



Growing Apples in Virginia

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Introduction

Growing apples in the home garden can be an enjoyable and rewarding experience, but consistent production of high quality fruit requires knowledge of tree and fruit growth and a willingness to perform certain practices at the appropriate time. Virginia is on the southern fringe of the U. S. apple producing region. Most apple varieties produce the highest quality fruit when night-time temperatures are cool (less than 60°F) at harvest time. Apples grown under warmer conditions tend to be large, soft, poorly colored, and less flavorful than when grown under cooler conditions. Our warm humid summers are also conducive for infection of many diseases. For these reasons, the best Virginia apples are grown at elevations higher than 800 feet above sea level in the western part of the state. However, even apples grown in eastern Virginia usually have quality superior to apples purchased in the supermarkets.

Site Selection

A. Cold Air Drainage - The most important factor contributing to annual cropping is the avoidance of frost during bloom. Air temperatures below 28°F during bloom may kill flowers and eliminate the crop. Covering trees with various materials is of little benefit. In general, high areas such as hill tops or hill sides, that are surrounded by lower ground, have the least frost damage. Cold air is heavier than warm air and flows into low areas much as water flows into low areas.

Minimizing frost injury

1. The most effective way to minimize frost injury is to avoid planting in low-lying areas. Sometimes a 10-foot increase in elevation makes the difference between a good crop and no crop.
2. Large bodies of water, such as lakes and large rivers,

hold heat and warm the air and may protect crops during fall and early winter. Planting trees close to water may reduce the likelihood of frost injury because the cool water cools the air and delays bloom.

3. Sprinkling the trees with water releases heat as the water freezes and may prevent bud freezing. Ice itself does not insulate or protect plants. This method is effective only on nights that are clear and calm. Windy conditions, especially when accompanied by low dew points, can cause the water to evaporate and may increase injury. Water should be turned on when the temperature reaches 33°F and sprinkling should continue until after sunrise when the ice has melted from the trees. When freezing temperatures persist for long periods, the buildup of ice can cause tree breakage.
4. Covering the trees with a tent or a piece of plastic will prevent frost injury only when there is a source of heat, such as a kerosene heater, inside the covering.

B. Soil Considerations. Apples grow well in a wide range of soils, but the best fruit quality is produced on moderately fertile soils.

Soil fertility and pH are not important considerations because they can be amended as recommended on soil test results.

Water drainage is the most important soil factor to consider. Trees may die if roots are covered with water for 10 days. To evaluate water drainage, dig a hole 2 feet deep. Just after a rain, when the soil is wet, fill the hole with water. If the water drains from the hole in three or four days, the soil should be suitable for apples.

Soil depth is important for tree growth. Rooting depth should be at least 18 inches deep.

Variety Selection

There are more than 3,000 apple varieties in the world, but only about 25 varieties are commonly grown in Virginia. Many varieties perform satisfactorily in Virginia, but some should be grown only at higher elevations, where night time temperatures are relatively low. Generally, apples grown with low (40 to 60°F) night-time temperatures have better red color, firmer flesh, better storage characteristics, and better flavor than fruit grown in warmer regions. Because most apple varieties are adapted to certain climates, local environmental conditions should be considered.

Personal preference for a given variety is an important consideration in variety selection. For example, 'McIntosh'-type varieties perform best in Northern states, but 'McIntosh' grown in Virginia are harvested before northern-grown 'McIntosh' are available in supermarkets. Therefore, Virginia-grown 'McIntosh' are the only 'McIntosh' available. Although the eating quality is only fair, it is acceptable.

Use of the fruit is another consideration. People differ in their opinions concerning the best varieties for sauce, pies,

juice, and eating out of hand. Therefore, select varieties you prefer to use for various purposes. Some varieties store better than others and this may be an important consideration.

Apple varieties ripen in Virginia from late-June until mid-November. If desirable, different varieties can be planted to provide fresh apples over a four-month period.

