STUDIES ON EFFECT OF BIOFERTILIZERS AND BIOSTIMULANT ON YIELD PARAMETERS OF GUAVA (*Psidium guajava* L.) cv. ALLAHABAD SAFEDA UNDER MEADOW PLANTING SYSTEM

ABSTRACT

The study was carried out at the Fruit research station, Sangareddy, Sri Konda Laxman Telangana State Horticultural University, Hyderabad during the period of June, 2019 to January, 2020 (Mrig bahar crop) to find out the effect of biofertilizers and biostimulant on yield parameters of guava (*Psidium guajava* L.) Cv. Allahabad Safeda under meadow planting system. The results revealed 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

Introduction

Guava (*Psidium guajava* L.) is one of the most popular fruit grown in tropical and subtropical regions of India, which belongs to the family Myrtaceae and originated in Tropical America. In India, guava is cultivated in an area of 2,64,000 hectares with a production of 40.53 lakh tonnes and productivity 15.3 MT ha^{-1}. Uttar Pradesh has highest area and production Andhra Pradesh leads in productivity (Anonymous, 2017-18). Telangana has 2,560 ha area in guava with production of 38,740 MT (Anonymous, 2017-18). Winter guava is mostly preferred in the state which gives flowering in June-July and comes to harvest during Nov - Dec.

Generally, guava is cultivated using traditional planting system (6.0 x 6.0 m), under which it is difficult to achieve desired levels of production, because large trees provide low production per unit area and need high labour inputs. Moreover, large trees take several years before they come into bearing and overall cost of production per unit area is further increased. Hence, there is an overriding need to improve the existing planting system (Gorakh Singh, 2001).

Certain important strategies have been identified for enhancing guava production in India in order to be competitive in the world market. It involves adaptation of modern, innovative and hi-tech

plantation methods e.g. high-density planting (3 x 1.5 m) or meadow orchard (2.0 x 1.0 m) coupled with pruning. In context of globalization era, there is a definite shift in farmer's perception from production to productivity and profitability which can be achieved through high density planting (Singh, 2008).

Among various aspects that influenced growth, development and quality of guava, nutrition is one of the important element of crop production. Indiscriminate use of chemical fertilizers has lead to several detrimental effects both on soil and environment. The soil, water and even air got polluted by the use of agro-chemicals. The residues left over by the inorganic fertilizers got into the food chain causing health problems to the human as well as animals. The chemical fertilizers are in short supply and considered as expensive input for developing countries like India. There is great demand for organically grown produce. All these necessitated to search alternate and cost effective materials for cultivation of crops. Switch over to the organic materials, which are natural source of nutrients, appears an effective alternative.

Materials and Methods

The experiment was carried out during the period of June, 2019 to January, 2020 (Mrig bahar crop) at Fruit Research Station (FRS), Sangareddy, SKLTSHU, Telangana. The soil type was sandy clay loam having pH 8.26, EC 0.20 dSm^{-1}, low in available N (120.61 kg ha^{-1}), low in available P (20.14 kg ha^{-1}) and medium in available potash (162.56 kg ha^{-1}). The experiment was laid out in Factorial Randomized Block Design (FRBD) in three replications with 12 treatment combinations comprised of three levels of biofertilizers *viz.*, B_1- *Azotobacter* @ 50 g $tree^{-1}$, B_2- Phosphate solubilizing bacteria @ 50 g $tree^{-1}$, B_3- *Azotobacter* @ 50 g $tree^{-1}$ + Phosphate solubilizing bacteria @ 50 g $tree^{-1}$ and four levels of biostimulant *viz.*, S_1- Seaweed extract @ 25 g $tree^{-1}$, S_2- Seaweed extract @ 50 g $tree^{-1}$, S_3- Seaweed extract @ 75 g $tree^{-1}$ and S_0- Control (without seaweed extract). The treatment combinations include B_1S_1: *Azotobacter* @ 50 g $tree^{-1}$ + Seaweed extract @ 25 g $tree^{-1}$, B_1S_2: *Azotobacter* @ 50 g $tree^{-1}$ + Seaweed extract @ 50 g $tree^{-1}$, B_1S_3: *Azotobacter* @ 50 g $tree^{-1}$ + Seaweed extract @ 75 g $tree^{-1}$, B_1S_0: *Azotobacter* @ 50 g $tree^{-1}$ + Control (without seaweed extract), B_2S_1: Phosphate solubilizing bacteria @ 50 g $tree^{-1}$ + Seaweed extract @ 25 g $tree^{-1}$, B_2S_2: Phosphate solubilizing bacteria @ 50 g $tree^{-1}$ + Seaweed extract @ 50 g $tree^{-1}$, B_2S_3: Phosphate solubilizing bacteria @ 50 g $tree^{-1}$ + Seaweed extract @ 75 g $tree^{-1}$, B_2S_0: Phosphate solubilizing bacteria @ 50 g $tree^{-1}$ + Control (without seaweed extract), B_3S_1: *Azotobacter* @ 50 g $tree^{-1}$ + Phosphate solubilizing bacteria @ 50 g $tree^{-1}$ + Seaweed extract @ 25 g $tree^{-1}$, B_3S_2: *Azotobacter* @ 50 g $tree^{-1}$ + Phosphate solubilizing bacteria @ 50 g $tree^{-1}$ + Sea weed extract @ 50 g $tree^{-1}$, B_3S_3: *Azotobacter* @ 50 g $tree^{-1}$

