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University of Kentucky
College of Agriculture,
Food and Environment
Cooperative Extension Service

Growing Tree Fruits

Kentucky Master Gardener Manual Chapter 16

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In this chapter:

Growing tree fruits and/or nuts can provide a great deal of satisfaction, but it takes a commitment to care for your trees year-round.

Planning

Variety Selection

When planning your orchard, choose varieties that not only are family favorites but are easy to care for. **Remember that dwarf trees are always the best choice for home orchards.**

Generally, the more varieties of fruit you grow, the more complex it is to manage them. However, if you enjoy a lot of different fruits and the management challenge, by all means plant a wide range.

Nearly all fruit and nut tree varieties (including some hazelnuts) are grafted to a genetically different root system, called a *rootstock*. When you choose a variety based on flavor, harvest period, disease resistance, color, etc., it is the grafted variety you are choosing, not the rootstock.

The ultimate size of a tree depends on the vigor of both the rootstock and the grafted variety. By knowing the vigor ratings of both, you can determine how big a tree will grow. See Table 1 for vigor ratings for some apple varieties. See the section on rootstocks below to learn more about vigor of various rootstocks.

Not all recommended varieties are included in the lists in this chapter. For apples alone, hundreds of varieties exist, and other fruits could have many more varieties. Consult the resources listed under "For More Information" to learn about additional varieties.

General types of apples include old style, cider, English, or flavor varieties. If you want to have fresh-off-the-tree apples for a long period of time in the summer and fall, choose varieties with staggered maturity dates (Table 2).

When buying trees for Kentucky, select disease-resistant varieties (Table 3) to reduce the impact of apple scab, cedar apple rust, fireblight, and powdery mildew.

Table 1. Apple variety vigor ratings.

High vigor
Earligold
Lodi
Mutsu or Crispin
Moderate vigor
Akane
Arkansas Black
Cortland
CrimsonCrisp
Delicious (red)
Empire
Enterprise
Freedom
Fuji
Gala
Golden Delicious
GoldRush
Granny Smith
Idared
Jersey Mac
Jonagold
Jonathan
Liberty
Melrose
Mollies Delicious
Newtown
Pixie Crunch
Pristine
Redfree
Sansa
Rome Beauty
Stayman
Suncrisp
Sundance
William's Pride
Low vigor
Spur Delicious
Spur Golden
Spur Granny Smith
Very low vigor
Spur Arkansas Black
Spur Delicious
Spur Rome
Super Spur

Rootstock Selection

When choosing a fruit tree, check to see what rootstock it uses. Rootstocks are not chosen for their fruit. Most originally were selected for their ability to control overall tree size. Some were selected for other characteristics, such as the following:

- Efficient yield production
- Disease resistance
- Tolerance of different soil conditions, including poorly drained soils
- Cold hardiness

Apples

The greatest choice in rootstocks exists with apples. The most vigorous apple rootstocks are seedlings, which are simply sprouted apple seeds. When an apple variety is grafted onto a seedling rootstock, the tree can easily grow more than 30 feet tall. Most home orchardists can't efficiently spray, thin, and harvest a tree this tall.

Researchers in England developed the Malling series of apple rootstocks, which offers the opportunity to select trees that grow to specific heights. The height may be anywhere from dwarf (4 to 12 feet) to semidwarf (16 to 18 feet). Each rootstock in this series is identified by the letter "M" (for Malling) or "MM" (for Malling Merton) and a number (Figure 1). Higher numbers don't represent taller trees.

The following list shows approximate sizes as a percentage of the size of a tree on seedling rootstock:

Rootstock	Percent
MM.111	90
MM.106	60 - 75
M.7, G.30	55 - 65
M.26, G.11	40 - 50
M.9, Bud 9	25 - 35
M.27	< 25

Most home orchardists select dwarf rootstocks, such as Bud 9, which are especially appropriate if you want to train a tree to grow along a trellis. Dwarf trees should be supported by stakes, poles, or wires.

The M.27 rootstock is the only choice for growing apples in containers. For container plantings, use *spur-type* varieties, which are the least vigorous.

M.7 produces semidwarf trees that normally do not require staking. However, some support might be required if early production is encouraged.

MM.106 and MM.111 produce larger trees that require no staking and are suitable for the home orchard. In nursery catalogs, these trees are identified as semistandard.

Figure 1. Approximate size of mature trees grown on various rootstocks.

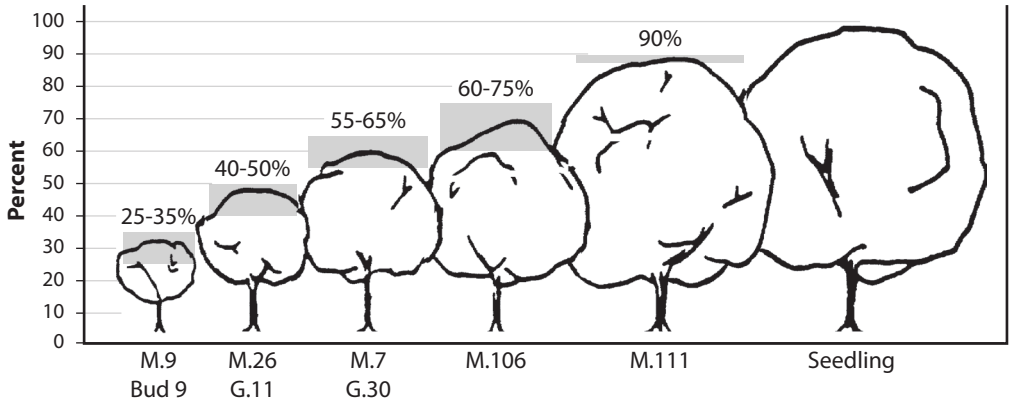


Table 2. Apple varieties grouped by general time of maturity.

