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Surbhi Goyal
Dept. of Horticulture, CoA, RVSKVV, Gwalior, Madhya Pradesh, India

Karan Vir Singh
Scientist, Dept. of Horticulture, CoA, RVSKVV, Gwalior, Madhya Pradesh, India

Vikas Mandloi
Ph.D. (Scholar), Dept. of Horticulture, CoA, RVSKVV, Gwalior, Madhya Pradesh, India

Devendra Vishvkarma
Ph.D. (Scholar), Dept. of Horticulture, CoA, RVSKVV, Gwalior, Madhya Pradesh, India

Corresponding Author:
Surbhi Goyal
Dept. of Horticulture, CoA, RVSKVV, Gwalior, Madhya Pradesh, India

Effect of foliar application of boron and GA_3 on morphological and quality parameters of guava (*Psidium guajava* L.) cv. Lalit

Surbhi Goyal, Karan Vir Singh, Vikas Mandloi and Devendra Vishvkarma

Abstract
An experiment entitled "Effect of foliar application of Boron and GA_3 on growth, yield and quality of guava (*Psidium guajava* L.) cv. Lalit" was conducted at University guava orchard, Department of Horticulture, College of Agriculture, Gwalior during *Mrig bahar* at 2016-17. The experimental was laid out in the randomized block design with three replications and total treatment combination nine. Result based on investigation study revealed that the highest value of morphological parameters such as shoot length (20.79 cm), shoot diameter (4.40mm), No. of flower per shoot (23.31), fruit set (83.5%) and quality parameter fruit volume (202.78 ml), specific gravity (1.06) and T.S.S. (11.37 ^{0}Brix) were recorded under interaction of treatment (B_2G_2) @ boron (0.4%)+GA_3 (100 ppm) at 90 Days. Conclude that the best treatment combination B_2G_2 with respect of morphological and quality parameters all three stage of guava.

Keywords: Foliar application, boron, GA_3, morphological, quality, guava, lalit etc

Introduction
Guava (*Psidium guajava* L.), the apple of the tropics, is one of the most popular fruit grown in tropical, sub-tropical and some parts of arid regions of India. The fruit are quite hardy and prolific bearer belongs to the family Myrtaceae. It is originated from tropical America and seems to have been growing from Mexico to Peru. The total area under its cultivation in India is 268.2 thousand ha with an annual production of 3668 thousand MT, productivity is 13.7 MT/ha, whereas in Madhya Pradesh, the area, production and productivity of guava is 22.4 thousand ha, 841.1 thousand MT and 37.6 MT/ha, respectively (NHB, 2014) [7]. Guava fruit is considered as one of the delicious fruit. These fruits are consumed either fresh or processed in the form of products like jam, jelly, cheese, juice, nectar, ready to serve (RTS) etc. Among the trace elements zinc and boron play significant role in flowering and fruiting process, N-metabolism, hormonal movement and cell division. Boron and zinc increase the fruit set reduce fruit drop and improve fruit quality in various fruit crops (El. Sherif *et al*., 1997) [17]. The plant growth regulators (PGR) act as messengers and needed in small quantities at low concentration. Generally their site of action and biosynthesis are different. Plant growth regulators enhance the rapid changes in physiological and biochemical characters and improve crop productivity. Gibberellic acid has been reported to influence vegetative growth, flowering, fruiting, and various disorders in many fruit crops.

Method and Material
The present investigation entitled "Effect of foliar application of Boron and GA_3 on growth, yield and quality of guava (*Psidium guajava* L.) cv. Lalit." was conducted at University guava orchard, Department of Horticulture (Fruit Science), College of Agriculture, RVSKVV, Gwalior (M.P) during 2016-17. The experimental was laid out in the randomized block design with three replications and total treatment combination nine *viz.*, foliar spray of three levels of boron (0, 0.2 and 0.4%), three levels of GA3 (0, 50 and 100 ppm) were applied. Aqueous solutions of boron and GA_3 were sprayed at the time of full bloom. the sprays under treatment were done on rainy season crop (Mrig bahar) at full bloom stage in early morning with the help of foot sprayer @ five liters per tree to ensure the maximum absorption of nutrients through the leaves. Each tree was sprayed thoroughly in such a way as to completely drench it with the spray solution.
Micronutrient solutions of boric acid (0.2 and 0.4%) were prepared by dissolving 8 g and 16 g and 30 g boric acid in four liters of supernatant lime water (by dissolving 100 g hydrated lime

