ASTES

Advances in Science, Technology and Engineering Systems Journal Vol. 1, No. 1, 19-22 (2016)

www.astesj.com

ASTESJ

ISSN: 2415-6698

Effect of Foliar Application of Zinc on Growth and Yield of Guava (Psidium Guajava L.)

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ARTICLE INFO

Article history:
Received: 29 March 2016
Accepted: 23 April 2016
Online: 25 April 2016

Keywords:
Guava
Zinc
Foliar Fertilizer
Agriculture
Sindh
Pakistan

ABSTRACT

In depth study focusing to ascertain the effect of different rates of Zinc (Zn) fertilization in improving the quality and yield of Guava fruit was carried out at Gharo, Sindh – Pakistan during year 2014-15. The outcome of the research revealed that there was no significant effect on the yield as well as quality, without using foliar Zn fertilizers. However, after application of the arrangement of foliar fertilizer the quality and production of fruits was significantly increased. The fruit yield in terms of plant height (3.111 m), length of fruit (6.989 cm), breadth of fruit (6.070 cm), weight of fruit (111.555 gm), number of fruits per plant (379.679), fruit yield (41.935 kg/plant) was recorded maximum in plants which were treated with Zn_5 (0.5%). Same treatment also showed the superior fruit quality traits evaluated in terms of TSS (9.373 %), Vitamin C (45.147 mg per 100 ml of juice), and Firmness (5.969 kg/cm^2) with lower acidity (0.485 %). Nearly same results were achieved by Zn_6 (0.6%) and Zn_7 (0.7%) treatments but statistically some parameters recorded less. However, plants with no foliar application showed un-satisfactory results regarding all the parameters. Too low or high concentration of Zinc solution may reduced the yield and yield parameters of guava.

1. Introduction

Crop yield in Pakistan is not satisfactory due to improper fertilizer management. Balanced nutrients are paid little attention. Its deficiencies emerge in the farmer's field and are recognized as the symptoms on foliage and reduction in the quality and yield. Foliar fertilizers are being used in vegetable and fruit crops that contain various macro and micronutrients [1]. This technology has come under use but is not common. Foliar Feeding is a technique for feeding plants by applying liquid fertilizer directly to their leaves. It is not a substitute for maintaining adequate levels of plant nutrients in the soil but can be beneficial in certain circumstances.

Most commonly, it is recommended for alleviating specific micronutrient deficiencies [2]. In recent years, products have been developed that contain growth hormones, natural plant sugars, microorganisms and other ingredients. The most effective means of foliar application is the use of spray equipment. Either low pressure or high pressure equipment may be used. Spray equipment provides better placement, less loss by dripping and more effective coverage of the foliage than most other methods of application [3].

The hose-end applicator may be used also. It does not provide as accurate coverage as the spray equipment does. It also results in greater loss of plant nutrients as it has a broader coverage than other types of spray. However, its lower cost, lower maintenance and ease of use often offset these disadvantages, especially for the home gardener [4]. For most fertilizer materials this is 2 to 4 pounds of the fertilizer in 100 gallons of water. Urea may be used at 12 lbs/100 gallons, sodium molybdate or molybdic acid at the rate of 2 lbs/100 gallons but only 4 to 8 ounces per acre of these are needed for plant growth. Borax or other Boron sources should be used at only 1 to 2 lbs/100 gallons of water. The chelate sources of iron, zinc, copper and manganese are used at 2 to 3 lbs/100 gallons of water. According to literature survey, many reports are available about foliar fertilizers on many plants as chrysanthemum, rose, tuberose and iris plants [9]. The present research was carried out to evaluate the impact of foliar application of Zinc on the growth, yield and development of Guava (Psidium Guajava L.).

2. Materials and Methods

Field experiment were carried out during 2014 and 2015 on a sandy loamy clayey soil at Gharo, Sindh – Pakistan. The soil moisture and temperature regimes at the site were Aridic and Thermic, respectively. An experiment was laid out in a complete Randomized Block Design with nine treatments and three replications. The existing guava plants (Allahabad variety) were studied in this research work and which were transplanted at a spacing of 6m x 8m during February 2009 on an area of 2 acres. The fruit trees were all planted at the same time and at the start of

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the experiment, they were more than 5 years old. The irrigation method was traditional flood irrigation throughout each year of the experiment. The water samples had been collected for the conductance of different water tests. Likewise, the samples of the soil were collected from different zones at 6 inch and 12 inch depth for different laboratory tests purposes on composite basis. The results of the soil and water samples are given in Table 1 and Table 2 respectively.

