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# Effect of different biofertilizers and organic manures on yield and quality of strawberry (*Fragaria* × *ananassa* Duch.) cv. chandler

**B Pradeep and S Saravanan**

**Abstract**
The experiment was laid out in a Randomized Block Design having 12 treatments and three replications of bio-fertilizers and organic manure at different levels. The result revealed that treatment $T_{12}$ (Phosphobacter 5kg $ha^{-1}$ + Azatobacter 5 kg $ha^{-1}$ + FYM 6 ton $ha^{-1}$ + Vermicompost 3 ton $ha^{-1}$ + Poultry Manure 3 ton $ha^{-1}$) was found to be best in terms of highest fruit yield per plant (75.94 g), fruit yield per plot (683.46gm), fruit yield per hectare (6.83t). Similarly the highest TSS of fruit (8.54 Brix), Lowest Acidity (0.46 %) and Highest pH of fruit (4.40) was observed in treatment $T_{12}$ (Phosphobacter 5kg $ha^{-1}$ + Azatobacter 5 kg $ha^{-1}$ + FYM 6 ton $ha^{-1}$ + Vermicompost 3 ton $ha^{-1}$ + Poultry Manure 3 ton $ha^{-1}$). The Treatment $T_{12}$ was significant in terms of economical aspects Viz; Maximum gross return (1079250 Rs), net return (696022.95 Rs) and benefit cost ratio (2.77:1) for cultivation of strawberry under Allahabad agro-climatic condition respectively.

**Keywords:** Azatobacter, acidity, TSS, brix, Phosphobacter

## Introduction
Strawberry (*Fragaria x sp.*) is native of temperate regions, but varieties are available which can be cultivated in subtropical climate. In India it is generally cultivated in the hills, its main center of cultivation are Nainital (District) and Dehradun in Uttar Pradesh, Mahabaleshwar (Maharashtra), Kashmir valley (J&K) Bangalore (Karnataka) and Kalimpong (West Bengal). In recent years, strawberry is being also cultivated successfully on plains of Maharashtra around Pune, Nashik and Sangali towns. Strawberry is the most widely adapted of the United States, as well as in Canada and South America. The wide variation in climates within these regions and the wide adaptation of the strawberry plant permit harvesting and marketing, the fruit during greater part of the year. Strawberry is a delicious fruit taken fresh in several ways. It also makes excellent ice cream and Jam on account of its rich aroma, and is also a good source of minerals (Calcium 14mg, Iron 0.38 mg, Magnesium 10mg, Phosphorus 10mg, Potassium 166 mg, Sodium 1mg etc.), Vitamin (Vitamin C, ascorbic acid 56.7 mg, Thiamin 0.02 mg, Riboflavin 0.066 mg, Niacin 0.23 mg, Pantothenic acid 0.34 mg, Vitamin B-6 0.059mg, Vitamin A 27 IU Vitamin E 0.14 mg etc. value per 100 grams of edible portion) amino acids (Isoleucine 0.014 g, Lysine 0.025 g, Methionine 0.001 g etc). It is a soft and a highly perishable fruit, often shipped in frozen condition in Western countries. Strawberry thrives best in temperate climate. It is a short day plant; which requires exposure to about 10 days of less than 8 hours sunshine for initiation of flowering. In winter, the plants do not make any growth and remain dormant Sharma and Sharma 2004 [1]. Strawberry fruits are attractive with distinct pleasant aroma and flavor, consumed as dessert and also have a special demand by the fruit processing units for the preparation of jams, ice cream, syrups, etc. Characteristic aroma in strawberries is due to presence of volatile esters. It is one of the important fruit in the world. It has become favorite fruit crop among the Indian growers near towns and cities, because of its remunerative prices and higher profitability, which has resulted a phenomenal increase in its area and production in the recent years Sharma *et al.*, 2006 [2].
Strawberry is a profitable fruit crop in the shortest possible time as compared to the other fruits. The fruits are delicious and attractive, having pleasant aroma and a delicate flavor. It is also nutrition and beneficial to anaemic patient. Besides rich in Vitamin C, the strawberry also provides iron and minerals. Strawberry can reduce the risk of developing cancer 50% due to the high levels of vitamin C as well as photochemical compared such as the elegiac acid present in this fruit. Being a rich source of Vitamins and minerals coupled with delicate flavors strawberry has now become an important table fruit of millions of people around the global. Beside Vitamin C, strawberry is also fairly a good source of vitamin A (60 IU/100 g of edible

