

The Effect of Biofertilizers on Growth, Yield and Quality of Cape Gooseberry (*Physalis Peruviana L.*) in Prayagraj Agro-climatic Conditions

Abstract

The present investigation “The effect of biofertilizers on growth, yield and quality of Cape Gooseberry (*Physalis peruviana L.*) in Prayagraj agroclimatic conditions” was undertaken at Central Research Field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (UP) during 2022-2023. The main objective of the experiment was to find out the effect of various biofertilizers on yield and quality of Cape Gooseberry and to estimate the economics of various treatments. The experiment was laid out in a Randomized Block Design (RBD) with 10 treatment combinations viz, **T₀**(Control), **T₁**(100% RDF), **T₂**(100% RDF+ Azotobacter) 10g, **T₃** (100% RDF + Azospirillum) 10g, **T₄** (100% RDF + Azotobacter)10g, **T₅** (75% RDF= Azotobacter) 10g, **T₆**(75% RDF + Azospirillum) 10g, **T₇**(75% RDF + Trichoderma) 10g, **T₈**(75% RDF + Azotobacter + Azospirillum) 10g, **T₉**(75% RDF + Azotobacter + Azospirillum + Trichoderma) 10g with three replications. From the present investigation treatment **T₉**(75% RDF + Azotobacter + Azospirillum + Trichoderma) 10g performed best in terms of yield parameters, (fruit weight (10.39g), and quality parameters Acidity (0.14%), of Cape Gooseberry. However, the highest B:C ratio was found in Treatment.

Keywords: Biofertilizers, Cape gooseberry, Growth, Yield, Quality.

Introduction

The Cape Gooseberry belongs to the Solanaceae family and is a minor fruit crop worldwide. It goes by a variety of names around the world, including golden berry (South Africa and the United Kingdom), huge ground cherry, Peruvian ground cherry, and Peruvian cherry (United States), poha (Hawaii), jam fruit (India), uvilla (Ecuador), and uchuva (Colombia). It is a fast-growing herbaceous crop that may be spread readily through seeds and cuttings. The cape gooseberry can acclimatize to a wide range of soil types and weather conditions. Essentially a warm season crop, it needs a lengthy growing season to provide a profit. It can also be grown in temperate, tropical, and subtropical climates. The cape gooseberry comes in three varieties that are native to South Africa, Kenya, and Colombia. Colombia is the world's largest producer of cape gooseberry followed by South Africa. The cape gooseberry is indigenous to South America but was cultivated in South Africa in the region of the Cape of Good Hope during the 19th century, imparting the common name, "cape gooseberry". "The species *P. peruviana* was introduced in South Africa by the Spanish from where it spread to different countries where it is grown commercially"(Kumar *et al.*,2018; Prasad andKushwaha, 2022)

A small fruit crop grown worldwide; the cape gooseberry belongs to the Solanaceae family. In many regions of the world, it is known by several names, including golden berry (South Africa and the United Kingdom), huge ground cherry, Peruvian ground cherry, and Peruvian cherry (U.S.), poha (Hawaii), jam fruit (India), uvilla (Ecuador), and uchuva (Colombia). It is a herbaceous crop that grows quickly and is easily multiplied from seeds or cuttings. The cape gooseberry is extremely adaptable

to various soil types and environmental conditions. Since it grows best during the warm months, the growing season must be somewhat extended to generate satisfactory harvests. It may also be grown in tropical, subtropical, and temperate climates. Worldwide, three distinct species of cape gooseberry, which are native to South Africa, Kenya, and Colombia, are grown. Gibberellic acid delays the senescence of fruits. Naphthalene acetic acid reduces the fruit drop and increases the number of fruits to be set **Smitha *et al.*, (2016)**. "Though plant growth regulators have great potential to influence plant growth morphogenesis but its application have to be judiciously planned in terms of optimal concentration, which constitute the major impediments in plant growth regulators applicability. Since very little information is available in the effect of growth regulators on growth and yield of cape gooseberry, the present investigation was aimed to find out suitable growth regulators for increasing the yield potential and quality in cape gooseberry. Generally, the fruit of *P. peruviana* L. is consumed fresh as well as vegetable salads. The whole fruit can be used in syrup and dried as it becomes a "very nice raisin. The fruit is also used in sauces and glazes for meats and seafood. It can also be used for making jams and jellies"(Meena*et al.*,2017). Pectinase content is high in the juice of ripe fruit, which lowers the cost of making jam and other comparable preparations **Sandhu *et al.*, (2015)**. The fruits can also be dried (much like grape raisins) and used in bakeries, drinks, snacks, and cereal breakfasts, even though cape gooseberries are primarily sold as fresh commodities. Additionally, they can be added to sauces, syrups, and marmalades.*P. peruviana* is favored in breeding and cultivation projects of many nations and is a commercially viable crop as an

exotic export fruit. *P. peruviana* fruits are sold under the names goldenberry and, occasionally, Pichuberry in the US to connect the fruit's cultivation in Peru with Macchu Picchu.

