

COMPARISON OF ROHDE RED AND COMMON VALENCIA JUICE COLOR AND MATURITY

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Abstract. The 'Rohde Red Valencia' orange cultivar (*Citrus sinensis* L. Osbeck) appeared as a limb sport in a Highlands county grove in 1955. Fruit is typical to many old-line 'Valencia' oranges in size and production, but develops a deeper juice color. Color scores have ranged from 39 to above 40. 'Rohde Valencia' selections have shown some tendency to be unstable exhibiting non-uniform color among fruit, low fruit yield, irregular bearing, and non-true-to-type leaf characteristics. Previous reports have shown clone RRV-472-11-43 (STG-19-2)-X-E to be superior to other 'Rohde Red Valencia' clones, and is the only selection available from the Florida citrus budwood program. Fruit quality measurements from fruit in the Budwood Foundation Block in Immokalee show color development in 'Rohde Red Valencia' begins to exceed common 'Valencia' about December and continues to enhance through maturity. 'Rohde Red Valencia' has lower acid, lower °Brix, higher ratio, and higher color than common 'Valencia'. The purpose of this report is to show when color development occurs in 'Rohde Red Valencia' during the development period in relation to other fruit maturity characteristics.

The 'Valencia' orange is grown in all the citrus producing regions of the world due to its high quality. In Florida the 'Valencia' has been the most propagated orange variety during the late 1990s and early 2000s (Fla. Dept. Agr. and Cons. Servs, 1997, 1998, 1999, 2000, 2001, 2002a). Approximately half of the nearly six million citrus nursery trees propagated each year in Florida have been one of the 'Valencia' clones, either a common 'Valencia' or 'Rohde Red Valencia' selection. The juice quality of 'Valencia' is an important economic factor in an industry that processes over 95% of its orange crop (Fla. Dept. Agr. and Cons. Servs., 2002b). The successful market product, not-from-concentrate (NFC) pasteurized orange juice is dependent on 'Valencia' oranges because of their high juice quality and juice color. The popularity of 'Valencia' NFC juice has generated interest in cultivars with enhanced juice color, particularly since early season cultivars don't meet the color score for Grade A juice.

Florida orange juice quality standards require a minimum color score of 36 to qualify as Grade A (Stewart, 1980). Juice of the late-season 'Valencia', which has the highest color of the oranges used for processing, is blended with the early-maturing varieties having less color in order to meet juice quality standards. Better juice color of the 'Valencia' clone means less juice needed for blending to attain the desired color. 'Rohde Red Valencia' is a clone that has been selected for its high juice color score, but limited information is available comparing juice color of 'Rohde Red Valencia' selections and other 'Valencia' clones, (Rouse, 2000; Rouse and Youtsey, 1993).

The 'Rohde Red Valencia' is a selection found in a 'Valencia' grove near Sebring in 1955 by Paul Rohde, Jr. of Winter Haven. The fruit is typical of common 'Valencia' with respect to appearance, time of maturity, and flavor. At maturity the juice color is deeper orange than common 'Valencia'. The objective of this report was to provide additional data to compare juice quality and color development between common 'Valencia' and 'Rohde Red Valencia'.

Materials and Methods

A 12-fruit sample was collected for juice analysis bi-monthly during crop year 2001-02 (November to April) of common 'Valencia' (*Citrus sinensis* L. Osbeck) VS-SPB-1-14-19-X-E and RRV-472-11-43 (STG-19-2)-X-E from 12-year-old scion trees on Swingle citrumelo rootstock in the Southwest Florida Research and Education Foundation citrus budwood grove at Immokalee. The grove layout and design has been described (Rouse, 2000; Rouse and Youtsey, 1993). Grove cultural practices since the time of planting have followed University of Florida, IFAS standard recommendations. Cultural management has included application of fertilizer with micro-elements applied as a dry formulation and as fertigation, chemical weed control, and irrigation by micro-sprinklers.

Juice quality was analyzed for maturity factors of percentage total soluble solids (TSS) as °Brix, percentage titratable acid, and juice color score. Fruit were washed and sanitized on a commercial packing line before juice was extracted from fruit by hand using a Sunkist bench top reamer (Sunkist, Los Angeles, Calif.). Juice was stored at 4 °F and juice color score determined using a HunterLab® D45-2 Citrus Colorimeter (Hunter Assoc., Fairfax, Va.). All juice analytical methods were those commonly employed for quality evaluation of citrus products as described in Kimball, 1999. Calculations were made to obtain TSS (°Brix) to acid ratio.

Statistical analysis was performed on the juice data using the SAS General Linear Models Procedure (GLM) with LSD calculated to separate means (SAS Institute, 1982).

Results and Discussion

The 'Rohde Red Valencia' had significantly higher juice color score than common 'Valencia' (Table 1). Juice color development began in late fall and by January 'Rohde Red Valencia' juice color exceed common 'Valencia', and remained higher throughout the maturity season. During the season

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Table 1. Juice quality data from common 'Valencia' clone VS-SPB-1-14-19-X-E and 'Rohde Red Valencia' clone 'RRV-472-11-43 (STG-19-2)-X-E for the 2001-02 crop year.