portion). Strawberry also has high pectin (0.55%), available in the form of calcium pectate, which serves as excellent ingredient for jelly making Mitra *et al*., 1991 [3]. Strawberry requires a well-drained medium loam soil, rich in organic matter. The soil should be slightly acidic with 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. In light soils and in those rich in organic matter, runner formation is better. Strawberry should not be cultivated in the same land for a number of years. It is preferable to plant it is green manure field. Alkaline soils and soils infected with nematodes should be avoided. Propagation is done by means of runners that are formed after the blooming season. The plants may be allowed to set as many runners as possible but not allowed to set any fruits. All the plants with good root system should be utilized to set a new plantation. Given the best attention and care, a single plant usually produces 12 to 18 runners. Farmyard manure occupies an important position among bulky organic manures. The FYM seems to act directly by increasing crop yield either by acceleration of respiratory process by cell permeability or by hormone growth action. It supplies N, P and K in available forms to plants through biological decomposition. Mahadeen *et al.,* 2009 [4] reported higher fruit yield (27.62 t $ha^{-1}$) of strawberry by application of 40 tonnes of organic fertilizer (FYM) + 60 kg $ha^{-1}$ NPK fertilizers, while the lowest strawberry yield (21.76 t $ha^{-1}$) was obtained in untreated plot. Lakpale *et al.* 2003 [5] observed the maximum number of branches per plant and pod yield of pea with the application of FYM @ 2.5 t $ha^{-1}$ in comparison to no FYM application. Rosati *et al.,* 2005 [6] reported application of large amount of organic manure may beneficial in improving soil parameters but in the presence of soil pathogen it is likely to cause them to proliferate. Rana *et al*. 2007 [7] reported that effect of inorganic fertilizer and FYM on French bean and observed that FYM @ 10 t $ha^{-1}$ resulted in significant increase in plant height, pods/plant, seeds/pod, seed and haulm yields. A balanced application of fertilizer is very important for successful crop production. Fertilizer is an essential input for increasing strawberry productivity. High productivity can be achieved through optimum fertilizer use. Biofertilizer that can be used in horticultural crops are mycorrhizae fungi, nitrogen fixer and phosphate solubilizer. VAM fungi are beneficial to the plant which they colonize. They make more nutrients available to the plant, especially phosphorus due to exploration by external hyphens of soil beyond root hairs, improve soil texture water holding capacity, improve disease resistance and help in better plant growth. Mycorrhizae fungi are also helpful in the biological control of root pathogens, increase survival rate and development of micro propagated plantlets, increase resistance to biotic and a biotic stress and increase fruit production. They also improve uptake of minor elements, produce plant hormone and increase the activity of nitrogen-fixing organisms in root zone. Fruit crop for VAM inoculation are citrus, apple, almond, peach, olive, grape, blackberry, strawberry, cherry, plum, papaya pineapple etc. Vesicular arbuscular mycorrhiza (VAM) plays an important role in the establishment, growth and productivity of strawberry plants. VAM fungi can supply phosphorus which affects floral differentiation and growth. Hormonal and nutritional conditions as a result of VAM fungal colonization's are also believed to contribute to a considerable extent for better growth and productivity Chavez and Ferrera 1990 [8].

