REVISED JANUARY 1978 PEST MANAGEMENT GUIDE 2

Commercial Recommendations for Disease, Insect, and Weed Control on Shade Trees and Shrubs

EXTENSION DIVISION

●

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Trade and brand names are used only for the purpose of information and the Virginia Cooperative Extension Service does not guarantee nor warrant the standard of the product, nor does it imply approval of the product to the exclusion of others which may also be suitable.

KEYS TO PROPER USE OF PESTICIDES

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

2. Keep pesticides in the containers in which you bought them. Put them where children or animals cannot get to them, preferably under lock and away from food, feed, seed, or other material that may become harmful if contaminated.

3. Dispose of empty containers in the manner specified on the label.

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

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. W. R. Van Dresser, Dean, Extension Division, Cooperative Extension Service, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061.

DISEASES

R. J. Stipes
Extension Specialist, Plant Pathology

Many landscape tree diseases can be controlled effectively with fungicides or with other chemicals. In all cases, however, trees should be maintained in the best possible vigor by a regular fertilization and watering program as needed. Soil tests are recommended before nutrients are applied. Additional information on several shade and ornamental tree diseases may be obtained from the County Cooperative Extension Office in the form of control series notes, bulletins, plant protection newsletters and mimeographed data.

Fungicides should be used only when a destructive disease is a known threat. For example, anthracnose control should be elected during prolonged, damp weather in late winter and early spring. Few diseases, however, require regular spray schedules on a yearly basis. Fungicides should be re-applied when washed off by rain following their application. Also, fungicides, for the most part, are designed primarily to be protective; that is, they must be applied *before* the fungus is deposited on the plant surface to prevent infection. They are ineffective, of course, when applied to established lesions. The addition of a spreader (surfactant)-sticker to the fungicide suspension often enhances disease control.

Pruning may be elected either as a horticultural practice, or in excising diseased or dead tissues or plant members. The disinfesting of tools used in these activities cannot be overemphasized. Many disease organisms are spread by careless workers who do not use disinfestants. Pruning tools should be dipped between cuts in some type of alcohol or in a household bleach solution made by combining 1 part of bleach and 9 parts of water; the solution is more effective when a little soap is added as a wetting agent. One may then apply a wound paint or spray, preferably one fortified with a disinfecting agent. Recent research indicates that certain wound paint preparations may not be effective in excluding wood-rotting organisms (See *ADDITIONAL COMMENT 3* at end of this section). In all cases, diseased tree parts of all kinds (whole trees, limbs, leaves, etc.) should be removed and, if possible, burned or buried. This eliminates or minimizes the source of inoculum.

A great number of decline problems are attributable directly to 1) *chemical exposure* (spillage of toxicants near or on roots, poisonous fumes, de-icing salts, excessive rates of turf herbicides, excessive rates of fertilizer, etc.); 2) *mechanical injury* (building, sidewalk or driveway construction, lawnmower injury at tree base, etc.); and to 3) *poor cultural factors* (improper planting or pruning method, inadequate or excessive soil moisture or fertilizer, lack of winter protection, etc.). In addition, trees that are weakened by the foregoing stresses are predisposed to the attack of disease organisms that normally are of little or no consequence. Insect control is also of great importance; insect attack is commonly observed in declining landscape trees and various species serve as vectors or carriers of important disease organisms. *Therefore, in the control of landscape tree diseases, one should seriously consider a total maintenance program.*

TREE AND DISEASE	FUNGICIDE, RATE[1/] AND REMARKS
APPLE, CRABAPPLE (*Malus*)	See *"Nursery Ornamentals"*, *"Home Ornamentals"* or *"Fruit Diseases"* sections.
ARBORVITAE (*Thuja*) Twig and leaf infections	See *"Nursery Ornamentals"* section.
ASH (*Fraxinus*) Anthracnose	Collect and either burn or bury fallen leaves. Also, see directions for control of anthracnose of maple.
Rust	Destroy the alternate host (marsh and cord grasses).
BASSWOOD (*Tilia*) (See LINDEN)	

1/ All rates (e.g., lbs./100 gal.) are *product rates*, not active ingredient rates, unless specifically stated otherwise.

Landscape Trees (Cont'd)

TREE AND DISEASE	FUNGICIDE, RATE[1] AND REMARKS
BIRCH (*Betula*)	
Anthracnose	Follow directions for anthracnose of maple.
Canker	Remove and destroy cankered branches by burning or burying in soil.
BUCKEYE (*Aesculus*)	
Leaf spot and blotch (See HORSE-CHESTNUT)	
CHESTNUT (*Castanea*)	
Canker	Excise cankers at least 1 inch beyond visibly stained bark tissues. A fungicide-amended wound dressing applied to the wound may be helpful in disease control (See *ADDITIONAL COMMENT 3* at the end of this section).
CATALPA (*Catalpa*)	
Leafspots	Collect and either burn or bury fallen leaves. No chemical can be recommended.
Powdery mildew	Spray with Benlate (0.5 lb./100 gal. = 1 tbsp./2 gal.) when disease first appears.
Verticillium wilt	See *Va. Coop. Ext. Ser. Control Series 117.*
DAWN REDWOOD (*Metasequoia*)	
Dothiorella Canker	Remove and destroy cankered branches by burning or burying in soil.
DOGWOOD (*Cornus*)	See section on *"Home Ornamentals."*
ELM (*Ulmus*)	
Black leaf spot	Collect and either burn or bury fallen leaves. Apply Bordeaux mixture (4-4-100) at budbreak in spring; repeat in 2-3 weeks.
Verticillium wilt	See *Va. Coop. Ext. Ser. Control Series 117.*
Dutch elm disease (DED)	An integrated program for susceptible elms is strongly recommended for maximum protection against DED. *PREVENTION* is the critical key to disease management. This integrated program consists of (1) sanitation--prompt removal and destruction of diseased trees by burning or burial, (2) supplemental spraying with methoxychlor to control the insect vector, (3) chemical or mechanical severance of root graft unions between diseased and healthy trees, and (4) prompt removal at the trunk of individual branches with new and restricted (5% or less of crown involvement) beetle-transmitted infections. *See Va. Coop. Ext. Ser. Control Series 103 for details.* Supplementary to this, foliar applications of benomyl have yielded additional efficacy, and these options are the use of (a) 1.0 lb. active ingredient (=2.0 lb Benlate product/100 gallons water, using 10-20 gallons of diluted spray per mature tree by hydraulic equipment OR (b) 4.0 lb. active ingredient (= 8.0 lb Benlate product)/ 100 gallons water, using 3 to 4 gallons of spray per mature tree by concentrate sprayer or mistblower. By either method, apply in spring when trees reach full leaf. A surfactant may be added to improve wetting of foliage.

[1] All rates (e.g., lbs./100 gal.) are *product rates*, not active ingredient rates, unless specifically stated otherwise.

Landscape Trees (Cont'd)

