chapter 15

Fruits

In a nutshell...

- Growing fruit is popular, but it can be a lot of work.
- Think outside the apple box: There are a number of fruits (and nuts) that will grow in Wisconsin.
- It's very difficult to grow unblemished apples and other fruit crops organically.
- Check the resources at **hort.extension.wisc.edu** for issues not covered in this chapter.

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Introduction

Fruit that has ripened on the tree is one of the great delicacies of summer and fall. Many Wisconsin gardeners have fruit crops of various sorts in their gardens—strawberries for early summer, raspberries for mid-summer, and apples for fall. To be successful at growing these and other small fruit and tree fruit crops, gardeners need to know something about the biology of fruit crops, how to plant them, and how to care for them.

Many cultural practices maximize fruit crop productivity and minimize adverse environmental conditions and pest pressure. This chapter describes the basic cultural practices for common small fruit and tree fruit crops in Wisconsin.

Learning objectives

1. The factors to consider when choosing fruit crops and cultivars for Wisconsin.
2. The pollination requirements for the different fruit crops.
3. Training and pruning practices for tree fruits and bush fruits.
4. Fertilizer, water, and pest management needs specific to tree and small fruit crops.

Fruit crops for Wisconsin

Wisconsin's short growing season and cold winters mean some fruit crops can't be grown at all and others can be grown but only when specific cultivars are selected. Be aware that most fruit crops require extra care and attention to be truly productive; marginal fruit crops may require special conditions and yield relatively little fruit.

Table 1 lists fruit crops that can reliably and marginally grow and bear fruit in Wisconsin.

TABLE 1. Reliable and marginal fruit crops for Wisconsin

Tree fruits	Small fruits
RELIABLE CROPS	
Apples	Strawberries
Tart cherries	Raspberries
Pears	Serviceberries (juneberries)
Plums (blue and red, not Asian)	Currants (red, white, black), gooseberries
	Grapes (American & French hybrids)
	Lingonberries, blueberries, elderberries
MARGINAL CROPS	
Apricots	Blackberries
Sweet cherries	
Peaches	
Quince	

Selecting crops and cultivars

Gardeners should consider the following when choosing crops or cultivars to plant:

- Not all fruit crops are hardy in Wisconsin's harsh climate, and some that are may require a longer growing season to bear fruit. For example, Granny Smith apple trees are hardy, but they require a longer growing season (180 days) than is generally found here.
- Space is another consideration. If your garden is small, you may want plant small fruits rather than fruit trees. If you choose to plant fruit trees, you should consider a dwarf rootstock, if available. Dwarf fruit trees occupy far less space than standard trees.
- Consider how much time you have to care for your plants. Most small fruits require regular maintenance, such as pruning or renovation. Fruit trees require more care: training and pruning during the dormant season and, in many cases, some spraying during the summer. For those who prefer an organic approach, managing pests with few or no chemicals takes more time and management expertise than traditional approaches.

Obtaining fruit crops

Always try to obtain your plants from a reputable nursery, which ensures the plant materials are true to name and generally disease-free. When you obtain plant materials from other sources, such as friends or a neighbor, you may inadvertently bring diseases, nematodes, or insect pests into your garden. And be wary of nursery catalog claims that seem extraordinary—they may in fact literally be too good to be true.

For those who purchase plants online or from mail-order catalogs, arrange for delivery in late April to early May. Because hardiness is controlled by genetics—not by where the nursery stock was produced—you don't need to order from nurseries in your climate zone. In fact, many nurseries don't produce their plant material on site—they may grow their plants in different places or contract with other suppliers located in other areas. Always make sure the varieties are suited for Wisconsin.

Fruit crop botany

As with any flowering plant, in order to produce fruit, a plant first has to produce flowers, those flowers need to be pollinated, and then fertilization must occur. Pollination is affected by both **pollenizers** (other plants required for cross pollination) and **pollinators** that transfer pollen between plants.

Fruit come in diverse botanical forms (see figure 1). These forms are classified by how the fleshy parts, seeds, and other structures are arranged and develop.

Remember that all plants have fruits, but our fruit crops have been selected or bred specifically for size, flavor, and other characteristics for their culinary use. The major fruit crops fall into four main groups—aggregate, berry, drupe, and pome—which are all fleshy fruits, but there are many other fruit types (see figure 1).

Fruits can be classified as simple fruits, aggregate fruits or multiple fruits. Simple fruits are those which develop from a single ovary from a single flower. These include apricot, cherries and peaches (drupe), pears and apples (pome), and grapes and cranberries (berries). Often the fruits are fleshy, as in the previous examples, but simple fruits can be dry if the fruit wall becomes papery or leathery and hard. Examples of simple dry fruits are peanut (legumes) and walnut (nut).

Aggregate fruits come from a single flower which has many ovaries. The flower looks like a simple flower with one corolla, one calyx and one stem, but it has many pistils or ovaries which are fertilized separately and independently. If ovules are not pollinated successfully the fruit will be misshapen and imperfect. Insect feeding or other damage to the developing seeds will also result in misshapen fruit, called **catfacing**. Raspberry, strawberry and blackberry are aggregate fruits.

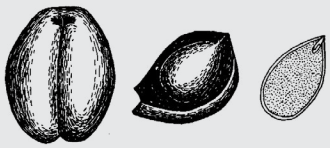
Multiple fruits are derived from a tight cluster of separate, independent flowers borne on a single structure. Each flower has its own calyx and corolla. Examples of multiple fruits include mulberry, fig and pineapple.

FIGURE 1. Botanical fruits

Fleshy fruits

DRUPE

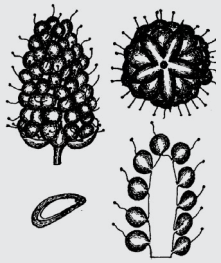
- A fleshy exterior with a hard (pit) inner layer surrounding the seed.



- **Examples:** apricots, plums, peaches, nectarines, cherries, coconut, olive, mango, date, pistachio.

AGGREGATE

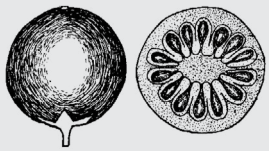
- A cluster of many small fruits (drupes); each segment—or **drupelet**—is a separate fertilized ovary held together by fine hairs similar to Velcro® and must be pollinated and fertilized for the full fruit to develop.



- **Examples:** raspberries, blackberries, strawberries.

BERRY

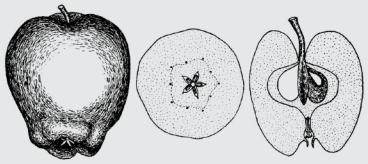
- Fleshy interior with one-to-many seeds.



- **Examples:** grapes, currants, cranberries, lingonberries, elderberries, gooseberries, avocado, banana, persimmon, goji berries, tomato, pomegranate, papaya.

POME

- A fleshy exterior surrounding a reproductive chamber (core).
- Typical of certain members of the rose family (Rosaceae).
- **Examples:** apples, pears, quince, serviceberries (or juneberries).



• OTHERS

- Hesperidium—a berry with a leathery rind and parchment-like partitions between sections; typical fruit of the citrus family (Rutaceae).
- Pepo—a berry with a hard, thick rind; typical fruit of the gourd family (Cucurbitaceae).

Dry fruits

DEHISCENT

(Splits open along definite seams.)

- Legume—an elongate single carpel "bean pod" splitting along two seams; typical fruit of the legume family (Leguminosae or Fabaceae).
- Silique—a slender, dry, dehiscent fruit that superficially resembles a legume, but is composed of two carpels with a partition down the center; typical fruit of the mustard family (Cruciferae or Brassicaceae).
- Capsule—seed pods that split open into well-defined sections; a very common dry fruit found in many plant families.
- Follicle—a single ripened ovary that splits open along one seam; found in many different families.

