Madras Agric. J., 99 (7-9): 500-502, September 2012
https://doi.org/10.29321/MAJ.10.100124

Short Note

Micronutrient Spray Effects on Growth, Yield and Quality of Papaya (*Carica papaya* L.) Cv. Madhu Bindu

P.K. Modi*, L.R. Varma, P.P. Bhalerao, P. Verma and A. Khade

Department of Horticulture, Chimanbhai Patel College of Agriculture Sardarkrushinagar Dantiwada Agricultural University Sardarkrushinagar - 385 506 (Gujarat)

The investigation was undertaken with a view to determine the "Effect of foliar spray of various micronutrients on growth, yield and quality of papaya (*Carica papaya* L.) cv. Madhu Bindu" and results revealed that the individual application of $ZnSO_4$ 0.5% and borax 0.3% exerted great influence on plant height, stem girth and number of leaves as well as earlier initiation of flower bud and minimum days taken from fruit setting to first harvest. The yield characters *i.e.* average weight of fruit, number of fruit and yield of fruits per plant with maximum yield per hectare was also recorded maximum with $ZnSO_4$ 0.5% and borax 0.3% when the plants sprayed at 30, 60 and 90 days after transplanting. In quality point of view, different levels of $ZnSO_4$ and borax had markedly influenced the quality of papaya fruits *i.e.,* ascorbic acid (mg/100g), total soluble solids (%), reducing sugar (%), non-reducing sugar and total sugar (%).

Key words: borax, zinc sulphate, foliar, micronutrients, yield and quality

Papaya (*Carica papaya* L.) is an important fruit crop of tropical and sub-tropical countries of the world. In India, Kerala has the largest area under papaya cultivation but Andhra Pradesh has the highest production and productivity. Papaya is widely cultivated in Andhra Pradesh, Kerala, West Bengal, Orissa, Maharashtra, Gujarat, Assam, Karnataka, Bihar, Tamil Nadu, Madhya Pradesh, Manipur and plains of Uttar Pradesh. In Gujarat State, it is cultivated on an estimated area 14130 ha with 72.2 lakh tonnes of production and productivity of fruit 51.08 t/ha (Annon., 2009). In Gujarat provide ideal climatic condition for its proper growth and development. Madhu Bindu is dioecious cultivar of papaya, its height medium, bears elongated fruits low on the trunk, pulp extra fine, sweet and has agreeable flavour. The essential trace elemental use, in plant system and their importance is outstanding discovery and achievement of plant sciences. These micro elements have proved in varied uses in the commercial culture of plant and now, man can change their pattern and development by stimulating the growth. Zinc is an essential element for several enzyme systems that regulate various metabolic activities in plant. Zinc sulphate could be used as a source of zinc. It is sufficient and economical source among different zinc carriers. Boron generally helps in the translocation of sugar as sugar borate complex. Due to its deficiency in papaya cause lumpy disease which uneven shape of papaya and retard growth of apical growing point. Younger leaves are misshaped wrinkled and often thicker. Amongst different boron carriers, the water soluble borax is the most effective and economical source of boron to be used for applications.

*Corresponding author email: pmodi.horti@gmail.com

Materials and Methods

The present investigation was carried out on entitled "Effect of foliar spray of various micronutrients on vegetative growth, flowering behaviour, yield and quality of papaya (*Carica papaya* L.) cv. Madhu Bindu." Factorial experiment in a Randomized Block Design was conducted at Horticultural Instructional Farm, Department of Horticulture, C.P. College of Agriculture, Sardar krushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat during the year 2008-9. The seedlings having uniform growth of about 20 cm height was selected for transplanting and pits for planting were dug 30 x 30 x 30 cm at the spacing of 1.8 x 1.8 m. Two seedlings were transplanted in each pit with 15 cm apart. There were three levels of zinc, *viz.,* Z_0 (Control) No spray, Z_1 (0.25 % $ZnSO_4$) and Z_2 (0.5 % $ZnSO_4$) and three levels of boron, *viz.,* B_0 (Control) No spray, B_1 (0.15 % borax) and B_2 (0.3 % borax). Thus, there were nine treatment combinations. The foliar applications was done at 30, 60 and 90 days after transplanting of papaya cv. Madhu Bindu. All the cultural practices were done as per recommendation of university. For observations of growth parameters, five plants were randomly selected, tagged and numbered for recording observation whereas, in case of yield attributes and quality parameters the observations are counted at ripening stage during experiment.

Sugar and ascorbic acid contents of fruit were estimated as per the proceeding of A. O. A. C. (1979).

