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HS920

Early-Maturing Sweet Oranges: Research Update on Earlygold, Itaborai, Ruby, and Westin Sweet Oranges [1]

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Earlygold, Itaborai, Ruby, and Westin are new sweet orange selections with varying combinations of exceptional juice color, interesting flavor, or good soluble solids development early in the fruit season. Considering these characteristics, these cultivars have commercial potential as juice oranges and are discussed here.

The first trees of these early-maturing sweet oranges were evaluated during the late 1980s and early 1990s in original Florida field trials at St. Cloud. Descriptions of these selections (and Vernia, an early maturing Valencia type orange), along with some of their performance characteristics, were published in the June 1999 issue of Citrus Industry magazine. Since then, Bureau of Citrus Budwood Registration records indicate that about 1.6 million trees of these selections (including Vernia) were propagated from 1999 through 2002. The most popular selection has been Earlygold (59% of the total) followed by Vernia (14%), Westin (13%), and Itaborai and Ruby (7% each).

Data are no longer being collected from the original trial at St. Cloud, but additional trials have been established in commercial groves on the Ridge and in the Immokalee area. The trees for these trials were propagated using buds from the original trees but on other rootstocks not used in the St. Cloud trial.

Ridge Site Results (Dundee)

This site is located east of Lake Hamilton on a typical Ridge soil (Candler sand). Earlygold, Itaborai, and Ruby trees on eight rootstocks (Table 1) were planted in 1995 at 12 feet x 22 feet and are irrigated with microsprinklers. This formal trial also includes normal mature-line commercial Hamlin trees on Swingle citrumelo for comparison.

Using buds from the above formal trial, Earlygold trees on either Benton citrange or two size-controlling rootstocks (C-35 citrange and K x R citrange) were also planted for informal observation. Using buds from the original St. Cloud trial, Westin trees were also similarly planted.

All trees grew well in the first 7 years after planting. In the formal trial, those on Carrizo and Kuharske citranges are among the tallest although the differences among trees on different rootstocks are not very great. However, virtually all trees of the new selections, except those on C-35 citrange, are taller than the Hamlin trees on Swingle.

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Results from the first 4 bearing years indicate that the new selections in this trial develop juice color superior to Hamlin. That advantage appears as soon as early September (Fig. 1 and Fig. 2). The color numbers continue to improve to about 35 or 36 by late October-early November depending on the year. *(Note that color number is the value measured by the official colorimeter; color score is the legal 2-digit value derived from rounding off the color number, e.g., a color number of 35.6 = color score of 36.)* Juice color also develops well ahead of peel color and at harvest, peel color usually changes from green to yellow. However, if fruit remain on the tree, or cool weather comes early, the peel can turn to an attractive orange with hints of red.

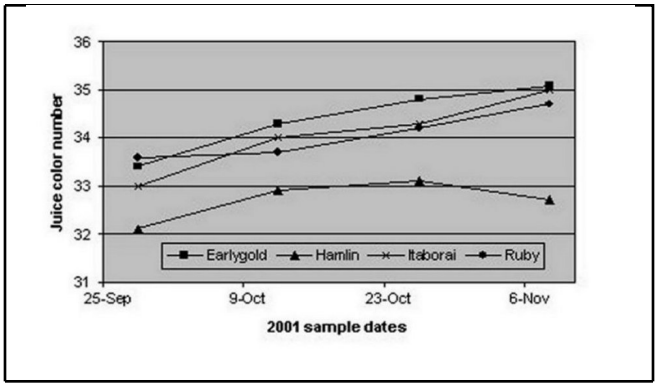

Figure 1. Changes in juice color number of early-maturing sweet orange selections on Swingle citrumelo rootstock at the Ridge site during the 2001-02 season.