INDEHISCENT

(Does not split open and usually contains only one seed.)

- Achene—a very small, one-seeded fruit that becomes dry and free from the seed at maturity; usually produced in clusters; typical fruit of the sunflower family (Compositae or Asteraceae).
- Anthocarp—an achene tightly surrounded by the persistent lower portion of the calyx; only in the four o'clock family (Nyctaginaceae).
- Grain or Caryopsis—a very small, dry, one-seeded, fruit with the actual seed coat completely fused to the ovary wall or pericarp; the outer pericarp layer is referred to as the bran, while the inner seed layer is called the germ; typical fruit of the grass family (Gramineae or Poaceae).
- Schizocarp—a small dry fruit composed of two or more sections that break apart but each section that contains a single seed does not split open; typical fruit of the carrot family (Umbelliferae or Apiaceae).
- Samara—a small, winged, one-seeded fruit, usually produced in clusters on trees.
- Nut—a larger, one-seeded fruit with a very hard pericarp, usually enclosed in a husk or cup-like structure.
- Utricle—a small, bladderlike, thin-walled, one-seeded, indehiscent fruit.

Small fruits

Small fruits that are hardy in Wisconsin are relatively easy to grow and can be integrated into the landscape to produce both fruit and visual beauty. In most cases, give them the same care as other landscape plants (see chapter 9, General Gardening Practices). All fruit crops, except blueberries and lingonberries, will grow best if the soil pH is between 6 and 7.5. In the following sections, only unusual care and management requirements are highlighted.

Strawberries

Strawberries (*Fragaria*) are native to both eastern and western hemispheres and have been known from antiquity. The modern garden strawberry has an interesting history. In 1712 Louis XIV of France sent French military engineer, mathematician, spy, and explorer Amédée-François Frézier to survey the coasts of Chile to gather information for the French military. While there he encountered the large-fruited Chilean strawberry (*Fragaria chiloensis*), and in 1714 he took potted plants on his return. After six months at sea, only five plants survived. Frézier gave two plants to the cargo master of the ship, who gave him water to keep the plants alive. He kept one for himself and gave one each to the minister of fortifications and the director of the royal gardens in Paris. It was in these gardens that hybrids of *F. chiloensis* and *F. virginiana* (from eastern North America) were produced. These hybrids were larger, and more productive and flavorful than either parent. The chance hybridization of two American strawberries in France produced *F. ananassa*, the forerunner of the modern garden strawberry.

The strawberry plant is an herbaceous perennial. The perennial portion is the **crown**, which is a shortened stem. The crown produces roots, leaves, runners, branch crowns, and flower clusters (see figure 2). Strawberry plants are shallow-rooted—50 to 90% of the roots remain in the top 6 inches of soil—and dry out more quickly than other plants when there is competition with weeds or drought.

Fruiting habit

Strawberries have three distinct fruiting habits: Junebearing, everbearing, and day-neutral.

- Junebearing strawberries produce flower buds in response to the shorter days of late summer and early fall. Flowers and fruit are produced the following spring, with the crop usually harvested beginning in early to mid-June.
- Everbearing strawberry cultivars produce flower buds in early summer in response to the lengthening days. They produce a small crop in June, another crop in July, and perhaps a third crop later in the summer.
- As the name implies, day-neutral cultivars don't respond to day length—they produce flower buds in flushes throughout the summer. It's possible to get three crops from one planting of day-neutral strawberries in a single year.

Planting and training strawberries

Strawberries need to be planted so half the crown is below the soil (see figure 3). If planted too shallow, new roots will dry out before they find soil. Plants set too deep will be smothered and won't grow.

FIGURE 2. Strawberry plants

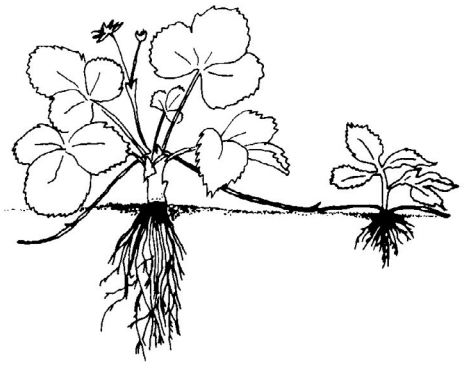
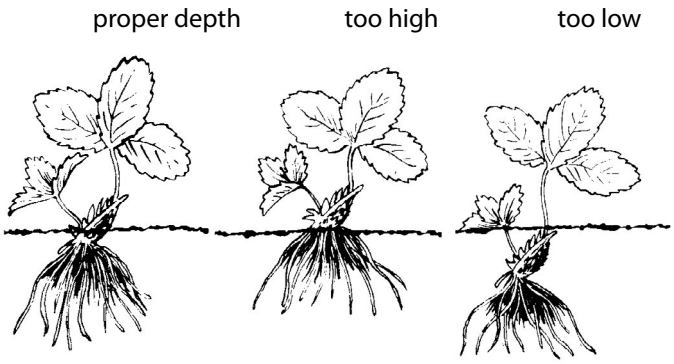


FIGURE 3. Proper strawberry planting depth

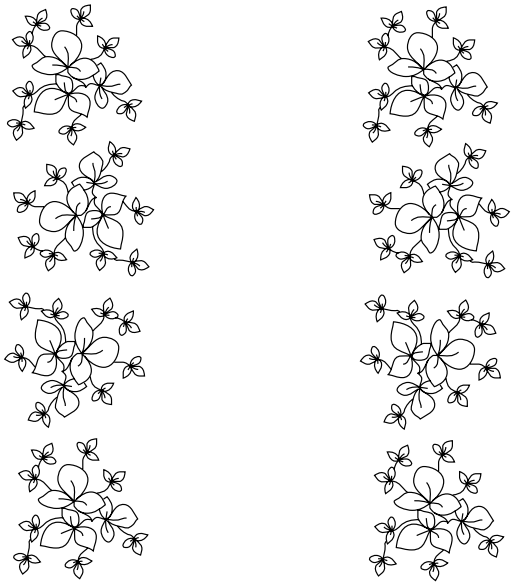


Two training systems are usually used for strawberries. The most common—and the one typically used for Junebearing strawberries—is the matted row system (see figure 4). To form a matted row:

- Space the plants 15 to 30 inches apart in rows that are about 36 inches apart.
- Remove the flowers that form the first year and encourage runners to grow. The runner plants will cover the area, making a solid mat of plants.
- In subsequent years, maintain the rows by rototilling or spading between them, keeping the rows no more than 15 inches wide.

Productivity is more closely related to the linear feet of row edge than to the square feet of ground surface covered. Matted row systems can be kept for 3 to 6 years if well cared for.

FIGURE 4. Matted row system



Spaced plant systems are commonly used for everbearing or day-neutral cultivars. Space plants from 6 to 12 inches apart in rows that are 24 to 36 inches apart. Remove any runners. Flowers and fruit are produced only on the original plants. This system encourages large crowns and larger berries on the original crown.

Irrigation

Water is key to successfully growing strawberries. Depending on soil type, strawberries require about 1 inch of water—from irrigation or rainfall—every week throughout the summer, even after fruit has been harvested. Since most of the roots are near the soil surface, frequent shallow irrigations are best.

Weed management

Be careful not to cultivate too deep as strawberry roots are shallow. Hoeing and hand weeding provide the best weed control for home strawberry plantings: herbicides are not recommended because they might contaminate the fruit. A light layer of organic mulch such as straw or wood chips will help keep the weeds down and moisture in.

Fertilization

After the first year, strawberry plants should not be fertilized until after harvest. Make the first application immediately after harvest (see "renovation") and the second about 3 to 4 weeks later.

