

Low Chill Apple Cultivars for North Florida and North Central Florida¹

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Introduction

Relatively few cultivars of apples (*Malus domestica* L.) can be grown successfully in Florida. Northern apple cultivars -- such as 'Golden Delicious', 'Red Delicious', 'Gala', 'Fuji', or 'McIntosh' -- are not exposed to enough low temperatures during Florida's mild winters. Consequently, both vegetative and reproductive spring growth are suppressed when these cultivars are grown in Florida.

Whether a region's climate is compatible with a cultivar's chilling requirement may be determined on the basis of the cumulative number of hours less than or equal to 45° F during the winter, or may be determined by the mean annual temperature of the coldest month. Although few apple cultivars with a low chilling requirement can be successfully grown in Florida, many homeowners in north Florida and north central Florida grow apple trees.

There is little potential for establishment of commercial apple orchards in Florida because apples are available year-round from the Pacific Northwest, and apples are also available from south of the

equator during the winter and spring. Additionally, the successful culture of apples in Florida is more difficult than in most temperate regions due to high rainfall and humidity in Florida during the apple-ripening season, late May through June. The Florida climate also contributes to enhanced insect and disease pressures on apples.

Site Requirements

Apple trees perform best in locations that receive full sun. Areas that receive shade more than half of the day are not suitable for growing apples. Additionally, early morning sun is more important than early evening sun due to the negative impact of morning dew on leaves and fruit. Locations and cultural practices that foster air movement should be encouraged to minimize disease problems associated with high humidity. Planting on hill tops is preferable to low-lying areas because hill tops facilitate good air circulation and drainage of surface water.

Apple trees grow well in most soils in north Florida and north central Florida, provided that the areas are well drained. A soil pH of 6 - 6.5 is best for growing apples. For a soil pH of less than 5.0, add 4 -

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6 lb/100 sq. ft. of lime prior to planting. Few soils in north Florida have a native pH greater than 7.0. However, application of elemental sulfur of 1 lb/100 sq. ft. will lower pH about 1 unit. In poorly drained soils or soils in low-lying areas, apple trees will succumb to anaerobiosis and/or Phythophora root rot. In extremely sandy soils, apple trees will have to be supplied with irrigation more frequently, especially for young trees during the dry, spring season in Florida, when apples are in a growth period.

Apple Cultivars

Apple cultivars that may be suitable for north Florida and north central Florida have a chilling requirement of less than 600 and 400 hours, respectively. A summary of apple cultivars evaluated in Florida is presented in Table 1.

Of the 43 cultivars tested, only 'Anna', 'Dorsett Golden' and 'TropicSweet' are recommended for Florida. 'Anna' and 'Dorsett Golden' originated in Israel and the Bahamas, respectively. 'TropicSweet' is a relatively new, patented cultivar from the University of Florida (UF) breeding program. These cultivars each have a chilling requirement of 250 - 300 hours. Additionally, these cultivars require accumulation of a substantial amount of heat units, before trees will bloom. As a result, these cultivars can be grown in Ocala and northward in Florida.

While frost injury to flower buds is common on most low-chill apple cultivars, such cultivars also exhibit a prolonged bloom period in late winter (usually late February), so that the later blooms often escape injury.

Most apple cultivars are not self-fruitful; more than one cultivar should be planted together for cross pollination. 'Anna', 'Dorsett Golden' and 'TropicSweet' all serve as pollinizers to each other. Fruit ripens on these three varieties from late May through June. Full bloom and fruit ripening are generally two to three weeks earlier in north central Florida than in north Florida. All three cultivars have good keeping quality and will last from six to eight weeks with refrigeration. Fruit characteristics of these cultivars are listed in Table 2.

Fruit of 'Anna' resembles that of 'Red Delicious' more than other low-chill apple cultivars. Fruit of 'Anna' typically attains a size of 2 1/4 - 2 1/2 inches with a 50 percent red blush and good flavor. These trees are upright to semi-spreading and medium in height. 'Anna' is the most widely planted apple cultivar in Florida. 'Dorsett Golden' fruit has good flavor, golden skin, and resembles 'Golden Delicious' fruit. Fruit of 'Dorsett Golden' are 2 - 2 1/2 inches, slightly smaller and also firmer than fruit of 'Anna'. 'Dorsett Golden' fruit have a 30 percent light-red blush that covers a yellow ground color. Trees are medium in height, upright and semi-spreading. 'TropicSweet' fruit are sweeter (14 - 15° Brix) and firmer than fruit of 'Anna', but are less red and less acidic. 'TropicSweet' fruit have a 30 percent red blush and are subject to skin russetting in some years. 'TropicSweet' trees are semi-spreading and medium height.

