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Growing Fruit for Home Use

John Avery, Patrick Byers, Martin Kaps,
Laszlo Kovacs, and Marilyn Odneal
Edited by Marilyn Odneal



State Fruit Experiment Station
Missouri State University
Mountain Grove



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INTRODUCTION

Why Grow Fruit?

Having fresh, home grown fruit on the table is an enticing idea that prompts many people to consider growing fruit for their own use. Creating a beautiful "edible" landscape is also a worthwhile goal. Growing fruit can be a rewarding hobby if it is understood that a certain amount of work and dedication are required.

In general, home grown fruit harvested at the peak of quality is much better than fruit harvested at a distant growing area and shipped hundreds of miles before sale. A limited group of fruit cultivars dominates the produce section at the supermarket. The apple lover can usually purchase only 5 or 6 cultivars (good though they may be) at the grocery store but is missing out on the unique flavors of hundreds of other cultivars. If you want to enjoy the "out of the ordinary", grow it yourself!

While it is difficult to calculate the monetary value of fruit produced at home, some savings over the price at the grocery store can be expected. This is especially true if excess fruit is canned, frozen, or dried.

Fruits and vegetables are an important part of a healthy diet. Fruit is a good, low calorie source of vitamins, minerals, and carbohydrates. In addition, research suggests that certain fruits contain materials that may have additional health benefits. The home fruit grower is "harvesting health".

Finally, for many people fruit growing has value beyond the value of the harvested product. A home fruit garden can be a restful and relaxing place to "unwind" after a hectic day at the office. Home fruit production is as good for the soul as for the body.

Selecting a Fruit Crop

Missouri fruit growers are fortunate that many fruit crops are adapted to the state. One type or another of fresh fruit can be harvested from mid-May to October (see Figure 1). However, if you have no experience growing fruit crops, it is a good idea to start small with 1 or 2 fruits that are relatively easy to grow and that you and your family enjoy. Home fruit production is not a matter of simply planting a crop and waiting for bountiful harvests. Proper planning and care are required at all stages. By starting small, you can see if growing fruit is your cup of tea without a large investment of time and money.

Even though a fruit crop may be adapted to Missouri's climate, occasionally extreme conditions can reduce or eliminate a crop or kill plants. Cold injury is common and can result from sudden freezes in the fall, midwinter cold, and spring frosts. Plants that are not winter hardy throughout Missouri and do better in the southern part of the state include peaches, nectarines, Japanese plums, most blackberries, most French-American hybrid grapes, and most seedless table grapes. Plants that are damaged by late frosts during blossom are peaches and, to a lesser extent, strawberries. Sweet cherries and apricots very seldom escape spring frost injury and are not recommended for that reason. Fruits that generally survive both the winter cold and spring frosts include apples, pears, sour cherries, European-type plums, American and French-American hybrid grapes, strawberries (with winter mulch), blueberries, and raspberries.

Fruits such as European (vinifera) and muscadine grapes, citrus, and figs are not hardy in Missouri without special protection during the winter.

In addition to climate extremes, insects, diseases, and weeds can reduce the amount of fruit harvested by the home fruit producer. At least one pest attacks each of the fruit crops adapted to Missouri. Certain fruit crops, however, are much easier to manage than others. In some cases, disease resistant cultivars of fruit crops are available (see cultivar descriptions), and these cultivars should be given consideration.

In the overall picture, crops considered relatively easy to grow in Missouri with proper care include apples, grapes, some blackberries, and strawberries. Plants that are difficult to establish include peaches, other stone fruits, and highbush blueberries. Raspberries are more difficult to grow on shallow Ozark soils. Pears are limited by the disease fire blight. Currants and gooseberries are better adapted to the northern part of the state, but can be grown in the south if they are mulched and afforded partial shade.

Once a crop is chosen, the next step is to choose among the many cultivars available. Whenever possible consider disease resistant cultivars. Some cultivars are better adapted to Missouri's climate than other cultivars. Check with state organizations such as the SMSU Fruit Experiment Station for recommended cultivars for Missouri. The experience of other fruit growers in your area is also valuable in selecting adapted cultivars. The following sections of this publication include lists of adapted cultivars. Season of harvest is another consideration. By selecting several cultivars that ripen at different times the home fruit grower can have fresh fruit for a longer period. Use of the crop is also important. Certain cultivars lend themselves to eating fresh, while others are excellent for processing.

What size should the home fruit planting be?

The size of the home fruit planting is primarily limited by two factors, the space available and the amount of time and energy that the home fruit producer is willing to devote to the planting. The planting should never be greater than the grower can properly care for. Poorly maintained fruit plantings become eyesores and sources of problems for neighboring fruit plantings. In most cases the planting should be large enough to provide fruit for the family, with some left over to give away. Equipment, labor and time become a problem if the planting becomes too large. Table 1 will be helpful in planning the size of the home fruit planting.

Selecting a Site

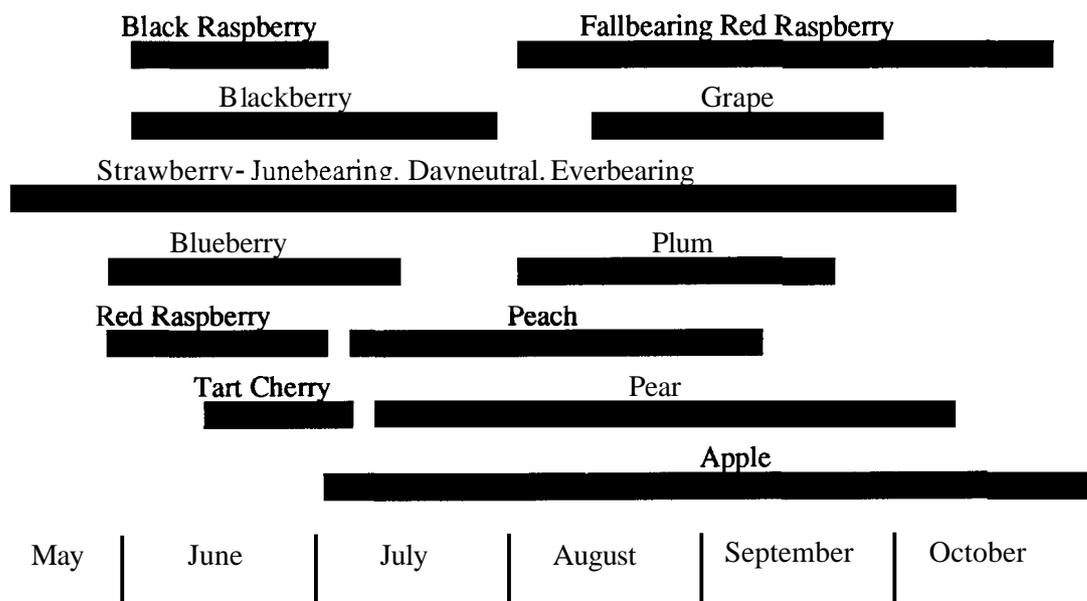
Urban home fruit growers often do not have the space for a fruit garden as such. However, fruit plants can be part of an attractive landscape. Such "edible landscaping" might include hedges of dwarf apples, brambles, grapes, and blueberries. Individual fruit trees can furnish beauty and shade as well as fruit. Grapes can cover an arbor, and strawberries make attractive borders and ground covers. Even apartment dwellers can grow strawberries and blueberries in containers.

If a choice of sites is available, several points should be considered. Once the orchard is planted, mistakes cannot be corrected later. The site should be close to the house and a source of water. Most fruit plants require full sun. Adequate air drainage is important for all fruit crops, but especially for crops sensitive to spring frosts and cold injury, such as peaches and other stone fruits, winter tender grapes, blackberries, and strawberries. To insure adequate air drainage, plant

Table 1. Bearing age, planting longevity, and estimated annual yield of fruit crops in Missouri.

Fruit Crop	Interval from planting to fruiting (years)	Life of plants (years)	Estimated annual yield per plant or row
Apple (standard)	4-6	35-45	10-15 bu/tree
Apple (semidwarf)	3-5	20-30	6-10 bu/tree
Apple (dwarf)	2-4	15-20	3-6 bu/tree
Pear	5-8	35-45	10-15 bu/tree
Peach	2-4	15-20	3-6 bu/tree
Plum	4-6	15-20	3-5 bu/tree
Tart Cherry	3-5	15-20	60-80 qt/tree
Grape	3	20-30	10-12 lb/vine
Strawberry (June bearing)	1	4-5	50-100 qt/100 ft row
Strawberry (everbearing)	3-4 months	2	50 qt/100 plants
Strawberry (dayneutral)	2-3 months	2	45-90 qt/100 plants
Raspberry (fallbearing red)	5-6 months	5-12	100-150 pt/100 ft row
Raspberry (summer red)	1	5-12	150 pt/100 ft row
Raspberry (black)	1	5-12	1 qt
Raspberry (purple)	1	5-12	1 1/2 qt
Blackberry (erect)	1	5-12	40 qt/100 ft row
Blackberry (semi-erect)	1	8-10	4-10 qt/plant
Blueberry	2-3	20-30	4-8 qt/plant
Gooseberry	2	10-20	5-10 qt/plant
Currant	2	10-20	3-4 qt/plant

Figure 1. Ripening seasons for fruit crops adapted to Missouri.



on high ground. Cold air is heavier than warm air and settles in low areas or in front of obstacles that obstruct downward flow, such as wooded areas. Adequate water drainage is also necessary for proper growth of fruit plants. Avoid planting in an area that has standing water during the season. In order to observe the internal water drainage, dig a hole a foot or so deep in the questionable area. After you fill the hole with water, note the amount of time it takes for the water to drain down. If 4 to 6 or more inches of water remain in the hole after 24 hours, a drainage problem is indicated. Do not run this test if the soil is very dry. If a poorly drained area must be selected, one option is to plant on raised beds or berms. Be prepared to irrigate the raised plantings more frequently in the summer than you would a level planting. Adequate water drainage is important for all fruit crops, but it is critical for blueberries, peaches and other stone fruits, raspberries, and strawberries.

The soil characteristics of the potential site are also important. Most fruit crops do best in a slightly acid, well drained, moderately fertile loam soil. Good fruit soils should be at least 2 feet in depth before reaching bedrock or fragipan (a hard soil layer that roots cannot penetrate). Fruit crops also benefit from organic matter. **Soil samples from all prospective fruit sites should be tested by University Extension.** A soil test will give you information concerning the nutrients available in your soil, the pH (acid or alkaline), the percent organic matter in your soil, and the texture of your soil (clay, silt, loam, and so on). To learn the procedure for taking a proper soil test, refer to UMC Agricultural Guides GO 9109 and GO 9110 (see **FOR MORE INFORMATION** section on page 45). Bring a soil sample to your local University Extension office, request a horticultural soil test form, and check the computer category for vegetable

and annual flower garden. The vegetable and flower category will give you computerized fertilizer and lime recommendations suitable for most fruit crops (with the exception of blueberries).

Preparing a Site for Home Fruit Production

Site preparation is an important part of home fruit production. Fruit plantings are long-term investments in money and effort. Everything the home fruit grower can do to properly prepare the site for fruit production will pay off dividends in plant health, productivity, and longevity of the planting.

Site preparation should begin in the year before planting. In spring mark off the rows in the prospective planting. Eliminate all troublesome perennial weeds such as bermudagrass, johnsongrass, wild brambles, or multiflora roses. The nonselective systemic herbicide glyphosate (Roundup) can be used. Once the herbicide has taken effect, till up the planting area. Apply fertilizers as directed by the soil test results. Now is also the time to apply lime or sulfur to modify the soil pH, as directed by the soil test results. Finally, plant a warm season cover crop such as Sudan grass, soybeans, or buckwheat in tilled areas. In the fall the warm season cover crop can be tilled under. Collect a second soil sample to check on nutrient levels and pH. Organic materials can be added at this time, and cool season cover crops (annual ryegrass, oats, or wheat) can be planted to provide cover over the winter. In the spring, the cool season cover crop should be tilled under before you begin to plant. Construct berms or raised beds, and make final preparations for planting.

A few words should be said about the importance of organic matter. Organic matter added to the soil improves the

soil's ability to hold both water and nutrients. Organic matter can "lighten" a heavy soil and can add "substance" to a sandy soil. Organic matter may be added to the soil in the form of animal or plant residues. If fresh manures or residues are used, put them on the field at least 6 months before planting. Fresh manure or materials that have not been composted often contain weed seeds; therefore, composted materials are preferred. Green manure crops are those that are sown, grown, and then plowed under. Suggested green manure crops include sudex (green graze) and buckwheat (both planted in mid to late spring), and oats and annual rye (both planted in late summer or early fall). Organic materials that can be spread out on the field and later plowed under include stable manures, sawdust, wood chips, shredded leaves, and lawn clippings. Commercial fertilizer may be added to the field before planting a green manure crop or after working non-decomposed materials into the soil (about 10 pounds 13-13-13 or 3 to 4 pounds ammonium nitrate 33-0-0 per 1,000 square feet).

Ordering and Handling Nursery Stock

An important aspect of the success of home fruit production is the nursery stock. All nursery stock should be purchased from a reputable nursery. Reputable nurseries guarantee that fruit plants are true to name, well grown, free from insects and diseases, and packed and shipped correctly. While price is a factor, the primary concern in purchasing nursery stock is to obtain the best plants possible. If there is a problem, a reputable nursery will offer replacements, often at no charge.

Local nurseries may have a limited number of different cultivars available; the widest choice of cultivars

is available from mail-order nurseries. Nurseries are even available that specialize in a single fruit crop. Bare root nursery stock is often available from mail-order nurseries. Container-grown stock is more often found locally.

The form of plant available from a nursery varies with the fruit crop. Tree fruits are usually available as grafted or budded plants, consisting of a rootstock and a scion (the cultivar) joined at the graft union. Grapes, blueberries, and gooseberries are available as rooted cuttings. Brambles are available as root cuttings, rooted suckers or tip layers. Strawberries are available as rooted runner plants. Some nursery plants are propagated by tissue culture, a laboratory technique that ensures that the stock is as free from disease as possible. Brambles, blueberries, and strawberries are propagated by this method. Further information on the best stock to purchase is found in the following pages of this publication.

All nursery orders should be placed as early as possible. If ordering is delayed, supplies of a desired cultivar may be exhausted, or only a lower grade may be available.

Once nursery stock arrives, immediately unpack and inspect the shipment. Be sure that the proper cultivars and numbers were sent. Inspect the condition of the plants. Problems are present if the nursery stock is shriveled or dried, if root systems are soggy or darkened, or if unpleasant smells are noted. Contact the nursery at once if problems are suspected.

Try to plant nursery stock upon arrival. If planting will be delayed for 2-3 days, moisten the roots, repack in the shipping material, and store in a cool place that does not freeze. If the delay is greater than a few days, heel

in (see glossary) the nursery stock outside or plant in pots.

The planting site should be ready for planting in advance of the shipping date of the nursery stock. In Missouri, most planting is done in early spring. Some fruit plants may also be planted in the late fall. Do not plant if the soil is too wet.

Dig a planting hole large enough to accommodate the root system. Do not force a 15 dollar root system into a 50 cent hole! In general, nursery stock should be planted at the same depth as in the nursery. Fill in the hole, firming the soil with your feet. Water the newly planted stock as soon as possible. Do not fertilize fruit plants at planting time.

