COMPARATIVE EVALUATION OF SOME SWEET ORANGE VARIETIES AT ISLAMABAD

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A study was conducted from 1988 to 1990 at National Agricultural Research Centre, Islamabad to evaluate twelve varieties of Sweet Ornage *(Citrus sinensis* L. Osbeck). Campbel Valencia produced 62.00 kg fruit plant^{-1} with average fruit weight of 206.67 g. Fruit of Casa Grande were the heaviest in weight (226.67 g) while smallest and lightest fruits were produced by Ruby Red (155.00 g). Because of red flesh and sweetness, Ruby Red and Blood Red were promising. In general, Sweet Orange varieties Salustiana, Pineapple and Casa Grande seem promising for economic returns. Campbel Valencia because of high acidity and juice volume could find better scope in the processing industry.

INTRODUCTION

Among the Sweet Orange group, the main varieties grown on commercial scale in Pakistan include: Blood red, Musambi and Pineapple, however, many other varieties were also tested in different areas of the country with varying degree of success. The superiority of a cultivar could be due to its growth behaviour as well as flowering and fruiting characters, hence, different workers have given due attention to both the parameters individually and collectively. Fruit characteristics are considered a key to the evaluation as reported by Aziz (1963) and Idris *et al.* (1972). Hussain and Khan (1967) and Salam (1971) also studied the phyiochemical characters of various varieties of citrus fruit for determining their commercial fitness.

The present study was designed for selection of high yielding Sweet Orange varieties suitable to agro-climatic conditions of Potohar particularly to that of Islamabad.

MATERIALS AND METHODS

Twelve varieties of Sweet Orange *(Citrus sinensis* L. Osbeck), namely Campbel, Frost Valencia, Olinda Valencia, Cutter Valencia, Casa Grande, Pineapple, Hamlin, Salustiana, Hinkely, Early Sweet Orange, Blood Red and Ruby Red were included in this study. All the trees were of the same age (7 years) raised on rough lemon *(C. jambehri* Lush) root stock. The experiment was conducted from 1988 to 1990 at National Agricultural Research Centre, Islamabad. The layout of the experiment was according to Randomized Complete Block Design with three replications, keeping three trees of each variety treatment^{-1} and subjected to uniform application of cultural practices throughout the growing period. Yield components and quality parameters included: trucnk, girth, plant height, tree spread, fruit size, shape, skin colour, fruit weight, number of seeds fruit^{-1}, juice volume, thickness of rind, total soluble solids, total sugars, acidity and ascorbic acid. Twelve fruits tree^{-1} were randomly selected and physio-chemical analysis was made. The data were analysed

by the analysis of variance and the test of significance was applied following Duncan's Multiple Range (DMR) test.

Table 1. Growth characteristics and yield of different sweet orange varieties at the age of 7 years

Variety	Plant height (m)	Trunk girth at base (cm)	Tree spread (m)	Yield (kg plant^{-1})	Number of fruit plant^{-1}
Campbel Valencia	2.5 abc	52.3 a	3.1 abc	62.0 d	300 a
Frost Valencia	2.7 abc	36.0 bc	3.4 a	42.7 cd	222 c
Olinda Valencia	2.2 bcd	30.0 c	3.00 bcd	33.3 f	187 d
Cutter Valencia	2.8 abc	37.3 bc	3.3 ab	39.7 de	215 c
Casa Grande	2.8 ab	35.0 bc	2.7 cd	46.3 bc	205 cd
Pineapple	2.7 abc	33.7 c	3.1 abc	42.7 cd	154 e
Hamlin	2.2 cd	42.7 abc	2.8 bcd	27.0 g	154 a
Salustiana	2.9 a	48.7 abc	2.9 abcd	35.7 ef	203 cd
Hinkely	2.8 abc	42.3 abc	3.1 abc	51.0 b	264 b
Early Sweet Orange	2.2 bcd	31.7 c	2.5 d	24.0 gh	140 e
Blood Red	1.4 e	30.0 c	1.7 e	21.3 hi	131 c
Ruby Red	1.7 de	27.3 c	2.5 d	17.0 i	103 i

Means followed by same letter(s) do not differ significantly at 1% level of significance.

