The Pharma Innovation Journal 2022; 11(7): 2715-2718

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(7): 2715-2718

www.thepharmajournal.com
Received: 01-05-2022
Accepted: 05-06-2022

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Response of soil application of zinc sulphate and ferrous sulphate on leaf nutrient status of guava plants cv. Hisar Safeda

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Abstract
The aim of present work was to evaluate lef nutrient status of 8 years old guava plants pertaining to soil application of zinc sulphate and ferrous sulphate. Uniform plants planted at 6m X 2m spacing at Research Orchard of Department of Horticulture, CCS Haryana Agricultural University, Hisar were selected for the investigation. Maximum nitrogen concentration was noted with the application of 90 g zinc sulphate. While for ferrous sulphate treatments, maximum nitrogen was analysed with the application of 20 g ferrous sulphate which was which was at par with 30 g ferrous sulphate. Maximum phosphorus content was observed under control treatment and it was at par with 30 g zinc sulphateas well as 90 g zinc sulphate and among ferrous sulphate treatments, maximum content was observed under control treatment as well as 10 g and 20 g ferrous sulphate. Maximum potassium for zinc sulphate treatment and phosphorus for both treatments were observed under control treatment. Highest zinc content was noted with application of 90 g zinc sulphate treatment. While application of 20 g and 30 g ferrous sulphate resulted in highest zinc and iron content, respectively.

Keywords: Soil, zinc, sulphate, sulphate, nutrient, Hisar Safeda

1. Introduction

Guava (*Psidium guajava* L.), a member of family Myrtaceae, native to tropical America, the apple of the tropics, is one of the most common fruits in India. It claims to be the fourth most important fruit in area and production after mango, banana and citrus. Being very hardy, it gives an assured crop even with very little care. Fertilizers applied by growers not only affect plant growth, yield or fruit quality, but also leaf nutrient composition. The analyses of total amounts of nutrients in selected leaves or leaf parts have become an important tool in evaluating fertility status of a number of plants. They have been especially useful to determine need for and composition of fertilizer side dressing and foliar sprays. (Wolf, 1982) [1]. It has been noticed that guava suffers severely from deficiency of micronutrients which reduce the quality of fruits. Knowledge of the chemical mineral composition of the leaves provide information to optimise the fertilization program to maximise efficient production and maintain soil fertility. Hence, the present study was undertaken to examine the leaf nutrient status of guava plant after soil application of zinc sulphate and ferrous sulphate.

2. Material Methods

The work was undertaken at the Orchard of Department of Horticulture, CCS Haryana Agricultural University, Hisar to study the effect of different levels of zinc sulphate (zero, 30, 60 and 90g/plant) and ferrous sulphate (zero, 10, 20 and 30g/plant) on leaf nutrient status of guava cv. Hisar Safeda. Uniform plants were selected for this study. Leaf samples were collected during August month from middle of non-fruiting branches. Forty to fifty leaves were taken from each tree. These were grinded using grinder and the powder formed was stored in clean polythene bags. These powdered leaf samples were used for digestion.

Table 1: Show the element Method of Estimation

Element	Method of Estimation
Total nitrogen (%)	Colorimetric or Nessler's method proposed by Lindner in 1944
Total phosphorus (%)	Vanado-molybdophosphoric yellow color method proposed by Koenig and Johnson (1942)
Total potassium (%)	Flame photometry
Total micronutrients [Zn and Fe (ppm)]	Atomic Absorption Spectrophotometer (AAS)

3. Result and Discussion

3.1 Nitrogen content in leaf

Persual from the data shown in Table 2 reveals that nitrogen content in guava leaf improved significantly on application of zinc sulphate. Maximum nitrogen content (1.74%) was observed from the leaves of plants receiving 90 g zinc sulphate treatment, while minimum (1.68%) was observed with control treatment. It may be due to the fact that increase in zinc sulphate leads to reducing nitrogen concentration in leaves. Similar results were obtained by Amiri *et al*., (2008) [4] in apple, where application of zinc (soil and foliar) significantly increased nitrogen concentration of leaf. In contradiction to the present results, non-significant results were obtained by Rasouli *et al*., (2002) [5] in apple and Shewy *et al*., (2014) [6] in peach. They reported non-significant effect of zinc sulphate on leaf nitrogen composition.

