Virginia Cooperative Extension

PUBLICATION 422-018

Growing Cherries in Virginia

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Origin and History

Cherries are grown in many parts of the world, but they have never gained the popularity in North America that they have in Europe and the Middle East. Cherries probably originated in the region between the Caspian and Black Seas, where trees still grow in the wild. Cherries were cultivated in Greece by 300 B.C., and not long after they were grown in Italy. The Romans brought cherries to England early in the first century, and there were many varieties by the 16th century. The French colonists brought cherries to the Canadian Maritime provinces. The English colonists grew cherry trees from seed in New England. There are reports that cherries were grown in abundance in Virginia during the second half of the 17th century. By the mid 1700s more than 20 varieties of grafted trees were offered for sale by a Long Island nursery. As settlers moved west, they brought with them fruit trees and seeds of fruit trees, including cherry. Today tart cherry production is concentrated along the Great Lakes in western Michigan, eastern Wisconsin, western New York, and northwestern Pennsylvania. Sweet cherries are grown primarily in California, Oregon, and Washington, but there are smaller acreages in Utah, Montana, Colorado, Michigan, New York, and Pennsylvania.

Nutritive value of cherries. Anthocyanin pigments are responsible for the red or purple colors in cherries. Anthocyanins are one class of flavonoid compounds that are dietary phenolics and they have antioxidant properties. There is anecdotal and epidemiological evidence that dietary anthocyanin pigments may have preventative and therapeutic roles in a number of human diseases including coronary heart disease, strokes, cancer development, and certain anthocyanins have anti-inflammatory properties. Cherries are also a source of a number of vitamins and minerals listed in Table 1.

Table 1. Nutritive values of sweet cherries (amount in 1.0 pound edible portion)[1]

Calcium (mg)	82.0	Ascorbic acid (mg)	36.0
Iron (mg)	1.8	Niacin (mg)	1.8
Phosphorous (mg)	91.0	Riboflavin (mg)	0.27
Thiamin (mg)	0.23	Vitamin A (I.U.)	2,815
Carbohydrates (g)	67.2	Protein (g)	5.0
Fat (g)	2.3	Calories	277

[1] Excerpt from USDA handbook 28 – Comparison of foods.

Types of Cherries

Cherry belongs to the genus *Prunus* of the *Rosaceae,* or rose family. The genus Prunus includes other stone fruits such as almond, apricot, plum, peach, and nectarine. There are many cherry species, but only a few have been domesticated.

The **sweet cherry** (*Prunus avium*) produces large trees (30 feet to 40 feet tall), usually shaped somewhat like a pyramid (Fig. 1). Branches grow fairly upright, the tree is slightly more tolerant of low temperatures than peach, and in favorable environments the trees may live for more than a century. Sweet cherry trees have fewer, but larger leaves than tart cherries. The fruits are large, have a deep stem cavity, can vary in color from yellow to red to purplish black, and the stems or pedicels are about 1.5 inches long. Flowers usually arise from clusters of 2 to 5 flowers on short spurs with multiple buds at tips; the distal bud develops into a leafy shoot (Fig. 2). The flesh ranges in texture from tender to firm, and is sweet. Most sweet cherries are consumed as fresh fruit, but some varieties are used for maraschino cherries. Sweet cherries can be dark red or light in color. Light cherries are yellow with red on part of the surface. Light cherries are used for maraschino cherries, but most varieties can be consumed as fresh fruit.

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Produced by Communications and Marketing, College of Agriculture and Life Sciences, Virginia Polytechnic Institute and State University, 2009

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The **tart cherry**, *Prunus cerasus*, is sometime called "red cherry" or "sour cherry" and may have arisen from an unreduced pollen grain of *Prunus avium* crossed with *Prunus fruiticosa*. The tree is relatively small (15 feet to 20 feet tall), fairly spreading, and usually without a strong central leader. The relatively thin limbs tend to droop and the tree has a bush-like appearance. Trees are very cold hardy, but are shorter lived than sweet cherry. Slightly more than half the flowers arise from buds on spurs, but about 40% of the flowers develop from axillary buds on 1-year-old wood. The fruit of most varieties have clear juice, the fruit is relatively small, and have a higher acid and lower sugar content than sweet cherry. Tart cherries are used for processing, jam, and pie filling. Tart cherry is the latest blooming of the stone fruits, therefore would be less frost prone than sweet cherry. However, frost is still a major limitation to tart cherry production in the eastern U.S.

The *Duke cherry* is a hybrid of *Prunus avium* and *Prunus cerasus* and all gradations between the two species exist, but most varieties more closely resemble sweet cherry. There are a number of varieties, but none are commercially important in North America.

Site Selection for Cherry Trees

Climate. Cherry trees generally do not thrive where summers are long and hot or where winter temperatures are high for short periods. For these reasons, cherry production is challenging in the piedmont and tidewater areas of Virginia. Virginia winters are not cold enough to injure cherry trees. However, cold weather events during early spring, before bloom, may kill flower buds. Above average temperatures during late winter and early spring, followed by a sudden drop in temperature (10º to 20º F), may injure flower buds on sweet cherry trees. These injured buds will usually not swell normally and will shrivel and fall from the tree by the normal bloom time.

Most sweet and tart cherry varieties have chilling requirements of about 1,000 hours; about 1,000 hours of temperatures between 35º and 55º F during the winter are required before buds will develop in response to warm spring temperatures. Avoid planting varieties requiring less than 800 hours of chilling because they will bloom early. Sweet cherries bloom after peaches and tart cherries bloom later than sweet cherries, but before apples. Therefore, a major consideration for location of cherry trees is the likelihood of spring frost during bloom that will kill flowers and eliminate the crop.

Critical temperatures for cherry fruit buds are 21ºF at the green tip stage, 25º at the 1/2 inch green stage (when young shoots are about 1/2 inch long), 28º at tight cluster through bloom, and 30º F at petal fall (when flower petals have just fallen off the flowers). These critical temperatures may actually be a few degrees higher or lower depending on the weather conditions during the several days before a frost event.

Spring frost is the primary consideration for choosing a site to locate an orchard. The best sites for all tree fruits in Virginia are located on the slopes of the Blue Ridge Mountains or on hills at the northern end of the Shenandoah Valley, at elevations of about 800 to 2,200 feet above sea level. Two types of frost events can occur in Virginia. *Radiational frosts* occur on clear still nights. During the day the ground absorbs heat energy, and during the night heat is radiated from the ground to the surrounding air. Because cold air is denser than warm air, cold air flows down slopes and settles into the low areas. Eventually a layer of cold air, varying in thickness from a few feet to about 50 feet, may develop along the ground. Above the layer of cold air is a layer of warmer air, called the inversion layer. *Advective freezes* occur when large cold air masses move down from Canada. These air masses usually are accompanied by low dew points (dry air) and wind.

Frost protection. There are several methods of minimizing the negative effects of radiational frosts during bloom.

- Plant trees on a site that is higher than the surrounding land, so the cold air can drain into the lower areas. Hillsides and hilltops are usually the preferred locations. The direction of the slope is much less important than the elevation.
- Wind machines (very large fans) or helicopters can be used to pull warm air out of the inversion layer toward the ground. These methods are expensive and results are inconsistent.
- Trees can also be sprinkled with water. As water freezes it releases heat and protects the buds. The ice has very little insulating value, so water must be applied continuously, from the time the temperature approaches freezing until all ice has melted in the morning. If irrigation is terminated too soon in the morning, injury will occur because heat required to melt the ice can be pulled out of the plant tissues.
- When only one or two trees need protection, a tent can be constructed over the tree with polyethylene

plastic or some other type of fabric. The tent itself will not protect the tree without adding a source of heat, such as a kerosene lantern or an electrical heater.