Early	Midseason	Late	
Akane	William's Pride	Jonathan	Idared
Dayton	Empire	Liberty	Jonagold
Erligold	Freedom	Arkansas Black	Melrose
Jersey Mac	Gala	Cortland	Mutsu or Crispin
Lodi	Ginger Gold	CrimsonCrisp	Newtown
Mollies Delicious		Delicious (Golden and Red)	Pixie Crunch
Monark		Empire	Rome Beauty
Pristine		Enterprise	Stayman
Redfree		Fuji	Sun Crisp
Sansa		Gold Rush	Sundance
		Granny Smith	York

Table 3. Disease-resistant apples.[1]

Variety	Resistance To				Comments	Harvest	Stores Until	Skin Color
	AS	CR	FB	PM				
Pristine[2]	VR	S	S	R	Good quality for season, not as tart as Lodi, makes excellent applesauce	early July	short storage	Light yellow with red blush
Williams Pride	VR	S	MR	R	Good quality for season, corkspot frequently observed, subacid, yellow flesh	mid-July	short storage	70-80% dark red
Redfree[2]	VR	VR	S	S	Firm, summer apple, juicy	late July	Oct	90-100% dark red on yellow
Dayton[2]	VR	R	MR	R	Similar to Prima	mid-Aug.	Sept	Up to 90% bright medium red
Liberty[2]	VR	R[3]	R	R	Fruit similar to Macoun, crisp, juicy, yellowish flesh, tart at harvest	late Aug.	Dec	90% dark red stripes on green-yellow
Nova Easygro	VR	VR	R	S	Fruit similar to Cortland, fair quality (for trial)	early Sept.	Dec	80% dark red on green-yellow
Spartan[2]	MR	R	MR	R	Firm McIntosh type, needs thinning to develop size	early Sept.	Jan	Dark to pale red depending on weather
Jonafree[2]	VR	S	S	R	Fruit similar to Jonathan, but less acid	early Sept.	Dec	90% red stripes
Pixie Crunch[2]	VR	—	—	—	Small, sweet flavored, super crisp, kids apple	early Sept.	Dec	Deep red
Macfree	VR	VR[3]	MR	S	Similar to McIntosh, mealy under hot conditions	mid-Sept.	Dec	75% medium red over green-yellow
Priscilla[2]	VR	VR[3]	VR	R	Tart, firm, somewhat coarse textured, crisp, juicy, small fruit size	mid-Sept.	Nov	70-90% dark red blush over yellow-green
SirPrize[2]	VR	S	R	R	Fine grain, crisp, tender, bruises very easily, sterile pollen	mid-Sept.	Dec	Greenish yellow, slight red blush
CrimsonCrisp	VR	MR	S	S	Medium sized red fruit, firm, crisp, tart, stores very well	mid-Sept.	March	95% red
Enterprise[2]	VR	VR[3]	MR	R	Sprightly, subacid, slightly aromatic and spicy, crisp, fine grained juicy flesh, stores well	early Oct.	Feb	Washed, 90% light to medium red
GoldRush[2]	VR	S	MR	S	Fruit very crisp, firm, tart at harvest and sweetens up after storage, very susceptible to black rot. Will store for 11 months.	mid-Oct.	April	Deep yellow with red blush
Sundance[2]	VR	VR	VR	VR	Excellent quality with fruity flavor like mild pineapple, fruit does not drop	mid-Oct.	Mar	Yellow, occasionally russets in stem cavity

AS = Apple Scab, CR = Cedar Apple Rust, FB = Fire Blight, PM = Powdery Mildew
VR = Very Resistant, R = Resistant, MR = Moderately Resistant, S = Susceptible, — = Insufficient Information
Note: All apples require cross-pollination by a different variety. Winesap and SirPrize cannot serve as pollinizers because they have sterile pollen.

1 Resistance to diseases other than scab has not been fully evaluated and may differ in some locations from that reported here.
2 Produces high quality apples in Kentucky.
3 Although these cultivars are resistant to cedar apple rust, they are susceptible to cedar quince rust.

The ultimate height of any tree can be greatly influenced by pruning, but rootstocks that impart more vigor make it harder to contain trees to the height and width desired.

Other commercially available apple rootstocks provide vigor control, disease resistance, and winter hardiness. The Budagorsky (Bud) series was introduced from central Russia. The G series was developed at Cornell University at the New York State Agricultural Experiment Station, Geneva, NY.