Varieties also differ in susceptibility to some diseases. Fireblight is a bacterial disease that can kill branches or even trees. Varieties such as 'Gala', 'Jonathan', 'Granny Smith', 'Paulared', 'Mutsu', 'York', and 'Jonagold' are particularly susceptible. Certain new varieties have been bred for resistance to some diseases. These so-called "disease resistant varieties" are resistant to apple scab, and sometimes cedar apple rust, powdery mildew, or fireblight. These varieties were not selected for resistance to the summer diseases, sooty blotch, fly speck, black rot, white rot, and bitter rot. Therefore, these varieties require fungicide sprays to produce high quality fruit.

Table 1 lists the characteristics of some varieties grown in Virginia. For information on other varieties, see VCE Publication 422-760.

Table 1. Apple varieties recommended for Virginia. Ripening dates are for Blacksburg. Dates for regions east of the Blue Ridge may be 5 to 14 days earlier.

Variety	Harvest Date	Fresh ^z	Cooking ^z	Color	Taste	Comments
Lodi	July 1	F	F-G	yellow-green	tart	stores poorly
Earlycrisp	July 13	G	F-G	yellow	tart/sweet	best very early apple
Ginger Gold	Aug. 12	E	G	yellow	mild/sweet	stores well
Redfree	Aug. 15	F-E	P	red	tart/sweet	best in cool seasons, scab resistance
Gala	Aug. 20	E	P	yellow	tart/sweet	best summer apple, very susceptible to fireblight
Jonagold	Sept. 8	G	E	green/yellow	tart/sweet	stores poorly, triploid
Red Delicious	Sept. 16	E	F	red	sweet	leading variety in US
Golden Delicious	Sept. 20	E	E	yellow	sweet/tart	best all-around variety
Empire	Sept. 23	E	F	red	sweet/tart	best McIntosh-type
Rome	Oct. 12	F	G	red	sweet/tart	large fruit
Winesap	Oct. 20	F	G	red	tart	stores well, triploid
York	Oct. 20	G	E	red	tart	tastes best after 2 months storage
Fuji	Oct. 25	G	E	red	sweet	stores for a year
Arkansas Black	Oct. 25	F	G	red	tart/sweet	tolerates heat

^z E = excellent, G = good, F = fair, P = poor

Pollination

Pollination is the transfer of pollen from the anther of a flower to the stigma of a flower. Insects are responsible for transferring apple pollen. Apple flowers usually will not set fruit when pollinated with pollen of the same variety. At least two apple varieties growing in fairly close proximity (no further than 100 feet apart) will ensure good fruit set. Triploid varieties such as 'Winesap', 'Jonagold', 'Mutsu', and 'Stayman' have three sets of chromosomes, produce nonviable pollen, and are not effective pollenizers. When triploids are planted, two additional diploid varieties are needed to ensure fruiting of all three varieties. The other factor to consider when selecting pollenizers is that the two varieties must have open blossoms at the same time. Crab apple trees within 100 feet of apple trees will usually provide adequate pollination.

Rootstocks

Apple trees grown from seed are not the same variety as the tree on which the seed developed. Therefore, to produce more trees of a variety the trees must be budded or grafted onto another apple tree. Certain apple varieties have been selected as rootstocks and varieties are grafted onto these rootstocks. Rootstocks are selected for certain characteristics such as tree size, fruitfulness, and disease resistance. The three general size categories for rootstocks are standard, semi-dwarf, and dwarf, but there is a range of tree size within each size group. Below is a brief description of the common apple rootstocks.

Standard

- Seedling - A mature tree may produce 300 to 400 lbs. of fruit. Seeds, usually 'Red Delicious', from juice plants are germinated to produce rootstocks. Trees on seedling rootstocks are large (18 to 22 feet tall), slow to produce fruit (the first crop is produced on 7- or 8-yr-old trees), resistant to most diseases, and do not lean.

Semi-dwarf

- Malling Merton III (MM.111) - The most reliable of the semi-dwarf rootstocks. Developed in a breeding program in England. Trees do not lean and are resistant to most diseases. Trees are large (16 to 20 feet tall), relatively slow to produce fruit (first crop is produced at 5 to 7 years), produce moderate amounts of root suckers and burrknots.