Table 2: Effect of zinc sulphate and ferrous sulphte on total nitrogen (%) content of guava leaf cv. Hisar Safeda

$ZnSO_4$ (g/plant)	$FeSO_4$ (g/plant)				
	Zero	**10**	**20**	**30**	**Mean**
Zero	1.66	1.67	1.69	1.68	1.68
30	1.71	1.73	1.76	1.74	1.73
60	1.68	1.70	1.74	1.72	1.71
90	1.72	1.73	1.76	1.74	1.74
Mean	1.69	1.71	1.74	1.72	
CD at 5%	Zn= 0.02, Fe= 0.02, Zn × Fe= NS				

Nitrogen content in leaves was significantly affected with the application of ferrous sulphate. Maximum nitrogen concentration (1.74%) was obtained from application of 20 g ferrous sulphate, which was at par with 30 g ferrous sulphate and significantly higher than all other treatments, while minimum (1.69%) was noted under control treatment. In opposite to it, Domenico *et al.*, (2003) [7] revealed that nitrogen concentration remain unaffected with iron application under greenhouse as well as field conditions. No significant effect on nitrogen content was found due to interaction between zinc sulphate and ferrous sulphate.

3.2 Phosphorus content in leaf

The phosphorus content in guava leaves was significantly affected due to application of zinc sulphate (Table 3). Maximum phosphorus content (0.18%) was observed under control treatment which was at par with 30 g zinc sulphateas well as 90 g zinc sulphate and significantly higher than all other treatments, whereas, minimum (0.16%) from plant receiving 60 g zinc sulphate. This may be because of the increment of biomass production by zinc sulphate resulting in dilution effects and thus, phosphorus concentration gets reduced. The reason may also be the antagonistic reactions between zinc and phosphorus. The results are in confirmation with the findings of Rasouli *et al.*, (2002) [5] who told that the concentrations of phosphorus were low in the samples from spray treatments of zinc sulplate. In contrary to it, Amiri *et al.*, (2008) [4] reported that soil and foliar spray combinations of N + Zn treatment in apple had relatively higher leaf phosphorus. Ferrous sulphate also significantly affected phosphorus content in leaves. Maximum content (0.17%) was observed under control treatment as well as plants receiving 10 g and 20 g ferrous sulphate, while minimum (0.16%) was noted from plants receiving 30 g ferrous sulphate. Phosphorus content in guava leaves did not vary significantly due to interaction between zinc sulphate and ferrous sulphate

Table 3: Effect of zinc sulphate and ferrous sulphte on total phosphorus (%) content of guava leaf cv. Hisar Safeda

$ZnSO_4$ (g/plant)	$FeSO_4$ (g/plant)				
	Zero	**10**	**20**	**30**	**Mean**
Zero	0.19	0.18	0.18	0.17	0.18
30	0.17	0.17	0.17	0.16	0.17
60	0.17	0.16	0.16	0.16	0.16
90	0.17	0.17	0.16	0.17	0.17
Mean	0.17	0.17	0.17	0.16	
CD at 5%	Zn= 0.01, Fe= 0.01, Zn × Fe= NS				

3.3 Potassium content in leaf

It is amply clear from the data showed in Table 4 that zinc sulphate had significant effect on potassium content in guava leaves. Maximum potassium content (1.61%) was observed under control treatment, which was significantly higher than all other treatments, while minimum (1.40%) was observed from the plants receiving 90 g zinc sulphate. The reason may be the increase in biomass production by zinc sulphate which leads to dilution effect resulting in reduction of potassium concentration. The results are in contradiction with the results obtained by Amiri *et al.*, (2008) [4] who told that soil and foliar spray combinations of N + Zn treatment had relatively higher leaf potassium, whereas non-significant effect was observed by Rasouli *et al.*, (2002) [5] in apple. Potassium content in leaves was affected significantly with the application of ferrous sulphate also. Maximum content (1.60%) was found under control treatment, while minimum (1.37%) was observed from plants receiving 10 g ferrous sulphate. The results are more or less in accordance with the findings of Huang *et al.*, (2012) [8] in Satsuma mandarin that leaf potassium content was significantly higher in the non-iron treatment tree than in the iron treatment. The interaction between zinc sulpahte and ferrous sulphate had non-significant effect on potassium content in leaves.

