban 4E at 1% (2 2/3 fl. oz. per gal, water or 3.3 gal. in 40 gal. water) For infested trees, logs, tops, branches - use 1/4% (1 gal./85 gal. water) lindane or 1% Dursban applied before beetles begin to emerge.	In forest stands, salvage timber as soon as possible. On high value trees or where spraying slash is justified, thoroughly soak bark with spray. Do not allow spray to get into bodies of water or runoff into waterways. Dursban is only registered for use by certified applicators for southern pine beetle.

INSECT	HOSTS	CONTROL	REMARKS
CANKERWORMS	many hardwoods	acephate 75WP 1/3-2/3 lb/100 gal. water Bacillus thuringiensis WP or aqueous concentrate as directed on the label. carbaryl 4F 1 qt./100 gal. water; 80S 1-1/4 lb./100 gal. For aerial spray use 80S or 4-oil as directed on the label. methoxychlor 25%EC 2-3 qts./100 gal. water or as directed on the label for aerial sprays.	Apply treatment when egg hetch is complete and larvae are young, usually in early to mid-May. Do not allow spray or spray runoff to get into bodies of water or streams.
FALL WEBWORM	many hardwoods	carbaryl and Bacillus thuringiensis as for cankerworms. diazinon AG 50 3 pts./100 gal. water.	Treat first generation in mid-late June, and if necessary the second generation in mid to late August.
GYPSY MOTH	many hardwoods	At the present time, control measures are implemented by county, state, and federal agencies. acephate, B. thuringiensis, bendiocarb, methoxychlor, diflubenzuron, carbaryl and trichlorfon are registered for use.	Survey and detection programs, parasite releases, and inspection of regulated articles are in progress to slow the spread of gypsy moth. Local spraying operations may be implemented as needed.
PINE REPRODUCTION WEEVILS (pales weevil) (northern pine weevil)	pines	For stumps and slash: Use lindane 20% EC 1 gal./40 gal. water. --- For seedling: lindane 20% EC 2 qts./100 gal. water chlorpyrifos 41.2% EC as a 20% spray (1.75 gal./44 gal. water) phosmet 50% WP and carbofuran 4F can be used as seedling dips as directed on the labels, prior to planting.	Thoroughly soak stumps and ground surface 1-2 ft. around stumps, or slash prior to mid-March. Only stumps or wood cut since previous summer needs treatment. Apply as a full coverage spray to seedlings immediately after planting. Be sure to read and follow all label directions and precautions carefully.
SPIDER MITES spruce mite	conifers, especially spruces, hemlock, fraser fir in nurseries and plantations	dicofol 35% WP 1-1/3 lbs./100 gal. water 18.5% EC NOTE: Cygon, Omite, Pentac and Vendex are effective for mites if dicofol is not available.	Although mites are active through multiple generations during the entire growing season, most damage results from buildup in early spring and fall. Treat in early spring and fall. Treat in early May and/or mid-September for best results. Dormant oil sprays and dimethoate also control spider mites.

INSECT	HOSTS	CONTROL	REMARKS
TENT CATERPILLARS forest and Eastern ten caterpillars	many hardwoods	B. thuringiensis WP or aqueous concentrate as directed on the label for ground or aerial application. acephate 75 W as directed. carbaryl 80S, 4F, XLR, 4-oil, or 50WP as directed on the label for ground or aerial application. diazinon AG500 and methoxychlor 25% EC are labeled for eastern tent caterpillar. Trichlorfon in labeled for use against forest tent caterpillar.	Treat for easter tent caterpillar when foliage is 1/2-3/4 expanded from buds. br. Treat for forest tent caterpillar when first leaves are fully expanded. Forest tent caterpillars do not make webbed nests in crotches. Larvae have a row of keyhole-shaped white spots in each segment. Eastern tent caterpillar has a solid white line down its back.
WHITE PINE WEEVIL	eastern white pine, scots and red pine, occasionally, and norway and white spruce	lindane 20% EC 2 qts./100 gal. water of 4 Tblsp./3 gal. water Oxydemeton methyl as a 1% spray (follow label directions for mixing)	Treat when plantations show 5% or more weeviled tips. Applications must be made prior to adult egg-laying usually April 1. Treat only 1-1/2-2 ft. of the main terminal shoot, not the entire tree or laterals. A 4-gallon knapsack sprayer load will treat approximately 200 terminal shoots.
PINE TIP MOTH	2 and 3 needled pines only	dimethoate 2.67E 3 pts./100 gal. water or 23.4% EC 2 qts./100 gal. water trichlorfon 4E 2-3 pts./100 gal. water or 80S 1-1/4 lbs./100 gal. water --- carbofuran 15% G --- Pydrin 2.4 EC, 1/3-2/3 teasp./gal. water	Thoroughly wet all shoots in early to late-April and repeat 1-2 times at 6-week intervals. NOTE: Furadan 10G is registered for use only in Virginia. Label directions must be in possession of user when applied. Incorporate in soil at planting according to label directions.
PINE WEBWORM	white, scots, red pine	diazinon AG500 1 pt./100 gal. water	Treat in late July or early August when masses of webs and grass first become evident, where webworm has been a problem.
SAWFLIES	certain hardwoods and pines	carbaryl, diazinon malathion, Pydrin or dimethoate according to label directions as a ground or aerial application.	Virginia pine sawfly has one generation occurring in early spring prior to development of new growth. Red-headed pine sawfly can appear at any time during the growing season.

INSECT	HOSTS	CONTROL	REMARKS
SCALE INSECTS			
pine needle scale, pine toroise scale	pines, especially scots, Austrian in plantations as young trees	malathion 57% EC 2 qts./100 gal. water diazinon AG500 1 pt./100 gal. water. --- dormant oil 60 sec or 70 sec 1 gal./100 gal. water	Scale insects are primarily a problem in nurseries and young plantations. infestations are usually scattered and localized but may spread if not controlled. Treat for pine needle scale form mid to late May and/or mid to late July and pine tortoise scale in mid to late June. For oil sprays, treat in late spring prior to bud break and new growth. Do not use oil on spruces or douglas fir.

Abbreviations: E-emulsifiable; EC-emulsifiable concentrate; WP-wettable powder; F-flowable; S-sprayable; gal.-gallon; pt.-pint; lb.-pound; Tsp.-teaspoon; Tblsp.-tablespoon.

Precautions: Carbaryl is highly toxic to honeybees. Do not allow any insecticides as sprays, drift, or runoff to contaminate bodies of water, streams, or drainage systems. Follow precautionary instructions on labels and use protective equipment wherever specified.

Equivalents: 1 lb. WP per 100 gals. = 1 Tablespoon per gal.; 1 pt. EC per 10 gals. = 1 teaspoon per gal.

Cross Reference to Pesticide Names

COMMON NAME	SIGNAL WORD	TRADE OR BRAND NAMES
Bacillus thuringiensis	non-toxic	Dipel, Thuricide, Bactospeine
bendiocarb	warning	Turcam
carbaryl	caution	Sevin
carbofuran	poison	Furadan
chlorpyrifos	warning	Dursban
diazinon	warning	DZN, Spectracide
dicofol	caution	Kelthane
dimethoate	warning	Defend, Cygon
dormant oil	caution	Scalecide, Voick, Superior
lindane	warning	-
malathion	caution	Cythion
methidathion	danger	Supracide
oxydemeton-methyl	danger	Metasystox-R
phosmet	warning	Imidan
trichlorfon	warning/caution	Dylox

Diseases of Forest Trees

Samuel A. Alexander, Extension Plant Pathologist

Chemical control of forest tree diseases has only limited application due primarily to unfavorable cost-benefit rations. In the forest situation, disease control is based on the application of selected biological and management techniques. However, for Christmas trees and nurseries, chemical control of diseases can be both effective and economical. Additional information on nonchemical control measures, causes and symptoms of forest diseases may be found in Virginia Extension Division forest tree disease leaflets.

CROP and Disease Controlled	Chemical and Formulation; Rate; Method	Remarks
OAK, All Species		
Oak Wilt (Ceratocystis fagacearum)	Vapam	2.0 qt per 100 sq. ft. in sufficient water to penetrate the depth of the root system.
PINE, All Species		
Needle Cast (several fungi)	Bordeaux mixture: 8.0 lb copper sulfate, 8.0 lb hydrated lime in 100.0 gal water; spray to run off	Apply when needles are one-half and fully developed in spring. Two weed intervals during heavy rains.
	Daconil 2787; 3.5 pt/100.0 gal water hydraulic spray	
	8.5 pt/100.0 gal water high pressure mist sprayers; spray to run off	
Brown Spot (Scirrhia accicola)	Daconil 1787; 8.5 pt/100.0 gal water for high-pressure mist sprayers; spray to run-off	Apply when needles are one-half developed in spring. In severely infected plantations or during an unusually wet year, a second spray should be applied 3-4 weeks earlier.
Diplodia Tip Blight (Diplodia pinea)	Bordeaux mixture; 8.0 lb copper sulfate, 8.0 lb hydrated lime in 100.0 gal water; spray to run-off	Apply first spray at bud swell, and a second application about 10 days later (candle stage).
PINE, Scotch		
Atropellis Twig Canker (Atropellis tingens)	None	Eradicate all twig cankers; remove cankers for lightly infected branches and burn the infected material at the earliest opportunity.
Eastern Gall Rust (Cronartium quercum f. sp. cerebrum) Pine-Pine Gall Rust (Endocronatium harkness)	None	Eradicate all heavily infected trees; remove galls for lightly infected branches; eradication and gall removal should be completed prior to the next spring.
Scleroderris Canker (Gremmeniella abletina)	Daconil 2787; 4.25 pt/100.0 gal water for hydraulic sprayers	Begin spray application in the spring when new growth appears, repeat at 2-3 week intervals until early July, continue at 4 week intervals until early September.
	8.5 pt/100.0 gal water for high pressure mist sprayers; spray to run-off	
PINE, White		
Air Pollution Injury	Fertilizer 25-9-9; 1 cup for tree < 3 ft, 2 cups for tree 3-5 ft, 3 cups of tree > 5 ft; ground application	Evenly apply to ground surface around drip-line of tree.
PINE, White, Scotch, and Loblolly		
White Pine Root Disease (Verticicladiella procera)	None	Remove infected trees and burn. Insect control is important. Avoid root injury in seed orchards. Replant infected area with other tree species when possible in Christmas tree plantations.

