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Research Article

# EFFECT OF PHOSPHORUS AND ZINCSULPHATE ON VEGETATIVE GROWTH AND PHYSIOLOGICAL ATTRIBUTES OF GUAVA (*Psidium guajava* L.) *CV.* GWALIOR 27

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**Abstract-** An experiment was conducted during 2013 to find out the effect of phosphorus, zinc sulphate and their combined effect on growth and quality of Guava (*Psidium guajava* L.) *cv.* G-27. The experiment was laid out in Randomized Block Design (RBD) with thirteen number of treatments replicated thrice in well established 15 years old plant of guava. There were four levels of phosphorus i.e., 300 g, 400 g, 500 g and 600 g., three levels of spray of zinc sulphate i.e., 0.25%, 0.50% and 0.75%, while the control plants received no fertilizer and no spray. The study revealed that 600 g phosphorus per plant, spray of 0.75% zinc sulphate($P_4xZn_3$), followed by $P_3$ X $Zn_3$ ($P_2O_5$ 500 g/ plant & $ZnSO_4$ @ 0.75 %) were found to be the best treatments for almost all vegetative and physical parameters of guava plant, for getting maximum growth with quality fruits in northern Madhya Pradesh.

**Keywords**- Guava, Phosphorus, Zinc sulphate, Growth, Physical.

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## Introduction

Guava (*Psidium* guajava L.), the apple of the tropics, which belongs to the family Myrtaceae, is one of the most popular fruits grown in tropical, sub-tropical and some parts of arid regions of India because of its low cost of cultivation, more tolerant to drought and semiarid conditions as well as salinity problems. It has wide adaptability to varying soil and climatic conditions. It is a cheap and very rich source of vitamin-C, carbohydrate, iron, fat and contains a fair amount of calcium and phosphorus. Guava fruits are also used for preparation of salad, chutney, jam, jelly, nector etc. These qualities make guava an important and one of the most popular fruits of India. India is the leading producer of guava in the world. The total area under guava cultivation and production of guava in India is about 2.19 lakh hectares and 25, 10, 400 MT, respectively. The productivity of guava in India is 11.41 MT/ha. The total area and production of guava in Madhya Pradesh is 16,500 hectares and 2.55 Lakh MT, respectively. Madhya Pradesh ranks first in productivity with 15.47 MT/ha. Guava shares 4.5 per cent of area and 3.3 per cent of production among fruit crops in India [NHB, 2015].

Gwalior is an important region in Madhya Pradesh, where guava is widely grown and several guava orchards are found in and around the Gwalior district. However, growth and productivity of the guava tree is influenced by a large number of factors. One of the important factors is inadequate supply of plant nutrients. Nutrient requirement of guava vary with varieties and agro climatic conditions. It gives good response to manuring and fertilization. Out of various major nutrients, phosphorus plays extremely important role in guava cultivation for optimum growth and performance. Uses of micronutrients also play an important role to avoid hidden nutrient hunger. Zinc is one of the important micronutrients required for growth, flowering, fruiting and quality of fruits. Gwalior-27 is a popular variety in northern Madhya Pradesh but nutritional requirement of this variety has not been standardized so for.

## MaterialsandMethods

The experiment was conducted at orchard of Department of horticulture, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior during the years 2013-14. The experiment was laid out in randomized block design with thirteen treatments including control replicated three times. The phosphorus was applied as basal dose prior to start of flowering in end of June, while single foliar spray of zinc sulphate was done after fruit set. The details of treatments are T0 (Control), T1 (Phosphorus @ 300 g+ Zinc sulphate @ 0.25 %), T2 (Phosphorus @ 300 g + Zinc sulphate @ 0.50 %), T3 (Phosphorus @ 300 g + Zinc sulphate @ 0.75 %), T4 (Phosphorus @ 400 g + Zinc sulphate @ 0.25 %), T5 (Phosphorus @ 400 g + Zinc sulphate @ 0.50 %), T6 (Phosphorus @ 400 g + Zinc sulphate @ 0.75 %), T7 (Phosphorus @ 500 g + Zinc sulphate @ 0.25 %), T8 (Phosphorus @ 500 g + Zinc sulphate @ 0.50 %), T9 (Phosphorus @ 500 g + Zinc sulphate @ 0.75 %) and T10 (Phosphorus @ 600 g + Zinc sulphate @ 0.25 %), T11 (Phosphorus @ 600 g + Zinc sulphate @ 0.50 %), T12 (Phosphorus @ 600 g + Zinc sulphate @ 0.75 %). The various observations recorded during the investigation were shoot length (cm), shoot diameter (cm), number of leaves, fruit length (cm), fruit width (cm), fruit volume (ml), specific gravity, pulp (%) and seed (%).