- Malling 7 (M.7) - Trees lean and will require support with many varieties ('Granny Smith', 'Gala', 'Stayman', 'York', 'Winesap', and 'Red Delicious'). Trees are 16 to 18 feet tall, produce a first crop at 4 to 6 years, produce numerous rootsuckers, and few burrknots.
- MM.106 - Mature semi-dwarf trees produce 200 to 300 lbs. of fruit. Trees are 14 to 16 feet tall, productive, produce first crop at 4 to 5 years and lean little. They are susceptible to collar rot and tomato ringspot virus (when 'Red Delicious' is the variety). Not recommended except on very well-drained soils.

Dwarf

- General: Mature dwarf trees may produce 50 to 100 lbs. of fruit. Trees on dwarfing rootstocks and on M.7 must be supported on a trellis or a wooden post (at least 3 inches in diameter) to a height of at least 6 feet.
- M.26 - Trees tend to lean with most varieties, trees are susceptible to fireblight, and produce trees 10 to 14' tall. Trees are productive and crop at 3 to 4 years. Not recommended because tree loss to fireblight has been excessive.
- M.9 - Trees tend to lean, and must be supported, they are moderately susceptible to fireblight, and produce trees 8 to 10' tall. Trees are productive and produce fruit at 3 years of age. The most reliable dwarf rootstock.

Purchasing Trees

Trees can be purchased locally at garden centers or from fruit tree nurseries. Information on rootstock and variety is often lacking at garden centers: rootstocks are often referred to as "dwarf", but there is no way of knowing which dwarf rootstock is used. Good quality trees of specific varieties, rootstocks, and tree sizes can be mail-ordered from fruit tree nurseries. Large trees and 2-yr-old trees are usually most expensive. Medium sized (1/2 to 5/8" diam., 4 to 6' tall) 1-yr-old trees perform very well. Most reputable nurseries provide free catalogs upon request and have a large selection of varieties on several rootstocks.

Tree Care Before Planting

Trees purchased in pots are relatively expensive. Garden centers purchase bare-rooted trees and plant them in pots within several months of being sold. These trees often produce no new roots before planting and should be

handled the same as bare-rooted trees. March and April is the best time to plant in most parts of Virginia. Bare-rooted trees arrive from fruit tree nurseries in paper bags or cardboard boxes, and roots are packed in moist sawdust or sphagnum moss. Upon arrival trees should be inspected for condition and accuracy of the order. Trees should be rewrapped and stored in a cool place (40 to 50° F if possible) until planting. Make sure roots do not dry out.

Preplant soil preparation. Several months before planting, the soil should be tested. Soil analysis kits can be obtained from your local county Extension office. Apply lime and fertilizer as recommended from the soil test. Lime moves extremely slowly in the soil and, if possible, should be plowed or cultivated into the soil. Also, apply phosphorous and potassium if soil test indicates a need. Because broad leaf plants can be infected with virus, such weeds should be eliminated to produce a solid stand of grass before trees are planted.

Tree Planting

Dig holes with a shovel or auger deep enough to set the tree in the hole. Holes 18 inches deep and 18 inches in diameter are usually adequate. Place the root system in the hole, partially fill the hole and tamp the soil to insure root-to-soil contact so roots will not become dry. Fill the hole and tamp the soil. Water the tree with at least 2 gallons per tree. The graft union should appear as a slight bulge or healed wound about 10 to 18 inches above the highest root. Sometimes trees are budded only 4 to 6 inches above the highest root. These trees should be planted so

3 inches of the rootstock is above ground to prevent the variety from rooting. At other times trees may be budded high and there may be 10 to 18 inches of rootstock below the bud union. In this case, plant the tree so the highest roots are about 4 inches below the soil. Where visible, the original soil line on the rootstock can be used as a guide for planting depth. If the variety roots, most characteristics of the rootstock will be lost. Place hardware cloth loosely around the base of the trunk to prevent rabbits from feeding on the bark.

Tree Spacing

Tree spacing varies with rootstock/varieties combination and soil type. One should also make allowances for the type and size of equipment to be used around the trees. Table 2 gives some general guidelines for determining spacing of apple trees.

