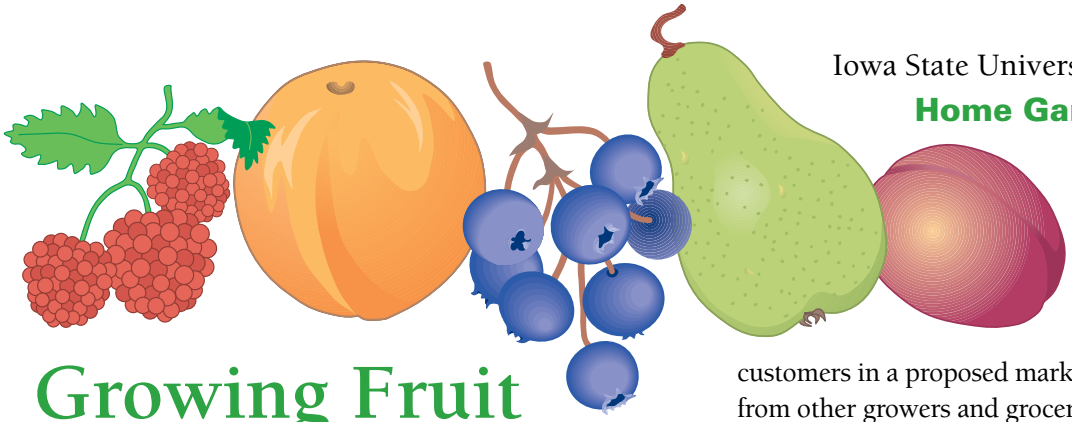

Growing Fruit in Iowa

By Paul Domoto, Richard Jauron, and Gail Nonnecke

Several species of fruits can be grown successfully in Iowa for home use or commercial sales. However, because of our winter temperatures and local soil conditions, not all fruits or fruit cultivars (cultivated varieties) are adapted to all areas of the state. This guide will assist home gardeners and potential commercial growers in selecting the fruit crops best adapted for their growing conditions. The guide also provides information on special crop needs and sufficient information to begin growing the crops. The companion publication, PM 453, *Fruit Cultivars for Iowa,* lists cultivars recommended for various regions of the state.

Home gardeners generally can grow a greater diversity of fruit than commercial growers because they are not confined by market demands and the need for consistent annual production. As a result, home gardeners can take greater risks related to fruit and cultivar selection and can be rewarded with quality fruit that may not be available from local grocers or commercial fruit growers. Such plantings can provide an abundance of nutritious, high quality, fresh fruit during the growing season. Surplus fruit can be preserved by freezing, canning, drying, or making preserves, juice, or wine. If you are successfully growing fruit and have the space, you might consider expanding into a small commercial enterprise, such as selling at a farmers' market.

If you are developing a commercial fruit planting, crop(s) and cultivars selected should be those that are productive and have good consumer demand. In determining how much to plant, evaluate the potential market relative to the marketing method(s) you wish to employ. In assessing your markets, consider the potential number of customers in a proposed marketing area and competition from other growers and grocery stores within and near that area. In marketing the crop, you can employ some method of direct marketing (pick-your-own, on-site stand, roadside stand, or farmers' market), or market wholesale to local grocery stores or other growers. Direct marketing is more profitable than wholesale marketing, but sales volume is more limited and location relative to consumer access becomes more important.

Guidelines for Success

Careful crop and site selection, and a commitment to perform the necessary cultural practices, are required to successfully grow quality fruit at home or commercially. The following guidelines help to ensure success for home and commercial fruit growing.

- Begin by selecting and planting fruit crops and cultivars recommended for your region of Iowa as listed in PM 453, *Fruit Cultivars for Iowa*, or in your hardiness zone. When selecting a cultivar, determine if it has any disease problems that might reduce your chances of success.

- Determine if the crop and/or cultivar has any special pollination requirements. Relative to their pollination requirements, fruit crops are subjectively classified as being either self-fruitful, partially self-fruitful, or self-unfruitful. Self-fruitful crops are those that will set fruit with pollen from the same plant or cultivar (self-pollination), and therefore a single plant will produce a crop. Self-unfruitful crops are those that will not set fruit with pollen from the same plant and require pollen from another cultivar of the same species or closely related species (cross-pollination) to set fruit. Partially self-fruitful crops will set some fruit through self-pollination but set larger crops when another cultivar is planted for cross-pollination. Because the degree of partial self-fruitfulness varies between cultivars within a crop, this group is often classified with the self-unfruitful crops.

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PM 1788 Reviewed March 2012

Within some fruit crops, a cultivar may either produce sterile pollen, or exhibit cross-incompatibility where the pollen of one cultivar will not cross-pollinate another specific cultivar. When either condition occurs, at least three cultivars must be planted to obtain fruit set on all the plants.

• Select a location that receives direct sunlight most of the day. Fruit plantings are most productive and produce higher quality fruit when grown in full sun.

• Avoid planting in low areas where cold air will settle on calm nights or where down-slope obstructions can impede the drainage of cold air away from the site. Such areas are more prone to late-spring and early-fall frosts.

• Whenever possible, avoid immediately replanting a site with the same crop or a closely related crop following the loss of plants or the removal of plants because of low productivity. In immediately replanting such sites, there is a greater risk of encountering problems with soilborne diseases (*Phytophthora* and *Verticillium* species), viruses, or root-feeding nematodes than if one were to select another site or wait a few years before replanting.

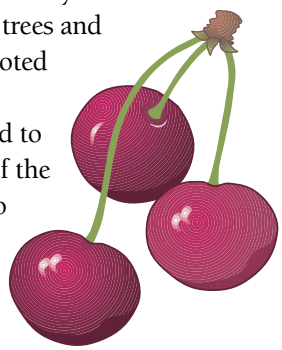
Because soilborne diseases have a wide host range and can remain dormant in the soil for several years, cultivars that are resistant to these diseases should be considered when replanting.

• Avoid planting on heavy, poorly drained soils. All fruit crops do best when planted on well-drained soils. Such soils are well aerated, which allows good root development, and plants are less prone to soilborne diseases (*Phytophthora* and *Verticillium* species). Soil drainage is a function of the slope as it affects surface run-off, soil texture, and the soil profile. Fine-textured clay soils have a high water holding capacity, but drain slowly and lack adequate aeration. Generally, loamy soils are considered best for fruit crops because they hold adequate moisture and provide good aeration. However, if the soil profile has a clay or compacted layer that impedes the downward movement of water, even these soils may be unsatisfactory. Information on your soil characteristics can be found in the county *Soil Survey* that is available at your county extension office. If poor soil drainage is a problem created by a shallow clay layer, as often occurs during home construction, you may be able to deep-till the soil to break up the clay layer. If poor drainage is a natural characteristic of the soil, planting on raised beds will alleviate part of the problem. Test holes can be dug during the growing season to evaluate the drainage characteristics of a soil. These holes should be 3 feet deep and filled with water. If water remains in a hole after 72 hours, the soil should be considered unsuited for fruit crops unless corrective measures are taken.Plant on sandy soils only if water and additional fertilization can be provided. Sandy soils have a low moisture holding capacity compared to loamy soils. When expressed in inches per foot of soil depth, the average available moisture for the various soils is as follows: sand, 0.5"; loamy sand, 1.0"; sandy loam, 1.5"; loam, 2.0"; silt loam and clay loam, 2.5"; and clay, 2.0". Also, sandy soils have a low nutrient retaining capacity (cation exchange capacity), and essential mineral nutrients, particularly nitrogen, are more subject to leaching.