Winter protection

Strawberries aren't hardy enough to tolerate all the winter conditions we experience in Wisconsin. In the late fall, usually around Thanksgiving, cover the plantings with a 2- to 4-inch layer of straw. The straw insulates the plants and prevents rapid and wide fluctuations in temperature. Remove the straw from the plants in the early spring, when new growth begins. Leave the straw between the rows to help keep weed growth down. Floating row covers are also suitable for winter protection.

Spring frost protection

Spring frosts are hazardous to strawberries, which are most susceptible when they are flowering. When frost is predicted, strawberries should be covered with a tarp or other covering to retain heat from the soil. The plants don't have to be warm—just above 30˚F. Remove the covering in the morning once temperatures are above 32˚F so heat doesn't build up under it.

Renovation

For continued production in succeeding years, strawberries grown in a matted row system should be renovated immediately after harvest. Follow the steps in table 2.

TABLE 2. Renovating strawberries grown in matted rows after harvest

Mow	Mow or cut off diseased leaves to reduce the amount of inoculum that may cause later disease outbreaks.
Narrow the rows	Narrow rows to 12 to 15 inches wide. Strawberries spread by sending out runners. To maintain aisles and maximize row edge, remove any plants between the rows with a spade or rototiller. Incorporate any organic mulch.
Control weeds	If weeds have become a problem, this is the best time to control them.
Fertilize	This is the best time to apply fertilizer. If phosphorus and potassium were applied prior to planting, only add nitrogen. Apply about ½ pound of ammonium nitrate or ⅓ pound of ammonium sulfate per 100 foot of row right after harvesting and again about 3 to 4 weeks later.
Water	Continue watering after harvest. Plants produce the flower buds for the following year's harvest in the late summer; stressed plants make fewer, smaller buds.

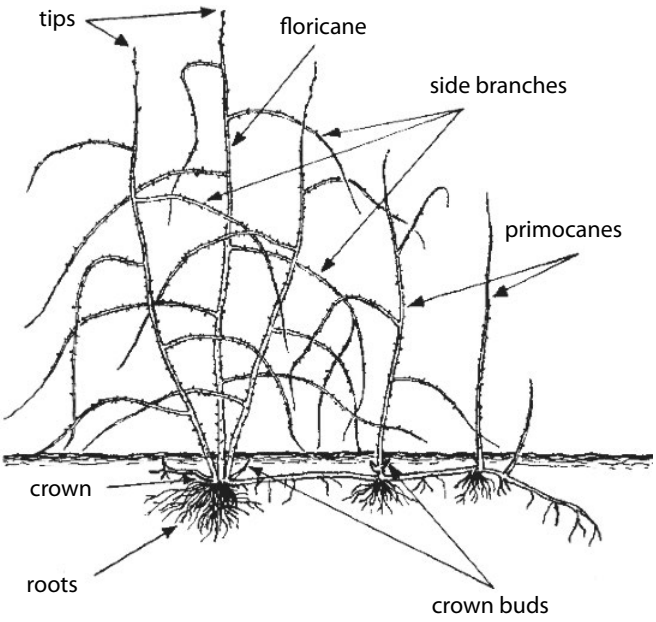
Raspberries and other bramble crops

Raspberries (*Rubus*) are native to both eastern and western hemispheres. Modern raspberry cultivars are combinations of eastern and western hemisphere raspberries.

- Red raspberries—and their recessive yellow color form—are most commonly grown in Wisconsin.
- Black raspberries, native to eastern North America, are also grown.
- Domestic (not wild) blackberries are not fully hardy here, but may survive and produce fruit in favorable sites. Thornless blackberries are not hardy in Wisconsin.
- Purple raspberries are hybrids of black and red raspberries. While not as productive as red raspberries, if given good care they produce fruit.

The raspberry plant is a woody perennial with a biennial growth and fruiting habit (see figure 5). The **crown** is perennial. **Canes** that appear during the growing year are called **primocanes**. Canes that have lived through the winter are called **floricanes**.

Figure 5. Raspberry plants



Cultivar selection

Raspberries are self-pollinating, so plantings of a single cultivar will produce fruit. Many cultivars of red, black, yellow, and purple raspberries will grow and fruit in Wisconsin. Blackberries, even transplanted wild ones, will not fruit reliably.

Fruiting habit

Raspberries have two fruiting habits: summer bearing and fall bearing.

Summer-bearing raspberries produce primocanes one year and produce flowers and fruit on these same canes (which become floricanes) the following summer.

- One way to manage summer-bearing raspberries is to prune them twice: once in the summer after harvest to remove the canes that have just finished fruiting and again in the winter to remove weak canes and thin the number of canes to four to five per foot of row.
- Another way to manage summer-fruiting raspberries is to mow off half the planting each year and harvest the other half, alternating every year. This system reduces overall yield by just 30%, even though only half the planting sets fruit.

Fall-bearing raspberries produce flowers and fruit on the upper nodes of the primocanes. Flowers are produced in mid-summer and the fruit matures in mid-August to mid-September, usually continuing until a killing frost. Raspberries grown in northern areas obviously have a shorter season than in southern areas. The same primocanes that fruited in the fall will produce a small summer crop the following July if they are kept over the winter. This summer crop can be difficult to harvest; for best results, harvest the fall crop and then cut all the canes to the ground during the dormant season.

It's important to know the fruiting habit of raspberry cultivars and which cultivar you have, because if you cut off all the canes of summer-bearing raspberries, no fruit will be produced, as summer raspberry fruiting is a two-year process.

Planting systems

Raspberries are typically planted using one of two systems: hill or hedgerow.

- In raspberries, a hill refers to the cluster of canes developed around a single plant. It does not mean a mound of soil for planting. In the hill system, plants are set in holes on a 4- x 4-foot grid. Provide a stake for each hill and tie the canes to the stake. The new shoots are limited in their spread to about a foot in diameter. Harvesting is easy, as the canopy does not become dense or thick. One advantage of this system is that one or more hills can be incorporated into a garden where space allows.
- Larger plantings are best set in a hedgerow system. Many variations on the hedgerow system exist, but basically raspberry plants are set 2 to 3 feet apart in rows 6 to 10 feet apart. A trellis keeps the canes from drooping—trellises can be as simple as metal fence posts on each end of the row with poly-twine or wire used to support the canes. Tie floricanes to the trellis wires and let the primocanes grow in the center. Don't let primocanes grow outside of the row.

Pruning

For consistent sustained production, summer-bearing raspberry canes need to be pruned (see figure 6). Remove fruited floricanes soon after harvest. This is also the time to cut canes on summer-bearing raspberries if they are being managed to fruit half the canes in alternate years.

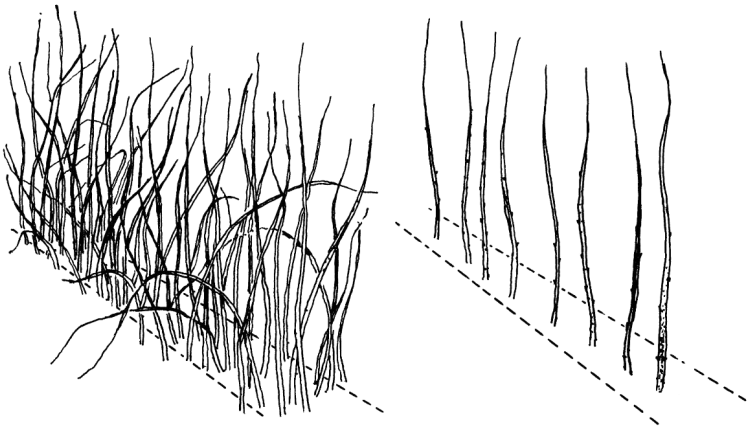
During the dormant season prune floricanes to remove about the top one-quarter of their length, a process known as **tipping**. Tipping stiffens the canes, results in better growth of fruit from lower nodes, and only removes a small portion of the crop. Remove any weak or damaged canes, keeping the thickest and most vigorous canes. Thin the canes to about four to five per running foot of row or six to eight per hill.

