

# CHAPTER 20: FRUIT



Originally compiled by Rosanne Sherry, Rhode Island Master Gardener State Coordinator, from “Tree Fruit” and “Small Fruit”, *Penn State Master Gardener Manual*.

## Tree Fruit

### POME FRUITS

Botanically referred to as pomes, apples and pears are excellent candidates for the home garden, as long as the grower is committed to the attention to detail and pest management that the crop requires. Advantages of home-grown pome fruit are numerous. One can:

- Grow cultivars that are not readily available in grocery stores.
- Control the level of pesticides used.
- Gain a greater understanding of the processes of nature that interact with the tree to produce these wonderful fruits.

However, it should be remembered that production of high-quality apple and pear fruit requires careful observation by the grower, as well as a knowledge of how to respond to the various pest problems that might be encountered.

It is difficult to grow quality fruit in Rhode Island without some use of pesticides because there are many insect and disease pests of both apples and pears. However, home gardeners are encouraged to purchase diseaseresistant cultivars, if available. These varieties are not resistant to all diseases that occur in Rhode Island, but are resistant to the major diseases. Pesticides may still be required, particularly in wet seasons, but the number of applications can be greatly reduced. Cultivars recommended for home planting are listed in **Table 20-1**.

### Nursery Stock Selection

The old adage “you get what you pay for” is an important consideration when buying fruit trees. Bargain plants may not be healthy or may be a variety not adapted to your area. Buy only trees of recommended varieties from a reliable source. The following are a few points to keep in mind when purchasing fruit trees:

- A healthy one-year-old whip, approximately four to six feet tall, with ½-inch caliper and a good root system, is preferred.
- A smaller tree with a good root system is more desirable than a large tree with a poor root system.
- Trees that are two years or older are often not as good as one-year-old trees. The older trees frequently do not have enough buds on the lower portion of the trunk to develop a good framework.
- Trees that appear stunted, poorly grown, diseased or insect injured should not be purchased.
- Check the label, make sure that you get the variety and rootstock you desire.

### Pollination

Trees can be grouped into two categories: those that bear fruit through self-pollination, called self-fruitful, and those that must be pollinated by another variety (called self-unfruitful).

Most varieties of apples and pears do not set fruit unless they are pollinated by another pollen compatible variety. Most apple varieties that do not set fruit when self-pollinated have pollen that sets fruit on other varieties. For example, Red Delicious doesn't set its own fruit with its own pollen, but sets fruit on Golden Delicious and vice versa. Some varieties, such as Rome Beauty, Newtown and Transparent, are self-fruitful.

Bartlett pears may set a few seedless pears without cross-pollination, but they set more if pollinated by d'Anjou. Bosc and Comice trees pollinate each other.

Plant pollen-compatible trees within 100 feet of each other to insure adequate pollination. The act of pollination depends mostly on bees, and to a lesser extent on other insect activity or, in the case of nuts, on wind. The bloom periods of the main and pollinator varieties must overlap enough to provide at least several days for cross-pollination to take place.

**Table 20-1. Pome fruit cultivars recommended for home planting.**

<b>Variety</b>	<b>Characteristics</b>
<i>Pears</i>	
Bartlett	Most widely grown pear; fruit ripens to yellow; medium to large size; pick near end of August. The standard against which all others are judged
Bosc	Large, long-necked fruit ripens to greenish-yellow; usually overlaid completely with a cinnamon color russet; excellent quality for all uses; good pollinizer for Bartlett; harvest three to four weeks after Bartlett
Gorham	Similar to Bartlett in size, shape, and color, but has shorter neck; always has russeting around stem end; sometimes develops blushed cheek; flesh firm, juicy, and sweet; good for canning and fresh; pick about one week after Bartlett
<i>Apples</i>	
Enterprise	Red with spicy and aromatic flavor; resistant to cedar apple rust; stores very well; ripens late October
Freedom	Slightly less disease resistant than Liberty; good fresh or used in sauce or pies; red fruit with subacid flavor; ripens late September
GoldRush	Pink blush over yellow background; tart and rich flavor, sweetens after picking; ripens mid-October
Liberty	High-quality dessert apple; most disease resistant of all apple varieties; subacid to tart; 90-100 percent red; ripens late September to early October
Nova Easygro	Red stripe over green background; very sweet; ripens early September
Pristine	Yellow finish; slightly spicy flavor; vigorous tree growth; good storage for an early variety; ripens late July
Redfree	Earliest scab- and cedar apple rust-resistant variety; moderately resistant to fireblight; sweet, red with cream-colored flesh; ripens mid-August
Sansa	Excellent dessert quality; ripens mid-August
William's Pride	Maroon-red color; excellent sweet-tart flavor; ripens mid-August

If no pollinator varieties are growing nearby, cut a bouquet of blooms from another variety and place it in a pail of water beside the tree while it is in bloom. Or, if you have a single fruit tree that needs a pollinator, graft a compatible variety onto the main variety

## Planting Trees

Before planting, the soil should be thoroughly prepared by deep cultivation, either by hand or with a rototiller. The soil pH should be maintained between 6.0 and 6.5. Therefore, have a soil test done and make the recommended adjustments before planting.

The planting hole should be wide enough to accommodate the roots freely without cramping or bending from their natural position. The hole should be deep enough so that the bud union of grafted plants will be no closer than 2 to 4 inches above the groundline after the soil settles.

Cut off all broken or mutilated parts of roots with pruning

shears, and then set the plant with the graft or bud union no more than 1 inch above the soil line. Put soil back into the hole and work it in and around the roots. When the hole is half filled, firm the soil by stepping on it before filling the hole. Pack the soil firmly when the hole is filled and do not leave a depression around the tree. Also, do not place fertilizer in the hole or fertilize immediately after planting. This should be done after the soil is settled by a drenching rain.

After planting, apply sufficient water to thoroughly soak the soil in the area of the tree roots. This will help bring the soil into closer contact with the roots and eliminate air pockets.

Also, remember that approximately one quarter of the root system was removed when the tree was dug. To compensate, remove the top quarter of the tree to reestablish the previous shoot-to-root ratio. On branched trees, it is good to prune following correct pruning practices (discussed below).

Apple trees typically are spaced from 5 to 20 feet apart; spacing between rows of fruit trees in general ranges from 12 to 24 feet. Dwarf trees can, of course, be planted closer to-

gether. If you are planning an orchard, compare the amount of space available to the number of trees you want to grow. Spacing trees closer together does push them into earlier production, but tightly spaced trees require more pruning at an earlier age in order to keep them productive.

## Nutritional Requirements

Generally, apple trees need fertilizing each year. Nitrogen is the most important nutrient needed, but phosphorus and potassium are also needed in relatively large amounts when the tree is young. Mature trees usually require only an annual application of nitrogen.

In the year of planting broadcast 6 ounces of 10-10-10 over a 2-foot circle about one month after planting, keeping the fertilizer 6 inches away from the trunk. Repeat this in June following planting. However, it is important to note that a tree's need for fertilizer varies according to the amount of available minerals in the soil.

## Irrigating

The amount of water needed by fruit trees depends on rainfall and soil type. The best way to determine their needs is to test soil moisture (squeeze a handful of soil) in the root zone. Remember that young trees have a very undeveloped root system and cannot absorb much water at one time. Watering young trees regularly in warm weather is very helpful to get them off to a good start.

Drip irrigation is preferred by many orchardists because the foliage, flowers, and fruit remain dry, an important factor in disease prevention. Over-watering, especially near the base of the trunk, can lead to crown rot.

## Fruit Thinning

Fruit thinning of apples and Asian and European pears is a very important part of orchard management; it improves the size and quality of fruit and helps ensure an adequate crop the next year. The most common method used to thin fruit is picking the tiny fruit or blossoms by hand. Mechanical thinning involves using a tool to knock fruit off the tree. In commercial orchards, plant-growth regulators are sprayed onto apple and pear trees during and after bloom to thin the crop. Early thinning of blossoms or fruit helps stimulate flower initiation for next year's crop, especially on cultivars that tend toward bearing fruit every other year, i.e., biennial bearing. Thinning also helps increase the size of harvested fruit by stimulating cell division in the remaining fruit.

When thinning apples by hand, first remove the smaller fruit. The king bloom is the middle blossom or fruit in the cluster, and it always produces the largest fruit. Decide

how much fruit to leave on the tree based on the vigor and general condition of the tree. In cultivars that tend toward biennial bearing, leaving every other spur without fruit helps ensure adequate return bloom. Leaving more than one fruit per spur is possible except on short-stemmed cultivars and red cultivars that color poorly. Fruits of short-stemmed varieties tend to push each other off the spur if there are two fruits per spur.

## Pruning and Training

Generally, fruit trees are pruned to:

- Develop desired tree shape.
- Maintain tree size.
- Make spraying easier.
- Improve fruit quality.
- Improve tree strength and induce branching.
- Improve air circulation within the tree and reduce potential for disease.

Excessive pruning encourages excessive shoot growth and reduces the quality of fruit on young (up to 10 years of age) trees. Trees 25 years or older will produce higher quality fruit following vigorous pruning. On young trees, tipping, i.e., pinching off the terminal one-half inch of new shoot growth in mid-June will encourage lateral branching.

Pruning should be done in late winter, February or March. For apple trees, this consists of removing undesirable limbs as well as tipping terminals to encourage branching. Summer training is most beneficial if done in early June and early August.

The preferred method of pruning and training non-trellised trees is the central leader system. At planting, the tree should be cut back to a height of 24-30 inches. This will bring the top and the roots back into balance and cause buds just below the cut to grow and form scaffold branches. When 2-3 inches of growth have occurred, it is necessary to begin training the tree. This is accomplished by using wooden spring-type clothes pins between the main branch and the new growth. This forces the new growth outward and upward. Allow the most vigorous upright branch to remain growing straight up, this will become the central leader.

The tree should then be pruned the winter following planting. There are two objectives:

- To develop a strong central leader and framework of scaffold branches.
- To try to leave only four to five main scaffold branches around the tree.

Repeat these steps for the second growing season. In succeeding years, continue to cut back the new terminal growth by one-fourth each year and remove any upright limbs.

**Table 20-2. Occurrence of diseases, insects, and mites on apples and pears during the growing season.**

Timing	S	PM	R	BER	CR	SB	SR	FS	AM	CM	ERM	GAA	PC	RAA	SJS	TPB	TSM	WAL
Dormant									-	-	-	+	-	++	++	-	-	-
1/2-Inch green	++	-	-	-	-	-	-	-	-	-	+	+	-	++	++	+	-	-
Prepink	++	++	-	-	-	-	-	-	-	-	+	+	-	++	-	++	-	-
Pink	++	++	+	-	-	-	-	-	-	-	+	+	-	++	-	++	-	-
Bloom period	++	++	++	++	++	-	-	-	-	-	-	-	-	-	-	-	-	-
Petal fall	++	++	++	++	++	-	-	-	-	-	++	+	+	+	++	++	-	+
Mid-June	++	++	++	++	++	-	-	-	-	++	+	++	++	+	++	-	-	++
Late June	++	++	-	-	-	++	++	++	+	++	+	++	++	+	++	-	+	++
Early July	++	++	-	-	-	++		++	++	+	+	++	-	-	+	-	+	-
Mid-July	++	++	-	-	-	++		++	++	+	++	-	-	-	+	-	++	-
Late July	++	++	-	-	-	++	++	++	++	+	++	-	-	-	+	-	++	+
Early to Mid-August	++	-	-	-	-	++	++	++	++	+	+	+	-	-	++	-	+	++
Late August to Mid-September	++	-	-	-	-	++	++	++	++	-	-	+	-	-	++	-	-	+

Apply pesticides only if pests are present in damaging numbers. Bloom period is assumed to occur during the second week in May; this date should be adjusted depending on local conditions. Sprays should be applied about once every two weeks.