Weed Control in Forest Trees

W.E. Chappell, Professor Emeritus of Weed Science

Problem and Application Technique	Chemical and Application Rate	Remarks
A. TREES (Over 3 inches diameter) Frill treatment	2,4-D (ester) 16.0 lb/100.0 gal oil	Apply to overflowing in ax trills about waist high that completely girdle the tree. Use on all species any time of the year except maple when dormant. Thoroughly clean all equipment exposed to AMS as it is very
	AMS (solution) 8.0 lb/2.0 gal of water, spring or early summer	
	dicamba (Banvel CST) at 1 ml/cut	Do not apply in areas where the possible downward movement of dicamba or picloram may come in contact with the roots of desirable plants.
	picloram (Tordon RTU) as directed on label	
	Banvel 4WS diluted 1:4 with water at 1 ml/cut	
Spaced frill treatment	2,4-D (amine) 1 ml from 4.0 lb gal in each cut	2,4-D is more effective May to August on all species. Picloram + 2,4-D or dicamba effective on all species except maple when dormant. DO NOT APPLY PICLORAM OR DICAMBA NEAR DESIRED SPECIES OR ALLOW THEM TO CONTAMINATE WATER USED FOR IRRIGATION OR OTHER DOMESTIC PURPOSES.
	picloram + 2,4-D (Tordon RTU) at 1 ml/cut	
	dicamba (Banvel CST) at 1 ml/cut	
	Banvel 4WS diluted 1:4 with water at 1 ml/cut	
Frill treatment with notches	AMS (dry crystal) 1 tablespoon (95% active per notch)	The dry crystals can be placed directly in notches spaced 4 to 6 inches around base of tree. Notches are made by two downward ax cuts, one above the other, prying out the chip. Use on all species any time of the year.
	Glyphosate (Accord) 25-50% Solution plus Cide-kick	Hack and squirt or special injection tool.
Spaced injector treatment	2,4-D (amine) 1 ml from 4.0 lb/gal ai/cut	Use a special tree injector calibrated to deliver 1 ml per cut. Space cuts 2 inches apart (edge to edge) at base of tree. Cuts MUST penetrate the bark and sapwood. DO NOT ALLOW PICLORAM OR DICAMBA TO CONTAMINATE WATER USED FOR IRRIGATION OR OTHER DOMESTIC PURPOSES.
	picloram + 2,4-D (Tordon RTU) 1 ml/cut	
	dicamba (Banvel CST) at 1 ml/cut Banvel 4WS diluted 1:4 with water at 1 ml/cut	
	2,4-D (ester) 4.0 lb ai/100 gal, oil	Apply to overflowing in overlapping cuts made with a special tree injector. Use on all species any time of year.
B. ALL WOODY SPECIES IN FUTURE PLANTING SITES (Site Preparation)	triclopyr amine (Garlon 3A) 2.0-3.0 gal in 10.0-30.0 gal of water/A	Apply aerially in June or July. Add 1/2% cide kick if permitted, burn in late fall or winter to eliminate debris. DO NOT PLANT CONIFER SEEDLINGS IN AREAS TREATED WITH TRICLOPYR LESS THAN 6 MONTHS AFTER TREATMENT.
	triclopyr ester (Garlon 4) 1.0-2.0 gal in 10.0-30.0 gal of water/A	
	triclopyr 1.0 gal + 2,4-D 2.0 gal	
	Garlon 3A 1.0 gal + picloram 1.0 gal	
	glyphosate (Accord) 3-5 qt plus Imazapex (Arsenel) 8-16 oz/A	Apply aerially or by ground methods in mid to late summer. Do not apply near crops or water supplies. Observe all label. Add 1/2% cide kick or other wetting agent.

Problem and Application Technique	Chemical and Application Rate	Remarks
C. PINE RELEASE	glyphosate (Accord) (1.5-2.0 qt)/A	Apply aerially or by ground methods in late summer after new growth on conifers has hardened off.
	hexazinone (Velpar L) 4.0-8.0 pt/acre in 5.0-15.0 gal of water Pronone 10G or Buckshot 10PH)	Apply 1-10 lb per acre as directed on label.
	Imazapex (Accord)	Check label. Use cide kick to 1/2% soln.
	sulfomenturon methyl (Oust) 3.0-8.0 oz	Loblolly and Virginia pine - apply aerially in 5-10 gal of water per acre or conventional ground spray.
	tryclopyr (Garlon 4) 1.5-3 qts	White Pine only. Apply areially 7.5 gal water/A
Stump treatment	2,4-D + 2,4-DP (Weedone 170) 3.0-4.0 gal/100.0 gal oil	Spray to wet thoroughly the cut surface at the junction of the wood and bark, sides, root collar and exposed roots of stumps. Applications should be made soon after cutting.
	picloram + 2,4-D (Tordon 101R)	Spray to wet the cut surface, especially the cambium area. DO NOT USE PICLORAM OR DICAMBA NEAR DESIRED SPECIES OR ALLOW EITHER TO CONTAMINATE WATER USED FOR IRRIGATION OR OTHER DOMESTIC PURPOSES.
	dicamba (Banvel CST) undiluted	Apply to stumps soon after cutting in water.
	Banvel 4WS diluted in water 1:4	
Stem treatment	tryclopyr (Garlon 4 or 3A) 1-6%	
Basal, thin line or streamline Basal	tryclopyr (Garlon 4) 20% diesel oil 70% Cide Kick II 10%	Apply one side of stems under 3 inches and both sides over 3 inches with knapsack in dormant season as directed spray to 18n
Selective Sprays	Glyphosate (Accord CR) 8-10%	Apply as directed. Spray to undesired species with knapsacks.
Herbaceous Weeds	Glyphosate (Accord CR) 16 oz plus 2-4oz A. Sulfomenturon (Oust)	Apply as directed spray in water.

NOTE: Always consult the product label before use of any herbicide. Some herbicides require the use of a spray adjuvant or a surfactant. The use of a high quality product in these instances will more readily insure good control. Most herbicide labels will suggest a product(s) when required. Spray additives such as Lo-Drift or Nalco-Trol may be needed at times to reduce spray drift.

Insect Pests of Christmas Trees

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Early detection and accurate identification of insect pests is the key to prevention of serious damage and loss in Christmas tree plantations. Effective control depends on the timely and thorough application of recommended control measures. Growers should be knowledgeable about the more common, injurious insects and mites - their recognition, host plants, damage, seasonal development, and habits. Control measures applied improperly or not in accordance with label directions not only are ineffective and a waste of time, materials, and labor, but may constitute a misuse of pesticides.

Amounts of pesticide to use in preparing sprays or applying treatment are specified in this control guide. Even so, they should be determined from the label on the container of the pesticide at the time of application. Be sure to read ALL of the directions and precautions on the label before and at the time of application of each treatment. Use ONLY the recommended amounts of the formulation.

Major Insects and Mites Infesting Christmas Trees

Insects and mites vary in their host preferences and their severity on different hosts. The following list of pests associated with each type of tree is an aid in identifying potentially damaging species. The pests are listed in order of importance and occurrence generally. Most insects and the spruce mite tend to be localized on scattered trees rather than uniformly distributed through plantations.

BALSAM FIR
- balsam woolly adelgid

BLUE (AND SITKA) SPRUCE
- cooley spruce gall adelgid
- spruce mite
- white pine weevil
- sawflies

DOUGLAS FIR
- cooley spruce gall adelgid
- spruce mite
- white pine weevil

EASTERN WHITE PINE
- white pine weevil
- pales weevil
- white pine aphid
- pine bark adelgid
- sawflies
- bagworm
- pine needle scale
- pine webworm

FRASER FIR
- balsam woolly adelgid
- aphids
- spruce mite

NORWAY SPRUCE
- spruce mite
- white pine weevil
- eastern spruce gall adelgid
- aphids
- pine needle scale
- sawflies

RED PINE
- pine tip moth
- sawflies
- pine root collar weevil
- northern pine weevil
- pine webworm

SCOTS PINE
- pine tip moth
- pine needle scale
- pine tortoise scale
- pine bark adelgid
- sawflies
- pales weevil
- pine webworm
- aphids
- spittlebug

VIRGINIA PINE
- Virginia Pine sawfly
- pine tip moth
- pales weevil
- pine webworm

WHITE FIR
- aphids

WHITE SPRUCE
- spruce mite
- white pine weevil
- sawflies

Pest	Where and When to Apply Control	Control	Remarks
ADELGIDS			
balsam woolly adelgid	Swollen or gouty twigs and crotches indicate infested trees. Adelgids are present and lay eggs during June and in the fall. Egg-laying is indicated by production of white cottony masses by adults. Treatments should be applied prior to egg-laying on symptomatic and nearby trees.	lindane (6 tblsp/3 gal. water)	Treat in June or when found from May to September.
pine bark adelgid	White cottony masses on bark of trunk, branches, and at bases of needles. Overlapping generations occur during the spring and fall. Dormant oil treatments should be applied in March. Other insecticides should be applied 2-3 times at 10-day intervals beginning in late April or May.	diazinon or malathion or lindane, or endosulfan Also, petroleum oil as dormant spray.	Strong spray streams are helpful in washing off the aphids and cottony masses. For a few infested trees, hosing clean with water alone may be effective.

Pest	Where and When to Apply Control	Control	Remarks
spruce gall adelgids	On douglas fir, white cottony patches occur on yellowed spots in the needles. No galls are produced. On blue spruce, pineapple-shaped galls are formed terminally on twigs. On Norway spruce, galls form at the bases of twigs. Spray the entire tree prior to April 1 on the production of cottony masses on the production of cottony masses on the needles or at the bases of the new buds. Sprays can also be applied in September or October.	diazinon or malathion or lindane or carbaryl	Cooley spruce gall adelgids occurs in Virginia on douglas fir. Cooley and eastern spruce gall aphids are rare on spruces in the State.
APHIDS (general) White pine aphid, balsam twig aphid, spruce aphids	Small winged or non-winged aphids may occur on twigs and/or needles throughout the season, especially in the spring and in fall.	diazinon or acephate or malathion or oxydemetonmethyl (Metasystox-R=MSR) or dimethoate (DeFend, Cygon) or endosulfan (Thiodan)	Continual surveillance of plants is necessary since aphids fly about to reinfest plants throughout the season. Re-entry time for fields treated with MSR is 48 hours.
BAGWORMS	Overwintering eggs inside "bags" on plants hatch in late May or early June. Use insecticide sprays during June with one application. Not effective in late season when larvae are larger.	acephate or B. thuringiensis or diazinon or malathion or carbaryl or dimethoate (Cygon)	Sprays applied later may help reduce the infestation, but will give poor control.
	From July until early May, "bags" may be removed and burned where light infestations involve relatively few trees.	remove and burn bags with larvae or eggs.	Bags dropped on the ground can result in egg hatch and infestation.
PALES WEEVIL and NORTHERN PINE WEEVIL	Adults move to freshly cut stumps, logs, slash beginning in March or April into early summer. Larvae feed on the bark of the stump, roots, logs, and slash until the following spring.	lindane (1 gal. 20% EC/40 gal. water)	Treat stumps after trees are cut in late fall or before mid-March the following spring.
	Adults emerge in late spring and early summer and feed on tree bark of newly planted seedlings and lateral branches of healthy trees. Before planting, new trees should be dipped down to and including the root collar only. Keep bundles loose enough to allow thorough penetration of the bundles.	phosmet (imidan)	Dip and swish bundles for 10-15 seconds, drain and allow to dry before planting. Wear rubber gloves during treatment and planting. An extender such as Nu-Film or plantgard may extend may extend the residue longer on the plants.
	Apply treatment as full-coverage foliar spray immediately after planting. Thoroughly wet seedlings to the point of runoff. Use a 2% spray (5 1/3 fl. oz, per gal. of water)	chlorpyrifos (Dursban)	Do not use in excess of 6 gallons per acre. Read precautions carefully - toxic to fish, birds, and other wildlife and highly toxic to bees.
	Apply 4 Flowable-clay slurry to roots of seeds prior to transplanting, using kaolin clay. (See label for directions to prepare slurry)	carbofuran (Furadan)	Thoroughly coat the roots and keep moist until transplanted. Furadan is extremely toxic. Follow all precautions.
	at transplanting, apply 10% Granules in a 6 inch radius on the soil around each seedling. Cover granules with soil.	carbofuran (Furadan)	Do not use at planting if seedlings were treated with Furadan 4F or imidan. Use 1 tsp. per seedling.
PINE TIP MOTH	Three overlapping generations occur during the season. Adults begin laying eggs in late-April. Eggs are laid on twigs and needles and larvae bore first into needles and then new shoots.	dimethoate (Cygon)	Spray entire tree to runoff. This spray is systemic and is trans-located from foliage to new growth. Treat in mid-late April and again in late May to early June, and in mid-August if populations remain high.

