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Yield and quality response of mango cv. Amrapali to foliar application of zinc and boron

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ABSTRACT

Yield and quality response of mango cv. Amrapali to foliar application of zinc and boron was studied for two consecutive years at an experimental farm, ICAR Research Complex for NEH Region, Jharnapani, Nagaland. The different concentrations of ZnSO4 (0.5, 1.0, and 1.5 %) and borax (0.25, 0.5, and 0.75 %) were sprayed at pea, and marble stages of the fruit growth and water spray served as control. Result indicated an increase of 2.5 % in final fruit set, 7.08 % in fruit retention, 2.95 % in number of fruits/tree, 8.01 % in yield, 3.9 % in fruit weight, 1.4 % in fruit length and 1.27 % in fruit breadth with the application of 0.5% borax (T5) over control. Similarly, pulp content was higher by 0.84 % with lower stone content of 2.49 % in 0.5 % borax (T5) as compare to control. Regarding quality parameters, application of ZnSO4 (1.0 %) indicated an increase of 0.71 % TSS, 2.02 % in total sugars and 5.47 % in TSS: acid ratio with 4.44 % lower acidity.

1. Introduction

Mango (*Mangiferaindica* L.), an important fruit, is regarded as the National Fruit of India due to its wide adaptability, delicious taste, and high nutritional value. It is rich in minerals, fibre, and vitamin A and C. The peel is rich in dietary fiber and antioxidant pigments (Rocha *et al.*, 2007; Ajila and Prasada, 2008). In India, mango occupies an area of 2.2 million hectares, producing 21.8 million tonnes with 9.7 t/ha productivity (Anon., 2018). In Nagaland, mango is cultivated in 640.0 ha with a total production of 4240.0 tonnes and productivity of 6.6 t/ha (Anon., 2018). The productivity of mango in Nagaland is low when compared to average national productivity. Nutrition deficiencies, poor nutrient management, various stresses, etc., affect the yield and quality of mango in Nagaland, of which micronutrients are crucial factors for low productivity, especially Zn and B. The Northeast India's soil is acidic in nature and deficit in zinc (Zn), boron (B), and Molybdenum (Mo) due to high rainfall, light texture, and high amount of iron (Fe) and aluminium (Al) oxides, etc. (Singh, 2007). Ao and Sharma (2020) reported in their experiment that available B in the soil of Nagaland is 0.52 mg kg-1. The Nagaland farmers follow traditional farming practices and do not apply any fertilizers and micronutrients such as Zn and B. Boron play a vital role in reproductive cell growth and development, flower initiation, and translocation of sugars (Masroor *et al.*, 2016). Zinc is another essential element involved metabolic process, growth process, and synthesis of amino acids (Hegde and Venkatesh, 2007). Deficiency of these vital elements leads to low fruit set, abnormal fruit drop, fruit cracking, and poor quality and ultimately affects the yield.

Heavy fruit drop is a significant factor contributing to low fruit yield in mango orchards, and sometimes less than 0.1% of fruit reach maturity (Chadha, 2003). Physico-chemical

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properties such as pulp content, total soluble solids, TSS: acid ratio, total sugars, acidity are major contributing factors for consumer acceptability of mango. Poor micronutrient management is the primary factor for low productivity in Nagaland. Application of Zn and B improved the fruit set, yield, and quality in mango. Maximum fruit retention, number of fruits per plant, yield per tree, and most Amrapali mango fruit quality traits were observed with foliar application of 0.5% borax (Bhowmick *et al.*, 2012).

Similarly, Singh and Dhillon (1987) reported that applying boric acid (500-5000ppm) improves the fruit retention and most desirable physico-chemical quality of mango. Daulata *et al.* (1981) and Bhowmick *et al.* (2012) reported improvement in fruit quality of mango by applying zinc sulfate. However, information on the effect of micronutrients on mango in Northeast India is still lacking. Keeping this in view, we attempted to study the impact of micronutrients (Zn and B) on the yield and quality of mango cv. Amrapali grown under the low hills of Nagaland, India.

