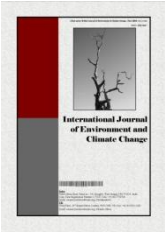

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Studies on Effect of Biofertilizers and Biostimulant on Yield Parameters of Guava (*Psidium guajava* L.) cv. Allahabad Safeda under Meadow Planting System

M. Sandhyarani [a*], A. Bhagwan [b#], A. Kiran Kumar [b†] and M. Sreedhar [c‡]

[a] Department of Fruit Science, College of Horticulture, Sri Konda Laxman Telangana State Horticultural University, Rajendranagar, Hyderabad-500030, India.
[b] College of Horticulture, Sri Konda Laxman Telangana State Horticultural University, Mulugu, Hyderabad-502279, India.
[c] Regional Sugarcane and Rice Research Station, Rudrur, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The research was carried out at Fruit research station, Sangareddy, Hyderabad during the period of June, 2019 to January, 2020 (Mrig bahar crop) to know the effect of biofertilizers and biostimulant on yield parameters of guava (*Psidium guajava* L.) cv. Allahabad Safeda under meadow planting system. The study indicated that interaction between biofertilizers and biostimulant significantly influenced yield parameters. Among the twelve treatment combinations application of B_3S_3- *Azotobacter* @ 50 g tree^{-1} + Phosphate solubilizing bacteria @ 50 g tree^{-1} + Seaweed extract @ 75 g tree^{-1} recorded maximum fruit set (56.68 %), fruit retention (54.95 %), fruit length (7.12 cm), fruit diameter (7.14 cm), fruit weight (180.69 g) and yield per tree (4.51 kg).

Keywords: Guava; azotobacter; phosphate solubilizing bacteria; seaweed extract; yield parameters.

[#] Registrar and Director of Research;
[†] Comptroller and Director of Extension;
[‡] Principal Scientist and Head;
**Corresponding author: E-mail: sandhyamaraboina12@gmail.com;*

1. INTRODUCTION

Guava (*Psidium guajava* L.) is one of the most important fruit crop. The fruit belongs to the family Myrtaceae, which has 140 genera and 3000 species widely distributed throughout the tropical and sub-tropical regions of the world. It is native to Tropical America. "At present in India it occupies nearly 2,64,000 hectares of area with 40.53 lakh tonnes of production and 15.3 MT ha^{-1} of productivity. Though it is successfully grown all over the country, the important guava growing states are Maharashtra, Madhya Pradesh, Uttar Pradesh, Bihar, West Bengal, Punjab, Gujarat, Karnataka, Andhra Pradesh, and Telangana. Telangana occupies 2,560 ha area in guava with production of 38,740 MT" [1].

In guava the meadow planting system is gaining popularity. Indiscriminate use of inorganic chemical fertilizers elevated chemical residues in field and in crop produce, leading to various health and environmental hazards along with socio-economic problems. Use of vermicompost, biofertilizers and biostimulant may help in improving tree productivity and fruit quality by increasing the availability of nutrients and stimulating the natural hormones. For sustaining highest productivity of the land and to increase soil fertility, the use of vermicompost, biofertilizers and biostimulant to crops has been suggested.

