Original Research Article

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

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 Higgibottom 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 T_{12} (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 ^{0}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.

***Key words*:** Strawberry, Azatobacter, Phosphobacter , FYM, Vermicompost, Poultry Manure and Yield.

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" (Akath and Singh, 2009)"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" (Abuzahara and Tahboub, 2008)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. Thus, there is tremendous pressure on non-renewable energy resources to meet the ever-increasing demandfor quality fruits. Hence, it has become imperative to turn to a more eco-friendly method of nutrition management in horticultural crops of which biofertilizers stands with prime importance. 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 (**Kumari *et al.* 1975)** 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. 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" (Iqbal et al, 2009).

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^{o} and 15^{o} North and longitude of 60^{o} 3` East and at an altitude of 98 meters above mean sea level (MSL). The minimum temperature ranged from 4^{o} -5^{o} C (during Oct - Feb) and maximum temperature ranged from 45^{o}

-48^{o} 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 aplied 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 [T_1 Control(RDF), T_2 (Phosphobacter 5kg/ha + Azatobacter 5 Kg/ha),T_3 (Phosphobacter 5kg/ha + Azatobacter 5 Kg/ha +FYM 25 t/ha), T_4 (Phosphobacter 5kg/ha + Azatobacter 5 Kg/ha + Poultry manure 12 t/ha), T_5 (Phosphobacter 5kg/ha +Azatobacter 5 kg/ha + Vermicompost 12 t/ha), T_6 (Phosphobacter 5kg/ha + Azatobacter 5 kg/ha + FYM 13 t/ha), T_7 (Phosphobacter 5kg/ha + Azatobacter 5 kg/ha + Poultry Manure 6 t/ha), T_8 (Phosphobacter 5kg/ha + Azatobacter 5 kg/ha + Vermicompost 6 t/ha), T_9 (Phosphobacter 5kg/ha + Azatobacter 5 kg/ha +FYM 13 t/ha +Poultry manure 6 t/ha), T_{10} (Phosphobacter 5kg/ha + Azatobacter 5 kg/ha + FYM 13 t/ha +Vermicompost 6 t/ha), T_{11} (Phosphobacter 5kg/ha + Azatobacter 5 kg/ha + Vermicompost 6 t/ha + Poultry Manure 6 t/ha), T_{12} (Phosphobacter 5kg/ha + Azatobacter 5 kg/ha + FYM 6 t/ha + Vermicompost 3 t/ha + Poultry Manure 3 t/ha]” (Pradeep and Saravanan, 2018)

RESULTS AND DISCUSSION

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. Vigorous maximum plant height was observed with T_{12} (19.67cm) followed by T_{10} (19.14cm). Minimum plant height was observed with T_1 (15.27cm), other treatments showed moderate plant height. Maximum plant spread in treatment T_{12} (26.43 cm), followed by T_{10} (25.00 cm). The plant spread was lowest in the T_1 (20.27 cm). The remaining treatments recorded medium plant spread significantly. Number of leaves per plant was treatment T_{12} had the maximum number of leaves (18.13), followed by treatment T_{10} (17.60). The least number of leaves was observed in the treatment T_1 (12.47). Maximum Petiole length in treatment T_{12} (4.96 cm), followed by T_{10} (4.77 cm). The Petiole length was lowest in the T_1 (3.41 cm). These increases may be due to of application of biofertilizer and organic manure. Similar results were reported by **Wang *et al.*, (1997).**

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 T_{10} (69.20). Minimum (70.47). Maximum fruit yield per plant (75.94 g) was observed in treatment T_{12} followed by treatment T_{10} (68.70 g). Minimum fruit yield per plant (39.95 g) was observed in treatment $T_{1.}$. Maximum fruit yield per plot (683.46 g) was observed in treatment T_{12} followed by treatment T_{10} (618.30 g). Minimum fruit yield per plant (359.55 g) was observed in treatment $T_{1.}$ Maximum fruit yield per hectare (6.83 t) was observed in treatment T_{12} followed by treatment T_{10} (6.18 t). Minimum fruit yield per plant (3.59 t) was observed in treatment $T_{1.}$ Similar results observed by **(Chavez and Ferrera, 1990).**

Fruit quality parameters

"Results of the investigations showed that TSS content, acidity, pH of the fruit juice and benefit cost ratio (table no. 1) Significantly maximum TSS content (8.54 ^{0}Brix) was noticed with T_{12} followed by treatment T_{10} (8.46 ^{0}Brix). The minimum TSS content (6.90 ^{0}Brix) was recorded in T_1. Minimum acidity score (0.46%) was noticed with T_{12} which was statistically at par with (0.49 %) followed by treatment T_{10}. Maximum acidity score (0.75 %) was recorded in T_1. Maximum pH of the fruit juice (4.40) was noticed with T_{12} followed by treatment T_{10} (4.30). The minimum pH of the fruit juice (3.9) was recorded in T_1. Maximum benefit-cost ratio (2.27:1) was recorded under treatments T_{12}. Minimum benefit cost ratio (1.39:1) was recorded in treatment T_1 (control). However, the use of various biofertilizers and organic manures may be the cause of the cultivar's higher fruit quality during the winter" (Ekka, et al. 2018; Umar et al. 2010).