TREE AND DISEASE	FUNGICIDE, RATE[1] AND REMARKS
ELM (*Ulmus*) Dutch elm disease (DED) cont'd	Lignasan BLP[2], a DuPont Company internally-administered systemic fungicide, has undergone preliminary trials for prevention and cure of DED. Even though promising results have been reported following applications in preventive (before contraction of disease) and curative (after contraction of disease) situations, research has not adequately revealed the (1) degree and completeness of disease control, (2) extend of translocation within the sapwood and therefore extent of internal protection or therapy, (3) residual life, (4) optimum dosage per individual trees of varying sizes and related information. Lignasan BLP, when administered to symptomatic elms, should be applied before the removal of diseased branches. Treatment administered after crown involvement exceeds 5% may not be effective. The VPI & SU Extension Division recommends the administration of Lignasan BLP or other systemics as a component part of our integrated DED control package, as outlined herein, but not as a substitute for it. Lignasan BLP is to be used by trained arborists and others acquainted with the identification of DED and injection techniques. Consult your Extension Agent for specific information. Arbotect 20-S, a Merck Company internally administered systemic fungicide, has undergone preliminary trials for prevention and cure of DED. Research is presently in progress to document how well it moves within the tree and affords protection and cure. Adequate data are not available to recommend its use on a preventive basis, although it is registered as a preventative. Its use on diseased trees is recommended as follows. For each 5 inches of turnk diameter, inject 2 fluid ounces of Arbotect 20-S concentrate diluted in 40 fluid ounces (=2 1/2 quarts) of water (this is the minimum dose). The maximum dose suggested under more intense disease situations is to inject 4 fluid ounces of Arbotect 20-S concentrate diluted in 160 fluid ounces (= 5 quarts) of water. Therapeutic applications should be made as soon as the current year infections initiated by bark beetles are seen. Treatment may not be effective in trees exhibiting more than 5% crown symptoms. Do not make more than 2 consecutive applications each year. Alkaline water (with pH greater than 7.0) may cause precipitation and should be avoided. Arbotect 20-S should be used by trained arborists or others trained in the identification of DED and in injection techniques (pressure, gravity-feed).
Wetwood (slime flux)	See *Va. Coop. Ext. Control Series*
HAWTHORN (*Crataegus*) Rust (*Gymnosporangium*)	See *"Nursery Ornamentals"* section.
HICKORY (*Carya*) Leaf spot	Collect and either burn or bury diseased leaves. Spray with zineb 75% WP (2 lb./100 gal. = 1 1/2 tbsp./gal.) at budbreak, then twice thereafter at 10-day intervals, OR use recommendations for anthracnose of maple.

[1] All rates (e. g., lbs./100 gal.) are *product rates*, not active ingredient rates, unless specifically stated otherwise.

[2] Methyl 2-benzimidazolecarbamate phosphate. Lignasan BLP, a solution, contains 0.7% a. i.

Landscape Trees (Cont'd)

TREE AND DISEASE	FUNGICIDE, RATE[1/] AND REMARKS
HORSE-CHESTNUT and BUCKEYE (*Aesculus*)	
Leaf blotch and other leaf spots	Same as for control of anthracnose leafspot of hickory with zineb.
JUNIPER	
Rust (*Gymnosporangium*)	Spray with zineb monthly as needed.
LINDEN or BASSWOOD (*Tilia*)	
Anthracnose, leaf spots and leaf blotch	Collect and either burn or bury diseased leaves. Spray with Bordeaux Mixture (8-8-100) just after budbreak, and repeat twice thereafter at 10-day intervals. Also for anthracnose control, see directions for anthracnose on maple.
Powdery mildew	Follow suggestions for powdery mildew of Catalpa.
MAGNOLIA (*Magnolia*)	
Powdery mildew	Follow suggestions for powdery mildew of Catalpa.
Leaf scorch, winter injury	Apply foliar anti-desiccant such as Vapor-Gard, Wilt Pruf NCF or other according to manufacturer's recommendation.
MAPLE (*Acer*)	
Anthracnose	Apply Benlate (1 lb./100 gal. = 1 tbsp./gal.) at budbreak and repeat at 10-14 day intervals throughout the growing season.
Zonate leaf spot	Collect and either burn or bury diseased leaves.
Tar spot	Spray with Bordeaux Mixture 4-4-100 at budbreak; repeat in 2-3 weeks.
Verticillium wilt	See *Va. Coop. Ext. Ser. Control Series 117.*
Scorch	Scorch, the "burning" of leaf margins, occurs commonly in early spring to summer due to moisture stress. Supplemental watering often alleviates or prevents the problem. Antitranspirants have proven helpful.
MIMOSA (*Albizia julibrissin*)	
Fusarium wilt	See *Va. Coop. Ext. Ser. Control Series 95.* Resistant cultivars are not available.
MOUNTAIN ASH (*Sorbus*)	
Fire blight	Follow directions for sanitation recommended for fire blight of apples in *Control Series Publication 35.*
Cytospora canker	Remove and destroy cankered branches by burning or burying in soil.
Leafspot	No chemical can be recommended.

[1/] All rates (e. g., lbs./100 gal.) are *product rates*, not active ingredient rates, unless specifically stated otherwise.

Landscape Trees (Cont'd)

TREE AND DISEASE	FUNGICIDE, RATE[1] AND REMARKS
OAK (*Quercus*)	
Anthracnose	Collect and either burn or bury diseased leaves. Spray with zineb 75% WP (2 lb./100 gal. = 1 1/2 tbsp./gal.) at budbreak and twice thereafter at 10-day intervals, OR follow directions for control of anthracnose of maple.
Endothia canker	*Endothia parasitica*, the chestnut blight pathogen, produces cankers on various species of oak, especially live oak. *Endothia gyrosa*, causal agent of pin oak blight, may also be pathogenic to other species of oak. Remove cankered branches at the trunk or at the major adjoining branch and destroy by burning or burying in soil. Avoid wounding of any kind, especially lawnmower injuries and trimming of lateral branches on the pin oak. Keep pin oaks well watered. Provide nutrients on a regular basis as needed.
Oak wilt	For prevention of root graft transmission: Immediately after a tree is positively diagnosed as having oak wilt, isolate the diseased tree from healthy oak trees by drilling holes about 0.75 to 1.0 inch in diameter, 15 inches deep, and 6-9 inches apart in a line between the diseased and healthy tree sufficiently long to kill all oak roots of the two adjacent trees that are likely to be root grafted. Dilute 1 volume of a 32.7% formulation of Vapam (SMDC) with 10 volumes of water. Fill each hole with the diluted solution to within 2 inches of the soil surface and close by tamping with the heel. In order to reduce grass kill, avoid overflowing the holes. If a diseased tree is less than 20 feet from a healthy one, or if the diseased tree has advanced symptoms, it is necessary to treat between the diseased tree and the first healthy appearing trees. About 2-3 weeks after Vapam application, the diseased tree should be removed and either burned or buried. For a diagrammatic sketch of the method, see *Control Series 103*. Although systemic fungicidal control methods are being developed, they are not recommended at this time. LIMITS: Should be done by professional applicators.
Chlorosis	Chlorosis (yellowing) is a common problem in Virginia on pin oak (*Quercus palustris*) and willow oak (*Quercus phellos*). Symptoms occur commonly, but not always, in sections of the affected tree, and may be caused by iron deficiency. For control, soil pH should be adjusted to about 6.0 or slightly less and an iron chelate supplement applied if needed. Extension Agents can provide detailed information. General chlorosis may also be caused by moisture stress, and if so can be controlled by supplemental watering during dry periods.
Mortality	The incidence of rapid death of landscape white oak (*Quercus alba*) appears to be increasing across Virginia. Trees die rather quickly, with their fully-expanded leaves attached and changing uniformly to a tan color. Control, of course, depends upon the cause which is unknown at this time. Since insect vectors and a causal fungus may be involved, it is advisable to promptly remove and burn symptomatic trees.

[1] All rates (e.g., lbs./100 gal.) are *product rates*, not active ingredient rates, unless specifically stated otherwise.

Landscape Trees (Cont'd)

TREE AND DISEASE	FUNGICIDE, RATE[1] AND REMARKS
PEAR (*Pyrus*)	For fire blight control, see *Control Series 88.*
PINE (*Pinus*)	
Tip blight and needle cast	Collect and either bury or burn diseased twigs and needles in autumn. Spray with Bordeaux Mixture (4-4-100) as new growth starts, as needles emerge from sheath and when needles are 2/3 of mature length. Use a spreader-sticker with fungicide if possible.
Mortality	The incidence of rapid death (as casually observed) of landscape white pine (*Pinus strobus*) is increasing across the state. Symptoms vary and in most cases air pollutants do not seem to be involved. Control of this problem depends on its cause which is unknown. Since a transmissible root (soil-borne) fungus may be involved, dead trees with root systems should be removed promptly and burned. White pine should not be replanted in the problem location.
POPLAR (*Populus*)	
Cankers	Remove and destroy cankered branches by burning or burying in soil.
PLANE-TREE, BUTTONWOOD (See SYCAMORE)	
SEEDLINGS, Various	
Damping-off	Soil sterilization: See procedures listed in *"Nematode Control"* section or consult Extension Agent.
SPRUCE (*Picea*)	
Cytospora canker	Remove and destroy cankered branches by burning or burying in soil.
SYCAMORE (*Platanus*)	
Anthracnose	Follow suggestions for control of anthracnose of maple.
WALNUT (*Juglans*)	
Anthracnose	Follow directions for anthracnose of maple.
WILLOW (*Salix*)	
Fungal cankers	Remove and destroy cankered branches by burning or burying in soil.
Crown gall	See *Ext. Publication MR-0-20, "Crown Gall of Ornamentals."* Galls on larger trees may be removed surgically, and a wound paint applied to wound. Disinfest tools between cuts. Galls should be removed during late fall or midsummer when sap flow is minimal.

