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Effect of Various Rootstocks on Leaf Mineral Composition and Productivity of Kinnow Mandarin

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ABSTRACT

Leaf analysis for mineral nutrients of Kinnow mandarin grafted on six different rootstocks i.e. Citrumelo 4475, Citrumelo 1452, Volkamariana, Yuma citrange, Mithi and Rough lemon was conducted. Nitrogen contents varied significantly among the plants grafted on these rootstocks. Maximum nitrogen (1.5%) was recorded in the leaves of the plants grafted on Citrumelo 4475 and Citrumelo 1452 rootstocks, while the minimum (0.58%) on Rough lemon and Yuma citrange. Phosphorus, potasium and calcium contents were not affected significantly by the rootstocks used. Rootstocks also differed in absorption of micronutrients. Maximum copper (16.6 ppm) was recorded in the leaves of the plants grafted on Rough lemon and minimum (7.33 ppm) on Citrumelo 1452 rootstocks, while maximum zinc (18.67 ppm) was on Citrumelo 4475 and minimum (13.3 ppm) on Volkamariana rootstocks. Percentage of male flowers ranged from 0 to 5.06% being minimum in plants grafted on Yuma citrange and maximum on Volkamariana. The highest number of fruits/plant was recorded on Citrumelo 4475 (310 fruits) and the lowest on Yuma citrange rootstock (54 fruits).

Key Words: *Citrus reticulata*; Kinnow; Rootstocks; Leaf analysis; Pakistan

INTRODUCTION

Citrus rootstocks differ in their adaptibility to soil with diffeerent textures, root distribution and mycorrhizal dependency resulting in variable leaf nutrient contents ultimately determining the production and quality of fruits. A number of experiments have been conducted to find out suitable rootstocks for various commercial cultivars of citrus throughout the world (Wutscher & Shull, 1972; Labanauskas *et al.*, 1975; Kumar *et al.*, 1979; Castle & Phillips, 1980; Heinz & Wutscher, 1982; Hutchison, 1982; Anjaneyulu & Misra, 1983; Fallahi *et al.*, 1989; Holtzhausen *et al.*, 1992; Rao *et al.*, 1996). The performance of different rootstocks is found variable under different climatic and edaphic conditions. Hence, it becomes desirable to conduct studies under local conditions to recommend dependable rootstocks. Therefore, the present studies were conducted to investigate and find out a suitable rootstock for Kinnow mandarin. The present work is part of an on going citrus rootstocks research project.

MATERIALS AND METHODS

Six rootstocks i.e. Citrumelo 4475, Citrumelo 1452, Volkamariana, Yuma citrange, Mithi (sweet lemon) and Rough lemon were used for grafting Kinnow mandarin (Citrus reticulata Blanco) as a scion cultivar. Six years old plants, growing under similar soil and cultural conditions, were selected and evaluated during a period of two years for leaf mineral composition and productivity. The experiment was laid out according to a Randomized Complete Block Design in three replications. The experimental plants were fertilized as usuall during February. Leaf samples were taken during September to determine their comparative nutritional status to enter into the winter season. For analysis, 4-6 months old healthy and uniform leaves were picked randomly from all sides of the plants. These samples were immediately taken to the laboratory and washed gently using a detergent in distilled water. The leaves were kept for an hour for air-drying and then were placed in an oven at 650°C for drying. The leaves were then crushed to a fine powder and stored in air tight plastic bottles for their chemical analysis. The nitrogen, phosphorus and potasium contents of leaves were estimated according to the method described by Chapman and Parker (1961). The concentrations of micro elements (copper and zinc) were determined by using an atomic absorption spectrophotometer. First standard curve was obtained for each element and then actual samples were fed and reading for the element was estimated directly in ppm from the standard curve.

To observe the effect of rootstocks on sex of flowers, twenty flushes of each tree were marked and data were recorded on total number of flowers and maleness percentage. At harvesting, total number of fruits per tree were counted to obtain the yield data. The

experiment was repeated the following year (when plant age was seven years), designated as second year of observation, and data on same parameters were recorded. The data, thus collected were analysed statistically using the Fisher's analysis of variance technique. The means were compared using Duncan's multiple range test at 5% probability (Petersen, 1994).

RESULTS AND DISCUSSION

Leaf nitrogen content. Data on nitrogen percentage of leaves indicated significant differences among the rootstocks used for nitrogen uptake (Table I). A comparison of the mean values revealed that the data existed in two groups. Citrumelo 4475, Citrumelo 1452 and Mithi constituted one group while the second group included Volkamariana, Yuma citrange and Rough lemon. Members of each group behaved significantly alike while the former group had significant dominance over the other. Some of the rootstocks absorbed comparatively more amount of nitrogen from the same soil and translocated to the vegetative organs. This could be due to genetic make up of these rootstocks. Nitrogen is one of the important elements for growth and thus ultimate yield of the tree depends on the nitrogen contents supplied through the rootstock. Similar results have also been reported by Ismail *et al.* (1965) and Labanauskas *et al.* (1975).

Phosphorus, potassium and calcium contents. Data regarding percentages of phosphorus, potassium and calcium in the leaves revealed non-significant differences for the rootstocks used. However, phosphorus percentage in Kinnow leaves varied from 0.117–0.150%, while potassium and calcium contents ranged from 0.650–0.790 and 3.067–3.760%, respectively (Table I).

