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Response of micro-nutrients on yield, fruit quality and nutrient status of mango cv. Dashehari

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ABSTRACT

A field experiment was conducted during 2016-2020 to assess the response of micro-nutrients on 16 years old uniform trees of mango cv. Dashehari. Long-term experimental results indicated that maximum mean flowering intensity (55.88%) and yield efficiency (0.52 kg/m^3) were recorded in T_6 (RDF + 100g Zinc Sulphate + 50g Copper Sulphate + 50 g Borax- soil application in the basin after harvest + foliar spray of 0.2% zinc sulphate +0.1% Boric acid - 2 spray just before flowering and marble stage) treatment. The highest mean number of fruits (194.79 /tree), fruit weight (250.15 g), fruit size (11.92 cm × 6.30 cm), and fruit yield (15.35 t/ha) and soil nutrient contents, namely zinc (0.65 mg/kg), copper (0.54 mg/kg), manganese (3.92 mg/kg), iron (5.35 mg/kg) and boron (0.56 mg/kg) were noticed in treatment T_7 (RDF + 100g Zinc sulphate + 50g Copper sulphate + 50 g Borax through soil application in the basin after harvest + foliar spray of 0.2% Zinc sulphate + 0.1% copper sulphate + 0.1% Boric acid through 2 sprays just before flowering and marble stage). Similarly, the foliar contents of zinc (22.94 ppm), manganese (248.23 ppm), and boron (34.21 ppm) were also recorded as maximum in the treatment T7 in mango cultivar Dashehari.

Keywords: *Mangifera indica* L., leaf and soil nutrient, yield efficiency

INTRODUCTION

Mango (*Mangifera indica* L.) is one of the important fruit crops of tropical and subtropical region of India, and being cultivated commercially to the tune of 2.3 million ha with an annual production of 20.5 million tons along with an average productivity of 8.9 t/ha (Anon.,1). In Uttar Pradesh, the major mango growing districts are Lucknow, Saharanpur, Pratapgarh, Varanasi, Faizabad, Basti, Moradabad, Barabanki, Unnao, Sitapur, Hardoi, and Gorakhpur. In the present scenario of climate change, a negative impact on the size and quality of mango fruits is also being observed due to some other factors like improper management practices such as pruning of branches to the desirable level and proper nutrition including micro-nutrients application. based on soil and leaf tissue analysis. It is important to timely application of optimum quantity of fertilizers to harness the yield potential of quality mangoes. Comparatively, foliar application of the soluble fertilizers is more effective than the soil application. Generally, the farmers apply urea as source of nitrogen, phosphorus through single supper phosphate and potassium supplied by muriate of potash to the orchard and hardly pay any attention towards the utility of micro-nutrients (Suman *et al*. , 17). Availability of micro-nutrients in the orchard soils is a function of soil management system, which support the tree metabolism, and quality fruit production. Deficiency symptoms of micro-nutrients (zinc, copper and boron) have been reported in mango cv. Dashehari by several researchers (Singh *et al*., 12; Agrawal *et al*., 2). Boron plays an important role in carbohydrate metabolism, translocation of sugar, starch and phosphorus in plant etc., while zinc is required for tryptophan synthesis, a precursor of auxin that helps in minimizing the fruit drop and increases the fruit retention. Therefore, keeping in view the low productivity and poor quality of mango, the present study was planned to evaluate the response of various micro-nutrients on fruit yield and quality of mango and nutrient status (soil and plants) under subtropical conditions.

MATERIALS AND METHODS

The present studies were made during 2016-2020 at experimental farm of ICAR-CISH Rehmankhera, Lucknow (26° 54' N latitude, 80° 45' E longitude and 127 m above mean sea level), Uttar Pradesh, India. Observations could not be recorded due to severe frost damage during 2017. Initially, the soil had organic carbon content 0.35-0.40 %, with available nitrogen (N), phosphorus (P) and potassium (K) contents ranging from 75.12 - 80.35, 10.51 - 13.12 and 92.52 - 96.25 mg/kg, respectively. Taxonomically classified experimental soil was mixed hyperthermic typic ustocrept, and derived from Indo-Gangetic alluvium with sandy loam texture. The climate is typically subtropical hot and dry summer and severe

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cold in winter months. The mean maximum extreme temperature was 39.3°C in May and mean minimum temperature 5.4 °C in January with an average annual rainfall of 1009 mm during the course of study. The existing 16 years old Dashehari mango trees, planted at 6 m × 5 m spacing were utilized for experimentations.

