

'Valentine,' A Recently Released Anthocyanin-pigmented Pummelo Hybrid Developed at the University of California Riverside

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In the last two decades, many distinctive citrus selections have become available, on a large or small scale, at retail markets in the United States. These include cultivars such as 'Cara Cara' navel orange, 'Cocktail' pummelo-mandarin hybrid, 'Variegated Pink' lemon, 'Seedless Kishu' mandarin, and 'Buddha's Hand' citron. Among specialty citrus growers, there is intense interest in acquiring new varieties with novel or unusual characteristics of appearance, coloration, flavor, size and functional properties.



In the 1950s, Drs. Robert Soost and James Cameron, citrus breeders for the University of California-Riverside, compared the effects of acid and nonacid pummelos as female parents on the acidity of citrus hybrids. Using six different mandarin, orange, tangor and pummelo pollen parents, they found that hybrids obtained by crossing the low-acid pummelo 'Siamese Sweet' (CRC 2240) with various medium-acid varieties as the pollen parents had consistently low to medium average acidity levels but favorable soluble solids early in the season (Soost and Cameron 1961). This contributed to their later use of 'Siamese Sweet' as a maternal parent and other varieties as the pollen parent in their breeding program, resulting in the low-acid pummelo-grapefruit hybrid selections eventually introduced as 'Oroblanco' and 'Melogold,' and the pummelo-mandarin hybrid

'Cocktail,' which was originally released as 'Mandalo' (Soost and Cameron 1980, 1986; Moore, 1987). 'Valentine' is the most promising of the pigmented low-acid pummelo hybrids selected by Drs. Soost and Cameron in 1986 from a cross of 'Siamese Sweet' pummelo x ('Ruby' blood orange x 'Dancy' mandarin).



'Valentine' pummelo hybrid fruit combines the large size and low acidity from its pummelo parent, complex, floral taste from 'Dancy,' and juicy red pulp from 'Ruby.' It received its name from former Staff Research Associate for the Citrus Variety Collection Otilia 'Toots' Bier, who nicknamed it 'Valentine' not only because the fruit matures in mid-February near the Valentine's Day holiday, but also because often when the fruit is cut lengthwise and turned upside down, the flesh of the fruit resembles a vibrant red heart. It is unique in being a grapefruit-like fruit with anthocyanin pigmentation, which is a potential marketing advantage at a time when many antioxidant-rich fruits, such as pomegranate, blueberry and blackberry, have seen sales increase because of their perceived health benefits.

'Valentine' fruit was formally evaluated by the UCR Citrus Variety Collection (www.citrusvariety.ucr.edu) from January to March of years 2006, 2007, and 2008. 'Valentine' fruits are round to somewhat pyriform in shape, usually with a slight to pronounced neck at the fruit base (stem end), but in some cases the neck is absent, resulting in a more typical spheroid grapefruit-like shape. The fruit

apex (blossom end) is rounded and smooth. The average fruit size is large with a mean width of 10.8 cm (4.25 inches) and a height (including the neck) of 11.0 cm (4.33 inches), giving an average height-to-width aspect ratio of 1.02, and a mean weight per fruit of 531.1 grams (18.7 ounces) (Table 1). Rind color is medium to dark yellow for fruit harvested in Riverside in mid-February, with similar values for fruit harvested from the Lindcove Research and Extension Center in Exeter, California. The average rind color based on a visual rating scale of 0 -13 with 0 being green and 13 being red-orange, was 8.6 for this hybrid from January through early March (Table 1). The rind texture is moderately smooth with a mean thickness of 8.8 mm (0.35 inches). Fruit samples from Lindcove generally have a thicker rind than samples from Riverside. The number of seeds per fruit averages 27.6 (Table 1). However, the mean number of seeds per fruit among 36 different 10-fruit samples ranged from 2.6 seeds per fruit to 51 seeds per fruit. The high seed content is probably the cultivar's biggest disadvantage for commercial growers. The rind is moderately easy to peel when fruits are mature. The mean juice weight is 201.8 grams (7.1 ounces) and the average juice content is 38.6% (Table 2). The red flesh color of 'Valentine' can be somewhat variable in its distribution and intensity inside the fruit. Color formation first appears in mid-January and becomes more intense in early to mid February. The anthocyanin pigmentation increases through March until the flavor becomes bland. Compared to Ruby blood orange, the flesh color of 'Valentine' is much more concentrated. Ruby flesh tends to be poorly colored in Riverside, containing a few red flecks of juice vesicles against bright orange flesh. 'Valentine' flesh is a clear red throughout.

