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Effect of soil and foliar application of macro and micronutrients on flowering, fruit set and yield of mango cv. Dashehari

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ABSTRACT

The experiment was carried out at Horticulture Research Centre, Pattharchatta, G. B. Pant University of Agriculture and Technology, Pantnagar, district- Udham Singh Nagar, Uttarakhand during the year 2015-16. The experiment was laid out in RBD (Randomized Block Design) with 10 treatments and 3 replications. The earlier (February10 - February 19) panicle emergence, maximum duration of flowering (27.66 days), number of fruit set per panicle at marble stage was found significantly higher (3.69), higher yield plant^{-1} (228.24 kg) and maximum shelf life (12.33 days) were found with the application of T_{10}: RDF + NPK: 20:20:20 @ 1% (2 Spray: first-15 days and Second- 45 days after fruit set) + foliar spray of $ZnSO_4$ @ 0.4% + Boric acid @ 0.2% + $CuSO_4$ @ 0.2% (2 Spray at just before flowering and marble stage). The maximum flowering intensity percentage was found maximum (48.48 %) in T_7 [RDF + ZnSO4 @ 100 g + CuSO4 @ 50 g + Boric acid @ 50 g (soil application) + Foliar spray of ZnSO4 @ 0.2 % + CuSO4 @ 0.1 % + Boric acid @ 0.1 % (2 sprays at just before flowering and marble stage], the minimum flowering intensity (32.66%) percentage was obtained in T_1 [Control (RDF)].

Key words: Dashehari, Flowering intensity, Fruit set, Mango, Yield.

INTRODUCTION

Mango is the national fruit of India and it has developed its own importance all over the world. Being a useful and delicious fruit, it is a part of culture and religion since long time. Mango can be grown under both tropical and sub-tropical climate. It is originated from Indo-Burma (Myanmar) region (Vavilov, 1926; Popenoe, 1920). It occupies prime place in fruit crops and has largest area under fruit cultivation in India. Mango belongs to the genus *Mangifera* of the family *Anacardiaceae*. The genus *Mangifera* consists of 69 species and classified into two subgenus *i.e. Mangifera* and *Limus* and 11 uncertain position species (Kosterman and Bumpard, 1993). The effects of mineral nutrients including macro and micronutrients on flowering, fruit set, yield and quality can be greatly enhanced by studying their effects on phenological events that contribute to productivity and fruit quality. An adequate supply of nutrients including both macro and micronutrients is critical to nutrient management and its sustainability. According to the criteria of essentiality, if a single essential element is below the critical level for availability, crop growth and yield will be affected even if the other elements are in sufficient supply. Balanced nutrition of plants should be a key priority management practices for every grower. Majority of soils across the country are mainly deficient in micronutrients like Zinc, boron, iron, and also in macronutrients like nitrogen, phosphorous, potassium. Thus, deficiency of micronutrients is very common resulting in yield and quality loss. Hence, management of micronutrients is critical for increasing the yield and quality. The effects of mineral nutrients including macro and micronutrients on productivity and fruit quality can be greatly enhanced by studying their effects on other phenological events that contribute to productivity and fruit quality. An adequate supply of nutrients including both macro and micronutrients is critical to nutrient management and its sustainability. According to the criteria of essentiality, if a single essential element is below the critical level for availability, crop growth and yield will be affected even if the other elements are in sufficient supply. Balanced nutrition of plants should be a key priority management practices for every grower. Fruit trees grown in well managed orchard, produce more stronger regular bearing and have better disease resistance and are more tolerant to stresses. Moreover, the regular and targeted assessment of mango tree mineral status will facilitate improved management of mango trees. Hence, our aim behind the soil and leaf nutrient study is to observe the current status of macro and micronutrients in crop production and to develop recommendations for farmers and information for extension worker for their adaptability in the field.

MATERIALS AND METHODS

The experiment was conducted to study the efficacy of soil and foliar application of macro and micronutrients

