



Growing Pears in Virginia

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Introduction

Pear is the second most important deciduous tree fruit after apple, and it has been grown in Europe since prehistoric times. Pears belong to the genus *Pyrus* and probably originated near the Black and Caspian Seas. French and English colonists brought pears to America and the first record of pears in the North America was in Massachusetts in 1630. Although pear is a popular fruit, it is not grown as widely as apple. Pears can be grown throughout much of North America because they tolerate a wide range of climatic conditions. However, commercial production is largely limited to the west coast states. One of the major limiting factors for commercial pear production is the bacterial disease known as fire-blight [*Erwinia amilovora* (Burrill)]. Humid conditions in the eastern U.S. favor development of this disease that can kill pear trees. There now exist several pear varieties that possess varying levels of fireblight resistance, making pear production possible in the east.

Two types of pears can be grown in Virginia. European pears (*Pyrus communis*) are the type most commonly seen in the supermarkets. Common varieties include 'Bartlett', 'D'Anjou', 'Bosc' and 'Comice'. These pears are picked when mature but before they are ripe, then they are exposed to a chilling period, and then ripened. The flesh of the ripe fruit is usually soft and mealy. Asian pears were developed from several *Pyrus* species, but are usually considered to belong to the genus *Pyrus* and the species *serotina*. Asian pears are sometimes marketed as "Sand pears", "Chinese pears", "Japanese pears", or "apple pears". Asian pears are usually fairly round and ripen on the tree. The flesh is usually white, crisp, sweet, and juicy. Asian pears are best eaten after being held in the refrigerator for a day or two. Then the fruit is peeled, cored, and sliced.

Requirements for Growing Pears

Climate. Most parts of Virginia have climatic conditions favorable for pear production. Most pear varieties require

about 1,000 to 1,200 hours below 45 degrees F during the winter to complete their dormant period. Although most pear varieties are slightly less winter hardy than apples, most varieties can withstand low winter minimum temperatures common in Virginia. Fully dormant trees can survive temperatures of -20 to -25 degrees F.

Pear trees usually bloom 3 to 7 days before apples, and flower buds or open flowers may be killed by spring frost. Temperatures of 26 degrees F or lower will generally kill open blossoms. Like other tree fruits, pear trees crop most consistently at higher elevations in Virginia. Periods of warm weather during late winter often result in early bloom, followed by frost in the Tidewater and Piedmont regions. Fluctuating winter temperatures are less common at higher elevations and trees tend to bloom later and avoid spring frost. The microclimate in coastal regions may also reduce the likelihood of frost damage. During late winter the cool ocean water lowers the air temperature and delays bloom. In addition, on frost nights the relatively warm water increases the air temperature preventing a frost.

Fruit trees are difficult to protect from spring frost. Covering trees with insulating materials is not effective unless there is a source of heat under the material. Constructing a tent, with polyethylene plastic, over the tree and placing a heater under the tent can protect individual trees from frost, but this is not feasible for an orchard. Sprinkling trees with water is sometime successful. Freezing water releases heat, but the ice itself provides no insulation. Sprinkling must begin when the temperature is about 31 degrees and must continue until morning when all the ice is melted. Sprinkling is most successful on nights with a radiational frost. Radiational frost occurs on clear calm nights. Sprinkling is not effective when there is an advective freeze, which accompanies large cold air masses with wind and low dew points. Under such conditions, some water evaporates before freezing and the process requires heat and actually cools the plant tissue. Sprinkling during an advective freeze

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often increases the frost damage. Some commercial fruit producers install large fans in their orchards.

During a radiational frost cold air sinks to the ground because it is heavier than warm air. This results in a layer of warm air above the cold air, which is called an inversion layer. During a radiational frost, fans pull warm air out of the inversion layer and warm the air near the ground. Fans often save a crop, but they are expensive to install and to operate.

Planting on a frost-free site is the best way to minimize frost injury. Sites with good air drainage are usually located at 800 to 2000 feet above sea level. However, the orchard must be located on ground that is higher than the surrounding ground so cold air will settle below the orchard and the trees will be in the inversion layer.

Soil. Pear trees tolerate a wide range of soil conditions. Soil fertility is not an important criterion for growing pears because it is easily modified. Soil pH should be about 6.2 to 6.8, and can be adjusted with surface applications of limestone. Plant nutrients such as nitrogen, phosphorous, potassium, and micronutrients also can be added to the soil. The most important considerations for pears are soil depth and water drainage. Pear is the most tolerant of all fruit trees to wet soils. However, if the roots are under water for more than several days the root system will be injured. Water drainage characteristics of the soil can be evaluated by digging a hole 3 feet deep. The day after a rain of at least one inch, while the soil is still moist, fill the hole with water. The soil is suitable if the water drains out of the hole within three days.

