Disease and Insects

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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 and 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 early pre-blossom time until harvest. Therefore, home gardeners who are not willing to contribute considerable time to their home fruit planting may be disappointed in their harvests. Homeowners who are unwilling to devote a considerable amount of their free time, on a regularly scheduled weekly basis, probably should select a less demanding hobby with more positive results. There are no short-cuts to quality fruit production.

Production of blemish-free fruit requires the timely protection of pesticides applied according to the manufacturer's label instructions. 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 grower 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 effect.

Information on insect and disease identification and monitoring, including many color photographs, is available in the Mid-Atlantic Orchard Monitoring Guide. This is available from the Natural Resource, Agriculture, and Engineering Service, (607) 255-7654, as NRAES-75. Information may also be obtained on the Web at the Virginia Fruit website at *http://www.virginiafruit.ento.vt.edu*. A spray guide for Home Fruit located at *http://www.virginiafruit.ento.vt.edu/SprayGuide/HomeFruitSprays.html* contains some of the printed information and may be updated during the season as new information becomes available.

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, 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.

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.

Table 3.1 - Recommended Protectant Pesticides

	Amount of pesticide to use in different amounts of water				
Pesticide	**1 gallon**	**5 gallons**	**10 gallons**	**25 gallons**	**50 gallons**
Special Purpose Pesticides (SPP)					
Captan 50% Wettable Powder	2.0 tbsp[2]	1.6 oz	3.2 oz	0.5 lb	1.0 lb
Malathion 50% Emulsifiable Concentrate	2.0 tsp	1.6 fl oz	3.2 fl oz	8.0 fl oz	1.0 pt
Ferbam 76% Wettable Powder[3]	1.5 tbsp	1.2 oz	2.4 oz	6.0 oz	12.0 oz
Immunox 1.55%[4] (rates for apples and stone fruits)	1.0 tbsp	2.5 fl oz	5.0 fl oz	12.5 fl oz	25.0 fl oz
M-Pede 49% Liquid[5]	2.5 fl oz	13 fl oz	26 fl oz	0.5 gal	1.0 gal
Sevin 80S[6]	1.0 tbsp	1.0 oz	2.0 oz	5.0 oz	10.0 oz
Sulfur 95% Wettable Powder[7]	1.0 tbsp	5.0 tbsp	1.6 oz	4.0 oz	8.0 oz
3336 50% WP[8]	2.5-3.5 tsp	4.0-6.0 tbsp	1.2-1.6 oz	3.0-4.0 oz	6.0-8.0 oz

[1]Do not exceed the label rate for any material on any crop.

[2]A teaspoonful (tsp) or a tablespoonful (tbsp) in this publication refers to a level standard measuring teaspoon or table spoon.

[3] 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.

[4]Immunox may be used to supplement Captan in the GPM for rust and mildew management on apples, peaches, nectarines, cherries, apricots, plums, prunes, and grapes. See following Spray Materials section for disease control spectrum and usage restrictions for each crop.

[5]If mites become a problem on apple, peach, or grape, use two sprays of M-Pede at 7-day intervals.

[6]Sevin can be used beginning in early June if Japanese beetles become a problem (minor foliar feeding is acceptable). Do not use before this period since it will thin some varieties of apples.

[7]Sulfur can be added to the GPM for powdery mildew control on apple. It is sold in concentrations of 52-95%.

[8]Systemic Fungicide 3336 WP 50% wettable powder is available as Dragon Systemic Fungicide 3336 WP and Cleary's 3336 WP for use on backyard (non-commercial) fruit trees such as apple, apricot, cherry, nectarine, peach, plum, and prune trees. This fungicide replaces Benlate, which is no longer registered for use. Do not apply 3336 WP within 24 hours of harvest.

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. Note that Captan does not control powdery mildew or apple rust diseases, which are common in Virginia. Do not use with spray oils or within one week of an oil application.

Chlorothalonil (Ortho Multi-Purpose Fungicide Daconil 2787) is registered for control of several early season diseases on peach, nectarine, apricot, cherry, plum, and prune. Consult the label for disease control spectrum and use directions. Do not apply after petal fall on plums and prunes or after shuck-split stage (about two weeks after petal fall) on peaches, nectarines, apricots, and cherries.

Ferbam is a 76% wettable powder and is effective against apple rust, black rot of grape, leaf spots of fruit crops, and peach leaf curl.

Immunox (Spectracide Immunox Multi-Purpose Fungicide) is a 1.55% emulsifiable concentrate myclobutanil fungicide formulation registered for apples, stone fruits (peaches, nectarines, cherries, apricots, plums, and prunes) and grapes. The Immunox rate is 1/2 fluid ounce per gal on all tree fruit crops. On apples, it is particularly suggested as a supplement for control of cedar apple rust, quince rust, and powdery mildew and is also effective for scab. For management of these diseases it should be used

on a 7- to 10-day schedule from green tip until about one month after petal fall. Do not apply Immunox to apples more than 10 times per season and do not treat within 2 weeks of harvest. On stone fruits, Immunox is registered for control of brown rot and powdery mildew. Treatments may be applied to stone fruits the day of harvest but no more than 7 times per season. On grapes, Immunox controls black rot, anthracnose, and powdery mildew. Mix 2 fluid ounces per gal of water and treat every 2 weeks. Do not treat within 2 weeks of harvest and do not apply to grapes more than 6 times per season. Immunox is also registered for numerous ornamental diseases. **Do not confuse Immunox with Immunox Plus, a formulation which is not registered for edible fruits.**

Wettable Sulfur is a fungicide that 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. Do not use with oil sprays or within 2 weeks of an oil spray.

Systemic Fungicide 3336 WP 50% wettable powder is available as Dragon Systemic Fungicide 3336 WP and Cleary's 3336 WP for use on backyard (non-commercial) fruit trees such as apple, apricot, cherry, nectarine, peach, plum, and prune trees. This fungicide replaces Benlate which is no longer registered for use in home plantings. Do not apply 3336 WP within 24 hours of harvest.

Table 3.2 - Effectiveness[1] of Fungicides for Control of Tree Fruit Diseases

Disease	3336 WP	Captan	Copper (Bordeaux)	Daconil 2787	Ferbam	Spectracide Immunox	Lime Sulfur	Sulfur
Apple								
Scab	E	G	-	-	G	E	G	F
Powdery mildew	G-E	-	-	-	-	E	G	G
Rusts	-	-	-		G	E	F	-
Sooty blotch, fly speck	E	G	-	-	G	-	F	-
Fruit rots	G	G	-	-	G	-	F	-
Peach and Nectarine								
Leaf curl	-	-	G	E	E	-	G	-
Scab	E	G	-	-	G	-	-	G
Brown rot	E	G	-	-	-	E	-	G
Plum								
Brown rot	E	G	-	-	-	E	G	G
Black knot	E	G	-	-	-	-	-	-
Cherry								
Brown rot	E	G	-	-	-	E	-	G
Leaf spot	E	G	-	G	G	-	-	-

[1]E = excellent; G = good; F = Fair; - = not recommended, not registered, or not applicable.

Note: Always check label for crop and disease, rate, timing, and minimum days to harvest.

Insecticides/Miticides

Carbaryl (Sevin) 80% soluble powder is recommended for control of Japanese beetle. 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. Do not spray apples for 6 weeks after bloom with Carbaryl as it is a thinning agent and will cause some fruit to drop. Carbaryl reduces populations of beneficial predators; use alternative insecticides when available.

Confirm (Tebufenozide) mimics the action of a natural insect hormone, disrupting the molting process. Confirm is highly selective toward most lepidopterous larvae (caterpillars), while having almost no activity against other orders of insects. This selectivity allows the preservation of beneficial predatory insects. Read the label for spray timing.

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 or with up to 1/2-1 inch of green showing.

Endosulfan (Thiodan) is a 50% wettable powder insecticide used to control peachtree borers. It is a chlorinated hydrocarbon that is highly toxic (use only with extreme caution). Do not use within 7 days of harvest. It is sometimes difficult for the homeowner to obtain in small quantities.

Malathion, an organophosphate, is used to control aphids, mites, and scale insects in the crawler stage. A 57% emulsifiable concentrate formulation and an 8 lb emulsion are the most commonly available for homeowners. Malathion does not persist long.

M-Pede is a potassium salt of fatty acids effective against soft-bodied insects and mites. It may be applied until the day of harvest, with a 12-hour restricted-entry interval. Apply to wetness; higher volumes can cause fruit injury. May cause marking of table grapes and pears. Do not apply after delayed dormant stage of pears.

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 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 1/4 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. There are too many variables in the types of sprayers that are available, the wetability 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 is to spray the foliage and fruits until droplets form and begin to run or drip off. For the beginner, the amount of pesticide suggested for coverage of different size trees (Table 3.3) will be helpful.

Table 3.3 - How Much Spray Per Tree with Different Dimensions

Height in feet	Spread in feet	Gallons per application[1]
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	30-35	15-18

[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 insect and diseases. Keep the height of the trees low to enable good 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 tops 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

Various sprayers and dusters are 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 small hand or power 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 4-6-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 will help the operator avoid being covered by the spray mist that falls when spraying overhead.

