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Effect of foliar application of zinc and boron on growth, reproductive and yield of pomegranate cv. Ganesh in hast bahar

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Abstract
A field experiment was conducted at Fruit Research Station Imaliya, Department of Horticulture, JNKVV, Jabalpur, India during Hast bahar of 2017-18 to assess the role of zinc and boron on growth, reproductive characteristics and yield of pomegranate. The experiment was laid out in randomized block design with three replications. The treatment consisted of two foliar applications of Zinc sulphate and Boric acid with their combinations *viz.*, T_1 (control), T_2 (B+Zn @ 0+0.2%), T_3 (B+Zn @ 0+0.4%), T_4 (B+Zn @ 0+0.6%), T_5 (B+Zn @ 0.2+0%), T_6 (B+Zn @ 0.2% each), T_7 (B+Zn @ 0.2+0.4%), T_8 (B+Zn @ 0.2+0.6%), T_9 (B+Zn @ 0.4+0%), T_{10} (B+Zn @ 0.4+0.2%), T_{11} (B+Zn @ 0.4% each), T_{12} (B+Zn @ 0.4+0.6%), T_{13} (B+Zn @ 0.6+0%), T_{14} (B+Zn @ 0.6+0.2%), T_{15} (B+Zn @ 0.6+0.4%) and T_{16} (B+Zn @ 0.6% each). The findings revealed that foliar spray of T_{11} (B+Zn @ 0.4% each) was found to be the best as compared to control treatment. Among the treatment the foliar application of B+Zn @ 0.4% each was effective in enhancing growth parameter *viz.* Plant height (m), Light transmission ratio (%), Energy interception (Cal cm^{-2} min^{-1}), Chlorophyll content index, reproductive parameter *viz.* first date of flower initiation, days taken for 50% flowering, number of flower /shoot, number of fruit /shoot and yield of hast bahar in pomegranate.

Keywords: zinc sulphate, boric acid, B+ Zn, pomegranate, growth, yield

Introduction
India ranks first in pomegranate production in the world but it has only 7% share of total world exports. The area under pomegranate production 1.43 lakh hectare in India and production is 17.74 lakh tonnes with a productivity 12.40 t/ha (Anonymous, 2016) [1]. In recent years the pomegranate has shown great importance for human health because of the high antioxidant content of its juice and peel, and its properties which prevent cancer and cardiovascular diseases (Shishodia *et al.*, 2006) [15]. Pomegranate is high value crop and its entire tree has great economic and medicinal importance. Its colourful, orange red flowers and dense, bushy growth habit make pomegranate an attractive ornamental. Micro-elements (Cu, Zn, B, Fe, Mn, Mo, Cl and Si) are essential elements required by plants in minute quantities. These elements plays role in growth and development of plants. Micro-element deficiencies often limit the production in many fruit crops. Boron is an important micro-nutrient governing many physiological and biochemical plant processes and its beneficial effects on horticultural crops have been reported (Dutta *et al.* 2000) [5].

Zinc is also an important nutrient element for growth, flowering and quality of fruits. It is involved in the biosynthesis of plant hormone Indole acetic acid. Zinc plays an important role in nucleic acid and protein synthesis and helps in the utilization of phosphorous and nitrogen. Favorable effects of zinc sprays on vegetative growth and health of fruit trees have been observed. (Ram and Bose 1994) [11]. Zinc and boron greatly vary from soil to soil in different climatic regions and thus commonly causing excess or deficiency in plants which adversely affecting production.

The recommended doses of fertilizers are applied immediately after pruning and irrigation is resumed. This leads to profuse flowering and fruiting. The fruits are ready for harvest 4-5 months after flowering. In tropical condition, there are three flowering seasons, *viz.*, January-February (Ambia bahar) June-July (Mrig bahar) and September-October (Hasta bahar). The choice of flowering/fruiting is regulated taking into consideration the availability of irrigation water, market demand and pest/disease incidence in a given locality. Therefore, keeping these facts in view, the present investigation on effect of foliar application of zinc and boron on yield and quality of pomegranate cv. Ganesh in hast bahar.

