

BIOPHYSICAL STUDIES OF SCION/STOCK COMPATIBILITY IN KINNOW (*CITRUS RETICULATA* BLANCO)

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Abstract

Rootstock has its prominent role in the successful establishment of orchards. In the present research project nine rootstocks: viz-a-viz Citrumelo 1452, Citrumelo 4475, Yuma citrange, Volkamariana, Rough lemon, Mithi, Carrizo citrange, Troyer citrange and Brazilian sour orange were selected for evaluation, using kinnow as scion. Results indicated that trees on Volkamariana rootstock and Rough lemon were superior to other rootstocks for both growth and yield. While performance of Carrizo was poor for yield component. Nitrogen contents were found maximum in the leaves of Yuma Citrange and Potassium contents were maximum in the leaves of Carrizo Citrange but Carrizo Citrange have poor response for Phosphorus. Volkamarina performed better to all other rootstocks in this experiment as for as yield and growth is concerned.

Introduction

Among citrus Kinnow (*Citrus reticulata* Blanco) has gained special significance and has monopolized citrus industry of the country; commercially cultivated for its high processing quality, fresh consumption and aromatic flavor, good yield and better adaptation. Hence, area under Kinnow is increasing day by day in citrus growing belt of Punjab. It has not only excelled other mandarin varieties but also substituted sweet oranges in this country. But since 1948, the average per hectare production of citrus in Pakistan remained about 1/3rd of the average production of citrus in other countries (Anonymous, 2002).

Citrus is inclined to progressive decline now-a-days. Among the various factors responsible for citrus decline, rootstock has been considered to be one of the most contributory one, with respect to climatic conditions. There is no controversy over the

importance of citrus rootstock for better citrus production. Rootstocks provide the growers a useful tool to manipulate the vigor and performance of orchard trees. Tree size, precocity, fruit production and maturity can be manipulated through interrelationship between the roots and canopy of the plant as they significantly alter the pattern of canopy development and functions such as photosynthesis (Richardson *et al.* 2001). There is a definite impact of different rootstocks on tree size in citrus (Castle, 1985).

Rootstock becomes a problem when it is not congenial to scion variety as it affects the physiology and morphology of the tree. Therefore, the failure and success of the orchard depends upon the selection of proper rootstock for scion variety. Unfortunately, there is no single rootstock available that can be regarded as ideal for Kinnow under all type of agro-climatic conditions.

Extensive research has been done on rootstocks for citrus species. Moeen

(2000) recorded better vigor, yield, and scion growth of Kinnow mandarin on Volkamariana rootstock. Malik and Malik (1990) found the tallest trees of Kaghzi lime on Nasnaran rootstock, closely followed by Sweet lime and Jallundhari Khatti while, maximum canopy volume, yield and average fruit weight was observed on Sweet lime. Shahid *et al.* (1999) recorded maximum nitrogen in the leaves of Kinnow plants grafted on Citrumelo 4475 and Citrumelo 1452 rootstocks while, minimum on Rough lemon and Yuma citrange. P, K and Ca contents were not affected significantly by the rootstock used.

The present project is hence designed as a preliminary effort to investigate a suitable rootstock for Kinnow considering vigor, productivity and leaf nutrient contents under the subtropical condition of the Punjab.

MATERIALS AND METHODS

The experiment was conducted on nine different rootstock. Kinnow mandarin (*Citrus reticulata* Blanco) in the Experimental Fruit Garden Sq. No. 9, Institute of Horticultural Sciences, University of Agriculture, Faisalabad during 2003-2004. Different rootstocks used were Citrumelo 1452, Citrumelo 4475, Yuma citrange, Volkamariana, Rough lemon, Mithi, Carrizo citrange, Troyer citrange and Brazillian sour orange.

Kinnow mandarin plants grafted on nine different rootstocks were fifteen year old. Data were recorded for vigor productivity and NPK status of Kinnow trees, for consecutive years (2003-2004).

Vigour of the trees was measured in terms of stem girth, both of rootstock and scion plant height and canopy spread. Productivity was recorded by measuring the Yield by

counting the number of fruits per tree as well as their weight.

Leaf sample were collected for N, P and K in February and September to observe the effect of different rootstocks on nutrient status of Kinnow as scion.

Experiment was laid out according to randomized complete block design (RCBD) and data recorded were subjected to analysis of variance technique at 5% probability level, to compare the treatment means for the parameters data was subjected to Duncan's multiple range tests. (DMRT).

Results and Discussion

Growth

Kinnow (*Citrus reticulata* Blanco) made satisfactory growth on all the nine rootstocks. The effective results for plant height were obtained by Volkamariana rootstock (13.85 feet) excelled over all other rootstocks for plant height closely followed the Rough lemon (12.7 feet). While, the minimum plant height was recorded of the plant on the Carrizo Citrange rootstocks (8.96 feet). The observations are closely related to the findings of Wright and Pena (2002), Moeen (2000).

Data regarding rootstocks and scion girth indicates that Volkmariana was the most promising rootstock for Kinnow w.r.t. compatibility, followed by Mithi. The poorest combination of rootstock and scion was observed in all the Citrange rootstocks, i.e. Carrizo Citrange, Troyer Citrange and Yuma Citrange. Our results verified with the work of Noda *et al.* (2001), Moeen (2000), Shahid *et al.* (1999). Although girth for rootstock varied greatly from 51.25 cm to 81.00 cm yet, the performance of all the rootstock was statistically similar.