General Cultural Information

Pollination

Most fruits require living seeds for proper fruit development, and living seeds are the result of pollination and fertilization. Pollination, the first step in this process, results from the transfer of pollen from an anther to the stigma of a flower. If both the pollen and the stigma are from the same flower or from another flower of the same cultivar, the process is called self pollination. Fruit crops that set fruit as the result of self pollination are called **self fruitful**. Self fruitful fruit crops include most apricots, tart cherries, peaches, nectarines, grapes, strawberries, brambles, and blueberries. Other fruit crops are called **self unfruitful**, and more than one cultivar must be planted for proper fertilization. Self unfruitful crops include most apples, pears, plums, and sweet cherries. Certain fruit crops, such as blueberries, while self fruitful, will set heavier crops if a second cultivar is available for cross pollination.

Irrigation

Missouri summers can be hot and dry. In most years irrigation is necessary to produce top quality fruit, while in some years irrigation is necessary for plant survival. Plantings must be irrigated regularly throughout the growing season. One to 1 1/2 inch of rain per week is ideal. Supplemental irrigation should be applied when rainfall does not supply this amount. More water is usually needed when the fruit on the plant is growing in size, but irrigation is important at all times during the growing season. Irrigation may be applied with sprinklers, soaker hoses, and trickle (drip) systems. A deep soaking is more beneficial than several light sprinklings. Using a garden hose and a sprinkler at regular home water pressure, it takes a little over 1 hour to put 1 inch of water on a 20 x 50 foot area (1,000 square feet).

Fertilization

The first step in planning a fertilization strategy is to look at the soil test results. The nutrients most needed by fruit crops are nitrogen (N), phosphorus (P), and potassium (K). If your soil test shows adequate amounts of P (at least 50 pounds/acre) and K (at least 200 pounddacre), then N is the only nutrient that you will need on an annual basis. If the test indicated low levels of P or K, add these materials before planting.

Nutrients can be supplied to fruit crops in synthetic or organic forms. Synthetic fertilizers are usually salt forms of nutrients, and are available in both granular and liquid forms. Synthetic fertilizers are easy to apply, and the amount of nutrient applied can be carefully controlled. Nutrients are quickly available, and synthetic fertilizers can be mixed to apply more than one nutrient. "A pint is a pound the world around" is a way to remember that 2 cups of dry granular

fertilizer weighs about 1 pound. It is often easier for home fruit growers to measure by volume than to weigh. Examples of synthetic fertilizers are ammonium nitrate and 13-13-13.

Organic fertilizers are usually animal or plant wastes. Because nutrients are released as the organic material decomposes, nutrients are more slowly available. Apply organic fertilizers in advance of when fruit plants will need nutrients. The exact amounts of nutrients in organic fertilizers is difficult to predict. A single organic fertilizer usually does not supply all the nutrients that may be needed. Organic fertilizers are also bulkier and less convenient to apply. Examples of organic fertilizers are manures and compost. As a general guide, 1/2 to 1 bushel of well rotted, composted stable manure may be substituted for each cup of 13-13-13 fertilizer recommended for any fruit crop except blueberries.

Pest Management

Pest management in the home fruit planting involves much more than just applying a spray at regular intervals. While some pests are difficult to control without spraying, others can be managed with a combination of the approaches listed below, with pesticide use as a last resort. The components of a pest management program include:

Resistant cultivars:

Fruit cultivars are available that have "built in" resistance to one or more pests. Choosing resistant cultivars is an important way to reduce the need for pesticides. Resistance sometimes means immunity, but more often means that the fruit cultivar is not seriously affected by the pest. Keep in mind that resistance to one disease does not imply resistance to all diseases that may attack a fruit. Along the same lines, fruit varieties that are disease resistant may still require insecticide sprays for control of insect pests.

Example: the apple cultivar 'Liberty' is resistant to apple scab, cedar apple rust, fireblight, and powdery mildew.

Sanitation: Fruit plantings should be maintained as clean as possible. All dead and/or diseased plant material should be removed. Alternate hosts, such as wild fruit plants, should be removed in the vicinity of the planting. Overwintering sites for pests should be eliminated. Example: grape black rot overwinters in shriveled fruit (mummies), which should be removed in the fall and winter to reduce the amount of black rot in the planting the next season.

Cultural control: Maintaining a fruit planting in good health is an important part of pest management. Plant only disease and insect free nursery stock. Properly select and prepare the planting site. Prune and train properly to maintain an open plant structure, which favors rapid drying of fruit and foliage and fewer disease problems. Fertilize properly and irrigate as needed to maintain plant vigor.

Biological control: Nature provides controls for many fruit pests and, in particular, insect pests. Whenever possible, use pesticides that cause minimal harm to beneficial insects. Attract predators, such as the lady bug, assassin bug, mantis, and parasitic wasps, to the fruit planting. Biocontrols such as Bt (for caterpillars) and Nosema (for grasshoppers) are also available. Additional information on biological control is available in publications on organic fruit production.

Chemical control: Pesticides are available to control diseases, insects and weeds in the home fruit planting. Before any pesticide is applied, the home fruit grower should identify the problem and the best spray material for control. Combination pesticides are

available that contain several fungicides and insecticides to give broad spectrum control. Combination pesticides seldom control all pests, however, and the user of combination pesticides also may be applying pesticides that are not needed. A better approach is to use specific pesticides for specific pests. The home fruit grower is advised to obtain a copy of MU Guide GO6010 Home Fruit Spray Schedules (see **FOR MORE INFORMATION** section on page 45) for further information on chemical pest control. Even if you are an organic gardener, this spray schedule will alert you to potential insect and disease problems.

Some fruit plants require more pesticide sprays than others. Apples, pears, peaches, plums, French-American hybrid grapes, and seedless table grapes require a high degree of chemical pest control while disease resistant apples, sour cherries, 'Norton' 'Concord' or 'Mars' grapes, strawberries, brambles, and blueberries do not require as many chemical sprays.

Weeds, diseases, and insects are not the only pests that bother fruit plantings. Birds eat or peck holes in ripe fruit. Fruit that should be netted for protection during harvest include brambles, blueberries, cherries, and red or purple French-American hybrid and seedless grapes. Various types of scare devices are also available that may help repel birds. Deer may damage young fruit trees by rubbing off bark in the fall with their antlers or by grazing off the tips of branches. Hanging mesh (nylon stocking) bags of human hair or hard milled bars of motel size soap on the side branches of trees or shrubs will help repel deer. Rabbits and mice gnaw the bark off of young trees and may kill them. Protect the trunks of young trees during fall and winter with plastic trunk guards, burlap, or wire mesh. Clear away dry

weeds or mulch from around the base of the tree trunks to discourage mice.

Controlling weeds in home fruit crops is a challenge best met if one "begins at the beginning." Perennial weeds should be destroyed in the planting row or site before planting. After plants are established, weeds must be controlled by hoeing, hand weeding, cultivating, mulch and/or use of herbicides. For guidelines concerning herbicide use, refer to the MU Guides GO 6951 and GO 6952 (see **FOR MORE INFORMATION** section on page 45).

Tools and Equipment for Home Fruit Production

The proper tool makes the difference between enjoyment and drudgery. Following is a list of tools and equipment that will keep the jobs associated with home fruit production from becoming drudgery. Whenever possible, purchase the highest quality tools. Good tools will provide years of use.

Pruners: Useful for pruning smaller stems and fruit clusters. Two types are available, the side cut and the anvil cut. The side cut is preferred, as it delivers a clean cut without crushing stems. Left handed pruners are available.

Loppers: Useful for making larger cuts, and for reaching inaccessible areas. Side cut loppers are preferred for the same reason mentioned above.

Saws: Pruning saws or small chainsaws are useful for large cuts. Pruning saws are fine toothed and designed to cut on the draw stroke. Small chainsaws are useful for larger cuts and to remove trees.

Shovels and spades: Useful for working the soil, digging planting

holes, transplanting, and removing weeds and plants.

Turning forks: Useful for the same jobs as shovels, as well as spreading mulch and manures.

Hoes: Useful for weed control and planting.

Sprayers: Several options are available for the home fruit grower. The following are all manually operated.

Compressed air sprayer: spray materials are distributed by compressed air built up by hand pumping. Useful for smaller plantings and small trees (up to 10 feet tall). Hand held and small capacity (1-5 gal).

Trombone sprayer: spray mixture is pumped from a container by the manual sliding action of the sprayer. Useful for taller trees (up to 20 feet tall).

Knapsack sprayer: a compressed air sprayer that is carried on the back. Sprayers are also available that are powered by gas or electric motors, as well as models that are powered by tractors. This type of sprayer is useful for larger plantings or large trees.

Before reading the various sections of fruit culture directions, note that this publication is basic and tailored to a traditional or formal home fruit gardening approach. Edible landscaping, decorative, and space saving training and pruning systems, container gardening, and similar approaches are not discussed; however, there are many popular references on these subjects available in the gardening sections of libraries or bookstores. See the **FOR MORE**

INFORMATION section on page 45 for additional reading.

CALENDAR OF EVENTS IN THE HOME FRUIT PLANTING

January

- prepare pest management strategy
- purchase pesticides and fertilizers
- clean, sharpen, and/or repair tools and equipment
- prune apple and pear
- sanitation (prune out fireblight strikes, remove black rot and brown rot mummies)

February

- prune stone fruits
- mow fall bearing brambles
- prune grapes
- prune summer bearing brambles
- prune blueberries
- sanitation (remove mummies and diseased plant parts)
- apply dormant sprays

March

- fertilize fruit plants (inorganic fertilizers)
- remove mulch from strawberries
- frost protection (esp. strawberries)
- plant new nursery stock
- implement pest management strategy

April

- frost protection (esp. strawberries)
- remove trunk wraps from trees
- weed control begins
- pest management

May

- train new shoots on trees
- thin fruit on tree fruits if necessary
- strawberry harvest begins
- pest management

June

- summer bearing bramble harvest begins
- blueberry harvest begins
- gooseberry harvest begins
- cherry harvest begins
- strawberry renovation
- irrigate as needed
- pest management

July

- peach harvest begins
- apple harvest begins
- pear harvest begins
- prune out dying bramble floricanes
- irrigate as needed
- pest management

August

- grape harvest begins
- fall bearing bramble harvest begins
- fertilize strawberries
- irrigate as needed
- pest management
- prepare nursery orders early

September

- irrigate as needed
- pest management

October

- clean up the fruit planting
- apply manures and other organics
- fall preparation for spring planting
- paint trunks of young trees

November

- apply strawberry mulches (late)
- rodent control, apply trunk wraps

December

- sit down with a hot mug of cider, take out the nursery catalogs, and start planning next season!

GLOSSARY OF FRUIT PRODUCTION TERMS

BARE ROOT stock is available from the nursery without soil on the root system. This type of nursery stock is available during the dormant season and is the type of stock generally available from mail order nurseries.

BERMS are raised ridges that run the length of the planting row. Berms for tree fruits are usually 6 to 10 feet wide and 18 inches high. Berms for small fruits are 2 to 4 feet wide and 12 inches high. Berms are useful if the planting has a drainage problem.

BRAMBLES refers to raspberries, blackberries, and other related fruits.

CONTAINER GROWN stock is available already established in a container of growing media such as soil.

CULTIVAR (or variety) is the "given name" of a special selection of a particular type of fruit. "Golden Delicious" is a cultivar or variety of apple and "Concord" is a cultivar or variety of grape.

DESSERT QUALITY refers to the quality of the fruit when eaten fresh.

FERTILIZERS supply nutrients essential for plant growth. Fertilizers may contain a single nutrient or several nutrients. Different types of fertilizers include:

Dry, granular fertilizers - fertilizers that are generally applied to the soil in a dry form.

Liquid fertilizers - soluble fertilizers that are dissolved in water before application to the soil or plant foliage.

Organic fertilizers - decomposing plant or animal waste products.

Slow release fertilizers - dry fertilizers that are prepared in such a way that nutrients are released over an extended period of time.

GRAFTING (OR BUDDING) is the usual way tree fruits are propagated. A grafted tree consists of two parts joined at the graft union, the **rootstock**, which forms the root system, and the **scion**, which form the fruiting portion of the tree.

HEELING IN is a method of storing fruit plants until planting. A trench is dug large enough to accommodate the root systems. The root systems are placed in the trench, which is filled with dirt.

PESTICIDE is a chemical that is used to control pests. Pesticides include:

Fungicide - controls diseases caused by fungi.

Antibiotic - controls diseases caused by bacteria.

Insecticide - controls insects.

Herbicide - controls weeds. Herbicides may be **preemergent** (control germinating seeds) or **postemergent** (control existing plants).

POME FRUITS refers to apples, pears, and related fruits.

PROCESSING QUALITY refers to the quality of the fruit when used for canning, freezing, drying, in jellies and jams, or for other cooking or baking uses.

RESISTANCE means the ability to fight off or to keep safe from. Disease resistance means the plant has some ability to keep from contracting certain diseases.

STONE FRUITS refers to peaches, nectarines, plums, cherries, and apricots.

SUSCEPTIBLE means unable to fight back or to keep safe from. Disease susceptibility means the inability to resist disease.

TISSUE CULTURE stock is a type of nursery stock that is produced under sterile conditions and is as disease- and insect-free as possible. This type of nursery stock is available for brambles, blueberries, and strawberries.

WINTER HARDY means the ability to withstand low winter temperatures. This is not to be mistaken with the ability to survive late frost during blossom. Apricots, for example, have very winter hardy buds that can withstand temperatures down to -25°F. Apricots blossom so early in the spring, however, that they lose their flowers to late frosts.

APPLES

Apples are well adapted to Missouri and completely hardy. Generally, apples will require a full spray schedule of 12 to 14 sprays applied at one to two week intervals through the growing season. Some apple cultivars have disease resistance and do not require as many sprays. These should be considered by home growers.

General: Apple trees have a long life and with proper care can produce for twenty-five years or more. Yield ranges from 5 to 10 bushels of fruit per mature tree. Season of harvest extends from July through October.

Cultivars:

Jerseymac - ripens early, red color, medium fruit size, dessert use and baking, McIntosh type, requires several pickings.

Lodi - ripens early, yellow color, large fruit size, good for sauce, short storage life.

Paulared - ripens early, red color, medium fruit size, dessert use and baking.

Gala - ripens mid season, red-orange medium size fruit, dessert use, fireblight susceptible.

Jonathan - ripens mid season, red color, medium fruit size, all-purpose apple, fireblight disease can be a problem.

Ozark Gold - ripens mid season, yellow color, medium to large fruit size, dessert use and baking, russet free, originated at the State Fruit Experiment Station of SMSU.

Empire - ripens mid season-late, red color, medium fruit size, all-purpose apple, stores well.

Golden Delicious - ripens late, yellow color, medium to large fruit size, all-purpose apple.

Red Delicious - ripens late, red color, medium to large fruit size, dessert use.

Rome Beauty - ripens late, red color, medium to large fruit size, baking and sauce. stores well.

Arkansas Black - ripens late, dark red, woody but softens in storage, long keeping.

Redfree - ripens early, red color, large fruit size, dessert use and sauce, resistant to apple scab and cedar rust.

Pristine - ripens early, yellow with red blush, dessert use and sauce, short storage life, resistant to apple scab, susceptible to cedar rust and powdery mildew.

