



Effect of Zinc and Boron on the Growth and Yield of Kinnow Mandarin

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ABSTRACT

The investigation was undertaken with a view to determine the "Effect of zinc and boron on the growth and yield of kinnow mandarin" and results revealed combined application of 0.2 per cent boric acid + 0.5 per cent zinc sulphate at fruit set and peach size stage of fruit through foliar spray exerted great influence on plant height, tree spread and shoot length. The yield characters i.e. fruit retention, number of fruits plant⁻¹, fruit weight (g), fruit volume (cc), fruit diameter (cm), yield plant⁻¹ (kg) with maximum yield ha⁻¹ were also recorded paramount with 0.2 per cent boric acid + 0.5 per cent zinc. The foliar application of 0.2 per cent boric acid + 0.5 per cent zinc sulphate at fruit set and peach size stage of fruit effectively increased the leaf zinc and boron level of kinnow mandarin leaves and brought them from deficient to optimum range.

INTRODUCTION

Kinnow a mandarin hybrid (*C. nobilis* Lour. × *C. deliciosa* Tenora) is one of the most important and finest varieties of mandarin grown especially in North India. It has assumed great importance among North Indian growers and a large acreage is being brought under its cultivation particularly in Punjab, Haryana, Rajasthan and Himachal Pradesh. Its pulp is used to make delicious desserts, jams and sauces and skin can be used to make cosmetics and essence. It is a well established fact that deficiency of micronutrient deteriorates vegetative growth, quality and production of fruit and causes heavy flower and fruit drop, which result in production of poor quality fruit coupled with yield losses. Among micronutrients, zinc (Zn) and boron (B) have much significance due to most wide spread deficiency of these micronutrients in the citrus cultivated areas in India. Zn is one of the important micro-element essential for plants due to its involvement in the synthesis of tryptophan which is a precursor of indole acetic acid synthesis. It has important role in starch metabolism, and acts as co-factor for many enzymes, affects photosynthesis reaction, nucleic acid metabolism and protein biosynthesis (Alloway, 2008). Similarly, boron (B) as a micronutrient is a part and parcel of the growth behaviour and productivity of citrus trees. It increases pollen grain germination, pollen tube elongation, consequently fruit set percentage and finally the yield (Abd-Allah, 2006), and in B deficient plants these processes may be severely impaired. At present, little is known about the effects of combined application of B and Zn on citrus in general and mandarin in particular under Rajasthan conditions. Therefore, keeping the above factors in view the present study "Effect of zinc and boron on the growth and yield of kinnow mandarin" was carried out at KVK, Chittorgarh, Maharana Pratap University of Agriculture and Technology, Udaipur during the year 2013-14.

MATERIALS AND METHODS

Five-year old, twenty seven uniform and healthy kinnow (king × willow leaf) mandarin trees grafted on rough lemon (*Citrus jambhiri* L.) root stock, planted according to square system of layout at 5 m distance and grown under uniform soil conditions at the KVK, Chittorgarh, Maharana Pratap University of Agriculture and Technology, Udaipur were used. The experiment consisted of 9 treatments comprising T₁ (control), T₂ (0.1% boric acid), T₃ (0.2% boric acid), T₄ (0.4% zinc sulphate), T₅ (0.5% zinc sulphate), T₆ (0.1% boric acid + 0.4% zinc sulphate), T₇ (0.1% boric acid + 0.5% zinc sulphate), T₈ (0.2% boric acid + 0.4% zinc sulphate), T₉ (0.2% boric acid + 0.5% zinc sulphate) applied at fruit set and

peach size stage of fruit through foliar spray. These treatments were evaluated under one way analysis of variance replicated thrice with adopting uniform cultural schedules during the experimentation. The observations were recorded on vegetative attributes and yield characteristics. The vegetative parameters regarding the tree height (m), tree spread [N-S & E-W (m)] were measured at the beginning and at end of the experiment and average increase in the tree height (m), tree spread (m) were recorded. Five newly emerged flushes were tagged from each side (North, South, East and West) of experimental trees to record the shoot length. The yield attributes per cent fruit retention was calculated on the basis of initial number of fruit set and total numbers of fruits at the time of fruit maturity. Average fruit weight was calculated by weighing fruit on digital electronic balance and fruit volume was measured by water displacement method. Fruit diameter and rind thickness were measured by digital vernier caliper. The total fruit yield tree⁻¹ was calculated by multiplying total number of fruits tree⁻¹ with the average fruit weight and estimated yield ha⁻¹ was calculated by multiplying total fruit yield per tree with number of plant ha⁻¹. Data were analyzed as per standard statistical methodology.