For the home fruit growers who have 25-50 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 15-50 gallons and pumps that will deliver from 50-350 pounds pressure per square inch. Therefore, start an inquiry about three months before you plan to buy one of these sprayers 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 an Extension Specialist at a land grant university who has the responsibility of 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 owner's 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 wash-water 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 gal sprayer, this type of spray 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 manufacturer's 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 conida, or summer spores, are formed in the infection lesion. Rain disperses the conida 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 that 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 occurs as early as pink stage 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 and severity of these diseases is related to the distance of the apple tree from infected cedars in the area. 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 during rainy periods, early in the growing season, from which spores are discharged that infect the apple.

Apple quince rust, incited by a fungus, has caused heavy fruit 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. Starting in mid-summer, quince rust sometimes produces tufts of fluorescent orange spores that are conspicuous and may be incorrectly identified as cedar apple rust. Protectant sprays are required from early pink through June 10 for control of the rust diseases. Immunox and Ferbam are the only fungicides listed here that adequately protect against rusts.

In some years rust infection occurs later than petal fall. Where rust pressure is heavy, 2 or 3 sprays of ferbam or Immunox may be required to cover the one month period of fruit and foliage susceptibility after petal fall.

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 to yellowish brown; thus, the popular common name frogeye leaf spot. Some types of spray injury may also look like frogeye leafspot.

Botryosphaeria 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 red skinned 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 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 that commonly appear on apples in late summer and fall. Although the two 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 that 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 peddle, the tissue becomes water-soaked and dark green. If the infection moves beyond the peddle, it invades the fruit spur and spreads 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, which spreads upward and downward. A severely infected apple or pear tree may have so many blighted terminals 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 margins 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 prevent canker formation on limbs, trunks, and roots of the trees.

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 2-3 sprays. CAUTION: Spray to wet only; antibiotics are usually locally systemic and over spraying 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. Applying boron every third year should control this disorder. Control also can 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 3-6 ft from the trunk of young trees and near the drip line of older trees.

Table 3.4 - A Checklist of Major Apple Diseases in Virginia

Disease	Usual stage of occurrence[1]	Infection conditions
Early season		
Scab	Green tip to whenever conditions are favorable	Extended wet periods, 33º to 76º F
Powdery mildew	Leaves; tight cluster, until shoot	Dry weather, 50º to 75º F
	growth stops	
Cedar apple rust	Tight cluster to 2nd cover	Extended wet periods above 56º F
Quince rust	Pink to 1st cover	Extended wet periods above 56º F
Fire blight	Bloom to mid-season	Open blossoms, daily mean above 60º F, wetting
Mid-season		
Frogeye-leaf spot (Black rot)	Pink to harvest	Moderate and wet, optimum 80º F
Moldy core	Bloom to petal fall	Moderate and wet
Brooks fruit spot	2nd to 4th covers	Moderate and wet
Sooty blotch	2nd cover to harvest	Moderate and wet, optimum 65º F
Fly speck	2nd cover to harvest	Moderate and wet
Late season		
Black rot	Pink to late season	Warm and wet periods, hail
Bitter rot	Mid to late season	insect, or mechanical fruit injury
White rot	Mid to late season	

[1]Refer to spray schedule for apples, Table 3.6 for spray timings.

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 is more susceptible than fruit picked at maturity.

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

Disease-resistant Apples

The varieties listed in nursery catalogs as “disease-resistant apples” are immune or highly resistant to scab, one of the most troublesome early season diseases. Many of them also have reduced susceptibility to powdery mildew and fireblight, but will require protection against these diseases if disease pressure is high. Although they may be indicated as resistant to cedar apple rust, they are mostly untested against quince rust and would therefore require fungicide protection (with ferbam or Immunox) from pink to first cover stages in rust-prone areas. All of the scab-resistant varieties are susceptible to the usual spectrum of insect pests, sooty blotch, fly speck, and fruit rots. Some scab-resistant varieties (not included below) are McIntosh types, which would not be expected to perform well in Virginia except at higher elevations.

The following scab-resistant varieties, listed in approximate order of ripening in central Virginia, are suggested for backyard trial in Virginia:

Table 3.5 - Some Suggested Scab-resistant Apple Cultivars for Virginia[1]

Cultivar	Ripening Period Winchester, Va.	Disease rating[2] PM	CAR	QR	FB	Description/weakness
Pristine	Mid to late July	R	S	R	S	Very early, yellow apple, pleasant mild flavor with a smooth, waxy, attractive finish. Blooms heavily; must be thinned well for good size.
Williams Pride	Late July	R	S	?	MR	Early, dark red-purple apple. Large fruited, semi-tart flavor. Sometimes shows water-core or bitter pit.
Redfree	Early to mid-Aug.	S	VR	R	S	Early, sweet summer apple. Red crisp. Fruit hangs on tree well. Does not store well.
Dayton	Mid to late Aug.	R	R	?	MR	A large attractive glossy red fruit with moderately tart flavor. An annual cropper and "grower-friendly" tree.
Jonafree	Mid to late Sept.	R	HS	S	S	Mid-season firm red apple, slightly tart. Flavor improves after storage. Similar to Jonathan.
Liberty	Late September	R	VR	S	MR	Attractive red over yellow skin. High-quality dessert apple. Good well-balanced sweet-tart flavor which improves after storage. Annual bearer. Being planted for direct sales in the Northeast.
Enterprise	Mid-October	R	VR	S	MR	Good quality, late season, large, smooth glossy red apple. Stores well. Susceptible to a fruit spotting disorder correctable with calcium sprays.
GoldRush	Mid-October	HS	HS	S	MR	Excellent quality fruit, good storage apple. Firm, Golden Delicious type. Fruit may crack.

[1]For the susceptibility status of other scab resistant cultivars see this web site:
http://www.caf.wvu.edu/kearneysville/tables/totscabsus.html

All of these cultivars are immune to scab based on ratings in Winchester, Va., and Kearneysville, W.V.

[2]PM = powdery mildew; CAR = cedar apple rust, QR = quince rust; FB = fire blight
VR = very resistant. No control needed in a home orchard.
MR = moderately resistant. Control only needed with fire blight susceptible rootstocks or under high disease pressure.
R = resistant. Control only needed under high disease pressure.
S = susceptible. Control usually needed where disease is prevalent.
HS = highly susceptible. Control always needed where disease is prevalent.

Apple Insects

Aphids - Three 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 1/4 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. Rootstocks in the MM series will reduce root damage from woolly apple aphids. (3) Green aphids - This mix of spirea aphids and apple aphids is most commonly seen on apple trees. When aphids infest more than an average of 4 leaves per shoot, treatment is justified, especially if less than 20% of the colonies harbor natural enemies. A variety of predators assist in controlling green aphids.

Codling Moth - Presence of this pest is usually recognized by a hole bored into the side or blossom end of the fruit. This larvae may completely destroy 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 tree to pupate under the bark or in debris on the soil surface where it overwinters. There are 2-3 generations in Virginia. Oriental fruit moth may cause similar injury in apples, especially late in the season.

Plum Curculio - Injury is in the form of small crescent-shaped cuts in the skin of 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 with a brown head capsule and no legs. Infested fruits fall prematurely and are usually hard, knotty, and misshapen. In some years, there may be two generations east of the Blue Ridge Mountains.

Apple Maggot - This black-and-white fly is a pest in orchards in the northeastern states; in Virginia the headless, legless larva is found mainly in backyard trees and abandoned orchards. Picking up dropped fruit promptly will aid in its control by preventing entry into the ground for pupation. Maggots cause winding brown paths through the fruit. Most adults emerge the following season. For a small number of backyard trees, commercially available apple maggot traps (red spheres or yellow panels) can help reduce infestation.

Mites - Two species are frequently injurious to apple foliage, the two-spotted spider 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 twospotted mite spins a silk webbing over the infested area, which explains the origin of the name "spider 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 has tan colored legs. A hand lens is required for accurate observation of these parts. **Do not apply miticides on a preventative basis.** Many predators of mites are native to Virginia and can help control this pest if not killed by sprays. More information on these predators can be obtained on the Virginia Fruit Web site.

Redbanded Leafroller - The first-generation adults emerge during April. Adult moths are approximately 3/8 inch long and reddish-brown with silver and gray 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. Related species, such as tufted apple bud moth and variegated leafroller, can cause similar injury.

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 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 2-3 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 during the growing season, one with crawlers occurring in late May or early June and the other in August. A third generation occurs after harvest.

Gypsy Moth - As the gypsy moth moves southward through Virginia, it will be seen on apple trees. It is susceptible to many spray materials, including Dipel. Time sprays to the end of the wave of immigration of first stage larvae. This is around petal-fall.

Peach, Nectarine, Plum, and Cherry 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 surfaces of twigs and buds 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 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, lime sulfur, or Bordeaux mixture 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 inch 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 conida. 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 the 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 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 that 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 inches below the knots. Knots on one side of large limbs that need to be saved can be removed 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.

Cherry Leaf Spot is a fungal disease that affects both sweet and tart cherries. The earliest symptom is a purple lesion and several lesions per leaf can cause the leaf to yellow and fall. Typically, defoliation is first noticed in the top of the tree. By midsummer all leaves are susceptible and, in a wet year, severe defoliation makes trees more prone to winter injury and death. Control is with suggested fungicides applied throughout the susceptible periods with the objective of holding the leaves on the tree until September.