Date	Cultivar	°Brix (TSS) ^a	Acid (%)	Ratio (TSS:acid)	Color score
19 Nov.	VS 1-14-19	—	—	—	35.1 a ^y
	RRV 472-11-43	—	—	—	35.6 a
18 Dec.	VS 1-14-19	10.6 a	1.08 a	9.83 b	36.2 a
	RRV 472-11-43	10.1 a	0.81 b	12.41 a	36.8 a
16 Jan.	VS 1-14-19	10.6	0.94	11.26	37.1
	RRV 472-11-43b	—	—	—	—
30 Jan.	VS 1-14-19	12.3 a	1.05 a	11.72 b	38.2 b
	RRV 472-11-43	11.7 b	0.76 b	15.32 a	41.6 a
13 Feb.	VS 1-14-19	12.4 a	0.93 a	13.32 b	38.1 b
	RRV 472-11-43	11.3 b	0.65 b	17.43 a	40.7 a
25 Feb.	VS 1-14-19	12.0 a	1.04 a	11.54 b	38.1 b
	RRV 472-11-43	11.2 b	0.72 b	15.61 a	41.0 a
27 Mar.	VS 1-14-19	12.9 a	0.87 a	14.79 a	38.0 b
	RRV 472-11-43	11.5 b	0.68 b	16.97 a	42.0 a
10 Apr.	VS 1-14-19	12.6 a	0.71 a	17.80 b	39.2 b
	RRV 472-11-43	11.9 b	0.58 b	20.55 a	42.8 a
26 Apr.	VS 1-14-19	12.8 a	0.69 a	18.60 a	40.0 b
	RRV 472-11-43	12.5 b	0.62 b	20.19 a	43.1 a
Means (season)	VS 1-14-19	12.0 a	0.91 a	13.61 b	38.1 b
	RRV 472-11-43	11.5 a	0.69 b	16.84 a	41.1 a

^aTSS = Total soluble solids measured as degree Brix.

^yMean separation in columns by LSD, 5%.

the mean color score difference between 'Rohde Red Valencia' and common 'Valencia' was 3.3 and the overall season mean difference was 4.0. This is a greater difference than previously reported in young trees among selections of common 'Valencia' and 'Rohde Red Valencia' of young trees (Rouse, 2000; Rouse and Youtsey, 1993). Stewart et al. (1975) showed the pigmentation in 'Rohde Red Valencia' juice was the carotenoid cryptoxanthin. The 'Rohde Red Valencia' had 50% more cryptoxanthin than common 'Valencia'.

Rootstock would not be expected to have a significant affect on juice color. There are few reports of rootstock influence on juice color. Published works from the 1940s (Harding et al., 1940; Miller et al., 1941) indicate no effect, although these results are contradicted by more recent works (Foguet et al., 1970; Wutscher and Bistline, 1988). Findings reported in 1993 (Rouse and Youtsey, 1993) and in 2000 (Rouse, 2000) found color differences only in rootstocks known to be at extreme opposite ends of the scale on affecting fruit maturity, example lemon type vs trifoliolate rootstock. Reported differences seem to occur among extreme juice color scores from a given year and may vary with scion clone and with time of testing, i.e., color improves as the season progresses.

Percentage acid in juice was significantly lower for 'Rohde Red Valencia' than the common 'Valencia' selection. This difference has been reported (Rouse, 2000; Rouse and Youtsey, 1993; Stewart et al., 1975) and has continued to be a difference between 'Rohde Red Valencia' and common 'Valencia'. The percentage acid in 'Rohde Red Valencia' was lower on every sample date, and the season mean difference was 0.22% lower than common 'Valencia'.

'Rohde Red Valencia' had higher TSS:acid ratio than common 'Valencia'. This too has been reported (Rouse, 2000; Rouse and Youtsey, 1993; Stewart et al., 1975) and has continued to be a difference between 'Rohde Red Valencia' and common 'Valencia'. Although the ratio for 'Rohde Red Valencia' and common 'Valencia' were not significantly different on two sample dates later in the season, the season mean ratio was significant with a difference of 3.23.

'Rohde Red Valencia' had lower °Brix than the common 'Valencia' on all but two sample dates, one date before the season and one date during the season. The season mean was not significantly different. This does not agree with previously published information that reported lower °Brix in 'Rohde Red Valencia' than common 'Valencia' when several clones were compared (Rouse, 2000; Rouse and Youtsey, 1993) or by Stewart (Stewart et al., 1975). This may have resulted from increased error due to analysis with missing data that occurred on 16 Jan. The LSD difference at the 5% level missed by 0.02.

Previous studies (Stewart et al., 1975) have reported higher juice volume in 'Rohde Red Valencia' than common 'Valencia', and others (Rouse, 2000; Rouse and Youtsey, 1993) found no differences in percentage juice per fruit among the old-line, nucellar, and 'Rohde Red Valencia' clones. When describing the original selection of 'Rohde Red Valencia', Stewart (Stewart et al., 1975) found no difference in seed per fruit or vitamin C content of juice between Common 'Valencia' and 'Rohde Red Valencia'.

In summary, fruit quality measurements from fruit in the Budwood Foundation Block in Immokalee show color development in 'Rohde Red Valencia' begins to exceed common 'Valencia' in January and continues to enhance through maturity. 'Rohde Red Valencia' had lower acid, lower °Brix, higher ratio, and higher color than common 'Valencia'. The market success of NFC orange juice should give 'Rohde Red Valencia' considerable potential where better juice color is desired. The significantly higher juice color of the 'Rohde Red Valencia' should be an advantage to processors and may give a harvesting advantage to growers during large crop years. Its lower acidity, high ratio, and high color score makes it especially desirable for blending with early season cultivars to make a uniform product of Grade A juice.

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