Pak. Jour. Agri. Sci.
22 (4), 206, 1985

EFFECT OF DIFFERENT ROOT STOCKS ON MINERAL CONTENTS OF LEAVES IN KAGHZI LIME LEAVES (*Citrus aurantifolia* Swing.)

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Leaf analysis of Kaghzi lime grafted on Jamberri Khatti, Jatti, Khatti Kharna Khatta, Kaghzi lime and Eureka lemon was done during August (1983), March and June (1984) with the objective of evaluating these root stocks for compatibility in terms of translocation of NPK and Fe.

Maximum amounts of nitrogen (1.88%) were found in the leaves of Kaghzi lime grafted on Kharna Khatta, closely followed by Kaghzi lime stock. Iron contents were found statistically similar on all rootstocks.

Soil analysis under the canopies of these trees revealed that NPK and Fe contents of the soil were statistically similar indicating soil uniformity. Soil pH and Ec was also found uniform through out the field.

INTRODUCTION

Commercial citrus varieties are propagated asexually by budding/grafting them on compatible rootstocks. Kaghzi limes is however, conventionally raised through seeds, which entails variation in quality and quanitity of the crop. Seedling trees also etart bearing very late. It is however deemed desirable to adopt the asexual method to establish the characteristics of the crop. Pursuing these efforts kaghzi lime was grafted on five rootstocks and relevant studies were initiated to recommend some suitable rootstock for this important fruit.

According to Smith *et al.* (1949) rootstocks determine the vigour, productivity of the plant and quality of the product by affecting absorption and translocation of mineral elements from soil which ultimately affect the overall performance of the scion trees.

Haas (1945) found more Ca, Mg and less K in grape-fruit, Navel and Valencia orange leaves grafted on sour orange than those on sweet orange. He also found highest nitrogen and phosphorus contents in Valenica orange leaves

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when budded on sweet orange roetstock. Sharples and Hilgeman (1973) found a significant differences for NPK in the leaves of Washington Navel and Valencia oranges; Dancy and kinnow mandarins and Marsh grapefruit grown on sour orange and rough lemon rootstocks. Kumar *et al.* (1979) reported varying level of NPK contents of 8-year old trees of Kinnow mandarin, Pearl tangelo, Campbell Valenica orange and wilking tangor grafted on Jatti Khatti, Kharna Khatta, Troyer citrange and carrizo citrange rootstocks.

Cassin *et al.* (1979) reported that mandarins on *Poncirus trifoliata* and Troyer citrange had higher leaf nitrogen than on sour orange. Heinz and wutscher (1982) noted that rootstock induced significant difference in N content of leaves on different rootstocks.

Haas (1945) reported that leaves of trees on pomelo and Sampson tangelo rootstocks contained the highest percentage of potassium than those of trees on rough lemon, sweet orange, soure orange and Cleopatra mandfin. Fahmy and Hassaballa (1977) reported that leaf potassium concentration increased to the highest on Troyer citrange and the lowest on Cleopatra mandarin rootstock, sour orange, rough lemon and Rangpur lime were in between.

Fuller and Hilgeman (1955) studied that absorption of phosphate by Navel orange was not significantly differnt when grown on either rough lemon or sour orange rootstocks. Wallace *et al.* (1981) analysed levels from evs, of orange, lemon, grapefruit and mandarin growing on rootstocks like sweet orange, grape-fruit, Cleopatra mandarin, rough lemon and sour orange. They found significant difference between root stock for phosphorus and trees on Cleopatra mandarin were observed the lowest in phosphurus.

Keeping this in mind, the present research programme was initiated as an attempt to associate the mineral composition of the leaves of Kaghzi lime grafted on some important rootstocks to evaluate their compatibility and productivity. This information may eventually be usefull in making nutritional programme of the crop.

MATERIALS AND METHODS

These studies were conducted in the New Experimental Fruit Garden, Department of Horticulture, University of Agriculture, Faisalabad on Kaghzi lime (*Citrus aurantifolia* Swing.) grafted on the following five rootstocks :

1.	Jamberri Khatti	*Citrus jambhiri* Lush.
2.	Jatti Khatti	*Citrus jambhiri* Lush.
3.	Kharna Khatte	*Citrus karna* Ruf.
4.	Kahgzi lime	*Citrus aurantifolia* Swing.
5.	Eureka lemon	*Citrus limon* (L.) Burm. f.

