

Original Research Article

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Economics Studies of Bio fertilizers and N, P, K Treated Strawberry (*Fragaria x ananassa* Duch.) cv. Chandler in Allahabad Region

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ABSTRACT

A field experiment was carried out during the winter season at Crop Research Farm, Department of Horticulture, SHIATS, Allahabad, (U.P.) India. The maximum plant height (19.29cm), the maximum number of leaves per plant (17.93cm), the maximum plant spread ((27cm²), The maximum petiole length (8.12cm), the maximum number of flower per plant (10.07), the maximum cumulative yield of fruit (298.13g / plant), the maximum fruit yield tonnes per hacter (16.89 t /ha⁻¹), the maximum fruit index (Ratio of fruit length and fruit diameter), the maximum total soluble solid (T.S.S. ⁰Brix) of fruits (10.09), the maximum cost of cultivation (Rs. 4,23,648.19), the maximum Gross return (Rs. 16,89,000), the maximum Net return (Rs.12,65,351.80) and the maximum benefit cost ratio was recorded T₉ : RDF 100% (150 : 75 : 100 kg/ha.) + Azotobacter 6 kg/ha.+ PSB 5 kg/ha. with (3.99), followed by T₈ : RDF 75 % (150 : 75 : 100 kg/ha.) Azotobacter 6 kg/ha. + PSB 5 kg/ha. and the minimum was recorded in T₀: control. Hence the application of RDF 100% (150 : 75 : 100 kg/ha.) + Azotobacter 6 kg/ha.+ PSB 5 kg/ha. is recommended for better plant growth and fruit yield in strawberry under Allahabad region (U.P.).

Keywords

Azotobacter, NPK,
PSB and strawberry

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Introduction

The cultivated strawberry (*Fragaria x ananassa* Duch.) is one of the attractive, delicious, tasty and nutritious fruit and distinct and pleasant flavor. It has a unique place among cultivated berry fruits. It is monoecious octoploid hybrid of two largely

dioecious octoploid species, *Fragaria chiloensis* and *Fragaria virginiana*. It is assumed the hybridization between *Fragaria chiloensis* and *Fragaria virginiana* had taken place spontaneously in Europe in early seventeenth century when female plant of *Fragaria chiloensis* of Chilean origin were grown in proximity to female *Fragaria* plant

of North American origin (Galletta and Bringhurst, 1990). The strawberry plant is a low-creeping, perennial, herbaceous and short day plant in which stem is compressed into a rosette crown with 2-mm long internodes. The axillary buds in the leaf nodes of the crown either remain dormant, or develop into branched crowns, or solons (runners), depending on the prevailing environment. The application of 6 kg *Azospirillum*/ha enhanced the total sugar (8.1), pH (3.62) and acidity (0.71%) of the juice (Sahoo *et al.*, 2005).

Azotobacter when applied to nursery, seedling and field soil resulted in maximum values of number of fruits per plant (19.23), fruit yield per plant (1109 g) and per hectare (356.9 q), 1000 seed weight (3.63 g), seed yield per plant (4.58 g) and per hectare (152.70 kg) and cost benefit ratio (1:1.45) (Kumar and Sharma 2006). The highest soil pH, available P₂O₅, and Significantly highest soil organic carbon, available nitrogen, fruit quality (juice, total soluble solids, total sugar and ascorbic acid) and yield with highest economic return (5.75) were observed where half of the recommended rate of inorganic N and P₂O₅ were supplemented through *Azotobacter* and PSB along with K₂O (600 g/plant) and MOC at 7.5 kg/plant (Medhi *et al.*, 2007).

The treatment nitrogen 100 kg + potassium 80 kg per hectare recorded maximum no. of leaves (8.34), plant spread (27.52 cm), petiole length (6.14 cm), plant height (11.50 cm), no. of flowers/plant (4.45), fruit length (1.40 cm), specific gravity (1.20), ascorbic acid (55.85 mg/100 g), pH (3.15) and yield/plant (367.60 g) (Dar *et al.*, 2010). The treatments included 4 levels of inorganic fertilizers (25, 50, 75 and 100% of the recommended dose, RDF) with 50 kg farmyard manure (FYM), with or without *Azospirillum* and phosphate solubilizing bacteria (PSB) at 10 g/tree. The number of fruits per tree and average fruit weight were increased significant with the

increasing levels of organic and inorganic fertilizers (Dheware *et al.*, 2010). The application of 100% P with seedling dip in PSB 1:10 solution recorded significantly higher plant height (86.30 cm), leaf area index (3.52), number of fruits/plant (16.32), fruit weight (77.75 g), fruit yield/plant (1125 g), yield (392.26 q/ha) and the highest (3.41) cost benefit ratio (Poonia *et al.*, 2012).