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 that usually go unnoticed until they reach numbers sufficiently high that they begin to injure the tree and fruit. Terrapin scale and European fruit lecanium are usually small 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 trees if uncontrolled. Terrapin and lecanium scales secrete honeydew that mars the fruit. 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 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.

Peachtree Borer - Partly grown to full grown grubs pass the winter in their burrows in peach, cherry, plum, prune, nectarine, or apricot trees. The caterpillars are yellowish-white with brown heads, 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 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. There is one generation per year.

Lesser Peachtree Borer - The lesser peachtree borer attacks many of the same trees as the peachtree 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 peachtree borer except that they are slightly smaller. The borers usually feed in the larger limbs and trunks of the trees. Injuries exude gum that contains sawdust-like particles. Limbs and trees are frequently killed by the feeding. There are two generations per year. Both peach tree borer and lesser peachtree borer may be monitored with pheromone traps. If a spray is needed, apply it two weeks after the first moth capture. Adults have slender, black bodies with white markings, and clear wings.

Oriental Fruit Moth - The larvae 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 that 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

Anthracnose - The 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 inch 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 shot-hole appearance. In general, fruit on infected canes ripens abnormally.

Cane Blight - The 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 surfaces of the leaves. The spots turn gray as the leaves mature. The infected areas may drop out to leave a shot-hole appearance. Symptoms may be slightly different on blackberry, where spots with whitish centers and purple or brown borders occur both on the leaves and canes.

Blackberry Psyllid - These are small winged insects about 1/8 inch long. Wings have 3 reddish stripes running lengthwise. Adults appear on the blackberry (but not raspberry) plants in the spring and are most common when near conifers. They jump when disturbed. Adult feeding causes leaves to be tightly curled and stunts the growth of the plant.

Japanese Beetles - These 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.

Borers - Three species may bore into brambles. These differ in controls required. Consult your Extension agent for identification and recommendations.

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 sides of the leaves as small purplish spots. Later, these spots enlarge to 1/4-1/2 inch in diameter and have 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, Klanmore, Rockhill, and Albritton are resistant to leaf spot; 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 surfaces of the leaves. These spots are more irregu-

lar 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 1/4-1 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. Gray 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 by spores from dead petals adhering to the fruit, another decayed berry, or a dead leaf. The disease first appears as a light brown, soft spot. The fruit rot completely decays the entire berry. The decayed berry becomes firm, tough, brown throughout, and is covered with a powdery grayish 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 they are not visible to the naked eye. The young mites are concentrated near the centers or crowns of the plants 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) 5WP, 1 tablespoon/gallon water, 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 - Two-spotted spider mite is the main species on strawberries. Hot, dry weather is favorable to their development. The time from egg hatch to adult may be five days at 75˚ F. Ten generations per season have been recorded in the Blacksburg area. Predatory mites may give control, but they are sensitive to certain pesticides (e.g. Sevin).

Aphids - Two species may cause problems on strawberries: strawberry aphid and strawberry root aphid. The former is a small, pale, yellow aphid widely distributed in the U.S. Wingless females overwinter around the bases of the plants. In the spring, winged forms develop and disperse to other plants. These give rise to several overlapping summer generations, all of which are females, which give birth to living young. Nymphs feed on the foliage (not the roots), mainly on the undersides of the leaves. As they feed on plant sap, honeydew is excreted, which may support a fungus growth on the leaves. Nymphs mature in about ten days, depending on temperatures, and adults may live 2-3 weeks while producing 20 to 25 nymphs. One of the main causes for damage is the transmission of viruses to the strawberry, notably “yellows.” Certified plant stock and pulling out diseased plants may be useful in virus control. An insecticide may be applied when aphids first appear in late May and two weeks later.

Spittlebugs - Adults resemble robust leafhoppers, but this group of pests is better known from the mass of “spittle” produced by nymphs. There are several species involved, but the meadow spittlebug is common and ranges from light brown to almost black. Eggs overwinter after being laid in rows of 1-30 between sheaths and stumps near the soil surface. These hatch in April. Nymphs are initially yellow but turn green as they grow. The nymphs feed on plant sap, and excretion products are mixed with air from a specialized “air canal.” This creates the spittle, a white frothy mass, which protects the nymphs from desiccation and possibly predation. The adult stage is reached in from 30-45 days, depending on temperature and other factors. After mating, females oviposit in late August or early September. There is only one generation per year. Spittlebugs are general feeders but may be particularly damaging to strawberry. Plant growth and yield may be reduced. They are also a source of annoyance to pickers.

Strawberry Root Aphid - This insect is a blue-green species found in the eastern U.S. The winter is spent as shiny black eggs on stems and foliage. In early spring, females hatch and begin feeding on new leaves. Ants carry some to the strawberry roots where several generations of wingless females occur. Winged females are produced in October; they then return to the foliage. These give birth to males and females that mate, producing overwintering eggs. In mild winters, wingless females may persist.

Fruit on infested plants dries up and falls. An infestation may not be detected until the plants are already low in vigor and have pale foliage. Another sign is the presence of many ants in the beds. When setting a new bed, use uninfested plants, and give the ground thorough cultivation in early spring to reduce ant populations. Injury may be reduced if aphids are controlled early enough.

Strawberry Rootworm - This is a shiny oval beetle with four dark blotches on the wings, about 3 mm long. Larvae feed on roots, but the most damage results from adult foliar feeding, especially in late summer. It is impractical to control larval populations. Adults may be controlled before egg laying begins when the weather warms in the spring.

Strawberry Root Weevil - Adult root weevils are light brown to black, ranging from a quarter to a half inch in length. The wing covers are marked by rows of punctures. Adults feed on strawberry leaves, but the main injury is caused by larval root feeding. Larvae are cream-colored, legless grubs with a brown head capsule. Adults may be controlled when actively feeding. Avoid planting strawberries after sod. If plowing of old beds can be delayed until fall, the old planting can serve as a trap crop.

Strawberry Weevil - This is a small (about 3 mm) brown weevil with a black patch on each elytron (wing cover). It feeds on wild and cultivated strawberries, brambles, and several other plants. Adults overwinter in debris and emerge in early spring. When strawberry blossom buds are formed, a single egg is deposited in a feeding puncture there. Then, below this site, the weevil cuts partly through the plant and the bud wilts, hangs, or drops to the ground. White, legless, curved grubs develop in these buds. The larvae pupate and emerge as adults in mid-summer. After feeding for a short time, the adults enter hibernation. There is only one generation per year. This insect is also referred to as the strawberry clipper.

Grape Diseases

Black Rot - This disease 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 not 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 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 - This 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 surfaces 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 surfaces of the leaves. The fungus spreads from the older foliage to the foliage at the ends 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 - This disease is caused by a fungus that is present in many vineyards. Because of extensive planting of French-American hybrids and vinifera type grapes, the disease has become of major 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 surfaces appear russet or scurfy. They fail to mature properly, and cracking of the fruit may allow entry of rot organisms. Mildew infection of the cluster stem may cause shelling if the fruit is not harvested immediately.

Anthracnose, **or Bird's-eye Rot** - This 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.

Phomopsis Blight, **or Dead Arm** - This is a fungus disease of the trunks 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 auxiliary 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 3-4 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 2-3 years before leaf symptoms appear. Apply sprays as suggested in the spray schedule for control of all grape diseases.

Grape Insects

Grape Berry Moth - Presence of this pest is shown by berries with broad reddish spots, webbed clusters, shriveled fruit, or foliage with semicircular holes cut in foliage. Caterpillars will be found in berries, usually dark gray or gray-green. Each larva may attack several berries during its feeding period of 3-4 weeks. Clusters may also be sticky from juice from injured fruit. There are 3-4 generations per year. Removing fallen leaves in the autumn may reduce infestations.

Grape Root Borer - Adults of this species strongly resemble paper wasps flying through the vineyard. Eggs are laid on trunks and weeds, and after first stage larvae penetrate the soil they feed on grape roots for almost two years. If declining vines are seen, probe around roots within a foot of the trunk with a hand trowel. Large caterpillars may be found in or on hollowed roots. Soil may be mounded around trunks to a depth of 8-10 inches around July 1 to prevent emerging adults from reaching the surface. Pull the mounds down in the spring.

Rose Chafer - Adults emerge in late May or early June, near grape blossoming time, and are tan, long-legged beetles related to the Japanese beetle. For about 2 weeks they may feed on blossoms or newly set fruit. Rose chafer is more prevalent in areas with light sandy soil.

Japanese Beetle - This is generally one of the most common insects feeding on Virginia's grapevines. On grape, beetles feed mainly on leaves, rarely gouging fruit. Peak adult activity is in July, but begins in late June and may extend into September. Populations are generally lower in seasons following drought years. Leaf damage occurring in the first part of the Japanese beetle activity period has less effect on fruit quality. Young vines are especially vulnerable.

Grape Phylloxera - Both foliar and root forms occur, but the root form is rare in eastern states. The less damaging foliar form is commonly seen in the form of galls on the lower leaf surfaces.

Grape Tomato Gall - This is one of several types of galls formed on grape leaves, tendrils, and buds by small gall midges. Complete control by sprays is difficult. Removing galls by hand may reduce future populations.

Grape Flea Beetle - Adult beetles appear on the vines at about the time of bud swell. Beetles feed on buds; they make a large hole in the side and gouge out the bud interior. Larvae are seen during the summer, brown grubs making chain-like feeding marks on leaves. This larval feeding is insignificant.