2. Materials and Methods

The study was conducted at an experimental farm, ICAR Research Complex for NEH Region, Jharnapani, Nagaland (25°45'24" N and 93°50'26" E; and an altitude of 265 m MSL) for two consecutive years (2015 and 2016) on five-year-old mango cv. Amrapali (a hybrid of Dashehari x Neelum) planted at 3 × 3 m spacing. The experimental site received an average of 164.32 cm rainfall annually, and the mean maximum and minimum air temperature varied from 26.50 °C to 34.00 °C and 11.10 °C to 24.80 °C respectively, during the study period (Source: Automatic weather station of the centre). The experiment was laid out in a Randomized block design with three replications. The different concentrations of ZnSO4 (0.5, 1.0, and 1.5 %) and borax (0.25, 0.5, and 0.75 %) were sprayed at pea, and marble stages of the fruit growth and water spray served as control.

The observations on initial fruit set, final fruit set, fruit retention (%), fruit weight (g), number of fruits tree^{-1}, fruit yield (kg tree^{-1}), total yield (t ha^{-1}), TSS (Brix), titratable acidity (%) and total sugars (%) were recorded. The fruit retention was recorded by tagging ten uniform and healthy panicles per tree from all directions at the fruit set stage. The total number of fruits on tagged panicles of each tree was counted at the pinhead stage and then at the harvest stage. The fruit retention at harvest was calculated and expressed as a percentage.

$$\text{Fruit retention percentage} = \frac{\text{Number of fruits retained}}{\text{Number of fruits set at initial stage}} \times 100$$

At the commercial harvest stage, the weight of each fruit was recorded and multiplied by the average number of fruits counted to record the yield. The TSS was recorded by using a hand refractometer and expressed as °Brix. The percent acidity and total sugars contents were estimated using the A.O.A.C. (1984) method and Ranganna (1986). Data collected on fruit retention, yield, and quality attributes were statistically analyzed as per the methods suggested by Panse and Sukhatme (1967) using MS Excel 2010.

3. Result and Discussion

3.1. Fruit retention and yield:

The data analysis revealed that no significant changes between the two years were observed in the initial fruit set and final fruit set. A slight increase in fruit retention (%) was observed in the second year over the first year, and the difference was not significant. The no. of fruits and yield per tree significantly increased over the first year, which may be due to tree growth and better micronutrient availability. The pooled data in table 1 indicated that the initial fruit set was higher in control than the rest of the treatments, while the final fruit set was highest in the application of 0.5 % borax (T5) which was 2.5 times higher over control. The fruit retention, number of fruits/tree, and yield was higher by 7.08 %, 2.95 % and 8.01 % respectively in the application of 0.5 % borax (T5) over control. The reduction in fruit drop by boron application might be due to the role of boron in causing increased production of auxin in fruit petiole or inhibition of ethylene production (Malik and Singh, 2006 and Bibi *et al.*, 2019). This result confirmed the finding of Rajput *et al.* (1976), who reported the lowest (98.36%) fruit drop percentage with boric acid (0.8%) over control (99.13%) in mango and Tripathi *et al.* (2018) in aonla (fruit drop, 68.08 %) with borax @ 0.6%. Foliar spray of boron increases fruit set and yields in several fruit trees species, such as almond, prune, olive, and sour cherry (Slavko *et al.*, 2001). This increment of output might be due to the beneficial roles of boron in the pollination process (Lee and Kim 1991) through increased pollen grains germination and pollen tube elongation, which consequently leads to higher fruit set and yield (Abd- Allah, 2006). These results are in harmony with Bhowmick *et al.* (2012) and Singh *et al.* (2013).