+ = Pest present, possible control; ++ = proper timing of control; - = control generally is not needed at this time

**Diseases**

- S = scab
- PM = powdery mildew
- R = rusts
- BER = blossom end rot
- CR = core rot
- SB = sooty blotch
- SR = summer fruit rots (black rot, white rot, bitter rot)
- FS = flyspeck

**Insects and mites**

- AM = apple maggot
- CM = codling moth
- ERM = European red mite
- GAA = green apple aphid
- PC = plum curculio
- RAA = rosy apple aphid
- SJS = San Jose scale
- TPB = tarnished plant bug
- TSM = two-spotted spider mite
- WAL = white apple leaf hopper

Broken or diseased limbs should also be removed. Always maintain the central leader as the highest point on the tree.

**Harvest and Handling**

The best, and most time-tested, method for judging when to pick fruit is the taste method. When enough starch has been converted to sugar and the flavor is developed, the fruit is ready to eat. If you intend to store the fruit, pick it before it is ripe because fruit continues to ripen in cold storage.

If storing fruit, cool it as soon as possible after picking. The sooner heat is removed from freshly picked fruit the longer the fruit will keep in decent condition. Handle fruit for storage gently. Bruises and wounds allow pathogens to infect the fruit, and disease will spread to adjacent fruits once it gets started.

**Insect and Disease Management**

You can control, prevent insect and disease problems in your orchards by knowing the probability of such problems and by closely monitoring trees. Keep insects in check through Integrated Pest Management (IPM). Manage diseases by timely applications of fungicides and by proper cultural practices (Table 20-2). One of the cornerstones of IPM is accurate pest monitoring. You can use visual inspection, trapping and phenology (crop development stage) models to first determine the presence or absence of a pest and then to measure its population density.

**Insects and mites of pome fruits**

Apple Maggot: The apple maggot (*Rhagoletis pomonella*),



also known as the “railroad worm”, is a serious pest of apples. The adult fly is black with three or four white stripes across the body and a prominent white spot in the middle of the back. The maggot is small, white and legless. Pitting and dimpling on the apple surface and brown, winding trails caused by the maggot’s tunneling and excrement, and by an associated bacterium under the apple’s skin, characterize injury.

There is only one generation each year, with peak emergence of adults in July and August. The mature maggots infest fruit, and after the apple has dropped to the ground the maggot enters the soil to overwinter until the following summer. For this reason, it is important to pick up and destroy all fallen, infested apples. Information on emergence activity of adult flies can be obtained by hanging sticky spheres, baited with feeding attractant in the trees. The traps should be placed at the edge of the orchard.

Codling Moth: The codling moth (*Cydia pomonella*) adult is approximately 3/8 inch long and grayish in color. The larvae have a cream to pinkish body and a brown head. They are from 1/2 to 5/8 inch long. The codling moth overwinters as a full-grown larva within a cocoon. First flight occurs when the apples are in full bloom, and peak flight occurs approximately two weeks later. Eggs are laid on leaves and newly hatched larva bore into the fruit to feed. There are two to three generations per year.

Damage to apples may be shown either by a tunnel through to the apple core, or by “stings”, which are small holes the size of pin pricks. Controlling the codling moth requires careful monitoring and timing of insecticidal applications, which must coincide with the hatching of the larvae. Applications should begin at late petal fall. To protect pollinators, spraying should not be done during full bloom. Some measure of codling moth reduction may be achieved by maintaining good orchard sanitation and removing loose bark from old trees. It may help to place corrugated cardboard bands around apple tree trunks in September to trap larvae, which should be removed and destroyed in December.

European Red Mite: The European red mite (*Panonychus ulmi*) overwinters as a round, bright red egg laid in roughened bark and around bud scales on twigs and branches. Eggs begin to hatch at prepink bud stages and continue throughout bloom. Young mites move to new leaves where they feed, mature and reproduce. Mites feeding on leaves cause injury to the tree by removing nutrients. The most serious injury occurs in early summer when trees are producing fruit buds for the following season. A characteristic brown foliage that, in severe cases becomes bronze, results from heavy mite feeding.

In general, on apple trees in the dormant period up to prepink, overwintering mite eggs may be evaluated with a hand lens. Pay particular attention to the bases of twigs and spurs. If the eggs are visible, especially to the unaided eye,

then an early-season pesticide application should be made.

There are several predators that can help control mites and reduce the use of pesticides. These include other predatory mites and other insect species. If the mite population is stabilized or decreasing, the predators may be eating enough mites to control it and no pesticide should be applied.

Green Apple Aphid: The apple aphid (*Aphis pomi*) is abundant during June and July on young trees, watersprouts, and vigorously growing terminal branches. It curls the foliage and covers it with honeydew, upon which a black fungus grows that smuts both the fruit and leaves and causes considerable discoloration, especially of early apples. The insect lives on the apple tree all year, breeding continuously during the summer.

This pest must be scouted for and managed until the terminals harden off. Beginning in early June, randomly select ten growing shoots (not watersprouts). On each shoot, determine the number of leaves that have aphids. If an average of more than 4.2 leaves per shoot are infested, an application of insecticide is recommended. In many years, green apple aphid is controlled by naturally occurring predators including fly and lacewing larvae and ladybird beetles.

Gypsy Moth: The gypsy moth (*Lymantria dispar*) may attack apple trees, causing leaf damage and, on young trees, defoliation can stunt or kill the plant. Egg masses deposited in July overwinter and hatch from late April through early May. Young larvae may stay near where they hatch or, by forming a long silk thread, be carried by the wind for great distances. The black, hairy caterpillars feed on leaves until mid-June, then pupate, molt to adults, and lay eggs.

Trees should be inspected in early June. If gypsy moths are found, they may be removed by hand and destroyed or killed with an insecticide. B.t. (*Bacillus thuringiensis*) is the least toxic insecticide to other animals.

Pear Psylla: Pear psylla (*Cacopsylla pyricola*) adults look like small cicadas. They are about 1/10 inch long and are dark reddish brown. They overwinter as adults that become active anytime the temperature is above 40°F. The pear psylla secretes large amounts of honeydew which runs down over foliage and fruit. This is where the sooty fungus grows. This causes the fruit skin to become blackened and scarred, and the foliage to develop brown spots. Heavy infestations may cause partial to complete defoliation of trees. Orchards with a history of severe psylla infestation should receive an intensive insecticide program beginning in the dormant period.

Plum Curculio: Rhode Island weather is variable during May and June, frequently changing from periods of cold wind and rain to those of abnormally high temperatures. These climatic irregularities govern the activities of the plum curculio (*Conotrachelus nenuphar*), an injurious pest of pome and stone fruits. Adults first appear in apple orchards during bloom and most activity, including egg laying, occurs

during the first warm period after petal fall, when the maximum temperature is 70°F or higher. Adults can be found in orchards for five to seven weeks.

After hatching, slight feeding occurs on petals, buds and blossoms, but there is little injury until the fruit is available. When fruit is approximately ½ inch in diameter, it provides abundant food and a convenient place for egg laying. The larvae feed heavily at the fruit's center for 16 days before maturing. Then they leave the fruit to enter the soil where they transform into adults and emerge during August, feeding for a short time before finding winter quarters.

The critical period for control is during the first few days of warm weather following petal fall, when the maximum temperature remains approximately 75°F. Low temperatures reduce feeding and also extend the period during which the curculio is active. Temperature monitoring is, therefore, important in timing sprays.

## Diseases of pome fruits

Apple Scab: Apple scab is the most important apple disease in Rhode Island, attacking wild and cultivated apple and crabapple. The first infections often occur on the leaves surrounding flower buds. Dull, olive-green areas visible on the undersides of leaves are the first evidence of the disease. As the lesions age, they assume a definite outline as olive-green or brown circular spots. Leaves are susceptible to infection for about five days after they unfold. Fruit may become infected at any time in its development. The spots may not show up until the apples are in storage.

The apple scab fungus (*Venturia inaequalis*) overwinters in leaves on the ground. In spring the spores are discharged over a four- to six-week period. When they land on wet apple buds, leaves or fruit, and if they remain wet for a few hours, they germinate and grow into the apple tissue. Development is most rapid at high temperatures; after eight to eighteen days a visible scab lesion is produced.

Scab infections may be prevented by applying fungicides at regular intervals throughout the growing season. The object is to provide a protective coating that will inactivate any spores landing on the fruit and foliage.

Plant disease-resistant apple trees. If susceptible cultivars are being grown, remove leaves soon after they have fallen to reduce the carryover of disease from one season to the next. Never allow fruit to remain on the ground from one season to the next. Prune the trees annually to improve air circulation and rapid drying off.

Fire Blight: Fire blight is destructive to apple and quince trees, and is the most serious pear disease in the eastern United States. It is caused by the bacterium *Erwinia amylovora*. Susceptible apple varieties include Jonathan, Rome, Yellow Transparent and Idared. The disease gains entry to the

tree through blossoms and new shoots, and often appears first in spring as blossom, fruit spur and new shoot blight.

Fire blight's two main symptoms are shoot blight and cankers on limbs. A characteristic symptom of shoot blight is the bending of terminal growth into the shape of a shepherd's crook. Pearly or amber colored droplets of bacterial ooze are often present on diseased blossoms, fruit, and leaf stems, succulent shoot stems, and the exterior of infected fruits. Cankers are slightly sunken areas of various sizes surrounded by irregular cracks.

Temperatures just before and during bloom will determine if fire blight becomes serious. In early spring daily temperatures must average 65°F or above, during pink through petal fall for bacterial populations to grow enough to cause severe disease.

Proper fertilization practices can help in reducing the potential for fire blight. Excessively vigorous trees due to high nitrogen applications can be more prone to fire blight. Proper cultivar selection can also help reduce the incidence. Cultivars such as Jonathan and Rome Beauty are more susceptible to fire blight.

Apple cultivars vary in their susceptibility to fire blight. All pear cultivars are susceptible. Crabapple trees are also susceptible and the disease may spread from crabapple to apple trees. Removing blighted shoots when they appear, about two weeks after bloom to late summer, is an important control strategy. When pruning out blighted shoots, it is better to break them by hand rather than prune them off to prevent spread of bacteria on pruning tools.

Aphids will spread the disease; good aphid control measures must also be followed in the summer.

Powdery Mildew: Powdery mildew, caused by the fungus *Podosphaera leucotricha*, attacks wild and cultivated apples and crabapples. It interferes with the proper functioning of leaves, reduces shoot growth, reduces fruit set and produces a netlike russet on the fruit of some cultivars. It is often a serious problem in apple nurseries.