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.

Reference

Abuzahara, T.R. and Tahboub.A.B.(2008) Effect of organic matter sources on chemical properties of soil and yield of strawberry under organic farming condition. *J. of World applied sciences.* **5**(3):383-388.

Akath Singh and Singh, J. N. (2009) Effect of biofertilizers and bioregulators on growth, yield and nutrient status of strawberry cv. Sweet Charlie. *Indian Journal of Horticulture*. **66**(2): 220-224.

Cabilovski1,RankoManojlovic,MajaBogdanovic,DarinkaMagazin,NenadKeserovic,Ran (2014) Mulch type and application of manure and compost in strawberry (Fragaria × ananassa Duch.) production: impact on soil fertility and yield. ISSN 1392-3196 / e-ISSN 2335-8947 Zemdirbyste-Agriculture, **(1)**101: 67–74.

Chavez, M. G. and Ferrera, R. (1990). Effect of vesicular arbuscular mycorrhiae on tissue culture-drived plantlets of strawberry. *Hort. Science*. 25:903-905.

Geddeda, Y. I., Trappe J. M. and Stebbins R. L., (1984). Effect of vasicular arbuscular mycorrhizae and phosphorus on apple seedlings. *J. of the American Society of Horticultural Sciences.* **109**(1):24-27

Iqbal, U., Wall, V. K., Ravi K., Mahital J,, (2009). Effect of fym, urea and *Azotobacter* on growth, yield and quality of strawberry cv. Chandler. Notulae Botanicae, Horti Agrobotanici, Cluj-Napoca **(1)**37:139-143.

Karlidag, H.; Yildirim, E.; Turan, M.; Donmez, M. F. (2010) Effect of plant growth-promoting bacteria on mineral-organic fertilizer use efficiency, plant growth and mineral contents of strawberry (*Fragaria* x *ananassa* L. Duch.). Hohenheim, Germany, (22): 218-226.

Kumari L., Kavimadanan M. S. and Rao K. N. S. (1975). Occurance of nitrogen fixing spirilium in root of sorghum, maize and other plants. *Indian J. of Exp. Biol.*14:638-639.

Macit, I., Koc, A., Guler, S., Deligoz, L. (2007) Yield, quality and nutritional status of organically and conventionally-grown strawberry cultivars. *Asian J. of Plant Sciences*. **7**(6): 1131-1136.

Rana, R. K. and Chandel, J. S. (2003) Effect of biofertilizers and nitrogen on growth, yield and fruit quality of strawberry. Progressive Horticulture. 3(5)1:25-30.

Uddin M R, M F Hossain, S M Zaman, M Islam and N Ara. (2013). Effect of organicmanure on growth and yield of strawberry. Wudpecker Journal of Agricultural Research ISSN 2315-7259 Vol. **3**(1):35 – 38.

Umar, I.; Wali, V. K.; Rehman, M. U.; Mir, M. M.; Banday, S. A.; Bisati, I. A. (2010) Effect of subabul (*Leucaena leucocephala*), Applied Biological Research. (2)12:50-54.

Wang, S. S., Patil, M. T. and Singh, B. R. (1997). Cultivar x Biofertilizer interaction study in strawberry *Recent Horticulture*. 4: 43-44.

Yavari, S., **Eshghi,** S.; **Tafazoli, E., and Yavari,** S. **(2008).** Effects of various organic substrates and nutrient solution on productivity and fruit quality of strawberry 'Selva' *(Fragaria* x *ananassa* Duch.). *Journal of Fruit and Ornamental Plant Research.* (16)34:167-178.

Pradeep B, Saravanan S. Effect of different biofertilizers and organic manures on yield and quality of strawberry (Fragaria x ananassa Duch.) cv. Chandler. Journal of Pharmacognosy and Phytochemistry. 2018;7(6):151-5.

Ekka RA, Kerketta A, Lakra S, Saravanan S. Effect of Zn, B, Cu and Fe on vegetative growth, yield and quality of strawberry (Fragaria x ananassa Duch.) cv. Chandler. Int. J. Curr. Microbiol. App. Sci. 2018;7:2886-90.

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	
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	