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Nitrogen Concentration at Various Growth Stages of Mango and Effect of Calcium Carbide on Fruit Quality

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Abstract: The research work to investigate nitrogen concentration in leaf blades and petiole of bearing mango trees were carried out during 1996-97, 1997-98. Further more, effect of nitrogen and calcium carbide on quality of mango fruit were also studied. In fertilized trees, concentration of nitrogen remained significantly higher in leaf blades than those of the unfertilized trees. The same behavior came into evidence in case of nitrogen concentration in leaf petiole. Higher concentration of nitrogen was found in April, which decreased during March, October and September gradually. Fruit obtained from fertilized trees showed higher total soluble solids and low acidity as compared to control. Influence of calcium carbide (CaC_2) on fruit quality was found better interms of total soluble solids, organoleptic quality, acidity and intensity of wrinkling.

Key words: Mango, leafblade, petiole, nitrogen, calcium carbide, acidity, total soluble solids

Introduction

Optimum vegetative growth, better yields, competent fruit quality and storage life of fruit depends upon proper nutrition to the plants, Nutritive needs of the important fruit of mango is a highly critical subject. In Pakistan recommendations on fertilizer requirements are generally based on soil analysis only. Such recommendations do not hold valid because of the fact, that plant tissue also consists of a fair amount of nutritive elements.
The correct diagnostic approachis, hence, to under take soil and tissue analysis s eparately. Pauline *et al.* (1993) recommended that leaf analysis is an essential step in citrus fertilizer program. They recommended leaf analysis every year but soil analysis every second year. Since nitrogen is the chief component, essential for growth, productivity, fruit quality hence, tissue analysis of mango to assess nitrogen concentration has been intended to study to set guidelines for effective nitrogen fertilizer program. Effect of nitrogen and calcium carbide (CaC_2) on fruit quality will also be apart of this study. An elaborated work by various workers has been reported on tissue analysis in different plants. Gardner *et al.* (1952) found that leaf buds have a high percentage of nitrogen, which steadily decreased during May and June, Johns *et al.* (1970) showed a higher percentage of nitrogen in fertilized trees as compared to control and maximum yield was obtained when nitrogen in leaves was 2.20%. Avilan (1971) reported higher nitrogen level in mango leaves at flowering and fruit formation. Naggar and Gaafar (1973) reported greatest loss of nitrogen in July and September in two man varieties (Piari and Hindi). Maan and Dhillon (1994) found better color and sugars in calcium carbide treatments. Saryanarayana (1978) reported that amino acids in mango leaves and shoots were highest in April and decline until October. Srivastava (1967) obtained improvement in yellow color of mango while treating with calcium carbide. Khan (1988) reported high significant effect of nitrogen on total soluble solids in guava. The maximum margin of total soluble solids was observed between 2 LBS of nitrogen and control, which produced 16.01% and 13.31% total soluble solids, respectively.

Materials and Methods

The research work was under taken at Faisalabad during 1996-97, 1997-98.

Selection of trees: The experiment was taken up on bearing trees of Dusehri variety of mango of the same age and vigour kept under similar cultural and management regimes for the last four years. The trial comprised of total number of four trees out of which two were kept under control (F1) and rest were (F2) fertilized with organic and inorganic fertilizer. Trees under (F2) fertilized with organic and inorganic fertilizer. Trees under (F2) received farmyard manure @ 80 Kg/tree during first week of January, 4 Kg. Urea, 4Kg S.S.P. and 3 Kg potassium sulfate (K_2SO_4 during third week of February, 1997 and 1998.

Leaf sampling: Following strictly the rules of leaf sampling, it was conducted on different dates viz; September (D1), October (D2), March (D3), and April (D$). Leaves were collected from terminal portion of the trees randomly. Each sample comprised of 48 leaves from unfertilized (F1) and fertilized (F2) trees. The samples were arranged in three replications hence each replication consists of 16 leaves. Leaf samples were then, washed with distilled water and dried in electric oven at 60 EC for 24 hours. Leaf petioles and blades were separated and grinned to the extent of its powdery appearance in case of both samples (F1) and F2). Nitrogen percentage was assessed using the standard method described by (Tecator, 1981).

Fruit sampling: Seventy two fruits, of uniform size, color and free from diseases, each from fertilized and unfertilized mango trees were harvested during last week of June, 1997 and 1998. The fruit was divided into 24 lots, of 3 fruits on each, from fertilized and unfertilized trees which again were divided in to 2 parts of 12 lots (36 fruits) each and 12 lots allowed to ripen naturally and other 12 were artificially i.e. treated with calcium carbide @ 2 gm per Kg of fruits. Lots were considered replications from each 4 parts i.e. fertilized control (F1 C2), fertilized treated (F1C1), unfertilized control (F2 C2), and unfertilized treated (F2 C1). Fruit was analyzed for physico chemical change i.e. skin color, pulp color, wrinkling, total soluble solids, acid ratio and organoleptic quality at every 4 days interval upto 13 days i.e. from 28 th June, to 10th July. First analysis was done during last week of June, (D1), Second during second week of July, (D2), third during lst week of July (D3) and final during second week of August, (D4) during each year. Fruit analysis was conducted as follow.

