Research Article

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Effect of foliar application of biofertilizers on productivity and quality of guava (*Psidium guajava* L.)

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ABSTRACT

This study examines the impact of foliar biofertilizer applications on the yield and quality parameters of guava (Psidium guajava L.) variety L-49. The results revealed significant improvements in both yield and quality parameters of guava with biofertilizer applications compared to the control. Among the treatments, T_7 (Trichoderma viride 10%) emerged as the most effective, significantly enhancing yield and quality parameters compared to the control (T_1). T_7 recorded the highest number of fruits per plant (96.50), with increases of 50% over the control, which is at par with Trichoderma viride 5%, Pseudomonas 10% and Pseudomonas 5%. Trichoderma viride at 10% exhibited the highest yield (21.95 kg/plant), with increases of 99% over the control, which is at par with Trichoderma viride 5%. It also demonstrated superior fruit dimensions, weight (226.99 g), and pulp percentage (96.29%), reflecting enhanced productivity. In terms of fruit quality, T_7 achieved the highest TSS (12.80 °Brix), TSS: acid ratio (39.03), ascorbic acid content (234.60 mg/100g), and sugar content (9.60%), while maintaining balanced acidity (0.328%).

Introduction

Guava (*Psidium guajava* L.), locally it is known by '*beehi*' and '*jaam*' is one of the important fruit crop in all over India, which belongs to the Myrtaceae family. It is not only a delicious table fruit, valued for its excellent flavor, nutritional content, and pectin, but it is also crucial for the processing industry. It is popular among the people of all social strata due to its comparative low price than some other fruits (Bhooriya *et al*., 2020). The fruit has fair source of Vitamin A and good source of Vitamin C (300mg/100g) which is highest among table fruit. It is also an excellent source of beta-carotene, lycopene, potassium and soluble fiber. Guavas are very rich in antioxidants, which can act against the free radicals that damage cells and cause cancer, diabetes and coronary diseases (Kuldeep *et al*., 2019). India is the major producer of guava fruit in the world and it shares about 45 % of total production of guava. Major guava producing states include Madhya Pradesh, Uttar Pradesh, Maharashtra, Bihar, West Bengal, Gujarat, and Karnataka. Madhya Pradesh is the second largest producer of guava after Maharashtra. With an area of 46069.6 ha and 875199.86 MT production (Anonymous, 2020).

The sole application of chemical fertilizers, even in balanced forms, may not sustain soil fertility in guava orchards. Research encourages integrating inorganic fertilizers with biofertilizers, organic manures, and crop residues to enhance soil productivity and crop yield (Singh *et al.*, 2011). Biofertilizers, carrier-based microorganisms, improve soil health and nutrient uptake. Microbial inoculants such as

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Azotobacter, phosphate-solubilizing microbes (PSM), and *Trichoderma* improve nitrogen fixation, nutrient availability, plant growth, and disease resistance (Adak *et al*., 2007).

Trichoderma are considered among the main biological control agents against phytopathogenic fungi, in addition to being biostimulants. Application of Trichoderma to plants activates secondary metabolites that help to promote growth, improve nutrient availability, and induce systemic resistance against diseases, mainly phytopathogenic fungi.

Phosphate-solubilizing microbes (PSM) are a group of microorganisms, primarily bacteria and fungi that have the ability to solubilize phosphorus present in the soil. By using PSM as biofertilizers, farmers can enhance the phosphorus uptake by plants and improve their growth and productivity. Biofertisol is rich in nitrogen and are a source of several trace elements. Biofertisol is a mixed product of fish hydrolysate and sea weed (rockweed) which contain N:P:K (4:2:3), micronutrients, phytohormones (like cytokinins), betaines and work as pH controller. In light of these findings, this study was undertaken to evaluate the influence of biofertilizer foliar applications on guava productivity and quality.

