

Original Research Article

<https://doi.org/10.20546/ijcmas.2020.907.145>

Effect of Zinc Sulphate on Vegetative Growth, Yield and Leaf Nutrient Status of Guava (*Psidium guajava* L.)

Brijpal Bisen^{1*}, J. P. Tiwari², K. K. Mishra² and Shant Lal²

¹Department of Horticulture, Jawaharlal Nehru Krishi Vishwa Vidyalaya,
Jabalpur (MP), India

²G. B. Pant University of Agriculture and Technology,
Pantnagar – 263 145 (Uttaranchal), India

*Corresponding author

ABSTRACT

Keywords

Guava, zinc sulphate, Pant Prabhat and ZnSO₄

Article Info

Accepted:
11 June 2020
Available Online:
10 July 2020

Two year old guava trees cv. Pant Prabhat were sprayed with zinc sulphate (0, 0.2, 0.4 and 0.6 %) First spray was applied in June and second in September only on fifty per cent of the trees. The number of foliar sprays and various concentrations of zinc sulphate did not affect the tree height, tree canopy, trunk diameter and tree volume. However, maximum increase in shoot length was observed with 0.6 per cent zinc sulphate. The minimum flower and fruit drop with maximum number of fruits per tree, fruit weight per tree and yield per ha was observed with double spray of zinc sulphate (0.6 %). The leaf N (1.091 %) and Zn (139.29 ppm) contents were found maximum with 0.6 per cent zinc sulphate while, leaf K (0.434 %) was found maximum with 0.4 per cent zinc sulphate. The leaf phosphorus content reduced with the increase in the concentration of zinc while leaf Ca + Mg remained unaffected.

Introduction

Guava (*Psidium guajava* L.) is one of the well known edible fruit of the tropical and sub-tropical climates and is also referred as “apple of tropics”. Due to its hardy nature, drought tolerance, high yield potential and diverse uses of fruits, the crop has gained ideal position for scarcity zones also where other fruits cannot be grown successfully. The fruit (berry) is an excellent source of vitamin C and pectin. Additionally, it is also abundant in dietary fibres, vitamin A (about 250 IU/100 g), calcium, phosphorus and iron. It is

normally consumed fresh as a dessert fruit, excellent salad and pudding are prepared from the shell of ripe fruit (Jagtiani *et al.*, 1988). Guava makes the best jelly, besides this, jam, sharbat, ice cream, cheese, canned fruit, RTS, nectar, squash and guava powder are also made. Two types of wines viz., guava juice and guava pulp wines are also prepared from guava fruits (Bardiya *et al.*, 1974). The roots, bark, leaves and green fruits are used as medicine in the tropical world to halt gastroenteritis, diarrhea and dysentery (Rathore, 1976).

Under North Indian conditions, guava bears twice in a year, known as rainy and winter season crop. Winter season crop is preferred for commercial use. The trees grown under field conditions are subjected to nutrient deficiencies which affect the growth, tissue composition, fruit production and quality. Among the different essential mineral nutrients, zinc (Zn) is an important micronutrient involved in enzymatic systems essential for protein synthesis, seed production and rate of maturity in plants (Swietlik, 1999 and 2002). It is required for synthesis of tryptophan, which is a precursor of indole acetic acid. It also plays an important role in starch metabolism in plants (Alloway, 2008). It is well known that Zn acts as a co-factor of many enzymes and affects many biological processes such as photosynthesis, nucleic acids metabolism, and biosynthesis of proteins and carbohydrates (Marschner, 1995).

The foliar feeding of fruit trees has gained much importance in recent years as fertilizers application through soil are needed in greater amount because some portion leaches down and some does not become available to the plant due to complex chemical reactions. *Tarai* soil is zinc deficient and symptoms of its deficiency have been observed in many crops. Although zinc deficiency has not been noticed in guava orchards in tarai area, there might be hidden hunger of zinc affecting the growth, yield and quality of guava. Therefore, the present investigation was undertaken to evaluate the effect of number of sprays and concentration of zinc sulphate on yield and leaf nutrient status in winter season crop of guava cv. Pant Prabhat.