For fall-bearing raspberries, prune all the canes to the ground during the dormant season if only a fall crop is the goal.

Irrigation

Raspberry plants are shallow-rooted. Because most roots are in the top 6 to 12 inches of soil—do not allow raspberries to dry out. They need about one inch of water per week, whether from rainfall or irrigation. Rather than short, shallow irrigations, water plants less often but deeply. If diseases have been a problem, plan to water early in the day so the foliage can dry before nightfall.

FIGURE 6. Summer-bearing red raspberries before and after summer pruning



Fertility

If the planting site was properly prepared, the only annual fertilization raspberries should need is nitrogen. Apply 0.4 to 0.6 pounds of high nitrogen fertilizer per 10 feet of row. Split the total amount between two applications, the first in early May and the second in early June. In most situations phosphorus or potassium applications are not needed on raspberries.

Weed management

Control weeds along the edges of the row or hill with a rototiller, if needed. This will also dig up the canes growing outside the rows and help keep them narrow.

Bush fruit

Currants, gooseberries, serviceberries, and blueberries are all perennials shrubs and have similar growth habits. All of these plants are self-fruitful so planting two cultivars for cross-pollination is not required. Planting two cultivars of blueberries will result in larger, more abundant fruit.

Currants and gooseberries

The genus *Ribes* includes the edible currants (white, black, and red) and gooseberries, all of which are native to the temperate zone of the Northern Hemisphere. Currants—and especially black currants—are alternate hosts for white pine blister rust disease, which can cause serious damage to white pines. Some states have restrictions on growing *Ribes* species for that reason, although Wisconsin does not. Consider the location of any white pine trees when deciding where to plant currants.

The gooseberry is also a species of *Ribes*. Gooseberries are native to Europe, northwestern Africa, and much of Asia. Note that like most *Ribes*, the gooseberry is a potential host for white pine blister rust. European gooseberries produce larger, sweeter, and deeper-colored fruit than domestic cultivars. They also produce more and longer thorns, so picking them can be a painful experience. For more information, see *Growing Currants, Gooseberries, and Elderberries in Wisconsin*.

Serviceberries

Amelanchier is a deciduous shrub or small tree native to temperate regions of the Northern Hemisphere, especially North America—at least one species of *Amelanchier* is native to every U.S. state except Hawaii. Known more commonly as serviceberry (or sarvisberry), shadbush, juneberry, or Saskatoon berry, the shrub is grown both for its ornamental qualities and its fruit. The blueberry-like berries can be eaten fresh but is more commonly used in pies and preserves as it contains a natural source of pectin.

Blueberries

Blueberries require an acidic soil with a pH of 5.5 to 6.0. To grow blueberries where soil pH is between 6.0 and 6.8, ammend the soil with elemental sulfur at least a year before planting to allow enough time for the soil pH to adjust. Soils in eastern Wisconsin have high carbonate content and don't respond to added sulfur. One option is to replace a volume of soil with peat moss and plant blueberries into peat moss. Another option is to grow blueberries in containers where it is much easier to control soil pH.

Growing bush fruit

Spacing

Bush fruits are almost always set as individual plants, for ease in harvesting, pruning, and cultivating around the entire plant. Planting bush fruits individually can also add texture and color to the garden. For currants and gooseberries, set plants 2 to 3 feet apart in rows 6 to 10 feet wide. Plant the bushes just lower than they were in the nursery pot, with the lowest branch at or just above the soil line. No trellis or other support is needed. For blueberries, space the plants 3 to 4 feet apart in rows 6 feet apart. Plant serviceberries 5 to 6 feet part in hedgerows.

Pruning

Prune bush fruits when the plants are dormant—usually in early spring, just before growth begins.

In currants and gooseberries, remove all but six to eight of the most vigorous shoots after the first year. Bush fruits must be pruned to renew fruiting wood. As stems become old and large, more resources are spent on the wood and less on fruit production. Removing old wood allows newer stems to grow and produce fruit. For mature plants, remove three to five of the largest stems and any weak, hanging, or crossing stems each year. Mature bush fruits should have eight to ten bearing stems and four to six new shoots to replace the old stems removed each year. Renovate old, neglected bush fruits by either cutting off all the stems or removing all but some of the most vigorous new shoots.

Serviceberries and blueberries require little pruning. For blueberries, remove any fifth year canes and above. For serviceberries, remove older branches and prune the branches of taller cultivars back to 6 feet.

Irrigation

Most bush fruits need about 1 inch of water per week from rain or irrigation. Blueberries will need more frequent irrigation. Once currants and gooseberries are well established, they shouldn't need irrigation except during the driest periods.

Weed management

Control perennial weeds before planting as bush fruits do not compete well with weeds. Frequent shallow cultivation will keep weeds away from the plants. Mulching the plants with organic material to a depth of 2 to 3 inches will retain moisture and reduce weeds.

Fertilization

Bush fruits are not heavy feeders. If the soil was properly prepared before planting, only nitrogen will be needed. Give young plants a high-nitrogen fertilizer annually in the spring. Applying aged manure can also supply nitrogen. Blueberries require nitrogen in the ammonium form: ammonium sulfate or urea fertilizer. More details can be found *Fertilizing Small Fruits in the Home Garden*.

Winter protection
Currants, gooseberries, and serviceberries need no winter protection in Wisconsin. Blueberries, however, will require some protection. Snow is great insulation: place a snow fence on the windward side of the plants so snow will drift over them. For individual bushes in small plantings, circle them with chicken wire and then place straw around each plant.

Grapes

Grapes (*Vitis* sp) were one of the first fruit species to be domesticated, and are the most important fruit crop in the world. Grapes are used primarily to make wine, and are consumed as fresh and dried fruit, in grape juice and jelly, and as an ingredient in cooking. The genus *Vitis* is native to temperate and subtropical areas of the Northern Hemisphere. The most popular cultivars grown in Wisconsin are derived from crosses between native grapes from North America (*Vitis riparia* and *V. labrusca*) and European grapes (*V. vinifera*). Seedless table grapes and most wine grapes are of European origin and not hardy in Wisconsin. Gardeners will have the most success with blue grapes (*V. labrusca*) or some of the hardiest French-American hybrids. Some American grape cultivars will grow and produce fruit almost anywhere in Wisconsin. Other cultivars, like Concord, fruit too late in the season to mature in central or northern Wisconsin.

Grapes are perennial woody vines. Fruit are produced from buds on the current season's growth. The grape bud is a compound bud with a primary, secondary, and tertiary bud. The compound bud is important because if the primary bud is damaged (by frost, etc.), the secondary bud will grow and produce a small crop. The tertiary bud, however, will only produce vegetation. If properly cared for, grapes will grow and produce fruit for many years.

Site selection

Site selection and preparation are especially important for grapes. The site must have a long enough growing season and warm temperatures to ensure the grapes will ripen.

It is important that cold air can drain away from the vines on frosty nights, so avoid planting grapes in low areas. Cold air accumulates in low spots and increases the probability of frost damage.

Avoid soils that are water-logged, (seasonally or during the year), extremely droughty (if grapes will not be irrigated), or compacted (restricts root development).

Be aware that herbicide usage on neighboring sites may result in herbicide drift and severely damage vines. Phenoxy-type herbicides, such as 2,4-D used for broadleaf weed control are harmful.

Cultivar selection

When choosing a grape cultivar for Wisconsin consider: hardiness, early ripening fruit, and fruit quality and flavor. See table 3 for wine and table grape variety recommendations.