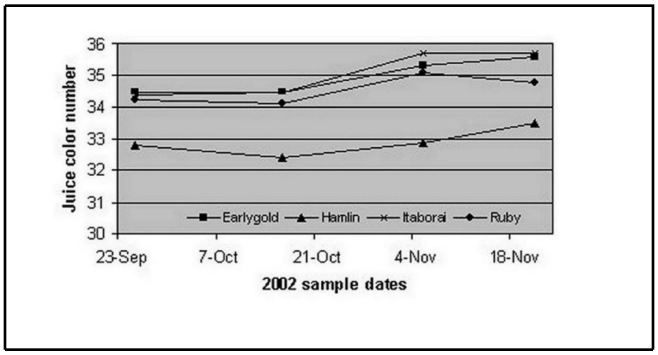

Figure 2. Changes in juice color number of early-maturing sweet orange selections on Swingle citrumelo rootstock at the Ridge site during the 2002-03 season.

The average yield across all rootstocks for the 2002-03 season was 3.3 boxes/tree for Earlygold, 2.4 boxes for Itaborai, and 2.1 boxes for Ruby sweet orange. The Hamlin trees on Swingle produced about 2 boxes per tree. These yields are slightly down from last year, probably reflecting the lower predicted sweet orange yield of the industry as a whole for this season.

Each year there have been only slight, but consistent differences in yield among the trees on the eight rootstocks. Cumulative performances over the earliest 4 bearing years, regardless of the scion selection, show that the trees on some rootstocks like Kuharske and C-35 citranges are producing well despite their differences in tree sizes, while others like Smooth Flat Seville are disappointing so far (Table 1 and Table 2). The Earlygold, Itaborai, and Ruby trees on Swingle have yielded as well as or better than the Hamlin trees on Swingle.

A more telling story is evident in the cumulative pounds-solids (PS^3) data (Table 1 and Table 2). Again, the differences among rootstocks are not large, but Earlygold, Itaborai, and Ruby sweet orange cumulative pounds-solids exceed that of Hamlin on Swingle by 500 to 2,000 PS/acre after 4 seasons. This range in PS is mostly the result of yield differences of these experimental cultivars on different rootstocks, but note the differences in juice quality as well (Table 3, Table 4 and Table 5). Over the last two seasons, trees of each selection generally produced the best quality juice (ratio and color number) when grown on Swingle or C-35. Trees on Smooth Flat Seville produced fruit with relatively poor juice quality and were relatively low-yielding (see boxes/tree in Table 1 and Table 2) which explain their low cumulative PS/acre.

Westin sweet orange trees on Benton citrange are part of the Ridge site although they are younger than the trees in the formal trial. The Westin trees have fruited since the 2000-01 season. Fruit tends to be somewhat flattened like a grapefruit with better PS than Earlygold and Itaborai. Westin also matures early, and its juice color is similar to Hamlin. However, in Brazil, Westin trees have a reputation for premature fruit drop. In the last season (2002) the trees were particularly well cropped and dropped about 5 to 10% of their fruit; this season the trees were not as well cropped and dropped very little fruit.

Southwest Site Results (Immokalee)

The trees at this site were planted at about the same time from the same batch of nursery trees as those used to plant the Ridge trial. The trees were not planted in a formal trial, but in whole beds of each sweet orange selection with trees within a bed grouped by rootstock. Seasonal tracking data of juice quality, yield observations, and tree height measurements have been recorded from this site.

All indications so far suggest that the trees at both sites are performing similarly. The trees at Immokalee have grown well, and their fruit show the same seasonal juice color and PS patterns as the fruit in the Ridge trial (Fig. 3, Fig. 4, Fig. 5 and Fig. 6).

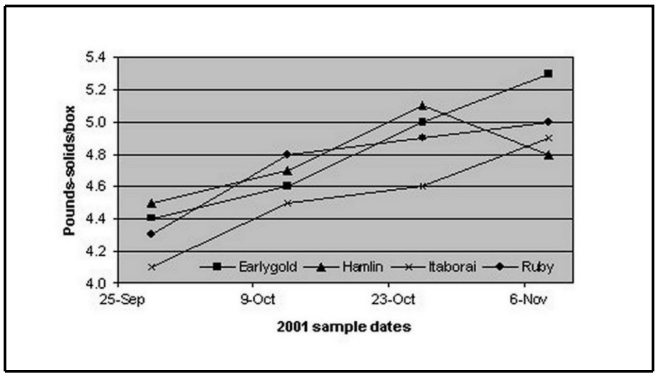

Figure 3. Changes in juice pound-solids/box of early-maturing sweet orange selections on Swingle citrumelo rootstock at the Ridge site during the 2001-02 season.

