

# Harvest and Evaluation of Strain Trials at Lindcove Research and Extension Center

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Our progress on the three portions of this study is outlined below.

**Navel Strain Trial:** Beginning in the 2007-2008 season we harvested the Palmer 2 as a late strain, as requested by the CRB. At the time of harvest, all fruit are run over the packline at UC Lindcove REC for size and grade. We collected fruit quality data for each strain at the time of harvest.

Harvest Date	Navel Strain
December	Atwood, Beck Earli, Fukumoto, TI Zimm.
March	Cara Cara, Cluster, Gillette, Palmer 1, Parent
May	Autumn Gold, Chislett, Lane Late, Navelate, Palmer 2, Powell, Rhode, Summer Gold

Tables 1 and 2 report a summary of the harvest quality of the fruit at the time of harvest. These values are the averages taken from 2001 through 2008. Note that within each maturity grouping, there are significant differences between the strains.

Table 1. Peel characteristics of navel orange strains harvested at varying points during the commercial harvest season. Values are the average of measurements taken from December 2001 through May 2008. Early season strains harvested in December, mid season strains harvested in February and late season strains harvested in May.

	Peel Puncture Resistance (g)	Peel Thickness (mm)	Peel Color (Hue°)	Peel Texture (1-8)	Length/Width Ratio
<b>EARLY SEASON STRAINS</b>					
Atwood	429.16 a <sup>z</sup>	4.91 c	74.96 a	2.93 c	0.99 a
Beck Earli	372.33 c	5.98 a	69.06 b	3.15 a	0.94 b
Fukumoto	407.83 b	5.36 b	64.93 c	3.02 b	0.99 a
TI Zimm.	448.40 a	5.01 c	73.61 a	2.74 d	0.98 a
<b>MID SEASON STRAINS</b>					
Cara Cara	330.54 bc	5.79 bc	64.41 b	3.02 a	0.98 ab
Cluster	391.21 a	6.02 ab	68.87 a	2.98 b	0.97 b
Gillette	348.39 b	6.28 a	64.27 b	3.01 ab	0.98 ab
Palmer 1	326.43 bc	5.74 c	63.95 b	2.98 b	0.99 a
Parent	317.04 c	5.77 bc	64.55 b	2.98 b	0.99 a
<b>LATE SEASON STRAINS</b>					
Autumn Gold	472.83 bc	5.11 ab	78.14 ab	3.03 ab	0.95 b
Chislett	515.46 a	5.18 a	79.57 a	3.02 b	0.97 b
Lane Late	448.48 cd	5.22 a	76.20 abc	3.08 a	0.97 b
Navelate	437.41 de	4.30 d	73.05 c	2.91 c	0.90 b
Powell	480.97 b	4.58 c	78.28 ab	3.02 b	0.96 b
Rhode	486.78 b	4.96 b	78.19 ab	2.99 b	0.98 b
Summer Gold	414.97 e	5.06 ab	75.58 bc	3.04 ab	1.08 a

<sup>z</sup> Mean separation within each group of strains using LSD at P ≤ 0.05.

Table 2. Juice characteristics of navel orange strains harvested at varying points during the commercial harvest season. Values are the average of measurements taken from December 2001 through May 2008. Early season strains harvested in December, mid season strains harvested in February and late season strains harvested in May.