Materials and Methods

The Experiment was conducted in Randomized Block Design (RBD) with one control and 09 treatments with the objective of growth, yield, quality and economics of cape gooseberry at the central research farm of Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences Prayagraj during 2022-23, with the following treatments T_0 (Control), T_1 (100% RDF), T_2 (100% RDF+ Azotobacter) 10g, T_3 (100% RDF + Azospirillum) 10g, T_4 (100% RDF + Azotobacter)10g, T_5 (75% RDF= Azotobacter) 10g, T_6 (75% RDF + Azospirillum) 10g, T_7 (75% RDF + Trichoderma) 10g, T_8 (75% RDF + Azotobacter + Azospirillum) 10g, T_9 (75% RDF + Azotobacter + Azospirillum + Trichoderma) 10g with three replications.

Results and Discussion

The maximum height (72.51cm) was recorded in the treatment T_9 (75% RDF+Azotobacter +Azospirillum+Trichoderma(10g). Minimum height (48.2cm) was observed in the treatment T_0 (control). The application of biofertilizer might have improved the soil physical and chemical properties and leading to the adequate supply of nutrients to the plants which might have promoted the maximum vegetative growth while the minimum plant growth was due to non-availability of nutrients. Similar findings were reported by *Sivaiah et al. (2013)*; *Meena et al. (2015)*; *Kumaret al. (2016)*; *Singhet al. (2018)*

The maximum Number of branches per plant (11.88) was observed in the treatment T_9 (75% RDF+Azotobacter+Azospirillum+Trichoderma

(10g). The minimum Number of branches per plant (6.33) was observed in treatment T_0 (Control). It was noticed that number of branches per plant increased with increasing plant height successively with the increasing levels of nutrients. Similar findings were reported by *Sivaiah et al. (2013)*.

The maximum number of leaves per plant (92.34) was observed in the treatment T_9 (75% RDF + Azotobacter + Azospirillum + Trichoderma (10g). The minimum numbers of leaves (49.22) were observed in treatment T_0 (Control). It was noticed that number of leaves per plant increased with increasing plant height successively with the increasing levels of micronutrient. Combination of inorganic manure and application of micronutrients also recorded maximum plant height and number of leaves also which helped the plants in better photosynthesis to attain vigor. The findings of the present investigation are in conformity with the reports of *Sivaiah et al. (2013)*; *Meena et al. (2015)*; *Kumaret al. (2016)*;

The maximum leaf area (69.34 cm²) was observed in the treatment T_9 (75% RDF+Azotobacter + Azospirillum + Trichoderma (10g). The minimum leaf area (51.88 cm²) was observed from the treatment T_0 (Control).

The maximum number of days to first flowering (64.67 days) was recorded in the treatment T_0 (Control). The minimum number of days to first flowering (64.67 days) was recorded in the treatment T_9 (75% RDF+Azotobacter + Azospirillum + Trichoderma (10g).

The maximum number of days taken to first fruiting (73 days) was recorded in the treatment T_0 (Control). The minimum number of days to first flowering (55.42 days) was recorded in the treatment T_9 (75% RDF+Azotobacter + Azospirillum + Trichoderma (10g).

The maximum number of flowers (96.33days) was recorded from the treatment T₀ (Control). The minimum numbers of flowers (74.62days) was recorded from the treatment T₉ (75% RDF + Azotobacter + Azospirillum + Trichoderma (10g)). Maximum number of flowers might be due to increased number of flowers which might have formed into fruits due to adequate availability of major and minor nutrients during its growth and development. Minimum number of fruits yield per plant in T₁(Control) might be due to non-availability of nutrients during its development. Similar findings were reported by **Sathyamurthy et al. (2017); Reddy et al. (2018)**.

The maximum number of fruits (82.52) was observed from the treatment T₉ (75% RDF + Azotobacter + Azospirillum + Trichoderma (10g)). The minimum numbers of fruits (61.67) were observed from the treatment T₀(Control). Maximum number of flowers might be due to increased number of flowers which might have formed into fruits due to adequate availability of major and minor nutrients during its growth and development. Minimum number of fruits yield per plant in T₁(Control) might be due to non-availability of nutrients during its development. Similar findings were reported by **Sathyamurthy et al. (2017); Reddy et al. (2018)**.

The maximum average fruit weight with husk (10.89g) and without husk (9.68g) was observed from the treatment T₉ (75% RDF + Azotobacter + Azospirillum + Trichoderma (10g)). The minimum average fruit weight with husk (7.01 g) and without husk (6.08g) was observed from the treatment T₀(Control). Biofertilizers play an important role in improving productivity and quality of horticultural crops. Added dose of biofertilizers along with RDF

and other essential nutrients increased the vigor of plants, assimilating area, size of fruit, thereby resulting into higher weight of fruit. These results are in close conformity with the findings of **Ali et al. (2015); Haleema et al. (2017)**.