Table 1. Analysis Results of Soil (at 6 and 12 inch depth on composite basis)

Parameters	Test Results	
	Sample 01 (06 inch depth)	Sample 02 (12 inch depth)
pH at 25° C	8.07	8.12
EC	1.81 ds/m	1.91 ds/m
Nitrogen	87.76 mg/kg	83.3 mg/kg
Phosphorus	54.23 mg/kg	80.75 mg/kg
Potassium	95.12 mg/kg	119.01 mg/kg
SAR	1.41	0.422
Zinc	0.46 mg/kg	0.54 mg/kg

Table 2. Analysis Results of Water

Parameters	Test Results
pH at 25° C	7.55
EC	3.85 ds/m
SAR	7.97
$CaCO_3$ Hardness	852.90 mg/l
HCO_3	300.17 mg/l
TDS	2636.00 mg/lit

Chemical analysis of the irrigation water indicated relatively high salinity of the irrigation water with an ECw of 3.85 dS/m. Since, Guava is moderately salt tolerant and the soil texture was sandy loamy Clay throughout the profile, fruit production generally has been economical. Soil analysis of the experimental field indicated Zn deficiency. On the basis of results obtained the type and amount of fertilizers applied per tree were Urea (twice, 350 g each time), Triple Super Phosphate (300 g), and Potassium Sulphate (300 g) accordingly. The treatments provided to the plants in two split phases i.e. half dose after last harvest and half before the fruiting of upcoming guava yield in September.

Fertilizer applied between the radial distances 200 to 260 cm away from trunk, 15-25 cm deep and then properly covered with soil. There is no clear recommendation for Zn nutrition of Guava in the area and there is doubt about its efficiency under saline conditions. Zn was foliar applied thrice, using a pesticide application machine at different Zinc concentration i.e. Zn_0 (control – no Zinc), Zn_1 (0.1%), Zn_2 (0.2%), Zn_3 (0.3%), Zn_4 (0.4%), Zn_5 (0.5%), Zn_6 (0.6%), Zn_7 (0.7%) and Zn_8 (0.8%), when the branches had produced young leaves, in both years of the experiment. The source of Zn was dry zinc sulfate ($ZnSO_4$; 34% Zn). For recording the fruit quantity and quality observations five mature fruits were randomly selected from each observational plant and same fruits were used for recording the various physico-chemical properties of guava. The data were statistically evaluated by using SAS software. Duncan's multiple range test at 5% level of probability was used for comparison of means.

3. Results and Discussion

The subject research was carried out to check the fruit yield and growth rate of guava in a saline land conditions with the application of constant rates of NPK fertilizers along with different rates of Zinc fertilizer to all plants under study. The subject study revealed that guava plant height, length of fruit, breadth of fruit, weight of fruit, number of fruits per plant, fruit yield, TSS%, Acidity, Vitamin C, and Firmness differed very significantly between application of different rates of Zinc fertigation as mentioned in Table 3. The critical gathered observations and data for the above discussed parameters during the subject research are appended below:

3.1. Plant Height

Statistically remarkable results were observed for plant height with maximum 3.111 m and minimum 2.767 m in Zn_5 and Zn_1 respectively. Nearly same results for maximum height were achieved by treatments Zn_6 and Zn_7. The detailed results for all foliar application of zinc are given in Table 3. The study clearly implies that the increment in foliar application of zinc directly increases the plant height which means that they are directly proportional to each other. The present finding is in agreement with the findings of [7] in guava.

3.2. Length of fruit

Different rates of foliar application of zinc had a very positive effect on length of Guava fruit as shown in Table 3. From the obtained results it is clear that length of fruit increased with the increase in Zinc treatment rates. The length of fruit was maximum 6.989 cm for Zn_5 and minimum 6.272 cm for Zn_0 respectively. However, near about same results for maximum fruit length was achieved by Zn_6 and Zn_7 treatments. The present finding is in agreement with [12] in guava.

3.3. Breadth of fruit

Statistically considerable results were observed for breadth of fruit as shown in Table 3. Maximum 6.070 cm and minimum 5.222 cm for breadth of fruit were recorded in Zn_5 and Zn_0 treatments respectively. Once again for the breadth of fruit same observation was noted with COV 6.454 %. The discussed findings are in accordance with [8] in guava.

3.4. Weight of fruit

The application of proper plants nutrients can boost up the growth of guava plant which eventually increases the weight of fruits per plant accordingly. According to the obtained results it had been observed that maximum 111.555 gm weight per fruit were recorded in Zn_5 and minimum 80.689 gm weight per fruit were recorded in control Zn_0. The similar findings were also reported by [5] in guava.

3.5. Number of fruits per plant

During the research study it had been observed that maximum number of fruit 379.679 was noted in Zn_5, while minimum 295.970

fruits per plant was observed in Zn_0 (control). The detailed results for all foliar application of zinc are given in Table 3. Once again for the number of fruits per plant same observations were noted with COV 29.482% and SE ± 9.989 respectively. The present finding is in agreement with [11] for guava.