Pest	Where and When to Apply Control	Control	Remarks
PINE TIP MOTH (continued)	NOTE: This is a special State registration; supplemental labeling must accompany the regular label when in use.	carbofuran	Apply to soil beneath the trees and incorporate with a suitable device. Apply 10G twice annually, once in early spring and again in mid-summer. Use 1/2 tsp. for each year of the age of trees (4 yr. old tree = 4 tsp).
PINE WEBWORM	Larvae feed on foliage and construct a web of silk and grass that is usually evident to the stem after most damage has been done and larvae have dropped to the ground of pupate. Spray should be applied when webs are just beginning to form. The timing for this occasional pest is not well known, but may start in late July or early August.	diazinon	There have been reports of larvae and webbing in June, indicating a possible early generation. Spray the foliage thoroughly.
SAWFLIES	Eggs may be laid on the needles or inserted into the needles. Virginia pine sawfly has one generation each year in early spring; spray in mid-to-late April. Red-headed pine sawflies and other species may occur at various times in the season; spray when seen, but when larvae are small.	malathion or carbaryl (Sevin) or methoxychlor	Sawflies are usually spotty; colonies infest branches or individual trees, here and there, unpredictably. Regular checking of trees for evidence of young, small sawflies is important. Spot treatments of infestations is usually sufficient.
SCALE INSECTS	Pine needle scale - overwintering eggs hatch from mid-to-late May. Eggs of the summer generation hatch in late July. Sprays should be applied after most crawlers have emerged (May 20-25, July 20-25).	malathion or carbaryl or diazinon or oxydemeton methyl (Metasystox R) or methidathion (Supracide)	Thorough applications of full coverage sprays are essential. Re-entry time for fields treated with MSR is 48 hours.
	overwintering eggs beneath females on needles	dormant oil and ethion	Do not spray oil on spruces or douglas fir
	Pine tortoise scale - immature females overwinter and eggs are laid in June. Crawler activity is at a peak in mid to late June. Treat June 20-25.	malathion or diazinon or carbaryl or Methidathion (Supracide)	Wet the bark of twigs and branches thoroughly.
	Overwintering immature females on twigs and branches.	dormant oil or dormant oil and ethion	Do not spray oil on spruces or douglas fir. Be sure to wet the bark thoroughly on twigs and branches.
SPRUCE MITE	Chlorotic stipling of the foliage, often associated with webbing, occurs on the needles. Treat during late April or early May, and/or in September and early October. Sprays during mid-summer may not be as effective	dicofol (Kelthane) Note: Cygon, Omite, Pentac and Vendex are effective miticidals if difocal is not available	Mites can build up rapidly and are cool weather pests. Do not wait until damage is severe to apply control.
WHITE PINE WEEVIL	Adult weevils emerge in the spring after periods of temperatures in the 70's. They attack only the upright terminals. Treat only the main leader down to the first whorl. Thorough coverage of all the bark is essential. Treat prior to April 10.	lindane (4T in 3 gals.) oxydemeton methyl (Metasystox-R)	Addition of a spreader-sticker is suggested. Apply 1% spray (see label). Wear protective clothing and a respirator. Do not aircraft. Re-entry time for fields treated with MSR is 48 hours.

Reference Guide to Pesticides Recommended

COMMON NAME AND TRADE NAME	LD_{50} (Mg/kg) Oral	Dermal	TYPE	CHEMICAL NAME	FORMULATIONS	AMOUNT TO USE 100 gal	3 gal
acephate	945	10,250	OP	O,S-Dimethyl acetyl-phosphoramidothioate	75% SP	1/3 lb	1 T.
B. thuringiensis Dipel 6L	exempt		B		2.6% SP	2/3-1 1/3 pt.	2/3-1 1/3 T
4L	exempt		B		1.76%	1 to 2 pts.	1-2 T
Thuricide 48 LV	exempt		B		2.4%	11-22 oz.	2 1/4-4 to 4 3/4
32 LV	exempt		B		1.6%	16-32 oz.	3-6 T
carbaryl (Sevin)	850	4000	C	1-napthyl n-methyl-carbamate	50% WP	2 lb	6 T.
					80% SP	1 1/4 lb.	3 3/4 T.
					SL	1 qt.	3 T.
carbofuran (Furadan)	5	6900	C	2, 3-dihydro-2, 2-dimethyl-7-benzofurayl methylcarbamate	4F 10 G	See pales weevil and pine tip moth	
chlorpyrifos (Dursban)	163	2000	OP	O,O-diethyl 0-(3,5,6-trichloro 2-pyridyl) phosphorothioate	41.2% EC	See pales weevil	
diazinon (DZN) (Spectracide)	400	900	OP	O,O-Diethyl 0-(2-iso-propyl-4-methyl-6 pyrimidinyl) phos-phorothioate	50% WP	1 lb.	3 T.
					AG 500, 4E (48 EC)	1 pt.	1 T.
					Spectracide 25.0 EC	1 qt.	2 T.
dicofol (Kelthane)	1100	1230	CH	1,1-Bis (chlorophenyl) 2,2,2-trichloroethanol	35% WP	1-1/3 lbs.	4 1/2 T.
dimethoate (Cygon)	371	650	OP	0,0-Dimethyl S-(N-Methylcarbamoyl-methyl)	2.67 EP	3 pts.	3 T.
				phosphorodithioate	2 E	2 qts.	4 T.
dormant oil (Scalecide) (Volck) (Superior)	exempt			highly refined petro-leum: 70-sec. viscosity; minimum Unsulfonated Residue-92%; paraffinic type	98% miscible	2 gal.	1 C.
endosulfan (Thiodan)	70	359	CH	Hexachlorohexahydro-methano-2, 4, 3-benzo-dioxathiepin oxide	50% WP	1 lb.	3 T.
					9.7% EC	2 1/2 qt.	5 T.
ethion-oil	96	115	OP	60 sec. visc., IR 92%; plus 0,0,0',0'-tetra-2% ethyl S,S'-methylene bis(phosphorodithioate)	98 miscible + (includes 2% ethion)	2 gal.	1 C.
lindane	125	1000	CH	Gamma isomer of 1,2,3,4 5,6-hexachlorocyclo-hexane	25% WP	1 lb.	3 T.
					20% EC	1 qt.	2 T.
malathion (Cythion)	1375	4444	OP	0,0-Dimethyl S-(1,2 dicarbeth-oxyethyl) phosphoroditioate	25% WP	1 lb.	3 T.
					57% EC	1 1/2 pts.	1 1/2 T.
methidathion (Supracide)	25	375	OP	0,0-dimethyl phosporo-dithioate, S-ester with 4-(mercaptomethyl) 2-methoxy-1,3,4-thia-diazolin-5-one	2E (24.4% EC)	1 qt.	2 T.
methoxychlor	6000	6000	CH	1,1,1-Trichloro-2,2-bis	2EC	3 qt.	6 T.

COMMON NAME AND TRADE NAME	LD_{50} (Mg/kg) Oral	Dermal	TYPE	CHEMICAL NAME	FORMULATIONS	AMOUNT TO USE 100 gal	3 gal
oxydemetion methyl (metasystox-R) (MSR)	65	250	OP	S-2 (Ethylsulfinyl) ethyl 0,0-dimethyl phosphorothioate	2E	1 qt.	2 T.
phosmet (imidan)	300	3160	OP	N-(mercaptomethyl) phthalimide S-(0, 0-dimethylphosphoro-dithioate	50% WP	Use a 4% Dip as directed on the label.	
trichlorfon (Dylox)	450	2000	OP	dimethyl (2,2,2-trichloro-1-hydroxyethyl) phosphonate	80% SP	1 1/4 lb.	3 3/4 T.
					4 E	2-3 pts.	2-3 T.

Abbreviations: B-bacteria, C-carbamate, CH-chlorinated hydrocarbon, OP-organic phosphate, OT-organic tin, E-emulsifiable concentrate, F-flowable, SP-sprayable or soluble powder, WP-wettable powder.

Lb.-pound, Pt.-pint, Qt. quart, Gal.-gallon, T-tablespoon, t-teaspoon, C-cup

NOTE: The lower the LD_{50} value, the more toxic the pesticide.

Diseases of Christmas Trees

Samuel A. Alexander, Extension Plant Pathologist

Chemical control of forest tree diseases has only limited application due primarily to unfavorable cost-benefit ratios. In the forest situation, disease control is based on the nurseries, chemical control of diseases can be both effective and economical. Additional information on nonchemical control measures, causes and symptoms of forest diseases may be found in Virginia Extension Division forest tree disease leaflets.

CROP Disease Controlled	Rate; Method	Chemical and Formulation; Remarks
PINE, All Species		
Needle Cast (several fungi)	Bordeaux mixture: 8.0 lb copper sulfate, 8.0 lb hydrated lime in 100.0 gal water; spray to run off	Apply when needles are one-half and fully developed in spring. Two week intervals during heavy rains.
	Daconil 2787; 3.5 pt/100.0 gal water hydraulic spray	
	8.5 pt/100.0 gal water high pressure mist sprayers; spray to run off	
Brown Spot (Scirrhia accicola)	Daconil 2787; 8.5 pt/100.0 gal water for high-pressure mist sprayers; spray to run-off	Apply when needles are one-half developed in spring. In severely infected plantations or during an unusually wet year, a second spray should be applied 3-4 weeks earlier.
Diplodia Tip Blight (Diplodia pinea)	Bordeaux mixture; 8.0 lb copper sulfate, 8.0 lb hydrated lime in 100.0 gal water; spray to run-off.	Apply first spray at bud swell, and a second application about 10 days later (candle stage).
PINE, Scotch		
Atropellis Twig Canker (Atropellis tingens)	None	Eradicate all twig cankers; remove cankers for lightly infected branches burn the infected material at the earliest opportunity.
Eastern Gall Rust (Cronartium quercum f. sp. cerebrum) Pine-Pine Gall Rust (Endocronatium harknessi)	None	Eradicate all heavily infected trees; remove galls for lightly infected branches; eradication and gall removal should be completed prior to the next spring.
Scleroderris Canker (Gremmeniella abletina)	Daconil 2787; 4.25 pt/100.0 gal water for hydraulic sprayers	Begin spray application in the spring when new growth appears, repeat at 2-3 week intervals until early July, continue at 4
	8.5 pt/100.0 gal water for high pressure mist sprayers; spray to run-off	weed intervals until early September.
PINE, White		
Air Pollution Injury	Fertilizer 25-9-9; 1 cup for tree < 3 ft, 2 cups for tree 3-5 ft, 3 cups for tree > 5 ft; ground application	Evenly apply to ground surface around drip-line of tree.
PINE, White and Scotch		
White Pine Root Disease (White Pine Root Decline) (Verticicladiella procera)	None	Remove infected trees and burn. Insect control is important. Replant infected area with other tree species when possible.

Weed Control for Christmas Trees

J.F. Derr, Extension Weed Scientist

Weed control is considerably more complicated in crops with a long-duration cropping sequence such as Christmas trees. Perennial weeds are not likely to become a serious problem in annual crops since they can be removed either mechanically or chemically after harvest or before planting. Since perennial weeds such as poison ivy, brambles, shrubs or small tree sprouts cannot be easily removed without serious risk to young Christmas trees, proper site preparation is critical to the long range management of a tree plantation. For a discussion on site preparation, see publication 450-033.

After an effective site preparation program has been complete, preemergence herbicides may be used to prevent the reestablishment of annual grasses and broadleaf weeds. The maintenance of a weed-free strip in the planted row will increase tree survival and subsequent growth.

