Original Research Article

Effect of different organic manure on vegetative growth, flowering & fruiting of intercropped strawberry (*Fragaria x ananassa* Duch) cv. sweet charley in banana orchard

Abstract:

Aims: Growing the organic strawberry fruit in tropical region with the help of shade of banana plants

Place and Duration of Study: The was carried out at Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad in the year 2017 to 2018.

Methodology: A field experiment was conducted with sweet charley of strawberry. The observations were recorded on various vegetative growths, flowering and fruiting, and yield parameters. The mean data were subjected to the various statistical and biometrical analyses.

Results: Results showed that there were significant differences between treatments T_3 Vermicompost (5 tonnes/ha) + Poultry manures (5 tonnes/ha) in plant height at 120 DAP (20 cm), number of leaves at 120 DAP (12.13), plant spread at 120 DAP (25.50 cm), days taken to first flower (60 days), number of flower per plant (14.37), days taken to first fruit (72 days), number of fruit per plant (7.40) fruit set % (52.12%), fruit yield per plant (155.20g), fruit yield per plot (776.00g), and fruit yield per hectare (69.84q/ha), net return (Rs. 787,600/ha.) and benefit cost ratio (3.02:1) and Weight of fruit (21.00g), Specific gravity (1.72), T.S.S. (^{0}Brix) of fruits (11.80 ^{0}Brix), pH of fruits (4.80), Acidity (%) of fruits (0.81%) and Ascorbic acid (54.79) throughout the experiment time. Obtained data shows that banana plants have a significant influence on the strawberry plant.

Conclusion: Considering the present investigation it is concluded that the treatment T_3 - Vermicompost (5 tonnes/ha) + Poultry manures (5 tonnes/ha) was found the best in terms of maximum yield (69.84q/ha) and quality of strawberry with net return (Rs. 787,600/ha.) with maximum benefit: cost ratio (3.02:1) in banana orchard.

Keywords: strawberry, banana, intercropping, vermicompost, poultry manure

1. INTRODUCTION

The strawberry (*Fragaria x ananassa* Duch.) an aggregate fruit, has attained the status of being one of the most important soft fruit of the world after grapes. Strawberries are one of the most popular

berries in the human diet. Their consumption increases every year [1]. Its fruits are attractive with a distinct, pleasant and refreshing aroma. There are approximately 20 different strawberry species and they belong to the botanical family rosaceae with a basic chromosome number of x =7. Genus *Fragaria* includes at least 17 other species (diploid, tetraploid, hexaploid, octoploid) the cultivated strawberry is also an octoploid (2n=8x=56). Fruit is small, firm, and pink to red, aromatic and Non-climacteric fruit. Most strawberry cultivars produce hermaphrodite flowers and are self fertile. However, some also produce male or staminate, imperfect and female or pistillate flowers. Hermaphrodite flowers are self-fertile and pistillate flowers require cross pollination Hermaphrodite flowers are self-fertile and pistillate flowers require cross pollination for fruits production. In some varieties, partial sterility has been reported.

The fresh ripe fruit of strawberry are the rich source of vitamins and minerals. Among vitamins, it is a fairly good source of vitamin A (60 I.U./100 g of edible portion) and vitamin C (50-60mg/100g of edible portion). It also has high pectin (0.55%), available on the form of calcium pectate, which serves as an excellent ingredient for jelly making [2]. Besides, it also has abundance of minerals, like potassium, calcium and phosphorus. The T.S.S. contents of fruits comprise sugar, acids and other substances dissolved in cell sap. The mature soft fruit contains about 5 % total sugar and 0.90% to 1.85% acids. Fructose and glucose are the major sugars found in strawberry with small proportion of sucrose.

The banana (*Musa paradisica*) is an edible fruit – botanically a berry – produced by several kinds of large herbaceous flowering plants in the genus *Musa*. In some countries, bananas used for cooking may be called plantains, in contrast to dessert bananas. The fruit is variable in size, color and firmness, but is usually elongated and curved, with soft flesh rich in starch covered with a rind which may be green, yellow, red, purple, or brown when ripe. The fruits grow in clusters hanging from the top of the plant. Almost all modern edible parthenocarpic bananas come from two wild species – *Musa acuminata* and *Musa balbisiana.* The scientific name of most cultivated banana is *Musa acuminata*, *Musa balbisiana*, and *Musa paradisia*. Banana (*Musa paradisica*) is the second most important fruit crop in India next to mango. Its year round availability, affordability, varietal range, taste, nutritive and medicinal value makes it the favourite fruit among all classes of people. It has also good export potential.