These plants were of the same age and growing under similar soil and cultural conditions. Experimental was laidout in 4 replications according to Completely Randomized Block Design for statisticel analysis by taking one plant per treatment. DMR test was applied for comparison of different rootstocks for mineral contents.

Following methods were applied to make the required observations :

Leaf Analysis :

About one hundred healthy leaves (4-7 months old) of similar age were collected at random from all sides of a tree during last week of August, 1983, second week of March and last week of June, 1984. Leaf samples were washed with a detergent in distilled water and oven dried at 55°C. Then these were crushed to powder form and stored in clean air tight plastic bottles. Leaf analyses for N,P,K and Fe were accomplished as under :

Nitrogen was determined by Gunning and Hibbard's method of sulphuric acid digestion and distiillation which was made with micro-Kjeldahl apparatus as described by Jackson (1958). Phosphorus determination was made according to methods described by Chapman and Pratt (1961). Potassium concentrations were determined by Flame Photometer. The iron determination was made by using Beckman Atomic Absorption Spectrophotometer, using conditions for obtaining maximum sensitivity.

Soil Analysis :

Representative soil samples were taken under the canopy of each tree with a sampling tube at a depth of 0-60 cm once during these studies. These samples were air dried, then ground in a wooden pestle and mortar, passed through a 2 mm plastic sieve and stored in clean polyethylene bags. For determinations of nitrogen, phosphorus, potassium and iron of soil, same procedures were adopted as described in case of leaf analyses.

Soil pH was determined by preparing a saturated soil paste of 200 mg of

soil in a beaker and keeping it for half and hour for equilibration. The pH was determined with a pH meter using glass electrodes.

Soil Electrical conductivity was recorded on Electrolytic Conductivity Measuring Set of the extract of soil paste which was done with suction pump.

RESULTS AND DISCUSSION

Leaf Analysis

Nitrogen : The nitrogen content of leaves has direct bearing on the ultimate fruiting capacity of fruit tree. Data presented in table 1 revealed that root stocks affected the level of N significantly during months of June and August. Maximum nitrogen contents (1 88%) were found in trees budded on Kharna Khatta. Trees budded on Kaghzi lime showed 1.68% nitrogen. Both of these rootstocks showed a non-significant difference with each other. In March, leaf analysis was again carried out but no significant difference was noted although Kharana Khatta maintained its superiority over the other rootstocks.

During June analysis there was a significant difference among the leaf N concentration. Trees on Kharna Khatta were again on top position giving a significantly high N concentration of 1.84% closely followed by Jamberri Khatti with concentration of 1.63% which was significantly better than Kahgzi lime, Eureka lemon and Jatti Khatti. The results are in accordance with the findings of wallace *et al.* (1981), Cassin *et al.* (1979), Heinz and Wutscher, (1982), and Kumar *et al.* (1979), who claimed that different rootstocks differed in their effect on nitrogen absorption and translocation.

Phosphorus : The quality of fruit is more or less associated with phosphorus content of the fruit plants during fruiting period. Data on phosphorus content of leaves presented in table 1 showed that effect of different root stocks on Kaghzi lime leaves was not significant during the months of August and March. Maximum phosphorus content (0.175%) was found on Kharna Khatta rootstock which was significantly superior than Jamberri Khatti and Jatti Khatti during the month of June. Trees budded on Kaghzi lime and Eureka lemon indicated a statistical parity with Khain Khatta. Several workers have conducted experiments on phosphorus nutrition on citrus fruits. Fuller and Hilgeman (1955) and Cassin *et al.* (1979) found little differences in phosphorus absorption by different rootstocks but results of Wallace *et al.* (1981) indicate that root stock affect phosphorus absorption and translocation which is also evident in our studies though varying at different times of year.

Potassium : Potassium plays a remarkable role in the growth and development of fruit plants especially the citrus trees by regulating the metabolic and enzymatic activities within the plant. Rootstocks affected the level of K significantly during months of August and March and there was non-significan response during the third week of June (Table 1). The highest potassium contents were found in the leavee of Kaghzi lime on Kharana Khatta and Kaghzi lime roostocks in the month of August showing 1.52 and 1 30% K respectively which was significantly superior than Jamberri Khatti, Jatti Khatti and Eureka lemon. In March leaf analysis showed that Kharna Khatta maintained its superiority over other rootstocks with potassium content of 1.28%. Lowest potassium content (0.88%) was observed on Kaghzi lime trees grafted on Jatti Khatti root stock

These results are in agreement with the findings of Haas (1945), Smith *et al.* (1949), and Fahmy and Hassaballa (1977),

