



Studies on the Effect of Different Biofertilizers and Organic Manures on Yield and Quality of Strawberry (*Fragaria ananasa* Duch.) cv. Chandler under Allahabad Agro Climatic Condition

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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 present investigation entitled "Effect of Different Biofertilizers and Organic Manures on Growth, Yield and Quality of Strawberry (*Fragaria ananassa* Duch.) cv. Chandler." An experiment was conducted at the research field, Department of Horticulture, Allahabad School of Agriculture, Sam Higginbottom Institute of Agriculture, Technology & Sciences, Allahabad during the year 2015-2016, the experiment was laid out in a Randomized Block Design having 12 treatments three replications of bio-fertilizers and organic manure at different levels. The result revealed that treatment T₁₂ (Phosphobacter 5kg/ha + Azatobacter 5 kg/ha + FYM 6 ton/ha + Vermicompost 3 ton/ha + Poultry Manure 3 ton/ha) was found to be best in terms of maximum plant height (19.67 cm), plant spread (26.43cm), number of leaves (18.13), petiole length (4.96 cm), day to first flowering (67.33), number of flowers per plant (16.80), fruit yield per plant (75.94 g), fruit yield per plot (683.46gm), fruit yield per hectare(6.83 t), TSS (8.54 °B), acidity (0.46%), pH of juice (4.40). Similarly the maximum gross return (1079250 rupees), net return (696022.95 rupees) and benefit cost ratio (2.77:1) for cultivation of strawberry under Allahabad agro- climatic condition. However, since these findings are based on a one-year experiment, additional trials may be required to support them.

Keywords: Strawberry; Azotobacter; phosphobacter; FYM; vermicompost; poultry manure and yield.

1. INTRODUCTION

“The area under fruit production in India is 7216 thousand hectares, with a production of 88977 thousand million tons (NHB, 2014). Strawberry (*Fragaria x sp.*) is native of temperate regions, but varieties are available which can be cultivated in the subtropical climate. Strawberry is a delicious fruit taken fresh in several ways. It is a soft and highly perishable fruit, often shipped in a frozen condition in Western countries. Strawberry thrives best in a temperate climate. It is a short-day plant; the varieties grown in milder subtropical climate do not require chilling and continue to make some growth during winter” [1]. “Strawberry requires well-drained medium loam soil, rich in organic matter. The soil should be slightly acidic with a pH from 5.7 to 6.5. At higher pH root formation is poor. The presence of excessive calcium in the soil causes yellowing of the leaves. Runner formation is better in light soils and those rich in organic matter” [2]. Strawberry should not be cultivated in the same land for a number of years. It is preferable to plant it in a green manure field [3,4]. Thus, there is tremendous pressure on non-renewable energy resources to meet the ever-increasing demand for quality fruits. Hence, it has become imperative to turn to a more eco-friendly method of nutrition management in horticultural crops of which biofertilizers stand with prime importance [5-7]. The beneficial effects of Azotobacter are not only due to its ability to fix nitrogen but also to its ability to synthesize auxin vitamins, growth substance and its capacity to produce anti-fungal antibiotics which improve plant stands in inoculated fields [8] by inhibiting root pathogens. “Azotobacter is a heterotrophic aerobic bacterium, the free living bacteria fixes nitrogen in the rhizosphere and provides it to the plant. Their inoculation is beneficial for horticultural crops with an increase in plant yield. The increase in yield is because in addition to adding nitrogen, these bacteria produce vitamins like biotin, folic acid and also produces antifungal antibiotics, which results in early roots development and better crop plant starts” [9,10]. “Azotobacter is free living nitrogen fixing bacteria fixing nitrogen equivalent to 25 to 30 kg nitrogen ha⁻¹. It is also found that crop plants inoculated with Azotobacter survive better in drought conditions” [11].

