

VIRGINIA COOPERATIVE EXTENSION SERVICE
PUBLICATION 456-017
REVISED - JANUARY 1983

Pest Control Information for Home Fruit Production



EXTENSION DIVISION ●
VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY ●
BLACKSBURG, VIRGINIA ●

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Issued in futherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, and September 30, 1977, in cooperation with the U. S. Department of Agriculture. Mitchell R. Geasler, Dean, Extension Division, Cooperative Extension Service, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061; M. C. Harding, Sr., Administrator, 1890 Extension Program, Virginia State University, Petersburg, Virginia 23803.

PEST CONTROL INFORMATION FOR HOME FRUIT PRODUCTION

Disease and Insect Control

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INTRODUCTION

Growing fruits in the home orchard or garden can be an interesting and satisfying hobby as well as an abundant source of appetizing and nutritious food for the home gardener. Tree fruits as well as small fruits require considerable care. They differ considerably in the amount of care required because of the severity of disease and insect attacks as well as competition from weeds and the length of time from bloom to harvest of the many fruit varieties. As a rule of thumb, the flowers and fruit of most fruit varieties should be protected from diseases and insects by protective sprays from pre-early-blossom time until harvest. Therefore, home gardeners who are not willing to contribute considerable time to their home fruit planting will no doubt be disappointed in their harvests. Those homeowners who are unwilling to devote a considerable amount of their free time, on a regularly scheduled weekly basis, could and probably should select a less demanding hobby with more positive results. There are no short-cuts to quality fruit production.

To produce clean, wholesome, attractive, nutritious fruit requires protective pesticides applied at the correct time in accordance with the manufacturers instructions on the label. The number of protective sprays required per season will vary with the fruit in question and the number of blemishes the grower can tolerate. It requires a greater number of protective sprays to grow a clean crop of apples or peaches than it does a crop of blackberries or strawberries. If a home owner is not interested in producing blemish-free fruit, but will tolerate a few disease or insect scars on the fruit surface, the number of protective sprays can be reduced substantially. The spray schedules in this publication are designed to assist the home fruit gardener in producing fruit for home use, not necessarily of market quality. Thus, the number of suitable protective pesticides specified and the number of applications recommended have been reduced to a minimum.

Several pesticide manufacturers have one-package, general-purpose fungicide and insecticide mixtures on the market that are prepared for home fruit growers. If these mixtures are used in accordance with the recommendations on the label, they should provide satisfactory control of the pest for which they are recommended. For any protectant pesticide to be effective it must be applied thoroughly at the proper time and cover all leaves and fruit, since protectants are based on prevention of disease and insect damage rather than a curative measure.

PRECAUTIONS

Generally, most pesticides are toxic or poisonous to animals and/or some plants. For the most part, however, pesticides recommended for homeowner use are selected from the least toxic of those available. Nevertheless, they should be kept in a locked container and kept out of reach of children and animals. Be safe, do not take pesticides lightly. When using pesticides, never breathe the dust or spray and always wear a pair of rubber gloves and goggles. Do not smoke or eat while using pesticides. Destroy pesticide containers as directed on the container label. Always change clothes and wash with soap and water immediately after completing the job and launder your clothes before they are worn again.

Do not use 2,4-D weed killing mixtures or other herbicides in the spray tank used to spray fruit trees, flowers, vegetables, or lawns. As a rule, herbicides cannot be satisfactorily removed from the spray tank; hence, you may cause injury to your most cherished plants. Use herbicides in sprayers kept for that purpose only.

GENERAL PURPOSE SPRAY MIXTURES

A general purpose spray mixture that is usually effective for protection against most diseases and insects that attack home fruit contains captan, methoxychlor, and malathion. These three chemicals can be purchased individually and mixed at the rates shown in Table 1 or they can be purchased already mixed from most garden supply stores. Other protectant pesticides such as sulfur, zineb, Kelthane, Diazinon, benomyl (Benlate), Carbaryl (Sevin), and ferbam (Fermate) and phosmet (Imidan) are used for special purposes and may be applied separately or they may be added to the general purpose mixture (GPM) Table 1 (see limitations on special purpose pesticides, footnotes Table 1).

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Table 1. Recommended Protectant Pesticides

Pesticide	Amount of pesticide to use in different amounts of water				
	1 gallon	5 gallons	10 gallons	25 gallons	50 gallons
<u>GENERAL PURPOSE MIXTURE (GPM)</u>					
Captan 50% Wettable Powder	2.0 Tbs ^{1/}	1.6 oz	3.2 oz	0.5 lb	1.0 lb
Malathion 25% Wettable Powder	3.0 Tbs	2.4 oz	4.8 oz	12.0 oz	1.5 lb
Methoxychlor 50% Wettable Powder	2.0 Tbs	1.6 oz	3.2 oz	8.0 oz	1.0 lb
<u>SPECIAL PURPOSE PESTICIDES (SPP)</u>					
Ferbam 76% Wettable Powder ^{2/}	1.5 Tbs	1.2 oz	2.4 oz	6.0 oz	12.0 oz
Sevin 50% Wettable Powder ^{3/}	2.0 Tbs	1.6 oz	3.2 oz	8.0 oz	1.0 lb
Benlate 50% Wettable Powder ^{4/}	2.0 Tsp	10.0 Tsp	6.5 Tbs	1.5 oz	3.0 oz
Sulfur 95% Wettable Powder ^{5/}	1.0 Tbs	5.0 Tbs	1.6 oz	4.0 oz	8.0 oz
Kelthane 35% Wettable Powder ^{6/}	1.0 Tbs	5.0 Tbs	1.6 oz	4.0 oz	8.0 oz
Phaltan 50% Wettable Powder ^{7/}	2.0 Tbs	1.6 oz	3.2 oz	8.0 oz	1.0 lb
Dikar 76% Wettable Powder ^{8/}	2.0 TBS	10.0 TBS	3.2 oz	8.0 oz	1.0 lb
Imidan 12.5% Wettable Powder ^{9/} or	3.0 TBS	15.0 TBS	4.8 oz	12.0 oz	1.5 lb
Imidan 50% Wettable Powder	1.0 Tbs	5.0 Tbs	1.6 oz	4.0 oz	8.0 oz

^{1/}A teaspoonful (Tsp) or a tablespoonful (Tbs) in this publication refers to a level standard measuring teaspoon or tablespoon.

^{2/}Ferbam provides good control of black rot of grapes, it should be added to the general purpose mixture for cedar and Quince rust control of apple (early pink to June 10), ferbam should be used on peaches and nectarines during the dormant stage (November or early March) for peach leaf curl control.

^{3/}Sevin can be substituted for methoxychlor beginning in early June if Japanese beetles become a problem. Do not use before this period since it will thin some varieties of apples.

^{4/}Benlate can be added to the GPM on all stone fruit 3 and 1 week before harvest for beginning brown rot control.

^{5/}Sulfur can be added to the GPM for powdery mildew control on apple.

^{6/}If mites become a problem on peaches or apples, use two sprays of Kelthane at 7-day intervals.

^{7/}Phaltan should be substituted for captan in the GPM beginning during early July for sooty blotch, fly speck, and rot control on apples. Phaltan should also be substituted for captan GPM for downy and powdery mildew control on grapes.

^{8/}Dikar can be substituted for captan in the GPM for all apple diseases.

^{9/}Imidan may be used as a general purpose insecticide but will not replace Sevin (3) for Japanese beetle control, Kelthane (6) for mite control or Malathion for aphid control.

SPRAY MATERIALS

The following spray materials may be obtained from a farm supply or a fungicide-insecticide dealer. When unable to find the needed chemicals, write or phone your local Extension agent for information on the nearest source of supply.

Fungicides

CAPTAN is a 50% wettable powder fungicide used to control apple scab, peach brown rot, and other fungus diseases of orchard fruit and brambles. Captan is not effective against powdery mildew.

BENOMYL (Benlate) is a 50% wettable powder fungicide which may be used for control of several fungus diseases of stone fruits (peaches, etc.), apple, pear, and strawberry. Benlate is also effective against powdery mildews on fruit crops and ornamentals; it may be used alone or in combination with other fungicides.

DIKAR is a 76% wettable powder fungicide used to control apple scab, powdery mildew, apple rust, apple rots, and fly speck and sooty blotch of apples. Dikar will also suppress red mites when used in several consecutive sprays.

FERBAM (fermate, Coromate, Niagara Carbamate and others) 76% wettable powder is effective against apple rust, black rot of grape, leaf spots of fruit crops, and peach leaf curl.

FOLPET (Phaltan) is a 50% wettable powder. This fungicide is effective against apple scab and rots. Also, folpet is used to control diseases on sour cherry, grape, raspberry, and strawberry.

WETTABLE SULFUR is a fungicide which is used for the control of apple scab, peach brown rot, powdery mildew, and other diseases. It is a finely-ground powder to which a small amount of wetting agent has been added. Do not use in high temperatures.

Insecticides-Miticides

CARBARYL (Sevin), 50% wettable powder is recommended for control of Japanese beetle and apple maggot. Add to general purpose spray or use separately as necessary about June 15 for Japanese beetle. Add to general purpose spray beginning June 1 and continue at 10-14 day intervals for remainder of season for apple maggot control.

DORMANT SPRAY OIL diluted with water, is effective in suppressing scale insects and red mite egg hatch. It should be used only on dormant trees.

ENDOSULFAN (Thiodan) is a 50% wettable powder insecticide used to control peach tree borers. It is an organic phosphate that is highly toxic (use only with extreme caution). Do not use within 30 days of harvest. It is sometimes difficult for the homeowner to obtain in small quantities.

IMIDAN is packed as a 12.5% wettable powder in 1.0 lb. packages for homeowner use. It is also available as a 50% wettable powder. Imidan is effective for control of a number of fruit pests (check label on package) and is relatively safe for use if label directions are followed.

KELTHANE is a 35% wettable powder used to control European red mite and spider mites which blanch the foliage of all fruit crops.

MALATHION, phosphate compound, is used to control aphids, mites, and scale insects in the crawler stage. A 25% wettable powder is suggested for fruit trees. Malathion does not persist long.

METHOXYCHLOR is used to control codling moth, oriental fruit moth, curculio, and Japanese beetle. A 50% wettable powder is recommended for fruit trees, grapes, etc.

PARADICHLOROBENZENE CRYSTALS-satisfactory for control of peach tree borers when applied in a soil covered band around the trunk of the tree. Rate varies according to tree age as follows: 1/2 oz. for trees under 3 years, 3/4 oz. for trees 3-6 years, and 1-1/2 oz. for trees over 6 years old.

WHEN AND HOW TO APPLY HOME FRUIT PESTICIDES

Timing: Proper timing and thorough application of pesticide sprays are essential for quality fruit production. Make certain that the spray reaches all parts of the tree and covers all of the foliage and fruit. If coverage is not uniform, it may be necessary to adjust or change the parts (disk) of the sprayer nozzle.

It is difficult to determine the exact time or date to start the protective spray, since there are usually several kinds and also varieties within a home fruit planting. A simple general rule, however, may be used for most home fruit plantings. Start the protectant pesticide spray program in the spring when the young foliage is approximately one-fourth inch long on the earliest variety to break-bud and spray all varieties at the same time. It is much easier to follow this procedure than it is to attempt to spray each variety according to its stage of growth. One will have to apply sprays during the full blossom stage of some varieties. This spray usually will not interfere with pollination because no insecticides are included with the fungicides recommended for use at this time.

