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SHORT COMMUNICATION

Effect of micro-nutrients spray on quality attributes of mango (*Mangifera indica* L.) cv. Amrapalli

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The mango occupies a pre-eminent place amongst the fruit crops grown in India as the king of fruits. Mango belongs to family Anacardiaceae. The mango is the choicest fruit of Hindustan, and people eat it from immature to ripening stage. Mango (*Mangifera indica* L.) is the fifth most important fruit of the world after apple, citrus, banana and grape. It is cultivated in more than 100 countries because of its delicious taste, excellent flavour, attractive fragrance and excellent source of vitamin A and C. Mango occupies about 70 per cent of the total area under fruits in India covering an area of 5.51 million hectares. The major mango producing countries are India (12.53 Mt), China (3.67 mt), Mexico (1.67 mt), Thailand (1.80 mt), Pakistan (16.06 mt), Indonesia (1.14 mt) and Philippines (1.003 mt). India shares in world mango production and share was 40.1% (N.H.B. Data Base, 2009) which has not increased since then substantially. The total annual production of mango in India is estimated to be 16.07 million tonnes, cultivated in 2.4 million hectare (2010-11). All the parts of the plant have various uses. Both ripe and unripe mangoes are used extensively by food processing industry to prepare a wide variety of products such as syrup, jam, squash, juice cereals flakes and toffee etc. The ripe mango, used to prepare pickles, chutney, slices, amchur, candy, jam, jelly preserve, squash etc from unripe mango. Chemical composition of mango differs with the variety and stage of maturity. It is a rich source of carbohydrate of well as vitamin A and C. A comprehensive report has been made on the chemical composition after analysis of more than 5 varieties of mango (Anonymous, 1964) varieties such as Fazli, Chausa, Langra, Dashari etc. Mango is one of the best exporting materials both in fresh and processed from and is being exported to U.K., U.S.A., France, Kuwait, Bahrain, Afghanistan, Malaysia, Quatar and Singapore etc.

In India, mango is distributed in all parts of the country except in hilly regions above 915 meter from the mean sea level. The mango being a deep rooted tree needs soil profile of at least 2 metered depth. It has been observed that the mango is cultivated well on alluvial as well as lateritic soil but deep black cotton soil of India have generally been considered unsuitable for mango cultivation. For mango growing the water table should be below 180 cm and pH of soil 5.5-7.5 has been found suitable (Singh, 1960). Although the mango is a tropical fruit is grows equally well under semi-tropical conditions. The most favourable temperature for the growth of young mango plant is 25 ^{0}C. The flowering of mango in India takes place as early as November-December in Rayalasema area of Andhra Pradesh, February-March in Northern India and slightly earlier January-February in eastern parts of the country. Since the flowering process is entirely depended on climatic conditions prevailing in an area. At some locations, like Kanyakumari, which have a very specific microclimate even cultivar like Neelum, Bangalora and Rumani have a tendency to flower in the off season and the fruit usually mature during January-February, much earlier than anywhere else in India. Although India has major area and production in the world, however, major mango producing states in India are Andhra Pradesh (2.37 mt), Uttar Pradesh (1.915 mt), Bihar (1.872 mt), Karnataka (1.180 mt), Tamilnadu (0.70/mt) (APEDA, Data Base Year). The average fruit production in India is 8-10 tons/ha which is quite lower than the world production of 14-16 tones/ha. The intensity of damage caused by fruit dropping can be minimized by foliar application of micro-nutrients, it also helps in improvement on quality and fruit yield of mango can be pushed-up by the use of micronutrients.

The present investigation was carried out at Main Experimental Station, Department of Horticulture, Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumargaj), Faizabad (U.P.) during the year 2011-12. Ten year old uniformly vigourous plants of mango cv. Amrapalli were selected for the study. The soil of orchard was sandy loam having pH 7. This region is characterized by sub-humid and sub-tropical climate. Approximately, 1200 mm precipitation occurs, out of which about 85 per cent is concentrated from mid June to end of September. Three distinct seasons viz., winter, summer and rainy prevail in the region. Winter months are cool and occasional frost occurs during this periods. A few rains are also

encountered during winter. The summer season starts from April and continuous up to onset of monsoon. Hot scorchy winds are common during summers.

The experiment was laid out in Randomized Block Design (R.B.D.), with seven treatments, T_1- $ZnSO_4$ (0.5%), T_2 - $FeSO_4$ (0.5%), T_3 - Borax (0.5%), T_4 - $MnSO_4$ (0.5%), T_5- Urea (0.5%), T_6- K_2SO_4 (0.5%), T_7- Control (Water Spray) replicated three times. The Chemical was sprayed as aqueous solution. The uniform management practices with respect to nutrition and irrigation were adopted for experimental trees. The Spray of nutrients was done at pea stage after fruit set. The fruits were harvested at the best physiological maturity. The observations were recorded on total soluble solids (TSS), acidity, ascorbic acid, total sugars, pulp weight, stone weight, pulp: stone ratio and pulp per cent. TSS was determined with the help of hand refractometer. The acidity was estimated by titrating known volume of juice against 0.1N NaOH using phenolphthalein as an indicator and the ascorbic acid (vitamin C) was determined by volumetric method through standard dye solution (Sadasivam and Thymoli 1987). The weight of stones was recorded by physical balance and the average stone weight was calculated and expressed in gram. Pulp weight was obtained by deducting the weight of seed (stone) from total fruit weight and the pulp: stone ratio was calculated in relation to pulp and stone weight. Statistical analyses of the data obtained in the different sets of experiments were calculated as suggested by Panse and Sukhatme (1985) and results were evaluated at 5 per cent significance.

