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Potential of Nonmelting Flesh Peaches for the Early Season Fresh Market

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Abstract

The post-harvest behavior of commercial, moderate-chill, melting flesh peach [*Prunus persica* (L.) Batsch] cultivars ('Flordaking', 'Flordacrest', 'June Gold' and 'Juneprince') was compared to recently released nonmelting flesh cultivars ('Gulfking', 'Gulfcrest', 'Gulfcrimson' and 'Gulfprince') over four seasons. Storage protocol was designed to approximate conditions likely to be encountered during shipment to market via refrigerated truck and subsequent retail marketing, i.e. 5 d at 4°C followed by 2 d at 20°C. The nonmelting flesh cultivars displayed superior post-storage firmness compared to current commercial melting flesh cultivars. Additionally, the nonmelting flesh cultivars generally displayed superior cropping ability, fruit shape, red skin blush, ground color development, and soluble solids/titratable acidity ratios. Moreover, they generally were of comparable marketable size and had a reduced incidence of split and shattered pits. This suggests that these new nonmelting flesh cultivars merit testing as alternatives to current commercial melting flesh cultivars.

The primary purpose of the three-way cooperative regional project involving the USDA-Agricultural Research Service, University of Georgia, and University of Florida is to develop improved fresh-market peach cultivars for use in the moderate-chill areas of the southeastern United States. Since 1995, this project has concentrated on the development of nonmelting flesh genotypes as an alternative to conventional melting-type cultivars (1). It is our belief that the slower softening, nonmelting characteristic will allow growers to pick fruit at a more mature stage, thus improving eating quality for consumers without sacrificing shipping ability. Nonmelting flesh germplasm has traditionally been utilized only for the development of canning peaches where this trait provides significantly stronger flesh integrity during the canning process. 'Gulfprince', the first nonmelting flesh cultivar from this program, was released in 1999 (17) followed by 'Gulfking' (2) and 'Gulfcrest' (12) in 2003 and 'Gulfcrimson' (3; Krewer et al., in submission) in 2007. This is a continuing project and additional releases are expected in the near future.

Earlier work by this program demonstrated that nonmelting flesh peaches softened much more slowly during ripening than did conventional melting flesh cultivars and selections (1). This offered the possibility of leaving fruit on the tree longer while it accumulates more flavor, soluble solids, red skin color, yellow-orange ground color and greater size. Moreover, titratable acidity typically declines as fruit ripen, thereby increasing the ratio of soluble solids (SS) to titratable acidity (TA) which, in turn, improves consumer acceptance (8). The purpose of this trial was to compare the performance of these new non-melting peach varieties to that of current standard commercial varieties that attain harvest maturity in the same timeframe.

Materials and Methods

'Flordaking' and 'June Gold' are the two most important commercial cultivars utilized in the moderate chill production area of south Georgia (11). 'Flordacrest', which ripens between 'Flordaking' and 'June Gold', and 'Juneprince', which ripens shortly after 'June Gold' are less widely planted. These four melting flesh cultivars typically ripen over a four week period, forming a series that can be harvested sequentially to provide a steady stream of fruit. Hence, they were utilized in

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this study as standards. Field performance of these cultivars has been previously reported (4) as has their post-harvest performance (1). Recently released nonmelting flesh cultivars from this program ('Gulfking', 'Gulfcrest', 'Gulfcrimson' and 'Gulfprince') that attain harvest maturity at the same time as these commercial cultivars were utilized to compare the performance of nonmelting flesh to that of the standard commercial melting flesh cultivars.

Field performance data and fruit samples were collected at the University of Georgia Research Station located in Attapulgus, GA. The same set of two or three trees of each cultivar were sampled in each of the four years of this study (except that no data were collected for 'Flordacrest' and 'Juneprince' in 2005). With the sole exception of 'Gulfprince', trees of each of the eight cultivars utilized in this study differed in age by no more than one year. Trees of 'Gulfprince' were three or four years older than the other cultivars.

