LOW-CHELL PEACHES ADAPTED TO SUBTROPICAL FLORIDA AND TROPICAL PUERTO RICO

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Abstract. Low-chill peach (Prunus persica L. Batsch) cultivars adapted for subtropical climates and tropical highlands have been developed by the University of Florida deciduous fruit breeding program. Cultivars requiring approximately 100 to 150 chill units have been evaluated in south Florida and Puerto Rico. Chilling has been accomplished in Florida by changing latitude and in Puerto Rico by changing altitude. Four cultivars (Flordaprince, TropicBeauty, Flordaglo, UFGold) have been evaluated in two localities of the central mountainous region of Puerto Rico. Parameters of tree growth, flowering time and formation, fruit development, and fruit quality have been evaluated. Preliminary results show trees fruit with commercial crops maturing in April and May with fruit 5 to 8 cm diameter weighing 80 to 130 gram during an optimum market window when there are no other peaches available. Three of the four low-chill peach cultivars are adapted to climatic conditions prevailing in the central mountainous region of Puerto Rico. The recommended cultivars are high quality and suitable for commercial, u-pick, and home planting.

Peach cultivars adapted to subtropical and tropical highland climatic conditions have been developed in the low-chill stone fruit breeding program at the University of Florida. Yellow-flesh cultivars, ‘Flordaprince’, ‘TropicBeauty’ (Rouse and Sherman, 1989a; Sherman et al., 1982), and white-flesh cultivars ‘Flordaglo’ and ‘TropicSnow’ (Rouse and Sherman, 1989b; Sherman and Lyrene, 1989b) are low-chill cultivars with melting flesh currently recommended for limited commercial plantings and home gardens of central and south Florida (Rouse and Sherman, 1989a, 1998; Williams et al., 1995). Additionally, ‘UF Sun’ (Rouse et al., 2004), a non-melting, yellow-flesh cultivar was released in 2004 with extended shelf life following harvest. UF Sun was released to replace ‘UF Gold’ (Sherman and Lyrene, 1997) in south Florida where cool night temperatures during bloom are required for fruit set (Rouse and Sherman, 2002).

Production of high quality peaches with good flavor and fruit size, and low-chilling requirement (less than 200 chill units) has caught the interest of commercial producers of tropical and sub-tropical fruit crops that have ready markets established. The addition of a deciduous fruit crop in Florida is appealing since tropical fruits are subject to occasional cold damage. In the tropics, a deciduous fruit like peach would command a premium in local markets. Peaches with the above mentioned characteristics would command high prices in commercial, u-pick, and local markets because fruit ripens in a market window when peaches are not currently available. Commercial producers of avocado, mango, limes, carambola, and other tropical and sub-tropical fruits have shown interest in having an additional fruit crop available, such as peaches, when their packing facilities are not at capacity and when peaches are unavailable elsewhere. Peaches from Chile have disappeared in markets by early April, before low-chill peaches would mature. Low-chill peaches would ripen before the earliest higher-chill peach cultivars would be available. It would be important to have several cultivars that mature fruit sequentially from mid-April to mid-May to fill the commercial or u-pick market window.

Like other deciduous fruit trees, peach trees grown in the subtropics and tropics, require cool temperatures during the winter for leaf and flower bud dormancy to be satisfied before growth will resume in the spring. This chilling requirement is measured in units: the maximum amount of chilling that can be satisfied in one hour at an optimum temperature (Richardson and Walker, 1974). The optimum temperature for chilling in temperate zone peach cultivars is believed to be near 7.2°C (Chandler and Tufts, 1934; Weinberger, 1950, 1956). Low-chill, subtropical, peach cultivars acquire chilling at higher temperatures (Gurdian and Biggs, 1964; Rouse and Sherman, 2003), and have performed satisfactorily without temperatures below 7.2°C when experiencing winter cold of 14.5°C and above (Sharpe, 1969). Nevertheless, inadequate chilling can result in delayed and erratic flowering and foliation, reduced fruit set, and oblong-pointed misshaped fruit. Low-chill peaches trees acquire chilling in the subtropics (Florida) by change in latitude. In the tropics (Puerto Rico) chilling is acquired by increasing altitude.