The experiment was arranged in Randomised Block Design and replicated thrice. There were eight treatment combinations consisting of T_1- Control as per the RDF (1000:500:1000g NPK for full grown tree) in basin after harvest, T_2- RDF + 200g Zinc sulphate + 100g Borax (soil application) in basin after harvest, T_3- RDF + 200g Zinc sulphate + 100g Copper sulphate + 100g Borax (Soil application) in basin after harvest, T_4- RDF + Foliar spray of 0.2% Zinc sulphate + 0.1% Boric acid (2 spray at just before flowering and marble stage), T_5- RDF+ Foliar spray of 0.2% Zinc sulphate + 0.1% Copper sulphate + 0.1% Borax (2 spray at just before flowering and marble stage), T_6- RDF + 100g Zinc sulphate + 50g Copper sulphate + 50g Borax (soil application) in basin after harvest + foliar spray of 0.2% Zinc sulphate + 0.1% Boric acid (2 spray at just before flowering and marble stage), T_7- RDF + 100g Zinc sulphate + 50g Copper sulphate + 50g Borax (soil application) in basin after harvest + Foliar spray of 0.2% Zinc sulphate + 0.1% Copper sulphate + 0.1% Boric acid (2 spray at just before flowering and marble stage) and T_8- RDF+ IIHR mango special @ 5 g/litre (2 months before flowering and fruits of 2-4 cm diameter).

The observations on fruit yield and yield attributing characters were recorded using standard procedures. The flower density was calculated by dividing the number of shoots flowered with number of shoots tagged and multiplied by 100. Total soluble solids was determined by using hand refractometer (0-32 °Brix), from 10 randomly collected fruits from all four side of tree periphery of different treatments. The physiologically mature fruits were harvested and weighed individually for working out fruit yield per tree and expressed in tons per hectare. The soil and leaf samples were collected during September of alternate year for nutrients analysis. The available nutrients were analysed as per the standard method suggested by Singh *et al*. (11). The data were analysed statistically as per Panse and Sukhatme (8) for interpretation of results and drawing conclusions.

RESULTS AND DISCUSSION

Flowering intensity, fruit yield and yield contributing characters as influenced by micronutrient application in mango are presented in Table 1. The flowering intensity varied year after year in different treatments due to climatic vagaries. The highest flowering intensity was recorded in treatment T_6 (55.88%) having similarly statistically with T_1,T_3,T_4,T_5 and T_7 treatments. The lowest flowering density was registered in the trees, subjected to T_2 (42.34%). The highest flowering intensity was in treatment T6 might be due to balance nutrition being supplied through basal and foliar application which efficiently translocated under favourable climatic conditions towards better flowering in mango. The similar finding were reported by Kumar *et al*. (6).

During the course of present study, the highest number of fruits was contributed by T_7 (194.79 fruits/tree) without showing the significant differences with T_5, T_6 and T_8 treatments (Table 1). Treatment T_1 yielded the lowest number of fruits (141.21 fruits/tree). Highest number of fruits in T_7 treatment might be due to basal as well as foliar application of micro-nutrients applied at active stage of plant growth and fruit development. Application of zinc could have been promoted the auxin synthesis in the plant system which might delay the formation of abscission layer

Table 1. Effect of micro-nutrients on flowering intensity and fruiting characters in mango cv. Dashehari (Pooled mean for four years data).

Treatment	Flowering intensity (%)	Number of fruits / tree	Fruit size (cm)	Fruit weight (g)	Yield (t/ha)
T_1	49.90	141.21	11.25 × 6.21	213.53	9.71
T_2	42.34	161.73	11.48 × 6.40	237.93	11.66
T_3	50.95	157.39	11.91 × 6.30	243.97	11.93
T_4	53.74	155.55	11.56 × 6.38	237.42	12.36
T_5	50.78	185.53	11.35 × 6.19	217.44	13.36
T_6	55.88	186.27	11.40 × 6.14	223.98	14.11
T_7	50.80	194.79	11.92 × 6.30	250.15	15.35
T_8	44.50	176.30	11.04 × 6.14	208.91	12.11
$LSD_{(0.05)}$	6.12	23.19	NS	32.67	2.67

during early stages of fruit development resulting to avoid fruit drop (Nason and Mcelary, 7). Similarly, the increase in the fruit retention by application of micro-nutrients has also been reported in peach (Yadav *et al*., 18).