RESULTS AND DISCUSSION

Growth behaviour: The data regarding height, stem girth and spread of plant (Table 1) showed significant difference among the varieties. The variety 'Salustiana' attained maximum height (2.87 m) and was statistically at par with 'Campbel Valencia', 'Frost Valencia', 'Cutter Valencia', 'Casa Grande', 'Pineapple' and 'Hinkely'. Plant height in Blood Red was minimum (1.37 m). Campbel Valencia attained maximum trunk girth (52.33 cm) followed by 'Salustiana', 'Hamlin' and 'Hinkely' with trunk girths of 48.77, 42.67 and 42.33 cm, respectively. Minimum plant girth was recorded in Ruby Red (27.3 cm). Maximum increase in spread of plant was observed in 'Frost Valencia' (3.40 m) followed by 'Cutter Valencia' (3.30 m), 'Campbel Valencia' and 'Hinkely' (3.10 m), Pineapple (3.07 m), Olinda Valencia, (2.97 m) and Salustiana (2.90 m). Blood Red showed the least increase in plant spread.

Yield and yield components: Maximum number of fruit (300) was recorded in Campbel Valencia followed by Hinkely (264) whereas minimum number (103 fruit plant^{-1}) was in Ruby Red (Table 1). Because of the highest fruit number, Campbel Valencia gave the maximum yield of 62.00 kg plant^{-1} followed by Hinkely. The lowest yield of 17.00 kg plant^{-1} was recorded for Ruby Red.

Physical fruit characteristics: The fruits of Casa Grande were the heaviest (226.67 g).

Average weight of fruit of Campbel Valencia and Hinkely were 206.67 and 193.6 g, respectively (Table 2). The juice volume was the highest (80.00 ml) in case of Casa Grande and the lowest (45.67 ml) in Olinda Valencia. Other varieties were in between these limits. The fruits of Casa Grande were bigger in size while those of Ruby Red were of small size. The fruits of other varieties were of medium size. The rind of Campbel Valencia, Casa Grande, Salustiana and Hinkely was thick while that of early sweet orange was thin (0.30 cm). Greater number of seeds fruit^{-1} were in Hinkely, Pineapple, Early Sweet Orange and Casa Grande whereas lower number of seeds were counted in Hamlin, Cutter Valencia, Blood Red, Frost Valencia and Olinda Valencia. The results coincide with those of Aziz (1963) who observed significant difference between fruit weight, size, shape, number of seeds, percentage of juice and peel thickness in sweet orange.

Fruit quality characters: The highest T.S.S. percentage (10.30) was recorded in Salustiana (Table 3). The other varieties exhibiting higher T.S.S. were Pineapple, Blood Red and Ruby Red with T.S.S. of 9.67, 9.53 and 9.30%, respectively. The values of T.S.S. for these varieties were statisticallt at par with one another. The T.S.S. value for Olinda Valenia was the lowest (6.63). Sweet Ornage varieties with acidity above 0.6% are considered sours and not acceptable in the market. The varieties possessing considerably high acidity percentage were Frost Valencia, Campbel Valencia, Olinda Valencia and Cutter Valencia where the acidity ranged from 1.03 to 1.27% (Table 3). The varieties with slightly high acidity percentage were Hinkely (0.75) and Pineapple (0.73) which could be acceptable in the market. In Casa Grande, Hamlin, Salustiana, Early Sweet Orange, Blood Red and Ruby Red, the acidity did not exceed 0.60% which is an acceptable level.

Table 2. Physical characteristics of fruits of different varieties of sweet orange

Variety	Length (cm)	Breadth (cm)	Weight (g)	rind thickness (cm)	Volume of juice (ml)	Number of seed fruit^{-1}
Campbel Valencia	7.5 a	6.8 bc	206.7 b	0.56 a	74.3 ab	9.0 bc
Frost Valencia	7.1 ab	7.1 ab	191.7 cd	0.41 c	58.7 cd	5.0 d
Olinda Valencia	5.8 e	6.2 c	179.0 de	0.42 c	45.7 ef	5.0 d
Cutter Valencia	6.4 d	6.6 bc	185.3 cde	0.43 c	51.3 def	4.0 d
Casa Grande	7.0 bc	7.5 a	226.7 a	0.52 ab	80.0 a	12.0 ab
Pineapple	6.5 de	6.6 bc	191.7 cd	0.41 c	70.0 abc	14.0 a
Hamlin	5.8 e	6.2 c	175.0 ef	0.37 c	39.3 f	3.0 d
Salustiana	6.3 de	6.7 bc	175.0 ef	0.37 c	39.3 f	3.0 d
Hinkely	6.6 cd	7.0 ab	193.7 c	0.52 ab	70.0 abc	15.0 a
Early Sweet Orange	6.3 de	6.4 bc	172.3 ef	0.39 c	58.0 cd	13.0 a
Blood Red	6.6 cd	6.6 bc	162.3 fg	0.43 c	56.3 de	4.0 d
Ruby Red	6.3 de	6.2 c	155.0 g	0.44 bc	62.33 bcd	6.0 cd

Means followed by same letter(s) do not differ significantly at 1% level of probability.