TABLE 3. Recommended wine and table grape varieties

WINE GRAPE VARIETIES		TABLE GRAPE VARIETIES			
Red wine	White wine	Red seedless	White/green seedless	Blue seedless	Seeded
Baltica	Brianna	Canadice	Himrod	Mars	Bluebell
Foch	Frontenac Gris	Einset	Marquis	Trollhauge	Buffalo
Frontenac	La Crescent	Petite Jewel			Concord
Leon Millot	La Crosse	Reliance			Swenson Red
Marquette	St. Pepin	Somerset seedless			
Petite Pearl					
St. Croix					

Planting and spacing

Grapes vines are most commonly sold as dormant bare-root or grafted plants. When planting the vines, make sure that the hole is big enough to accommodate the entire root system and distribute the roots uniformly within the hole. After the soil has been filled in around the vine, gently pull the vine upwards so that the roots are oriented vertically. Bare-root vines should be planted just lower than they were in the nursery to reduce vine mortality. The graft union in grafted vines should be 2 inches above the surface of the soil when planted. Irrigate the vines after planting to remove pockets of air within and around the root system. Space plants 6 to 8 feet apart in a row, allowing 3 to 4 feet of cordon on either side of the trunk for vine growth. Individual vines can be planted along a garden fence to add variety and visual texture to the landscape. After planting the vines, and preferably after buds are swelling, prune back the vines to 2-3 buds above the soil surface. Place a stake into the soil near the vine and tie new growth to the stake to help conduct the shoots.

Trellis systems

Grape vines require some sort of support structure. Commercial growers sometimes build elaborate trellis systems. For home gardens, most any kind of trellis will work—even a single wire running between two posts. Chain link fencing works well. The trellis just needs to be strong enough to support the canes and fruit and be tall enough to allow sufficient canopy (see figure 7).

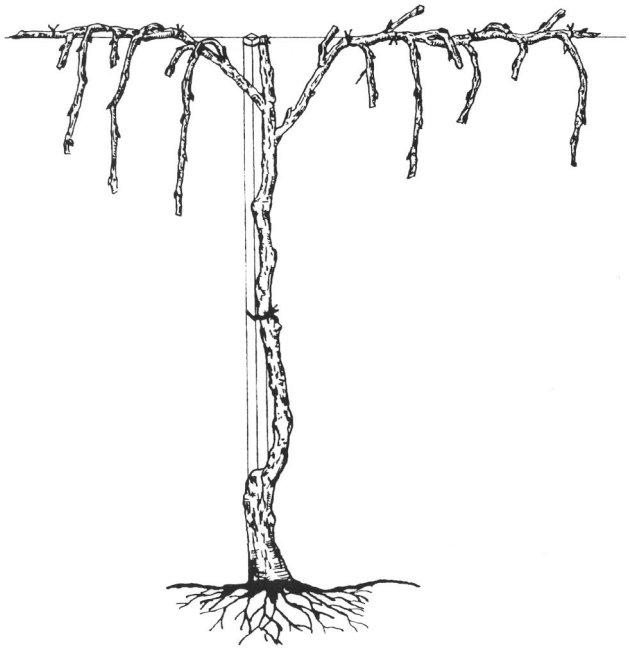
Pruning

The most common mistake people make when pruning grapevines is to remove too few canes. Grapes produce a significant amount of cane growth each year—much of this growth must be removed to balance root and vegetative growth and fruiting.

Vines are pruned during the winter months when vines are dormant. Pruning is especially important to determine the number of buds and the crop load for the following growing season. Grapes can be grown and trained in multiple ways, however a few training and pruning principles can be applied to most of them:

- Fruit is produced on one-year-old wood (previous year growth).
- Mature grapevines produce high amounts of vegetative growth (shoots and leaves); approximately 70-90 percent of it has to be removed during dormant pruning.
- Grapevines set more fruit than they can support. Vines that are over cropped will not be able to fully ripen their fruit, resulting in immature and green fruit.

FIGURE 7. A simple grape trellis



- Growing habits vary among cultivars. American grape vines (e.g., Concord) tend to have canes that grow in a downward direction, while French-American hybrids generally grow with a more upward direction.

The main goal of vine training during the development years is to create well-established root systems and trunks. Many training systems have been adapted to grape production. However, all grape training systems are modifications of two training systems (cordon trained, head trained) and two pruning systems (cane pruned, spur pruned). Thus, four basic systems are possible.

One concept worth noting is balanced pruning, which involves balancing the number of nodes left with the amount of wood removed.

- For American grapes, follow the 30 plus 10 system. Retain 30 fruiting nodes for the first pound of prunings plus 10 nodes for each additional pound. For a vine with 3 pounds of prunings, for example, retain 50 fruiting nodes. Do not count renewal spur buds.
- For French-American hybrids follow a 20 plus 10 system. Retain a maximum of 40 to 50 buds per plant.

Fertilization

In general, grapes do not need as much fertilizer as other fruit crops, and more problems are associated with over fertilization than under fertilization. During the first year of planting, depending on soil fertility, an addition of 0.5 to 1 ounce of nitrogen (N) is recommended. Use a well-balanced fertilizer containing nitrogen, phosphorous and potassium. In the following years 1.5; 2 or 2.5 ounces of N per plant should be applied around bud break. Place the fertilizer 1 foot away from the vine trunk. Over-fertilizing with nitrogen will cause excessive vegetative growth, resulting in less, poor quality fruit. If vines are too vigorous, stop fertilizing them for a couple of years.

Winter protection

French-American hybrid grapes will need some winter protection in most locations. While the winter cold may not kill the vines, it can damage the buds, so they will not produce fruit. To produce fruit and to keep vines alive, vines should be protected with snow, soil, or mulch during the winter. This can be done in two ways:

- Train vines so they can be removed from the trellis, placed on the ground, and covered with mulch, soil, or snow for insulation.
- Keep the trunk of the vine short and mound up mulch or soil around the trunk before winter to create protection.

Tree fruits

In general, growing tree fruits requires more time and effort than growing small fruits. Tree fruits are typically long-lived (15 or more years), so it's even more important to select the right spot and prepare the site properly.

All tree fruit are perennial. The buds that produce flowers and fruit in a given year actually begin to grow during the previous year. Thus, fruiting is a 16-month process rather than a 4-month process. Cold hardiness is critical to successful tree fruit production: the fruit buds must develop during one growing season and then survive the winter. Fruit trees that are not fully hardy will not be as productive.

- Most apples, tart cherries, and blue plums are hardy in Wisconsin.
- Apricots are mostly hardy, but are susceptible to early spring frosts.
- Peaches and sweet cherries are marginally hardy in Wisconsin and thus are not grown commercially; they may be successful in southern areas with an appropriate microclimate.

Pome fruits (apples and pears) and stone fruits (cherries, plums, peaches, and apricots) are quite different in their growth and fruiting habits. The biggest difference gardeners will notice is where the fruit is borne: terminally—ends of the branches in stone fruits, and laterally—along the branches for pome fruits.

Fruit set and development

Fruit set is the initial step in the tree fruit production cycle and requires compatible pollen. Some tree fruits are self-pollinating (their own pollen can fertilize the egg) and others require cross-pollination (see table 5). If you select one cultivar to provide pollen for another, make sure their bloom periods overlap. Insects—generally bees—transfer the pollen.

TABLE 5. Pollination requirements of common fruit trees

Crop	Cross-pollination
Apple	Required*
Pears	Required
Tart cherry	Not required
Sweet cherry	Required + incompatibility*
Plums	Usually not required
Apricots	Not required
Peaches	Not required

*Some cultivars have specific cross-pollination requirements.

