

Impact of Zinc and Boron on Growth, Yield and Quality of Kinnow (*Citrus deliciosa* x *Citrus nobilis*) in Sub-tropical Conditions of Punjab

Davinder, Anis Mirza*, Anjil Kumar, Rupinder Singh,
Sudhir Pratap and Bhupinder Singh

Department of Horticulture, SAGR, Lovely Professional University, Phagwara, Punjab-144411, India.

<http://dx.doi.org/10.22207/JPAM.11.2.59>

(Received: 10 May 2017; accepted: 05 June 2017)

Kinnow is the most preferred cultivar in Punjab due to its wider adaptability, yield and higher economic returns. However, excessive fruit drop is becoming a major cause for achieving low fruit yield. This could be attributed mainly to the lack of appropriate nutrient management for Kinnow orchards. The soil and leaf chemical analysis showed severe deficiency of Zn and B in Kinnow. Therefore the present study was carried out in the farmer's field at Abohar, Punjab with an objective to examine the influence of micronutrients on the growth and quality of Kinnow and in order to frame the appropriate dose. The experiment was laid out in randomized block design with ten treatments and three replications. Results show that in basal dose, treatment of Zn and B (250 gm/plant) gives fruit weight (198.78 g), number of fruits (269.66), weight of fruit/plant (58.00 kg) and vitamin C (20.83%), fruit drop(33.21%) and in foliar dose, treatment of Zn (3gm) and B (2gm) gives plant height (25.40cm), number of fruits (298), weight of fruit/plant (60.00 kg) and vitamin C(17.50%), while combination treatment of basal + foliar of Zinc (250+3gm) and boron(250+2gm) significantly improved the plant height (29.46cm), fruit length (4.95cm), width (5.61cm) and vitamin C (24.16%) with lowest fruit drop of 28.48% was obtained.

Keywords: Kinnow, zinc, boron, growth, yield, quality.

Among the Citrus, Kinnow is placed at first position with respect to its area and production in India. Kinnow a mandarin hybrid (*C. deliciosa*Tenora x *C. nobilis*Lour.) 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 area is being brought under its cultivation particularly in Punjab, Haryana, Rajasthan and

Himachal Pradesh. The area under Kinnow cultivation is 48,182 hectares with the production of 118618 lakh tonnes and the productivity of 21,607 kilos per hectare (NHB 2015-16). It is mostly grown in areas of Fazilka, Ferozpur, Muktsar and Bathinda of Punjab. Kinnow are a fair source of vitamin C and daily consumption protects mankind from scurvy. Its pulp is used to make jam, squash, juice, sauce, syrup and its outer skin can be used to make cosmetics and essence. It is the main source of peel oil, citric acid which has international market value. It is rich in fibre (Sharma *et al.* 2007 and Altaf, 2006). Therefore for growth, yield and quality, use of micronutrients

* To whom all correspondence should be addressed.
E-mail: anis.19474@lpu.co.in

in Kinnow fruit crop is essential as they also help in enzyme activation and biosynthesis (Edward Raja, 2009). 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. Zinc is one of the important micronutrient essential for plants due to its involvement in the synthesis of tryptophan which is a precursor of indole acetic acid synthesis. Similarly, boron (B) increases pollen grain germination, pollen tube elongation, consequently fruit set percentage and finally the yield (Abd-ullah, 2006). Therefore, keeping the above factors in view the present study "Influence of zinc and boron on growth, yield and quality of Kinnow in sub-tropical conditions of Punjab" was carried out at V.P.O Ramsara Tehsil Abohar District Fazilka, Punjab during the year 2016-17.

MATERIAL AND METHODS

Experimental Site

The field experiment was conducted during the years 2016-17 in the orchard of Kinnow located at V. P. O. Ramsara, Tehsil Abohar, District Fazilka, Punjab under the Horticulture department of LPU Phagwara, Punjab during the year 2016-17. In this experiment five year old trees with thirty uniform and healthy kinnow plants were chosen to check the influence of micronutrients. The soil analysis report shown in table-1 shows that kinnow orchard soils are deficient to micronutrients; therefore the current study was undertaken to frame the appropriate dose.

Treatment Details

The present experiment having 10 treatments comprising T₁-basal (250gm chelated zinc), T₂-foliar (3gm zinc sulphate), T₃-basal (250gm borax), T₄-foliar (2gm boron), T₅-basal+ foliar (250gm chelated zinc+3gm zinc sulphate), T₆-basal and foliar (250gm borax+ 2gm boron), T₇-basal (250gm chelated zinc+ 250gm borax), T₈-(3gm zinc sulphate+ 2gm boron), T₉-basal and foliar (250gm chelated zinc+borax+3gm zinc sulphate+ 2gm boron), T₁₀-(Control).