Materials and Methods

The experiment was laid out in randomized block design, comprising of 9 treatment combinations each replicated thrice. Treatments were randomly arranged in each replication, divided into 27 plots. The treatments combined specifications of the layout, *etc.* are given below. T₀ – control, T₁ – RDF 50% + *Azotobacter* 6 kg/ha⁻¹, T₂ - RDF 75% + *Azotobacter* 6 kg/ha⁻¹, T₃ - RDF 100% + *Azotobacter* 6 kg/ha⁻¹, T₄ - RDF 50% + PSB 5 kg/ha⁻¹, T₅ - RDF 75% + PSB 5 kg/ha⁻¹, T₆ - RDF 100% + PSB 5 kg/ha⁻¹, T₇ - RDF 50% + *Azotobacter* 6 kg/ha⁻¹ + PSB 5 kg/ha⁻¹, T₈ - RDF 75% + *Azotobacter* 6 kg/ha⁻¹ + PSB 5 kg/ha⁻¹, T₉ - RDF 100% + *Azotobacter* 6 kg/ha⁻¹ + PSB 5 kg/ha⁻¹. Fertilizer Dose- 150:75:100:20 tones FYM ha⁻¹ was applied before 15 days of planting. The half dose of Nitrogen (75 kg ha⁻¹) and full dose of Phosphorous (75 kg ha⁻¹), K₂O (100 kg ha⁻¹) were applied in basal dose to each pot. The remaining half dose of Nitrogen was applied in two split doses by applying half of it after the establishment of plants in 40 days and remaining half dose 60 days. The chemical fertilizers used to supply N, P and K were urea, Single Super Phosphate and Muriate of Potash respectively. The seedlings were inoculated with *Azotobacter* and PSB by root dipping for five minutes in the respective microbial suspensions. *Azotobacter* and PSB was also applied by placing the five centimeters below the surface of the soil in each plot before transplanting.

Results and Discussion

The maximum plant height was recorded in 120 days T₉ : RDF 100% (150 : 75 : 100 kg ha⁻¹) + Azotobacter 6 kg ha⁻¹ + PSB 5 kg ha⁻¹ with (19.29cm), followed by T₈ : RDF 75 % (150 : 75 : 100 kg ha⁻¹) Azotobacter 6 kg ha⁻¹ + PSB 5 kg ha⁻¹ with (18.41cm) and the minimum was recorded in T₀ (control) with (14.56cm). Similar result found by Umar *et al.*, (2010) and Singh and Singh (2009).

The maximum number of leaves was recorded in 120 days T₉ : RDF 100% (150 : 75 : 100 kg ha⁻¹) + Azotobacter 6 kg ha⁻¹ + PSB 5 kg ha⁻¹ with (17.93cm), followed by T₈ : RDF 75 % (150 : 75 : 100 kg ha⁻¹) Azotobacter 6 kg ha⁻¹ + PSB 5 kg ha⁻¹ with (17.07cm) and the minimum was recorded in T₀ (control) with (12.00cm). These may be due to the fact that PSB and Azotobacter had increased the nutrition absorption. The above mentioned result was also confirmed by Singh *et al.*, (2009), Sahoo and Singh (2005), Jaen Contreras *et al.*, (1997) and Srisakaran *et al.*, (1995) in Strawberry. The maximum plant spread was recorded in 120days T₉: RDF 100% (150 : 75 : 100 kg ha⁻¹) + Azotobacter 6 kg ha⁻¹ + PSB 5 kg ha⁻¹ with (27cm²), followed by T₈ : RDF 75 % (150 : 75 : 100 kg ha⁻¹) Azotobacter 6 kg ha⁻¹ + PSB 5 kg ha⁻¹ with (26.96cm²) and minimum was recorded in T₀ (control) with (21.49cm²). The results are supported by Umar *et al.*, (2010) and Jaen Contreras *et al.*, (1997). The maximum petiole length was recorded in 120days T₉ : RDF 100% (150 : 75 : 100 kg/ha⁻¹) + Azotobacter 6 kg ha⁻¹ + PSB 5 kg ha⁻¹ with (8.12cm), followed by T₈ : RDF 75 % (150 : 75 : 100 kg ha⁻¹) Azotobacter 6 kg/ha⁻¹ + PSB 5 kg ha⁻¹ with (7.89cm) and the minimum was recorded in T₀ (control) with (6.17cm). The results are supported by Singh *et al.*, (2009), Rana and Chandel (2003) and Srisakaran *et al.*, (1995) in Strawberry. The maximum number of flower per plant was recorded in 120 days T₉: RDF