The first sign of powdery mildew in spring is a three- to four-day delay in the opening of infected buds. Leaves and blossoms of these buds soon become covered with a white to light gray powder – the spores of the fungus. Flowers do not develop normally, are likely to be greenish white, and produce no fruit. By midsummer, leaves and shoots may turn brown.

Protective mildew sprays should begin at the tight cluster bud stage. Where the disease is severe, mildew fungicides need to be continued until new shoots stop growing.

Plant disease-resistant apple trees. If susceptible cultivars are being grown, prune off white infected terminals as they appear from bloom to mid- June. Remove prunings from the orchard.

Rust Disease: There are three rust diseases cedar-apple rust, hawthorn rust and quince rust. These diseases can cause economic losses in several ways. Severe leaf infection and defoliation may make trees susceptible to winter injury. Severe defoliation reduces fruit size and quality; infected fruit is deformed, sometimes very seriously. The hosts of cedar-apple rust are leaves and fruit of apple and crabapple trees. The hosts of hawthorn rust are leaves of pear, hawthorn, apple and crabapple. The hosts of quince rust are the leaves and fruit of quince and the fruit of pear, apple, and crabapple.

The most common rust, cedar-apple rust, caused by the fungus *Gymnosporangium juniperi-virginianae*, first appears as small, pale yellow spots on the upper surfaces of leaves. The spots enlarge and eventually black fruiting bodies appear. Fruit lesions are somewhat like leaf lesions but much larger and often cause the fruit to become disfigured or to develop unevenly.

Plant disease-resistant apple trees. If susceptible cultivars are being grown, remove red cedar trees from the orchard area if possible. If this is not possible then prune the galls off the cedar tree each spring before the apples bloom. Fungicide applications should be made at the pink bud stage.

Sooty Blotch and Flyspeck: Affecting apple, crabapple, and pear trees, sooty blotch is caused by a combination of at least three different fungi and flyspeck. The fungus *Microthyriella rubi* of apple trees are separate diseases, but both are normally present on the same fruit. They cause only surface blemishes that detract from fruit appearance. Sooty blotch appears on fruit surfaces as olive green to black sooty areas with indefinite outlines. Flyspeck looks like true flyspecks in groups of 10 to 50 or more. Routine fungicide sprays normally control this disease.

There is no known cultivar resistance to these diseases. Prune trees annually to improve air circulation and reduce the potential for disease. Cool fruit after picking to retard development of the disease.

Sooty Mold: Sooty mold attacks many plants, but is most common on pear. The sooty mold fungi (genus *Capnodium*) cause an unsightly blackening over the surface of fruit and leaves. The fungi live on honeydew excreted by insects such as aphids, psylla and white flies. Control of sooty mold is directed against the insects producing the honeydew.

## STONE FRUITS

Peaches, nectarines, plums, and cherries are all members of the genus *Prunus*, and are thus closely related. They are commonly referred to as “stone fruits” because the seed is very large and hard. Most stone fruits are native to warmer climates of the world and, therefore, are very susceptible to injuries from low winter temperatures. In addition, they

flower earlier in spring and the flowers frequently suffer damage from spring frosts. Therefore, backyard culture is more difficult than for apples and pears. Nectarines are also more susceptible to the disease organism that causes brown rot. Sweet cherries tend to crack as harvest nears if there is excessive rainfall. Regardless of your location in the state, stone fruits should only be planted on the very best sites with excellent air and water drainage and protection from high wind.

## Cultivars

There are no suitable dwarfing rootstocks for any of these stone fruits that will survive under Rhode Island conditions. Advertisements that list these fruits on dwarfing rootstocks should not be considered. Recommended cultivars are listed in **Table 20-3**.

Two basic types of plums are commonly grown; Japanese and European. The former are used only for fresh eating, whereas the latter may be used for fresh eating, dried or processed.

Cherries can be divided into two types, sweet and tart. The sweet are used mainly for fresh eating, while the tart are used for pies and canning. Sweets have a disadvantage in that the fruit will split or crack as it approaches maturity if rainfall occurs. Some of the sweets are less susceptible to this tendency and should be the only ones planted. With both sweet and tart cherries, bird damage will be a major problem and steps should be taken to reduce their feeding.

Tart cherries are self-fruiting and do not require a pollinizer. Many of the older sweet cherries, on the other hand, do not require specific cultivars for pollinators. The exceptions are four self-fertile cultivars: Stella, Lapins, Sunburst, and Starkrimson.

## Planting Trees

Lime an area based on a soil test 10 feet by 10 feet where a tree will be planted. The planting hole should be wide enough to accommodate all of the root system without bending or bunching. It should be deep enough so that the bud union of grafted plants will be no closer than 2-4 inches above the groundline after the soil settles.

Cut off all broken or mutilated parts of roots. Work soil in and around the roots. When the hole is half-filled, firm the soil with your feet before filling the hole. When the hole is filled, pack the soil firmly. Do not leave a depression around the tree. Also, do not place fertilizer in the hole or fertilize immediately after planting. Fertilize with 6 oz of 10-10-10 after the soil is settled by a drenching rain. Water thoroughly after planting in order to soak the soil in the area of the roots. This will help bring the soil into closer contact with all



**Table 20-3. Stone fruit cultivars recommended for home planting.**

<u>Variety</u>	<u>Characteristics</u>
<i>Peaches</i>	
Raritan Rose	Developed in New Jersey as a white-fleshed peach with red streaks. Fruit is medium to large with a sweet to slightly subacid flavor. Harvest is approximately seven days after Redhaven.
Reliance	Developed in New Hampshire. Its chief advantage is that it has better-than-average bud hardiness. Fruit quality is only fair, ripening approximately five days after Redhaven. If growers are on a marginal site for growing peaches, this is the only cultivar they should try.
Redhaven	The standard and most popular peach cultivar planted commercially. Fruit quality is good, although fruit size may be small if not properly thinned. Fruit has above-average quality for freezing but below-average quality for canning. Average first harvest is around the first week of August.
Canadian Harmony	A medium to large fruit with a firm flesh and good fresh eating quality. Color is 80 percent red over a yellow ground color. Harvest is approximately 21 days after Redhaven.
Cresthaven	Fruit is medium to large, nearly round, and very uniform. Color is golden overlaid with an abundance of bright red. It is a yellow-fleshed freestone and shows considerable red around the pit. Harvest is approximately 28 days after Redhaven.
<i>Nectarines</i>	
Fantasia	A large, yellow-fleshed fruit that is firm, highly colored, and of good quality.
Redgold	A good late-maturing freestone whose skin color is red over yellow. The flesh is yellow with red around the pit. It is susceptible to bacterial spot. Harvest is approximately 30 days after Redhaven.
<i>Plums</i>	
Methley	An early-ripening plum of good quality and appearance. Round purple fruit with red blush; sweet and very juicy. Flowers are partly self-fruitful, but adding Shiro or Ozark Premier will increase yields. Ripens around mid-July.
Shiro	A round yellow plum with an occasional pink blush. Fruits are very juicy although they are a clingstone type. Harvest is around the beginning of August.
Ozark Premier	Large, bright red fruit with tough skin. Flesh is yellow and juicy with fair quality. Flavor tends to be on the tart side. Clingstone fruit but with a small seed. Harvest around mid- to late August. Will not pollinate Stanley or Bluefre.
Bluefre	A European type that produces large, blue, yellow-fleshed freestone fruit. Fruits hang well on the tree but many split pits are produced. Harvest is approximately the first week in September.

sides of the roots and eliminate air pockets around the roots. In subsequent years, broadcast 6-12 oz of 10-10-10 fertilizer under the tree in early spring. Maintain pH at 6.0 to 6.5. Never fertilize after July 15.

## Pruning and Training

Because stone fruit trees bear fruit on wood that grew the previous year, the pruning system best suited to keep the

fruit-bearing surface close to the ground is called the “open center.” Using this system produces a vase-shaped tree. Also, since all stone fruits are susceptible to brown rot, open center trees allow better air circulation within the tree and better light penetration; both important factors in reducing development of brown rot on fruit. An unbranched tree, or one with no branches 20-30 inches above the soil line, should be cut to 26- 30 inches after planting, otherwise the major branches are too high above the ground. If there are



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**Table 20-3. Stone fruit cultivars recommended for home planting - continued.**

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<b>Variety</b>	<b>Characteristics</b>
Stanley	A medium dark blue freestone that is oval in shape with a distinctive neck. Fruit is very well suited for processing and drying. Flesh is greenish yellow, juicy, and fine-grained. Harvest is around the last week in August.
<i>Cherries</i>	
Montmorency (tart)	This is the number one tart cultivar grown and it is the industry standard. Productive, but the flowers are susceptible to late spring frosts. Ripens around the last week of June to the first week of July.
Meteor (tart)	Medium-sized, semifirm, good-quality fruit. Trees are somewhat larger than Northstar. The oddly shaped pit has prevented this cultivar from being commercially accepted because the pit can shatter during processing, but for home use this is not a problem. Harvest is approximately three to seven days after Northstar.
Vista (sweet)	A nearly black fruit, barely one inch in size. Excellent quality fruit that ripens around the last week in June.
Ulster (sweet)	A medium-sized, firm, dark-skinned, dark-fleshed cherry introduced from New York. Harvest is approximately two days after Vista.
Emperor Francis (sweet)	A large, high-quality cherry of the Napolean type but less subject to cracking. It can be used for either brining or fresh use. Fruit has an attractive red blush over a yellowish background. Harvest date is approximately one week after Vista.
Sam (sweet)	An early ripening, large, black cherry. The tree is large, vigorous, and upright. Blooms later than most other sweets. Has good resistance to rain-induced cracking. Harvest date is approximately 11 days after Vista.
Kristin	Introduced from Norway. Fruit averages one inch in diameter. It is of good quality, combining good flavor and high sugar content. Moderate resistance to rain cracking. Harvest is approximately the last week in June.
Viscount	Introduced in 1983 from Canada, it produces medium large, firm, good-quality, dark glossy red cherries. It is productive and has good crack resistance. Harvest is approximately the beginning of July.
Hedelfingen	A medium large, firm, good quality black cherry with moderate resistance to cracking. Trees are early bearing and very productive. Harvest is approximately the beginning of July.

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healthy branches 18-30 inches above the soil line, select three or four, follow the compass points, that are growing at 60 to 90 degrees from the main axis. Cut them back by one half to a healthy outside-facing bud. Remove all branches that are less than 18 inches above the soil line and cut the tree off just above the topmost selected scaffold. During the summer, pinch off any shoots that begin to grow toward the center. In the subsequent two years, continue to prune by r

emoving dead or broken branches and shoots that may have developed on the inside of the main scaffold. In the third and subsequent years, only light corrective pruning should be necessary to maintain the open center. Prune every year to maintain tree size and prevent limb breakage. Always prune peach trees in late winter. Do not prune trees from January through March and do not prune before bud swell. The best time to prune is from bloom to two weeks after

petal fall.

## Fruit Thinning

The practice of thinning stone fruits is much discussed but little understood. Thinning is done for two reasons. First, a certain portion of the fruit is removed so that the remainder will develop adequate size and quality. Second, the thinning process serves to increase the plant's ability to form flower buds for the next year – provided the thinning is done early enough.