	Juice Content (%)	Soluble Solids Content (%)	Titrateable Acidity (%)	SSC/TA Ratio	BrimA (K=4)
<b>EARLY SEASON STRAINS</b>					
Atwood	39.82 a <sup>z</sup>	11.27 b	0.92 a	12.58 c	7.60 c
Beck Earli	35.86 bc	11.57 ab	0.73 c	18.82 a	8.67 a
Fukumoto	36.52 b	11.65 a	0.89 a	13.31 bc	8.08 b
TI Zimm.	34.59 c	11.43 ab	0.82 b	14.27 b	8.67 b
<b>MID SEASON STRAINS</b>					
Cara Cara	38.45 b	12.19 b	0.57 a	21.77 c	9.90 b
Cluster	36.41 c	12.15 b	0.52 b	23.60 a	10.07 ab
Gillette	38.99 b	12.48 ab	0.56 a	22.71 b	10.23 a
Palmer 1	40.54 a	12.59 a	0.57 a	22.57 bc	10.32 a
Parent	40.36 a	12.43 ab	0.58 a	22.08 bc	10.13 ab
<b>LATE SEASON STRAINS</b>					
Autumn Gold	38.62 bc	12.40 b	0.46 ab	27.10 e	10.54 bc
Chislett	37.23 c	12.52 ab	0.44 bc	28.82 bc	10.75 b
Lane Late	38.47 bc	11.98 c	0.44 bc	27.40 de	10.21 c
Navelate	37.37 c	12.58 ab	0.43 c	29.44 b	10.86 b
Powell	41.79 a	12.30 bc	0.49 a	25.33 f	10.34 c
Rhode	36.99 c	12.32 bc	0.45 bc	28.05 cd	10.54 bc
Summer Gold	40.11 ab	12.83 a	0.39 d	35.74 a	11.27 a

<sup>z</sup> Mean separation within each group of strains using LSD at P ≤ 0.05.

Table 3. A comparison of fruit quality attributes between Palmer1 and Palmer2. Both strains harvested as mid season strains from 2002 – 2006. Palmer2 harvested as late season strain commencing in 2007 <sup>z</sup>.

	Juice Content (%)	Soluble Solids Content (%)	Titrateable Acidity (%)	SSC/TA Ratio	BrimA (K=4)	Peel Puncture Resistance (g)	Peel Thickness (mm)	Peel Color (Hue°)	Peel Texture (1-8))	Length/ Width Ratio
<i>Palmer1 and Palmer2 harvested as midseason strains 2002 – 2006</i>										
Palmer1	39.88	12.18	0.54	22.68	10.01	276.81	5.70	62.45	2.98	0.99
Palmer2	37.34	12.19	0.54	23.29	10.04	265.53	5.91	62.02	3.00	0.98
Sign.	*	ns	ns	ns	ns	ns	ns	ns	ns	ns
<i>Split Harvest 2007 – 2008 (Palmer1 harvested in February and Palmer2 harvested in May)</i>										
Palmer1	42.14	13.61	0.63	22.29	11.97	425.67	5.82	67.69	2.97	0.99
Palmer2	36.95	13.77	0.45	30.94	11.09	342.94	5.28	66.01	2.83	0.97
Sign.	***	ns	***	***	***	***	*	*	*	ns

<sup>z</sup> Mean separation within each group of strains using LSD at P ≤ 0.05.

Table 2 presents data collected on juice characteristics. Table 3 presents a comparison of fruit quality of Palmer 1 harvested with the other mid season strains and Palmer 2 which was harvested with the late strains. In previous comparisons when the 2 strains were harvested at the same time no differences were detected. In particular note the softening of the Palmer 2 associated with the later harvest. The peel of the Palmer 2 became extremely soft (even more so than reflected by the numerical values) when harvest was delayed.

Delta, Midnight and Olinda Valencia Orange Trial: Through 2007 we split the harvest of the trees in each plot. One tree of the 2-tree plot was harvested in April, and the

remaining tree in each plot were harvested in July. As planned, we went back to a single harvest for the 2008 season with all trees harvested in June.

Table 4 reports the average yield per tree for the years with the split harvest as compared to the yield for 2008 with a single harvest. Delaying harvest reduced the yield for all strains with the Midnight the most affected. This difference was also apparent in 2008 when there was only a single harvest. Tables 5 and 6 present the data for the fruit evaluations we conduct each year at the time of harvest. This is the data up through 2007 so that one can observe the impact of an early vs. late harvest of both peel and juice characteristics.

**Sweet Orange Planting in Field 81:** In 2003, Thomas Chao established a sweet orange planting in Field 81 at the UC Lindcove REC. Dr. Chao selected 6 sweet orange varieties for inclusion in this trial, each replicated 15 times on 4 rootstocks. The planting is designed as a randomized block design. The rootstocks included in this trial are Carrizo citrange, Swingle citrumelo, C35 citrange and *C. volkameriana*. The sweet orange selections are Olympic Gold Navel, Ricalate Navel, Johnson Navel, Cukuroval Navel, UCR Navel and Smith Red Valencia. The trees had their first harvest during 2007/08. The navel oranges were harvested in April and the Smith Red Valencia was harvested in early June 2008. From this first harvest we observed a slight difference in yield due to rootstock but little difference in overall yield (Table 7). In this first year of data collection, there was no significant selection x rootstock interaction.