Jonafree - ripens mid season, red color, small to medium fruit size, dessert use and baking, Jonathan type, resistant to apple scab and powdery mildew.

Liberty - ripens mid season, red color, medium fruit size, dessert use, resistant to apple scab, cedar rust, fireblight, and powdery mildew diseases.

Enterprise - ripens late, red color, dessert use and baking, resistant to apple scab and powdery mildew diseases.

Goldrush - ripens late, yellow with red blush, fresh use and baking, resistant to apple scab, susceptible to cedar rust, powdery mildew and black rot.

Freedom - ripens late, yellow color with red blush, medium fruit size, dessert use, resistant to apple scab, cedar rust, fireblight, and powdery mildew diseases.

Spacing: Apple cultivars on seedling or MM 111 rootstocks are self supporting. Semi-dwarf apples may require support and full dwarf will require support by staking or trellising. Seedling rootstock apple trees will grow to 25-30 feet, require a 25 foot in-row by 35 foot between row spacing, and take 4-6 years to bear fruit. MM 111 rootstock apple trees will grow about 75% of seedling tree size, require a 20 foot in-row by 28 foot between row spacing, and take 4-5 years to bear fruit. M 7-A semi-dwarf rootstock apple trees will grow to about 60% of seedling tree size, require a 16 foot in-row by 24 foot between row spacing, and take about 3-4 years to bear fruit. Apple cultivars on MM 111 or M 7-A rootstocks are recommended for the home grower. Those interested in planting other semi-dwarf or full dwarf apple trees should contact the Fruit Experiment Station concerning spacing and support requirements.

Planting: Plant trees in the spring as soon as the ground can be worked. Trees are usually obtained bare-rooted. Keep roots moist during planting. Water trees after they are set. Refer to bulletins 40 and GO6021 for additional information (see **FOR MORE INFORMATION**, page 45).

Pruning and Training: Training is done the first three years to form a central leader in the tree and establish the scaffold limbs. Start the training process immediately after planting. If the newly set tree is an unbranched whip, cut it back to 30 inches above the ground. If the tree has branches, select up to four that form wide angles (45° or larger) with the trunk. It is desirable to have these branches separated 4 to 6 inches from each other along the stem and spaced around it. Remove any branches within 20 inches of the ground and prune the top at 12 inches above the highest branch. Of the remaining branches, prune to about three-fourths their length. IN THE SECOND AND THIRD YEAR dormant season, select additional branches to form the lower scaffold limbs. Do not allow these limbs to outgrow the central leader. Light pruning will keep them smaller. Refer to Figure 2 for an illustration of central leader training. Refer to Bulletin 40, Training and Pruning Deciduous Tree Fruits, for more information in this important area (see **FOR MORE INFORMATION**, page 45).

Pruning is done every year during the dormant season (January through March). Pruning consists of removing broken or crossing branches, watersprouts (shoots that grow straight up from the upper side of scaffold limb), and any crowding branches. When trees grow beyond their allotted space, light pruning will keep

Figure 2. Central Leader Training System

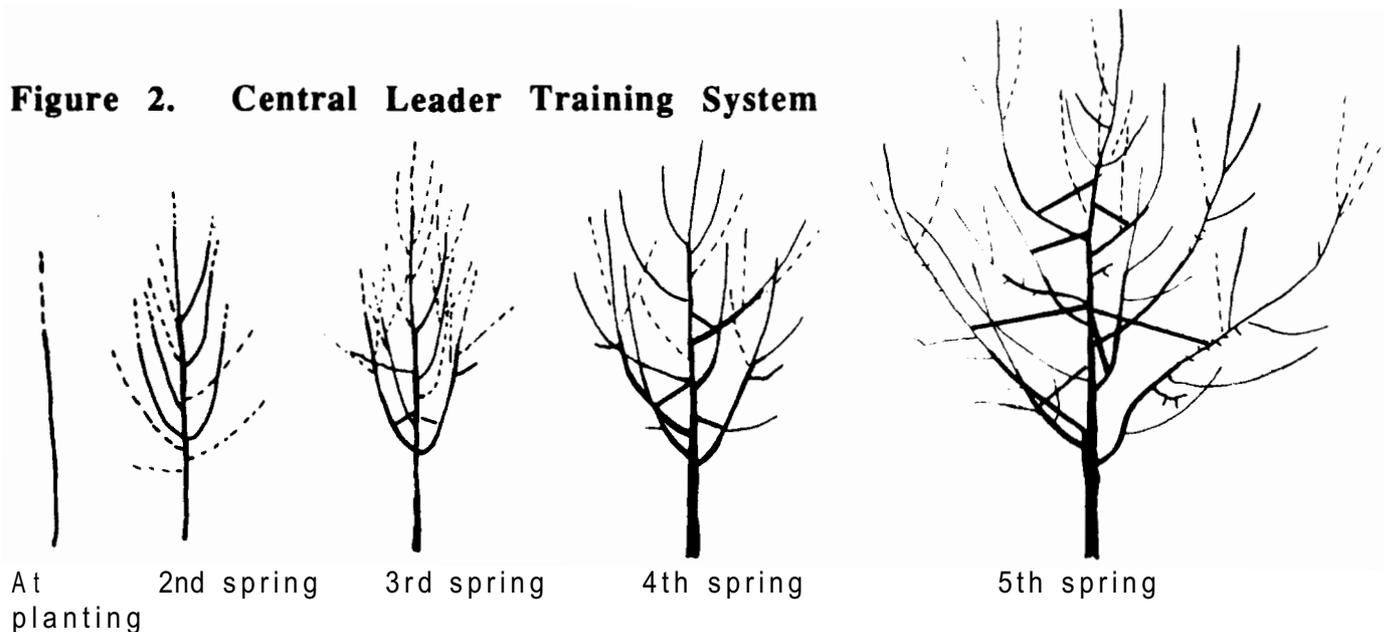


Figure 3. Multiple Leader Training System

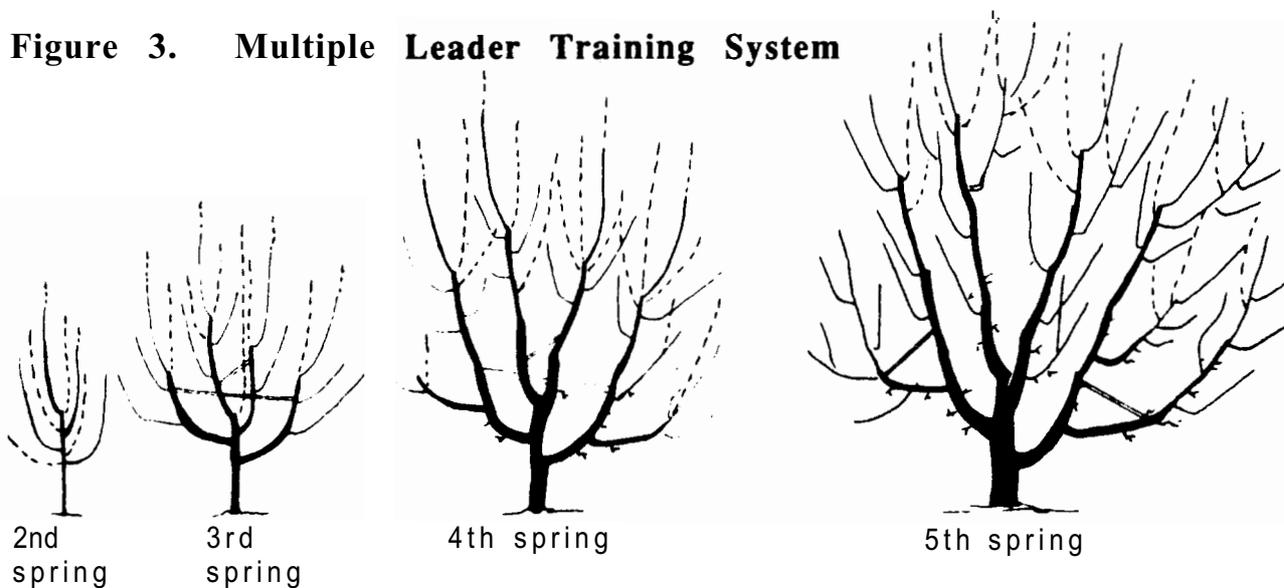
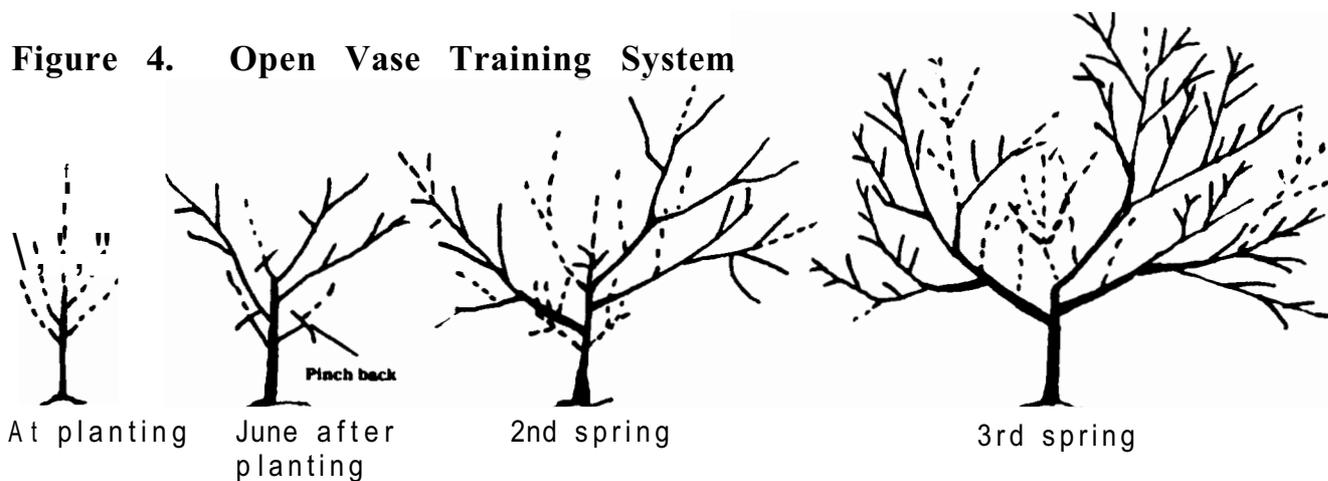


Figure 4. Open Vase Training System



Figures 2 and 3 are reprinted from Training and Pruning Apple and Pear Trees, by R.L. Stebbins. Copyright 1980 by P.N.W. Cooperative Extension Services. Figure 4 is reprinted from Growing Peaches in Kentucky, by G.R. Brown et al. Copyright 1981 by University of Kentucky Cooperative Extension Service.

branches from spreading further. Refer to Bulletins 40 and GO 6021 for additional information on training and pruning (see **FOR MORE INFORMATION**, page 45).

Blossoms and Pollination: Consistent cropping from year to year can usually be obtained for apple due to its later blossoming. Late spring frost can occasionally cause blossom loss. Apples need to be cross-pollinated to insure good fruit production. Two or more cultivars need to be in the planting. Summer (early) bearing apples cannot be depended on as pollinators for fall bearing apples because of their earlier blossoming. If both summer and fall (late) apples are planted, two or more cultivars of each type should be in the planting.

Flowering will sometimes occur when trees are young. Remove all flowers or developing fruit during the first two years to prevent stunting of the tree. A few fruits can be left on the third year, but none on the central leader.

Fertilization: Do not fertilize trees at planting. Wait until they leaf out. Apples should have about 10 to 20 inches of new growth each year when young (1 to 6 years old) and about 6 to 10 inches of new growth each year when mature (over 6 years old). Apply 13-13-13, 10-10-10 or similar fertilizer at the rate of 1/2 pound or 1 cup per year of tree age (maximum 3 pounds or 6 cups per tree). Scatter the fertilizer beneath the branch spread of the tree keeping a foot away from the trunk.

Fruit Thinning: Thin apples from late May through June to 1 fruit every 6 to 8 inches of branch. Thinning promotes fruiting every year, improves fruit size and quality, and reduces stress on the tree.

Harvest: Red apple cultivars change color long before they are ripe. Ripening progression is characterized by ground color change from green to yellow, flesh softening, sweeter taste, and fruit stem loosening from the branch. As harvest season approaches, periodically sample apples for desired taste and harvest when they are crisp and flavorful. Fruit may need to be picked several times. Seeds in the apple turn fully brown when the fruit is ripe.

Summer (early) apples do not store well and need to be processed soon after harvest. Fall apples can be stored several months if they are picked before they are over mature, and are held at a cool temperature. Storage of apples in a perforated plastic bag in the refrigerator will increase the humidity and keep fruit from drying out.

Winter Protection: Young trees need trunk protection from mice and rabbits. Use plastic spiral trunk protectors, wire mesh, or paper wraps. A slightly mounded pile of crushed rock or gravel placed at the base of the tree extending about a foot from the trunk will help discourage rodents. Keep weed growth cut back around the base of trees during the dormant season. Deer may rub antlers on young trees in the fall causing limb breakage. Human hair placed in nylon stockings or hard milled motel-type soap bars can be hung on lower limbs to repel deer.

Apple Disease Problems

Scab: Apple scab is caused by a fungus that can infect the leaves and fruit. Leaves that are infected with the apple scab fungus are distorted, and have brown spots that turn black with age. Infected fruit has brown, 'corky' spots that develop around the blossom end of the fruit early in the season.

The control measures for apple scab include planting resistant cultivars; the removal of fallen apple leaves from the orchard in the fall; and the use of fungicides

to control the disease. The Home Fruit Spray Schedule is a good reference for the type of spray, the amount to use, and when to apply chemical sprays.

Cedar Apple Rust: This disease is caused by a fungus that spends part of its life cycle on red cedar, and part on apple trees. Symptoms of this disease include small, pale yellow spots that develop on the upper leaf surface, and fruit in the spring. The spots enlarge, turning an orange color. In the summer, yellow colored spots appear on the underside of the leaves.

On infected cedar trees, the fungus produces a brown gall. During rainy periods in the spring, bright orange, 'jelly-like' fingers grow out of the galls and spread spores to apple trees.

The control measures for cedar apple rust include planting resistant cultivars, the removal of the galls on nearby cedar trees, and following the spray program outlined in the Home Fruit Spray Schedule.

Fire Blight: Fire blight is a bacterial disease that can be very damaging to susceptible apple trees. Fire blight can infect all parts of the tree. The infected areas wilt, and turn a dark brown to black (resembling fire damage). After infection, the bacteria can move throughout the tree, sometimes killing it in one season.

Control measures for fire blight include planting resistant cultivars, using surface-sterilized pruning shears to remove any infected tissue (cut 8-10 inches below where you see the infection) and following the Home Fruit Spray Schedule for fire blight control.

Powdery Mildew: This disease is caused by a fungus and can cause serious losses by killing vegetative shoots, flower buds, and causing russetting of the fruit. Infected leaves have white, felt-like patches of the fungus on the underside. The leaves may be narrow and become brittle with age. Fruit that is infected with the powdery mildew fungus is russeted and may be dwarfed in size.

Control measures for powdery mildew include planting resistant cultivars and applying the necessary fungicides to control the disease.

