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Effect of micro-nutrients spray on yield attributing characters 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 as 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) 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 meter depth. It has been observed 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 growth equally well under semi-tropical conditions. The most favourable temperature for the growth of young mango plant is 25 °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, 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). 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 cause by fruit dropping can be minimized by foliar application of micro-nutrients, its also helps in improvement of quality and fruit yield.

The present investigation entitled "Effect of micro-nutrients spray on yield attributing character of mango (*Mangifera indica* L.) cv. Amrapali" 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 uniform in vigour plants of mango cv. Amrapali 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 per cent fruit drop, fruit retention, fruit yield, fruit size and fruit weight. Data on fruit drop was recorded from five randomly pre-tagged branches. Data on misshapen fruits were recorded by taking the weight of such fruits after harvesting of fruits of all the treatments under investigation separately. Size of fruit was recorded with the help of meter scale and thread. 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. Data pertaining to per cent fruit drop significantly recorded minimum due to foliar application of $ZnSO_4$ @ 0.5% at different fruit development stages shown in Table-1. A perusal of data recorded on number of fruits/ shoot, fruit retention and fruit drop per cent have been presented in (Table-1) clearly indicated that number of fruits, fruit retention and minimum fruit drop per cent were recorded maximum with the spray of $ZnSO_4$ @ 0.5% whereas maximum fruit drop, minimum number of fruits and fruit retention per cent were noted in control (water spray). Fruit retention per cent increase might be due to increase the endogenous level of auxin and other metabolites. The role of zinc is known to be essential for the biosynthesis of auxin (IAA) as it is an activator of the enzyme tryptophane synthetase. Increased fruit retention under sprays is suggestive of interference that the treatments have in one way or other influencing the auxin balance to prevent fruit drop. Boron plays an important role in the translocation of food materials from leaf to developing fruits and thereby it reduces the fruit dropping. The beneficial effect of urea is increasing fruit retention because role of urea in improving the plant vigour thereby increasing food reservoirs. Similar observations on fruit drop and fruit retention in mango have been recorded by Singh *et al.* (1991) stated that appreciable decreased fruit drop and increased fruit retention in mango with the foliar spray of urea 3.0 per cent. Maximum fruit retention, fruit set and reduced fruit drop 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).

Data recorded on fruit yield (kg/ tree) duplicated in Table 1 that application of $ZnSO_4$ @ 0.5% was found to be best to increase fruit yield, whereas, minimum (24.92 kg) fruit yield/ tree was observed in control. The increased fruit yield due to foliar feeding of nutrients, might be attributed to more uptake of nutrients because efficient absorption and consequently more luxuriant vegetative growth in the initial stage, which later on resulting more metabolites for developing fruits. The importance of these nutrients in improving the physiological activities, which improve width of fruit, length of fruit and weight of fruit, ultimately increasing the yield. These results are in close conformity with the findings of Singh *et al.* (2001) found that combined spray of 0.5% ZnSO4, 0.2% Borax and 0.4% CuSO4 significantly increased fruit yield in aonla cv. Fransis. Dhua and Datta (2002) reported that foliar application of ZnSO4 @ 0.1%, $FeSO_4$ @ 0.5% and Mn SO_4 @ 2% concentration at the flowering and before flowering + pea stage on the quality of mango fruit cv. Himsagar, significantly enhance higher fruit yield and quality over the untreated control. Kumar *et al.* (2004) stated that spray of micronutrients effectively increased the yield of Litchi cv. Dehradun.

It is evident from the data shown in (Table-1) indicated that significantly increased in fruit size and fruit weight. The maximum fruit length, fruit breadth, fruit weight and fruit volume were recorded with the spray of $ZnSO_4$ @ 0.5%. The minimum fruit size was recorded with control treatment. The reasons for increase fruit size due to spraying of nutrients might be attributed to efficient absorption and accumulation of metabolites in initial stage of developing fruit. Spraying of $ZnSO_4$, which provide zinc to the plant, might have regulated the cell-wall permeability, thereby allowing more mobilization of water in fruit attributing to larger fruit size. Increase in weight and volume of fruits by zinc application might be due to rapid cell division and higher pulp content. The increase in fruit weight by urea spray may be due to the accumulation of more food material in fruit trees. These results are in close conformity with foliar application of GA_3 @ 20ppm + NAA @ 50ppm + $ZnSO_4$ @ 0.4% + Urea @ 2% in phalsa fruit (Kumar *et al.* 2014). Yadav *et al.* (2011) also reported such result by the application of micro-nutrients on flowering, fruiting yield and quality of mango cv. Amrapali under high density orcharding which resulted maximum fruit weight.

Table 1. Showing the effect of micro-nutrients spray on yield attributing characters of mango fruit.

Treatments	Number of fruits/ shoot	Fruit drop (%)	Fruit retention (%)	Fruit yield (kg/tree)	Fruit length (cm)	Fruit breadth (cm)	Fruit weight (g)	Volume of fruit (cm^3)
T_1 : $ZnSO_4$ @ 0.5%	3.57	91.17	8.83	40.46	10.11	6.62	152.72	151.11
T_2 : $FeSO_4$ @ 0.5%	2.31	93.67	6.33	37.44	9.09	6.26	148.17	140.25
T_3 : Borax @ 0.5%	3.54	92.33	7.67	37.70	9.62	6.51	151.65	150.33
T_4 : $MnSO_4$ @ 0.5%	2.31	93.34	6.66	32.33	8.95	5.84	137.43	131.50
T_5 : Urea @ 2.0%	2.03	94.35	5.65	35.21	8.92	5.43	134.76	124.50
T_6 : K_2SO_4 @ 2.0%	2.85	92.48	7.52	35.58	9.42	5.73	150.71	145.20
T_7 : Control	1.92	95.64	4.36	24.92	8.75	5.55	120.28	121.75
S Em ±	0.23	0.33	0.57	2.23	0.48	0.36	5.80	5.04
C.D. at 5%	0.70	NS	1.76	6.87	NS	NS	17.86	15.52

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