Skin color: Skin color was compared with horticultural color charts and marking done from 0-10 (O for white and 10 for deep chrome color). The pulp color was also compared with Horticulture color charts and marking done, from 0-10 (0 for white and 10 for deep orange color). Wrinkles were visually observed and marked from 0-5 for smooth to wrinkled fruits. Percentages of total soluble solids were determined by hand refractometer. 4. 10 ml of juice was extracted and titrated against N/10 NaOH using few drops of. Phenophathlene as an indicator, the value were expressed as % age of citric acid. For observing acceptable organoleptic quality of the fruit, a panel of judges was asked to assess the fruit samples and assessing maximum scores were rated the best of all. The data was analyzed by using Duncan's New Multiple Range Test (Leclerg *et al.*, 1982).

Results and Discussions

Observations on the assessment of nitrogen from fertilized (F1) and unfertilized (F2) trees furnished a good deal of information about the nitrogen status in leaf blade and petiole of treated and untreated plants.

Table 1: Mean values of percentage of nitrogen present in leaf blades and petioles at different dates as affected by fertilizer During (1996-97 to 1997-98)

Treatments	Nitrogen in leaf blades	Nitrogen in leaf petioles
Fertilizer		
F-1 (Fertilized)	2.077a	1.633a
F-2 (Un-Fertilized)	1.639a	1.084b
Dates		
D-1 (September)	1.728d	1.353b
D-2 (October)	1.768c	1.262c
D-3 (March)	1.918b	1.417a
D-4 (April)	2.017a	1.403a
Interactions (FXD)		
F-1 D-4	2.173a	1.700a
F-1 D-3	2.170b	1.707a
F-1 D-2	2.013c	1.510c
F-1 D-1	1.950d	1.617b
F-2 D-4	1.860e	1.107d
F-2 D-3	1.667f	1.127d
F-2 D-2	1.523g	1.013e
F-2 D-1	1.509h	1.090d

DMR test at 5% probability level

Table 2: Mean values of physico-chemical characteristics of mango fruit on different dates as affected by fertilizer and calcium carbide during 1996-97 to 1997-98

Treatment	T.S.S (%)	Acidity (%)	Organopletic quality	Skin color marks	Pulp color	Wrinkledness
Fertilizer						
F-1 (Fertilized)	16.12a	0.55b	4.76a	3.18a	5.10a	0.78b
F-2 (Un-fertilized)	14.13b	0.92a	4.61b	2.90b	4.97b	0.86a
Calcium Carbide						
C-1 (Applied)	17.74b	1.42a	5.20a	4.11a	4.97b	0.75b
C-2 (Not applied)	15.51a	1.43a	4.17b	1.97b	5.10a	0.90a
Dates						
D-1 (28-6-97)	7.34d	2.07a	0.00d	0.22d	0.58d	0.00d
D-2 (02-7-97)	10.92a	0.27b	5.09c	1.55c	4.30c	0.03c
D-3 (06-7-98)	17.52b	0.29b	7.00a	4.33b	6.75b	1.23b
D-4 (10-8-98)	15.72c	0.30b	6.66b	6.07a	8.32a	2.04a
Interaction CxFxD						
C-1 F-1 D-1	8.53g	1.40b	0.00j	0.23k	0.61i	0.00g
C-2 F-1 D-1	8.53g	1.40b	0.00j	0.23k	0.61i	0.00g
C-1 F-2 D-1	5.15h	2.73a	0.00j	0.22k	0.55i	0.00g
C-2 F-2 D-1	6.15h	2.73a	0.00j	0.22k	0.55i	0.00g
C-1 F-1 D-2	22.90a	0.21de	6.33d	1.61h	3.47h	0.08g
C-2 F-1 D-2	22.30a	0.20e	4.27h	1.47j	5.13g	0.05g
C-1 F-2 D-2	14.30f	0.34c	5.73g	1.58hi	3.47h	0.04g
C-2 F-2 D-2	20.17b	0.34c	4.03i	1.53ij	5.13g	0.04g
C-1 F-1 D-3	16.97d	0.28cde	7.70a	6.50b	7.37d	0.72f
C-2 F-1 D-3	18.84c	0.32c	6.36d	3.06f	6.71e	1.47d
C-1 F-2 D-3	18.23c	0.34c	7.54b	5.43c	7.28d	1.20e
C-2 F-2 D-3	16.03de	0.22de	6.39d	2.33g	6.42f	1.51d
C-1 F-1 D-4	15.37e	0.22d	7.21c	8.64a	8.44b	1.75c
C-2 F-1 D-4	15.50e	0.35c	6.20ef	3.73d	8.46b	2.26a
C-1 F-2 D-4	15.47e	0.35c	7.12c	8.68a	8.57a	2.23a
C-2 F-2 D-4	16.53d	0.29cd	6.10f	3.21e	7.79c	1.91b

Further more, the impact of calcium carbide (CaC_2) treated plants viz fertilized plants with nitrogen, produced valuable information on the shelf life of mango fruit.