Tree Care the First Year

At planting, the tree needs to be pruned to induce proper branching. Some trees from the nursery have branches, some do not. If the tree is a nonbranched whip, cut off the top at 36 inches above ground. If the tree is branched, remove branches lower than 24 inches above ground, remove dead and broken branches, and branches with narrow crotch angles (less than 30° from vertical). Dwarf trees should be tied to wooden post or some type of support when the central leader (top upright extension shoot developing below the pruning cut) is 12 to 15 inches long, to prevent it from flopping in the wind.

Table 2. Suggested tree spacings for different soil types and variety/rootstock combinations.

Rootstock	Vigorous varieties ¹ or strong soils	Moderately vigorous varieties ² or moderately fertile soil	Less vigorous varieties ³ or weak soil
M.9	12 x 18	10 x 16	6 x 12
M.9/MM.111	14 x 20	10 x 16	6 x 12
MARK	10 x 18	10 x 16	6 x 12
M.26	14 x 20	12 x 18	8 x 14
M.7	16 x 24	14 x 20	10 x 18
MM.106	14 x 22	12 x 18	8 x 14
MM.111	18 x 26	16 x 24	14 x 22
Seedling	22 x 30	18 x 26	16 x 24

¹Vigorous varieties include York, Stayman, and Gala.

²Moderately vigorous varieties include Standard Delicious, Winesap, Rome, and Golden Delicious.

³Less vigorous varieties include spur-type Delicious, Rome, Jonathan, and Idared.

Trees should be watered every 14 days unless at least 1 inch of rain fell since the last watering. Use herbicides or cultivation to eliminate weeds and grass within 2 inches of trunk. Organic mulches conserve water and eliminate weeds, but as the material decomposes, nitrogen is released during the late summer when high levels of nitrogen are not desirable. Late-season nitrogen delays the development of cold hardness and causes fruit to be poorly colored and soft. Mulches also provide good habitat for rodents that feed on tree roots and bark. For the above reasons, organic mulches are not recommended for fruit trees.

Fertilize trees twice (2 weeks and 6 weeks after planting) with a nitrogen fertilizer (examples include ammonium nitrate, calcium nitrate, or urea) or a complete fertilizer (10-10-10, 10-20-20, or 5-10-10) at the rate of 0.05 pounds of actual nitrogen per tree per application (1/2 lb. of 10-10-10-, 1 lb. of 5-10-10, or 1/3 lb. of calcium nitrate). To avoid root injury, place fertilizer in a band 6 to 18 inches from the trunk around the tree. Organic forms of fertilizer (manure, blood meal, and bone meal) are not recommended because the nutritional analysis is usually unavailable and the release rate cannot be controlled. High levels of nitrogen are required early in the season, and low levels are desirable during late summer.

Tree Care, Second Year

During late winter, or early spring within a few weeks before bloom, trees should be pruned. Pruning temporarily reduces tree cold hardness. Pruning just before bloom, or even during bloom, reduces the likelihood of winter injury.

The central leader will have 2 to 4 narrow-crotched upright shoots developing just below the previous year's pruning cut. Retain the longest straightest shoot and remove the top 1/3 of it. Remove all narrow-crotched shoots below the new central leader. Retain all limbs with wide-angled crotches except those developing within 2 feet of the ground. Upright growing branches should be reoriented to 45 to 60° from horizontal. Branches can be spread by placing stiff pieces of wire or wooden sticks between the trunk and upper surface of the branch. Branches can also be spread by tying the branch down with string or hanging weights on the ends of the branch. Prune as little as possible to encourage early fruiting.

Fertilization. About a month before bloom fertilize the tree with 0.15 lbs. of actual nitrogen per tree (e.g., 1.5 lbs. of 10-10-10, 3 lbs. of 5-10-10, or 1 lb. of calcium nitrate).

Weed control. Control vegetation under the tree, with cultivation or herbicides, for a distance of 3 feet from the trunk.