## Result and Discussion

The data pertaining to various vegetative parameters of the guava plant *viz.* shoot length, number of leaves per plant and shoot diameter are given in [Table-1].

### Shoot length (cm)

The data pertaining to effect of phosphorus with and without zinc sulphate and their interaction on the shoot length are presented in [Table-1]. Scrutiny of data summarized in [Table-1] revealed that successive increase in the shoot length of guava plant increased after application of phosphorus up to 600 g/plant. Various

increases in shoot length of guava with increasing levels of phosphorus were, substantial but not consistently significantly. As a result, that 600 g P2O5 / plant exhibited the longest shoot length (13.15 cm) and the minimum length of shoot was observed in 300 g P2O5 / plant (11.89 cm). The effect of foliar application of zinc sulphate was significant on shoot length. A trend of increase in length of shoot up to 0.75 % $ZnSO_4$ spray was observed. The foliar application of $ZnSO_4$ 0.75 %, the shoot length was recorded to 13.63 cm as compared to 11.55 cm in $ZnSO_4$ @ 0.25 %. However, foliar application of $ZnSO_4$ @ 0.50 % gave shoot length 13.00 cm which was significantly superior to the $ZnSO_4$ @ 0.25 %.Both the experimental variable interacted to each other in respect of the growth character like shoot length. However, the maximum shoot length (13.66 cm) and the minimum shoot length (9.45 cm) was annexed with the treatment combination $P_4xZn_3$ (P2O5 600g /plant X $ZnSO_4$ 0.75 %) and P4xZn1(P2O5 300g /plant X $ZnSO_4$ 0.25 %), respectively.