A second tier of apple cultivars conditionally recommended for Florida includes 'Ein Shemer',

'Elah', 'Maayan', 'Michal' and Shlomit. These cultivars, all from Israel, ripen later in the summer, when rainfall-induced insect and disease pressures are very high in Florida. Fruit characteristics of these cultivars, only conditionally recommended for Florida, are also presented in Table 2.

Rootstock

A problem apple growers frequently encounter worldwide is that trees become overly vigorous, very large when planted on seedling rootstocks. However, 'Anna', 'Dorsett Golden' and 'TropicSweet' are spur type trees and, as a result, do not produce large trees on seedling rootstock. Use of a dwarfing rootstock for dooryard planting of these cultivars may further reduce tree size. Additionally, many apple rootstocks have been developed that reduce vegetative growth of scions, compared to the vegetative growth that results from seedling rootstocks.

A rootstock trial was initiated during January 1988 at the UF North Florida Research and Education Center (NFREC) in Monticello, Fla. Apple rootstocks included in the trial were the following: Mark, M7A, P22, MM106. Seedling rootstocks were initially included in the experiment, but were deleted from the

study because the scion cultivars were not true to type from the nursery. A summary of rootstock characteristics appears in Table 4.

'Anna' or 'Dorsett Golden' were grafted onto each rootstock. The experiment was designed and analyzed as a 2 x 4 factorial design. Each rootstock/scion was replicated five times. Trees were trained to a modified central leader system. In October 1990 trunk diameter at a height of 2 feet above the ground and also tree height were measured.

Trees on M7A or MM106 were subjectively rated as acceptable. However, trees on Mark or P22 were unacceptable because of inadequate vigor and poor health.

Because trees are pruned yearly, tree size is not as accurate an indicator of relative vigor as is trunk diameter. However, this trial indicated that trunk diameter and tree height were both significantly affected by rootstock, and these variables were not affected by scion (Table 3). Trunk diameter and tree size were greater for trees on M7A or MM106 than for trees on either Mark or P22. For example, mean trunk diameters of M7A or MM106 varied between 2.0 - 2.2 inches. By contrast, trunk diameter of Mark or P22 varied between 0.7 - 1.5 inches.

Burr knots (a swollen mass of gall-like tissue just above the graft union) were also especially prominent on Mark or P22 rootstocks. This physiological disorder results from incompatibility of the scion and rootstock and sometimes causes adventitious root formation.

Planting

Healthy, bare-root trees that are 1- to 2-years-old and obtained from a nursery should be planted without allowing the roots to dry. Apple trees may be planted any time during the dormant season, January to March. However, planting apples trees in Florida from late December to February will allow sufficient time for roots to become established before spring growth begins. When transplanting container-grown trees, care should be taken to spread the roots. Trees purchased in containers can be planted throughout the year provided adequate water is applied, including throughout the dry spring months and other dry

periods and especially during the establishment year.

Planting holes should be large enough to ensure that the root system is neither crowded nor bent. Extra long or broken roots should be placed in an upright position in the hole and planted at approximately the same depth as in the nursery. Put a small amount of soil into the hole, pack the soil around the roots, and repeat this procedure until the hole is full of soil and the plant is firmly in place. After planting, make a soil ring around the edges of the hole to form a reservoir for water. This reservoir then should be completely filled with water to settle the soil around the roots. Do not fertilize at planting, and never put fertilizer in the planting hole.

Cultivation

Cultivation is usually necessary only for weed control and should be as shallow as possible to avoid damage to the root system. An area approximately 4 - 6 feet from the trunk should be maintained weed-free. Chemical weed killers with low human/animal toxicity are usually practical for home use. When using pesticides, always follow label directions. Prior to application of herbicides, all suckers emanating from the rootstock or lower trunk should be removed. Mulches may be used to control weeds and conserve moisture, but do not allow the mulch to be in contact with the tree trunk.

Fertilization

Optimum fertilizer application rates for apple trees are largely unknown for Florida conditions. A balanced fertilizer -- such as 10-10-10 with micro-nutrients -- is recommended. About one pound of this mixture for each year of the tree's age can be applied annually up to a maximum of 15 pounds per year. In each of two fertilizer applications yearly, apply half of the total annual amount of fertilizer. The first application should be made during the dormant period, in January to March. Another application should be made at the beginning of the rainy season, in June. Broadcast the fertilizer evenly beneath the tree canopy.