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 among normal blue fruit are often the first sign of this important disease.

Phomopsis Twig Blight - Conditions in Virginia and North Carolina favor 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 part way 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 a disease that affects 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 that 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.

Spraying Fruit for Pests and Diseases

Table 3.6 - Spray Schedule for Apples and Pears

Time of Application	Materials to Use Fungicide or Insecticide per Gallon of Water[1]	To Control	Remarks
Dormant Prior to bud swell	**No Fungicide** superior oil	Mites and scales	Follow manufacturer's recommendations as to amount. Apply when a half-inch of green shows at buds.
Delayed Dormant When leaves are 1/2-3/4 inch long	1.0 tbsp Immunox 1.55% EC or 1.0 tsp Fungicide 3336WP + 1.5 tsp ferbam 76W + 2.0 fl oz permethrin 2.5% or 2.0-4.0 tbsp esfenvalerate 0.425%	Scab, powdery mildew, rust, mites, aphids, leafrollers	Scab infection may occur at this time. Important spray for mites and aphids. Immunox and 3336 WP are not registered for use on pears.
Pre-Pink First pink in floral	Same as delayed dormant buds, plus 2.5 fl oz M-Pede	Scab, powdery mildew, rust, aphids, mites, leafrollers	Important for rust and powdery mildew control.
Pink When flowers have separated just before bloom	Same as delayed dormant + add streptomycin 1.0 tsp	Scab, powdery mildew, rust, apple rot, fire blight, aphids, mites, green fruitworms, leafrollers	Add streptomycin for fire-blight control according to manufacturer's recommendations.
Bloom	1.0 tbsp Immunox 1.55% EC or 3336 WP 3.0 tsp + 1.5 tsp ferbam 76W + 1.0 tsp streptomycin 15W[2] **Protect Bees - Do Not Use Insecticide**	Scab, rust, powdery mildew, apple rots, fire blight	Also follow label recommendations for rate of streptomycin.[2] Immunox and 3336 WP are not registered for use on pears.

[1]Materials to use are given for one gallon, but the user can easily calculate the required amount of material to make five, ten, fifteen, twenty, or twenty-five gallons of spray (See Table 3.1).

[2]Streptomycin sulfate (15-21%) should be used at 60 PPM (approximately 1 tsp/gal).

[3]See Apple Disease section for discussion of boron deficiency and its control.

[4]See Apple Disease section for discussion of bitter pit and its control.

Table 3.6 - Spray Schedule for Apples and Pears (cont.)

Time of Application	Materials to Use Fungicide or Insecticide per Gallon of Water[1]	To Control	Remarks
Petal Fall When most of the petals have fallen **First Cover** 10 days after petal fall and **Second Cover** 14 days after first cover	1.0 tbsp Immunox 1.55% EC or 3336 WP 3.0 tsp + 1.5 tsp ferbam 76W + 2.5 fl oz M-Pede or 2 tbsp Thionex 50W + 2.0 fl oz permethrin 2.5% or 2.0-4.0 tbsp esfenvalerate 0.425% or 1.5 tsp Confirm T/O	Scab, rust, powdery mildew, rots, fire blight, curculio, codling moth, aphids, mites, boron deficiency[3]	If fire blight is present, add streptomycin to this spray. Important sprays for codling moth control. Confirm at first and second cover is effective for codling moth; not effective for plum curculio. Permethrin + esfenvalerate are toxic to orchard predators. Immunox and 3336 WP are not registered for use on pears.
Third Through Fifth Cover Sprays At 14 day intervals	2.0 tbsp Captan 50W plus 3336 WP 3.0 tsp plus same insecticides as petal fall	Sooty blotch, flyspeck, Brooks spot, rots	If mites become a problem, add 1.0 tbsp of Kelthane 50W to the spray. If Japanese beetles become a problem, add 2.0 tbsp Sevin 50W. (Do not use Sevin until 30 days after bloom.) Some Captan formulations and 3336 WP are not registered for pears; substitute ferbam for Captan in mid-season sprays if pears are not listed on the Captan label.
Sixth And Seventh Cover Sprays 2 week intervals, may not be required for early maturing varieties	2.0 tbsp Captan 50W plus 3336 WP 3.0 tsp + same insecticides as petal fall	Apple rots, sooty blotch, flyspeck, apple maggots (AM), codling moth, bitter pit[4]	Same as 3rd-5th covers. Generally speaking, apply protectant sprays up to 25-30 days before harvest. Sticky sphere traps are available that can control AM on a few backyard trees. Pick up all drop fruit to help control AM. Do not apply 3336 WP within 24 hours of harvest. Do not apply 3336 WP to pears.

[1]Materials to use are given for one gallon, but the user can easily calculate the required amount of material to make five, ten, fifteen, twenty, or twenty-five gallons of spray (See Table 3.1).

[2]Streptomycin sulfate (15-21%) should be used at 60 PPM (approximately 1 tsp/gal).

[3]See Apple Disease section for discussion of boron deficiency and its control.

[4]See Apple Disease section for discussion of bitter pit and its control.

Table 3.7- Spray Schedule for Cherries[1], Nectarines, Peaches, Plums[1], and Prunes[1]

Time of Application	Materials to Use Fungicide or Insecticide per Gallon of Water[2]	To Control	Remarks
Dormant Before buds begin to swell	1.5 tsp Ferbam 76W or Daconil 2787 1.0 tbsp + Superior oil	Peach leaf curl Scale, mites	Apply to nectarine and peaches only. All buds must be thoroughly covered. Follow manufacturer's recommendations. Remove and destroy all mummified fruit still hanging on the tree and on the ground. This will reduce inoculum that causes blight and the later fruit brown rot.
Pink Spray Early pink to full pink	General purpose mixture (Table 3.1) + [22]1.0 tbsp Carbaryl 80S (Sevin)	Green aphids, tarnished plant bug, blossom blight, black knot	Plums and cherries are not pink, but apply spray at same stage of bud development. See comment on aphid under petal fall spray.
Blossom Sprays Apply just before first blossoms open, and when in full blossom	2.0 tbsp Captan 50W plus 3336 WP 3.0 tsp or Daconil 2787 1.0 tbsp **Protect Bees - No Insecticide**	Brown rot blossom blight, peach scab, powdery mildew, cherry leaf spot, black knot	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	2.0 tbsp Captan 50W + 3336 WP 3.0 tsp + 1.0 tsp malathion 57EC + 2.0-4.0 tbsp esfenvalerate 0.425% 1st - 5th cover General purpose mixture (Table 3.1)	mites, aphids, plum curculio, oriental fruit moth, Brown rot, peach scab, cherry leaf spot	Esfenvalerate is toxic to orchard predators. If mites build up, a 2.0% solution of JMS Stylet Oil may be applied at 10- to 14-day intervals against mite eggs, as long as mites persist. Malathion is not registered for aphids or oriental fruit moths on nectarines, but if used for other insects, aphid and oriental fruit moths will not be a problem.
Pre-Harvest Apply 3 and 1 week before harvest on all varieties	3336 WP 3.0 tsp plus 2.0 tbsp Captan 50W or 1.0 tbsp Immunox 1.55% **No Insecticide** (See Remarks)	Brown rot on fruit	If Japanese beetles are a problem, 2.0 tbsp of Sevin 50W can be added to the spray up to 1 day before harvest. Do not apply 3336 WP within 24 hours of harvest.
After-Harvest 2 weeks after harvest	3336 WP 3.0 tsp + 2 tbsp Captan 50W	Cherry leaf spot	Cherries only.
Peachtree Borer Sprays These two sprays should be applied about July 15 and August 15-25 to all species and varieties	2.0 tbsp endosulfan 50W (Thionex)	Peachtree borer, lesser peachtree borer	Apply endosulfan to trunks and large limbs only. Do not apply it within 21 days of harvest. Use after harvest if possible. Endosulfan "Highly toxic."

[1]Most fungicides are not specifically registered for black knot control on plums, prunes, or cherries in home fruit planting; however, where a good spray program for brown rot control is followed, black knot usually will not be a problem. To achieve effective control with fungicides, all knots should be removed and destroyed during the dormant period or when they appear.
[2]Materials to use are given for one gallon, but the user can easily calculate the required amount of material to make five, ten, fifteen, twenty, or twenty-five gallons of spray (See Table 3.1).

Table 3.8 - Spray Schedule for Grapes

Time of Application	Materials to Use Fungicide or Insecticide per Gallon of Water[1]	To Control[2]	Remarks
Dormant Before buds swell	8.0 tbsp copper sulfate + 8.0 tbsp hydrated lime (Bordeaux Mixture)	Anthracnose	This spray is necessary only in vineyards where Anthracnose has been a problem.
Bud Swell Spray	General Purpose Mix (Table 3.1)	Grape flea beetle	Apply only if adult beetles are present in damaging numbers.
New Shoot Sprays When new shoots are 1- to 2-inches long, also when new shoots are 6- to 8-inches long.	General purpose mixture[2] (Table 3.1) + 4.0 tbsp Immunox	Black rot, downy mildew, Anthracnose, powdery mildew	Rake up and destroy all mildew, dead arm, grape leaves, 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 3.1) + 2.0 tsp Ferbam 76W[2] or 4.0 tbsp Immunox	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 3.1)	Same as prebloom	Same as prebloom. If powdery mildew or black rot are problems, include Immunox.
Pea Size Spray When berries are about pea size, but before they touch in clusters (7-10 days after postbloom spray)	Same as post-bloom spray	Same as post-bloom	If Japanese beetles have appeared, substitute 2.0 tbsp Sevin 50W for methoxychlor.
Berries Touch In Cluster 10-14 days after pea size spray, and at 2 week intervals until harvest.	2.0 tbsp Captan 50W + 1.0 tbsp Sevin 80S	Same as pea size spray plus Japanese beetle	Continue good coverage. Do not apply Immunox more than 6 times per season or within 2 weeks of harvest.
Later Cover Sprays Apply at 2-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 2.2 tsp of Captan 50W and spray only with Captan during harvest.
Grape Root Borer		In second week of June, mound soil 8-12 inches high around base of trunk, extending 2-3 feet from trunk crown. Pull mound down in fall or spring. Only necessary where grape root borer has been a problem. Control weeds in vine row.	Weed control near vine will cause larval mortality before caterpillars reach roots.