Materials and Methods

A field experiment was conducted at Fruit Research Station Imaliya, Department of Horticulture, JNKVV, Jabalpur, India during hast bahar of 2017-18. The experiment was laid out in randomized block design with three replications. The treatment consisted of two foliar applications of Zinc sulphate and Boric acid with their combinations *viz.*, T_1 (control), T_2 (B+Zn @ 0+0.2%), T_3 (B+Zn @ 0+0.4%), T_4 (B+Zn @ 0+0.6%), T_5 (B+Zn @ 0.2+0%), T_6 (B+Zn @ 0.2% each), T_7 (B+Zn @ 0.2+0.4%), T_8 (B+Zn @ 0.2+0.6%), T_9 (B+Zn @ 0.4+0%), T_{10} (B+Zn @ 0.4+0.2%), T_{11} (B+Zn @ 0.4% each), T_{12} (B+Zn @ 0.4+0.6%), T_{13} (B+Zn @ 0.6+0%), T_{14} (B+Zn @ 0.6+0.2%), T_{15} (B+Zn @ 0.6+0.4%) and T_{16} (B+Zn @ 0.6% each). The sprays of nutrients were applied in the 10th September 2017 and 25th February 2018. Various quantitative and qualitative parameters of fruits, *viz.*, (A) Growth Parameters; Plant Height (m), Light transmission ratio (%), Energy interception (Cal cm^{-2} min^{-1}), Chlorophyll content index, (B) Reproductive Parameter*:* Date of first flower appearance, Days taken for 50% flowering, No. of flower/shoot, First date of fruit initiation. (C) Yield Parameter**;** Number of fruit/plant, Weight of fruit (g), Fruit cracking % and Yield (kg/plant). The significance of variation among the treatments was calculated by applying analysis of variance (ANOVA) and critical difference (CD) test at 5% probability level.

Results and Discussion

(A) Effect on growth parameters

The combined effect of Zn and B resulted in significant increase in the plant height (Table 1). The incremental plant height of 0.13 m (from 3.31m at initial stage to 3.44 m at harvest stage) were observed and found maximum under foliar application of boron + zinc 0.4% each. The increase in plant height may be due to the combined application of Zn and B which increased the availability of Zn and B to the plant and in turn resulted in more synthesis of food material and other metabolites required for growth and development of fruit plant. Involvement of Zn in the synthesis of tryptophan which is a precursor of in dole acetic acid synthesis, consequently it increased tissue growth and development. Zinc has play important role in starch metabolism, and acts as co-factor for many enzymes, affects photosynthesis reaction, nucleic acid metabolism and protein biosynthesis. Boron is much required for cell division and development in the growth regions of the plant near the tips of shoots and roots. Ullah *et al*. (2012) [18] reported that the foliar application of B significantly affected the vegetative growth parameters of kinnow mandarin tree. Tree height, spread, stem diameter, flush length and leaf width was significantly increased by the foliar application of Boron.

Light transmission ratio

The light transmission ratio (LTR) varied due to various treatment combination of boron and zinc (Table 1). The LTR uptake at harvest stage (85.51%) was observed under foliar application of B (0.4%) + Zn (0.4%). Probable reasons for enhanced more light transmission ratio may be due to reduction in LAI and leaf orientation which might due to have permitted more light penetration. There was a continuous decrease in light transmission ratio during the canopy development stage. In the interception of light (LI) by a canopy, difference between the solar incident radiation and reflected radiation by the soil surface is a determining factor in crop development and provides the energy needed for fundamental physiological processes such as photosynthesis and transpiration. A similar observation has also been reported by Biscoe and Gallagher (1977) [3]. Radiation interception varied from emergence to harvesting (Watiki *et al*.1993) [20]. This result is obvious on the basis of the fact that canopy leaf area index also varies from emergence to harvesting.