Results and Discussion

Growth Characters

From the Table1, it is revealed that the plant height, stem girth and number of leaves were increased with increasing levels of $ZnSO_4$ and borax. In that, the maximum plant height, stem girth and number of leaves per plant at final harvesting stage has been recorded under the individual application of $ZnSO_4$ (0.5%) and borax (0.3%) at 30, 60 and 90 DAP over control. The action of zinc in above cases was the involvement of metabolism of nitrogen and synthesis of auxin in the plant and it was also involved in cell division and cell enlargement as well as enhance the plant growth and development. Present findings may attribute both by cell division and cell enlargement to cause is sound growth of plant. Similar result was reported by Wear and Haggler (1968). In case of boron, it increases the phenolic compounds which regulate polar auxin transport (Brawn and Amber, 1973). The increased auxin activity results in increased vegetative growth characters. These results are in conformity with the findings reported be Lokhande and Moghe (1988) in papaya and Banik and Sen (1997) in mango. On the contrary, the application of boron consistently proved effective in all the observations and characters, which cumulatively influenced the early flower bud initiation. When borax and $ZnSO_4$ were compared, it was found that both the levels of borax significantly affected the initiation of early flower bud whereas, $ZnSO_4$ had no significant effect in respect of flower bud initiation in papaya. These findings are in conformity with Alila *et al.* (2004) in papaya.

Table 1. Effect of micronutrients on growth characters of papaya cv. Madhu Bindu

Treatment	Plant height (cm)			Stem girth (cm)			Number of leaves			Days taken from fruit setting to first harvest
	At initiation of flowering	At 1st harvest	At final harvest	Days taken flower bud initiation	Days taken from fruit setting to first harvest	At final harvest	At initiation of flowering	At 1st harvest	At final harvest	
Levels of Zinc sulphate (Z)										
Z_0 : (No spray)	70.43	139.33	158.98	16.37	31.51	37.92	21.19	34.32	50.03	80.61
Z_1 : (0.25 %)	71.32	143.38	166.39	17.27	33.38	40.08	22.64	37.16	52.24	77.92
Z_2 : (0.5 %)	71.74	146.40	169.87	17.87	34.75	42.18	23.33	38.38	54.09	76.42
S.Em.±	1.00	1.91	2.36	0.31	0.72	0.64	0.38	0.84	0.93	1.13
C.D. at 0.05 %	NS	NS	7.07	0.92	2.17	1.92	1.12	2.51	2.78	NS
Levels of Borax (B)										
B_0 : (No spray)	70.77	131.13	153.47	15.44	29.44	34.73	20.50	31.99	44.04	82.74
B_1 : (0.15 %)	70.84	143.86	166.09	17.25	33.72	41.09	22.67	36.83	54.31	78.00
B_2 : (0.3 %)	71.88	156.33	175.69	18.81	36.48	44.36	23.98	41.04	58.01	74.22
S.Em.±	1.00	1.910	2.36	0.31	0.72	0.64	0.38	0.84	0.93	1.13
C.D. at 0.05 %	NS	5.73	7.07	0.92	2.17	1.92	1.12	2.51	2.78	3.39
Interaction										
Z x B	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.V. (%)	4.21	4.01	5.22	5.34	6.54	4.80	5.02	6.85	5.34	4.33

Table 2. Effect of micronutrients on yield parameters of papaya cv. Madhu Bindu

Treatment	Average weight of fruit (kg)	Number of fruits/plant	Yield of fruit/ plant (kg)	Yield of fruit/ hectare (tonnes)
Levels of Zinc Sulphate (Z)				
Z0 :(No spray)	0.643	33.21	21.65	60.14
Z1 :(0.25 %)	0.673	35.58	24.14	67.05
Z2 :(0.5 %)	0.702	38.14	27.15	74.87
S.Em.±	0.01	0.73	0.52	1.51
C.D. at 0.05 %	0.029	2.20	1.56	4.53
Levels of Borax (B)				
B0 :(No spray)	0.597	30.46	18.23	50.53
B1 :(0.15 %)	0.687	34.82	23.95	66.53
B2 :(0.3 %)	0.739	41.64	30.76	84.90
S.Em.±	0.01	0.73	0.52	1.51
C.D. at 0.05 %	0.029	2.20	1.56	4.53
Interaction				
Z x B	NS	NS	NS	NS
C.V. (%)	4.35	6.18	6.43	6.72

Yield and Yield Attributing Characters

Effectiveness of zinc and boron was found to be significant in increasing the yield characters of papaya cv. Madhu Bindu (Table 2). The single foliar application of $ZnSO_4$ (0.5 %) and borax (0.3 %) significantly increased the yield parameters *viz.,* average weight of fruit (kg), number of fruits per plant, yield of fruits per plant (kg) and per hectare (t). It might be due to fact that the role of zinc in regulating the semi-permeability of cell wall thus mobilizing more water into the fruits and it is helpful in chlorophyll synthesis which increases photosynthetic activities of leaves. In case of boron, it is due to cell elongation, cell division as well as increases in cavity index and also the beneficial effect on fertilization and faster fruit development by increasing pollen producing capacity of the anthers, the viability of pollen grains and as well as it also stimulates germination of pollen tube growth. The findings are supported by results of Pant and Lavania (1998) and Kavitha *et al.* (2000) in papaya.

