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IMPACT OF FOLIAR APPLICATION OF BORON, IRON AND MAGNESIUM ON YIELD AND SEED QUALITY OF GUAVA CV. HISAR SURKHA

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Abstract

An experiment was conducted at the research farm of department of Horticulture, CCS Haryana Agricultural University, Hisar, Haryana to study the effects of foliar application of boron, iron and magnesium on fruit parameters, yield and seed attributes of guava (*Psidium guajava* L. cv. Hisar Surkha). The experiment consisted of 21 treatments in different combinations of H_3BO_3, $FeSO_4$ and $MgSO_4$. The results revealed that most of the parameter *viz.* fruit retention, fruit size, fruit and pulp weight, number of fruits per plant, seed index and yield were noticed superior under treatment T_{21} (0.5 % of each i.e. boric acid, ferrous sulphate and magnesium sulphate). However, fruit drop and pulp: seed ratios were significantly lowest under the treatment T_{21}. Some of the parameters *viz.* fruit length: width ratio, fruit colour, pulp colour, specific gravity of guava fruit, seed hardness and total number of seeds per fruit were non-significantly influenced by the nutrient sprays.

Introduction

Guava (*Psidium guajava* L.) belongs to family Myrtaceae and has its origin in Tropical America. In India, total area occupied by guava crop is 2.87 lakh ha having a total production of 43.07 lakh MT (Anonymous 2020). Foliar feeding refers to the application of vital nutrients to plants to the above plant parts. Inadequate supply of plant nutrients is one of the major limiting factor for crop growth and productivity. Both macronutrients *i.e.* nitrogen, phosphorus and potassium and micronutrients *i.e.* zinc, iron, copper, manganese and boron etc. plays a vital role in enhancing plant growth, development, vigour, yield, quality of produce, and efficient nutrient assimilation (Zagade *et al.* 2017). Foliar spray appears to be a productive and sustainable method for managing fruit crops in this situation in order to increase fruit yield. Taking into consideration the significance of applying micronutrients through foliage to enhance the quality of fruits, the current investigation was carried out to assess the impact of foliar application of boron, magnesium and iron on fruiting parameters and yield of rainy season crop of guava cv. Hisar Surkha.

Materials and Methods

The study was conducted at experimental orchard of the CCS Haryana Agricultural University at Hisar (29º 10´ N, 75º 46´ E, 215.2 m altitude) during the year 2020-21 and 2021-22 in a winter season crop of guava trees in randomized block design. During the study period, 63 evenly grown guava trees cv. Hisar Surkha planted at 6 m × 6 m spacing were selected randomly and maintained under uniform conditions of orchard management. All the agronomic practices

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were carried out in strict accordance with the recommended package of practices (*i.e.* 14-year-old plants of guava is 75 kg FYM + 1.5 kg Urea + 1.25 kg Super phosphate + 0.5 kg Potassium sulphate.) in the orchard. Treatments T_1 : Control; T_2 :- H_3BO_3 (0.25%) + $MgSO_4$ (0.25%); T_3 - H_3BO_3 (0.25%) + $MgSO_4$ (0.5%); T_4 - H_3BO_3 (0.5%) + $MgSO_4$ (0.25%); T_5 - H_3BO_3 (0.5%) + $MgSO_4$ (0.5%); T_6 - $FeSO_4$ (0.25%) + $MgSO_4$ (0.25%); T_7 - $FeSO_4$ (0.25%) + $MgSO_4$ (0.5%); T_8 - $FeSO_4$ (0.25%) + H_3BO_3 (0.25%); T_9 - $FeSO_4$ (0.25%) + H_3BO_3 (0.25%) + $MgSO_4$ (0.25%); T_{10} - $FeSO_4$ (0.25%) + H_3BO_3 (0.25%) + $MgSO_4$ (0.5%); T_{11} - $FeSO_4$ (0.25%) + H_3BO_3 (0.5%); T_{12} - $FeSO_4$ (0.25%) + H_3BO_3 (0.5%) + $MgSO_4$ (0.25%); T_{13} - $FeSO_4$ (0.25%) + H_3BO_3 (0.5%) + $MgSO_4$ (0.5%); T_{14} - $FeSO_4$ (0.5%) + $MgSO_4$ (0.25%); T_{15} - $FeSO_4$ (0.5%) + $MgSO_4$ (0.5%); T_{16} - $FeSO_4$ (0.5%) + H_3BO_3 (0.25%); T_{17} - $FeSO_4$ (0.5%) + H_3BO_3 (0.25%) + $MgSO_4$ (0.25%); T_{18} - $FeSO_4$ (0.5%) + H_3BO_3 (0.25%) + $MgSO_4$ (0.5%); T_{19} - $FeSO_4$ (0.5%) + H_3BO_3 (0.5%); T_{20} - $FeSO_4$ (0.5%) + H_3BO_3 (0.5%) + $MgSO_4$ (0.25%) and T_{21} - $FeSO_4$ (0.5%) + H_3BO_3 (0.5%) + $MgSO_4$ (0.5%). Treatments were given twice, i.e. 1st after fruit set and 2nd one month after 1st treatment during each year. A power operated Knapsack Sprayer was used for the foliar application.