in tap water) (Sidhu *et al*., 1980). The solutions of plant growth regulator used i.e. GA_3 (50 ppm and 100 ppm) was prepared by weighing (50 mg and 100 mg) GA_3 separately with the help of digital balance. This was dissolved in 95% 10 ml alcohol, respectively. Thereafter, 1000 ml of distilled water was added to it and stirred with a glass rod, so that GA_3 would thoroughly mix with distilled water. The observation was recorded of morphological parameters such as shoot length (cm), shoot diameter (mm), No. of flower per shoot, fruit set% and quality parameters fruit volume (ml), specific gravity and T.S.S. (^{0}Brix) selected under each plant within each treatment.

Results and Discussion

Morphological parameters

Shoot length and shoot diameter are important character of the vegetative phase. In the present, study vegetative observation were recorded at 30, 60 and 90 days after spraying (DAS) of the plant. At all these stages tree showed significant differences with respect to shoot length and shoot diameter. The effect of boron and GA_3 on length of terminal shoot is very obvious and consistent. At 30 days, the highest shoot length was observed in B_2, G_2 and B_2G_2 (6.05, 6.25 and 6.46cm, respectively). At 60 days, the highest shoot length was observed in B_2, G_2 and B_2G_2 (12.48, 14.24 and 15.12cm, respectively). At 90 days, the highest shoot length was observed in B_2, G_2 and B_2G_2 (17.73, 19.68 and 20.79cm, respectively).

At 30 days, the highest shoot diameter was observed in B_2, G_2 and B_2G_2 (2.92, 2.99 and 3.01 mm, respectively). At 60 days, the highest shoot diameter was observed in B_2, G_2 and B_2G_2 (3.80, 3.96 and 4.12 mm, respectively). At 90 days, the highest shoot diameter was observed in B_2, G_2 and B_2G_2 (4.05, 4.23 and 4.40 mm, respectively). The results finding are agreement with Goswami *et al*. (2015) [5], Hada *et al*. (2014) [1], Pizetta *et al*., (2005) [8], Prasad and Yadav, (2003) [9] and Sisler *et al.*, (1956) [15] in guava.

Number of flowers per shoot and fruit set% are important character of the reproductive phase. The maximum number of flowers per shoot was counted with B_2, G_2 and B_2G_2 (20.25, 22.20 and 23.31). Similarly, followed by B_1, G_1 and B_1G_2 (19.66, 18.87 and 22.77, respectively). The minimum no. of flowers per shoot was recorded with B_0, G_0 and B_0G_0 (18.73, 17.57 and 16.79, respectively).

The maximum fruit set% was obtained with B_2, G_2 and B_2G_2 (76.68, 80.83 and 83.05). Similarly, followed by B_1, G_1 and B_1G_2 (73.27, 77.14 and 80.24, respectively). The minimum fruit set% was recorded with B_0, G_0 and B_0G_0 (69.72, 61.70 and 57.20, respectively). Reproductive phase results are similar to the findings by Hada *et al*. (2014) [1] and Yadav *et al*. (2011) [14] in guava.