+ Phosphate solubilizing bacteria @ 50 g tree^{-1} + Sea weed extract @ 75 g tree^{-1}, B_3S_0: *Azotobacter* @ 50 g tree^{-1} + Phosphate solubilizing bacteria @ 50 g tree^{-1} + Control (without seaweed extract)

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

Results and Discussion

1. Fruit set (%)

Interaction between biofertilizers and biostimulant had significant effect 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} + Sea weed extract @ 75 g tree^{-1}, followed by B_3S_2- *Azotobacter* @ 50 g tree^{-1} + Phosphate solubilizing bacteria @ 50 g tree^{-1} + Sea weed extract @ 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 seaweed extract.

The application of vermicompost, biofertilizers and seaweed extract enhances the nutrient availability from vermicompost, phosphorus through Phosphate solubilizing bacteria and nitrogen from *Azotobacter* are known for accumulation of dry matter and their translocation as well as favour synthesis of different growth regulators like brassinosteroids, auxins, cytokinins and gibberellins were effective in stimulating pollen germination and pollen tube growth which ultimately increases pollination, fertilization and fruit set (Gajbhiye *et al.*, 2003). These results are in accordance to the findings of Godage *et al.* (2013) in guava, Tripathi *et al.* (2010) in strawberry.

2. Fruit retention (%)

Interaction between biofertilizers and biostimulant had significant effect 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} + Sea weed extract @ 75 g tree^{-1}, followed by B_3S_2- *Azotobacter* @ 50 g tree^{-1} + Phosphate solubilizing bacteria @ 50 g tree^{-1} + Sea weed extract @ 50 g tree^{-1} (52.19 %). The minimum fruit retention (34.41 %) was recorded with the application of B_1S_0- *Azotobacter* @ 50 g tree^{-1} and without seaweed extract.

The increase in fruit retention percentage might be due to the reason that application of biofertilizers and seaweed extract 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 (Whapmam *et al*., 1993). These results are in accordance to the findings of Ruiz *et al.* (2001) in citrus, Aseri *et al*. (2008) in pomegranate, Percival (2010) in apple.

3. Fruit length (cm)

Interaction between biofertilizers and biostimulant had significant effect on fruit length (cm). Maximum fruit length (7.12 cm) was recorded with the application of B_3S_3- *Azotobacter* @ 50 g tree^{-1} + Phosphate solubilizing bacteria @ 50 g tree^{-1} + Sea weed extract @ 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} + Sea weed extract @ 50 g tree^{-1} (7.10 cm). The minimum fruit length (5.09 cm) was recorded with the application of B_1S_0- *Azotobacter* @ 50 g tree^{-1} and without seaweed extract.

The increased fruit length might be due to the reason that application of biofertilizers and seaweed extract enhances the availability of nutrients and growth promoting substances like auxins and cytokinins which in turn stimulate cell division, cell enlargement and increased sink strength of the fruits (Shubash *et al.*, 2018). These results are in accordance to the findings of Sharma *et al*. (2013), Binepal *et al*. (2013), Dhomane and Kadam (2013), Kumar *et al*. (2017) in guava.

4. Fruit diameter (cm)

Interaction between biofertilizers and biostimulant had significant effect on fruit diameter (cm). Maximum fruit diameter (7.14 cm) was recorded with the application of B_3S_3- *Azotobacter* @ 50 g tree^{-1} + Phosphate solubilizing bacteria @ 50 g tree^{-1} + Sea weed extract @ 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} + Sea weed extract @ 50 g tree^{-1} (7.12 cm). The minimum fruit diameter (5.11 cm) was recorded with the application of B_1S_0- *Azotobacter* @ 50 g tree^{-1} and without seaweed extract.

Improvement in fruit diameter by application of biofertilizers and seaweed extract were probably due to accumulation of dry matter and their translocation as well as favours synthesis of different growth regulators like auxins, gibberellins and cytokinins stimulate cell division and elongation, consequently the growth and development of fruit has enhanced and resulted in increase of fruit diameter (Awasthi *et al*., 1998). Sharma *et al*. (2013), Binepal *et al*. (2013), Dhomane and Kadam (2013), Kumar *et al*. (2017) in guava.