[1]Materials to use are given for one gallon, but the user can easily calculate the required amount of material to make five, ten, fifteen, twenty, or twenty-five gallons of spray (See Table 3.1).

[2]Captan and ferbam do not control powdery mildew. If powdery mildew is a serious problem, substitute sulfur formulation or Immunox and use according to the label. Do not use Captan more than three times after bloom. Imidan 12.5W 3.0 tbsp may be substituted for methoxychlor in the grape schedule.

Table 3.9 - Spray Schedule for Blackberries and Raspberries

Time of Application	Materials to Use Fungicide or Insecticide per Gallon of Water[1]	To Control[2]	Remarks
Delayed Dormant When buds begin to break	8.0 tbsp copper sulfate + 8.0 tbsp hydrated lime (Bordeaux Mixture)	Anthracnose, cane blight, spur blight	A good thinning, pruning and general clean-up and removal of dead canes will help control Anthracnose as well as cane and spur blight.
New Cane Spray When new canes are 6-12 inches high		Same as delayed dormant except no cane blight	Good coverage is important since the canes and foliage are hard to wet. Note: Few fungicides are available for use in home berry production. If a fungicide is needed, use a registered copper fungicide with caution, according to the label. Some phytotoxicity should be expected.
Pre-bloom Just before blossoms open	1.5 tsp malathion 57EC or 2.0-4.0 tbsp esfenvalerate 0.425%	Same as new cane spray plus thrips, strawberry weevil, blackberry psyllid	Coverage is a must to be sure of insect control. Fruit worms may or may not be present.
Post-bloom Until Harvest At 10-14 day intervals	1.5 tsp malathion 57EC + 1.0 tsp Sevin 80S	Same as pre-bloom spray plus Japanese beetles and fruit rot	Malathion is necessary if sap beetle appears as fruit begins to color. Observe 7 day preharvest interval for Sevin.
After Harvest Apply in 14 days	1.0 tbsp Sevin 80S	Anthracnose, Japanese beetles	Various borers cause problems in the canes of brambles.[1]

[1]Materials to use are given for one gallon, but the user can easily calculate the required amount of material to make five, ten, fifteen, twenty, or twenty-five gallons of spray (See Table 3.1).

[2]Canes with borer damage, wilted and with galls, should be cut and burned. Also control weeds because they harbor insects and disease. Three main borer species differ in additional control measures required. Consult your Extension agent for identification and recommendation.

Table 3.10 - Spray Schedule for Strawberries

Time of Application	Materials to Use Fungicide or Insecticide per Gallon of Water[1]	To Control	Remarks
When Blossom Buds Are Visible In The Crown	2.0 tbsp Captan 50W + 2.0 tsp malathion 57 EC + 1.0 tbsp Sevin 80S	Weevil, spittlebug, spider mites, leaf aphids, fruit rots, and leaf spots Strawberry rootworm	Good thinning and mulching of plants during late February to early March is important for fruit rot control. Spray Sevin for rootworms if adults are seen feeding on leaves in the spring in high numbers (10/sq ft).
Pre-bloom When flowers have pushed	Same as above	Same as above, cyclamen mite	Essential spray for later fruit rot control.

Table 3.10 - Spray Schedule for Strawberries (cont.)

Time of Application	Materials to Use Fungicide or Insecticide per Gallon of Water[1]	To Control	Remarks
Bloom When most blossoms are full open	2.0 tbsp Captan 50W **No Insecticide**	Fruit rots, leaf spots	Be sure of complete coverage for future fruit rot control.
Post-bloom Apply 10 days after bloom and continue at 7-10 day intervals until harvest	2.5 tsp Captan 50W[2] + 2.0 tsp malathion 57EC	Fruit rots, leaf spots, aphids, root weevils	Spraying for strawberry pests must be thorough to get good coverage. Use 40-50 pounds of pressure in the tank and hold nozzle close enough to force spray between foliage.

[1]Materials to use are given for one gallon, but the user can easily calculate the required amount of material to make five, ten, fifteen, twenty, or twenty-five gallons of spray (See Table 3.1).

[2]Captan 50W 2.5 tsp/gal can be used during harvest for fruit rot control.

Note: AGRI-FOS is registered for control of red stele and leather rot of strawberries caused by *Phytophthora* sp. As a preplanting dip, dip planting material in 1/3 fl oz of AGRI-FOS/gal of water for 30 minutes, then plant within one day. After planting as a foliar spray to perennial crops, make the first application 14 to 21 days post planting, and repeat at 1- to 2-month intervals when disease is evident.

For leather rot control, use 2 to 3 tsp of AGRI-FOS/gal of water and apply at 10% bloom and early fruit set, then at 1- to 2-week intervals as required for disease control.

Table 3.11 - Spray Schedule for Blueberries[2]

Time of Application	Materials to Use Fungicide or Insecticide per Gallon of Water[1]	To Control	Remarks
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 Remarks	Mummy berry cups on soil	Use clean culture between rows and around the plants. Rake or hoe around plants to bury (2 inches) fungus cups that form on the mummified berries.
Leaf Bud Break Through Petal Fall (7-10 day intervals)	2.0 tbsp Captan 50W	Phomopsis twig blight, Mummy berry twig/ flower infection	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)	1.0 tbsp Carbaryl 80S (Sevin) or 1.5 tsp Confirm T/O	Cherry fruit worm, Cranberry fruit worm,	Use good coverage.
When Berries First Turn Blue (Repeat at 10- to 14-day intervals through harvest)	0.15 lb Surround at Home or 1.0 tbsp Carbaryl 80S (Sevin) + 2.0 tbsp Captan 50W	Blueberry tip borer Blueberry maggot, blueberry tip borer, fruit rot	Sevin will control Japanese beetles and fruit worms.
Post Harvest	2.0 tbsp wettable sulfur	Phomopsis twig blight	Prune out all diseased canes and destroy by burning.

[1]Materials to use are given for one gallon, but the user can easily calculate the required amount of material to make five, ten, fifteen, twenty, or twenty-five gallons of spray (See Table 1).

[2]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 lower the pH (increase the acidity) one pH number. Work the sulfur lightly in the soil on a 15- to 18-inch radius around each bush.

Table 3.12 - Spray Schedule for Pecans

Time of Application	Materials to Use Fungicide or Insecticide per Gallon of Water[1]	To Control	Remarks
First Prepollination Spray When buds are bursting and leaves show green	1.0 tbsp dodine 65W or 3.0 tsp 3336 WP 50W + 2.0 tsp malathion 57EC	Scab, leaf casebearer	Be sure of good coverage.
Second Prepollination Spray When leaves are half grown	1.0 tbsp dodine 65W or 3.0 tsp 3336 WP 50W		These first two sprays are extremely important for scab control.
First Cover Spray When young nuts first appear	1.0 tbsp dodine 65W or 3.0 tsp 3336 WP 50W + 2.0 tsp malathion 57EC	Scab, aphids, mites, nutcasebearer	This is an important spray.
Second Cover Spray 2 weeks after first cover	1.0 tbsp dodine 65W or 3.0 tsp 3336 WP 50W	Scab, powdery mildew	3336 WP is needed at this time for powdery mildew control. If insects are a problem, use malathion 9.0 oz/100 gal.
Third Cover Spray 2 weeks after second cover	3.0 tsp 3336 WP 50W	Scab, downy mildew, powdery mildew, brown leaf spot	3336 WP is probably the best fungicide at this time.
Fourth Cover Spray 2 to 3 weeks after third cover	3.0 tsp 3336 WP 50W + 2.0 tsp malathion 57EC	Scab, powdery mildew, downy spot, brown leaf spot, aphids, mites, shuck worm	This spray is extremely important for shuck worm control. Malathion is not registered for shuck worm, but if used for other insects, shuck worm will not be a problem.
Fifth Cover Spray 2 to 3 weeks after fourth cover	3.0 tsp 3336 WP or 1.0 tbsp dodine 65W + 2.0 tsp malathion 57EC	Scab, powdery mildew, downy spot, brown leaf spot, weevil[2]	Important spray for brown leaf spot, downy spot, aphids and mites.
Sixth Cover Spray 2 to 3 weeks after fifth cover spray	3.0 tsp 3336 WP or 1.0 tbsp dodine 65W + 2.0 tsp malathion 57EC	Shuck worm, scab, black aphid	Important spray for scab and insect control. We believe this spray is extremely important. See fourth cover concerning shuck worm.