RESULTS AND DISCUSSION

Foliar application of zinc and boron significantly affected the vegetative growth parameters of kinnow mandarin (Table-1). Trees sprayed with 0.2 per cent boric acid + 0.5 per cent zinc sulphate at fruit set and peach size stage of fruit (T₉) revealed the maximum increase in tree height (3.55 m), tree spread (3.98 and 3.98 m) N-S and E-W, respectively and shoot length (102.92 cm) of kinnow mandarin as compared to minimum in control (Table-1). This might be due to the favourable influence of applied micronutrients (zinc + boron) on vegetative characteristics because of their catalytic or stimulatory effect on most of the physiological and metabolic process of plants. Zinc and boron are essential component of enzymes responsible for nitrogen and carbohydrates metabolism respectively, thereby resulting into increased uptake of nitrogen by the plant. Further, involvement of Zn in the synthesis of tryptophan which is a precursor of indole acetic acid synthesis, consequently increased tissue growth and development. Boron increases the phenolic compounds which regulate polar auxin transport. The increased auxin activity results in increased vegetative growth characters. The present results in kinnow are in line with those of Ullah *et al.* (2012). Khan *et al.* (2012) also reported a synergistic effect of B and Zn on the vegetative growth in Feutrell's Early mandarin when applied at fruit set stage.

Maximum fruit retention (71.77 %) and maximum number of fruits plant⁻¹ (486.24) were recorded with foliar application of 0.2 per cent boric acid + 0.5 per cent zinc sulphate at fruit set and peach size stage of fruit (T₉) as compared to minimum in control (Table-1). Increase in fruit retention and fruit number might be due to reduction in the fruit drop. Zn is required for preventing the abscission layer formation and consequently, the reduction in pre-harvest fruit drop. Zinc and boron application reduce fruit drop and increase fruit retention might be due to the fact that zinc play important role in biosynthesis of IAA. These finding are in conformity with those of Sajid *et al.* (2010) in sweet orange and Trivedi *et al.* (2012) in guava.

The fruit weight and fruit volume of kinnow differed significantly with the sprays of zinc and boron alone or in combination. The maximum fruit weight (163.23 g) and volume (194.79) were recorded when 0.2 per cent boric acid + 0.5 per cent zinc sulphate (T₉) was sprayed. The increase in fruit weight and volume might be due to increased rate of cell division and cell enlargement

leading to more accumulation of metabolites in the fruit (Babu and Singh, 2001).

The foliar spray of zinc and boron showed better response in improving the fruit diameter, yield plant⁻¹ and estimated yield ha⁻¹. The maximum increase in fruit diameter (7.16 and 6.10 cm) equatorial and polar, respectively, yield plant⁻¹ (79.32 kg) and estimated yield ha⁻¹ (31.73) were observed with T₉ (0.2 % B + 0.5% Zn) which is at par with T₈ (0.5% 0.2% B + 0.4% Zn) treatments were applied at fruit set and peach size stage of the fruit as compared to minimum in control (Table-1). The higher fruit diameter due to combined application of zinc and boron may be attributed to their stimulatory effect of plant metabolism. The results are inconformity with the observations recorded by Rawat *et al.* (2010) in guava. The present results are in conformity with the findings of Rajkumar *et al.* (2014) in gua

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Table -1: Effect of zinc and boron on growth and yield attributes of kinnow mandarin

