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PERFORMANCE OF KINNOW MANDARIN (*Citrus reticulata* Blanco) ON TRADITIONAL AND EXOTIC ROOTSTOCKS

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Abstract

Citrus is a leading fruit crop of Pakistan. Among citrus, Kinnow is the most prominent cultivar and shares about 95% of total production. The monopolized cultivation of Kinnow scion grafted over rough lemon needs a substituted rootstock for higher yield/return and for longer tree life. Trials for the selection of suitable rootstock for Kinnow mandarin under subtropical environmental conditions and highly alkaline rhizosphere were carried out in the Experimental Fruit Orchard (Square 9), Institute of horticultural sciences, University of Agriculture, Faisalabad during 2003-2005. The studies revealed that Volkamer lemon, Brazilian sour orange and citrumello as reliable rootstocks for citriculture industry of Punjab province.

Key words: Citrus, Kinnow, rootstocks, yield, exotic

INTRODUCTION

The significance of citrus in the entire scenario of global fruit culture and its ultimate share in the trade is very well recognized. Citrus being an important genus of family *Rutaceae* have entered in an era of commercialization being freshly consumable and processed product due to its versatile organoleptic qualities. Various species of this importance genus originated in Asia and Malyian Archipelago (Hooker, 1872). However, it has become an important exportable crop of Northern and Southern hemispheres.

For the healthy flourishing of this sector of immense significance; role of rootstock is very crucial. Rootstock not only affect the horticultural characters of tree but there role in fields and quality of fruit is a known reality. Rootstock have a direct bearing on tree size, yields, fruit quality, precocity fruit, production and ultimate fruit maturity.

Reliance on one rootstock creates a type of its dominance as stressed in Punjab where all the scion varieties are grafted on rough lemon rootstock. Negative aspects of rough lemon include susceptibility against phytophothora, foot rot, nematodes increasing level of salinity and incompatibility problem with different sweet orange cultivars. Continuous use of this rootstock has malaised our fruit sector creating inevitability to opt for other rootstocks tenable for the problems of soil born nature and other narrated therein. In the light of an elaborated worked on rootstocks performed in different countries of the world, Trifoliate orange and Carrizo citrange produced qualitative fruits (high TSS etc.) as compared to Rough Lemon (Castle et al., 1988). Moreover, (Richardson et al., 2003) reported the role of rootstocks to influence the water/mineral

uptake to alter the pattern of tree canopy. Walter et al. (2002) favored the use of trifoliate orange as a rootstock for inducing dwarfness besides qualitative harvest of citrus fruit. Since no single rootstocks can prove worth exploiting for various situations hence citrus sector under various agro ecological conditions should select rootstocks which are well adaptable to certain agro climatology besides addressing other problems the citrus sector is confronted with best criterion for the rootstock selection is! What are the priorities and problems and which of the rootstocks can overcome the problems and stand in line to the priorities. The present research endeavor is an effort to this direction.

MATERIALS AND METHOD

The studies were carried out at Postgraduate Students Agricultural Research Station (PARS) and Experimental Fruit Orchard (Square 9), Institute of Horticultural Sciences, University of Agriculture, Faisalabad. Following rootstocks viz-a viz. Citrumelo 4475, Citrumelo 1452, Volkamariana, Yuma citrange, Rough lemon, Mithi, Troyer citrange, Carrizo citrange, Brazillian sour orange were used. The experiment was layed out according to the Completely Randomized Design (CRD) and the data was analyzed through analysis of Variance techniques (Steel et al., 1996).

For the physiochemical analysis, 100 fruits of each cultivar were selected. The analyses of fruit were conducted in Post Graduate Pomology Lab, Institute of Horticultural Sciences, University of Agriculture, Faisalabad. Following physiochemical parameters were studied scion girth, rootstock girth, canopy spread, plant height, number of fruits per plant, Juice (%), TSS (°Brix), acidity (%) and vitamin C (mg $100g^{-1}$). Girth measurement was taken at a fixed height of 25 cm from above the graft union for scion girth and 10 cm below the graft union for girth of rootstock. The positions were marked with paint for recurrent observations. Plant height was measured by telescope pole while canopy spread was calculated by using the formula Canopy spread = $4/3\ \pi\ r^3$.