Crop	Weed Problem	Chemical Rate/A	Remarks
Site Preparation	Woody brush and trees	glyphosate 2.0-5.0 lb (Roundup 2.0-5.0 qt/A OR 1.3-2.6 oz per gal and spray to wet)	Apply in strips in the fall prior to planting. Do not disturb treated soil for at least 7 days after treatment.
		triclopyr 1.0-4.5 lb (Garlon 3A 1/3-1 1/2 gal or Garlon 4 1.0-4.0 qt + 1/4-1.0 pt surfactant in 20-100 gal spray)	Apply when broadleaf weeds (vines, brambles, brush, etc.) are actively growing. May be combined with 2,4-D for broader spectrum weed control. Will not injure grasses. Use the amine formation, Garlon 3A, if sensitive crops (vegetables, fruit, ornamentals) are nearby instead of the ester formulation Garlon 4. Do not plant conifers until 6 months after treatment. For small areas use 1.0-4.0 fl oz Garlon 3A or 0.7-2.9 fl oz Garlon 4 per 1000 sq ft.
Preemergence to weeds	Most annual grasses and certain annual broadleaf weeds	napropamide 4.0-6.0 lb (Devrinol 50WP 8.0-12.0 lb, 5G 80.0-120.0 lb or 2G 200.0-300.0 lb)	Apply to clean cultivated soil in fall or early spring. Rainfall or irrigation within 2-3 days after application is needed for maximum weed control. Tank-mixing with other herbicides such as simazine improves the spectrum of broadleaf weeds controlled. For small areas apply 2.9-4.4 oz Devrinol 50 WP per 1000 sq ft.
		oryzalin 2.0-4.0 lb (Surflan 75W 2.6-5.3 lb, 4AS 2.0-4.0 qt)	Apply to established plants (at least 2 weeks in containers). May be applied overtop of trees, but must be applied before weeds emerge. May be tank-mixed with other herbicides such as simazine to control a greater number of broad-leaf weeds in field grown Christmas trees. Should be applied in the fall or early spring when rainfall is likely to activate the herbicide. For small areas, apply 1.5-2.9 fl oz Surflan 4AS per 1000 sq ft.
	Most annual grasses and broadleaf weeds	oxyfluorfen 1.0-2.0 lb (Goal 1.6E 5.0-10.0 pt)	Apply as over-top treatment to newly planted or established conifers before bud-break in the spring or after foliage has hardened-off. Preemergence control plus control of small emerged weeds less than 3 to 4 inches in height. Will injure tender growth if applied after buds break dormancy. For small areas, apply 1.8-3.6 fl oz Goal 1.6E per 1000 sq ft.
		pronamide 1.0-2.0 lb (Kerb 50W 2.0-4.0 lb)	Fall application to fir or pine species established one growing season. High rate has given control of quackgrass and other perennial cool season grasses like fescue, bluegrass, and orchardgrass. For small areas, apply 0.7-1.4 oz Kerb 50W per 1000 sq ft.

Crop	Weed Problem	Chemical Rate/A	Remarks
		simazine 2.0-4.0 lb (Princep 80W 2.5-5.0 lb, Princep 4L 2.0-4.0 qt, or Princep 4G 50.0-100.0 lb)	Make application after rainfall has firmed the soil around the roots of Christmas trees and before weeds start to emerge. Simazine may be applied in the spring or fall but do not use more than one application of simazine per year or injury may result. Do not use on seedlings less than 3 years of age. For small areas, apply 1.5-2.9 fl oz Princep 4L per 1000 sq ft.
Postemergence to weeds	Emerged weeds	amitrole 1.05 lb + simazine 3.15 lb (Amizine 7.0 lb/A)	Mow heavy growth of weeds around the trees. When weed growth reaches 3 to 4 inches, use the prescribed rate (7 lb/A of commercial formulation) as a directed spray. Spray will damage trees if allowed to contact foliage. Simazine will provide residual control of many annual weeds.
		glyphosate 2.0-5.0 lb (Roundup 2.0-5.0 qt, for wiper applications, use 1 part Roundup to 2 parts water)	Apply as a directed spray to pine, spruce or fir when trees are not in active growth. Conifers are most tolerant to Roundup in the fall. Do not allow spray to contact foliage of Christmas trees, especially if earlier applications are made. For small area application with a hand sprayer use 2 oz/gal of water and lightly wet the foliage.
		paraquat 0.5-1.0 lb (Gramoxone Super 3.0-5.0 pt + X-77 spreader sticker 9.0-32.0 fl oz per 100 gal)	Apply as a directed spray for contact kill of annual weeds. Perennial weeds will require repeat application. Do not allow spray to contact desired foliage. May be combined with other herbicides such as simazine for residual control. For small area application use 1.5 fl oz plus 0.5 fl oz spreader sticker/gal of water and lightly wet foliage. Thorough coverage is important.
	Annual and perennial grasses	fluazifop-butyl 0.50 lb (Fusilade 4E 1.0 pt + 1/2 pint nonionic surfactant per 25.0 gal)	May be applied overtop of selected trees (see label) but should be used as a directed spray after bud break until new growth hardens. (For spot treatments with hand-held sprayers use 0.5 fl oz of Fusilade 4E or 1.5 fl oz Fusilade 2000 plus 0.5 oz of surfactant per gal of water.) Treat perennial grasses at the following stages of growth: bermudagrass, 4-8 inch runners; johnsongrass, 12-18 inches tall; quackgrass, 3-5 leaves but not more than 10 inches tall. Apply only to actively growing grasses not under moisture stress. A repeat application may be necessary in 7-14 days on some perennial grasses.
		fluazifop-P-butyl 0.25 lb (Fusilade 2000 2.0 pt + 0.5 pt nonionic surfactant per 25.0 gal)	
		sethoxydim 0.28-0.47 lb (Poast 1.5-2.5 pts + crop oil concentrate 1.0 qt/A)	May be applied overtop of young trees or banded to conserve material. Use lower rates on annual grasses less than 6 inches tall and higher rate on taller annual grasses and perennial grasses. Apply only to actively growing grasses; Do not use under severe moisture stress. For spot treatment use 1.25 fl oz of Poast and 1.25 fl oz of crop oil concentrate per gal of water. A repeat application may be needed to control perennial grasses.

Table 1. Guide for Herbicide Selection - Christmas Trees [1]

	Fraser Fir	Norway Spruce	Scotch Pine	White Pine
Amizine	X	X	X	-
Devrinol	X	X	X	X
Fusilade	X	X	X	X
Goal	X	X	X	X
Gramoxone	X	-	X	X
Kerb	X	X	X	X
Poast	X	X	X	X
Princep	X	X	X	X
Roundup	X	X	X	X
Surflan	X	X	X	X

[1] An "X" indicates the herbicide is labeled for that particular species. Check the product label for a more complete listing of plants and directions for use.

Table 2. Weed Susceptibilities to Preemergence Herbicides Labeled for Use in Christmas Tree Production [1]

	Devrinol	Goal	Kerb	Princep	Surflan
ANNUAL GRASSES					
Crabgrass	E	G	F	G	E
Foxtails	E	G	F	G	E
Fall panicum	G	G	P	G	G
ANNUAL BROADLEAVES					
Lambsquarters	G	E	F	E	G
Morningglory	N	G	P	G	N
Ragweed	F	G	P	E	N
Smartweed	P	G	F	E	P
PERENNIAL GRASSES AND SEDGES					
Bermudagrass	P	N	P	P	P
Johnsongrass	P	N	P	P	P
Fescue	P	N	E	F	P
Yellow nutsedge	P	N	N	N	N
PERENNIAL BROADLEAVES					
Poison ivy	N	N	N	N	N
Blackberry	N	N	N	N	N
Honeysuckle	N	N	N	N	N

[1] E = 90% or greater control, G = 75 to 90% control, F = 50 to 75% control, P = slight control, and N = no control.

Table 3. Weed Susceptibilities to Postemergence Herbicides Labeled for Use in Christmas Tree Production [1]

	Amizine	Fusilade	Paraquat	Poast	Roundup
ANNUAL GRASSES					
Crabgrass	E	E	E	E	E
Foxtails	E	E	E	E	E
Fall panicum	E	E	E	E	E
ANNUAL BROADLEAVES					
Lambsquarter	E	N	E	N	E
Morningglory	E	N	E	N	E
Ragweed	E	N	E	N	E
Smartweed	E	N	E	N	E
PERENNIAL GRASSES AND SEDGES					
Bermudagrass	F	G	P	G	G
Johnsongrass	F	G	P	G	G
Fescue	F	F	P	F	G
Yellow nutsedge	P	N	P	N	G
PERENNIAL BROADLEAVES					
Poison ivy	F	N	P	N	G
Blackberry	F	N	P	N	G
Honeysuckle	F	N	P	N	G

[1] E = 90% or greater control, G = 75 to 90% control, F = 50 to 75% control, P = slight control, and N = no control.

Weed Control in Ponds and Lakes (Aquatics)

S.W. Bingham, Extension Weed Scientist

Use of pesticides in aquatic environments is quite restricted because of the use of these area for irrigation, recreation, and domestic water supplies. It is important that chemicals used in these areas be applied strictly in accordance with label directions.

MOST AQUATIC HERBICIDES WILL BE MORE EFFECTIVE IF APPLIED WHEN WEEDS FIRST BEGIN ACTIVE GROWTH. THIS SHOULD BE CHECKED BY SAMPLING THE LAKE BOTTOM IN THE LATE SPRING OR EARLY SUMMER IN AREAS HEAVILY INFESTED THE YEAR BEFORE.

TREATMENT OF DENSE WEED GROWTH CAN RESULT IN LOSS OF FISH. DURING THE DECOMPOSITION OF THE DEAD PLANTS, OXYGEN DEPLETION CAN OCCUR AND THIS CAN CAUSE FISH KILL.

Recommendations for aquatic areas are based on rate per surface areas, rate per acre foot, or parts per million (ppm). In this particular case, rate per acre foot was chosen rather than ppm. If label directions are given in ppm, they may be used in accordance with the instructions on the label.

A acre foot is 1 acre of water 1 foot deep. For a pond with a gradual slope, acre feet may be determined approximately by multiplying 1/2 the depth at the deepest point, times the surface area. A pond with 1 surface acre and a gradual slope to 10 feet depth at the deepest point would contain approximately 5 acre feet of water.

Weed Problem	Chemical (Product Rate)	Remarks
ALGAE		
FILAMENTOUS and PLANKTON	copper sulfate (Copper sulfate, pentahydrate 1.35-2.7 lb/A ft)	For optimum control, spray over surface when algae growth first becomes visible. Expect temporary control, repeat treatments often necessary. Do not use copper sulfate in trout ponds. Hard water requires more copper sulfate than soft water. The copper complex formulation does not precipitate as fast as copper sulfate and usually more effective control results. Dilute copper complex with 9 parts of water and spray surface. Water temperature should be about 60 degrees F. Corrosive to spray equipment. Water may be used immediately for swimming, fishing, irrigation and potable water. Do not use copper complex in water containing trout if the carbonate hardness of the water does not exceed 50 ppm.
	Copper complex (Cutrine Plus 0.6 gal/A ft or Cutrine Plus Gran. 60.0 lb/A)	
UNICELLULAR ALGAE (SCUM)	simazine (Aquazine 1.7-3.4 lb/A ft)	Use only in pond with little or no run-off after treatment. Treat after seasonal flow has stopped, early in the weed and algae growth period (April 1 to May 15). Apply before water temperature exceeds 75 degrees F. Use lighter rate for light infestations, heavier rate for heavy infestations. Algae may need retreatment. Treated ponds can be used immediately for swimming and fishing. Do not use water from treated ponds for irrigation or spraying of agricultural crops, for watering animals or for human consumption until 12 months following treatment. Trees with visible roots bordering on treated ponds may be injured.
CHARA	copper sulfate (Copper sulfate, pentahydrate 5.4 lb/A ft)	See above, treat only 0.3-0.5 of pond at one time. Allow 7-14 days between applications. Excessive rates may cause fish kill.
	copper complex (Cutrine Plus 1.2 gal/A ft or Cutrine Plus Gran. 60.0 lb/A)	
	dichlobenil (Casoron G10 70.0-150.0 lb/A)	Apply granules uniformly before weeds emerge, late winter or early spring preferred. Most effective if applied to exposed pond bottom after draw-down (70-lb rate). Use 100-lb rate if water is less than 2 ft deep and 150-lb rate if water is 5-6 ft deep. Do not use fish for feed or food for 90 days following application.