Observations Detail

These treatment applications were given during fruit set, pea size fruit set and after monsoon in October. The observations were recorded on

yield, quality and morphological parameters. The morphological parameters regarding the tree height (cm) was recorded using measuring tape from the crown level to base of leaf apex, fruit set (%) was recorded by taking the number of fruits divided by numbers of flowers, fruit drop (%) was recorded by total number of fruits set and number of fruit dropped were counted and calculated and expressed in percent. The yield regarding average fruit weight was calculated by weighing fruit on electronic balance and the number of fruit will be counted at the time of maturity and expressed as number of fruit/plant and fruit length were measured by vernier caliper. The total fruit yield per tree was calculated by multiplying total number of fruits per tree with the average fruit weight and estimated yield hectare was calculated by multiplying total fruit yield per tree with number of plant per hectare. The quality parameters regard TSS (^oB) with optical refractometer, acidity (%) and ascorbic acid (%) were also recorded during the investigation. And all observation were determined by the methods described by AOAC.

Experimental Design And Statistical Analysis

The data was analysed by Randomized Block Design. And (ANOVA) was calculated by the help of OPSTAT software.

RESULTS AND DISCUSSION

The basal and foliar application of zinc and boron significantly affects the growth, yield and quality parameters of Kinnow (Table-2 and 3).

Basal application of Zinc and Boron

Trees with basal dose of 250 gm each of zinc and boron in T₇-basal (250gm chelated zinc+ 250gm borax) has given better results than other basal treatments T₁(250gm chelated Zn) and T₃(250gm borax). The fruit weight (198.78 gm), number of fruit/plant (269.66), weight of fruit/plant (58.00 kg), vitamin C (20.83%) are significantly improved by basal application of 250 gm chelated zinc + borax in basal followed by T₁(250gm chelated Zn) and T₃(250gm borax) basal treatments as presented in Table -2, 3. The increase in fruit weight might be due to increased rate of cell division and cell enlargement leading to regulating metabolites in the fruit (Babu and Singh, 2001). Similar results were also obtained by Asadi and Akhlagi (2005) which are in conformity with

our findings.

The observations recorded in table- 3 show that the maximum total soluble solid and acidity was recorded in Zn basal application on kinnow. In T₁ (basal 250 gm chelated Zinc) recorded maximum total soluble solid of 11.53 °B and acidity of 2.63% .Zinc treated plants recorded maximum total soluble solid in kinnow because zinc is considered as one of the important micronutrient essential for plants synthesis of tryptophan which is a precursor of indole acetic acid. Similar results by Bhatnagar et al. (2015) observed maximum TSS and ascorbic acid and

other quality traits.

Foliar application of Zinc and Boron

Data in table-2, 3 illustrate that in foliar application T₈ foliar (3gm zinc sulphate+2gm boron) treatment gives enhanced ascorbic acid of 17.50%, weight of fruit/plant (60.00kg), number of fruit/plant (298) as compared to T₂ foliar (3gm zinc sulphate) and T₄ foliar (2gm boron). The increase in fruit size might be due to combined applications of zinc and boron because of their stimulatory effect on plant metabolism. The above results in kinnow are in line with those of Khan, Malik, Saleem & Rajwana (2009).

The observations recorded in table- 3 shows that the maximum total soluble solid and acidity was recorded in Zn foliar application on kinnow. T₂ (foliar 3gm zinc sulphate) total soluble solid of 11.46 °B and acidity of 3.46% was recorded as compared to T₅-basal+ foliar (250gm chelated zinc+3gm zinc sulphate) treatment. Zinc has important role in starch metabolism, nucleic acid and protein biosynthesis. Similarly, Monga and Josan (2000) also recorded maximum total soluble solids under the Zinc sulphate (0.3%) treatment in kinnow. Malik *et al.* (2000) observed the increased total soluble solid in trees receiving 0.8% percent Zinc Sulphate as foliar spray in kinnow mandarin. Somdutt and Bhambota (1966) observed that Zinc concentration (0.4, 0.6, 0.8 and 1.0 per cent ZnSO₄) applied twice a year i.e., in early March and September increased TSS in juice of sweet orange cv. Blood Red.