Zinc deficiency is common in apples grown in Florida. One pound of zinc oxide (ZnO) or zinc sulfate ($ZnSO_4$) should be applied annually if symptoms of zinc deficiency appear. Boron, another

important micronutrient, is critical to apple fruit set, retention and firmness. Boron deficiency can also cause bitter pits and internal breakdown of apples.

Irrigation

Amount and timing of irrigation depends not only on amount and frequency of rainfall, but also on soil type. For young trees as little as 5-10 gallons of water per tree is satisfactory while old trees could require over 50 gallons of water. For trees grown in sandy soil, more frequent irrigations are required than for trees grown in clay soils. During each irrigation, the area beneath the canopy of the tree should be wet to a depth of 2 feet. For large trees this degree of saturation may require more than 50 gallons of water per tree per irrigation, or could require as little as 5 - 10 gallons per tree for young trees. Under extremely dry conditions, irrigation may be required daily for newly planted trees. For established trees weekly or bi-weekly irrigation is usually satisfactory.

Training and Pruning

Train and prune apples trees during the dormant season, January to March. Young apple tree should be trained to a modified central leader system. On 2-year-old trees, five or six strong scaffold limbs should be selected to develop a strong framework. These limbs should have wide angles, almost perpendicular to the trunk of the tree, and should be radically spaced around the tree trunk and vertically spaced approximately 6 - 8 inches from each other, up or down the trunk. If branch angles are too narrow (i.e. less than 60 degrees), a bark inclusion can occur, and the scaffold limb may split where it joins the central leader. When limbs are still young and herbaceous, clothes pins or tree spreaders can be used to increase branch angles. Later pruning of the tree will be for the purpose of removing diseased or dead wood, and to trim the tree to the desired shape. Be sure to remove tightly packed limbs and shoots to facilitate air movement throughout the tree canopy.

Harvesting and Storage

Apples ripen satisfactorily on the tree. The fruit should be picked when it has reached optimum size and color. Most slightly immature fruit will also ripen with satisfactory quality in a refrigerator. If fruit

diseases increase with summer rainfall, it may be advisable to harvest the fruit slightly before optimum harvest maturity. 'Ein Shemer' fruit becomes mealy if overripe and does not store more than two weeks, even under refrigeration. However, fruit of 'Anna', 'Dorsett Golden', and 'TropicSweet' have been stored satisfactorily in refrigeration for six to eight weeks.

Pest Control

Prevention and control of pests -- including weeds, diseases and insects and more -- is necessary to maintain healthy trees that produce good quality fruit. Contact your county Cooperative Extension Service office for current recommendations. Some of the most common pests are discussed below.

Diseases

You may also want to consult EDIS Publication PDMG-V3-05, 2007 Florida Plant Disease Management Guide: Apple (*Malus sylvestris*), <http://edis.ifas.ufl.edu/PG004> (Momol et al. 2007).

Apple Scab. This fungus, caused by *Venturia inaequalis*, affects leaves, flowers and fruit. Lesions develop on both leaf surfaces, causing leaf distortion. Scabby, dark spots are clearly seen on infested fruit. In regions having a warm climate, these spots commonly appear as russeted scars as the fruit matures. Previous infection of immature fruit results in cracking and distortion of the area associated with the scab lesions. Efficient control of apple scab may be achieved by fungicide applications.

Fireblight. This bacterial disease, induced by *Erwinia amylovora*, spreads from tree to tree primarily during bloom. Fireblight is normally only a severe problem during a prolonged cool period in the spring. Typically, shoot tips become blackened and appear as if they have been burned. Fireblight can generally be controlled by reducing nitrogen fertilizer, which results in over-vigorous growth.

When fireblight infection is present, the infected area should be pruned out, cutting at least 8 - 10 inches below the lowest visible site of infection. The pruned-off limbs then should be burned.

Botryosphaeria canker. This fungal disease, also known as white rot, is caused by *Botryosphaeria dothidea* and is by far the most debilitating disease of apple trees in Florida. Twig cankers first appear as water-soaked spots, which eventually enlarge and produce rings of black fruiting structures. This canker can spread from twigs to scaffold limbs and eventually to the trunk, causing bark to darken and eventually to slough off. The fungus is spread as spores, particularly during wet and humid weather. *B. dothidea* is especially severe from June through August. Fruit infection can also occur and appear as small circular brown spots with red borders. Control is by pruning and removal of infected wood. Pruning cuts should be made beyond the area of visible infection into healthy tissue.

Bitter Rot. This fungal disease, incited by *Colletotrichum gloeosporioides*, infects the fruit, but causes stem cankers. Bitter rot on the fruit starts as a small, circular, light-brown area. Spots enlarge rapidly and become darkened. A distinctive characteristic is a saucer-shaped depression with fruiting structures in center and concentric rings to the periphery. Stem cankers should be pruned out and burned.