Nitrogen level in leaf balades: Observations on the percentage of nitrogen in leaf blade remained significantly higher in fertilized trees than that of control. Level of nitrogen in leaf blade in case of (F1) was 2.077 where as nitrogen percentage in case of unfertilized (F2) was 1.639. As regards the influence of time on the accumulation of nitrogen in leaf blade and petioles the difference remained conspicuous particularly when leaves were collected in April (D4), Compared to its counterpart dates i.e., October (D2), March, (D3) and Sep. (D1). Nitrogen concentration in April collected samples was 2.017. March collected samples stood close second and gave nitrogen concentration 1.198. Nitrogen concentration in September B October collected samples went upto 1.720 and 1.768% respectively.

Nitrogen concentration in petioles: Data produced in Table 1 revealed that nitrogen concentration of unfertilized trees remained low (1.63%) as against leaf samples of fertilized (F1) trees where it was 2.077%. In leaf petioles of unfertilized trees (F2) 1.084% nitrogen was found as compared to 1.639% nitrogen in leaf samples of fertilized trees. The effect of different sampling nitrogen concentration in leaf petioles did not stay variant to the accumulation of nitrogen in leaf blade as influenced by the different times of sampling. Here again more nitrogen concentration was noted when samples were analyzed in April and March. Nitrogen concentration during these months remained (1.417 and 1.40%, respectively. Avilan (1971) who reported that nitrogen in mango leaves was higher during flowering and fruit formation. Vitamova (1983) found that leave petioles contain less nitrogen as compared to Lamina.

Total soluble solids (T.S.S.) and acidity: Data presented in Table 2 showed that total soluble solids contains 75% sugars and are considered important as they are determinant of the quality of fruits when form a farmable blend with acidity combination of these important constituents also give taste and flavor to the fruit. The total soluble solids and acidity of harvested mango fruit in response to fertilized and unfertilized trees of nitrogen was found significant (level give) fruit harvested from fertilized trees produced T.S.S./Acid ration of 16.12 : 0.55 where in unfertilized trees (F) it remained 14.13 : 0.92. As regards, the impact of calcium carbide, the fruits obtained from fertilized trees exhibited low T.S.S/Acid ratio i.e. 14.74: 1.42, but higher total soluble solids (15.51 and almost equivalent amount of acidity i.e. 1.43). The findings of Khan (1988) are supportive to our results. He obtained the higher amount of total soluble solids in nitrogen fertilized trees of Guava. Maan and Dhillon (1974) also found better color and sugars in calcium carbide treated mangoes.

Organolaptic quality: Data (Table 2) on organoleptic quality of fruit in response to different treatments indicated that fruits obtained from fertilized trees exhibited better taste and earned more acceptability by the panel of judges. The impact of calcium carbide also favorable on the internal fruit quality as it resulted to produce appreciable development of sugar acid ratio. These findings are in agreement with the findings of Maan and Dhillon (1974).

Skin color and wrinkling: Color of skin and its appearance are the most important feature to attract the consumers acceptability. Fruit free of wrinkles, blemishes and other skin disorders give pleasing appearance to the commodity and always stand meritable from market view point. Data presented in Table 2 depicted that fruit obtained from nitrogen fertilized trees (F2) enjoyed superiority over unfertilized trees. Highest score of 3.18 was given in case of fruits obtained from fertilized trees. Unfertilized trees earned score of 2.90. The impact of calcium carbide on skin color was noted excellent (4.11) as against the untreated fruit where the maximum score remained 1.97. The effect of different storage times exhibited a significant response on skin color. Best skin color same into evidence when the fruit was observed in D4), followed by (D3) so far as wrinkling is concerned it remained in lesser extent as compared to the fruits obtained from unfertilized trees. It was further noted that more wrinkling came under observation when the storage period under some temperature was allowed to proceed. Studies indicated that unfertilized trees exhibited more wrinkling. These observations are in line with (Srivastava, 1967).

Pulp color: In mangoes color of the pulp apart from external skin color is also chief contributory to the quality determination (Table 2). The studies led us to find out that better color was developed in fruits obtained from fertilized trees whereas fruit from unfertilized trees could not get development of pulp color comparable to the fruits of fertilized trees. Effect of calcium carbide on

pulp color development remained significant and better pulp color was noticed in fruit treated with calcium carbide after harvest. Behavior of mangoes regarding pulp color development in response to the different storage intervals also stood significant. Fruit analyzed during lst week of August showed best pulp color followed by the fruits analyzed during lst week of July. Fruits analyses during last week of June and during lst week of July showed the poorest results in respect of color development. These observations are supported by Maan and Dhillon, 1974, Srivastava, 1967.

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