**Table-1** *Effect of phosphorus and zinc sulphate on vegetative and physiological parameters of guava*

| Treatment | | Shoot length (cm) | Shoot diameter (cm) | Number of leaves | Fruit length (cm) | Fruit width (cm) | Fruit volume (ml) | Specific gravity | Pulp (%) | Seed (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Phosphorus | | | | | | | | | | |
| Control | | | | | | | | | | |
| $P_1$ 300g/plant | | 11.89 | 10.85 | 0.41 | 6.34 | 6.45 | 181.12 | 1.039 | 96.87 | 194.66 |
| $P_2$ 400g/plant | | 12.76 | 10.98 | 0.46 | 6.62 | 6.54 | 185.81 | 1.038 | 96.87 | 197.88 |
| $P_3$ 500g/plant | | 13.11 | 11.30 | 0.47 | 6.52 | 6.62 | 188.60 | 1.037 | 96.89 | 204.00 |
| $P_4$ 600g/plant | | 13.15 | 11.32 | 0.48 | 6.72 | 6.66 | 191.46 | 1.037 | 97.05 | 205.11 |
| S.Em.± | | 0.195 | 0.222 | 0.02 | 0.038 | 0.020 | 0.881 | 0.001 | 0.160 | 0.420 |
| C.D. at 5% | | 0.568 | NS | 0.05 | 0.109 | 0.059 | 2.563 | NS | NS | 1.22 |
| $ZnSO_4$ | | | | | | | | | | |
| $Z_0$ 0.0% | | | | | | | | | | |
| $Z_1$ 0.25%/ plant | | 11.55 | 10.66 | 0.41 | 6.14 | 6.30 | 170.31 | 1.041 | 96.62 | 189.00 |
| $Z_2$ 0.50% plant | | 13.00 | 11.34 | 0.47 | 6.61 | 6.51 | 187.89 | 1.037 | 97.01 | 203.91 |
| $Z_3$ 0.75% plant | | 13.63 | 11.63 | 0.50 | 6.90 | 6.89 | 202.06 | 1.034 | 97.20 | 208.33 |
| S.Em.± | | 0.169 | 0.193 | 0.01 | 0.033 | 0.017 | 0.764 | 0.002 | 0.138 | 0.363 |
| C.D. at 5% | | 0.492 | 0.560 | 0.04 | 0.095 | 0.050 | 2.220 | 0.005 | 0.402 | 1.058 |
| Interaction (PXZ) | | | | | | | | | | |
| $T_{(1)}$ | $P_1Z_1$ | 9.45 | 10.70 | 0.31 | 5.40 | 6.20 | 161.12 | 1.043 | 96.57 | 176.67 |
| $T_{(2)}$ | $P_1Z_2$ | 12.62 | 11.24 | 0.46 | 6.67 | 6.43 | 183.20 | 1.038 | 96.90 | 202.66 |
| $T_{(3)}$ | $P_1Z_3$ | 13.58 | 11.44 | 0.48 | 6.96 | 6.73 | 199.06 | 1.035 | 97.16 | 204.66 |
| $T_{(4)}$ | $P_2Z_1$ | 11.91 | 10.19 | 0.43 | 6.39 | 6.25 | 168.00 | 1.041 | 96.42 | 185 |
| $T_{(5)}$ | $P_2Z_2$ | 12.76 | 11.28 | 0.46 | 6.59 | 6.34 | 187.12 | 1.037 | 96.99 | 201.66 |
| $T_{(6)}$ | $P_2Z_3$ | 13.61 | 11.45 | 0.49 | 6.89 | 6.93 | 202.32 | 1.034 | 97.21 | 207.00 |
| $T_{(7)}$ | $P_3Z_1$ | 12.40 | 11.02 | 0.44 | 6.32 | 6.35 | 175.03 | 1.040 | 96.73 | 196 |
| $T_{(8)}$ | $P_3Z_2$ | 13.26 | 11.39 | 0.47 | 6.48 | 6.59 | 188.07 | 1.037 | 96.99 | 206.00 |
| $T_{(9)}$ | $P_3Z_3$ | 13.65 | 11.47 | 0.51 | 6.75 | 6.93 | 202.70 | 1.034 | 97.22 | 210 |
| $T_{(10)}$ | $P_4Z_1$ | 12.43 | 11.06 | 0.45 | 6.45 | 6.40 | 177.08 | 1.039 | 96.77 | 198.33 |
| $T_{(11)}$ | $P_4Z_2$ | 13.36 | 11.42 | 0.47 | 6.70 | 6.60 | 193.16 | 1.036 | 97.15 | 205.33 |
| $T_{(12)}$ | $P_4Z_3$ | 13.66 | 11.48 | 0.52 | 7.01 | 6.97 | 204.15 | 1.034 | 97.32 | 211.66 |
| S.Em.± | | 0.338 | 0.385 | 0.03 | 0.065 | 0.035 | 1.528 | 0.003 | 0.277 | 0.727 |
| C.D. at 5% | | 0.984 | NS | NS | 0.189 | NS | 4.440 | NS | NS | 2.116 |

**Number of leaf per shoot**

Data presented in [Table-1] showed that the number of leaf per shoot did not significantly increase with the application of phosphorus. The maximum number of leaf per shoot (11.32) was recorded under P2O5 600 g / plant. Similar result was found in the treatment P2O5 500 g/ plant, while the minimum number of leaf per shoot (11.13) was recorded under P2O5 300 gm / plant. Data presented in [Table-1].Showed that the number of leaf per shoot was significantly increased by the spray of zinc sulphate. The mean maximum number of leaf per shoot (11.46) was recorded under the treatment $Zn_3$ ($ZnSO_4$ @ 0.75 %), while the minimum number of leaf per shoot (10.75) was recorded under $Zn_1$ ($ZnSO_4$ @ 0.25 %).Number of leaf per shoot was not significantly influenced with the combined treatment of soil application of phosphorus and foliar application of zinc sulphate. [Table-1], whereas, the mean maximum number of leaf per shoot (11.48) was recorded under treatment combination P2O5 (600 g/ plant) x $ZnSO_4$ @ 0.75 %) and the treatment combination P2O5 (500 g/ plant) x $ZnSO_4$ (0.75 %) (11.47) show better results, while the minimum (10.70) in P2O5 (300 g/ plant) x $ZnSO_4$ (0.25 %).