Mushroom Root Rot: This fungal disease -- incited by, *Armillaria tabescens* -- attacks the roots and can result in tree death. The disease is especially problematic in recently cleared land that contains residual tree roots. These roots can serve as a source of inoculum. In diseased trees, foliage turns yellow and then brown. Underneath the bark of the trunk at the soil line, inspect for white layers of fungus. Mushrooms, like fruiting bodies, may emerge from the lower trunk or from roots located close to the surface.

No satisfactory chemical control is available.

Insects

Scale Insects. Several scale insects -- primarily San Jose Scale (*Quadraspidiotus perniciosus*) -- may infest leaves, twigs, branches or fruit. Scale is usually controlled by a 2-3 percent dormant oil application.

Plum Curculio. The plum curculio (*Conotrachelus nenuphar*) is a common pest of stone

fruit and apple. The female plum curculio makes a small, crescent-shaped cut in the immature fruit and deposits an egg in the flesh. The eggs rapidly hatch, and the larvae (a small, whitish worm) migrate to the fruit interior. Within a few weeks of infection with plum curculio, most apples will drop to the ground.

Catfacing insects. These tarnished plant bugs, stink bugs and leaf-footed bugs are among the insect species *Nezara* and *Leptoglossus* spp., medium-large (3/8 - 3/4 inch-long), sucking insects that cause fruit deformities and reduce fruit marketability. Catfacing insect feeding during early fruit development cause fruit deformities, and feeding during mid- to late-fruit development can lead to brown rot and other fruit diseases.

Nuisance Mammal

Rabbit. Rabbits eat the bark of apple trees during the winter months and can kill the tree. For best control, a physical barrier -- such as hardware cloth or plastic tree guards - should be placed around the trunk of the tree.

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Table 1. Adaption, Quality and Origin of Apple Cultivars Tested in North Florida and North Central Florida

Apple Cultivar	Origin	Area Tested ^z	Chilling Hours ^y	Ripening Season ^x	Fruit Quality ^w	Tree Adaptability ^v	Recommendation Status ^u
'Adina'	Australia	M	600+	L	G	A	NR
'Akane (Tohuku #3)'	Japan	M	600+	L	P	NA	NR
'Anna'	Israel	G&M&Q	300	E	G	A	R
'Anoka'	South Dakota	M	550	M	P	A	NR
'Beverly Hills'	California	G	600	L	P	NA	NR
'Carmen'	Unknown	G	550	L	P	NA	NA
'Coast'	Africa	G	575	L	P	NA	NR
'Cole'	Victoria	M	600+	L	P	NA	NR
'Culinaria'	Brazil	G	600+	L	P	NA	NR
'Davilla Spur Golden'	Mexico	G&M	600	L	F	A	NR
'Davilla Spur Red Del.'	Mexico	M	600+	L	F	NA	NR
'Dorsett Golden'	Bahamas	G&M&Q	250	E	G	A	R
'Ein Shemer'	Israel	G&M&Q	450	M	F	A	CR
'Elah 8-6'	Israel	G&M	450	M	G	A	NR
'Fugi'	Japan	M	575	L	G	A	NR
'Gala (Kids D-8)'	New Zealand	M	600	M	G	A	NR
'Gibbs A'	Georgia	M	600+	M	P	A	NR
'Gloria Mundi'	New York	M	600+	-	-	NA	NR
'Gordo'n	California	M	550	L	P	A	NR
'Granny Smith'	Australia	M	600+	L	-	NA	NR
'Hollin'	Georgia	M	600+	-	-	A	NR
'Huerto Los Gruelos'	Mexico	M	600+	L	-	NA	NR
'Java Red'	Unknown	G	600+	L	-	NA	NR
'Jotter'	Unknown	G	600+	L	-	NA	NR
'Key West'	Unknown	G	600+	L	-	NA	NR
'Legana'	Australia	M	575	L	P	A	NR
'Maayan'	Israel	M	450	M	G	A	CR
'Marchant'	Georgia	M	600+	-	-	NA	NR
'Medina'	New York	M	600+	L	F	A	NR
'Michal'	Israel	G&M	425	M	G	A	CR
'Mississippi #1'	Mississippi	G	600	L	-	NA	NR

Table 1. Adaption, Quality and Origin of Apple Cultivars Tested in North Florida and North Central Florida