Material and Methods

The experiment was conducted on 8-year-old guava variety L-49 at the Fruit Research Station, JNKVV, Jabalpur (MP) during 2020-21. The location falls on 23.9° North latitude and 79.58° East longitudes with an altitude of 411.8 m above the mean sea level. The experiment was laid out in Randomized Block Design with four replications. The treatments comprised of Control (water spray), T_2 (Trichoderma viride 5%), T_3 (Trichoderma viride 10%), T_4 (Pseudomonas 5%), T_5 (Pseudomonas 10%), T_6 (Biofertisol 5%), and T_7 (Biofertisol 10%). The treatments were imposed as foliar spray at pre-flowering and 30 days post-fruit set. The treatments were applied as foliar sprays at the pre-flowering stage and 30 days after fruit set.

The observations were recorded on various parameters of biochemical and yield attributing characters with different treatments application. In yield parameters includes number of fruits/ plant, yield/ plant (kg), fruit length (cm), fruit width (cm), fruit weight (g), and pulp percent. TSS (^{o}Brix), acidity (%), TSS acid ratio, ascorbic acid (mg/100 g) and total sugar (%) was recorded in quality parameters.

At each picking, the number of fruits per plant was independently recorded and at the time of harvest fruit length and width of the fruit was recorded with the help of Vernier Calipers in centimeters. The pulp percent was calculated by deducting the weight of seed and peel from the total weight of fruit. Pulp percent was calculated by total weight of pulp divided by total weight of fruit. To record TSS (^{o}Brix), using a hand refractometer, a few drops of extracted juice were put on the surface of the refractometer's prism with the assistance of a clean glass rod. The acidity (%), TSS acid ratio, ascorbic acid (mg per 100 g), total sugar (%), was determined using the AOAC (1970) technique.

Result and Discussion

The different yield attributing parameters (Table 1) of the guava show that the highest number of fruits per plant (96.50) was recorded in T_7 (*Trichoderma* viriIde 10%), significantly surpassing the control (64.36) by 50%. The yield per plant in T_7 was 21.95 kg, a 99% increase compared to the control (11.03 kg). This substantial improvement highlights the efficacy of *Trichoderma viride* 10% in enhancing guava productivity. T_7's yield was significantly superior to both T_6 (18.52 kg) and T_5 (17.43 kg), indicating its dominant performance. T_7 exhibited the maximum fruit length of 6.78 cm, fruit width (7.13 cm) and fruit weight (226.99 g,) which was higher than the control (171.22 g). The treatment T_7 achieved the highest pulp percentage of 96.29%, which was significantly higher than the control (93.47%). The investigation aligned with the hypothesis proposed by Dey *et al.* (2005), which states that biofertilizers, being microbial in origin, serve as viable alternatives due to their ability to enrich the soil with beneficial microorganisms. They facilitate the conversion of nutritionally important elements from non-usable to usable forms through biological processes, thereby enhancing the production of various fruit crops. Numerous studies on the broad spectrum of horticultural crops have shown that the use of beneficial microorganisms (e.g., the fungus *Trichoderma sp*.) may promote primary or secondary plant metabolism and boosts crop yield (Rouphael *et al*., 2017). Molla *et al*. (2012) found that the application of Trichoderma improved the quality of the tomato fruit.

The different quality attributing parameters (Table 2) of the guava show that T_7 exhibited the maximum TSS (12.80 °Brix), which was significantly higher than the control (11.27 °Brix). This higher TSS reflects improved sweetness and quality of the fruit. T_7 maintained a balanced acidity (0.328%), which is statistically at par with T_6 (0.335%) but significantly lower than the control (0.355%), contributing to enhanced fruit palatability. The TSS:acid ratio was the highest in T_7 (39.03), which was significantly superior to T_1 (29.32) and at par with T_6 (32.85). A higher TSS:acid ratio indicates better flavor and sweetness in the fruit. T_7 recorded the highest ascorbic acid content (234.60 mg/100g), which was significantly higher than the control (175.12 mg/100g). It was followed closely by T_6 (225.93 mg/100g). This suggests that *Trichoderma viride* at 10% enhances the ascorbic acid content, which is critical for nutritional quality. T_7 had the highest sugar content (9.60%), significantly superior to T_1 (8.64%) and at par with T_6 (9.36%). This increase in sugar contributes to the overall sensory quality of the fruit. The significant differences in quality parameters highlighted the efficacy