How much spray per tree: There is no accurate measure of how much spray to apply per tree. Professional scientists have debated the subject for the past five decades with no agreement. There are too many variables in the "types of sprayers" that are available, the wet-ability of the leaves and fruit of the different species of fruit, the amount of wetting agent (surfactant) contained in the different pesticides, and the extreme variability of the environment (wind blowing, dry, hot, wet, cool, etc., each of which influences wetting the foliage) when the protectant pesticide is being applied. A general rule of thumb for gardeners or fruit growers to follow is to spray the foliage and fruits until droplets form and begin to run or drip off. For the beginner and for an idea only; the amount of pesticide suggested for coverage of different size trees (Table 2) will be helpful.

Table 2. How much spray per tree with different dimensions

Height in feet	Spread in feet	Gallons per $\frac{1}{}$ application
5-8	3-6	1
8-10	4-8	1-2
10-15	8-15	4-5
15-20	15-25	8-10
20-25	25-30	11-14
25-30	30-25	15-18

$\frac{1}{}$ As indicated in the text, these amounts are only for guidance. The environment at the time of spraying, as well as how the tree is pruned will influence the amount of spray that will properly cover a tree.

Pruning: Spray coverage can be improved through good pruning practices. Trees should be "opened up" to allow spray and sunlight penetration. Prune-out all dead and decaying branches because such wood may harbor insects and diseases. Keep the height of the trees low to enable good spray coverage.

Thinning: It is important to thin fruit properly to provide good disease and insect control. Thin all tree fruits so that the mature fruits will not touch each other. Protectant pesticides cannot effectively cover fruits that touch each other; hence, this provides a place for insects and diseases to become established.

Tree size: It is almost impossible to produce high-quality fruit in the home orchard on old, large trees because the spray pressure commonly used is inadequate to force the pesticides to the top of such trees. Therefore, old trees should be replaced with dwarf or semi-dwarf trees that are allowed to reach a height of no more than 12-15 feet.

SPRAYERS

There is a variety of sprayers and dusters available to the home fruit grower. Generally, however, dusters are not satisfactory for protectant pesticide application to home fruit trees. Therefore, the home fruit grower is limited to a choice of hand or small powder sprayers to protect his fruit crops. There is no one sprayer that is equally satisfactory for all home fruit spray problems. Hence, the grower will have to make the decision on what type of sprayer to purchase for his particular planting.

If there are only a few trees (5 to 8) to spray, along with a few strawberries and brambles, a hand sprayer of the compressed-air type would probably be adequate. However, the type of hand sprayer where the compressed air tank is pumped-up before one starts to spray is relatively poor because there is an uneven air pressure at different times during the application of the protectant pesticide. The "knapsack" type of sprayer which is hand pumped as the operator moves along, has the advantage in that the pressure in the tank remains relatively constant as the spray is being applied. The overall reach of the hand sprayers can be extended somewhat by removing the short brass tube where the nozzle is attached, and replacing it with a 4 to 6 foot piece of copper tubing that one can buy at a hardware store. Have the copper tubing threaded with the same size threads as the brass tube so that the nozzle will fit properly. This inexpensive alteration of the hand sprayer will facilitate coverage of trees up to 12 feet in height and also help the operator avoid being covered by the spray mist that falls when spraying overhead.

For the home fruit growers who have 25 to 50 fruit trees, as well as home lawns and gardens to spray, a small power-driven sprayer would probably be more satisfactory. These sprayers are distributed by various dealers. They come with tank capacities of 15 to 50 gallons and pumps that will deliver from 50 to 350 pounds pressure per square inch. Therefore, start an inquiry about 3 months before you plan to buy a sprayer and read all the information that you can obtain on the different types. Check with your nearest pesticide dealer, farm machinery distributors, large department stores, local extension staff, and last but not least, an extension specialist at your land grant university who has the responsibility to know about protecting plants from their many pests. After the correct size has been decided on, it would probably be more satisfactory to purchase a standard brand that you can obtain parts for or have repaired when it breaks down.

Tips on sprayer maintenance: Some pesticides are corrosive to metals; therefore, a sprayer must be properly cleaned after each use. For best results with any sprayer, study the owners manual and follow instructions carefully. Keep hose clamps tight and the trigger mechanism working properly without dripping. At the end of the day or treatment, thoroughly wash the nozzle(s), hose pipes, and tank both inside and out. Caution: Never wash a sprayer where the water will puddle or stand where children or pets will play in it. There may be enough toxicant in the washwater to cause serious injury to children or pets. Never store a sprayer where small children can play with it. There may be enough of the pesticide toxicant left on the sprayer, if a child rubs its hands over the sprayer then puts them in its mouth, to cause serious illness or even be fatal.

Garden hose sprayers: There are several types and models of the garden hose type sprayer. They attach to a garden hose and the pressure is derived from the water system rather than from a hand or motor pump. None of the types or models that we have worked with perform a perfect spray job, but, perhaps for a person who is unable to lift a 3-4 gallon sprayer, this type of sprayer would be satisfactory. When purchasing, be sure that the sprayer is designed to use wettable powders. Since wettable powders do not dissolve in water, but remain in suspension, be sure that the screen over the end of the suction hose is not so fine that it will become clogged with pesticide particles. Read and follow the manufacturers instructions.

APPLE DISEASES

APPLE SCAB, a fungus disease of apples, is found in all countries where apples are grown. This disease causes almost as much loss to apple growers as all the rest of the apple diseases put together. The scab fungus attacks leaves, stems, and fruit. The apple scab fungus overwinters in the dead apple leaves under the trees. During the winter months the fungus forms small, black, flask-like structures in the leaves called perithecia. The mature perithecia are filled with minute spores called ascospores. Spring rains cause the perithecia to discharge ascospores into the air where they are carried by the air current to the new green leaves and opening fruit buds of the apple tree. The first visible sign of infection is a light brown or olive colored spot. Depending on the temperature, first visible symptoms may show as soon as 8 days after the initial penetration by the ascospore. Hundreds of new spores called conidia or summer spores are formed in the infection lesion. Rain disperses the conidia or summer spores from the infection lesion to healthy leaves and to the young developing fruit, where they start a secondary infection. Thus, the fruit and foliage must be protected from green-tip until harvest with protectant fungicides.

POWDERY MILDEW, a fungus disease, is of major importance on several apple varieties grown in Virginia. Varieties such as Jonathan, Rome, and Stayman have been the most seriously affected: York and Delicious have been less severely attacked. The powdery mildew fungus attacks twigs, leaves, blossoms, and fruit. The disease appears with the opening of buds which were infected the previous season. The first symptoms are felt-like patches of fungus mycelium on the lower surfaces of leaves which soon become crinkled and curled. The fungus spreads rapidly and soon covers the entire leaf surface with mycelium and a powdery coating of spores. The entire growing terminal may be affected. The terminals become stunted and may be killed as a result of the disease. Blossoms may become infected from the overwintering mycelium in the dormant buds. In this case, the floral parts are so badly deformed that no fruit is produced. Fruit infection usually occurs shortly after blossoming and appears on the fruit as a net-type russett. Protectant sprays are required from early pink through mid-summer to suppress this disease.

APPLE RUSTS - Both cedar rust and Quince rust are serious apple diseases in the Appalachian area. Red cedar is the alternate host for both the cedar-apple and Quince rusts. Cedar rust, caused by a fungus, appears as orange or greenish yellow spots on the fruit and as yellowish to orange spots on the leaves. Leaf infection results in extensive defoliation and devitalization of the tree during dry periods. York Imperial, Rome Beauty, and Jonathan are the most susceptible of the varieties grown in Virginia. Cedar-apple rust galls or "cedar apples" are located on the twigs of cedar. They develop masses of gelatinous spore horns early in the growing season, during rainy periods, from which spores are discharged that infect the apple.

Apple Quince rust, incited by a fungus, has caused heavy losses of Red Delicious, Stayman, Winesap, Rome, and York under Virginia conditions. The disease appears as sunken or deformed areas in the fruit, ranging from deep green to brown. The sunken or deformed areas usually are located on the calyx end of the fruit. The infection goes deep into the fruit and makes it worthless. Quince rust does not affect apple foliage. Protectant sprays are required from early pink through June 10 for control of the rust diseases.

BLACK ROT OF APPLE, a fungus disease, occurs throughout the warmer regions of the world. The fungus attacks fruit, leaves, and limbs. Infection of the fruit may occur from the time the fruit is initiated until harvest. Also, the fungus may cause postharvest decay. The disease first appears as a small brown spot any place on the surface of the fruit. The black rot infection develops slowly and complete decay of the fruit usually does not occur until the fruit is mature. As the rot progresses, the decayed tissue is firm and leathery. Eventually the decayed fruit becomes shrunken and mummified. Finally, the rotted fruit turns black; hence, the common name, black rot. Symptoms first appear on the leaves as small dark purplish spots. As the spots enlarge, they are irregularly shaped. The margins of the lesions retain their purple cast while the centers become brown or yellowish brown; thus, the popular common name, frog-eye leaf spot.

BOTRYOSPHERA ROT OF APPLE, caused by a fungus, is widespread and attacks many host plants. Fruit infection may occur from the time of initiation to harvest. The small lesions (rot infections) first appear as small, circular, brown spots surrounded by a conspicuous red area. The infections start slowly but progress rapidly as the fruit approaches maturity. The lesions on fruit of the redskinned varieties may bleach during the decaying process; thus, the disease has acquired the name "white rot". Completely rotted fruit exudes droplets of a clear gummy fluid and eventually mummifies.

BITTER ROT OF APPLE, caused by a fungus, is occasionally a serious disease of apples in Virginia. It is most serious during warm, moist summers. These conditions frequently exist in the eastern and southern sections of Virginia. Bitter rot begins on the fruit as small, light brown spots just under the skin. These spots grow rapidly in warm, moist weather. Masses of spores are formed in pustules arranged in concentric rings on the surfaces of the spots. Rain disperses the spores to other fruit and branches below where they may start a new infection. The rotted fruit hangs on the tree and dries out. It is important that all mummified fruit and cankered branches be removed during the pruning operation, since they may supply inoculum for new infections.

SOOTY BLOTCH AND FLY SPECK are surface blemish diseases which commonly appear on apples in late summer and fall. Although the 2 diseases almost always appear together, they are caused by different fungi. Sooty blotch appears as more or less sooty smudges or spots; while fly speck appears as small circular black spots which occur in groups and resemble true fly specks. The development of both diseases is favored by moderate temperatures and high humidity. Infection may occur as early as June, but late-summer infection is the major concern with these diseases. Both diseases are superficial and do not rot the fruit, although sooty blotch-affected fruit may shrivel in storage as a result of the ruptured cuticle.