• Collect a soil sample and have it tested to determine if there is a need to amend the soil before planting.

Information is available from your county extension office on how to collect and submit a soil sample. Such testing provides information on the soil pH and lime requirement and availability of phosphorous (P) and potassium (K). Except for blueberries, most grape and berry crops grow best on soils that are slightly acid (pH 5.5 to 6.5) but do well on near-neutral soils (pH 6.5 to 7.0). Tree fruits grow best on near-neutral soils. Within these ranges, the essential mineral nutrients are available in adequate supply for the crops when present in the soil. The soil pH can be raised with lime that contains calcium (Ca) or lowered with elemental sulfur (S) or a S-containing compound. Because fruit plantings are perennial, and the downward movement of Ca, P, and K in the soil is very limited, it is difficult to raise the pH or correct deficiencies after planting.

• Provide water for irrigation during dry periods. With respect to their effective rooting depths, strawberries and blueberries should be considered very shallow-rooted (less than 1 foot); raspberries, blackberries, gooseberries, currants and bush cherries are moderately shallow-rooted (up to 2 feet); while all fruit trees and grapes are considered to be deep-rooted (3 feet or more) crops. Because the availability of soil moisture is related to the soil texture and rooting depth of the plant, it becomes more important to be able to irrigate shallow-rooted crops than deep-rooted crops.



Young trees and grapes have shallower, less developed root systems than established mature plants and may require irrigation during the first few years following planting. When determining the need for irrigation,fruit crops require about 1 inch of rainfall per week during the growing season and grow best when they do not have to deplete in excess of 80 percent of the available soil moisture from their effective root zones. When irrigating individual plants, keep in mind that most of the roots do not extend beyond the drip-line (perimeter of the canopy), and a gallon of water applied on a 3 × 3 feet area is equivalent to about 0.2 inch of rainfall. (See PM 823, *Watering the Home Garden,* for information on installing a trickle irrigation system.)

• Fertilize annually to maintain a good balance between vegetative growth and fruiting. Of the essential mineral elements required for growth and fruiting, plants exhibit the greatest response to nitrogen (N) applications. With too little N, vegetative growth is poor and fruiting is reduced. Too much N will promote excessive vegetative growth and inhibit flower bud formation for fruiting. In addition, plants receiving excess N tend to be less winter hardy.

• Learn to properly prune those fruit crops that require pruning. Along with fertilization, annual pruning aids in maintaining a good balance between vegetative growth and fruiting. In addition, proper pruning and training controls the shape and size of a plant and improves light distribution within the plant canopy. (See PM 780, *Pruning and Training Fruit Trees;* PM 1706, *Growing Raspberries in the Home Garden*; or PM 1707, *Growing Grapes in the Home Garden.*)

• Control insects and diseases for production of quality fruit. (See PM 175, *Home Fruit Insect and Disease Management,* for home plantings, and either PM 1282, *Iowa Commercial Fruit Tree Spray Guide,* or PM 1375, *Iowa Commercial Small Fruit and Grape Spray Guide,* for commercial plantings.) The selection of cultivars having resistance to diseases that affect the foliage and fruit will reduce the need for sprays.

• Control weeds in the planting to eliminate competition for water and nutrients. If they do not interfere with plant development, summer mulches can be used to reduce weeds and conserve soil moisture lost through evaporation. However, during periods of high rainfall, mulches can contribute to problems of excess soil moisture. Therefore, in determining whether or not a mulch will be beneficial, you need to consider the soil texture and its moisture-holding capacity, and the crop relative to its rooting depth, tolerance to wet soils, and resistance to soilborne diseases. Also, mulches can create a favorable habitat for voles (mice) that can be a problem for some crops during the winter.

Many home and commercial plantings fail to produce fruit, or at least high quality fruit, because one or several of the above recommendations are not followed. Because fruit plantings are perennial and require considerable effort to grow, we cannot overemphasized the importance of planning ahead in regard to crop and cultivar selection as it relates to your site and soil conditions.

Crop Adaptation

Because of the way perennial plants acclimate during the fall to withstand low winter temperatures and de-acclimate in response to above freezing temperatures during dormancy, the greatest risk of winter injury occurs either in late-fall to early-winter during the acclimation process, or in late-winter when a severe freeze follows a thaw. During the fall acclimation process, fruit crops are more susceptible to winter injury when they are grown under conditions of excess N fertilization or on fertile soils that are high in organic matter. This is because N from over-fertilization or N released from the organic matter prolongs vegetative growth and delays the onset of the acclimation process.

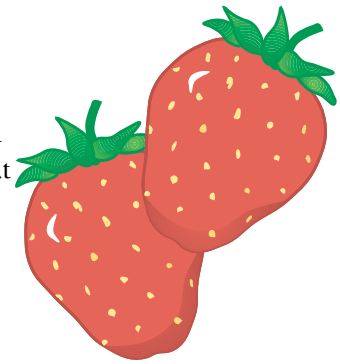
Strawberries, red raspberries, currants, and gooseberries will grow throughout Iowa if reasonably good sites and soils are selected. Black raspberries and blackberries are less winter hardy, and should only be considered for southern and central Iowa. Grapes are best suited to southern and central Iowa, but with careful selection of hardy cultivars, reasonably good production can be obtained in northern Iowa. Blueberries are hardy in Iowa but require acid soils that are not commonly found in the state.

Apples are the most winter hardy fruit tree and can be grown throughout Iowa if hardy cultivars are selected and the trees are planted on well-drained soils. Although European (common) pears are more tolerant of wet soils and are almost as hardy as apples, only a few cultivars perform well in Iowa. Asian pears are a relatively new U.S. crop but are not well adapted to Iowa conditions.

Except for bush cherries, which can be grown throughout Iowa, stone fruits (apricots, cherries, peaches, nectarines, and plums) are less winter hardy than apples. Even in southern Iowa, they should be considered short-lived trees for two reasons. (1) The trees do not acclimate well in the fall, particularly when over-fertilized with nitrogen, or when they are planted on fertile soils that are high in organic matter. (2) All stone fruits have a very low tolerance to wet soils. Sour cherries and plums perform reasonably well in central and southern Iowa on well-drained soils, but only the most hardy cultivars should be attempted in northern Iowa. Sweet cherries, peaches, nectarines, and apricots are not reliably hardy or productive, even in southern Iowa. However, many home gardeners plant a few and are occasionally rewarded with a crop.

Most home gardeners have neither space nor time to set out and care for a planting of all kinds of fruit. In most instances, it costs more to grow your own fruit than if you were to purchase it. This is particularly true for fruit trees, which often require several pesticide sprays to reduce insect and disease problems to acceptable levels. Where space is limited, you should first consider planting strawberries. If additional space is available, raspberries would be the next choice. These two fruits give greater returns for your labor than any other fruit. However, the availability of fruit from other sources and your fruit preference should be considered in selecting what to plant.