Summer Rots: There are two fungi that can infect the leaves, branches and fruit of susceptible cultivars. The first of these is black rot, also referred to as "frog-eye leaf spot" due to the irregularly shaped, purple spots with alternating bands of light and dark colors. Infected areas on the limbs and twigs are a reddish-brown color and are slightly sunken. Infected fruit develop a brown to black rot, commonly at the blossom end of the fruit.

White rot is also caused by a fungus that produces cankers on branches and limbs as well as causing a fruit rot. Development of the disease is favored by warm temperatures. Bark cankers begin as small, circular blisters. Older cankers have papery outer bark which comes off easily. Infected fruit often looks "bleached out" at first, then turns a deep brown.

The control measures for both summer rot fungi include pruning out and destroying all infected tissue, maintaining tree vigor, and applying the appropriate fungicides to control the disease.

Apple Insect Problems: codling moth, plum curculio, aphids, mites, scales, leaf rollers, oriental fruit moth, borers. For more information, see **COMMON FRUIT INSECT CONTROL** section, page 43.

PEARS

Pears are more difficult to grow than apples because they are more susceptible to fireblight, a bacterial disease. Selection of blight resistant cultivars and careful pruning and fertilizing practices make it possible to grow pears in Missouri. Like apples, a full spray schedule is required during the growing season.

General: Pear trees have a long life and with proper care can produce for twenty-five years or more. Yield ranges up to 5 bushels for a standard size tree. Season of harvest extends from August through October.

Cultivars (European - "pear shaped"):

Moonglow - ripens early, yellow color, large fruit size, dessert use or preserving, fireblight resistant.

Magness - ripens mid season, yellow color, light russet, medium oval fruit size, dessert use and preserving, not a pollinator, fireblight resistant.

Seckel - ripens mid season, yellow-brown color, russeted, small fruit size, preserving and cooking, moderately fireblight resistant.

Starking Delicious (Maxine) - ripens mid season, yellow color, large fruit size, all-purpose pear, moderately fireblight resistant.

Kieffer - ripens late, yellow-green color, large fruit size, preserving and cooking, moderately fireblight resistant.

Cultivars (Asian - "round apple pears"):

Shinseiki - ripens early, medium round fruit size, yellow skin, dessert use, susceptible to fireblight.

Chojuro - ripens mid season, large round fruit size, brown to orange skin, russeted, dessert use, moderate fireblight resistance.

Shinko - ripens mid season, large fruit size, golden yellow skin, russeted, dessert use, moderate fireblight resistance.

Starking Hardy Giant - ripens mid season, large round fruit size, yellow skin, dessert use and pear butter, moderate fireblight resistance.

Spacing: Pears are best obtained grafted to a rootstock called 'Old Home x Farmingdale'. Cultivars on this rootstock will be self supporting. This produces a tree that has more fireblight resistance than grafting to common seedling pear rootstock. Selection 97 of 'Old Home x Farmingdale' will grow a standard size tree that will require a 20 foot in-row by 26 foot between row spacing. Selection 333 of 'Old Home x Farmingdale' will grow a semi-dwarf tree about 75% of standard tree size that will require an 18 foot in-row by 24 foot between row spacing. Asian pears should be grafted to *Pyrus betulaefolia* or *P. calleryana* rootstocks and planted at 15 foot in-row by 20 foot between row spacing. Dwarf pears are available grafted to quince

rootstock, but these are not very hardy and are susceptible to fireblight. Because of this, dwarf pears are not recommended for the home planting.

Planting: Same as for apples.

Pruning and Training: First year training is the same as for apple. Pears are best trained to a multiple leader system. This is illustrated in Figure 3. Pears require only minimal pruning. Narrow angled and overcrowded limbs should be removed. Limbs may be spread to 45° from vertical with wooden spreaders or with ties and stakes. Refer to Bulletin 40, Training and Pruning Deciduous Tree Fruits for more information in this important area (see **FOR MORE INFORMATION** section, page 45).

Blossoms and Pollination: Same as for apples.

Fertilization: Half the amount recommended for apples with a maximum of 2 pounds or 4 cups 13-13-13 or equivalent per tree.

Fruit Thinning: Same as for apples.

Harvest: European pears, unlike apples, are picked when they are still firm and not fully ripe. Pick when the ground color changes to a light green or yellowish green, and when the fruit stem separates from the branch with an upward twist. Fruit that are allowed to ripen on the tree lose quality. Pear storage is similar to fall apples. After removal from storage, pears will ripen at room temperature in about four days. Asian pears obtain their best eating quality when ripened on the tree and can be stored like fall apples if harvested slightly immature.

Winter Protection: Same as for apples.

Pear Disease Problems

Fire Blight: Fire blight of pear is caused by the same bacteria that causes fire blight of apple. This disease can be very serious on pears, infecting the blossoms, fruit and limbs of the trees. The symptoms and control measures are similar to those for fire blight of apple.

Pear Insect Problems - codling moth, aphids, mites, scales, leaf rollers, oriental fruit moth, borers. For more information, see **COMMON FRUIT INSECT CONTROL** section, page 43.

STONE FRUITS

Stone fruits include peaches, nectarines, European and Japanese plums, sweet and sour cherries, and apricots. Entire or partial stone fruit crops are often lost to late frosts in spring during blossom, but crop loss also occurs due to cold (-10°F or lower) temperatures during winter. Apricots and sweet cherries blossom so early in the season that they are not recommended for Missouri conditions due to frequent loss of the crop to frost. Proper site selection is critical for the productivity of stone fruits. Proper air drainage is important due to their susceptibility to frost and cold injury. Stone fruits are very sensitive to poor water drainage and heavy or shallow soils. Berming on problem areas is suggested. A berm is a gently ridged row about 6-10 feet wide and 12 inches high along the tree row and tapering to grade between the rows. Stone fruits require that you follow the recommended spray program conscientiously. This means 8 to 10 sprays applied at one to two week intervals through the growing season. Sour cherries are the most disease resistant of the group.

General: Cherries ripen in June while peaches, nectarines, and plums ripen in July and August. Peaches and nectarines begin to bear 2 to 3 years after planting, whereas plums and sour cherries bear 3 to 5 years after planting. Mature, standard size sour cherry trees are 15 feet in height and can bear 1 to 3 bushels of fruit. Mature, standard size peach and nectarine trees reach 20 feet at maturity and can bear 3 to 5 bushels of fruit.

Cultivars:

Peaches (freestone)

Redhaven - ripens early, medium fruit size, yellow flesh, red skin, good dessert quality also for canning and freezing, moderate bud hardiness.

Reliance - ripens early, medium fruit size, yellow flesh, dull red blush over yellow skin, fair dessert quality, very bud hardy.

Glohaven - ripens mid season, large fruit size, yellow flesh, red blush over yellow skin, good dessert quality also for canning and freezing, moderate bud hardiness.

Summer Pearl - ripens mid season, medium fruit size, white flesh, red blush over yellow skin, good dessert quality, very bud hardy.

Cresthaven - ripens late, medium fruit size, yellow flesh, red blush over yellow skin, good dessert quality also for canning and freezing, moderate bud hardiness.

Encore - ripens late, large fruit size, yellow flesh, red blush over yellow skin, good dessert quality, very bud hardy.

Nectarines: Harko, Hardired, Mericrest.

Plums:

European (blue): Earliblue, Bluefre, Stanley, Damson. The first two originated at the State Fruit Experiment Station of SMSU.

Japanese (red): Santa Rosa, Ozark Premier, Redheart (a good pollinator for the first two). Ozark Premier originated at the State Fruit Experiment Station of SMSU.

Cherries:

Sour: Montmorency, North Star.

Spacing: Peaches and nectarines on Lovell or Halford rootstocks, plums on myrobalan rootstock and sour cherries on mahaleb rootstock should be spaced 18 feet apart in the row with 24 feet between rows. Cultivars on these rootstocks will be self supporting. If you plant the genetic dwarf sour cherry, North Star, space it 10 feet apart in the row with 14 feet between rows. There are no proven dwarfing rootstocks for stone fruits in Missouri.

Planting: Plant in spring at the same depth the tree was growing in the nursery. Stone fruit roots are much more sensitive to poor drainage and heavy soils than are apples or pears. Berming is recommended on poor sites.

Pruning and Training: Prune in March up until blossom. Peaches in particular may be damaged if pruned earlier in the dormant season. Peaches and nectarines should be trained to the open center system (see Figure 4). Prune annually after training is complete. Peaches and nectarines need severe pruning relative to apples or pears. Approximately 50% of the new wood can be removed from healthy trees. It is wise to prune late, after blossom survival can be evaluated. European plums are best trained to a multiple leader system (see Figure 3). Prune only lightly when young and avoid heavy annual pruning. Japanese plums are best trained to the open center system (see Figure 4). but may also be trained to a multiple leader system. Prune more severely than European plums. Sour cherries are trained either to a multiple leader or open center system (see Figures 3 and 4). Pruning severity is similar to apples. Refer to Bulletin 40, Training and Pruning Deciduous Tree Fruits, for more information in this important area (see **FOR MORE INFORMATION**, page 45).

Blossoms and Pollination: Peaches, nectarines, and sour cherries do not require two cultivars to be planted for cross pollination. European plums generally do not require two cultivars to be planted for cross pollination, but there are some exceptions and best production is achieved if two cultivars are planted. Japanese plums require two cultivars for cross pollination. European plums will not pollinate Japanese plums.

Fertilization: Do not fertilize at planting, but wait until the buds start to grow. Peaches and nectarines should have about 15 to 25 inches of new growth each year when young (1 to 6 years old) and 10 to 15 inches of new growth each year when mature (over 6 years old). Plums and sour cherries should have about 10 to 20 inches of new growth each year when young (1 to 6 years old) and about 8 to 12 inches of new growth each year when mature (over 6 years old). Apply 13-13-13, 10-10-10 or equivalent at the rate of 1 pound or 2 cups per year of tree age (maximum 3

pounds or 6 cups/tree). Apply half the total amount at blossom and the rest later only if a crop has set. Adjust fertilizer amounts to keep shoot growth in the suggested ranges. Scatter beneath the branch spread of the tree keeping a foot away from the trunk.

Fruit Thinning: Peaches, nectarines, and plums need to have the fruit crop thinned. Thinning is done to improve fruit size and quality, and reduces stress on the tree. Sometimes weather conditions will thin the fruit for you. In late May or June, thin peaches and nectarines to 1 fruit for every 6 to 8 inches of branch. Thin plums to 1 fruit for every 2 to 3 inches of branch, but wait to thin plums until late June.

Harvest: Sample fruit to determine when they should be picked. Cherries may need to be protected from birds during harvest with mesh netting or other methods. Stone fruits are somewhat perishable, but may last up to 2 weeks in the refrigerator.

Winter Protection: Same as for apples.

Stone Fruit Diseases

Brown Rot: This disease infects peach, plum, cherry, apricot, and nectarine and can cause serious loss of fruit. The fungus can also infect blossoms and twigs. Fruit that is infected by brown rot develops small, circular, light brown spots on the surface that can grow together very quickly. An entire fruit may be rotted in a short period of time. The disease is favored by cool, wet weather and is often very destructive when these weather conditions occur during harvest. Infected blossoms wilt, turn brown and may persist into the summer months. From the infected blossoms, the fungus grows down into the woody tissue, forming small cankers. The cankers may enlarge and girdle the branch or twig.

An important control measure for this disease is to remove the dried, shriveled fruit that persists in the orchard on trees or on the ground. These "mummies" serve as overwintering sites for the fungus, and removal will make brown rot control easier the following season. Insect feeding opens fruit up to increased infection by the brown rot fungus, so insect control is important in brown rot control. Fungicides are available that help control brown rot of stone fruits.

Peach Leaf Curl: This disease is caused by a fungus that can infect the leaves and twigs of peach and nectarine. In the early spring, leaves appear "puckered" and may be a red to purple color. The leaves then become very thick, turn yellow and fall from the tree. Loss of leaves caused by severe cases of peach leaf curl will reduce tree vigor and can lead to increased winter damage. Infected twigs are stunted, swollen and may have curled leaves at the tip.

Peach leaf curl can be controlled by applying a fungicide in the late fall (after leaf drop) or early spring before the buds begin to swell. Refer to the Home Fruit Sprav Schedule for the chemicals and rates of application. Maintain the vigor of infected trees by thinning the fruit, providing adequate irrigation, and applying a nitrogen fertilizer in the spring.

Bacterial Spot: This disease can be serious on susceptible cultivars of peach, plum, nectarine and apricot. It infects the leaves (sometimes defoliating the entire tree) as well as the fruit and young shoots. Leaf lesions begin as small, brown to black spots on the underside of the leaf, which then develop on both sides of the leaf and often have a red colored margin. The infection generally spreads from the tip of

the leaf. Infected fruit develops cracks in the skin which may develop into deep "pits".

The control measures for bacterial spot include planting resistant cultivars and following a good fertilization program that avoids excess nitrogen. Chemical sprays are available that suppress, but do not eliminate bacterial leaf spot.

Peach Scab: The fungus causing peach scab can also attack apricot and nectarine trees. This disease can infect the leaves, twigs and especially the fruit of susceptible cultivars. Infected fruit have small, gray to green, circular spots on the surface. As the disease progresses, these spots grow together, giving the fruit a "velvety" appearance. If the infection is severe, the skin of the fruit may crack.

Control measures include pruning the tree so that there is an open canopy which provides good air circulation, reducing the risk of infection. Fungicide sprays recommended for brown rot control will help control this disease.

Cherry Leaf Spot: This disease is caused by a fungus that can infect both sweet and sour cherry trees. The disease appears first as small, circular, purple spots on the upper surface of the leaves. After the leaves become infected, they turn yellow and fall from the tree. If the infection is severe, all the leaves on the tree may fall before harvest.

The disease is controlled by cultivating or mowing around the base of the infected trees in the late fall and early spring. This disturbs the infected leaves and keeps them from infecting the new leaves. Also, the use of fungicide sprays should help control the disease.

Black Knot: Black knot is caused by a fungus that can infect plum, prune, and cherry trees. The disease is characterized by corky swellings or "knots" on the limbs of infected trees. These "knots" may become quite large and are a dark gray to black color. Eventually the knots will girdle and kill the limb.

Wild plum and cherry trees can serve as hosts of black knot, and should be removed from the vicinity of cultivated trees. If any knots are found in a home orchard, prune them out and destroy them in the late winter or early spring, before the disease has a chance to spread.

Stone Fruit Insects: plum curculio, aphids, mites, scales, oriental fruit moth, borers, catfacing insects. For more information, see **COMMON FRUIT INSECT CONTROL** section, page 43.

STRAWBERRIES

Three types of strawberries can be grown in Missouri: Junebearing, Everbearing, and Dayneutral. Weeds are a major problem that must be addressed throughout the season.

Junebearing Strawberries

General: Junebearing strawberries ripen in May and June, and are usually managed to produce a crop the season following planting. The blossoms are removed in the planting year. Runners with daughter plants produced by the mother plant that is set in spring will fill in the matted row.

Culivars:

Earliglow - ripens early. Berries medium-large size and good fresh or frozen. Blossoms early therefore more susceptible to spring frost injury. Yield is high and plants resist leaf scorch but are susceptible to leaf spot.

Annapolis - ripens early. Berries are medium-large in size and good fresh or frozen. Plants are susceptible to the leaf diseases.

DelMarvel - ripens early-mid season. Berries are medium size and good fresh or frozen. Plants are resistant to anthracnose, red stele, and verticillium wilt with variable resistance to the leaf diseases.