Materials and Methods

The experiment was conducted at the Horticultural Research Centre, Pattharchatta of Govind Ballabh Pant University of

Agriculture and Technology, Pantnagar, Distt. Udham Singh Nagar (Uttarakhand) on two year old guava trees cv. Pant Prabhat and trees were maintained under uniform cultural schedule.

The experimental was laid out in two factor randomized block design. All the treatments were replicated thrice and two trees served as a unit of treatment in each replication. The plants were sprayed with different concentrations of zinc sulphate (0.2, 0.4 and 0.6 %) and water spray (control). The spraying was done with the help of a foot sprayer, using 0.1 per cent 'Teepol' as surfactant. Treatments were given in June and September, and leaf sampling was done in the month of October.

The height of the tree was measured from the ground level to the highest crown level with the help of a measuring pole. The canopy was measured in both the direction i.e. East-West and North-South and calculated by the formula $(N-S)+(E-W)/2$. The trunk diameter was measured with the help of vernier calipers at the marked point i.e. 10 cm above ground level and was presented in centimeters and calculated by the formula $(N-S) + (E-W)/2$. The tree volume was calculated as per formula:

$$\text{Tree volume} = \frac{4}{3}\pi a^2 b$$

[Where, $\pi=3.14$, $a= \frac{1}{2}$ of the spread (m) and $b= \frac{1}{2}$ of the tree height (m)]

The shoot length was measured in cm by using a meter scale at 4 months interval for each treatment. In studying the flower drop and fruit set, four branches per tree in all the found directions were tagged on each tree and number of flowers and fruits were counted and mean weight (g) of fruits was calculated by taking weight of five fruits, divided with number of fruits (i.e. 5). Yield tree was

calculated by manual counting of total fruits per tree and multiplying with mean fruit weight (g). Whereas fruit yield per ha was calculated by multiplying the mean yield per tree with number of trees per ha in each treatment.

Five –month –old leaves from the previously tagged non fruiting shoots were taken for the study of mineral composition of leaves and 20 pairs of leaves were sampled from 4th and 5th positions from the base of shoots spread over all the direction of the plants. The collected leaves samples were washed in tap water and then rinsed in 0.1 N HCl followed by three successive rinsing with single distilled water. Thereafter, the leaves were washed with double distilled water. Washed samples were placed in butter paper bags and dried in the oven at 65 °C for 48 hours to get constant dry weight. The leaf samples were grounded with a Willey's Mill to powder form for further analysis purpose. Nitrogen, phosphorus and potassium contents were estimated by the micro-kjeldhal method (AOAC, 1970), Vanado molybdophosphoric yellow collar method (Jackson, 1973) and flame photometric methods, respectively. Calcium and magnesium were estimated by Versanate (EDTA) method (Chang and Bray, 1951). Zinc was determined directly feeding di-acid digest in atomic absorption spectrophotometer.

Results and Discussion

Effect of zinc sulphate on vegetative growth

The data presented in Table 1 clearly indicated that the number of foliar sprays and various concentrations of zinc sulphate did not affect the tree height and it was in conformity with the results of Switlik and Laduke (1991).The interaction between foliar sprays and concentrations of zinc sulphate

was found to be significant for tree height. The maximum increase in plant height was found with double spray x 0.6 % zinc sulphate combination. Similar results were also found in case of tree canopy (Bahadur *et al.*, 1998 and Banik and Singh, 1997), trunk diameter and tree volume. However, the increase in shoot length was higher in trees with higher concentrations of zinc sulphate.

