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Effect of zinc sulphate and ferrous sulphate on soil nutrient status of guava orchard CV. Hisar Safeda under high density planting

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Abstract
The investigation was carried out at Research Orchard of Department of Horticulture, CCS Haryana Agricultural University, Hisar. The application of ZnSO4 and FeSO4 was made to randomly selected uniform plants during mid of February and August. Nitrogen, phosphorus and potassium content was reduced in the soil by both zinc sulphate and ferrous sulphate applications. The soil samples receiving 30 g ferrous sulphate resulted in maximum iron content, which was closely followed by 20 g ferrous sulphate application per plant. Application of 90 g zinc sulphate resulted in maximum zinc content in soil, which was at par with 60 g zinc sulphate. Values for electrical conductivity, pH and organic carbon content did not vary significantly after application of zinc sulphate and ferrous sulphate.

Keywords: zinc sulphate, ferrous sulphate, soil nutrients, EC, pH

Introduction

Guava (*Psidium guajava* L.) one of the most familiar fruit trees, belongs to the Myrtaceae family called as the 'Apple of the tropics' and 'Poor man's apple'. It is an important fruit of India. Guava is grown under a wide variety of climatic conditions. It is one of the few tropical and sub-tropical fruit crops, which have tolerance to salinity and can be grown on marginal lands with a minimal care. It is a more income generating crop without much care and input as it is sturdy in nature and prolific in bearing even on marginal lands. In India, it is grown in an area of 254.9 thousand hectare with annual production and productivity of 4047.8 thousand metric tons and 15.87 MT per hectare respectively. Madhya Pradesh is largest producer of guava followed by Uttar Pradesh and Bihar (Saxena and Rao, 2017) [1]. The area under guava in Haryana is 12.08 thousand hectare with production of 137.02 thousand tones and productivity 11.34 tonnes per hectare (Anonymous, 2017) [2]. Sonipat, Karnal, Mewat, Hisar, Yamunagar are the major guava producing districts of Haryana. It was revealed by Ahlawat *et al.* (1990) [3] in ber that 75% of orchards were deficient in organic carbon and 90% were deficient in P. However, the K content was optimum. The present study describes the effect of different concentrations of zinc sulphate and ferrous sulphate on soil nutrient status of guava orchard under high density planting.

Material Methods

The present study was carried out on 8 years old guava plants in the orchard of Department of Horticulture, CCS Haryana Agricultural University, Hisar during the year 2016-17. In this experiment, soil application of zinc sulphate and ferrous sulphate was done on guava plants planted at 6m × 2m spacing. Forty eight uniform plants were selected and the experiment was conducted with three replications in completely randomized block design. During the study period, plants were maintained under uniform orchard management conditions and all the agronomic practices were carried out as per package of practices.

Soil samples were collected with trowel at the start as well as at the end of experiment from the area under tree canopy in four directions, mixed and kept in clean polythene bags. Soil samples were air dried in shade for three to four days. These were grinded using wooden mortar and pestle and passed through 2mm sieve to separate out the coarse fragments. Coarse fragments were discarded and fine earth samples were used for analysis in the laboratory of Department of Soil Science.

Element	Method of Estimation
Organic carbon (%)	Wet digestion method (Walkley and Black, 1934)
Available nitrogen (Kg/ha)	Alkaline permanganate method (Subbiah and Asija, 1956)
Available phosphorus (Kg/ha)	Olsen's method (Olsen *et al.*, 1954)
Available potassium (Kg/ha)	NH_4OAC solution using flame photometer (Hanway and Heidal, 1952).
Available micronutrients [Zn and Fe (ppm)]	DTPA solution using atomic adsorption spectrophotometer (Lindsay and Norvell, 1978)