[1] All rates (e.g., lbs./100 gal.) are *product rates*, not active ingredient rates, unless specifically stated otherwise.

Landscape Trees (Cont'd)

ADDITIONAL COMMENTS:

1. If Bordeaux Mixture is unavailable, another copper-containing fungicide may be substituted if there is a label clearance for its specific use.

2. For information on chemical injury to shade and ornamental trees, see *Va. Coop. Ext. Ser. Control Series CS 129*. Currently, no control measures can be recommended for injuries resulting from air or other chemical pollutants. Supplemental feeding may be helpful.

3. For the exclusion of wood-rotting fungi, any of the following compounds may be applied thinly and evenly over freshly-cut surfaces and wounds: 1.0% thiram, 3.3-10.0% copper naphthenate or 2.0% sodium o-phenylphenate in an asphalt or other non-fortified tree wound preparation.

4. If trees susceptible to Verticillium or Fusarium wilts or other root diseases must be planted in sites from which such diseased trees were removed, one must carefully and thoroughly fumigate the infested soil according to approved recommendations in the *"Nematode control"* section of this publication.

5. The vigor of unthrifty and undernourished trees, commonly susceptible to various diseases and environmental stresses, often can be greatly improved by periodic applications of nutrients. Soil tests are always recommended prior to feeding especially if a soil fertilization program has been in effect. In general, a 10-10-10 (NPK) fertilizer at the rate of 2-4 lbs. per inch of tree diameter at waist height can be applied in holes evenly distributed in the ground beneath the tree. See *Control Series 106* for specific recommendations.

INSECTS

John A. Weidhaas, Jr.

These recommendations are for use by nursery producers, commercial and municipal arborists, and other Certified Applicators, Category III, who are responsible for the production, care, and protection of shade trees, shrubs, and other woody ornamental plants. Pest control is a highly complex and technical part of ornamental horticulture requiring technical knowledge, effective planning, and skillful implementation of cultural and pest control practices.

There is no simple, magic formula for pest control on trees and shrubs. More than 250 species of insects and mites are commonly found which damage or are potentially injurious to over 100 genera of woody ornamentals. Great diversity by insects in host preferences, seasonal development, periods of activity, habits, and susceptibility to insecticides requires careful planning and critical timing of control measures. It is a simple fact that insects and mites will occur , multiply, and cause serious losses if ignored or inadequately controlled. The most frequent cause of insect problems is the failure of nurserymen and arborists to carry out necessary control procedures properly at the right time due to pressures from other phases of production and maintenance. The consequence, without exception, is a much more difficult and costly situation.

The best way to control insects and mites is a preventive program. First, do not introduce pest problems. In nursery production, propagate or buy ONLY clean, uninfested stock plants. In municipal tree planting or private landscaping, set out ONLY insect-free plant materials. The presence of a few, hardly noticeable insects or mites at planting time is a sure source of extra work and costly effort later on. Second, draw up a seasonal pest control schedule to prevent the establishment and buildup of insects and mites which may have been overlooked or can move in from nearby areas by natural migration. Third, maintain regular surveillance of established plant materials and be prepared to schedule special remedial control measures for difficult or complex pest problems which arise. Take advantage of assistance from your local Extension Agent, Agriculture, and the Extension Specialists at the University in Blacksburg.

How to use these recommendations

Prepare a seasonal control schedule for your specific plant types and pest problems. Each nursery, municipality, or local area tends to have its own unique pest situation depending on routine cultural and control practices. If the pest situation is not known, conduct a thorough survey to determine which problems exist and what the control needs are. Review and study the recommendations so that a seasonal spray schedule can be planned. Select those treatments which most conveniently fit the work plan in your own operation. For example, the use of dormant sprays on many plants will minimize or eliminate the need for spraying operations during the busier periods or at times when it is essential to be involved controlling other critical pests. Another example is controlling spruce and southern red mite in the fall rather than the spring, or controlling pine needle scale in late July rather than in May. With careful study and planning, these recommendations can be adapted to an effective, seasonal, preventive control program. There are numerous built-in options and alternatives. It is essential to carry out the program precisely. Thoroughness and proper timing are critical in obtaining effective results.

Precautions

Be absolutely sure to read and follow ALL of the directions and precautions on the labels and accompanying brochures of the pesticides used. Every statement included is important and can prevent serious injuries or losses. Be absolutely sure that those involved in the application of pesticides are fully informed of all precautions for use and are trained in the application techniques. Formulations and amounts to mix in preparing sprays are not given here. Consult the labels for directions. It is illegal to use pesticides inconsistent with uses specified on the label. Be sure the host plants and pests to be controlled are stated on the label of the product you use.

Toxicity and hazard to man and animals.

As a guide to general hazards of chemicals, know the relative toxicities of common insecticides. Also study the precautionary statements on pesticide labels. Certain chemicals may be more readily absorbed through the skin, or may be less toxic when skin exposure is involved than if the chemical is ingested. Some may be relatively non-toxic to bees and birds, but highly toxic to fish. In using pesticides, avoid application where undesirable side effects may result. In spraying it is essential to stay out of drift and direct spray. Wear protective equipment when using the more toxic materials.

Plant injury

Insecticides vary greatly in their phytotoxicity. Be sure to avoid treating sensitive plants. Cautions on the label usually indicate plants which should not be sprayed. Read the entire label carefully. Dimethoate is one of the more variable chemicals, causing foliage injury on elms, chrysanthemums, andromeda, some varieties of azaleas but not others, burford and Chinese holly but not Japanese or other types, honey locust, dogwood, crab apples, and maple. Carbaryl may injure tender foliage if plants are wet when treated or in the presence of high humidity; it should not be used at any time on Boston ivy or Virginia creeper. Endosulfan may injure white birch, redbud, and Anderson yew. Malathion may cause injury to certain junipers, eleagnus, hibiscus, some rose varieties, certain ferns. Methoxychlor should not be used on Chinese elm, Japanese maple, red maple, or redbud. Petroleum oils for dormant or summer spraying are much safer now than in earlier days, but should not be used on birch, beech, sugar and Japanese maple, hickory, walnut, butternut, douglas fir, spruces, or juniper.

It is important not to mix pesticides which are not compatible with each other, and to avoid formulations not intended for use on plants. Formulations used for structural pest control should not be applied to plants.