Cherries

Most cherry trees in Kentucky are grown on Mazzard rootstocks. However, recent research on growth-controlling rootstocks has produced more choices. New dwarf varieties are now being grown on Gisela rootstocks, and new European rootstocks are being tested each year. The most common Gisela rootstocks are Gisela 5, Gisela 6, and Gisela 12. They produce trees that are 50, 70–90, and 60 percent of Mazzard, respectively. Other new rootstocks include MxM2 (100 percent), MxM60 (100 percent of Mazzard), and MxM14 (75–85 percent of Mazzard). They bear earlier and have better disease resistance than Mazzard seedlings.

Pruning Terminology

Crotch angle—The angle formed between the trunk and a limb. The strongest crotch angle is 45° to 60°.

Leader—The uppermost portion of a scaffold limb.

Scaffold limb—A large limb that forms a tree's framework.

Shoot—The length of branch growth in one season. The bud scale scars (ring of small ridges) on a branch mark the start of a season's growth.

Spur—(1) A short shoot that bears flower buds on the end (terminally) or on the sides (laterally). (2) A short shoot that fruits.

Sweet cherries generally do not survive or produce well in Kentucky. Some of these newer rootstocks are available to home gardeners from a few mail-order nurseries in the Pacific Northwest. See HortFact 3002—*Fruit and Nut Cultivar Nursery Sources,* which is listed in the "For More Information" section at the end of this chapter. See Table 4 for cherry varieties.

Table 4. Cherry varieties.

Sweet
Black Gold
Hedelfingen
Lapins
Sweetheart
Tart
Danube
Montmorency
North Star
Surefire

Table 5. Pear varieties.

European
Blake's Pride
Harrow Sweet
Honey Sweet
Kieffer
Magness
Potomac
Seckel
Asian
Chojuro
Korean Giant, Olympic
Megietsu
Shinko
Yoinashi

Table 6. Nectarine varieties.

Nectarines
Fantasia
Flavortop
Red Gold
Sunglo

Table 7. Peach varieties (westside).

Maturity		
July	**August**	**September**
Gala	Allstar	Encore
Harrow Diamond	Biscoe	Flamin' Fury PF-27A
Garnet Beauty	Blushing Star (White)	Flameprince
Redhaven	Bounty	Laurol
Sentry	Contender	Ouachita Gold
Topaz	Coralstar	Victoria
	Cresthaven	
	Ernie's Choice	
	Glowing Star	
	John Boy	
	Loring	
	Madison	
	Redskin	
	Summer Breeze	

Pears

Most European pears are grown on one of many selections from the Old Home-Farmingdale cross. Asian pears sometimes use these rootstocks but also are grown on two species of *Pyrus*: *Pyrus betulaefolia* and *Pyrus calleryana*. See Table 5 for pear varieties.

Plums and peaches

Plums are produced on a wide variety of *Prunus* rootstocks, such as peach, plum, apricot, and almond. Peaches usually are grown on peach seedling rootstocks. There are no suitable dwarfing rootstocks for peaches. See Tables 6 and 7 for nectarine and peach varieties.

Pollination Methods

Trees can be grouped into two categories: those that bear fruit through self-pollination (called *self-fruitful*) and those that must be pollinated by another variety (called *self-unfruitful*).

Cherries

Lapins, Black Gold, and Sweetheart are self-fruitful sweet cherry varieties, as are tart (pie) cherries.

Some sweet cherries do not set fruit unless they are pollinized by another pollen-compatible variety. Hedelfingen is pollinated by Lapins or Sweetheart.

Apples

Some apple varieties, such as Rome Beauty, Newtown, and Transparent, are self-fruitful, but most varieties of apples do not set fruit unless they are pollinated by another pollen-compatible variety. Most apple varieties that don't set fruit when self-pollinated do have pollen that sets fruit on other varieties. For example, Red Delicious doesn't set its own fruit with its own pollen, but sets fruit on Golden Delicious, and vice versa. Gravenstein requires an early-blooming pollinizer such as Lodi, but does not produce good pollen for other varieties. Mutsu does not pollinize other varieties, but requires another variety to set fruit itself. McIntosh is self-unfruitful but pollinizes other early-blooming varieties such as Gravenstein.

Other fruits

Most varieties of pears do not set fruit unless they are pollinated by another pollen-compatible variety.

Most European plums are self-fruitful.

See Table 8 for nut varieties.

Table 8.
Nut varieties.

Hazelnuts (filberts)*
Gamma
Jefferson
Santiam
Yamhill
Walnuts, Persian
Allegheny
Coble No. 2
Kaiser
Walnut, Black
Leon Pounds II
Neel No. 1
Rowher
Sauber No. 1
Surprise
Thomas-Myers

*Complete resistance to eastern filbert blight (EFB).
Note: Gamma, Santiam and Jefferson are good pollinators for the best variety, Yamhill.

Planting for Pollination

Plant pollen-compatible trees within 100 feet of each other to ensure adequate pollination, which depends mostly on bees and to a lesser extent on other insect activity. For nuts, pollination depends on wind. The bloom periods of the main and pollinizer varieties must overlap enough to provide at least several days for cross-pollination to take place. Orchards with many pollinizers are more fruitful than those with only one pollinizer.