**Shoot diameter (cm)**

The data pertaining to soil application of phosphorus (P2O5) with and without foliar application of zinc sulphate ($ZnSO_4$), and their interaction on the shoot diameter are presented in [Table-1]. The perusal of data presented in [Table-1], revealed that the shoot diameter was significantly increased by the application of phosphorus over the other level of treatment. The mean maximum shoot diameter (0.48 cm) was recorded under $P_4$($P_2O_5$ 600 g /plant) followed by the $P_3$ ($P_2O_5$ 500 g /plant) 0.47 cm which were at par with the $P_2$ ($P_2O_5$ 400 g /plant), while the minimum shoot diameter (0.41 cm) was recorded under $P_1$($P_2O_5$ 300 g / plant). Data presented in [Table-1] revealed that the shoot diameter was significantly affected due to the spray of zinc sulphate. The mean maximum shoot diameter (0.50 cm) was recorded under $Zn_3$ ($ZnSO_4$ @ 0.75 %), which was at par with the treatment $Zn_2$ ($ZnSO_4$ @ 0.50 %), while the minimum shoot diameter (0.41 cm) was recorded under treatment $Zn_1$ (0.41 cm). The interaction effect of soil application of phosphorus and foliar application of zinc sulphate on shoot diameter was found non-significantly [Table-1]. The maximum shoot diameter (0.52 cm) was recorded under treatment $P_4$ x $Zn_3$ ($P_2O_5$ @ 600 g/plant & $ZnSO_4$ @ 0.75 %)while the minimum (0.31 cm) under the treatment combination P1 x Zn3 (P2O5 @ 300 g/plant & $ZnSO_4$ @ 0.25 %), respectively.

**Fruit length (cm)**

Data pertaining the effect of soil application of phosphorus ($P_2O_5$), foliar application of zinc sulphate ($ZnSO_4$) and their interaction on the fruit length are presented in [Table-1]. Revealed that the fruit length (cm) was significantly increased by the application of phosphorus over the other levels of treatment. The mean maximum fruit length (6.72 cm) was recorded under P2O5 600 g/plant which was at par with the treatment $P_2O_5$ 400 g/ plant while the minimum fruit length (6.34 cm) was recorded under $P_2O_5$ 300 g / plant, respectively. Data presented in [Table-1], revealed that the fruit length (cm) was significantly affected due to the spray of zinc sulphate over the other levels of treatment. The mean maximum fruit length (6.90 cm) was recorded under $Zn_3$ ($ZnSO_4$ @ 0.75 %), which was significantly superior to the other levels of $Zn_1$ and $Zn_2$ ($ZnSO_4$ @ 0.25 % & $ZnSO_4$ @ 0.50 %, respectively), while the minimum fruit length (6.14 cm) was recorded under treatment $Zn_1$ (0.25% $ZnSO_4$) respectively. The interaction effect of phosphorus and zinc sulphate on fruit length (cm) was influenced significantly

[Table-1]. The maximum fruit length (7.01 cm) was recorded under treatment P4 x $Zn_3$ ($P_2O_5$ @ 600 g/plant & $ZnSO_4$ @ 0.75 %),which was at par with the treatment combination $P_1$ x $Zn_3$ ($P_2O_5$ @ 300 g/plant & $ZnSO_4$ @ 0.75 %) and $P_2$ x $Zn_3$ ($P_2O_5$ @ 400 g/ plant & $ZnSO_4$ @ 0.75 %) 6.96 cm and 6.89 cm respectively, while the minimum (6.32 cm) under the treatment combination $P_3$ x $Zn_3$ ($P_2O_5$ @ 500 g/ plant & $ZnSO_4$ @ 0.25 %).

**Fruit width (cm)**

The data pertaining to effect of soil application of phosphorus, foliar application zinc sulphate and their interaction on the fruit width are presented in [Table-1]. The perusal of data presented in [Table-1], revealed that the fruit width (cm) was significantly increased by the application of phosphorus over the other levels of treatment. The mean maximum fruit width (6.66 cm) was recorded under (P4 600 g/ plant), which was at par with the treatment P3 (6.62 cm), while the minimum fruit width (6.45 cm) was recorded under P1 (P2O5 300 gm / plant), respectively. Data presented in [Table-1], revealed that the fruit width (cm) was significantly affected due to the spray of zinc sulphate over the other levels of treatment. The mean maximum fruit width (6.89 cm) was recorded under $Zn_3$ ($ZnSO_4$ @ 0.75 %), which was significantly superior to the other levels of $Zn_1$ and $Zn_2$ ($ZnSO_4$ @ 0.25 % & $ZnSO_4$ @ 0.50 %, respectively), while the minimum fruit width (6.30 cm) was recorded under treatment $Zn_1$. The interaction effect of phosphorus and zinc sulphate on fruit width (cm) was not significantly influenced by the different combinations of the treatments [Table-1]. The maximum fruit width (6.97 cm) was recorded under treatment $P_4$ x $Zn_3$ ($P_2O_5$ @ 600 g/ plant & $ZnSO_4$ @ 0.75 %),while the minimum (6.2 cm) under the treatment combination $P_1$ x $Zn_3$ ($P_2O_5$ @ 300 g/ plant & $ZnSO_4$ @ 0.25 %), respectively.