Result and Discussion

Nitrogen content

Persual from the data presented in Table 1 indicated that initial status of nitrogen in soil samples was non-significant before application of zinc sulphate and ferrous sulphate. Application of zinc sulphate in soil led to reduction of nitrogen content in soil. Maximum nitrogen (168.3 kg/ha) was observed finally under control treatment, which was at par with 60 g zinc sulphate and significantly higher than all other treatments, while minimum (166.7 kg/ha) was found in the soil sample receiving 90 g zinc sulphate per plant. This was because increase in nutrient concentration of soil may have led to increased plant nutrient uptake. Application of ferrous sulphate also significantly reduced nitrogen content in soil. Maximum nitrogen (168.7 kg/ha) content of soil was found under control treatment, which was at par with 10 g ferrous sulphate and significantly higher than all treatments, whereas minimum nitrogen (166.3 kg/ha) was observed from the soil sample receiving 20 g ferrous sulphate per plant. The interaction between zinc sulphate and ferrous sulphate treatment was found to be non-significant for nitrogen content of soil.

Table 1: Effect of zinc sulphate and ferrous sulphate on soil available nitrogen content (kg/ha) of guava orchard cv. Hisar Safeda under high density planting

$ZnSO_4$ (g/plant)	$FeSO_4$ (g/plant)									
	Before Application					After Application				
	Zero	10	20	30	**Mean**	Zero	10	20	30	**Mean**
Zero	172.0	171.1	169.5	170.3	170.7	170.3	168.8	166.7	167.4	168.3
30	170.2	170.5	169.7	170.3	170.2	168.0	166.7	165.9	166.5	166.8
60	170.5	169.1	168.5	169.1	169.3	168.2	167.9	167.2	167.3	167.6
90	170.4	169.2	168.4	169.1	169.8	168.4	166.7	165.6	166.1	166.7
Mean	170.8	170.0	169.0	169.7		168.7	167.5	166.3	166.8	
CD at 5%	Zn= NS, Fe= NS, Zn × Fe= NS					Zn= 1.00, Fe= 1.00, Zn × Fe= NS				

Phosphorus content

The data exhibited in Table 2 shows that initial values for phosphorus content in soil were non-significant before application of zinc sulphate and ferrous sulphate. Zinc sulphate treatments had no significant effect on phosphorus content of soil. Numerically, maximum phosphorus content (13.06 kg/ha) was observed from the samples under control treatment and minimum (12.67 kg/ha) was obtained from the soil samples supplied with 30 g zinc sulphate per plant. Application of ferrous sulphate significantly reduced the phosphorus content of soil. Maximum phosphorus (13.09 kg/ha) was recorded from control samples whereas, minimum (12.63 kg/ha) was observed from samples receiving 20 g ferrous sulphate per plant. Increase in nutrient concentration causing increased uptake might be the reason behind reduction of soil phosphorus. Phosphorus content in soil did not vary significantly due to interaction between zinc sulphate and ferrous sulphate.

Table 2: Effect of zinc sulphate and ferrous sulphate on soil available phosphorus content (kg/ha) of guava orchard cv. Hisar Safeda under high density planting

$ZnSO_4$ (g/plant)	$FeSO_4$ (g/plant)									
	Before Application					After Application				
	Zero	10	20	30	**Mean**	Zero	10	20	30	**Mean**
Zero	14.93	14.80	14.47	14.60	14.70	13.35	13.17	12.80	12.90	13.06
30	14.67	14.60	14.27	14.40	14.48	12.99	12.67	12.43	12.61	12.67
60	14.60	14.60	14.47	14.60	14.57	13.02	12.90	12.54	12.65	12.78
90	14.67	14.40	14.20	14.40	14.42	12.99	12.94	12.77	12.87	12.89
Mean	14.72	14.60	14.35	14.50		13.09	12.92	12.63	12.76	
CD at 5%	Zn= NS, Fe= NS, Zn × Fe= NS					Zn= NS, Fe= 0.29, Zn × Fe= NS				

Potassium content

It is evident from the data presented in Table 3 that initial status of soil for potassium content was found to be non-significant before application of zinc sulphate and ferrous sulphate. No significant effect was found on soil potassium content due to zinc sulphate application. Numerically, maximum potassium content (284.7 kg/ha) was found from control samples and minimum (280.1 kg/ha) was observed with the application of 60 g zinc sulphate. Application of ferrous sulphate reduced potassium content of soil significantly. Maximum potassium content (285.7 kg/ha) was recorded from control soil samples, which was at par with 10 g as well as 20 g ferrous sulphate applications, whereas minimum (279.0 kg/ha) was observed in soil samples receiving 30 g ferrous sulphate per plant. Increased uptake by plants due to increased soil nutrient concentration might be the cause behind reduction of potassium in soil. No significant effect was found on potassium content of soil due to interaction effect of zinc sulphate and ferrous sulphate.