The increase in shoot length may be ascribed to Zn in its capacity as a constituent of carbonic anhydrase, which is an important enzyme involved in the photosynthesis. It has been demonstrated that without the activity of this enzyme a 50–70% reduction in net photosynthesis may occur depending on the plant species and the severity of deficiency, consequently reducing the food reserves and adversely affecting tree growth (Alloway, 2008). Similarly, the above result is in conformity with the results of Jawanda (1966), Manchanda (1967) and Dutt and Bhambata (1967) in citrus, Dawood *et al.*, 2001 in Sweet Orange and Razzaq *et al.*, 2013 in Kinnow Mandrin.

Effect of zinc sulphate on flower and fruit drop percentage

Data presented in Table 2 revealed that the maximum flower drop and fruit drop was observed with control, while minimum was found with higher concentrations of zinc sulphate. Trees sprayed with 0.6% zinc sulphate exhibited the highest reduction in the pre-harvest fruit drop percentage compared to control tree. The effect of zinc sulphate on reduction of flower drop might be due to increased concentration of auxin in shoots as zinc plays a major role in tryptophan synthesis which is a precursor of auxin biosynthesis which consequently improves the endogenous level of auxins at abscission zone to avoid flower and fruit drop.

Table.1 Effect of foliar sprays and various concentrations of zinc sulphate on vegetative growth

Treatment	Increase in tree height (%)	Increase in tree canopy	Increase in trunk diameter (%)	Increase in tree volume (%)	Increase in shoot length (%)
Number of foliar sprays					
Single (June)	22.34 (28.90)	23.27 (28.70)	25.55 (30.28)	78.85 (62.85)	53.61 (47.09)
Double (June + September)	24.21 (29.39)	25.03 (29.97)	26.43 (30.90)	78.08 (62.89)	50.72 (45.41)
S.Em±	(0.67)	(0.56)	(0.78)	(1.66)	(0.83)
C.D. at 5 %	NS	NS	NS	NS	NS
Zinc sulphate concentration (%)					
0.2	23.46 (28.82)	22.49 (28.10)	24.82 (29.78)	78.05 (62.16)	54.95 (47.88)
0.4	20.61 (26.90)	26.40 (30.64)	25.77 (30.44)	78.11 (63.48)	45.63 (42.48)
0.6	24.41 (29.51)	23.02 (30.64)	27.79 (31.79)	79.52 (63.46)	55.22 (48.00)
Control	24.62 (29.74)	25.05 (29.98)	25.57 (30.34)	78.20 (62.38)	52.86 (46.64)
S.Em±	(0.95)	(0.79)	(1.109)	(2.35)	(1.17)
C.D. at 5 %	NS	NS	NS	NS	(3.56)

Figures in parenthesis indicate arcsine values

Table.2 Effect of foliar sprays and various concentrations of zinc sulphate on yield parameters

Treatment	Flower drop (%)	Fruit drop (%)	Fruits per tree	Weight of fruits (kg/tree)	Fruit yield (q/ha)
Number of foliar sprays					
Single (June)	36.22 (36.98)	13.58 (21.61)	16.58	1.69	2.64
Double (June + September)	32.72 (34.84)	12.42 (20.58)	23.15	2.45	3.82
S.Em±	(0.69)	(0.23)	0.73	0.36	0.13
C.D. at 5 %	2.08	0.69	2.21	0.26	0.40
Zinc sulphate concentration (%)					
0.2	35.82 (36.76)	13.01 (12.14)	20.67	2.15	3.36
0.4	32.75 (34.89)	12.59 (20.76)	22.33	2.37	3.69
0.6	30.87 (33.70)	11.61 (20.76)	24.08	2.58	4.03
Control	38.44 (38.30)	14.78 (22.59)	12.37	1.18	1.84
S.Em±	(0.97)	(0.32)	1.03	0.121	0.19
C.D. at 5 %	2.94	0.97	3.13	0.367	0.57

Figures in parenthesis indicate arcsine values

Table.3 Effect of foliar sprays and various concentrations of zinc sulphate on leaf N,P, K and Zn content on dry weight basis