100% (150 : 75 : 100 kg ha⁻¹) + Azotobacter 6 kg ha⁻¹ + PSB 5 kg ha⁻¹ with (10.07) days, followed by T₈ : RDF 75% (150 : 75 : 100 kg ha⁻¹) Azotobacter 6 kg ha⁻¹ + PSB 5 kg ha⁻¹ with (8.53) and the maximum was recorded in T₀ (control) with (4.87). Similar result found by Vestberget *al.*, (1994) in Strawberry. The maximum cumulative yield of fruit (g/plant) was recorded in T₉: RDF 100% (150 : 75 : 100 kg ha⁻¹) + Azotobacter 6 kg ha⁻¹ + PSB 5 kg ha⁻¹ with (298.13g / plant). The minimum was recorded in T₀ (control) with (198.40 g/plant). The maximum fruit yield tonnes per hacter was recorded in T₉: RDF 100% (150 : 75 : 100 kg ha⁻¹) + Azotobacter 6 kg ha⁻¹ + PSB 5 kg ha⁻¹ with (16.89 t /ha⁻¹), followed by T₈ : RDF 75 % (150 : 75 : 100 kg ha⁻¹) Azotobacter 6 kg ha⁻¹ + PSB 5 kg ha⁻¹ with (14.49 t / ha⁻¹) and the minimum was recorded in T₀ (control) with (8.73 t ha⁻¹). Similar result found by El-Hamdet *al.*, (2006), Sahoo and Singh (2005). The maximum fruit index (Ratio of fruit length and fruit diameter) was recorded in T₉ : RDF 100% (150 : 75 : 100 kg ha⁻¹) + Azotobacter 6 kg ha⁻¹ + PSB 5 kg ha⁻¹ with (1.56), followed by T₈ : RDF 75 % (150 : 75 : 100 kg ha⁻¹) Azotobacter 6 kg ha⁻¹ + PSB 5 kg ha⁻¹ with (1.50) and the minimum was recorded in T₀ (control) with (1.28). However, it was noticed that fruit index was directly and positively related to polar diameter and radial diameter of the fruits. Similar findings have also been reported by Shashi *et al.*, (2008) in strawberry. The maximum total soluble solid (T.S.S. °Brix) of fruits was recorded in T₉ : RDF 100% (150 : 75 : 100 kg ha⁻¹) + Azotobacter 6 kg ha⁻¹ + PSB 5 kg ha⁻¹ with (10.09), followed by T₈ : RDF 75 % (150 : 75 : 100 kg ha⁻¹) Azotobacter 6 kg ha⁻¹ + PSB 5 kg ha⁻¹ with (9.97) and the minimum was recorded in T₀ (control) with (8.38). The decline in T.S.S. might be due to the fact that increased nitrogen has showed excessive growth consumed most of the metabolites. El-Hamd *et al.*, (2006), Sahoo and Singh (2005) and Shashi *et al.*, (2008)

Table.1 Economics of Bio fertilizers and N, P, K treated strawberry cv. Chandler in Allahabad region