Pest	Control	Timing of Treatment	Remarks
APHIDS (general)	petroleum oil (Scalecide, Volck, Superior, etc.) (60-70 Visc, 92% UR min.) or oil plus ethion	March and April before buds open and when temperature will not go below 40°F (5°C) for 12-24 hours following treatment.	Kills overwintering eggs and aphids. Dilution rate varies as to pest and host. Follow label directions carefully. Do not use oil on sugar or Japanese maple, beech, black walnut, butternut, hickory, redbud, or juniper.
	malathion or diazinon or Sevin or Thiodan or Metasystox-R or DeFend or Cygon or Trithion or DiSyston	Generally when aphids are first seen. Some (such as spirea, willow twig, white pine aphid) occur in the spring. Others (such as willow leaf, elm leaf, linden maple and oak) build up in mid-summer. Many (including white pine aphid) may be present, migrating to hosts, throughout the season and in the fall.	Apply control measures before populations become large. Aphids may infest buds, leaves, stems, branches, or trunks of the host plants. Be sure to follow all label directions and precautions. Use less toxic and less hazardous materials in public areas, around homes, and where plants are to be moved or transplanted. Do not re-enter areas sprayed with MSR or Trithion for 48 hours without protective clothing.
APHIDS (phylloxerids) general	petroleum oil or oil plus ethion	March and April before buds open and when temperatures will not go below 40°F (5°C) for 12-24 hours following treatment.	Do not use oil on douglas fir or blue spruces; oils remove the bloom of the foliage. Otherwise, this treatment can be used for the pine bark aphid, hemlock woolly aphid, and spruce gall aphid excepting blue spruce and douglas fir.
spruce gall aphids	lindane or malathion or diazinon or Thiodan	Treat just before buds break in the spring, and/or in September and early October after galls have opened.	Spring treatments should be applied before cottony egg masses are evident on buds in the spring. Cooley spruce gall aphid on douglas fir does not produce galls; it feeds openly on the needles. Do not use Thiodan on birch trees.
pine bark aphid	lindane or malathion or diazinon or Thiodan or Trithion	Treat in late April or early May and repeat 2-3 weeks later.	Use a forceful spray to penetrate cottony excretions and wash aphids from twigs and bark. Use less toxic materials in public areas and around homes. Do not use Thiodan on birch trees. Do not re-enter areas sprayed with Trithion for 48 hours without protective clothes

Pest	Control	Timing of Treatment	Remarks
hemlock woolly aphid	diazinon	Treat in late June and/or in September and October.	Thoroughly wet entire plant including the bark of branches and the trunk. Use a forceful spray, but be sure the new growth is thoroughly wet.
hickory leafstem gall aphid	malathion or MetaSystox-R	Treat just as new buds are beginning to open. Timing is critical.	Because aphids begin feeding immediately as leaf buds begin to open, control is very difficult and often ineffective. Do not re-enter areas sprayed with MetaSystox-R for 48 hours without protective clothes.
BAGWORM	diazinon or malathion or Sevin or DeFend or Cygon or Dursban or Dylox or Orthene or Trithion	Apply treatments in mid-June when young caterpillars are active. As the season progresses, controls become more difficult and less effective.	Lightly misting the foliage is sufficient. Mist blower treatments are effective. Do not use the more toxic or hazardous materials in public areas or around homes. Do not re-enter areas sprayed with Trithion for 48 hours without protective clothing.
	Dipel or Biotrol	Treat when larvae are young in mid to late June. May be effective in July.	Lightly misting the foliage is sufficient. Mist blower treatments are effective.
	Remove and burn bags	August to May for light infestation of relatively few insects or few infested trees.	Overwintering eggs remain inside the bags until hatching in late May. Destroy the bags; eggs will hatch from bags thrown on the ground.
BARK BEETLES general	lindane or Thiodan (on felled logs or trees only)	Since most beetles attack weakened, recently cut, or dying wood, treatments should be applied to prevent infestation of and breeding in the bark. Treat wood with bark attached or trees as soon as they become susceptible. Treat weakened or injured trees in late april and repeat 2-3 times at monthly intervals.	Thoroughly soak the bark of the trunk and branches. Sprays are more concentrated than usual foliar treatments; avoid excessive drip and wear protective clothing and equipment.
elm bark beetle (See Control Series 103 "Dutch Elm Disease")	sanitation	Immediately destroy all branches larger than 1-1/2" in diameter and wood with bark as soon as it dies or is in a dying condition, or is cut, to prevent infestation and breeding by beetles.	Wood should NEVER be piled or stored unless all of the bark is removed. Where possible susceptible wood should be burned or buried with at least 18" fill.
	methoxychlor	As late in the spring as possible before LEAF BUDS open, usually early April or late March depending on plant zone. This treatment can be supplemented with a second spray in early June.	Complete coverage of all bark is absolutely essential, especially the one year old twigs in the tops and outer reaches of the trees. The trunk and larger branches should be soaked thoroughly. Spraying is supplementary to sanitation. (See Control Series 103).

Pest	Control	Timing of Treatment	Remarks
pine bark beetles, southern pine beetle, engraver beetles, turpentine beetles (Ips, Dendroctonus)	lindane	Treat unhealthy, weakened or damaged growing trees in early April, early June, and August if near infested areas. Also effective in preventing spread if sprayed on infested trees or wood before beetles emerge, or in preventing infestations in uninfested wood that is cut but cannot be disposed of immediately.	Thoroughly wet all of the bark. Healthy vigorous trees are not likely to be attacked and do not require spraying. Beetles will not reinfest nor attack wood or trees dead more than one year.
	sanitation	Throughout the year, particularly during the growing season, when trees begin dying or wood is cut. Prune out large, dying or recently dead branches.	Dispose of susceptible wood, slash, and bark from stumps by utilization, burning, or burying where feasible. Beetles will not reinfest nor attack wood or trees dead longer than one year.
shot-hole borer, fruit tree bark beetles, ash bark beetle (Scolytus)	lindane	Protect the bark of healthy trees through the growing season by sprays applied in April, June.	Normally, these pests are infrequent so that it is not necessary to spray all healthy trees annually. If any beetles or signs of their presence are found, treat all healthy trees in the vicinity.
BORERS ash borer	lindane or Dursban	Treat trunk and main stems in mid-late May and again in mid-late June.	Control measures are preventive treatments aimed at egg-laying adults and/or newly hatched larvae prior to tunneling into the tree. Treatments also kill emerging as well as entering beetle borers. Thorough wetting and soaking of the bark is necessary. Foliage need not be treated.
lilac borer	lindane or Dursban or Thiodan	Treat trunk and branches in mid-late May and repeat 2-3 times at 10 day intervals.	
dogwood borer	lindane or Thiodan	Treat trunk and larger branches in early May and repeat 2-3 times at three week intervals.	
peach tree borer	lindane or Thiodan	Treat the trunk and soil around the base in late May and repeat with treatments at 3 week intervals.	
rhododendron borer	lindane	Treat the trunks and larger branches in early May. Repeat twice at 3 week intervals.	
bronze birch borer	lindane	Treat all bark surfaces especially in the uppermost part of the tree in mid-May, early, mid-and-late June	
two-lined chestnut borer	lindane	Treat trunk and branches, during mid-late May and mid-late June.	
azalea stem borer, dogwood twig borer	lindane	Treat one year old stems throughout the tree in mid-May and in mid-June.	
round-headed and flat-headed tree borer	lindane	Treat bark of trunk and branches in early May, early June, and early July	
mottled willow borer (popular and willow borer)	lindane	Treat all bark surfaces in mid-late June and in late August-early September	

Pest	Control	Timing of Treatment	Remarks
BORERS (continued)			
locust borer	lindane	Treat the trunk and larger branches in late August to mid-September (after goldenrod is in bloom).	
Zimmerman pine moth	lindane or Thiodan or DeFend	Treat in mid-April and in late fall. Thoroughly drench bark and branch crotches.	
round-headed and flat-headed borers, bark beetles, and bark weevils in felled logs or trees only	lindane or Thiodan	Thoroughly wet the bark surface immediately after trees or logs are cut.	
CICADA (periodical cicada)	Sevin	Treat bark of twigs on susceptible hosts soon after adult male singing becomes evident, usually around early May.	Cicada damage is caused by adult females inserting eggs in deep slits in twigs. Control is necessary only in the year of various 13-year and 17-year brood emergence.
DEFOLIATORS (general)	Sevin or diazinon or malathion or methoxychlor or Thiodan or Bacillus thuringiensis or Dursban or Imidan or Orthene	When insects are first observed feeding. Timing varies with the species. It is critical to observe plants regularly to detect feeding as soon as it begins.	Specific uses are limited by current labeling directions. Many species, though important are not included on present labels. Insecticide combinations marketed by formulators and distributors are available. Consult the labels for specific uses and precautions. Seeintro. Plant Injury. Mist blowers are effective.
cankerworms	methoxychlor or Imidan or Bacillus thuringiensis or diazinon	In the spring where the leaves are half to two-thirds full size, treatments must be applied when loopers are small.	Do not use methoxychlor on Chinese elm, Japanese or red maple, or redbud. See intro., Plant Injury. Mist blowers are very effective.
elm leaf beetle	Sevin or methoxychlor	Treat in mid-to late May, when eggs have hatched, but larvae are small. Second generation may need treatment in mid-to-late July.	Do not use methoxychlor on Chinese elm. Sevin may injure tender foliage if plants are wet when treated or humidity is high.
fall webworm	diazinon or methoxychlor or Dursban or Bacillus thuringiensis.	When larvae first begin to feed in late June. Repeat in late July.	Do not use methoxychlor on Chinese elm, Japanese red maple, or redbud.
flea beetle	diazinon or Sevin	When insects are found feeding on host plants as adults or as larvae.	See precautions above for Sevin and intro, Plant Injury.
grasshoppers	Dursban	When grasshoppers are found feeding.	Grasshoppers are very infrequent pests but can be destructive.
gypsy moth	Sevin or Imidan or Bacillus thuringiensis or methoxychlor or Orthene.	When leaves have expanded but caterpillars are small, usually in early or mid-May.	See intro.,Plant Injury. Mist blowers and aerial applications are effective.