Small Fruits



Strawberries are self-fruitful and can be grown throughout Iowa with proper winter protection. They do best on well-drained soils but can be grown on moderately well-drained soils if cultivars are selected for resistance to red stele (*Phytophthora*) and *Verticillium* wilt root diseases. Because *Verticillium* wilt has a wide host range that includes strawberries, raspberries, blackberries, tomatoes, potatoes, peppers, eggplants, alfalfa, and stone fruits, avoid planting susceptible cultivars where these crops were previously grown. In addition, strawberries can be selected that are resistant to leaf spot, leaf scorch, and powdery mildew, which are the major diseases affecting the foliage. No genetic resistance exists for *Botrytis* fruit rot (gray mold) and leather rot, which affect the fruit. Major insects that attack the fruit include plant bugs, spittle bugs, crickets, sap beetles, and slugs.

You can plant traditional June-bearing cultivars or extend your harvest season with day-neutral or ever-bearing cultivars. Day-neutral cultivars have superior quality fruit and are more productive than ever-bearing cultivars. However, if you are planting strawberries as an ornamental, ever-bearing cultivars would be more appropriate. Because of the non-traditional harvest season and high berry quality, day-neutral strawberries have a lot of potential for the farmers' market. Plantings of both June-bearing and either day-neutral or ever-bearing cultivars will supply fresh berries for 8 to 10 weeks of the year. Strawberries freeze well for added months of use.

June-bearing strawberries do best in Iowa when grown in the matted-row (bed) system. In this system, plants are set 18 to 24 inches apart in rows, and plantlets produced on runners are allowed to root and establish a bed that is about 18 to 24 inches wide. To encourage good runner production after planting, any blossoms that appear should be removed that first year. Such plantings can remain productive for several years when annual renovation of the bed is practiced following harvest. This is accomplished by mechanically narrowing the bed, thereby removing the oldest plants, and allowing the bed to re-establish from the new plantlets produced on the runners. (See PM 672d, *Production Guide for Commercial Strawberries,* or PM 717, *Growing Strawberries at Home.*)

Day-neutral and ever-bearing strawberries can be grown as either an annual or perennial crop. They are most productive when maintained as individual plants (hill system) that are set about 12 inches apart in double rows. This is accomplished by removing any runners that form. Also, to ensure better out-of-season production on day-neutral cultivars, early-season flowers should be removed until about July 1, and a summer mulch should be placed around the plants to shade the soil. Because berry size and productivity decline as the plants become older, perennial plantings of day-neutral and ever-bearing strawberries should be replaced after two years.

June-bearing strawberries

Day-neutral strawberries

All perennial strawberry plantings should be mulched in late fall to protect the plants from low winter temperatures. (See "Winter Protection" section, page 15.)

Raspberries do not tolerate wet soils. Some cultivars are resistant to *Phytophthora* root rot, but all cultivars are susceptible to *Verticillium* wilt. Like strawberries, avoid planting raspberries where *Verticillium* wilt susceptible crops were previously grown. Other diseases of raspberries include anthracnose, cane and spur blight, powdery mildew, leaf spot, orange rust, and *Botrytis* fruit rot. Insect pests that damage the fruit include plant bugs and sap beetles, while borers can attack the canes and crown (underground, perennial portion of the plant).

Raspberries require more space but less work than strawberries. The returns per hour of labor are similar to strawberries. A well cared for planting on a well-drained soil can be expected to give at least 10 years of good production. You can select from summer-bearing (floricane-fruiting) red, black, purple (red × black hybrid), and yellow (originally a color mutation of red) cultivars; or fall-bearing (primocane-fruiting) red and yellow cultivars. Among these types, black raspberries are the least hardy and can be grown in only central and southern Iowa.

All raspberries are self-fruitful and do best with some type of system to support the fruiting canes. Besides differences in time of fruiting and fruit color, raspberries differ in growth character and cultural practices. Red and yellow raspberries produce many new canes (suckers) along the roots and will form a uniform bed of plants in about two years. They are grown in a hedgerow system with a trellis support. Black raspberry plants do not produce suckers along the roots, and new canes develop from the crown in close proximity to the original plant. They can be grown as individual plants in a hill system with a stake for support or in a hedgerow with a trellis. Purple raspberries are intermediate in character and can be grown either like red or black raspberries. In an adapted site, black and purple raspberry plants are more vigorous than red and yellow raspberries. To accommodate this vigor, black raspberries should be planted 3 to 4 feet apart, while purple raspberries should be planted 3 to 5 feet apart in a hedgerow system. Red and yellow raspberries can be planted 2 to 3 feet apart. Black and purple raspberries also benefit from summer pruning (removal of the top 3 to 4 inches) of the new canes. This practice forces lateral canes to develop and is done when black and purple raspberry canes are about 3 and 4 feet tall respectively.

Summer-bearing raspberries have biennial canes that grow vegetatively for one season (primocane) and produce a crop the following year (floricane), while fall-bearing cultivars produce the crop on current-season canes (primocanes). Because of this difference in fruiting, summer-bearing raspberries are more prone to winter injury and require greater pruning and pest control than fall-bearing raspberries. Also, because fall-bearing raspberries produce fruit on current-season canes, dormant pruning consists of removing all canes at the ground. However, *Heritage* and *Redwing* cultivars can be grown for a fall and summer crop by dormant pruning them like summer-bearing red raspberries. Other fall-bearing raspberry cultivars appear to lack sufficient winter hardiness to successfully adapt to this practice.

Plantings of both summer-bearing or fall-bearing cultivars will provide fresh berries for 6 to 8 weeks during each season. The berries also can be frozen for later use. Plants may need protection from rabbits and mice.

Raspberries

Blackberries

Raspberries are susceptible to virus diseases that infect many native plants in Iowa, so it is best to purchase virus-free raspberry plants from a reliable nursery or garden center. Purchase No. 1, one-year-old root or sucker plants.

Erect and **trailing blackberries** have the reputation of poor performance in almost all areas of Iowa. However, there are a few areas in eastern Iowa where native, erect plant-type blackberries are growing. Trailing plant-type cultivars exhibit extreme lack of fruit bud hardiness during Iowa winters. To be successful with these, you must remove the canes from the trellis and provide winter protection on the ground with a layer of mulch.

Erect blackberries are more hardy than trailing blackberries and can be grown in some sections of Iowa. Several thornless erect blackberry cultivars have been developed in recent years, but they are not as hardy as some of the hardiest thorny cultivars. The USDA cultivar **Darrow** (a thorny-type) appears to be very hardy. Blackberries bloom early in the spring and are often damaged by frosts and freezing temperatures. Like raspberries, they do not tolerate wet soil conditions and are susceptible to *Phytophthora* and *Verticillium* wilt root rots. Other diseases that affect blackberries include anthracnose, cane and spur blight, orange rust, and *Botrytis* fruit rot. They are also highly susceptible to virus diseases, which infect many of the native plants growing in eastern Iowa. Major insect pests are the same as for raspberries.