Some apple cultivars do not produce viable pollen and or are too genetically similar that they cannot be used as a pollinizer. Nurseries often suggest pollinator matches for cultivars that have specific cross-pollination requirements. Ornamental crabapples are also a viable pollen source.

Fruit trees almost always produce more flowers than they do fruit.

- Some flowers do not get pollinated and simply drop off the tree.
- Some flowers are pollinated and fertilized, but the seeds fail to develop.

If a tree has lots of fruit, the individual fruit will be small. If a tree has fewer fruit, the individual fruit will tend to be larger. To get larger fruit and maintain regular bearing, thin out the fruit on mature trees that present biennial bearing, when trees produce a large crop one year and a small crop the next. Seeds developing in the fruit produce plant hormones that prevent the growth of flower buds nearby. Some scientists also believe that the large crop one year depletes carbohydrate reserves resulting in a small crop the next year. Reducing the number of fruits in a year with a heavy crop load will help balance the tree and promote a more consistent fruit production over the years.

Timing of fruit thinning is critical to affect fruit size or annual yield. In general the window to perform this task is only one to two weeks. Cell number determines final fruit size, and cell division occurs only during the period shortly after flowering, ranging from about 10 days for cherries to about 25 days for apples or pears. If you thin after this time, you'll just end up with fewer small fruit.

Cherries and plums are seldom thinned. Peaches and apricots will benefit from early thinning. Apples and pears are regularly thinned. Thin apples within 35-40 days of fruit set. Apple blossoms have a central flower that is slightly bigger and earlier than the others (referred to as the king blossom), that will produce the biggest fruit. When thinning apple trees, remove all but the king blossom, leaving one about every six inches.

Propagation

Tree fruits do not come true from seed. Therefore, all tree fruits are asexually propagated. In general, cuttings from apple and pear trees won't root. Some softwood cuttings from stone fruits will root given proper care. The typical method for propagating tree fruits is to graft or bud onto a **rootstock**. See chapter 19, Plant Propagation.

Rootstocks

Until the 1950s, most apple orchards in North America were propagated with seedling rootstocks. Seedling trees were grown and then the cultivar was grafted to the seedling tree. The resulting trees were highly variable in size, vigor, hardiness, anchorage, and fruitfulness. Nowadays, almost all apple trees are propagated on clonal rootstocks to control these characteristics.

Apple (see figure 8), cherry, pear, prune and plum rootstocks are available in dwarf and semi dwarf sizes. Trees grafted on dwarf or semi-dwarf rootstocks will be shorter and use less space than full-size trees. They also will set fruit sooner than full-size trees. For a list of recommended rootstocks, see table 6.

Obtaining plant material

Propagating trees by grafting and budding can be a fun hobby, but trees propagated at nurseries are more uniform and generally hardier. Further, plants coming from nurseries will be true to name and free of any known diseases. Because fruit tree hardiness is determined by genetics, you can purchase hardy plants from nurseries located in warm climates.

Planting

For trees on size-controlling rootstocks, be sure the graft union is 3 to 4 inches above the final soil line. If soil is placed around the scion, the scion will root and the dwarfing influence of the rootstock will be lost. Trees on seedling rootstocks can be placed with the graft union at or slightly below the soil line.

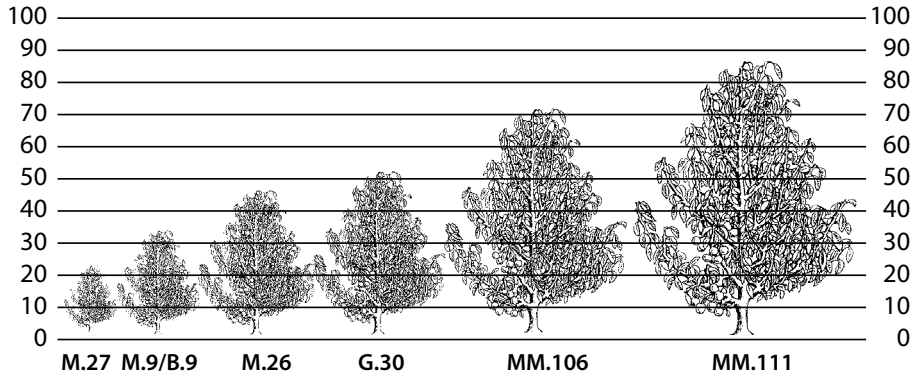
If trees are well branched (3 to 4 branches evenly spaced at a good height), retain the branches. If there are no branches or if the branches are all on one side, cut the tree to about 36 inches and remove any branches. New branches will begin to grow from buds below the cut.

Staking

Fruit trees benefit from staking for the first few years. Stakes help the central leader in the tree and the tree itself to grow straight. Further, apple trees on dwarfing rootstocks must always be staked since the roots tend to be brittle and may break if not supported.

Soon after planting, place a stake 2 to 3 inches from the tree trunk and tie the tree loosely to the stake with a fastener that won't cut into the bark. Suitable stakes include ¾-inch metal conduit, 2- x 2-inch treated wood posts or 3-inch round treated wood posts. The post should extend at least 2 feet into the soil and 8 feet above ground.

FIGURE 8. Relative size of apple trees propagated on clonal apple rootstocks



General maintenance

Keep vegetation 2 to 3 feet from the base of trees. Grasses are most competitive and should not be allowed to grow around tree trunks. Organic mulches such as wood chips or shredded bark will keep weed growth down.

If the site was well prepared, the only nutrient a fruit tree should need is nitrogen. The best gauge for fertilizer application is the amount of tree growth. Non-bearing trees should have 12 to 15 inches of new growth per year. Bearing trees should have between 8 and 12 inches of new growth per year. If trees are producing more growth than this, reduce or eliminate nitrogen fertilizer applications. If there is less growth than this, increase the amount of fertilizer slightly.

Deficiencies of mineral nutrients, particularly micronutrients, are diagnosed through tissue analysis. Collect leaves from the mid-part of the current season's growth and submit them to a testing lab for analysis.

Frost protection

An early spring cold snap may injure flowers, resulting in crop loss. Avoid spring frosts by selecting spots with good air drainage so colder air can settle away from the trees. Protect dwarf or young trees by covering them with a tarp. To provide additional heat, suspend a 60-watt light bulb in the canopy center and leave it on through the night. Remember: The tree doesn't need to be warm—just above 30˚F. Promptly remove the tarp once the air temperature exceeds 32˚F.

Pest management

Mice, voles, and rabbits can girdle and kill fruit trees.

- Reduce populations by eliminating brush cover, mowing the area regularly, and keeping mulch from becoming compacted and piled against trees.
- Tree guards will protect the trunk. The best tree guard is a 2 foot-high piece of ¼- to ⅜-inch wire mesh or hardware cloth encircling the trunk. Check tree guards annually to be sure they are not constricting the trunk or roots and are placed correctly to prevent rodent entry. Spiral plastic guards aren't recommended: although less expensive, they aren't as long lasting, provide less protection, and need to be removed during summer growth.

Training and pruning

Training and pruning are essential practices for producing fruit. Understanding the underlying physiology of training and pruning will help you make good decisions.

The primary object of training and pruning fruit trees is to manage light. Shading of one leaf by another reduces light interception of the shaded leaf by 90%, reducing photosynthesis by 28%. About 30% of full sunlight is required to achieve the maximum rate of photosynthesis. A secondary reason to train and prune trees is to improve aesthetics.