2. MATERIALS AND METHODS

The research was conducted at Fruit Research Station (FRS), Sangareddy, SKLTSHU, Telangana at the time of June, 2019 to January, 2020 (Mrig bahar crop). Soil of the experimental site was sandy clay loam with pH of 8.26, EC 0.20 dSm^{-1}. It had 120.61 kg ha^{-1} of N, 20.14 kg ha^{-1} of P and 162.56 kg ha^{-1} of K. The experimental design was Factorial Randomized Block Design (FRBD) with three replications and 12 treatment combinations consisting of three levels of biofertilizers *viz*., B_1- *Azotobacter* @ 50 g $tree^{-1}$, B_2- PSB @ 50 g $tree^{-1}$, B_3- *Azotobacter* @ 50 g $tree^{-1}$ + PSB @ 50 g $tree^{-1}$ and four levels of biostimulant *viz*., S_1- SWE @ 25 g $tree^{-1}$, S_2- SWE @ 50 g $tree^{-1}$, S_3- SWE @ 75 g $tree^{-1}$ and S_0- Control (without SWE). The treatment combinations include B_1S_1: *Azotobacter* @ 50 g $tree^{-1}$ + SWE @ 25 g $tree^{-1}$, B_1S_2: *Azotobacter* @ 50 g $tree^{-1}$ + SWE @ 50 g $tree^{-1}$, B_1S_3: *Azotobacter* @ 50 g $tree^{-1}$ + SWE @ 75 g $tree^{-1}$, B_1S_0: *Azotobacter* @ 50 g $tree^{-1}$ + Control (without SWE), B_2S_1: PSB @ 50 g $tree^{-1}$ + SWE @ 25 g $tree^{-1}$, B_2S_2: PSB @ 50 g $tree^{-1}$ + SWE @ 50 g $tree^{-1}$, B_2S_3: PSB @ 50 g $tree^{-1}$ + SWE @ 75 g $tree^{-1}$, B_2S_0: PSB @ 50 g $tree^{-1}$ + Control (without SWE), B_3S_1: *Azotobacter* @ 50 g $tree^{-1}$ + PSB @ 50 g $tree^{-1}$ + SWE @ 25 g $tree^{-1}$, B_3S_2: *Azotobacter* @ 50 g $tree^{-1}$ + PSB @ 50 g $tree^{-1}$ + SWE @ 50 g $tree^{-1}$, B_3S_3: *Azotobacter* @ 50 g $tree^{-1}$ + PSB @ 50 g $tree^{-1}$ + SWE @ 75 g $tree^{-1}$, B_3S_0: *Azotobacter* @ 50 g $tree^{-1}$ + PSB @ 50 g $tree^{-1}$ + Control (without SWE).

*__Note__: Vermicompost @ 5 kg $tree^{-1}$ is common to all the treatments

PSB: Phosphate solubilizing bacteria
SWE: Sea weed extract

3. RESULTS AND DISCUSSION

3.1 Fruit Set (%)

"The combination of biofertilizers and biostimulant was significant on fruit set (%). The maximum fruit set (56.68%) was recorded with the application of B_3S_3- *Azotobacter* @ 50 g $tree^{-1}$ + Phosphate solubilizing bacteria @ 50 g $tree^{-1}$ + SWE @ 75 g $tree^{-1}$, followed by B_3S_2- *Azotobacter* @ 50 g $tree^{-1}$ + Phosphate solubilizing bacteria @ 50 g $tree^{-1}$ + SWE @ 50 g $tree^{-1}$ (54.40%). The minimum fruit set (32.07%) was recorded with the application of B_1S_0- *Azotobacter* @ 50 g $tree^{-1}$ and without SWE" [2].

Application of vermicompost, biofertilizers and SWE enhanced nutrient availability from vermicompost, phosphorus through Phosphate solubilizing bacteria and nitrogen from *Azotobacter* are familiar for gathering of dry matter and their dislocation furthermore favour synthesis of different plant growth regulators like brassinosteroids, auxins, cytokinins and gibberellins were effective in stimulating pollen germination and pollen tube growth which eventually increases pollination, fertilization and fruit set percentage [3]. Similar results are observed by Godage et al. [4] in guava, Tripathi et al. [5] in strawberry.

3.2 Fruit Retention (%)

"The combination of biofertilizers and biostimulant was significant on fruit retention percentage (%). Maximum fruit retention (54.95%) was recorded with the application of B_3S_3- *Azotobacter* @ 50 g $tree^{-1}$ + Phosphate solubilizing bacteria @ 50 g $tree^{-1}$ + SWE @ 75 g $tree^{-1}$, followed by B_3S_2- *Azotobacter* @ 50 g $tree^{-1}$ + Phosphate solubilizing bacteria @ 50 g $tree^{-1}$ + SWE @ 50 g $tree^{-1}$ (52.19%). Fruit retention (34.41%) recorded

minimum with the application of B_1S_0- *Azotobacter* @ 50 g tree^{-1} and without SWE" [2].

The rise in fruit retention percentage might be due to biofertilizers and SWE have been associated with increased tolerance to biotic and abiotic stress with higher chlorophyll concentration, enhanced photosynthesis and mobilization of nutrients to the reproductive organs which ultimately increased fruit retention percentage by reducing flower and fruit abortion [6]. Similar results are observed by Ruiz et al. [7] in citrus, Aseri et al. [8] in pomegranate, Percival [9] in apple.