The time to thin excess fruit is when the fruits are the size of the end of your little finger – about ½ inch in diameter. Simply start at one end of a branch and systematically remove fruit, leaving one fruit every 6-8 inches. Be sure to leave only one fruit at a given site. Where doubles and triples are left, bugs and disease will find a happy home. Keep in mind that only seven or eight percent of the tree's flowers are needed to set full crop of fruit.

Thinning also reduces the total load on the branches and reduces breakage. Thinning is necessary for peaches, nectarines and plums; cherries should not be thinned.

## Pests

Green Peach Aphid: The green peach aphid (*Myzus persicae*) is a pest of peaches. Aphids cause direct injury by extracting sap from plants. Toxins emitted by feeding aphids cause curling, distortion, occasional foliage discoloration and premature leaf drop. Feeding aphids also excrete copious amounts of honeydew as a waste product; a black smut fungus grows on it.

Trees should be inspected weekly from petal fall until the terminals harden off. If more than two colonies per tree are found, an insecticide should be applied, especially to the lower leaf surface.

Japanese Beetle: The Japanese beetle (*Popillia japonica*) is one of the best-know pests encountered by fruit growers, nursery operators and gardeners. It is often the most important pest of tree-ripened peaches. This beetle overwinters in the soil as a grub and completes its growth early in the spring. Adults emerge in greatest numbers in July and are active for a month. There is only one generation per year.

Beetles chew leaf tissue between veins and leave a lacelike skeleton. Severely injured leaves soon turn brown and often drop. Fruit of early-ripening peach trees may be gouged in irregular, shallow patches or completely devoured.

Fruit and foliage may be protected by using a pesticide, as necessary, when beetle feeding causes unacceptable damage, and beginning when beetles first cause injury. Since sprayed trees can be reinvaded, they should be inspected weekly when adults are present.

Oriental Fruit Moth: The oriental fruit moth (*Grapholita molesta*) is a pest of most stone and pome fruits. In pome fruits, its appearance and injury is similar to that of the codling moth. This moth has a black “anal comb” on the top of the last body segment, distinguishing it from the codling moth. Several generations of fruit moth are produced each year, but the first generation is the most numerous. They overwinter as larvae in silken cocoons on the tree or on the ground, pupate in April and begin to emerge as adults during late April, shortly before fruit trees bloom.

The earliest indication of injury is a dying back of the new growth of twigs in spring. Later-generation larvae may enter the fruit and make feeding burrows that usually extend to the pit. Spray timing can be aided using a pheromone trap where sprays are applied after the peak of male trap catch to affect the exposed egg-laying females and eggs. Traps should be hung in early April and checked weekly. Orchard sanitation also helps through removal of ground litter.

Peach Tree Borer: The peach tree borer (*Synanthedon exitiosa*) is primarily a pest of peach and nectarine trees, but it also attacks apricot, cherry and plum. The larvae overwinter and then become active and resume feeding on tree bark in April. One of the first signs of peach tree borer attack is a mass of gum exuding from the trunk base approximately 3 inches below to 1 foot above soil surface. Burrowing larvae weaken the tree, resulting in lower fruit production or, if borers are numerous, death of the tree. Neglected trees or those suffering from drought or winter injury are most likely to be infested. One method for controlling this pest after infestation has been noted. Individual larvae may be killed by stabbing them with a length of wire inserted into their burrows.

Tarnished Plant Bugs and Sucking Bugs: The tarnished plant bug (*Lygus lineolaris*) and sucking bugs are the most common pests in this group. Most emerge and are active in early spring.

Sucking bugs feed by sucking sap from plants and they are believed to inject a toxic substance into the plant, when feeding, to break down plant tissue. Their feeding is very destructive to fruit and other tender plant parts. These bugs are active in the spring. Stink bugs feed at almost any time during the growing season.

Tarnished plant bugs often cause the most damage because they feed on swelling fruit and leaf buds, causing the buds to dry up. Blossoms may never open or may be deformed when fruit buds are damaged. Damaged fruit may fall but if it doesn't it becomes scarred and malformed, catfaced or dimpled as it grows. Tarnished plant bug feeding on young, tender, terminal or lateral shoots can also cause wilting or dying back, sometimes giving young trees a bushy appearance.

Cultural practices can provide some suppression of sucking bugs. Destroying broadleaved winter annual weeds and legumes in and around orchards is an excellent practice. However, disturbing weeds during bloom or shortly thereafter may drive the bugs into the trees, causing more damage.

**Two-Spotted Spider Mite:** This mite (*Tetranychus urticae*) is a pest of apple, peach and other fruit trees. In spite of their small size their populations build to high numbers very rapidly on the leaves of trees, causing the leaves to yellow. Adults overwinter in protected places and, with the arrival of warm weather in spring, they start looking for food plants. Once established, the population may become a serious infestation and may cause injury. These mites also spin a fine silken web over many infested leaves.

The occurrence of insect and mite pests during the stone fruit growing season is shown in **Table 20-4**.

## Diseases

**Black Knot of Plum:** This is a fungal disease caused by *Diobotryon morbosum*. The disease is characterized by black, warty knots on the branches of infected trees. These trees grow poorly and gradually become stunted, occasionally the limbs may be girdled. The swellings first become visible in late summer or the following spring on new shoots.

New plantings of plums should not be made next to old ones with black knot. Once the disease appears on the trees, remove the knots. When they occur on twigs and small branches, prune out the infected branches about 4 inches below the knot. This is done most effectively in August.

**Brown Rot:** Brown rot is caused by the fungus *Monilinia fructicola*. It affects peaches, apricots, nectarines, plums and cherries. Blossoms are affected first, they wilt and turn brown. Fruit decay occurs as the fruit ripens. The infection begins as small brown spots, and the entire fruit can rot within a few hours under favorable conditions. Rotted fruits dry out becoming mummified. Infected blossoms serve as a source of the fungus for future infections.

Removing all rotted fruit after harvest is important in reducing the amount of fungus overwintering in the orchard. Adequate pruning will increase air circulation, allowing faster drying and fewer fruit infections. Fungicide sprays are applied during bloom and as the fruit ripens.

**Cherry Leaf Spot:** Cherry leaf spot, caused by the fungus *Coccomyces hiemalis*, attacks the leaves, leaf stems, fruit and fruit stems of tart, sweet and English Morello cherries. The disease is most severe on leaves and may cause them to drop prematurely. When defoliation occurs before harvest, the fruit fails to mature normally, remaining light-colored and low in sugar. Buds and wood become susceptible to winter injury.

The disease first emerges on upper surfaces of leaves as tiny, red to purple, circular spots. These enlarge in diameter and become red-brown to brown. After the leaves become infected, they turn yellow and fall. Rotary mowing after leaves drop in the fall will hasten leaf decay and reduce the numbers of the fungus that can overwinter. Otherwise, fungicide applications are the primary means of control.

**Crown Gall of Peach:** This disease is caused by the bacterium *Agrobacterium tumefaciens*. It affects peach, nectarine, apricot, plum, cherry, apple, pear and quince trees. Crown gall is readily recognized by wartlike swellings, or galls, on tree roots and crown. If the galls are numerous, or are located on the major roots, they may disrupt the flow of water and nutrients. Trees show reduced growth, an unhealthy appearance and possibly nutritional deficiency symptoms. Avoid planting infected nursery stock or wounding trees at the time of planting.

**Cytospora Canker:** This is one of the most destructive diseases of peaches, nectarines, apricots, sweet cherries and plums. It may cause trees in young orchards to die. Infected trees in older orchards gradually lose productivity and slowly decline. The fungus attacks woody parts of trees through bark injuries, pruning cuts, and dead shoots and buds. The cankers form and enlarge more along the length than the width of the branch. Each year the canker enlarges by repeated invasion of healthy tissue. Managing *Cytospora* canker involves total orchard management. Since no stone fruit tree is immune, and fungicide treatments alone are not effective, control efforts must be aimed at reducing tree injuries where the infection could begin. Also, control the lesser peach tree borer since it aids in canker expansion and death of the tree. Control brown rot, the Oriental fruit moth and peach tree borer since injuries inflicted by these agents serve as infection sites.

**Peach Leaf Curl:** The peach leaf curl fungus, *Taphrina deformans*, destroys early peach leaves, defoliation in successive seasons may kill the tree. Infected leaves, which begin appearing in mid-May, are puckered and thicker than normal. Deformed areas are yellow at first and then turn brown. Eventually, the infected leaves fall from the tree. They then produce powdery gray spores which are blown by winds to peach twig surfaces to remain for the winter.

Peach leaf curl is simple to control with a single fungicide application in fall after the leaves drop, or in spring before bud swell. Where leaf curl is severe, it is very important to maintain tree vigor by:

- thinning fruit to reduce demand on the tree
- irrigating to reduce drought stress
- fertilizing trees with nitrogen by June 15.

## Small Fruit

**Table 20-4. Occurrence of insect and mite pests during the stone fruit growing season.**

Timing	ERM	GPA	JB	OFM	PTB	PC	SJS	SB	TPB	TSM
Dormant	+	+	-	-	-	-	++	-	-	-
Pink	-	++	-	-	-	-	-	-	++	-
Bloom	-	-	-	-	-	-	-	-	-	-
Petal Fall	+	++	-	+	-	-	-	+	++	-
Shuck Fall	+	+	-	+	-	++	-	++	++	-
Early June	+	+	-	++	-	++	-	++	+	+
Mid-June	+	+	+	++	+	+	+	+	+	+
Early July	+	-	++	++	++	-	++	+	+	+
Mid-July	+	-	++	++	++	-	++	+	-	+
Early August	-	++	++	++	++	++	-	-	+	-

Apply pesticides only if pests are present in damaging numbers. Bloom period is assumed to occur during the second week in May; this date should be adjusted depending on local conditions. Sprays should be applied about once every two weeks.

+ = Pest present, possible control; ++ = proper timing of control; - = control generally is not needed at this time

#### ***Insects and mites***

ERM = European red mite

GPA = green peach aphid

JB = Japanese beetle

OFM = Oriental fruit moth

PC = plum curculio

PTB = peach tree borer

SJS = San Jose scale

SB = stink bugs

TPB = tarnished plant bug

TSM = two-spotted spider mite

## **Grapes**

The grapevine adapts relatively well to a wide range of soils and can be grown and manipulated rather easily. To plant grapes, follow these steps:

- After setting plants, remove all but one cane and leave up to a maximum of six buds.
- After shoot growth begins, and danger of spring frost is past, remove all but the two strongest shoots.
- Maintain an adequate water supply at least until mid-June. Supplement rainfall, to ensure the equivalent of one inch of rain per week.
- Remove all flower clusters.
- Keep an area 18-24 inches wide around the plants as weed free as possible.
- Remove all suckers – maintain only two shoots.
- Keep vines off the ground and tied, either to stakes or trellises.
- Follow the spray program, to ensure proper control of insects and disease.

Two to three weeks after planting, apply 2 oz of 10-10-10 to the plants, taking care to keep the fertilizer one foot away from the vine. In 2-4 years, apply 2, 4, or 8 oz 10-10-10 per plant before buds start swelling in spring. Apply 16 oz per plant in year 5 and beyond. If vines are too vigorous, omit

nitrogen for one to two years. Maintain pH between 5.6 and 6.4. Lime with dolomitic limestone if soil magnesium and/or soil pH is low. Pests and disease can be avoided by growing resistant cultivars (Table 20-5).