of *Trichoderma viride* (10%) in improving guava quality. Treatment T_7 (*Trichoderma viride* 10%) was significantly better than T_1 (control) across all parameters and was at par with T_6 (*Trichoderma viride* 5%) and T_3 (Biofertisol 10%) in most of the attributes. These findings are closely supported by the studies of Molla *et al.* (2012), and Lal *et al.* (2017), who reported that the foliar application of *Trichoderma* enhanced total soluble solids (TSS), the ratio of TSS to titratable acidity, and ascorbic acid content. These finding is nearly supported with Molla *et al.* (2012) and Lal *et al.* (2017) found foliar application of Trichoderma increased the total soluble solids (TSS), ratio of total soluble solids to titratable acidity and ascorbic acid. In case of acidity (%) foliar application of Pseudomonas 10% (T_5) was recorded to have minimum acidity (0.311%) and maximum non reducing sugar (4.05%) which was significant among all the treatments.

Table 1. Effect of various biofertilizers on yield parameters of 8-year-old guava

Treatments		Number of fruits/ plant	Yield/ plant (kg)	Fruit length (cm)	Fruit width (cm)	Fruit weight (g)	Pulp (%)
T_1	Control (water spray)	64.36	11.03	5.63	6.05	171.22	93.47
T_2	Biofertisol 5%	68.50	13.08	6.25	6.89	191.97	95.40
T_3	Biofertisol 10%	75.25	15.33	6.38	6.90	204.46	95.25
T_4	Pseudomonas 5%	87.75	15.98	5.93	6.47	181.60	94.37
T_5	Pseudomonas 10%	92.25	17.43	6.10	6.43	188.63	95.11
T_6	*Trichoderma viride* 5%	89.50	18.52	6.49	7.01	206.25	95.28
T_7	*Trichoderma viride* 10%	96.50	21.95	6.78	7.13	226.99	96.29
	SEm±	4.35	1.281	0.202	0.14	9.19	0.26
	CD at 5%	12.94	3.81	0.600	0.41	27.30	0.77

Table 2. Effect of various biofertilizers on quality parameter of 8-year-old guava

Treatments		TSS (°Brix)	Acidity (%)	TSS acid ratio	Ascorbic acid (mg per 100 g)	Total sugar (%)
T_1	Control (water spray)	11.27	0.355	29.32	175.12	8.64
T_2	Biofertisol 5%	11.42	0.343	32.03	198.39	8.80
T_3	Biofertisol 10%	11.61	0.340	32.62	213.86	9.31
T_4	Pseudomonas 5%	11.40	0.350	30.73	189.37	8.72
T_5	Pseudomonas 10%	11.55	0.278	33.25	200.14	9.16
T_6	*Trichoderma viride* 5%	11.73	0.335	32.85	225.93	9.36
T_7	*Trichoderma viride* 10%	12.80	0.328	33.13	234.60	9.60
	SEm±	0.15	0.011	0.87	5.89	0.14
	CD at 5%	0.46	0.033	2.57	17.50	0.42

Conclusion

The study demonstrates the efficacy of Trichoderma viride 10% (T_7) in enhancing guava productivity and quality parameters. T_7 exhibited superior performance in yield attributes such as the number of fruits per plant, yield per plant, fruit size, and pulp percentage, and quality traits like TSS, ascorbic acid, and sugar content. Overall, Trichoderma viride 10% proves to be a highly effective and sustainable biofertilizer, supporting enhanced fruit productivity, superior quality, and nutritional quality of guava.

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Conflict of Interest

The authors have no conflict of interest.

Data Sharing

All relevant data are within the manuscript.

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