None of these methods of frost protection are effective for advective frosts. Wind machines don't work because there is no inversion layer to provide a source of warm air. Trees on sites with good air drainage may be injured by advective freezes because there is no inversion layer. Sprinkling can actually do more harm than good because the dry wind evaporates water before it freezes. Evaporation, like ice melting, requires heat and actually lowers the temperature more than if water is not applied.

Large bodies of water, such as the Great Lakes or the Chesapeake Bay, modify the air temperature and may offer protection against frost. Air over the water is cooled in the spring and the cool air delays bud development and bloom in the spring. Every day of bloom delay reduces the likelihood of a frost. On cold nights, the water warms the air and frost is avoided. To take advantage of this "lake effect," trees must be planted close to the water.

To determine if a site is likely to have frost problems, place thermometers at several locations on the available property and check the temperatures at sunrise following a radiational frost. Sometimes an elevation difference of only 3 feet can affect the temperature by 5ºF. Neighbors with fruit trees can also provide information concerning the cropping history or the area.

Rainfall during harvest. Precipitation, heavy fog, or dew just before harvest cause cherry fruit to crack. For some varieties in some years as much as 90% of the fruit may crack. Cracking is caused by absorption of water through the fruit skin. Water on the skin has a relatively high osmotic potential and the water within the fruit contains sugars and other solutes that result in a lower osmotic potential. Water moves from areas of high osmotic potential to areas of lower osmotic potential within the fruit. As water moves into the fruit, the fruit swells until it eventually bursts. Even a slight crack can serve as an entry point for fungi that cause fruit rot. Fruit cracking is one of the primary factors limiting commercial sweet cherry production to the arid west. Cracking is most severe on young and lightly cropped trees. Varieties with soft fruit tend to be less susceptible to damage. Tart cherries are less susceptible to cracking than sweet cherries.

Soil Considerations. Cherry trees can grow in a wide range of soil types, so soil characteristics are much less important than cold air drainage. In general, the soil should be well drained, with a pH of 6.2 to 6.8, and have a rooting depth of at least 3 feet. Soil fertility and pH can be amended with fertilizer and lime applications. Cherry roots are extremely sensitive to excessive moisture, which may stunt tree growth or kill the tree. Tree losses caused by the soil-borne fungus *Phytophthora* (crown rot or collar rot) tend to be greater in wet or poorly drained soils. Where soil moisture is excessive, trees may be planted on burms or raised beds 18 to 30 inches high and 5 feet wide at the base. A good method of evaluating soil water drainage is to dig a hole 3 feet deep and if water remains in the hole for three days after a heavy rain, the soil is probably too wet for cherry trees.

Cherry Varieties

There are many cherry varieties and there are several cherry breeding programs in North America, so new varieties are periodically released. Cherry varieties released in the past 20 years have not been evaluated in Virginia, so the following descriptions come from nursery catalogues, cherry breeders, and cherry researchers in New York, Michigan, and British Columbia, Canada.

Tart Cherries

'**Montmorency**' originated in the Montmorency Valley of France before the 17th century. The trees are productive and the fruit are relatively large, bright red, white fleshed, have clear juice, firm flesh, and are of good quality. This is the standard tart cherry variety and about 90% of the tart cherries grown in North America are 'Montmorency'. There are several strains of 'Montmorency', such as 'Galaxy'. Ripens in late June in Blacksburg.

'Northstar' resulted from a cross between 'English Morello' and 'Serbian Pie' and was introduced in 1950 by the University of Minnesota Fruit Breeding Program at Excelsior. The mahogany red fruit has red juice, and is medium size. Trees are small, which makes them easy to cover with bird netting. Ripens in late June or early July. The trees possess some resistance to leaf spot and brown rot.

'Meteor' resulted from a cross between 'Montmorency' and a selection of a Russian type, and was introduced in 1952 by the Minnesota Fruit Breeding program at Excelsior. The medium sized bright red fruit ripens about a week after 'Montmorency'; it is tart with clear juice, semi-firm flesh, and good-quality fruit. The vari ety is not acceptable for commercial processing

because the pit is oddly shaped, and sometimes shatters during pitting. This is not a problem for home production and it can extend the harvest season because it ripens about 5 days after 'Northstar'. Trees bloom after 'Montmorency' and 'Northstar' and have some resistance to leaf spot.

'Surefire' resulted from a cross between 'Borchert Black Sour' and NY 6935 ('Richmorency' x 'Schatternmorelle') and was introduced in 1993 by the New York Agricultural Experiment Station at Geneva. It is late blooming, so is less susceptible to spring frost. The fruit is bright red, medium in size, firm, and very tart.

'Danube' is a new tart cherry for fresh consumption and ripens a few days earlier than 'Montmorency'. The fruit is dark red, medium to large, and sweeter than most tart cherries. This variety is being planted widely in Europe.

'Balaton' originated in Ujfeherto, Hungary, as a local variety. It was released and trademarked by Michigan State University in 1996. Compared to 'Montmorency' the fruit is larger, firmer, sweeter and redder and it has a juicy flesh. The pits are slightly larger than other varieties and may cause problems for processors. This is a very high quality variety and is being recommended for fresh consumption, processing, and the home garden.

Dark Sweet Cherries

'Cavalier' is a new black variety that ripens very early, probably around June 3. Fruit is medium to large, dark red, and has dry, firm flesh with good flavor, and is resistant to cracking.

'Viva' was released in 1972 by the Vineland Research Station in Canada and the parentage is unknown. It produces a medium-sized dark red fruit with flesh that is semi-firm, sweet and of good quality. Trees are moderately productive and fruit ripens around June 8 and is moderately crack resistant.

'Black Tartarian' is an old variety. Fruit are purplish black, small to medium in size, heart-shaped, and good quality. The flesh is dark red, soft and juicy. At one time it was used to extend the season, but newer varieties are superior and more crack resistant.

'Hartland' is an open pollinated selection of 'Windsor' and was introduced in 1992 by the New York Agricultural Experiment Station at Geneva. The fruit ripens around June 12. The tree is productive, and the purple fruit is fairly susceptible to cracking, medium size, round, medium firmness, and good flavor.

'Kristin' resulted from a cross between 'Emperor Francis' and 'Gil Peck' and was introduced in 1982 by the New York Agricultural Experiment Station at Geneva. The fruit is large, aromatic, firm, sweet, dark red, attractive, and moderately resistant to cracking, and trees are vigorous and productive. Fruit can be used for fresh consumption and processing.

'Ulster' resulted from a cross between 'Schmidt' and 'Lambert' and was introduced in 1964 by the New York Agricultural Experiment Station at Geneva. The fruit is large and sweet, and the flesh is dark red and crisp. This high quality fruit is moderately crack resistant, and ripens around June 15. Good for fresh consumption and processing.

'Stella' resulted from a cross between 'Lambert' and 'John Innes Seeding' and was introduced in 1968 by the Canadian Department of Agriculture Research Station at Summerland, British Columbia. This is a large, black, heart-shaped cherry that is sweet, and has medium firm flesh, but is susceptible to cracking. It ripens around June 12 and is self-fertile.