Total Soluble Solids were measured by Digital Refractometer (ATAGO, RX 5000). Acidity in juice was determined by taking 10 ml of juice from each sample and diluting with distilled water in a 100 ml beaker. 2-3 drops of phenolphthalene were added for end point. The samples were titrated against N/10 NaOH (Hortwitz, 1960). The results were expressed as percent citric acid.

$$\text{Citric acid (\%)} = \frac{\text{N/10 NaOH used} \times 0.0064}{\text{Volume or weight of sample used}} \times 100$$

The method described by Ruck (1961) was used for estimation of Vitamin C in juice. 10 ml juice was taken into 250 ml conical flask and volume was made upto the mark using 0.4% Oxalic acid solution. 5 ml of filtered aliquot was taken in a flask and titrated against 2,6-dichloropheno indophenol dye to a light pink colour which persist for 10-15 seconds. Vitamin C was calculated as:

$$= \frac{1 \times R_1 \times V}{R \times W \times V_1} \times 100 \text{ mg ascorbic acid per 100 ml juice}$$

Where,

R_1	:	ml dye used in titration of aliquot
R	:	ml dye used in titration of 1 ml of standard ascorbic acid solution prepared by adding 1 ml of 0.l% Ascorbic acid + 1.5 ml of 0.4% Oxalic Acid
V_1	:	ml of juice used
V	:	Volume of aliquot made by addition of 0.4% Oxalic Acid
W	:	ml. of aliquot used for titration

Whereas, TSS/Acid Ratio was calculated by dividing the TSS by acidity

RESULTS AND DISCUSSION

Rootstock Girth Increment (cm)

Rootstock and scion girth is considered very important for the stionic relationship of various rootstocks with the scion. Sometime rootstock shows incompatibility with scion. It caused unbalancing in physiological function, plant vigor, productivity as well as fruit quality. The observations for this parameter showed significant differences among rootstocks for increment in stock girth. Maximum rootstock increment was observed in Rough lemon (2.00 cm) followed by Volkamer lemon (1.25 cm) whereas, minimum in Brazillian Sour Orange (BSO) which showed almost no increment as shown in table.

Scion Girth Increment (cm)

The results indicated that Rough lemon had statistically maximum increment (3 cm) followed by Yuma citrange (2.50 cm). Whereas, Citrumelo 1452 (0.75 cm), Mithi (0.75 cm) and Brazilian sour orange (0.75 cm) minimum annual increment in scion girth. Our results were found to be in agreement with those of Noda et al. (2001), Moeen (2000), Shahid et al. (1999) and Malik et al. (1984) who reported that different rootstocks affect scion and stock girth significantly.

Plant Spread Increment

Canopy Increment proved to be non-significant for the rootstocks. However, maximum increment was observed in Citrumelo 4475 (1.60 m^3) followed by Volkamariana rootstocks (0.43 m) while minimum in Mithi (0.01 m^3).Our results were according to the findings of Kumar et al. (1994) and Malik et al. (1984).

Plant height increment (feet)

Plant height which is an important vegetative character as for as its increment was concerned Rough Lemon gained (1.75 ft) and proved to be superior closely followed by Volkamariana (1.25 ft) and Citrumelo 4475 (1.03 ft), while the minimum plant increment was attained by Brazilian sour orange (0.37ft) rootstocks. Our findings were found to in agreement with those of Wutscher and Shull (1975).

Fruits per plant

The data on yield was taken by counting the number of fruits per plant and analyzed statistically. Results indicated significant difference in rootstock treatments with respect to total number of fruits. It was observed that Brazilian sour orange (1022.25) had maximum number of fruits closely followed by Volkamariana (892.50) and Rough lemon (695.50). While, Citranges [Troyer (380.50), (Yuma203.25), Carrizo (127.50)] revealed poor results and Carrizo Citrange (127.50) proved to be the poorest of all. Our results were closely related to Georgiou (2000); Wutscher and Bistline (1988) who also observed maximum yield from the trees on Brazillian sour orange (BSO) and Volkamariana rootstock.