Avoid soils with a rooting depth less than 2 or 3 feet. A layer of clay or rock can sometimes limit the rooting depth. Such a layer restricts root growth to the upper layer of soil and prevents water movement into or out of the root zone. Therefore, the soil is too wet after rain and the soil dries out quickly during a drought. Shallow rooted trees are also more likely to lean or fall over during wind events.

Pear Rootstocks

All fruit trees, including pear, are not grown from seed. Trees grown from seed will not be of the same variety as the seed and rarely is the eating quality of the fruit acceptable. The only way to maintain the genetic identity of a variety is through vegetative propagation. Pear trees

do not root easily, so pears are propagated by budding or grafting onto a rootstock. Rootstocks are propagated from seed or from cuttings. Large nurseries, specializing in fruit trees, produce the rootstocks, bud or graft the variety onto the rootstock, grow the tree in the nursery for a year, and ship the trees to the consumer.

Rootstocks can influence tree growth in several ways. Some rootstocks are more tolerant of different soil conditions and soil-borne diseases. Some rootstocks produce dwarf or semi-dwarf trees. Some rootstocks cause the tree to produce fruit at a young age. Therefore, it is important to purchase trees budded onto rootstocks that are known to perform well in the eastern U.S.

European Pears. Domestic Seedlings [seeds of the European pear varieties 'Winter Nelis' (*Pyrus communis*) or 'Bartlett'] are the most commonly used pear rootstocks. These rootstocks produce standard size trees, but perform poorly on wet soils. In Oregon trees on 'Winter Nelis' are slightly more vigorous than trees on 'Bartlett'.

Pyrus betulaefolia Seedlings are adapted to poorly drained or wet soils. Trees are more vigorous than 'Bartlett' seedlings. This rootstock tends to produce deep roots, so it performs well on droughty soils.

Hybrids of 'Old Home' and 'Farmingdale' (OH x F) are propagated from cuttings, they are moderately resistant to fireblight, they are compatible with common varieties, and they provide good anchorage. OH x F #18 is very vigorous and is used for Asian Pears. OH x F #97 is vigorous and produces a tree similar in size to Domestic Seedling. OH x F #333 and OH x F #282 are semi-dwarf and produce trees about 75 to 80% of Domestic Seedling.

Selections of Quince (*Cydonia oblonga*) are propagated from cuttings, and are the most dwarfing rootstock available for pear. Quince produces trees about 70% of Domestic Seedling and induces early fruiting. Some varieties, such as 'Bosc' and 'Bartlett', are not compatible with Quince and require a compatible interstem. Information from Oregon indicates that Quince is about as susceptible to fireblight as Domestic Seedling.

Asian Pears. Asian pear trees are weak growing and require rootstocks more vigorous than *Pyrus communis*. *Pyrus betulaefolia* is usually used for Asian Pears.

Pear Varieties

European Pears.

Most of the popular commercial varieties are very susceptible to fireblight and are not recommended for Virginia. No pear variety is immune to fireblight, but some have considerable resistance. Most of the resistant varieties have not been evaluated in Virginia and the following descriptions were summarized from nursery catalogues and reports from other states.

‘Harrow Delight’ – This variety is a hybrid of (Old Home x ‘Early Sweet’) x ‘Bartlett’, and was introduced in 1982 by the Harrow Research Station, in Harrow, Ontario, Canada. The fruit is medium size, similar to ‘Bartlett’ in appearance and has excellent flavor. The skin is light green to yellow-green with 20% to 30% light red blush. The flesh is smooth with no grit cells. It ripens about two weeks ahead of ‘Bartlett’.

‘Stark Honeysweet’ – This variety is a hybrid of ‘Seckel’ x (‘Vermont Beauty’ x ‘Roi Charles de Waurtemburg’) and was patented by Stark Brothers Nurseries in 1979. The large fruit is covered with golden russet and ripens in late August. The flesh is smooth, and buttery with no grit. The flavor is rich, sweet and similar to ‘Seckel’.

‘Moonglow’ – This variety is a hybrid of US-Mich. 437 x ‘Roi Charles de Waurtemburg’ and was introduced in 1960 by the USDA, Beltsville, MD. The fruit is medium to large in size and yellow. The flesh is soft, white, moderately juicy, and nearly free of grit cells. The flavor is mild and sub acid. It ripens in early to mid-August, about one week ahead of ‘Bartlett’.

‘Harvest Queen’ – This variety is a hybrid of ‘Barseck’ x ‘Bartlett’ and was introduced by the Harrow Research Station in Harrow, Ontario in 1982. This is a new ‘Bartlett’ type pear with good fireblight resistance. The flesh is similar to Bartlett, but less gritty. It ripens one week ahead of ‘Bartlett’. The fruit is very similar to ‘Bartlett’ in appearance and flavor, but slightly smaller in size. Reports indicate that it is good for canning.

