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Low Chill Apple Cultivars for North and North Central Florida[1]

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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 low enough temperatures during Florida's mild winters, and consequently both vegetative and reproductive spring growth are suppressed. However, a few apple cultivars with a low chilling requirement can be successfully grown in Florida. Chilling requirements may be quantified on the basis of the cumulative amount of hours less than or equal to 45° F during the winter, or by the mean annual temperature of the coldest month.

Although there are only a few very small u-pick type apple orchards in Florida, many homeowners grow apple trees, in central and throughout north Florida. There is low potential for establishment of commercial apple orchards in Florida because apples are available fall and winter from the Pacific Northwest or from south of the equator in spring and summer. In addition, the successful culture of apples in Florida is more difficult than most temperate region due to high rainfall and humidity during the ripening season and the associated enhanced insect and disease pressures.

Site Requirements

Apple trees perform best in locations that receive full sun. Areas that receive shade more than 50% of the day should be avoided. Locations and cultural practices that foster air movement should be encouraged to minimize disease problems associated with high humidity. Early morning sun is more important than early evening sun due to the negative impact of morning dew on leaves and fruit.

Apple trees grow well in most soils in north and north central Florida provided that they are well drained. Soils with a pH of 6 to 6.5 are best, but if your soil has a pH less than 5.0 then add 4 to 6 lb/100 sq ft of lime prior to planting. Few soils in north Florida have a pH greater than 7.0. Application of elemental sulfur of 1 lb/100 sq ft will lower about 1 unit. In poorly drained soils or soils that are located in low lying areas, apple trees will succumb to anaerobiosis and/or Phythophora root rot. In extremely sandy soils, trees will have to be supplied with irrigation more frequently, especially during the dry spring growth period.

Frost injury to flower buds is common on most low chill apple cultivars; however, most low chill cultivars exhibit a rather prolonged bloom period in

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late winter (usually late Feb.), such that the later blooms often escape injury. Planting on hill tops is preferable to low lying areas because hill tops confer good air and surface water drainage.

Apple Cultivars

Potential apple cultivars for north and north central Florida have a chilling requirement 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 'Tropic Sweet' are recommended. They all have a chilling requirement of 250 to 300 hours, but with a high heat requirement that delays bloom, which means that they can be grown in Ocala and northward in Florida. Most apple cultivars, are not self-fruitful; thus more than one cultivar should be planted together for cross pollination. 'Anna' and 'Dorsett Golden' originated in Israel and the Bahamas, respectively. 'Tropic Sweet' is a new patented cultivar from the University of Florida breeding program. All three varieties serve as pollinizers to each other. Fruit ripens on these three varieties from late May through June. Tree bloom and fruit ripening are generally 2 to 3 weeks earlier in north central than in north Florida. All three cultivars have good keeping quality and will last up to six to eight weeks with refrigeration. Fruit characteristics are listed in Table 2.

Fruit of 'Anna' resembles that of 'Red Delicious' more than other low-chill apple cultivars. It typically attains a size of 2 1/4 to 2 1/2" with a 50% red blush and good flavor. Trees are upright to semi spreading and medium in height. 'Anna' is the most widely planted apple cultivar in Florida.

'Dorsett Golden' fruit resembles 'Golden Delicious,' and are slightly smaller than 'Anna,' 2 to 2 1/2", firmer and have a golden skin and also have a good flavor. A 30% light red blush covers a yellow ground color. Trees are medium in height, upright and semi spreading.

'Tropic Sweet' fruit are less red, firmer, less acidic and sweeter (14 to 15 Brix°) than either 'Dorsett Golden' or 'Anna'. Fruit have a 30% red blush and are subject to skin russett in some years. Trees are semi spreading and medium height.

A second tier of conditionally-recommended cultivars (all from Isreal) includes 'Ein Shiemer,' 'Elah,' 'Maayan,' 'Michal' and 'Shlomit.' They are conditionally recommended, mainly because they ripen later in the summer when rainfall-induced insect and disease pressures are very high. Fruit characteristics of these conditionally-recommended cultivars are also presented in Table 2.

Rootstock

A problem frequently faced by apple growers worldwide, is that trees are overly vigorous when planted on seedling rootstocks. 'Anna,' 'Dorsett Golden,' and 'Tropic Beauty' are spur type trees and thus do not produce large trees on seedling rootstock, but tree size may be further reduced for dooryard planting with a dwarfing rootstock. Most varieties become very large trees on seedling rootstock. Fortunately, many apple rootstocks have been developed that tend to reduce vegetative growth of scions compared to what would be the case with seedling rootstocks.