FIRE BLIGHT - caused by the bacterium *Erwinia amylovora*, is one of the most destructive diseases of apple and pear in the United States. The fire blight bacterium may attack any part of the tree from the roots to the leaves. The disease usually appears in the spring as blossom, leaf, and twig blight. Infected blossoms suddenly wilt and soon turn light to dark brown. As the disease progresses down the pedicel, the tissue becomes water-soaked and dark green. If the infection moves beyond the pedicel, it invades the fruit spur and out into the leaves. The leaves wilt and the entire spur growth turns brown on apple or dark brown to black on pear and dies. The blighted leaves remain attached throughout the growing season.

Twig blight begins with an infection of the young terminal shoots. The invading bacteria progress more rapidly down the shoots or twigs than in the fruit spur. Infected shoot tissue becomes watery, dark green, and has an oily appearance. The leaves on the blighted terminals, as in spur blight, turn brown on apple or dark brown to black on pear and remain attached throughout the growing season, and in many cases they remain attached after the healthy leaves have fallen in the fall. A characteristic symptom of twig-blight is the bending of the blighted terminal which resembles a shepherd's crook.

The fire blight bacteria may move down the twig and into branches and limbs, where the infection becomes established. These infected branches and limbs may become entirely girdled with the infection spreading upward and downward. A severely infected apple or pear tree may have so many terminals blighted that it has the appearance of being scorched or burned by fire. Thus, the name fire blight was coined for the disease.

Fruit infection may occur on apple and pear. The fruit becomes water-soaked with numerous exuding droplets of bacterial ooze. The diseased fruit is firm and later leathery. Still later, the fruit shrivels, turns brown on apple or black on pear and usually remains attached to the spur.

The causal bacteria overwinter in living host tissue at the margins of cankers on the larger twigs, branches, and trunk. In the spring, highly infectious, milky-white to cream colored droplets of ooze containing tremendous numbers of bacteria are produced at the margin of active cankers. The bacterial ooze usually appears first when the trees are in the late-pink to early-bloom stage of development. Wind-blown rain, and insects help spread the causal bacteria from the oozing cankers to the developing blossoms and young leaves where new infections may develop.

Fire blight control, like most bacterial diseases, is difficult and expensive. As a rule, fire blight is much worse on tissues that are succulent. Thus, home fruit growers should attempt to manage their trees so as to prevent extensive rapid growth of young shoots in varieties of pear and apple especially susceptible to blight. The excessive use of nitrogenous fertilizers, and the cultivation of the orchard to promote excessive growth and excessive pruning should be avoided.

Water sprouts or suckers should be removed as they are formed on susceptible varieties. Their removal will often avoid canker formation on limbs, trunks, and roots of the tree.

Avoid any pruning during the blossom period and immediately thereafter. Large populations of sucking insects are present in the trees during bloom, and it has been demonstrated that sucking insects spread the bacteria to blossoms and open wounds. Thus, the use of effective phosphate insecticides "following bloom" to control such insects as aphids, plant bugs, and leaf hoppers is advisable when blossom blight occurs.

Streptomycin sulfate, an antibiotic, is the most effective material for fire blight control. Use streptomycin at the rate of 60 ppm of dilute spray. The first application should be completed just before the center blossoms begin to open. Additional applications should be made at 5-day intervals until all petals have fallen. This will usually mean 2 or 3 sprays. CAUTION: spray to wet only; antibiotics are usually locally systemic and overspraying may cause foliage chlorosis and reduce fruit set.

BORON DEFICIENCY CORKING - Aside from nitrogen, boron is the nutrient most commonly deficient in Virginia orchards. The most common symptom on fruit is referred to as corking. It consists of clusters of dead cells that are usually tan to brown in color. They may occur anywhere in the fleshy portion of the fruit, their location being affected by the variety and severity of the deficiency. Boron deficiency corking in apple fruit can be confused with other types of cork. A fruit analysis showing less than 10 ppm of boron is sometimes used to confirm the diagnosis. Affected fruit may ripen and drop prematurely.

Boron deficiency can be corrected through the application of 0.5 lb of agricultural borax to each mature tree. This rate may be increased to a pound for very large trees and should be reduced to 0.25 lb for dwarf or young trees. The treatment to be effective during a given year should be applied during the preceding fall or winter. Apply boron every third year should control this disorder. Control can also be obtained by applying 1.0 lb of Solubor per 100 gallons in 2 sprays during late bloom and early post bloom each year.

If applied at too high a rate or too close to the trunk of young trees, soil applications of borax can cause injury. It should be applied in an area 3 to 6 ft from the trunk of young trees and near the drip line of older trees.

BITTER PIT - is a type of corking that is distinct from other types. It consists of small cork-like clumps of tissue just beneath the surface of the fruit. These spots appear as dark areas and are concentrated at the calyx end of the fruit. One distinctive characteristic of this type of corking is that it does not appear until near harvest time or during fruit storage. As with other types of corking, bitter pit is more common on some varieties than on others. Grimes Golden is more susceptible than most varieties grown in Virginia. The maturity of the fruit at harvest affects the occurrence of bitter pit. Early harvested fruit are more susceptible than fruit picked at maturity.

Calcium nitrate sprays have generally reduced the severity of bitter pit from 50 to 90%. This treatment might be justified where severe bitter pit has been experienced. To reduce bitter pit, use one-half ounce of calcium nitrate per 1.0 gallon of water. Make four applications at 2-week intervals starting 10 weeks before picking time.

APPLE INSECTS

APHIDS - Two species of aphid frequently cause problems: (1) Rosy Apple Aphid - This pink-bodied aphid causes severe puckering and knotting of the fruit. Infestations may be noted by the curling and wrinkling of leaves near young apples, but, by this time, much of the fruit will be lost. At weekly intervals, beginning when the leaves are about 1/2 inch long, look for aphids in the foliage. (2) Woolly Apple Aphid - This aphid affects the root systems primarily, but may be found in cracks and wounds on the upper portions of the trees. They produce a white waxy mass over their reddish-purple bodies. On the roots they cause galls and an increased number of secondary roots, which stunt the tree and reduce production.

CODLING MOTH - Presence of this pest is usually recognized from a hole bored into the side or blossom end of the fruit. This larva completely destroys the infested fruit. It is a pinkish-white worm approximately 1/2 inch long with a brown head. At maturity, the larva leaves the apple and falls to the ground or climbs to the trunk of the tree to pupate under the bark or in debris on the surface where it overwinters.

PLUM CURCULIO - Injury is in the form of small crescent-shaped cuts in the skin of the small fruits. An egg is deposited in a small hole at one end of the incision. Depressions in the fruit usually develop at such sites. Examination reveals a grayish-white worm inside. Infested fruits fall prematurely and are usually hard, knotty, and misshapen. In some years, there may be two generations a year east of the Blue Ridge Mountains.

MITES - Two species are frequently injurious to apple foliage--the two-spotted mite and the European red mite. They produce a stippling of the leaves by puncturing the cells of the leaf and sucking out the juices. The two-spotted mite spins a silk webbing over the infested area, which helps to explain the origin of the name "spike mites". The two-spotted mite may be green or orange in color, depending on host plant, time of year, and maturity of the mites. They have two large dark spots on the lateral margins of their abdomens. The European red mite is dark red with dorsal hairs on humps of the body and it has tan colored legs. A hand lens is required for accurate observation of these pests.

RED-BANDED LEAFROLLER - The first-generation adults emerge during April. Adult moths are approximately 3/8 inch long and reddish-brown with silver and grey markings. The larvae, which cause the fruit damage, are slender, yellowish, green worms that reach a length of 5/8 inch when full grown. Several generations are found per year in Virginia. The second and third generations cause the most damage. Injury to fruit is caused by the feeding of the caterpillars on the skin and upper layers of flesh.

SAN JOSE SCALE - The San Jose scale overwinters as an immature scale on the bark of twigs and limbs of a wide variety of fruit trees. The scales mature rapidly in the spring. Young, called "crawlers", are produced in large numbers. They have legs and spread to all parts of the tree, or may be carried on the feet of birds or by the wind to other trees. These small yellowish crawlers soon settle down, insert their beaks into the bark and begin to secrete a waxy scale covering. Scales feed on the sap of trees. They may kill a young tree within 2 or 3 years when a heavy infestation exists. When scales settle on the fruit, reddish rings occur around the insect on the fruit skin. There are two generations per year, one occurring in late May or early June and the other occurs in August.

PEACH AND NECTARINE DISEASES

PEACH LEAF CURL, a fungus disease, is found throughout the world where peaches are grown. The disease is destructive and causes economic losses under Virginia growing conditions. Peach leaf curl is carried overwinter by tiny fungus spores lodged on the surface of twigs and bud scales of the peach or nectarine trees. With the coming of spring and the swelling of the buds, if conditions of moisture and temperature are suitable, the spores germinate, and those that come into contact with the young developing leaves cause an infection. The infected leaves are thickened, and as they develop, the leaf becomes folded with the edges curling inward, so that the undersurface of the leaf is a series of concaved chambers. Very shortly after leaf symptoms appear, it turns red to purple and becomes extremely conspicuous. The bright color soon fades into a yellowish brown to brown, and the leaf withers and falls off. One application of Ferbam during November or early spring before bud break will control this disease.

PEACH SCAB, a fungus disease, is widespread in peach and nectarine growing areas of Virginia. The main loss from the disease is from the unsightly blotches on the fruit. The disease first appears on the fruit as small, poorly defined, olivaceous spots less than 1/16" in diameter, usually on the upper exposed surface of the fruit. The spots may be numerous on the upper surface of the fruit, more scattered on the sides, and nearly absent on the protected lower surface. The spots may merge forming a uniform, dark-olivaceous, velvety blotch over the surface of the scabbed area. Since the cork area cannot expand with growth of the fruit, fissures and/or cracks appear in the fruit providing avenues for brown rot infection.

BROWN ROT, caused by a fungus, is the most destructive disease of cherry, nectarine, peach, and plum. The brown rot fungus may overwinter on mummies (old decayed fruit) on the ground, mummies on the tree, and in twig cankers. The brown rot fungus becomes active about the time pink begins to show in the buds, provided there is sufficient rainfall. The brown rot fungus spores attack the blossoms, twigs, and fruit. Blossom blight and early twig infections establish centers of infection which may supply inoculum for fruit infection during periods of rainfall throughout the growing season. Therefore, it is important to control these early infections. Brown rot on the fruit becomes more evident as the fruit approaches maturity. The first evidence of the rot is the appearance of a small, circular brown spot that enlarges very rapidly as the fruit approaches maturity. The rotted fruit soon becomes covered with ash colored tufts of conidia. These masses of spores supply inoculum to infect other fruit. The greatest loss from brown rot occurs from fruit rot in the orchard, in transit, and in the market place. The fungus decays or rots a mature fruit very rapidly. Use chemical sprays as suggested in spray schedule for brown rot control.

BLACK KNOT is the most conspicuous disease of plum, prune, and cherry trees. Most commercial and home-fruit growers, at one time or another, have observed the black warty growth on twigs and branches of plum and cherry trees. Trees infected with black knot become almost worthless after a few years, if no control practices are used. Twigs and branches may be girdled by the infection and with a large number of infections per tree, the trees go into a general decline. Black knot is caused by a fungus. It attacks many species of wild and cultivated plums and cherries including American, European, and Japanese varieties of plums, Damson Plum, and prunes and both sour and sweet cherries. The disease is destructive and widespread in Virginia.