‘Magness’ – This variety is a hybrid of ‘Seckel’ seedling x ‘Comice’, and was released from the USDA breeding program in 1968. The fruit is medium in size and the skin is covered with a slight russet. The flesh is soft, juicy, and nearly free of grit cells. The flavor is sweet, highly perfumed, and aromatic. The fruit is generally consid-

ered to be of very high quality. It ripens about a week after Bartlett. ‘Magness’ does not produce good pollen and must be planted with two other varieties to ensure that all three varieties will produce fruit.

‘Potomac’ – This is a hybrid of ‘Moonglow’ x

‘Buerre D’Anjou’ and was released in 1993 by the USDA. The fruit is moderate in size and the skin is light green and glossy. The flesh is moderately fine, buttery, and has some grit cells. The flavor is mild and sub acid and the aroma is mild. It ripens about two weeks after Bartlett.

‘Seckel’ – This variety is sometimes called “sugar pear.” The fruit is small and yellowish brown with a pale red russet. The flesh is fine grained, smooth, juicy, and extremely sweet. The tree is fairly resistant to fireblight and is considered to be one of the highest quality pears. It is excellent for canning whole or for making spiced pears.

‘Harrow Sweet’ – This variety is a hybrid of ‘Bartlett’ x Purdue 80-51, and was recently released by the Harrow Research Station in Harrow, Ontario. This new variety ripens about 25 days after ‘Bartlett’ and has good fireblight resistance. The size is similar to ‘Bartlett’. The skin is yellow with red blush and some russetting. The flesh is white, sweet, juicy, and flavorful.

Asian Pears. Asian pears vary in their resistance to fireblight, but most are susceptible to fireblight.

‘Shinseiki’ (English translation = Twentieth Century) – This pear originated as a chance seedling in Japan in 1888. This variety is the standard against which other Asian pears are compared. This pear ripens in early August. The fruit is round and the skin is greenish yellow with no russet and is semi-glossy. The flesh is sweet, crisp, and juicy, and the fruit stores for about 20 weeks.

‘Kosui’ (English translation = Good Water) – This variety is a hybrid of ‘Kikusui’ x ‘Wasekoso’ and was released in 1959 by the National Horticultural Research Station, Tsukuba, Japan. The fruit is medium in size, and the surface is yellow-bronze with russet. The flesh is crisp, very sweet, juicy, and has low acid **‘Hosui’** (English translation = Much Water) – This variety is a hybrid of ‘Kikusui’ x ‘Yakumo’ and was released in 1972 by the National Horticultural Research Station, Tsukuba, Japan. The fruit is large and round globular in shape. The skin is

solid russet and golden with pronounced lenticels. The flesh is off-white sweet, mild, crisp, and juicy. There is a little acid, which gives it a fairly complex flavor. Fruits store about 4 weeks.

‘Nitaka’ – This is a highly russeted orange-brown pear with excellent size. The flesh is juicy and sweet and is heavier textured than most Asian Pears. Fruit can be stored six months.

‘Olympic’ – This round, large, heavily russeted brown Asian Pear has a crisp, juicy sweet taste. Fruit can be stored eight months.

Pollination.

Like apples, pear is self non-fruitful and usually will not set a good crop of fruit with its own pollen. Therefore, at least two different varieties must be planted near each other for cross-pollination. Insects, especially honeybees, carry pollen from one tree to another. Unfortunately, pear flowers produce little nectar and are less attractive to bees than many other types of flowers. Therefore, it is important to plant pear trees close together, preferably within 70 feet of each other for cross-pollination.

Purchasing and Handling Trees

There are no fruit tree nurseries in Virginia, so all fruit trees are imported from other states. Pear trees can be purchased from local garden centers and most of the trees are shipped from the west coast. Garden centers usually purchase trees as bare-root trees, plant the trees in containers, and sell them as soon as possible. These trees grow well, but the selection of varieties and rootstocks is often limited. Usually the rootstocks are not identified and are referred to as “semi-dwarf” or “dwarf”. The only way to ensure a good selection of varieties and rootstocks is to purchase trees, through the mail, from a nursery that specializes in growing fruit trees. Most reputable nurseries now have websites. Some nurseries sell two-year-old trees. These trees were often too small to sell after one year in the nursery, so they grow them for an extra year. These large trees are usually more expensive than smaller trees. There is little advantage to planting large trees, because medium-size trees (2 feet to 4 feet tall with a 1/2 inch trunk diameter) grow very well. Large trees often grow poorly the first year because there is too little root system to support the large top. Medium-size and large trees planted in the spring are usually similar in size by fall.