Like summer-bearing raspberries, blackberries have biennial canes. Erect blackberry plants spread by suckers like red raspberries but have the vigor of black and purple raspberries. They do best with a trellis system to support the fruiting canes and should be planted 3 to 4 feet apart. Like black raspberries, they benefit from summer pruning the new canes when they are 3 to 4 feet tall to force lateral canes to develop. Blackberries are self-fruitful and can be grown as a single cultivar planting. Purchase No. 1, one-year-old root plants.

Grapes grow well in a wide range of soil conditions but do best on well-drained soils. They are self-fruitful and can be grown throughout Iowa. However, winter survival of the buds limits their productivity in northern Iowa. Bud injury on the more tender cultivars will begin to occur as the temperature drops below –10°F, while some of the hardiest cultivars can withstand temperatures below –30°F. Consequently, grapes are better adapted to southern and eastern Iowa than other regions of the state. In most seasons, few sprays are needed for diseases and insects. Major diseases of grapevines include black rot, downy and powdery mildews, anthracnose, and *Botrytis* bunch rot. Major insect pests that feed on the fruit are the grape berry moth and wasps.

Some grape cultivars are very sensitive to sulfur fungicides used to control powdery mildew. If sulfur is applied on these cultivars, severe "burning" of the foliage will occur. Slight to moderate sulfur injury may occur on other cultivars when temperatures are at or above 85°F during or immediately following application.

There are four common types of grapes that can be grown in Iowa: American type (*Vitis labrusca*), American hybrids (*V. labrusca* × *V. riparia*), French hybrids (*V. vinifera* × *Vitis* species), and seedless cultivars of American or American × European parentage. The American hybrid types are the hardiest and can be grown throughout the state. The American types are the next hardiest with

Grapes

some cultivars being adapted to northern Iowa, while the French hybrids are the least hardy and some cultivars may require winter protection. Such protection involves removing the vine from its trellis and covering it with a mulch layer. European grapes (*V. vinifera*) are not recommended for Iowa because of their lack of winter hardiness and susceptibility to grape phylloxera (an insect that damages *V. vinifera* roots).

Next to improper cultivar selection, the primary limiting factor for good grape production is the careless use of 2,4-D and related weed killers. Grapes are one of the most sensitive food crop plants to 2,4-D injury, and plantings of grapes often experience herbicide injury. The most prominent symptom of 2,4-D injury is small, misshapen terminal leaves with an abnormally serrated margin and a "fan-like" venation pattern. When this occurs, cane growth ceases, and depending on the severity, normal growth may or may not resume for the remainder of the growing season or into the following year. Injured grapevines are more prone to winter injury. Exposure to 2,4-D also causes uneven berry ripening. Because 2,4-D and related weed killers are volatile and subject to drift, injury to grapevines has been observed from applications made as far as 5 miles away. Therefore, it is best not to use 2,4-D and related weed killers near grapevines. But if 2,4-D needs to be applied, use a low-volatile (amine) form, and apply it before bud break in the spring or in the fall when the canes have stopped growing.

Grapes can be a good crop for home or commercial planting under more favorable conditions. A trellis system to support the vines is required with vines spaced 6 to 8 feet apart, and annual pruning to control vine growth and maintain production is needed. Protection

Currants

against rabbit damage is often needed when the plants are young. Purchase No. 1 one-year-old plants or rooted cuttings.

Gooseberry and **currant** fruit are not readily available in most markets, but wild gooseberries can be found throughout the state. Gooseberries and currants are hardy, easy to grow, and only a few plants are needed to supply a family with fruit. Currants have ornamental value in the landscape and can be planted as a hedge or individual plants. However, gooseberries and currants are alternate hosts for white pine blister rust, a serious disease of white pines. Many black currant cultivars are extremely susceptible to white pine blister rust, while red currants and gooseberries exhibit varying degrees of susceptibility. This should be considered before planting them in areas where white pines are grown extensively. Other major diseases include anthracnose, powdery mildew, and leaf spot. The gooseberry fruitworm can be a problem in Iowa. When planted in rows, gooseberries and red currants should be spaced 3 to 4 feet apart.

Black currants are more vigorous and should be planted 4 to 5 feet apart. Gooseberries and currants are considered self-fruitful, but some cultivars are self-unfruitful. Young plants may need protection against rabbit damage. Little or no pruning is required during the first three years, then the oldest canes are removed and replaced by new canes emerging from the crown. Purchase No. 1 one-year-old plants.

Jostaberries are a cross between black currants and gooseberries and exhibit similar characteristics of both parents. They are extremely vigorous and can attain a height of 8 feet at maturity.

Gooseberries

Blueberries

Blueberries require well-drained, acid soils that are high in organic matter. Because very few Iowa soils meet these special requirements, few blueberries have been grown in the state. However, blueberries can be grown in Iowa by selecting a well-drained soil and acidifying it to a pH of 4.5 (they will tolerate a pH range of 4.0 to 5.5) with elemental sulfur (S), aluminum sulfate, ferrous sulfate, or another soil acidifying product. The following table lists the approximate amount of S required (in pounds per 100 ft^2) to lower the soil pH to 4.5 for sandy and loamy soils.

Current Soil pH	Soil Type:	Sandy	Loamy
5.0		0.4	1.2
5.5		0.8	2.4
6.0		1.2	3.5
6.5		1.5	4.6
7.0		1.9	5.8

Because the soil acidifying response to S is slow, it should be applied and incorporated a year before planting blueberries. The soil acidifying response to aluminum sulfate and ferrous sulfate applications is quicker, but they are required in much higher amounts (6-fold and 8-fold, respectively) than S, and they can be toxic to blueberry plants in some soils. To maintain the low soil pH, you also will need to fertilize with acid forms of nitrogen fertilizer (ammonium sulfate or one formulated for plants that prefer acid soils). To increase the soil organic matter and aid in lowering the soil pH, add Canadian sphagnum peat to the soil. When planting blueberries, fill the hole with a mixture that is one-half moist peat and one-half soil. In addition, most blueberry roots are located in the top 8 inches of soil and quickly become stressed during hot, dry weather. To help retain moisture and moderate the soil temperature, apply a 3- to 5-inch layer of mulch around the plants that extends out to the drip-line. Sawdust, wood chips, pine needles, and shredded leaves are excellent mulch materials. Even with a good mulch, it may be necessary to water blueberries as often as twice a week during dry weather.

Blueberries are susceptible to *Phytophthora* root rot that emphasizes the importance of a well-drained soil. Because blueberries have not been extensively grown in Iowa, foliage and fruit diseases have not been a problem, and growers can generally produce a crop without fungicide sprays. However, in production areas around the Midwest, plants are affected by anthracnose, stem blight, stem canker, and mummy berry. Insect problems also have been low, but fruit maggots and fruit worms may need to be controlled when they appear. The most serious problem has been with birds feeding on the fruit, and it may be necessary to cover the plants with netting as the berries begin to turn color.

Blueberries are considered to be self-fruitful, but fruit size can be improved by planting more than one cultivar for cross-pollination. Depending upon your location, you can select between northern highbush and half-high blueberry cultivars. Half-high cultivars are a cross between the northern highbush and lowbush blueberry. Plants attain a height of 2 to 4 feet and have potential as landscape plants. Highbush blueberries can develop into 6- to 8-foot shrubs. Highbush blueberries should be planted 4 to 5 feet apart, while half-high blueberries can be spaced 3 to 4 feet apart. Blueberries require little or no pruning during the first five to six years, then the oldest canes are removed and replaced by new canes emerging from the crown. Purchase No. 1, two-year-old 7- to 12-inch or three-year-old 12- to 18-inch plants.