Energy interception

Energy interception presented in (Table 1) and it is revealed that the maximum (0.91 Cal cm^{-2} min^{-1}) energy interception at after harvest was recorded where, it was minimum under control i.e. (0.317 Cal cm^{-2} min^{-1} at harvest stage). The higher energy interception in these treatments may be attributed to the higher magnitudes of assimilatory surface area in these treatments and leaf phytotoxic which might have permitted higher solar energy interception. Light has been recognized as one of the factors controlling plant growth, solar radiation produces a set of reaction in the plants, which are evaluated in term of energy reaction. The high light energy reactions are largely manifested in the storage of solar energy by photosynthetic enzymes in the form of chemical energy. On the other hand, low light reactions are recognized by photo-morphogenesis, which implies the effect of visible light over growth, development and differentiation of plant parts. The interception of radiation in green plant is done by green leaves, which is influenced by the size, shape, angle and orientation. The canopy structure in terms of radiation interception varies with climatic conditions *viz*. sun angle, direct and diffused radiation, properties of absorbing surfaces, CO_2 profiles and micro climate of crop. The crop stands is the product of amount of solar energy intercepted and the efficiency of intercepting tissue (Hesketh and Baker 1967) [7].

Chlorophyll content index

Chlorophyll content index presented in (Table 1) revealed that the maximum chlorophyll content index 66.40 at harvesting stage was recorded under foliar application of boron (0.4%) + zinc (0.4%) while, minimum chlorophyll content index 48.91 at harvesting stage was noted under control. The leaf serves as the major photosynthetic organ in crops and much of the difference in rate of photosynthetic area was due to variation in leaf macro and micro nutrients. These findings are agree with the findings of Malakouti *et al*. (2005) [9] who reported that the increase in leaf chlorophyll was related to raising N, Mg and Fe in leaves. These elements have key roles in chlorophyll structure and synthesis. The effect of Zinc on chlorophyll content, nitrogen percentage and protein content are increased also reported by kusum *et al*. (2015) [8].

Table 1: Effect of foliar application of Zn and B on growth parameters

Treatment	Plant Height (cm)	LTR (%)	Energy interception (Cal cm^{-2} min^{-1})	Chlorophyll content index
T_1 B_0 + Zn_0 (0%)	2.92	95.19	0.32	48.92
T_2 B_0 + Zn_1 (0% +0.2%)	3.01	92.02	0.51	49.88
T_3 B_0 + Zn_2 (0% + 0.4%)	3.75	90.94	0.58	51.01
T_4 B_0 + Zn_3 (0% + 0.6%)	3.15	92.04	0.53	49.64
T_5 B_1 + Zn_0 (0.2% + 0%)	3.02	92.02	0.49	54.42
T_6 B_1 + Zn_1 (0.2% + 0.2%)	3.56	90.99	0.57	56.41
T_7 B_1 + Zn_2 (0.2% + 0.4%)	3.60	90.01	0.61	58.71
T_8 B_1 + Zn_3 (0.2% + 0.6%)	3.50	92.25	0.47	62.32
T_9 B_2 + Zn_0 (0.4% + 0%)	4.11	89.01	0.70	62.82
T_{10} B_2 + Zn_1 (0.4% + 0.2%)	2.47	88.81	0.70	63.91
T_{11} B_2+ Zn_2 (0.4% + 0.4%)	3.44	85.51	0.91	66.40
T_{12} B_2 + Zn_3 (0.4% + 0.6%)	2.65	90.32	0.62	61.10
T_{13} B_3 + Zn_0 (0.6% + 0%)	3.36	89.98	0.64	62.71
T_{14} B_3 + Zn_1 (0.6% + 0.2%)	2.95	90.07	0.60	63.80
T_{15} B_3 + Zn_2 (0.6% +0.4%)	3.33	89.95	0.61	64.65
T_{16} B_3 + Zn_3 (0.6% + 0.6%)	2.71	90.72	0.57	63.34
SE m ±	0.29	1.03	0.06	0.71
C.D. at 5%	0.86	2.99	0.18	2.07