When trees are purchased locally in pots, the trees should be watered every few days to prevent drying out and planted as soon as possible. Dormant trees will usually grow better than trees with leaves because dormant trees will have a chance to grow roots before the leaves start to demand water. If trees are purchased through the mail, they will arrive in a paper bag or a waxed cardboard box. The roots are covered with moist sawdust or some other material. Open the bag to make sure you have received trees of the correct variety and rootstock. Check the material covering the roots and, if dry, moisten it. Plant the trees as soon as possible. If trees can't be planted for several weeks, then leave the trees in the bag and place the bag in a cool place, such as the basement, the garage, or the north side of a building.

Planting Trees.

If dormant trees are available, trees can be planted in late fall and early winter. Most nurseries ship trees in the late winter and early spring. Plant trees as early in the spring as possible (March and early April). Trees planted in May and June may not grow as well as earlier planted trees. Root growth occurs when soil temperatures are above 45 degrees F. Best tree growth occurs when root growth begins before leaves are produced by the tree.

The roots should be moist when planting. Soak the roots in water for 30 minutes to an hour before planting. Dig a planting hole large enough to accommodate the root system; a hole 18 inches deep and 18 inches wide is usually adequate. Remove broken roots and shorten long roots so they fit in the hole. Set the tree at the same depth at which it grew in the nursery, or set the tree so the highest roots are about 4 inches below the soil. After putting the root system into the hole, partially fill the hole and tamp the soil to ensure root-to-soil contact so roots will not become dry. Fill the hole and tamp the soil by walking around the tree. Water the tree with at least 2 gallons of water per tree. Place a cylinder of hardware cloth loosely around the base of the trunk to prevent rodents from feeding on the bark.

Because there are no truly dwarfing rootstocks for pears, the trees tend to be large. Well-pruned mature trees are 18 feet to 20 feet tall and 16 feet to 18 feet in diameter. Trees growing in fertile soils will be a little larger, and those planted on shallow or sandy soils will be a little smaller. In general, pear trees should be planted at least 16 feet apart. If planted in rows, trees can be spaced 16 feet within the row and 22 feet to 24 feet between rows.

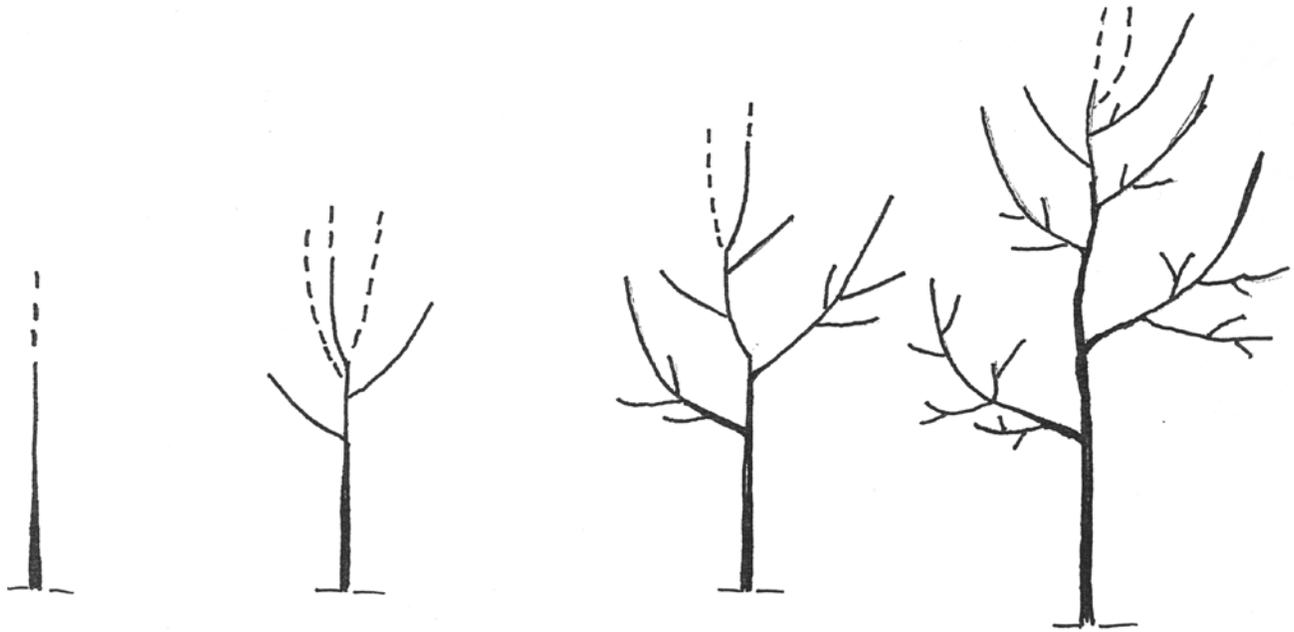


Figure 1. Training and pruning pear trees to the modified leader form during the first four years (left to right). Dotted lines represent portions of the tree that should be removed by pruning during the late winter.