3.6. Fruit yield

On the basis of conducted study and statistical analysis of all harvesting operations it had been observed that foliar application of different rates of Zinc fertilizer had a positive effect on the yield kg / plant with COV 12.827% and SE ± 4.343 accordingly. Maximum yield was found to be 41.935 kg / plant when fertilized with treatment Zn_5. Likewise the minimum production was recorded in control 23.644 kg per plant for treatment Zn_0. The similar findings were also reported by [10] for guava.

Table3. Effect of different Zinc concentration on fruit quantity parameters of guava.

Treatment	Plant Height	Length of Fruit	Breadth of Fruit	Weight of Fruit	Number of fruits per plant	Fruit yield
	m	cm	cm	gm		kg / plant
Zn_0	2.767	6.272	5.222	80.689	295.970	23.644
Zn_1	2.778	6.333	5.414	86.618	315.039	27.018
Zn_2	2.808	6.393	5.616	88.234	326.260	28.502
Zn_3	2.858	6.464	5.686	90.597	334.845	30.037
Zn_4	3.111	6.989	6.070	111.555	379.679	41.935
Zn_5	3.091	6.595	5.939	107.929	351.046	37.511
Zn_6	3.070	6.595	5.808	100.960	335.552	33.542
Zn_7	2.990	6.464	5.737	93.021	336.764	31.017
Zn_8	2.909	6.464	5.737	90.708	338.956	30.441
SE(m)±	0.172	0.253	0.212	10.878	9.989	4.343
LSD (p<0.05)	NS**	NS**	NS	NS	NS	NS
COV(%)	9.817	6.706	6.454	12.938	29.482	12.827

* Means followed by different letter shows significant result at 5% level of significance.

3.7. Fruit Quality Parameters

The chemical fruit quality in terms of maximum total soluble solids 9.373%, minimum acidity 0.485%, Vitamin C (45.147 mg per 100 ml of juice) and firmness 5.969 kg/cm^2 were recorded with treatment Zn_5 whereas, lowest total soluble solids 9.080%, maximum acidity 0.586%, Vitamin C (25.078 mg per 100 ml of juice) and firmness 3.808 kg/cm^2 were recorded in treatment Zn_0 control. These results are in accordance with [6] and [11] in Guava.

4. Conclusions

The subject study clearly pointed out that Zinc foliar application remarkably increase the yield and quality of Guava fruit. Amongst different concentration of Zinc, Zn_5 (0.5%) was observed to be more suitable and economical dose as the fruit yield in terms of plant height (3.111 m), length of fruit (6.989 cm), breadth of fruit (6.070 cm), weight of fruit (111.555 gm), number of fruits per plant (379.679), fruit yield (41.935 kg/plant) was recorded maximum. Same treatment also showed the superior fruit quality traits evaluated in terms of TSS (9.373 %), Vitamin C (45.147 mg per 100 ml of juice), and Firmness (5.969 kg/cm2) with lower acidity (0.485 %). Nearly same results were achieved by Zn_6 (0.6%) and Zn_7 (0.7%) concentration but statistical some parameters recorded less.

Table 4. Effect of different Zinc concentration on fruit quality parameters of guava.

Treatment	Fruit Quality Parameters			
	TSS	Acidity	Vitamin C	Firmness
	%	%	(mg per 100 ml of juice)	kg /cm^2
Zn_0	9.080	0.586	25.078	3.808
Zn_1	9.312	0.545	28.846	4.767
Zn_2	9.474	0.515	30.250	4.515
Zn_3	9.242	0.495	27.593	5.020
Zn_4	9.373	0.485	45.147	5.969
Zn_5	9.332	0.566	25.078	4.737
Zn_6	9.575	0.495	43.895	4.959
Zn_7	9.534	0.475	37.623	4.747
Zn_8	9.373	0.566	35.108	4.141
SE(m)±	0.364	0.495	4.646	2.121
LSD (p<0.05)	NS	NS	NS	NS
COV(%)	6.656	20.432	24.371	33.754

* Means followed by different letter shows significant result at 5% level of significance.

However, control plants showed un-satisfactory results regarding all the parameters. Too low or high Zinc concentration can reduced the yield and yield parameters of guava. From the obtained statistical results it can be concluded that the 0.5% micro-nutrient Zinc solution concentration has a best suited dose to increase the Guava yield in the arid region of Gharo, Sindh – Pakistan. However, further investigation is necessary to establish the present findings in other regions of Pakistan with Guava and other fruits.

5. Acknowledgment

The authors wish to express their gratitude to Mr. Farukh Mazhar the owner of the Gharo model farm for allowing this research to be carried out on his farm, to the staff of the farm especially to Mr. Allah Bakhsh the farm supervisor, Mr. Mazhar Iqbal Sheikh for his kind assistance throughout the study, and all other individuals who have been source of help throughout the research period.

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