Effect of different organic manure on vegetative growth, flowering and fruiting of intercropped Strawberry (*Fragaria X ananassa* Duch.) Cv. sweet charley inside banana orchard

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Authors 'contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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 concededat Research Farm, Department of Horticulture, 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 show that there were major difference among treatments T_3 Vermicompost (5 tonnes/ha) + Poultry manures (5 tonnes/ha) in plant height on 120 DAP (20 cm), number of leaves on 120 DAP (12.13), plant spread at 120 DAP (25.50 cm), days taken to first flower (60 days), number of flower plant^{-1} (14.37), days taken to first fruit (72 days), number of fruit plant^{-1} (7.40) fruit set % (52.12%), throughout the experiment time. obtain data show that banana plants have a major 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 vegetative growth flowering and fruiting of strawberry 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. Strawberry is one of the most popular fruit in the human diet. Their expenditure 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 and basic chromosome is X =7. Genus *Fragaria* includes 17 other species (Diploid, Tetraploid, Hexaploid, Octoploid) the cultivated strawberry is also octoploid (2n=8x=56). Fruit is small, firm, and pink to red, aromatic and Non-climacteric fruit. Most strawberry cultivars produce male and female in one flower. Hermaphrodite flowers are self-fertile and pistillate flowers require cross pollination.

The fresh ripe strawberry fruit are the rich source of Vitamins and Minerals. Ii is good source of ascorbic acid and retinol. It also has high pectin (0.55%), available on the form of calcium pectate, very important 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 fully grown soft fruit contain about 5 % total sugar and 0.90% to 1.85% acids. Fructose and glucose are the most important sugars found in strawberry with small proportion of sucrose.

The banana (*Musa paradisica*) is an important fruit in whole fruits. In some countries, bananas used for cooking may be call plantains, in contrast to sweet bananas. The fruit variable in shape and size, colour and firmness, but is usually elongated and curved, with soft flesh rich in starch covered with the rind which may be Green, Yellow, Red Purple, Brown when ripe. The fruit grow in cluster hanging from the top of the plant. Almost all morden edible parthenocarpic bananas come from two wild species – *Musa acuminata* and *Musa balbisiana*.

Strawberry 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 lay out in a Randomized Block Design (RBD) 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. RESULT AND DISCUSSION

The present research 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, 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 result of effect of organic manure on growth, yield and fruit quality on different growth and yield parameters have been critically

studies and presented in this chapter. Some charecters are also illustrated with the help of graphs and diagrams wherever felt essential to clarify the results in 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). 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). 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). Highest number of days to produced initial flower 69 days was taken by T_0 – (control). Similar result found by [8] in strawberry and [9] in okra.

3.5 Number of flower plant^{-1}

The highest number of flowers plant^{-1} was observe 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). Highest number of days to produced initial 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). 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). 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

5. COMPETING INTERESTS

Authors have declared that no competing interests exist.

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 orchard.

Notations	Treatments combination	Plant Height (cm)	Number of leaves	Plant spread (cm)	Days taken to first flower	Days taken to first fruit	Number of flower plant^{-1}	Number of fruit plant^{-1}	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 manure (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 tonne/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

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