Honeoye - ripens early-mid season. Berries are medium-large in size and good fresh or frozen. Skin is soft and easily bruised. Plants are winter hardy. Plants are resistant to the leaf diseases.

Redchief - ripens early-mid season. Berries are medium in size and are good fresh or frozen. Caps are easily removed. Blossoms are somewhat resistant to spring frost. Plants are resistant to red stele, verticillium wilt, and leaf scorch with variable resistance to leaf spot.

Surecrop - ripens early-mid season. Berries are medium size and are good fresh or frozen. Plants are resistant to red stele and verticillium wilt with variable resistance to the leaf diseases.

Primetime - ripens mid season. Berries are large and are good eaten fresh. Plants are resistant to red stele and verticillium wilt and are tolerant of the leaf diseases.

Seneca - ripens mid season. Berries are medium-large in size and are good fresh or frozen.

Allstar - ripens mid-late season. Berries are large and are good fresh. Berries have better keeping quality in the refrigerator than many other varieties. Plants are resistant to the leaf diseases, powdery mildew, verticillium wilt, and red stele.

Lateglow - ripens late. Berries are large and good fresh or frozen. Plants are resistant to red stele and verticillium wilt and are tolerant of the leaf diseases.

Spacing: Matted row plants are set 18 - 30 inches apart in the row and keep the rows about 42 inches apart (see Figure 5). Daughter plants from runners produced by the mother plants will fill in the row.

Planting: Plant strawberries in spring as soon as ground can be worked (see Figure 6). Keep the roots moist during planting and water plants after they are set.

Figure 5. Junebearers in Matted Row System

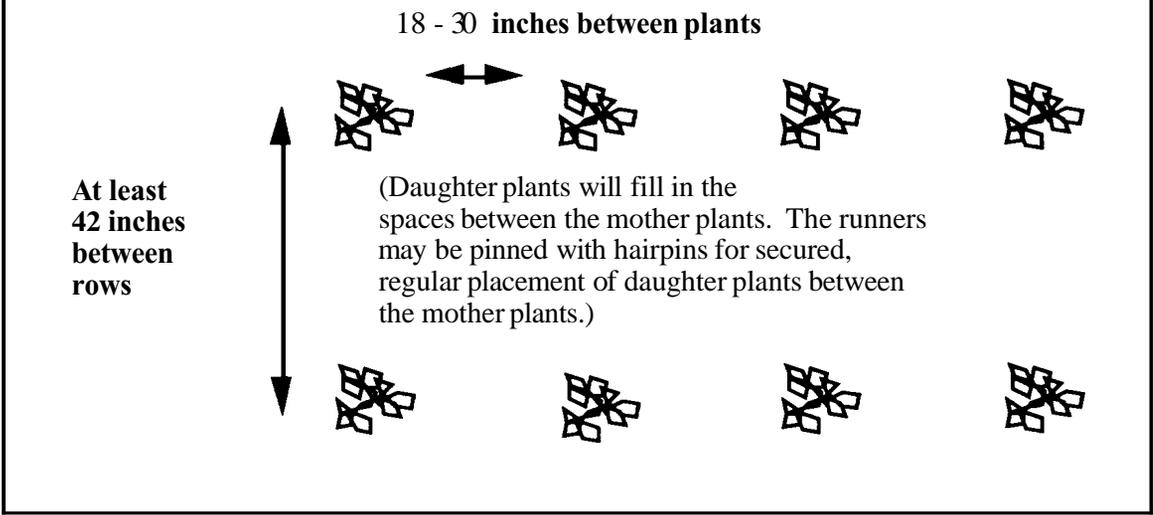
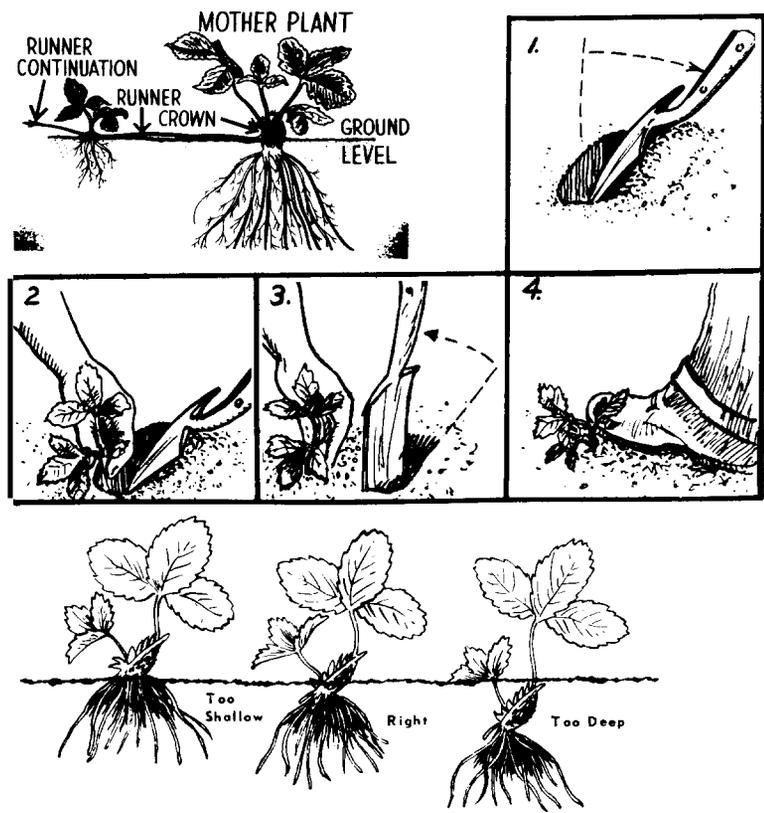


Figure 6. Planting Strawberries



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Blossoms and Pollination: Remove all blossoms in the planting year. Protect blossoms from spring frosts in subsequent years by covering them when a frost is predicted. You do not need to plant 2 cultivars for cross pollination.

Fertilization: Two weeks after planting (new bed) or after harvest at renovation (established bed), apply 1/3 cup 13-13-13 per 25 feet of row. Repeat late August to mid September. You do not have to apply fertilizer directly after planting if it was incorporated into the soil prior to planting.

Harvest: Strawberry fruit ripen in May and June and should be picked when the berries are colored red down to the tip of the berry. Berries must be harvested as they ripen or rot problems develop. Strawberries are perishable and should be removed from the field as soon as possible. Berries will keep in the refrigerator up to 5 days.

Renovation: After harvest, you need to renovate if you plan to produce good quality fruit for the next season. Renovation includes: (1) narrowing the row to 6 to 12 inches wide, (2) removing weeds and raking out dead leaves (you may mow leaves off and remove them from the planting to control leaf spots if you are careful not to injure the crowns), (3) rake about 1 inch of soil over the plants, (4) fertilize as recommended, (5) use a preemergent herbicide if desired, and (6) water the plants.

Winter Protection: Place 3 to 4 inches of straw over the plants in late November or early December, or after about a week of below-freezing weather. Remove the mulch in March when active growth is observed on the plants. Synthetic row covers are also available to home growers for winter protection.

Everbearing Strawberries

Blossoms are removed until July in the planting year, so a crop is not produced until fall of the first year for everbearing strawberries. Everbearing strawberries produce peak yield in the spring and fall the next year. Everbearers do well in strawberry barrels, pyramids, and pots. They must be adequately watered, especially if planted in containers. Partial shade should be provided when the weather gets very hot.

Cultivar:

Ozark Beauty - medium size berries with good dessert and freezer quality.

Spacing: In the garden row, space plants 12 inches apart and keep at least 30 inches between rows. Staggered rows may be used (see Figure 7).

Planting: Same as for Junebearing strawberries.

Blossoms and Pollination: Remove all blossoms after planting until July and allow the everbearers to set a late summer or fall crop in the first year. You do not need to plant 2 cultivars for cross pollination.

Fertilization: Two weeks after planting apply 1/3 cup 13-13-13 per 25 feet of row if soil was not fertilized before planting. Fertilize with 1/3 to 1/2 cup 13-13-13 per 25

Figure 7. Everbearers in Double Staggered Row System

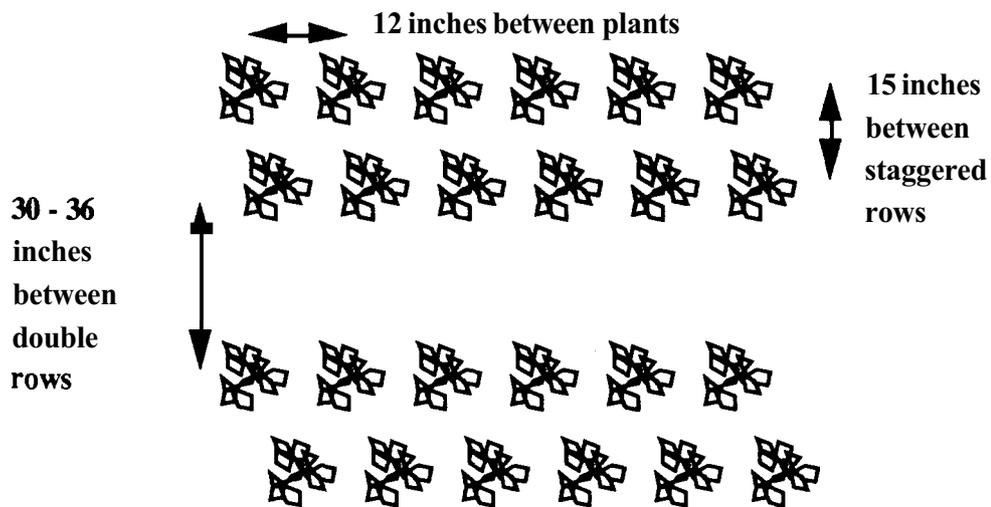
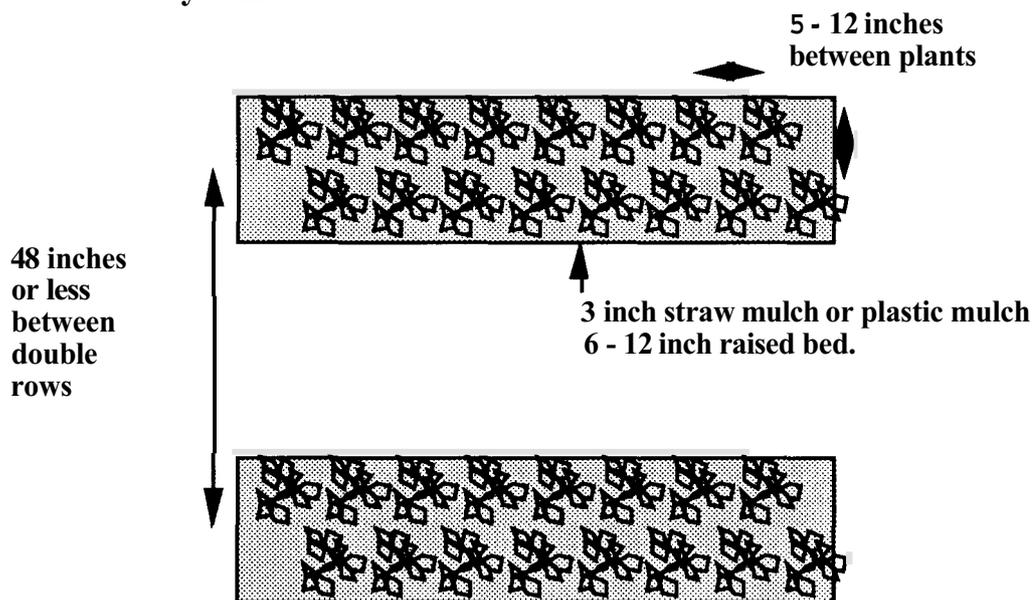


Figure 8. Dayneutrals in Double Staggered Row System



feet of row three times per year. Another option is weekly fertilization with a soluble fertilizer through trickle irrigation lines or soaker hose.

Harvest: Everbearers will bear fruit in fall of the planting year. The following year, peak harvest will occur in the spring and fall.

Winter Protection: Follow the guidelines for Junebearing strawberries.

Dayneutral Strawberries

Dayneutral strawberries require much different care than do the Junebearing and older everbearing types. Runners are not needed to fill in the rows, so **all runners are removed throughout the season**. If runners are not removed, yield will be reduced. Dayneutrals bear fruit throughout the season so the average home producer should keep the patch small and close to the house if possible. The east side of the house is ideal if it receives morning sun. Some protection from the afternoon sun is beneficial. Dayneutrals produce flower buds continuously if the temperatures are not too high (85°F+). Dayneutrals are usually maintained the planting year and the year after, and then are replanted.

Cultivars:

Tribute - Berries are medium to large in size, firm, and with good dessert quality.

Tristar - Berries are medium in size, firm, and with good dessert quality.

Spacing: Dayneutrals are planted close together with 5 - 12 inches between plants in double staggered rows (see Figure 8). Runners are removed throughout the season because they are not needed to fill in the row. A three inch deep straw mulch or a plastic mulch should be maintained around the staggered double row.

Planting: See Junebearing strawberries. Plant as early in spring as possible and maintain a 3 inch deep straw mulch or a plastic mulch around the plants.

Blossoms and Pollination: Remove all blossoms for 6 weeks after planting. You do not need to plant 2 cultivars for cross pollination.

Fertilization: Compared with Junebearers, more constant fertilizer application during the growing season is recommended. A slow release fertilizer can be used at planting, soluble fertilizer can be applied weekly through the irrigation system, or a monthly dry granular fertilizer application can be made. Recommended dry granular fertilizer rates per 25 feet of row are as follows: 3 3/4 ounces (approximately 1/3 to 1/2 cup) 33-0-0 per month during the growing season or 8 1/2 ounces (approximately 1 cup) 13-13-13 per month during the growing season. Follow label directions if using slow release or soluble fertilizers.

Harvest: In the planting year, with blossom removal, berries should ripen from the middle of June through frost, with peak yield in late August or early September. If dayneutrals are overwintered, they will produce throughout the next season with three peak yields periods.

Winter Protection: If you wish to overwinter these plants, follow the same procedure as for Junebearing strawberries.

Strawberry Disease Problems

Gray Mold: Gray mold of strawberry is caused by a fungus that primarily infects the fruit and can result in serious losses. Cool, wet weather favors development of the disease, which is characterized by a felt-like, gray to tan growth on the surface of the ripe fruit. Unripe fruit can also become infected.

Control measures for gray mold of strawberry include good sanitation practices that keep the fruit and foliage as dry as possible, good weed control, mulching, and maintaining good plant vigor. Protective fungicides should be applied beginning at or before bloom, continuing through harvest.

Leaf Spots: Leaf spots on strawberry plants are caused by several fungi and are common diseases. Leaf spots begin as small, dark purple spots with light brown centers which may develop on the leaves, petioles and fruit. If the leaf is heavily infected, the spots may grow together and give the leaf a "scorched" appearance. The disease is spread by splashing rain and wind.

To control leaf spots, resistant cultivars should be planted. If susceptible cultivars are grown, protective fungicides may be needed for control. Good sanitation practices, such as the removal and destruction of infected leaves at renovation and mulching, are important control measures. Good air circulation in the patch promotes rapid drying of the leaves and fruit after a rain and will decrease the chance of infection by leaf spot fungi.