Treatment	Plant height	No. of leaves	Plant spread (cm)	Petiole length (cm)	No of flower per plant	Yield per plant (g)	Wt. of fruit (g)	Fruit yield (t ha ⁻¹)	Fruits index	T.S.S (%) of fruits	Cost of cultivation ⁻¹ Rs ha	Gross return ⁻¹ Rs ha	Net return ⁻¹ Rs ha	Benefit cost ratio
T ₀	14.56	12.00	21.49	6.17	3.87	198.40	10.87	3.96	1.28	8.38	4,23286.50	3,96,000	-27286.50	0.94
T ₁	16.32	14.47	25.09	7.38	5.60	222.80	15.97	10.65	1.48	9.61	4,23455.84	1065000	641544.16	2.52
T ₂	15.77	15.53	26.11	7.51	5.73	228.53	17.41	11.64	1.46	9.41	4,23540.50	1164000	740459.50	2.75
T ₃	17.60	16.20	26.22	7.63	6.40	267.53	15.93	12.51	1.48	9.79	423666	12,51,000	827334	2.95
T ₄	15.59	14.07	24.82	7.61	5.60	230.80	15.72	10.15	1.40	9.45	4,23453.48	1015000	591546.52	2.40
T ₅	16.69	15.33	25.85	7.61	6.00	236.80	17.21	11.18	1.42	9.55	4,23536.96	1118000	694463.04	2.64
T ₆	16.97	16.07	26.46	7.73	6.20	261.67	19.04	12.62	1.46	9.70	4,23620.45	1262000	838379.55	2.98
T ₇	16.98	15.20	26.19	7.48	5.67	238.80	17.09	12.07	1.42	9.51	4,23492.70	1207000	783507.30	2.85
T ₈	18.41	17.07	26.96	7.89	6.60	277.47	20.23	14.49	1.50	9.97	4,23570.40	1449000	1025429.600	3.42
T ₉	19.29	17.93	27	8.12	7.40	298.13	23.18	16.89	1.56	10.09	4,23648.19	1689000	1265351.81	3.99
CD.(0.5%)	1.21	0.16	1.42	0.16	0.56	14.95	3.10	0.37	0.08	0.51	-	-	-	-

Cost of cultivation

The cost of cultivation recorded under the different treatments was statistically analyzed and is being presented in table 1. The maximum cost of cultivation (Rs. 4,23,648.19) was recorded under treatments T₉ : RDF 100% (150 : 75 : 100 kg ha⁻¹) + Azotobacter 6 kg ha⁻¹ + PSB 6 kg/ha⁻¹ Followed by (Rs.423625.19) with T₃: RDF 100% (75 : 37.5 : 50 kg ha⁻¹) + Azotobacter 6 kg ha⁻¹. The minimum cost of cultivation (Rs. 4,23,286.50) was recorded in treatment T₀ (Control).The gross return recorded under the different treatments was statistically analysed and is being presented in table 1. The maximum gross return (Rs. 16,89,000) was recorded under treatments T₉ : RDF 100% (150 : 75 : 100 kg ha⁻¹) + Azotobacter 6 kg ha⁻¹+ PSB 6 kg ha⁻¹. Followed by (Rs.1449000) with T₈: RDF 75% (75 : 37.5 : 50 kg ha⁻¹) + Azotobacter 6 kg ha⁻¹ + PSB 6 kg ha⁻¹. The minimum gross return (Rs. 3,96,000) was recorded in treatment T₀ : control. The net return recorded under the different treatments was statistically analyzed and is being presented in table 1. The maximum net return (Rs.126531.81) was recorded under treatments T₉: RDF 100% (150: 75 : 100 kg ha⁻¹) + Azotobacter 6 kg ha⁻¹ + PSB 6 kg ha⁻¹Followed by (Rs.1025429.60) with T₈: RDF 75% (75 : 37.5 : 50 kg ha⁻¹) + Azotobacter 6 kg ha⁻¹ + PSB 6 kg ha⁻¹. The minimum net Return (Rs.-27286.50) was recorded in treatment T₀: control. The maximum benefit cost ratio (3.99) was recorded under treatments T₉ : RDF 100% (150 : 75 : 100 kg ha⁻¹) + Azotobacter 6 kg ha⁻¹ + PSB 6 kg ha⁻¹ Followed by (3.42) with T₈: RDF 75% (75 : 37.5 : 50 kg ha⁻¹) + Azotobacter 6 kg ha⁻¹ + PSB 6 kg ha⁻¹. The minimum benefit cost ratio (0.94) was recorded in treatment T₀: control.

A field experiment was carried out during the winter season at Crop Research Farm,

Department of Horticulture, SHIATS, Allahabad, (U.P.) India. On the basis of results obtained, It is concluded that the treatment T₉:RDF 100% (150:75:100 kg/ha) +Azotobacter 6 kg/ha.+ PSB 5 kg/ha. was found to be the best in terms of maximum yield (16.89 t /ha.) and quality of strawberry with net return (1265351.81Rs/ha.) and maximum cost benefit ratio (1:3.99) followed by yield (14.49 t /ha.), quality, net return (278657.40 Rs/ha.) and cost of benefit ratio (1:3.42) with T₈ :RDF 75% (150 : 75 : 100 kg/ha.) + Azotobacter 6 kg/ha⁻¹ + PSB 5 kg/ha and the minimum yield 3.96 t ha⁻¹, quality, net return (Rs. -27286.50 ha⁻¹) and cost of benefit ratio was recorded in T₀: control with (1:0.94).

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