The maximum polar diameter with husk (4.23 cm) and without husk (2.78 cm) was recorded from the treatment T₉ (75% RDF + Azotobacter + Azospirillum + Trichoderma (10g)). The minimum polar diameter with husk (3.11cm) and without husk (1.88cm) was observed from the treatment T₀(control). Biofertilizers play an important role in improving productivity and quality of horticultural crops. Added dose of biofertilizers along with RDF and other essential nutrients increased the vigor of plants, assimilating area, size of fruit, thereby resulting into higher weight of fruit. These results are in close conformity with the findings of **Ali et al. (2015); Haleema et al. (2017)**.

The maximum radial diameter with husk (3.78cm) and without husk (2.88cm) was recorded from the treatment T₉(75% RDF + Azotobacter + Azospirillum + Trichoderma (10g)). The minimum radial diameter with husk (2.95 cm) and without husk (2.25 cm) was observed from the treatment T₀ (control). Biofertilizers play an important role in improving productivity and quality of horticultural crops. Added dose of biofertilizers along with RDF and other essential nutrients increased the vigor of plants, assimilating area, size of fruit, thereby resulting into higher weight of fruit. These results are in close conformity with the findings of **Ali et al. (2015); Haleema et al. (2017)**.

The maximum yield kg per plant (3.64kg) was observed from the treatment T₉(75% RDF + Azotobacter + Azospirillum + Trichoderma (10g)). The minimum yield kg per plant (1.20kg) was observed from

the treatment T₀(control). Biofertilizers play an important role in improving productivity and quality of horticultural crops. Added dose of biofertilizers along with RDF and other essential nutrients increased the vigor of plants, assimilating area, size of fruit, thereby resulting into higher weight of fruit. These results are in close conformity with the findings of **Pandiyan et al. (2018); Singh et al. (2018) and Shnainet al. (2021)**.

The maximum Total soluble solids (12.52 °Brix) were observed from the treatment T₉ (75% RDF + Azotobacter + Azospirillum + Trichoderma (10g)). The minimum total soluble solids (8.5 °Brix) were recorded from the treatment T₀(control). The maximum TSS might be due to increased availability of major as well as minor nutrients specially nitrogen and potassium supplied by biofertilizers, because they play vital role in enhancing the quality. The minimum TSS in T₁(Control) might be to lack of availability of nutrients. Similar findings were also reported by **Aliet al. (2015); Kumaret al. (2017)**.

The maximum acidity (0.42%) was observed from the treatment T₀ (control). The minimum acidity (0.14%) was recorded from the treatment T₉(75% RDF + Azotobacter + Azospirillum + Trichoderma (10g)). The maximum acidity % might be due to increased availability of major as well as minor nutrients specially nitrogen and potassium supplied by biofertilizers, because they play vital role in enhancing the quality. The minimum acidity % in T₁(Control) might be to lack of availability of nutrients. Similar findings were also reported by **Aliet al. (2015); Kumaret al. (2017)**.

The maximum ascorbic acid (47.52 mg/100g) was observed from the treatment T₉(75% RDF + Azotobacter + Azospirillum + Trichoderma (10g)).

The minimum ascorbic acid (19.53 mg/100g) was recorded from the treatment T₀(control). The maximum ascorbic acid might be due to increased availability of major as well as minor nutrients specially nitrogen and potassium supplied by biofertilizers, because they play vital role in enhancing the quality. The minimum ascorbic acid in T₁(Control) might be to lack of availability of nutrients. Similar findings were also reported by **Aliet al. (2015); Kumaret al. (2017)**.

Conclusion

On the basis of present investigation, it is concluded that the Treatment T₉ (75% RDF + Azotobacter + Azospirillum + Trichoderma (10g)) was found to be the best treatment combination with respect to growth (plant height, number of branches per plant, number of leaves per plant, leaf area), yield (no. of fruits, average weight of fruits, polar and radial diameter), yield (kg/plant) and quality (acidity, T.S.S, ascorbic acid) and the highest benefit cost ratio (0.54) was found in T₉ (75% RDF + Azotobacter + Azospirillum + Trichoderma (10g)).

Future Scope

The future of agriculture lies in the widespread adoption of biofertilizers. These natural, eco-friendly alternatives enhance soil fertility, promote plant growth, and reduce environmental impact. By harnessing beneficial microorganisms and organic compounds, biofertilizers increase nutrient availability, leading to sustainable yields. With growing concerns over synthetic fertilizers' negative effects on ecosystems and human health, biofertilizers offer a promising solution for enhancing agricultural productivity while maintaining ecological balance. Their potential to improve soil health, increase crop resilience, and reduce chemical dependency positions them as a pivotal component of

future agriculture, ensuring food security and
environmental sustainability.