Copper. Rootstocks exhibited highly significant differences for leaf copper contents (Table I). The plants grafted on Rough lemon rootstock contained significantly higher copper concentration followed by the plants grafted on Mithi, which occupied the second best position. Citrumelo 4475 and Citrumelo 1452 were observed at the bottom. Copper is also an important element for the production of some essential material, which in turn plays an important role on the productivity of plants. In the present studies, Rough lemon, the recommended rootstock, being utilized in commercial citrus orchards outclassed rest of the rootstocks for copper absorption.

Zinc. Observation recorded on zinc spelt out significant differences for the rootstocks (Table I). Citrumelo 4475 expressed superiority over all other rootstocks for leaf zinc contents except Citrumelo 1452 which behaved alike. Zinc is considered as an essential micro–nutrient in view of its function in plant biochemical system. Although it is needed in minute quantities, its defficiency shows clear cut symptoms

Table I. Effect of different rootstocks on leaf mineral composition and productivity of Kinnow mandarin

Rootstock used	Leaf nitrogen (%)	Phosphorus (%)	Potassium (%)	Calcium (%)	Copper (ppm)	Zinc (ppm)	Male flowers (%)	Yield per tree (no. of fruits)
Citrumelo 4475	1.40 a* (1.50 a)	0.14 a (0.15 a)	0.78 a (0.78 a)	3.27 a (3.36 a)	8.33 d (9.30 d)	18.67 a (18.67 a)	2.33 b (2.30 b)	261.33 a (310.10 a)
Citrumelo 1452	1.40 a (1.50 a)	0.14 a (0.15 a)	0.75 a (0.75 a)	3.07 a (3.16 a)	7.33 d (8.30 d)	17.00 ab (17.01 ab)	1.01 bc (1.02 bc)	212.33 a (298.30 a)
Volkamariana	0.58 b (0.68 b)	0.12 a (0.13 a)	0.73 a (0.73 a)	3.07 a (3.40 a)	10.67 c (11.60 c)	13.33 c (13.30 c)	5.06 a (5.01 a)	258.00 a (301.70 a)
Yuma citrange	0.58 b (0.68 b)	0.12 a (0.12 a)	0.77 a (0.77 a)	3.43 a (3.53 a)	11.00 bc (12.00 bc)	14.67 bc (14.60 bc)	0.00 c (0.00 c)	53.67 b (102.00 b)
Mithi	1.28 a (1.38 a)	0.12 a (0.13 a)	0.79 a (0.79 a)	3.57 a (3.63 a)	12.67 b (13.60 b)	14.33 bc (14.30 bc)	0.79 bc (0.77 bc)	210.00 a (280.00 a)
Rough lemon	0.58 b (0.68 b)	0.12 a (0.12 a)	0.69 a (0.65 a)	3.66 a (3.76 a)	15.67 a (16.60 a)	14.00 c (14.10 bc)	1.68 bc (1.67 bc)	65.00 b (115.00 b)

* Means sharing similar letters in a column are statistically non-significant at 5% probability (DMR test).
Data in parenthesis relate to the second year of observation when plants were 7 years old.

reflecting upon vitality of plants and its subsequent productivity. Therefore, Citrumelo 4475 can be used as a rootstock for Kinnow mandarin in places where soils are becoming deficient in zinc, provided that the other characters are suitable. Similar results have also been reported by Wutscher and Shull (1972) and Anjaneyulu and Misra (1983).

Percentage of male flowers. Informations procured on percentage of male flowers depicted significant differences for rootstock effect (Table I). Maleness percentage ranged from 0.00 to 5.06%. Maximum number of male flowers were produced when Volkamariana rootstock was used while no male flowers were produced when Yuma citrange was used. All other rootstocks used behaved alike and no significant differences were located among them. Kinnow mandarin generally blooms complete flowers while sometimes few male flowers also appear towards end of the bloom. The deficiency of nitrogen and zinc induces maleness (Shavit, 1956), which appeared also in the present studies. If the data on nitrogen and zinc levels is reviewed, it becomes clear that these both elements are at the lowest level in plants with high percentage of male flowers.

Yield per plant. Data on yield per plant revealed significant differences for various rootstock means. Results indicated that Citrumelo 4475, Citrumelo 1452, Volkamariana and Mithi constituted one group while Rough lemon and Yuma citrange formed another group. Members of each group stood at par but former group pre-dominated over the latter (Table I). Yield is the outcome of a number of factors. Plant nutrition also contributes towards the yield. It is interesting to note that four rootstocks behaved alike in their own group. This offers a very week point to pin out the superiority of a particular rootstock over others. It means that some other factors besides these as well as found in data (Table 1) would be needed to account for the yield factor. These results are in accordance with the findings of Castle and Phillips (1980), Hutchison (1982); Fallahi *et al.* (1989) and Rao *et al.* (1996).

CONCLUSION

An overall performance of Citrumelo 4475 rootstock was better in terms of mineral uptake and yield as compared to other rootstocks used. Therefore, this can be used as a rootstock for Kinnow mandarin.

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