If you do not wish to go to all the effort required for growing blueberries, you might consider the **saskatoon**

berry (*Amelanchier alnifolia*, also called serviceberry, Juneberry, or shadberry). They are self-fruitful, and their fruit is similar in size and color to blueberries but have larger seeds. They can be eaten fresh and make excellent pies, jams, or jellies. The plants are hardy, tolerate a wide soil pH range (6.0 to 7.8), and are more drought tolerant than blueberries. They are susceptible to fire blight, several rusts, powdery mildew and leaf spot, but do not appear to have any insect problems. However, like blueberries, birds can be a serious problem. Low-growing cultivars that sucker freely can be pruned similar to gooseberries and currants, while cultivars that produce few suckers should be pruned similar to fruit trees with thinning of shoots for light distribution and replacement of older fruiting branches. Taller-growing cultivars can be pruned back to about 6 feet for ease of harvesting.

Fruit Trees

Apples will grow in most areas of Iowa. Consideration of hardy cultivars and soil drainage are of utmost importance. Considerable time must be devoted to pruning and other cultural practices, such as thinning and spraying, to attain and maintain consistent productivity of acceptable fruit. Bearing apple trees may have to be sprayed for insects and diseases up to 10 to 12 times each year. However, a number of cultivars have been developed with resistance to the major apple diseases (apple scab, cedar-apple rust, powdery mildew, and fire blight), and their need for disease sprays is significantly reduced. Although some of these new disease-resistant apple cultivars have not been fully tested in Iowa, their potential in low maintenance plantings is excellent and we recommend them for trial in central and southern Iowa. Apples have no resistance to the major insect pests that attack the fruit (codling moth, apple maggot, and "cat-facing" insects).

Some apple cultivars are prone to various physiological disorders (cork spot, bitter pit, Jonathan spot, water core, storage scald, and internal breakdown) that affect fruit quality and storage life. These disorders can develop under certain environmental and/or cultural conditions, and all have been associated with low levels of calcium (Ca) in the fruit. Because Ca uptake by the roots is closely related to soil moisture conditions and Ca transport into the fruit occurs during the early stages of development, these disorders are most prevalent in years when the soil is either too wet or too dry in the spring. Cultural practices that promote excessive tree

Apples

vigor, such as over-fertilizing with nitrogen or over-pruning, also contribute to a higher incidence of these disorders. Harvesting the fruit at the proper time can aid in reducing the incidence of water core, Jonathan spot, internal breakdown, and storage scald. With susceptible cultivars, it may be necessary to apply Ca-containing sprays.

While most cultivars exhibit some degree of partial self-fruitfulness, apples are considered to be self-unfruitful. Therefore, they do best when planted with one or more other cultivars to ensure cross-pollination and fruit set. Apple cultivars also bloom at different times in the spring and are classified as either early-, mid-, or late-season blooming cultivars. To ensure that cross-pollination will occur, it is best not to plant an early-season blooming cultivar with a late-season blooming cultivar unless a mid-season blooming cultivar is included. A few cultivars, such as **Jonagold**, **Mutsu**, and **Winesap**, have sterile pollen and require a third cultivar for fruit set on all trees. Crabapples that bloom at the same time will pollinate apples.

Some apple cultivars are available as improved color or spur-type strains. These are genetic mutations of the parent cultivar and will not cross-pollinate the parent cultivar or another strain of the same cultivar. Spur-type strains have a more compact growth habit and produce a smaller tree than the parent cultivar.

Historically, apple trees were only propagated on vigorous seedling rootstocks that produced trees that were up to 25 feet tall with a spread up to 30 feet. These trees required several years (six to eight) before they began to bear fruit. Nurseries now offer most apple cultivars on dwarfing rootstocks or interstems that require less space

and induce earlier fruiting. The size of tree produced on these dwarfing rootstocks are classified as "dwarf" or "semi-dwarf." Trees on the dwarf and semi-dwarf rootstocks will grow to heights of 8 to 15 feet, respectively. However, this is influenced by the inherent vigor of the apple cultivar. Depending on the vigor of the cultivar (classified as "low vigor," "medium vigor," "vigorous," and "very vigorous" in this publication), apple trees on a dwarf rootstock can be spaced 8 to 12 feet apart, those on a semi-dwarf rootstock can be spaced 10 to 16 feet apart, while those on a standard rootstock will need to be spaced 18 to 24 feet apart. Unless a nursery specifies both dwarf and semi-dwarf trees, it is probable that trees listed as "dwarf" are actually semi-dwarf and should be planted as semi-dwarf trees.

Because apple trees on dwarfing rootstocks require less space, bear fruit at an earlier age, and are easier to take care of in regards to pruning, spraying, and harvesting, hardy cultivars on dwarfing rootstocks or interstems are preferred over the same cultivars on hardy seedling roots. However, there are two disadvantages in planting apple trees on currently available dwarf rootstocks (M.26, M.9, Mark, B.9, O.3). (1) They are not well anchored (particularly M.9, Mark, B.9) and require a stake or trellis to support the trees. (2) Dwarf rootstocks (particularly M.26) are susceptible to fire blight (a serious bacterial disease that attacks apples and pears for which there is little control). If these dwarf rootstocks become infected, the tree will die. Therefore, they should not be used as a rootstock for a fire blight susceptible cultivar or be planted near susceptible cultivars. Apple trees on semi-dwarf rootstocks (M.7A or M.7 EMLA) have been the most reliable in the Midwest.

Standard, semi-dwarf, and dwarf apple trees are available as two-year-old branched trees or as one-year-old trees that may or may not be branched. They are graded by height and/or trunk diameter (caliper). For healthier trees that will grow well, purchase better grade trees (4 to 6 feet, or $\frac{1}{2}$- to $\frac{3}{4}$-inch diameter) of a given age.

Pears of both European and Asian origin are available from many nurseries. Several European (common) pear cultivars can be grown successfully in Iowa, but have not been planted extensively due to their susceptibility to fire blight, a bacterial disease that can be serious in Iowa. Fire blight is very difficult to control, and it is advisable to plant only fire blight resistant cultivars. The regular fruit tree sprays do not control fire blight. Besides fire blight, pears have fewer pest and disease problems than apples with codling moth and pear scab being the only other major problems in Iowa. For best quality, European pears should not be allowed to ripen on the tree. When left on the tree too long, the flesh develops an undesirable, gritty texture. Therefore, they should be harvested at the "green-mature" stage when the skin color begins to change from a green to a greenish-white or greenish-yellow color. For immediate consumption, pears should be allowed to ripen at room temperature. Extra fruit can be refrigerated for later fresh consumption or be allowed to ripen and preserved by canning.

Pears

Asian pears are less hardy than European pears, and all cultivars exhibit little resistance to fire blight. Therefore, any planting of Asian pears should be on a trial basis. Asian pears can be eaten firm like an apple or be allowed to fully ripen like European pears.