3.2. Fruit physical characters:

Pooled data in Table 2 showed an increase of 3.9 % in fruit weight, 1.4 % in fruit length and 1.27 % in fruit breadth with 0.5% borax (T5) over control (T7). Similarly, pulp content was better by 0.84% with minimum stone content of 2.49 % with 0.5% borax (T5) as compare to control. On the other hand, peel content was lower by 2.13 % in 0.75 % borax (T6) in comparison with control which was however, statistically at par with 0.5 % borax. These findings

are consistent with those of Bhowmick *et al.* (2012). Further, Bhatia *et al.* (2001) reported that the application of 1.0% boric acid resulted in the maximum fruit weight of guava. The increase in fruit weight with the sprays of borax might be due to the involvement of boron in hormonal metabolism, increase in cell division and expansion of cell wall as well as stimulate the fast mobilization of water and sugar in the fruit, resulting in an increase in dry matter buildup within the fruit (Bhatt *et al.*, 2012).

3.3. Quality attributes:

All the fruit quality parameters such as TSS, titratable acidity, total sugars, and TSS: acid ratio were found significantly affected by zinc and boron application (Table 3). Application of ZnSO4 (1.0 %) indicated an increase of 0.71% in TSS, 2.02% in total sugars and 5.47% in TSS: acid ratio against control which was statistically at par with values obtained in 0.5 % borax ((T5). Similarly, acidity was lower by 4.44% in treatment with ZnSO4 (1.0 %) as compare to control. This increase in total soluble solids, total sugars, and TSS: acid ratio with the lowest acidity by foliar application of zinc sulphate might be because zinc plays an important role in photosynthesis which leads to the accumulation of carbohydrates and also regulated the activity of enzymes that metabolized the carbohydrates into simple sugars. These findings corroborated those of Bhowmick and Banik (2011) in mango and Kumar *et al.* (2018) in aonla.

4. Conclusion:

From the above observation, it may be concluded that foliar application of borax at 0.5% is effective for improving fruits' retention, yield, and physical parameters. Biochemical parameters, on the other hand, were enhanced with foliar application of ZnSO4 at 1.0%. Therefore, combined borax at 0.5% and ZnSO4 at 1.0% may be recommended to improve the yield and quality of mango cv. Amrapali at lower hills of Nagaland.

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6. References

Abd-Allah ASE (2006). Effect of spraying some macro and micro nutrients on fruit set, yield and fruit quality of Washington Naval trees. *Journal of Applied Science Research*, 2(11): 1059-1063.

Ajila CM, PrasadaRao UJ (Jan 2008). "Protection against hydr peroxide induced oxidative damage in rat erythrocyt *Mangiferaindica* L. peel extract". *Food and Chen Toxicology,* 46(1): 303-309.

Ao M, Sharma YK (2020). Effect of Lime, Phosphorus and Boron on Yield and Chemical Composition of Maize (Zea mays L.) and Properties of Acid Soil of Nagaland. *International Journal of Current Microbiology and Applied Sciences*, 9(12): 398-408

Anonymous (2018). All India area and production of fruits and vegetables. Indian Hort. Database, National Horticultural Board, Ministry of Agriculture, Govt. of India., pp. 146 (http.//www.nhb.gov.in).

AOAC (1984). Official Method of Analysis. 14th Edition, Association of Official Agriculturist Chemist. Washington D. C., p 16.

Bhatia SK, Yadav S, Ahlawat VP, Dahiya SS (2001). Effect of foliar application of nutrients on the yield and fruit quality of winter season guava cv. L-49. *Haryana Journal of Horticultural Science*, 30(1/2):6-7.

Bhatt A, Mishra NK, Mishra DS, Singh CP (2012). Foliar Application of Potassium, Calcium, Zinc and Boron Enhanced Yield, Quality and Shelf life of Mango. *Hort. Flora Research Spectrum*, 1(4):300-305.

Bhowmick N, BanikBC, Hasan MA and Ghosh B (2012). Response of pre-harvest foliar application of zinc and boron on mango cv. Amrapali under New Alluvial Zone of West Bengal. *Indian Journal of Horticulture,* **69**(3): 428-431.