If no pollinizing varieties are growing nearby, cut a bouquet of blooms from another variety and place it in a pail of water beside your tree while it is in bloom. Or, if you have a single fruit tree that needs a pollinizer, graft a compatible variety onto the main variety.

Tree Spacing

Apple trees typically are spaced from 6 feet apart (high density) to more than 20 feet apart. Spacing between rows for other fruit trees ranges from 12 to 24 feet because they often lack growth-controlling rootstocks.

True genetic dwarf trees can, of course, be planted closer. Dwarf trees trained on trellises have the closest spacing.

In planning your orchard, compare the amount of space available to the number of trees you want to grow. Spacing trees very close together does push them into earlier production, but tightly spaced trees require more pruning at an earlier age in order to keep them productive and so foliage does not dry out as rapidly, which can lead to more disease problems.

Planting and Fertilizing

Orchard trees grow best in deep, well-drained soils. To have adequate room for root development, trees need at least 4 feet of soil above an impenetrable soil layer or water table. In poor soil conditions, raised beds can be helpful. Always choose a spot that gets full sun.

Fruit trees usually are sold bare root. It's very important to plant a tree at the right level. Try to plant the tree at the same level at which it was growing in the nursery. Make sure the graft union is aboveground; if it is not, the rootstock will produce shoots that may overpower the grafted or budded stock. The scion (grafted variety) may also produce roots that lessen the effect of the rootstock.

Dig a hole large enough to comfortably accommodate the tree's root system. Don't leave smooth soil on the sides of the hole—roughen the sides with a shovel so the roots can grow into the soil. Place the roots over a low mound of soil in the hole.

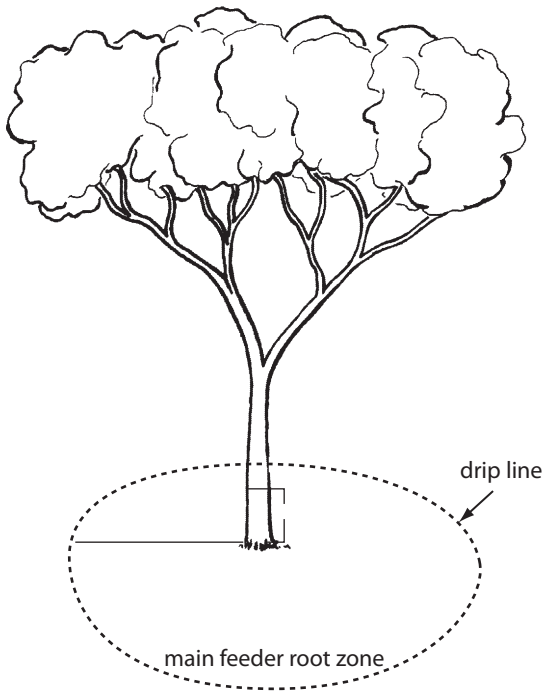
Paint the trunk with a white, water-based indoor latex paint to reflect sunlight and help prevent sunburn. To save paint and make it easier to apply, you can dilute the paint with water to 50 or 70 percent paint. A tree protector placed around the trunk will protect it from damage from small animals and sunscald.

Protection from deer is important, too. Fencing is the best method, but caging also works. Hanging soap, human hair, animal scents, or other deer repellents will help prevent damage for only a short time.

A tree's need for fertilizer varies according to the amount of minerals available in the soil. Soil types vary within a specific area and regionally. For example, fruit trees generally don't need much phosphorus in the Central Kentucky area, but respond to phosphorus applications in most other areas of the state. Consult your county extension office for specific recommendations.

Fruit trees do need nitrogen. The amount needed varies from very little to 2 pounds of actual nitrogen per tree for fully mature trees. The best way to gauge nitrogen needs is to watch the amount of annual growth and check for yellowing of older leaves. If a tree has at least 12 to 18 inches of new growth each year, it is thriving. Over application of nitrogen may cause excessive tree

Figure 2. Locating a tree's drip line.



growth as well as physiological problems in the fruit, such as bitter pit in apples.

Most gardeners use a complete fertilizer (one with nitrogen, phosphorus, and potassium) around the yard and vegetable garden. These fertilizers are fine for fruit trees, but if they are used every year, phosphorus and potassium levels build up far in excess of the tree's actual need.

Most home orchardists do not apply boron to their fruit trees. Although boron is needed only in small amounts (it is a micronutrient), it is essential for plant health and productivity, especially for fruit set. Trees that are low in boron have poor shoot growth and poor fruit set.

An easy source of boron is Borax. If you need to apply boron to a fruit tree, add a tablespoon of Borax to 2 gallons or more of water and apply it to the soil within the tree's drip line (Figure 2). If you think your soil has boron deficiency, it is best to have the soil analyzed before adding more. Too much boron is toxic to the trees.

Irrigating

The amount of water fruit trees need depends on rainfall and soil type. The best way to determine your trees' needs is to check the soil moisture in the root zone at 12 and 24 inches deep.

To test, remove some soil with a soil probe or shovel and squeeze a handful of it into a ball. If it crumbles when released, the trees are dry and need water. If the ball of soil stays together but does not feel wet, the trees have adequate moisture. If the soil ball drips water when squeezed, there is more than enough moisture.