Azatobacter is heterotrophic aerobic bacterium, the free living bacteria fixes nitrogen in the rhizosphere and provides it to the plant. Their inoculation is useful for horticultural crop with an increase in plant yield Ranna and chandel 2003 [9]. The increase in yield is because in addition to adding nitrogen, these bacteria produce vitamins like biotin, folic acid also produces antifungal antibiotics which results an early development of roots and better starts of crop plant initially. Azatobacter is free living nitrogen fixing bacteria fixing nitrogen equalent to 25 to 30 kg nitrogen $ha^{-1}$, thus released nitrogen is quickly absorbed by the plant. Subba Rao *et al.,* 1993 [10] reported that *Azotobacter* cells are not usually present on the rizoplane (root surface) but are in abundant in the rhizosphere.

**Materials and Methods**

The field experiment was conducted during Rabi season of 2015-16 at pomology section, Department of Horticulture, Allahabad School of Agricultural, Sam Higginbottom University of Agriculture Technology and Sciences, Allahabad. The experimental site is situated at a latitude of 20º and 15º North and longitude of 60º 3º East and at an altitude of 98 meters above mean sea level (MSL). Minimum temperature ranged from 4º -5º C (during Oct - Feb) and maximum temperature ranged from 45º -48º C (during March - June). The soil was sandy loam in texture having a pH (7.3), EC (0.26), organic carbon (0.40%), available N (250 kg $ha^{-1}$), P (13.50 kg $ha^{-1}$), K (313 kg $ha^{-1}$), S (13.93 ppm), and Zn (0.50 ppm) during the experimental year. 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 as per the requirement and applied to each treatments and replication at 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. Irrigation was scheduled at 10 days interval during vegetative growth & total of 6-8 irrigations were applied at critical stages of the crop. However other normal cultural practices were followed timely as; weeding at 25 DAS was done respectively. One quadrate (1 $m^2$) was harvested in every plot for the determination of results and data was subjected to statistical analysis separately by using analysis of variance technique. The experiment was down in randomized block design (RBD) and following treatment consists. $T_1$: Control,$T_2$: Phosphobacter 5 kg $ha^{-1}$ + Azatobacter 5 Kg $ha^{-1}$, $T_3$: Phosphobacter 5 kg $ha^{-1}$ + Azatobacter 5 Kg $ha^{-1}$ + FYM 25 t $ha^{-1}$, $T_4$: Phosphobacter 5 kg $ha^{-1}$ + Azatobacter 5 Kg $ha^{-1}$ + Poultry manure 12 t $ha^{-1}$, $T_5$: Phosphobacter 5 kg $ha^{-1}$ + Azatobacter 5 kg $ha^{-1}$ + Vermicompost 12 t $ha^{-1}$, $T_6$: Phosphobacter 5 kg $ha^{-1}$ + Azatobacter 5 kg $ha^{-1}$ + FYM 13 t $ha^{-1}$, $T_7$: Phosphobacter 5 kg $ha^{-1}$ + Azatobacter 5 kg $ha^{-1}$+Poultry Manure 6 t $ha^{-1}$, $T_8$: Phosphobacter 5 kg $ha^{-1}$ + Azatobacter 5 kg $ha^{-1}$ + Vermicompost 6 t $ha^{-1}$, $T_9$: Phosphobacter 5 kg $ha^{-1}$ + Azatobacter 5 kg $ha^{-1}$ + FYM 13 t $ha^{-1}$ + Poultry manure 6 t $ha^{-1}$, $T_{10}$: Phosphobacter 5kg $ha^{-1}$ + Azatobacter 5 kg $ha^{-1}$ + FYM 13 t $ha^{-1}$ + Vermicompost 6 t $ha^{-1}$, $T_{11}$: Phosphobacter 5 kg $ha^{-1}$ + Azatobacter 5 kg $ha^{-1}$ + Vermicompost 6 t $ha^{-1}$ + Poultry Manure 6 t $ha^{-1}$, $T_{12}$: Phosphobacter 5 kg $ha^{-1}$ + Azatobacter 5 kg $ha^{-1}$ + FYM 6 t $ha^{-1}$ + Vermicompost 3 t $ha^{-1}$ + Poultry Manure 3 t $ha^{-1}$. The difference among treatment means was compared by using least significant difference test at 5% probability levels.