Table 1. Soil Analysis Report

Properties	Nutrient Requirement	Available Nutrient
Soil Ph	5.5-7.5	7.6
Electrical conductivity hos/cm	<0.50	0.15
Organic carbon (%)	0.40-0.75	0.51
Boron (ppm)	0.50	0.05
Calcium (ppm)	408-616	276
Copper (ppm)	2.5-5.1	1.1
Iron (ppm)	10.9-25.2	2.5
Potassium (ppm)	146.8-311.9	134
Magnesium (ppm)	85.2-163.2	63.3
Magnese (ppm)	7.5-23.2	0.49
Molybdenum (ppm)	0.15	0.007
Phosphorus (ppm)	6.6-15.9	3.4
Sulphur (ppm)	10.00	23.6
Zinc (ppm)	0.59-1.26	0.41

Table 2. Influence of zinc and boron on growth and yield of Kinnow mandarin

T	Plant Height (cm)	Fruit Drop (%)	Weight of Fruit/plant(kg)	No.of fruit/plant	Fruit length (cm)	Fruit width (cm)
T ₁	25.40	47.06	20.00	87.33	4.67	5.18
T ₂	23.37	35.68	48.33	227.00	4.90	5.39
T ₃	24.38	42.02	47.33	255.33	4.86	5.34
T ₄	20.34	63.48	4.00	15.66	4.76	5.24
T ₅	20.32	53.81	15.33	74.33	4.81	5.32
T ₆	18.28	34.28	73.66	341.00	4.95	5.56
T ₇	27.44	33.21	58.00	269.66	4.83	5.28
T ₈	25.40	42.67	60.00	298.00	4.75	5.28
T ₉	29.46	28.48	49.00	230.66	4.95	5.61
T ₁₀ (control)	16.26	57.29	23.66	138.66	4.91	5.37
SE(m)	3.59	12.71	8.83	45.51	0.09	0.09
C.D.	N/A	N/A	26.46	136.28	N/A	N/A

Table 3. Influence of zinc and boron on quality of Kinnow mandarin

T	Fruit weight(g)	TSS (^o B)	Acidity(%)	Ascorbic acid(%)
T ₁	175.27	11.53	2.63	19.16
T ₂	200.80	11.46	3.46	15.83
T ₃	181.82	10.68	4.50	13.33
T ₄	161.15	11.25	4.60	10.00
T ₅	199.53	10.11	7.06	16.66
T ₆	207.41	10.23	4.80	19.16
T ₇	198.78	11.08	5.30	20.83
T ₈	181.60	10.66	5.10	17.50
T ₉	207.13	10.80	5.76	24.16
T ₁₀ (control)	204.33	10.66	4.90	14.16
SE(m)	10.60	0.48	0.60	1.01
C.D.	N/A	N/A	1.82	3.03

Basal and Foliar application of both Zinc and Boron

The data in table- 2, 3 showed that combined applications of zinc and boron in treatment T₉ (basal dose 250 gm chelated zinc+borax +foliar 3gm zinc sulphate+ 2gm boron) the maximum plant height of 29.46cm, ascorbic acid of 24.16%, fruit length of 4.95cm and fruit width of 5.61cm was observed compared to T₁₀ (Control) and T₅ (basal 250 gm chelated Zinc+foliar 3gm zinc sulphate) and T₆ (basal 250 gm borax+foliar 2gm boron)... These findings are also in line with the Ram and Bose (2000), as they observed the maximum height and spread of mandarin orange with spray of 0.5% zinc. Similarly Dawood *et al.* (2001) observed that the plant height of young tree of Washington Navel orange, Valencia orange and Balady mandarin was increased with the application of 0.4% zinc sulphate spray.

In present findings the minimum fruit drop(28.48%) was obtained in treatment T₉ (basal dose 250 gm chelated zinc+borax + foliar 3gm zinc sulphate + 2gm boron) followed by 33.21% in T₇ treatment (basal and foliar dose of 250 gm chelated zinc+ borax) was recorded compared to 57.29% in T₁₀ (control) as shown in table-2. Zinc and boron play an important role in reducing the fruit drop because zinc helps in biosynthesis of IAA, while as boron helps in translocation of sugars in the plants These results are accordance with the results of choudhari et al. (1982) in sweet orange and kachave and bhosale (2007) in kagzi.

The observations recorded in table-2, 3 shows that fruit weight, weight of fruit per plant, number of fruit per plant significantly improves with the combined applications of basal and foliar of boron. In T₆ (basal 250gm borax+foliar 2gm boron),the maximum fruit weight (207.41g), weight of fruit/plant (73.66 kg), the number of fruit/plant (341) was recorded. Gurunget *al.* (2016) foliar application of boron (0.1%) improved growth morphology, fruit yield attributes is also effective in enhancing the fruit yield with better fruit quality.