Remember that young trees have an undeveloped root system and cannot absorb much water at a time. In warm weather, watering young trees regularly is very helpful to get them off to a good start.

Drip irrigation is preferred by many orchardists because it allows the foliage, flowers, and fruit to remain dry, an important factor in disease prevention. If you drip-irrigate, take care not to overwater, especially near the base of the trunk, where excessive moisture can lead to crown rot.

Fruit Thinning

Thinning of apples, peaches, and Asian and European pears is an important part of orchard management. It removes some of the developing embryos that otherwise would produce flowering inhibitors. It improves the size and quality of fruit and helps ensure an adequate crop the next year.

The effect of fruit thinning is greatest on cultivars that tend to have a heavy fruit set. Determine the size of fruit you want and thin accordingly.

There are three ways to thin fruit. Picking the tiny fruit or blossoms by hand is the most commonly used method. Mechanical thinning involves using a tool to knock fruit off the tree. Plant-growth regulators are sprayed onto apple and pear trees in commercial orchards during and after bloom to thin the crop.

Timing

Early thinning of blossoms or fruit helps stimulate flower initiation for the next year's crop, especially on cultivars that tend toward biennial bearing (bearing fruit every other year). Apples initiate flower buds for the following year's crop within 40 days of full bloom, so thinning has a positive effect on the next year's bloom if done within this period. Pears form buds a little later, so you can thin them within 60 days of full bloom. Attaining adequate return bloom on peaches is seldom a problem, but early thinning generally helps.

Thinning also helps increase the size of harvested fruit by stimulating cell division in the remaining fruit. More cell division means more cells per fruit and thus larger fruit. The period of cell division for apples lasts four to five weeks after petal fall. For peaches, it lasts four weeks after petal fall, and pears continue cell division for seven to nine weeks after petal fall. All fruits continue some cell division in the epidermis layer (the skin) much longer than in the main part of the fruit flesh.

Sometime during the cell-division phase, cell enlargement begins. Enlargement continues throughout the growth of the fruit and often is positively influenced by fruit thinning.

How to Thin

Apples

Home orchardists generally thin by hand. With apples, remove the smaller fruit first, remembering that the relative sizes of the fruit do not change throughout the season and that the largest fruit early in the season will be the largest fruit at harvest.

Decide how much fruit to leave on the tree based on the vigor and general condition of the tree. In cultivars that tend toward biennial bearing (every two years), leaving every other spur without fruit and spacing fruit 6 inches apart helps ensure adequate return bloom.

Asian pears

Asian pears must also be thinned. Thin early to get large fruit. Each blossom cluster contains several flowers. Save the blossom/fruit in the middle and remove the rest. Research has shown that this middle fruit is the roundest. By keeping that in mind and by counting the flowers as they appear starting from the base of the cluster, you can determine which fruit to remove. For example, if there are seven flowers, save the fourth fruit from the base of the cluster. Depending on the tree's vigor, you might experiment by leaving two fruits per spur and checking the fruit size response.

Peaches

Thin peaches to about 6 to 8 inches from one another. This spacing gives them adequate room to mature to full size.

Harvest and Handling

Nursery catalogs, Cooperative Extension publications, and other sources give a general idea about when given varieties ripen. However, ripening times may vary from year to year depending on the weather. Keep in mind that apples with codling moth damage drop about one to one-and-a-half weeks before the crop is ripe.

The best and most time-tested method of judging when to pick fruit is the taste method. When enough starch has been converted to sugar and the flavor is developed, the fruit is ready to eat. Fruit continues to ripen in cold storage, so pick fruit before it is ripe if you intend to store it.

Fruit changes color as it ripens. The *base color*, or ground color, is the color underneath the red striping or blush of peaches, apples, pears, and cherries. In most fruits, the fruit is ripening when the ground color turns green to yellow. The surface color may develop before the fruit is actually mature.

If storing fruit, cool it as soon as possible after picking. The sooner heat is removed from freshly picked fruit, the longer the fruit will keep.

Handle fruit for storage gently. Bruises and wounds allow pathogens to infect the fruit, and disease will spread to adjacent fruits once it gets started.