'Lapins' resulted from a cross between 'Van' and 'Stella' and was introduced in 1983 by the Agriculture Canada Research Station at Summerland, British Columbia. The fruit is very large, somewhat resistant to cracking, has good flavor, and ripens around June 15. The tree is very productive.

'Hedelfingen'is an old European variety. The black fruit is medium to large, firm, and high quality, and is more crack resistant than most varieties. The fruit is good for fresh consumption, freezing and processing. This variety ripens around June 20 and has performed well in Virginia.

'Sweetheart' is a self-fertile cherry resulting from a 'Van' cross and introduced by the Agriculture Canada Research Station at Summerland, British Columbia. Trees are productive and fruit is medium to large in size, very firm, and has good flavor. The fruit is dark red and moderately susceptible to cracking.

'Hudson' resulted from a cross between 'Oswego' and 'Giant' and was introduced in 1964 from the New York Agricultural Experiment Station at Geneva. This late-season variety ripens around June 25. The fruit is dark red, medium to large in size, sweet and very firm. The trees bloom late, are vigorous, and are moderately productive, and may come into production late. Fruit is very crack resistant.

Light Sweet Cherries

'Emperor Francis' – A good quality early cherry that is yellowish white with a red blush. Trees survive well and the fruit is large, but not very crack resistant. Ripens around June 16 in Blacksburg, Virginia.

'Gold' – This variety is early, the trees are productive and fairly resistant to bacterial canker, but the fruit are small and fairly crack resistant. This variety is used primarily for brining and the eating quality is poor.

'Napoleon' – also called 'Royal Anne' or 'Napolean Wax'. The fruit is pale yellow with bright red cheeks. The fruit is medium in size, firm, sweet, and juicy, with fair fresh eating quality. Productivity in Virginia is fair, but it has fairly good resistance to cracking.

'Rainier' – resulted from a cross of 'Bing' and ' Van' and was introduced in 1960 by the Washington Agricultural Experiment Station and the USDA in Prosser, WA. The fruit is very large and sweet; the skin is yellow with quite a bit of red blush. The fruit is firm and the juice is clear. The fruit is good for brining or fresh consumption. Reports from Michigan indicate it is exceptionally crack resistant for a firm cherry, but reports from New York indicate that it is moderately susceptible to cracking.

Approximate Harvest dates for cherries – dates for most varieties are estimated from descriptions from researchers in New York and Michigan, and commercial nursery catalogues. Dark red sweet varieties are in red shading, yellow sweet varieties are in yellow shading, and tart varieties are in green shading.

Harvest dates for cherry varieties in Blacksburg, Va

			June				July	
Variety	**1**	**5**	**10**	**15**	**20**	**25**	**1**	**5**
Cavalier	X	X	X					
Viva	X	X	X					
Hartland		X	X	X				
Bl. Tartarian			X	X	X			
Napolean			X	X	X			
Kristan			X	X	X			
Ulster			X	X	X			
Stella			X	X	X			
Emperor Francis			X	X	X			
Rainier			X	X	X			
			June				**July**	
Variety	**1**	**5**	**10**	**15**	**20**	**25**	**1**	**5**
Lapins			X	X	X	X		
Hedelfingen				X	X	X		
Gold					X	X	X	
Sweetheart						X	X	X
Hudson						X	X	X
Tart Cherries								
Danube			X	X	X			
Montmorency					X	X	X	
Northstar					X	X	X	
Surefire					X	X	X	
Balaton						X	X	X
Meteor						X	X	X

Cherry Pollination

Pollination is the transfer of pollen from the male part of a flower (anther) to the female part of a flower (stigma). The pollen grain germinates and grows down through the style, which is the stalk below the stigma, into the embryo sac where fertilization occurs to produce a seed. *Self-pollination* is the transfer of pollen from anthers of a flower of one variety to the stigma of a flower of the same variety. *Cross-pollination* is the transfer of pollen from a flower of one variety to the stigma of a flower of another variety. A variety capable of producing viable seeds and setting fruit following self-pollination is *self-fertile* and one that is not capable of producing seeds and fruit is *self-sterile*. When cross-pollination fails to produce a full crop, the two varieties are *inter-sterile* or partially inter-sterile and are considered incompatible. Incompatibility usually results from the presence of substances in the tissues of the stigma and style that inhibit pollen germination or growth of the pollen down the style. When cross-pollination produces a full crop, the two varieties are *inter-fertile* and the varieties are considered compatible.

All commercial varieties of tart cherry are self-fertile, and there is no need to plant more than one variety. Pollination requirements for sweet cherries are complicated by the fact that most commercial varieties are self-sterile, and some combinations are incompatible, so it is critical to select varieties that are compatible. In addition, good pollinating varieties must bloom at the same time. In the eastern U.S., most commercial varieties generally bloom at about the same time, so bloom date is not an important consideration for variety selection. Eighteen incompatibility groups have been identified. Varieties in the same group cannot be used to pollinate each other. To ensure effective pollination in

commercial plantings, at least three varieties should be planted. It is easier to manage solid rows of a single variety than rows containing more than one variety. To ensure adequate pollination, alternating rows of varieties is ideal. An acceptable planting pattern includes two or three rows of one variety adjacent to at least one row of a compatible variety.

Most of the varieties previously described are compatible and can be used to pollinate each other. The following chart was adapted from information generated by Dr. Robert Anderson, Jay Freer, Kenneth Livermore, and Cheol Choi, at Cornell University. The information was obtained from bloom-time records and controlled pollination tests and/or S-allele genotyping by Polymerase Chain Reaction (PCR). PCR is a laboratory technique used to study genes located in sections of DNA molecules. Self-fertile varieties, such as 'Stella', 'Lapins', and 'Sweetheart', are recommended for home orchards because they do not require cross-pollination and they can be used as universal donors to pollinate all varieties.

Sweet cherry pollination chart – A dot in the box indicates that the variety on the left is self-sterile and/or inter-sterile with the variety located at the top. Varieties sharing a dot will not pollinate each other. Where there is no dot in the box, varieties listed on the left can be used as reliable pollinators for cross-pollination with the variety located at the top. For example, 'Kristin' is self-sterile and requires another variety for pollination. 'Kristin' and 'Ulster' are inter-sterile and should not be used to pollinate each other. 'Hartland' is self-sterile, but it is compatible with all other varieties listed.

Cherry Rootstocks

Like all species of fruit trees, cherries are not propagated by seed because trees arising from seeds do not possess the same characteristics as the parent tree. Cherry is also difficult to propagate from cuttings. Commercial nurseries plant seeds and bud or graft the desired variety onto the seedling. The resulting tree consists of two parts that have been joined together by budding. The portion grown from seed becomes the root system and is called the *rootstock*, and the portion that develops from the inserted bud of a designated variety becomes the aboveground portion of the tree and is known as the *scion*. Rootstocks vary in their susceptibility to low temperatures, root diseases and tolerance to wet and dry soils. Rootstocks can also influence the size and shape of the tree, the length of time a tree requires to bear fruit, and productivity. Therefore, proper rootstock selection can be an important factor influencing the success of the orchard. Until recently both tart and sweet cherries were propagated primarily on seedlings of Mahaleb (*Prunus mahaleb*) or Mazzard (*Prunus avium*), but recently new rootstocks have been introduced and commercial fruit tree nurseries offer about a dozen cherry rootstocks, which are described below.