## **Pruning**

Grapes can be grown to conform to numerous shapes: arbors, fences, decorative trellises, etc. Some of the traditional training systems often used by both commercial and backyard grape growers, called viticulturists, are described below.

1. Umbrella kniffin system: This is established by bringing the trunk up to the top wire and leaving four or more canes near the top of the trunk (head) bearing a final total of 50-60 buds. Retie the trunk and bend the canes sharply over the top wire so the outer bark cracks and tie the tips to the bottom wire.
2. Six-cane kniffin system: This is developed by bringing the trunk up to the top wire and leaving two canes, one in each direction for each wire, that arise at a point just below the wire. Retie the trunks and the tips of the canes onto the wires.
3. Single curtain cordon (no-tie) system: The trained vines require a trellis similar to the other two systems, two parallel wires but with a special wire as the top. Preferably, this wire should be galvanized, crinkle wire or brite basic No. 8 wire. The reason for this is



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**Table 20-5. Grape cultivars recommended for home planting.**

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<i>Bunch grapes</i>	
Catawba	Late ripening cultivar that requires a favorable site and a long growing season.
Concord	Primary cultivar grown in the Northeast and the standard for hardiness.
Delaware	High quality for eating fresh and for making white wine. Requires deep, fertile, well-drained soil for satisfactory vine growth.
Niagra	Leading white grape cultivar; not as hardy as Concord. Moderately susceptible to several diseases.
Ontario	Good quality white fruit. Vines are vigorous but not as hardy as those of Concord.
<i>Seedless grapes</i>	
Canadice	Hardy, productive; bunch rot often a problem.
Einset	Hardy, productive; thick skin; stores well.
Himrod	Good white grape. Vigorous vine with moderate resistance to disease.
Reliance	High quality but thin skins susceptible to cracking and disease.
Vanessa	High quality but thin skins susceptible to cracking and disease.

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that, once the system is established, the wire cannot be retightened. Select two strong canes and place them bilaterally along the top wire. For first-year pruning, leave several branches spurs that are five to seven buds long. The canes should be wrapped loosely around the wire and tied at each end. Shoots should be separated carefully and placed vertically downward from the top wire for a distance of 18-24 inches. This should be done two to three weeks after peak bloom. During the second year, and thereafter, leave at least five buds on each spur along the canes for fruiting purposes.

## Pests

Climbing Cutworm: Larvae climb onto vines from soil litter on warm nights to feed on developing primary grape buds. To examine for cutworms, search under the bark and in the soil litter beneath a vine with damaged buds, or search the vine with a flashlight after dark.

European Red Mite: These spider mites (*Panonychus ulmi*) are especially severe in vineyards adjacent to apple orchards. Adult mites are dark red and heavily infested leaves take on a characteristic bronze coloration.

Grape Berry Moth: These (*Endopiza viteana*) are one of the more serious pests of grapes. The larvae feed internally on grape berries. External signs of feeding are the silk webs that tie several berries together. The larvae cut flaps in grape leaves where they overwinter as pupae, emerging as adults in late May to lay eggs. Timing of sprays is best accomplished with a combination of pheromone traps and visual scouting f

or “stung” berries.

Grape Phylloxera: Two forms of this insect (*Daktulosphaira vitifoliae*) occur; sometimes several generations of each may occur in any given year. The root gall form feeds on the outside of galls on the roots. Loss, due to this form, can be reduced by grafting to a resistant rootstock. The leaf gall form lives inside galls on the underside of leaves. Examine foliage weekly before and after bloom and spray when 15 percent of the shoots become infested. Repeat spray in 10 to 14 days if new growth becomes infested.

Grapevine Weevils: (*Ampelogypter ater*) are small black weevils that girdle canes by chewing two series of holes several inches apart, generally beyond the last grape cluster. Control sprays should be applied at the new shoot stage to provide protection through bloom. To culturally control these insects, cut off and burn infested parts of canes before adults emerge from them in late summer.

The black vine weevil: (*Otiorhynchus sulcatus*) feeds on foliage, especially just before unfertilized berries drop. Significant natural controls are not known. To monitor adults, strip loose bark from a vine and wrap the vine in corrugated cardboard tied with a plastic tie. Adults will hide between the corrugations and the vine trunk during the day. Weekly inspections are recommended between early May and early July.

Japanese Beetle: Adult beetles (*Popillia japonica*) cause damage by feeding on foliage and occasionally berries. Vines with smooth thin leaves are most susceptible to attack. Young vines should be monitored closely to prevent excessive damage.

## Diseases

**Black Rot:** This is one of the most serious pests of grapes in the eastern United States. The fungus (*Guignardia bidwelli*) can infect all green parts of the vine. Later fruit infections can destroy many grapes, even the entire crop. First, reddish-brown leaf spots appear on the upper leaf surface and soon the center of the spot becomes tan to light brown. Infected grapes become dark and shatter; this usually occurs when the grape is pea-sized or larger. The final stage is a black, wrinkled mummy in which the fungal spores overwinter. Infected prunings and mummified berries should be removed before new growth begins. Where susceptible cultivars are grown, or where black rot was a problem the previous year, early season fungicide sprays should be timed to prevent early infection. Should infections become numerous, it is very difficult to protect against fruit rot later in the season.

**Botrytis Bunch Rot:** This fungus (*Botrytis cinerea*) is commonly associated with the decay of ripe, or nearly ripe grapes. Water is required for spore germination, but only one to four hours, depending on temperature. Any break in the grape skin provides an ideal point of entry for the fungus. Two sprays of fungicide are suggested on susceptible varieties during bloom period. Preharvest fungicide applications are also recommended.

**Crown Gall:** This disease is characterized by galls on the roots, trunk and canes of grape vines. When numerous, or located on major roots or on the root crown, the galls disrupt the translocation of water and nutrients, sometimes leading to death of the entire vine. The disease is caused by a soil-borne bacterium (*Agrobacterium tumefaciens*). A fresh wound is required for tumor formation to start; this may be made during pruning or machinery operation, as well as from winter injury. Examine new plants before planting and discard any that have galls. Remove large galls on the upper parts of the trunk or on the canes by pruning below the affected tissue.

**Downy Mildew:** Outbreaks of this disease, caused by the fungus *Plasmopara viticola*, coincide with periods of wet weather because water is necessary for the spores to swim and to infect. Fungicide should be applied just before bloom, 7-10 days later, 10-14 days later and three weeks later. For susceptible cultivars or where the disease was severe the previous season, an additional application is suggested two weeks before the first blossoms open.

**Phomopsis Disease:** Phomopsis cane disease, leaf spot, and fruit rot, caused by the fungus *Phomopsis viticola*, is often the first disease of the growing season. Infection on new shoots first appear as tiny reddish spots. The cane and leaf infections can be prevented by one or two early-season fungicide sprays. Regular fungicide applications are necessary to prevent disease.

## BRAMBLES

Brambles are defined as any species belonging to the genus *Rubus*. Practically speaking, the brambles of concern to home gardeners are raspberries, blackberries, and some hybrids. In some ways, brambles are the perfect home garden plant; they are relatively easy to grow, requiring little more than a patch of full sun and some well-drained soil. And, since they are highly perishable and often unavailable commercially, home planting assures a supply.

If soil is prepared properly before planting, only nitrogen should be necessary on an annual basis. Apply no more than 5 lb of 10-10-10 per 100 linear feet of row in the first year, and no more than 10 lbs in subsequent years. Do not overfertilize. If plants appear to be too vigorous, reduce the amount of fertilizer.

Brambles benefit from irrigation, especially during fruit swell which occurs during the week prior to ripening. Trickle irrigation is preferred for brambles because wetting the fruit with overhead irrigation may increase the incidence of disease. Plants generally require 2 inches of water per week, and up to 4 inches during harvesting.

Brambles, like all small fruit crops, should be harvested in the morning after dew has dried. Ripe berries should be rolled off the plant, rather than squeezed or pulled, and put in one-half pint containers. Raspberries are notorious for poor shelf life. To maximize shelf life, maintain good disease control and pick berries in the morning. Do not allow overripe berries to remain on the canes. Refrigerate berries immediately. They will keep for up to a week under these conditions. Blackberries should be handled similarly, although blackberry shelf life is several days longer than that of raspberries.

## Characteristics

The three most commonly grown raspberries are red, black, and purple, gold raspberries are also available, although not widely grown. The difference among them is not only fruit color, but growth habit, disease problems, and other characteristics. See **Table 20-6** for cultivar selection.

Eastern blackberries can be thornless and trailing, or thorny and erect. Thornless types are much more cold sensitive and, because of their trailing habit, they require trellising. Thorny types often have excellent fruit quality, sweeter than thornless types, but the thorns are brutal. They are cold tolerant and do not require trellising.

Red raspberries may be either summer-bearing or primo-cane-bearing, also called "everbearing." Summer-bearing red raspberries bear fruit from late June to August. They have the typical biennial life cycle of a bramble, i.e. canes die after

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**Table 20-6. Bramble cultivars recommended for home gardens.**

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<b>Variety</b>	<b>Characteristics</b>
<i>Red Raspberry (summer)</i>	
Boyne	Very hardy, early season; good flavor; susceptible to anthracnose
Canby	Mid-season; buds may winter kill; nearly thornless; susceptible to <i>Phytophthora</i>
Encore	Good sweet flavor; late mid-season; tolerant to <i>Phytophthora</i>
Festival	Fair to good flavor; very hardy; mid-season; few spines; very susceptible to yellow rust
Hilton	Good flavor; moderate hardiness; mid-season
K81-6	Good flavor; very hardy; late season
Kilarney	Good flavor; very hardy; early season; susceptible to mildew and anthracnose
Latham	Mild flavor; very hardy; few thorns
Lauren	Mild flavor; vigorous, long-season fruit; moderately hardy; early season
Newburgh	Fair flavor, good for freezing; few thorns; hardy
Nordic	Good quality fruit; hardy; exhibits less anthracnose than others
Nova	Somewhat acidic taste; vigorous and very hardy; few thorns; mid-season; resistant to most common cane diseases
Prelude	Good flavor; hardy; early season; resistant to <i>Phytophthora</i> root rot
<i>Raspberry (fall)</i>	
August Red	Mild flavor, hardy, earliest
Autumn Britten	Good flavor, high quality, hardy, early season
Caroline	Flavorful; hardy and vigorous; mid-season; moderate tolerance to <i>Phytophthora</i>
Dinkum	Good flavor; large, high quality fruit; early season
Fall Red	Good flavor, hardy, early season
Goldie	Yellow, blushes more than Kiwigold; excellent quality; sport of Heritage
Heritage	Good flavor; standard, hardy, late season; resistant to most diseases
Kiwigold	Yellow, blushes pink when fully ripe; excellent quality; late; sport of Heritage
Polana	Good flavor; early; needs extra nitrogen to perform well; susceptible to <i>Verticillium</i> wilt
Redwing	Good flavor, hardy, late season
Ruby	Mild flavor, hardy, late season; susceptible to root rot
Summit	Good flavor; short, vigorous canes; early season
<i>Purple Raspberry (not hardy below -10°F)</i>	
Royalty	Best purple available; very sweet; vigorous and hardy; late season; susceptible to crown gall and <i>Phytophthora</i> ; immune to large raspberry aphid
Success	Excellent flavor, very hardy, mid-late season

fruiting. Primocane-bearing raspberries fruit an additional time in spring, on the buds below those that fruited the previous fall. Red raspberries are the most winter hardy of the raspberries.