(B) Effect on reproductive parameters

The data showed that the date of first flower appearance ranged from 28-09-2017 to 04-10-2017 was observed in all the treatments (Table 2). The earliest first flower bud appearance in 18 days from the date of spray and days 32.92 taken to attain 50% flower from the date of spray was noted under foliar spray of B (0.4%) + Zn (0.4%). Whereas, maximum days of 24 and 39.09 was noted under control to appearance of first flower bud and to attained 50% flowering from the days of spray. It might be due to significant role of zinc as it is an important element for flowering, fruiting, growth and yield and quality of fruit. Zn also increase the chlorophyll content of leaves and play an important role in enzymatic activities and necessary for growth and development of fruit. Chermahini *et al*. (2010) [4] and Syamal *et al. q* (2008) [17] reported that the earliness in flowering and fruiting is due to optimum level of nitrogen which is an important component of protoplasm and it helped in chlorophyll synthesis which increase in photosynthetic rate resulting more accumulation of carbohydrates leading to flower initiation and profuse flowering. The data showed that the foliar application of B and Zn significantly affect the number of flower and fruit per shoot. The foliar spray of B +Zn both @ 0.4% has showed maximum number of flower (5.25) and fruit (4.02) per shoot. The results obtained in the present study are in accordance with the findings of Singh and Maurya (2004) [16].

Table 2: Effect of foliar application of Zn and B on Reproductive parameters

Treatment	Date to first flower appearance	Days to 50 % flowering	No. of flower/shoot	First date to fruit initiation	No. of fruit/shoot
T_1 B_0 + Zn_0 (0%)	03-10-2018	39.09	2.17	50.20	1.50
T_2 B_0 + Zn_1 (0% +0.2%)	04-10-2018	36.22	3.17	47.21	2.08
T_3 B_0 + Zn_2 (0% + 0.4%)	02-10-2018	36.56	3.58	46.51	2.33
T_4 B_0 + Zn_3 (0% + 0.6%)	03-10-2018	37.07	2.75	46.79	1.83
T_5 B_1 + Zn_0 (0.2% + 0%)	02-10-2018	36.25	3.83	45.09	2.83
T_6 B_1 + Zn_1 (0.2% + 0.2%)	01-10-2018	35.12	4.08	44.95	3.0
T_7 B_1 + Zn_2 (0.2% + 0.4%)	29-09-2018	36.55	4.08	45.01	2.83
T_8 B_1 + Zn_3 (0.2% + 0.6%)	30-09-2018	36.44	3.42	46.12	2.50
T_9 B_2 + Zn_0 (0.4% + 0%)	28-09-2018	35.75	4.08	43.76	2.92
T_{10} B_2 + Zn_1 (0.4% + 0.2%)	30-09-2018	34.89	4.25	43.33	3.0
T_{11} B_2+ Zn_2 (0.4% + 0.4%)	28-09-2018	32.92	5.25	42.30	4.02
T_{12} B_2 + Zn_3 (0.4% + 0.6%)	29-09-2018	35.36	3.58	45.22	2.25
T_{13} B_3 + Zn_0 (0.6% + 0%)	30-09-2018	36.04	3.25	44.40	2.17
T_{14} B_3 + Zn_1 (0.6% + 0.2%)	29-09-2018	36.62	3.33	45.50	2.16
T_{15} B_3 + Zn_2 (0.6% +0.4%)	03-10-2018	37.49	3.12	46.48	2.16
T_{16} B_3 + Zn_3 (0.6% + 0.6%)	03-10-2018	37.99	2.62	48.13	1.83
SE m ±	-	0.42	0.28	0.44	0.22
C.D. at 5%	-	1.24	0.81	1.30	0.65

(C) Effect on yield parameters and yield

Under present investigation the yield parameter such as number of fruits per plant, weight of fruit (g) and fruit yield (kg) per plant significantly increased over control. Maximum number of 57.66 fruits, fruit weight 301.74 (g) and yield 18.44 kg per plant noted (Table 3) with foliar spray of B (0.4%) + Zn (0.4%) which was significantly superior than over rest of the treatments. Similar results were also reported by Goswami *et al*. (2012) [6] and Rani and Brahmachari (2001) [12]. Zinc play important role in auxin synthesis, resulted into better photosynthesis, greater accumulation of starch in fruits and balance of auxin in plant regulates the fruit drop or retention in plants, which altered the control of fruit drop and increased the total number of fruit per plant (Venu *et al.* 2014) [20]. Similar result is obtained by Banik *et al.* (1997) [2]. It is an established fact that zinc is credited with definite role in the hydrolysis of complex polysaccharides into simple sugars, synthesis of metabolites and rapid translocation of photosynthetic products and minerals from other parts of the plants to developing fruits leading to increase in fruit weight, volume and size (Rawat *et al.* 2010) [13] Similar results are also found by Parmar *et al.* (2014) [10]. Boron particularly helps in sugar translocation to target sites and is also known to improve stigma thus resulting in better pollination and fruit set.