Symptoms - Infection occurs primarily on wood of the current season's growth. The infections are caused by small (microscopic) spores which attack the tree from bloom through late May to early June depending on the climatic conditions. The first evidence of the disease is swelling of the infected twigs or branches during the late summer or fall of the year of infection. Ordinarily, the infected area swells rapidly and the bark is ruptured the following spring. The infection continues to develop throughout the second growing season and the life cycle is usually completed during the second spring after infection with the production of small spores (seed), called ascospores, which may start new infection centers. The elongated black swelling may be from less than an inch to more than a foot in length. The malformation may encircle the entire branch, but is usually one-sided. The cankered areas are greenish when they are first formed, but become black with age. Branches not killed by the disease may be killed by insects that enter the infected area. Infrequently, twigs or branches are deformed and turn right angles at the point of infection.

Control - Sanitation is extremely important in controlling black knot. All the knots on small twigs and branches should be pruned-out during the dormant season and burned. The cuts should be made 4" below the knots. Knots on one side of large limbs that need to be saved can be moved by cutting out the swellings. When knots are removed from a limb, the wound area should be painted with a good asphalt or oil-base paint. Close observation should be made annually during the pruning season to detect and remove any new black knot infections. Pruning alone, however, is not adequate control of the disease. The use of a fungicide spray program (see section on recommended chemical control) along with the sanitation program will usually give good control of black knot.

PEACH INSECTS

SCALES - Four different scale insects may be found on this fruit -- White Peach scale, San Jose scale, Terrapin scale, and European Fruit Lecanium. These are small insects which usually go unnoticed until they reach numbers sufficiently high that they begin to injure the tree and fruit. The Terrapin and European Fruit Lecanium are small, usually, and shiny brown in color, whereas the San Jose scale is almost the same color as the tree bark and gives the tree a roughened appearance when the population is high. The White Peach scale is easily recognized because the white males give a branch a white-washed appearance when they are abundant. All these scales have more than one generation a year on peach, reproduce rapidly, and can kill branches and even the trees if uncontrolled. These insects suck plant juices and gradually hinder tree development. The easiest times to control them are in the crawler stages (just after hatching from the egg). Where populations are found, make checks and spray for live scales throughout the growing season.

SHOTHOLE BORER - This small beetle is a serious pest of the young buds. They grow and reproduce in dead or dying wood in the tree or trees. They are highly productive and have overlapping generations. They feed on the buds as well as the trunks and branches. Their common name was derived from the numerous little holes they make in the branches where they emerge -- resembling a branch shot by a shotgun. If the bark is removed, the wood beneath has numerous galleries and pockets with small white C-shaped larvae. Any dead or dying branch of trees should be removed as soon as possible and destroyed. Sap oozing from numerous buds and small holes in the branches is a good indication of infestation. The pest is a small black beetle about 1/16 inch long and round in shape.

PEACH TREE BORER - The winter is passed by partly grown to full grown grubs in their burrows in peach, cherry, plum, prune, nectarine, or apricot trees. The caterpillars are yellowish-white with a brown head, and are about 1 1/4 inch long when mature. The adult moths emerge from May to September. The adult female lays eggs on or near the tree trunk. The eggs hatch and the small grubs enter the trunk. The grubs or "borers" feed in the tree trunk at or below the ground level and will girdle and kill small trees in a single season if several borers are feeding. Borer injury is evident by masses of gum and sawdust-like "frass" occurring at the base of the tree.

LESSER PEACH TREE BORER - The lesser peach tree borer attacks many of the same trees as the peach tree borer. Again, this borer overwinters in various stages of development from young to full-grown caterpillars. After completing development in the spring, the adults can be found from April to October. The female moths may deposit eggs at any location on the tree but prefer injured areas. The caterpillars or "borers" resemble those of the peach tree borer except that they are slightly smaller. The borers usually feed in the larger limbs and trunk of the tree. Injuries exude gum which contains sawdust-like particles. Limbs and trees are frequently killed by the feeding.

ORIENTAL FRUIT MOTH - The larva may severely damage new shoot growth or the fruit as they bore down the young shoots and into the fruit through the stems. They feed throughout the fruit and even into the seed. Some fruit may show no signs of damage until after picking. Trees should be examined for new or young terminals which die suddenly to determine if larvae tunneling in the shoots are the cause. There are several generations a year; the latter generations often bore into the sides of the fruit much like the codling moth in apples.

PLUM CURCULIO AND MITES - See section under apples.

RASPBERRY AND BLACKBERRY DISEASES AND INSECTS

The ANTHRACNOSE fungus attacks the leaves and canes of both raspberries and blackberries. Anthracnose symptoms first appear on the canes as light grayish spots about 1/8" in diameter. The spots enlarge and develop rather conspicuous borders (dark in color) with gray centers. Infected canes may become girdled or cracked causing either decline or death. Spots on the leaves are small with gray centers and purple margins. Leaf infection rarely causes defoliation. The infected tissue, however, may drop out and give the leaf a shothole appearance. In general, fruit on infected canes ripens abnormally.

The CANE BLIGHT disease is widespread in areas of raspberry culture. The causal fungus enters the canes only through wounds. Dark-brown cankers appear at the wound site, and, as the disease progresses, they extend down the cane and may encircle it. The lateral branches of infected canes wilt and die during warm weather.

LEAF SPOT - The disease occurs throughout the United States and is of economic concern in Virginia. Symptoms are first noticed on raspberry as tiny greenish-black spots on the upper surface of the leaves. The spots turn gray as the leaves mature. The infected area may drop out to leave a shothole appearance. Symptoms may be slightly different on blackberry. Spots with whitish centers and purple or brown borders occur both on the leaves and canes.

JAPANESE BEETLES usually appear in large numbers and feed on the leaves and fruit of many plants. They may cause defoliation, stunting, and reduced production or death if defoliation is too severe.

STRAWBERRY DISEASES

LEAF SPOT - The disease is caused by a fungus that attacks the leaves, petioles, fruit stalks, stolons, and fruit caps. The first symptoms appear on the upper side of the leaves as small purplish spots. Later, these spots enlarge to 1/4 to 1/2 inch in diameter with gray to tan centers and distinct purple margins. The spots are tan to bluish on the underside of the leaves. The varieties Dorsett, Fairfax, Premier, Midland, Klommore, Rockhill, and Albritton are resistant to leaf spot; while, the varieties Blakemore, Catskill, Earlidawn, Robinson, and Surecrop are moderately resistant to slightly susceptible.

LEAF SCORCH - The disease is caused by a fungus that attacks leaves, petioles, stolons, fruit stalks, and fruit caps. Symptoms appear as small dark purple spots up to 1/4 inch in diameter on the upper surface of the leaves. These spots are more irregular in outline than the leaf spot disease and they never have tan centers. The varieties Albritton, Blakemore, Catskill, Fairfax, Premier, Surecrop, Sunrise, Earlibell, and Dorsett are resistant to leaf scorch.

LEAF BLIGHT, a fungus disease, is usually less destructive than leaf scorch or leaf spot in Virginia. The fungus overwinters on infected plants and is dispersed to healthy plants by rain and cultural tools. The disease first appears as red to brown spots with purplish margins. Spots are from 1/4 to 1 inch across and are oval to triangular in shape. The varieties Earlidawn, Empire, and Premier seem to have some resistance to leaf blight.

STRAWBERRY ROOT DISEASES. Several destructive root diseases occur on strawberry. Black root rot, Red Stele, Verticillium wilt, and nematode infection are the major root diseases. One or more of the diseases may kill the plants in large areas of the planting or damage the roots so badly that production is greatly reduced. The root disease fungi and nematodes usually survive in the soil of infested fields for a number of years. They may be carried into disease-free fields on new plants or in soil carried on equipment or washed in by surface water. Strawberry root diseases are too complex to be discussed in this publication.

FRUIT ROTS - There are several fruit rots of strawberries but only one is of major importance in Virginia. Grey mold, caused by a fungus is the most important of the fruit rots in Virginia. The berries may be attacked at any stage of their development. The fungus often attacks blossoms and green fruit, particularly where the fruit stalk or fruit cap has been injured by frost. The berries may become infected from spores from dead petals adhering to the fruit, another decayed berry, or from a dead leaf. The disease first appears as a light brown, soft spot. The rot completely decays the entire berry. The decayed berry becomes firm, tough, brown throughout, and is covered with a powdery greyish growth of the fungus. Spray strawberries as suggested in the spray schedule for disease control.

STRAWBERRY INSECTS

CYCLAMEN MITE - These tiny, whitish mites may be found in crevices of leaves, along stems and among the hairs of plants, but are not visible to the naked eye. The young mites are concentrated near the center or crown of the plant where they feed on the young tender expanding leaves. Their feeding causes severe distortion and stunting, often accompanied by a bronze discoloration. They reproduce rapidly and often reach populations dense enough for the feeding to reduce yields severely. Insecticides such as malathion remove natural predators and allow the mites to reproduce unchecked. Endosulfan (Thiodan) 50 WP, 1 tbs/gal., applied in sufficient volume to completely penetrate and wet the crowns, will give control. However, this material is difficult for the homeowner to procure in small packages.

SPIDER MITES - See section under apples.

APHIDS - Infestation is often not noticed until there is loss of vigor in plants. The leaves become pale, fruit dries up and fails to mature properly. These pests may be found on the roots of the plants and injury reduced if they are detected and controlled early enough. They are small and bluish green in color. Their presence may also be associated with a high ant population in the strawberry patch.

STRAWBERRY WEEVIL. The hard shelled, long beaked, snout beetles move from their winter quarters under debris in the early spring about the time the blossom buds are swelling. The female punctures the blossom with her beak, lays a single egg, and girdles the stem, causing the bud to wilt and fall. Adult feeding also causes irregular holes in the flower petals.

SPITTLEBUG. There are several species that may be involved. Eggs hatch in early spring and give rise to brightly colored (yellowish) nymphs that immediately begin feeding on the plant juices. These "froghoppers" begin to produce a frothy "spittle" that soon covers their bodies and is thought to protect them from predation. Their feeding can weaken or stunt plants but they are most serious as a nuisance or annoyance to pickers. A routine protective spray program will usually give control.

GRAPE DISEASES

BLACK ROT is a widespread disease of grapes, and it probably causes greater loss to growers in Virginia than all other diseases combined. This disease is caused by a fungus that attacks the leaves, shoots, tendrils, canes, blossoms, and fruit. Only the youngest tissues are susceptible, although the fruit may become infected until it is almost fully grown.

The foliage infections appear in the spring as tiny, more or less circular spots. They are reddish-brown and are usually encircled by a yellow ring. Through the coalescence of many spots, large areas of the leaf may become affected. Although spotting occurs on the foliage in the spring, the disease does not attract much attention until mid-summer, when the nearly half grown grapes begin to rot.

The disease on the fruit first appears as light-brownish, soft, circular spots, which enlarge rapidly, and after a few days the entire berry is discolored. The decaying berries soon begin to shrivel, and within a week they are transformed into black, hard, shriveled mummies, which may remain attached to the bunch for several weeks. The attached mummied fruit is covered with small fruiting bodies of the black rot fungus that exude infective spores during moist wet weather to start new infections on susceptible parts of the vines.