Treatment	N (%)	P (%)	K (%)	Ca+Mg (Me/l)	Zinc (ppm)
Number of foliar sprays					
Single (June)	1.008 (5.75)	0.227 (2.77)	0.536 (4.18)	15.35	58.10
Double (June + September)	1.006 (5.75)	0.226 (2.71)	0.562 (4.27)	13.06	120.39
S.Em±	0.063	0.31	0.084	0.54	2.35
C.D. at 5 %	NS	NS	NS	1.65	7.12
Zinc sulphate concentration (%)					
0.2	0.988 (5.70)	0.254 (2.89)	0.607 (4.38)	13.70	80.62
0.4	1.011 (5.77)	0.238 (2.79)	0.709 (4.65)	13.08	95.20
0.6	1.091 (5.99)	1.164 (2.32)	0.434 (3.69)	15.50	139.29
Control	0.937 (5.55)	0.249 (2.85)	0.497 (4.19)	14.54	41.87
S.Em±	0.088	0.446	1.12	0.47	3.32
C.D. at 5 %	0.27	0.135	0.36	2.34	10.06

Figures in parenthesis indicate arcsine values

These results are also confirmed by the findings of Awasthi *et al.*, (1975) in litchi, Manusour and El-Slid, 1981 and Sharma *et al.*, 1993 in guava and Forlov, 1967 in sweet orange.

Effect of zinc sulphate on number of fruits per plant, fruit weight per tree and fruit yield per ha

Foliar application of zinc sulphate significantly increased fruit weight and number. Trees treated with 0.6% zinc sulphate exhibited maximum fruit weight and numbers per tree than control (Table 2). It has been observed that double spray of 0.6 % zinc sulphate produced significantly higher number of fruits per tree and yield per ha. Number of fruits per tree and yield per ha in general increased with increase in zinc sulphate concentrations and the maximum yield (4.03 q/ha) was recorded with foliar spray of 0.6 per cent zinc sulphate. The increase in number of fruits per tree and yield per ha were due to the more fruit set and less fruit drop. Similar findings were also reported by Hoda *et al.*, (1978); Dixit *et al.*, (1978), Sharma *et al.*, (1998) and Rajkumar *et al.*, 2014 in guava cv. Pant Prabhat. The increase in fruit yield with foliar application of zinc sulphate may be ascribed to increase in the fruit retention on the tree consequently reducing the pre-harvest fruit drop.

Effect of zinc sulphate on leaf nutrient status

Foliar application of zinc sulphate significantly improved the leaf N content of guava leaves (Table 3). All treated-trees showed higher level of leaf N contents than control. Trees sprayed with 0.6% zinc sulphate exhibited highest increase in the leaf N level than untreated trees. Similarly, all treated-trees showed significantly higher level of leaf K as compared to control. Application

of 0.6% zinc sulphate resulted in maximum increase in K contents of guava leaves compared to control trees. However, the leaf concentration of Zn, P content reduced with the increase in the concentration of zinc sulphate and minimum (0.164 %) was found with 0.6 % zinc sulphate.

This increase in the level of macro-nutrients with foliar application of Zn may be due to some synergetic relationship between N, K and Ca with Zn. It is evident from the data in Table 3 that the leaf N₂, P and K content were not affected by number of sprays. While Ca+, Mg and Zn content significantly affected by number of sprays. The maximum leaf nitrogen (1.091 %) and zinc (139.29 ppm) were recorded with 0.6 %, zinc sulphate while leaf K (0.434 %) was found maximum with 0.4 % zinc sulphate. This increase in the level of macro-nutrients with foliar application of Zn may be due to some synergetic relationship between N, K and Ca with Zn (Samra, 1985; Sayed *et al.*, 2004). While leaf Ca+Mg remained unaffected. The above results are similar to the findings of Sharma and Bhattacharya (1989) in guava cv. Allahabad Safeda and Supriya *et al.*, (1995) in guava cv. Allahabad Safeda and Supriya *et al.*, (1995) in ber. Bhambata and Kanwar (1969) Hasani *et al.*, (2012) in pomegranate also found decreased leaf P concentration with increased concentration of leaf zinc.