The variations in fruit size were observed in this study over the years under different treatments, but failed to exert the significant influence on fruit size (Table 1). However, the highest fruit length was noticed in T_7 (11.92 cm), while it was lowest in T_1 (11.25 cm). Similarly, the highest and lowest fruit width were recorded in T_2 (6.40 cm) and T_6 or T_7 (6.14 cm in each), respectively. The highest fruit size was recorded in T_7 treatment might be due to optimum combined application of macro and micro-nutrients which might have improved cell division and cell elongation of fruits during fruit growth and development. The results are in accordance with the findings of Bhowmick *et al*. (3) and Sarkar *et al*. (10) in mango.

The treatment T_7 tended to show the heaviest fruit (250.15 g) and highest fruit yield (15.35 t/ha), however, it proved similar statistically with T_2, T_3, T_4, and T_6 treatments for fruit weight, and T_5 and T_6 for fruit yield per hectare. The lowest fruit weight (213.53 g) and fruit yield (9.71 t/ha) were recorded in T_1. The maximum fruit weight in T_7 treatment might be due to their involvement in cell division, cell elongation and volume increment of inter cellular space in the mesocarpic cells. Similarly due to higher synthesis of metabolites and optimum mobilization of food and minerals from other parts of the plant towards developing fruits in horticultural crop. These results are in accordance with the report of Singh *et al*. (13) and Singh and Maurya*,* (14) in mango. The higher fruit yield in T_5, T_6 and T_7 treatments might be due to impact of micro-nutrients application especially zinc, copper and boron at right quantity and right time to improve fruit yield which might be resulted into better photosynthesis, more accumulation of starch in fruits and zinc involvement in auxin synthesis. The balance amount of auxin availability in plant regulates further retention of fruit which leads to check the fruit drop ultimately resulting in increasing fruit yield in mango (Dutta,4; Rani *et al*., 9; Singh *et al*.,16).

The over all mean for four years data indicated that maximum yield efficiency was recorded in T_6 (0.52 kg/m^3) closely followed by T_7, T_4, T_5 and T_3 treatment in mango cultivar Dashehari (Table 2). The yield efficiency was higher in T_6 treatment without showing any significant difference in mango cultivar Dashhari. The higher yield efficiency in T_6 treatment might be due to more uptake of available nutrients from root to efficiently transported to aerial part of the plants resulted better yield per unit area of tree. Similar findings were reported by Kumar *et al*. (6) under north Indian conditions.

The fruit TSS content was recorded to be the highest in T_4 (20.04 °B) having similarly statistically with T_6 (19.94 °B) and T_2 (19.89 °B) in mango cv. Dashehari (Table 2). Increase of TSS in fruits subjected to micro-nutrient treatments might be due to hydrolysis of polysaccharides into simple sugar, synthesis of metabolites and fast translocation of photosynthesis activity and mineral from other part of the plants to developing fruits. These findings are also in accordance with the finding of Ghosh (5) and Singh *et al*. (15).

The fruit quality traits like titratable acidity, pulp content, peel content and stone percentage did not show any significant impact of various treatmnts tested in the present study. However, the highest pulp (77.40%) with lowest stone proportion (11.40%) were noticed in T_7 treatment. The highest pulp weight in T_7 treatment might be due to proper supply and translocation of mineral nutrient from other part of

Table 2. Effect of micro-nutrient on yield efficiency and fruit quality of mango cv. Dashehari (Pooled mean for four year data).

Treatment	Yield efficiency (kg/m^3 CV)	TSS (°Brix)	Acidity (%)	Pulp (%)	Peel (%)	Stone (%)
T_1	0.31	19.38	0.22	74.8	12.4	12.8
T_2	0.32	19.89	0.21	76.8	11.5	11.7
T_3	0.40	19.31	0.21	76.1	12.2	11.7
T_4	0.48	20.04	0.18	76.7	11.1	12.2
T_5	0.45	19.31	0.21	76.6	11.9	11.5
T_6	0.52	19.94	0.20	76.5	11.6	11.9
T_7	0.48	18.83	0.20	77.4	11.2	11.4
T_8	0.39	18.98	0.20	75.2	12.1	12.7
$LSD_{(0.05)}$	0.12	0.61	NS	NS	NS	NS

the plants to developing fruits. These results are in agreement with the findings of Singh *et al*. (15).