Data in table (3) showed that treatment B (0.4%) + Zn (0.4%) has reduced fruit cracking significantly found most effective in control was found most effective in reduced fruit cracking. These results are in line with the findings of Sen and Chauhan (1983) [14] in pomegranate.

Table 3: Effect of foliar application of Zn and B on yield parameters and yield

Treatment	No. of fruit/plant	Weight of fruit (g)	Fruit cracking % at 30 days second spray	Yield kg/plant
T_1 B_0 + Zn_0 (0%)	20.33	222.98	19.32	4.55
T_2 B_0 + Zn_1 (0% +0.2%)	25.67	254.58	11.44	6.51
T_3 B_0 + Zn_2 (0% + 0.4%)	26.33	264.48	8.29	6.59
T_4 B_0 + Zn_3 (0% + 0.6%)	26.33	251.38	8.14	6.57
T_5 B_1 + Zn_0 (0.2% + 0%)	34.33	254.57	6.83	8.81
T_6 B_1 + Zn_1 (0.2% + 0.2%)	38.67	261.11	4.67	9.80
T_7 B_1 + Zn_2 (0.2% + 0.4%)	45.67	251.37	4.42	11.49
T_8 B_1 + Zn_3 (0.2% + 0.6%)	40.33	244.12	6.11	10.10
T_9 B_2 + Zn_0 (0.4% + 0%)	43.67	279.13	4.16	12.19
T_{10} B_2 + Zn_1 (0.4% + 0.2%)	42.33	286.53	3.79	12.04
T_{11} B_2+ Zn_2 (0.4% + 0.4%)	57.67	301.74	3.15	18.44
T_{12} B_2 + Zn_3 (0.4% + 0.6%)	46.67	249.17	5.83	11.59
T_{13} B_3 + Zn_0 (0.6% + 0%)	38.33	249.24	7.14	9.23
T_{14} B_3 + Zn_1 (0.6% + 0.2%)	34.33	255.98	9.28	8.79
T_{15} B_3 + Zn_2 (0.6% +0.4%)	25.67	245.18	10.60	6.23
T_{16} B_3 + Zn_3 (0.6% + 0.6%)	24.00	234.90	12.34	5.62
SE m ±	1.90	6.49	0.46	0.69
C.D. at 5%	5.51	18.85	1.33	2.02

Conclusion

On the basis of results obtained in present investigation it is Concluded that foliar spray of B_2 (0.4%) + Zn_2 (0.4%) was found to be the best as compared to control treatment. Among the treatment the foliar application of B_2 (0.4%) + Zn_2 (0.4%) was effective in enhancing growth parameter *viz*., Plant height (m), Light transmission ratio (%), Energy interception (Cal cm^{-2} min^{-1}), Chlorophyll content index, reproductive parameter *viz*. first date of flower initiation, days taken for 50% flowering, number of flower/shoot, number of fruit/shoot and yield of hast bahar in pomegranate.

