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Texas A&M AgriLife Extension

Texas Fruit and Nut Production

Apples

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Of the many attempts to grow apples commercially across Texas, the most successful have centered in the Davis Mountains and the High Plains region near Lubbock. More apple varieties can be grown in these areas because they have fewer fungal and bacterial diseases and higher winter chilling, which is traditionally the number of hours of temperatures below 45°F from November to March.

In Texas, apples ripen from July to October (Fig. 1), depending on the variety, and the flavor of Texas-grown apples can be outstanding. However, if nights are warm during fruit ripening, the color of red varieties can be poor, a problem for commercial producers in the wholesale market. The in-hand eating quality of these apples is unaffected for homeowners and local sales.

Figure 1. Apple tree at harvest

Climate

The major factor limiting the selection of apple varieties is the chilling requirement. Temperate fruit trees need a specific range of winter chilling to break down the trees' internal growth inhibitors and enable the blooms and leaves to emerge normally in the spring.

Many commercial apple varieties grown in areas such as the Pacific Northwest, along the Great Lakes, and in New England have chilling requirements of 1,000 to 2,200 hours. However, the highest chill hour zone in Texas averages only 800 to 1,000 hours each year (Fig. 2).

Apple varieties selected for a particular growing

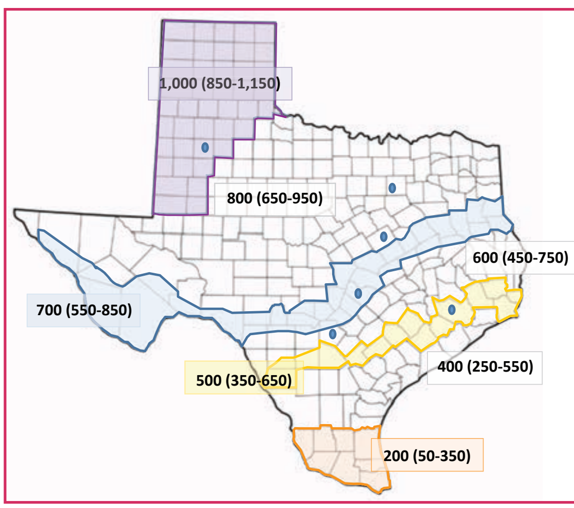

Figure 2. Chill hour zones in Texas

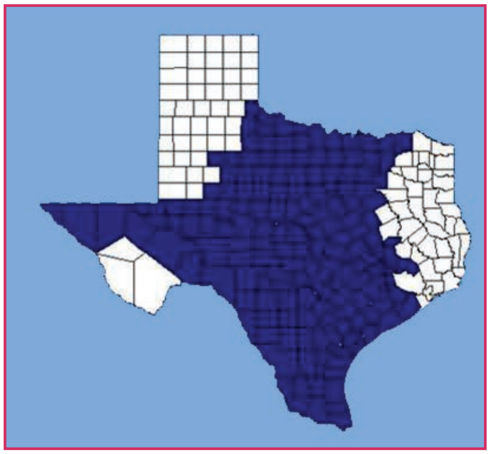

Figure 3. Texas counties where cotton root rot probably occurs (Source: S. D. Lyda)

Figure 4. 'Anna'

Figure 5. 'Fuji'

area should have a chilling requirement within 150 hours of the average winter chilling. If the chilling requirements are too low, bloom can occur too early in the year, and later spring freezes and frosts can reduce or destroy the crop.

In years when a variety's chill requirement is higher than what actually accumulates, many buds will not form flowers, and the bloom crop will be reduced and develop over a protracted (prolonged) period. Leaf buds have chilling requirements as well, and low-chilling years cause the canopy to develop late.

Lack of chilling is very stressful on trees, and the stress can be cumulative. Consecutive low-chilling years can actually kill unadapted apple trees.