## Results and Discussion

### Yield Attributes

The observations regarding yield attributes of Strawberry Viz., Number of fruit yield per plant (g), Fruit yield per plot (g), Fruit yield (q $ha^{-1}$) were influenced by every increment dose of organic manures and biofertilizers and this beneficial effect was seen during all the growth period, it is also may be due to synchronized availability of essential plants nutrients to the crop especially NPK for a longer period during its growth & reproductive stages. Treatment $T_{12}$ Phosphobacter 5 kg $ha^{-1}$ + Azatobacter 5 kg $ha^{-1}$+ FYM 6 t $ha^{-1}$ + Vermicompost 3 t $ha^{-1}$+ Poultry Manure 3 t $ha^{-1}$ has recorded maximum number of Fruit yield per plant (75.94 g), Fruit yield per plot (683.46 g), Fruit yield per q $ha^{-1}$ (68.34 q), while minimum number of Fruit yield per plant (39.95 g), Fruit yield per plot (359.55 g), Fruit yield per q $ha^{-1}$ (35.95 q) were recorded in treatment $T_1$ Control (RDF). However, treatment $T_{11}$ and $T_{10}$ was found to be statistically at par to treatment $T_{12}$ (Table 1) and (Fig 1). The probable reason may be due to beneficial effect of biofertilizers and organic manures resulting increase Fruit yield per plant (g), Fruit yield per plot (g), Fruit yield (q $ha^{-1}$) of strawberry. However the essential role of organic manure and biofertilizers has been established as a component of several enzymes concerned with carbohydrate and NPK metabolism, in addition to its involvement directly or indirectly in regulating the various physiological and reproductive processes of plants. The findings have been confirmed by Sahoo *et al.*, 2005 [11] and Umar *et al.*, 2010 [12]. Similar finding are also reported by Prasad *et al.*, 2017 [13].

### Quality Attributes

The observations regarding quality of strawberry Viz., T. S. S. ($^0$Brix), Acidity (%) and pH were influenced by every increment dose of organic manures and different biofertilizers and this beneficial effect was seen in fruit quality, it is also may be due to synchronized availability of essential plants nutrients and optimum weather during maturity and ripening of the fruit especially NPK and vital micronutrients for a longer period during its reproductive stages. The data reveals that there exists a useful and meaningful impact on fruit quality. Treatment $T_{12}$ (Phosphobacter 5 kg $ha^{-1}$ + Azatobacter 5 kg $ha^{-1}$+ FYM 6 t $ha^{-1}$ + Vermicompost 3 t $ha^{-1}$+ Poultry Manure 3 t $ha^{-1}$) has recorded the highest total soluble solid (8.54 Brix), Minimum acidity (0.46 %)and highest pH (4.40). While lowest total soluble solid (6.90 Brix), Maximum acidity (0.75%) and lowest pH (3.9) in treatment $T_1$ Control (RDF). However the essential role of organic manure and biofertilizers has been established as a component of several enzymes concerned with carbohydrate and NPK metabolism, in addition to its involvement directly or indirectly in regulating the various physiological and reproductive processes of plants. Findings are confirmed by Yusuf *et al.*, 2003 [14] and results are also reported by Sahoo *et al.*, 2005 [11]. The higher TSS and total sugar with lower acidity (0.481 per cent) under the application of vermicompost + *Azotobacter* + *Azospirillum* + PSB in strawberry Singh *et al.*, 2012 [15]. Similar findings are also reported by Singh and Singh 2009 [16].