'Muzalma'	Turkestan	M	600+	L	-	NA	NR
'Orleans'	New York	M	600+	L	G	A	NR
'Prince'	Georgia	M	600+	-	-	-	NR
'Puritan'	Massachusetts	M	600+	-	-	-	NR
'Rainha'	Brazil	G	600+	L	P	NA	NR
'Red Statesman'	New Zealand	M	600+	L	-	NA	NR
'Shlomit'	Israel	G&M	375	M	G	A	CR
'Tropical Beauty'	South Africa	G&M	550	L	P	A	NR
'Tropic Sweet (patented)'	Florida	G&Q	300	E	G	A	R
'Vered'	Israel	G	250	E	F	A	NR
'Winter Banana'	Indiana	M	575	L	-	NA	NR
'Zamadani'	Unknown	G	525	M	F	A	NR

^U Patented +R=recommended, CR=conditionally recommended, NR=not recommended^V A=adapted, NA=not adapted
^w G=good, F=Fair, P=poor
^x E=early(late May to July), M=mid-season(July), L=late (August)
^y Equivalent winter chill hours required for normal bloom and foliation
^z G=Gainesville, M=Monticello, Q=Quincy
 This table is modified from Miller and Baker (1982)

Table 2. Fruit Qualities of Apple Cultivars for Florida

Cultivar	Flavor ^z			Color		Fruit Characteristics				Resistance to Browning ^z	
	Taste	Aroma	Sweet	Acid	Ground Color	Over Color	Fruit wt (oz)	Juice ^z	Texture		Shape
'Anna'	7	7	6	5	Light green to red	40 - 60% solid red	7.0	7	Crisp	Oblong conic	8
'Dorsett Goldon'	7	6	6	4	Light green to yellow	25 - 50% striped solid light red	5.3	7	Crisp	Oblique to conic	9
'Ein Shemer'	6	6	6	5	Light yellow	25 - 50% red	6.2	7	Medium	Oblong conic	8
'Elah'	6	6	7	5	Light green to yellow	25% light red	3.5	7	Medium	Round to oblique	8
'Maayan'	6	6	7	7	Light green	100% dull dark red	3.5	8	Crisp	Round oblong	8
'Michal'	6	6	6	5	Light green to yellow	50% red striped	5.3	7	Very	Round to oblate	2
'Shlomit'	6	6	6	7	Light green to light	25% rusty red	4.4	8	Crisp	Round to oblate	8
'Tropic Sweet'	8	7	9	5	Light green	50% light to red	7.0	NT	Crisp	Round conic	9

^z1=lowest, 10=highest, NT=not tested

Table adapted largely from Miller and Baker (1982)

Table 3. Trunk Diameter and Tree Height of Third Leaf for 'Anna' and 'Dorsett Golden' Apple Trees on Four Dwarfing Rootstocks

Rootstock	Scion	Trunk Diameter (inches)	Tree height (feet)
Mark	'Anna'	1.5 ± 0.3	6.6 ± 0.5
M7A	'Anna'	2.0 ± 0.2	7.7 ± 0.6
P22	'Anna'	0.9 ± 0.2	6.2 ± 0.9
MM106	'Anna'	2.0 ± 0.2	8.4 ± 0.4
Mark	'Dorsett Golden'	0.7 ± 0.1	4.2 ± 1.5
M7A	'Dorsett Golden'	2.1 ± 0.3	8.7 ± 0.6
P22	'Dorsett Golden'	0.9 ± 0.3	6.4 ± 2.6
MM106	'Dorsett Golden'	2.2 ± 0.2	7.3 ± 2.1
Main effects ^y			
Rootstock		***	*
Scion		N.S.	N.S.
Interactive effects			
Rootstock * Scion		N.S.	N.S.

^zValues correspond to means ± SE.
^ySignificance based on F Values, *, ***, and N.S. correspond to significant at 5%, 0.1%, or not significant, respectively.

Table 4. Characteristics of Four Dwarfing Apple Rootstocks^z

	Mark	M7A	P22	MM106
Percentage dwarfing ^y	35%	65%	35%	80%
Precocity inducement	Exc.	Exc.	Exc.	Exc.
Production inducement	Exc.	Exc.	Exc.	Exc.
Anchorage	Good	Fair	Good	Good
Sucker production (lack of)	Good	Fair	Good	Very Good
Sandy soil tolerance	Good	Good	Not tested	Good
Clay soil tolerance	Good	Fair	Not tested	Good
Drought resistance	Not tested	Fair	Not tested	Good
Flooding tolerance	Not tested	Not tested	Not tested	Fair
High pH tolerance	Not tested	Not tested	Not tested	Good
Crown rot resistance	Not tested	Fair	Good	Poor
Fire blight resistance	Fair	Good	Fair	Fair
Powdery mildew resistance	Fair	Not tested	Not tested	Poor