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on yield and quality of mango (*Mangifera indica* L.) cv. Dashehari at Horticulture Research Centre, Patharchatta, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, U.S. Nagar (Uttarakhand) during the years 2015-2016. The experiment was laid out in RBD (Randomized Block Design) with 10 treatments and 3 replications. The 10 treatments consisting of recommended dose of fertilizer, macro (primary nutrients), micronutrient and their combinations were selected to see the effect on flowering, fruit set, yield and quality of mango cv. Dashehari. The treatments consists T_1 : Control (RDF), T_2 : RDF + $ZnSO_4$ @ 200 g + Boric acid @ 100 g (soil application) in basin after harvest, T_3 : RDF +$ZnSO_4$ @ 200 g + $CuSO_4$@ 100 g + Boric acid @ 100 g (soil application) in basin after harvest, T_4**:** RDF + Foliar spray of $ZnSO_4$@ 0.4 % + Boric acid @ 0.2 % (2 sprays at just before flowering and marble stage), T_5**:** RDF + Foliar spray of $ZnSO_4$ @ 0.4 % + $CuSO_4$ @ 0.2 % + Boric acid @ 0.2 % (2 sprays at just before flowering and marble stage), T_6 : RDF + $ZnSO_4$@ 100 g + $CuSO_4$ @ 50 g + Boric acid @ 50 g (soil application) + Foliar spray of $ZnSO_4$ @ 0.2 % + Boric acid @ 0.1 % (2 sprays at just before flowering and marble stage), T_7 : RDF + $ZnSO_4$ @ 100 g + $CuSO_4$@ 50 g + Boric acid @ 50 g (soil application) + Foliar spray of $ZnSO_4$ @ 0.2 % + $CuSO_4$ @ 0.1 % + Boric acid @ 0.1 % (2 sprays at just before flowering and marble stage), T_8 : RDF + IIHR Mango Special @ 5 g/ l (2 sprays at two months before flowering and marble stage), T_9 : RDF + NPK: 20:20:20 @ 1 % (2 spray: first- 15 days and Second - 45 days after fruit set) + $ZnSO_4$ @ 200g + Borax @ 100g + CuSO4 @ 100g (Soil application) in basin after harvest, T_{10} : RDF + NPK: 20:20:20 @ 1% (2 Spray: first-15 days and Second- 45 days after fruit set) + foliar spray of $ZnSO_4$ @ 0.4% + Boric acid @ 0.2% + $CuSO_4$@ 0.2% (2 Spray at just before flowering and marble stage). Date of first panicle initiation of was noted by regular visit at alternate days during the month of February, Date of start of flowering was noted by visual observations of each tree at start of flowering by regular visit starting from 2nd fortnight of February to 1st fortnight of March, 2016, Flowering duration of was calculated by taking the days from the start of flowering up to the date of full bloom and expressed in days. Flowering intensity was measured by counting the total number shoots and flowering panicles present in one square meter area and per cent flowering intensity was calculated by dividing the number of flowering panicles with total number of shoots. Number of fruits per panicles at marble stage was counted and average number of initial fruit set was calculated. The harvesting of fruits were carried out in last week of June and weighed. The yield was expressed in terms of kg plant^{-1}. The freshly harvested fruits were placed at room temperature for a period of time unless the fruit retains all the desired physical and chemical properties with respect to acceptable and edible quality and accordingly the shelf life was noted in days. The data were analysed according to the procedure of analysis for Randomized Block Design as explained by Cochran and Cox (1983). The mean values for all parameters were calculated and analysis of variances (ANOVA) for the characters was accomplished by F-variance test.

RESULTS AND DISCUSSION

The data presented in Table 1 on date of panicle emergence, start of flowering, date of full bloom, flowering intensity and fruit set. The emergence of panicle was found earlier (February, 10 - February, 19) in T_{10} and late emergence found in T_5**.** The date of start of flowering was affected with the application of different treatments, which varied from February, 27 to March, 12 during the year 2016. The start of flowering was found earlier (February, 27 – March, 3) in the trees treated with T_{10} and flowering was found late (March, 4 – March, 12) in the trees treated with T_1**.** Full bloom in different trees under different treatments varied from March, 19 - April, 3. The blooms were found earlier (March, 19 - March, 25) in T_{10} and late blooms (March, 27 -April, 3) were found in T_2 [RDF + $ZnSO_4$ @ 200 g + Boric acid @

Table 1: Effect of soil and foliar application of nutrients on panicle emergence, start of flowering, full bloom, flowering intensity and fruit set in mango cv. Dashehari.