Bhowmick N and Banik BC (2011). Influence of pre-harvest foliar application of growth regulators and micronutrients on mango cv. Himsagar. *Indian Journal of Horticulture*, 68: 103-7.

Bibi F, Ahmad I, Bakhsh A, Kiran S, Danish S, Ullah H and Rehman A (2019). Effect of Foliar Application of Boron with Calcium and Potassium on Quality and Yield of Mango cv. Summer Bahisht (SB) Chaunsa. *Open Agriculture*, 4: 98–106.

Chadha KL (2003). Handbook of Horticulture. Published by Directorate of information and publications of Agriculture, ICAR, New Delhi.

Daulta BS, Singh HK and Chauhan KS (1981). Effect of zinc and ccc sprays on flowering, fruiting and physico-chemical composition of fruit in mango (*Mangiferaindica* L.) cv. Dashehari. *Haryana Journal of Horticultural Science*, 10: 161-65.

Hegde VL, Venkatesh YP (2007). Anaphylaxis following ingestion of mango fruit. *Journal of Investigative Allergy*, 17,341–344.

Kumar A, Tripathi VK, Dubey V, Katiyar NK and Tiwari P (2017). Influence of foliar application of calcium, zinc and boron on fruit drop, yield and quality attributes of aonla (*Emblicaofficinalis*) cv. NA-7. *Research on Crops*, 18 (1) : 91-97.

Lee SS and Kim KR (1991). Studies on the internal browning of apple fruits, caused by excessive boron application and mineral and some organic contents of fruit according to excessive B application. *Journal of Korean Society of Horticultural Science*, 32(2):184-90.

Masroor HM,Anjum MA,Hussain S,Ejaz S, Ahmad S,Ercisli S, Zia-Ul-Haq M (2016). Zinc amelioratesfruit yield and quality of mangoes cultivated in calcareous soils. *Erwerbs-Obstbau*, 58, 49–55.

Panse VG and Sukhatme PV (1985). Design of Experiments. VIII Randomized Blocks and Latin Square. In: Statistical Methodology for Agricultural Workers, ICAR, New Delhi, pp. 145-56.

Rajput CBS, Singh BP and Mishra HP (1976). Effects of foliar application of boron on mango. *ScientiaHorticulture*, 5: 311-13.

Rangana S (1986). Handbook of Analysis and Quality Controls for Fruit and Vegetable Products. Tata McGraw Hill Co. Ltd., New Delhi.

Rocha Ribeiro SM, Queiroz JH, Lopes Ribeiro de Queiroz ME, Campos FM, PinheiroSant'ana HM (2007). Antioxidant in mango (*Mangiferaindica* L.) pulp. *Plant Foods Human Nutrition,* 62(1): 13-17.

Singh AK, Singh CP, ShantLal and Pratibha (2013). Effect of micronutrients and sorbitol on fruit set, yield and quality of mango cv. Dashehari. *Progressive Horticulture*, 45(1):43-48.

Singh MV (2007). Problems of micro- and secondary-nutrients in acidic soils of India and their management. In: Rattan RK (ed)Bulletin of the Indian society of soil science, Vol 25, pp 27–58.

Singh Z and Dhillon BS (1987). Effect of foliar application of boron on vegetative and panicle growth, sex expression, fruit retention and physico-chemical characters of mango (*Mangiferaindica* L.) cv. Dashehari. *Tropical Agriculture,* 64: 305-8.

Slavko P, Brown PH, Connell JHN, yomora AMS, Dordas C, Hu H (2001). Foliar boron application improves flower fertility and fruit set of olive. *Horticultural Science*, 36:714-16.

Tripathi VK,BhadauriaAS, Singh A and Gupta S (2018). Influence of foliar application of boron, zinc and gibberellic acid on fruit drop, yield and quality attributes of Aonla cv. NA-7. International Conference on Global Research Initiatives for Sustainable Agriculture & Allied Sciences, At: Rajasthan Agricultural Research Institute Durgapura, Jaipur, Rajasthan, India.