### Economics

The highest gross return (1079250 □ $ha^{-1}$), net return (696022.95 □ $ha^{-1}$) and B:C ratio (2.27:1) was observed in Treatment $T_{12}$ (Phosphobacter 5 kg $ha^{-1}$ + Azatobacter 5 kg $ha^{-1}$ + FYM 6 t $ha^{-1}$ + Vermicompost 3 t $ha^{-1}$ + Poultry Manure 3 t $ha^{-1}$), where as minimum gross return (538500 □ $ha^{-1}$), net return (156913.2 □ $ha^{-1}$) was observed in treatment $T_9$ Phosphobacter 5 kg $ha^{-1}$ + Azatobacter 5 kg $ha^{-1}$ + FYM 13 t $ha^{-1}$ + Poultry manure 6 t $ha^{-1}$. Similarly minimum B; C ratio was observed in treatment$T_6$ Phosphobacter 5 kg $ha^{-1}$ + Azatobacter 5 kg $ha^{-1}$ + FYM 13 t $ha^{-1}$.

**Table 1:** Effect of different biofertilizers and organic manures on yield attributes of strawberry

| | Treatments | Fruit yield plant $^{-1}$ (gm) | Fruit yield plot$^{-1}$ (gm) | Fruit yield (q $ha^{-1}$) |
|---|---|---|---|---|
| $T_1$ | Control (RDF) | 39.95 | 359.55 | 35.95 |
| $T_2$ | Phosphobacter 5kg/ha + Azatobacter 5 Kg $ha^{-1}$ | 46.68 | 420.09 | 42.01 |
| $T_3$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 Kg $ha^{-1}$ + FYM 25 t $ha^{-1}$ | 44.64 | 431.76 | 43.17 |
| $T_4$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 Kg $ha^{-1}$ + Poultry manure 12 t $ha^{-1}$ | 48.14 | 433.29 | 43.32 |
| $T_5$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 kg $ha^{-1}$ + Vermicompost 12 t $ha^{-1}$ | 46.37 | 417.36 | 41.73 |
| $T_6$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 kg $ha^{-1}$ + FYM 13 t $ha^{-1}$ | 46.31 | 416.76 | 41.67 |
| $T_7$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 kg $ha^{-1}$ + Poultry Manure 6 t $ha^{-1}$ | 50.65 | 455.88 | 45.58 |
| $T_8$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 kg $ha^{-1}$ + Vermicompost 6 t $ha^{-1}$ | 55.86 | 502.74 | 50.27 |
| $T_9$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 kg $ha^{-1}$ + FYM 13 t $ha^{-1}$ + Poultry manure 6 t $ha^{-1}$ | 52.51 | 472.56 | 47.25 |
| $T_{10}$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 kg $ha^{-1}$ + FYM 13 t $ha^{-1}$ + Vermicompost 6 t $ha^{-1}$ | 68.70 | 618.30 | 61.83 |
| $T_{11}$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 kg $ha^{-1}$ + Vermicompost 6 t $ha^{-1}$+ Poultry Manure 6 t $ha^{-1}$ | 60.60 | 545.37 | 54.53 |
| $T_{12}$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 kg $ha^{-1}$+ FYM 6 t $ha^{-1}$ + Vermicompost 3 t $ha^{-1}$+ Poultry Manure 3 t $ha^{-1}$ | 75.94 | 683.46 | 68.34 |
| F-test | | S | S | S |
| SEd(±) | | 1.63 | 10.71 | 1.07 |
| CD (P=0.05) | | 3.34 | 21.95 | 2.19 |

**Table 2:** Effect of different biofertilizers and organic manures on quality attributes of strawberry

| | Treatments | T.S.S ($^0$Brix) | Acidity (%) | pH |
|---|---|---|---|---|
| $T_1$ | Control (RDF) | 6.90 | 0.75 | 3.9 |
| $T_2$ | Phosphobacter 5kg/ha + Azatobacter 5 Kg $ha^{-1}$ | 7.70 | 0.56 | 4.0 |
| $T_3$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 Kg $ha^{-1}$ + FYM 25 t $ha^{-1}$ | 7.78 | 0.62 | 3.92 |
| $T_4$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 Kg $ha^{-1}$ + Poultry manure 12 t $ha^{-1}$ | 7.61 | 0.61 | 4.0 |
| $T_5$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 kg $ha^{-1}$ + Vermicompost 12 t $ha^{-1}$ | 7.69 | 0.57 | 4.05 |
| $T_6$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 kg $ha^{-1}$ + FYM 13 t $ha^{-1}$ | 7.68 | 0.63 | 4.10 |
| $T_7$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 kg $ha^{-1}$ + Poultry Manure 6 t $ha^{-1}$ | 7.83 | 0.54 | 4.10 |
| $T_8$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 kg $ha^{-1}$ + Vermicompost 6 t $ha^{-1}$ | 7.80 | 0.70 | 4.10 |