A rootstock trial was initiated during Jan. 1988 at the NFREC-Monticello. Apple rootstocks included in trial were Mark, M7A, P22A, MM106. Seedling rootstocks were initially included in the experiment, although they were deleted from the study because the scion cultivars were not true to type from the nursery. 'Anna' or Dorsett Golden' were grafted onto each rootstock. The experiment was designed and analyzed as a factorial design. Each rootstock/scion was replicated 5 times. Trees were trained to a modified central leader system. Cultural practices were standard (Crocker and Sherman, 1986). Trunk diameter at a height of 0.6 m above the ground and tree height were measured during Oct. 1990.

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. Trunk diameter and tree height were significantly affected by rootstock but these variables were not affected by scion (Table 3). Trunk diameter and tree size were greater for trees on M7A or MM106 than either Mark or P-22. For example, mean trunk diameters of M7A or MM106 varied between 5.2 to 5.6 cm, whereas trunk diameter on Mark or P22 varied

between 1.8 to 3.8 cm. Tree size is not as accurate an indicator of relative vigor as trunk diameter since trees are pruned yearly. Burr knots (a swollen mass of gall-like tissue just above the graft union) were also especially prominent on Mark or P-22 rootstocks. This is a physiological disorder of scion/rootstock incompatability and sometimes results in adventitious root formation. A summary of rootstock characteristics appears in Table 4.

Planting

One to two-year-old healthy bare root trees obtained from a nursery should be planted without allowing roots to dry. Apple trees may be planted any time during the dormant season, but the period from January late to February is best because this allows time for the roots to become established before spring growth begins. Trees purchased in containers can be planted throughout the year provided adequate water is applied. If trees are obtained growing in containers then care should be taken to spread the roots at the time of planting. Water should be applied throughout the dry spring months and other dry periods.

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 it was in the nursery. It is advisable to put a small amount of soil into the hole and pack it 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 in order to settle the soil around the roots. Do not fertilize at planting.

Cultivation

Cultivation is usually necessary only for weed control and should be done as shallow as possible to avoid damage to the root system. An area approximately four to six feet from the trunk of the tree should be maintained in a weed-free condition. Chemical weed killers with low human/animal toxicity are usually often practical for home use. 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 each year of the tree's age is applied yearly until a maximum of 15 pounds per year is reached. The fertilizer should be applied with one-half of the fertilizer in each application. The first application should be made during the dormant period in January and another application at the beginning of the rainy season in June. The fertilizer should be broadcast evenly beneath the tree canopy. Zinc deficiency is common on apples in Florida. One pound of zinc oxide (ZnO) or zinc sulfate (ZnSO4) should be applied annually if symptoms appear.

Irrigation

The amount of water and when to apply it depends not only on frequency and amount of rainfall, but also on the soil type. More frequent irrigations will be required on sandy than on clay soils. The area beneath the canopy of the tree should be wet to a depth of two feet at each irrigation which may require more than 50 gallons of water per tree for large trees or as little as 5 to 10 gallons for young trees. Irrigation may be required daily for newly planted trees under extremely dry conditions. For established trees weekly or bi-weekly is satisfactory.

Training and Pruning

Young apple trees should be trained to a modified central leader system. On two year-old-trees, five to 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, should be radially spaced around the tree trunk and vertically spaced approximately 6" to 8" 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 as it joins the central leader. Clothes pins or tree spreaders can increase branch angles while limbs are still young and herbaceous. Later pruning of the tree will be to

remove diseased or dead wood and to trim the tree to the desired shape. It is well advised to remove tightly packed limbs and shoots to facilitate air movement through tree canopy.

Harvesting and Storage

Apples ripen satisfactorily on the tree. They should be picked when they have reached optimum size and color. 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 them slightly before optimum harvest maturity. 'Ein Shemer' fruit becomes mealy if overripe and does not store more than two weeks even under refrigeration. Fruit of 'Anna,' 'Dorsett Golden,' and 'Tropic Sweet' have been stored satisfactorily in refrigeration for six to eight weeks.

Pest Control

Preventive control of pests is required to maintain healthy trees producing good fruit quality. Contact your county Cooperative Extension Service office for current pest control recommendations.

Apple scab: This fungus, caused by *Venturia ineaqualis*, affects leaves, flowers and fruit. Lesions develop on both leaf surfaces causing leaf distortion. Scabby, dark-spots are clearly seen on infested fruit. As the fruit matures in regions having a warm climate, the spot commonly appears as russeted scars. Previous infection of immature fruit results in cracking and distortion of the area associated with 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. It can generally be controlled by reducing nitrogen fertilizer which results in over vigorous growth. When infection is present, the infected area should be pruned out, cutting at least 8" to 10" below the lowest visible infection. The pruned-off limbs then should be burned.