**Fruit volume (ml)**

The data recorded for effect of soil application of phosphorus and foliar application of zinc sulphate and their interaction on the fruit volume are presented in [Table-1]. The perusal of data presented in [Table-1], revealed that the fruit volume (ml) was significantly increased by the application of phosphorus over the other levels of treatment. The mean maximum fruit volume (191.46 ml) was recorded under P2O5 600 g/ plant, the treatment P3 also showed better result compare to the treatment P2, while the minimum fruit volume (181.13 ml) was recorded under P2O5 300 g / plant, respectively. Data presented in [Table-1], revealed that the fruit volume (ml) was significantly affected due to the spray of zinc sulphate over the other levels of treatment. The mean maximum fruit volume (202.06 ml) was recorded under $Zn_3$ ($ZnSO_4$ @ 0.75 %), which was significantly superior to the other levels of $Zn_1$ and $Zn_2$ ($ZnSO_4$ @ 0.25 % & $ZnSO_4$ @ 0.50 %), respectively, while the minimum fruit volume (170.31 ml) was recorded under treatment ($Zn_1$). The interaction effect of phosphorus and zinc sulphate on fruit volume (ml) was significantly influenced by the different combinations [Table-1]. The maximum fruit volume (204.15 ml) was recorded under treatment combinations $P_4$ x $Zn_3$ ($P_2O_5$ @ 600 g/ plant & $ZnSO_4$ @ 0.75 %), which was at par with the treatment combination $P_3$ x $Zn_3$ ($P_2O_5$ @ 500 g/ plant & $ZnSO_4$ @ 0.75 %) and $P_2$ x $Zn_3$ ($P_2O_5$ @ 400 g/ plant & $ZnSO_4$ @ 0.75 %), (202.70 ml and 202.32 ml), respectively, while the minimum fruit volume (161.12 ml) was noted under the treatment combination $P_1$x $Zn_3$ ($P_2O_5$ @ 300 g/ plant & $ZnSO_4$ @ 0.25 %).

**Specific gravity**

The data recorded for effect of soil application of phosphorus and zinc sulphate and their interaction on the specific gravity of fruit are presented in [Table-1]. The perusal of data presented in [Table-1], revealed that the specific gravity was not significantly influenced by the application of phosphorus over the other levels of treatment. The mean maximum specific gravity (1.039) was recorded under P2O5 300 g/ plant, while the minimum specific gravity was found in treatment P4 and P3 (600 and 500 g/ plant) respectively. Data presented in [Table-1] revealed that the specific gravity was significantly affected due to the spray of zinc sulphate over the other levels of treatment. The mean maximum specific gravity (1.04) was recorded under $Zn_1$ ($ZnSO_4$ @ 0.25 %), which was significantly superior to the other levels of $ZnSO_4$, respectively. The minimum specific gravity was found in treatment $Zn_3$ ($ZnSO_4$ @ 0.75 %). The interaction effect of phosphorus and zinc sulphate on specific gravity was not significantly influenced by the different combinations [Table-1]. The maximum specific gravity (1.038) was recorded under treatment combinations P1 x Zn3 ($P_2O_5$ @ 300 g/ plant & $ZnSO_4$ @ 0.50 %),while the minimum (1.034) under the treatment combination $P_4$ x $Zn_3$ ($P_2O_5$ @ 600 g/ plant & $ZnSO_4$ @ 0.75 %), respectively.

**Pulp (%)**

Data recorded for the effect of soil application of phosphorus and zinc sulphate and their interaction on the pulp percentage are given in [Table-1]. The perusal of data presented in [Table-1], revealed that the pulp percentage was not significantly influenced by the application of phosphorus over the other level of treatment. The mean maximum pulp percentage (97.05 %) was recorded under $P_2O_5$ 600 g/ plant, while the other treatments also showed better results, whereas the minimum pulp percentage (96.87 %) was recorded under the treatment $P_2O_5$ 400 g/ plant and $P_2O_5$ 300 g/ plant, respectively. Data presented in [Table-1], revealed that the pulp percentage was significantly affected due to the spray of zinc sulphate over the other levels of treatment. The mean maximum pulp percentage (97.20 %) was recorded under $Zn_3$ ($ZnSO_4$ @ 0.75 %), which was significantly superior to the other levels of $ZnSO_4$, while the minimum pulp percentage (96.62 %) was recorded under the treatment $ZnSO_4$ @ 0.25 %, respectively. The interaction effect of phosphorus and zinc sulphate on pulp percentage was not significantly influenced by the different combinations [Table-1]. However, the maximum pulp percentage (97.32 %) was recorded under treatment combinations $P_4$ x $Zn_3$ ($P_2O_5$ @ 600 g/ plant & $ZnSO_4$ @ 0.75 %),while the minimum pulp percentage (96.42 %) under the treatment combination P2 x $Zn_1$ ($P_2O_5$ @ 400 g/ plant & $ZnSO_4$ @ 0.25 %) respectively.