Weed Problem	Chemical (Product Rate)	Remarks
FILAMENTOUS, ROOTED ALGAE		
CHARA, WATERNET	simazine (Aquazine 4.24 lb/A ft)	See Unicellular Algae.
SUBMERSED WEEDS		
BLADDERWORT	diquat (Ortho Diquat 1.0-2.0 gal/A)	Apply, early in the season before weeds have grown to surface, uniformly over the surface or inject below water surface. May be applied in 20-ft strips if diluted or 40-ft strips if poured from the container. Avoid stirring of mud from the bottom. Do not apply in muddy water. Retreatment may be necessary if regrowth occurs from underground vegetative parts. Do not use treated water for drinking purposes for 14 days, or animal consumption, spraying, swimming, or for irrigation within 10 days after treatment. Diquat may be fatal if swallowed, inhaled, or absorbed through skin.
	fluridone (Sonar 0.5-1.5 qts/surface acre in ponds or 0.75-4.0 qts/surface acre in lakes)	Apply early in the season as weeds begin active growth. Apply uniformly over surface. Effects on plant will be gradual from 30 to 90 days for complete response. One treatment per year. Does not work as a spot treatment in small areas. Do not irrigate with water for 30 days. Water may be used for swimming, drinking and fishing.
	2,4-D (Aqua-Kleen 20G 150.0-200.0 lb/A)	Apply in the spring and early summer, during the time when weeds start to grow. Do not apply to water used for irrigation, agricultural sprays, watering dairy animals or domestic water supplies. Average water temperature should be about 65 degrees F at the time of treatment.
COONTAIL	dichlobenil (Casoron G10 70.0-150.0 lb/A)	Same as under Chara.
	diquat (Ortho Diquat 2.0 gal/A)	Same as under Bladderwort.
	simazine (Aquazine 3.4-6.8 lb/A ft)	Same as under Algae.
	endothal, potassium salt (Aquathol K 0.6-1.3 gal/A ft or Aquathol gran. 27.0-54.0 lb/A ft)	Apply at early stages of weed growth. Granular materials preferred for spot treatment or treating marginal areas of a pond. Water temperature should be 65 degrees F or above. If areas of heavy vegetation are treated, treat in sections 5-7 days apart to prevent fish kill by oxygen depletion during vegetation decay. Do not use treated water for irrigation or agricultural sprays on food crops, or for livestock or domestic purposes within 7 days of treatment. Fish may be used within 3 days and water for swimming 24 hours after treatment. POISONOUS-FOLLOW LABEL FOR SAFE HANDLING.
	fluridone (Sonar 0.5-1.5 qts/surface acre in ponds or 0.75-4.0 qts/surface acre in lakes)	Same as under Bladderwort above.
	2,4-D (Aqua-Kleen 20G 150.0-200.0 lb/A)	Same as under Bladderwort.
ELODEA	diquat (Ortho Diquat 2.0 gal/A)	Same as under Bladderwort.

Weed Problem	Chemical (Product Rate)	Remarks
ELODEA (continued)	dichlobenil (Casoron G10 70.0-150.0 lb/A)	Same as under Chara.
	fluridone (Sonar 0.5-1.5 qts/surface acre in ponds or 0.75-4.0 qts/surface acre in lakes)	Same as under Bladderwort above.
FANWORT	simazine (Aquazine 8.5 lb/A ft)	See Unicellular Algae.
MILFOIL, PARROTFEATHER	diquat (Ortho Diquat 1.0-2.0 gal/A)	Same as under Bladderwort.
	2,4-D (Aqua-Kleen 20G 100.0 lb/A)	Same as under Bladderwort.
	endothal, potassium salt (Aquathol K 1.3-1.9 gal or Aquathol gran. 54.0-81.0 lb/A ft)	Same as under Coontail.
	simazine (Aquazine 3.4-6.8 lb/A ft)	See Unicellular Algae.
EMERGED PARROTFEATHER	dicamba + 2,4-D amine (Banvel 720 1.0 gal in 50.0 gal water per surface acre)	Follow label directions and precaution. Use only when emerged parrotfeather shoots are obvious above water surface.
PONDWEEDS (Potamogeton spp.)		
CURLY LEAF, LEAFY SAGO, SMALL AND SOUTHERN NAIAD	dichlobenil (Casoron 70.0-150.0 lb/A)	Same as under Chara.
	diquat (Ortho Diquat 2.0 gal/A ft)	Same as under Bladderwort.
	endothal, potassium salt (Aquathol K 0.3-1.9 gal or Aquathol gran. 13.0-81.0 lb/A ft)	Same as under Coontail. Rate will be dependent on most difficult weed to control in the pond.
	fluridone (Sonar 0.5-1.5 qts/surface acre in ponds or 0.75-4.0 qts/surface acre in lakes)	Same as under Bladderwort above.
	simazine (Aquazine 3.4-6.8 lb/A ft)	See Unicellular Algae.
SOUTHERN NAIAD	diquat (Ortho Diquat 1.0 gal/A)	Repeat treatment as needed. Same as under Bladderwort.
FLOATING PLANTS		
DUCKWEED	diquat (Ortho Diquat 1 cup/5.0 gal of water + Multifilm X-77 1 tbsp)	Spray to wet weed foliage when needed. Same as under Bladderwort.
	Simazine (Aquazine 3.4-6.8 lb/A ft)	See Unicellular Algae.

Weed Problem	Chemical (Product Rate)	Remarks
EMERSED PLANTS		
ARROWHEAD, BULL RUSH, SEDGES	diquat (Ortho Diquat 1 cup/ 5.0 gal of water + Multifilm X-77 1 tbsp	Thoroughly wet foliage. Same as under Bladderwort.
	dicamba + 2,4-D amine (Banvel 720 0.5 gal in 50.0 gal of water per surface acre)	Follow label directions. Use when Foliage is above water surface.
CATTAIL	glyphosate (Rodeo 4.5 to 6.0 pt/A + surfactant)	Follow label directions. Apply in 20 gal of water per acre as a broadcast spray. Apply to actively growing cattail at the early to full bloom stage of growth.
	dalapon, sodium salt (Dowpon 4.0 oz/gal of water + surfactant)	Wet foliage to run-off. Use on marsh areas only. Do not contaminate domestic or irrigational waters.
	dicamba + 2,4-D + dalapon (Banvel 720 + Dowpon, 1.0 gal + 6.0 lb per surface acre.)	Use 50 gal of water per surface acre for application to wet the foliage. Follow label precautions and directions.
	diquat (Ortho Diquat 1 cup/5.0 gal of water + Ortho X-77 1 tbsp)	Thoroughly wet foliage before cattail blooms. See diquat under Bladderwort.
SPATTERDOCK, WATERLILLY, WATERSHIELD	2,4-D (Aqua-Kleen 20G 150.0-200.0 lb/A)	Broadcast over weeds. Same as under Milfoil. Avoid drift of dust to susceptible plants.
	fluridone (Sonar 0.5-1.5 qts/surface acre in ponds or 0.75-4.0 qts/surface acre in lakes)	Same as under Bladderwort above.
SPATTERDOCK	glyphosate (Rodeo 6.0 pt/A + surfactant)	Apply in 20 gal of water per acre as a broadcast spray. Apply when most plants are in full bloom.

Weed Control in Rights-of-Way and Noncrop Areas

W.E. Chappell, Professor Emeritus of Weed Science

The treatments given in this section are not for use in crop land unless otherwise indicated under a given crop section. Note: Most of the chemicals listed herein perform better when wetting agents are added at 1/2% of the total volume. Use nonionic substances such as X77, Cide Kick or other suitable wetting agents.

Brush Control

Problem and Application Technique	Chemical and Application Rate	Remarks
FOLIAGE SPRAY High-volume application with hand gun or fixed nozzle. Ground applications often use volumes ranging form 100-500 gpa. Our research has shown good results with volumes as low as 30-60 gpa if uniform coverage can be obtained. Note: Drift control agents such as Nalcotrol or Polycontrol at 4 oz/100 gal greatly reduces risk of the Right-of-Way damage. Use controlled size droplets to reduce risk of off the Right-of-Way damage wherever practical.	Garlon 4 1/2 gal + Dicamba 4S 1/2 gal + Cide Kick 2.0 qt/100 water/acre	Wet stems and foliage thoroughly. Density of brush will determine rate/A. Use on all species during June and July. May be used near susceptible crops.
	2,4-D + MCPP + dicamba (Trimec 352) 2.0-3.0 gal/100 gal of water	Apply in 30-35 gal of water per acre as a coarse spray. Use higher rates for larger or more dense stands. DO NOT APPLY WITHIN 100 FT OF DESIRABLE PLANTS OR ALLOW SPRAY TO CONTAMINATE WATER USED FOR IRRIGATION OR OTHER DOMESTIC PURPOSES. Dicamba may move down slopes for considerable distances.
	fosamine (Krenite) 8.0-12.0 lb/A (2.0-3.0 gal in 50.0-300.0 gal of water + 2.0 qt Cide Kick/A or other wetting agent + 1.0 pt crop oil/100 gal)	Apply in late summer or early fall (during the 2 month period prior to leaf coloration) to species listed on label. Susceptible species fall to leaf out the next spring and subsequently die. If rainfall occurs within 24 hours, effectiveness will be reduced. Thorough coverage and the use of a surfactant is imperative for complete control.
	fosamine 1 1/2 gal + Arsenal 1 1/2 pt + Cide Kick 2.0 qt in 25-50 gal water in late summer	Apply with Radiara or other CDA sprayer.
	picloram + 2,4-D (Tordon 101 or Amdon 101) 1.0 gal/100 gal of water	Apply uniformly over top of brush as a coarse spray. Use on all species during June and July. DO NOT APPLY WITHIN 400 FT OF DESIRABLE PLANTS OR ALLOW PICLORAM OR DICAMBA TO CONTAMINATE WATER USED FOR IRRIGATION OR OTHER DOMESTIC PURPOSES. Both may move down slopes for considerable distances.
	dicamba 2.0 lb + 2,4-D 4.0 lb/A (Banvel 720 2.0 gal/A)	
	Dicamba 2.0-4.0 lb/A (0.5-1.0 gal Banvel 4WS)	DO NOT APPLY WITHIN 400 FT OF DESIRABLE PLANTS OR ALLOW DICAMBA TO CONTAMINATE WATER USED FOR IRRIGATION OR OTHER DOMESTIC PURPOSES. Dicamba may move down slopes for considerable distances. DO NOT APPLY WHEN DAILY TEMPERATURE IS EXPECTED TO EXCEED 85 degrees F.
	glyphosate (Roundup) 1.0-2.0 gal/100 of water + Cide Kick 2.0 qt or other wetting agent	Wet foliage thoroughly after full leaf development. Do not store diluted chemical in metal containers or for more than 12 hours before using.
	triclopyr amine (Garlon 3A or Garlon 4) 0.5-1.0 gal/100 gal + 2,4-D amine 2.0 gal	Apply 100-400 gal per acre when plants are actively growing. Do not apply within 400 ft of susceptible plants. Use higher rates on resistant species or in late growing season applications. Do not use when temperatures are above 85 degrees F.
	imazapper (Arsenal) 0.5-1.0 lb ai/A	Apply 50-200 gal water per acre. Do not apply near trees or other desired vegetation.
	Escort 4.0 oz/A + fosamine at 1.0 gal/A	Apply in 50 gal water with Cide Kick or other nonionic wetting agent.