Soil

Apple trees prefer deep, well-drained soils with a pH of 6.5 to 7.0. Production is generally unsuccessful in areas (Fig. 3) that are warmer and have alkaline soils (above 7.0) because of cotton root rot *(Phymatotrichopsis omnivora)*.

Because apples are strongly cross pollinated, you'll need to plant more than one variety with overlapping bloom dates (similar chilling requirements) for good fruit production. Although some apple varieties can produce with a moderate amount of chilling, all moderate-chilling varieties perform best in years with more than average chilling hours.

In high-chilling years, bloom is less protracted and fruit set is more uniform. This is important in thinning fruit appropriately to prevent overcropping (excessive production) and to help control diseases.

Varieties

For areas with more than 400 hours of winter chilling, suitable apple varieties include 'Fuji', 'Gala', 'Imperial Gala', 'Mollie's Delicious', 'Mutsu', 'Pink Lady', and 'Royal Gala'. In areas receiving 400 or fewer hours of chilling, two varieties will grow and fruit reliably: 'Anna' and 'Dorsett Golden' (Table 1, Figs. 4 through 8).

Figure 6. 'Gala'

Figure 7. 'Mollie's Delicious'

Figure 8. 'Mutsu'

Table 1: Apple varieties suitable for growing in Texas

Variety	Chill hours needed	Fruit	Harvest	Notes
'Anna'	400	Relatively large; light greenish-yellow skin and slight red blush; sweet, slightly tart, crisp with a creamy white flesh; stores very well	Late June	Produces at an early age; from Israel; a good southern choice for fresh eating, pies, or applesauce
'Dorsett Golden'	350	Medium size; yellow skin with an orange-red blush; firm, smooth, crisp flesh; sweet and tart flavor	Early July	Moderately vigorous with rounded, upright growth habit; a reliable pollinizer for 'Anna'
'Fuji'	600	High quality; marginal commercially acceptable appearance; medium size; tall; rectangular shape, yellow-green skin with orange to red stripes; crisp, juicy, white flesh; good texture; good shelf life in cold storage	140–160 days from bloom; ripens in mid-summer	Vigorous, productive, somewhat bushy tree; needs some annual detailed pruning; developed in Japan and introduced in 1962; cross between 'Ralls Janet' × 'Red Delicious'; heat resistant; susceptible to bitter rot and red mites
'Gala'*	600	Red striping on golden skin, giving it a red-orange color; crisp, dense, and aromatic; excellent quality; stores well	140–160 days from bloom	Large, vigorous tree; shows some self-fertile characteristics but should be pollinated with other varieties with similar chilling requirements; Texas growers struggle to produce consistently large fruit from 'Gala' or any of its sports; high rainfall seasons produce good-sized apples without compromising in-hand eating quality
'Imperial Gala'*	600	Medium size, oval to round; bright scarlet over yellow ground colored fruit; extremely firm, very juicy and distinctly aromatic with yellow, creamy flesh	Ripens with 'Gala'	Vigorous, upright tree, relatively precocious bearer; sport of 'Gala'
'Mollie's Delicious'	450–500	Large, attractive fruit with unique, slightly conical shape; light yellow background about half covered with a red blush; high-quality flesh with good flavor; stores for about 10 weeks in refrigeration	Summer	Vigorous, productive tree; excellent pollinator with a protracted bloom period; introduced in 1966; not to be confused with 'Red Delicious' strains; fruit tends to set in clusters, requiring two or three pickings; some disease resistance
'Mutsu' ('Crispin')	600	Large, round, yellow fruit; crunchy flesh; good juice and tartness; distinctive, delicate, spicy flavor; good dessert and processing apple; excellent for cider and applesauce	~180 days after bloom	Large, spreading, vigorous, and reliable tree; developed in Japan in 1948; resistant to powdery mildew; susceptible to scab, bitter rot, and blister spot
'Pink Lady'	500–600	Oblong green fruit turns yellow at maturity, overlaid with pink or light red; fine-grained, white flesh; thin skin bruises easily	October	Hard to train; prone to producing blind wood (dormant buds); a cross between 'Golden Delicious' and 'Lady Williams' from the Western Australian apple-breeding program
'Royal Gala'*	600	Matures to a bright overall red; medium size, conical to round fruit; bold red stripes over a yellow background; firm, juicy, fine textured, yellow-white flesh; sweet, slightly tart flavor	Ripens with 'Gala'	Compact growth habit; prolific bearer; requires heavy thinning to maintain fruit size and prevent biennial bearing; developed in New Zealand