Third Year and Beyond

Prune trees as in the second year. As trees start to fruit, the weight of the fruit may pull branches down and cause the branches to “weep.” This situation can be corrected by tying branches up. Another way to deal with the problem, while dormant pruning, is to cut off the drooping end of the branch to a more upright-growing shoot. When the tree attains the desired height, pruning the top of the tree should promote renewal of the branches. First, lower the central leader by cutting into 2-yr-old wood just above a wide-crotched, moderately vigorous shoot. When the diameter of a branch in the top third of the tree is 1/2 the diameter of the trunk at the point of attachment, the branch should be removed. New shoots will develop from around the pruning cut. Remove all of these but one relatively wide angled shoot and, if needed, reorient it to about 40-45° from horizontal. In this manner, branches in the top of the trees will always be young and relatively short and will not shade the lower part of the tree.

Fruit thinning. Trees on dwarf rootstocks may flower and fruit as early as the second or third year. Allowing too many fruit to develop on a tree will have several negative consequences.

1. Trees and limbs may break under the weight of an excessive crop.
2. Heavy cropping inhibits flower bud formation for the following year. Flower buds form one summer bloom and set fruit the following spring. Therefore, to ensure annual blooming, limit cropping to a moderate level.
3. Heavy cropping trees have inadequate leaf area per fruit to produce large, well colored fruit with high sugar levels.
4. Heavy cropping trees usually have clusters of fruit and the fruits touch each other. Pest control is difficult in such trees because spray material cannot cover the entire fruit surface.

Ideally there should be no more than one fruit per spur and fruits should be spaced every 6-8 inches along the branch. To ensure bloom the following year, trees must be partially defruited within four weeks after bloom. Early fruit removal also results in the largest increase in fruit size.

There are two ways to remove excess fruit.

1. Remove fruit by hand any time between full bloom and 4 weeks after bloom. It is usually best to wait about 3 weeks after bloom, when average fruit diameter is 1/2 inch. Fruits developing from flowers that were not pollinated or fertilized will drop before developing to the 1/2 inch size. More fruit will fall before average fruit diameter is 1 inch, probably due to a lack of carbohydrate in the tree. A compromise would be to do part of the fruit thinning job 2 to 3 weeks after bloom and complete the job 4 to 5 weeks after bloom after natural fruit drop is complete.
2. Chemicals are used by commercial fruit growers to reduce the number of fruit. The only chemical widely available to noncommercial apple growers is the insecticide Sevin (carbaryl is the active ingredient). Spraying trees with Sevin when average fruit diameter is about 1/2 inch, usually removes 20 to 30% of the fruit, which is often acceptable for return bloom and improved fruit size. Fruits will drop from the tree about 8 to 15 days after Sevin application. If Sevin removes too few fruits, excess fruits can be removed by hand.

Harvesting Fruit

Determining when to harvest apples is not an easy task. The terms “mature” and “ripe” are often confused and will be used in this discussion. The term “mature” indicates that upon removal from the tree, the fruit is able to ripen. The term “ripe” refers to a fruit with acceptable eating quality, and includes texture and flavor.

As fruits mature they soften, the skin on the side of the fruit facing the sun turns red or yellow and the ground color (nonred side) changes from green to greenish yellow, the starch content within the fruit declines, sugars increase, acids decline, and flesh color changes from greenish to white or yellow. Red color is not a good indication of maturity because red color can be influenced by other factors such as temperature, light level, tree nutrition, and drought stress. No single index adequately measures maturity in any given year. More than one index should be used to determine harvest date. A brief explanation follows.

1. Days from full bloom to harvest is usually a fairly accurate (within 5 to 10 days) indication of harvest date. Each variety requires a certain number of days to mature. The table shows some examples.