Problem and Application Technique	Chemical and Application Rate	Remarks
Low-volume application to foliage aerial or ground. Note : Use wetting agents and drift control agents Follow label recommendations. Use CDK sprayer such as Radiarc or Micromax for ground sprays to help reduce drift. Thickeners such as Nalcotrol or Polycontrol help prevent drift.	picloram + 2,4-D (Tordon 101 or Amdon 101) 1.0-3.0 gal in 20.0-50.0 gal water/A	Apply during the growing season. Use either drift control agent or equipment that prevents drift by control of droplet size. DO NOT APPLY WITHIN 400 FT OF DESIRABLE PLANTS OR ALLOW CONTAMINATION OF WATER USED FOR IRRIGATION OR OTHER DOMESTIC PURPOSES. Picloram may move down slopes for considerable distances.
	triclopyr (Garlon 3A or Garlon 4E) 2.0-3.0 gal in 20-100 gal water/A, ground or aerial	For aerial application consult label. Do not apply Garlon 4 when temperatures are above 85 degrees F.
	triclopyr (Garlon 3A or Garlon 4) 0.5-1.0 gal + 1.0-2.0 gal 2,4-D or Tordon 101 (Picloram + 2,4-D) in 20-100 gal water/A, ground or aerial	Same as above. (See Picloram cautions.)
	dicamba 3.0 lb + 2,4-D 6.0 lb (3 gal Banvel 720)/15.0-30.0 gal water	Apply during the growing season with aerial equipment. Use either drift control agent or equipment that prevents drift by control of droplet size. DO NOT APPLY WITHIN 100 FT OF DESIRABLE PLANTS OR ALLOW CONTAMINATION OF WATER USED FOR IRRIGATION OR OTHER DOMESTIC PURPOSES. Dicamba may move down slopes for considerable distances.
	dicamba 4.0-8.0 lb (Banvel 4WS)/A in 10.0-40.0 gal water	
	fosamine 6.0-12.0 lb (1.5-3.0 gal Krenite) in 10.0-30.0 gal water/A + Cide Kick or other wetting agent + 1.0 pt crop oil/acre	Apply with aerial equipment in the late summer to species listed on the label. No "brown-out" occurs. Susceptible species fail to leaf-out the next spring and subsequently die. If rainfall occurs within 12 hours, effectiveness will be reduced. Thorough coverage and the use of a surfactant is imperative for complete control.
	glyphosate 3.0-4.0 lb (Roundup 0.75-1.0 gal) in 5.0-15.0 gal water/A	Wash aircraft after using. Do not store diluted chemical in metal tank.
	2,4-DP 4.0 lb + 2,4-D 4.0 lb (2.0 gal Weedone 170) in 10.0-20.0 gal water/A	Do not contaminate water.
	imazapper (Arsenal) 0.5-1.0 lb ai/A	Apply with Micromax or other low volume spray in 10.0-25.0 gal of water/A.
DORMANT STEMS OR BASAL	dicamba 1.0-3.0 lb + 2,4-D 2.0-6.0 lb (1.0-3.0 gal Banvel 520)/100 gal oil OR 1.0-3.0 gal Banvel 520 + 10.0-15.0 gal oil + Emulsifier (0.5 gal Accutrol or 1.0 gal Cide-Kick) + enough water to make 100 gal total solution	Apply as a broadcast treatment to dormant stems. Good control of most species. DO NOT APPLY WITHIN 100 FT OF DESIRABLE PLANTS OR ALLOW DICAMBA TO CONTAMINATE WATER USED FOR IRRIGATION OR OTHER DOMESTIC PURPOSES. May move down slopes for considerable distances. Oil-water emulsions require constant agitation.
	Garlon II 4 1/2 gal + dicamba 1/2 gal or Trimec 2.0 gal or Dicamba + 2,4-D (Banvel 720) 2.0 gal + Cide Kick 2.0 gal/100 gal of water	Apply in late winter or early spring as a stem spray.
	dicamba + 2,4-D (Banvel 520) + triclopyr Ester (Garlon 4) 1.0 gal in 10.0 gal of diesel oil	Apply any time during year except when temperatures are above 85 degrees or near sensitive crops. Wet lower 2 ft of stems.

Problem and Application Technique	Chemical and Application Rate	Remarks
(continued)	2,4-D 6.0-8.0 lb + 2,4-DP 6.0-8.0 lb (Weedone 170 3.0-4.0 gal)/100 gal oil OR Weedone 170 3.0-4.0 gal emulsified as above	Wet thoroughly the lower 18-24 inches of stem. Density of brush will determine rate/A. Use on all species any time of the year. DO NOT APPLY WITHIN 100 FT OF DESIRABLE PLANTS OR ALLOW CONTAMINATION OF WATER USED FOR IRRIGATION OR DOMESTIC PURPOSES. Use with soybean oil to reduce grass kill. Add 1-5% Cide Kick for better penetration.
	triclopyr 6.0-8.0 lb (Garlon 4 1.5-2.0 gal)/100 gal oil OR Garlon 4 2.0 gal + 25.0 gal oil + 0.50 gal Sponto 712 + 72.0 gal water)	
STUMP TREATMENT	2,4-D (ester) 12.0 lb ai/100 gal oil	Spray to wet thoroughly the cut surface at the junction of the wood and bark, sides, root collar, and exposed roots of stumps. Application should be made soon after cutting.
	2,4-D + 2,4-DP (Weedone 170) 3.0-4.0 gal/100 gal oil	See remarks for 2,4-D ester + oil.
	picloram + 2,4-D (Tordon 101R)	Spray to wet the cut surface, especially the cambium area. DO NOT USE PICLORAM OR DICAMBA NEAR DESIRED SPECIES OR ALLOW EITHER TO CONTAMINATE WATER USED FOR IRRIGATION OR OTHER DOMESTIC PURPOSES.
	dicamba (Banvel CST) undiluted or Banvel 4WS diluted in water 1:4	
SOIL APPLICATION (Dry material)	picloram 5.0-8.0 lb ai/A (Tordon 10K 50.0-80.0 lb) OR hexazinone 3.6-7.2 lb ai/A (Velpar Gridball) OR tebuthiuron (Spike 5G) 2.0 oz/stem OR granular dicamba (Banvel 10G) 50.0-60.0 lb/A	Apply on all species during any season at base of clumps. Any tree with roots extending into the treated area may be killed. DO NOT APPLY WITHIN 100 FT OF DESIRABLE PLANTS OR ALLOW MATERIAL TO CONTAMINATE WATER USED FOR IRRIGATION OR DOMESTIC PURPOSES. These materials may move down slopes for considerable distances. Apply broadcast spray between late winter and early summer. Consult the Gridball, Banvel or Spike labels for specific application methods.
	hexazinone (Buckshot OR Pronone)	Apply 10-20 lb per acre as directed on label.

General Weed Control - Mixture of Annual Grasses and Broadleaf Weeds

Caution. All use recommendations of herbicides as listed under this category must be regarded as non-selective. Therefore, do not use in crop areas except as shown under SELECTIVE CHEMICAL WEED CONTROL RECOMMENDATIONS. When treating land that will later be used to grow crops, observe all label precautions with respect to critical dosages, waiting intervals before cropping, and residue tolerances in the crops. Avoid spray drift onto crops and ornamentals to prevent injury and illegal residues. Do not apply soil sterilants within the root development area of adjoining crops, ornamentals or other desirable species, also avoid use in areas where there is danger of chemical runoff.

Apply these herbicides during the growing season as a foliar spray for general weed control.

Herbicide	Application Rate ai/A	Remarks
amitrole + simazine (Amizine)	1.05 lb + 3.15 lb (7.0 lb/A Amizine/50.0-100 gal)	This treatment provides both foliar kill and some residual control of annual weeds.
2,4-D amine + wetting agent (broadleaf weeds only)	2.0 lb (ae + 6.0 lb + 1 pt/100 gal 2.0 lb (ae) + 6.0 lb + 1/2 pt/100 gal	Spray to wet all foliage; volume of spray/acre will depend on height and density of growth. Apply when weeds are 3-4 inches high. Repeat applications when additional weeds appear.
glyphosate (Roundup)	2-4 qt + Cide kick 1/2% or other wetting agent	Apply in 20-30 gal of water per acre. Glyphosate is slow acting and may require 5-10 days before visible results occur. If rainfall occurs within 6 hours, effectiveness may be reduced. Do not use with galvanized spray equipment. Use of mechanical agitation or additional wetting agent will cause excessive foaming. Do not allow spray drift to contact desirable plants. Glyphosate leaves no soil residue.

Herbicide	Application Rate ai/A	Remarks
glyphosate (Roundup) + sulfomenturon (Oust) + wetting agent	1.0-2.0 qt + 2.0 oz of product	Gives season long control.
imazapper (Arsenal)	0.5-1.0 pt product	Do not use near desired vegetation.
Apply these herbicides when they will be leached into the soil by precipitation or by supplemental irrigation.		
atrazine bromacil diuron hexazinone (Velpar 90SP or L) imazapper (Arsenal) monuron simazine sulfomenturon (Oust) surflan 75W tebuthiuron (Spike) triclopyr (Garlon)	2.4-4.8 lb/50-100 gal 2.4-4.8 lb/50-100 gal 2.4-4.8 lb/50-100 gal 2.0-12.0 lb/50-100 gal 0.5-1.0 pt/50-100 gal 2.4-4.8 lb/50-100 gal 2.4-4.8 lb/50-100 gal 0.1-2.0 oz/50-100 gal 2.0-4.0 lb/50-100 gal 3.0-6.0 lb/50-100 gal 0.5 + 1.0 lb/50-100 gal	Apply before or just after weeds emerge. Adequate rainfall must follow to move chemicals into the root zone of weeds. Use lower volume for boom spraying, higher volume for offset nozzles. Continuous agitation of spray mixture is necessary to avoid settling-out in the spray tank. Nozzle screens of 50 mesh are desirable. Finer screens may clog. Where weeds are up, add 1 lb amitrole/A to simazine, monuron, and diuron; add to atrazine and bromacil if weeds are over 6 inches high. Do not apply near desirable plants.
Borate and mixture of borate with other herbicides, e.g., chlorate, monuron, bromacil, etc.	Variable, depending on the formulation	Several products are available. Follow manufacturer's directions.
hexazinone (Velpar L)	3.0-6.0 gal/A	Consult label for species controlled.

Specific Perennial Weeds (Except Woody Plants)

(See also SOIL STERILIZATION below for general nonselective control, including perennial weeds).

Weed	Chemical Rate ai/A	Remarks
Bermudagrass (wiregrass)	glyphosate 3.0-4.0 lb ai/A (Roundup 3.0-4.0 qt) + wetting agent	Best control is obtained when treatment is made at late stages of growth but prior to seed head emergence. See remarks for glyphosate under annual grasses and broadleaf weeds above. Repeat as needed.
Canada thistle	amitrole or amitrole-T or 2,4-D 2.0-3.0 lb/100 gal	Apply in early summer when thistles are in early bud to early bloom stage. Respray new growth at very early bud stage. Several retreatments may be necessary for eradication. Thoroughly wet all foliage and stems.
	picloram 0.5 lb/100 gal water (Tordon K 0.25 gal) OR picloram 0.5 lb + 2,4-D 2.0 lb (1.0 gal Tordon 101)	See above comments. Avoid drift to neighboring crops or ornamentals. Soil effects may persist for one year or longer. DO NOT ALLOW DICAMBA OR PICLORAM TO CONTAMINATE WATER USED FOR IRRIGATION OR OTHER DOMESTIC PURPOSES. Both may move down slopes for considerable distances.
	dicamba 4.0 lb/100 gal water (1.0 gal Banvel 4WS) OR Banvel II 2.0 gal/100 gal water	
	chlorosulfuron (Telar) 0.25-0.5 oz	Apply in early spring. Will inhibit grasses.
Johnsongrass	MSMA or DSMA 3.0-5.0 lb/50.0-100 gal	Weed control is most effective when air temperature is 70 degrees F or above. Some commercial products are formulated with wetting agent. If not, add surfactant at 1 to 2 qt/100 gal. Treat any time when grass is growing vigorously. If regrowth occurs, reapply. For complete kill, 3 to 5 applications may be required.