Strawberry Insect Problems - aphids, mites, leaf rollers, borers, catfacing insects. See **COMMON FRUIT INSECT CONTROL** section, page 43.

GRAPES

American and French-American hybrid grapes are adapted to Missouri. American cultivars are generally hardier and more disease resistant than the French-American hybrid cultivars. Grapes require a more intensive spray schedule than do the other small fruit crops. Birds may be a problem; therefore, some cultivars should be netted for protection. A trellis or support on which to train the grapevine is necessary to keep the fruit off the ground and well exposed to light and air.

American cultivars:

Catawba - ripens late, pink fruited winter hardy vines. Fruit used fresh, for juice and wine.

Buffalo - ripens mid season. Berries are blue-black in color, and vines are cold hardy. Fruit is used fresh and for juice.

Concord - ripens late. Berries are blue-black in color, and vines are cold hardy, with some disease resistance. Fruit is used fresh and for juice, jam, jelly, and wine. Concord is particularly good for use in arbors as it is disease resistant, winter hardy and not attractive to birds.

Delaware - ripens mid season. Berries are red in color, and vines are hardy, with some disease resistance. Fruit is used fresh and for juice, jam, jelly and wine. Delaware is very attractive to birds, so this cultivar should be netted.

Norton/Cynthiana - ripens late, small black clusters used for red wine. Disease resistant.

Marquis - ripens mid season. Seedless berries are large and white, and clusters are large. This variety is not fully tested in Missouri, but is worthy of trial.

Mars - ripens early. Seedless fruit is blue-black in color, and vines are moderately cold hardy, with some disease resistance. Fruit is used fresh.

Reliance - ripens early. Seedless fruit is red in color, and vines are cold hardy. Fruit is used fresh, for juice, and for home dried raisins. Fruit is attractive to birds, so this cultivar should be netted.

French American hybrid cultivars:

Seyval blanc - ripens mid season. Fruit is white in color, and vines are moderately cold hardy. Fruit is used for white wine.

Vidal blanc - ripens mid season. Berries are white in color, and vines are moderately cold hardy. Fruit is used for white wine.

Cayuga White - ripens mid season to late mid season. Berries are white in color, and vines are moderately cold hardy. Clusters are large. Fruit is used for white wine. This variety makes a nice white wine with fruity, citrus notes.

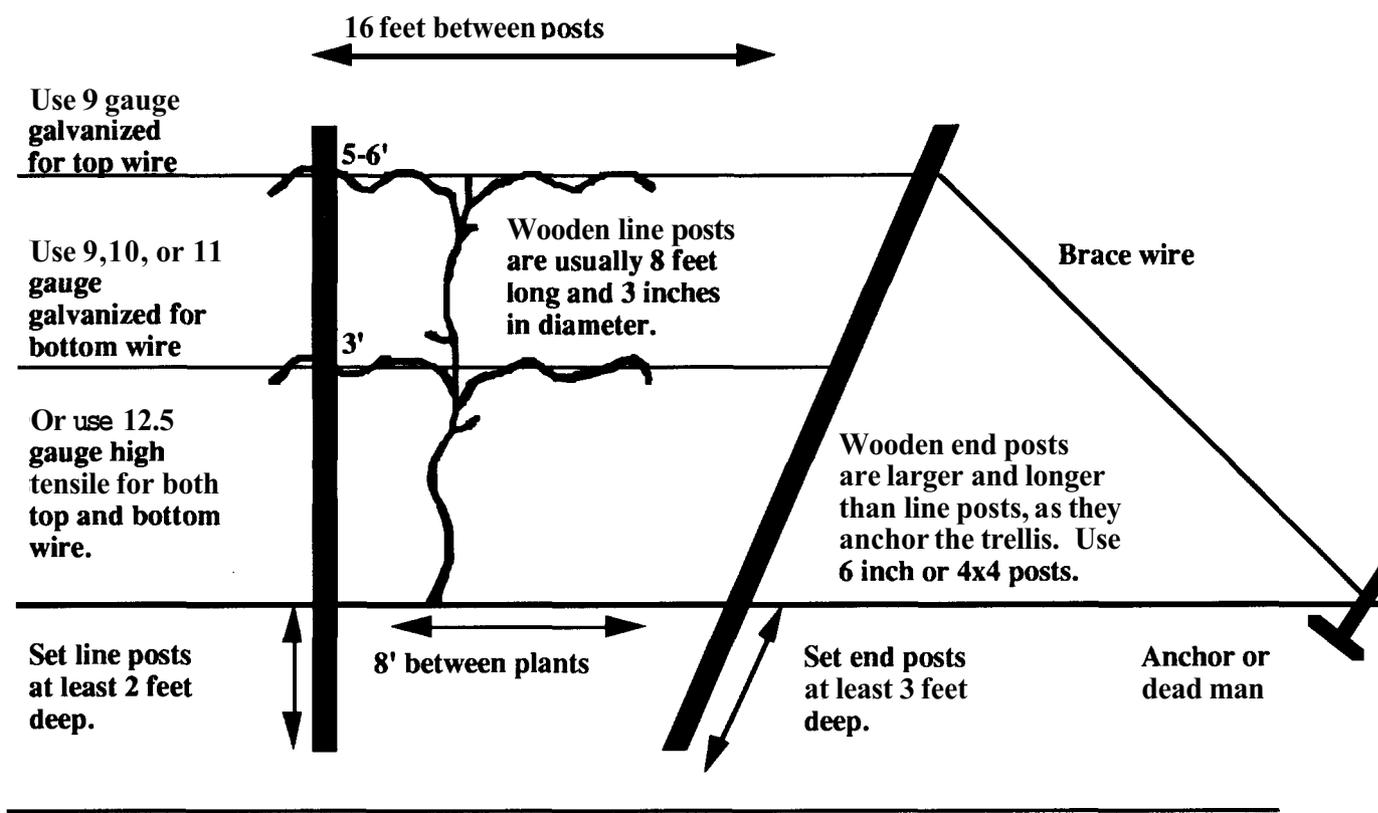
Chambourcin - ripens mid season. Berries are black in color, and vines are moderately cold hardy. Fruit is used for red wine.

Spacing: Space 8 feet apart in the row. Spacing between rows should be 10 feet.

Planting: Plant in the spring as soon as the ground can be worked. Plants are usually obtained as bare-rooted cuttings. Keep roots moist during planting. Water plants after they are set and prune the top to 1 stem containing 3 or 4 buds. Buds are located at the enlarged areas along the cane.

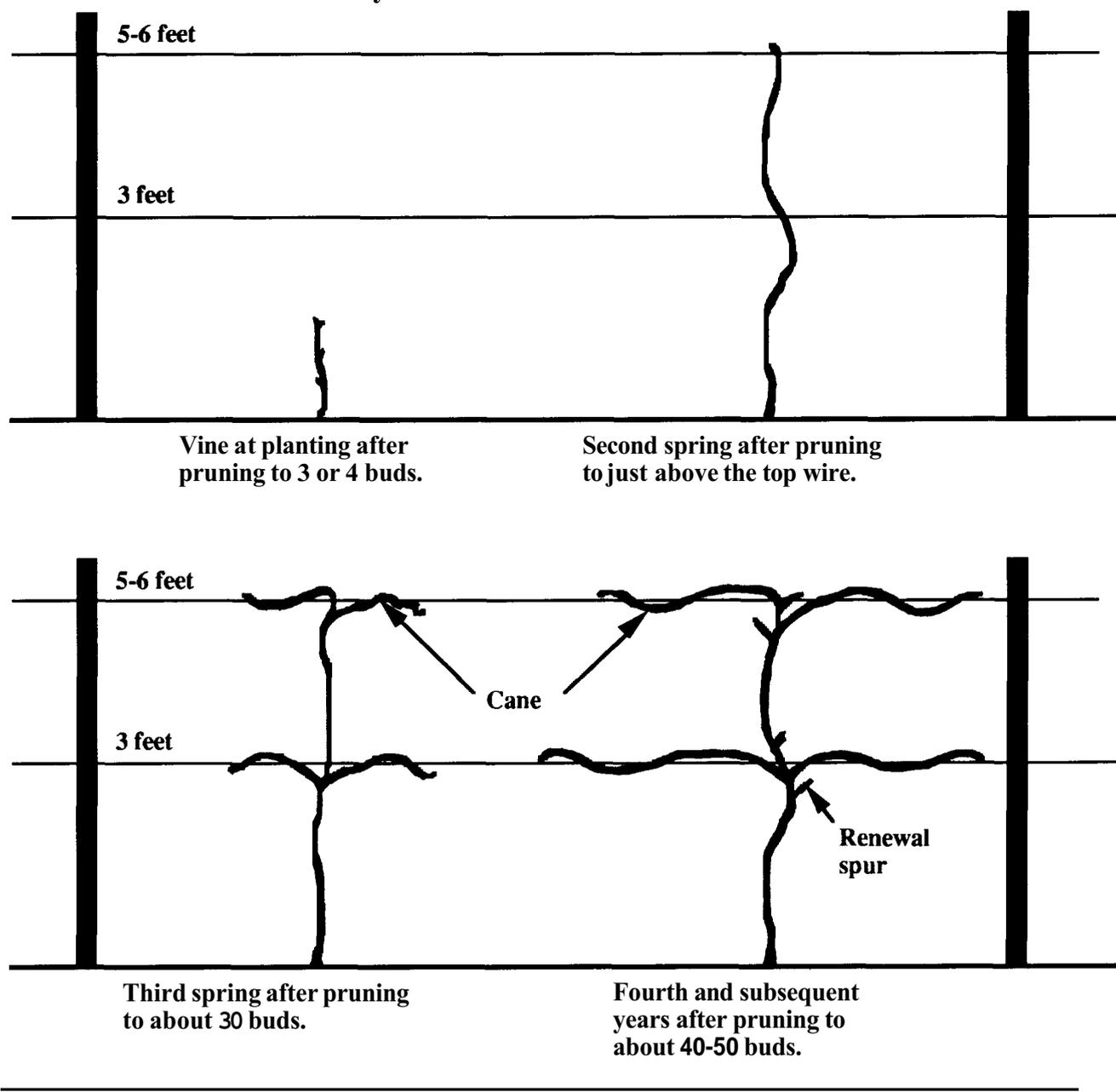
Training and Pruning: A trellis, arbor, or some other support structure is required for grapevines. To construct a trellis, use a two wire trellis with the top wire at 5 to 6 feet and the bottom wire at 3 feet supported by wooden or steel posts (see Figure 9).

Figure 9. Grape Trellis Construction



A common training system is the 4-cane-Kniffen (Figure 10). Three years are required to train vines to the system. In the first season at least two shoots are trained to the top wire. One shoot is retained after dormant pruning to form the trunk. In the second season shoots are trained along the top and bottom wires in both directions. In the third season fruiting shoots will grow from the wood trained along the wires. Prune every year in the dormant season (February - March). Pruning wounds may bleed, but this is no cause for alarm. Shoots which have turned brown in color at the end of the growing season are called canes. The canes will produce the crop, for grapes do not produce fruit on wood that is two years old or older. Most of the canes are removed when the vines are pruned; however, 40 to 50 buds (enlarged areas along the cane) on healthy canes are retained to produce next year's crop. Canes that are not used to produce the crop should be cut back to one or two buds close to the trunk or cordon. These "renewal spurs" will produce the canes necessary to produce the crop in the following year. The trunk is maintained year after year and new canes are selected from this wood every year. Refer to MS 14, Training and Pruning Small Fruit Crops in Missouri, for more information on this important area (see **FOR MORE INFORMATION**, page 45).

Figure 10. Training and Pruning of Grapevines
4 Cane Kniffen System



Blossoms and Pollination: Flower clusters are produced on new shoot growth and blossoming occurs in May; therefore, grapes are usually not injured by late frost. Two cultivars are not needed for cross pollination.

Fertilization: On new plantings, fertilize after growth starts with 3 tablespoons of 13-13-13 or similar fertilizer scattered in a 24 inch diameter circle around each plant, keeping 6 inches away from the trunk. Repeat twice at monthly intervals, scattering in slightly larger circles each time (36 to 48 inches). On older plantings, apply the

same fertilizer at the rate of one and a half cups per vine scattered beneath the plant. Apply fertilizer in March or early April.

Harvest: Grapes will turn color long before they are ripe. Season of harvest extends from August through September. Grapes for table use can be harvested as soon as they taste good. Grapes for wine are best harvested when there is a good "balance" between sweet and tart tastes. Cut clusters off with clippers or shears when ripe. Grapes kept in the refrigerator will last two to three weeks.

Grape Diseases

Black Rot: Black rot of grapes is probably the most common grape disease. This disease is caused by a fungus that can infect the leaves and fruit of grapevines. The first symptom of infection of the leaves is a small tan to yellow spot on the upper surface of the leaf. The spot continues to enlarge and tiny, black structures develop inside the spot. On infected fruit, the berries begin to shrivel, turning a dark black color. The berries eventually shrivel up and are referred to as "mummies". These "mummies" may remain attached to the vine, or may fall to the ground, spreading the disease.

Control measures for black rot include opening the canopy to allow for good air circulation so the foliage and fruit dry quickly after a rain, removing and destroying black rot mummies, and following a fungicide spray program.

Downy Mildew: Downy mildew of grape is caused by a fungus that attacks all the green parts of the vine. Leaves that are infected with the fungus have yellow, "oily" spots on the upper surface of the leaves and a white, "cottony" growth on the lower surface of the leaves. Young berries are very susceptible to infection by the downy mildew fungus. Infected berries become covered with the downy mildew fungus and appear gray to light tan in color and remain firm, compared to healthy berries which soften as they ripen.

The control measures for downy mildew include pruning and destroying any infected leaves and fruit. Cultivation underneath the vine to destroy infected leaves and fruit will help keep the fungus from overwintering. Chemical control is the most effective means of downy mildew control.

Powdery mildew: Powdery mildew is similar to downy mildew in that it is caused by a fungus that can infect all the green parts of a vine. Infected leaves and fruit have a white to gray colored, powdery growth on the surface. Both sides of the leaves may have the white, powdery growth of the fungus (versus downy mildew which usually only has the growth of the fungus on the lower surface of the leaf.) The fungus causes a net-like pattern on infected berries. Infected berries may split open and fall to the ground before they are completely ripe.

Control measures for powdery mildew are similar to those for downy mildew and include good sanitation practices and fungicide applications.

Grape Insect Problems - grape flea beetle, grape berry moth. See **COMMON FRUIT INSECT CONTROL** section, page 43.

RASPBERRIES AND BLACKBERRIES

Raspberries and blackberries can grow well in Missouri but must be kept in bounds with proper pruning. Management for disease control is important. Raspberries in particular need deep, well-drained soils that are high in organic matter. Many cultivars of blackberries are not reliably hardy in Missouri, especially the eastern trailing thornless type. It is best to obtain bramble plants from a source that offers tissue cultured plants or plants that are certified to be as free of viruses as possible.

The base or crown and roots of bramble plants are perennial and therefore live year after year. The canes, however, only live for two years. Generally, the primocanes, or first year canes, grow vegetatively and do not produce fruit. Primocanes that go through the winter are called floricanes or "flowering cane" the second season. Floricanes will produce fruit the next growing season and then will die. The fruit producing canes are removed after harvest or later in the dormant season, while the primocanes are allowed to grow for the rest of the season so they can bear fruit the following year. The exception to this rule occurs with fall or everbearing raspberries, since they actually can bear fruit on the primocanes in middle to late summer and fall. If the primocanes that have borne fruit in fall are left over winter, they will bear fruit again, lower on the cane, in the late spring, early summer, and then die. It is easier and more productive to manage fall or everbearing raspberries for the primocane or fall crop only, and this method is discussed in a following section.