DOWNY MILDEW is a fungus disease, primarily of the grape foliage. If the disease occurs early in the season, however, the young bunches of berries may be entirely killed. The causal fungus is widespread in nature. The first evidence of the disease on the leaves appears as light-yellow spots on the upper surface of the oldest leaves in the center of the vine. Later, a white moldy growth of the fungus mycelial threads and spores forms on the under surface of the leaves. The fungus spreads from the older foliage to the foliage at the end of the canes as the leaves mature. By autumn, highly susceptible varieties are completely defoliated and the clusters of fruit may be scalded by the sun. Also, vines defoliated before the ripening season cannot mature the fruit normally and the fruit is of inferior quality.

POWDERY MILDEW is caused by a fungus that is present in many vineyards, but it is of little economic importance in Virginia. The fungus primarily attacks the foliage and cluster stems; it appears on the berries only in unusually favorable seasons. Powdery mildew infection appears as a superficial, grayish-white growth on the infected parts of the vine. Severely infected leaves turn brown and defoliation occurs. If the berries are infected, the surface appears russet or scurfy. They fail to mature properly, but no rot is associated with the injury. Infection of the cluster stem may cause shelling if the fruit is not harvested immediately.

ANTHRACNOSE, OR BIRD'S-EYE ROT, disease is sporadic in nature and its occurrence is usually localized. It is caused by a fungus that may do considerable damage in a vineyard or locality for a few years, then disappear. The fungus overwinters in the infected canes and gives rise to infective spores during the spring. The fruit, young shoots, tendrils, petioles, leaf veins, and fruit stems may be attacked severely. Numerous spots will unite and cause girdling. Similar spots develop on the petioles and leaves. Badly infected leaves curl downward from the margins, becoming distorted and spotted and the diseased areas drop out so that the leaf appears ragged. On the fruit, the spots are circular, sunken, and ashy gray. In the late stages of the disease, the spots are surrounded by a dark margin. The name of "bird's-eye rot," sometimes applied to this disease, is derived from the appearance of the spots on the berries.

DEAD ARM is a fungus disease of the trunk and main branches of grape vines. The fungus can attack young shoots, fruit stems, and occasionally berries. The fungus overwinters in the infected tissue and produces spores during May and June to cause new infections. The most easily recognized symptom is the dead arm (branch) on the vine. This is observed in the spring when the vine either fails to put out shoots or the shoots die back after a few weeks. In June or early July the young branches or shoots on the diseased arm are stunted and have shortened internodes which become progressively shortened and stunted from year to year. The primary leaves are about half the size of normal leaves and are misshapen. Badly lesioned vines are weakened and usually die during the dormant period. Early symptoms occur in June and are frequently masked by secondary growth that occurs from axillary buds in early July. The new growth, however, usually dies by late July or August.

The disease occurs on new cane growth as small purple to black sunken lesions on the first 3 or 4 internodes. These lesions may also occur on the leaf petioles or fruiting stems. The necrotic lesions can be seen under the bark of older canes and trunk tissue. The lesion stage on the trunk may exist 2 to 3 years before leaf symptoms appear. Apply sprays as suggested in the spray schedule for control of all grape diseases

GRAPE INSECTS

GRAPE BERRY MOTH - Infestation is indicated by the webbing together of grape berries. They turn dark purple in color and drop from the stems when grapes are the size of garden peas. Small holes are eaten in the almost ripened grapes. The webbed clusters may also include parts of leaves and frass. Close examination will reveal that small grayish-green worms may be found inside damaged berries.

GRAPE ROOT BORER - This pest is a major problem on bunch grapes. Vines become weak and die for no apparent reason. Upon digging into the root system, various size, round, white larvae may be found eating on the roots and trunk of the vine. These pests may be controlled by digging out the larvae or by covering the root area with 8 to 10 inches of soil around the vine in early August. The mound of soil should be removed from around the vines in the spring.

ROSE CHAFER - This long-legged, fawn-colored beetle feeds on the leaves and blossoms of grapes. It is most numerous for the first 2 or 3 weeks after bloom.

JAPANESE BEETLE - See section under Raspberry and Blackberry Diseases and Insects.

GRAPE TOMATO GALL - Large reddish-purple swellings occur on the leaves, flowers, and petioles of the vines. This is caused by a small fly; regular control measure will prevent its occurrence. The name is noted from the tomato-like smell of the galls once they are opened.

BLUEBERRY DISEASES

The diseases listed below are representative of a much larger group of problems that affect Highbush and Rabbiteye blueberry cultivars. While these are the most common problems, local conditions may occasionally result in severe damage from less common pathogens. The key to control and management of blueberry diseases is prevention. Start with the best plants or cuttings available. Insist upon virus-free certification. Follow plant selection with proper site selection and preparation. Finally, use recommended cultural practices and carefully monitor your planting for abnormal growth or appearance of plants.

MUMMY-BERRY DISEASE - The fungus causing this disease overwinters in dropped, infected fruit. In early spring, small cups grow from the dropped fruit and discharge spores to infect new leaves and, ultimately, flowers and fruit. Direct crop losses and reduced plant size and vigor result. White or pale-red berries amongst normal blue fruit are often the first sign of this important disease.

PHOMOPSIS TWIG BLIGHT - Conditions in Virginia and North Carolina favor a twig die-back disease rather than the stem canker caused by Phomopsis fungi in northern areas. Buds and tips die first followed by a downward spread of blighted tissue.

STEM CANKERS - Several fungi enter stems and destroy the bark tissues. The resulting cankers are often first noticed when large branches "flag" or wilt with off-colored foliage. These branches usually have one or more cankers partway down the stems. Severe damage to plants and whole fields can result.

LEAF-SPOTS - Fungal-caused leaf spots can defoliate plants and eventually reduce their vigor. They also may be the first stages in disease that affect stems and fruit. This is particularly true in the case of Anthracnose which causes leaf, stem and fruit problems.

ROOT ROTS - Most root-rots are associated with poor site selection or planting practices. Cuttings placed too deep in soil or planted in heavy, poorly-drained sites seem especially prone to fungi which destroy the roots and, of course, the entire plant.

VIRUSES - Virus infected plants are poor producers and have short lives. They also serve as reservoirs of disease for passing insect or nematode vectors. A number of virus and virus-like diseases occur in blueberries. The most severe problems are Shoestring and Stunt (a virus-like disease). Other diseases are Mosaic, Red-ring spot and Witches-broom. Virus-free plants and cuttings are the key to control of these problems.

SPRAY SCHEDULE FOR APPLES AND PEARS

Time of Application	Materials to Use - $\frac{\text{Fungicide}}{\text{Insecticide}}$ - -/Gallon ^{1/}	To Control	Remarks
DORMANT Prior to bud swell	NO FUNGICIDE superior oil	Mites and Scales	Follow manufacturer's recommendation as to amount. Apply 1 week before bud break.
DELAYED DORMANT When leaves are 1/2 to 3/4 inch long	2.0 Tbs. Dikar 76W ^{2/} + 3.0 Tbs. Malathion 25W 2.0 Tbs. Methoxychlor 50W **	Scab, Powdery mildew, Rust, Mites, Aphids, Leafrollers	Scab infection may occur at this time. Important spray for mites and aphids.
PRE-PINK First Pink in floral buds	Same as Delayed Dormant	Scab, Powdery mildew, Rust, Aphids, Mites, Leafrollers	Important for rust control.
PINK When flowers have separated just before bloom	Same as Delayed Dormant + Add Streptomycin	Scab, Powdery mildew, Rust, Apple rot, Fire blight, Aphids, Mites, Green fruit worms, Leafrollers,	Add Streptomycin as to manufacturer's recommendations.
BLOOM	2.0 Tbs. Captan 50W + 1.0 Tsp. Streptomycin 15W * DO NOT USE INSECTICIDE PROTECT BEES	Scab, Rust, Powdery mildew, Apple rots, Fire blight	*Also follow label recommendations for rate of Streptomycin.
PETAL FALL When most of the petals have fallen	2.0 Tbs. Dikar 76W + 3.0 Tbs. Malathion 25W + 2.0 Tbs. Methoxychlor 50W **	Scab, Rust, Powdery mildew, Rots, Fire blight, Curculio, Coddling moth, Aphids, Mites, ***Boron deficiency	If Fire blight is present, add Streptomycin to this spray. Important for coddling moth control.
FIRST THROUGH FIFTH COVER SPRAYS First cover 10 days after petal fall, second through fifth at 14-day intervals	Same as Petal fall	Same as Petal fall	If Mites become a problem, add 1.0 Tbs. of Kelthane 35W to the spray. If Japanese beetles become a problem, substitute 2.0 Tbs. Sevin 50W for Methoxychlor (Do not use Sevin until 30 days after bloom).
SIXTH AND SEVENTH COVER SPRAYS Two-week intervals, may not be required for early maturing	2.0 Tbs. Phaltan 50W or 2.0 Tsp. benomyl 50W + 3.0 Tbs. Malathion 25W + 2.0 Tbs. Methoxychlor 50W **	Apple rots, Sooty blotch, Flyspeck, Apple maggots, Codling moth, ****Bitter pit	Same as 1st through 5th covers. Generally speaking, apply protectant sprays up to 25 to 30 days of harvest.

^{1/} Material to use is given for one gallon, but the user can easily substitute the required amount of material to make five, ten, fifteen, twenty, or twenty-five gallons of spray.

^{2/} Dikar is not registered for pears, substitute either captan or benomy for pears.

**Imidan 12.5W 3.0 Tbs. (or 50% WP 1.0 Tbs.) may be substituted for Malathion and Methoxychlor in these sprays.

***See page 7 for discussion of boron deficiency and its control.

****See page 7 for discussion of bitter pit and its control.

**SPRAY SCHEDULE FOR CHERRIES*, NECTARINES, PEACHES,
PLUMS* AND PRUNES***

Time of Application	Materials to Use		To Control	Remarks
	- Fungicide -	- Insecticide - - /Gallon		
DORMANT Before buds begin to swell	2.0 Tbs. Ferbam 76W		Peach leaf curl	Apply to nectarine and peaches only. All buds must be thoroughly cov- ered. Follow manufacturer's recommendation.
	Superior spray oil		Scale, Mites	

	Remove and destroy all mummified fruit still hanging on the tree and on the ground. This will reduce inoculum that causes blossom blight and the later fruit brown rot.			
PINK SPRAY Early pink to full pink	General Purpose Mixture (Table 1) Plus** 2.0 Tbs. Carbaryl 50W (Sevin)		Green aphids, Tarnished plant bug, and Blossom blight	Plum and cherries are not pink, but apply spray at same stage of bud develop- ment. See comment on aphid under petal fall spray.
BLOSSOM SPRAYS Apply just before first blossoms open, and in full blossom	2.0 Tbs. Captan 50W + 1.0 Tbs. benomyl 50W NO INSECTICIDE--PROTECT BEES		Brown rot blossom blight	This is an important spray, particularly late full bloom, as the deteriorating petals are susceptible to the brown rot fungus.
PETAL FALL THROUGH FIFTH COVER Apply when all petals have fallen, then at 14-day intervals for 5 spray applications	Petal fall only 2.0 Tsp. benomyl 50W + 3.0 Tbs. Malathion 25W + 2.0 Tbs. Methoxychlor** 50W 1st through 5th cover General Purpose Mixture (Table 1)		Brown rot, Scab, Powdery Mildew, Curculio, Mites, Aphids, Oriental fruit moth (See Remarks)	If Mites build up, add 1.0 Tbs. Kelthane to any of the sprays. Neither Malathion or Methoxychlor are registered for aphids or oriental fruit moth on nectarines, but if used for other insects, aphid and oriental fruit moth will not be a problem.
PRE-HARVEST Apply 3- and 1-week before harvest on all varieties	2.0 Tsp. benomyl 50W NO INSECTICIDE (See Remarks)		Brown rot on fruit	If Japanese beetles are a problem, 2.0 Tbs. Sevin 50W can be added to the spray up to 1 day before harvest.
AFTER HARVEST Immediately after harvest	2.0 Tsp. benomyl 50W		Cherry leaf spot	Cherries only
PEACH TREE BORER SPRAYS These two sprays should be applied about July 15 and August 15 to 25 to all species and varieties	2.0 Tbs. Endosulfan 50W (Thiodan) OR Paradichlorobenzene crystals (see application rate and mehtod, page 3)		Peach tree borers	Apply to trunks and large limbs only. Caution: Do not spray fruit with this chemical. Do not apply within 21 days of harvest. Use after harvest if possible. "Extremely toxic."