	Cavalier	Viva	Bl. Tartarian	Hartland	Kristin	Ulster	Stella	Lapins	Hedelfingen	Sweetheart	Hudson	Emp. Francis	Gold	Nepolean	Rainier
Cavalier	•	•													
Viva	•	•													
Bl. Tartarian			•												
Hartland				•											
Kristin					•	•									
Ulster					•	•									
Stella															
Lapins															
Hedelfingen									•						
Sweetheart															
Hudson											•				•
Emp. Frances						•						•		•	
Gold													•		
Napolean						•						•		•	
Rainier											•				•

Mahaleb – Mahaleb is a general name for wild seedlings of *Prunus mahaleb L.*, indigenous to western and central Europe. There are several clones of this standard rootstock for tart cherry, but it can also be used for sweet cherry. It is slightly dwarfing (20% smaller than mazzard) and produces a spreading tree for sweet cherry, especially on lighter soils. Compared to Mazzard, it is more tolerant of cold and drought, less tolerant of wet soils, trees are more productive at a young age, but trees are often shorter lived. It resists crown gall, bacterial canker and some nematodes. It is quite susceptible to collar rot and should not be planted on poorly drained soils. Some varieties, such as 'Van', are not compatible with mahaleb.

Mazzard – Mazzard is a generic name for wild seedlings of *Prunus avium L*, sweet cherry, which are indigenous to Western Europe. It can be used as a rootstock for both tart and sweet cherry, but is most often used for sweet cherry. Compared to trees on mahaleb, mazzard produces a larger tree, is more compatible with some sweet cherry varieties, induces fruiting at a later age, and is more tolerant of wet soils. There are several clones and it is resistant to bacterial canker.

Mahaleb x Mazzard (MxM) – In an attempt to obtain dwarfing rootstocks that would tolerate a wide range of soils and diseases, Lyle Brooks of Daybreak Nursery in Oregon made selections from a population of mahaleb open-pollinated seed. Vegetative characteristics indicate the pollen parent was Mazzard, hence the designation "MxM." The selections were numbered and the numbering system has nothing to do with the characteristics of the different stocks. The rootstocks are produced clonally from hardwood cuttings, and all produce quite a few root suckers.

MxM 2 was patented in 1993 and can be used for both tart and sweet cherry. Compared to mazzard seedling, trees on MxM 2 are slightly larger, and earlier bearing. It has good resistance to wet soils, crown gall, collar rot, and is somewhat tolerant to bacterial canker. MxM 2 is probably better than mazzard for sweet cherry on most soil types.

MxM 60 was patented in 1993 and is used for both tart and sweet cherry. Trees on MxM 60 are about 90% the size of mazzard seedling, and are earlier bearing and productive. It is adaptable to a wide range of soils from sand to heavy clay, with good resistance of crown gall, collar rot, and is somewhat resistant to bacterial canker. This rootstock may be better than mahaleb for tart cherry on loam and sandy soils and soils infested with Armillaria root rot.

Gisela – The Gisela rootstocks were developed in the early 1960s, at Justus Liebig University in Giessen, Germany, by Werner Gruppe and Hanna Schmidt. These rootstocks resulted from a series of interspecific crosses between several vigorous and non-vigorous cherry species. The resulting rootstock candidates were selected for dwarfing, compatibility, disease resistance, and induction of early fruiting. Seventeen of the most promising clones were imported into North America in the early 1980s by Wallace Heuser, Hilltop Orchards and Nurseries Inc. Most were included in the 1987 NC-140 rootstock trial plantings and were evaluated at 16 locations in North America. Based on results from this trial, some commercial nurseries have started propagating trees on several of the more promising Gisela rootstocks, which are described below. It is important to remember that experience with these rootstocks is still limited. Cropping has been so heavy on these rootstocks that fruit size is often smaller than on other rootstocks. Cultural practices such as fruit thinning or spur pruning may be required to consistently produce large fruit.

Gisela 1 is a hybrid of *Prunus fructicosa* 'Klon 64' and *Prunus avium*. It is a triploid and produces a tree about 25% the size of Mazzard, and induces early and heavy production. It can be used for both sweet and tart cherry. Trees produce some rootsuckers, and trees are poorly anchored and must be staked for support. It is sensitive to pollen-born viruses like Prunus necrotic ringspot virus and prune dwarf virus and possibly others. The rootstocks are propagated from greenwood cuttings and are not recommended for commercial planting.

Gisela 5 is a hybrid of *Prunus cerasus* 'Shattenmorelle' and *Prunus canescens* and was patented in 1996. It is a triploid, produces a tree about 45% the size of Mazzard, and can be used for both tart and sweet cherry. Gisela 5 induces wide branch angles, good lateral branching, and early and heavy production. It is tolerant of cherry viruses, and heavy soils, but might produce rootsuckers. The rootstocks are propagated from greenwood cuttings and tree support is recommended.

Gisela 7 is a hybrid of *Prunus cerasus* 'Shattenmorelle' and *Prunus canescens* and was patented in 1994. It produces a tree about 50% the size of Mazzard, and can be used for both tart and sweet cherry. It induces very early bearing, heavy production, wide-angled branching, and good lateral branching. Trees will produce some rootsuckers. Gisela 7 is about as sensitive to Prunus necrotic ringspot virus as Mazzard or Mahaleb, and is propagated from greenwood cuttings.

Gisela 6 is a hybrid of *Prunus cerasus* 'Shattenmorelle' and *Prunus canescens* and was patented in 1994 and can be used for both tart and sweet cherry. It is a triploid and produces a tree about 60% to 95% the size of Mazzard, depending on the scion variety. It induces very early bearing, heavy production, wide-angled branching, good lateral branching, and few rootsuckers. It has good resistance to cherry viruses, does not require support, and is propagated from greenwood cuttings.

Purchasing Trees

Trees can be purchased locally at garden centers or from nurseries that specialize in fruit tree production. Information on rootstock and variety is often lacking at garden centers. There is usually no choice of rootstocks for cherries, and only certain nurseries sell trees on the MxM and Gisela rootstocks. Good quality trees of specific varieties, rootstocks, and tree sizes can be mail-ordered from fruit tree nurseries. Large trees and 2-yr-old trees are relatively expensive, but medium sized (1/2 inch trunk caliper and 3 to 5 feet tall) 1-year-old trees are less expensive and perform very well. Most reputable nurseries provide free catalogs upon request and have a large selection of varieties on several rootstocks. Most nurseries now have web sites with variety descriptions and information on growing fruit trees.

Establishing Cherry Trees

Tree Care Before Planting. Trees purchased in pots from garden centers are relatively expensive. Garden centers purchase bare-rooted trees from fruit tree nurseries and plant them in pots. Depending on the length of time between planting and purchase, these trees may produce few new roots before the consumer plants the tree. Trees with a good root system should be removed from the pot with the rooting medium and planted at the same depth as in the pot. Trees with little new root growth should be handled the same as bare-rooted trees. Late February through March is the best time to plant in most parts of Virginia. Bare-rooted trees arrive from the nursery in paper bags, sometimes lined with plastic, or cardboard boxes. The roots are packed in moist sawdust or sphagnum moss. Upon receiving the package, the trees should be inspected for condition and accuracy of the order. Trees should be rewrapped and stored in a cool place (35 to 45 ˚F if possible) until planting. The trees should be planted as soon as possible and the roots should not be allowed to dry out.