Table 1: Effect of Biofertilizers on Plant height (cm), no. of branches, no. leaves, leaf area (cm²), Days to flowering and Days to fruiting.

Treatment	Plant Height			No. of Branches		No. of leaves			Leaf area			Days to Flowering	Days to fruiting
	20 DAT	40 DAT	60 DAT	40 DAT	60 DAT	20 DAT	40 DAT	60 DAT	20 DAT	40 DAT	60 DAT		
T ₀	12.20	27.35	48.20	2.83	6.33	5.83	29.44	49.22	22.29	38.46	51.88	64.67	73.00
T ₁	24.26	42.18	62.51	3.16	6.67	6.17	34.73	65.96	22.34	45.80	64.58	62.00	71.67
T ₂	30.35	44.37	70.69	3.33	7.67	6.83	34.58	76.41	23.23	42.11	62.29	61.00	70.67
T ₃	26.33	48.76	63.46	4.16	8.00	7.00	32.81	65.51	23.62	42.75	52.48	59.67	69.00
T ₄	24.72	42.28	64.74	4.67	10.00	7.17	40.70	74.09	23.95	45.59	66.67	58.33	67.67
T ₅	22.25	36.1	63.29	4.67	9.16	8.16	39.36	80.11	24.14	48.72	70.77	56.33	65.33
T ₆	23.08	37.75	58.88	5.33	10.50	8.33	36.48	81.17	24.25	52.01	70.86	53.00	62.33
T ₇	21.38	35.61	59.23	5.5	10.83	8.67	41.35	85.73	24.89	49.67	66.18	50.66	60.67
T ₈	27.01	38.62	58.51	5.67	11.50	9.17	44.87	91.58	25.32	49.18	68.83	47.33	56.67
T ₉	30.44	46.18	72.51	5.82	11.80	9.82	45.23	92.34	25.89	49.57	69.34	46.54	55.42
F Test	S	S	S	S	S	S	S	S	S	S	S	S	S
SE (d)	12.2	27.35	48.2	1.101	1.984	1.15	4.82	12.70	1.147	4.227	6.968	6.30	6.24
CD	1.654	1.958	2.152	0.348	0.627	0.36	1.52	4.02	0.362	1.336	2.203	1.99	1.97

Table 2: Effect of Biofertilizers on days to flower bud initiation, days to fruiting, average weight of fruit, polar diameter, radial diameter, yield/plant, acidity %, ascorbic acid (mg/100g), tss, ascorbic acid and b:c ratio.

Treatment	Days to Flower bud initiation	Days to fruiting	Average weight of fruit		Polar Diameter		Radial Diameter		Yield/plant (kg)	Acidity %	TSS	Ascorbic Acid	B:C Ratio
			With Husk	Without Husk	With Husk	Without Husk	With Husk	Without Husk					
T ₀	96.33	61.67	7.01	6.08	3.11	1.88	2.95	2.25	1.20	0.42	8.50	19.53	0.55
T ₁	93.67	63.00	7.00	6.50	3.33	1.96	3.17	2.25	1.44	0.39	9.00	37.43	0.81
T ₂	91.67	63.66	8.25	7.40	3.4	1.98	3.20	2.30	1.82	0.38	9.63	40.14	0.94
T ₃	81.67	66.50	8.33	7.50	3.41	2.03	3.21	2.48	2.10	0.34	10.00	41.07	1.36
T ₄	79.33	66.83	8.75	7.67	3.43	2.05	3.28	2.48	2.26	0.3	10.30	42.81	1.42
T ₅	78.00	68.50	9.33	8.33	3.45	2.1	3.35	2.53	2.44	0.29	10.77	44.38	1.48
T ₆	77.00	77.83	9.66	8.67	3.5	2.15	3.36	2.55	2.64	0.27	11.13	44.45	1.54
T ₇	76.67	78.50	10.06	9.03	3.53	2.2	3.38	2.60	2.89	0.23	11.67	45.13	1.63
T ₈	75.83	81.83	10.16	9.33	3.65	2.25	3.42	2.68	3.23	0.17	12.03	47.1	1.74
T ₉	74.62	82.52	10.89	9.68	4.23	2.78	3.78	2.88	3.64	0.14	12.52	47.52	1.88
F Test	S	S	S	S	S	S	S	S	S	S	S	S	
SE (d)	8.18	8.18	1.27	1.20	0.291	0.252	0.21	0.20	0.768	0.093	0.09	8.15	
CD	2.59	2.59	0.40	0.38	0.092	0.079	0.07	0.06	0.243	0.029	0.03	2.577	

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