COMPARATIVE EVALUATION OF SOME SWEET ORANGE VARIETIES AT ISLAMABAD

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A comparative study was conducted from 1988 to 1990 at National Agricultural Research Centre, Islamabad to evaluate twelve varieties of sweet orange *(Citrus sinensis* Osbeck). Campbel Valencia produced maximum fruit per plant (300) yielding 62.00 kg per plant with average fruit weight 206.67 g. Fruit of Casa Grande were the heaviest in weight (226.67 g) while the 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 Sulstiana, Pineapple and Casa Grande seem promising for economic and juice volume could find better scope of utility in the processing industry.

INTRODUCTION

Citrus is the most important fruit crop of the country and is grown on an area of 170 thousand hectares with a total production of about 1.6 million tonnes. Out of the total production, more than 95% comes from the province of Punjab, and the major species include the Mandarins and oranges. The sweet oranges have an edge over the other groups being more tasty and hence the demand is also increasing day by day and more orchards of oranges are being established in different parts of the country. 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 germplasm collection and evaluation is an important step in the development of all the agricultural commodities including fruit crops. Identification of a promising cultivar may result a major change as this has been experienced in the past. The superiority of a cultivar could be due to its growth behaviour or flowering and fruiting characters, hence different workers have given due attention to both the parameters individually and collectively. Soost and Cameron (1960) studied the trees. Relationship between vigour and yield of the trees was reported by Randhawa (1945). Fruit characteristics considered a key to the evaluation as reported by Aziz (1963) and Cook (1963). Hussain and Khan (1967) and Salam (1971) studied the physico-chemical characters of various varieties of citrus fruit for determining their commercial fitness.

The present study was designed for the selection of high yielding sweet orange varieties suitable to agro-climatic conditions of Potohar plains, particularly to that of Islamabad.

MATERIALS AND METHODS

Twelve varieties of sweet orange *(Citrus sinensis,* Osbeck), namely Campbell, Frost Valencia, Olinda Valencia, Cutter Valencia, Casa Grande, Pineapple, Hamlin, Salustiana, Hinkely, Early sweet orange, Blood Red and Ruby Red were included in the study. All the trees were of the same age (7 years) raised on rough lemon *(C. jam-*

behri Lush) rootstock. The experiment was conducted from 1988 to 1990 at National Agricultural Research Centre, Islamabad. Randomised Complete Block design with three replications, keeping three trees of each variety per treatment. The plants were spaced at 3 meters square and subjected to uniform application of cultural practices throughout the growing period. The data were collected on the trunk girth, plant height, tree spread, fruit size, shape, skin colour, fruit weight, number of seeds per fruit, juice volume, thickness of rind, total soluble solids, total sugars, acidity and ascorbic acid. The data were analysed by the analysis of variance and the test of significance was applied following Duncan's Multiple Range test.

showed significant differences among the varieties. The variety 'Salustiana' attained the maximum height of 2.87 meters and was statistically at par with 'Campbell Valencia', Frost Valencia, Cutter Valencia, Casa Grande, Pineapple, and Hinkely (Table 1). Plant height recorded Blood Red was minimum (1.37 m) indicating it to be dwarf in nature. Campbell 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 (27.33 cm). Maximum increase in spread of plant was observed in 'Frost Valencia' (3.40 m) followed by 'Cutter Valencia' (93.30 m) 'Cambell Valencia' and 'Hinkely' (3.10 m), Pineapple (3.07 m),

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

Variety	Plant height (m) (m)	Trunk girth at base (cm)	Tree spread (m)	Yield (kg per plant)	Fruits per plant
Campbell Valencia	2.50 abc	52.33 a	3.10 abc	62.00 d	300 a
Frost Valencia	2.70 abc	36.00 bc	3.40 a	42.67 cd	222 c
Olinda Valencia	2.23 bcd	30.00 c	2.97 bcd	33.33 f	187 d
Cutter Valencia	2.77 bcd	37.33 bc	3.30 ab	39.67 de	215 c
Casa Grande	2.83 ab	35.00 bc	2.70 cd	46.33 bc	205 cd
Pineapple	2.67 abc	33.67 c	3.07 abc	42.67 cd	223 c
Hamlin	2.17 cd	42.67 abc	2.80 bcd	27.00 g	154 e
Salustiana	2.87 a	48.67 abc	2.90 abcd	35.67 ef	203 cd
Hinkely	2.77 abc	42.33 abc	3.10 abc	51.00 b	264 b
Early Sweet Orange	2.23 bcd	31.67 c	2.50 d	24.00 gh	140 e
Blood Red	1.37 e	30.00 c	1.67 e	21.33 hi	131 e
Ruby Red	1.73 de	27.33 c	2.47 d	17.00 i	103 f

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

RESULTS AND DISCUSSION

Growth behaviour: The data regarding height, stem girth and spread of plant

Olinda Valencia, (2.97 m) and Salustiana (2.90 m). Blood Red showed the least increase in plant spread (1.67 m).

