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Effect of Foliar Application of Nutrients on Growth, Yield and Quality of Mango under Rain-Fed Conditions of Himachal Pradesh

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ABSTRACT

Present study was conducted by KVK Mandi for two years to assess the effect of foliar application of nutrients on the various parameters of mango. The uniform trees of cultivar Dashehari planted at a distance of 8x10 m were selected for the study. The treatment consists of calcium chloride @1.0% (T_1), borax @ 0.5% (T_2), calcium chloride @ 1.0% + borax @ 0.5% (T_3), zinc sulphate @ 0.5% (T_4) and control (T_5). The experiment was laid under randomized block design with five treatments and four replications. The nutrients were applied at marvel stage of fruits. The data of both the years were pooled and mean was given in the result. All the treatments significantly influenced the growth, yield and quality of fruits over control. Treatment combination comprising of calcium chloride @1.0% + borax @ 0.5% (T_3) resulted in highest shoot extension growth (37.20 cm), yield (45.93 q/ha), fruit weight (200.45 g) and fruit volume (195.57 ml) followed by application of Borax @0.5% (T_2) during both the years of study. Chemical quality parameters *viz.,* total soluble solids, reducing and total sugars were found better under borax @ 0.5% (T_2) treatment while acidity was maximum under zinc sulphate @ 0.5% (T_4). Lowest values of all these parameters were recorded under control (T_5).

Key Words: Fruit quality, Growth, Mango, Nutrients, Yield.

INTRODUCTION

Mango is one of the most important fruit crop of the tropical and subtropical regions of India. This is the king of fruit and belongs to family Anacardiaceae. In Himachal Pradesh, the area under mango is 42248 ha with a production of about 43540 MT (Anon, 2018). Calcium and boron are the two micronutrients which play important role in several physiological functions. Pre-harvest spray of calcium increased fruit quality of mango (Romero *et al*, 2006). Calcium nitrate at lower concentration i.e. 1.0 % showed beneficial effect in prolonging the storage life of guava (Singh *et al*, 2007). The fruits from the boron deficient papaya plants ripen unevenly and have low sugar content (Chapman *et al*, 1978). Pre-harvest spray of boron has beneficial effect on quality of guava fruit (Aly and Isamail, 2000). For rapid response and correction of deficiencies of mineral nutrients, foliar application of nutrients especially calcium, boron and zinc alone or in combination is beneficial for accelerating development of growth parameters, flowering, yield and quality (Bhatt *et al* , 2012) .

Foliar sprays of nutrients not only improve the size but also enhance qualitative parameters of fruit. The foliar application of macro-nutrients has very important role in improving the productivity and quality of fruits. Various trials have earlier conducted on foliar sprays of macro-nutrients in different fruit species and shown significant response to improving yield and quality of fruits. Yet precise information on its fertilization with respect to micronutrient is lacking. The present study was therefore carried out to find out the effects of nutrients on the growth, yield and quality parameters of mango.

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Table 1. Effect of foliar application of nutrients on growth and yield of mango cultivar Dashehari.

Treatment	Shoot extension growth (cm)	Plant height (m)	Fruit retention at harvest stage (%)	Fruit yield (q/ha)
T_1: Calcium chloride (1.0%)	30.92	5.12	1.07	36.56
T_2: Borax (0.5%)	35.10	5.20	1.20	41.09
T_3: Calcium chloride (1.0%) + Borax (0.5%)	37.20	5.42	1.30	45.93
T_4: Zinc sulphate (0.5%)	30.42	5.05	1.02	35.12
T_5: Control (Water spray)	28.00	4.90	0.90	27.89
$CD_{0.05}$	2.20	0.24	0.17	4.90

MATERIALS AND METHODS

On farm trial was conducted on 10 yr old bearing trees of mango cultivar Dashehari during 2016 and 2017 at Jarol and Dehar area of the Sundernagar block of Mandi district. The uniform trees of cultivar Dashehari planted at a distance of 8x10 m were selected for the study. The experiment was laid out in a randomized block design with five treatments and four replications for each treatment and five trees per replication. The data of both the years were pooled and mean was given in the result. The altitude of the site ranges between 850 to 920 m amsl. The treatment consists of calcium chloride @1.0% (T_1), borax @ 0.5% (T_2), calcium chloride @1.0% + borax @ 0.5% (T_3), zinc sulphate @ 0.5% (T_4) and control as water spray (T_5). The nutrients were applied at marvel stage of fruits. Rest of the cultivation practices were as per the university's package of practices. The vegetative growth parameters like plant height (m), shoot extension growth (cm) were recorded by standard methods. Fruit retention percentage at harvest stage was calculated by using formula given by Westwood (1993). Fruit yield was recorded by removal of crop load during harvesting season as kg/tree and later converted into q/ha. The weight of fruit was taken with the help of a top pan balance. The unit sample consisted of ten fruits and the results were expressed as weight in grams per fruit. Fruit diameter was recorded with the help of Vernier caliper. The volume of fruit was determined by water displacement method and expressed in ml. Total soluble solids were determined using a hand refractometer, percentage of titratable acidity in fruit juice was determined according to AOAC, (1995) and total sugar in the fruit pulp was determined by phenol sulphuric method according to (Dubois *et al,* 1956).The data pertaining to fruit retention, yield and quality parameters were subjected to statistical analysis as per (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Growth and fruit yield