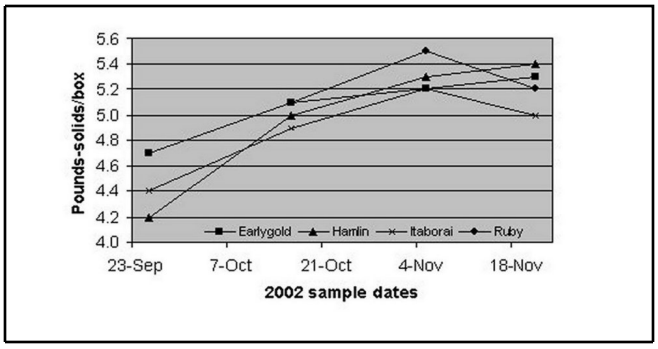

Figure 4. Changes in juice pound-solids/box of early-maturing sweet orange selections on Swingle citrumelo rootstock at the Ridge site during the 2002-03 season.

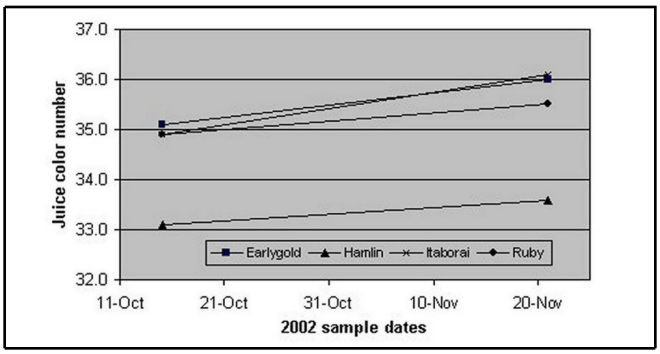

Figure 5. Changes in juice color number of early-maturing sweet orange selections on Swingle citrumelo rootstock at the Immokalee site during the 2002-03 season. The Hamlin fruit were obtained from a nearby, but different grove.

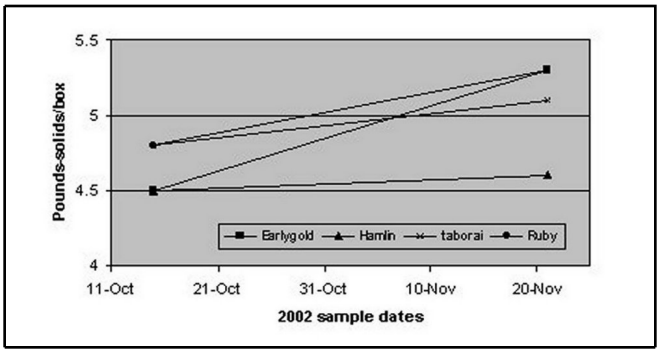

Figure 6. Changes in juice pound-solids/box of early-maturing sweet orange selections on Swingle citrumelo rootstock at the Immokalee site during the 2002-03 season. The Hamlin fruit were obtained from a nearby but different grove.

Grower Cautions

Growers are encouraged to plant these new sweet oranges, but should also be restrained in their expectations. As you examine and interpret the data presented, it may be tempting to draw comparative conclusions about the scion selections or the rootstocks, but that would be risky at the moment. It is safe to conclude that Earlygold, Itaborai, and Ruby have distinct juice color advantages over Hamlin, but it is not timely to conclude that any of the new scion selections will otherwise out-perform Hamlin on a yield or PS basis. The PS/box values of the new selections may strike some readers as low, but a quick check of the November Florida Agricultural Statistical Service maturity data (http://www.nass.usda.gov/fl/) shows that these new cultivars are nearly identical to Hamlin for early season fruit. Hamlin trees can produce fruit with nearly 6 pounds of solids/box, but not ordinarily in November.