Table 3. Chemical composition of fruit of differrent varieties of sweet orange

Variety	T.S.S. (%)	Acidity (%)	Ascorbic acid (mg 100 g^{-1})	Total sugars (%)	T.S.S. to acid ratio
Campbel Valencia	7.2 de	1.25 a	41.8 d	8.6 a	5.7
Frost Valencia	7.7 de	1.27 a	44.7 cd	8.43 ab	6.0
Olinda Valencia	6.6 e	1.19 a	45.2 bcd	8.1 abc	5.6
Cutter Valencia	6.7 e	1.03 b	53.2 ab	8.0 bcd	6.5
Casa Grande	7.4 de	0.42 d	50.5 abc	6.7 b	17.5
Pineapple	9.7 ab	0.73 c	58.6 a	7.9 cd	13.2
Hamlin	8.0 cdc	0.48 d	54.7 a	8.2 abc	16.6
Salustiana	10.3 a	0.52 d	45.7 bcd	7.5 de	19.8
Hinkely	8.2 bcde	0.75 c	55.0 abc	7.0 ef	10.9
Early Sweet Orange	8.5 bcd	0.52 d	51.9 abc	6.8 f	16.3
Blood Red	9.5 ab	0.48 d	53.1 ab	6.5 f	19.8
Ruby Red	9.3 abc	0.49 d	52.1 abc	7.0 ef	19.0

Means followed by same letter(s) do not differ significantly at 1% level of significance.

The varieties Pineapple, Hinkely and Hamlin were among those showing higher ascorbic acid (Table 3) and was minimum in Campbel Valencia but sugar percentage was fairly higher in Campbel Valencia. The other varieties showing higher percentage were Frost Valencia, Hamlin and Olinda Valencia. The lowest sugar was found in Blood Red (6.50%). The varieties Blood Red, Salustiana and Ruby Red possessed high T.S.S. acid ratio. Cook (1963), Hussain and Khan (1967), Salam (1971) and Idris *et al.* (1972) also reported variation of chemical characteristics in different sweet orange varieties.

Skin colour, shape and edible qualities of fruit of different sweet orange varieties have been summarised in Table 4. Observations based on organoleptic tests are also tabulated. Sweet oranges of good size with bright skin colour and good taste are preferred in the market and sold at a premium price. Varieties Salustiana, Hinkely, Pineapple and Campbel Valencia possess some of these characters. The dark red colour enjoy superiority over others and this characteristic was possessed by Blood Red and Ruby Red.

The data indicated that it is quite difficult to get all the desirable characters in a single variety, however, based on individual characters, varieties could be selected. In general, the varieties Casa Grande, Pineapple and Salustiana were found high yielding with better quality characters and hence could be acceptable to majority of the consumers. The plants of these varieties are vigorous in growth and hence produce enough synthates to support the higher number of fruits to maintain the quality characters. Further the recovery of juice also indicates that higher juice avail-

Table 4. Fruit shape, skin colour, taste, flaour and T.S.S. to acid ratio of various sweet orange varieties

Variety	Shape of fruit	Colour	Taste	Flavour
Campbel Valencia	Slightly oblong to spherical	Golden orange	Acidic	Rich and sprightly
Frost Valencia	"	"	Acidic	"
Olinda Valencia	"	"	"	"
Cutter Valencia	"	"	"	"
Casa Grande	Spherical	Pale	Sweet	Fair
Pineapple	Spherical to slightly oblate	Deep golden orange	Acidity and sweet well blended	Rich sprightly
Hamlin	Oblate to spherical	Orange	Sweet	Rich
Salustiana	Subglobose to spherical	Orange	Sweet	Rich
Hinkely	Spherical	Light orange	Fairly sweet	Fair
Early Sweet Orange	Round	Orange	Fairly sweet	Fair
Blood Red	Round to oblate	Light blood orange	Fairly sweet	Very rich and pleasant
Ruby Red	Globose to slightly oblate	Well coloured reddish flesh	Fairly sweet	rich

ability and maximum yield could rank them on top for juice industry which is developing very fast in the country. Campbel Valencia was found to be heavy yielder with higher juice volumes but had high acidity level. It could find better scope in the processing industry. The varieties Blood Red and Ruby Red having red flesh could also fetch higher price and compensate the lower yield.

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