Table 4: Effect of zinc sulphate and ferrous sulphte on total potassium (%) content of guava leaf cv. Hisar Safeda

$ZnSO_4$ (g/plant)	$FeSO_4$ (g/plant)				
	Zero	**10**	**20**	**30**	**Mean**
Zero	1.77	1.49	1.55	1.62	1.61
30	1.65	1.34	1.45	1.54	1.49
60	1.55	1.33	1.42	1.44	1.44
90	1.45	1.33	1.40	1.42	1.40
Mean	1.60	1.37	1.46	1.51	
CD at 5%	Zn= 0.07, Fe= 0.07, Zn × Fe= NS				

3.4 Zinc content in leaf

Data from Table 5 shows that zinc content in guava leaves varied significantly due to zinc sulphate treatment. Maximum zinc content (34.34 ppm) was observed with the application of 90 g zinc sulphate, which was closely followed by 60 g zinc sulphate and significantly higher than all other treatments, while minimum (29.33 ppm) was noted under control treatment. This may be because of the reason that zinc easily moved down the soil profile and was efficiently taken up and transported to above ground parts. These findings are in close agreement with the results of Wood (2007) [9] who told that zinc concentration in desirable foliage increased proportionally as the amount of soil-banded zinc increased in pecan orchard. Similar increasing trend was noted by Nijjar and Brar (1977) [10] in Kinnow, Devi *et al.*, (1997) [11] in Sathgudi orange, Pavan (1998) [12] in apple, Kavitha *et al.* (2002) [13] in papaya, Rasouli *et al.*, (2002) [5], Wojcik (2007) [14], Amiri *et al.*, (2008) [4] in apple and Bahadur *et al.*, (1998) in mango. Ferrous sulphate also had significant effect on zinc content in leaves. Maximum zinc content (33.63 ppm) was found with application of 20 g ferrous sulphate, which was significantly higher than all other treatments while, minimum (30.36 ppm) was noted from plants under control treatment. Zinc and iron were found to be inter-competitive in leaves and the increase of leaf iron concentration could reduce zinc concentration. Earlier such findings were reported by Huang *et al.*, (2012) [8] in Satsuma mandarin that leaf zinc concentrations were significantly higher in the non-iron treatments than that in the iron treatment. The interaction between zinc sulphate and ferrous sulphate gave non-significant results for zinc concentration in leaves.

Table 5: Effect of zinc sulphate and ferrous sulphte on total zinc content (ppm) content of guava leaf cv. Hisar Safeda

$ZnSO_4$ (g/plant)	$FeSO_4$ (g/plant)				
	Zero	**10**	**20**	**30**	**Mean**
Zero	27.20	28.13	31.36	30.60	29.33
30	28.84	30.71	32.67	31.14	30.84
60	32.23	33.20	34.81	33.84	33.52
90	33.18	33.82	35.67	34.71	34.34
Mean	30.36	31.47	33.63	32.57	
CD at 5%	Zn= 0.87, Fe= 0.87, Zn × Fe= NS				

3.5 Iron content in leaves
Persual from the data shown in Table 6 indicates that zinc sulphate had no significant effect on iron content in leaves. Numerically, maximum iron content (169.4 ppm) was observed from the plants receiving 30 g zinc sulphate, whereas minimum (167.7 ppm) was noted under control treatment. This may be because the iron was immobilized somewhere in the leaf in an unavailable form. Similar increase in iron concentration of leaf with iron treatment had been observed by Huang *et al.*, (2012) [8] in Satsuma mandarin that leaf iron concentrations were less in the non-iron treatments than that in the iron treatment. Iron content in leaves was significantly affected with the application of ferrous sulphate also. Maximum iron (174.1 ppm) was observed from the plants receiving 30 g ferrous sulphate, which was significantly higher than all other treatments, while minimum (163.8 ppm) was noted from control treatment. No significant effect was found on iron content in leaves due to interaction between zinc sulphate and ferrous sulphate.

Table 6: Effect of zinc sulphate and ferrous sulphte on total iron content (ppm) content of guava leaf cv. Hisar Safeda

$ZnSO_4$ (g/plant)	$FeSO_4$ (g/plant)				
	Zero	**10**	**20**	**30**	**Mean**
Zero	160.0	168.5	170.4	172.0	167.7
30	166.7	168.7	170.2	172.0	169.4
60	163.7	165.9	167.8	176.7	168.5
90	164.9	166.6	168.7	175.7	169.0
Mean	163.8	167.4	169.3	174.1	
CD at 5%	Zn= NS, Fe= 2.85, Zn × Fe= NS				

4. Conclusion
From the results of present study, it is concluded that the maximum nitrogen concentration was noted with the application of 90 g zinc sulphate. While for ferrous sulphate treatments, maximum nitrogen was analysed with the application of 20 g ferrous sulphate which is at par with 30 g ferrous sulphate. Maximum potassium for zinc sulphate treatment and phosphorus for both treatments were observed under control treatment. Highest zinc content was noted with application of 90 g zinc sulphate treatment. While application of 20 g and 30 g ferrous sulphate resulted in highest zinc and iron content, respectively.

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