Another way to store trees before planting is called "healing in." Dig a trench about 24 inches deep and 18 inches wide. Place the roots in the trench and lean the trees at an angle of about 45 degrees towards the south to reduce the amount of the tree surface exposed to the sun. If trees are in bundles, separate the trees so the roots can be spread apart. Fill the trench with moist soil and tamp the soil around the roots to eliminate air pockets around the roots to prevent drying out. Trees can also be healed in on the north side of a building to keep the trees cool and to delay bud development.

Preplant soil preparation. Several months before planting, the soil should be tested. Soil analysis kits, including instructions, are available from your local county Extension office. Soil is tested to determine if the soil pH needs adjustment, and if phosphorous and potassium levels are adequate. Apply lime and fertilizer as recommended from the soil test results. Lime and phosphorous move very slowly in the soil and, if possible, should be plowed or cultivated into the soil. Because broad leaf plants can be infected with virus, such weeds should be eliminated to produce a solid stand of grass before trees are planted.

Planting distance. Tart cherry trees are relatively small and can be planted 14 to 18 feet within the row and 20 to 22 feet between rows. Sweet cherry trees on vigorous rootstocks should be planted 16 to 20 feet within the row and 22 to 26 feet between rows. Sweet cherry trees on dwarfing rootstock can be planted 10 to 14 feet within the row and 16 to 20 feet between rows.

Planting the tree. Commercial orchards usually plant trees with tree planters. These machines are pulled behind tractors and workers sitting on the machine place trees into furrows created by V-shaped plows. Thousands of trees can be planted per day and the trees grow very well. Smaller orchards can be set by digging holes with 12-inch augers. When the soil is wet or when soil has high clay content, augers can cause glazing of the sides of the hole. This compacted soil around the hole can be impervious to roots, so the roots grow in circles around the hole. The sides of the hole can be easily broken up with a shovel point. When only a few trees are planted, the hole can be dug with a shovel. Dig a hole 18 inches deep and 18 inches wide. Place the root system in the hole, partially fill the hole and tamp the soil to insure root-to-soil contact so roots will not become dry. Pull the tree up, if necessary, to place the graft union about 3 inches above the soil line and fill the hole and tamp the soil. Water the tree with at least 2 gallons per tree to eliminate any air pockets in the soil. Place a cylinder of hardware cloth, about 12 inches high, loosely around the base of the trunk to prevent rabbits from feeding on the tree trunk.

Tree Care the First Year

During the digging process in the nursery, the ratio of top to root is altered. The root system is small relative to the top of the tree. Therefore, the tree is less able to obtain adequate amounts of water and nutrients. Water the tree every 14 days unless at least 1 inch of rain fell since the last watering. Use herbicides or cultivation to eliminate weeds and grass within 2 feet of the trunk. Organic mulches conserve moisture and eliminate weeds, but as the material decomposes nitrogen is released. High levels of nitrogen are not desirable during the late summer because they may delay the development of cold hardiness. Mulches also provide excellent habitat for rodents that feed on tree roots and bark. For the above reasons, organic mulches are not recommended for fruit trees.

If the soil fertility was properly amended before planting, nitrogen is usually the only nutrient that needs to be applied on an annual basis. Fertilize the trees twice (2 weeks after planting and 6 weeks after planting) with a nitrogen fertilizer (examples include ammonium nitrate, urea, or calcium nitrate) or a complete fertilizer, such as 10-10-10, 5-10-10, or some other formulation, at the rate of 0.05 pounds of actual nitrogen per tree per application. The amount of fertilizer per tree varies depending on the formulation: 1/2 lb. of 10-10-10, 1.0 lb. of 5-10-10, or 1/3 lb. of calcium nitrate. To avoid root injury, place fertilizer in a band 6 to 8 inches from the trunk around the tree. Organic forms of fertilizer (manure, blood meal, and bone meal) are not recommended because the nutritional analysis is usually unavailable and because nutrients may be released continuously all season. Trees require high levels of nitrogen early in the season and low levels are desirable during the late summer.

Annual Tree Care

Weed control – Weeds compete with trees for water and nutrients and cherry trees do not compete well with weeds and grass. The amount of growth a tree makes is positively related to the size of the weed-free area around the tree. Use herbicides or cultivation to maintain a weed-free zone for 3 to 4 feet on all sides of the tree. Organic mulches, such as wood chips or straw, can be used, but the mulch should be removed by November to discourage wildlife from living around the tree.

Irrigation – Cherry trees can be grown with less water than most other deciduous tree fruits and many eastern cherry orchards are not irrigated. Young trees grow better and mature trees are more productive with supplemental irrigation, especially during drought or where soils have poor water-holding capacity.

Mineral nutrition – Many elements are not readily available, even when present in adequate amounts, when the soil pH is above 7.0 or below 5.5. The soil around the tree should be tested every 3 or 4 years to determine the need for lime application to maintain soil pH in the appropriate range. Occasionally potassium or manganese deficiency may occur, but before these elements are applied the deficiency should be verified with leaf analysis. Leaf analysis kits, from the Agricultural Analytical Services Laboratory at The Pennsylvania State University, can be obtained at your local county Cooperative Extension office. Payment must be included with samples sent to the lab.

Nitrogen is usually the only nutrient that is needed on an annual basis. Shoot growth can be used as a visual guide for application of nitrogen. Shoots on young nonbearing trees should grow about 18 to 30 inches per year, trees starting to fruit should produce shoots 6 to 12 inches long, and mature bearing trees should produce shoots about 4 to 8 inches long. Applying more nitrogen can encourage shoot growth and applying less nitrogen can discourage it.

Fertilizer recommendations are difficult to make because amounts should be varied depending on soil type: light sandy soils require greater amounts than soils with high organic matter. The general rule of thumb is to apply 0.05 to 0.10 pounds of actual nitrogen per tree per year of tree age until trees are about 8 years old. Thus, a five year-old tree should receive about 0.25 pounds of actual nitrogen: this is equivalent to 2.5 pounds of 10-10-10, 5 pounds of 5-10-10, 1.7 pounds of calcium nitrate, 0.75 pounds of ammonium nitrate, or 0.5 pound of urea. Mature trees should receive about 0.6 to 1.0 pounds of actual nitrogen each year. Apply fertilizer about a month before bloom in a broad band around the tree, extending from about a foot from the trunk to the drip line of the tree.

Wildlife Problems

Several species of animals may feed on various parts of cherry trees or on the fruit. The severity of the problem varies around the state. Below is a brief discussion of the most common problems and possible control measures.

White tail deer – Deer populations are increasing rapidly throughout the eastern United States. Deer coexist very well with humans and they often feed on garden

plants including fruit trees. Deer seem particularly fond of sweet cherry trees. Deer browsing on young succulent shoots of sweet cherry trees can be so severe that the trees may never produce fruit or the trees may die. Bucks can partially debark a tree or break branches by rubbing their antlers against the trees in the fall. When the deer population is relatively low, taste repellents such as hot sauces and Ropel™ work fairly well, but they must be applied every 7 to 10 days and after rain. Hanging bars of soap or small cloth bags of unwashed human hair or blood meal are effective odor repellents. In areas with high deer populations, repellents are not effective. In such areas, the only effective method is exclusion. Surrounding individual trees with wire fence or surrounding a planting with an electrical fence will help keep deer away from trees. These exclusion methods are often not completely effective, but they usually deter deer feeding enough so the trees grow and produce fruit.