Red (and Purple) Summerbearing Raspberries

Cultivars

Latham - ripens late season. The berry is red, firm but crumbly and is only of fair quality. Plants are very vigorous, and thorns are not terrible. Fruit is good for canning and freezing.

Royalty - purple raspberry ripens later than the mid season black raspberries. Berries are large, tart, and firm, and plants are very hardy, vigorous, and productive. Royalty is a cross between a black and a red raspberry, but culture and pruning are similar to red raspberry.

Spacing: Space plants 2 feet apart in the row, with at least 8 feet between rows. New plants arise as suckers on underground stems and will eventually fill in the hedgerow.

Planting: Plant in spring as soon as the ground can be worked. Keep roots moist during planting and cut the cane down to ground level after the plant is set. Remove cane from planting. Water after planting.

Blossoms and Pollination: You do not need 2 cultivars for cross pollination.

Fertilization: One month after planting, apply 1 cup 13-13-13 per 10 feet of hedgerow (per 5 plants). The year after planting, apply 1 cup 13-13-13 per 10 feet of

hedgerow in March. Third season and thereafter, apply 2 cups 13-13-13 per 10 feet of row in March.

Pruning: In January or February remove damaged or spindly canes and thin if necessary to 3 or 4 canes per square foot. Hedge the top of the row so that it is about 5 feet high; however, never remove more than 1/4 of the cane. Immediately after harvest, cut the canes that bore fruit, and burn or remove them from the planting. You will be left with the new canes at this point. Thin out broken and spindly new canes and leave about 3 or 4 good canes per square foot. Keep the hedgerow 6 to 18 inches wide. Recent research has indicated that a narrow row is more productive. Refer to MS 14, Training and Pruning Small Fruit Crops in Missouri, for more information on this important area (see **FOR MORE INFORMATION** section, page 45).

Harvest: Berries are ripe when they turn a "dusty" red color and can be easily removed from the plants. Berries are perishable, so remove them from the field as soon as possible. Raspberries may be kept in the refrigerator up to 4 days. A temporary trellis support may be used to aid harvest. Install wooden or steel posts every 25 feet in the row. When the primocanes are blossoming in midsummer, tie heavy gauge baling twine between the posts about 1 1/2 to 2 feet high on either side of the raspberry hedgerow, so as to support the fruit bearing tips of the canes and keep them from bending over when the fruit ripens.

Fall or Everbearing Raspberries

Although fallbearing or everbearing raspberries can be managed to bear both a summer and fall crop, only management for the fall crop is discussed in this section. More berries are produced with less work if you manage for the fall crop only.

Cultivars:

Heritage - berries are large, red and firm. Vigorous upright canes. Heritage begins to bear fruit in early August in southern Missouri.

Caroline - berries are large, red and flavorful. Ripens earlier than Heritage. Not fully tested in Missouri but promising. Reported to be tolerant of root rot and yellow rust.

Kiwigold - berries are large, firm and yellow, with blush when overripe. Ripens August to September. Vigorous, upright canes. Not fully tested in Missouri, but promising.

Anne - berries are yellow. Ripens August to September. Not fully tested in Missouri, but a promising cultivar to try.

Spacing: Space plants 1 to 2 feet apart in the row, with rows at least 8 feet apart. New plants arise as suckers on underground stems. Use the closer spacing if you want to harvest more berries the first year in the available space.

Planting: Same as for summerbearing red raspberries

Blossoms and Pollination: You do not need 2 cultivars for cross pollination.

Fertilization: One month after planting, fertilize with 1 cup 13-13-13 per 10 feet of row. When blossoms appear in midsummer, apply 2 tablespoons ammonium nitrate (33-0-0) per 10 feet of row. In the years following planting, fertilize in spring with 2 cups 13-13-13 per 10 feet of hedgerow. When blossoms appear in early to midsummer, apply 4 tablespoons of ammonium nitrate (33-0-0) per 10 feet of row.

Harvest: Same as for summerbearing red raspberries. Fallbearing raspberries bear fruit the year they are planted from August until frost.

Pruning: Cut all canes down as close to the ground (making sure you do not damage the crown) with a mower or with shears in January or February. Remove and burn old canes to control disease. Refer to MS- 14 Training and Pruning Small Fruit Crops in Missouri.

Black Raspberries

Cultivars:

Bristol - black raspberry ripens mid season. Berries are large, firm and highly flavored. The plants are vigorous, winter hardy, and productive with some disease resistance.

Jewel - black raspberry ripens mid season. The berries are large, glossy, black and slightly wooly. The plants are winter hardy and disease resistant.

Spacing: Space plants 4 feet apart in the row with the rows at least 8 feet apart. New plants arise when the tips of canes or lateral (side branches) contact the ground and are left to root in August. If you do not want additional plants, remove these laterals or make sure they do not contact the ground. Some purple raspberry cultivars ('Brandywine') have a growth habit similar to black raspberries and are handled as such.

Blossoms and Pollination: You do not need 2 cultivars for cross-pollination.

Fertilization: One month after planting, apply 1/4 cup 13-13-13 or equivalent per plant. In the second year, apply 1/4 cup 13-13-13 or equivalent per plant in March. Third year and annually thereafter, apply 1/2 cup 13-13-13 or equivalent per plant in March.

Harvest: Berries are ripe when they turn a dull, black (or purple if purple raspberry) color and can be easily removed from the plant. Berries are perishable, so remove them from the field as soon as possible. Raspberries may be kept in the refrigerator for up to 4 days.

Pruning and Training: The use of a "T" trellis is optional for support of black and purple raspberries. The trellis setup includes 2 wires 24 to 28 inches high and 18 inches apart running parallel to the ground on either side of the row. Throughout the summer, cut tips of non-trellised primocanes off when they reach a height of 24 inches (black) to 30 inches (purple) in height. Cut tips of trellised primocanes off when they reach 30 inches (black) to 42 inches (purple) in height. Summer tipping primocanes will promote the development of side branches (laterals)

that will bear fruit the following year (on floricanes). In subsequent years, summer tip the primocanes and cut the canes that bore fruit (floricanes) down to the ground after harvest or in the dormant season. In late winter, cut the laterals back 7 - 12 inches and remove laterals that are near the ground. Thin canes leaving 3 to 6 per plant. Refer to MS 14 Training and Pruning Small Fruit Crops in Missouri.

Erect Blackberries

Erect blackberries bear fruit the year following planting and do not need a trellis, although one may be helpful in windy areas. The major limiting factor of erect blackberries in Missouri is winter hardiness.

Cultivars:

Shawnee - ripens mid-late season. Fruit is large, firm, and of good quality. Plants are vigorous and productive

Kiowa - ripens mid-late season. Fruit is very large and good quality. Not fully tested in Missouri.

Chickasaw - ripens mid-late season. Fruit is large, firm, and good quality. Not fully tested in Missouri.

Illini Hardy - ripens late, fruit is medium size and of good quality. Plants are vigorous, very thorny, and winter hardy.

Navaho - ripens late, fruit is medium size, firm and of good quality. Plants are thornless. The hedgerow is best established with plants rather than root cuttings. Navaho is susceptible to orange rust. It is best adapted to southern Missouri.

Apache - ripens late. Fruit is large and good quality. Plants are thornless. Not fully tested in Missouri.

Spacing: Space root pieces 2 feet apart in the row or space plants 2 to 4 feet apart in the row. Keep rows at least 8 feet apart.

Planting: Plant in the spring. If planting root pieces, lay the root piece horizontally in the bottom of a planting furrow 4 inches deep. Cover with soil and firm soil down around root. If planting rooted tips or plants, dig a hole that is large enough to spread the roots out evenly, cover with soil and firm soil down around the plants. After planting, cut the cane to the ground and remove the old cane from the planting to control diseases. Water after planting. New plants arise as suckers from the roots and will eventually fill in the hedgerow. Growth in the planting year does not look very "erect", but the erect character is expressed in the second and subsequent years.

Blossoms and Pollination: You generally do not need to plant 2 cultivars for cross pollination.

Fertilization: Same as for summerbearing red raspberries.

Harvest: Berries are ready to harvest when they are black, turn from shiny to a bit dull, and come off the plant easily. Black color does not necessarily mean ripeness. Blackberries are perishable and should be refrigerated as soon as possible after picking. Blackberries may keep in the refrigerator for 4 days and freeze well.

Pruning: During the summer allow primocanes to grow and cut off the tips when they are between 3 and 4 feet high. This will help the side branches or laterals to develop (like pinching houseplants) and will prevent the blackberries from becoming too tall and spindly. Do this several times during the summer. In the years after planting, remove the fruit bearing canes (floricanes) after harvest or in the dormant season. In January or February cut back the lateral or side branches so they are about 1 foot in length. Remove laterals that are close to the ground. Remove weak, spindly, and winter damaged canes at ground level and leave about 6 canes per square foot. Maintain the hedgerow width at 18 inches. Refer to MS 14, Training and Pruning Small Fruit Crops in Missouri, for more information on this important area (see **FOR MORE INFORMATION** section, page 45).

Semi-Erect Thornless Blackberries

The fruit of semi-erect thornless blackberries are generally more tart than other blackberries. Semi-erect thornless blackberries are not reliably hardy in Missouri and require a trellis or support system.

Cultivars:

Black Satin - fruit is large, firm, slightly tart with good flavor. Plants are vigorous, productive, and somewhat disease resistant.

Chester - fruit is large, firm, and tart with good flavor. Plants are vigorous, productive and resistant to cane blight. Chester has been observed to be hardier than the other available eastern trailing thornless blackberry cultivars.

Hull - fruit is large and firm. Plants are vigorous.

Triple Crown: fruit is medium size, firm, slightly tart with good flavor. Not fully tested in Missouri.

Spacing: Space plants 6 feet apart in the row with at least 8 feet between rows.

Planting: Same as for summerbearing red raspberries.

Blossoms and Pollination: You generally do not need 2 cultivars for cross pollination.

Fertilization: One month after planting sprinkle 1 cup 13-13-13 evenly around each plant. The years after planting, apply 2 cups 13-13-13 per plant in March.

Harvest: Same as for erect thorny blackberries.

Pruning and Training: Semi-erect thornless blackberries must be supported by a trellis similar to that used for grapes (see Figure 9 in the grape section). The trellis can consist of 5 or 6 foot high posts spaced 12 feet apart. Support is provided by either one wire at the top or 2 wires (one 3 to 3-1/2 feet from the ground and the other at the top). In summer, tie 6 to 8 canes per plant to the trellis in the shape of a fan. Cut the canes off when they are about 6 inches past the top wire. This will allow the laterals or side branches to grow. Cut out low lying laterals and drape the remaining laterals over the trellis so they do not root at the tips. In the years after planting, remove the fruit producing canes immediately after harvest. In March, shorten laterals to between 18 and 24 inches. Refer to MS 14, Training and Pruning Small Fruit Crops in Missouri for more information on this important area (see **FOR MORE INFORMATION** section, page 45).

Bramble Disease Problems

Anthracnose: Anthracnose is caused by a fungus that can infect the canes, leaves, and fruit of brambles and is especially destructive to black raspberry. Infected canes have red to purple spots on the new canes in the spring. The spots enlarge and the centers turn a light brown to gray color. Infected leaves have small, purple spots with white centers. The infected tissue may drop out of the leaf creating a "shot-hole" effect. Infected fruit have drupelets that are small, pitted and slow to ripen.

Control measures for anthracnose include any measures that improve air circulation within the planting (to help dry the leaves, canes and fruit after a rain) The removal and destruction of any infected leaves, canes and fruit will also help control the disease. Liquid lime sulfur may be applied as a "delayed dormant application" when the plant is just beginning to break dormancy. Any sprays of liquid lime sulfur later than the delayed dormant application may injure the new plant growth. Refer to the Home Fruit Spray Schedule for the recommended rates of application.

Botrytis Fruit Rot and Blossom Blight: This disease is often called "gray mold" and is caused by a fungus that can infect the blossoms, fruit or canes of blackberries and raspberries. The disease is favored by cool, wet weather, and can cause heavy losses if these conditions exist during harvest. Flowers may be infected just as they open in the early spring. Infected flowers turn a dark brown color and may fall from the cane. Infected fruit is covered with a dusty brown growth of the fungus. Any type of injury to the developing fruit, such as insect feeding, greatly increases the severity of the disease. Unpicked, overripe fruit is often infected by the gray mold fungus.

Control measures for the gray mold fungus include an open plant canopy that allows for better air circulation to dry the leaves and fruit after rainfall. Pruning to maintain a narrow row, and controlling weeds next to the brambles will help control the disease. Fungicides are available to help control gray mold.

Orange Rust: Orange rust can be a serious disease of blackberries and black raspberries. Red raspberries are reported to be "immune" to this disease. Symptoms of an infection appear on the new growth in the spring. The new leaves are spindly and stunted. As the leaves mature, bright orange growths of the fungus appear on the lower surface of the leaves. Plants may become infected at the crown and remain

infected for the life of the plant. Therefore, the best control measure for this disease is to remove and destroy any plants that are infected at the crown.

Spur Blight and Cane Blight: These two diseases of brambles are both caused by fungi that can infect the leaves and canes of blackberries and raspberries. Cane blight only infects canes that have been wounded in some way. Mechanical wounds or pruning wounds are good entry points for the cane blight fungus.

The spur blight fungus infects at the leaves, causing a dark brown wedge-shaped area of discoloration at the tip of the leaf. The fungus then grows through the leaf and enters the cane, causing a dark brown lesion on the cane. The spur blight fungus can also infect at a wound site on the cane.

An important control measure for these two diseases is opening up the canopy to improve air circulation and promote rapid drying of the leaves and canes after rainfall. Other control measures include planting resistant cultivars, avoiding mechanical injury to the canes, and the removal and destruction of any infected canes. Fungicides are available that will also help control these two diseases.

Bramble Insect Problems - rednecked cane borers, other borers. See **COMMON FRUIT INSECT CONTROL** section, page 43.

HIGHBUSH BLUEBERRIES

Highbush blueberries are winter hardy shrubs that are adapted to Missouri. They are difficult to establish due to their strict requirements concerning planting site. Blueberries are adapted to an acid soil (pH_{soil} 4.3-4.9 Missouri Soil Testing Service or pH_{water} 4.8-5.2 for water based tests); therefore, blueberry sites should not be limed. Sulfur may be added at least a month before planting to acidify the soil if necessary. You need to take a soil test and show the results to a grower advisor or extension agent for recommendations as to the amount of sulfur if needed. Blueberries are very sensitive to both standing water and to dry soil conditions; therefore, they must have perfect water drainage and must be mulched and watered regularly. Plants do best on a sandy loam soil that is high in organic matter. Blueberries do not require as many pesticide sprays as do some other fruit crops. Birds can be a problem at harvest; the most effective control is netting.

Cultivars:

Earliblue - ripens early. Berries medium size and light blue. Bush is upright and vigorous.

Duke - ripens early. Berries are large and medium blue. Bush is upright and open.