References

1. Anonymous. 2016. Horticulture Statistics at a Glance, Horticulture Statistics Division Department of Agriculture, Cooperation and Farmers Welfare Ministry of Agriculture and Farmers Welfare Government of India. 2015, URL: http://www.nhb.gov.in.
2. Banik BC, Sen SK. Effect of three levels of zinc, iron, boron and their interactions on growth, flowering and yield of mango cv. Fazli. The Horticultural Journal 1997; 10(1):23-29.
3. Biscoe PV and JN Gallagher. Weather, dry matter production and yield. In Lsndsberg, J.J., Cutting, C.V. (Eds.), Environmental Effects on crop physiology. Academic press, London. 1977; 75-100.
4. Chermahini AS, Moallemi N, Zargar AS. Effect of winter foliar application of urea on some quantitative and qualitative characters of flower and fruit set of orange cv. 'Valencia'. J Applied Hort. 2010; 12(1):59-61.
5. Dutta N, Sharma K and Hasan QZ. Effect of feed allowance on selection, intake and nutrient utilization of green maize (*Zea mays*) by goats. Asian-Aust. J Anim. Sci. 2000; 13(4):483-486.
6. Goswami AK, Shukla HS, Kumar P, Mishra DS. Effect of pre harvest application of micro-nutrients on quality of guava (*Psidium guajava* L.) Cv. Sardar. HortFlora. Research Spectrum. 2012; 1(1):60-63.
7. Hesketh J, Baker D. Light and carbon assimilation by plant communities. Crop Sci. 1967; 7:285-293.
8. Kusum M, Satish K, Singh KP. Effect of zink, molybdenum and urea on chlorophyll and protein content of mungbean (*Vigna radiate* L. Wilczek), International Journal of plant sciences. 2015; 10(2):152-157.
9. Malakouti MJ, Majidi A, Sacheshmepour M, Dehghani F, Shahabi AA, Keshavarj P, *et al*. Nutrional disorders, determination of quality indices and optimum levels of nutrients in fruits grown on the calcareous soils of Iran. Soil and Water, 2005.
10. Parmar JM, Karetha KM, Rathod PJ. Effect of foliar spray of urea and zinc on growth and flowering attributes of guava (*Psidium guajava*) cv. bhavnagar red. ARJCI. 2014; 5(2):140-143.
11. Ram RA, Bose TK. Effect of foliar application of magnesium and micronutrients on growth, yield and fruit quality of mandarin orange (*Citrus reticulata* Blanco). Indian Journal of Horticulture. 2000; 57(3):215-220.
12. Rani Ruby, Brahmachari VS. Effect of foliar application of calcium, zinc and boron on tracking and physiochemical composition of litchi. Orissa J Hort. 2001; 29(1):50-54.
13. Rawat V, Tomar YK, Rawat JMS. Influence of foliar application of micronutrients on the fruit quality of guava cv. Lucknow-49. J Hill Agri. 2010; 1(1):63-66.
14. Sen NL, Chauhan KS. Effect of different NPK on physico-chemical composition of pomegranate fruits cv. Local Selection. Prgg. Hort. 1983; 20(1-2):77-79.
15. Shishodia S, Adams L, Bhatt ID, Aggarwal BB. Anticancer potential of pomegranate, In: seeram NP, Schulman RN, Heber D(Eds) Pomegranates : Ancients roots to modern Medicin, Taylor and Francis Group, New York, 2006,107-116.

16. Singh J, Maurya AN. Effect of micronutrients on bearing of mango (*Mangifera indica*) cv. Mallika. Prog. J Agri. 2004; 4(1):47-50.
17. Syamal MM, Singh SK, Singh BP. Effect of urea and zinc on growth flowering fruiting, and fruit quality of Kagzi lime (*Citrus aurantifolia* Swingle). Environment and Ecology. 2008; 26(3):1036-1038.
18. Ullah S Khan, AS Malik, AU Afzal I Shahid, M, Razzaq K. Foliar application of boron influences the leaf mineral status, vegetative and reproductive growth, and yield and fruit quality of 'kinnow' mandarin (*Citrus reticulata* Blanco.). J Plant Nutrition. 2012; 35(13):2067-2079.
19. Venu A, Delvadi DV, Sharma LK, Gardwal PC, Makhmale S. Effect of micronutrient application on flowering, fruiting and yield of Acid lime (*Citrus aurantifolia* L.)" Kagzi lime. National Academy of Agric. Sci. 2014; 32:3-4.
20. Watiki JM, Fukai S, Bandia JA, Keating BA. Radiation interception and growth of maize/cowpea intercrop as affected by maize plant density and cowpea cultivar. Field Crops Res. 1993; 35:123-133.