Since 'Valentine' pummelo hybrid is a complex pummelo, blood orange and mandarin hybrid it would not be appropriate to use legal maturity standards that apply to pummelo, sweet orange or grapefruit fruits. Fruits of 'Valentine' reach complete pigmentation in February when the solids to acid ratio is an average of 16:1. A ratio of this level produces an extremely sweet, juicy and delicious fruit. However, as for 'Cocktail' hybrid, the flesh texture of 'Valentine' is soft, which may prove problematic for large-scale commercial packing and shipments, but should not be an issue for local or farmers market sales or for use as a backyard tree for homeowners.



The tree shape and growth habit of 'Valentine' is spreading and fairly vigorous. Older non-pruned trees tend to have long drooping branches. Thorns are absent on both twigs and branches. Leaves are ovate in shape with a slight winged petiole of medium width, similar to normal grapefruit in size and shape. The tree canopy has medium density branching with fruit borne singly on the inner parts of the canopy and skirting. The trees do not tend to bear fruit in clusters. 'Valentine' has only been grown and observed on trifoliolate-type rootstocks of a few different varieties. Ten-year-old trees on Carrizo citrange rootstock have yielded fairly vigorous trees approximately 12 feet tall at Riverside and Lindcove, California, and 30-year-old trees are approximately 14 feet tall at Riverside. A single 10-year-old tree on Rich 16-6 trifoliolate in Riverside has yielded a slightly less vigorous 10-foot-tall tree with an apparently lower yield. Two young trees on C-35 citrange have been planted in the Citrus Variety Collection, but are too immature to assess their performance. There have been no indications of rootstock-scion incompatibility or disease susceptibility using these rootstocks.

The performance of 'Valentine' trees has not been observed in desert or coastal locations. However, our knowledge of the inadequate performance of the pummelo and blood orange parents of 'Valentine' in desert and coastal areas would suggest that 'Valentine' would also not perform well in desert and coastal areas. The bright red pigmentation of this pummelo hybrid is what makes it unique; however these locations tend to produce little to no

color in otherwise heavily anthocyanin-pigmented varieties. No yield data have been collected for 'Valentine'. The trees examined have never had any intervening cultural treatments and have been observed to bear low to moderate crops. Yield when isolated from other pollen sources is not known. The data presented here, from Riverside and Lindcove, indicates that 'Valentine' is adapted to both the interior region of Southern California and the San Joaquin Valley.

The fruit of 'Valentine' pummelo hybrid is attractive, juicy, sweet and distinctive. Displays of fruit of this hybrid have elicited positive comments from a number of citrus nursery owners and growers when viewed at fruit displays and field days. No large-scale field trials have been conducted for this hybrid. Many questions remain about its commercial characteristics, such as yield, fruit quality in growing areas different than those where it has been evaluated, and range of rootstock-scion interactions.

Based on the disclosure of fruit quality data of 'Valentine' described here, the College of Natural and Agricultural Sciences gave approval for its release in July 2009. Georgios Vidalakis, director of the Citrus Clonal Protection Program (CCPP), evaluated CCPP's sources of 'Valentine' and reported that the CCPP has two vigorous, disease-tested trees of this hybrid (VI 597) in the protected Foundation Block that the CCPP registered with the California Department of Food and Agriculture (CDFA) for budwood distribution. In anticipation of the Valentine release the CCPP propagated six extra trees in January of 2009 that can serve as budwood sources in the case of increased demand. These trees will supply budwood for the September budwood cut (ordering deadline is September 17) via the "Early Release" program through which each nursery can purchase 12 buds to start propagating trees.

Please go to the Citrus Clonal Protection Program website at <http://www.ccpp.ucr.edu> for more information about how to obtain budwood of 'Valentine.' Registered users of the online budwood ordering system may visit <http://ccpp.ucr.edu/budwood/budwood.php>. If you are not a registered user, you can e-mail ccpp@ucr.edu with your name, address, e-mail, and

phone number and the CCPP will generate a username and password for you. After becoming a registered user you will also receive announcements about future budwood distributions for other citrus varieties.