Training and Pruning.

The basic principles and practices of pruning fruit trees are discussed in detail in another bulletin (*Training and Pruning Apple Trees*, VCE Publication 422-021). A condensed discussion of pruning will be presented here.

There are three basic forms to which fruit trees can be trained. The Central Leader consists of a tree with one main trunk, with about 12 to 16 primary scaffold branches originating from the trunk. The top of the tree is kept narrower than the bottom of the tree, so the tree has a conical or Christmas tree shape. The open center or open vase consists of three to five major branches arising from the trunk within three feet from the ground. The mature tree has few branches in the center and is shaped like a bowl. The Modified Leader consists of a main trunk with five to seven primary branches arising from the trunk within about 6 feet from the ground. The mature tree is usually oval-shaped.

Some pear growers prefer to train trees as modified leaders or open vase. If fire blight kills one of the leaders, then two-thirds to four-fifths of the tree remains. Other pear growers prefer the central leader form because trees will usually start to produce fruit a year or two earlier than when trained with multiple leaders.

Asian Pears. Asian pears and European pears have very different natural growth habits and this must be considered while training the trees. Asian pears are relatively small trees (usually 8 feet to 12 feet tall) and they often produce fruit by the third season. The branches also have very narrow crotch angles, which are usually considered undesirable because narrow crotches are weak and may split. Techniques used to improve crotch angles with other tree fruits are less successful with Asian pears, so trees should be allowed to grow fairly naturally. Experience in Virginia indicates that Asian pears perform well when trained to a modified leader and the trees are fairly easy to train to this form (Figure 1).

At planting, remove the top of the tree by heading at 36 inches above ground. This heading cut will cause buds just below the cut to develop into shoots. These shoots will become the primary scaffold branches. Also remove any branches that are broken or that originate lower than 30 inches above ground. If there are branches with wide crotches longer than 30 inches, these shoots should be shortened to about 20 inches.

Trees should be pruned during late winter, 7 to 30 days before bloom. The first winter there should be two to four upright shoots of similar vigor that developed from buds on the leader just below the heading cut. Retain the longest straightest shoot and this will be the leader. Head

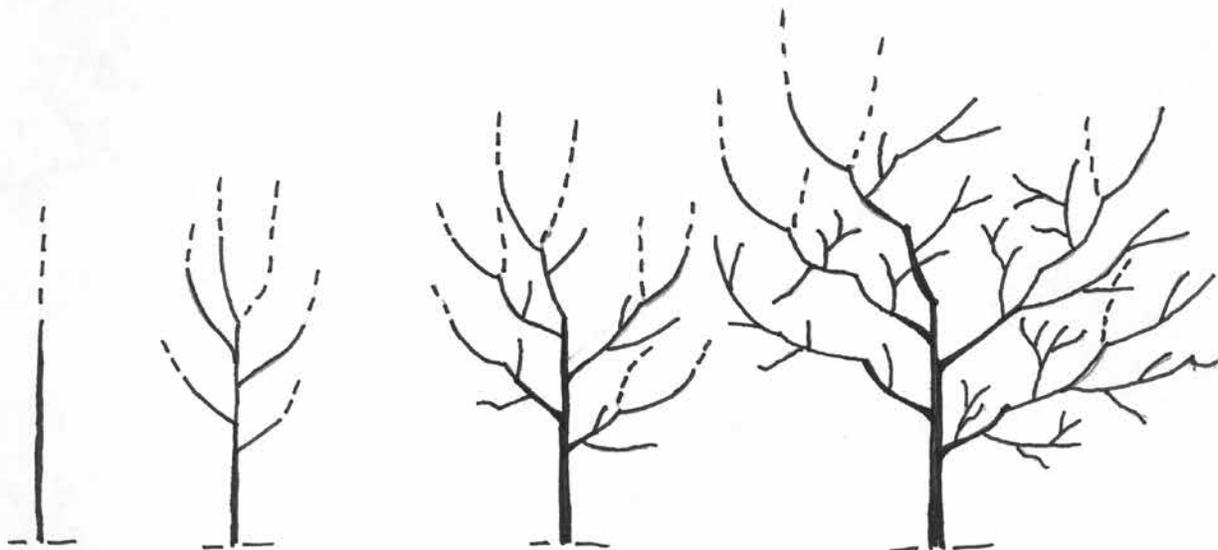


Figure 2. Training and pruning pear trees to the central leader form during the first four years (left to right). Dotted lines represent portions of the tree that should be removed by pruning during the late winter.

the leader to remove the top one-third of the shoot. Remove the two or three competing leaders. If the tree grew well there should be one to five shoots developing along the lower two-thirds of the leader. These shoots are usually shorter and have wider crotch angles than the shoots above them. Remove all shoots lower than 2 feet from the ground and retain all other shoots with wide crotch angles. Remove the topmost one-third of each shoot with a heading cut. The heading cuts will stiffen the branches and induce several vigorous shoots to develop from buds below the cut.