Juice (%)

Juice percentage in the fruit is considered to be very important. The ultimate demand of customer is higher juice percentage in the fruit. Results regarding the juice percentage revealed significant difference for different rootstocks. Volkamariana was found to be superior and produced the maximum juice (50.52%), which was statistically at par with Rough lemon (49.60%) and Mithi (48.80%). It was followed by Carrizo Citrange (47.01%), Brazilian sour orange (46.41%) and Yuma Citrange (46.19%). Minimum juice was produced by the trees grafted on Citrumelo 1452 (38.99%).

Total Soluble Solids (TSS)

Kinnow is considered to be full of vitamin C and other elements like Mg, Fe and Ca. Total soluble solids (TSS), acidity and ascorbic acid have their importance in standardizing the citrus fruit quality parameters. Rootstocks affected all above discussed parameter significantly.

Data pertaining to TSS revealed significant difference among rootstocks. Maximum total soluble solids were recorded in Brazilian sour orange (13.60), which was statistically similar to all other rootstocks except Yuma Citrange (11.05), which produced the minimum total soluble solids. Other rootstocks Mithi (13.18), Citrumelo 4475 (13.01), Troyer citrange (12.85), Citrumelo 1452

(12.09), Carrizo citrange (12.05), Volkamariana (11.80) and Rough lemon (11.45) were statistically at par with respect to total soluble solids.

Acidity (%)

The data regarding the acidity subjected to statistical analysis showed significant effect of treatments on acidity as the table indicates that Citrumelo 4475 had the maximum acidity (1.07), which was statistically at par with the Citrumelo 1452 (1.04), Yuma Citrange (1.03), Carrizo Citrange (0.96), Troyer Citrange (0.94) and Brazilian sour orange (0.94). While minimum acidity (0.82) was recorded in fruits of Rough lemon.

Vitamin C (mg $100g^{-1}$)

Statisticaly significant differences were observed between the rootstocks for vitamin C. The data revealed that maximum vitamin C (33.42 mg $100g^{-1}$) was recorded for trees grafted on Rough lemon. It was followed by Yuma Citrange (30.81 mg $100g^{-1}$), Carrizo Citrange (30.65 mg $100g^{-1}$), Citrumelo 1452 (30.47 mg $100g^{-1}$), Mithi (30.36 mg $100g^{-1}$) and Volkamariana (30.34 mg $100g^{-1}$). While, minimum vitamin C was recorded in fruit on Citrumelo 4475 (26.85 mg $100g^{-1}$).

Our observations regarding TSS, Acidity and Vitamin C were in consonance with the findings of Jianguo et al. (2001), Wutscher and Hill (1995) and Wutscher and Shull (1976) that rootstocks affect TSS, acidity and vitamin C.

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Table: Physiochemical properties of citrus cultivars

Sr. No.	Rootstock girth increment (cm)	Scion girth increment (cm)	Canopy increment (m^3)	Plant height increment (ft)	Fruits per plant	Juice (%)	TSS (°Brix)	Acidity (%)	Vitamin C (mg $100g^{-1}$)
1	0.63bc	2.00abc	1.60	1.03b	271.5	44.38	13.4	1.13	29.94
2	0.50bc	0.75c	0.16	0.85c	579.5	39.31	12.48	1.02	32.98
3	1.25ab	1.00bc	0.43	1.25b	920.5	50.84	12.19	0.94	33.43
4	0.50ab	2.50ab	0.31	0.95c	230.5	46.51	11.44	1.09	33.9
5	2.00a	3.00a	0.05	1.75a	723.5	49.92	11.84	0.88	33.9
6	0.25bc	0.75c	0.01	0.71c	432.5	49.12	13.57	0.96	33.45
7	0.75bc	1.00bc	0.09	0.95c	411.0	43.69	13.24	1.02	31.55
8	0.73bc	1.00bc	0.10	0.76c	155.5	47.33	12.44	1.02	33.74
9	0.00c	0.75c	0.11	0.37d	1050.25	46.73	13.33	1.14	31.77