*There are no fungicides approved for "black knot" control on plums, prunes, or cherries. In home fruit planting where a good spray program for brown rot control is followed, black knot usually will not be a problem.

**Imidan 12.5W 3.0 Tbs. (or Imidan 50W 1.0 Tbs.) may be substituted for methoxychlor.

SPRAY SCHEDULE FOR GRAPES

Time of Application	Materials to Use		To Control	Remarks
	- Fungicides -	- Insecticides - /Gallon		
DORMANT Before buds swell	8.0 Tbs. Copper Sulfate + 8.0 Tbs. Hydrated lime (Bordeaux Mixture)		Anthracnose	This spray is necessary only in vineyards where Anthracnose has been a problem.
NEW SHOOT SPRAYS When new shoots are 1-2" long, when new shoots are 6-8" long	General Purpose Mixture** (Table 1) + 1.0 Tbs. Folpet 50W (Phaltan)		Black rot, Downy mildew, Dead arm, *Anthracnose, Powdery mildew	Rake up and destroy all grape leaves, broken canes, dead twigs, and branches early in the spring to reduce disease and insect incidence.
PREBLOOM SPRAY Just before blossoms open	General Purpose Mixture (Table 1) + 1.0 Tbs. Ferbam 76W**		Same as new shoot spray plus berry moth, leafhopper	Important black rot spray, thorough coverage necessary for control.
POST-BLOOM SPRAY Immediately after bloom	General Purpose Mixture (Table 1) + 1.0 Tbs. Folpet 50W (Phaltan)		Same as Prebloom	Same as Prebloom. If Powdery mildew is a problem, substitute 2.0 Tsp. benomyl 50W for folpet.
PEA SIZE SPRAY When berries are about pea size, but before they touch in clusters	Same as Post-bloom spray		Same as Post-bloom	If Japanese beetles have appeared, substitute 2.0 Tbs. Sevin 50W for Methoxychlor.
BERRIES TOUCH IN CLUSTER 10-14 days after pea size spray	1.0 Tbs. Folpet 50W + 2.0 Tsp. benomyl 50W** + 3.0 Tbs. Malathion 25W + 2.0 Tbs. Sevin 50W		Same as Pea size spray plus Japanese beetle	Continue good coverage.
JUNE AND JULY Apply at two-week intervals until harvest	Same as Berries-touch-in-cluster spray		Same as Berries-touch-in-cluster spray plus ripe rots	During harvest, if rots are a problem, substitute 2.0 Tbs. of Captan 50W for benomyl and spray only with Captan and/or folpet during harvest.

*There are no organic fungicides approved for Anthracnose. But if a good control program is used for other diseases, anthracnose usually will not be a problem.

**Captan and Ferbam are not satisfactory for powdery mildew control. If powdery mildew is a problem, use Benlate or folpet. Benlate is not approved for ripe rot. But if other diseases are controlled, ripe rot will not be a problem. Do not use captan more than three times after bloom. Imidan 12.5W 3.0 Tbs. may be substituted for Methoxychlor in the grape schedule.

SPRAY SCHEDULE FOR BLACKBERRY AND RASPBERRY

Time of Application	Materials to Use		To Control	Remarks
	- Fungicides -	- Insecticides - /Gallon		
DELAYED DORMANT When buds begin to break	8.0 Tbs. Copper Sulfate + 8.0 Tbs. hydrated lime (Bordeaux Mixture)		Anthraco-nose, cane blight, spur blight	A good thinning, pruning and a general clean-up and removal of dead canes will help control Anthrac-nose as well as cane and spur blight.
NEW CANE SPRAY When new canes are 6-12" high	2.0 Tbs. Captan 50W + 1.0 Tbs. Ferbam 76W No Insecticide		Same as Delayed Dormant except no cane blight	Good coverage is important since the canes and foliage are hard to wet.
PRE-BLOOM Just before blossoms open	General Purpose Mixture (Table 1) + 1.0 Tbs. Kelthane 35W		Same as New cane spray plus thrips, Mites, Strawberry weevil.	Coverage is a must to be sure of insect control, fruit worms may or may not be present.
POST-BLOOM UNTIL HARVEST At 10- to 14-day inter-vals	2.0 Tbs. Captan 50W + 3.0 Tbs. Malathion 25W + 2.0 Tbs. Sevin 50W + 1.0 Tbs. Kelthane 35W		Same as Pre-bloom spray plus Japanese beetles and fruit rot	Malathion is necessary if sap beetle appears as fruit begins to color.
AFTER HARVEST Apply in 14-days	2.0 Tbs. Captan 50W + 2.0 Tbs. Sevin 50W		Anthraco-nose Japanese beetles	Various borers do cause problems in the canes of brambles*.

*Canes with borer damage, wilted and with galls, should be cut and burned. Also control weeds because they harbor insects and diseases.

SPRAY SCHEDULE FOR STRAWBERRIES

Time of Application	Materials to Use		To Control	Remarks
	- Fungicides -	- Insecticides - /Gallon		
WHEN BLOSSOM BUDS ARE VISIBLE IN THE CROWN	General Purpose Mixture (Table 1) + 1.0 Tbs. Kelthane 35W + 2.0 Tsp. benomyl 50W		Weevil, Spittlebug, Spider mites, Leaf aphids, Fruit rots, and Leaf spots.	Good thinning and mulching of plants during late February to early March is important for fruit rot control.
PRE-BLOOM When flowers have pushed out of the crown	Same as above		Same as above plus Cyclamen Mite	Essential spray for later fruit rot control. See note, page 9.

SPRAY SCHEDULE FOR STRAWBERRIES (CONT'D)

Time of Application	Materials to Use		To Control	Remarks
	Fungicides -----/Gallon	Insecticides		
BLOOM When most blossoms are full open	3.0 Tbs. Captan 50W 2.0 Tsp. benomyl 50W 1.0 Tbs. Kelthane 35W	No Insecticide	Fruit rots, Leaf spots, Mites	Be sure of complete cover- age for future fruit rot control.
POST-BLOOM Apply 10-days after bloom and continue at 7-10 day intervals until harvest	3.0 Tbs. Captan 50W* 2.0 Tsp. benomyl 50W 1.0 Tbs. Kelthane 35W 3.0 Tbs. Malathion 25W		Fruit rots, Leaf spots, Aphids, Mites	Spraying for strawberry pest must be thorough to to get good coverage. Use 40-50 pounds of pres- sure in the tank and hold nozzle close enough to force spray between foliage.

*Captan 50W 3.0 Tbs./gallon can be used during harvest for fruit rot control.

SPRAY SCHEDULE FOR BLUEBERRIES ^{1/}

Time of Application	Materials to Use		To Control	Remarks
	Fungicides -----/Gallon	Insecticides		
DORMANT		None	Insect stem gall, scale insects, twig blight	Prune out insect or disease infested canes or parts of canes and destroy prunings by burning or burying in a land-fill.
DELAYED DORMANT		3.0 fl. oz. Superior Oil	Scale insects	This spray is not necessary if no scale insects are present.
FROM TIME OF BUD BREAK UNTIL BLOSSOMS OPEN		See Below	Mummy berry cups on soil	Use clean culture between rows and around the plants. Rake or hoe around plants to bury (2 in.) fungus cups that form on the mummified berries.
LEAF BUD BREAK THROUGH PINK BUD STAGE (maximum 3 sprays at 7- to 10-day intervals)		3.0 Tbs. Funginex 18.2 EC	Mummy berry twig/ flower infection	Tips of twigs and flowers are infected leading to fruit infection.
LEAF BUD BREAK THROUGH PETAL FALL (7- to 10-day intervals)		1.0 Tbs. Benlate 50WP	Mummy berry twig/ flower infection	Tips of twigs and flowers are infected leading to fruit infection.

^{1/} Blueberries thrive best when the pH of the soil where they are growing is between 4.3 and 4.8. If the acidity needs to be increased, sulfur is a safe and economical chemical compound to use. It usually will require 1.0 lb of sulfur per plant to increase the acidity one pH number. Work the sulfure lightly in the soil on a 15-18 inch radius around each bush.

SPRAY SCHEDULE FOR BLUEBERRIES^{1/} (CONT'D)

Time of Application	Materials to Use		To Control	Remarks
	Fungicides ----- /Gallon	Insecticides		
LEAF BUD BREAK THROUGH PETAL FALL (7- to 10-day intervals)	1.0 Tbs. Benlate 50WP and 2.0 lbs Captan WP		Phomopsis twig blight	Twig blight affects top several inches of the twig tops. This schedule will control both mummy berry and Phomopsis twig blight.
WHEN 3/4 OF BLOSSOMS HAVE FALLEN (Repeat in 10 days).	4.0 Tbs. Malathion 25W or 2.0 Tbs. Carbaryl 50W (Sevin)		Cherry fruit worm, cranberry fruit worm	Use good coverage.
WHEN BERRIES FIRST TURN BLUE (Repeat at 10-14 day intervals through harvest).	3.0 Tbs. Malathion 25W or 2.0 Tbs. Carbaryl 50W (Sevin)		Blueberry maggot	Sevin will control Japanese beetles, and fruitworms.
POST HARVEST	1.0 Tbs. Wettable sulfur or 5 gal/acre lime sulfur		Phomopsis twig blight	Prune out all diseased canes and destroy by burning

SPRAY SCHEDULE FOR PECANS

Time of Application	Materials to Use		To Control	Remarks
	Fungicides / ----- / Size	Insecticides / Tree		
FIRST PREPOLLINATION SPRAY (When Bud are bursting and leaves show green).	3.0 oz. Cyprex 65% W or 1.5 oz. benomyl 50W + 9.0 oz. Malathion 25W		Scab, leaf Casebearer	Be sure of good coverage.
SECOND PREPOLLINATION SPRAY (When leaves are half grown).	3.0 oz. Cyprex 65W or 1.5 oz. benomyl 50W		Scab	These first two sprays are extremely important for scab control.
FIRST COVER SPRAY (When young nuts first appear)	3.0 oz. Cyprex 65W or 1.5 oz. benomyl 50W + 9.0 oz. Malathion 25W		Scab Aphids Mites Nutcusebearer	This is an important spray.
SECOND COVER SPRAY (2 weeks after first cover)	3.0 oz. Cyprex 65W or 1.5 oz benomyl 50W		Scab, Powdery Mildew	Benomyl is needed at this time for powdery mildew control. If insect are a problem, use malathion 9.0 oz./10 gal.