Herbicide	Application Rate ai/A	Remarks
	Asulam 2.5-5.0 lb (0.75-1.5 gal Asulox)/100 gal water	Apply when johnsongrass is taller than 15 inches but prior to heading.
	glyphosate 1.0-2.0 lb (Roundup 1.0-2.0 qt)	Best control is obtained when treatment is made at late stages of growth but prior to seed head emergence. See remarks for glyphosate under annual grasses and broadleaf weeds above.
	Roundup 1.0 qt + 1/8 oz sulfomenturon (Oust) + wetting agent	Apply in 5-50 gal water per acre at time of seedhead formation.
Honeysuckle	2,4-D 2.0-3.0 lb/100 gal OR glyphosate 3.0-4.0 lb/A OR dicamba + 2,4-D 1.0 lb + 2.0 lb/A OR picloram + 2,4-D 0.5 lb + 2.0 lb (Tordon 101)	Apply in spring or summer when plants are in full leaf and actively growing. Thoroughly wet all foliage and stems. Density of cover will determine volume of spray per acre. Spot treat regrowth as required. Do not use Picloram near desired vegetation.
Kudzu	2,4-D + MCPP + dicamba (Trimec 352) 2.0-3.0 gal/100 gal of water/A	Apply in 30-35 gal of water per acre as a coarse spray. Use higher rates for more dense stands. DO NOT APPLY DICAMBA WITHIN 100 FT OF DESIRABLE PLANTS OR ALLOW SPRAY TO CONTAMINATE WATER USED FOR IRRIGATION OR OTHER DOMESTIC PURPOSES. Dicamba may move down slopes for considerable distances.
	Dicamba 1.0-2.0 lb/A (Banvel 4WS 1.0-2.0 qt)	
	glyphosate 4.0 lb/A (Roundup 1.0 gal)	Apply when actively growing.
	triclopyr 2.0-3.0 lb/A (0.67-1.0 gal Garlon 3A or 0.50-0.75 gal Garlon 4E)	Apply when actively growing. Consult label.
	dicamba 1.0 + 2,4-D 2.0 lb (Banvel 720 1.0 gal)/A	Apply in early summer when weeds are in early bud to bloom stage. Thoroughly wet all foliage and stems. Retreat as needed. DO NOT APPLY DICAMBA OR PICLORAM WITHIN 100 FT OF DESIRABLE PLANTS OR ALLOW EITHER TO CONTAMINATE WATER USED FOR IRRIGATION OR DOMESTIC PURPOSES. Both may move down slopes for considerable distances.
	picloram 1.0 lb + 2,4-D 4.0 lb (Tordon 101 2.0 gal)/A	
	fosamine 6.0-8.0 lb (1.5-2.0 gal Krenite)/100 gal water + wetting agent + crop oil 1.0 pt/100 gal	Apply as a foliar spray in late summer or every fall. The use of a high quality surfactant is imperative for good control.
Milkweed (Common and Dogbane)	dicamba 1.5-2.0 lb (0.38-0.5 gal Banvel 4WS)/A	Apply prior to flowering while plants are actively growing. DO NOT APPLY DICAMBA OR PICLORAM WITHIN 100 FT OF DESIRABLE PLANTS OR ALLOW EITHER TO CONTAMINATE WATER USED FOR IRRIGATION OR DOMESTIC PURPOSES. Both may move down slopes for considerable distances.
	dicamba 1.0 lb + 2,4-D 2.0 lb (1.0 gal Banvel 101)/A	
	picloram 0.5 lb + 2,4-D 2.0 lb (1.0 gal Tordon 101)/A	
	picloram 2.0 lb (20.0 lb Tordon 10K Pellets)/A	
Mugwort (wild chrysanthemum)	dichlobenil 6.0-8.0 lb or 5.0-6.0 lb (incorporated)	Use granular formulation only. Apply to soil surface, nonincorporated treatments from November 1-January 1; incorporated treatments may be in late fall or spring (before May 1).
	2,4-D (LVE) 5.0 lb + fenac (EC) 3.0 lb/30.0-60.0 gal of water	Apply in early spring when mugwort is less than 4 inches tall.
Mullen	2,4-D 2.0 lb/A	Apply in early summer when in rosette stage. The hairy leaf surface makes this plant difficult to wet, therefore, the use of a surfactant is important.

Herbicide	Application Rate ai/A	Remarks
Musk and Curled thistles	2,4-D ester 2.0-3.0 lb/50.0-100 gal water	Apply in midspring. Midday temperatures should be above 60 degrees F for 2 to 3 days after application. Observe above mentioned precautions when using dicamba.
	dicamba 1.5 lb (0.38 gal Banvel 4WS)/A	
	dicamba 1.0 lb + 2,4-D 2.0 lb (1.0 gal Banvel 720)/A	
	chlorosulfuron (Telar) 0.25-0.5 oz product	Apply in early spring. Will inhibit grass growth. Not for pastures. Add .5% Cide Kick or other wetting agent.
Nutsedge (nutgrass)	EPTC 6.0 lb/30.0-60.0 gal	Apply any time after existing stands of nutsedge have been destroyed by tillage. Mix into the soil 6 inches deep immediately after spraying by cross-discing or use of a power driven rotary tiller. Will suppress nutsedge for 8 to 12 weeks.
	2,4-D 1.0-2.0 lb/30.0-60.0 gal water	Make first application when nutsedge is 8 inches tall, completely wetting all leaves. Repeat at 3-week intervals or when regrowth reaches 4-6 inches. Several retreatments may be required for eradication.
Poison ivy	fosamine 6.0-8.0 lb (1.5-2.0 gal Krenite)/100 gal water	Apply in late summer before leaf coloration. The use of a high quality surfactant is imperative for good control.
	dicamba 1.0 lb + 2,4-D 2.0 lb (1.0 gal Banvel 720)/A	Apply during periods of active growth. DO NOT APPLY WITHIN 400 FT OF DESIRABLE PLANTS OR ALLOW DICAMBA TO CONTAMINATE WATER USED FOR IRRIGATION OR OTHER DOMESTIC PURPOSES. Dicamba may move down slopes for considerable distances. Thoroughly wet all foliage and stems. Density of cover will determine volume of spray per acre. Spot treat regrowth as required. Thorough coverage and the use of a surfactant is imperative for complete control.
	amitrole 2.0-3.0 lb/100 gal water	
	2,4-D 2.0-3.0 lb/100 gal water	
	triclopyr 4.0 lb (1.0 gal Garlon 4E) 100 gal water	
	ammonium sulfanate (AMS) 75.0 lb/100 gal water	
	glyphosate 4.0 lb (1.0 gal Round-up)/100 gal water	
Quackgrass	amitrole 4.0 lb/50.0 gal amitrole-T 2.0 lb/50.0 gal	Spray when vigorous young growth is 4-6 inches tall, Plow when plants appear white, usually 10-14 days after treatment. Spot treat any green growth.
	dalapon 10.0-15.0 lb + wetting agent 1.0-2.0 pt/30.0-60.0 gal	Treat in early fall or early spring when grass is actively growing and 6-12 inches tall. Repeat at 10-20 day intervals for 2 or 3 applications. The area should not be disturbed for at least 3 days after treatment but tillage after this period will improve control and hasten the dissipation of the herbicides. Spot Treatment: Use 1 lb/5 or 10 gal of water and spray to wet the foliage.
	dichlobenil 6.0-8.0 lb or 5.0-6.0 lb (incorporated)	Use granular formulation only. Apply to soil surface, nonincorporated treatments from November 15-January 1; incorporated treatments may be made in late fall or spring (before May 1)
	MSMA 2.0-4.0 lb + wetting agent (already included in some formulations) 1.0-2.0 pt./30.0-60.0 gal	Make first application when quackgrass is 4-6 inches tall, completely wetting all foliage. Respray new growth as often as necessary when it reaches 4-6 inches.
	glyphosate 2.0-4.0 lb (Roundup 2.0-4.0 qt)	Best control is obtained when treatment is made at late stages of growth but prior to seed head emergence. See remarks for glyphosate under annual grasses and broadleaf weeds above.

Herbicide	Application Rate ai/A	Remarks
General broadleaf weed control in turn areas	triclopyr ester (Garlon 4E) 1.0-2.0 qts in water or soybean oil + 1.0 qt Cide Kick in 25 gal of water/A	Soybean oil will not injure grass. Best control is obtained in Spring or Fall when weeds are actively growing. (Use CDA or other low volume equipment any time when weeds are present)
Multiflora rose	2,4-D 4.0 lb + 2,4-DP 4.0 lb (2.0 gal Weedone 170)/100 gal water	Apply 2,4-D, 2,4-DP, dicamba, triclopyr, and trimec when plants are actively growing. Glyphosate should be applied after full leaf expansion, July through early September. Apply picloram pellets just before or at budbreak for best results. Apply fosamine in the late summer or early fall. The use of a high quality surfactant and complete coverage is imperative for good control. DO NOT APPLY WITHIN 400 FT OF DESIRABLE PLANTS OR ALLOW SPRAY TO CONTAMINATE WATER USED FOR IRRIGATION OR OTHER DOMESTIC PURPOSES. Dicamba may move down slopes for considerable distances.
	dicamba 2.0 lb + 2,4-D 4.0 lb (2.0 gal Banvel 720)/100 gal water	
	2,4-D + dicamba + MCPP (2.0-3.0 gal Trimec 352)/100 gal water	
	glyphosate 2.0-3.0 lb (0.50-0.75 gal Roundup)/100 gal water	
	triclopyr 1.5-3.0 lb (0.5-1.0 gal Garlon 3A, 0.38-0.75 gal	
	fosamine 8.0-12.0 lb (2.0-3.0 gal Krenite)/100 gal water + wetting agent	
	picloram 2.0 lb (20.0 lb Tordon 10K Pellets)/A	
	Escort 1.0-2.0 oz products + wetting agent in 50 gal of water/A	Apply in late summer or fall while foliage is present.
	Garlon IV 1/2 gal + Banvel 1/2 spray gal + Cide Kick 2.0 gal per 100 gal water	Apply as a wetting January - April to dormant stem.
Cedar	hexazinone 1.0 lb/10.0 gal water (1.0 lb Velpar 90% SP or 0.5 gal Velpar L)	When preparing the liquid mixture, with Velpar 90% SP, the water should be at room temperature to completely dissolve the powder. Spray 3 oz of the solution per 2 inch basal diameter on the soil near the base of the stem. FOR SPOT CONTROL ONLY. DO NOT TREAT LARGE AREAS OR EVERY STEM IN DENSE STANDS AS EROSION MAY RESULT. Hexazinone may move down slopes for considerable distances. Do not use near desirable plants.
	hexazinone pellets (3 Velpar gridballs/2 inch basal stem diameter)	
	Krenite 3.0 gal/100 gal water	Apply after July 15. Use wetting agent and wet foliage thoroughly with at least 50 gal of water per acre.

Soil Sterilization

Soil sterilant chemicals by definition, render the soil incapable of supporting plant growth for varying periods. The effect may be temporary, as with fumigants, or for an extended period (semi-permanent). In either case, the action is nonselective at rates specified for use as soil sterilants. Therefore, do not apply within the root development area of adjoining crops or desirable species. Do not use in crops or where there is danger of chemical runoff. NOTE: Since effectiveness varies considerably with the weed species, degree of infestation, soil and environmental conditions, several herbicidal materials and a range of rates are provided to allow selection of product and dosage based on specific need.

Lower rates (A) apply to annuals, biennials, shallow-rooted perennials, and seedling perennials;
Higher rates (B) apply to established deep-rooted and other hard-to-kill perennials. Read and follow directions on the label for further details.

methyl bromide	870 (2.0 lb/100 sq ft)	Soil fumigant. Apply in concentrated form under vaporproof cover, when soil is moist but not wet, and in good tilth. Remove cover after 24 to 48 hours. WARNING: MEHTYL BROMIDE IS POISONOUS.
amitrole + simazine (Amizine)	(A) 1 + 3 (7.0 lb product) (B) 3 + 9 (21.0 lb product)	Early growth to first bloom gives longer lasting control than amitrole alone, but a single application will not kill all deep-rooted perennials.

Herbicide	Application Rate al/A	Remarks
borate mixtures with sodium chlorate and/or other chemicals	variable	Follow instructions on the label. Apply as a spray on early growth to first bloom or broadcast as a soil treatment.
bromacil	(A) 3-6 (B) 10-25	If dense growth is present, results will be improved if vegetation is removed prior to treatment. Do not apply to frozen ground.
chlorate mixtures with borates or other chemicals	variable	Follow instructions on label. Fire hazard usually less than pure sodium chlorate but caution still is necessary.
diuron or monuron	(A) 5-20 (B) 20-80	Diuron gives somewhat longer soil sterility. Monuron is more effective on deep-rooted weeds.
tebuthiuron (Spike)	(A) 4.0-6.0 (B) 6.0-16.0	Follow label directions.
hexazinone (Velpar)	(A) 1.8-4.5 (B) 5.4-10.8	Apply in early spring. Do not apply near desirable vegetation. Consult label for specific rates on different soil types.
prometon	(A) 10-15 (B) 20-60	Mix in water or oil. Provides quicker contact kill of top growth with oil. Apply to early growth up to first heading.
simazine or atrazine	(A) 5-20 (B) 20-40	Simazine requires more precipitation for effective root kill, and remains effective in the soil longer. This treatment will not control johnsongrass.
imazapper (Arsenel)	0.5-1.0 lb/A	Do not apply near trees or other desired vegetation.