	Apple	Pear	Peach	Tart Cherry	Plum and Prune
Stage **1**	**Dormant** 	**Dormant** 	**Dormant** 	**Dormant** 	**Dormant** 
Stage **2**	**Silver tip** 10% kill 15° F 90% kill 2° F 	**Swollen bud** 10% kill 15° F 90% kill 1° F 	**Swollen bud** 10% kill 18° F 90% kill 2° F 	**Bud burst** 10% kill 17° F 90% kill 5° F 	**Swollen bud** 10% kill 14° F 90% kill 1° F 
Stage **3**	**Green tip** 10% kill 18° F 90% kill 10° F 	**Bud burst** 10% kill 20° F 90% kill 7° F 	**Half-inch green** 10% kill 23° F 90% kill 5° F 	**Green tip** 10% kill 25° F 90% kill 14° F 	**Bud burst** 10% kill 18° F 90% kill 3° F 
Stage **4**	**Half-inch green** 10% kill 23° F 90% kill 15° F 	**Green cluster** 10% kill 26° F 90% kill 15° F 	**Pink** 10% kill 25° F 90% kill 18° F 	**Tight cluster** 10% kill 26° F 90% kill 17° F 	**Green cluster** 10% kill 26° F 90% kill 16° F 
Stage **5**	**Tight cluster** 10% kill 27° F 90% kill 21° F 	**White bud** 10% kill 26° F 90% kill 22° F 	**Bloom** 10% kill 27° F 90% kill 24° F 	**Swollen bud** 10% kill 27° F 90% kill 24° F 	**White bud** 10% kill 26° F 90% kill 21° F 
Stage **6**	**Pink** 10% kill 28° F 90% kill 25° F 	**Bloom** 10% kill 28° F 90% kill 23° F 	**Petal fall** 10% kill 28° F 90% kill 25° F 	**Bloom** 10% kill 28° F 90% kill 25° F 	**Bloom** 10% kill 27° F 90% kill 23° F 
Stage **7**	**Bloom** 10% kill 28° F 90% kill 25° F 	**Petal fall** 10% kill 28° F 90% kill 24° F 	**Fruit set: shucks on** 10% kill 28° F 90% kill 25° F 	**Petal fall** 10% kill 28° F 90% kill 25° F 	**Petal fall** 10% kill 28° F 90% kill 23° F 
Stage **8**	**Petal fall** 10% kill 28° F 90% kill 25° F 	**Fruit set** 10% kill 28° F 90% kill 24° F 	**Fruit set: shucks off** 	**Fruit set** 10% kill 28° F 90% kill 25° F 	**Fruit set** 
Stage **9**	**Fruit set** 10% kill 28° F 90% kill 25° F				

Insect and Disease Management

Many insect and disease problems can affect home orchards. You can control or prevent them by knowing the probability of such problems and by closely monitoring trees. Keep insects in check through a system called *integrated pest management* (IPM), which integrates cultural, mechanical, chemical, and biological controls in addition to taking the environment into consideration.

The IPM approach differs from a standard calendar approach, which uses dates and developmental stages of the plant to determine when to apply control sprays regardless of whether pests are present.

Successful IPM programs are based on solid research and practical experience. One of IPM's cornerstones is accurate pest monitoring. You can use visual inspection, trapping, and *phenology* models (crop development stage models) to determine the presence or absence of a pest and then measure its population density. Figure 3 shows growth stages of several tree fruits.

Economic thresholds are the level at which pest damage justifies the cost of control. Economic thresholds are important in IPM. Of course, economics are not as important in home orchards as in commercial situations. Each orchardist must decide how much damage to allow before applying a control. The level of damage considered acceptable can vary from one gardener to another.

Pheromones are chemical messengers used by animals to communicate with each other. Pheromones are used in IPM in the following ways:

- Female sex pheromones are used to attract males to a trap.
- Small pieces of glass or plastic containing female sex pheromones are spread throughout an area to confuse males.
- Pheromones are mixed with pesticides, such as an insecticide, to attract pests to the chemical control.

The UK Cooperative Extension publication *Kentucky Backyard Apple Integrated Pest Management Manual* (IPM-9) provides a more in-depth discussion of IPM.

Learning the life cycles of important insects and diseases that may attack your orchard is part of IPM. The next section discusses some of the more common orchard insect pests and their IPM-control strategies.

Codling Moth

Following are the stages in the life cycle of the codling moth, which typically produces three generations per year.

- It overwinters as a mature larva under loose bark on trees, in leaf litter under trees, or in other protected places.
- It pupates in spring and emerges as an adult in late May to early June.
- Adults begin depositing eggs two or three days after emergence and continue depositing eggs for a month.
- Eggs hatch in 12 to 14 days, and larvae enter fruit.
- Larvae feed for about three weeks then pupate in protected places.
- Second-generation adults emerge one to two weeks later, in early July.
- These adults lay eggs on fruit during July and August.
- Eggs hatch in six to seven days, and larvae enter fruit to feed.
- Larvae stay in fruit for a month then emerge and look for overwintering sites.

Pheromone-trapping program for codling moth

- Place traps in the orchard by mid-May.
- Place the traps along all sides of the orchard.
- Check the traps once per week through mid-September. Replace the lures every four weeks.
- If you want to use a threshold approach, apply an insecticide control 250 degree days, base 50° F after you catch five moths per week in a trap.

- Follow spray recommendations for codling moth control listed in the UK Cooperative Extension publication *Disease and Insect Control Programs for Homegrown Fruit in Kentucky Including Organic Alternatives* (ID-21).
- If you want to use a calendar approach to control, spray 15 to 21 days after petal fall for the first generation and again two weeks later.
- For the second generation, spray the first week in July and again two weeks later.

Sprays for Disease and Insect Control

Dormant (winter) sprays

Most home orchardists try to control overwintering mites, aphids, and scales with a dormant (winter) oil spray, which essentially smothers the pests.

Winter sprays are also used to control diseases that enter the tree through the buds.

Follow two general rules when applying winter sprays on fruit trees:

- Use a *sticker*, unless the label says not to. Stickers improve the spray's adherence to leaves.
- Obtain good coverage. Timing and the choice of material are important, but if the spray doesn't cover the tree and stay in place, pests will not be controlled.