Fruit volume was measured in each treatment at harvest. The highest fruit volume 175.11 ml was measured in B_2 (Boron @ 0.4%) which was significantly superior to B_1 (Boron @ 0.2%) and B_0 (Boron @ 0%) which gave 162.51 ml and 156.77 ml fruit volume, respectively. Similarly among the GA_3 treatments G_2 (GA_3 @ 100 ppm) resulted in the highest fruit volume (187.79 ml) which was significantly higher to G_1 (GA_3 @ 50 ppm) and G_0 (GA_3 @ 0 ppm) which gave 160.41 ml and 146.19 ml fruit volume, respectively. The interaction effect of boron and GA_3 markedly influenced the fruit volume. The highest fruit volume 202.78 ml was recorded in treatment B_2G_2 (Boron @ 0.4% and GA_3 @ 100 ppm) followed by 184.06 ml in B_1G_2 (Boron @ 0.2% and GA_3 @ 100 ppm). The minimum (141.19 ml) fruit volume was noted in B_0G_0. In unfortunately, specific gravity was found non-significant by the foliar spray of boron and GA_3. The specific gravity was obtained with B_2, G_2 and B_2G_2 (1.05, 1.05 and 1.06, respectively). The present results are in conformity Arora and Singh (1972) [3]. Boron was reported to regulate the semi-permeability of cell wall thus mobilizing more water into the fruits, thereby increasing the size of fruit (Babu *et al*., 1982) [4]. Meena *et al*. (2005) [6] and Yadav *et al*. (2011) [14] also reported the similar results in the guava.

The highest TSS 10.04 ^{o}brix was measured in B_2 (Boron @ 0.4%) which was significantly superior to B_1 (Boron @ 0.2%) and B_0 (Boron @ 0%) which gave 9.73 ^{o}brix and 9.05 ^{o}brix TSS, respectively. Similarly among the GA_3 treatments G_2 (GA_3 @ 100 ppm) resulted in the highest TSS (11.06 ^{o}brix) which was significantly higher to G_1 (GA_3 @ 50 ppm) and G_0 (GA_3 @ 0 ppm) which gave 9.71 ^{o}brix and 8.05 ^{o}brix TSS, respectively. The interaction effect of boron and GA_3 did not markedly influence the TSS. The highest TSS 11.37 ^{o}brix was recorded in treatment B_2G_2 (Boron @ 0.4% and GA_3 @ 100 ppm) followed by 11.08 ^{o}brix in B_1G_2 (Boron @ 0.2% and GA_3 @ 100 ppm). The minimum (7.71 ^{o}brix) TSS was noted in B_0G_0. Increase in TSS content by boron spray has previously been shown by Ahmad (1998), Goswami *et al*. (2015) [5], Hada *et al*. (2014) [1], Rajput and Chand (1976) [10], Sharma *et al*. (1991) [11], Singh and Chhonkar (1983) [13] and Singh and Ahlawaten (1995) [12].

Table 1: Effect of boron, GA_3 and their combinations on shoot length at successive growth stages

Treatments	Shoot length at 30 DAS (cm)			
	G_0	**G_1**	**G_2**	Mean
B_0	5.39	5.53	5.89	5.60
B_1	5.47	5.54	6.38	5.80
B_2	5.51	6.18	6.46	6.05
Mean	5.46	5.75	6.25	
	B	G	B x G	
S.Em.	0.145	0.145	0.250	
$CD_{at\ 0.5\%}$	0.434	0.434	0.751	
Treatments	**Shoot length at 60 DAS (cm)**			
	G_0	**G_1**	**G_2**	**Mean**
B_0	9.70	11.61	12.91	11.41
B_1	10.40	10.58	14.68	11.89
B_2	11.18	11.13	15.12	12.48
Mean	10.43	11.11	14.24	
	B	G	B x G	
S. Em.	0.27	0.27	0.47	
$CD_{at\ 0.5\%}$	0.81	0.81	1.41	
Treatments	**Shoot length at 90 DAS (cm)**			
	G_0	**G_1**	**G_2**	**Mean**
B_0	14.29	16.20	18.00	16.16
B_1	15.07	16.34	20.27	17.23
B_2	15.89	16.51	20.79	17.73
Mean	15.08	16.35	19.68	
	B	**G**	**B x G**	
S.Em.	0.35	0.35	0.61	
$CD_{at\ 0.5\%}$	1.06	1.06	NS	

Table 2: Effect of boron, GA_3 and their combinations on shoot diameter at successive growth stages