2. MATERIALS AND METHODS

The current experiment was carried out in pomology section, Department of Horticulture, SHIATS, Allahabad, during 2015-2016, in a randomized block design replicated with thrice, the experimental site is situated at a latitude of 20° and 15° North and longitude of 60° 3` East and at an altitude of 98 meters above mean sea level (MSL). The minimum temperature ranged from 4° -5° C (during Oct - Feb) and maximum temperature ranged from 45°-48°C (during March - June). One cultivar with uniform-sized strawberry runners were planted during November 2015, maintaining a spacing of 30 X 30 cm. The biofertilizer and organic manures were prepared per the requirement and applied to each treatment and replication before planting and observations recorded. The recommended package of practices was followed for raising the successful crop. Data on plant growth, fruit yield and quality of strawberry characters were recorded when the plants were fully grown. Treatments [T₁ Control(RDF), T₂ (Phosphobacter 5kg/ha + Azotobacter 5 Kg/ha), T₃ (Phosphobacter 5kg/ha + Azotobacter 5 Kg/ha + FYM 25 t/ha), T₄ (Phosphobacter 5kg/ha + Azotobacter 5 Kg/ha + Poultry manure 12 t/ha), T₅ (Phosphobacter 5kg/ha + Azotobacter 5 kg/ha + Vermicompost 12 t/ha), T₆ (Phosphobacter 5kg/ha + Azotobacter 5 kg/ha + FYM 13 t/ha), T₇ (Phosphobacter 5kg/ha + Azotobacter 5 kg/ha + Poultry Manure 6 t/ha), T₈ (Phosphobacter 5kg/ha + Azotobacter 5 kg/ha + Vermicompost 6 t/ha), T₉ (Phosphobacter 5kg/ha + Azotobacter 5 kg/ha + FYM 13 t/ha + Poultry manure 6 t/ha), T₁₀ (Phosphobacter 5kg/ha + Azotobacter 5 kg/ha + FYM 13 t/ha + Vermicompost 6 t/ha), T₁₁ (Phosphobacter 5kg/ha + Azotobacter 5 kg/ha + Vermicompost 6 t/ha + Poultry Manure 6 t/ha), T₁₂ (Phosphobacter 5kg/ha + Azotobacter 5 kg/ha + FYM 6 t/ha + Vermicompost 3 t/ha + Poultry Manure 3 t/ha) [12].

3. RESULTS AND DISCUSSION

3.1 Growth Parameters:

The average treatment results for growth characteristics such plant height, spread, number of leaves per plant, and petiole length are shown in Table 1, where there are substantial variances for these growth parameters.

Table 1. Effect of different biofertilizers and organic manures on growth, yield and quality of Strawberry (*Fragaria × ananassa* Duch.) cv. chandler

Treatment	Plant height (cm)	Plant spread (cm)	Number of leaves	petiole length (cm)	Days taken to first flowering	Number of flower per plant	Fruit yield per plant	Fruit yield per plot (g)	Fruit yield per ha (tonns)	TSS of fruit	Fruits acidity	pH of the fruit juice	Cost benefit ratio
T ₁	15.27	20.27	12.47	3.41	70.47	11.33	39.95	359.55	3.59	6.90	0.75	3.9	1.39
T ₂	16.29	22.10	15.33	3.84	70.27	12.73	46.68	420.09	4.19	7.70	0.56	4.0	1.45
T ₃	16.35	21.33	15.13	3.77	69.33	12.60	44.64	431.76	4.31	7.78	0.62	3.92	1.79
T ₄	16.29	22.37	14.47	3.80	69.53	12.80	48.14	433.29	4.33	7.61	0.61	4.0	2.13
T ₅	16.77	22.23	14.93	3.93	69.60	12.53	46.37	417.36	4.17	7.69	0.57	4.05	2.05
T ₆	16.61	22.63	14.53	3.87	69.87	12.67	46.31	416.76	4.16	7.68	0.63	4.10	1.10
T ₇	16.91	22.07	15.20	3.85	69.27	12.00	50.65	455.88	4.55	7.83	0.54	4.10	1.69
T ₈	16.90	22.00	14.80	4.11	69.47	13.20	55.86	502.74	5.02	7.80	0.70	4.10	1.72
T ₉	16.79	22.73	14.87	4.11	69.80	12.80	52.51	472.56	4.72	7.67	0.60	4.15	1.98
T ₁₀	19.14	25.00	17.60	4.77	69.20	16.07	68.70	618.30	6.18	8.46	0.49	4.30	1.49
T ₁₁	18.74	23.80	16.07	4.32	69.80	15.20	60.60	545.37	5.45	8.34	0.51	4.34	1.67
T ₁₂	19.67	26.43	18.13	4.96	67.33	16.80	75.94	683.46	6.83	8.54	0.46	4.40	2.27
F - test	S	S	S	S	S	S	S	S	S	S	S	S	S
CD (0.05%) =	0.76	1.27	0.83	0.20	3.61	0.68	3.34	21.95	0.22	0.41	0.03	0.28	
CV (%) =	3.32	3.31	4.06	3.67	3.88	3.81	4.70	3.42	3.42	3.93	4.45	5.03	
S Ed (±)	0.37	0.61	0.41	0.10	1.76	0.33	1.63	10.71	0.11	0.20	0.02	0.14	