Peaches need winter sprays to control peach leaf curl and bacterial canker. For peach leaf curl, which causes reddish, twisted, distorted leaves, spray after leaf drop in the fall. Chlorothanlonil or fixed coppers are effective.

Blossom sprays

Ideally, blossom sprays should be applied at three stages: pink, full-bloom, and petal-fall (Figure 3). Use fungicides and insecticides listed in the UK Cooperative Extension publication *Disease and Insect Control Programs for Homegrown Fruit in Kentucky Including Organic Alternatives* (ID-21).

Cherries, peaches, and plums—Applying protective fungicide sprays before, during, and after the blossom period can control brown-rot blossom blight on cherries, peaches, and plums.

Brown-rot blossom blight is caused by fungi. These fungi overwinter on infected peach, plum, and cherry fruit (causing what's called *fruit mummies*) and on buds and cankers. The fungal spores are spread mostly by wind but also by splashing rain.

The fungi infect blossoms, and from there can travel into twigs to cause twig blight and cankers. They also infect fruit later in the season, entering maturing fruit more easily than green fruit.

Apples and pears—Blossom sprays can also control apple scab, cedar apple rust, and powdery mildew on apples and pears.

Apple scab must be controlled each year on most varieties. Scab infects leaves and fruit. It overwinters on leaves, so sanitation can help control the problem by removing sources of *inoculum* (fungal spores). Apply sprays at the prepink, pink, calyx, and first-cover stages.

Cedar apple rust must also be controlled annually on most apple varieties with sprays from pink through second cover.

Fire blight is a serious problem on susceptible apple and pear varieties. A final copper spray during the dormant period and streptomycin sprays during bloom are recommended.

Powdery mildew sprays are recommended for four stages: prepink, pink, calyx, and first-cover.

Summer Sprays

If an orchard has a mite, aphid, or scale problem, a dormant oil spray in winter can reduce populations of these insects. However, some summer control often is necessary.

Look for scale in June. The timing of summer control is important for these tiny insects. You must apply the spray when the insects are in the crawler stage, which is when the young scales move out from their protective shells and are vulnerable to pesticides.

Place double-sided sticky tape or black electrical tape with the sticky side out around infested branches. This traps the crawlers so you can see them with a hand lens (20-power is good). Spray when there is substantial insect activity.

Bagging

Bagging individual apples and pears on a tree when they are about an inch in diameter provides excellent insect and disease control for the rest of the season. See the *Apple Bagging Alternative Pest Management for Hobbyists* (ENTFACT-218) and the video *Apple Bagging* (VHO-1386). Both are available through county extension offices.

Pruning

Pruning is a necessary part of home orchard care. Prune trees to direct growth, maintain health, and manage fruit-bearing potential. For a more complete discussion of pruning, see Chapter 4. The discussion here covers only guidelines specific to pruning fruit trees.

Fruiting Habits

Pruning strategy should take into account the fruiting habit of each tree. The type and age of wood that bears fruit varies with the kind of tree. Some fruits bear on more than one kind of wood. For example:

- Persian walnuts produce fruit on the *current season's shoots*.
- Hazelnuts, nectarines, and peaches produce fruit on the *previous season's shoots*.
- Sour cherries, some apples, and some pears produce fruit on the *previous season's spurs and shoots*.
- Some apples, sour cherries, sweet cherries, pears, and plums (European and Japanese) produce fruit on *long-lived spurs*.

Good light penetration is necessary for fruit spur formation and productivity, so trees that fruit on spurs should be maintained in a fairly open form. Those that form their crop on 1-year-old wood (such as peaches and hazelnuts) benefit from pruning because it stimulates new wood formation (and more fruit).

Pruning Guidelines

- Prune all fruit and nut trees at planting time. Cut just above the height where you want the lowest branches to grow (usually 30 to 40 inches above the ground).
- Prune young trees very lightly; heavy pruning delays fruiting.
- Prune mature trees more heavily, especially if they have shown little growth.
- Prune the top portion of trees more heavily than the lower portion.
- Train young trees in the first few years after planting to avoid corrective pruning later. Spread main scaffolds to a 45° to 60° angle from the trunk.
- To keep trees small (unless they are dwarf trees) prune moderately every year and do not apply excess fertilizer, manure, or compost.
- Prune during the dormant season (after fall or early winter freezes, but before full bloom in spring).
- When removing large limbs, first cut partially through from the underside about 6 inches out from the collar, then make a second cut from the top a little farther out, cutting all the way through until the branch falls away. Finally, cut the stub back to the branch collar. Do not remove the branch collar.
- There is no need to paint pruning wounds. The best protection for a wound is to leave the branch collar intact so the tree is protected from wood-rotting fungi.