2. These numbers need adjustment depending on early season temperatures. If average temperature is cooler than normal during the first 6 weeks after bloom, then 1 to 5 additional days may be required for maturity. To the contrary, warm weather would shorten the time to maturity.
3. Ground color is usually a reliable indicator of maturity. When the ground color changes from green to a cream color or greenish yellow, the fruits are nearing maturity. With red varieties like Red Delicious, ground color may not be visible. In such cases flesh color is a helpful index.
4. Starch is usually a fairly reliable indicator of maturity. Starch can be somewhat quantified by cutting a fruit in half so the stem is on one end. Place the cut surface in a solution of iodine for about 5 seconds and then place it, cut surface up, on a paper towel for several minutes. Tissue containing starch turns blackish-blue. Immature fruits develop stain across the entire surface. As a fruit matures, starch is hydrolyzed to sugar in the center of the fruit, so the core area remains unstained or white. When most of the area within the vascular bundles is not stained, the fruit is ready for harvest (Fig. 1).
5. Taste. When some of the indices indicate the fruit is mature, it is a good idea to taste some fruit. Immature fruits may taste starchy, tart, or astringent. Mature fruits are not astringent, but may still be somewhat starchy. Ripe fruits may be sweet and soft.

Indices that are mistakenly used to determine harvest date include:

- Red color development of the skin.
- When fruits start to drop from the tree.
- Some people mistakenly believe that early-blooming varieties mature earlier than late-blooming varieties.

Fruit Storage

Apples can be stored after harvest, but storage characteristics differ with variety. Varieties such as Fuji, Braeburn, York, Winesap, and Arkansas Black usually maintain good eating quality until at least March. Early-season varieties usually keep only 2 or 3 weeks, whereas most mid-season varieties store until early February. Varieties with russeted skin (‘Golden Delicious’, and ‘Gala’) will shrivel in storage unless placed in perforated polyethylene bags.

Variety	Days from bloom to harvest
Lodi	65
Ginger Gold	100
Gala	105
McIntosh	130
Red Delicious	150
Golden Delicious	155
Rome	160
Stayman	165
Winesap	170
York	170
Fuji	180
Granny Smith	195

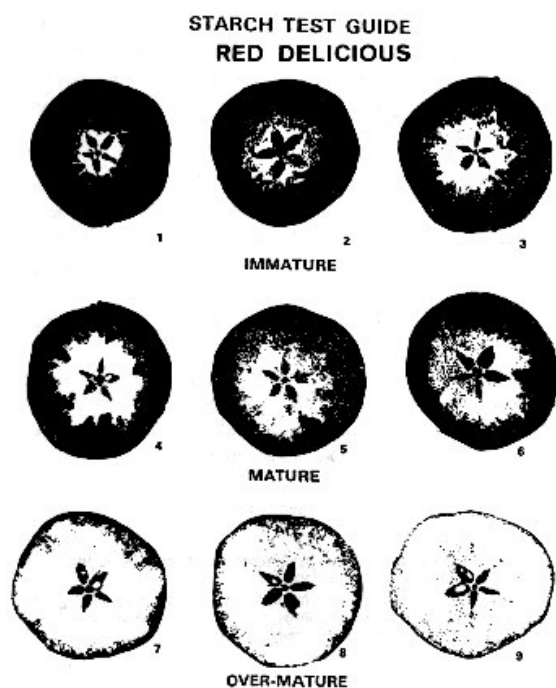


Figure 1. Example of charts used to assess maturity using starch/iodine test.

The storage potential is directly related to temperature. Fruits are living tissue. The object of storage is to prolong the life of the fruit tissue. Metabolic processes within the fruit, including respiration and senescence, are slow at low temperatures. The ideal storage temperature for most varieties is 30° F, but some varieties such as ‘Liberty’ and ‘McIntosh’ store better at 36° F. If it is not possible to store apples at the ideal temperature, use the lowest temperature available, even 50° F is better than room temperature. Most household refrigerators are set at 45° F. Maximum storage life (maintenance of flesh firmness and flavor) for

a given variety declines as storage temperature increases. Cool the fruit as soon as possible after harvest and keep the fruit cool until consumed. Fruits harvested in the morning are relatively cool and can be cooled to the optimum temperature quite quickly.

Physiological Disorders are visual symptoms that occur on the skin or in the flesh, before or after harvest, and are not caused by a living organism. Below is a brief discussion of each disorder along with control measures.