Strawberry is a short day and temperate region fruit. In sub-tropical plains, the adverse climatic condition is the main problem for strawberry cultivation. When the temperature is decreases in sub-tropical region in winter season (Nov - Jan.), is the only suitable time for strawberry growth & development. Intercropping is another factor for good quality & high yield of strawberry because banana plants have wide leaves and providing partial shade which reduces the soil temperature.

Organic manure (FYM, VC & PM) is very effective on strawberry plant for growth & development as well as banana also. A balance application of manure is essentials for successful crop production, beside organic manure fertilizers are being used increasingly because of the quick availability of the nutrients to the plants. The micronutrients are known to stimulate various physiological activities when present in very small quantity.

2. MATERIALS AND METHODS

The details of materials used in study are mentioned in (Table 1). The experiment was laid out in a Randomized Block Design with three replications and thirteen treatments at Department of Horticulture, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad, during November. 2017 to March, 2018. The experiment site had sandy loam soil, low in organic carbon and slightly alkaline having pH=7.4. six plants were raised separately for each plot in 1m2 plot at a spacing of 45 X 30 cm. in three replications. The data were analysed by the methods F'variance ratio test using mean values of random 5 plants in each treatments.

Table -1 Treatments detail

Notation	Treatment combination
T_0	Control
T_1	Vermicompost (5 tonnes/ha) + FYM (10 tonnes/ha)
T_2	Vermicompost (5 tonnes/ha) + FYM (5 tonnes/ha)
T_3	Vermicompost (5 tonnes/ha) + Poultry manures (5 tonnes/ha)
T_4	Vermicompost (5 tonnes/ha) + Poultry manures (2.5 tonnes/ha)
T_5	FYM (5 tonnes/ha) + Vermicompost (2.5 tonnes/ha)
T_6	FYM (10 tonnes/ha) + Vermicompost (2.5 tonnes/ha)
T_7	FYM (5 tonnes/ha) + Poultry manures (5 tonnes/ha)
T_8	FYM (5 tonnes/ha) + Poultry manures (2.5 tonnes/ha)
T_9	Poultry manures (2.5 tonnes/ha) + FYM (10 tonnes/ha)
T_{10}	Poultry manures (5 tonnes/ha) + FYM (10 tonnes/ha)
T_{11}	Poultry manures (2.5 tonnes/ha) + Vermicompost (2.5 tonnes/ha)
T_{12}	Poultry manures (5 tonnes/ha) + Vermicompost (2.5 tonnes/ha)

3. RESULTS AND DISCUSSION

The present investigation entitled "Intercropping of strawberry in banana orchard and effect of different organic manure on growth, yield and quality of strawberry (*Fragaria* x *ananassa* Duch.) cv.

sweet charley under sub-tropical condition" was conducted in Rabi Season 2017-18, at the Plant Research Farm, Banana orchard, Department of Horticulture, Naini agricultural institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad. The data on all the parameters were recorded during the course of investigation and subjected to statistical analysis for valid inferences. The results of the effect of organic manure on growth, yield and fruit quality on different growth and yield parameters have been critically studied and presented in this chapter. Some characters are also illustrated with the help of graphs and diagrams wherever felt essential to clarify the resultsin Table -2.

3.1 Plant height (cm)

At 120 DAT, it was observed that T_3 - Vermicompost (5 tonnes/ha) + Poultry manures (5 tonnes/ha), highest plant height was (20.00 cm) and was at par with T_1- Vermicompost (5 tonnes/ha) + FYM (10 tonnes/ha (19.87 cm). There was significant difference at 5% level with other treatments also. The minimum plant height was T_0 - control (14.77 cm). Similar results have been reported [3], [4], [5].

3.2 Number of leaves

At 120 DAT, it was observed that T_3 - Vermicompost (5 tonnes/ha) + Poultry manures (5 tonnes/ha), highest number of leaves (12.13) and was at par with T_1 - Vermicompost (5 tonnes/ha) + FYM (10 tonnes/ha) (12.04). There was significant difference at 5% level with other treatments also. The minimum number of leaves was T_0 -control (9.27). The results are supported by [6].