References Cited

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Additional color photographs are available on the Citrus Variety Collection website at

<http://citrusvariety.ucr.edu/citrus/Valentine.htm>

A Sabbatical Message from Gary Bender

I can't believe I am already three months into my one year sabbatical! I have been using my sabbatical time for travel to meet with other experts in the field, research the latest information and develop new programs and a website for alternative fruit crops for San Diego County.

In my absence, Ben Faber is answering your avocado and citrus questions. Ben's phone number is (805) 645-1462 and his email address is bafaber@ucdavis.edu. For questions other than avocado and citrus, please call our San Diego office at (858) 694-2845 or our San Marcos office at (760) 752-4724.

Table 1. Characteristics of Valentine Pummelo Hybrid

CULTIVAR	SAMPLE LOCATION	DATE	FRUIT PER SAMPLE	AVG LENGTH/FRUIT (cm)	AVG WIDTH / FRUIT (cm)	LENGTH /WIDTH RATIO	AVG WT/FRUIT (grams)	EXTERNAL RIND COLOR	RIND TEXTURE	RIND THICKNESS/FRUIT (mm)	SEED NUMBER/FRUIT	AVG JUICE WT/FRUIT (grams)	% JUICE	TOTAL SOLUBLE SOLIDS	TSS/DATE AND LOCATION	% ACID	% ACID/DATE AND LOCATION	RATIO (TSS / % ACID)	AVG RATIO/DATE/LOCATION
Valentine	Riverside	1/23/2006	10	12.0	11.1	1.09	637.9	9.0	4.0	9.5	18.7	277.7	43.5	10.9	11.8	0.8	0.8	14.6	15.4
Valentine	Riverside	1/23/2006	10	10.2	10.2	1.00	484.9	9.0	4.0	7.9	34.9	229.8	47.4	11.6		0.8		14.7	
Valentine	Riverside	1/23/2006	10	10.2	9.5	1.08	395.7	9.0	2.0	8.1	31.2	185.6	46.9	12.9		0.7		17.4	
Valentine	Riverside	1/23/2006	10	10.1	9.7	1.04	405.3	9.0	2.0	8.2	33.1	192.0	47.4	11.9		0.8		15.0	
Valentine	Lindcove	1/25/2006	10	11.3	10.9	1.03	521.7	7.0	3.0	11.7	12.8	185.2	35.5	8.9	8.9	0.6	0.6	15.7	15.7
Valentine	Lindcove	2/16/2006	10	11.7	11.4	1.03	570.3	9.0	3.0	9.7	13.8	211.3	37.1	8.8	8.8	0.6	0.6	15.2	15.2
Valentine	Riverside	3/6/2006	10	11.5	10.2	1.12	490.5	8.0	3.0	10.5	27.1	205.6	41.9	11.9	11.8	0.8	0.7	15.4	16.9
Valentine	Riverside	3/6/2006	10	11.6	10.5	1.11	504.1	8.0	2.5	9.6	33.6	219.4	43.5	12.6		0.7		19.1	
Valentine	Riverside	3/6/2006	10	10.6	10.4	1.02	507.9	8.0	4.0	8.5	28.6	234.1	46.1	12.3		0.8		15.9	
Valentine	Riverside	3/6/2006	10	12.2	12.4	0.98	754.4	8.0	4.0	9.0	29.2	325.7	43.2	10.4		0.6		17.1	
Valentine	Lindcove	3/9/2006	10	10.5	10.9	0.97	471.0	10.0	2.0	11.5	2.6	166.4	35.3	8.3	8.3	0.6	0.6	15.1	15.1
Valentine	Riverside	1/16/2007	10	9.0	9.6	0.94	362.6	7.0	3.0	6.2	39.6	114.0	31.4	15.4	14.1	1.6	1.3	9.7	11.4
Valentine	Riverside	1/16/2007	10	8.6	8.9	0.96	306.0	7.0	3.0	5.0	51.0	120.1	39.3	15.8		1.4		11.4	
Valentine	Riverside	1/16/2007	10	9.9	10.2	0.98	454.9	8.5	3.5	7.4	22.9	168.2	37.0	11.5		1.2		10.0	