(Note: Table 7 on page 26)

Table 4. Average yield of Delta and Midnight sweet orange and Olinda Valencia orange on either Carrizo or C-35 citrange rootstock harvested either in April or July each year (2000 – 2007; excluding 2005) or June 2008 <sup>z</sup>.

	Average yield 2000-2007 – split harvest	Average Yield 2008 – single harvest
STRAIN		
Delta	254.1 b	395.0 a
Midnight	186.7 c	234.2 b
Olinda	294.9 a	410.7 a
ROOTSTOCK		
Carrizo	245.2 a	354.7 a
C-35	245.3 a	339.6 a
HARVEST DATE		
April	273.9 a	447.6 a
July	216.6 b	239.7 b

<sup>z</sup> Mean separation within each group of strains using LSD at P ≤ 0.05.

Table 5. Peel characteristics of Delta and Midnight sweet orange and Olinda Valencia orange on either Carrizo or C-35 citrange rootstock harvested either in April or July each year (2000 – 2007; excluding 2005). Values are the average of measurements taken <sup>z</sup>.

	Peel Puncture Resistance (g)	Peel Thickness (mm)	Peel Color (Hue <sup>o</sup> )	Peel Texture (1-8)	Regreening (1-5)
STRAIN					
Delta	468.8 b	5.56 b	79.28 a	3.19 ab	1.00 a
Midnight	489.5 a	5.74 a	77.51 b	3.16 b	0.69 c
Olinda	433.3 c	5.74 a	78.24 c	3.22 a	0.84 b
ROOTSTOCK					
Carrizo	462.8 a	5.61 b	77.80 b	3.17 b	0.82 a
C-35	463.8 a	5.75 a	78.90 a	3.21 a	0.87 a
HARVEST DATE					
April	446.2 b	5.85 a	72.37 b	3.25 a	0.26 b
July	481.1 a	5.50 b	84.61 a	3.13 b	1.28 a

<sup>z</sup> Mean separation within each group of strains using LSD at P ≤ 0.05.

Table 6. Juice characteristics of Delta and Midnight sweet orange and Olinda Valencia orange on either Carrizo or C-35 citrange rootstock harvested either in April or July each year (2000 – 2007; excluding 2005). Values are the average of measurements taken <sup>z</sup>.

	Juice Content (%)	Soluble Solids content (%)	Titrateable Acidity (%)	SSC/TA Ratio	BrimA (K=4)
STRAINS					
Delta	43.19 b	10.98 b	0.90 b	13.64 a	7.39 b
Midnight	40.51 c	10.94 b	0.86 c	13.58 a	7.52 a
Olinda	45.59 a	11.17 a	0.97 a	12.64 b	7.28 c
ROOTSTOCK					
Carrizo	43.41 a	11.09 a	0.89 b	13.70 a	7.52 a
C-35	42.83 a	10.97 b	0.93 a	12.87 b	7.26 b
HARVEST DATE					
April	43.40 a	11.07 a	1.22 a	10.21 b	6.58 b
July	42.84 a	10.99 a	0.69 b	16.45 a	8.23 a

<sup>z</sup> Mean separation within each group of strains using LSD at P ≤ 0.05.

Table 7. Average yield of 5 navel orange selections and 1 sweet orange on 4 rootstocks harvested either April or June 2008. The navel oranges were harvested in April 2008 and the Smith Red Valencia in June 2008.

	Lb/tree <sup>z</sup>
SELECTION	
Johnson Navel	88.29 a
Olympic Gold Navel	77.34 ab
UCR Navel	74.64 b
Smith Red "Valencia"	69.96 bc
Cukuroval Navel	67.16 bc
Ricalate Navel	61.55 c
ROOTSTOCK	
C. volkameriana	79.63 a
C-35 citrange	76.79 a
Carrizo citrange	73.84 a
Swingle citrumelo	62.06 b
z Mean separation within each group of strains using LSD at P ≤ 0.05.	

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