The data pertaining to the effect of foliar application of nutrients on growth and yield revealed that significantly higher shoot extension growth (37.20 cm), plant height (5.42 m), fruit retention percentage (1.30) and yield (45.93 q/ha) were observed with the application of calcium chloride @ 1.0 % + borax @ 0.5% (T_3) which was found statistically at par with the borax @ 0.5% (T_2) . However lowest shoot extension growth (28.00 cm), plant height (4.90 m), fruit retention percentage (0.90) and yield (27.89 q/ha) were recorded under control (T_5). It may be due to increased photosynthetic rate and carbohydrate accumulation as a result of sufficient level of micronutrients in the plant system which helped for better plant growth (Gautam *et al,* 2012). The highest fruit retention and fruit yield with the Calcium chloride and borax in combination or borax alone

Table 2. Effect of foliar application of nutrients on physico-chemical quality parameters of mango cultivar Dashehari.

Treatment	Fruit weight (g)	Fruit diameter (mm)	Fruit volume (ml)	TSS (^{0} B)	Acidity (%)	Reducing sugars (%)	Total sugars (%)
T_1: Calcium chloride (1.0%)	191.03	63.00	188.00	16.00	0.28	4.52	12.20
T_2: Borax (0.5%)	195.45	61.50	190.68	16.85	0.26	4.85	12.46
T_3: Calcium chloride (1.0%) + Borax (0.5%)	200.45	64.82	195.57	16.27	0.30	4.70	12.25
T_4: Zinc sulphate (0.5%)	188.95	58.05	185.15	15.02	0.32	4.45	11.30
T_5: Control (Water spray)	177.62	52.20	172.84	14.28	0.24	3.90	10.92
$CD_{0.05}$	12.80	4.50	11.50	0.49	0.02	0.28	0.18

may be accredited to the positive effect of these two nutrients on increasing rates of carbohydrates and RNA metabolism (Parr and Loughman, 1983). Beneficial effects of micronutrient on growth and yield parameters in different cultivars of mango have been elucidated by number of workers (Bhatt *et al*, 2012; Krishnamoorthy and Hanif, 2015; Parauha and Pandey, 2019)**.**

Quality parameters

The foliar application of nutrients had significant effect on physical and chemical quality parameters of the fruit (Table 2). Application of T_3 (Calcium chloride 1.0% + Borax 0.5%) resulted in maximum fruit weight (200.45 g), fruit diameter (64.82 mm) and fruit volume (195.57ml) closely followed by T_1 (Calcium chloride 1.0 %) and T_2 (Borax 0.5%) but superior to the rest of the treatments including control (177.62 g, 64.82 mm and 195.57 ml respectively). The enhancement in physical quality parameters of fruit could be due to the catalytic action of micronutrients particularly at higher concentration. Hence, the foliar application of micronutrients quickly increased the uptake of nutrients in the tissues and organs of the mango plants, decreased the nutritional deficiencies and improved the fruit quality. Appreciable improvement in physical quality parameters with the application of micronutrients especially borax and calcium have also been reported by Dutta (2004) and Bhatt *et al* (2012) in mango cultivar Himsagar and Dashehari, respectively.

The maximum total soluble solids (16.85^0 B), reducing sugars (4.85%) and total sugars (12.46 %) were recorded under T_2 (Borax 0.5%) followed by T_3 (Calcium chloride 1.0 % + Borax 0.5%) whereas minimum values (14.28 ^{0}B, 3.90% and 10.92 %) of these parameters were recorded under control. The increase TSS content, reducing and total sugars with the application of borax was perhaps due to the translocation of sugars from leaves to fruits by the formation of sugar borate complex (Gauch and Dugger, 1953). Similar results have been obtained by Pushparaj *et al,* (2004) in mango cultivar Dashehari. The acidity was found maximum (0.32%) under T_4 (Zinc sulphate 0.5%) and lowest value (0.24%) was recorded under control. The decrease in acidity of fruits with borax or calcium treatment might have been attributed to their conversion in sugars and their derivatives by the reactions involving reversal of glycolytic pathway and also might be used in respiration.

CONCLUSION

Plant nutrients especially calcium and boron play an important role in growth, fruit retention and development and cause efficient yield and quality improvement. Results revealed that spraying mango trees with calcium, borax as individual or in combination (calcium and borax) had a positive effect on growth, fruit retention, yield and fruit quality. It could be concluded that the treatments comprising application of Calcium chloride 1.0% + Borax 0.5% followed by Borax 0.5% at marvel stage of fruits are effective in enhancing growth, yield and quality parameters of mango.

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