Quality Parameters

The data on fruit analysis are furnished in Table 3 in respect ascorbic acid, total soluble solids, reducing sugars. Comparatively higher percentage were recorded by control. Zinc and boron recorded significantly higher percentage of total soluble solids and total sugars and lower of ascorbic acid over control. Zinc improves the auxin content and it also acts as a catalyst in oxidation-reduction processes in plants. Besides, it also helps in other enzymatic reactions like transformation of carbohydrates, activity of hexokinase and formation of cellulose and change in sugar are considered due to its action on zymohexose. Increase of sugars and total soluble solids in fruits was also reported by Pant and Lavania (1989), Kavitha *et al.* (2000) and Alila *et al.* (2004) in papaya and Bahadur *et al.* (1998) in mango. Forgoing discussion highlights the individual foliar applications of $ZnSO_4$ at 0.5% and borax at 0.3% influence the growth, fruit yield and quality of papaya cv. Madhu Bindu.

Table 3. Effect of micronutrients on quality attributes of papaya cv. Madhu Bindu

Treatment	Ascorbic acid (mg/100g)	Total soluble solids (%)	Reducing sugar (%)	Non- reducing sugar (%)	Total sugar (%)
Levels of Zinc Sulphate (Z)					
Z_0 :(No spray)	58.27	9.82	5.80	1.25	7.05
Z_1 :(0.25 %)	55.13	10.08	6.08	1.29	7.38
Z_2 :(0.5 %)	52.73	10.44	6.4	1.32	7.72
S.Em.±	1.34	0.29	0.11	0.02	0.12
C.D. at 0.05 %	4.01	NS	0.34	0.05	0.36
Levels of Borax (B)					
B_0 :(No spray)	62.38	8.83	5.36	1.17	6.53
B_1 :(0.15 %)	52.60	10.32	6.20	1.30	7.50
B_2 :(0.3 %)	51.16	11.19	6.74	1.38	8.12
S.Em.±	1.34	0.29	0.11	0.02	0.12
C.D. at 0.05 %	4.01	0.86	0.34	0.05	0.36
Interaction					
Z x B	NS	NS	NS	NS	NS
C.V. (%)	7.25	8.49	5.60	4.04	4.82

References

Anonymous. 2010. Indian Horticulture Database 2010. National Horticulture Board, pp. 99-100.

A.O.A.C. 1979. Official Methods of Analysis, Association of Agricultural Chemists, 11th edition, Washington, D. C. U.S.A.

Alila, P., Sanyal, D. and Sema, K.A. 2004. Influence of micronutrient application on quality of papaya Cv. Ranchi. *Haryana J. Horti. Sci.,* **33**: 25-26.

Bahadur, L., Malhi, C.S. and Zora Singh 1998. Effect of foliar and soil applications of zinc sulphate on zinc uptake, tree size, yield and fruit quality of mango. *J. Pl. Nutr.,* **21**: 589-600.

Banik, B.C. and Sen, S.K. 1997. Effect of three level of zinc, iron, boron and their interaction on growth, flowering and yield of mango Cv. Fazli. *Hort. J.,* **10** : 23-29.

Brawn, J. and Amber, J.E. 1973. Genetic control of uptake and role of boron in tomato. *Soil Sci. Soc. Am. Proc.,* (Maryland). **37**: 63-66.

Kavitha, M., Kumar, N. and Jeykumar, P. 2000. Effect of Zinc and Boron on biochemical and quality characters of papaya Cv. CO-5. *J. South Indian Hort.,* **48**: pp. 1-5.

Lokhande, N.M. and Moghe, P.G. 1988. Nutrients and hormonal effect on growth, promotion and productivity in ring spot infected papaya crop. *J. South Indian Hort.,* **39**: pp. 23-26.

Pant, V. and Lavania, M.L. 1989. Effect of foliar sprays of iron, zinc and boron on quality of papaya fruits. *Prog. Hort.,* **21**: 165-167.

Pant, V. and Lavania, M.L. 1998. Effect of foliar sprays of iron, zinc and boron on growth and yield of papaya (*Carica papaya* L.). *J. South Indian Hort.,* **46**: pp.1-2, 5-8.

Wear, J.I. and Haggler. 1968. Relationship of zinc uptake by corn and sorghum to soil zinc measured by three extractants. *Soil Sci. Soc. Am. Proc.*, **32**: 543-546.

Received: January 9, 2012; Revised: April 26, 2012; Accepted: May 15, 2012