During the second winter, retain the straightest shoot developing on the leader and remove all competing shoots. Retain shoots below each heading cut that are most horizontally oriented and remove all the other vigorous shoots below the heading cut. Remove low branches and any vertically oriented vigorous shoots. Use heading cuts to shorten all shoots and the leader by one third. By the third year, the trees will start to fruit and the weight of the fruit will pull the ends of the branches down. The tree will eventually develop a drooping appearance. As trees start to fruit, shoot growth becomes less vigorous and little pruning is required. Each winter remove any vigorous upright shoots. As the ends of the scaffold branches droop below the horizontal, shorten the branches by cutting into 2- or 3-year-old wood to a more horizontally oriented branch. The mature tree will be about 8 to 12 feet tall.

European Pears. Trees can be trained to the modified leader form described above. However, to encourage early fruiting, the central leader tree form is recommended for European pears. The central leader consists of a tree with one leader and the tree has a conical or Christmas tree shape (Figure 2).

At planting head the leader at 36 inches above ground and remove all branches lower than 30 inches above ground. Remove all broken branches and branches with narrow crotch angles. During the first growing season, several vigorous shoots will develop from buds just below the heading cut. During the first winter, retain the longest, most vertical of these shoots and remove the other vigorous shoots with narrow crotch angles. Retain less vigorous limbs with wide crotch angles that are at least 28 inches above ground. If branches are very upright, the branches can be reoriented to an angle of about 30 to 40 degrees from vertical with a spreader. Spreaders can be made from pieces of stiff wire sharpened at the ends or strips of wood with a sharpened nail in each end. One end of the spreader is placed in the trunk and the other end is placed in the branch. Spreaders can be removed after several months. The resulting wounds in the bark heal rapidly. Each year during the dormant season head the central leader by about one third and remove competing vigorous leaders with narrow crotch angles. Retain all branches with wide crotch angles. Do not head the branches. Eventually there will be too many branches. After the tree has fruited for at least two years some of the

branches should be removed. Eventually the ends of the branches will droop from the weight of the fruit. Shorten these branches by cutting into 2- or 3-year-old wood to a more horizontal branch. The ideal tree will have four to six branches radiating around the tree like spokes of a wheel about 3 feet to 5 feet above ground. These branches are permanent branches. The branches should be spaced vertically with about 4 inches to 6 inches between the branches. Above this first layer of branches there should be about 8 to 12 branches radiating around the trunk. These branches can be considered temporary branches. Each year remove branches that are at least one half the diameter of the trunk at the point where the branch originates from the trunk. New shoots will develop near the pruning cut and can be retained to replace the overly vigorous branch. This process of limb replacement will keep the treetop narrow and relatively non-vigorous. The mature tree will be about 16 to 24 feet tall.

Mineral Nutrition.

Like all green plants, pear trees require certain mineral nutrients for growth. Pear trees that grow vigorously are very susceptible to fireblight. Therefore, less nitrogen is applied to pear trees than to apple trees. The year before planting contact your local county Extension office for a soil testing kit and send the sample to the Soil Testing Lab at Virginia Tech. The test results will be accompanied by recommendations for lime to adjust the soil pH to about 6.5. If possible, lime should be applied the year before planting because lime moves very slowly into the soil. If phosphorous or potassium are in the medium or high range, there is no need for additional applications. If phosphorous or potassium are in the low range, then apply 1/4 pound of fertilizer containing 10% K₂O or 10% P₂O₅ such as 10-10-10 or 5-10-10, or apply 0.125 pounds of 10-20-20 fertilizer per tree. Before planting spread the fertilizer and lime over a 3 foot x 3 foot area where the tree will be planted and incorporate it into the soil with a shovel or rototiller. This is all the fertilizer that is needed the first year. In future years nitrogen is usually the only nutrient needed for good growth. Commercially, nitrogen fertilizers such as urea, ammonium nitrate, or calcium nitrate are preferred because these are the least expensive sources of nitrogen. For non-commercial situations, complete fertilizers are more convenient. The fertilizer formulation is not important; any complete fertilizer used for the lawn or garden can be used. Each spring apply fertilizer in the spring, about a month before bloom, at the rate of about 0.10 pounds of actual nitrogen per tree: this is equivalent to 1.0 pound

of 10-10-10, 2.0 pounds of 5-10-10, or 1.25 pounds of 8-8-8 fertilizer. For trees growing in sandy soils or if for some reason shoot growth is less than desired, the nitrogen application can be doubled. Apply the fertilizer evenly under the drip line of the tree.