References

- AOAC 1970. Official methods of analysis. Association of official agricultural chemists. 11th Ed., Washington, D.C., USA.
- Alloway, B. J. 2008. *Zinc in Soils and Crop Nutrition*. Brussels: The International Zinc Association.
- Awasthi, R. P.; Tripathi, B. R. and Singh, A. 1975. Effect of foliar sprays of zinc on fruit drop and quality of litchi (*Litchi*

- chinensis* Sonn.). The Punjab Horticultural Journal, 15 (1 & 2) : 14 – 16.
- Bahadur, Lal; Malhi, C. S. and Singh, Zora. 1998. Effect of foliar and soil application of zinc sulphate on zinc uptake, tree size, yield and fruit quality of mango. *Journal of Plant Nutrition*. 21 (3) : 589 – 600.
- Balakrishnan K. 2001. Effect of foliar application of micronutrients on guava. *Madras Agri. J.* 88(4-6):316-317.
- Banik, B. C. and Sen, S. K. 1997. Effect of tree levels of zinc, iron, boron and their interactions on growth, flowering and yield of mango cv Fazli. *Horticultural Journal*. 10 (1) : 23 – 29.
- Bardiya, M.C., Kundu, B.S. and Tauro, P. 1974. Studies on fruits wines: 1st Guava wines. Haryana. *J. Hort. Sci.*, 3(3-4): 140-146.
- Bhambata, J. R. and Kanwar, J. S. 1969. Paper presented at Hort. Seminar and P.A.U. Ludhiana. Quotid from Kanwar, J. S. and Randhawa, N. S. 1989 *Micronutrient Research in New Delhi*. pp 107 – 196.
- Chang, K. L. and Bray, H. R. 1951. Determination of calcium and magnesium in soil and plant material. *Soil Sci*. 72 : 449 – 458.
- Dixit, C. K.; Yamdagni, R. and Jindal, P. C. 1979. Effect of foliar application of zinc and iron on chkarasis and yield of kinnow. A Mandrin Hybrid. *Prog. Hort*. 10 (1) : 13 – 19.
- Frolov, A. I. 1967. The influence of micronutrients on flower and fruit drop vinodelic I Kingradarstvo. 27 (2) : 39 – 40.
- Hasani M., Zamani Z., Savaghebi G., and Fatahi R. 2012. Effects of zinc and manganese as foliar spray on pomegranate yield, fruit quality and leaf minerals. *J. Soil Sci. Plant Nutr.* 12(3):471-480.
- Hoda, M. V.; Syamal, N. B. and Chhonkar, O. S. 1973. Growth substances and zinc on litchi fruit drop. *The Indian Journal of Horticulture*. 30 (1 & 2) : 456 – 460.
- Jackson, M. L. 1973. Soil chemical analysis. Asia Publishing House, New Delhi.
- Jagtiani, J., Chan, H.T., Jr, Sakai, W.S. 1988. Tropical fruit processing. New York: Academic Press Inc.; pp. 9–43.
- Jat, G. and Kacha, H. L. 2014. Response of guava to foliar application of urea and zinc on fruit set, yield and quality. *Journal of AgriSearch*. 1(2):89-91.
- Jawanda, J. S. 1966. Zinc deficiency of citrus. A review. *Punjab Hort. J.* 6 : 88 – 103.
- Manchanda, H. R. 1974. Chemical composition of sweet orange leaves (*Citrus sinensis* (L.) Osbeck) as affected by foliar application variety Pineapple. *Indian Journal of Horticulture*. 31 (1) : 34 – 37.
- Mansour, N. M.; El-Sud, Z. A. K. 1981. Effect of zinc sulphate on fruit set and yield of guava trees. *Agricultural Research Review*. 59 : 119 – 136.
- Marschner, H. C. 1995. *Mineral Nutrition of Higher Plants*. London: Academic Press.
- Rajkumar, Tiwari, J.P. and Shant, L. 2014. Effect of foliar application of zinc and boron on fruit yield and quality of winter season guava (*Psidium guajava*) cv. Pant Prabhat. *Annals Agri. Bio Research* 19(1): 105-108.
- Rathore, D. S. 1976. Effect of season on the growth and chemical composition of guava (*Psidium guajava* L.) fruits. *J. Hort. Sci.* 51 : 41 – 57.
- Razzaq K., Khan, A. S., Malik, A. U., Shahid M. and Ullah S. 2013. Foliar application of zinc influences the leaf mineral status, vegetative and reproductive growth, yield and fruit quality of 'kinnow' mandarin. *Journal of Plant Nutrition*. 36:10, 1479-1495.
- Samra, N. R. 1985. Yield and fruit quality of