Trees were planted at a 3.7 m (within row) by 5.5 m (between row) spacing. The soil was an Orangeburg Loamy Sand. The trees were maintained according to standard commercial practices of the region (10) and received supplemental irrigation via a microsprinkler system as needed. Methodology for most characteristics evaluated in the field has been published (4). In this study, mean fruit weight was estimated in the field from a sample of 10 fruit. Fruit diameter was estimated in the field with a handheld device that converted circumference to diameter (Cranston Machinery Co., Oak Grove, Ore.). The largest and smallest fruit in the sample of 10 were measured and then averaged. Appearance and quality were rated subjectively in the field. Fruit with an approximately round shape and sufficient red blush (typically 60% minimum) and ground color development (combined with only minimal greenish ground color at the stem end) were scored as a 7 on the 10-point scale. Fruit with sufficient soluble solids to be perceived as being sweet without an excess of acidity were also scored as 7.

Fruit for post-harvest work were picked as ground color changed from green to yellow (6, 7), transported on trays in iced Styrofoam coolers to the USDA-ARS laboratory at Byron, GA for testing, and stored overnight at 4°C before initial physical measurements were made. The following day a 15 fruit sample of each cultivar was selected for processing through the storage protocol. Any fruit with visible splits or damage were discarded. Prestorage firmness was measured destructively on a separate sample of 7-15 fruit (remainder of original sample) of each genotype with a McCormick fruit pressure tester, Model FT011 or FT327 (McCormick Fruit Tech, Yakima, Wash.), fitted with an 8 mm tip. A single firmness measurement was made on one randomly selected cheek of each fruit after removal of a patch of skin *ca*. 25 mm in diameter. This set of fruit was then discarded.

Fruit in the 15-fruit storage protocol sample of each genotype were weighed and yellow ground color was measured. Ground color was measured on the greenest area of the fruit using a Minolta CR-200 Chroma Meter (Minolta Corp., Ramsey, NJ). Color was measured in CIELAB and converted to L*=lightness, C*=chroma and h°=hue angle (0°=red-purple, 90°=yellow, 180°=bluish-green) as described by McGuire (13). The instrument was calibrated on a white target (CRA43), using C illuminant and d/0 illuminant/viewing geometry. After initial measurements, fruit were placed in cold storage at 4°C for 5 d and transferred to a 20°C environment for 2 d before the final set of measurements.

Following completion of the storage protocol, weight and ground color measurements were repeated on the 15 fruit sample. These fruit were then subjected to firmness measurements as described for the pre-storage sample. After, fruit were destructively sampled for percent soluble solids (SS), and titratable acidity (TA). A slice *ca*. 25 mm in diameter was removed from the remaining undamaged cheek of each fruit and squeezed to express juice onto a digital refractometer (Atago, Model PR-1, NSG Precision Cells, Farmingdale, NY) for determination of SS.

The fifteen fruit sample of each genotype was divided into three groups of five fruit each. A small sample of flesh (*ca*. 2 grams) was collected from one cheek (same one sampled for SS) of each of the five fruit, composited into one sample, and the final weight adjusted to 10 g. Fifty ml of distilled water were added and the sample pureed in a Waring blender. Pureed samples were stored at –10°C until analyzed for pH and TA (15). Finally, fruit were sliced in half and inspected for internal split pits.

Data from each pair of cultivars were analyzed by the General Linear Models (GLM) program of the Statistical Analysis System for personal computers (16). A randomized complete block model was utilized with years treated as replications. Prior to analysis, the percentage values for crop load (Crop), red color (Red), SS (SS), TA (TA), and split pits (Splits) data were transformed as arcsine (square root) as recommended by Gomez and Gomez (9). The authors recognize the limitations of this type of analysis on the discontinuous, subjective data collected for firmness, quality, shape, and appearance in the field.

Results and Discussion

'Gulfking' ripened with 'Flordaking' and offered an attractive alternative (Fig. 1). 'Gulfking' was judged in the field to have superior shape, red skin color, and overall appearance (Table 1). Although somewhat smaller than 'Flordaking', all 'Gulfking' fruit exceeded 90 grams (data not shown) which is a typical weight for a 57 mm diameter peach (2.25"), the most common size sold in the early season. Compared to 'Flordaking', 'Gulfking' offered higher post-storage firmness, a more attractive yellow-orange ground color, and significantly lower TA (Table 2). This last trait translates to a superior soluble solids/titratable acidity (SS/TA) ratio, much closer to a ratio of 15 which is thought by some to be the threshold for a high quality main season fruit (8, 14). Moreover, 'Gulfking' produced significantly fewer split pits than did 'Flordaking'. Growers typically report up to 20% of their 'Flordaking' fruit are culled in the field or packing house for visible splits (H. Lawson, personal communication). Split pits have been a major criticism of 'Flordaking'.