[1]Materials to use are given for one gallon, but the user can easily calculate the required amount of material to make five, ten, fifteen, twenty, or twenty-five gallons of spray (See Table 1). Use about 10 gal of spray/medium size tree (25-30 feet in height).

[2]Starting the first week of August, three weekly applications of Carbaryl (Sevin) 50% W at the rate of 5.0 tbsp/gal of water will greatly reduce the pecan weevil. Spraying is impractical in many cases. Growers may jar limbs with a padded pole during late summer and collect adults on a sheet spread on the ground.

Limited Spray Schedule for Chestnuts

There is no chemical pesticide spray program that will control the chestnut blight disease that 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 homeowners. 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 suggest that the program be continued since it may aid in the control of weevils. Starting during the last of July, four weekly applications of Carbaryl (Sevin) 50%W at the rate of 4.0-6.0 tbsp/gal of water will greatly reduce the weevil problem.

Control Rodents and 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 trunks 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

Weeds

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Measures considered practical weed control by the homeowner on a small area are quite different from those employed by the commercial producer. Homeowners often have a very limited area that may make a precise pesticide application difficult. Thus, some of the materials recommended for commercial use are excluded from homeowner recommendations because they are highly toxic, not readily available in small quantities, or require rather precise applications.

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.

Chemical Control

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 ounces of both active ingredient (and commercial product) per 1000 sq ft. These are extremely small quantities and very careful measurement and application are required.

Products cannot be measured on a volume basis because 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 weight 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 tablespoons) 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 refill the sprayer. Then divide by 16 (16 cups/gallon) to get the number of gallons. Usually, adequate coverage for ground sprays can be obtained with 1–2 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, because this would result in a heavier application near the tree trunk and may result in injury. To obtain uniform distribution of material on an 8 x 8 area, apply a 4 x 8 ft strip on both sides of the tree.

Nonchemical Control

For extremely small areas, the mechanical removal by mowing or tillage is often the most practical. Mulching is also an extremely effective way to handle annual weeds on a limited area. Several types of material may be used as mulch. Some commonly used include: black plastic, landscape fabrics, several layers of newspapers, pine bark and 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.

Table 3.13 - Relative Effectiveness of Preemergence Herbicides in Fruit

(E=Excellent ; G=Good ; F=Fair ; P=Poor; N=None; – =Unknown)

	Dichlobenil (Casoron)	Diuron (Karmex)	Napropamide (Devrinol)	Norflurazon (Solicam)	Oryzalin (Surflan)
Annual Grasses					
Barnyardgrass	G	G	G	E	G
Cheat	G	G	G	G	G
Crabgrass	G	G	E	E	E
Fall panicum	F	F	G	E	G
Foxtails	G	G	E	E	E
Goosegrass	F	G	E	G	E
Johnsongrass (seedling)	F	G	P	G	F-G
Annual Broadleaf Weeds					
Annual fleabane	E	G	G	F	G
Annual morning-glory	G	G	N	F	P-F
Black nightshade	G	G	N	F-G	P-F
Carpetweed	G	E	G	G	G
Common chickweed	G	E	G	G	G
Common lambsquarters	G	E	F-G	G-E	G
Common ragweed	G	E	F	F	P
Hairy galinsoga	G	E	G	-	P
Henbit	G	E	F	-	G
Horseweed	G	G	P	G	F
Knotweed	G	G	G	F	G
Mustards	G	G	P	F	P-F
Pennsylvania smartweed	G	G	P	-	P-F
Pigweeds	G	E	G	F	G
Prickly lettuce	G	G	G	-	F
Prickly sida	F-G	G	N	P	P-F
Purslane	G	E	G	G	G
Shepherds' purse	G	G	F	G	G
Speedwells	-	-	-	-	-
Velvetleaf	-	F	N	-	P-F
Virginia pepperweed	G	G	F	G	G
Perennial Grasses And Sedges					
Bermudagrass	N	N	N	P	N
Dallisgrass	-	F	N	P	N
Fescues	G	F	N	F	N
Johnsongrass (rhizome)	-	P	N	P	N
Nimblewill	-	P	N	F	N
Orchardgrass	G	P-F	N	F	N
Purpletop, Redtop	-	P	N	F-G	N
Quackgrass	G	G	N	P	N
Yellow nutsedge	P-F	P	P	P	N

Table 3.13 - Relative Effectiveness of Preemergence Herbicides in Fruit (cont.)

(E=Excellent ; G=Good ; F=Fair ; P=Poor; N=None; – =Unknown)

	Dichlobenil (Casoron)	Diuron (Karmex)	Napropamide (Devrinol)	Norflurazon (Solicam)	Oryzalin (Surflan)
Perennial Broadleaf Weeds					
Broadleaf plantain	G	P-F	N	P	N
Buckhorn plantain	G	P-F	N	P	N
Canada thistle	P-F	N	N	N	N
Chicory	G	G	N	N	N
Common mallow	G	F	N	N	N
Common milkweed	-	N	N	N	N
Common yarrow	-	N	N	N	N
Dandelion	E	P-F	N	N	N
Docks (broadleaf, curly)	G	F	N	N	N
Goldenrod	F-G	-	N	N	N
Ground ivy	E	N	N	N	N
Hemp dogbane	N	N	N	N	N
Horsenettle	N	P-F	N	N	N
Mugwort	G-E	P	N	N	N
Red sorrel	G	N	N	N	-
Thistles (bull, musk, curl)	F	N	N	N	N
White flowered aster	G	N	N	N	N
Wild carrot	G	P	N	F	N
Wild strawberry	G	G	N	P	N
Yellow rocket	G	P	N	F	N
Yellow woodsorrel	G	F	N	F	N
Special Perennial Weed Problems					
Bigroot morning-glory	N	N	N	N	N
Brambles (Rubus spp.)	N	N	N	N	N
Common greenbriar	N	N	N	N	N
Japanese honeysuckle	N	N	N	N	N
Poison ivy	N	N	N	N	N
Virginia creeper	N	N	N	N	N
Wild garlic	F	N	N	N	N

	Oxyfluorofen (Goal)	Simazine (Princep)	Terbacil (Sinbar)
Annual Grasses			
Barnyardgrass	F	F-G	G
Cheat	-	G	G
Crabgrass	F	F-G	F-G
Fall panicum	-	F-G	G
Foxtails	F	G	G
Goosegrass	F	E	-
Johnsongrass (seedling)	-	N	-

Table 3.13 - Relative Effectiveness of Preemergence Herbicides in Fruit (cont.)

(E=Excellent ; G=Good ; F=Fair ; P=Poor; N=None; – =Unknown)

	Dichlobenil (Casoron)	Diuron (Karmex)	Napropamide (Devrinol)	Norflurazon (Solicam)	Oryzalin (Surflan)
Annual Broadleaf Weeds					
Annual fleabane	G	G	E		
Annual morning-glory	G	E	G		
Black nightshade	G	E	-		
Carpetweed	G	E	E		
Common chickweed	G	E	G		
Common lambsquarters	G	E	G		
Common ragweed	F	E	G		
Hairy galinsoga	G	E	E		
Henbit	G	E	G		
Horseweed	F	E	G		
Knotweed	G	E	G		
Mustards	G	G	E		
Pennsylvania smartweed	G	E	G		
Pigweeds	G	E	G		
Prickly lettuce	G	E	G		
Prickly sida	G	G	-		
Purslane,	G	E	E		
Shepherds'-purse	-	E	G		
Speedwells	G	-	-		
Velvetleaf	G	G	G		
Virginia pepperweed	-	E	-		
Perennial Grasses And Sedges					
Fescues	N	P	F		
Johnsongrass (rhizome)	N	N	P		
Nimblewill	N	P	P		
Orchardgrass	N	P-F	G-E		
Quackgrass	N	P-F	G		
Yellow nutsedge	N	N	F-G		
Purpletop, Redtop	N	N	F-G		
Dallisgrass	N	N	F-G		
Bermudagrass	N	N	F		
Perennial Broadleaf Weeds					
Broadleaf plantain	N	G	F		
Buckhorn plantain	N	G	F		
Canada thistle	N	N	N		
Chicory	N	P-F	G		
Common mallow	N	N	-		
Common milkweed	N	N	N		
Common yarrow	N	-	N		

Table 3.13 - Relative Effectiveness of Preemergence Herbicides in Fruit (cont.)