Nutrient status especially Zn, Cu, Mn, Fe and B in soil were significantly influenced by the treatments in mango orchard (Fig. 1). The mean maximum soil zinc (0.65 mg/kg), copper (0.54 mg/kg), manganese (3.92 mg/kg), iron (5.35 mg/kg) and boron (0.56 mg/kg) contents were recorded in T_7 treatment. The improvement in soil micro-nutrients might be due to effect of applied nutrients under optimum soil moisture regimes. These findings are in agreement with the results of Sarkar *et al*. (10).

A perusal of data (Fig. 2) on status of leaf micro-nutrients as influenced by application of various micro-nutrients in showed that the leaf zinc, copper, manganese, iron and boron content varied from 18.45 to 22.94, 8.09 to 12.26, 241.12 to 248.23, 253.64 to 271.96 and 26.96 to 34.21 ppm, respectively. The application of T_7 treatment registered the highest leaf zinc (22.94 ppm), manganese (248.23 ppm) and boron (34.21 ppm) contents, whereas, copper (12.26 ppm), iron (271.96 ppm) contents were found highest with T4 and T_6 treatment, respectively in mango cultivar Dashehari. The improvement in leaf

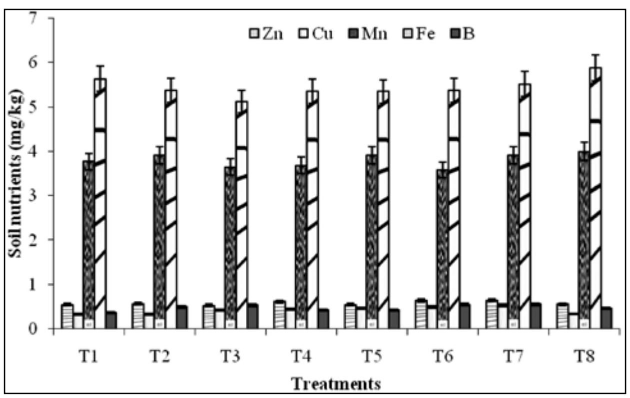

Fig. 1. Effect of micro-nutrients on soil Zn, Cu, Mn, Fe and B content in mango cv. Dashehari

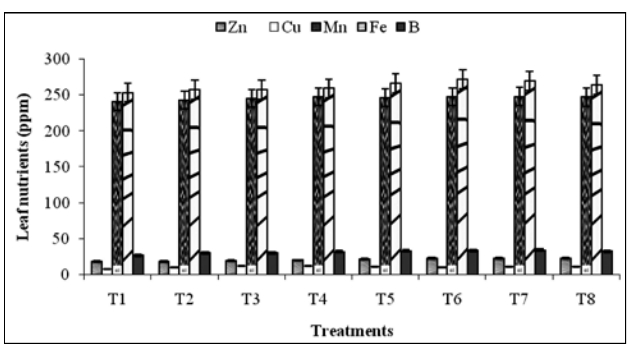

Fig. 2. Effect of micro-nutrients on leaf Zn, Cu, Mn and Fe and B content in mango cv. Dashehari

micro nutrients under T_7 treatment might be due to exogenous application of these nutrients under congenial soil environmental conditions at appropriate time. These results are in accordance with the findings of Rani *et al.* (9) in mango under subtropical region of Jammu.

Based on the experimental results, it can be concluded that recommended dose of fertilizer along with 100g Zinc sulphate, 50g Copper sulphate and 50g Borax may be applied through basal application in tree basin after fruit harvest coupled with two foliar sprays of 0.2% ZnSO4, 0.1% CuSO4 and 0.1% Boric acid during before onset of flowering and at marble stage in mango cv. Dashehari under North Indian conditions.

AUTHORS' CONTRIBUTION

Conceptualization of designing of the research experiment (Dinesh Kumar and G. Pandey), execution of field/lab experiment and data collection (Dinesh Kumar, V.K. Singh and K.K. Srivastava), Data analysis (Dinesh Kumar), preparation of manuscript (Dinesh Kumar, G.Pandey, K.K. Srivastava and V.K.Singh).

DECLARATION

The author declare no conflict of interest.

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