Pest	Control	Timing of Treatment	Remarks
DEFOLIATORS (continued)			
Japanese beetle	Sevin or methoxychlor or malathion	In late June or early July after adults have begun to congregate on selected hosts. Repeat at 2 or 3 week intervals as necessary into August.	Since adults are active flyers and move continuously, they seem to be present constantly even where treatments have been applied. See intro., Plant Injury.
orange tortrix puss caterpillar	Sevin	In mid-or late summer when insects are seen.	Sprays are usually ineffective if applied when caterpillars are mature. See intro., Plant Injury.
rose chafer	Thiodan	During June or mid-summer when insects are found.	Adults are active flyers and move continually onto susceptible hosts.
rose slugs	Sevin	Throughout the growing season when young larvae are seen on plants.	Close inspection of plants is necessary to time treatments when larvae are young and damage is not yet severe. See intro, Plant Injury.
sawflies	malathion	Timing varies in the season depending on the host plant and the sawfly species.	Host plants specified on labels; are limited to pines, larch, ash and spruce.
tussock moth	methoxychlor	In mid-May or late August	Treat when larvae are small.
willow leaf beetle	Sevin	In May, June, and later if infestations persist. There may be several generations in a season.	Be sure to treat the undersides of the leaves.
GALL INSECTS	No insecticide registered for most gall insects.	Most gall insects sting or feed on the host to incite the galls. The site of attack and intensity of populations is unpredictable. Most galls are not serious or fatal.	Most gall insects leave the galls when mature. Disposing of galls is not effective in reducing the pest unless they can be cut out while they are actively growing, such as horned oak gall and gouty oak gall.
LACEBUGS	Sevin or lindane or malathion or dimethoate or DiSyston or methoxychlor	On evergreens, overwintering eggs hatch in mid-late May. Treat in late May or early June and repeat 2-3 times at 3 week intervals. On deciduous hosts, adults emerge in May. Treat in late May and repeat 2-3 times at 3 week intervals.	Consult the label for host plants and specific pests listed under directions for use. Treatments must cover the undersides of the leaves thoroughly. Control of the first generation is most important to slow population buildup.
LEAFHOPPERS	Sevin or Dursban or MetaSystox-R	When leafhoppers are first seen and before stipling on uppersides of leaves becomes extensive.	Thorough coverage is essential on the undersides of the leaves. Do not re-enter areas sprayed with MSR for 48 hours without protective clothing.
LEAFMINERS			
azalea leaf miner	dimethoate or Azodrin	Treat in mid-late May or when larvae are first seen on the plants.	Azodrin is labeled for use by commercial nurserymen only. Be cautious with dimethoate on azaleas, some varieties may be susceptible to plant injury.
boxwood leafminer	diazinon or malathion or Sevin or lindane	Treat in late April or early May when adults are active.	Numerous adults can be eliminated before eggs are laid.
	dimethoate	Treat in mid-late June after eggs have hatched.	This systemic treatment is most effective in eliminating miners. It is also effective later in the season, but mining will be present in the foliage.

Pest	Control	Timing of Treatment	Remarks
LEAFMINERS (continued) holly leafminer	diazinon or Dylox	Treat in mid May when adults are active on the foliage.	Helps to reduce feeding punctures on undersides of leaves but may not prevent all mines in the foliage.
	dimethoate or MetaSystox-R*	Treat in mid-late June after eggs have hatched.	These systemics are effective in eliminating miners, they are also effective later in the season, but mining will be present on the foliage. DO NOT TREAT CHINESE OR BURFORD HOLLIES.
locust leaf miner	lindane	Treat when mines first begin to show. Repeat in early July.	Thoroughly spray the foliage with a full coverage spray.
LEAFROLLERS, LEAF TIERS	Sevin or diazinon or Imidan	Treat when insects are first seen. On some hosts, injury occurs in early spring when new buds are opening.	Imidan is currently labeled for fruit trees and can be used on flowering fruits only. Consult the label for specific host plants listed.
MEALYBUGS	petroleum oil (Volck, Superior, etc.) or oil plus ethion	Treat in late spring, before new growth begins.	Forceful spray streams help penetrate cracks and crevices in the bark and waxy secretions that protect the mealybugs. Spray on warm days when the temperature is not likely to go below 40°F (5°C) for 12-24 hours. Do not spray sensitive plants listed on the label.
	malathion or Sevin or dimethoate or Dursban	Treat whenever mealybugs are first noticed. Repeat 2-3 applications if necessary until infestation is eliminated.	Forceful spray streams help penetrate cracks and crevices in the bark and waxy secretions that protect the mealybugs. See intro. - "Spray Injury".
MITES			
hemlock rust mite	petroleum oil (Scalecide, Volck Superior, etc.)	Treat in early spring before new growth develops.	Do not use on sensitive plants indicated on the label. Oil-ethion can be used.
	Kelthane	Mites reproduce and build up when temperatures are in the fifties. Treat on warm days when freezing is not likely to occur in early spring or late fall. Treat when mites are found during the growing season.	Thoroughly wet the upper and lower leaf surfaces with a full coverage spray.
spruce mite and southern red mite boxwood mite	Kelthane or dimethoate or MetaSystox-R*	Treat in late April or early May and/or in September and October.	Thoroughly wet all of the foliage and stems with a full coverage spray.
honeylocust mite	Kelthane	One application in late June or early July will prevent damage. Treat when mites occur to control established infestations.	Thoroughly wet the undersides of the leaves in a full coverage spray.
two-spotted mite	Kelthane or dimethoate or MetaSystox-R* or DiSyston	Treat whenever mites first appear. Infestations may occur from spring to fall. Mite infestations are directly proportionate to increasingly warmer temperatures.	Follow the label directions for host plants to be treated and precautions for application of sprays.

*Do not re-enter areas sprayed with MSR for 48 hours without protective clothing.