^{1/} Blueberries thrive best when the pH of the soil where they are growing is between 4.3 and 4.8. If the acidity needs to be increased, sulfur is a safe and economical chemical compound to use. It usually will require 1.0 lb of sulfur to increase the acidity one pH number. Work the sulfur lightly into the soil within a 15-18 inch radius around each bush.

^{2/} Use about 10 gallons of spray/medium size tree (25 to 30' height).

SPRAY SCHEDULE FOR PECANS (CONT'D)

Time of Application	Materials to Use		To Control	Remarks
	Insecticides /	Fungicides/Medium ^{1/} Size Tree		
THIRD COVER SPRAY (2-weeks after second cover)	1.5 oz. benomyl 50W		Scab, Downy Mildew, Powdery Mildew, Brown leaf spot	Benomyl is probably the best fungicide at this time.
FOURTH COVER SPRAY (two to three weeks after 3rd cover)	1.5 oz. benomyl 50W + 9.0 oz. Malathion 25W		Scab, Powdery Mildew, Downy spot, Brown leaf spot, Aphids, Mites, Shuck worm (See Remarks)	This spray is extremely important for shuck worm control. Malathion is not registered for shuck worm, but if used for other in- sects shuck worm will not be a problem.
FIFTH COVER SPRAY (two to three weeks after fourth cover)	1.5 oz. benomyl 50W or 3.0 oz. Cyprex 65W + 9.0 oz. Malathion 25W		Scab, Powdery Mildew, Downy spot, Brown leaf spot.	Important spray for Brown leaf spot, Downy spot, aphids, mites.
SIXTH COVER SPRAY (two to three weeks after 5th cover spray)	1.5 oz. benomyl 50W or 3.0 oz. Cyprex 65W + 9.0 oz. Malathion		Shuck worm Scab, and Black aphid (See Remarks)	Important spray for Scab and insect control. I be- lieve this spray is extremely important. See fourth cover concerning shuck worm.

^{1/}Use about 10 gallons of spray/medium size tree (25 to 30' height).

LIMITED SPRAY SCHEDULE FOR CHESTNUTS

There is no chemical pesticide spray program that will control the chestnut blight disease which destroyed the native American chestnut. The Chinese chestnut, however, is blight resistant and hardy in the United States. Thus, they can be grown in Virginia without a disease control program. Although the fruit (nuts) are inferior to the native chestnut, they are desirable for many home owners. There are two insects that may cause extensive damage to all chestnut species. Japanese beetles are extremely destructive to chestnut leaves and flowers. There are two species of weevil that often attack the nuts causing them to be wormy. If you have been using an insecticide on your chestnut trees for the control of Japanese beetles we would suggest that the program be continued since it may aid in the control of weevils.

CONTROL OF BROADLEAF WEEDS AND GRASS AROUND HOME FRUIT TREES. Rodents are serious pests of home fruit trees. They eat bark from the main roots and trunk near and below the ground line. The injury may occur at any time, but is usually more serious in the fall and winter months. Natural predators such as hawks, owls, and cats will reduce the rodent population if the protective cover is eliminated. Mow the grass closely around the trees and throughout the home orchard. Use herbicides or a hoe and remove all vegetation within 18 inches of the trunk of each tree. This will usually take care of the rodent problem.

PREVENT RABBIT DAMAGE TO YOUNG FRUIT TREES. During the winter months when food is scarce and hard to find, rabbits will eat the bark from the trunk and lower limbs (scaffold limbs) of young fruit trees. They rarely bother older trees. One can purchase a circular metal guard 18 inches tall and approximately 8 inches in diameter made of hardware cloth or similar material which, when placed around the young trees, will protect them from rabbits. Aluminum foil, however, is more economical and will serve the same purpose. Either staple it around the young tree trunks or wrap it around them and secure it with a string. Remove the aluminum foil each spring. It should be noted, however, that if a deep snow forms a crust, rabbits may be able to stand on the snow and eat above the guards. Therefore, also wrap the lower scaffold limbs with aluminum foil.

WEED CONTROL IN HOME FRUIT

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Measures considered practical for control of weeds by the home owner on a small area are quite different than those employed by the commercial producer. Home owners often have a very limited area that may not justify a precise pesticide application. Thus some of the materials recommended for commercial use are excluded from home owner recommendations because they are highly toxic, not readily available in small quantities, or require rather precise application.

If your need for use of these materials is sufficient, you may consult the information designed for commercial production. Some of the materials used by commercial growers require that the applicator be certified as a pesticide applicator.

For extremely small areas, the mechanical removal of weeds by mowing or tillage is often the most practical. Mulching is also an extremely effective way to handle weed problems on a limited area. Several types of material may be used as mulch. Some commonly used include: black plastic, several layers of newspaper, tarred felt (roofing paper), grass clippings that have not been treated with pesticides. Some pesticides can be carried in the grass clippings and may affect the growth of the plants in the mulched area or result in undesirable chemical residues in the fruit itself.

If you are not familiar with the application of pesticides, consult a knowledgeable individual before proceeding. Used correctly, herbicides can be very effective, but if misused they may kill the desirable crop plant.

Rates of application are given in pounds of both active ingredient (and commercial product) per acre. The following table will be helpful for converting to small areas. Note that 3 pounds per acre is only 1.0 oz per 1000 sq ft. These are extremely small quantities and very careful measurement and application are required.

CONVERSION OF HERBICIDE PRODUCTS FOR SMALL AREAS¹

Recommended Product (lb/A)	Gram/1000 sq ft	Oz/1000 sq ft
1	10	.37
2	21	.73
3	31	1.1
4	42	1.5
5	52	1.8
6	62	2.2
7	73	2.6
8	83	2.9
9	94	3.3
10	104	3.7

¹ Approximate values.

Products cannot be measured on a volume basis since products vary in density. Even a given product will vary depending upon whether it is loose or compressed.

You can make the conversion to a volume basis by weighing a given volume of product and measuring the volume occupied. For instance, 10 oz of a given wettable powder, loosely compacted, might occupy 20 oz on a volumetric basis. Once you determine a volumetric conversion factor, you can proceed to measure the product volumetrically (teaspoons or ounces) rather than by weight.

Small Sprayer Calibration

To determine the output of a manually-pressurized sprayer, fill the sprayer with water, measure a 1000 sq ft area (8 x 125 ft), and using the same procedure that you would use to spray the orchard floor, spray the entire 1000 sq ft area. Then measure the number of cups of water required to fill the sprayer. Then divide by 16 (16 cups/gallon) to get the number of gallons. Adequate coverage for ground sprays can be obtained with 1 to 2 gallons per 1000 sq ft. Next, determine the amount of herbicide needed for 1000 sq ft and add this to the volume of water required to spray the area.

During application do not make a circle around a tree since this would result in a heavier application near the trunk of the tree and may result in injury. To obtain uniform distribution of material on an 8 ft x 8 ft area, apply a 4 ft x 8 ft strip on both sides of the tree.

Crop	Herbicide (Product/Acre)	Remarks
APPLES and PEARS	AMS 57 lb (Ammate 60 lb or 1.4 lb + 1 Tbs surfactant in 2 gal water to cover 1000 sq ft)	Apply as a directed spray to annual weeds, poison ivy, or honeysuckle during period of active growth. AMS is a contact killer and has little residual soil activity. AMS is corrosive; wash spray equipment immediately after use. Can be used on bearing or nonbearing trees. Spray on bark only if it is well developed and shows no green. Avoid excessive wetting of bark.
	dalapon 7.4 lb (Dowpon 10 lb or 4.0 oz + 1 Tbs surfactant/gal water)	Apply for control of annual or perennial grasses around trees established at least 4 years. Wet grass foliage thoroughly, but without run off, when the grass is actively growing and prior to seed head formation (preferably 6-10 inches high). A repeat application 2 weeks later is necessary for good control. Do not apply within 30 days of harvest. Keep spray off tree foliage and fruit. Do not make more than 2 applications per year. Do not graze livestock on the treated area.
	dichlobenil 6 lb (Casoron 4 G 150 lb or 3.4 lb/1000 sq ft)	Apply granules in the late winter or early spring. Shallow incorporation may improve weed control, especially if application is made during warm temperatures. Do not apply to newly planted trees until 4 weeks after transplanting. Will not give season-long weed control. Do not make more than one application per year. Do not apply within 1 month of harvest. Do not allow livestock to graze treated area.
	simazine 2-4 lb (Princep 80W 2.5, 5.0 lb, 1-2 oz/1000 sq ft)	Apply to clean cultivated soil around trees established 1 year or more. Best results are obtained with winter or early spring applications. Adjust rate of application to soil type. Do not use on sandy or gravelly soils. Do not make more than one application per year.
	2,4-D 2.0 lb (Weedone 638 5.3 pt, 2 oz/gal water or (Emulsamine E3 5.3 pt, 2 oz/gal water or (Dacamine 4D 2 qt, 3 Tbs/gal water	Use only the acid or oil soluble amine formulations. Apply as a directed spray to actively growing broadleaf weeds. Gives good control of annual broadleaf weeds and partial control of perennials. Keep spray off tree foliage and fruit or serious injury may result. Use a course spray and low pressure to avoid spray drift.
	diuron 3.2 lb (Karmex 80W 4.0 lb, 1.5 oz/1000 sq ft)	Apply once as a directed spray to orchard floor in early spring (March-May) before fruit sets. Does not kill emerged weeds but may be used in conjunction with a contact herbicide. <u>Apply only to trees established 2 years or more.</u> Do not use on dwarf or semi-dwarf trees. Do not use on light (sand, loamy sand, or gravelly) soil or on soils having less than 1% organic matter. Avoid contact of foliage or fruit. Do not replant treated area to any crop within 2 years after last application.
	diuron 0.8-1.6 lb + terbacil 0.8-1.6 lb (Karmex 80W 1.0-2.0 lb + Sinbar 80W 1.0- 2.0 lb)	Use on apples only. Terbacil is not registered for use on pears. Apply tank mixture either in the spring or after harvest in the fall before weeds emerge or during early seedling stage of weed growth. <u>Use only under trees established for at least 2 years.</u> Use lower rates on light soils and soils with low organic matter (1-2%); higher rates on soils with a higher percentage of organic matter. Do not use on soils with less than 1% organic matter, or on eroded areas where tree roots are exposed. Do not replant treated areas to any crop within 2 years after the last application. Avoid spraying tree foliage and fruit.