Occasionally, symptoms of boron deficiency will develop in pear fruit. This disorder is known as internal corking and the symptoms appear as brown corky areas within the fruit. When the deficiency is severe the fruit may be misshapen. Boron deficiency can be alleviated with a soil application of 0.037 ounces (this is equivalent to about 1.0 gram or 1/3 teaspoon) of borax every three years. Don't apply boron unless there is evidence that the tree is deficient because too much boron can injure or kill a tree.

Weed Control

Weeds growing under trees compete for water and nutrients, and result in poor tree growth, especially for young trees. Commercial fruit producers use both pre-emergent and post-emergent herbicides to control weeds. Weeds can be controlled in the backyard with a hoe or by spreading mulch under the tree. Weeds should be controlled to a distance of about 3 feet from the trunk. Some mulches provide a desirable habitat for rodents that feed on the bark and roots. During late fall examine the mulch for evidence of vole activity. If active runs are obvious, the voles can be eliminated with mousetraps.

Fruit Thinning

Pear trees often set more fruit than the tree can properly size and mature. If trees are allowed to have too many fruit, the fruit are small and may not develop high sugar levels. In addition, over-cropping a tree may result in limb breakage and may reduce the amount of bloom produced the following year. The earlier in the season partial fruit removal (thinning) is completed, the greater will be the benefits. European pears usually have clusters of five blossoms, whereas Asian pears usually have clusters of 10 to 12 blossoms. Therefore, Asian pears are most prone to over-cropping.

Commercial pear producers apply chemical thinners within three weeks after bloom to partially thin trees. The plant growth regulator naphthaleneacetic acid (NAA) at 10 to 15 parts per million can be applied when average fruit diameter is about 5 to 12 mm (7 to 14 days after petal fall). Naphthylacetamide (NAD) can be applied at the rate of 25 to 40 PPM at 4 to 8 days after

full bloom. Chemical thinning experiences in Virginia are limited, so growers will have to experiment with different concentrations and timings for different varieties.

Even with the use of chemicals, adequate fruit removal may require some hand thinning. When fruit set is relatively heavy, fruit should be thinned to retain one fruit every 6 inches along the limb. Asian pears have not been successfully thinned with chemicals. To obtain large fruit, remove all but one or two blossoms per cluster during bloom. Thinning should be completed within four weeks after bloom.

Harvesting Pears

Asian Pears. Like apples, Asian pears ripen on the tree. Fruit should be harvested when the color of the skin changes from green to greenish yellow. Just to make sure the fruit are ripe, taste one that appears to be ripe. If the flesh is juicy and sweet, then the fruit are ready to pick. Most varieties are harvested when the flesh firmness is 8 to 10 pounds. Flesh firmness is measured with a penetrometer using the large plunger (7/16" diameter). Some fruit on the tree may be less ripe than others and fruit may need to be picked several times over a 10-day period to harvest all fruit at optimum ripeness. Asian pears will maintain their harvest quality for 7 to 10 days at room temperature. If held at 32 degrees F, most varieties can be stored for 3 to 5 months.

European Pears. To attain highest quality, European pears must be harvested when they are mature, but before they are ripe. A mature fruit has the ability to ripen and develop acceptable eating quality after harvest. If allowed to tree-ripen, pears typically ripen from the inside out, so the center is mushy by the time the outside flesh is ready to eat. However, if picked when too immature, they often shrivel in storage, lack sweetness and flavor, and are susceptible to storage scald. Scald is a disorder that appears as discolored fruit skin. However, if fruit is picked too ripe it will ripen quickly, has little storage life, and may become gritty. It is difficult to determine proper harvest dates for European pears. Unlike other fruit, the full flavor of a pear only develops after adequate ripening off the tree. Pears picked with improper maturity either lose their capacity to ripen after storage or ripen with poor quality. Maturity is a process involving many changes and should not be judged by a single factor alone. Some of these factors are discussed below.

Flesh firmness – The firmness of the flesh declines as a fruit matures and it is one of the best ways to judge maturity. A penetrometer is used to measure firmness on two sides of the fruit. Most varieties should be harvested when firmness is 16 to 19 pounds.

Soluble Solids – Soluble solids, sometimes called brix, is a measure of soluble sugars in the juice of fruit. Soluble solids generally increase as the fruit becomes mature. Usually, fruit should not be harvested until the soluble solids are at least 10%. However, soluble solids are not always a reliable index of maturity because they can be affected by crop load and weather conditions that influence photosynthesis.

Starch-iodine test – Leaves manufacture sugars in the process called photosynthesis. Some of the sugars are transported to the fruit and are converted to starch for storage. As a fruit matures the starch is converted back to sugar. Cutting a fruit in half and placing the cut surface of the stem end in iodine can be used to evaluate the starch conversion process. The starch in the fruit flesh will stain black or dark blue. The entire cut surface of immature fruit will become stained, and the entire cut surface of an over mature fruit will have little stain because the starch has been converted to sugar. A fruit is ready to pick when about 60% of the maximum starch content remains.