Pest	Control	Timing of Treatment	Remarks
PLANT BUGS	Sevin or malathion	Treat when insects or signs of damage first appear.	Control is difficult because plant bugs are active flyers and move around continuously.
SAWFLIES	Malathion Sevin Methoxychlor	Treat when insects are first seen. Various species can occur throughout the growing season. Treat in April for Virginia pine sawfly. Larvae are gregarious, thus broods are clustered on one branch or localized on scattered trees.	A number of damaging species are not listed on labels. Ash, larch, pines, and spruces are listed.
SCALE INSECTS	petroleum oil (Scalecide, Volck, Superior, etc.) --- oil plus 2% ethion	Treat in late March or early April before new growth develops, and when temperatures are not likely to go below 40°F (5°C) for 12-24 hours.	Do not spray oil sensitive plants listed under precautions on the label. Be sure to follow the dosage rates given on the label for the various scale species.
azalea bark scale	Sevin or malathion or diazinon	Crawlers: June 5-30. Treat June 10 and 20.	
brown soft scale	Sevin or diazinon or Trithion	Treat when scale insects appear. Treat 2-3 times at 10-day intervals.	This scale insect does not winter out-of-doors in Virginia.
camellia scale	dimethoate	Crawlers: May 1-June 5; and September 15-30. Treat May 10 and 20 and/or September 10 and 20.	
cottony maple scale	Sevin	Crawlers: June 5-25. Treat June 10 and 20.	
euonymus scale	malathion or dimethoate	Crawlers: first generation May 5 to June 10; second August 1-25. Treat May 10 and 20, and August 5 and 15.	Be sure to cover thoroughly stems and branches near the ground.
European elm scale	Sevin or diazinon	Crawlers: June 5-25. Treat June 10-15.	
European fruit lecanium scale	Sevin or Trithion	Crawlers: June 1-20. Treat June 10-15.	Do not re-enter areas sprayed with Trithion for 48 hours without protective clothing.
fiorinia hemlock scale	dimethoate	Crawlers: peak May 15-June 20, some produced throughout the season. Treat May 20-25 and June 5-10.	
fletcher scale	Sevin or dimethoate	Crawlers: June 5-25. Treat June 10-15.	
forbes scale	Sevin or malathion or Trithion	Crawlers: June 1-15. Treat June 5-10.	Label uses restricted to flowering fruits. Do not re-enter areas sprayed with Trithion for 48 hours without protective clothing.
golden oak scale	dimethoate	Crawlers: June 1-30. Treat June 10 and June 20.	
juniper scale	Sevin or malathion	Crawlers: April 5-20 and June 5-20. Treat April 10-15 and/or June 10-15.	
latania scale	Trithion	Crawlers continuous through season. Treat June 25, July 10, and September 20.	Do not re-enter sprayed areas for 48 hours without protective clothing.

Pest	Control	Timing of Treatment	Remarks
SCALE INSECTS (continued)			
lecanium scale	diazinon or Dursban	Crawlers: June 5-25. Treat June 15-20. For oak lecanium, Treat July 5-10.	
oak kermes	malathion	Crawlers: June 1-20. Treat June 10-15.	
oystershell scale	Sevin or Trithion	Crawlers: May 1-20 and July 15-25. Treat May 5-10 and/or July 20-25.	Do not re-enter areas sprayed with Trithion for 48 hours without protective clothing.
pine needle scale	Sevin or malathion or diazinon or Dursban or Trithion or Supracide	Crawlers: May 15-30 and July 10-20. Treat May 5-20 and/or July 15-20.	Do not re-enter areas sprayed with Trithion for 48 hours without protective clothing.
pine tortoise scale	Sevin or Supracide	Crawlers: June 10-July 5. Treat June 20-25.	
rose scale	Sevin	Crawlers: late May-June 30 possible second generation in August. Treat June 5-10 and 20-25 and in mid-August.	
San Jose scale	Sevin or diazinon or Trithion	Crawlers: at least 3 generations June, July and September. Treat June 10-15, July 10-15, September 10-15.	Do not re-enter areas sprayed with Trithion for 48 hours without protective clothing.
tea scale	dimethoate or Dursban or Trithion	Crawlers: Throughout season in overlapping generations. Treat 2-3 times at 10 day intervals when infested.	Do not re-enter areas sprayed with Trithion for 48 hours without protective clothing. Do not use dimethoate on Chinese or burford hollies.
wax scale	Sevin	Crawlers: June 5-25. Treat June 5-10.	Thoroughly wet foliage and bark in full coverage spray.
white peach scale	Dursban or diazinon or malathion	Crawlers: April 25-May 15, July 1-15, August 20-September 15. Treat May 1&10, July 5&15. September 1&10.	
TENT CATERPILLARS	Sevin or methoxychlor or Bacillus thuringiensis or diazinon	Treat in early spring as new growth is developing and when caterpillars are small.	Caterpillars leave the nests to feed on the foliage during the day. Apply full coverage spray to the entire tree.
THORNBUGS (tree hoppers)	Sevin	Treat when nymphs are seen on twigs (usually in clusters) before adults are present to begin egg-laying - usually in late summer and fall.	Apply sprays to cover the small twigs thoroughly.
TIP MOTHS	dimethoate or Dylox or DiSyston	Treat with Dylox in mid April, June and July when moths are flying. Treat with Dimethoate when larvae activity begins in late April, late May and early June. Treat with DiSyston soil application 2-3 weeks prior to adult activity in late March.	Spray entire tree to runoff. Two and three needle pines are susceptible to tip moth. Soil systemic treatment with DiSyston requires only one application annually; for nursery use and professional applicators only.

Pest	Control	Timing of Treatment	Remarks
WEBWORMS			
cotoneaster webworm	diazinon	Treat when larvae are first found. Timing not well established.	Apply a full coverage spray wetting foliage to the point of runoff.
juniper webworm	diazinon	Treat in late July or August when larvae are small. Spring treatments may be applied when plants are found to be infested.	Apply a forceful spray to penetrate badly webbed foliage. Thoroughly wet the foliage to runoff.
fall webworm	diazinon or Dursban or Bacillus thuringiensis or methoxychlor	Treat in late June or early July when larvae are small and webs just starting to form.	Caterpillars are gregarious and infest individual branches. Apply full coverage foliar spray to infested area, or entire trees in years of high populations.
mimosa webworm	diazinon or Sevin or Dursban or DiSyston	Treat in mid-late June and repeat 2 or 3 times at 3-week intervals. Apply soil treatments of DiSyston in early-mid June.	Apply a full coverage spray to the foliage. DiSyston is restricted to commercial nurseries and professional applicators.
WHITEFLIES	diazinon or dimethoate or MetaSystox-R or Thiodan or malathion	Apply foliage sprays at 4-5 day intervals until the infestation is controlled. Apply soil treatments of systemic insecticides as a preventive control measure.	Do not re-enter areas sprayed with MSR for 48 hours without protective clothing.
	resmethrin	When whiteflies are found. Treat every 3 weeks until infestation is controlled.	Registered for use only in greenhouses. Kills all stages but the eggs.
WHITE PINE WEEVIL	lindane or MetaSystox-R*	Apply sprays in the spring before adults lay eggs, normally prior to April 1-10.	Treat only the main terminal leaders of the tree down to the first whorl of branches. Thoroughly wet the bark.
	cut out and burn infested leaders.	Prune out infested leaders during June.	Adults begin emerging from infested leaders in July.
ZIMMERMAN PINE MOTH	Thiodan or Dylox or lindane or dimethoate	Treat in early to mid-April and in early September.	Apply as full coverage spray to the point of runoff.

*Do not re-enter areas sprayed with MSR for 48 hours without protective clothing.

AMOUNTS OF FORMULATION TO USE PREPARING SPRAYS

CHEMICAL	FORMULATION	PESTS CONTROLLED	AMOUNT TO USE		PHYTOTOXICITY
			In 100 gallons	In 3 gallons	
acephate (Orthene)	75% SP	gypsy moth larvae	2/3 lb. (hydraulic)	2 tblsp.	crabapple, huckleberry, Gilead cottonwood, yew, Lombardy poplar; use caution on American elm as foliar injury may occur
			1 1/3 lb. (mist)	4 tblsp. (2 oz.)	
		bagworms	2/3 lb. (hydraulic)	2 tblsp.	
		cankerworms	1/3-2/3 lb. (hydraulic)	1-2 tblsp.	
Azodrin (monarotophos)	3.2 lb/gal. WATERMISIBLE	aphids, mites, leafhopper	1 1/2 pts. per acre	1 1/2 tblsp.	Use only on ornamentals specified on label
		leaf miners, sawflies	3/4 pts. per acre	2 1/4 tsp.	
		thrips	1 pt. per acre	1 tblsp.	
	5 lbs/gal. WATERMISIBLE	aphids, mites, leafhopper	1 pt. per acre	1 tblsp.	
		leaf miners, thrips	3/4 pt. per acre	2 1/4 tsp.	
		sawflies	1/2 pt. per acre	1 1/2 tsp	
Bacillus thuringiensis Biotrol	16K WP	gypsy moth, bagworm Spring and Fall canker-worm, Fall webworm	1/2-1 1/2 lb. (hydraulic)	1 1/2-4 1/2 tblsp.	
			1/2-1 1/2 lb. per 10 gallons (mist blower)		
		elm spanworm	1-1 1/2 lb. (hydraulic)	1 1/2-4 1/2 tblsp.	
Dipel	3.2% WP	gypsy moth, bagworm	1/2-1 lb.	1 1/2-3 tblsp.	
		Spring and Fall canker-worm, Fall webworm	1/2 lb.	1 1/2 tblsp.	
		forest tent caterpillar	1/4-1/2 lb.	3/4-1 1/2 tblsp.	
		elm spanworm	1 lb.	3 tblsp.	
		Above rates are for hydraulic sprayers. For mist blowers, use rate (lbs.) recommended for 100 gal. in 10 gal. of water.			
diazinon	48% L (AG 500)	aphids, bagworms, clover mites, cyclamen mites, dipterous leafminers, European red mites, flea beetles, Holly bud moths, leafhoppers, obscure root weevils, omniverous leaf-tiers, privet mites, Scale crawlers, thrips, twospotted mites, web-worms, whiteflies, mimosa webworms	1 pt.	1 tblsp.	gardenia