'Gulfcrest' ripened with 'Flordacrest' and is a potentially more attractive alternative (Fig. 2). 'Gulfcrest' was comparable in size and weight to 'Flordacrest' and offered superior red skin color and overall appearance (Table 1). 'Gulfcrest's' post-harvest performance also offered advantages over 'Flordacrest' including higher post-storage firmness, a more yellow-orange ground color, and a higher SS/TA ratio. Both cultivars had a low number of splits pits.

'Gulfcrimson' (proposed for release in 2007) ripened with 'June Gold' and offered a much more attractive alternative (Fig. 3). 'Gulfcrimson' has a significantly better cropping history largely due to the fact that 'June Gold' often suffers from inadequate chilling, causing it to bloom late and set poorly in South Georgia. 'Gulfcrimson' was comparable in size to 'June Gold' and provided better shape, red skin color, and overall appearance (Table 1). 'Gulfcrimson' also provided higher post-storage firmness, yellow-orange ground color, and lower TA which translates to a significantly higher SS/TA ratio (Table 2). Additionally, 'Gulfcrimson' had a significantly lower incidence of split pits, which has also been a major criticism of 'June Gold'.

'Gulfprince' ripened with 'Juneprince' and offered a more attractive product (Fig. 4). 'Gulfprince' was comparable to 'Juneprince' in size and red skin color, but provided superior shape and overall appearance (Table 1). 'Gulfprince' displayed higher post-storage firmness and SS/TA ratio. Like 'Juneprince', it produced very few split pits.

For all cultivars tested, weight loss (shrinkage) during the post-harvest storage period ranged from 4-8% (data not shown) and was not significantly different between melting and nonmelting flesh cultivars. There were generally no significant differences in initial pH (during TA determination) which ranged from 3.1 to 3.5 (data not shown).

In general, compared to the standard melt-

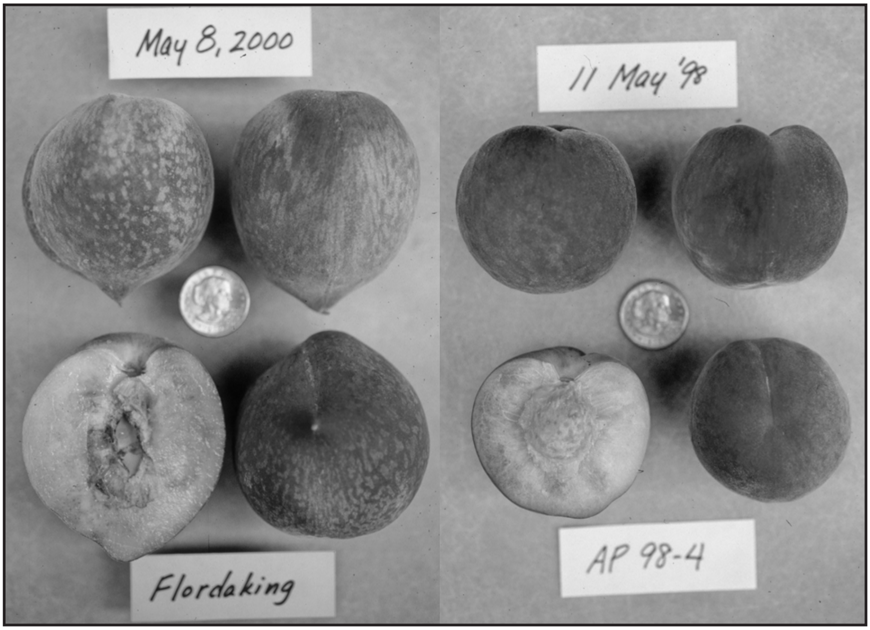

Figure 1. Typical fruit of ‘Flordaking’ and ‘Gulfking’ (AP98-4) peaches. Diameter of coin in photo is 26.5 mm.