The fruit drop was determined by conducting a subtraction between the count of fruits that were initially set and the total number of fruits that were retained upon maturity. Fruit retention was calculated by dividing the number of fruits retained at harvest by the number of initial fruits set at the initial stage. The width and length of the fruit were measured with a digital vernier caliper. The length/width ratio is calculated by dividing the length of the fruit by its width. Fruit and pulp weight were taken with the help of digital weighing machine. The estimation of the aggregate quantity of fruits per plant was established through the enumeration of the total number of collected fruits from various harvests. Yield per tree was estimated by multiplying average fruit weight with the total number of fruits per tree. The number of seeds per fruit was counted manually.

Seed index was calculated by measuring the weight of 100 completely oven dried seeds. Pulp: seed ratio was calculated by dividing fruit pulp weight to weight of seeds of same fruit. Calculation of specific gravity was done by dividing fruit density by the density of water. A four-point system, chosen arbitory, was followed to evaluate the fruit colour and pulp colour with values ranging from 1 to 2 indicating poor coloring, 2 to 3 representing moderate coloring, 3 to 4 indicating high coloring, and 4 to 5 signifying extremely vibrant coloring. Hardness was calculated on the basis of the pressure exerted on the completely oven dried seeds with the help of seed hardness meter. Then, the collected data were analyzed by using software OPSTAT (Sheoran *et al.* 1998), a windows-based computer program, at 5% level of the significance.

Results and /Discussion

Data in Table 1 revealed that the minimum fruit drop (21.29%) was recorded with the treatment T_{21} (0.5% of each $FeSO_4$, H_3BO_3 and $MgSO_4$ in combination). However, rest of the treatments had significantly higher fruit drop per cent and maximum fruit drop (39.61%) was observed with the control (T_1) while vice-versa trends was followed in case of fruit retention i.e. maximum fruit retention (78.71%) was recorded with the treatment T_{21} and minimum fruit retention (60.39%) was noticed in the treatment T_1. The decrease in fruit drop could potentially be attributed to the circumstance that these micronutrients affect the metabolic activities of the plant which ameliorate the source sink relationship and directly influenced the metabolic profile, hence, results in increased fruit retention. Guava response was improved with boron foliar spray was observed by Suman *et al.* (2016).

Pertaining of data showed that the maximum fruit length (6.55 cm) and fruit width (6.19 cm) were recorded with the treatment T_{21} that was statistically similar with T_{12}, T_{13}, T_{18} and T_{20}. While, rest of the treatments had significantly lower fruit length and fruit width. However, minimum fruit length (5.23 cm) and fruit width (5.11 cm) were noticed in T_1. Fruit length to width ratio was recorded significantly at par with all treatments. The ameliorate in length and diameter of guava fruit might be due to the apprehension that micronutrients appear to perform secondary function in accelerating cell division and elongation processes (Kumar *et al.* 2015, and Shireen *et al.* 2018). The possible cause of an increase in guava fruit dimension is foliar feeding of nutrients and, as a result, rapid fruit development induced by easy accessibility of nutrients to the plants (Thiruppathi 2020).