CHEMICAL	FORMULATION	PESTS CONTROLLED	AMOUNT TO USE		PHYTOTOXICITY
			In 100 gallons	In 3 gallons	
diazinon (continued)	48% L (AG 500)	apple-and-thorn skeletonizers, cotoneaster webworms, Fall webworms, Hemlock chermes, oak loopers, oblique banded leafrollers, pear slugs, tent caterpillars	3 pts.	3 tblsp.	
dimethoate Cygon	2E	For aphids, bagworms, mites on arborvitae; for mites on cedar; for aphid bagworms, midges, mites on juniper; for golden oak scale; for aphids, bagworms, European pine shoot moth, Nantucket pine tip moth, Zimmerman pine moth on pine; for Fletcher scale, mealybugs, mites on taxus.	2 qts.	4 tblsp. (2 oz.)	azalea, andromeda, hydrangea, honey locust, dogwood, elm, viburnum, maple flowering almond, crab, apple, plum, peach, cherry Chinese holly, burford holly
DeFend	2.67 E	Foliar spray for listed pests on birch	3/4 pt.	2 1/4 tsp.	
		Foliar spray for listed pests on roses	1 pt.	3 tsp.	
		Foliar spray for listed pests on azalea, boxwood, camellia; gardenia, hemlock, American and English holly	1 1/2 pts.	4 1/2 tsp.	
		Foliar spray for listed pests on arborvitae cedar enonymus, juniper, oak, pine, taxus	3 pts.	3 tblsp.	
		Soil drench on camellias	4 tblsp. per gal. of water per plant up to 6 ft. tall. Increase rate for larger plants.		
Di-Syston (disulfoton)	15% granular	All labeled uses	2.5 to 2.7 oz. per tree or 2.5 oz. per inch of trunk diameter. Spread uniformly from trunk to drip line. Work into soil and water thoroughly.		DO NOT USE WITH PRE-EMERGENT HERBICIDES.
Dursban (chlorpyrifos)	2E	aphids, bagworms, Eastern tent caterpillars, Fall webworms, grasshoppers, mites, orange-striped oakworms, spittlebugs, whiteflies, yellow-necked caterpillars.	1 pt.	1 tblsp.	azaleas, camellias, poinsettias, roses, variegated ivy
		cutworms, leafhoppers, mealybugs, mimosa webworms, red humped caterpillars, exposed thrips	1 qt.	2 tblsp.	
		ash borers, lilac borers, scale crawlers	2 qts.	4 tblsp. (2 oz.)	

CHEMICAL	FORMULATION	PESTS CONTROLLED	AMOUNT TO USE		PHYTOTOXICITY
			In 100 gallons	In 3 gallons	
Dylox (trichlorfon)	80% SP 40.5% LS	Nantucket pine tip moth Zimmerman pine moth	1 1/4 lbs. SP or 2 pts. LS	3 3/4 tblsp. or 2 tblsp.	hydrangeas
		armyworms, bagworms, climbing cutworms, dipterous leaf miners, lygus bugs, stink bugs, tarnished plant bugs, tobacco budworms, webworms	1 1/4-1 3/4 lb. SP or 2-3 pts. LS	3 3/4-5 1/4 tblsp. or 2-3 tblsp.	
Imidan (phosmet)	50-WP	Use for elm spanworm, Spring cankerworm, gypsy moth on deciduous shade and ornamental trees; for gypsy moth on evergreens; for birch leaf miner on birch	1 1/2 lbs.	4 1/2 tblsp.	
Kelthane (dicofol)	18.5% L	mites	1-2 pts.	1-2 tblsp.	roses
lindane	25% WP	all labeled uses	1 lb.	3 tblsp.	soil drenches may injure some ornamentals
	20% L	borers	3 pts.	3 tblsp.	
		spruce gall aphids	1 1/2-2 pts.	1 1/2-2 tblsp.	
		taxus weevils, pine root collar weevils	3-4 pts.	3-4 tblsp.	
		white pine weevils	2 qts.	4 tblsp. (2 oz.)	
		engraver beetles	1 gal. per 400 gals. of water		
		Southern pine beetles	2 qts. per 44 gals. of fuel oil. Prior to attack: 1 gal. per 40-85 gals. of water.		
		turpentine beetles	1 gal. per 20 gals. of water		
malathion (Cythion)	25W	tent caterpillars	2 lbs.	6 tblsp. (3 oz.)	Canaerti, Juniper, eleagnus, hibiscus, some rose varieties, ferns
		aphids, mealybugs, spider mites, whitefly	2 1/2 lbs.	7 1/2 tblsp.	
		Fletcher scale	3 lbs.	9 tblsp.	
		bagworms, lace bugs, pine needle scale	4 lbs.	12 tblsp.	
		black scale crawlers, juniper scale, soft scale	6 lbs.	18 tblsp.	
	5 EC	all labeled uses	1.5 pts. (hydraulic) or 1.5 gal. (mist)	1.5 tblsp. (hydraulic)	
Meta-Systox-R (oxydemeton) methyl)	25% SC	aphids, birch leafminers, holly leafminers, leafhoppers, mites, thrips	1-1 1/2 pts.	1-1 1/2 tblsp.	Ficus sp. and English ivy
		pine needle scale	2 pts.	2 tblsp.	
		sitka spruce weevil, white pine weevil	8 pts. (1 gal.) per 24 gals. of water		

CHEMICAL	FORMULATION	PESTS CONTROLLED	AMOUNT TO USE		PHYTOTOXICITY
			In 100 gallons	In 3 gallons	
methoxychlor (Marlate)	50 WP	all labeled uses	2-3 lbs.	6-9 tblsp.	Chinese elm, Japanese and red maple, redbud, privet and viburnum, repeated use on evergreens
petroleum oils Scalecide Superior Volck	98%	all labeled uses; use as dormant spray only	2 gals.	16 tblsp. (8 oz. 1 cup)	sugar maple, Japanese maple, beech, birch, black walnut, butternut, hickory, redbud, juniper, douglas fir, spruce
carbaryl (Sevin)	50W	all labeled uses	2 lbs.	6 tblsp.	Do not apply to wet foliage or in high humidity, injury may result
	80% Sprayable		1 1/4 lbs.	3 3/4 tblsp.	
	Sevimol 4		1 qt.	3 tblsp.	
endosulfan (Thiodan)	50 WP	aphids, cyclamen mites, rose chafers, whitefly	1 lb.	3 tblsp.	white birch, redbud, Anderson yew
Trithion (carbofenothion)	4E	all labeled uses	1 1/2-2 pts.	1 1/2-2 tblsp.	
	8E	all labeled uses	3/4-1 pt.	3/4-1 tblsp.	

NOTES

Abbreviations: W, WP = wettable, wettable powder; S, SP = sprayable, sprayable powder; L, LS = liquid, liquid spray; E, EC = emulsifiable, emulsifiable concentrate; SC = spray concentrate

Precautions: Do not apply liquid concentrates when the temperature is above 85°F (29-30°C.) or any spray when the temperature is above 90°F (32°C).