(E=Excellent ; G=Good ; F=Fair ; P=Poor; N=None; – =Unknown)

	Dichlobenil (Casoron)	Diuron (Karmex)	Napropamide (Devrinol)	Norflurazon (Solicam)	Oryzalin (Surflan)
Dandelion	N	P-F	G-E		
Docks (broadleaf, curly)	N	N	F		
Goldenrod	N	N	P-F		
Ground ivy	N	N	N		
Hemp dogbane	N	N	N		
Horsenettle	N	P	F-G		
Mugwort	N	N	P		
Red sorrel	N	N	P		
Thistles (bull, musk, curl)	-	N	-		
White flowered aster	N	N	N		
Wild carrot	-	N	F		
Wild strawberry	-	N	N		
Yellow rocket	-	P	G		
Yellow woodsorrel	G	F	G		
Special Perennial Weed Problems					
Bigroot morning-glory	N	N	N		
Brambles (*Rubus* spp.)	N	N	N		
Common greenbriar	N	N	N		
Japanese honeysuckle	N	N	N		
Poison ivy	N	N	N		
Virginia creeper	N	N	N		
Wild garlic	N	N	N		

Table 3.14 - Relative Effectiveness of Postemergence Herbicides in Fruit

(E=Excellent ; G=Good ; F=Fair ; P=Poor; N=None; – =Unknown)

	Fluazifop-P-Butyl (Fusilade)	Glufosinate (Rely)	Glyphosate (Roundup)	Sethoxydim (Poast)	2,4-D
Annual Grasses					
Barnyardgrass	E	G	E	E	N
Cheat	G	-	E	G	N
Crabgrasses	E	G	E	E	N
Fall panicum	E	G	E	E	N
Foxtails	E	G	E	E	N
Goosegrass	E	G	E	E	N
Johnsongrass (seedling)	E	-	E	E	N
Annual Broadleaf Weeds					
Annual fleabane	N	-	E	N	G
Annual morningglory	N	G	E	N	E
Black nightshade	N	G	E	N	F-G
Carpetweed	N	-	E	N	E
Common chickweed	N	G	E	N	P
Common lambsquarters	N	G	E	N	G
Common ragweed	N	G	E	N	G
Hairy galinsoga	N	-	E	N	G
Henbit	N	G	E	N	P
Horseweed	N	G	E	N	G
Knotweed	N	-	E	N	F
Mustards	N	G	E	N	G
Pennsylvania smartweed	N	G	E	N	P
Pigweeds	N	G	E	N	G
Prickly lettuce	N	G	E	N	P
Prickly sida	N	G	E	N	G
Purslane	N	G	E	N	F
Shepherds' purse	N	G	E	N	G
Speedwells	N	-	E	N	P
Velvetleaf	N	G	E	N	G
Virginia pepperweed	N	-	E	N	G
Perennial Grasses and Sedges					
Bermudagrass	G	P	G	G	N
Dallisgrass	G	-	E	G	N
Fescues	P-F	F	E	P-F	N
Johnsongrass (rhizome)	G	P	E	G	N
Nimblewill	F-G	-	G-E	F-G	N
Orchardgrass	F	P	E	F	N
Purpletop, Redtop	G	-	E	G	N
Quackgrass	G	P	G	G	N
Yellow nutsedge	N	P	G	N	N

Table 3.14 - Relative Effectiveness of Postemergence Herbicides in Fruit (cont.)

(E=Excellent ; G=Good ; F=Fair ; P=Poor; N=None; – =Unknown)

	Fluazifop-P-Butyl (Fusilade)	Glufosinate (Rely)	Glyphosate (Roundup)	Sethoxydim (Poast)	2,4-D
Perennial Broadleaf Weeds					
Broadleaf plantain	N	F	E	N	G
Buckhorn plantain	N	F	E	N	G
Canada thistle	N	-	F-G	N	F-G
Chicory	N	-	E	N	G
Common mallow	N	-	E	N	-
Common milkweed	N	-	G	N	P-F
Common yarrow	N	-	G	N	F
Dandelion	N	G	E	N	G
Docks (broadleaf)	N	-	G	N	G
Docks (curly)	N	-	E	N	F-G
Goldenrod	N	-	E	N	P-F
Ground ivy	N	G	G	N	P-F
Hemp dogbane	N	-	F	N	P-F
Horsenettle	N	F-G	F-G	N	P
Mugwort	N	-	F	N	P
Red sorrel	N	G	G	N	P
Thistles	N	-	G	N	F
(bull, musk,curl)	N	-	G	N	G
White flowered aster	N	-	E	N	N
Wild carrot	N	-	E	N	G
Wild strawberry	N	-	E	N	P-F
Yellow rocket	N	-	E	N	P-F
Yellow woodsorrel	N	G	E	N	F
Special Perennial Weed Problems					
Bigroot morning-glory	N	-	F-G	N	F-G
Brambles (Rubus spp.)	N	F-G	G	N	P
Common greenbriar	N	-	P	N	N
Japanese honeysuckle	N	-	F-G	N	P-F
Poison ivy	N	-	G	N	F
Virginia creeper	N	-	F-G	N	F
Wild garlic	N	G	F	N	F

Table 3.15 - Spray Schedule for Weed Control in Home Fruit Orchards

Crop	Herbicide Active Ingredient/1000 sq ft (Product/1000 sq ft)	Remarks
Apples and Pears	dichlobenil 0.1 lb (Casoron 4G 3.4 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/year. Do not apply within one month of harvest. Do not allow livestock to graze treated area. Especially effective for many herbaceous perennial weeds.
	diuron 1.2 oz (Karmex 80DF 1.5 oz)	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 two 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 two years after last application.
	diuron 0.3-0.6 oz + terbacil 0.3-0.6 oz (Karmex 80DF 0.4-0.8 oz + Sinbar 80W 0.4-0.8 oz)	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. Use only under trees established for at least two years. 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 eroded areas where tree roots are exposed. Do not replant treated areas to any crop within two years after the last application. Avoid spraying tree foliage and fruit.
	fluazifop-P-butyl 0.19 oz (Fusilade DX 0.75 fl oz + 1.5 fl oz crop oil concentrate or 0.5 fl oz nonionic surfactant in 1.0 gal of water)	Spot treatment for emerged grasses. Use in non-bearing orchards only. Use as a directed spray on actively growing grasses. Treat annual grasses with lower rate before tillering or heading. Treat perennial grasses according to the following stages of growth: johnsongrass, field paspalum, and purpletop before boot stage; bermudagrass, 4–8 inch runners; quackgrass, 3–5 inch leaves and not more than 10 inches tall. Perennial grasses such as bermudagrass, paspalums, and quackgrass need to be treated with Fusilade when regrowth is evident. Do not treat trees to be harvested within one year after application.
	glufosinate (Rely)	Controls annual weeds and certain perennial weeds. Apply when weeds are actively growing. Mix 4.0 fl oz/gal. Ensure thorough coverage of weed foliage. Do not allow spray to contact desired foliage or green bark. Do not apply within 14 days of harvest. Use only on apples.
	glyphosate (Roundup and various other formulations. See label for 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 two years, suckers, or fruit of desirable trees. Spray contact with other than mature bark on main trunk can cause serious localized or systemic injury. Injury may become increasingly severe the second season. WARNING: Do not mix, store, or apply Roundup spray solution in galvanized metal or lined steel tanks. Chemical reaction produces hydrogen gas, which is very explosive.
	napropamide 1.5 oz (Devrinol 50 DF 3.0 oz)	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/season.
	norflurazon 0.75-1.5 oz (Solicam 80 DF 1.0-1.9 oz)	Apply as a directed spray to weed-free soil and avoid contact with fruit or foliage. May be applied under new plantings if there are no depressions or large cracks which allow the herbicide to accumulate around the root system. Pears must be established one year before treatment. Use the lower rate on sandy soils and the higher rate on clay and loamy soils.

Table 3.15 - Spray Schedule for Weed Control in Home Fruit Orchards (cont.)

Crop	Herbicide Active Ingredient/1000 sq ft (Product/1000 sq ft)	Remarks
Apples and Pears (cont.)	oryzalin 0.75-2.3 oz (Surflan 4AS 1.5-4.5 fl oz)	For use under newly planted or established 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 (6–8 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/growing season.
	oxyfluorfen 0.2-0.7 oz (Goal 2XL 0.7-2.9 fl oz)	Apply to dormant trees only. Will control certain small seedling weeds plus provide soil residual control of annual broadleaf weeds and certain annual grasses.
	sethoxydim 0.21 oz (Poast 1.5E 1.25 fl oz + 1.25 fl oz crop oil concentrate in 1.0 gal of water)	Do not apply within 14 days of harvest. Spot treatment for emerged grasses. Apply lower rate to annual grasses up to six inches, apply higher rate to annual grasses up to 12 inches tall and to perennial grasses.
	simazine 0.8-1.6 oz (Princep 4L 1.5-3.0 fl oz)	Apply to weed free 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/year.
	terbacil 0.3-0.6 oz (Sinbar 80W 0.4-0.7 oz)	Use on apples only, not registered for use in pears. Apply once in early spring as directed spray to orchard floor where trees have been established three 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, soil 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 last application. Keep spray off crop foliage and fruit.
	2,4-D 0.5 oz (Weedar 64, Orchard Master 1.1 fl oz)	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 coarse spray and low pressure to avoid spray drift. Do not harvest within 14 days of application.
Peaches	dichlobenil 0.1 lb (Casoron 4G 3.4 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 four weeks after transplanting. Will not give season long weed control. Do not make more than one application/year. Do not apply within 1 month of harvest. Do not allow livestock to graze treated area.
	diuron 1.2 oz (Karmex 80 DF 1.5 oz)	Apply once as a directed spray to weed-free orchard floor in early spring (March-May) before fruit sets. Apply only to trees established two 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 two years after last application.

Table 3.15 - Spray Schedule for Weed Control in Home Fruit Orchards (cont.)