Most European and Asian pear cultivars are self-unfruitful and require planting of more than one cultivar of either type to ensure cross-pollination and fruit set. Two European pear cultivars, **Bartlett** and **Seckel**, do not cross-pollinate each other. Nurseries offer a choice between dwarf and standard sized trees for both European and Asian pears. However, those being marketed as "dwarf" (European pears on OH×F333 rootstock and Asian pears on *Pyrus betulaefolia* rootstock) produce semi-dwarf trees that are about 70 percent as large as standard trees. Depending on tree vigor, standard size pears should be spaced 18 to 24 feet apart. Purchase 4 to 6 feet ($\frac{1}{2}$- to $\frac{3}{4}$-inch diameter), one- or two-year-old trees.

Sour cherries

Sweet cherries

Sour (tart) cherries are well suited for southern and central Iowa. They are one of the hardiest stone fruits but should be considered short-lived in Iowa. Because their roots do not tolerate wet soils, sour cherries should only be considered for planting on well-drained sites. They require less care and spraying than apples, but in wet years, cherry leaf spot (a fungal disease) can defoliate the trees if no control measures are taken. Other major diseases include powdery mildew and brown rot. Insect pests that may need to be controlled are the cherry fruit fly and borers. Sour cherries are self-fruitful, thus planting of only one cultivar is adequate for pollination. Where nurseries offer a choice, trees marketed as "semi-dwarf" are preferred because the rootstock (Mahaleb) is hardier than that used for "standard" trees (Mazzard). However, these semi-dwarf trees are more sensitive to wet soil conditions. At present, there are no full-dwarfing rootstocks available for sour cherries, but **Northstar** is a natural dwarf cultivar and **Meteor** is a semi-dwarf cultivar. Sour cherry trees on standard rootstocks should be spaced 18 feet apart and semi-dwarf rootstock 15 feet apart. Northstar trees can be spaced 8 to 10 feet apart, while Meteor trees can be spaced 12 to 14 feet apart. Purchase 3 to 6 feet ($\frac{1}{2}$- to $\frac{3}{4}$-inch diameter), one-year-old trees.

Sweet cherries are not well adapted to Iowa conditions with the possible exception of one or two of the yellow-fruited cultivars such as **Gold**. Even this cultivar should not be tried north of U.S. Highway 30 in Iowa. Sweet cherry trees appear to grow well even as far north as central Iowa. However, they produce few blossoms and even fewer fruits because their fruit buds lack winter hardiness. Also, sweet cherries bloom earlier than sour cherries and are more prone to late-spring frosts. Like sour cherries, they do not tolerate wet soils and have the same disease and insect pest problems. If sweet cherry trees survive, they will produce larger trees than standard-sized sour cherry cultivars. Like sour cherries, trees marketed as "semi-dwarf" (Mahaleb rootstock) are preferred over "standard" size trees (Mazzard rootstock). Presently, there are no full-dwarfing rootstocks available for sweet cherries, but some irradiated dwarf cultivars are available. Most sweet cherries are self-unfruitful and require another cultivar for cross-pollination. Some cultivars exhibit cross-incompatibility where the pollen of a cultivar will not cross-pollinate other specific cultivars (not a problem with cultivars listed in this publication). Sweet cherry trees should be planted 15 to 20 feet apart. Purchase 4 to 6 feet ($\frac{1}{2}$- to $\frac{3}{4}$-inch diameter), one-year-old trees.

Bush cherries are a group that includes sand cherries (*Prunus besseyi*), Nanking cherries (*P. tomentosa*), and cherry plums (*P. besseyi* × plum or tree cherry hybrids). They are hardy and will grow almost anywhere in Iowa on well-drained soils. The fruit can substitute for sour cherries in baking, canning, and making jellies and jams. Plants also make good ornamentals, and seldom need sprays, but can be affected by the same diseases and insect pests that attack sour cherries. Sand cherries and Nanking cherries are suitable for hedges, windbreaks, and wildlife habitat. Named cultivars are considered to be self-unfruitful, so two or more cultivars of the same type should be planted for cross-pollination. Seed-grown selections are quite variable and should be considered partially self-fruitful. When grown as individual plants, sand cherries should be planted 6 feet apart, while Nanking cherries should be planted 8 feet apart. Cherry plums are propagated on wild plum (*Prunus americana*) or St. Juliens rootstocks, produce small trees or large shrubs, and may require up to 15 feet between plants.

Sand and Nanking cherries require little pruning, while plum cherries should be trained as spreading shrubs and once in production, about 1/4 of the oldest fruiting wood should be removed each year. Purchase No. 1, 18- to 24-inch sand and Nanking cherry plants; 3 to 4 feet (7/16- to 9/16-inch diameter) cherry plum plants.

Plums of European (domestic), Japanese, and Japanese × American hybrid origin are available from many nurseries. However, they vary in hardiness and pollination requirements, so careful cultivar selection is important. Japanese plums are not reliably hardy for even southern Iowa, while some European plum cultivars and most Japanese × American hybrid plum cultivars will grow well throughout the state. Like sour cherries, all plums should be considered short-lived trees in Iowa. They are more tolerant of wet soils than sour cherries but do best on well-drained soils. All European plums grown in the Midwest are partially self-fruitful and can be grown as a single cultivar, but will produce better crops if another cultivar is planted for cross-pollination. Japanese and Japanese × American hybrid plums are self-unfruitful and require another cultivar for cross-pollination. Plum cultivars of different origins will not cross-pollinate each other. All plums require a rather extensive spray program to control insects and diseases to an acceptable level. Diseases that attack plums include black knot, plum pockets, and brown rot. Major insect pests are the plum curculio and borers. Both dwarf and standard-sized trees are available from most nurseries. However, those being marketed as "dwarf" (St. Juliens rootstock) produce semi-dwarf trees that are about 70 percent as large as standard trees. Depending on cultivar vigor, plums on standard-size rootstocks should be planted 15 to 18 feet apart. Purchase 3 to 6 feet (1/2- to 3/4-inch diameter), one-year-old trees.

Plum

Peaches

Peaches and **nectarines** are not reliably winter hardy for any part of Iowa and do not tolerate wet soils. Even in southern Iowa, they can only be expected to produce a crop once every four or five years. The trees are not very winter hardy, and their fruit buds are even less hardy. During dormancy, damage to the fruit buds begins to occur when the temperature drops to –11°F and they are killed when it drops below –18°F. Peach trees are very short-lived in Iowa, often living only six to eight years under the best conditions. They are highly susceptible to attack by borers and bacterial diseases. Other major diseases and insect pests include peach leaf curl, powdery mildew, scab, brown rot, and cat-facing insects. A rather extensive spray program is needed, even when there is no fruit. Peaches are self-fruitful and do not require another cultivar for cross-pollination. Through improved rootstock selection, you can choose between dwarf and standard-sized trees. However, those being marketed as "dwarf" (St. Juliens rootstock) produce semi-dwarf sized trees that are about 70 percent as large as standard trees. Presently, there are no reliable full-dwarfing rootstocks available for peaches and nectarines. Peaches on standard-size rootstocks should be planted 15 feet apart. Purchase 3 to 5 feet (3/8- to 5/8-inch diameter), one-year-old trees.