Treatments #	Date of panicle emergence	Date of start of flowering	Date of full bloom	Flowering intensity (%)	Number of fruit set per panicle (at marble stage)
T_1	Feb. 14 –Feb. 22	Mar. 4 – Mar. 12	Mar. 25 – Apr. 1	32.66	0.95
T_2	Feb. 19 – Feb. 27	Mar.2 – Mar. 8	Mar. 27 – Apr. 3	38.23	1.14
T_3	Feb. 14 – Feb. 27	Mar. 3 – Mar. 11	Mar. 20 – Mar. 27	39.66	1.33
T_4	Feb. 15 – Feb. 26	Feb. 27 – Mar. 8	Mar. 20 – Mar. 29	38.00	1.58
T_5	Feb. 20 – Feb. 28	Mar. 2– Mar. 9	Mar. 19 – Mar. 28	45.35	2.36
T_6	Feb. 20 – Feb. 27	Mar. 2- Mar. 9	Mar. 20 – Mar. 26	47.93	2.49
T_7	Feb. 14 – Feb. 22	Mar. 4 – Mar. 10	Mar. 25 – Apr. 2	48.58	2.64
T_8	Feb. 19 – Feb. 28	Feb. 27 – Mar. 4	Mar. 25 – Mar. 28	34.71	1.65
T_9	Feb. 14 – Feb. 18	Feb. 27 – Mar. 5	Mar. 20 – Mar.27	46.56	2.92
T_{10}	Feb .10 – Feb . 19	Feb. 27 – Mar. 3	Mar. 19 – Mar. 25	44.16	3.69
SEm±	-	-	-	**1.57**	**0.015**
CD (5%)	-	-	-	**4.66**	**0.046**

100 g (soil application) in basin after harvest]. This might be due to stimulation effect of zinc sulphate, boric acid and copper sulphate along with the foliar application of primary macronutrients (NPK) that causes the physiological and harmonal changes in the tissues which ultimately influences the flowering characterstics.

Table 2: Effect of soil and foliar application of nutrients on yield, yield efficiency, fruit weight and shelf life in mango cv. Dashehari.

Treatments #	Yield plant^{-1} (kg)	Yield efficiency (kg m^{-3})	Fruit weight (g)	Shelf life (days)
T_1	76.66	0.16	105.00	9.00
T_2	91.66	0.16	125.20	9.33
T_3	101.66	0.18	136.10	9.33
T_4	112.30	0.21	178.94	10.67
T_5	146.66	0.26	198.26	11.33
T_6	155.00	0.34	195.30	11.00
T_7	165.92	0.36	212.00	12.00
T_8	115.00	0.28	191.58	12.00
T_9	187.25	0.46	216.41	11.00
T_{10}	228.24	0.5 3	254.60	12.33
SEm±	**13.00**	**0.02**	**18.24**	**0.56**
CD (5%)	**38.64**	**0.08**	**54.20**	**1.67**

Similar findings were also reported by Haldankar *et al.* (2012) in Kokum and Chaudhary *et al.* (2016) in kinnow mandarin, Yadav *et al.* (2014) in ber, and Gurjar and Rana (2014) in kinnow. The data related to the flowering intensity percentage and number of fruit set per panicle at marble stage are presented in Table 1 and Fig. 1. The data related to flowering intensity and fruit set showed singnificant difference under different treatments, which varied from 32.66 to 48.48 %. The maximum Flowering intensity percentage (48.48 %) was found in T_7, which was found statistically at par with T_5, T_6, T_9 and T_{10} whereas, the minimum flowering intensity (32.66%) percentage was obtained in T_1, which was found statistically at par with T_2. The higher fruit set at marble stage (3.69) was obtained with T_{10} followed by T_9 (2.92), T_7 (2.64) and T_6 (2.49), whereas, lower fruit set (0.95) was found with T_1 followed by T_2 (1.14), T_3 (1.33) and T_4 (1.58). Increase in fruit set might be due to promoting effect of boron on cell division and multiplication as well as cell elongation of the plant and retention of fruit more on the trees treated with foliar application of both macro

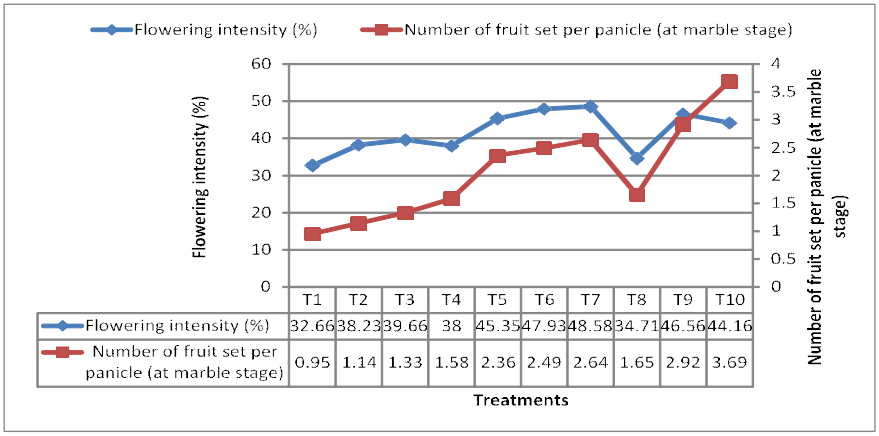

Fig 1: Effect of soil and foliar application of nutrients on flowering intensity and fruit set at marble stage in mango cv. Dashehari.