Table 1: Effect of zinc and boron on fruit retention and yieldof mango cv. Amrapalli

Treatments	Initial fruit-set (no/panicle)			Final fruit-set (no/panicle)			% of fruits retained atharvest			No. offruits/tree at harvest			Yield (tonnes/ha)		
	1st year	2nd year	Mean	1st year	2nd year	Mean	1st year	2nd year	Mean	1st year	2nd year	Mean	1st year	2nd year	Mean
T1: ZnSO4 0.5%	23.07	20.93	21.90	1.58	1.49	1.53	6.85	7.12	6.99	33.50	48.60	41.05	10.31	14.59	12.45
T2: ZnSO4 1%	26.29	22.71	24.35	1.63	1.54	1.58	6.2	6.78	6.49	32.00	45.80	38.90	8.82	11.65	10.23
T3: ZnSO4 1.5%	31.24	26.19	28.65	1.69	1.6	1.65	5.41	6.11	5.76	29.50	41.70	35.60	8.02	10.37	9.19
T4: Borax 0.25%	25.00	22.92	23.86	1.81	1.76	1.78	7.24	7.68	7.46	32.80	47.10	39.95	11.28	14.06	12.67
T5: Borax 0.5%	23.43	22.82	23.13	1.87	1.83	1.85	7.98	8.02	8.00	35.20	50.00	42.60	12.36	16.50	14.43
T6: Borax 0.75%	32.16	27.86	29.80	1.73	1.68	1.7	5.38	6.03	5.71	30.60	42.90	36.75	7.86	10.51	9.19
T7: Control	33.19	29.88	31.59	1.51	1.44	1.48	4.55	4.82	4.69	27.40	38.40	32.90	6.86	9.16	8.01
SEm ±	0.44	0.38	0.43	0.006	0.005	0.005	0.06	0.06	0.05	0.04	0.05	0.44	0.33	0.35	0.23
CD (p=0.05)	1.08	0.95	1.01	0.05	0.05	0.04	0.21	0.22	0.20	1.30	1.32	1.31	1.22	1.28	1.24

Table 2: Effect of zinc and boron on fruit physical characters of mango cv. Amrapalli

Treatments	Weight (g)	Length(cm)	Breadth(cm)	Pulp (%)	Peel (%)	Stone (%)
T1: ZnSO4 0.5%	303.99	8.70	5.95	70.58	14.50	14.92
T2: ZnSO4 1%	264.99	8.40	5.70	69.75	13.48	16.77
T3: ZnSO4 1.5%	260.19	8.45	5.95	70.80	14.00	15.20
T4: Borax 0.25%	321.21	9.20	6.00	71.58	13.00	15.42
T5: Borax 0.5%	340.57	9.35	6.20	73.88	12.15	13.97
T6: Borax 0.75%	251.01	8.55	5.55	73.54	11.98	14.48
T7: Control	244.52	8.20	5.50	68.00	14.54	17.46
SEm ±	3.61	0.06	0.05	0.06	0.05	0.05
CD(p=0.05)	11.13	0.21	0.16	1.50	1.38	1.42

Table 3: Effect of zinc and boron on biochemical composition of mango cv. Amrapalli

Treatments	Total soluble solids (°Brix)	Titratable acidity (%)	Total sugars (%)	TSS: acid ratio
T1: ZnSO4 0.5%	18.75	0.24	14.25	78.13
T2: ZnSO4 1%	19.52	0.18	16.62	108.44
T3: ZnSO4 1.5%	18.55	0.25	14.45	74.20
T4: Borax 0.25%	18.80	0.22	15.52	85.45
T5: Borax 0.5%	19.25	0.20	15.95	96.25
T6: Borax 0.75%	19.00	0.22	15.00	86.36
T7: Control	18.22	0.26	13.82	70.08
SEm ±	0.06	0.004	0.05	2.08
CD(p=0.05)	0.19	0.05	1.20	6.41