Yield and yield components: Maximum

number of fruits (300) was recorded in Campbell Valencia followed by Hinkely (264) whereas minimum number of 103 fruits plant was recorded in Ruby Red (Table 1). Because of the highest fruit number Campbell Valencia gave the maximum yield of 62.00 kg per plant followed by Hinkely in which 51.00 kg per plant yield was recorded. The lowest yield of 17.00 kg per plant was recorded in Ruby Red.

for cultivars. 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 smaller size. The fruits of other varieties were of medium size. The rind of Campbell Valencia, Casa Grande, Salustiana and Hinkely was found to be thick while that of early

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

Variety	Fruit length (cm)	Fruit breadth (cm)	Fruit weight (g)	Rind thickness (cm)	Volume of juice (ml)	Seed per fruit
Campbell Valencia	7.47 a	6.77 bc	206.67 b	0.56 a	74.33 ab	9.00 bc
Frost Valencia	7.13 ab	7.07 ab	191.67 cd	0.41 c	58.67 cd	5.00 d
Olinda Valencia	5.83 e	61.7 c	179.00 de	0.42 c	45.67 ef	5.00 d
Cutter Valencia	6.40 d	6.57 bc	185.33 cde	0.43 c	51.33 def	4.00 d
Casa Grande	6.97 bc	7.47 a	226.67 a	0.52 ab	80.00 a	12.00 ab
Pineapple	6.47 cd	6.60 bc	191.67 cd	0.41 c	70.00 abc	14.00 a
Hamlin	5.83 e	6.23 c	175.00 ef	0.37 c	39.33 f	3.00 d
Salustiana	6.33 de	6.73 bc	175.00 ef	0.51 ab	70.67 abc	4.00 d
Hinkely	6.57 cd	7.03 ab	193.67 c	0.52 ab	70.00 abc	15.00 a
Early Sweet Orange	6.27 de	6.43 bc	172.33 ef	0.39 c	58.00 cd	13.00 a
Blood Red	6.57 cd	6.53 bc	162.33 fg	0.43 c	56.33 de	4.00 d
Ruby Red	6.30 de	6.23 c	155.00 g	0.44 bc	62.33 bcd	6.00 cd

Means in columns followed by same letters do not differ significantly at 1% level of probability.

Physical fruit characteristics: The fruits of Casa Grande were recorded as the heaviest in weight (226.67 g). Average weight of fruit of Campbell Valencia and Hinkely were 206.67 and 193.6 g (Table 2) respectively. The fruits of Ruby Red were minimum in weight being 155.00 g in average. The differences of means were highly significant

sweet orange was the thinnest (0.30 cm). The varieties which possessed greater number of seeds per fruit were 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 (Table 2). The results of present studies co-

incide with those of Frost and Cameron (1951) and Aziz (1963) who while studying physical characters of fruits of sweet oranges observed significant difference between fruit weight, size, shape, number of seeds, percentage of juice and peel thickness, etc.

Olinda Valencia and Cutter Valencia where the acidity ranged from 1.03 to 1.27% (Table 3). The varieties with slightly high acidity were Hinkely (0.75%) and pineapple (0.73%) which could be acceptable in the market. In Casa Grande, Hamlin, Salus-

Table 3. Chemical composition of different varieties of sweet orange

Varieties	TSS (%)	Acidity (%)	Ascorbic acid (mg/100 g)	Total sugars (%)	TSS % acid ratio
Campbell Valencia	7.17 de	1.25 a	41.83 d	8.60 a	5.73
Frost Valencia	7.67 de	1.27 a	44.73 cd	8.43 ab	6.03
Olinda Valencia	6.63 e	1.19 a	45.23 bcd	8.07 abc	5.57
Cutter Valencia	6.70 e	1.03 b	53.17 ab	7.97 bcd	6.50
Casa Grande	7.37 de	0.42 d	50.50 abc	6.70 b	17.54
Pineapple	9.67 ab	0.73 c	58.57 a	7.87 cd	13.24
Hamlin	7.97 cde	0.48 d	54.67 a	8.23 abc	16.60
Salustiana	10.30 a	0.52 d	45.73 bcd	7.47 de	19.80
Hinkely	8.17 bcde	0.75 c	55.00 abc	6.97 ef	10.89
Early sweet orange	8.47 bcd	0.52 d	51.90 abc	6.77 f	16.29
Blood Red	9.53 ab	0.48 d	53.13 ab	6.50 f	19.85
Ruby Red	9.30 abc	0.49 d	52.13 abc	6.97 ef	18.98

Means followed by same letters do not differ significantly at 1% level by DMR test.

Fruit quality characters: The highest total soluble solids (TSS) (10.33%) were recorded in Salustiana (Table 3). The other varieties exhibiting higher TSS values were Pineapple, Blood Red and Ruby Red with TSS percentage of varieties were statistically at par with one another. The TSS value for Olinda Valencia was the lowest (6.63%). Sweet orange varieties with acidity above 60% are considered sours and are not acceptable in the market. The varieties possessing considerably high acidity percentage were Frost Valencia, Campbell Valencia, tiana, Early Sweet Orange, Blood Red and Ruby Red, the acidity did not exceed 0.60% which is an acceptable level.

Regarding ascorbic acid concentration, the varieties pineapple, Hinkely and Hamlin were among those showing higher values (Table 3). Minimum ascorbic acid concentration was recorded in Campbell Valencia but sugar was fairly higher in Campbell Valencia. The other varieties showing high sugar percentage were Frost Valencia, Hamlin and Olinda Valencia. The lowest sugar was found in Blood Red (6.50%).

Blood Red, Salustiana and Ruby Red possessed high TSS to acid ratio. Frost and Cameron (1951), Cook (1963), Hussain and Khan (1967), Salam (1971) and Idris *et al.* (1973) also reported variation of chemical characteristics in different sweet orange varieties.

Skin, colour, shape and edible qualities 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 Campbell Valencia possess some of these characters. The dark red colour enjoy superiority over other and this characteristic was possessed by Blood Red and Ruby Red.

The data reported indicate that it is quite difficult to get all the desirable characters in a single variety, however, based on individual 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 availability and maximum yield could rank them on top for juice industry which is developing very fast in the country. Campbell Valencia was found to be heavy yielder with higher juice volume but had high acidity level. It could find better scope of utility 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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