Low-chill peach cultivars have been suggested for southwestern and central south Florida based on presumed chilling unit accumulation calculated from winter temperature records. Many times a chilling requirement for a low-chill cultivar is determined in an area that receives more than adequate chilling for that cultivar (i.e., Gainesville at 29°38’N, 82°21’W). The subtropical climate of southwest Florida allows the evaluation of cultivars at their extreme lower limits for acquiring chilling. Although selected cultivars at Gainesville may appear to be suitable for south Florida, they must be tested in any new location before final recommendations can be made (Topp and Sherman, 1989). Climatic adaptation, insect, and disease pressures vary at different locations. The objective of this study was to grow low-chill peach cultivars in southwest Florida and Puerto Rico, observe their adaptability to climatic conditions, and make observations that might encourage or limit their use in commercial specialty market windows, local markets, commercial u-pick operations, and home gardens.

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Materials and Methods

Peach cultivars ‘Flordastar’ (Sherman and Lyrene, 1989a), ‘Flordaprince’, ‘TropicBeauty’, ‘UFGold’, ‘Flordaglo’, ‘FloridaGrande’ (Rouse et al., 1984), ‘TropicSnow’ and ‘Rayon’ (Sherman et al., 1992) were budded to Flordaguard peach rootstock and planted in southwest Florida near Fort Myers (26°39'N, 81°45'W) and Immokalee (26°27'N, 81°26'W) between 1993 and 1996. Cultivar ‘UFSun’ was evaluated between 2000 and 2003. Although cultivars ‘Flordastar’ and ‘Rayon’ may be considered obsolete due to the availability of more recent cultivars, they were included because they satisfy the low-chill requirement and provide a comparison to other cultivars (Rouse, 1989; Rouse and Sherman, 1989a).

Peach cultivars ‘Flordaprince’, ‘TropicBeauty’, ‘UFGold’, and ‘Flordaglo’ were planted in 2002 at two University of Puerto Rico experiment stations at Adjuntas (18°10.530'N, 66°47.966'W) elevation 1,837 ft (670 m) and Corozal (18°19.377'N, 66°21.634'W) elevation 760 ft (277 m).

Trees in both Florida and Puerto Rico were spaced 15.0 ft (4.6 m) apart in a row and 22.0 ft (6.7 m) between rows, fertilized with a dry soluble complete blend 3 to 5 times per year, irrigated with microsprinklers, and maintained weed free beneath the canopy with contact/systemic herbicides. Trees were pruned to establish open centers and topped to maintain a maximum height of 8.0 ft (2.4 m). Fruit were lightly thinned and some over cropping occurred as a result of inexperienced personnel.

Bloom and fruit maturity dates were noted. Fruit shape, firmness, skin and internal color, taste, and resistance to flesh browning were all subjectively rated on a scale of 1 to 10, with 10 being the highest value for most desirable. Round fruit without protuberances or suture bulges received highest ratings. Fruit that matured unevenly or lacked firmness at the time of harvest, as evaluated by ground color change from green to yellow, received low scores because they are less acceptable for commercial use. Red peel color is desirable in U.S. markets and usually receives the best price, so cultivars with bright red color received a high rating. Fruit taste was subjectively scored highest for high aroma, sweetness, and a balanced sugar:acid ratio. Cultivars that bruise easily or have flesh that browns and darkens easily when cut and exposed to air are unacceptable and are rated low. Although white flesh color is not currently a major segment in U.S. markets, two selections with fruit characteristics equal to, in our opinion, the best yellow flesh cultivars were included.

Observations were made of insect and disease pressures to fruit and trees. Specific attention was given to bacterial spot [Xanthomonas campestris pv. pruni (Smith) Dye] disease resistance and peach leaf rust (Tranzschelidia disolor, (Fuckel) Tranzschel & Litvinov) in both Florida and Puerto Rico due to the humid climate and driving rainstorms associated with the summer rainy season.