Iron : Results of leaf analysis during the months of August, March and June presented in Table 1 showed that the effect of rootstocks on iron concentration of Kaghzi lime leaves on different rootstocks was non-significant Highest iron contents of 48.5 ppm, 43.92 ppm and 46.05 ppm resulted from the leaf analysis of Kaghzi lime on Kharna Khatta during the months of August, March and June respectively. Minimum iron contents 45.46 and 38.35 ppm were shown by Jamberti Khatti during months of August and June respectively. Eureka lemon translocated lowest iron content of 36.55 ppm in the month of March. Research findings of Wallace *et al.* (1981) are to some extent, in accordance to the present studies, which indicate that Fe concentration in citrus leaves is inconsistently affected by rootstocks

Soil Analysis :

N, P, K and *Fe contents* : Data in table 2 indicate the results of soil analysis in drip line of trees which show that N contents of soil under trees grafted on Kharna Khatta Kaghzi lime, Eureka lemon, Jatti Khatti and Jamberri Khatti were 0.084, 0.075, 0.085, 0.075 and 0.0717 percent; phosphorus concentration 8.75, 6.75 6.02, 5.5 and 5.5 ppm and potassium contents 132, 154, 145, 143 and 126 ppm respectively. Iron contents were found to be 85.03, 80.38, 81.97 and 70.1 ppm in the soil under Kaghzi lime trees grafted on Jamberri Khatti, Jatti Khatti, Kharna Khatta, Kaghzi lime Eureka lemon rootstocks respectively.

All of the above results of soil analysis were statistically non-significant indicating uniformity of the plot in which rootstocks were grown.

Table 1. *Amount of Nitrogen, Phosphorus, Potassium and Iron, estimated on different dates in the leaves of Kaghzi lime grafted on 5 different Rootstocks*

	Nitrogen (%)			Phosphorus (%)			Potassium (%)			*Iron (ppm)		
	27.8.83	10.3.84	21.6.84	27.8.83	10.3.84	21.6.84	27.8.83	10.3.84	21.6.84	27.8.83	10.3.84	21.6.84
1. Jamberi Khatti	1.41 b	1.24N.S.	1.63a	0.147NS	0.117NS	0.127b	1.16b	1.01a	1.83NS	45.65	43.77	38.35
2. Jatti Khatti	1.46 b	1.33	1.37b	0.140	0.107	0.137b	1.07b	0.88b	1.78	47.07	36.97	41.32
3. Kharna Khatti	1.88 a	1.50	1.84a	0.147	0.145	0.175a	1.52a	1.28a	2.04	48.5	43.92	45.02
4. Kaghzi lime	1.68 a	1.41	1.50b	0.147	0.132	0.147a	1.30a	0.67b	1.95	48.3	37.30	40.97
5. Eureka lemon	1.37 b	1.15	1.46b	0.145	0.122	0.117a	1.16b	0.97b	1.77	46.02	36.55	39.65

— Similar letters indicate non-significant

NS = Non-significant * = All results are non-significant

Table 2. *Soil (0—60cm depth) characteristics under the canopy of Kaghzi lime plants grafted on five different rootstocks*

	Nitrogen (%)	Phosphorus (ppm)	Potassium(ppm)	Iron ppm)	Soil pH	Electrical Conductivity
		P_2O_5	K_2O			mmhos/cm
1. Jamberi Khatti	0.0717	5.5	132	85.03	8.10	1.632
2. Jatti Khatti	0.0752	5.5	154	80.38	8.11	1.392
3. Kharna Khatta	0.084	8.75	145	98.88	8.11	1.650
4. Kaghzi lime	0.0805	6.75	143	81.97	8.12	1.428
5. Eureka lemon	0.0752	6.02	126	70.1	8.13	1.716

All results are non significant

pH and Electrical Conductivity : The values for pH and Ece are tabulated in table 2 which shows that the soil under the trees of Kaghzi lime grafted on Jamberri Khatti, Jatti Khatti, Kharna Khatta, Kaghzi lime and Eureka lemon have pH, of 8.10, 8.11, 8.12, 8.12 and 8.13, and electrical conductivity 1.63,1.39, 1.65, 1.42 and 1.71 mmhos/cm respectively. Results indicate non-significant difference also for soil pH and electrical conductivity.

It is concluded that kharna khatta (*Citrus karna*) proved to be the most efficient of all the root stocks in translocating various important nutritive elements from soil to the top of the scion variety, record being Kaghzi lime under the uniform conditions of soil pH and electric conductivity.

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