Treatments	Tree height (m)	Tree spread (m)		Shoot length (cm)	Fruit retention (%)	No. of fruits plants ⁻¹	Fruit weight (g)	Fruit volume (cc)	Fruit diameter (cm)		Yield plant ⁻¹ (kg)	Yield hac ⁻¹ (t)
		N-S	E-W						Equatorial	polar		
A. Absolute control v/s rest treatments:												
Control	3.46	3.90	3.86	96.35	65.83	446.00	145.53	174.64	6.25	5.33	64.92	25.97
Treatment	3.51	3.95	3.92	99.64	68.73	465.31	154.90	185.42	6.69	5.80	72.14	28.85
SEm±	0.01	0.01	0.02	1.64	1.34	9.10	4.09	1.99	0.11	0.09	2.86	1.14
CD at 5%	0.04	0.05	NS	NS	NS	NS	NS	5.97	0.34	0.29	NS	3.47
B. Among treatments:												
T ₀	3.49	3.92	3.87	96.75	67.61	457.71	147.50	177.00	6.34	5.55	67.48	26.99
T ₁	3.53	3.94	3.91	97.05	68.18	460.96	148.83	178.59	6.44	5.57	68.64	27.45
T ₂	3.49	3.92	3.90	97.43	67.00	453.59	151.37	181.64	6.56	5.65	68.68	27.47
T ₃	3.51	3.95	3.91	99.26	67.13	454.47	154.13	183.93	6.62	5.90	70.12	28.05
T ₄	3.51	3.96	3.92	100.45	68.92	466.58	156.33	187.58	6.71	5.78	72.99	29.20
T ₅	3.53	3.97	3.93	101.11	69.27	468.95	157.73	188.75	6.78	5.83	74.00	29.60
T ₆	3.52	3.98	3.96	102.20	70.02	474.03	160.14	191.08	6.91	6.08	75.94	30.37
T ₇	3.55	3.98	3.98	102.92	71.77	486.24	163.23	194.79	7.16	6.10	79.32	31.73
SEm±	0.012	0.01	0.02	1.33	1.10	7.43	3.33	1.62	0.09	0.08	2.33	0.93
CD at 5%	0.037	0.04	0.06	4.01	3.30	22.29	10.01	4.87	0.28	0.24	7.01	2.80

REFERENCE

- Abd-Allah, A.S. 2006. Effect of spraying some macro and micro nutrients on fruit set, yield and fruit quality of Washington Navel orange trees. J. Appl. Sci. Res., 2: 1059-1063. | Alloway, B.J. 2008. Zinc in soils and crop nutrition. Int. Zinc Asso. Brussel, Belgium. | Babu, N. and Singh, A.R. 2001. Effect of foliar application of boron, zinc and copper on chemical characteristics of litchi fruits. Bioved., 12 (½): 45-48 | Khan, A.S., Ullah, W., Malik, A.U., Ahmad, R., Saleem, B.A. and Rajwana, I.A. 2012. Exogenous applications of boron and zinc influence leaf nutrient status, tree growth and fruit quality of Feutrell's Early (Citrus reticulata Blanco). Pakistan J. Agric. Sci., 49 (2): 113-119 | Rajkumar, Tiwari, J.P. and Shant Lal. 2014. Effect of foliar application of zinc and boron on fruit yield and quality of winter season guava (Psidium guajava) cv. Pant Prabhat. Annals of Agri Bio Res., 19 (1): 105-108. | Rawat, V., Tomar, Y.K. and Rawat, J.M.S. 2010. Influence of foliar application of micronutrients on the fruit quality of guava cv. Lucknow-49. J. of Hill Agri., 1 (1):75-78. | Sajid, M., Rab, A., Ali, N., Arif, M., Ferguson, L. and Ahmed, M. 2010. Effect of foliar application of Zn and B on fruit production and physiological disorders in sweet orange cv. Blood orange. Sarhad J. Agri., 26 (3): 355-360. | Trivedi, N., Singh, D., Bahadur, V., Prasad, V.M. and Collis, J.P. 2012. Effect of foliar application of zinc and boron on yield and fruit quality of guava (Psidium guajava L.). HortFlora Res Spectrum, 1 (3): 281-283. | Ullah, S., Khan, A.S., Malik, A.U., Afzal, I., Shahid, M. and Razaq, K. 2012. Foliar application of boron influences the leaf mineral status, vegetative and reproductive growth, yield and fruit quality of 'kinnow' mandarin (Citrus reticulata Blanco.). J. Plant Nutri., 35 (13): 2067-2079.