Rabbits – Rabbits may feed on bark just above the ground and, if damage is extensive, the trees may be weakened or killed. Surrounding the trunk with hardware cloth to a height of at least 12 inches above ground usually prevents rabbit damage.

Voles – Voles are small rodents that feed on plants and are often confused with mice. Voles feed on roots of plants, and they can feed on roots or bark on cherry trees. Low populations can be controlled by placing household mousetraps in runs or on the ground around the tree. Make the ground under the tree undesirable for voles by controlling the vegetation under the tree and do not place organic mulches under the tree.

Birds – Sweet cherry fruit is a favorite food of several bird species. Just as the fruit are ripening, birds can eliminate the entire crop in one day. Birds also feed on tart cherries, but they usually eat less than 70% of the crop. Various types of noisemakers are moderately effective for scaring birds. Placing scarecrows near trees, hanging aluminum pie plates that rattle in the wind, placing large balloons with an eye painted on the side, or placing plastic snakes in the trees do little to scare birds. Birds eat fruit in large cherry plantings, but there are so many cherries that growers still harvest a sizeable crop. The only effective control for birds in small cherry plantings is with a physical barrier such as covering the tree with netting.

Growth habit and tree physiology of tart cherry

Before discussing tree training and pruning, it is helpful to understand how the tree grows and fruits. Tart cherry trees have a spreading growth habit and are easily trained to the modified-leader system. In most commercial orchards, tart cherry trees are mechanically harvested and are trained to facilitate tree shaking. Tart cherry trees require less pruning than apples or peaches and, with pruning, the tree height can be maintained at less than ten feet. Described below is a modification of the training system used in Michigan commercial orchards for trees not to be mechanically harvested.

The fruiting habit of tart cherries differs with variety, tree vigor, and tree age. The more vigorous shoots generally produce mostly vegetative buds that develop into lateral shoots and short spurs during the following season. Vegetative buds on strong growing shoots may produce laterals at the expense of spurs. This condition is common in young trees. Shoots that are 6 to 10 inches in length are usually most desirable because the vegetative buds borne on them will usually develop one or two lateral branches and several fruit spurs. Shorter shoots usually have several flower buds and few leaf buds. To maintain high-yielding trees, it is desirable to have about one-third of the shoots 6 to 8 inches in length. These shoots produce both spurs and strong laterals. High yields can be maintained only through the production of new side shoots from lateral vegetative buds through the formation of new fruit spurs.

Training and Pruning Tart Cherry Trees

At planting. Most tart cherry trees come from the nursery with feathers or branches. Remove all branches less than 24 inches above ground and remove all branches with narrow crotches. Branches arising from narrow crotch angles are very prone to splitting off when the tree produces its first big crop. Narrow crotches also often become infected with diseases and are sites for borer entry. Wide crotch angles are much stronger and selection of such branches usually prevents branch splitting. If there is only one desirable branch on the tree, it should be removed. Limbs 24 inches above ground that are removed should be removed by pruning to 1/4 – 1/2 inch stubs. These stubs should be just long enough to retain the bud that usually occurs on the bottom of 1-year-old limbs right next to the leader. The bottom buds will develop into a new lateral with

Figure 1. Four-year-old sweet cherry tree trained as a central leader. This tree is about 10' tall and is supported with a stake.

a wide crotch. If present, retain 2 to 4 branches with wide crotch angles and spaced at least 6 to 8 inches apart vertically along the trunk. These will become permanent scaffold branches. If two or three branches are selected with less distance between them, they will choke out the leader and the leader will be weak. Head the leader because it is desirable to have many buds to break to produce future scaffold branches.

First summer. Most shoots developing during the first summer will need no manipulation, but some will need to be spread to improve the crotch angle. When shoots are 3 to 5 inches in length, place clothespins on the leader directly above the shoots with narrow crotches to create a 90-degree crotch angle. Remove the clothespins after two weeks.

First winter. Avoid pruning until late winter or early spring (late February to late March). Pruning temporarily reduces the resistance of trees to low temperatures. Trees pruned within two weeks before severe cold often have winter injury. Remove all shoots with narrow crotches, especially those developing from buds directly beneath the top bud. Remove limbs less than 24 inches above ground. Ultimately we want four primary scaffold branches with wide crotches in the lower part of the tree and spaced along the leader from 24 to about 56 inches above ground. Other lateral limbs that are not being saved as scaffolds that are located above the scaffolds should be cut back to 4- to 6-inch stubs. These stubs will result in shoot growth that helps direct the growth of the scaffolds outward rather than turning too upward. These stubs will be removed the next year.

Second winter. Basically follow the same procedure described for the first winter. If the tree grew well, the basic structure should be developed. Remove the stubs that were saved the previous year. Remove the one to three vigorous upright branches emerging from the buds just below the terminal buds on each scaffold limb and the leader. Do not remove too many of the new shoots from the leader. Three or four more branches can be retained as weaker scaffold branches above the lower four branches. Use the 4- to 6-inch stubbing technique on some of the remaining limbs. Over pruning the leader tends to cause the scaffold to grow too

upright. Eventually the leader will become weak and develop into a scaffold branch. Do not bench-cut scaffold limbs by removing the terminal in favor of a lower, more outward growing lateral. Bench cuts leave a weak spot that often breaks later. Bench cuts also often slow the growth of the scaffold.

Third winter and thereafter. Remove the one to three upright, most competitive branches competing with the terminals of the scaffolds and leader. Mature trees require very little pruning: thin out branches as needed to keep adequate light into trees. If the tree grows taller than desired, lower the tree by cutting into 2- or 3-year-old wood by cutting to a strong outward-growing branch. Remove dead or broken branches each winter.

Growth habit and tree physiology of sweet cherry

Sweet cherry trees are taller, more upright growing, and branch less than tart cherry trees (Fig. 1). Sweet cherry flower buds do not contain vegetative parts and produce only flowers. After flowering and fruiting, these flower buds die. Flower buds are located at the base of one-year-old shoots and on spurs on older wood (Fig. 2). Spurs are short shoots less than 4 inches long. The spurs may bear from zero to several buds and each flower bud may contain one to several flowers. For a spur to flower more than one year there must be new growth each year for the development of flower buds. On one-year shoots all but the basal buds are vegetative and these may develop into spurs. As branches age, they become less vigorous and the numbers of spurs decrease and the spurs usually produce fewer flower buds. Buds just below the terminal bud on non-pruned branches will develop into side shoots (Fig. 3). The number, the angle of growth, and the vigor of the lateral branches depend on the variety.