Magnesium being the metallic constitute of chlorophyll is directly correlated with higher photosynthetic activity of plant and photosynthate translocation (Tränkner *et al*. 2018). In addition, magnesium also affects plant metabolism, more synthesis of nucleic acids, engaged in enzymatic activities, protein synthesis and cell reproduction (Waskela *et al.* 2013). This might be the reason to increase the fruit size due to magnesium application. ~~Our~~ Results are supported by the earlier work of Meena *et al.* (2014) and Kumar *et al.* (2017), who reported that the length: diameter ratio was observed to be non significant with the foliar application of micronutrients. The effect of boron, magnesium and iron as foliar sprays reveals that maximum fruit weight and pulp weight were recorded 158.32 g and 155.99 g, respectively with the treatment T_{21} which was statistically at par with T_{12}, T_{13} and T_{20} (Table 1). The findings are similar to those reported by Kumawat *et al.* , (2012) in guava and Meena *et al.* (2014). Yield parameters like fruit and pulp weight were increased in magnesium treated plants may be on account of exhilarating plant metabolism (Vikas 2019). Applying micronutrient to the plants improved fruit quality by enhancing the leaf photosynthetic capacity, escalating the formation and translocation of carbohydrates from the shoot to storage organs and inciting a higher assimilates availability for fruit growth (Mahmoud *et al*. 2017). Maximum seed hardness was noticed in treatment T_{21} which remained statistically at par with all treatment. The present results are supported by the work of ~~(~~Kumar *et al.* (2015) who found that foliar application of nutrients in guava showed no-significant influences on seed hardness. It is evident from the data presented in Table 1 that maximum number of fruits (194.54) was found with the treatment T_{21} which was statistically at par with T_{20} whereas, minimum number of fruits (162.93) was observed with the treatment T_1 Table 1 indicated that the highest fruit yield (30.83 kg/tree) was recorded with treatment T_{21}, which is statistically at par with treatments T_{12}, T_{13} and T_{20} and minimum (20.56 kg/tree) in control results are supported by Bhoyar and Ramdevputra (2016) in guava. The effect of different treatments of foliar application of iron, magnesium and boron was no significant on fruit colour and pulp colour of guava when assessed visually according to an arbitory four-point system was used to evaluate the fruit colour. These results were contradictory to Ulfatullah *et al.* (2021) in pomegranate where change in color was observed which may be either due to the synthesis of plant pigments or due to unmasking of already existing color. The degradation of the chlorophyll structure is the underlying cause of the loss of green color. A possible explanation for this phenomenon is the increase in chlorophyll synthesis resulting from the foliar application of magnesium and iron(Peng *et al.* 2019). Specific gravity was found to be non-significant with foliar application of boron, magnesium and iron. Maximum fruit specific gravity (1.04) was recorded with T_1 and T_{17} whereas, minimum specific gravity (1.01) was recorded with T_2. Maximum weight of 100 seeds (1.03 g) was recorded with the treatment T_{21} which was statistically at par with T_{13} and T_{20}. Minimum weight of 100 seeds (0.72 g) was observed with the treatment T_1. Perusal of the data showed that minimum number of seeds per fruit (210.00) was recorded with the treatment T_1. Inspite of that rest of the treatments had significantly higher value of number of seeds per fruit

while highest number of seeds per fruit (227.50) was observed with the treatment T_{21}. Data regarding to effect of boron, magnesium and iron sprays reveals that maximum pulp to seed ratio (82.89) was recorded with the treatment T_1. Although, rest of the treatments had significantly lower value of pulp to seed ratio while minimum pulp to seed ratio (66.87) was observed with the treatment $T_{21.}$ Iron and magnesium are involved in chlorophyll synthesis and photosynthetic activity might have resulted in accumulation of higher photosynthates and thereby increasing seed weight, which ultimately decreases the pulp to seed ratio. Findings are in conformity with more of Thiruppathi, (2020) who reported that weight of 100 seeds has been directly affected by foliar spraying of boron and calcium. The effect of different treatments of foliar application of boron, magnesium and iron found to be non-significant on fruit specific gravity of guava. The present results are in line with the earlier work of Kumar *et al.* (2015) and Pippal *et al.* (2019) who reported that foliar application of nutrients in guava showed non-significant influences on fruit specific gravity significantly.