Color change – As pears mature the skin color changes from green to light green or greenish yellow. Pears should be picked when light green and before they turn yellow.

Ease of picking – As pears mature they become easy to detach from the tree. Fruit are ready to pick when they snap off the tree when twisted upwards. If tugging is needed to pick the fruit, then the fruit is probably not ready to harvest. If they nearly fall off the tree, then the fruit are over mature.

Days from bloom to harvest – Number of days from bloom to harvest is fairly consistent, but may vary from one part of the country to another. In Washington, the following intervals are suggested: 'Bartlett' = 100 to 115; 'Bosc' = 130 to 135; and 'D'Anjou' = 145 to 150 days from bloom to harvest.

Storing Pears

Harvested fruit is living tissue. The objective of storage is to slow down the rate of respiration and prolong the life

of the tissue. To attain the highest quality, most pear varieties should be cooled as soon as possible to about 30 degrees F. Fruit doesn't freeze at this temperature because the sugars and other compounds in the juice lower the freezing point below that of pure water. The ideal temperature for long-term storage is 30 degrees F, but 40 degrees is better than 50 degrees. Most household refrigerators are set for 40 to 45 degrees F. Pears can be stored for three to five months depending on the variety. Under ideal conditions 'Bartlett' can be stored about 3 to 4 months and 'D'Anjou' can be stored about 5 to 8 months. Storage life decreases at higher storage temperatures.

Ripening Pears

Compared to other fruits, pears are unique because they have to undergo a ripening process after storage in order to develop full flavor. Most pears are resistant to ripening right after harvest and will not ripen evenly until they have had a period of chilling. Without some post harvest chilling, a mature fruit will eventually shrivel and decompose without ripening. 'Bartlett' pears need to be chilled for only a day or two, whereas winter pears such as 'D'Anjou', 'Bosc', and 'Comice' require two to six weeks of chilling. Pears purchased in the supermarket have already had their chilling requirement. Pears should be ripened at 65 to 75 degrees F and high humidity. The length of time required for ripening differs with variety: 5 days for 'Bartlett', 7 days for 'Bosc' and 'Comice' and 9 days for 'D'Anjou'. Pears are ready to eat when the fruit flesh just below the stem yields slightly to pressure when squeezed.

Pest Control

There are a number of insect and disease pests of pear. In general, pears have fewer pests than apples and adequate pest control may require only 7 to 10 pesticide applications per season. Control measures are not discussed in this publication because registrations change frequently. Descriptions of pests and chemical control measures can be found in two Virginia Cooperative Extension publications. Non-commercial producers should obtain a copy of the *Virginia Pest Management Guide for Horticultural and Forestry Crops*, VCE Publication 456-017; and commercial fruit producers should obtain a copy of the *Spray Bulletin for Commercial Tree Fruit Growers*, VCE Publication 456-419.

Fireblight has the potential to devastate pear plantings in the eastern United States. Therefore, special practices

should be considered to minimize and control fireblight infection. Below are some practices that may help reduce fireblight problems. Following infection, the bacteria become systemic and can move down a branch and into the rootstock. There is no cure for fire blight, so a control program should focus on preventing infection. Plant pathologists disagree on the effectiveness of some of these treatments, but anecdotal evidence suggests that they may help.

1. Plant varieties and rootstocks with fireblight resistance.
2. Avoid stimulating vigorous vegetative growth of the trees because succulent tissue is susceptible to fireblight. Suppressing vigor can be accomplished by judicious fertilization with nitrogen, and by avoiding severe pruning.
3. Apply copper sulfate or Boudreaux mixture at the 1/4 foot green stage of bud development. This is when about 1/4 inch of green tissue appears in most buds in the early spring. Copper will reduce the population of bacteria on the tree surface.
4. Apply the antibiotic streptomycin every 5 to 7 days while there are open blossoms on the tree. The blossoms provide a natural opening where the bacteria can enter the tree. The bacteria can be splashed around on the tree by rain and the bacteria can be carried from one blossom to another by pollinating insects.
5. Apply streptomycin immediately after a hailstorm. Hail can create openings in the leaves and the bark where infection can occur.
6. Avoid injuring the tree during the growing season.
7. Remove fireblight strikes by removing the shoot 8 inches below the lowest visible sign of symptoms, as soon as possible during the season. Between cuts, spray the pruning shears with rubbing alcohol to kill the bacteria.
8. Remove fireblight infected shoots while dormant pruning and disinfect the shears between cuts.
9. Do not prune trees in the rain or when the trees are wet.
10. Remember that fungicides will not control bacterial diseases such as fire blight.