The Ridge trial trees are now 7 years old and the best combinations are starting to produce 3 or 4 boxes/tree, depending on the rootstock. PS/box values are very similar to Hamlin values, but growers should recognize that these three selections cannot be held on the tree into late December or January like Hamlin. Every year the Brix/Acid ratio has either approached or exceeded 20 by mid-November. These sweet orange selections are very much early maturing and must be harvested early. For this reason, the use of these selections as resets in a Hamlin grove, or to convert a Hamlin grove, should be carefully considered.

Earlygold has been the most heavily favored in propagation of these selections thus far. The Ridge site data tend to support that decision. However, take a closer look at the Hamlin/Swingle data. Those data vary among the trees included in each of the areas where an experimental scion selection is being grown. For example, the Hamlin trees growing among the Ruby trees have a cumulative yield of 6.5 boxes/tree. The Hamlin trees in the Itaborai area yielded 9.1 boxes. What if the Ruby trees had been planted where the Itaborai trees are and vice versa? The results might be different and could lead to different conclusions. Other factors could have affected these yields.

Juvenility

One strategy for introducing new sweet oranges and other cultivars into Florida is to obtain seeds from promising varieties grown in different citrus producing regions around the world. Sweet orange seeds are highly nucellar which means that most sweet orange trees (and fruit) grown from seed are going to be genetically similar to the tree from which they came. Other citrus scion cultivars, especially mandarin hybrids like Robinson, Fallglo, and Ambersweet do not have a high percentage of nucellar seedlings and seedling trees and fruit probably will not be identical to the parent tree.

Citrus nurserymen use budwood from mature trees that are already flowering and fruiting to propagate new nursery trees. This ensures that trees will come into production as soon as possible and will not have to go through a juvenile period, as most seedling trees do, before flowering. In the past, it was thought that seedling sweet orange trees and buds taken from these seedling trees would not flower for seven to ten years. However, in the original field trial at St. Cloud planted in the late 1980s and 1990s, buds taken from 1-year old sweet orange seedling trees and budded onto Swingle rootstock began to bear fruit after three to four years.

Yield and fruit characters are also related to tree juvenility. The trees at the Ridge and Immokalee sites are relatively juvenile. They are still vigorous, upright in growth habit, and thorny which is understandable given that they were propagated with buds taken from trees only about 6 years beyond the seedling stage. In contrast, the Hamlin trees in the Ridge trial were propagated from mother trees many years away from the original Hamlin and, thus, have virtually no juvenile tree or fruit traits.

The full loss of juvenile traits in the new sweet orange selections will require time and can be accelerated by serial propagations. Buds from seedlings (1st generation) were used to propagate the original trial trees (2nd generation) at St. Cloud. Buds from these trial trees were then used to produce the Ridge site trees (3rd generation). Budwood source trees (4th generation) propagated from the Ridge site trees will generally be less juvenile than ones produced from the St. Cloud trees. Therefore, as a practical matter, growers should always inquire about the origin of the bud-source trees used to produce nursery trees and buy trees propagated from trees as far removed as possible from the original trees at St. Cloud. Nursery managers should also consider this factor in sourcing buds for increase blocks or nursery trees, or propagating their own mother trees. Trees produced from the latest generation mother trees will be more “settled” and more like normal grove trees.

Growers will notice that Earlygold, Itaborai, and Ruby trees look and behave differently than normal trees. The trees at both locations have relatively dense canopies resulting in shading that leads to some fruit drop and shoot dieback especially when the trees produce good crops and the branches pull down. The fruit have a thicker, coarser peel unlike the smooth, thin peel of Hamlin fruit. Those juvenile traits may be particularly problematic for fresh fruit growers.

Limited experience suggests that the “stiffness” of the peel may cause unexpected oil release during handling resulting in oleocellosis damage (go to http://edis.ifas.ufl.edu/CH119 for a fact sheet on oleocellosis).