- Balady mandarin as affected by zinc and GA3 application. *Journal of Agriculture Science Mansoura University* 10: 1427–1432.
- Sarolia, D. K., Rathore, N.S and Rathore, R. S. 2007. Response of zinc sulphate and iron sulphate sprays on growth and productivity of guava cv. Sardar. *Curr. Agric.* 31(1-2):73-77.
- Sayed, R. A., Solaiman, B. M. and Abo-El Komsan, E. O. 2004. Effect of foliar sprays of some mineral nutrients, GA3 and or biostimulant on yield and fruit quality of Valencia orange trees grown in sandy soil. *Egyptian Journal of Applied Sciences* 19: 222–238.
- Sharma, R. K., Thakur, S. and Kumar, R. 1993. A note on the effect of foliar feeding of zinc and GA on fruiting of guava trees (*Psidium guajava* L.). *Haryana J. Hort. Sci.* 22 (3) : 207 – 208.
- Sharma, R. and Bhattacharya, R. K. 1989. Effect of foliar nutrition of zinc on the nutrient concentration of guava leaves. *South Indian Hort.* 37 (6) : 323 – 325.
- Singh, Y. P. Tiwari, J. P. and Misra, K. K. 2003. Effect of micronutrients on fruit yield and physico-chemical composition of mango (*Mangifera indica* L.) fruit yield and physico-chemical characters of mango cv.Dashehari. *Prog.Hort.* 35(1):34-37.
- Supriya, L.; Bhattacharya, R. K. and Langthasa, S. 1996. Effect of foliar application of related and non-related zinc on growth and yield of Assam lemon (*Citrus limon* Burm F.). *Horticultural Journal.* 6 (1) : 35 – 38.
- Swietlik, D. 1999. Zinc nutrition in horticultural crops. In: *Horticultural Reviews*, ed. J. Janick, pp. 109–118. New York: John Wiley & Sons.
- Swietlik, D. 2002. Zinc nutrition of fruit trees by foliar sprays. *Acta Horticulturae* 93: 123–129.
- Yadav, R. K., Rana, G.S., Ahlavat, V.P. and Kumar, S. 2011. Effect of zinc application on growth and fruit drop of sweet orange (*Citrus sinensis*) Cv.Jaffa. *Haryana J.Horti.Sci.* 36(3&4):205-206.

How to cite this article:

Brijpal Bisen, J. P. Tiwari, K. K. Mishra and Shant Lal. 2020. Effect of Zinc Sulphate on Vegetative Growth, Yield and Leaf Nutrient Status of Guava (*Psidium guajava* L.). *Int.J.Curr.Microbiol.App.Sci.* 9(07): 1265-1273. doi: <https://doi.org/10.20546/ijcmas.2020.907.145>