Crop	Herbicide (Product/Acre)	Remarks
APPLES and PEARS (Cont'd)	terbacil 1.6-3.2 lb (Sinbar 80W 2.0-4.0 lb)	Use in apples only; not registered for use in pears. Apply once in early spring as directed spray to orchard floor where trees have been established 3 years or more. Kills most existing weeds and gives residual control of annual weed seedlings. Use lower rates on light soils and soils with low organic matter (2% or less); higher rates on heavy soils with 2% or more organic matter. Do not use on sand, loamy sand, gravelly soils, soils with less than 1% organic matter, nor on eroded areas where tree roots are exposed. Do not replant treated areas to any crop within 2 years after last application. Keep spray off crop foliage and fruit.
	glyphosate 1.5-5.0 lb (Roundup 1.5-5.0 qt, annual weeds 1.0 oz, perennial weeds 3.0 oz/gal water)	Apply 1.5 qt in 10-40 gal of water per acre for control of annual weeds. Use 2-5 qt per acre for control of perennial grasses and weeds (see label for specific rates). Apply as a directed spray. Do not contact bark or foliage of trees or severe injury may result. Extensive care must be exercised to avoid contact of spray, drift or mist with green foliage, green bark or bark of trees established less than 2 years, suckers, or fruit of desirable trees. Spray contact with other than mature bark on main trunk can cause serious localized or systemic damage. Injury may become increasingly severe the second season. WARNING: Do not mix, store, or apply Roundup spray solution in galvanized metal or unlined steel tanks. Chemical reaction produces hydrogen gas which is very explosive.
	napropamide 4.0 lb (Devrinol 50 WP 8.0 lb, 3 oz/1000 sq ft)	Use in trees established one year or more. Apply to the soil surface in the fall through early spring prior to weed emergence. Do not apply to frozen ground. Does not control existing weeds. Use as a directed spray and avoid contact with fruit or foliage. Do not apply when fruit is on the ground during the harvest period. Do not graze treated areas. Make only one application per season.
	oryzalin 2.0-4.0 lb (Surflan 75W 2.66-5.33 lb or 4AS 2.0-4.0 qt, 1.0-2.0 oz/1000 or 4AS 2.0-4.0 qt, 1.5-3.0 fl oz/1000 sq ft)	Use in bearing or non-bearing trees. Areas to be treated should be free of weeds. Remove or thoroughly mix trash into the soil before application. Use lower rate for short-term control (4 months) and higher rate for long-term control (6 to 8 months). Apply as a directed spray and avoid spray contact with leaves, branches or trunks of trees. Do not apply to newly transplanted trees until soil has settled and there are no cracks present. Make only one application per growing season.
PEACHES	dichlobenil 6 lb (Casoron 4 G 150 lb)	Apply granules in the late winter or early spring. Shallow incorporation may improve weed control, especially if application is made during warm temperatures. Do not apply to newly planted trees until 4 weeks after transplanting. Will not give season-long weed control. Do not make more than one application per year. Do not apply within 1 month of harvest. Do not allow livestock to graze treated area.
	simazine 2-4 lb (Princep 80W 2.5-5.0 lb)	Apply to clean cultivated soil around trees established 1 year or more. Best results are obtained with winter or early spring applications. Adjust rate of application to soil type. Do not use on sandy or gravelly soils. Do not make more than one application per year.

Crop	Herbicide (Product/Acre)	Remarks
PEACHES (Cont'd)	diuron 3.2 lb (Karmex 80W 4.0 lb)	Apply once as a directed spray to orchard floor in early spring (March-May) before fruit sets. Does not kill emerged weeds but may be used in conjunction with a contact herbicide. Apply only to trees established 2 years or more. Do not use on dwarf or semi-dwarf trees. Do not use on light (sand, loamy sand, or gravelly) soil or on soils having less than 1% organic matter. Avoid contact of foliage or fruit. Do not replant treated area to any crop within 2 years after last application.
	diuron 0.8-1.6 lb + terbacil 0.8-1.6 lb (Karmex 80W 1.0-2.0 lb + Sinbar 80W 1.0-2.0 lb)	Use on apples only. Terbacil is not registered for use on pears. Apply tank mixture either in the spring or after harvest in the fall before weeds emerge or during early seedling stage of weed growth. <u>Use only under trees established for at least 2 years.</u> Use lower rates on light soils and soils with low organic matter (1-2%); higher rates on soils with a higher percentage of organic matter. Do not use on soils with less than 1% organic matter, or on eroded areas where tree roots are exposed. Do not replant treated areas to any crop within 2 years after the last application. Avoid spraying tree foliage and fruit.
	terbacil 1.6-3.2 lb (Sinbar 80W 2.0-4.0 lb)	<u>Use in apples only; not registered for use in pears.</u> Apply once in early spring as directed spray to orchard floor where trees have been established 3 years or more. Kills most existing weeds and gives residual control of annual weed seedlings. Use lower rates on light soils and soils with low organic matter (2% or less); higher rates on heavy soils with 2% or more organic matter. Do not use on sand, loamy sand, gravelly soils, soils with less than 1% organic matter, nor on eroded areas where tree roots are exposed. Do not replant treated areas to any crop within 2 years after last application. Keep spray off crop foliage and fruit.
	napropamide 4.0 lb (Devrinol 50 WP 8.0 lb)	Use in trees established three years or more. Apply to the soil surface in the fall through early spring prior to weed emergence. Do not apply to frozen ground. Does not control existing weeds. Use as a directed spray and avoid contact with fruit or foliage. Do not apply when fruit is on the ground during the harvest period. Do not graze treated areas. Make only one application per season.
	oryzalin 2.0-4.0 lb (Surflan 75W 2.66- 5.33 lb or 4AS 2.0- 4.0 qt)	Use in bearing or non-bearing trees. Areas to be treated should be free of weeds. Remove or thoroughly mix trash into the soil before application. Use lower rate for short-term control (4 months) and higher rate for long-term control (6 to 8 months). Apply as a directed spray and avoid contact with leaves, branches or trunks of trees. Do not apply to newly transplanted trees until soil has settled and there are no cracks present. Make only one application per growing season.
	glyphosate (1 part Roundup to 2 parts water)	Wick or wiper application only. Use on emerged annual and perennial weeds with fully expanded leaves.

Crop	Herbicide (Product/Acre)	Remarks
BLACKBERRIES and RASPBERRIES	simazine 2.0-3.0 lb (Princep 80W 2.5- 3.75 lb)	Apply for control of annual grasses and broadleaf weeds in the early spring; or as a split treatment with 1/2 applied in the spring. Do not use more than 1/2 rate on new plantings less than 6 months old. Do not apply to foliage or while fruit is present.
GRAPES	diuron 2.0 lb (Karmex 80W 2.5 lb) or simazine 2-2.5 lb (Princep 80W 2.5- 3.12 lb)	Apply a single application per year in the early spring after clean cultivation and where vines have been established at least 3 years. Single applications may give season-long control of annual weeds. Do not plant treated area to any crop not on the label for 2 years.
	glyphosate 1.5-5.0 lb (Roundup 1.5-5.0 qt)	Use as a directed spray in established vineyards or for site preparation prior to transplanting new vines. Do not apply when green shoots or canes or foliage are in the spray zone. Do not allow spray, drift or mist to contact green foliage, green bark, suckers or vines and renewals less than 3 years of age. Spray contact, other than with mature bark on the main trunk, can result in serious localized or translocated damage. If repeat treatments are necessary, do not exceed a total of 10.6 qts per acre per year. Do not treat between 14 days before harvest and fall dormancy when no green vegetables, canes or shoots exist.
	napropamide 4.0 lb (Devrinol 50 WP 8.0 lb)	Use in vineyards established three years or more. Apply to the soil surface in the fall through early spring prior to weed emergence. Do not apply to frozen ground. Does not control existing weeds. Use as a directed spray and avoid contact with fruit or foliage. Do not apply when fruit is on the ground during the harvest period. Do not graze areas. Make only one application per season.
	oryzalin 2.0-4.0 lb (Surflan 75W 2.66- 5.33 lb or 4AS 2.0- 4.0 qt)	Use in bearing or non-bearing vineyards. Areas to be treated should be free of weeds. Remove or thoroughly mix trash into the soil before application. Use lower rate for short-term control (4 months) and higher rate for long-term control (6 to 8 months). Apply as a directed spray and avoid contact with leaves, branches or trunks of vines. Do not apply to newly transplanted vineyards until soil has settled and there are no cracks present. Make only one application per growing season.
STRAWBERRIES	DCPA 9 lb (Dacthal 75W 12 lb)	Apply over the top of the plants at transplanting or to established planting in the fall or early spring before annual grasses germinate. Do not apply after first bloom. Annual grass control usually lasts 8-12 weeks.
	chloroxuron 4 lb (Tenoran 50W 8 lb)	Apply over the top of established plants for preemergent control of most annual weeds. Control of emerged seedling can be obtained while they are in the 2-3 leaf stage. Do not apply on new transplants until they are well established. Do not make more than 2 applications per year. Do not apply within 50 days of harvest.
	2,4-D amine 1.0 lb (Dow Formula 40 1 qt)	Apply for control of emerged broadleaf weeds in established beds. Apply in the early spring when strawberries are dormant, or apply immediately after last picking. Do not apply during bud, flower, or fruit stage; or during runner formation. Some foliar injury is to be expected.

Crop	Herbicide (Product/Acre)	Remarks
STRAWBERRIES (Cont'd)	diphenamid 4.0-6.0 lb (Enide 50W 8.0-12.0 lb, Enide 90W 4.4-6.7 lb)	Apply over the top of established plants for preemergent control of most annual weeds. Make application after bed renovation and clean cultivation. Do not apply within 60 days of harvest.
	napropamide 4.0 lb (Devrinol 50 WP 8.0 lb)	Use on newly transplanted and established strawberries. Delay application until the desired number of daughter plants have become established. Do not apply from bloom to harvest. Make only one application per season. Does not control established weeds.
BLUEBERRIES	dichlobenil 4.0-6.0 lb (Casoron G4 100-150 lb or 2.3-3.4 lb/1000 sq ft)	Apply as soil surface treatment in late fall from November to March in areas where perennial weeds have been established and not disturbed since the growing season. Applications made in warm weather not effective unless followed by light incorporation. Do not apply within 4 weeks of transplanting.
	Chloro IPC 8.0-12.0 lb (Furloe 4E, 8.0-12.0 qt, Furloe 20G 40.0-60.0 lb)	Dormant application only in late fall or early spring before weed growth resumes.
	Simazine 2.0-4.0 lb (Princep 4L 2.0-4.0 qt, 80W 2.5-5.0 lb, 90W 2.2-4.4 lb, 4G 50.0-100.0 lb)	Apply to weed-free soil. Split application possible with the 1/2 rate in Fall and 1/2 rate in Spring. On plantings less than 6 months old use the 1/2 the total rate of application.
	Terbacil 2.4-3.2 lb (Sinbar 80W 3.0-4.0 lb)	Treat only plantings established for 1 year or more. Use higher rate on heavy soils (clay) and soils with high organic matter (3%+). May be applied in early spring or late fall.
	Paraquat 0.5-1.0 lb (Paraquat Cl, Gramoxone 1.0-2.0 qt + 8.0 oz spreader per 100 gal water)	Apply as coarse directed spray to thoroughly wet emerged weeds. Apply before emergence of new shoots. Do not allow spray to contact new shoots or green stems otherwise injury is likely.

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.