Results and Discussion

In Florida trees of all observed peach cultivars (except ‘UFGold’) yielded good crops most years from 1997 to 2005 in southwest Florida. Table 1 shows tree and fruit characteristics of these cultivars. All cultivars had fruit with diameter exceeding 2.0 inches (5.0 cm). ‘Flordastar’, ‘Flordaprince’, and ‘UFSun’ were the first fruit to mature each season in mid-April. Fruit harvest of each cultivar lasted only 5 to 7 d after fruit becoming firm ripe. Cultivars matured fruit sequentially as listed in Table 1.

In Puerto Rico, results showed good growth, adaptability, and yield (fruit numbers) for all four cultivars, although ‘UFGold’, and ‘Flordaprince’ showed lower yield as compared to ‘Flordaglo’ and ‘TropicBeauty’ (Table 2). Fruit weight was recorded at different harvest dates. Results show that cultivars ‘Flordaprince’ and ‘TropicBeauty’ produced fruits with the highest weight as compared with ‘UFGold’ and ‘Flordaglo’ in the three orchards at Adjuntas and Corozal (Table 3). Thinning may have affected fruit weight and probably could be more selective and severe to produce larger and heavier fruit.

Fruit quality characteristics were observed and analyzed (Table 4). Fruit of cultivar ‘Flordaprince’ has attractive yellow melting flesh, with thinner skin when tree ripe, bright red exterior blush color, highly aromatic, very sweet and excellent flavor. ‘TropicBeauty’ has deep yellow melting flesh, with thinner skin when tree ripe, bright red interior blush color, highly aromatic, very sweet and excellent flavor. ‘TropicBeauty’ has deep yellow melting flesh, with thinner skin when tree ripe, bright red interior blush color, highly aromatic, very sweet and excellent flavor.

Table 1. Tree and fruit characteristics of lowchill subtropical peach cultivars grown in southwest Florida and Puerto Rico. Ratings compiled from observations during four years (1997-98 to 2000-03) in Florida and 2002-03 in Puerto Rico. Recommended cultivars in bold.

<table>
<thead>
<tr>
<th>Peach cultivar</th>
<th>Estimated chill units(^a)</th>
<th>Fruit wt. (g)</th>
<th>Pit(^b)</th>
<th>Flesh color(^c)</th>
<th>Firmness(^c)</th>
<th>Taste(^c)</th>
<th>Bacterial spot resistance(^c)</th>
<th>Browning(^c)</th>
<th>Ripe date(^c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flordastar</td>
<td>250</td>
<td>73</td>
<td>SC</td>
<td>Y</td>
<td>9</td>
<td>7</td>
<td>9</td>
<td>8</td>
<td>mid-April</td>
</tr>
<tr>
<td>Flordaprince</td>
<td>150</td>
<td>85</td>
<td>SC</td>
<td>Y</td>
<td>8</td>
<td>8</td>
<td>6</td>
<td>9</td>
<td>late-April</td>
</tr>
<tr>
<td>TropicBeauty</td>
<td>150</td>
<td>110</td>
<td>SF</td>
<td>Y</td>
<td>10</td>
<td>8</td>
<td>6</td>
<td>9</td>
<td>late-April</td>
</tr>
<tr>
<td>UFGold</td>
<td>200</td>
<td>100</td>
<td>C</td>
<td>Y</td>
<td>10</td>
<td>8</td>
<td>8</td>
<td>9</td>
<td>late-April</td>
</tr>
<tr>
<td>UFSun</td>
<td>100</td>
<td>105</td>
<td>C</td>
<td>Y</td>
<td>10</td>
<td>8</td>
<td>9</td>
<td>9</td>
<td>late-April</td>
</tr>
<tr>
<td>Flordaglo</td>
<td>150</td>
<td>124</td>
<td>SC</td>
<td>W</td>
<td>9</td>
<td>9</td>
<td>8</td>
<td>9</td>
<td>late-April</td>
</tr>
<tr>
<td>FloridaGrande</td>
<td>75</td>
<td>100</td>
<td>F</td>
<td>Y</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>early-May</td>
</tr>
<tr>
<td>TropicSnow</td>
<td>175</td>
<td>140</td>
<td>F</td>
<td>W</td>
<td>9</td>
<td>10</td>
<td>9</td>
<td>10</td>
<td>early-May</td>
</tr>
<tr>
<td>TropicSweet</td>
<td>250</td>
<td>111</td>
<td>F</td>
<td>Y</td>
<td>9</td>
<td>10</td>
<td>9</td>
<td>9</td>
<td>mid-May</td>
</tr>
<tr>
<td>Rayon</td>
<td>175</td>
<td>130</td>
<td>F</td>
<td>Y</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>8</td>
<td>late-May</td>
</tr>
</tbody>
</table>

\(^a\)One chill unit = one hour of chilling at an optimum temperature near 7.2°C.