3.3 Plant spread (cm)

T_3- Vermicompost (5 tonnes/ha) + Poultry manures (5 tonnes/ha), maximum plant spread was (25.50 cm) and was at par with T_1- Vermicompost (5 tonnes/ha) + FYM (10 tonnes/ha) (24.90 cm). There was significant difference at 5% level with other treatments also. The minimum plant spread was T_0 -control (19.67 cm). Similar results have been reported by [7].

3.4 Days taken to first flowers

Comparing the different level of organic manure, data revealed that T_3 - Vermicompost (5 tonnes/ha) + Poultry manures (5 tonnes/ha) took significantly minimum days 60.00 after transplanting followed by 61.00 with T_1 -Vermicompost (5 tonnes/ha) + FYM (10 tonnes/ha). There was a significant difference between all the treatments. Maximum number of days to produced first flower 69 days was taken by T_0 -control. Similar result found by [8] in strawberry and [9] in okra.

3.5 Number of flowers per plant

The highest number of flowers per plant was recorded in the treatment T_3- Vermicompost (5 tonnes/ha) + Poultry manures (5 tonnes/ha) *i.e.* (14.37) followed by (13.73) with T_1 -Vermicompost (5 tonnes/ha) + FYM (10 tonnes/ha) being statistically at par with T_2 (13.67), T_4 (13.60), T_{10} (13.37) and the minimum number of flowers (10.50) was recorded with T_0 –control [10].

3.6 Days taken to first fruit

Comparing the different level of organic manure, data revealed that T_3 - Vermicompost (5 tonnes/ha) + Poultry manures (5 tonnes/ha) took significantly minimum days 72.00 after transplanting followed by 75.00 with T_1 -Vermicompost (5 tonnes/ha) + FYM (10 tonnes/ha). There was a significant difference between all the treatments. Maximum number of days to produced first flower 84 days was taken by T_0 -control. Similar result found by [11].

3.7 Number of fruits per plant

It was observed that T_3- Vermicompost (5 tonnes/ha) + Poultry manures (5 tonnes/ha), highest number of fruits (7.40) and was at par with T_1- Vermicompost (5 tonnes/ha) + FYM (10 tonnes/ha) (6.57). There was significant difference at 5% level with other treatments also. The minimum number of fruits was T_0- control (4.33). These finding are similar to the reports in strawberry [12].

3.8 Fruit set percentage

It was observed that T_3- Vermicompost (5 tonnes/ha) + Poultry manures (5 tonnes/ha), highest fruits set % (52.12%) and was at par with T_1- Vermicompost (5 tonnes/ha) + FYM (10 tonnes/ha) (51.37). There was significant difference at 5% level with other treatments also. The minimum fruits set % was T_0- control (41.09%).

4. CONCLUSION

Considering the present investigation it is concluded that the treatment T_3 - Vermicompost (5 tonnes/ha) + Poultry manures (5 tonnes/ha) was found the best in terms of maximum yield (69.84q/ha) and quality of strawberry with net return (Rs. 787,600/ha.) with maximum benefit: cost ratio (3.02:1) in banana orchard

Table-2 Effect of different organic manure on vegetative growth, flowering and fruiting of intercropped strawberry (*Fragaria* x *ananassa* Duch) cv. Sweet charley in banana orcha