**Seed (%)**

Data regarding the effect of soil application of phosphorus and foliar application of zinc sulphate and their interaction on the seed percentage are given in [Table-1]. The perusal of data presented in [Table-1] revealed that the seed percentage was not significantly influenced by the application of phosphorus over the other level of treatment. The mean minimum seed percentage (0.32 %) was recorded under $P_2O_5$ 400 g/ plant, which was at par with the treatment $P_2O_5$ 500 g/ plant and $P_2O_5$ 600 g/ plant, while the maximum seed percentage (0.42 %) was recorded under the treatment $P_2O_5$ 300 g/ plant and $P_2O_5$ 300 g/ plant, respectively. Data presented in [Table-1], revealed that the seed percentage was not significantly affected due to the spray of zinc sulphate over the other levels of treatment. The mean minimum seed percentage (0.32 %) was recorded under $Zn_3$ ($ZnSO_4$ @ 0.75 %), which was at par with the other treatment of $ZnSO_4$, while the maximum seed percentage (0.40 %) was recorded under the treatment $ZnSO_4$ @ 0.25 % respectively). The interaction effect of phosphorus and zinc sulphate on seed percentage was not significantly influenced by the different combinations [Table-1]. The minimum seed percentage (0.30 %) was recorded under treatment combinations $P_2$ x $Zn_1$ ($P_2O_5$ @ 400 g/ plant & $ZnSO_4$ @ 0.0.25 %), while the maximum seed percentage (0.59 %) under the treatment combination $P_1$ x $Zn_1$ ($P_2O_5$ @ 300 g/ plant & $ZnSO_4$ @ 0.25 %) respectively.

**Discussion**

**Effect of Phosphorus**

**Vegetative Parameters**

The vegetative parameters of the guava plant were significantly improved by the soil application of phosphorus over the control. The maximum shoot length (13.15 cm) was recorded under $P_4$ ($P_2O_5$ 600 g/ plant), which was at par with the $P_3$ ($P_2O_5$ 500 g/ plant), (13.11 cm) and minimum shoot length (11.89 cm) noticed $P_1$ ($P_2O_5$ 300 g/ plant), The maximum number of leaf per shoot (11.32) was recorded under the treatment $P_4$ ($P_2O_5$ 600 g/ plant), treatment $P_3$ ($P_2O_5$ 500 g/ plant) showed better result (11.30), whereas minimum number of leaf per shoot (10.85) was noticed under $P_1$ ($P_2O_5$ 300 g/ plant). The increased shoot diameter was recorded under $P_4$ ($P_2O_5$ 600 g/ plant) (0.48 cm), which was superior to other treatments while, minimum shoot diameter (0.41 cm) was recorded with the $P_1$ ($P_2O_5$ 300 g/ plant). It is quite clear from the findings of the present study that the positive effect of phosphorus could be explained on the ground that phosphorus

plays an important role in function of enzymes required for the vital process and growth. Similar findings were reported by [5,9].