Table 3: Effect of zinc sulphate and ferrous sulphate on soil available potash content (kg/ha) of guava orchard cv. Hisar Safeda under high density planting

ZnSO4 (g/plant)	FeSO4 (g/plant)									
	Before Application					After Application				
	Zero	10	20	30	**Mean**	Zero	10	20	30	**Mean**
Zero	292.1	287.5	287.2	285.7	288.1	289.0	284.1	283.7	282.0	284.7
30	291.8	286.7	286.4	284.6	287.4	288.3	282.9	282.4	280.5	283.5
60	286.3	283.6	287.4	282.1	284.9	282.9	280.7	280.9	275.9	280.1
90	286.6	284.8	285.2	280.3	284.2	282.5	279.5	283.1	277.7	280.7
Mean	289.2	285.6	286.6	283.2		285.7	281.8	282.5	279.0	
CD at 5%	Zn= NS, Fe= NS, Zn × Fe= NS					Zn= NS, Fe= 4.31, Zn × Fe= NS				

Iron content

The data exhibited in Table 4 shows that value for iron content in soil were found to be non-significant before application of zinc sulphate and ferrous sulphate. Soil iron content did not vary significantly due to application of zinc sulphate. Numerically, maximum iron content (6.78 ppm) was found under control treatment and with application of 60 g zinc sulphate, whereas all other samples had minimum (6.77 ppm) value for iron content. Application of ferrous sulphate increased soil iron content significantly. Maximum iron content (6.80 ppm) was observed from soil samples receiving 30 g ferrous sulphate, which was closely followed by 20 g ferrous sulphate and significantly higher than other treatments, while minimum (6.75 ppm) was observed under control treatment. This might be due to soil application of ferrous sulphate significantly increased the soil available iron status of soil. The results of the present investigation are in conformity with the findings of Zhang *et al.* (2014) [9] who revealed that soil available iron concentration in Satsuma mandarin orchard was raised significantly through soil application of Fe-EDDHA. No significant effect was found on soil iron content due to interaction between zinc sulphate and ferrous sulphate.

Table 4: Effect of zinc sulphate and ferrous sulphate on soil available iron content (ppm) of guava orchard cv. Hisar Safeda under high density planting

ZnSO4 (g/plant)	FeSO4 (g/plant)									
	Before Application					After Application				
	Zero	10	20	30	**Mean**	Zero	10	20	30	**Mean**
Zero	6.76	6.77	6.78	6.78	6.77	6.74	6.76	6.79	6.80	6.77
30	6.80	6.78	6.81	6.77	6.79	6.75	6.77	6.79	6.80	6.78
60	6.78	6.80	6.80	6.78	6.79	6.74	6.76	6.78	6.79	6.77
90	6.78	6.82	6.79	6.77	6.79	6.76	6.78	6.80	6.81	6.78
Mean	6.78	6.79	6.80	6.77		6.75	6.77	6.79	6.80	
CD at 5%	Zn= NS, Fe= NS, Zn × Fe= NS					Zn= NS, Fe= 0.02, Zn × Fe= NS				

Zinc content

Data pertaining to zinc content of soil presented in Table 5 shows that initial values for zinc content in soil were non - significant before application of zinc sulphate and ferrous sulphate. Zinc sulphate treatments led to significant increase in zinc content in soil. Maximum zinc content (2.23 ppm) was observed from soil samples receiving 90 g zinc sulphate, which was at par with 60 g zinc sulphate and significantly higher than all other treatments, whereas, minimum (2.11 ppm) was observed under control treatment. Increase in soil available zinc status might be due to soil applied zinc sulphate. Ferrous sulphate had no significant effect on zinc content in soil. Numerically, maximum zinc content (2.20 ppm) was observed from soil samples receiving 20 g ferrous sulphate and minimum was observed under control treatment. The interaction between zinc sulphate and ferrous sulphate was found to be non-significant for zinc content. Results obtained by Gangadharan *et al.* (2015) [10] show that combined soil application of 25 kg $ZnSO_4$ per ha + 50 kg $FeSO_4$ per ha + 25 kg $MnSO_4$ per ha + 10 kg Borax per ha registered higher uptake values of N, P_2O_5, K_2O, Zn and Fe in mulberry.