1. Bitterpit - small (1/8” diameter) dark brown or black sunken spots in the skin of the fruit. Just under the skin there may be some corky tissue. Bitterpit usually develops after harvest, but sometimes becomes evident in fruit on the tree before harvest. Sometimes rot organisms can invade this dead tissue. Bitterpit is caused by low calcium concentration in the fruit. The following factors can be managed to reduce the incidence of bitterpit.
 - Spray the trees every 2 weeks, starting 6 weeks after bloom, with calcium chloride (0.025 lbs./gallon).
 - Avoid light crops and excessively large fruit. Plant trees on good sites and thin trees to moderate crop loads to prevent alternate bearing.
 - Test the soil under trees every 3 years and apply lime to maintain the proper soil pH.
 - Because calcium uptake by roots is best in moist soil, irrigate during drought periods.
 - Do not harvest fruit before they are mature.
2. Cork spot is another disorder related to low calcium levels in the fruit. Symptoms appear in late summer on the tree as dark green sunken areas, 1/4 to 1/2 inch in diameter. Brown corky tissue is apparent under the skin. The same management practices discussed for bitterpit pertain to cork spot.
3. Internal corking is not obvious until one cuts into the fruit and there are areas of brown corky tissue in the fruit interior. Internal corking is related to low fruit boron levels. Severe symptoms appear as misshapen fruit. Early-season boron sprays help reduce this problem.
4. Superficial scald appears as skin discoloration, resembling scalded skin, on fruit and usually develops after 3 or 4 months of cold storage. Scald can be reduced by delaying harvest until fruit are mature.
5. Internal breakdown is a browning and softening of the fruit flesh in cold storage. Avoid storing fruit at very low temperatures that may cause chilling injury.

6. Fruit russet appears as rough, golden brown areas on the fruit skin. Russet is usually associated with wet conditions (rainfall or fog) during the first 6 weeks after bloom. Some pesticides or frost injury can aggravate the problem and varieties such as 'Golden Delicious', 'Roxbury Russet', and 'Gala' are most susceptible to the problem. Russet is primarily a cosmetic problem and does not affect the eating quality of the fruit.
7. Preharvest drop. In some years a high percentage of fruit of some varieties can fall to the ground before fruits are mature. Commercial fruit growers spray trees with plant growth regulators, such as naphthalene acetic acid, to delay fruit drop. Avoid planting varieties that are prone to early drop ('McIntosh', 'Liberty', and 'Stayman').
8. Fruit cracking. There are two types of fruit cracking. ³Physiological Cracking² often occurs on 'Stayman' when a high percentage of fruit may split or crack, starting in July. This type of cracking is probably related to the water status in the tree and fruit, but there is no way to suppress cracking to acceptable levels. "Maturity Cracking" develops on varieties such as 'Golden Delicious' and 'Gala', often at the stem end, as the apples become mature. This type of cracking can be minimized by harvesting fruit as the first fruits start to crack.

around the state, but below is a brief description of the problem and possible control measures.

- White tail deer populations are increasing rapidly throughout the eastern U. S.. Deer feed on apple fruits and young succulent shoots, and the males can partially debark a tree or break branches by rubbing their antlers against trees. When the population is relatively low, taste repellants such as hot sauces and Ropel™ work fairly well. Hanging bars of soap or small cloth bags of human hair in trees are effective odor repellents. In areas with high deer populations, repellants are not effective. In such areas, the only effective method is exclusion. Surrounding individual trees with a wire fence or surrounding a planting with an electrical fence will help keep deer away from trees.
- Rabbits may feed on bark just above ground and, if damage is extensive, the trees may be weakened or killed. Surrounding the trunk with hardware cloth to a height of at least 12 inches above ground usually prevents rabbit damage.
- Voles or Mice can feed on roots or bark on the trunk and kill trees. Low populations can be controlled by placing household mouse traps, baited with pieces of apple, in the runs or near the trunk. Make the ground under a tree undesirable for mice by controlling the vegetation under the tree and do not place organic mulches under the tree.
- Birds can feed on the ripening fruit: this is especially true for summer apple varieties. Various types of noise makers are moderately effective for scaring birds. The most effective control is to place netting over the trees.