*Note: 'Gala', 'Imperial Gala', and 'Royal Gala' will not serve as adequate pollinizers for each other.

Selecting a rootstock

Many years ago, most apple orchards were planted on seedling 'Red Delicious' root systems. These trees were tall, inefficient yielders and came into production very slowly.

Rootstocks were first used in apples to overcome the wooly apple aphid, a soil-borne insect that kills the roots of susceptible trees; some of these rootstocks had the advantage of reducing the size of the bearing tree. The benefits of dwarfing apple rootstocks are that they come into production at a younger age, can better produce high-quality fruit, use space more efficiently, and bear fruit that can be harvested easily.

Figure 9. Trellised apple trees

Decisions on tree spacing and trellising are based largely on the degree of dwarfing caused by the rootstock:

- Rootstocks that are somewhat dwarfing, such as M7 and MM111, do not need a support system and are more efficient and precocious (bearing at a young age) than are standard seedling stocks. For these reasons, these two stocks are common in both commercial and home plantings.
- Extremely dwarfing stocks such as EM 26 and M9 have shallow roots and must have a trellis-type support structure. In areas where space is limited, the expense of a small trellis may be justified for a home planting.
- Avoid MM106, an intermediate dwarfing stock, because it does not grow well in poorly drained soils and is susceptible to the soilborne fungus *Phytopthora cactorum,* or collar rot.

Pruning and training

Apples have a naturally erect growth habit and traditionally are trained in a central leader system. The central leader system resembles a Christmas tree shape, with a dominant central trunk and an array of scaffold limbs (primary branches) every 4 to 5 feet. The goal is to minimize shade and effectively intercept sunlight to manage vigor, minimize disease pressure, and produce high-quality fruit.

Scaffold limbs are strongest when they are trained to a 90-degree angle. In some cases, spreaders or limb weights are used to achieve these ideal angles. Some apple varieties develop specialized lateral fruiting branches, or spurs, that produce fruit yearly. Spur-type trees tend to be more compact, easier to train, and come into production earlier than non-spur types.

Although many younger commercial Hill Country apple orchards are trellised, this practice is an option, not a necessity. Trellis support is needed for sev rely dwarfing rootstocks like M 9 because of their shallow, brittle, poorly anchored root systems (Fig. 9). Trees on less dwarfing rootstocks such as MM 111, EM 7, and MM 106 are best grown freestanding (Table 2).

Table 2: Apple rootstock characteristics

Rootstock	Size (% of standard)	Remarks
EM 26	40–50%	Semi-dwarf rootstock; less precocious but anchored better than M9; more cold hardy than other dwarfing stocks but susceptible to collar rot
EM 7	50%	One of the most popular free-standing stocks in the commercial industry; tolerates a wide range of well-drained soils and is moderately resistant to collar rot; prone to suckering (producing shoots from the ground or below the graft union)
MM 106	60–70%	Well-anchored and deep-rooted stock; does not sucker but is very susceptible to collar rot
MM 111	75%	Better adapted to heavy soils and resistant to collar rot; considered by some to be a standard-sized tree but is more precocious than seedling 'Delicious' stock; rather tolerant of wetter soils; is commonly used in replant situations

Irrigation

The water needs of apple trees vary depending on tree age, soil type, and rootstock. Table 3 offers general recommendations for irrigating young apple trees.