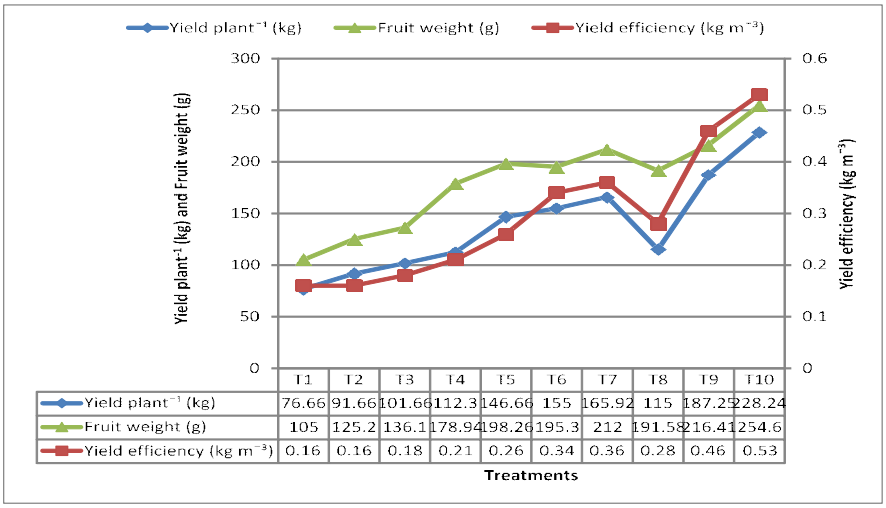

Fig 2: Effect of soil and foliar application of nutrients on yield per plant, yield efficiency and fruit weight in mango cv. Dashehari.

and micronutrients because efficiency of primary nutrient increases due to catalysing effect of micronutrients. This study on fruit set was also in conformity with the observations made by Phillips (2004), Jayaprahasam *et al*. (2010) in mango and Singh *et al.* (2013) in mango. The data pertaining to yield per plant, yield efficiency and fruit weight are presented in Table 1 . and Fig. 2 show significant influence of different treatments under study. The higher yield (228.44 kg plant^{-1}) was obtained with the application of $T_{10,}$ which showed significantly higher yield as compared to the other treatments. The lower yield per tree (76.66 kg plant^{-1}) was recorded in T_1, which was found statistically at par with T_2 (91.66 kg plant^{-1}), T_3 (101.67 kg plant^{-1}) and T_4 (112.30 kg plant^{-1}). The maximum yield efficiency (0.53 kg m^{-3}) was found in T_{10}, whereas minimum yield efficiency was found in T_1. The wide range of fruit weight from 105.00 to 254.60 g was obtained with different treatments under study. The maximum (254.60 g) fruit weight was obtained in T_{10}, which was found statistically at par with T_9 (216.41g) and T_7 (212.00 g), whereas, the minimum fruit weight (105.00 g) was recorded with T_1, which was found statistically at par with T_2 (125.20 g) and T_3 (136.10).

The maximum duration of shelf life (12.33) in T_{10} whereas, the lower duration of shelf life (9.00 days) was recorded with T_1 which was found statistically at par with T_2, T_3 and T_4. It was suggested that the application of zinc promotes the auxin synthesis in the plant which might delayed the formation of abscission layer during the early stages of fruit development and also the foliar application of potassium at time of fruit set was also one of the reason of improvement of shelf life. The results of shelf life are in agreement with findings of Bhatt *et al.* (2012) in mango and Tamboli *et al.* (2015) in Fig 2.

CONCLUSION

On the basis of above observations it may be inferred that the application of RDF + NPK : 20:20:20 @ 1 % (2 spray : first-15 days and second 45 days after fruit set) + foliar spray of $ZnSO_4$ @ 0.4 % + Boric acid @ 0.2 % + $CuSO_4$ @ 0.2 % (2 spray at just before flowering and marble stage) was also found to be most effective for increasing the number of fruit set at marble stage (3.69), yield plant^{-1} (228.24 kg), fruit weight (254.60 g) and maximum shelf life (12.33 days) but in case panicle initiation and earlier start of flowering and full blooms there was no significant effect was found under different treatments. Thus, finally it may be concluded that the micronutrients must also be supplied with application of NPK to the plants to have better flowering intensity, fruit set, yield and ultimately increase in productivity of mango. To standardize the optimum doses and time of foliar application of macro and micronutrients, the long term study is suggested to arrive at valid recommendation.

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