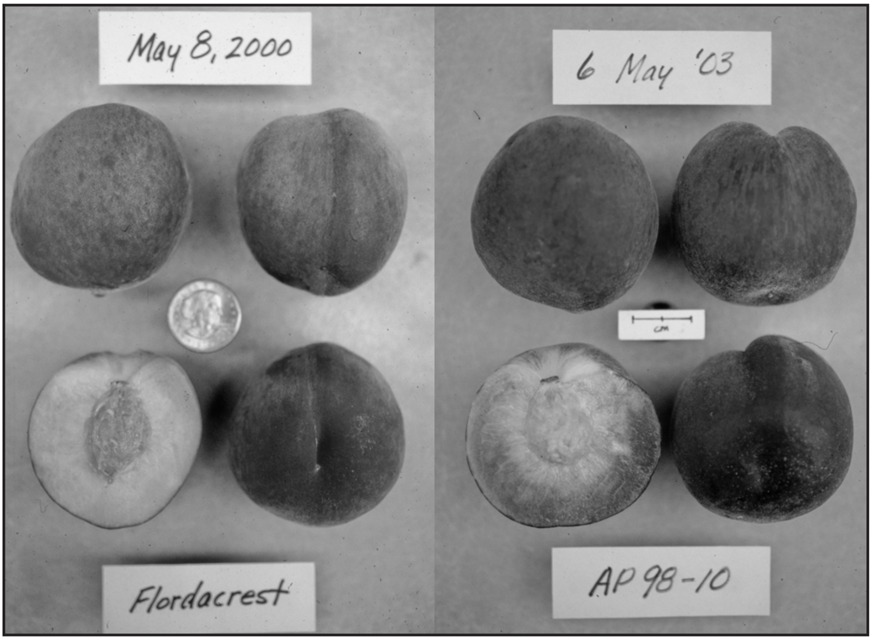

Figure 2. Typical fruit of ‘Flordacrest’ and ‘Gulfcrest’ (AP98-10) peaches. Diameter of coin in photo is 26.5 mm.

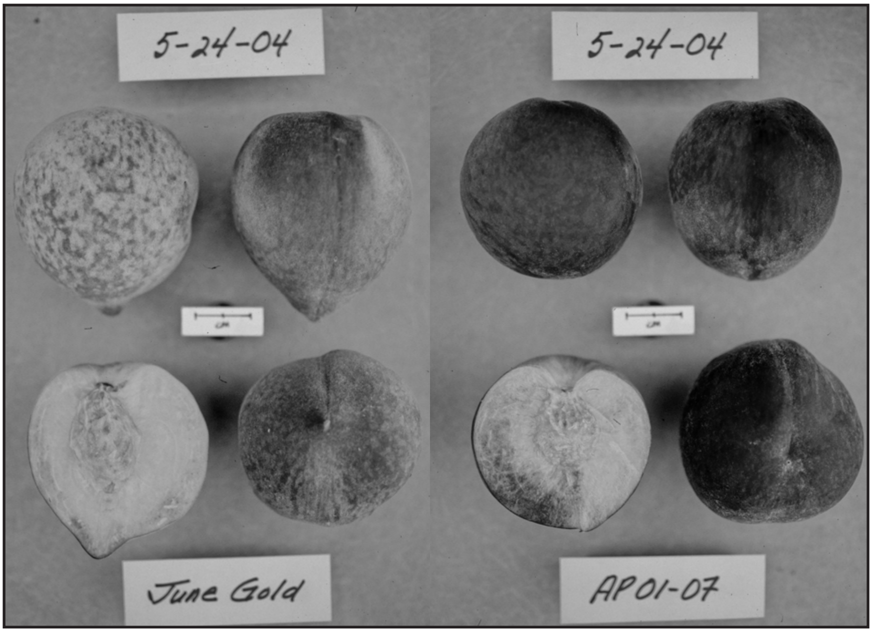

Figure 3. Typical fruit of ‘June Gold’ and ‘Gulfcrimson’ (AP01-7) peaches.