TABLE 6. Recommended rootstocks

Apple	Pear	Plum	Apricot	Peach	Cherry
Dwarf—M.9, BuMdM.1agovsky 9 Semi-dwarf—M.26 or M.7 Standard—not recommended	Bartlett seedling is standard OH x F series are acceptable Pyrodwarf is a new dwarfing rootstock, not tested in Wisconsin Quince is used as a dwarf rootstock for pears, but is not hardy	Myrobalan seedling St. Julien	Manchurian apricot seedling	Lovell, Bailey	Mahaleb—very vigorous Mazzard—very vigorous Gisela 5, 6 and 7—dwarfing to semi dwarfing

Training

Training causes the branches to grow in a particular direction or fashion. Branches that are growing mostly upward are very vigorous but not fruitful. Branches that are growing mostly horizontal are very fruitful but have too little vegetative vigor. The ideal branch angle is about 30˚ above horizontal, which allows for vegetative growth while providing as much fruitfulness as possible. It creates a balance between growth and fruiting.

Another reason to have wider growing branches is to create strong **crotches**. Narrow crotches are naturally weaker than wide crotches and more likely to break or split under a heavy load of fruit or snow. Spreading branches when the tree is young will produce wide strong crotches.

Apple and pear trees are typically trained to have a central vertical trunk with two to three layers (whorls) of branches extending from the trunk. Stone fruits, especially peaches, are typically trained to an open center to allow light into the tree center.

Training trees begins the year they are planted. The height of the first branches is determined by how high the tree is cut off at planting. The branches that begin to grow during the first year will form much of the framework for the rest of the tree. When the new branches are still green and supple (about 4 to 6 inches long), push the branches to horizontal to create a good strong crotch. As the branches grow longer, the tips will naturally begin to grow upwards.

Many different approaches can be used to train limbs.

- **Spreading:** Use wood sticks, metal rods, or spring-type clothespins to push branches downwards (see figure 9).
- **Tying:** Use string or twine to pull branches downwards. The twine can be connected to a stout stake or to a nail or screw in the base of the tree stake.
- **Weighting:** Fasten small weights on branches to push them downwards. Filling small paper cups with concrete makes a simple weight. Put a U-shaped piece of wire in the cup while the cement is wet. Hang the weight to the tree with a clothespin.
- **Trellising**: Many different types of trellises can be used for fruit trees. Some, such as espalier, are elaborate. Others simply consist of two to three horizontal wires connected to strong posts. Limbs are then attached to the wires to hold them in certain positions.

All of these practices position limbs so they don't grow vertically. Trellises can also help support a growing crop. Trellis systems don't work very well for stone fruits. You can find directions for trellis systems, or at least pictures and diagrams, online or in gardening books.

FIGURE 9. Training young fruit trees

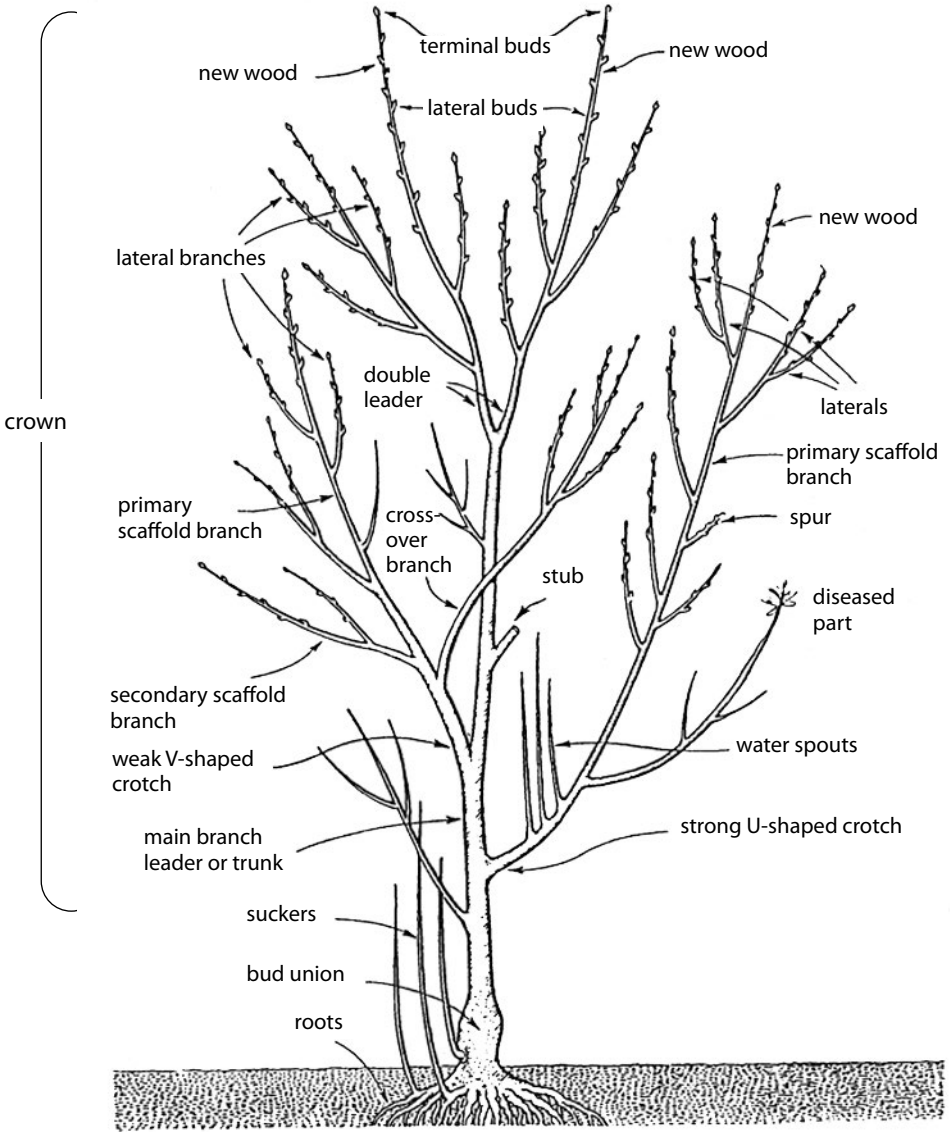
Pruning

The key to keeping fruit trees productive is annual pruning. The goal is to allow light and air into the canopy, which boosts fruit production and reduces problems with pests and disease. These objectives are quite different from maintaining ornamental trees, although pruning techniques are the same (see chapter 10, Woody Ornamentals). Pruning and training a newly planted small tree is much easier than a tree that hasn't been pruned in several decades.

Knowing the terminology of the various types of wood found on a tree (see figure 10) is very useful when pruning.

- **Suckers** arise from the roots.
- **Water sprouts** are vigorous upright shoots inside the canopy, usually near a pruning cut.
- **Spurs** are short shoots.
- The **leader** is the main vertical axis of the tree.
- **Scaffolds** are major lateral branches.

FIGURE 10. Types of wood on a tree



Source: Adapted with permission from *Tree Pruning Techniques* (Guide H-156); college of Agriculture, Consumer and Environmental Sciences, New Mexico State University.

Pruning steps

1. Remove any large branches needed to open the canopy to light.
2. Remove broken and damaged branches.
3. Remove hanging branches.
4. Remove the weaker branch of any crossing branches.
5. Remove old complex spurs.

It can be helpful to think about how trees respond to different pruning cuts. Thinning cuts—when the entire branch is removed—produce less regrowth and are generally preferred for maintaining fruit trees. Heading cuts—removing part of a branch, but not the entire branch—produce strong growth just below the cut. Where a single branch grew before, several strong branches will grow the following year. While this result is great for creating a denser ornamental plant, this is usually not desirable in fruit trees. Where large cuts are made in the canopy interior, particularly on old trees, significant regrowth occurs, usually as water sprouts which produce little fruit. Making large cuts usually results in a "cut-and-grow" cycle that is hard to escape, so regular pruning is really important.

When to prune

The best time to do most pruning is in the early spring when the trees are still dormant, normally from February to late April. Without leaves in the way it is a lot easier to see the structure of the tree. Summer pruning is not harmful—and sometimes is useful to slow down overly vigorous trees—but can slow fruit ripening or expose fruit to sunburn.