Pruning and Training Sweet Cherry Trees

Sweet cherry trees are pruned to maintain tree size and shape, to allow good light distribution throughout the canopy, and to balance vegetative growth with reproductive growth. Most of the fruit are produced

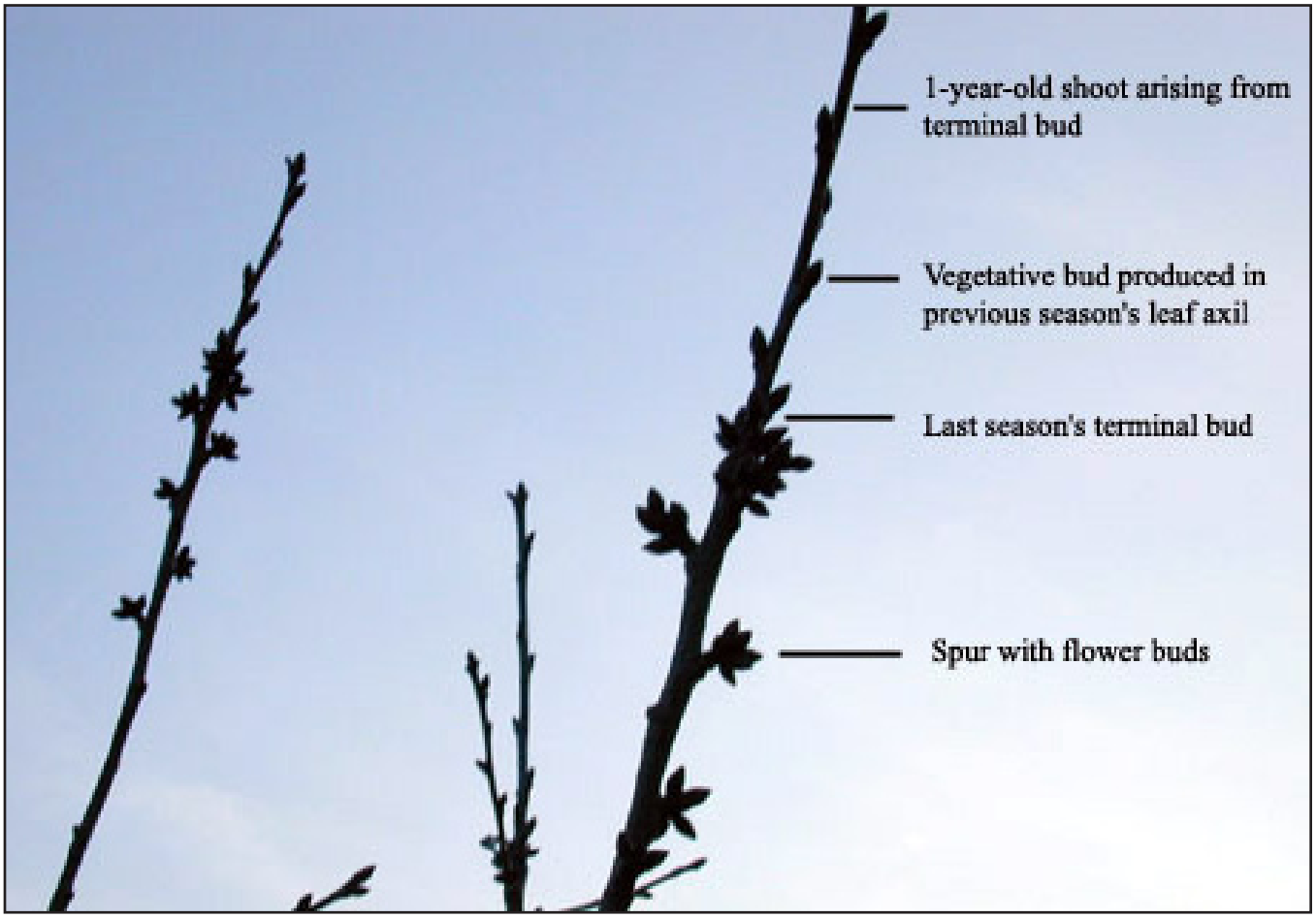

Figure 2. The growth and fruiting habits of sweet cherry trees are shown in this picture. Vegetative buds developed in leaf axils along the 1-year-old section of the branch; spurs with flower buds are located on the 2-year-old sections of the branch.

on spurs. Spurs are short shoots that usually grow less than an inch in a given year. They arise from the lateral leaf buds, usually on shoots that are one year old. Spurs always have a terminal bud and several flower buds that are borne laterally, often in clusters, on the portion of the spur that grew the previous year. The terminal bud produces a leafy shoot, so the spur elongates in a nearly straight line for several years. Spurs remain productive for 10 to 12 years, but the largest and highest quality cherries are produced at the base of the previous season's growth and on 1- to 3-year-old spurs. Therefore, it is important to grow many new 10- to 12-inch-long shoots throughout the tree while limiting the number of old spurs.

There are many training systems for sweet cherry trees. The two systems described here include the central leader and the open vase forms. The central leader form is probably best for trees on dwarf rootstocks and the open vase form is best for trees on vigorous rootstocks. Sweet cherry trees are large and vigorous and can attain a height of 30 feet. Without some type of manipulation, they produce long shoots with few lateral branches. Such branches are not very fruitful and they are difficult to maintain. Properly pruned trees produce more branches that are closer together, but heavy pruning of young trees also will delay fruiting. Trees on vigorous rootstocks and pruned with traditional methods rarely produce a crop before the fifth or sixth year. Dwarfing rootstocks make it much easier to control vigor and the trees produce fruit in the third year.

Central leader Training

Central leader training of sweet cherry is fairly new and several methods are being developed in Europe for trees on dwarfing rootstocks. As we gain experience with central leader training, the techniques will continue to evolve. Presented below is a method developed from ideas suggested by cherry researchers in Michigan and Washington.

At planting. All branches are usually removed at planting because few branches are at the appropriate

Figure 3. Growth habit of the sweet cherry tree is characterized by whirls of shoots located along a branch. Each year several shoots develop just below the terminal bud, resulting in long non-branched sections between the whirls.

height. If a tree has at least three nice branches arising from the leader at 24 inches or more above ground and with wide crotches, the branches can be retained. Head the branches about 50%. Heading involves removing the terminal end of a branch. Heading will stiffen the branch and induce branching near the heading cut. Head the leader to a height of about 30 inches above ground.

First summer. When newly developing limbs are 3 to 5 inches long, attach clothespins to the trunk above limbs with narrow crotches to push the limb outward and widen the crotch. The ideal crotch angle is 90 degrees. Large clothespins work better than standard pins. Using clothespins later in the season is less successful because limbs are difficult to reorient as they become stiff at the base.

Later in the summer if some potential scaffolds are growing too upright, they can be tied down, but they should be kept above the horizontal. Vigorous shoots should be headed by 25%.

First winter. Completely remove all limbs lower than 24 inches above ground. Retain 4 to 6 scaffold branches with wide crotches. With a horizontal cut that leaves the bud at the base of the limb, remove upright limbs with narrow crotches. This type of cut will usually stimulate a branch to form, with a wide crotch, from the bud. Limbs above the desired scaffolds that have wide crotches should remain, but if too upright or dominant, they can be tied or weighted down, or cut back to 8- to 10- inch stubs. Sweet cherry trees tend to produce shoots from two to four buds directly below the terminal bud and these developing shoots inhibit development of shoots from lower buds. If trees are allowed to grow naturally, there is a central leader with a whirl of branches with narrow crotches at the tip of each year's growth and blind wood (sections of the leader with no branches) between the whirls of branches. Most of the branches with narrow crotches should be removed. Such trees are not very productive during the early years due to inadequate numbers of desirable branches.

At 1/2 inch bud growth – When the vegetative buds are about 1/2 inch long, leader manipulation is required to slow the vertical growth of the tree and to induce better branching. If the leader grew more than 20 inches, it should be headed to remove 1/3 of last year's growth. Debud the leader by removing the buds for 3 to 4 inches below the terminal bud. This includes removing buds on either side of the terminal bud if the terminal was not headed. If last year's terminal growth was less than about 30 inches, also remove every other bud. If last year's terminal growth was greater than 30 inches, remove two out of three buds. Remove shoots that grew on last year's terminal growth.