Observations on effect of different treatments were recorded to assess the growth behaviour under uniform management situation. Maximum accumulation of total soluble solids (T.S.S.) content in mango fruits was recorded with spray of $ZnSO_4$ @ 0.5%, while minimum total soluble solids (T.S.S.) was obtained with the control shown in Table-1. Total Soluble Solids content of fruit may be due to fact that nutrients have played important role in photosynthesis which ultimately lead to the accumulation of carbohydrates and attributed to increase T.S.S. of mango fruit. The urea stimulates the functioning of more enzymes in the physiological process which probably cause in increase T.S.S. content. The adequate amount of zinc improved the auxin content and it also acted as catalyst in oxidation process. Increase in the total soluble solids may be because of more carbon assimilation promoted by application of boric acid. The results are in closed conformity with the finding of Modi *et al.* (2012) noted that foliar application of micro-nutrient spray, on the quality of fruit from papaya (*Carica papaya* L.) cv. Madhu Bindu. The combination of ferrous sulphate, zinc sulphate and borax resulted in the highest total soluble solids.

The use of different treatments significantly influence of acidity percentage in mango fruits. The minimum acidity per cent was noted $ZnSO_4$ with the foliar application of $ZnSO_4$ @ 0.5%, whereas, maximum was noted in control treatment. Acidity content of fruit decrease with the foliar application of nutrients, might be due to increase in translocation of carbohydrates and increase metabolic conversion from acidity to sugar by the reaction involving reversal of glycolytic path way by used in respiration or both similarly. Acidity per cent was reduced with nutrients treated fruits, which might be due to early ripening induced by the nutrient spray during which degradation of acid might have occurred. The similar results were reported by Kundu and Mitra (1999) observed that foliar spray of 0.3 per cent copper, 0.1% Borax and 0.3% Zn reduced acid content in guava fruits.

The effect of foliar spray of nutrients on ascorbic acid content have been portrayed in Table-1 clearly indicated that the maximum amount of ascorbic acid was found with the foliar spray of $ZnSO_4$ @ 0.5%, whereas, minimum was recorded with control. The increased ascorbic acid content of fruit juice was due to increase synthesis of catalistic activity by enzyme and coenzyme, which are represented ascorbic acid synthesized. The adequate amounts of zinc improve the auxin content and it also acted as catalyst in oxidation process. These findings is closely confirmed with the results of a significant improvement in ascorbic acid content was noted by Singh *et al.* (2001) with the application of 0.5 % $ZnSO_4$, 0.2 % Borax and 0.4 % $CuSO_4$ in aonla cultivar francis and (Kumar *et al.*, 2014) on phalsa

The similar pattern in respect to total sugars content was also noted for increase total sugars in mango fruit as influenced by different treatments presented in Table 1. The highest total sugar content was recorded with the spray of $ZnSO_4$ @ 0.5% and minimum with control. Increased in sugar per cent may be due to involve in the translocation of more sugar to the fruits. It has been reported that there is a greater conversion of starch into sugar (source to sink) in the presence of these nutrients. The results are conformed with the finding of Bhatt *et al.* (2012) observed that foliar application of Borax 0.5%, K_2SO_4 0.5% at marvel stage of mango fruit cv. Dashehari significantly increased total sugars over control. Maximum total sugars, reducing and non-reducing sugars were also noted in aonla fruits by (Vishwakarma *et al.* (2013) with the spraying of combined spray of Calcium carbonate and Borax (0.4 per cent each).

Observations recorded on pulp weight, stone weight, pulp per cent and pulp: stone ratio shown in (Table 1) clearly indicated that application of $ZnSO_4$ @ 0.5% was found to be significant increase of all these characters in mango fruit. The minimum pulp weight was observed in control treatment. Increase in pulp percentage may be due to more absorption of water, nutrients and increase the volume of inter-cellular spaces in the pulp. Results are in conformity to those reported by Singh and Banik (2011) observed that foliar application of $ZnSO_4$ (0.5%, $CaSO_4$ (0.6%), Borax (0.2%), $MnSO_4$ (1%) twice in August and October in mango cv. Himsagar significantly enhanced averaged fruit weight

and fruits yield per tree. Singh (2002) also found the maximum value of pulp: stone ratio by foliar spray of Urea 2% + $ZnSO_4$ 0.50% + K_2SO_4 2.0% in Ber fruit cv. Banarasi Karaka.

Table 1. Showing the effect of micro-nutrients spray on physico-chemical attributes of mango fruit

Treatments	T.S.S. (^{0}Brix)	Total sugars (%)	Ascorbic acid (mg/100 g pulp)	Acidity (%)	Pulp weight (g)	Stone weight (g)	Pulp : stone ratio	Pulp per cent
T_1 : $ZnSO_4$ @ 0.5%	20.07	14.84	29.54	0.143	118.66	39.09	1:3.04	75.21
T_2 : $FeSO_4$ @ 0.5%	17.63	14.88	27.44	0.170	110.67	37.51	1:2.89	74.30
T_3 : Borax @ 0.5%	19.12	15.22	29.22	0.156	116.33	39.09	1:3.03	75.20
T_4 : $MnSO_4$ @ 0.5%	17.37	14.45	26.44	0.174	100.73	36.74	1:2.75	73.27
T_5 : Urea @ 2.0%	18.52	14.17	26.27	0.170	98.63	36.09	1:2.74	73.21
T_6 : K_2SO_4 @ 2.0%	19.01	14.99	27.53	0.164	110.69	37.51	1:2.86	74.05
T_7 : Control	17.00	12.13	26.00	0.189	84.98	35.34	1:2.41	70.62
SEm±	0.30	0.53	0.53	0.007	3.15	1.42	0.07	0.52
C.D. at 5%	0.94	1.62	1.64	0.022	9.72	NS	0.23	1.60

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