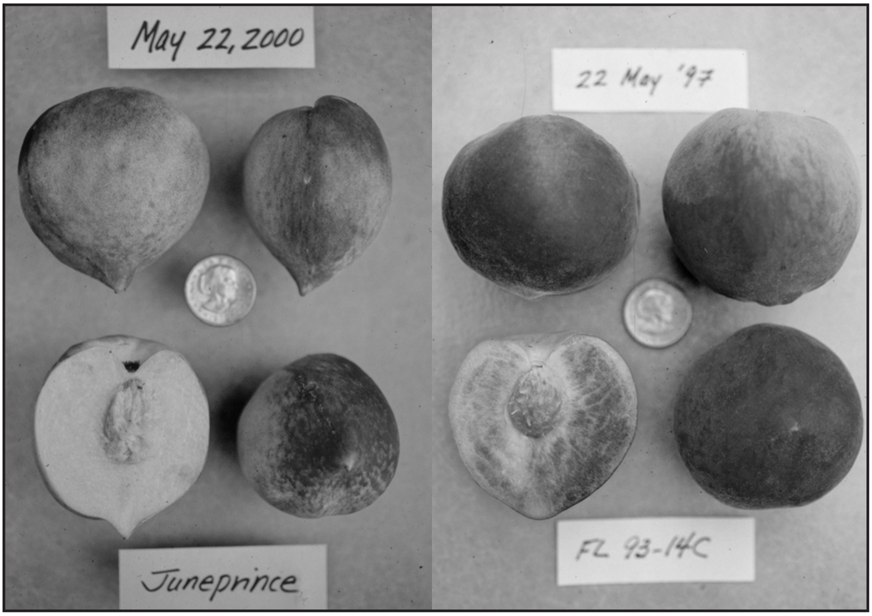

Figure 4. Typical fruit of ‘Juneprince’ and ‘Gulfprince’ (FL93-14C) peaches. Diameter of coin in photo is 26.5 mm.

ing flesh peach cultivar with which they attain harvest maturity, each nonmelting flesh cultivar offered equal or better cropping ability, shape, appearance, red skin color, and firmness in the field in combination with superior post-storage firmness, a more attractive yellow or yellow-orange ground color, and reduced split pits. Their SS/TA ratios were at or above those suggested for high consumer acceptance for fruit in this range of TA (5). In short, they offered an attractive alternative not only in terms of production efficiency (i.e. cropping reliability) and marketing (appearance and firmness), but also in fruit quality (SS/TA ratio and reduced split pits).

These results indicate that nonmelting flesh peaches are a viable alternative to conventional melting-flesh cultivars for the early season shipping industry. Continued breeding and development is expected to provide further improvements in size, appearance, soluble solids and eating quality.

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Erratum

The following two tables were inadvertently omitted from an article published in the April 2008 issue of Journal of the American Pomological Society. The correct citation for this article should therefore be as follows:

Beckman, T.G., G.W. Krewer, J.X. Chaparro and W.B. Sherman. 2008. Potential of nonmelting flesh peaches for the early season fresh market. J. Amer. Pomol. Soc. 62: 52-57, 139-140.

Table 1. Field performance of standard peach cultivars vs. recently released nonmelting flesh cultivars (Attapulgus, Ga., 2002-2005).

Cultivar	Type[z]	Chill (hr)[y]	Crop (%)[x]	Harvest date[w]	Diameter (mm)	Weight (g)	Firmness[v]	Quality[v]	Shape[v]	Red (%)	Appearance[v]
Flordaking	M	350	45	128	68.4	155	6.0	6.0	4.8	28	5.3
Gulfking	NM	350	63	125	63.4	119	8.7	6.8	8.0	80	8.3
Significance (P)[u]			0.423	0.080	0.009	<.001	0.015	0.444	0.007	0.002	0.063
Flordacrest	M	350	69	133	65.2	136	7.0	6.0	6.3	48	6.0
Gulfcrest	NM	525	80	135	64.1	129	9.0	7.2	7.0	82	8.0
Significance (P)			0.304	0.391	0.120	0.091	<.001	0.057	0.423	0.038	<.001
June Gold	M	650	55	145	62.4	135	7.0	5.2	4.0	35	5.0
Gulfcrimson	NM	400	90	148	65.9	135	8.7	7.0	7.5	80	7.7
Significance (P)			0.092	0.391	0.306	0.917	0.006	0.006	0.001	0.001	0.011
Juneprince	M	600	63	151	66.2	154	7.0	6.7	5.3	60	6.0
Gulfprince	NM	400	97	151	69.4	145	8.3	7.3	8.0	47	7.3
Significance (P)			0.114	0.423	0.867	0.264	0.057	0.183	0.015	0.183	0.057