Rootstocks

Smooth Flat Seville appears to be unsuited for these orange selections on the Ridge because of low yield and relatively poor juice quality. Of the other rootstocks similar to Smooth Flat Seville (Gou tou and Kinkoji), trees on Kinkoji have performed the best so far. Little information is available about Kuharske citrange, but the results from these trials are encouraging.

Tree size is smaller for those on C-35 citrange as compared with those on other rootstocks, but excellent juice quality and yield for the size of tree continue to encourage the use of this rootstock. Given the juvenile nature of the scion material generally available, the scion vigor and size-controlling aspects of this rootstock is a good match.

Acknowledgements

The continued support of Orie Lee on whose property the original trial was conducted, and the generosity of Harold McTeer who provides his wisdom and support for the current trial, are greatly appreciated. Thanks also to Agtoprof and Kahn Grove Service, and the Florida Citrus Production Research Advisory Council for funding through grant 0110-31I.

Additional Notes:

3. Pounds-solids (PS): The major determinants of citrus juice quality are percent total soluble solids or sugars (TSS), also called degrees Brix, percent titratable acidity (TA), the ratio between total soluble solids and titratable acidity (TSS:TA or the Brix:Acid ratio) and percent juice content.

Commercially, when fruit enter a processing plant, the load is sampled and PS are determined with standard equipment that measures the total soluble solids and percent juice of each sample. For example, a field box of oranges weighs 90 pounds. If 50% of the 90 pounds is juice (50% x 90 pounds=45 lbs juice per box) and if the TSS are 10% of juice weight, then PS per box=4.5 lbs. PS/box can range from 4.5 for Hamlins to as high as 9.0 for Valencia oranges.

Table 1. Ridge site. Earlygold and Itaborai sweet orange cumulative yields and PS/acre measured from 1999 through 2003 (4 seasons), and tree heights measured in November 01.

Scion	Rootstock	Cum. yield, boxes/tree	Cum. PS/acre	Tree ht., ft.
Earlygold	Benton citrange	8.5	7,634	8.5
	C-35 citrange	9.7	9,090	7.3
	Carrizo citrange	10.2	8,589	10.0
	Gou tou	8.6	6,651[b]	8.8
	Kinkoji	10.1	8,841	9.7
	Kuharske citrange	11.4	9,769	10.0
	Smooth Flat Seville	8.0	6,771	8.3
	Swingle citrumelo	10.1	8,935	8.9
Hamlin	Swingle[a]	7.5	6,243	7.5
Itaborai	Benton	9.1	7,839	8.5
	C-35 citrange	8.1	7,350	7.5
	Carrizo citrange	8.8	7,052	9.3
	Gou tou	7.1	5,426[b]	8.8
	Kinkoji	7.3	6,245	9.4
	Kuharske citrange	11.0	9,117	9.0
	Smooth Flat Seville	4.7	3,818	8.6
	Swingle citrumelo	9.6	8,065	8.5
Hamlin	Swingle[a]	9.1	7,589	

[a] Commercial nursery trees produced using mature-line buds.
[b] Estimated. No juice data for 2002-03.

Table 2. Ridge site. Ruby sweet orange cumulative yield and PS/acre measured from 1999 through 2003 (4 seasons), and tree height measured in November 01.

Rootstock	Cum. yield, boxes/tree	Cum. PS/acre	Tree ht., ft.
Benton citrange	8.9	8,145	7.9
C-35 citrange	7.8	7,133	7.8
Carrizo citrange	9.3	8,015	8.9
Gou tou	6.7	5,449[b]	9.3
Kinkoji	7.5	6,811	8.4
Kuharske citrange	9.5	8,182	8.6
Smooth Flat Seville	6.8	5,794	8.5
Swingle citrumelo	6.7	6,007	8.1

Table 2. Ridge site. Ruby sweet orange cumulative yield and PS/acre measured from 1999 through 2003 (4 seasons), and tree height measured in November 01.

Rootstock	Cum. yield, boxes/tree	Cum. PS/acre	Tree ht., ft.
Hamlin/Swingle[a]	6.5	5,518	7.5

[a] Commercial nursery trees produced using mature-line buds.
[b] Estimated. No juice data for 2002-03.