3.3 Fruit Length (cm)

The combination of biofertilizers and biostimulant was significant on fruit length (cm). Highest fruit length (7.12 cm) was noted with the application of B_3S_3- *Azotobacter* @ 50 g tree^{-1} + Phosphate solubilizing bacteria @ 50 g tree^{-1} + SWE @ 75 g tree^{-1}, which is on par with B_3S_2- *Azotobacter* @ 50 g tree^{-1} + Phosphate solubilizing bacteria @ 50 g tree^{-1} + SWE @ 50 g tree^{-1} (7.10 cm). Fruit length (5.09 cm) recorded minimum with B_1S_0- *Azotobacter* @ 50 g tree^{-1} and without SWE.

Increased fruit length might be due to biofertilizers and seaweed extract enhanced the availability of nutrients and plant growth regulators like auxins and cytokinins successively stimulate cell division, cell enlargement and increased sink strength of the fruits [10]. Similar results are observed by Sharma et al. [11], Binepal et al. [12], Dhomane and Kadam [13], Kumar et al. [14] in guava.

3.4 Fruit Diameter (cm)

The combination of biofertilizers and biostimulant was significant on fruit diameter (cm). Fruit diameter (7.14 cm) was maximum with the application of B_3S_3- *Azotobacter* @ 50 g tree^{-1} + Phosphate solubilizing bacteria @ 50 g tree^{-1} + SWE @ 75 g tree^{-1}, which is on par with the application of B_3S_2- *Azotobacter* @ 50 g tree^{-1} + Phosphate solubilizing bacteria @ 50 g tree^{-1} + SWE @ 50 g tree^{-1} (7.12 cm). The fruit diameter (5.11 cm) was minimum with the use of B_1S_0- *Azotobacter* @ 50 g tree^{-1} and without SWE.

Improvement in fruit diameter by application of biofertilizers and seaweed extract were probably due to familiar for gathering of dry matter and their dislocation furthermore favour synthesis of different plant growth regulators like auxins, gibberellins and cytokinins stimulate cell division and elongation, ultimately the growth and development of fruit has enhanced and resulted in increase of fruit diameter [15]. Similar results are observed by Binepal et al. [12], Dhomane and Kadam [13], Sharma et al. [11] and Kumar et al. [14] in guava.

3.5 Fruit Weight (g)

"The combination of biofertilizers and biostimulant was significant on fruit weight (g). Highest fruit weight (180.69 g) was noted with the use of B_3S_3- *Azotobacter* @ 50 g tree^{-1} + Phosphate solubilizing bacteria @ 50 g tree^{-1} + SWE @ 75 g tree^{-1}, which is on par with the application of B_3S_2- *Azotobacter* @ 50 g tree^{-1} + Phosphate solubilizing bacteria @ 50 g tree^{-1} + SWE @ 50 g tree^{-1} (177.65 g). The fruit weight (112.75 g) was minimum with the use of B_1S_0- *Azotobacter* @ 50 g tree^{-1} and without SWE" [2].

Improvement in fruit weight might be due to nutrients, plant growth hormones, trace elements and vitamins present in biofertilizers and seaweed extract may have resulted in higher photoassimilate supply to the growing fruit as a consequence of intensification of the sink demand, thereby increasing the weight of fruit. Similar results are reported by Dalal et al. [16] in sapota, Sheikh and Rao [17] in pomegranate.

3.6 Yield per Tree (kg)

The combination of biofertilizers and biostimulant was significant on yield per tree (kg). Yield per tree (4.51 kg) was maximum with the use of B_3S_3- *Azotobacter* @ 50 g tree^{-1} + Phosphate solubilizing bacteria @ 50 g tree^{-1} + SWE @ 75 g tree^{-1}, followed by B_3S_2- *Azotobacter* @ 50 g tree^{-1} + Phosphate solubilizing bacteria @ 50 g tree^{-1} + SWE @ 50 g tree^{-1} (4.17 kg). Yield per tree (1.12 kg) was minimum with the use of B_1S_0- *Azotobacter* @ 50 g tree^{-1} and without SWE.