[z] Flesh type (Type): melting (M) or nonmelting (NM).
[y] Chilling hours (Chill) below 7ºC required to break winter rest.
[x] Percent crop load (Crop) is judged as percent of a full crop, i.e. fruit evenly spaced 10-15 cm apart throughout canopy.
[w] Julian day.
[v] Subjective firmness, quality, shape and appearance ratings: 1=least desirable, 7=minimum commercial acceptability, 10=most desirable.
[u] Significance (P) of difference between means in each column (within each cultivar pair). Percent Crop Load (Crop) and Red Skin Color (Red) were transformed as arcsine (square root) prior to analysis (Gomez and Gomez, 1984). Untransformed means presented.

Table 2. Post-harvest performance of standard peach cultivars vs. recently released nonmelting flesh cultivars (Attapulgus, Ga., 2002-2005).

		Pre-storage					Post-storage								
				Ground color[x]					Ground color						
Cultivar	Type[z]	Weight (g)	Firmness (kg)[y]	L*	C*	h°	Weight (g)	Firmness (kg)	L*	C*	h°	SS (%)[w]	TA (%)[v]	SS/TA	Splits (%)
Flordaking	M	159	2.6	69	44	94	150	1.1	71	44	93	10.7	1.26	8.5	55
Gulfking	NM	136	2.2	58	45	76	125	1.9	58	45	70	10.6	0.89	12.1	3
Significance (P)[u]		0.254	0.614	0.002	0.235	0.001	0.166	0.033	0.029	0.573	0.031	0.970	0.035	0.035	0.015
Flordacrest	M	127	3.6	66	44	80	122	1.0	66	45	76	10.1	1.21	8.4	0
Gulfcrest	NM	125	2.1	50	38	63	116	2.1	51	38	56	9.9	0.87	11.8	7
Significance (P)		0.706	0.011	0.255	0.134	0.122	0.465	0.028	0.263	0.247	0.169	0.610	0.103	0.116	0.423
June Gold	M	147	3.4	66	44	84	141	0.9	65	44	78	10.5	1.24	8.6	52
Gulfcrimson	NM	149	2.2	52	43	59	143	2.0	53	42	58	11.3	0.81	14.4	0
Significance (P)		0.859	0.081	0.016	0.216	0.032	0.873	0.049	0.061	0.241	0.135	0.197	0.050	0.017	0.058
Juneprince	M	136	2.6	66	45	78	130	0.7	66	45	74	10.6	1.31	8.2	3
Gulfprince	NM	145	2.0	61	48	80	138	1.9	62	48	76	11.8	1.16	10.2	0
Significance (P)		0.862	0.360	0.129	0.069	0.725	0.860	0.008	0.445	0.122	0.731	0.078	0.147	0.048	0.423

[z] Flesh type (Type): melting (M) or nonmelting (NM).
[y] Penetrometer force (Firmness) determined with a McCormick Fruit Pressure Tester, Model FT011 or FT327, fitted with 8 mm tip.
[x] Measured using a Minolta chroma meter CR-200 in CIELAB and converted to L*=lightness, C*=chroma and h°=hue angle (0°=red-purple, 90°=yellow, 180°=bluish-green) as described in McGuire, 1992. Instrument was calibrated on a white target (CRA43), using C illuminant and d/0 illuminant/viewing geometry.
[w] Percent soluble solids (SS) determined with digital refractometer.
[v] Titratable acidity (TA) as % malic acid.
[u] Significance (P) of difference between means in each column (within each cultivar pair). Percent soluble solids (SS), titratable acidity (TA), expressed as % malic acid, and percent split pits (Splits) were transformed as arcsine (square root) prior to analysis (Gomez and Gomez, 1984). Untransformed means presented.