**Physico-chemical parameters of fruits**

The quality parameters of guava fruits were significantly improved by the soil application of phosphorus. The maximum fruit length (6.72 cm) and fruit width (6.66 cm) was recorded under the treatment $P_4$ ($P_2O_5$ 600 g/ plant), which was superior to other treatments while, the minimum fruit length (6.34 cm) and fruit width (6.45 cm) were recorded with $P_1$ ($P_2O_5$ 300 g/ plant). The maximum fruit volume (191.46 ml), specific gravity (1.04) and pulp percentage (97.05 %), were also recorded under the treatment $P_4$ ($P_2O_5$ 600 g/ plant), which were significantly superior to the other levels of $P_3$ ($P_2O_5$ 500 g/ plant), $P_2$ ($P_2O_5$ 400 g/ plant), $P_1$ ($P_2O_5$ 300 g/ plant). The minimum seed percentage (0.32 %) recorded under the treatment $P_2$ ($P_2O_5$ 400 g/ plant), whereas, the minimum fruit volume (181.12 ml) and pulp percentage (96.86 %), were recorded under $P_1$ ($P_2O_5$ 300 g/ plant). The maximum specific gravity (1.039) of fruit was recorded under $P_1$ ($P_2O_5$ 300 g/ plant), while minimum specific gravity (1.037) noticed under $P_4$ ($P_2O_5$ 600 g/ plant), $P_3$ ($P_2O_5$ 500 g/ plant). The findings of present investigation are in confirmation with the findings of [2].

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**Effect of zinc sulphate**

**Vegetative Parameters**

The vegetative parameters of the guava plant were significantly influenced by the different concentration of zinc sulphate by foliar application over the other levels of treatment. The mean maximum shoot length (13.63 cm) and number of leaf per shoot (11.63) of guava were recorded under $Zn_3$ ($ZnSO_4$ @ 0.75 %), which was superior with other treatments whereas, the minimum shoot length (11.55 cm) and number of leaf per shoot (10.66) were noticed under $Zn_1$ ($ZnSO_4$ @ 0.25 %). Increased shoot diameter (0.50 cm) was recorded under the treatment $Zn_3$ ($ZnSO_4$ @ 0.75 %) while, the minimum shoot diameter (0.41 cm) was recorded under $Zn_1$ ($ZnSO_4$ @ 0.25 %). Increase in shoot length by zinc spray may be due to zinc which plays an important part in the fundamental process involved in the cellular mechanism and respiration [10]. The presence of zinc in chloroplast cell was also considered the possible cause of increased growth of plants [12]. Improvement in vegetative growth was also observed with Zn by several workers; [2,11] or[6] in guava. Similar findings were also reported by [3,4] in guava.

**Physical parameters of fruits**

The quality parameters of guava fruits were significantly improved by the different concentrations of zinc sulphate. Fruit length (6.72 cm), fruit width (6.89 cm) and volume (202.06 ml) was recorded under $Zn_3$ ($ZnSO_4$ @ 0.75 %), while the minimum was recorded under $Zn_1$ ($ZnSO_4$ @ 0.25 %). Pulp percentage (97.20 %) and minimum seed percentage (0.32 %) was also recorded under the treatment $Zn_3$ ($ZnSO_4$ @ 0.75 %) whereas the minimum pulp percentage and maximum seed percentage were found in treatment $Zn_1$ ($ZnSO_4$ @ 0.25 %). The maximum specific gravity of fruit (1.041) was recorded under $Zn_1$ ($ZnSO_4$ @ 0.25 %).However, the minimum specific gravity of fruit (1.034) was recorded under $Zn_3$ ($ZnSO_4$ @ 0.75 %). This increase in length and width of guava fruits might be due to the fact that zinc appears to have indirect role in hastening the process of cell division and cell elongation due to which size and weight would have improved. Zinc was reported to regulate the semi-permeability of cell wall thus mobilizing more water into the fruits, thereby increasing the size of fruit [1, 8, 13] also reported the similar results in the guava.

**Interaction effect of phosphorus and zinc sulphate**

**Vegetative Parameters**

The interaction effect of phosphorus and zinc sulphate significantly improved the vegetative parameters of guava plant except number of leaf per shoot and shoot diameter. The maximum shoot length (13.66 cm) were recorded under $P_4$ X $Zn_3$ ($P_2O_5$ 600 g/ plant & $ZnSO_4$ @ 0.75%), which was at par with the treatment $P_3$ X $Zn_3$ ($P_2O_5$ 500 g/ plant & $ZnSO_4$ @ 0.75 %) and $P_1$ X $Zn_3$ ($P_2O_5$ 300 g/ plant & $ZnSO_4$ @ 0.75 %), whereas the minimum shoot length (9.45 cm) was recorded under $P_1$ X $Zn_1$ ($P_2O_5$ 300 g/ plant & $ZnSO_4$ @ 0.25 %). The maximum shoot diameter (0.52 cm) was recorded under $P_4$ X $Zn_3$ ($P_2O_5$ 600 g/ plant & $ZnSO_4$ @ 0.75 %) while, the minimum shoot diameter (0.31 cm) was noticed under $P_1$ X $Zn_1$ ($P_2O_5$ 300 g/ plant & $ZnSO_4$ @ 0.25 %). The foliar sprays of micronutrient viz., Zn, and soil application of phosphorus might have induced the synthesis of chlorophyll and thus lead to increase in chlorophyll content which in turn resulted in higher vegetative growth [11].