Crop	Herbicide Active Ingredient/1000 sq ft (Product/1000 sq ft)	Remarks
Peaches (cont.)	diuron 0.3-0.6 oz plus terbacil 0.3-0.6 oz (Karmex 80 DF 0.4-0.8 oz plus Sinbar 80W 0.4-0.8 oz)	Apply tank mixture either in the spring or after harvest in the fall before weeds emerge or during early seedling stage of weed growth. Use only under trees established for at least two years. 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 two years after the last application. Avoid spraying tree foliage and fruit.
	fluazifop-P-butyl 0.19 oz (Fusilade DX 0.75 fl oz + 1.5 fl oz crop oil concentrate or 0.5 fl oz nonionic surfactant in 1.0 gal of water)	Do not harvest within 14 days of application. Use as a directed spray on actively growing grasses. Treat annual grasses with lower rate before tillering or heading. Treat perennial grasses according to the following stages of growth: johnsongrass, field paspalum, and purpletop, before boot stage; bermudagrass, 4–8 inch runners; quackgrass, 3–5 leaves and not more than 10 inches tall. Perennial grasses such as bermudagrass, paspalums, and quackgrass need to be treated with Fusilade when regrowth is evident.
	glyphosate (Roundup and various other formulations. See label for rates.)	Wick or wiper application only. Use on emerged annual and perennial weeds with fully expanded leaves.
	napropamide 1.5 oz (Devrinol 50 DF 3.0 oz)	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 and foliage. Do not apply when fruit is on the ground during the harvest period. Do not graze treated areas. Make only one application/season.
	norflurazon 0.75-1.5 oz (Solicam 80 DF 1.0-1.9 oz)	Apply as a directed spray to weed-free soil and avoid contact with fruit or foliage. May be applied under new plantings if there are no depressions or large cracks which allow the herbicide to accumulate around the root system. Use the lower rate on sandy soils and the higher rate on clay and loam soils.
	oryzalin 0.75-2.3 oz (Surflan 4AS 1.5-4.5 fl oz)	Areas to be treated should be free of weeds. Remove or thoroughly mix trash into the soil before application. Use the lower rate for short term control (4 months) and the higher rate for long-term control (6–8 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/growing season.
	oxyfluorfen 0.2-0.7 oz (Goal 2XL 0.7-2.9 fl oz)	Apply to dormant trees only. Will control certain small seedling weeds plus provide soil residual control of annual broadleaf weeds and certain annual grasses.
	sethoxydim 0.21 oz (Poast 1.5E 1.25 fl oz + 1.25 fl oz crop oil concentrate in 1.0 gal of water)	Spot treatment for emerged grasses. Apply lower rate to annual grasses up to 6 inches. Apply higher rate to annual grasses up to 12 inches tall and to perennial grasses. Do not apply within 14 days of harvest.
	simazine 0.8-1.6 oz (Princep 4L 1.5-3.0 fl oz)	Apply to weed free 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/year.

Table 3.15 - Spray Schedule for Weed Control in Home Fruit Orchards (cont.)

Crop	Herbicide Active Ingredient/1000 sq ft (Product/1000 sq ft)	Remarks
Peaches (cont.)	terbacil 0.3-0.6 oz (Sinbar 80W 0.4-0.7 oz)	Apply once in early spring as directed spray to orchard floor where trees have been established three 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, or on eroded areas where tree roots are exposed. Do not replant treated areas to any crop within two years after last application. Keep spray off crop foliage and fruit.
	2,4-D 0.5 oz (Weedar 64, Orchard Master 1.1 fl oz)	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 coarse spray and low pressure to avoid spray drift. Do not harvest within 40 days of application.
Blackberries, Blueberries, and Raspberries	dichlobenil 1.4 oz (Casoron 4G 2.3 lb)	Apply dry granules in late winter or early spring. Use only on established plantings and do not apply during new shoot emergence.
	fluazifop-P-butyl 0.19 (Fusilade DX 0.75 fl oz + 1.5 fl oz crop oil concentrate or 0.5 fl oz nonionic surfactant in 1.0 gal of water)	Spot treatment for emerged grasses. Use in non-bearing orchards only. Use as a directed spray on actively growing grasses. Treat annual grasses with lower rate before tillering or heading. Treat perennial grasses according to the following stages of growth: johnsongrass, field paspalum, and purpletop before boot stage; bermudagrass, 4 to 8 inch runners; quackgrass, 3 to 5 leaves and not more than 10 inches tall. Perennial grasses such as bermudagrass, paspalums, and quackgrass need to be retreated with Fusilade when regrowth is evident. Do not treat plants to be harvested within one year after application.
	glyphosate (Roundup and various other formulations. See label for rates.)	Use lower rate to control annual weeds and higher rates for perennial weeds. Can be applied preplant or as a spot treatment after planting. Do not allow spray to contact desired stems or foliage.
	napropamide 1.5 oz (Devrinol 50 DF 3.0 oz)	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/season.
	oryzalin 0.75-2.3 oz (Surflan 4AS 1.5-4.5 fl oz)	Apply in early spring for control of annual grasses and certain broadleaf weeds. Apply to new plantings after rainfall has firmed the soil. May be tank-mixed with simazine or diuron for increased broadleaf weed control.
	sethoxydim 0.21 oz (Poast 1.5E 1.25 fl oz + 1.25 fl oz crop oil concentrate in 1.0 gal of water)	Do not apply within 45 days of raspberry or blackberry harvest or within 30 days of blueberry harvest. Apply as spot treatment for emerged grasses. Treat emerged annual grasses prior to tillering. Perennial grasses may require retreatment.
	simazine 0.8-1.2 oz (Princep 4L 1.5-3.0 fl oz)	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 and 1/2 applied in the fall. 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.
	terbacil 0.3-0.6 oz (Sinbar 0.4-0.7 oz)	Only treat plantings established one year or more. Use higher rate on clay soils and soils with high organic matter (3%+). Do not apply over 0.3 oz of terbacil/1000 sq ft to blackberries or raspberries.

Table 3.15 - Spray Schedule for Weed Control in Home Fruit Orchards (cont.)

Crop	Herbicide Active Ingredient/1000 sq ft (Product/1000 sq ft)	Remarks
Grapes	dichlobenil 1.4-2.2 oz (Casoron 4G 2.3-3.4 lb)	Apply granules in winter or early spring. Do not apply until four weeks after transplanting.
	diuron 0.8 oz (Karmex 80 DF 1.0 oz)	Apply a single application per year in the early spring after clean cultivation and where vines have been established at least three years. Single application may give season-long control of annual weeds. Do not plant treated area to any crop not on the label for two years.
	fluazifop-P-butyl 0.19 oz (Fusilade DX 0.75 fl oz + 1.5 fl oz crop oil concentrate or 0.5 fl oz nonionic surfactant in 1.0 gal of water)	Spot treatment for emerged grasses. Use in non-bearing vineyards only. Use as a directed spray on actively growing grasses. Treat annual grasses before tillering or heading. Treat perennial grasses according to the following stages of growth: johnsongrass, field paspalum, and purpletop, before boot stage; bermudagrass, 4–8 inch runners; quackgrass, 3–5 leaves and not more than 10 inches tall. Perennial grasses such as bermudagrass, paspalums, and quackgrass need to be retreated with Fusilade when regrowth is evident. Do not treat trees to be harvested within one year after application.
	glufosinate (Rely)	Controls annual weeds and certain perennial weeds. Apply when weeds are actively growing. Mix 1.5 to 4.0 fl oz/gal. Ensure thorough coverage of weed foliage. Do not allow spray to contact desired foliage or green bark. Do not apply within 14 days of harvest.
	glyphosate (Roundup and various other formulations. See label for rates.)	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 three years of age. Spray contact, other than with mature bark on the main trunk, can result in serious localized or systemic injury.
	napropamide 1.5 oz (Devrinol 50 DF 3.0 oz)	Apply to 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/ season.
	oryzalin 0.75-2.2 oz (Surflan 4AS 1.5-4.5 fl oz)	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 (6–8 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/growing season.
	oxyfluorfen 0.2-0.7 oz (Goal 2XL 0.7-2.9 fl oz)	Dormant application only. Will control certain small seedling weeds plus provide soil residual control of annual broadleaf weeds and certain annual grasses.
	sethoxydim 0.21 oz (Poast 1.5E 1.25 fl oz + 1.25 fl oz crop oil concentrate in 1.0 gal of water)	Do not apply within 50 days of harvest. Spot-treatment for emerged grasses. Treat annual grasses prior to tillering. Perennial grasses may require repeat treatment.
	simazine 0.8-1.6 oz (Princep 4L 1.5-3.0 fl oz)	Apply a single application in fall or early spring to weed-free soil. Vineyards must be established at least three years.

Table 3.15 - Spray Schedule for Weed Control in Home Fruit Orchards (cont.)

Crop	Herbicide Active Ingredient/1000 sq ft (Product/1000 sq ft)	Remarks
Strawberries	napropamide 1.5 oz (Devrinol 50 DF 3.0 oz)	Use on established strawberries. Delay application until the desired number of daughter plants has become established. Do not apply from bloom to harvest. Make only one application/season. Does not control established weeds.
	sethoxydim 0.21 fl oz (Poast 1.5E 1.25 fl oz plus 1.25 fl oz crop oil concentrate in 1.0 gal of water)	Do not apply within 7 days of harvest. Spot-treatment for emerged grasses. Treat annual grasses prior to tillering. Perennial weeds may require retreatment.
	2,4-D amine 0.4 oz (Formula 40 0.7 fl oz)	Apply for control of emerged broadleaf weeds in established beds. Apply in late winter or 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.