Valentine	Riverside	1/16/2007	10	9.4	9.7	0.96	389.1	10.0	2.0	7.6	37.2	132.4	34.0	13.7		1.0		14.4	
Valentine	Lindcove	1/23/2007	10	11.8	12.1	0.98	632.8	6.0	3.5	11.7	19.8	176.9	28.0	8.6	8.6	0.6	0.6	13.5	13.5
Valentine	Riverside	2/12/2007	10	9.0	9.0	1.00	332.2	10.0	2.5	7.3	45.4	118.7	35.7	16.4	13.1	1.0	0.9	16.1	15.2
Valentine	Riverside	2/12/2007	10	9.4	9.9	0.95	370.0	7.0	3.5	9.0	10.0	120.5	32.6	9.7		0.7		14.2	
Valentine	Riverside	3/5/2007	10	8.3	8.3	1.01	263.6	10.0	2.0	5.4	41.4	97.1	36.8	17.3	14.4	1.1	0.9	15.4	16.1
Valentine	Riverside	3/5/2007	10	10.8	10.2	1.05	471.8	10.0	3.5	7.5	15.8	181.1	38.4	12.6		0.8		16.2	
Valentine	Riverside	3/5/2007	10	9.1	9.2	0.99	338.5	10.0	2.5	8.3	19.2	122.1	36.1	13.4		0.8		16.7	
Valentine	Lindcove	1/7/2008	10	13.1	14.1	0.93	857.7	6.5	3.5	13.6	18.6	249.8	29.1	8.6	8.8	0.5	0.5	18.0	18.0
Valentine	Riverside	1/7/2008	10	9.8	9.4	1.03	367.1	7.0	2.5	7.7	24.2	146.2	39.8	10.6	10.4	0.6	0.6	16.5	18.3
Valentine	Riverside	1/7/2008	10	9.7	9.6	1.02	379.7	6.0	2.5	7.1	35.0	167.4	44.1	9.6		0.6		15.5	
Valentine	Riverside	1/7/2008	10	10.8	11.0	0.98	568.3	8.0	3.0	7.1	16.1	255.3	44.9	10.7		0.6		19.4	
Valentine	Riverside	1/7/2008	10	10.7	10.4	1.03	500.1	6.0	3.0	5.7	30.5	216.1	43.2	10.7		0.5		21.9	
Valentine	Lindcove	2/4/2008	10	13.0	13.8	0.95	782.0	8.0	3.0	13.0	23.8	238.1	30.4	8.8	8.8	0.5	0.5	16.4	16.4
Valentine	Riverside	2/4/2008	10	12.7	12.1	1.05	786.3	10.0	3.0	7.1	26.5	324.2	41.2	10.5	10.2	0.7	0.7	14.5	14.6
Valentine	Riverside	2/4/2008	10	13.0	12.1	1.07	781.8	10.0	3.0	7.9	36.6	310.9	39.8	10.8		0.6		17.3	
Valentine	Riverside	2/4/2008	10	10.5	10.0	1.05	440.7	10.0	2.5	8.0	30.5	188.2	42.7	10.9		0.9		12.1	
Valentine	Riverside	2/4/2008	10	11.0	10.3	1.07	467.0	10.0	2.5	7.9	35.4	191.0	40.9	8.7		0.6		14.5	
Valentine	Riverside	2/25/2008	10	11.4	10.4	1.10	506.7	10.0	3.0	8.9	36.1	220.9	43.6	11.1	10.9	0.7	0.6	15.8	17.6
Valentine	Riverside	2/25/2008	10	10.2	9.9	1.04	412.1	10.0	2.0	7.8	30.2	179.0	43.4	10.2		0.7		14.5	
Valentine	Riverside	2/25/2008	8	15.7	15.2	1.03	944.2	10.0	2.0	7.8	35.8	301.1	31.9	11.0		0.6		18.7	
Valentine	Riverside	2/25/2008	5	13.6	12.8	1.06	867.0	10.0	3.0	14.4	26.0	328.0	37.8	11.3		0.5		21.3	
Valentine	Lindcove	2/29/2008	10	13.9	12.9	1.08	795.0	8.0	4.0	14.3	18.6	163.2	20.5	8.6	8.6	0.5	0.5	18.6	18.6
Means for all fruit sampled, sample dates and both locations:				11.0	10.8	1.02	531.1	NA	2.9	8.8	27.5	201.0	38.6	NA	NA	NA	NA	NA	NA

Rind color and texture are visual ratings. Rind color is based on a scale of 0-13, with 0 being green and 13 being red-orange. Rind texture based on a scale of 1-8 with 1 being very smooth and 8 being extremely coarse.