Black raspberries initiate new canes from the crown rather than from root suckers and, therefore, they are grown in a “hill” system; each plant is grown independently, with pruning and maintenance done on a per plant basis. They require summer tipping because canes will grow to uncontrollable

lengths. Black raspberries bear fruit in late June through July. They are the most winter tender of the raspberries.

Purple raspberries initiate new canes predominantly from the crown, but may sucker between plants as well. They are essentially grown like black raspberries and are intermediate in cold hardiness.

## Pruning

**Table 20-6. Bramble cultivars recommended for home gardens - continued.**

<u>Variety</u>	<u>Characteristics</u>
<i>Black Raspberry (not hardy below -10°F; susceptible to viruses and diseases)</i>	
Blackhawk	Good flavor, vigorous, relatively hardy
Bristol	Excellent flavor; vigorous and very productive; early season
Early Sweet	Good quality, vigorous, early season
Jewel	Excellent quality; hardiest, vigorous; mid-season; improvement over Bristol
Mac Black	Excellent flavor, hardy, late season
<i>Blackberry (thorny)(sweeter than thornless; not hardy below -10°F)</i>	
Darrow	Excellent quality, vigorous, late season
Illini	Excellent quality, vigorous, resistant to <i>Phytophthora</i>
Chester	Large, good quality fruit; late season; resistant to cane blight
Dirksen	Slightly tart; vigorous; late season; resistant to anthracnose
Hull	Sweet, mid- to late season
Triple Crown	Flavorful, semi-erect, early to mid-season

Fruiting canes of all brambles except the primocane-bearing types will die after fruiting is completed. These dead canes should be removed immediately after fruiting to facilitate air circulation.

Raspberries can be pruned any time canes are fully dormant. In the dormant season, thin canes to 6-8 inches between canes and top remaining canes to 48-60 inches in height. Be sure to retain those canes with the largest diameter.

Black and purple raspberries require summer topping throughout the summer, two to three times in addition to floricanes removal. They should be topped at 36 inches, removing 3-4 inches of new growth. For dormant pruning, remove all dead, damaged and weak canes. Thin remaining canes to 5-10 canes per plant. Vigorous plants can support longer lateral branches otherwise, keep them to 4-7 inches on blacks and 6-10 inches on purples.

Everbearing red or gold raspberries should be mowed to a height of 1-2 inches in the dormant season.

Erect blackberries should be pruned similarly to black and purple raspberries; specifically, headed back to 36 inches in the summer, with laterals cut back to 12-18 inches and canes thinned to 10 inches apart during the dormant pruning.

Trailing blackberries should be summer tipped at about 6 inches above the highest trellis wire and tied to it during summer months. For dormant pruning, select five to eight of the strongest canes and remove all laterals originating on the lower three feet. Tip back remaining laterals to 12-18 inches.

## Pests

**Raspberry Cane Borer:** These borers (*Oberea bimaculata*) are small black beetles with a bright orange section behind the head. The beetles girdle the cane by boring two characteristic rows of punctures that encircle the cane about 1 inch apart. The eggs are inserted into the two rows. Girdling of the cane causes the tip to wilt. Then, when the eggs hatch, the larvae tunnel to the base of the cane, taking until fall or the entire winter, and further weakening the cane and killing it before fruit matures. Remove wilted tips several inches below punctures by mid-summer. Remove and destroy older canes and any wild brambles that are nearby.

**Aphids:** Four species of aphids are found in the Northeast. They are sucking insects that cause two types of damage to raspberries: removal of nutrients from phloem tissue and spreading disease, notably viruses. The viruses can, in turn, stunt plant growth, distort and discolor leaves and decrease flower and fruit production.

Aphid control is important in reducing the secondary spread of the virus. The virus problems may be reduced in the following ways:

- Eliminate virus-infected raspberries.
- Plant raspberries that are certified to be virus free and use proper fertilizing, pruning and irrigation practices.
- Control aphids with insecticides and by conserving natural enemies.
- Plant aphid and virus-resistant varieties.

**Mites:** The two-spotted spider mite (*Tetranychus urticae*)



infests leaves, which first appear to have areas of white stippling and later may bronze, dry, and eventually fall off. This is the result of mites piercing cells to remove nutrients and chlorophyll. In heavy infestations, silken threads will be spun across the undersides of the leaves. Mites are more prevalent during hot, dry periods. Heavy mite populations may also predispose plants to winter injury.

Insecticides applied for other pest problems can contribute to mite problems; chemicals that kill beneficial mite predators often do not kill mites. Miticide treatment is recommended if a large infestation is noted or leaf spotting appears.

## Diseases

The diseases discussed below are common to all brambles however, susceptibility to these diseases varies within the bramble groups. **Table 20-7** shows the occurrence of insects and mites on brambles.

**Anthracnose:** Commonly called “cane spot” or “gray bark”, this is considered a serious disease, especially on black and purple raspberry. Severe yield loss may result due to defoliation, reduction in fruit size, and quality and death of canes. Anthracnose is caused by the fungus *Elsinoe veneta*. Symptoms, reddish purple spots in spring which enlarge with sunken centers, are most serious on canes but also occur on leaves, petioles, flower buds and fruit. By late summer or early fall, the typical “gray bark” can be observed, especially on the red raspberry. Canes weakened by anthracnose are more susceptible to winter injury and eventually may die. Infected fruit, uncommon, is typically dry and seedy.

Sanitation is an effective management practice for the control of anthracnose. Plant disease-free nursery stock, cut out diseased canes, and provide good air circulation by removing weeds and spindly canes.

**Botrytis:** Botrytis fruit rot or “gray mold” is caused by the fungus *Botrytis cinerea* and is usually found on overripe and bruised fruit. Good air movement, and pruning out weak canes, speeds drying of plants and helps in control of disease. Also, eliminate weeds and harvest fruit before it is overripe.

**Cane Blight:** This disease is caused by the fungus *Leptosphaeria coniothyrium*, which also causes canker in roses and fruit rot of apple and pear. The black raspberry is more susceptible to cane blight than other brambles. Infections occur in late spring or early summer through pruning wounds and those made by insects. Symptoms appear late in the season on new shoots. Fruiting canes show sudden wilting of branches when fruit begins to ripen. Weakened canes are more susceptible to winter injury.

For control of cane blight choose a planting site with good air movement. Time pruning so that cuts have three days to dry before a rain. Fertilize to promote plant vigor, remove old canes after harvest and control insect pests to reduce plant injuries.

**Crown Gall and Cane Gall:** These are bacterial diseases. Crown gall is the more widespread of the two diseases and affects all brambles as well as apples, grapes, peaches and roses. Cane gall occurs only on brambles the black and purple raspberries being more frequently infected than red raspberries and blackberries.

Both diseases are caused by soil-borne bacteria *Agrobacterium tumefaciens*, crown gall, and *A. rubi*, cane gall, which infect the plant through wounds. Both diseases are characterized by the spongy, rough, tumorlike swellings that become brown, woody knots with age and range in size from that of a pinhead to a golf ball. Crown galls develop in spring on underground parts; cane galls develop as whitish eruptions on fruiting canes, in mid-June, which later turn brown and then black, and begin to disintegrate. Plants show water

**Table 20-7. Occurrence of insects and mites on brambles during the growing season.**

Timing	A	CB	JB	M	SB	TC	TPB
Domant	-	++	-	-	-	++	-
Bud Break	-	-	-	-	-	-	+
8-inch shoots	-	-	-	-	-	-	++
Petal Fall	+	+	-	+	-	-	++
Preharvest	++	+	+	+	++	-	++
Mid-harvest	++	+	++	++	-	-	-
Postharvest	++	++	++	++	-	+	-

+ = Pest present, possible control; ++ = proper timing of control; - = control generally is not needed at this time

### Insects and mites

A	= Aphids	SB	= sap beetle
CB	= cane borers	TC	= tree cricket
JB	= Japanese beetle	TPB	= tarnished plant bug
M	= mites		

stress and nutrient deficiency symptoms because the movement of water and nutrients is disrupted. The best control measure is prevention, plant only disease-free stock and take care not to wound the plants, especially the root system, at planting time. If a diseased plant is detected, remove and burn the roots and tops of the plants. No chemical control is known.

**Orange Rust:** This is a fungal disease caused by *Arthuriomyces peckianus*, particularly affecting blackberries, dewberries, and black raspberries. It is a systemic disease. Once the plant is infected, the entire plant is infected for life. Symptoms occur early in spring; new leaves are stunted, deformed and pale green to yellowish. Waxy blisters cover the undersides of the leaves. These blisters later become bright orange and powdery, thus the name of the disease.

The fungus enters the plant through the leaves and grows internally through the canes, crowns and roots.

Plant disease-free stock. Inspect all plants in spring for symptoms of infection. At the first sign of infection, remove the entire plant. Remove and destroy all wild blackberries and raspberries in the area that may serve as a source of disease. No chemical control is known. Some blackberries are reported to exhibit resistance.

**Spur Blight:** Spur blight is caused by a fungus (*Didymella appianata*) that affects red raspberries more than black raspberries. Symptoms appear in late spring or early summer as chocolate-brown, dark blue or purplish spots or bands on new canes and petioles. The lesions enlarge until the cane is girdled, and by late summer, canes may crack and split lengthwise. The effects of spur blight are that plants show an increase in winter injury and reduced yield with eventual death of infected laterals. Suggested controls are the same practices as for cane blight, Botrytis blight, and anthracnose.

**Verticillium Wilt:** The pathogen is a soil borne fungus (*Verticillium dahliae*) that has a wide host range. Black raspberries are more susceptible to the disease than red raspberries, blackberries are also attacked but are not as prone to wilting. The fungus enters the roots and moves into the plant's vascular system, causing a systemic infection. Symptoms appear in June or early July, shoots are stunted and leaves, starting at the base of the plant, turn yellow, wilt and drop. Soon the entire shoot withers and dies. If the canes die before reaching maturity, the fruit becomes mummified.

Verticillium is favored by cool weather and is most severe in poorly drained soils following a cool, wet spring. To minimize this disease, choose a planting site with no known history of this problem. Avoid land recently planted with tomatoes, potatoes, eggplants, peppers, strawberries, raspberries or stone fruits. Also avoid land infested with horsenettle, ground cherry, red-root pigweed, and lambsquarters. Plant disease-resistant stock.

**Virus Disease:** Virus diseases can seriously damage bram-

bles, especially the raspberry, and can affect the lifetime of a planting. Once the plant is infected, the entire plant will be infected for its life. Start a planting with healthy stock obtained from a reputable nursery. Once the planting is established, viruses can be introduced into the planting by various means. They may be carried by a vector, such as aphids, nematodes, and pollen. Control of viral diseases is based on preventing the initial infection. Remove sources of virus near the planting, mainly wild brambles, as well as the vectors.