Do not prune fruit trees during the fall. Pruning is invigorating; trees that have been pruned in the fall may not harden off properly, leaving them less able to withstand cold than trees that have not been pruned. It's okay to do minor pruning of fruit trees in late July to early August to increase the amount of light reaching the fruit.

Be sure to disinfect the pruning tools between cuts when removing diseased branches. Use 70% rubbing alcohol or 10% bleach solution for disinfecting the pruning tools.

Pruning procedure

Sometimes it's hard to know where to begin when pruning fruit trees. Although different fruits are pruned in slightly different ways, there are three main steps for pruning most fruit trees.

1. Prune away any wood that is dead, damaged or diseased, and remove any suckers or watersprouts. It is important to prune the branches completely and not leave stubs.
2. Remove any crossing branches, those growing downward or toward the center of the tree, and all but the strongest (or one with the best crotch angle) of multiple branches in one place. The goal is to end up with evenly spaced scaffolds coming out from the leader with 6-12 inches of airspace around each branch.
3. Cut off 20-30% of the previous year's growth on the outermost part of the tree to keep the branches thick and sturdy. Each branch should be cut back to ¼ inch above a bud that faces the direction you want that branch to grow the following year.

Evaluation during pruning is important. Periodically take a step or two back to see what the tree shape looks like. Can you see a dense mass of limbs? Can light penetrate into the tree interior? You should be able to see through the tree when leaves are not present. Don't just look through the tree from each side; look upwards through the canopy as well.

Reclamation pruning

Sometimes people want to attempt to reclaim an overgrown and neglected apple tree. This is a very difficult task to do. Trees that have been neglected will have dense masses of limbs on the tree interior that need to be thinned out to allow light and air through the canopy. As these cuts are made, additional growth is stimulated. That new growth will have to be removed the following year, which, in turn, will stimulate more growth. In addition, older trees are frequently on seedling rootstocks and occupy substantial space. Limbs may be rotting on the inside, and the tree may not be structurally sound.

It's usually easier to plant a new tree than to save an older one. But if you have an emotional attachment to an older tree, you can collect **budwood** from the tree and send it to a nursery for propagation onto a new rootstock. This will preserve the tree genetics and allow for better quality fruit in less space.

Conclusion

In Wisconsin, fruit can come from trees, brambles, vines, or small plants. The right plant in the right place is very critical for success with fruit crops. Our state's growing zones and different soil types can make growing certain fruit crops challenging even for the most seasoned gardener.

Though the maintenance for each—pruning, fertilization, watering, pest control—may vary slightly, to successfully grow any of these kinds of fruit crops a gardener must be willing to manage them to some degree. The extent of the management depends on the yield you expect. If you want perfect, blemish-free fruit, you'll need to stay on top of pests. If you don't mind some spots or blemishes, you won't have to work as hard—and you'll still be able to enjoy the fruits of your labors.

Resources

Wisconsin Horticulture publications are available at hort.extension.wisc.edu.

FAQs

Do I have to have two (cherry, apple) trees?
If you live in an urban environment with ornamental crabapples and cherries nearby, you don't need multiple cherry or apple trees. In a more rural location, plant more than one tree for pollination success.

How do I prune my raspberries?
Prune summer-bearing raspberries right after the last harvest. Remove canes that bore fruit at ground level. For fall-bearing raspberries, cut or mow off all canes at the soil surface in late fall or very early spring.

What do I spray on my apples?
Identify the pest or disease problems you have, and consult extension publications for recommendations on how to treat them.

How do I restore an old apple tree?
With lots of pruning. It may be best to remove it and plant a newer, pest resistant variety and/or a smaller dwarf variety.

Should I prune suckers/water sprouts?
Yes. Prune before they become a significant part of the tree canopy when removing large chunks of wood could affect the health of the plant (see question above).

Can I grow peaches? Can I grow blueberries?
Yes, you may be able to grow a tree for a few years, but it may not bear fruit or survive a harsh winter. Blueberries require acidic soils, so get a soil test to determine if you have the right soil type.

Do I have to prune my grapes?
It is strongly recommended because it helps prevent diseases and improves production. See Division of Extension publications for the best methods.

Fruits, practice exam questions (continued on page 291)

1. **The best fruit crop cultivar for your site is one that is:**
   a. Hardy in your area
   b. On its own rootstock
   c. The same type as sold in your grocery store
   d. Can be managed with an organic approach
2. **Our main fruit crops:**
   a. Are in four main groups
   b. Are all fleshy fruits
   c. Have been selected or bred for size, flavor and other characteristics
   d. All of the above
3. **Aggregate fruits come from**
   a. Many separate flowers on a single structure
   b. A single flower with a single ovary
   c. A single flower which has many ovaries
   d. A single flower with its own calyx and corolla
4. **Everbearing strawberries produce flower buds**
   a. In response to the shorter days of late summer and early fall
   b. In early summer in response to lengthening days
   c. In flushes throughout the summer
   d. Year-round
5. **Maintenance for strawberries includes:**
   a. Removing flowers and encouraging runners
   b. Rototilling after harvest for weed management
   c. Fertilizing as soon as the plants start growing in the spring
   d. Covering the plants with a 2-4 inch layer of straw in the fall
6. **Raspberries**
   a. Require a different cultivar as a pollinizer
   b. Produce fruit only on floricanes
   c. Can be planted in hill or hedgerow systems
   d. Should be pruned in the spring
7. **Currants and gooseberries**
   a. Are alternate hosts for the fungus that causes white pine blister rust
   b. Need no winter protection
   c. Should have all but 6-8 of the most vigorous shoots removed after the first year
   d. All of the above
8. **Blueberries**
   a. Require an acidic soil (pH 5.5 to 6.0)
   b. Should have the soil amended with sulfur dioxide just before planting
   c. Should be heavily pruned just after growth begins in spring to promote bloom
   d. All of the above

Answers on page 291.

Fruits, practice exam questions (continued)

9. When growing grapes
- a. Select a site that will have cool nights to help ripen the fruit
- b. Choose late maturing varieties
- c. Provide a trellis of some type
- d. Space plants at least 10 feet apart

10. Grape pruning
- a. Is necessary only every other year
- b. Should remove 70-90% of the vegetative growth annually
- c. Should be minimized to allow vines to set a lot of fruit
- d. Is best done right after harvest

11. Tree fruits that are reliably hardy in Wisconsin are
- a. Apples, plums, and tart cherries
- b. Apples, plums, and sweet cherries
- c. Apples, peaches, and plums
- d. Apples, peaches, and sweet cherries

12. Thinning on tree fruits
- a. Is rarely done for apples
- b. Is rarely done for cherries and plums
- c. Results in a large crop one year and a small crop the next year
- d. Reduces the size of the remaining fruits

13. Fruit trees generally
- a. Are propagated from seeds
- b. Are available on dwarf rootstocks to produce smaller fruits
- c. Benefit from being staked for the first few years
- d. Should be pruned to maintain bushy growth

14. Fruit trees are pruned and trained to
- a. Have a an open center to allow light into the interior of the tree
- b. Create strong crotches
- c. Encourage branches to grow about 30 degrees above horizontal
- d. All of the above

15. The best way to reclaim an old and overgrown apple tree is to
- a. Collect budwood for propagation onto a new rootstock
- b. Remove up to a third of the largest branches each year until it is growing vigorously
- c. First remove broken and dead branches, then cut back water sprouts about half way
- d. Be sure to prune in fall to create less stress on the tree

Answer key
1. (a) 2. (d) 3. (c) 4. (b) 5. (d) 6. (c) 7. (d) 8. (a) 9. (c) 10. (b) 11. (a) 12. (b) 13. (c) 14. (d) 15. (a)