Apricots appear to do better in the southern half of Iowa than in northern Iowa. Apricots bloom earlier than any of the other fruits listed in this publication and, therefore, are much more prone to damage from late-spring frosts. A crop once every three or four years may be all you should expect. Apricot trees require less care than apples and plums but still need regular sprays when they do bear fruit. Major diseases and insect pests of apricots include powdery mildew, brown rot, cat-facing insects, and borers. Apricots are more tolerant to wet soil condition than cherries but grow best in well-drained

Apricots

soils. Most apricots are self-fruitful. However, two hardy cultivars, **Moongold** and **Sungold** are self-unfruitful and require cross-pollination to set fruit. Some nurseries offer a choice between dwarf and standard-sized trees. However, depending on the nursery, those trees being marketed as "dwarf" can range from a full-dwarf (*Prunus besseyi* rootstock) to a semi-dwarf (St. Juliens rootstock) sized tree. Standard-size apricot trees should be planted 18 to 22 feet apart. Purchase 3 to 6 feet ($\frac{1}{2}$- to $\frac{3}{4}$-inch diameter), one-year-old trees.

Purchasing Fruit Plants

Because nurseries that propagate fruit plants grow them under very controlled conditions and are required to have the plants inspected for interstate shipment, the chances of receiving disease-infected plants are minimized. However, many viruses cannot be detected by visual inspection. Therefore, when purchasing fruit plants, try to obtain plants that have been certified "virus-free." This means that the plants were propagated from parent material that was tested to be free of known viruses and were grown under conditions to minimize the chances of virus infection. These plants are not immune to viruses and can become infected by a virus sometime after planting. Virus-free plants are preferred because they are more vigorous for better establishment and will remain more productive than virus-infected plants.

Both small fruits and tree fruits are available through local garden centers and mail order nurseries. Garden centers are convenient, allow personal selection from their stock, and can provide proper care of the plants prior to sales. However, garden centers may not stock as many cultivars as listed by some mail order nurseries.

When purchasing plants from a mail order nursery, you should place your order early for the best chance of getting your selected cultivars. The cultivar of fruit, not the location of the nursery or where the plant was grown, determines its relative hardiness. For example, plants of a hardy cultivar produced in Missouri or California will be just as hardy when grown in Iowa as plants of the same cultivar produced in Minnesota.

Time of Planting

In Iowa, early spring is the recommended time to plant all fruit crops listed in this publication. They should be planted soon after the risk of a spring freeze (below 25°F for strawberries and below 20°F for all other fruits) has passed, and the soil has thawed and can be worked without "balling-up." Mail order nurseries deliver based on predetermined schedules that have been developed to coincide with local planting conditions. However, during a wet spring, the soil may be too wet to plant when your order arrives. Whenever the soil is too wet for planting, it is always best to store the plants in a cool place until conditions improve. Small plants, such as strawberries, can be stored in a refrigerator, but never store plants with fresh fruit (fresh fruit give off ethylene gas that will force the buds to grow). Larger plants can be stored in the shade on the north side of a building. Covering the plants with a mulch will provide additional cooling. When storing plants, always check to make sure that the roots do not become dry.

Planting

When you are ready to plant, a hole should be dug that is large enough to allow the roots to be spread out. Care should be taken to avoid compacting the walls of the hole. Such compaction can inhibit root development beyond the hole and affect soil water movement. Except for blueberries or planting on sandy soils, it is not advisable to add peat to the planting hole. Such a practice will increase available water and provide nutrients for the plant, but in a wet year or with frequent watering, it can hold excess water that can be injurious to the plant. On most Iowa soils, most fruits do best when the planting hole soil and surrounding soil are uniform in character. Soils lacking fertility or good physical structure (sandy soils or soils low in organic matter), can be improved by incorporating organic matter (a cover crop, compost, peat, or composted manure) into the entire area before planting.

Plants grow best when they are planted at the same depth or slightly deeper than they grew in the nursery. For strawberry plants, care must be taken to ensure that the roots are covered with soil and the crown (short, compact stem) is exposed. It is often necessary to plant fruit trees a little deeper than they grew in the nursery to obtain proper anchorage. However, for trees on dwarfing rootstocks, care must be taken to ensure that the graft union remains above the soil-line. If the graft union is below the soil-line, the trunk area above the graft may root. When this occurs, the dwarfing effect of the rootstock is lost. It is generally best to set the graft union 3 to 4 inches above the soil-line in case the tree settles after planting.

Following planting, plants should be watered to help settle the soil and establish good contact with the roots. Fruit trees should be pruned to select desirable branches, induce branching, and to attain a better balance between the top portion of the tree and its root system. Additional care during the first year should consist of applying fertilizer to promote growth, controlling weeds to reduce the competition for nutrients and water, watering the plants as needed during dry periods, and a few sprays to control diseases that attack the leaves.

Fertilization

The times during which fruit crops require the most nitrogen are when vegetative growth is most active and when they are initiating flower buds. For most fruit crops (except strawberries, gooseberries, and currants), this is in early spring when they begin to grow until mid- to late-June. To ensure that N is available to the plants during this period, it should be applied before growth begins (bud break). Some crops, such as raspberries and blueberries, respond well to split applications where the prescribed rate of N is divided into two applications with the first being applied before bud break, and the second applied about four to six weeks after bud break. Gooseberries and currants respond well to split applications where $^1/_3$ of the total N required is applied in the spring, and the remaining $^2/_3$ is applied in the summer or fall.

For June-bearing strawberries, N is applied to stimulated runner formation in late-May to early-June in the planting year or after renovation in following years (60 percent of the total N applied), and for flower bud initiation in mid-August (40 percent). A light spring application is only recommended for June-bearing strawberries grown on sandy soils. Day-neutral and ever-bearing strawberries require high levels of N throughout the growing season and are either fertilized monthly or once after planting (or in the spring) with a slow-release form of N.

The amount of N required by a fruit crop varies with the soil texture and organic matter content. Nitrogen is more subject to leaching in sandy soils than in loamy soils. Therefore, to minimize leaching on sandy soils, N should be applied in two or more applications. Except for strawberries, gooseberries, and currants, any N application should be made before July 1 to avoid any risk of delaying the acclimation process and contributing to winter injury. Because N is released from the soil organic matter during the growing season, plants grown on soil with high levels of organic matter require lower rates of applied N than those grown on soils with moderate to low levels of organic matter. The following table provides the approximate amount of actual N required by the various fruit crops on a per plant or per area basis for a loamy soil with a moderate level of organic matter. However, these rates should be adjusted based on soil conditions and the plant response to the previous year's N application.