SOIL STERILANTS ARE VERY POTENT PLANT KILLERS AND SHOULD NOT BE USED AROUND THE HOME GROUNDS OR NEAR DESIRABLE PLANTS, AS WITH ALL PESTICIDES, CONSULT THE LABEL BEFORE USE.

E. GRASS INHIBITION - RIGHTS-OF-WAY ONLY

Maleic hydrazide	(Various brands) 4.0 lb/A in 50.0 gal water	Apply March 1 - April 10 for seedhead inhibition of K31 Fescue and bluegrass. Mix with trichlopyr, dicamba or 2,4-D for broadleaf weed control. Read label.
EPTC (Shortstop)	EPTC 60.0 (Shortstop) lb/A (product)	Apply March or early April for fescue, bluegrass seedhead inhibition.
chlorosulfuron **PLUS**	1/8 - 1/4 oz product /A + 1/2 pt Embark + 1.0 qt/A Cide Kick	Apply late March to late April.
Mefluidide (Embark) **PLUS** Escort	1/2 pints/A **PLUS** 1/4 ounces **PLUS** 1 qt/A Cide kick or other wetting agent.	Apply as directed on label.

F. BERMUDAGRASS RELEASE - RIGHTS-OF-WAY ONLY

glyphosate + sulfomenturon	(Roundup) 1.0 qt + (Oust) 1.0 oz + Cide Kick 1.0 qt	Apply in early spring or October for control of cool season grasses (Ky 31, fescue, et al) and weeds.

G. SUMMER GRASSES IN BERMUDAGRASS - RIGHTS-OF-WAY ONLY

sulfomenturon + glyphosate	(Oust) 0.25-0.5 oz + (Roundup) 1.0-2.0 pt + Cide Kick 1.0 qt	Apply in June for control of Dallas, broomsedge, johnson and annual grasses in 50 gal of water.

H. STABILIZED SHOULDERS AND GUARD RAILS		
glyphosate + diuron	(Roundup) 2.0-4.0 qt + Karmex 2.0-4.0 lb (product) + Cide Kick 1.0 qt	Apply in 50 gal of water in spring. Repeat of necessary. Keep off desired vegetation. Do not apply more than 2 ft past guard rail or edge of shoulder to prevent erosion of soil. Will not control bermudagrass.
glyphosate + surflan	(Roundup) 2.0-4.0 qt + Surflan 4.0 lb (product) + Cide Kick 1.0 qt	

Multiflora Rose and its Control in Pastures

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Multiflora rose (Rosa multiflora thumb.) has been planted in Virginia for more than forty years. It was grown in large quantities at a U.S. Soil Conservation nursery at Sandy Level, Virginia (near Gretna) from the late 1930's until 1953 when the nursery was closed. The nursery supplied the Civilian Conservation Corps and the Soil Conservation Service with plants for growing "living fences" and wildlife plantings. Plants were grown by the millions and shipped all over the United States. These original plantings have continued to spread resulting in the present widespread distribution.

In recent years, the Virginia Department of Highways has used multiflora rose in medians on interstate and other four-lane highways as crash barriers and for reducing headlight glare. The plants' vigorous growth habits made it ideal for these purposes. Multiflora rose has not been planted by the Virginia Department of Highways since the late 1960's at which time the planting of multiflora rose was totally discontinued by the agency. Nurserymen throughout the country continue to use the tough multiflora rose as rootstocks for cultivated roses. This use has likely been responsible for many infestations by sprouts coming from these rootstocks after the grafted plants died from diseases or other causes.

Well-established multiflora rose plants produce enormous quantities of fleshy seed that are eaten by birds and the seeds are spread over wide areas. Young plants produce a few seeds and it takes several years for them to become major sources of seed. Heavy infestations usually occur only where a nearby group of seed-producing plants at least ten years of age are present. Unfortunately, there are now enough of these old stands to thoroughly infest the state.

Methods of Application for Chemical Control

SUMMER FOLIAGE APPLICATIONS: BROADCAST SPRAYING Broadcast spraying of multiflora rose with a fixed boom is usually very difficult due to varying heights of individual plants and because the heavy growth of thorny stems makes the areas almost impenetrable. Probably the most satisfactory method of broadcast spraying from ground is to use a multiple orifice or "cluster nozzle" that will cover from 20-25 feet. Complete coverage with any ground broadcast spray rig is almost impossible. In heavy infestations, aerial applications will usually give better coverage and consequently better control. Aerial applications should be made with booms equipped with nozzles that deliver 15-25 gallons per acre using droplet sizes that are large enough to penetrate the dense foliage and to prevent drifting to sensitive crops. The liquid formulations of Tordon are not labeled for use on pastures but can be used on non-crop areas such as fence rows.

SPOT SPRAYING Spraying individual plants or clumps of multiflora rose is the most satisfactory method of ground application. A handgun directed on the plants insures good coverage and conserves the chemicals since the total area is usually not infested. Either a power sprayer or knapsack sprayer can be used. Use nozzles that produce large droplets since large droplets are less likely to drift onto sensitive crops or other nearby desirable vegetation.

Summer foliage application should be made with the low-volatile ester or amine formulation. Ester formulations of foliarly-applied herbicides are more effective than amine formulations, but ester formulations pose a greater hazard to nontarget plants due to the greater risk of volatilization and drift. Use amine formulations if crops sensitive to 2,4-D are growing near the site of application. Spraying should be done during the spring or early summer when plants are in full leaf and actively growing. Usually 50 gallons or more per acre are required to give good coverage. Most other woody plants are also controlled but resprouting may occur and another treatment may be required for complete kill.

DORMANT SPRAYING Certain formulations can be mixed with No. 2 fuel oil or kerosene and applied to the stem and base of multiflora rose during the dormant season. Oil mixtures kill grass and should be applied only as spot treatments where the area sprayed can be carefully controlled. Most of the formulations for use with oil will be designated as "O.S." or oil soluble. This means that they mix freely with oil. With certain oil soluble formulations, up to 85% water can be substituted for fuel oil--but only if designated on the label.

In making dormant applications with oil or oil-water mixtures as a carrier, it is necessary to thoroughly wet the lower third of te stems and the base of the multiflora rose. Oil and oil-water mixtures will drift as far as, or further than, sprays of water alone and care should be exercised when spraying near desirable vegetation.

GRANULAR APPLICATIONS The granular materials labeled for control of multiflora rose in pastures are picloram (Tordon 10K) and tebuthiuron (Spike 20P).

CAUTION: PICLORAM IS A HIGHLY MOBILE COMPOUND AND MAY BE MOVED WITH SURFACE OR UNDERGROUND WATER FOR SEVERAL HUNDRED FEET FROM THE POINT OF APPLICATION. MINUTE QUANTITIES WILL KILL LARGE TREES AND OTHER DESIRED VEGETATION. IT IS ESPECIALLY HARMFUL WHEN WASHED INTO PONDS USED FOR IRRIGATION. TOBACCO, TOMATOES, AND POTATOES ARE EXTREMELY SENSITIVE AND MAY NOT GROW FOR SEVERAL YEARS IN CONTAMINATED SOIL. SEVERE INJURY TO TOBACCO HAS OCCURRED FROM RIGHT-OF-WAY APPLICATION OF GRANULAR PICLORAM.

Picloram is highly effective because of the following properties: It (1) is water soluble and highly mobile, (2) is absorbed by both top and roots of plants, (3) is translocated both upward and downward to growing points, (4) decomposes slowly and, (5) is highly toxic to woody plants at very low concentrations. These characteristics also contribute to the injury of nontarget plants. Tobacco has been injured by the material getting into irrigation water and even from animal excretions after the animal grazed in treated areas. Tulip poplar and other trees growing 100 ft from area of treatment have been injured when roots growing into treated areas absorbed the chemical. Damage to trees or sensitive vegetation may occur at much greater distances when the material moves down a slope with surface or underground water. The label Restrictions for Pasture and Range Land Use and Use Precautions are especially important.

The label states "for use where training of applicators by state personnel or other state supervised programs are conducted in cooperation with the Dow Chemical Company." Proper training is extremely important because of the high degree of potency and extended soil persistence of picloram. Use of Tordon 10K for multiflora rose control in pastures is not considered a legal or recommended practice until the training has been completed or the applicator has been certified to use "Restricted Use" pesticides.

Tebuthiuron (Spike) is a nonselective herbicide, which can lead to bare ground at the site of application. Extent of injury to pasture grass depends on rate applied, soil type and other factors. Do not apply tebuthiuron near the root zone of desired trees.

Summary of Chemical Treatments for Use in Pastures

Method of Application	Chemical and Application Rate Active Ingredient	Application Techniques and Precautions
Foliar application	dicamba 1.0 lb + 2,4-D 2.0 lb/A (Banvel 1.0 qt + appropriate amount of a registered formulation of 2,4-D)	Ground applications: Wet foliage thoroughly in spring or early summer using 50-100 gals water/A. Aerial applications: Use 15 gals of water with drift control nozzle. Application same as above: Do not apply near desirable plants or in locations where chemical may move and come in contact with roots of desirable plants. Do not graze meat animals within 30 days before slaughter or dairy animals as follows: 7 days if 1/2 lb/A is used, 21 days if 1 lb/A is used, 40 days if 2 lb/A is used. Hay harvesting intervals appear on the label.
	2,4-D 2.0 lb + triclopyr 1.0 lb (Crossbow 1.0 gallon per 100 gallons water)	Spray to give thorough coverage of foliage and stems when multiflora rose is actively growing. Withdraw livestock from treated forage at least 3 days before slaughter during the year of treatment. Do not graze lactating dairy animals on treated areas for 1 year following treatment. Do not harvest grass for hay from treated areas for 1 year following treatment.
	glyphosate 2.0 lb (Roundup 2.0 qts/A, for spot treatment use 1 1/3 oz/gal or 1 gal per 100 gal) + 1/2% Cide kick or other wetting agent	Spot treatment for rose control. Will injure turfgrass. Remove livestock before application and wait 14 days after application before grazing livestock or harvesting grass.
Dormant spray	dicamba 0.25 lb (Banvel) 8.0 fl oz + 20 fl oz diesel fuel/gal of spray)	Mix with No. 2 fuel oil or kerosene as designated on label. Include an emulsifier to prevent oil and water from forming separate layers. Apply as directed with handgun on lower stems and base of plants. Grass will be severely injured or killed by this treatment. Apply as above--same precautions apply with dicamba as with foliage spray.
Granular applications	picloram 2.0-4.0 lb/A overall (20.0-40.0 lb of 10% Tordon 10K or Amdon 10K pellets)	Caution: Picloram is very mobile. Do not apply where runoff is likely to reach ponds used for irrigation. Do not apply within 100 feet of desired vegetation. It will kill plants located above the treated area if their roots extend into the treated area. Read special instructions on label for safe and effective use. Do not overapply as multiflora rose is very susceptible. Restricted use chemical.
	tebuthiuron 2.0 lb (Spike 20P 10.0 lb/A)	Apply prior to resumption of growth in spring. Grazing is only allowed in areas treated with 20 lbs or less of Spike 20P. In areas treated with 20 lbs or less of Spike 20P, grass may be cut for hay one year after applications. Will injure turfgrass. Do not apply in the root zone of desired trees.

The above treatments have clearance for use in pastureland. They may also be used in non-crop areas by following the label directions. Make sure the area where you want to apply pesticides is indicated in the directions of this label.