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PERFORMANCE OF MANDARIN (*CITRUS RETICULATA* BLANCO) VARIETIES AT ISLAMABAD

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Five exotic varieties of mandarin were compared with one commercially important local mandarin variety "Kinnow" at National Agricultural Research Center, Islamabad. Wilking produced maximum number of fruits plant^{-1} (670.0) with average yield of 91.67 kg plant^{-1}. Kinnow produced the largest fruit weighing 193.3 g and the highest juice volume (61.0 ml). It ranked next to Wilking. Pixie and Honey mandarin though had medium yields but their good characteristics of quality, juice volume and rind thickness can be used to improve commercially cultivated varieties through some systematic breeding programmes.

INTRODUCTION

Mandarin (*C. reticulata* Blanco) group includes some of the finest and most highly reputed citrus fruit which is a good source of vitamin C (Ahmed and Mazhar, 1964). In Pakistan only two mandarin varieties Kinnow and Feutrell's Early, are commercially grown. A narrow choice of mandarin varieties grown in the country leaves a little option with the consumers which necessitates the introduction and testing of some new cultivars.

The cultivars introduced from foreign countries, although are well known but their performance under a new situation might be different. The variation in the fruit characters of the varieties may occur because of difference in soil and climate (Chapot and Nadir, 1965). Cameron *et al.* (1965) reported two new mandarin hybrids, "Encore" and "Pixie" for late season maturity. Hussain and Khan (1967), Salam (1971) and Idris *et al.* (1972) studied the physio-chemical characters of various varieties of citrus to determine their commercial fitness. Uddin and Ahmad (1978) recommended Feutrell's Early, Kinnow and Nagpuri for growing in and around Sylhet. The present studies were, therefore, conducted to make comparative studies of local as wall as exotic varieties of mandarin under sub-tropical and sub-humid conditions of Islamabad.

MATERIALS AND METHODS

Six mandarin varieties viz. Wilking, Kinnow, Honey mandarin, Willow Leaf, Pixie and Ponkan were selected for study. The studies were conducted from 1987 to 1990 at National Agricultural Research Centre, Islamabad. All the trees were of same age (7 years) raised on Rough Lemon (*C. limon* Linn. Burn) rootstock. Plantation was made according to randomized complete block design (RCBD). The plants were spaced at 3 m^2 and subjected to similar cultural practices through out the growing period. The plants were allowed to grow normally without pruning. The data on trunk girth, plant height, spread, fruit size, shape of fruit, skin colour, fruit weight, number of seeds fruit^{-1}, juice volume, rind thickness, total soluble solids, acidity, ascorbic acid and yield were collected. Twelve fruits tree^{-1} were randomly selected and were analysed chemically. The data were analysed by the analysis of variance and Duncan's Multiple

Range (DMR) test of significance was applied.

RESULTS AND DISCUSSION

Maximum height (2.6 m) was attained by Ponkan (Table 1) while Honey mandarin and Willow leaf were of the lowest height (2.1 m). Maximum trunk girth was recorded in Kinnow (39.0 cm) and minimum in Wilking (25.3 cm). The highest spreading varieties were Pixie and Kinnow whereas the least spreading varieties were Ponkan and Honey mandarin. Uddin and Ahmad (1978) found significant differences in plant spread but the plant height and trunk girth did not show any significant difference.

Kinnow were on the top. Uddin and Ahmad (1978) also reported variability of fruit yield in different mandarin varieties.

Physical characteristics of fruit: The data (Table 2) revealed that Kinnow had the biggest fruit followed by Ponkan and Willow Leaf with fruit size of 6.3, 6.1 and 5.8 cm, respectively. Among all the varieties, the fruits of Kinnow were the heaviest in weight (193.3 g) followed by Willow Leaf (181.2 g). The fruits of Wilking were highest in weight being 136.3 g. The rind of Kinnow was thicker compared to other varieties while that of Wilking was the thinnest (0.26 cm). Maximum juice volume fruit^{-1} was recorded in Kinnow (61.0 ml) while Ponkan, Pixie and Wilking, it was 58.7, 53.7 and 49.3 ml,

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

Variety	Plant height (m)	Girth at base (cm)	Spread of plant (m)	Number of fruit plant^{-1}	Yield (kg plant^{-1})
Wilking	2.2	25.3	2.4 b	670 a	91.7 a
Kinnow	2.2	39.0	2.8 a	266 b	51.3 b
Honey Mandarin	2.1	28.3	2.4 b	244 b	34.7 bc
Willow Leaf	2.1	25.0	2.5 b	195 b	35.3 bc
Pixie	2.5	28.3	3.0 a	295 b	41.0 bc
Ponkan	2.6	29.9	2.3 b	116 b	20.0 c

Means followed by the same letter(s) do not differ significantly at 5% level of probability.