For More Information

UK Cooperative Extension publications

Fruit/General

Disease and Insect Control Programs for Homegrown Fruit in Kentucky Including Organic Alternatives, 2008 (ID-21) http://www.ca.uky.edu/agc/pubs/id/id21/id21.pdf

Fertility Guidelines for Home Fruit & Nut Plantings (HortFact-3004) http://www.uky.edu/Ag/Horticulture/fertilityguides.pdf

Fruit Insect-Pest Calendar for Kentucky http://www.ca.uky.edu/entomology/entfacts/fruitcalendar.asp

Home Composting: A Guide to Managing Yard Waste (HO-75) http://www.ca.uky.edu/agc/pubs/ho/ho75/ho75.pdf

Home Fruit Variety Recommendations, 2007 (HortFact-3003) http://www.uky.edu/Ag/Horticulture/homefruitrec07.pdf

Fruit and Nut Cultivar Nursery Sources, 2007 (HortFact-3002) http://www.uky.edu/Ag/Horticulture/frtnurs-ery07sources.pdf

Fruit and Vegetable Ripening Dates in Kentucky (HortFact-3000) http://www.uky.edu/Ag/Horticulture/ripedate06.pdf

Rootstocks for Kentucky Fruit Trees (HO-82, revised) http://www.ca.uky.edu/agc/pubs/ho/ho82/ho82.pdf

Reproducing Fruit Trees by Graftage: Budding and Grafting (HO-39) http://www.ca.uky.edu/agc/pubs/ho/ho39/ho39.pdf

Cultivar Evaluations of Apple, Peach and Grape (new resource) http://www.uky.edu/Ag/Horticulture/masabni/cvevaluation.htm

Fruit and Vegetable Insect and Disease Identification Picture Sheets, http://www.uky.edu/Ag/IPM/picturesheets/picturesheets.htm

Dry Pesticide Rates for Hand-Held Sprayers (HO-83) http://www.uky.edu/Ag/Horticulture/masabni/Publications/HO-83.pdf

Nuts

European Red Mite (ENTFACT-205) http://www.ca.uky.edu/entomology/entfacts/ef205.asp

Nut Tree Growing in Kentucky (ID-77) http://www.ca.uky.edu/agc/pubs/id/id77/id77.pdf

Nut Weevils (ENTFACT-206) http://www.ca.uky.edu/entomology/entfacts/ef206.asp

Pecan Insects ENTFACT-210) http://www.ca.uky.edu/entomology/entfacts/ef210.asp

Tree Fruit

Apple Scab (PPA-24) http://www.ca.uky.edu/agc/pubs/ppa/ppa24/ppa24.htm

Bagging Apples: Alternative Pest Management for Hobbyists (ENTFACT-218) http://www.ca.uky.edu/entomology/entfacts/ef218.asp

Apple Cultivar Performance (HortFact-3006) (new resource) http://www.uky.edu/Ag/Horticulture/masabni/Publications/applecultivar.pdf

Cherry Fruit Flies (ENTFACT-217) http://www.ca.uky.edu/entomology/entfacts/ef217.asp

Codling Moth (ENTFACT-203) http://www.ca.uky.edu/entomology/entfacts/ef203.asp

Controlling Apple Insect Pests (ENTFACT-201) http://www.ca.uky.edu/entomology/entfacts/ef201.asp

European Red Mite (ENTFACT-205) http://www.ca.uky.edu/entomology/entfacts/ef205.asp

Fire Blight (PPA-34) http://www.ca.uky.edu/agc/pubs/ppa/ppa34/ppa34.htm

Green Fruitworms (ENTFACT-214) http://www.ca.uky.edu/entomology/entfacts/ef214.asp

Growing Peaches in Kentucky (HO-57) http://www.ca.uky.edu/agc/pubs/ho/ho57/ho57.pdf

Peach Fruit Diseases (PPFS-FR-T-09) (new resource) http://www.ca.uky.edu/agcollege/plantpathology/ext_files/PPFShtml/PPFS-FR-T-9.pdf

Kentucky Backyard Apple Integrated Pest Management Manual (IPM-9) http://www.uky.edu/Ag/IPM/manuals/ipm9h-map.pdf
Leafhoppers on Apples (ENTFACT-215) http://www.ca.uky.edu/entomology/entfacts/ef215.asp
Leafrollers (ENTFACT-216) http://www.ca.uky.edu/entomology/entfacts/ef216.asp
Lesser Peachtree Borer (ENTFACT-213) http://www.ca.uky.edu/entomology/entfacts/ef213.asp
Oriental Fruit Moth (ENTFACT-212) http://www.ca.uky.edu/entomology/entfacts/ef212.asp
Peach Cultivar Performance (HO-6) http://www.ca.uky.edu/agc/pubs/ho/ho6/ho6.htm
Peachtree Borer (ENTFACT-200) http://www.ca.uky.edu/entomology/entfacts/ef200.asp
Plum Curculio (ENTFACT-202) http://www.ca.uky.edu/entomology/entfacts/ef202.asp
Rosy Apple Aphid (ENTFACT-211) http://www.ca.uky.edu/entomology/entfacts/ef211.asp
Rust Diseases of Apple (PPA-23) http://www.ca.uky.edu/agc/pubs/ppa/ppa23/ppa23.htm
San Jose Scale (ENTFACT-204) http://www.ca.uky.edu/entomology/entfacts/ef204.asp
Training and Culture of Dwarf Apples Using the Vertical Axis System (HortFact 3501) (new resource) http://www.uky.edu/Ag/Horticulture/appletraining.pdf

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