Table 5: Effect of zinc sulphate and ferrous sulphate on soil available zinc content (ppm) of guava orchard cv. Hisar Safeda under high density planting

ZnSO4 (g/plant)	FeSO4 (g/plant)									
	Before Application					After Application				
	Zero	10	20	30	**Mean**	Zero	10	20	30	**Mean**
Zero	2.06	2.03	2.14	2.16	2.10	2.08	2.04	2.17	2.15	2.11
30	2.13	2.12	2.18	2.09	2.13	2.14	2.18	2.19	2.18	2.17
60	2.15	2.01	2.09	2.16	2.10	2.21	2.20	2.22	2.20	2.21
90	2.07	2.09	2.04	1.99	2.05	2.22	2.24	2.23	2.2	2.23
Mean	2.10	2.06	2.11	2.10		2.16	2.17	2.20	2.19	
CD at 5%	Zn= NS, Fe= NS, Zn × Fe= NS					Zn= 0.05, Fe= NS, Zn × Fe= NS				

Electrical conductivity

The values for electrical conductivity in soil were found to be non-significant initially (Table 6) before application of zinc sulphate and ferrous sulphate. Effect of zinc sulphate treatments and ferrous sulphateon soil electrical conductivity was found to be non-significant. The highest electrical conductivity was observed under control treatment as well as in 30 g zinc sulphate, whereas all other treatments resulted in minimum values. Electrical conductivity was not significantly affected with ferrous sulphate application also. Numerically, maximum electrical conductivity was noted under control treatment and 30 g application and minimum with 10 g and 20 g ferrous sulphate. No significant effect on electrical conductivity was found due to interaction between zinc sulphate and ferrous sulphate.

Table 6: Effect of zinc sulphate and ferrous sulphate on soil electrical conductivity (dSm^{-1}) of guava orchard cv. Hisar Safeda under high density planting

ZnSO4 (g/plant)	FeSO4 (g/plant)									
	Before Application					After Application				
	Zero	10	20	30	**Mean**	Zero	10	20	30	**Mean**
Zero	0.26	0.25	0.23	0.24	0.25	0.24	0.23	0.22	0.22	0.23
30	0.24	0.24	0.22	0.23	0.23	0.23	0.22	0.23	0.23	0.23
60	0.24	0.24	0.23	0.24	0.24	0.23	0.22	0.22	0.22	0.22
90	0.24	0.23	0.22	0.23	0.23	0.22	0.22	0.22	0.22	0.22
Mean	0.25	0.24	0.23	0.24		0.23	0.22	0.22	0.23	
CD at 5%	Zn= NS, Fe= NS, Zn × Fe= NS					Zn= NS, Fe= NS, Zn × Fe= NS				

pH

Data presented in Table 7 shows that the initial values for pH in soil were non-significant before application of zinc sulphate and ferrous sulphate. Zinc sulphate as well as ferrous sulphate treatments did not significantly affect pH in soil. Numerically, maximum pH was found in soil sample supplied with 30 g and 90 g zinc sulphate, while minimum was observed from soil sample under control treatment and 60 g zinc sulphate application. Maximum pH was noted with application of 10 g as well as 20 g ferrous sulphate while, minimum under control treatment and 30 g ferrous sulphate application. The interaction between zinc sulphate and ferrous sulphate treatments also gave non-significant results for soil pH.