Yield and yield components: Wilking was the highest yielder with 670 fruits plant^{-1} whereas Ponkan produced only 116 fruits plant^{-1} (Table 1). The varieties with medium number of fruits were Kinnow and Pixie. Honey mandarin and Willow Leaf were below medium, producing 244 and 195 fruits plant^{-1}, respectively. The yield recorded has also similar trend. However, Pixie produced smaller fruits. The varieties Wilking and

respectively. Minimum juice volume was recorded in Willow Leaf (32.2 ml). Among six varieties, fruits of Kinnow were the most seedy having 21.2 seeds fruit^{-1} followed by Willow Leaf and Pixie having 16 and 15.3 seeds fruit^{-1}, respectively. Fruits of Wilking and Ponkan were orange while those of Kinnow, Honey mandarin, Willow Leaf and Pixie were yellowish orange. Colour of flesh of these varieties was yellowish. These

Table 2. Physical characteristics of fruits of different varieties of mandarin

Varieties	Length of fruit (cm)	Breadth of fruit (cm)	Fruit weight (g)	Rind thickness (cm)	Volume of juice (cc)	Number of seeds fruit^{-1}
Wilking	4.90 cd	6.50 abc	136.3 c	0.26 d	49.3 a	10.0 c
Kinnow	5.67 ab	6.87 a	193.3 a	0.36 a	61.0 a	21.2 a
Honey Mandarin	5.23 abc	6.27 bc	142.0 c	0.31 b	35.4 b	13.0 bc
Pixie	4.83 d	6.70 ab	140.3 c	0.28 c	53.7 a	15.3 b
Ponkan	5.83 a	6.33 bc	17.2 b	0.30 bc	58.7 a	10.3 c
Willow leaf	5.43 abc	6.27 bc	182.0 a	0.32 b	32.0 b	16.0 b

Means followed by the same letter(s) do not differ significantly at 5% level of probability.

observations agree with the findings of Uddin and Ahmad (1978).

Table 3. Chemical composition of different varieties of mandarin

Variety	T.S.S. (%)	Acidity (%)	Ascorbic acid (g 100 g^{-1})	T.S.S. acid ratio
Wilking	10.1 a	0.86	43.3 a	11.7
Kinnow	9.6 a	1.03	30.9 b	9.3
Honey	9.9 a	1.07	41.7 a	9.2
Mandarin Willow Leaf	8.1 a	0.89	31.2 b	9.1
Pixie	9.7 a	1.35	30.3 b	7.2
Ponkan	8.0 a	0.75	27.1 b	10.7

Means followed by the same letter(s) do not differ significantly at 5% level of probability.

Fruit quality characters: The values of T.S.S. of all the varieties were statistically similar and ranged from 8.0 to 10.0 (Table 3). The acidity was the lowest in Ponkan (0.75%) and the highest in Pixie (1.35%), but the difference among the value in all mandarin varieties was statistically non-significant. Regarding ascorbic acid contents, the highest value was recorded in Wilking (43.3 g 100 g^{-1}) and minimum in Ponkan (27.1 g 100 g^{-1}). Statistically there existed no difference between Wilking and Honey mandarin. Ponkan, Pixie, Willow Leaf and Kinnow were also at par with one another. The T.S.S. to acid ratio was higher in Wilking and Ponkan, being 11.7 and 10.7, respectively whereas Pixie exhibited the lowest ratio of 7.2.

It is concluded the commercial variety of mandarin, Kinnow is still holding good and only one variety Wilking could out yield it. As the plant of Kinnow is vigorous which helps to produce sufficient number of fruits of good size, hence it could yield higher compared to many other varieties. Wilking although yielded higher but the fruit size is smaller than Kinnow but can find a place for commercial cultivation in the country. The

ble 4. **Fruit shape, skin colour, taste and flavour of various Mandarin varieties**

Variety	Shape	Colour	Taste	Flavour
Wilking	Slightly oblate	Orange at maturity		Rich, springtly aromatic
Kinnow	- do -	Yellowish orange		Rich, aromatic
Honey Mandarin	Oblate	- do -		Rich and sweet
Willow leaf	Moderately oblate	- do -	Sweet	Sweet, pleasantly aromatic
Pixie	Subglobose to to round	- do -		Pleasant and mild
Ponkan	Globose to moderately oblate	Orange		Mild and pleasant

only draw back in Kinnow is the character of seediness, which probably could be improved through selection and breeding.

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