Maximum yield per tree might be due to the use of biofertilizers and SWE regulates the plant bio-physiological activities like increasing chlorophyll content in the leaf, nutrient uptake, photosynthetic activity and synthesis of plant growth regulators during growth and development of fruit which might have ultimately improved yield per tree. The present results were in agreement with those of Dhomane and Kadam [13], Sharma et al. [11], Yadav et al. [18] and Kumar et al. [14] in guava [19-21].

Table 1. Effect of biofertilizers and biostimulant on yield parameters of guava cv. Allahabad Safeda under meadow planting system

Treatments	Fruit set (%)	Fruit retention (%)	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (g)	Yield per tree (kg)
T_1 - (B_1S_1)	40.83	41.85	5.36	6.15	136.81	1.90
T_2 - (B_1S_2)	43.76	42.65	5.53	6.31	160.73	2.56
T_3 - (B_1S_3)	46.34	43.85	5.85	6.58	168.74	2.86
T_4 - B_1S_0)	32.07	34.41	5.09	5.11	112.75	1.12
T_5 - (B_2S_1)	41.74	42.08	5.43	6.29	142.51	2.13
T_6 - (B_2S_2)	45.26	43.01	5.65	6.47	164.79	2.82
T_7 - (B_2S_3)	47.03	45.90	5.91	6.73	170.77	3.08
T_8 - (B_2S_0)	34.23	36.65	5.16	5.14	115.00	1.26
T_9 - (B_3S_1)	50.30	47.83	6.73	6.85	173.89	3.64
T_{10} - (B_3S_2)	54.40	52.19	7.10	7.12	177.65	4.17
T_{11} - (B_3S_3)	56.68	54.95	7.12	7.14	180.69	4.51
T_{12} - (B_3S_0)	36.84	38.62	5.29	5.17	118.65	1.41
SE (m) ±	0.31	0.26	0.04	0.05	1.50	0.02
CD at 5%	0.90	0.76	0.12	0.14	4.42	0.06

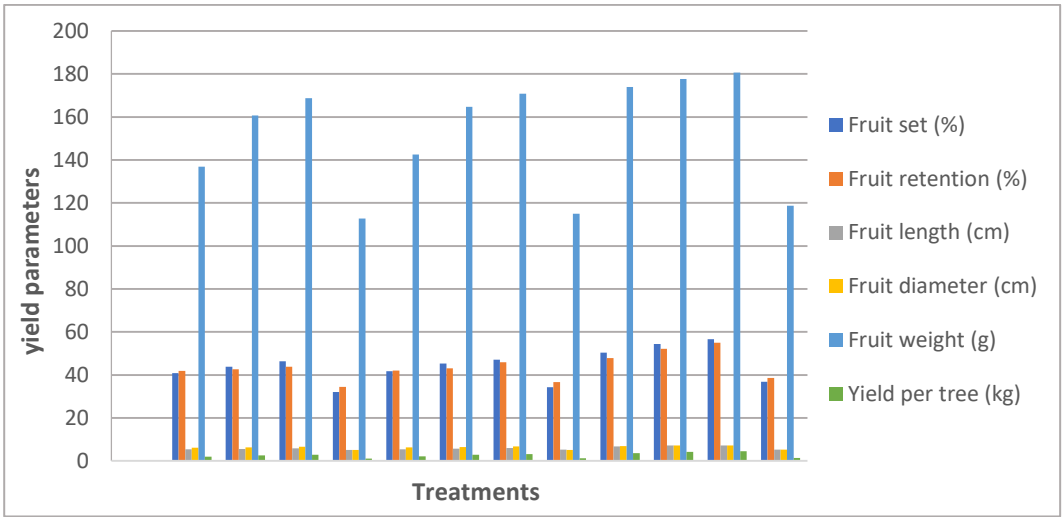

Fig. 1. Effect of biofertilizers and biostimulant on yield parameters of guava cv. Allahabad Safeda under meadow planting system

4. CONCLUSION

From this research, it can be concluded that T_{11} ($B_3S_{3)}$) - *Azotobacter* @ 50 g tree^{-1} + PSB @ 50 g tree^{-1} + SWE @ 75 g tree^{-1} per tree increased yield parameters like fruit set percenatge, fruit retention percenatge, fruit length (cm), fruit diameter (cm), fruit weight (g) and yield per tree cv. Allahabad Safeda under meadow planting system.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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