Maximum rootstock girth was recorded for Volkamariana (81.0 cm). While, minimum for Brazilian sour orange (51.25 cm). Maximum scion girth was observed on Volkamariana (73.50 cm), which was statistically similar to the trees on Rough lemon (67.00 cm), Mithi (57.00 cm) and

rootstocks. Rough lemon (49.1 kg) and Citrumelo 1452 (44.5 kg) also revealed statistically similar results, while the trees on Carrizo Citrange (19.6 kg) and Yuma Citrange (14.1 kg) proved to be the poorest rootstock. Our results are closely related to Georgiou (2000), Moeen (2000), Wustcher (1988). But

Table 1: Effect of rootstock on plant height and spread and stem girth

Rootstocks	Height (feet)	Plant spread (m)	Stem girth (cm)	
			Rootstock (cm)	Scion (cm)
Citrumelo 4475	12.48b	6.23a	70.00 ^{NS}	64.50ab
Citrumelo 1452	11.20e	4.23cd	65.50	54.50bc
Volkamariana	13.85a	5.98ab	81.00	73.50a
Yuma Citrange	9.77f	3.24d	64.25	55.00bc
Rough lemon	13.75a	5.15abc	67.00	70.50ab
Mithi	11.96d	4.29bcd	61.50	57.00bc
Troyer Citrange	12.21c	4.44bcd	68.25	56.00bc
Carrizo Citrange	8.96g	2.20de	58.23	46.00c
Brazilian sour orange	11.87d	4.66abcd	51.25	47.25c

Citrumelo 4475 (64.50 cm).

As plant spread was concerned Volkamariana (5.98m) presented superiority over others followed by Rough lemon (5.15m). The lowest values for canopy was obtained for the trees grafted on Carrizo Citrange rootstock (2.20m). Our results are in accordance to the findings of Wright and Pena (2002) and Moeen (2000).

Yield

Maximum number of fruits were recorded from the trees on Brazilian sour orange (1022.25) closely followed by Volkamariana (892.50) and Rough lemon (695.50). While, citranges (Yuma, Carrizo and Troyer) yielded poor results and Carrizo Citrange (127.50) proved to be the poorest of all the citranges.

Kinnow trees produced maximum fruit by weight when grafted on Volkamariana rootstock (67.2 kg) observed superior over all other

results are contrary to those reported by Richardson *et al.* (2001) that less vigours rootstocks produce more yield.

Leaf Nutrient status

Nutrient status of the leaves was determined according to the procedures followed by Chapman and Parker (1961) and Yoshida *et al.* (1976).

The result revealed statistically difference among rootstocks and seasons and their interaction was non-significant.

Nitrogen contents of Kinnow were statistically different on all the rootstocks used for Kinnow. Data could be differentiated into their groups. One group contained Citrumelo 1452 (2.69), Yuma Citrange (2.56), Rough lemon (2.58) had maximum nitrogen content. 2nd group include Volkamariana (2.52), Citrumelo 4475 (2.49), Mithi (2.46) having moderate contents and 3rd

Table 2: Effect of rootstocks on yield in Kinnow trees

Rootstocks	Fruit yield	
	Fruit count	Fruit (kg)
Citrumelo 4475	243.50f	17.1d
Citrumelo 1452	594.50d	44.5b
Volkamariana	892.50b	67.2a
Yuma Citrange	203.25f	14.1de
Rough lemon	695.50c	49.1b
Mithi	404.50e	29.5c
Troyer Citrange	380.50e	27.2c
Carrizo Citrange	127.50g	19.6e
Brazilian sour orange	1022.25a	64.7a

group included Troyer Citrange (2.38), Brazilian sour orange (2.38) and Carrizo Citrange (1.96) contained the lowest nitrogen contents. Our results are verified by the work of Shahid *et al.* (1999).

Phosphorus contents in the leaves were observed in minute difference between the rootstocks. However Carrizo Citrange (0.17) performed poorly. Best rootstocks was Yuma Citrange (0.29) which was statistically similar to Volkamariana (0.29) and

Citrumelo 4475 (0.29). Other treatments were statistically similar.

The maximum potassium contents in Kinnow leaves were observed on Carrizo Citrange (1.69%), while these could be constituted three groups with respect to the other rootstocks. Potassium contents of Kinnow were statistically similar when Citrumelo 1452 (1.36%), Citrumelo 4475 (1.31%) and Troyer citrange (1.31%) were use as rootstock. Minimum phosphorus was recorded when Yuma citrange

Table 3: Effect of rootstocks on N, P and K Status of kinnow leaves

Rootstocks	N	P	K
Citrumelo 4475	2.49bc	0.28ab	1.31bc
Citrumelo 1452	2.69a	0.29ab	1.36b
Volkamariana	2.52b	0.30a	1.19bcd
Yuma Citrange	2.56ab	0.29ab	1.11d
Rough lemon	2.58ab	0.21c	1.12d
Mithi	2.46bc	0.22c	1.17cd
Troyer Citrange	2.38c	0.20c	1.31bc
Carrizo Citrange	1.96d	0.17d	1.69a
Brazilian sour orange	2.38c	0.27b	1.12d

(1.11%) was used as rootstock. Our observations were closely related to the finding of Shahid *et al.* (1999), Path *et al.* (1989), Wustcher and Shull (1976).

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