Table 3: Recommended number of gallons of water to apply per tree per week*

Year	Month					
	April	May	June	July	August	September
1	7	7	14	21	21	14
2	14	14	21	28	28	21

*The amounts will vary according to temperature, soil type, and natural rainfall.

Trees need more water as they age. The amount needed is determined by the amount and density of the tree canopy, which varies by site, variety, and rootstock. Increase irrigation gradually until individual trees receive as much as 40 gallons of water per week if environmental conditions warrant.

Because apple trees are sensitive to *Phytopthora* and other soil-borne pathogens, pay close attention to water placement. The irrigation emitters must be placed 12 to 15 inches from the trunk in Year 1. Afterward, move them 6 to 12 inches farther from the trunk each year, depending on tree growth.

The point is to supply water to the area of the root system that is actively drawing water and nutrients and to keep the crown of the tree relatively dry.

Figure 10. Bitter pit disorder

Figure 11. Lenticel blotch pit

Fertilization

Before establishing the orchard, have the soil tested. If soil pH is too low, apply lime to make the soil more neutral in its acidity. It is extremely difficult if not impossible to lower soil pH effectively, which is why commercial apple endeavors have failed where soils are infested with cotton root rot. If elements that move very slowly in the soil, such as potassium and phosphorous, are needed, incorporate them into the soil before planting.

Nitrogen fertilizer is usually needed every year because it leaches (seeps) into the soil past the roots. Although large amounts of nitrogen inputs are probably not needed, small, frequent applications will promote early canopy development and maintain leaf health throughout the fall. Stop applying nitrogen no later than August 1 each year to enable the vegetative tissue to mature properly and to become hardy for winter.

Calcium deficiency is common on the fruit of apple trees grown in Texas, even where soils have abundant calcium. Most of the calcium that the trees take up from the soil goes to the developing leaf tissue, not the fruit. The resulting calcium deficiency in fruit can cause several maladies, all of which affect the integrity and storage quality of apples.

Two common calcium-related disorders are bitter pit and lenticel blotch pit.

Bitter pit: Areas of brown, dry tissue develop initially in the fruit flesh (Fig. 10). The peel then discolors and browns, and a pit forms on the fruit surface. Most of the affected areas are usually toward the calyx end (opposite the stem end) of the fruit. Symptoms typically appear before and after harvest.

Lenticel blotch pit: Small, dark, dying areas surround the fruit lenticels (pores) and then develop slight pits (Fig. 11). Although lenticel blotch pit may occur just before harvest, it usually appears during storage.

Calcium deficiencies are more severe when the trees are under environmental stresses such as high heat or drought. To reduce the incidence of these disorders, spray calcium during fruit development, and harvest when the fruit have matured properly.

Calcium nitrate and calcium chloride can help supply needed calcium, but check with the local Extension horticulturist to determine the timing, rate, and risks associated with these sprays under some environmental conditions.

Weed control

Like all other perennial crops, apples compete with native plants for nutrients, sunlight, and water. The most limiting factor to orchard establishment is the failure to control weeds in new apple orchards (Fig. 12).

Although cultivation (plowing or disking) has long been considered the most cost-effective and environmentally sound way to manage weeds, it should be the method of last resort because of the potential for erosion and harm to tree roots. Most of an apple tree's feeder roots are in the top 6 inches of soil. Cultivating weeds cuts the feeder roots, leaving the trees less able to absorb water and nutrients.

Figure 12. Inadequate weed control in apple tree rows

Many nonrestricted contact herbicides are approved for weed control in apple orchards. Some target only grasses; others manage both grasses and broadleaf weeds. Unlike many chemical herbicides used in the past, these newer formulations are relatively safe to apply and have little effect on the environment.