5. Fruit weight (g)

Interaction between biofertilizers and biostimulant had significant effect on fruit weight (g). Maximum fruit weight (180.69 g) was recorded with the application of B_3S_3- *Azotobacter* @ 50 g

tree^{-1} + Phosphate solubilizing bacteria @ 50 g tree^{-1} + Sea weed extract @ 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} + Sea weed extract @ 50 g tree^{-1} (177.65 g). The minimum fruit weight (112.75 g) was recorded with the application of B_1S_0- *Azotobacter* @ 50 g tree^{-1} and without seaweed extract.

The increase in fruit weight might be due to the reason that 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. These results are more or less in conformity with the findings reported by Dalal *et al*. (2004) in sapota, Sheikh and Rao (2005) in pomegranate.

6. Yield per tree (kg)

Interaction between biofertilizers and biostimulant had significant effect on yield per tree (kg). Maximum yield per tree (4.51 kg) was recorded with the application of B_3S_3- *Azotobacter* @ 50 g tree^{-1} + Phosphate solubilizing bacteria @ 50 g tree^{-1} + Sea weed extract @ 75 g tree^{-1}, followed by B_3S_2- *Azotobacter* @ 50 g tree^{-1} + Phosphate solubilizing bacteria @ 50 g tree^{-1} + Sea weed extract @ 50 g tree^{-1} (4.17 kg). The minimum yield per tree (1.12 kg) was recorded with the application of B_1S_0- *Azotobacter* @ 50 g tree^{-1} and without seaweed extract.

The increase in yield per tree might be due to the reason that application of biofertilizers and seaweed extract increased the soil nutrient availability and their uptake by the plants that result in better vegetative growth, which might have produced higher quantum of carbohydrates needed for the development of fruits thereby, increase in number, size and weight of fruits which ultimately increased the yield. The present results were in agreement with those of Dhomane and Kadam (2013), Sharma *et al.* (2013), Yadav *et al.* (2013) and Kumar *et al*. (2017) in guava.

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

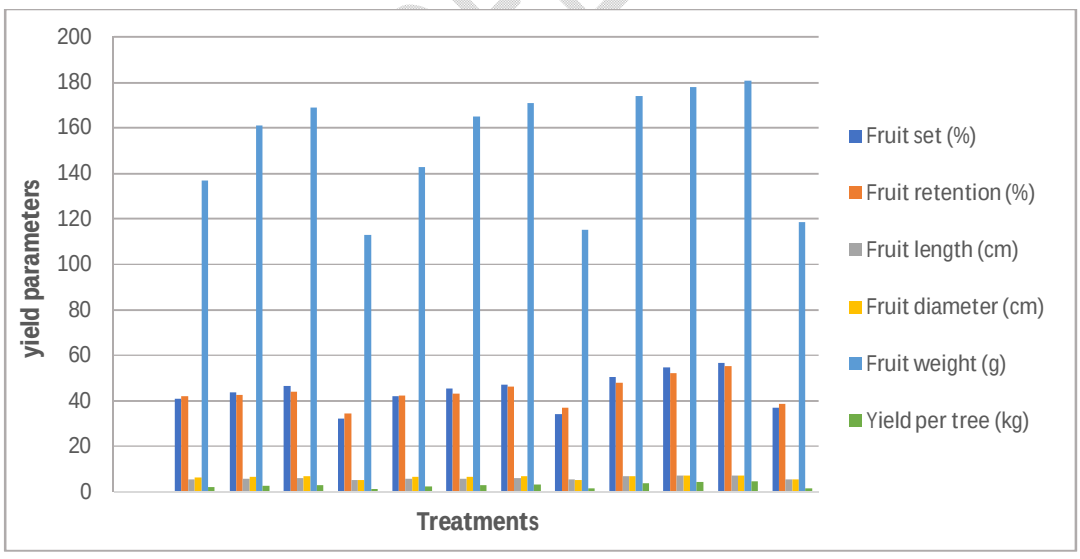

Fig 1: Effect of biofertilizers and biostimulant on yield parameters of guava cv. Allahabad Safeda under meadow planting system

Conclusion

Interaction between biofertilizers and biostimulant significantly influenced yield parameters. Among all the interactions B_3S_3- *Azotobacter* @ 50 g tree^{-1} + Phosphate solubilizing bacteria @ 50 g tree^{-1} + Sea weed extract @ 75 g tree^{-1} recorded maximum fruit set, fruit retention, fruit length, fruit diameter, fruit weight and yield per tree cv. Allahabad Safeda under meadow planting system.

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