Wildlife Problems

Different species of animals may feed on various parts of the tree or on the fruit. The severity of the problem varies

Table 3

Name of Spray	Pests Being Controlled
Green tip - green tissue first appears in buds	aphid eggs, apple scab
Half-inch green - about 1/2 inch of green tissue protrudes from buds	mite eggs, aphid eggs, apple scab
Pink - pink tissue appears in flower buds	mite eggs, aphids, fruitworms, plant bugs, apple scab, rusts, fireblight, mildew
Bloom - 50 to 80% of flowers are open	apple scab, fireblight, rusts, mildew
Petal fall - flower petals fall from the blossom	white apple leaf hopper, spotted tentiform leafhopper, plum curculio, green fruit worms, plant bugs, aphids, leaf rollers, codling moth, apple scab, rusts, powdery mildew, rots
1st & 2nd cover sprays - 2 and 4 weeks after petal fall, respectively	Plum curculio, leafhoppers, codling moth, leafminers, scale, leafrollers, apple scab, rusts, powdery mildew, rots
3rd - 7th cover spray - 2 week intervals after 2nd cover spray	leafminers, codling moth, leafrollers, apple maggot, apple scab, powdery mildew, sooty blotch, fly speck, rots

Pest Control

There are many insects and diseases that attack apple trees. Some pests are “direct pests” and damage the fruit, whereas others are “indirect pests” and damage the leaves. Loss of foliage results in poor fruit growth, poor fruit color, low sugar levels, and poor storage ability. Adequate control of these pests usually requires sprays containing fungicides and insecticides 10 to 15 times throughout the season. Because pesticide registrations change, and choice of pesticide and spray timing are critical, a discussion of pest control is beyond the scope of this publication. A list of important insects and diseases and times to spray

is found in Table 3. For more detailed information on spray timing and recommended pesticides, commercial growers should purchase VCE Publication 456-419, The Spray Bulletin for Commercial Tree Fruit Growers, and noncommercial growers should purchase VCE Publication 456-017, Virginia Pest Management Guide for Horticultural and Forestry Crops.

Apples are usually sprayed with a combination of insecticide and fungicide, and sometimes fertilizer such as calcium chloride, every 2 to 3 weeks during the season. Below is a brief schedule for pesticide applications.

Fruit Growers Calendar: Fruit Production is a Year-Round Activity

<p>January</p> <ul style="list-style-type: none"> • Order trees from nurseries. • Begin pruning apple trees. 	<p>July</p> <ul style="list-style-type: none"> • Harvest early summer varieties. • Apply forth & fifth cover sprays. • Irrigate when soil is dry.
<p>February</p> <ul style="list-style-type: none"> • Continue pruning. • Apply fertilizer 4 to 6 weeks before bloom. 	<p>August</p> <ul style="list-style-type: none"> • Harvest summer varieties. • Continue weed control. • Apply sixth & seventh cover spray. • Irrigate when soil is dry.
<p>March</p> <ul style="list-style-type: none"> • Finish pruning. • Plant new trees. 	<p>September</p> <ul style="list-style-type: none"> • Harvest early fall varieties. • Take soil samples to determine next year’s fertilizer needs.
<p>April</p> <ul style="list-style-type: none"> • Apply dormant oil spray, green tip, prepink, and pink sprays for insects and diseases. • Measures to control weeds should begin early 	<p>October</p> <ul style="list-style-type: none"> • Harvest late varieties. • Remove fruit as they fall to ground. Remove and dispose of decaying, hanging fruit. • Check the ground around trees for mouse activity and take in the season.control measures.
<p>May</p> <ul style="list-style-type: none"> • Install rodent guards around trunk of newly planted trees. • Thin fruit with chemicals or by hand. • Apply petal fall and first cover spray. • Remove fireblight strikes. • Discourage deer from eating young shoots by using commercially available repellents. 	<p>November</p> <ul style="list-style-type: none"> • Apply lime if soil tests indicate a need. • Cover trunks and lower branches of young trees with white latex paint to reduce winter injury.
<p>June</p> <ul style="list-style-type: none"> • Apply second and third cover sprays. • Continue weed control. • Irrigate if soil is dry. 	<p>December</p> <ul style="list-style-type: none"> • Update your record book for application dates for fertilizer and pesticides.

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