Table 7: Effect of zinc sulphate and ferrous sulphate on soil pH of guava orchard cv. Hisar Safeda under high density planting

ZnSO4 (g/plant)	FeSO4 (g/plant)									
	Before Application					After Application				
	Zero	10	20	30	**Mean**	Zero	10	20	30	**Mean**
Zero	7.9	7.8	7.6	7.7	7.8	7.8	7.9	7.8	7.8	7.8
30	7.7	7.7	7.6	7.7	7.7	7.9	7.8	7.9	7.8	7.9
60	7.7	7.7	7.5	7.6	7.8	7.8	7.8	7.9	7.8	7.8
90	7.7	7.6	7.5	7.6	7.7	7.8	7.9	7.9	7.9	7.9
Mean	7.8	7.7	7.6	7.7		7.8	7.9	7.9	7.8	
CD at 5%	Zn= NS, Fe= NS, Zn × Fe= NS					Zn= NS, Fe= NS, Zn × Fe= NS				

Organic carbon

It is amply clear from the data presented in Table 8 that values for organic carbon content in soil were non-significant before the application of zinc sulphate and ferrous sulphate. Organic carbon content in soil did not vary significantly due to application of zinc sulphate treatments. Numerically, maximum organic carbon was observed with 30 g and 90 g zinc sulphate application, whereas minimum organic carbon was observed under control and 60 g zinc sulphate application. Ferrous sulphate application also did not affect the organic carbon in soil significantly. Numerically minimum value was observed under control treatment, while all other treatments resulted in same values. The interaction between zinc sulphate and ferrous sulphate also gave non-significant results for organic carbon content in soil samples.

Table 8: Effect of zinc sulphate and ferrous sulphate on soil organic carbon content (%) of guava orchard cv. Hisar Safeda under high density planting

ZnSO4 (g/plant)	FeSO4 (g/plant)									
	Before Application					After Application				
	Zero	10	20	30	**Mean**	Zero	10	20	30	**Mean**
Zero	0.41	0.42	0.44	0.38	0.41	0.41	0.41	0.43	0.40	0.41
30	0.40	0.40	0.39	0.43	0.41	0.43	0.43	0.43	0.42	0.42
60	0.41	0.41	0.44	0.41	0.42	0.40	0.40	0.40	0.44	0.41
90	0.39	0.42	0.41	0.42	0.41	0.41	0.43	0.42	0.42	0.42
Mean	0.40	0.41	0.42	0.41		0.41	0.42	0.42	0.42	
CD at 5%	Zn= NS, Fe= NS, Zn × Fe= NS					Zn= NS, Fe= NS, Zn × Fe= NS				

References

1. Saxena M, Rao SP. Horticultural stastistics at a glance. NHB, Ministry of Agriculture, Government of India, Gurgaon, Haryana, 2017.
2. Anonymous, 2017. www.hortharyana.com.
3. Ahlawat VP, Sindhu SS, Gupta OP and Thareja RK. Nutrient elements status of soil and leaves of ber (*Zizyphus mauritiana* Lamk.) trees in Haryana. Haryana Journal of Horticultural Sciences. 1990; 19(1&2):106-111.
4. Walkley AJ, Black CA. Estimation of soil organic carbon by the chromic acid titration method. Soil Science 1934; 37:29-38.
5. Subbiah BV, Asija GL. A rapid procedure for the determination of available nitrogen in soils. Current Science. 1956; 25:259-60.
6. Olsen SR. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. US Department of Agriculture, 1954.

7. Hanway JJ, Heidel HH. Soil analysis methods as used in Iowa State College, Soil Testing Laboratory. Iowa State College Bull. 1952; 57:1-131.
8. Lindsay WL, Norvell WA. Development of a DTPA soil test for zinc, iron, manganese and copper. Soil Science Society of America Journal. 1978; 42:421-28.
9. Zhang Y, Hu CX, Tan QL, Zheng CS, Gui HP, Zeng WN *et al.* Plant nutrition status, yield and quality of Satsuma mandarin (*Citrus unshiu* Marc.) under soil application of Fe-EDDHA and combination with zinc and manganese in calcareous soul. Scientia Horticulturae. 2014; 174:46-53.
10. Gangadharan S, Ramamoorthy K, Vaiyapuri K. Nutrient uptake and leaf chlorophyll content of mulberry (*Morus alba* L.) in response to soil application of Zn, Fe, Mn and B. Trends in Biosciences. 2015; 8(10):2499-2503.