\(^b\)F = free, SF = semifree where pit is loose when fruit is soft ripe, SC = semicling, C = cling.

\(^c\)Rated on a 1 to 10 scale where 10 is most desirable.
var (Rouse, 2003), good taste, longer shelf life, fruits ripened late as compared with the other tree cultivars. ‘Flordaglo’ is a melting type white flesh peach. Fruit quality analysis is shown in Table 4.

Flowering usually occurred in early February and the first fruit, depending on cultivar, matured 75 to 110 d later. Although there was some flowering in the fall and during warm periods in December or January, most premature flowers did not persist to produce fruit, and sufficient flower buds remained to produce a full crop.

The chilling requirement for these subtropical cultivars is relatively low, estimated at 75 to 200 chill units, making them suitable for the mild winters and subtropical and tropical highland climate conditions. All cultivars, except ‘Flordastar’, received adequate chilling each winter they were evaluated, and except for ‘UFGold’, produced excessive fruit that required thinning to get adequate size fruit. Trees experience limb breakage due to heavy fruiting if not thinned. The only chilling model that is suitable for predicting chilling received is the Mean Temperature Model (Okie, 1998; Sherman and Rodriguez-Alcazar, 1987; Sharpe et al., 1990; Rouse and Sherman, 2003) using January mean temperature as an indicator of chilling received in these low-chill cultivars requiring about chill units. The fact that the recommended cultivars near 150 chill units in Table 1 produced excessive crops but did not always receive the calculated adequate chilling (Rouse and Sherman, 2003) supports previous findings (Gurdian and Biggs, 1964; Sharpe, 1969; Sharpe et al., 1990) that low-chill clones are effectively chilled at progressively higher temperatures than high-chill clones each winter that effectively to temperatures near 60°F (15°C) (Sharpe et al., 1990). In some areas of the world it has been reported that low-chill peach cultivars set a fruit crop when half or less of the required chill hours at 45°F (7.2°C) have been received (Sharpe et al., 1990). ‘Flordastar’ (250 chill units) was marginal in receiving adequate chilling in the mild winters of 1997-98, 1998-99, 1999-00, and 2000-01 in south Florida, and may be better suited to central Florida and areas north of Orlando.

These cultivars are all self-fruitful and require no pollenizer. Trees required extensive pruning to achieve desired tree shape due to a 300 d growing season in Florida and Puerto Rico. Trees can grow to ten feet tall in the first year in Puerto Rico.

Pest problems were primarily due to diseases. The widely distributed disease bacterial spot was present on leaves of all cultivars, but did not cause excessive leaf loss until late in the growing season. Another disease, known as peach leaf rust, is more likely to be limiting to peach production in south Florida and was observed to cause early fall defoliation. Rust builds up quickly after harvest when the summer rainy season begins in mid-June in south Florida. All cultivars appeared susceptible. It was not uncommon for the trees to defoliate in late August or September and produce some bloom with partial re-foliation before winter.

Insect pests, although present, were not observed to be an uncontrollable problem. Plant bugs (Leptoglossus spp.) like the leaf-footed bug (Leptoglossus phyllopus L.), citron bug (L. Gonagra Fabricius), and stink bug (Nezara viridula L.) were observed in the spring during fruit development. Plum curculio (Conotrachelus nenuphar Herbst) was not observed. Sap beetles were only observed in overripe fruit still hanging on the tree. Caribbean fruit fly (Anastrepha suspensa Loew) known in south Florida and in dooryard peaches along the coastal areas, has not been observed in April ripening peaches grown interior to the state in southwest Florida. Caribbean fruit fly has been observed in Florida in May in over-ripe fruit remaining on the tree and in fruit on the ground. Caribbean fruit fly was not evaluated in Puerto Rico, but were not observed in fruit during the 2003 season. Caribbean fruit fly has been observed in guava and loquat that ripen latter during the summer. Diaprepes root weevil (Diaprepes abbreviatus (L.)) is indigenous to Puerto Rico, but no damage was observed. Peach white scale [Psaulacaspis pentagona (Targioni-Tozzetti)] has been observed on isolated trees in both Florida and Puerto Rico.