Organic and inorganic weed barriers are popular today for controlling weeds around fruit trees, especially in landscapes or small home orchards. Although inorganic weed barriers control competitive plants acceptably, organic mulches have many added benefits. Besides reducing weed competition, organic mulches conserve moisture, improve soil structure, and moderate soil temperatures.

To be effective, organic mulches need to be about 6 inches thick and reapplied regularly as breakdown and natural erosion dictates. To help prevent collar rot, apply organic mulches no closer than 1 foot from the trunk.

Diseases

Pesticides are used more on apples than perhaps any other deciduous fruit crop grown in North America. A multitude of fungal pathogens (disease-causing organisms) such as powdery mildew, bitter rot, black rot, and apple scab can injure foliage, fruit, and woody tissue. Commercial growers commonly apply conventional fungicides and insecticides, and noncommercial growers in more humid regions of Texas struggle to grow clean fruit without spraying.

Collar rot *(Phytophora cactorum)* is a soil-borne disease problem of apples in Texas. The incidence of collar rot can be

Figure 13. Pulling up trees killed by cotton root rot

reduced by proper site and rootstock selection and managed with fungicide applications as needed.

Fireblight, caused by the bacterial pathogen *Erwinia amylovora*, causes twig and limb dieback and can even kill the tree. Apple trees in humid areas of the state are more prone to serious fireblight damage. Varieties differ in their resistance to the disease, and susceptible varieties should be avoided.

To manage the disease, grow resistant varieties, prune infected limbs, apply agricultural antibiotics during flowering, and reduce nitrogen fertilization to slow vegetative growth.

Managing cotton root rot

There is no diagnostic test to determine whether cotton root rot is present at a site. Previous cotton plantings likewise have no bearing on whether the disease may be problematic. There are no known resistant rootstocks, and no fungicides have proven effective in preventing losses from cotton root rot in apple orchards (Fig. 13).

The best management tactic is to choose sites in areas where the pathogen is not known to occur and to plant new orchards in soils that are slightly acidic. Neutral or acidic soils severely limit the potential losses from this pathogen.

Attempts to acidify high-pH soils have largely failed. Likewise, biological agents or organic supplements that are sold as "natural" solutions to cotton root rot may work on shallow-rooted annual crops, but it is virtually impossible to deliver and maintain enough of these agents deep in the soil profile.

In all susceptible fruit crops, the cotton root rot fungus moves easily from tree to tree or vine to vine. Dense plantings of apple trees worsen the problem within an orchard once infection begins. This has especially been true on very dwarfing stocks, which are commonly planted 4 or 5 feet apart within the row. Some apple growers have transitioned toward less dense plantings, even on dwarfing stocks, as a way of keeping the root systems of trees separated and managing cotton root rot.

Insects

Apple trees and fruit can be severely damaged by many insect pests, including apple maggot, coddling moth, scale insects, tarnished plant bugs, flat-headed apple tree borer, and several stink bug species.

Growers must be extremely cautious about applying insecticides, especially during bloom, to protect important pollinators such as bees and other beneficial insects. Because pesticide products and their labels change often, contact your county Texas A&M AgriLife Extension office for current recommended pest-management suggestions.

Harvest

Apple maturity is judged by fruit color, firmness, and soluble solid content. For local sales, many growers keep the fruit on the trees until they intend to place it in their stands. This practice allows them to select the ripest fruit on an ongoing basis, affording buyers the highest quality fruit.

For more distant markets, the fruit is generally picked according to the ground color, which is the color of an apple's skin other than the areas that have turned red. The fruit is ready for harvest when the ground color changes from green to yellow or pink on colored varieties. At this point, the apples are firmer and better able withstand transport and arrive at the market in good shape.

After they are harvested, the apples will continue to soften, change internally, and give off ethylene. To maintain optimal quality, refrigerate and humidify the apples after harvest.

For more information

Fruit and Nut Resources, Aggie Horticulture®:
http://aggie-horticulture.tamu.edu/fruit-nut

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