## STRAWBERRIES

Strawberries are the ideal fruit crop for growers with very limited space. The plants are low growing, herbaceous perennials and they fruit well in rows, beds, or even pots. They make an attractive groundcover when not fruiting. The shallow root system is, in part, responsible for the strawberry plant's sensitivity to water deficit and excess.

### Cultivars

June bearing strawberries provide fruit in June, as their name implies. This is the type most often grown by commercial growers. They are the result of decades of breeding for productivity, size and other attributes.

Day-neutral strawberry cultivars bear fruit throughout the growing season. They are highly productive and have very flavorful berries. These cultivars have three peaks of production each year, one in June, one in midsummer and one from late August through frost. The summer crop is often very small due to high temperatures, but this can be ameliorated by a heavy straw mulch to keep the temperatures low.

Everbearing strawberry cultivars bear two crops during the year and are generally not as high quality or productive as the day-neutral types. Therefore, day-neutral cultivars are preferred if continuous cropping is desired. (See **Table 20-8**)

### Planting and Renovation

Plants should be kept in a shady area or refrigerator up until planting. Roots should be placed in water about one-half hour prior to planting. Strawberries should be planted in April, as soon as the soil is in good condition i.e., well-worked soil, without excess moisture. The planted field should be irrigated immediately. Optimal soil moisture levels need to be maintained throughout the season for the plant to become well established. Strawberry size can be dramatically increased by timely irrigation as the berry enlarges. Avoid overwatering, as too much water will dilute the flavor of the berry, giving it a bland, unappealing taste. Apply 1 lb of 10-10-10 fertilizer per 100 feet of row after planting, and once a month from June to September, thereafter.

For overwintering, strawberry plantings require mulching for protection from the cold and soil heaving that can result from sudden drops in temperature. Apply approximately 4 inches of weed-free wheat, oat or rye straw in December. The mulch should be removed in spring, usually mid-March to early April, after danger of freezing passes but before mush leaf yellowing occurs.

June-bearing beds can be renovated and maintained for several years. Renovation thins beds and this invigorates the re-

maining plants. Plant thinning is essential because beds that retain too many plants yield small berries that are difficult to find under the dense foliage. The renovation process should begin immediately after harvest is completed. To renovate, remove weeds, narrow rows to 6-12 inches and thin plants so that there is a plant about every 3-4 inches. Try to select strong runner “daughter” plants and remove mother plants when they are three to four years old. Renovation is not recommended for day-neutral strawberries. These plants will

**Table 20-8. Strawberry cultivars recommended for home gardens.\***

**Early Season**

Annapolis	Good flavor; vigorous, short ripening period; very susceptible to powdery mildew
Cavendish	Excellent fruit quality; very productive, long picking season; resistant to <i>Verticillium</i> wilt
Cornwallis	Good flavor, vigorous, productive
Delmarvel	Large fruit, good flavor; vigorous, short picking season; resistant to anthracnose
Earliglow	Best tasting berry; high quality, vigorous; some resistance to <i>Verticillium</i> wilt
Mira	Good quality; vigorous, long picking season; only some resistance to red stele
Mohawk	High quality, vigorous, resistant to <i>Verticillium</i> wilt
Northeaster	Unique flavor, vigorous, resistant to <i>Verticillium</i> wilt

**Mid-season**

Allstar	Large, sweet fruit; vigorous; some resistance to <i>Verticillium</i> wilt
Brunswick	Good flavor and size; vigorous
Cabot	Large, firm fruit; good flavor; needs high fertility
Darselect	Very good flavor; large fruit; moderately resistant to red stele
Lester	Large fruit; good flavor; vigorous; resistant to <i>Verticillium</i> wilt and powdery mildew
Mesabi	Large fruit; vigorous, high yielding; resistant to leaf spot
Midway	Good flavor, vigorous, resistant to <i>Verticillium</i> wilt
Primetime	Large fruit; mild flavor; vigorous; very susceptible to powdery mildew

**Late Season**

Lateglow	Large fruit; good flavor; vigorous; resistant to <i>Verticillium</i> wilt
Latestar	Large fruit; mild flavor; vigorous; resistant to most leaf diseases and fruit rots
Sparkle	Dark red fruit, excellent flavor; vigorous; only some resistance to red stele
Winona	Large, firm fruit; good flavor; very hardy

\* All resistant to red stele.

need to be replaced every third year.

## Pests

**Strawberry Bud Weevil:** This insect, *Anthonomus signatus*, is also known as the “strawberry clipper” because of its habit of clipping buds. Adult beetles leave their winter quarters as temperatures approach 60°F around the end of April. Females deposit a single egg inside a nearly mature flower bud and then girdle the buds and clip the stems nearly or completely off. The larva develops inside the bud and adults emerge in June to repeat their life cycle.

If more than one cut bud per linear row foot is found, a pesticide treatment is justified. The first spray should be applied in early May and a second spray 10 days later.

**Tarnished Plant Bug:** This small, inconspicuous sucking plant bug, *Lygus lineolaris*, is a general feeder attacking a great variety of plants. As a strawberry pest, the tarnished plant bug causes considerable loss by feeding on the seeds of young fruits before the receptacle expands. In feeding, it sucks out the plant juices. Injured berries remain small, have a woody texture and fail to mature. The injury is known as “button berry.”

An insecticide application may be necessary if nymphs are present just before bloom. Shake flower and fruit clusters over a light-colored plate. When an average of 20 to 25 bugs per 50 flower clusters are found, spraying is advised.

**Slugs:** Slugs can cause considerable damage by making small, moderately deep holes in ripening berries. Most feeding takes place at night or on dark overcast days. It is fairly easy to determine slug injury by the tell-tale slimy trail left on the fruit surface. Slug control begins with the removal of nesting and breeding places, such as boards, stones, trash piles and compost piles. If slug damage is severe, a pesticide application may be necessary. Diatomaceous earth, a desiccant, may also be applied if a nontoxic material is desired.

**Spider Mites:** The spider mites (*Tetranychus* spp.) Frequently attack strawberry plants. Heavily infested fields lose their healthy green color and the undersides of the leaves become brown until the entire leaf looks bronzed. The mites suck sap from the leaves and can interfere with normal physiological processes. Plants may become stunted and yield may be greatly reduced.

Spider mites have many natural enemies to keep them in check. However, the undersides of leaves should be examined every week and if a sharp population increase is noted, or if plant symptoms begin to appear, then a miticide should be used.

**Meadow Spittlebug:** Feeding activities of large numbers of these insects, *Philaenus spumarius*, cause plants to become stunted and berries do not attain full size. However, the greatest impact of this insect is the spittle masses on plants,

which are very annoying to strawberry pickers. Weedy fields are more heavily attacked. Spittlebug populations infrequently need pesticide treatment and should only be treated when there are more than a few per square feet.

**White Grubs.** White grubs, the larvae of May beetles or June bugs, do severe damage when strawberries are planted on newly plowed sod that has been infested with grubs. The most severe damage usually occurs between the time of planting and runner development. The grubs feed on the roots of strawberry plants and either kill or severely weaken them. Avoid planting strawberries on newly plowed sod, rotate crops and cleanly cultivate the crop that precedes strawberries.

## Diseases

**Black Root Rot:** This disease may be caused by several factors, including any or all of the following:

- pathogenic soil fungi
- drought and other environmental conditions
- winter injury to the root system
- freezing or water logging of soil
- fertilizer burn, nutrient deficiencies
- pesticide injury.

Symptoms include an uneven “patchy” appearance in the strawberry bed. Brown areas start to appear on the normally white or tan roots and then, they blacken and deteriorate until the entire root will break off when bent. The disease is generally associated with soils having high clay content and soil compaction. Excessive irrigation should be avoided.

**Gray Mold:** This disease, also known as Botrytis blight, causes a greater loss of strawberry flowers and fruit than any other disease. The causal organism, *Botrytis cinerea*, can live as a parasite, as well as a saprophyte, on decaying plant debris. Botrytis blight usually starts as a blossom blight that eventually invades the developing fruits causing them to rot. Once the fungus becomes established, it can continuously produce spores throughout the growing season.

The disease is favored by humidity and relatively cool conditions. The fungus thrives on debris and sanitation is essential for control. Dead plants and fallen leaves should be removed and burned or buried.

**Leaf Spots:** There is a wide array of leaf spots that infect strawberry plants. The fungi overwinter on infected plants, plant debris and weed hosts. In the spring, spores are produced and are discharged by splashing rain into air currents. They then land on, and infect, new leaves. The “spots” are more numerous on the upper leaf surfaces and appear circular to irregular in shape. Typically, there are reddish purple to rusty brown borders that surround necrotic areas. Susceptible cultivars may be partly or completely defoliated



by late summer.

Sanitation and the use of resistant cultivars is needed if nymphs are present just before bloom. Shake flower and fruit clusters over a light-colored plate. When an average of 20 to 25 bugs per 50 flower clusters are found, spraying is advised.

**Powdery Mildew:** Powdery mildew is usually observed as a foliage disease, but occasionally causes a serious fruit rot. The disease is caused by the fungus *Sphaerotheca macularis*, an obligate parasite. Flowers and fruit are affected at all stages of development. Flowers are deformed and killed, immature fruit becomes hard and does not ripen normally, and mature fruit is soft, pulpy and may fail to color. Disease development is primarily influenced by rainfall and temperature, with dry weather and cool temperatures being more favorable.

The use of resistant varieties and adequate plant and row spacing aid in control of the disease. Removal of overwintering leaves may be of some benefit.

**Red Stele:** Red stele, or red core, is the most serious disease of strawberry plants in areas with cool, moist soil conditions, especially soils heavy in clay that are saturated with water during cool weather. The disease is caused by the fungus *Phytophthora fragariae*. Healthy roots are infected by spores which grow within the root system. A few days after infection, roots begin to rot and eventually the spores and the rotted roots become incorporated into the soil.

**Verticillium Wilt:** Verticillium wilt, caused by the soil-borne fungus *Verticillium albo-atrum*, infects over 300 kinds of cultivated plants throughout the temperate zones of the world. Strawberry plants are most susceptible in their first year of growth. Initial symptoms appear rapidly in late spring. Only the outer leaves are affected, they wilt and dry, turning a reddish-yellow to dark brown at the margins and between the veins. The inner leaves remain green and turgid until the plant dies. Planting resistant varieties, and disease-free plants, will help control the disease.

## BLUEBERRIES

Several species of blueberry are indigenous to the United States. They include: the lowbush blueberry (*Vaccinium angustifolium*), which is of commercial importance in Maine and Canada, the rabbit eye blueberry (*V. ashei*), grown commercially in the southern United States and the highbush blueberry (*V. corymbosum*).

The blueberry plant is a perennial with a shallow root system and woody canes that originate from the crown. Appropriate cultivar selection is a crucial decision. Blueberry cultivars can be selected so that they can be harvested from July through mid-September, if desired. A description of some available cultivars is given in **Table 20-9**.

## Planting

The best soils for blueberries are moist, porous and acidic (pH between 4.5 and 5.0). The year before planting, eliminate all noxious weeds, increase soil organic matter by manure application and/or cover crops and test the soil. Do not plant blueberry plants in high pH soils without amending them first. Most soils will require considerable amendment with organic matter if plants are to thrive.