**Physical parameters of fruits**

The Physiological parameters of guava fruits were significantly improved by the combined application of phosphorus and zinc sulphate over the lower concentrations. The maximum fruit length (7.01 cm) and fruit width (6.97 cm) were recorded under treatment $P_4$ X $Zn_3$ ($P_2O_5$ 600 g/ plant & $ZnSO_4$ @ 0.75 %), whereas, the minimum fruit length (6.32 cm) and fruit width (6.20 cm), were noticed under $P_1$ X $Zn_1$ ($P_2O_5$ 300 g/ plant & $ZnSO_4$ @ 0.25 %). The maximum fruit volume (204.15 ml) and pulp percentage (97.32 %) were recorded under the treatment $P_4$ X $Zn_3$ ($P_2O_5$ 600 g/ plant & $ZnSO_4$ @ 0.75 %), while, the minimum volume of fruit (161.12 ml) and pulp percentage (96.57 %) were recorded with $P_1$ X $Zn_1$ ($P_2O_5$ 300 g/ plant & $ZnSO_4$ @ 0.25 %). The minimum seed percentage (0.31 %) was recorded under treatment $P_2$ X $Zn_1$.

**Conclusion**

It is concluded that soil application of phosphorus and foliar spray of zinc sulphate and their interaction had significantly improved the vegetative growth and physico-chemical parameters of guava. Individual spray of phosphorus i.e. $P_4$ ($P_2O_5$ 600 g/ plant) followed by $P_3$ ($P_2O_5$ 500 g/ plant), and individual spray of zinc sulphate i.e. $Zn_3$ ($ZnSO_4$ @ 0.75 %) followed by $Zn_2$ ($ZnSO_4$ @ 0.50 %) were found to be the best treatments for almost vegetative and physical parameters of guava plant. In the interaction effect of phosphorus and zinc sulphate, the treatment $P_4$ X $Zn_3$ ($P_2O_5$ 600 g/ plant & $ZnSO_4$ @ 0.75 %) followed by $P_3$ X $Zn_3$ ($P_2O_5$ 500 g/ plant & $ZnSO_4$ @ 0.75 %) were found to be the best treatments for almost vegetative and physico- chemical parameters of guava plant.

**Conflict of Interest: None declared**

**References**


[1] Babu R.S.H., Rajput C.V.S. and Rath S.R. (1982) *Haryana J. Hort. Sci.,* 11(1), 59-65.

[2] Balakrishnan K. (2001) *Annals of Plant Physiology*; 2000, publ. 2001, 14(2), 151-153.

[3] Chhonkar V.S. and Singh P.N. (1981) Effect of zinc ,boron and molybdum as foliar sprays on the growth ,flowering , fruiting and yield of guava (*Psidium guajava* L.) *cv.* Allahabad safeda. Naitonal symposium on tropical and sub tropical fruit crops, Banglore p.88

[4] Ghosh S.N. (1986) *South Indian Hort.,* 34 (5), 327-330.

[5] Griffith B. (2011) Efficient fertilizer use- Phophorus. Cited at htpp:// www. Rainbowplantfood.Com/ agronomics/ efu/ phosphorus.Pdf.

[6] Kundu S. and Mitra S.K. (1999) *Indian Agric.,* 43 (1&2), 49-54.

[7] Mansour N.M. and El Sied Z.A.H. (1981) *Agril. Res. Review.,* 3, 119-134.

[8] Meena R.P. Mohammed S. and Lakhawat S.S. (2005) *J. of Horticultural Sciences*., 11, 2, 90-93.

[9] Marschner H. (1995) Mineral nutrition of higher plants. Academic Harcourt BracJananoivish Publisher. Pp: 674-682.

[10] Reed H.S. (1946) *American J.G. Bot*., 33,778-784.

[11] Sharma R. and Bhattachharya R.K. (1994) *South Indian Hort.,* 42, 200-203.

[12] Wood J. G. and Sibley P. M. (1950) *Ans. J. Sci. RES. Series- B.* Biological Science 3, 14-27.

[13] Yadav H.C., Yadav A.L., Yadav D.K. and Yadav P.K. (2011) *Plant Archives,* 11(1), pp. 147-149.