Crop	Rate of Actual Nitrogen
June-bearing strawberries	.18 pounds / 100 ft^2 / year
Ever-bearing strawberries	.07 pounds / 100 ft^2 / month
Day-neutral strawberries	.07 pounds / 100 ft^2 / month
Summer-bearing red raspberries	.11 - .16 pounds / 100 ft^2 / year
Fall-bearing red raspberries	.16 - .23 pounds / 100 ft^2 /year
Black and purple raspberries	.09 - .11 pounds / 100 ft^2 / year
Blackberries	.09 - .11 pounds / 100 ft^2 / year
Gooseberries and currants	.60 - 1.0 ounces / plant / year
Blueberries	.10 ounces / plant / yr of age to 6 yrs
Grapes	.08 - .10 pounds / vine / year
All fruit trees	.10 pounds / inch of trunk diameter/ year

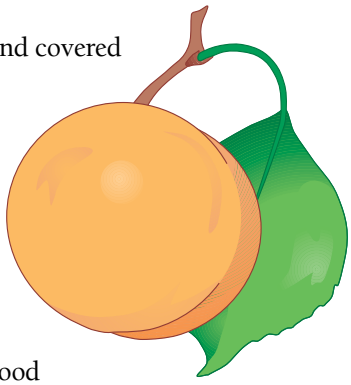
Fertilizer products indicate the percentage N, P, and K the product contains. A balanced fertilizer such as 13-13-13 (N-P-K) contains 13 percent of each of the essential nutrients, while urea (46-0-0) contains 46 percent N, 0 percent P, and 0 percent K. To determine how much fertilizer product to apply, divide the amount of actual N from the table by the percentage of N the product contains. For example, June-bearing strawberries require .18 lb of actual N per 100 ft^2 per year. If you are applying 13-13-13, then divide the amount of actual N required by the percentage of N in the product to determine how much of the product is needed (.18 pounds / .13 = 1.38 or ~ 1.4 pounds of 13-13-13).

Winter Protection

Good winter protection begins with selecting fruit crops and cultivars adapted to your climatic and soil conditions. Once planted, maintaining good cultural practices during the growing season becomes important in reducing the risk of winter injury. Conditions that reduce photosynthesis (severe insect or disease infestation, drought, or N deficiency) will adversely affect the fall acclimation process. Conversely, conditions that promote excessive vegetative growth (too much N and/or over pruning) will delay the onset of the acclimation process. Even with the proper cultivar selection and good cultural practices, some fruit crops require additional winter protection.

Strawberry plantings need protection against winter temperatures. Temperatures below 20°F can kill the flower buds and damage the roots and crowns of exposed plants. A 3- to 5-inch layer of straw mulch should be applied in late fall (usually in mid- to late-November) when temperatures begin to drop into the lower 20s. Remove the straw mulch when the plants begin to grow again in the spring. Maintaining a mulch around the plants through the harvest period will aid in reducing the incidence of fruit disease.

Gooseberries, currants, American hybrid grapes, and bush cherries are very hardy, while fall-bearing raspberry canes do not need to survive the winter. Therefore, these crops can be grown without protection against low temperatures. Proper selection of cultivars is important for summer-bearing raspberries, erect blackberries, blueberries, and American-type grapes because it is very difficult to provide winter protection. Trailing blackberries and some French hybrid grapes are not winter hardy, and the canes must be removed from the trellis, laid on the ground, and covered with a mulch for protection against low temperatures. For summer-bearing raspberries, blackberries, and blueberries, snow fencing and other practices that aid to trap snow in the planting will improve the chances for a good crop.



Even the trunks of hardy fruit trees are susceptible to winter sun scald (a form of winter injury). This can occur on clear winter days with little or no wind. Under such conditions, the dark surface of the trunk absorbs energy from the sun and can warm up to temperatures that are higher than experienced during the growing season when the trunk is shaded. At sunset, the trunk temperature rapidly drops to the air temperature. Such extreme changes in trunk temperature can cause winter sun scald and make the trunk more vulnerable to other forms of winter injury. As trees become older, they become more prone to winter sun scald because of the increase in trunk mass. Reflective trunk wraps or cylinders, or painting the trunk white (with an interior-grade latex paint that has been diluted in half with water), greatly reduces the risk of winter injury on fruit trees by minimizing the difference between the trunk and air temperature. Trunk wraps or cylinders should be placed on the trees in late-fall after the leaves have fallen and removed in the spring when new leaves begin to emerge.

Wildlife Protection

Rabbits, voles (mice), pocket gophers, raccoons, deer, and birds can be a problem in fruit plantings either during the growing season and/or during the winter. During the growing season such damage can include feeding on new shoots by rabbits and deer; on fruit by raccoons, birds, and deer; or on roots by pocket gophers. During the fall, deer will rub their antlers on young fruit trees and cause severe injury. During the winter, voles can girdle small fruit canes and fruit tree trunks; rabbits will feed on small fruit canes or on the bark, shoots, and buds of fruit trees; and deer will feed on the shoots and buds of fruit trees at a higher level than can be reached by rabbits. Before any control measures can be undertaken, it is important to be able to identify which wildlife pest is causing the problem.

Exclusion and the use of repellents are the two methods that can be used to protect fruit plantings from wildlife pests. Of these methods, exclusion practices, such as trunk guards, perimeter fencing, or netting, are more effective than repellents. Repellents include commercial and home-remedy scent or taste repellents and scare objects or sounds. These repellents may or may not work or may work for a limited time. Scent and taste repellents need to be re-applied to remain effective. For more information, ISU Extension has several publications on controlling these wildlife pests:

PM 1302a	*Managing Iowa Wildlife: Pocket Gophers*
PM 1302d	*Managing Iowa Wildlife: Problem Birds Around Houses and Farmsteads*
PM 1302e	*Managing Iowa Wildlife: Raccoons*
PM 1302g	*Managing Iowa Wildlife: Deer*
WL 46	*Mouse Damage in Tree Plantings*
WL 47	*Rabbit Damage in Tree Plantings*

The following ISU Extension publications contain additional information on growing fruits:

IDEA 2	*Small Fruits—Insect and Disease Management for Backyard Fruit Growers in the Midwest*
IDEA 3	*Tree Fruits—Insect and Disease Management for Backyard Fruit Growers in the Midwest*
PM 175	*Home Fruit Insect and Disease Management*
PM 225	*Fire Blight of Fruits and Ornamentals*
PM 254	*Cedar Apple and Related Rusts*
PM 463-10	*Common Fruit Insects*
PM 672b	*Planning and Managing a New Commercial Apple Orchard*
PM 672d	*Production Guide for Commercial Strawberries*
PM 673	*Recognizing Common Apple Diseases in Iowa*
PM 717	*Growing Strawberries at Home*
PM 780	*Pruning and Training Fruit Trees*
PM 820	*Garden Soil Management*
PM 823	*Watering the Home Garden*
PM 1052	*Tree Fruit Pollination*
PM 1078	*Harvesting and Storing Apples*
PM 1083	*Why Fruit Trees Fail to Bear*
PM 1086	*Characteristics and Sources of Apple Cultivars*
PM 1117	*Characteristics and Sources of Pear Cultivars*
PM 1706	*Growing Raspberries in the Home Garden*
PM 1707	*Growing Grapes in the Home Garden*
ST 11	*Soil Sample Information Sheet for Horticultural Crops*

For additional information on the culture of fruits listed in this publication, consult *Growing Fruit in the Upper Midwest* by Don Gordon (University of Minnesota Press). The book is a practical "how-to" guide for growing fruit in home gardens and small commercial plantings. Because the author relied heavily on extension bulletins from Iowa, Wisconsin, Minnesota, North Dakota, and South Dakota, it serves as an excellent reference regarding cultivar selection.

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