Because the blueberry plant is very sensitive to fluctuating moisture, mulch and irrigation are essential for a healthy planting and consistent yield. Blueberry plants require at least 1 inch of water per week. Mulch should be applied to a depth of 4 inches and replenished whenever necessary.

Sawdust or peat moss should be worked into the planting hole, replacing about one-half of the original soil. After watering in and applying fertilizer, plants should be mulched as described above. Immediately after planting, prune back 50 to 60 percent of the wood. Remove flowers from two-year-old plants completely, so that the plant will become well established.

If the soil is properly prepared prior to planting, only nitrogen fertilizer is required on an annual basis. Do not fertilize in the first year since the root system is very susceptible to root burning at this stage. In subsequent years, always fertilize with ammonium sulfate in March or April, apply 4 oz in year 2, 5 oz in year 3, 6 oz in year 4, 7 oz in year 5 and 8 oz in year 6 and subsequent years.

Blueberries will generally tolerate temperatures to -20°F, although there is some cultivar variation. Most require 750 hours of chilling below 45°F.

## Pruning

Pruning controls crop load, thus increasing fruit quality. It also invigorates the plant, forcing essential new growth from the base. Pruning is best accomplished toward the end of the dormant season, usually sometime in March. Fall pruning is not recommended as it can force the plant to produce new shoots that will be killed by winter cold.

In March fruit buds are easy to recognize, they are plumper than vegetative buds. All of these buds should be removed for the first growing season in order to force vegetative growth in the plant.

To prune a mature plant, first remove small, spindly branches and canes that lie on the ground. Then remove the centermost canes that block the sunlight. After five years, begin removing the oldest canes while retaining the three best new ones. After canes are removed, remaining canes should be thinned. Remove weak lateral branches and dense bushy twigs. Long canes, with many flower buds, should be headed back to remove some of the crop. If plants have not

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**Table 20-9. Blueberry cultivars recommended for home planting.**

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<b>Variety</b>	<b>Characteristics</b>
Bluecrop	Best early midseason variety presently available. Bush vigorous and upright, but canes tend to be slender and whippy which may make for difficult mechanical harvest. Fruit large, firm, small-scarred; good flavored; resists cracking; consistent good production and hardiness; season tends to be prolonged (makes it impossible to harvest fruit in one picking)
Blueray	Ripens just before Bluecrop; vigorous and propagates easily; fruit borne on small tight clusters makes it difficult to harvest mechanically; tight clusters can cause berries to drop, especially in hot weather; berries large, light-medium blue, with medium scar, but resist cracking; productive, good pick-your-own and commercial variety
Chandler	Hardy, bush 5-6 feet; fruits in four to six weeks; nice flavor; largest berries available; mid- to late season
Darrow	Hardy, exceptional flavor, late season
Duke	Very hardy, good quality; bush 4-6 feet; early season.
Elliott	Very late season; bush vigorous and upright, can be machine harvested in one or two pickings; productive, hardy, and resistant to mummy berry disease; medium, light blue berry with firm flesh and fair dessert quality; late small fruit can be tart which may affect dessert quality. Interplanting with another late-blooming variety has provided cross pollination and improved size and flavor.
Jersey	Late season; bush vigorous and erect with open fruit cluster, very good for machine harvesting; medium-size fruit, good color, fair flavor; may have fruit set problems; without pollination fruit does not size; good processing variety
Nelson	Hardy and vigorous; good flavor; late season
Northland	Very hardy; very flavorful; half-high bush (4 feet); midseason
Spartan	Vigorous, upright, and open; good machine harvest variety; fruits large, firm, light blue, and highly flavored; partially resistant to mummy berry

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been pruned for many years, the plant can be rejuvenated by cutting back all of the canes and allowing regrowth, or by cutting back half the canes in one year and half in the following year.

## **Pests**

Plum Curculio: Plum curculio (*Conotrachelus nenuphar*) infestations can usually be detected by examining green berries for the typical oviposition scar. Adult weevils are secretive and nocturnal, but they can be found early in the morning or late in the evening by shaking branches of a bush over a white cloth that has been placed on the ground. Frequent cultivation can facilitate control because the weevil spends much of its life cycle on the ground under the bushes. Effective control is obtained by post pollination applications of insecticides. Make sure flowers have dropped in treated blocks so that bees will not be killed.

Blueberry Maggot: Blueberry maggot (*Rhagoletis mendax*)

is a major pest of blueberries in many parts of the Northeast. Control of the insect is complicated by its long emergence period, its migration tendencies and the fact that it usually does not attack fruit until after harvest has begun. The potential for infestations of blueberry maggots can be assessed by trapping adults with yellow sticky traps before their numbers reach damaging levels. If control is necessary, a relatively nontoxic, short residual insecticide should be used so that it does not interfere with harvest.

## **Diseases**

Botrytis Blight and Fruit Rot: This fungal disease, caused by *Botrytis cinerea*, is a common occurrence, especially in cool, humid weather. The tips of shoots turn brown to black and die back. Infected blossoms appear water-soaked and turn brown. Brown discoloration may spread down the twig. Immature fruits shrivel and turn bluish-purple, ripe, mature fruits become tan. In damp weather, all infected plant parts become covered with the characteristic “gray mold” of the

fungus. To help control these diseases do not overfertilize because rapidly growing tips are more susceptible.

**Mummy Berry:** This disease is most serious and widespread in the North following moist spring weather conditions. It is caused by the fungus *Monilinia vaccinii-corymbosi*. The tips of new leaves, buds, stems and flower clusters will suddenly wilt and turn brown and eventually will be covered with a powdery mass of spores. When nearly mature, infected berries become dry and shriveled and drop early. These shriveled berries are called “mummies.”

Several practices may help control mummy berry. Remove and dispose of fallen leaves and old berries. Cover old berries with at least 2 inches of soil. Thoroughly cultivate around and under plants after each hard rain.

**Phomopsis Twig Blight:** Phomopsis twig blight usually will infect bushes that have been weakened by other factors. It is caused by the fungus *Phomopsis vaccinii*. Young twigs will die back from elongated cankers produced by the fungus. In hot weather, leaves on infected twigs turn brown. As canes mature, they become girdled by the diseased lesions. Control recommendations include removing and burning all blighted and discolored wood during dormant pruning. When blighted shoots appear in the summer, cut shoots back to a point where pith appears normal.

## GOOSEBERRIES AND CURRANTS

There is often confusion as to the legality of growing gooseberries and currants in Rhode Island. Since 1956, there has been a regulation under RI general law Title 2, Chapter 17 “suppression of White Pine blister rust.” That effectively puts a ban on growing *Ribes* species. The ban was established because gooseberries and currants can serve as alternate hosts to white pine blister rust (*Cronartium ribicola*), a fungus that needs both *Ribes* and white pine to complete its life cycle.

A significant portion of the state has large stands of native pines surrounding the Scituate reservoir, Burlingame State Park and Goddard Park. In many of these areas pines were planted to act as natural buffers to protect the adjacent soil from contaminated runoff. Also, many local wholesale and retail nurseries throughout the state grow or carry white pine for sale. If you live within the approved areas you need to contact RI Department of Environmental Management to receive a permit to send to a catalog company to purchase plants.

## GENERAL ORCHARD MANAGEMENT

Young fruit trees should be mulched or cultivated until they begin to bear. Weeds must be eliminated so they will not compete for available moisture and fertilizer. Cultivation

must be shallow to avoid injury to roots near the surface. The cultivated or mulched area should extend a little beyond the spread of the branches.

Use of mulch in the home fruit garden pays in many ways. It keeps down weeds, adds humus to the soil, conserves moisture, and keeps the soil cool during hot months.

Many materials may be used, including grass clippings, hay, straw, pine needles, peat moss, sawdust and shavings. Where sawdust is used, a layer 2 inches deep may be sufficient; for more bulky materials, at least 5 or 6 inches should be applied.

Temporary nitrogen deficiency may occur when mulch material low in nitrogen begins to decay. This can be overcome by the addition of nitrogen fertilizer. Usually about ¼ lb of ammonium nitrate or ½ lb of nitrate of soda to each 100 sq ft of mulched area will be enough.

The use of black polyethylene plastic as a mulch has given good results. Holes may be punched in the plastic to allow for moisture penetration. Although it does not decay and add humus to the soil, neither does it cause a temporary nitrogen shortage.

When trees are planted in rows, the area between the rows may be allowed to grow in sod or be used for interplanting with low-growing vegetables or strawberries. There is no objection to this practice in the home orchard, provided ample plant nutrients and moisture are available for proper development of the fruit trees. Under sod culture, frequent close mowing during the growing season is desirable. This reduces competition for necessary moisture and plant nutrients, and also aids in disease and insect control.

Fruit trees, especially those on dwarfing rootstock, are becoming prominent in home landscape designs. They respond to the same general care and are no more difficult to handle under average lawn conditions than are ornamental trees and shrubs that are normally used.

Under lawn culture, fruit trees can be given more attention than is usually convenient under other systems of culture. Equipment and materials for watering, pruning, spraying, and other cultural practices are essentially the same as those required for ornamental plantings.

It is good practice to apply mulch or cultivate lightly for the first year or two, or until the tree has become firmly established. Chemicals for weed control should be used with extreme caution in the home garden. Careless use can result in severe injury to fruit trees and nearby ornamental plantings.

## Mouse and Rabbit Control

Mice may cause serious damage to the home fruit planting. They chew off the bark at ground level or below and often completely girdle a tree, causing it to die. Most of this dam-

age takes place during winter. Keep mulch pulled away from the base of the tree, and examine it frequently for mice. In many home and commercial plantings, mice are controlled by placing poison bait in their runways. Mice may also be controlled by trapping. This can be successful where only a few trees are involved.

Rabbits are responsible for the loss of thousands of young fruit trees each year. Perhaps the most satisfactory method of preventing rabbit damage is the use of a mechanical guard. Galvanized screen or hardware cloth with a ¼-inch mesh is frequently used. A roll 36 inches wide may be cut lengthwise, forming two 18-inch strips. By cutting these strips into pieces 14 inches long, you will have guards measuring 14 by 18 inches. Roll or bend the guard around the trunk of the tree so that the long side is up and down the trunk and the edges overlap. Twist a small wire loosely about the center to prevent the strip from unrolling. Push the lower edges well into the ground. This metal guard will last indefinitely and can be left in place all year.

Tar paper, building paper, sheets of magazines and aluminum foil can also be used in a similar manner, but must be removed in early spring to prevent damage to the tree. Perfo-

rated plastic guards are also available. Like the metal guards, these can be left in place year round. Other methods of rabbit control have been successful. Ordinary whitewash has given good results in some instances. Also, rabbit repellents under various trade names are available. All these materials may be applied with a paint brush to the trunk of a tree from the ground up into the scaffold limbs.

## Sanitation

Adopt good orchard sanitation practices. The destruction of harboring places for insects and diseases plays a large part in sustainable pest control programs. These are some practices to include in your orchard sanitation program:

- Collect and burn debris.
- Remove and destroy all dropped fruit.
- Rake and burn apple and cherry leaves.
- Remove loose bark from trunks, crotches, and main limbs of apple trees.
- Prune out and destroy all dead or diseased limbs, branches, and twigs.

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