Notations	Treatments combination	Plant height (cm)	No. of leaves	Plant spread (cm)	Days taken to first flower	Days taken to first fruit	No. of flower per plant	No. of fruit per plant	Fruit set %
T_0	Control	14.77	9.27	19.67	69.00	84.00	10.50	4.33	41.09
T_1	Vermicompost (5 tonnes/ha) + FYM (10 tonnes/ha)	19.87	12.04	24.90	61.00	75.00	13.73	6.57	51.37
T_2	Vermicompost (5 tonnes/ha) + FYM (5 tonnes/ha)	18.67	11.60	24.43	62.00	77.00	13.67	6.50	51.35
T_3	Vermicompost (5 tonnes/ha) + Poultry manures (5 tonnes/ha)	20.00	12.13	25.50	60.00	72.00	14.37	7.40	52.12
T_4	Vermicompost (5 tonnes/ha) + Poultry manures (2.5 tonnes/ha)	18.53	11.13	24.08	63.00	77.33	13.60	6.67	48.96
T_5	FYM (5 tonnes/ha) + Vermicompost (2.5 tonnes/ha)	17.40	10.20	22.42	65.00	79.33	12.80	6.10	45.73
T_6	FYM (10 tonnes/ha) + Vermicompost (2.5 tonnes/ha)	17.73	10.27	22.77	64.33	79.00	12.87	6.50	46.93
T_7	FYM (5 tonnes/ha) + Poultry manures (5 tonnes/ha)	17.77	10.40	23.25	64.00	78.33	13.17	6.27	48.82
T_8	FYM (5 tonnes/ha) + Poultry manures (2.5 tonnes/ha)	15.63	10.03	22.15	66.00	81.00	12.63	5.57	44.16
T_9	Poultry manures (2.5 tonnes/ha) + FYM (10 tonnes/ha)	16.77	10.13	22.22	65.33	80.00	12.67	5.57	44.32
T_{10}	Poultry manures (5 tonnes/ha) + FYM (10 tonnes/ha)	18.40	10.60	23.53	63.67	78.00	13.37	6.33	48.83
T_{11}	Poultry manures (2.5 tonnes/ha) + Vermicompost (2.5 tonnes/ha)	15.20	9.40	21.01	68.00	83.00	12.03	5.60	41.22
T_{12}	Poultry manures (5 tonnes/ha) + Vermicompost (2.5 tonnes/ha)	15.40	9.87	21.55	67.00	82.00	12.40	5.43	43.98
F test		S	S	S	S	S	S	S	S
Sed ±		0.39	0.22	1.39	2.02	2.09	0.70	0.52	2.89
CD (P=0.05)		0.8	0.45	2.87	4.18	4.31	1.44	1.08	5.97

5. REFERENCES

1. FAO-stat. Food supply – Crops primary equivalent. Retrieved March 3, 2017 from. Http:www.fao.org/faostat/en/#data/CC.
2. Mitra, S. K. Strawberries. (in): Temperate Fruit. (Bose, T.K., Mitra, S.K. and Rathore, D.S. Eds.). Horticulture and Allied publishers, Calcutta. 1991, Pp. 549-596.
3. Arancon, N. Q., Edwards, C. A., Beriman, P., Metzger, J. D., Lee, S. and Weich, C. Effect of vermicompost on growth and marketable fruit of field grown strawberry. Pedbiologia. 2003, 47 (5-6):731–735.
4. Arancon, N. Q., Edwards, C. A., Beriman, P., Welch, C. and Metzger, J. D. Influence of vermicomposts on field strawberries: Effect on growth and yields. Bioresource Technology. 2004, 93 (2):145–153.
5. Ustad, A. I., Patil, C. P., Swamy, G. S. K., Athani, S. I. and Patil, P. B. Effect of different combination of biofertilizers on growth and yield of banana cv. Rajapuri. J. Maharastra Agr Univ. 2005, 30(1):44–46.
6. Sahu, S. K. and Singh, D. B.. Effect of different levels of biofertilizers of growth yield and quality of Strawberry (*Fragaria x ananassa* Duch.) cv. Sweet Charley. Orissa J Hort. 2005, 33(2):82-85.
7. Umar, I., Wali, V. K., Rehman, M. U., Mir, M. M., Banday, S. A. and Bisati, I. A. Effect of subabul (*Leucaena leucocephala*), urea and biofertilizer application on growth, yield and quality of strawberry cv. Chandler. Applied Biological Research. 2010, 12(2):50-54.
8. Wange, S. S., Patil, M. T. and Singh, B. R. Cultivar x biofertilizer interactions study in Strawberry. Resent, Hort. 1997, 4: 43-44.
9. Nawalkar, L. R., Khiratkar, S. D., Badge, S. A., Chopde, N. K. and Dadgal, S. S. Effect of biofertilizers and growth regulater with reduced doses of NPK on growth and yield of Okra. J. of soils and crops. 2007, 17: 1, 145-149.
10. Singh, R., Sharma, R. R., Kumar, S., Gupta, R. K. and Patil, R. T. Vermicompost substitution influences the physiological disorders, fruit yield and quality of strawberry (*Fragaria x ananassa* Duch). Bio resource Technol. 2008, 99:8507–8511.
11. Wange, S. S., Patil, M. T. and Singh, B. R. Cultivar x biofertilizer interactions study in Strawberry. Resent, Hort. 1997, 4: 43-44.
12. Chavez, Mc. G. and Ferrera, C. R. Effect of endomicorrhizal inoculation of yield and number of fruit for strawberry cultivar rise from in vitro culture. Nort. Science. 1990, 25:903-904.