Second and Third Winters. If necessary, head the leader to 30 inches of new growth. Debudding leaders in the third year may be desirable, but usually no debudding is needed thereafter. Remove very upright limbs with horizontal cuts. Begin removing or shortening back limbs that are too dominant. Minimize pruning of vigorous trees to encourage early fruiting, but less vigorous trees or trees on dwarfing rootstocks may require heavier pruning to balance cropping and vegetative growth.

Scaffold branch management during the third and fourth years depends on the vigor of the trees. When trees are growing vigorously, the scaffold branches should not be headed to encourage fruiting. When tree vigor is low, especially on dwarfing rootstocks, the trees may over crop and stop growing before they have grown large enough to produce large crops. To prevent over cropping of young trees, head the scaffolds during the first, second, and third winters. Head to an upright bud, and the next winter the shoot developing from the upright bud is removed by heading to an outward growing shoot. This type of heading will reduce the fruiting potential by reducing the number of future spurs.

Fifth winter and thereafter. Prune to maintain adequate vigor and light throughout the tree. Because of the high productivity of dwarf rootstocks, pruning may need to be more severe to attain adequate growth to achieve large fruit size. The extent of this pruning is determined by the tree vigor, the fruiting potential of the variety, and the desired fruit size.

Open Vase Training.

At planting. All branches on newly planted trees are usually removed because they are at the wrong height or because they have narrow crotches. If there are no branches on the tree, head the leader 30 inches above ground. If there are at least two desirable branches (branches with wide crotches and located 24 to 30 inches above the ground), then retain those branches and remove all branches arising less than 24 inches above ground and all branches with narrow crotches; head the leader by 1/3. The branches should be cut back only if necessary to reduce the longest ones to about the same length as the shortest.

First summer. When shoots are 3 to 5 inches long, spread them with clothespins to develop wide crotch angles.

First winter. Remove all branches less than 24 inches above ground and all branches with narrow crotches. Retain 3 or 4 scaffold branches with wide crotches that arise on different sides of the tree. Ideally, the branches should be arranged around the leader about 90 degrees from one another. The branches should also be spaced 6 to 10 inches apart, vertically along the leader. Branches selected in this manner will be stronger and more resistant to winter injury and canker than poorly formed branches. Sometimes, especially when the tree does not grow vigorously, it may require another season to develop the desired number of scaffold branches. Remove the two buds just below the terminal bud.

Second winter. Remove all branches with narrow crotches or that arise less than 24 inches above ground. If necessary, select the remaining permanent branches. There should be no more than 4 primary scaffold branches. Secondary branches will develop from the buds just below the previous season's terminal bud. Remove any secondary branches with narrow crotches arising along the primary scaffold branch.

Third winter and beyond. After selecting the scaffold branches, little additional pruning is needed. Too much pruning will reduce fruiting. When the tree becomes too tall, shorten the branches by cutting the most upright branches to outward-growing limbs.

Prevent winter injury

Cherry trees are susceptible to low temperature injury. Winter temperatures in Virginia are rarely low enough to kill trees or young shoots. However, warm sunny days followed by rapid cooling in the evening can injure bark on the trunk and lower sections of branches. During the winter the angle of the sun is low, and the temperature of bark on trunks and branches may be well above the air temperature because there is no foliage to provide shade. On clear winter nights, especially when there is snow on the ground, air temperatures may drop very fast and cause bark injury, especially on the southwest side of the trunk, on the upper surfaces of relatively flat branches, or in narrow branch crotches. This type of injury is commonly referred to as "southwest injury" and sometimes causes bark splitting. If bark splitting is discovered within a day or two of occurring, before the bark dries out, tack down the bark against the tree with roofing nails to repair the damage. Paint the damaged surfaces with an asphalt-based tree coating material to prevent drying and improve healing of the bark. Often low temperature injury is not apparent for several months when the dead bark appears as a sunken area, and there is nothing that can be done to improve healing. These areas of dead bark become entry sites for borers and disease infection.

Southwest injury can be minimized by painting trunks, especially on the southwest side, with white **latex** paint during the early fall. The white paint reflects the sun's heat away from the bark and minimizes the rapid temperature fluctuations that cause injury. After leaf fall during the first, third, and fifth years after planting, paint the trunk from the ground to the lower branches, the lower branch crotches, and the lower sections of scaffold branches with a solution of half white latex paint and half water. Never use oil base paint because the oil will injure the bark. Paint can be applied with brushes or with a sprayer. A fairly efficient method of applying paint involves inserting a latex or rubber glove inside a cotton glove. Dip the gloved hand in the paint and rub your hand over the trunk and branches. Older trees are less susceptible to southwest injury, possibly because the bark is thick enough to resist injury.

Insect and Disease Pests of Cherries

There are many insect and disease pests of cherry trees. Pesticide registrations change frequently and are not discussed here. Current recommendations for pesticide materials, timings, and rates for commercial fruit growers can be obtained from the VCE Publication 456-419, *The Spray Bulletin for Commercial Tree Fruit Growers*, and noncommercial growers should purchase VCE Publication 456-017, *Virginia Pest Management Guide for Horticultural and Forestry Crops*.

Bacterial canker is a disease of cherry and is caused by the bacteria *Pseudomonas syringae* pv. *syringae* and *Pseudomonas syringae* pv. *morsprunorum*. A discussion of this disease is presented here because it can kill or seriously damage trees and because there are some cultural practices that can minimize infection. Other cultural practices may encourage infection and should be avoided. The bacteria is active in all phases of the growing season but is most devastating to young trees which are most susceptible to damage. The bacteria over-winter in bark tissues at canker margins, in apparently healthy buds and/or systemically in the vascular system. In the spring, especially when the conditions are cool and wet, bacteria multiply and emerge from their over-wintering sites and are disseminated throughout the orchard by wind and rain. Entry sites for bacteria include natural openings (stomata, flowers,

and lenticels), wounds, pruning cuts, or winter injury sites. The bacteria can infect flower buds and spurs. It can kill new spurs and leaves and then move into the trunk. Cankers can continue to develop in lateral branches and the trunk. The cankers will sometimes increase in size for several years. If trunks or scaffold branches of young trees are infected, a canker may develop that may weaken or even kill the tree. Cankers typically ooze amber-colored gum and often become entry sites for borers. In young plantings this disease can kill up to 10% of the trees and it can reduce yields in mature orchards 10 to 50%.

Bacterial canker is very difficult to control in Virginia. Below is a combination of chemical control and cultural practices from New Jersey to minimize the severity of this disease.

- In the spring apply 1 to 2 applications of Bordeaux mixture before bud break. This mixture contains copper and sterilizes the tree surface.
- Do not dormant prune because the wounds heal slowly.
- Summer prune immediately after harvest. Prune cankered limbs well below visible cankers. Avoid pruning in early spring and fall when bacteria are most active. Sterilize pruning tools with Clorox or alcohol before pruning healthy trees.
- Remove wild species of Prunus species adjacent to the orchard to reduce inoculum.
- Do not stake trees to provide support because infection develops where the trunk rubs against the stake.
- Apply an antibiotic, such as streptomycin, just before debudding or pruning in the spring and summer. The antibiotic is systemic and provides better control than copper. Copper, applied during the growing season, may also cause leaf injury.
- When mowing or cultivating around the tree, take care not to damage the bark because the wounds can become entry sites for the bacteria.

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