Treatments	Shoot diameter (mm) at 30 DAS			
	G_0	G_1	G_2	Mean
B_0	2.63	2.87	2.96	2.82
B_1	2.67	2.92	3.00	2.86
B_2	2.83	2.93	3.01	2.92
Mean	2.71	2.90	2.99	
	B	G	B x G	
S. Em.	0.056	0.056	0.096	
CD at 0.5%	0.167	0.167	0.289	
Treatments	Shoot diameter (mm) at 60 DAS			
	G_0	G_1	G_2	Mean
B_0	3.11	3.62	3.71	3.48
B_1	3.15	3.67	4.06	3.63
B_2	3.58	3.70	4.12	3.80
Mean	3.28	3.67	3.96	
	B	G	B x G	
S. Em.	0.056	0.056	0.097	
CD at 0.5%	0.167	0.167	0.290	
Treatments	Shoot diameter (mm) at 90 DAS			
	G_0	G_1	G_2	Mean
B_0	3.30	3.86	3.96	3.71
B_1	3.35	3.91	4.33	3.86
B_2	3.81	3.95	4.40	4.05
Mean	3.49	3.91	4.23	
	B	G	B x G	
S. Em.	0.069	0.069	0.119	
CD at 0.5%	0.207	0.207	0.358	

Table 3: Effect of boron, GA_3 and their combinations on number of flower per shoot

Treatments	Number of flower per shoot			
	G_0	G_1	G_2	Mean
B_0	16.79	18.87	20.52	18.73
B_1	17.53	18.70	22.77	19.66
B_2	18.39	19.05	23.31	20.25
Mean	17.57	18.87	22.20	
	B	G	B x G	
S. Em.	0.387	0.387	0.670	
CD at 0.5%	1.160	1.160	2.009	

Table 4: Effect of boron, GA_3 and their combinations on fruit setting (%)

Treatments	Fruit setting (%)			
	G_0	G_1	G_2	Mean
B_0	57.20	72.77	79.19	69.72
B_1	60.65	78.92	80.24	73.27
B_2	67.25	79.74	83.05	76.68
Mean	61.70	77.14	80.83	
	B	G	B x G	
S. Em.	1.628	1.628	2.820	
CD at 0.5%	4.88	4.88	NS	

Table 5: Effect of boron, GA_3 and their combinations on fruit volume

Treatments	Fruit volume (ml)			
	G_0	G_1	G_2	Mean
B_0	141.19	152.57	176.54	156.77
B_1	146.71	156.77	184.06	162.51
B_2	150.66	171.90	202.78	175.11
Mean	146.19	160.41	187.79	
	B	G	B x G	
S. Em.	2.50	2.50	4.33	
CD at 0.5%	7.50	7.50	12.99	

Table 6: Effect of boron, GA_3 and their combinations on specific gravity

Treatments	Specific gravity			
	G_0	G_1	G_2	Mean
B_0	1.05	1.05	1.05	1.05
B_1	1.05	1.04	1.05	1.05
B_2	1.04	1.05	1.06	1.05
Mean	1.05	1.05	1.05	
	B	G	B x G	
S.Em.	0.022	0.022	0.039	
$CD_{at\ 0.5\%}$	NS	NS	NS	

Table 7: Effect of boron, GA_3 and their combinations on total soluble solids (^{0}Brix)

Treatments	Total soluble solids (^{0}Brix)			
	G_0	G_1	G_2	Mean
B_0	7.71	8.71	10.72	9.05
B_1	8.07	10.04	11.08	9.73
B_2	8.37	10.38	11.37	10.04
Mean	8.05	9.71	11.06	
	B	G	B x G	
S.Em.	0.136	0.136	0.236	
$CD_{at\ 0.5\%}$	0.408	0.408	NS	

Conclusion

The present result on guava concludes that different treatments significantly increased various growth, yield and quality parameters in comparison to control. Besides it, higher concentrations all of boron and GA_3 helped more to achieve the desired value for different growth, yield and quality parameters. B2 (Boron @ 0.4%) and G_2 (GA_3 @ 100 ppm) proved in increasing the characters which were studied. So it may be recommended at farmer's level for profitable crop production without affecting the soil health.

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