CONCLUSION

From the present study it has been concluded that basal and foliar application of 250gm each of chelated zinc and borax with 3gm zinc sulphate and 2gm boron showed better performance in plant height, fruit length, fruit width, ascorbic acid and is helpful for the reduction in fruit drop of kinnow fruit. Therefore, effective nutrient management of citrus is obtained to get desired productivity and quality of fruits that involves appropriate rate, time and method of application as well as selection of suitable combination of fertilizers.

REFERENCES

1. Abd-Allah, A.S. Effect of spraying some macro and micro nutrients on fruit set, yield and fruit quality of Washington Navel orange trees. *J. Appl. Sci. Res.*, 2006; 2: 1059–1063
2. Alloway, B.J. Zinc in soils and crop nutrition.

- Int. Zinc Asso.Brussel, Belgium, 2008.
3. Asadi, K. A. and Akhlagi, A. N. Effect of zinc sulphate on yield and quality of Citrus inshiu. *Soil Research Journal*, 2005; **21**(1): 16-24.
 4. Babu, N. and Singh, A.R. Effect of foliar application of boron, zinc and copper on chemical characteristics of litchi fruits. *Bioved.*, 2001; **12** (½): 45-48.
 5. Bhatnagar, P., Sharma, M.K. and Singh, J. Analysis of fruit quality of kinnow mandarin hybrid in arid irrigated areas of rajasthan. *HortFlora Research Spectrum*, 2015; **4**(1): 52-55.
 6. Choudhari, K.G., Desai, U. T., Rane, S. D. and Patil, Y. S. Influence of some plant growth substances in reducing the fruit drop in sweet oranges. *J. Maharashtra Agric. Univ.*, 1982; **7**(2): 163-164.
 7. Dawood, S.A.; Meligy, M. S. and Hamady-EI, M. M. Influence of zinc sulphate application on tree, leaf and fruit characters of young citrus varieties grown on slightly alkaline clay soil. *Annals of Agricultural Science*. 2001; **39**(1): 433-477.
 8. Edward Raja, M. Importance of micronutrients in the changing horticultural scenario in India. *Journal of Horticulture science*. 2009; **4**(1): 1-27.
 9. Gurung, S., Mahato, S. K., Suresh, C. P. and Chettri, B. Impact of Foliar Application of Growth Regulators and Micronutrients on the Performance of Darjeeling Mandarin. *American Journal of Experimental Agriculture*, 2016; **12**(4): 1-7.
 10. Kachave, D. B. and Bhosale, A. M. Effect of plant growth regulators and micronutrients on fruiting and yield parameters of Kagzi lime (*Citrus aurantifolia* Swingle) fruits. *Asian J. Hort.*, 2007; **2**(2): 75-79.
 11. Khan, A.S., Malik, A.U., Pervez, M.A., Saleem, B.A., Rajwana, I.A., Shaheen, T. and Anwar, R. Foliar application of low-biuret urea and fruit canopy position in the tree influence the leaf nitrogen status and physico-chemical characteristics of Kinnow mandarin (*Citrus reticulata* Blanco). *Pakistan J. Bot.*, 2009; **41**: 73-85
 12. Monga, P.K. and Josan, J.S. Effect of micronutrients on leaf composition, fruit yield and quality of Kinnow mandarin. *Journal of Applied Horticulture*, 2000; **2**(2): 132-133.
 13. NHB-(2015-16) NHB_Database_(2015-16).pdf
 14. Ram, R. A. and Bose, T. K. Effect of foliar application of Mg and micronutrients on growth, yield and fruit quality of mandarin orange (*Citrus reticulata* Blanco). *Indian J. Hort.*, 2000; **57** (3): 215-220.
 15. Sharma, S., Singh, B., Rani, G., Zaidi, A. A., Hallan, V., Nagpal, A. and Virk, G. S. Production of Indian citrus ring spot virus free plants of Kinnow employing chemotherapy coupled with shoot tip grafting. *Central Europ. Agric. Journal*, 2007; **8**: 1-8.
 16. SomDutt and Bhambota, J.R. Effect of different concentrations of zinc on the incidence of chlorosis in sweet orange (*Citrus sinensis*). *Indian Journal of Horticulture*. 1966; **24**(1-2): 50-59.