Botryosphaeria canker: This fungal disease is caused by *Botryosphaeria dothidea* is by far the most debilitating disease of apple trees in Florida. Twig cankers first appear as water-soaked spots that eventually enlarge and produce rings of black fruiting structures. It can spread from twigs to scaffold limbs and eventually to the trunk. It causes bark to darken and eventually to slough off. The fungus is spread as spores, particularly during wet and humid weather. Bot canker is especially severe from June through August. Fruit infection can also occur and appear as small circular brown spots with red borders. Control is achieved by pruning and removal of infected wood. Pruning cuts should be made beyond the area of visible infection into healthy tissue. There is no good chemical control.

Bitter rot: This fungal disease, incited by *Glomenella cinqulata*, 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. It is especially problematic in recently cleared land that contains residual tree roots that serve as a source of inoculum. 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. There is no satisfactory chemical control.

Scale insects: Several scale insects, primarily San Jose Scale, may infest leaves, twigs, branches or fruit and is usually controlled by a 2-3% dormant oil application.

Rabbit Control: Rabbits eat the bark of apple trees during the winter months and can kill the tree by the trunk. For best control, a physical barrier such as hardware cloth or plastic tree guards should be placed around the trunk of the tree. Rabbits will also feed on prunings in preference to young trees.

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Table 1. Adaptation, quality and origin of apple cultivars tested in north and north central Florida.

Cultivar	Origin	Area tested[z]	Chill hr[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 (Kidds 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
Gordon	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

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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
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

Table 1. Adaptation, quality and origin of apple cultivars tested in north and north central Florida.

Cultivar	Origin	Area tested[z]	Chill hr[y]	Ripening season[x]	Fruit quality[w]	Tree adaptability[v]	Recommendation status[u]

[u]Patented +R=recommended, CR=conditionally recommended, NR=not recommended
[v]A=adaptable, NA=not adaptable
[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.

	Flavors						Fruit Characters				
Cultivar	Taste	Aroma	Sweet	Acid	Ground color	Red skin	Fruit	Juice[z]	Texture	Shape	Brown-ing [z]
Anna	7	7	6	5	Light green to red	40-60% solid red	200	7	Crisp	Oblong conic	8
Dorsett	7	6	6	4	Light green to light	25 to 50% striped solid light red	150	7	Crisp	Oblique to conic	9
Ein Shemer	6	6	6	5	Light yellow	25 to 50% red	175	7	Medium	Oblong conic	8
Elah	6	6	7	5	Light green to yellow	25% light red	100	7	Medium	Round to	8
Maayan	6	6	7	7	Light green	100% dull dark red	100	8	Crisp	Round	8
Michal	6	6	6	5	Light green to	50% red striped	150	7	Very	Round to	2
Shlomit	6	6	6	7	Light green to light	25% rusty red	125	8	Crisp	Round to oblate	8
Tropic Sweet	8	7	9	5	Light green	50% light to red	200	NT	Crisp	Round conic	9

[z] 1=lowest, 10=highest, NT=Not tested
Table adapted largely from Miller and Baker 1982

Table 3. Trunk diameter and tree height of 3rd leaf 'Anna' and 'Dorsett Golden' apple trees on 4 dwarfing rootstocks.

Rootstock	Scion	Trunk Diameter (cm)	Tree height (m)
Mark	Anna	3.8 ± 0.8[z]	2.00 ± 0.14
M7A	Anna	5.2 ± 0.5	2.36 ± 0.168
P22	Anna	2.4 ± 0.6	1.90 ± 0.26
MM106	Anna	5.2 ± 0.4	2.57 ± 0.12
Mark	Dorsett Golden	1.8 ± 0.3	1.28 ± 0.45
M7A	Dorsett Golden	5.4 ± 0.8	2.64 ± 0.17
P22	Dorsett Golden	2.2 ± 0.8	1.95 ± 0.79
MM106	Dorsett Golden	5.6 ± 0.4	2.23 ± 0.65
Main effects[y]			
Rootstock		***	*
Scion		N.S.	N.S.
Interactive effects			
Rootstock * Scion		N. S.	N. S.

[z] Values correspond to means ± SE.
[y] Significance based on F Values; *, ***, and N.S. correspond to significant at 5%, 0.1%, or not significant, respectively.

Table 4. Characteristics of 4 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.

Table 4. Characteristics of 4 dwarfing apple rootstocks.[z]

	Mark	M7A	P22	MM106
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

[z] Sources: Cummins and Aldwinkle 1982; Carlson and Hull 1975; Westwood 1978.
[y] Percentage of seedling vigor.