Do not apply dormant oil sprays if the temperature is below 40°F (4-5°C) or is likely to approach or go below freezing within 24 hours.

Never use a sprayer or a tank which has previously been used to apply herbicides.

Use only the recommended dosage rates. The label directions are the final authority.

Wettable powders and other suspensions (flowable) require continuous agitation in the tank to avoid settling. Do not allow spray suspensions to remain in the tank without agitation or any spray mixture to remain in a non-operating sprayer for more than 1 hour.

Clean all spraying equipment thoroughly after each use.

Use spreader-stickers only for hard-to-wet foliage and special uses. Unnecessary wetting agents and spreaders cause excess run-off.

Equivalents: 1 pt. liquid in 100 gals. = 1 tsp. in 1 gal.
1 lb. powder in 100 gals. = 1 tblsp. in 1 gal.

1 gal. = 4 qts. = 8 pts. = 128 fl. oz.
1 fl. oz. = 1/8 cup = 2 fl. oz. = 29.57 milliliter
1 tblsp. = 1/2 fl. oz. = 3 tsp. = 14.78 milliliter
1 cup = 1/2 pt. = 8 fl. oz. = 16 tblsp.

1 lb. = 16 oz. = 454 grams
1 oz. = 28.3 grams

WEEDS

J. S. Coartney

FLOWER BEDS

Crop	Weed Problem	Chemical Rate/100 sq ft	Remarks
FLOWER BEDS* Soil Fumigation	Most annual and perennial weeds	methyl bromide (1 lb can)	Expose soil to chemical for at least 24 hours and then aerate for 24 to 48 hours before transplanting. Use an air-tight cover, and soil temperature should be above 55°F. METHYL BROMIDE IS EXTREMELY POISONOUS! Do not breath vapor or let it get on your skin.
		metham (SMDC, Vapam, VPM 0.8-1 qt of 32% formulation)	If air-tight cover can be installed immediately after application, rate can be reduced to 1 pt/100 sq ft. Any type of cover (paper, plastic film, etc.) will increase effectiveness. Apply to freshly prepared, moist soil when temperature is above 55°F. Soil should be moist enough to form a crumbly ball. Keep cover on for 48 to 72 hours and do not disturb area for at least 14 days. Work soil to a depth of 2" at least 7 days prior to transplanting. Cover may be left on over winter to prevent reinfestation after treatment. Do not get SMDC in your eyes or on your skin, clothing, or shoes. If application requires walking over the area, wear rubber boots.
Post-transplant Preemergence to weeds	Annual grasses and certain broadleaf weeds	DCPA (Dacthal 75W 1/2 oz)	Apply to clean cultivated soil after plants are well established. Residual is short (about 8 weeks in warm weather). Repeat treatment if full season control is desired.
		diphenamid (Dymid 80W 0.3 oz; Dymid 5G 4 oz; Enide 50W 0.5 oz)	Apply to clean cultivated soil after plants are well established.
		trifluralin (Greenfield Preen 10 oz of 1.47% gran)	Apply to clean cultivated soil. Incorporate lightly or apply a mulch immediately after treatment. Plants should be at least transplant size. Use as directed on container label.

*Follow label directions and use only on species listed on label.

WOODY NURSERY STOCK

More than one application per year will usually be required to give full season weed control. A program that has proved very effective in V.P.I. and S.U. tests is late fall-winter application of simazine, dichlobenil or diphenamid followed by spring or summer applications of DCPA or diphenamid.

Crop	Weed Problem	Chemical Rate/A	Remarks
WOODY NURSERY STOCK* Preplant	Certain annual weeds and nutsedge (Nutgrass)	EPTC 5 lb (Eptam 7E 5.75 pt or Eptam 10G 50 lb)	Apply to a clean cultivated soil and incorporate immediately to a 2-4" depth. If higher rates of EPTC are used for mugwort control, transplanting should be delayed 4 weeks.
	Annual grasses and certain broadleaf weeds	trifluralin 1 lb (Treflan EC 1 qt or Treflan 5G 20 lb)	Incorporate immediately behind applicator. Will not control cocklebur, velvetleaf, jimsonweed, ragweed, and nutgrass. Granular material may be allowed to remain on the soil surface by using 80 lb/A. Control is not as good as incoporated treatment.
Postplant, but pre-emergence to weeds	Annual grasses and certain broadleaf weeds	DCPA 10 lb (Dacthal 75W 13 1/3 lb)	May be used any time after transplanting. Apply to weed-free area after hand weeding or clean cultivation. More than one application is required for season-long control. Duration of control is usually about 8 weeks.
		dichlobenil 4 lb (Casoron 4G 100 lb)	Apply only to a well prepared, weed-free soil in the late fall, winter or early spring before seeds of annual weeds germinate, or after cultivation has removed all growing weeds. If dichlobenil remains on the soil surface during warm weather, activity will be lost. Do not apply until 4 weeks after transplanting. Use 6 lb/A rate to obtain control of mugwort (wild chrysanthemum).
		diphenamid 4 lb (Dymid 80W 5 lb; or Dymid 5G 80 lb or Enide 50W 8 lb	Apply immediately after transplanting or after clean cultivation. Will not control perennials nor weeds that have started to grow. Shallow cultivation will not completely destroy effectiveness. Diphenamid does not control venice mallow, prickly sida, velvetleaf, jimsonweed, cocklebur, ragweed, and fleabane (Erigeron sp.).
	Nutgrass and many annual weeds	EPTC 5 lb (Eptam 7E 5.75 pt or Eptam 10G 50 lb)	Apply to established plants after hand weeding or to weed-free areas. Direct the spray onto the soil. Cultivate immediately to incorporate. Spray or nozzle may be mounted on front of cultivator.

* Apply only to species listed on the container label.

Woody Nursery Stock (Cont'd)

Crop	Weed Problem	Chemical Rate/A	Remarks
WOODY NURSERY STOCK* (Cont'd) Postplant, but pre-emergence to weeds (Cont'd)	Many annual weeds (Cont'd)	pronamide 1-2 lb (Kerb 50W 2-4 lb)	Fall application after clean cultivation. High rate has given quackgrass control. Do not use on fine textured soils of high organic content. Kerb should not be applied to transplants less than 1 year old. Label presently includes fir, pine, juniper, yew, azalea, rhododendron, holly (all), and forsythia.
		simazine 2-3 lb (Princep 80W 2.5-3.75 lb Princep 4G 50-75 lb)	Fall or winter application only. Apply immediately after hand weeding and clean cultivation. Do not apply on azaleas, Japanese holly, or rhododendron. Apply no more than once per year. For band applications reduce the rate in proportion to area actually treated.
		trifluralin 1 lb (Treflan EC 1 qt)	Apply as a directed spray and cultivate immediately after application. Will not control cocklebur, velvetleaf, jimsonweed, ragweed and nutgrass.
		trifluralin 4 lb (Treflan 5G 80 lb)	Apply as a broadcast treatment to clean soil around established plants. Rainfall or irrigation immediately following application will improve performance. Use 15-20 lb rate if material can be incorporated.
Early postemergence to weeds	Many annual weeds	amitrole 1.05 lb + simazine 3.15 lb (Amizine 7 lb)	Fall or winter application only. Direct spray onto weeds and keep off leaves and stems of nursery stock. Weeds should be small. Do not apply on azaleas, Japanese holly or rhododendron.
	Perennial grasses	dalapon 8-10 lb (Dowpon 10 2/3-13 1/3 lb)	Apply in spring or summer to actively growing grass 4" to 8" high. Add detergent or wetting agent to spray mixture and use a minimum of 50 gal of spray per acre. Do not contact foliage of nursery stock. Repeat application may be required. Do not apply near nandina.
	All weeds contact kill	paraquat 0.5-1 lb (Ortho Paraquat CL 1-2 qt + X-77 spreader-sticker)	Paraquat must be applied as a directed spray. Do not contact desirable foliage or green bark. Will not injure woody bark. May be combined with simazine to give residual activity. For small area application mix 1 oz of paraquat/gal of water and lightly wet weed foliage.

* Apply only to species listed on the container label.