The peach cultivars found adapted and most suitable for commercial production are described. ‘Flordaprince’ trees require about 150 chill units and fruit ripen in mid-April. Fruit are attractive, having a bright red blush over a yellow background. Yellow flesh is semi-cling to the pit when fully mature. Fruit have highly aromatic flavor giving them an excellent taste and are consistently 2.0 inch (5.0 cm) or larger when properly thinned. ‘TropicBeauty’ trees require about 150 chill units, fruit ripens at the end of April and holds on the tree better than most other cultivars. Fruit have a high percentage red overcover on bright yellow background with very short fuzz, making the fruit highly attractive. The round, firm fruit have melting, deep-yellow flesh that frees from the pit at soft ripe. Fruit size is about 2.25 to 2.6 inch (5.7 cm to 6.4 cm) diameter.

‘UFGold’ is the first of a series of non-melting flesh cultivars that can fully ripen on the tree for maximum flavor and yet have the desirable qualities of low-chill melting flesh culti-
vars of good taste, and great external appeal (more firmness and longer shelf life). Trees require about 200 chill units with fruit ripening in late April. Fruit are 2.5 inch (5.7 cm) diameter and larger. The cultivar ‘UFGold’ has a fruit set problem when experiencing high-night temperatures during bloom (Rouse and Sherman, 2002). Cultivar ‘UFGold’ has been replaced with ‘UFSun’.

‘UFSun’ is a non-melting flesh cultivars with fruit quality characteristics similar to ‘UFGold’ and can fully ripen on the tree for maximum flavor. Trees require about 100 chill units with fruit ripening in late April. Fruit are 5.7 cm diameter and larger. Fruit picked at the commercial harvest stage of maturity are 50% to 70% red over a bright yellow ground color. Fruit shape is nearly round and slightly squat with no suture bulge and may have a slight tip at the bottom of the suture. Eating quality is good, sweet and slightly acid with a pleasing aftertaste with no bitterness.

‘Flordaglo’ is a white flesh peach requiring about 150 chill units. Fruit have high red overcolor on melting white flesh with a semicling pit. Fruit size is 5.7 cm to 6.4 cm diameter and it ripens late April to early May.

‘TropicSnow’ fruit are white fleshed, freestone, and trees require about 175 chill units. Taste is tart, but sweet, and aromatic. Fruit are large for the season at 5.7 cm or larger diameter and ripen early May to mid-May.

Peach cultivars found unsuitable were ‘Flordastar’, ‘FlordaGrande’, ‘TropicSweet’, ‘Rayon’ and ‘UFGold’. Cultivars ‘Flordastar’ failed to set full crops due to lack of chilling. Cultivar ‘Rayon’ matured fruit too late for the market window and was in competition with early maturing fruit during late May and early June in north Florida and south Georgia. Cultivar ‘FlordaGrande’ has been replaced with newer cultivars, and fruit ripened unevenly with a blossom-end point making it unsuitable for shipping. ‘UFGold’ had a fruit set problem and has been replaced with a newer cultivar.

In summary, low-chill peach cultivars can be successfully grown and fruiting in south Florida and the tropical highlands of Puerto Rico. They have fruit of good size, appearance and firmness, and warrant further use in the development of fruit cultivars for commercial, u-pick, and home gardens. Trees of the recommended cultivars (Table 1) are available from commercial nurseries in Florida that grow peaches. A few commercial plantings have been established in south Florida. Plantings range between 5 and 30 acres. There are also smaller acreage peach plantings with commercial u-pick operations that specialize in blueberries and other fruits.

**Literature Cited**