Vigorous maximum plant height was observed with T₁₂ (19.67cm) followed by T₁₀ (19.14cm). Minimum plant height was observed with T₁ (15.27cm), other treatments showed moderate plant height. Maximum plant spread in treatment T₁₂ (26.43 cm), followed by T₁₀ (25.00 cm). The plant spread was lowest in the T₁ (20.27 cm). The remaining treatments recorded medium plant spread significantly. Number of leaves per plant was treatment T₁₂ had the maximum number of leaves (18.13), followed by treatment T₁₀ (17.60). The least number of leaves was observed in the treatment T₁ (12.47). Maximum Petiole length in treatment T₁₂ (4.96 cm), followed by T₁₀ (4.77 cm). The Petiole length was lowest in the T₁ (3.41 cm). These increases may be due to of application of biofertilizer and organic manure. Similar results were reported by Wang et al. [13].

3.2 Flowering and Fruiting Characters

The data pertaining to the flowering and fruiting characters like Days taken to first flowering, number of flowers per plant, number of fruits per plant and fruit yield per plant was recorded under one cultivar of strawberry and 12 treatments presented in table no. Maximum Days taken to first flowering (67.33) followed by T₁₀ (69.20). Minimum (70.47). Maximum fruit yield per plant (75.94 g) was observed in treatment T₁₂ followed by treatment T₁₀ (68.70 g). Minimum fruit yield per plant (39.95 g) was observed in treatment T₁. Maximum fruit yield per plot (683.46 g) was observed in treatment T₁₂ followed by treatment T₁₀ (618.30 g). Minimum fruit yield per plant (359.55 g) was observed in treatment T₁. Maximum fruit yield per hectare (6.83 t) was observed in treatment T₁₂ followed by treatment T₁₀ (6.18 t). Minimum fruit yield per plant (3.59 t) was observed in treatment T₁. Similar results observed by [14].

3.3 Fruit Quality Parameters

“Results of the investigations showed that TSS content, acidity, pH of the fruit juice and benefit cost ratio (Table) Significantly maximum TSS content (8.54 °Brix) was noticed with T₁₂ followed by treatment T₁₀ (8.46 °Brix). The minimum TSS content (6.90 °Brix) was recorded in T₁. Minimum acidity score (0.46%) was noticed with T₁₂ which was statistically at par with (0.49 %) followed by treatment T₁₀. Maximum acidity score (0.75 %) was recorded in T₁. Maximum pH of the fruit juice (4.40) was noticed with T₁₂ followed by treatment T₁₀ (4.30). The minimum pH of the fruit juice (3.9) was recorded in T₁. Maximum benefit-

cost ratio (2.27:1) was recorded under treatments T₁₂. Minimum benefit cost ratio (1.39:1) was recorded in treatment T₁ (control). However, the use of various biofertilizers and organic manures may be the cause of the cultivar's higher fruit quality during the winter” [15,16].

4. CONCLUSION

Based on the findings of the study, it is determined that treatment combination of Phosphobacter 5kg/ha + Azatobacter 5kg/ha + FYM 6 t/ha + Vermicompost 3 t/ha + Poultry Manure 3 t/ha was the best treatment for growth, yield and fruit quality of strawberry and 2.27:1 maximum benefit cost ratio. The experiment may be repeated to substantiate the findings, which are on the basis of one year trial.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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