Table 3. Ridge site. Earlygold sweet orange juice quality during the 2001-02 and 2002-03 seasons. Data based on fruit samples harvested on November 4th or 5th each year.

Rootstock	Year	Ratio	Color number	PS/box
Benton citrange	01-02	23.0	35.4	5.4
	02-03	23.9	35.5	5.4
C-35 citrange	01-02	23.8	36.0	5.7
	02-03	27.0	36.0	5.9
Carrizo citrange	01-02	23.2	34.2	4.6
	02-03	24.5	35.2	5.3
Gou tou	01-02	23.0	34.5	4.6
	02-03	-[b]	-	-
Kinkoji	01-02	20.6	34.6	4.9
	02-03	24.3	35.3	5.5
Kuharske citrange	01-02	21.4	34.0	4.9
	02-03	23.9	35.0	5.1
Smooth Flat Seville	01-02	21.9	33.9	4.9
	02-03	22.9	34.6	5.1
Swingle citrumelo	01-02	21.5	35.1	5.3
	02-03	23.1	35.3	5.2
Hamlin/Swingle[a]	01-02	18.2	32.8	4.8
	02-03	18.7	32.9	5.2

[a] Commercial nursery trees produced using mature-line buds.
[b] No juice data for 2002-03.

Table 4. Ridge site. Itaborai sweet orange juice quality during the 2001-02 and 2002-03 seasons. Data based on fruit samples harvested on November 4th or 5th each year.

Rootstock	Year	Ratio	Color number	PS/box
Benton citrange	01-02	19.5	35.0	4.9
	02-03	20-3	35.7	5.2
C-35 citrange	01-02	20.6	35.2	5.2
	02-03	22.2	35.8	5.6
Carrizo citrange	01-02	18.9	34.5	4.6
	02-03	19.4	34.2	4.6
Gou tou	01-02	18.8	32.8	4.4
	02-03	-[b]	-	-
Kinkoji	01-02	18.6	34.3	4.9
	02-03	20.0	35.3	5.2
Kuharske citrange	01-02	20.4	34.2	4.8
	02-03	20.6	35.1	4.9
Smooth Flat Seville	01-02	18.3	34.4	4.7
	02-03	19.0	34.5	4.7
Swingle citrumelo	01-02	18.0	35.0	4.9
	02-03	19.6	35.7	5.2
Hamlin/Swingle[a]	01-02	18.2	32.8	4.8
	02-03	18.7	32.9	5.2

[a] Commercial nursery trees produced using mature-line buds.
[b] No juice data for 2002-03.

Table 5. Ridge site. Ruby sweet orange juice quality during the 2001-02 and 2002-03 seasons. Data based on fruit samples harvested on November 4th or 5th each year.

Rootstock	Year	Ratio	Color number	PS/box
Benton citrange	01-02	23.9	34.7	5.2
	02-03	25.1	35.2	5.5
C-35 citrange	01-02	22.4	34.9	5.3
	02-03	25.3	24.9	5.4
Carrizo citrange	01-02	21.3	34.1	5.1
	02-03	23.3	34.5	4.9

Table 5. Ridge site. Ruby sweet orange juice quality during the 2001-02 and 2002-03 seasons. Data based on fruit samples harvested on November 4th or 5th each year.

Rootstock	Year	Ratio	Color number	PS/box
Gou tou	01-02	23.0	33.6	4.7
	02-03	-b	-	-
Kinkoji	01-02	22.0	34.4	5.2
	02-03	24.7	34.9	5.2
Kuharske citrange	01-02	23.4	34.4	5.0
	02-03	23.3	34.4	4.9
Smooth Flat Seville	01-02	22.4	34.0	5.0
	02-03	23.4	34.6	4.7
Swingle citrumelo	01-02	22.0	34.7	5.0
	02-03	24.3	35.1	5.5
Hamlin-Swingle[a]	01-02	19.1	32.4	4.8
	02-03	18.7	32.9	5.2

[a] Commercial nursery trees produced using mature-line buds.
[b] No juice data for 2002-03.