Northland - ripens early-mid season. Berries are medium size and dark blue. Bush is upright, vigorous and dense. It is the most winter cold hardy of the recommended cultivars and is a nice choice for ornamental use in the landscape.

Bluejay - ripens early-mid season. Berries are medium size and light blue. Bush is upright and vigorous.

Blueray - ripens mid season. Berries are medium size and light blue. Bush is upright, spreading and vigorous, but long canes may bend down into the row with the weight of the fruit.

Bluecrop - ripens mid season. Berries are large and light blue. Bush is upright and vigorous. Bluecrop is the standard cultivar in our area.

Berkeley - ripens mid season. Berries are large and light blue. Bush is spreading and vigorous and adaptable to a wider in-row plant spacing.

Jersey - ripens mid-late season. Berries are small - medium size and dark blue. Jersey is preferred for pies and muffins. Bush is very vigorous and upright. Plant is the largest of this group.

Coville - ripens late. Berries are large and medium blue. Bush is upright, spreading and vigorous.

Lateblue - ripens late. Berries are large and light blue. Bush is open, spreading and vigorous.

Spacing: Space plants 4 - 6 feet apart in the row and space rows 10 feet apart.

Planting: Plant in spring or fall. Purchase 1-year jumbo rooted cuttings, or two-year-old plants. Plants may be bare rooted, machine balled, or containerized. You will need 1 gallon of moist **sphagnum** peat moss per plant. Make sure you are using sphagnum peat moss, since it has a pH of around 4. If container plants are used, make sure you cut the root ball in 3 or 4 places and tear the bound root ball to spread out the roots. Dig a hole about 8 to 12 inches deep and wide enough so that you can spread all of the roots out evenly. Mix the gallon of moist sphagnum with the replacement soil. Make certain that you plant the blueberry no deeper than it was growing in the nursery or it may die. Firm the soil around the plant roots. If your soil is heavy, plant on a gentle ridge about 8 inches high in the center and about 3 to 4 feet wide down the row. Water the plants after planting and mulch afterwards.

Mulching: Blueberries must be mulched to a depth of 4 to 6 inches, spread in a 3 to 4 foot wide band down the row. Mulch after planting and replenish the mulch every year. Mulch materials include bark chips, wood shavings, aged sawdust, pine needles, or other suitable materials. You may need to add extra nitrogen if you use non-composted sawdust or shavings. You do not have to worry as much about the pH properties of the mulch as you do about the fertilizer you use or the peat moss (sphagnum) you incorporate in the planting hole. The mulch is not incorporated around the roots, but is placed above the roots conserving moisture and keeping roots cool.

Blossoms and Pollination: Blueberries blossom in April and are not usually injured by spring frost. Planting 2 cultivars for cross-pollination improves yield but is not necessary for home production.

Fertilization: During the first growing season, fertilize with 2 tablespoons 13-13-13 sprinkled evenly around the plant when growth begins in the spring (fall planted bushes) or 4 to 6 weeks after planting (spring planted bushes). Six weeks later, fertilize with 1 tablespoon ammonium sulfate (21-0-0) per plant. Second growing season, fertilize in spring when buds break with 4 tablespoons 13-13-13 per plant, then 6 weeks later with 2 tablespoons ammonium sulfate per plant. Repeat the ammonium sulfate application 1 or 2 more times at 6 week intervals. For plantings 3 years or older, fertilize in spring at bud break with 1/2 cup 13-13-13 per plant, then 6 weeks later apply 1/4 cup ammonium sulfate per plant. Repeat the ammonium sulfate application 1 or 2 times at 6 week intervals. If your soil is very acid, you may substitute urea for ammonium sulfate.

Harvest: Blueberries are ready to harvest when they are blue and do not have a violet ring around the "stem" where the berry connects to the bush. Birds are a problem at this time, and protective netting is recommended. The fruit can stay on the bush over a week after ripening. Blueberries keep over a week in refrigeration, and they freeze well.

Pruning: Prune in February or March before bud break. In the first and second seasons, prune very lightly, only removing dead or broken branches. In the third and fourth seasons, prune lightly, removing some of the spindly previous season's growth and cut out any weak, broken, or dead shoots. In or after the fifth season, cut out the weakest young shoots from the previous season, and remove 20 percent of the oldest producing canes from the base, Refer to MS 14 , Training and Pruning Small Fruit Crops in Missouri, for more information on this important area (see **FOR MORE INFORMATION** section, page 45).

Blueberry Disease Problems

Stem Blight: Stem blight of blueberries is caused by a fungus that can also cause diseases on apple trees and thornless blackberry plants. The symptoms of infection by the stem blight fungus on blueberries include 1 or 2 dead canes adjacent to living canes in the same plant. When a cane becomes infected, the leaves turn yellow, then red, and eventually wilt. The most characteristic symptom of stem blight infections is the pecan-brown discoloration of only 1 side of the cane. Stem blight infections usually spread from wounds created by pruning, frost injury, insect feeding or other mechanical wounds on the canes.

The control measures for stem blight infections include good sanitation practices that remove and destroy any infected canes. Pruning shears should be surface sterilized with rubbing alcohol between cuts on an infected bush. Keeping the plants healthy and protected from mechanical injury will also help prevent stem blight infections. Sufficient fertilization and enough water during hot, dry, summer months is important.

Blueberry Insect Problems - curculio. See **COMMON FRUIT INSECT CONTROL** section, page 43.

COMMON FRUIT INSECT PESTS

Codling Moth (apple, pear)

The codling moth is the most serious apple pest in Missouri. Adults are small, gray moths with dark gray wing margins. Codling moth larvae (worms) feed within fruit. Damage ranges from "stings" in the fruit surface to damage within the fruit caused by the feeding of the larvae. Control includes insecticide sprays.

Plum Curculios (apple, stone fruits, blueberry)

Plum curculios is a small, brown weevil that feeds on many fruit crops. Adult feeding causes scarring or cat facing, while larvae feed within the fruit. Control includes insecticide sprays, destroying wild sources of infestation, and cultivation to destroy pupae in the soil near fruit plants.

Aphids (apple, pear, stone fruit, strawberry, grape)

Several types of aphids, among them the apple aphid and the rosy aphid, can damage apples in Missouri. Aphids are tiny, soft bodied insects that feed by sucking sap from leaves, shoots, and fruit. Leaves and shoots may be curled and distorted, and injured fruit have a knotty appearance. Control includes insecticide sprays and favoring natural predators, such as lady beetles.

Mites (apple, pear, stone fruit, strawberry, brambles)

Mites are tiny relatives of spiders that feed by sucking the contents of leaf cells. Damaged leaves may become bronzed or whitish, and defoliation can occur if damage is severe. Control includes favoring natural mite predators and the use of miticides.

Scales (apple, pear, stone fruits)

Scales of several species may be found in Missouri. Scales are tiny insects covered by a protective shell called a "scale". Scales may be present in large numbers and feed on all parts of the tree. Damage is seen as reddish discoloration of the bark and fruit, and a loss in vigor of severely infested trees. Severe scale infestations may kill trees. Control includes a thorough application of superior oil during the dormant season.

Leaf Rollers (apple, pear, strawberries)

Several species of leaf rollers can be problems in Missouri. Larvae feed on foliage, spinning webs that roll or fold leaves. Fruit may also be attacked. Control includes insecticide sprays.

Oriental Fruit Moth (stone fruits, apple, pear)

The oriental fruit moth is a small gray moth. Larva feed on many fruits but are a particular pest of stone fruits. Early in the season larva burrow into new shoots, causing shoot dieback. Later in the season larvae feed within fruit. Feeding activity can increase fruit rot problems. Control includes insecticide sprays and orchard sanitation (especially removing dropped fruit).

Borers (stone fruits, apple, pear, blueberry, brambles, strawberry)

Several species of borers can attack the crown, trunks, and lower limbs of fruit trees. The peach tree borer and the lesser peach tree borer are problems on stone fruits. Adults are clear winged moths. Extensive damage can result from feeding activity of larvae under the bark. Control includes physically killing the borers and the application of insecticide trunk sprays. Other borers attack the canes and crowns of small fruits. The rednecked cane borer is a small beetle that has a reddish area behind the head. Larvae feed inside current season bramble canes, causing swellings. Control includes the removal of all infested canes during dormant season pruning, and the use of insecticides.

Grape Flea Beetle (grapes)

Adults are small, bluish green beetles that feed on the contents of buds in the spring, destroying the shoot and fruit that would normally develop. Control includes insecticide sprays.

Grape Berry Moth (grape)

Adult grape berry moth are small, brownish moths. Larvae are small caterpillars that feed on flower buds and developing fruit. At harvest infested clusters may contain many hollowed out berries. Bunch rot diseases are more of a problem when grape berry moth larva are present. Control includes insecticide sprays.

Catfacing insects (stone fruits, strawberry, brambles)

Several types of insects cause fruit distortion, or catfacing, on many fruits. Tarnished plant bugs, stink bugs, and leaf footed bugs feed on developing fruit and disrupt fruit development. Feeding injury also leads to increased damage from fruit rots. Control includes the use of insecticide sprays.

Many other insect pests can damage fruit crops in Missouri. The first step in controlling a pest is proper identification. If a home fruit grower has any questions concerning insect identification, guidebooks (see **FOR MORE INFORMATION** section, page 45) are available at libraries and bookstores. Information on insect identification is also available from the SMSU Fruit Experiment Station or University Extension.

FOR MORE INFORMATION

The following group of publications may be obtained from the Fruit Grower Advisor, SMSU Dept. of Fruit Science, 9740 Red Spring Road, Mountain Grove, MO 65711-2229.

MS-14 Training and Pruning Small Fruit Crops in Missouri
MS-18 Growing Fruit for Home Use
MS-21 Fruit Cultivars Released by the State Fruit Experiment Station
Bul. 39 Growing Blackberries in Missouri
Bul. 40 Training and Pruning Deciduous Fruit Trees
Bul. 42 Growing Blueberries in Missouri
Bul. 43 Growing Raspberries in Missouri

The following group of publications may be obtained from county University Extension offices or from Extension Publications, 2800 Maguire Blvd., University of Missouri-Columbia, Columbia, MO 65211.

Fruit Production Guides

GO6000 Pruning Raspberries, Blackberries, and Gooseberries
GO6005 Fruit and Nut Varieties for Missouri Home Plantings
GO6010 Home Fruit Spray Schedules
GO6012 Fruit and Nut Cultivar Nursery Sources
GO6020 Fireblight
GO6021 Home Fruit Production: Apples
GO6030 Home Fruit Production: Peaches
GO6085 Home Fruit Production: Grape Varieties and Culture
GO6090 Home Fruit Production: Grape Pruning Systems
GO6130 Strawberry Varieties for Missouri
GO6135 Home Fruit Production: Strawberries
GO6160 Establishing a Vineyard in Missouri
GO6161 Pruning and Training Grapevines
GO6162 Training Systems for Missouri Vineyards
GO6951 Understanding and Using Garden and Home Grounds Herbicides
GO6952 Garden and Home Grounds Weed Control
GO6956 Compost
GO6960 Mulches
GO6970 Home Propagation of Garden and Landscape Plants
GO6971 Grafting
GO6972 Budding
GO7870 Cedar Apple Rust
GO9109 Submitting a Soil Sample for Testing
GO9110 How to Get a Good Soil Sample
GO9111 Using Your Soil Test Results
MX0346 Apple Diseases I
MX 0347 Apple Diseases II
PS0010 Common Fruit Insects
RP0237 Growing Nuts

Harvest and Use of Fruit Crops

GHI455	Fruitful Canning: How to Safely Can Fresh Fruits
GHI502	Quality for Keeps: Freezing Fruits
GHI563	Quality for Keeps: How to Dry Foods at Home
MP0582	From Harvest to Health: Strawberries
MP0583	From Harvest to Health: Blueberries
MP0585	From Harvest to Health: Peaches
MP0599	From Harvest to Health: Grapes
MP0600	From Harvest to Health: Apples
MP0621	From Harvest to Health: Raspberries

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SUGGESTED SOURCES OF FRUIT PLANTS AND HORTICULTURAL SUPPLIES*

<u>Name</u>	<u>Address</u>	<u>Product</u>
Adams County Nursery	P.O. Box 108, Aspers, PA 17304	tree fruit
W. F. Allen Co.	Salisbury, MD 21801	small fruit
Blossomberry Nursery	Hwy. 21 N. Ludwig Clarksville, AR 72830	small fruit
Boyer Nurseries	405 Boyer Nursery Rd Biglerville, PA 17307	old and unusual fruit
Concord Nursery	10175 Mile Block Rd., North Collins, NY 14111	grapes
C & O Nursery	P.O. Box 116, Wenatchee, WA 98807	tree fruit
Cooley's Strawberry Nursery	P.O. Box 47 Augusta, AR 72006	strawberry
Cumberland Valley Nursery	Box 394, McMinnville, TN 37110	tree fruit
Daisy Farms	28355 M-152, Dowagiac, MI 49047	small fruit
DeGrandchamps Blueberry Farm	76241 14th Ave., South Haven, MI 49090	blueberry
Edible Landscaping	P.O. Box 77, Afton, VA 22920	old and unusual fruit
Forrest Keeling Nursery	88 Keeling Ln., Elsberry, MO 63343	general fruit
Gardens Alive!	5100 Schenley Place, Lawrenceburg, IN 47025	organic supplies
Grootendorst Nursery	15202 Lakeshore Rd., Lakeside, MI 49116	rootstocks
Haley Nursery	1207 Haley Rd., Smithville, TN 37116	tree fruit
Hartmann's Plantation	Rt. 1, Grand Junction, MI 49056	blueberry
HollyDale Nursery	Hwy. 415, Pelham. TN 37366	tree fruit
Hummert's Seed Co.	2746 Chouteau Ave, St. Louis MO 62103	supplies, chemicals
Indiana Berry and Plant	5218 W. 500 South, Huntingburg, IN 47542	small fruit
Ison's Nursery	6857 Hwy. 16, Brooks, GA 30205	small fruit
Krohne Plant Farms	65295 CR 342, Hartford, MI 49057	strawberries

Lawson's Nursery	2730 Yellow Creek Rd., Ball ground, GA 30107	old and unusual tree fruits
A. M. Leonard	6665 Spike Rd, Piqua, OH 45356	horticultural supplies
Newark Nursery	60397 CR 681, Hartford, MI 49057	general fruit
Northwoods Nursery	29696 S. Cramer Rd, Molalla, OR 97038	old and unusual fruit
Nourse Farms	41 River Rd., South Deerfield, MA 01373	small fruit tissue cultured (tc)
Raintree Nursery	391 Butts Road, Morton, WA 98356	disease resistant fruit, rootstocks
Sakuma Bros. Farms	P. O. Box 427, Burlington, WA 98233	strawberry, bramble (tc)
Southmeadow Fruit Gardens	P.O. Box 211, Lakeside, MI 49116	old and unusual fruit, rootstocks
Stark Bros. Nursery	P. O. Box 10, Louisiana, MO 63353	general fruit
Tower View Nursery	70912 CR 388, South Haven, MI 49090	blueberry
Van Well Nursery	P.O. Box 1339, Wenatchee, WA 98807	tree fruit

*This list is a reference, not a recommendation.

For a copy of this publication please write to State Fruit Experiment Station,
9740 Red Spring Road, Mountain Grove, MO 65711-2999
or visit our website <http://mtngrv.missouristate.edu/>



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