Table 1. Effect of boron, iron and magnesium on, yield fruit and seed parameters (pooled data).

Treatments No.	Fruit drop (%)	Fruit retention (%)	Fruit length (cm)	Fruit width (cm)	Fruit weight (g)	Pulp weight (g)	Number of fruits/tree	Yield (Kg/tree)	Seed index (g)	Pulp to seed ratio
T_1	39.61	60.39	5.17	5.11	126.01	124.50	162.93	20.56	0.72	82.89
T_2	37.40	62.60	5.29	5.26	130.78	129.19	166.98	21.86	0.75	80.85
T_3	34.17	65.83	5.67	5.53	139.12	137.32	174.22	24.26	0.83	75.96
T_4	33.14	66.86	5.80	5.70	142.89	140.97	177.46	25.40	0.87	73.73
T_5	31.36	68.64	5.97	5.72	145.16	143.16	181.06	26.31	0.90	71.81
T_6	37.78	62.22	5.26	5.17	128.26	126.70	164.51	21.12	0.74	81.07
T_7	36.54	63.46	5.48	5.33	134.06	132.40	169.88	22.81	0.77	80.08
T_8	37.02	62.98	5.42	5.28	131.96	130.33	168.50	22.26	0.76	80.28
T_9	29.12	70.88	6.06	5.82	148.12	146.05	182.98	27.12	0.93	70.47
T_{10}	27.95	72.05	6.11	5.86	150.25	148.15	184.06	27.68	0.94	70.59
T_{11}	32.13	67.87	5.86	5.67	143.22	141.27	179.21	25.71	0.89	72.36
T_{12}	25.28	74.72	6.36	5.96	154.24	152.01	188.81	29.18	0.99	68.26
T_{13}	24.56	75.44	6.43	6.00	155.85	153.59	190.32	29.69	1.00	68.11
T_{14}	35.98	64.02	5.53	5.39	135.95	134.26	171.76	23.38	0.78	79.88
T_{15}	35.28	64.72	5.59	5.47	136.84	135.08	172.34	23.61	0.81	76.95
T_{16}	33.60	66.40	5.73	5.56	141.02	139.16	176.08	24.85	0.85	74.84
T_{17}	26.78	73.22	6.20	5.90	151.73	149.59	185.73	28.24	0.96	70.01
T_{18}	26.10	73.90	6.32	5.94	152.95	150.80	187.41	28.70	0.96	70.09
T_{19}	30.33	69.67	6.02	5.76	147.02	144.98	181.86	26.77	0.92	71.27
T_{20}	23.55	76.45	6.48	6.10	156.92	154.62	191.88	30.15	1.02	67.11
T_{21}	21.29	78.71	6.55	6.19	158.32	155.99	194.54	30.83	1.03	66.87
CD @ 5%	2.09	2.11	0.27	0.26	4.20	4.14	4.83	1.65	0.03	0.49

The study provides a specific recommendation for the concentration and timing of the foliar spray, which can be useful for farmers and researchers. Foliar application of boron, magnesium and iron alone and in combination was found to be an instant and effective method of nutrient

application. Two times foliar spray, first at fruit set and second after one month of the first spray @ 0.5% each of boron, magnesium and iron was found to be most effective for improving yield and quality of guava cv. Hisar Surkha. Foliar spray of above mentioned concentration and timing influences most of the parameters *viz.* fruit retention, fruit size, fruit and pulp weight, number of fruits per plant, seed index and yield.

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