| | | | | |
|---|---|---|---|---|
| $T_9$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 kg $ha^{-1}$ + FYM 13 t $ha^{-1}$ + Poultry manure 6 t $ha^{-1}$ | 7.67 | 0.60 | 4.15 |
| $T_{10}$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 kg $ha^{-1}$ + FYM 13 t $ha^{-1}$ + Vermicompost 6 t $ha^{-1}$ | 8.46 | 0.49 | 4.30 |
| $T_{11}$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 kg $ha^{-1}$ + Vermicompost 6 t $ha^{-1}$+ Poultry Manure 6 t $ha^{-1}$ | 8.34 | 0.51 | 4.34 |
| $T_{12}$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 kg $ha^{-1}$+ FYM 6 t $ha^{-1}$ + Vermicompost 3 t $ha^{-1}$+ Poultry Manure 3 t $ha^{-1}$ | 8.54 | 0.46 | 4.40 |
| F-test | | S | S | S |
| Sed (±) | | 0.20 | 0.02 | 0.14 |
| CD (P=0.05) | | 0.41 | 0.03 | 0.28 |

**Table 3:** Effect of different biofertilizers and organic manures on economics of strawberry

| | Treatments | Gross Returns (□ $ha^{-1}$) | Net Returns (□ $ha^{-1}$) | B:C Ratio |
|---|---|---|---|---|
| $T_1$ | Control (RDF) | 985500 | 548485.95 | 1.39:1 |
| $T_2$ | Phosphobacter 5kg/ha + Azatobacter 5 Kg $ha^{-1}$ | 931500 | 548835.38 | 1.45:1 |
| $T_3$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 Kg $ha^{-1}$ + FYM 25 t $ha^{-1}$ | 1046250 | 663778.05 | 1.79:1 |
| $T_4$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 Kg $ha^{-1}$ + Poultry manure 12 t $ha^{-1}$ | 927000 | 544528.05 | 2.13:1 |
| $T_5$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 kg $ha^{-1}$ + Vermicompost 12 t $ha^{-1}$ | 922500 | 539965.05 | 2.05:1 |
| $T_6$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 kg $ha^{-1}$ + FYM 13 t $ha^{-1}$ | 910740 | 503235.84 | 1.10:1 |
| $T_7$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 kg $ha^{-1}$ + Poultry Manure 6 t $ha^{-1}$ | 866250 | 483585.08 | 1.69:1 |
| $T_8$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 kg $ha^{-1}$ + Vermicompost 6 t $ha^{-1}$ | 646000 | 463261.88 | 1.72:1 |
| $T_9$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 kg $ha^{-1}$ + FYM 13 t $ha^{-1}$ + Poultry manure 6 t $ha^{-1}$ | 538500 | 156913.2 | 1.98:1 |
| $T_{10}$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 kg $ha^{-1}$ + FYM 13 t $ha^{-1}$ + Vermicompost 6 t $ha^{-1}$ | 610740 | 493235.81 | 1.49:1 |
| $T_{11}$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 kg $ha^{-1}$ + Vermicompost 6 t $ha^{-1}$+ Poultry Manure 6 t $ha^{-1}$ | 901502 | 448835.48 | 1.67:1 |
| $T_{12}$ | Phosphobacter 5kg $ha^{-1}$+ Azatobacter 5 kg $ha^{-1}$+ FYM 6 t $ha^{-1}$ + Vermicompost 3 t $ha^{-1}$+ Poultry Manure 3 t $ha^{-1}$ | 1079250 | 696022.95 | 2.27:1 |

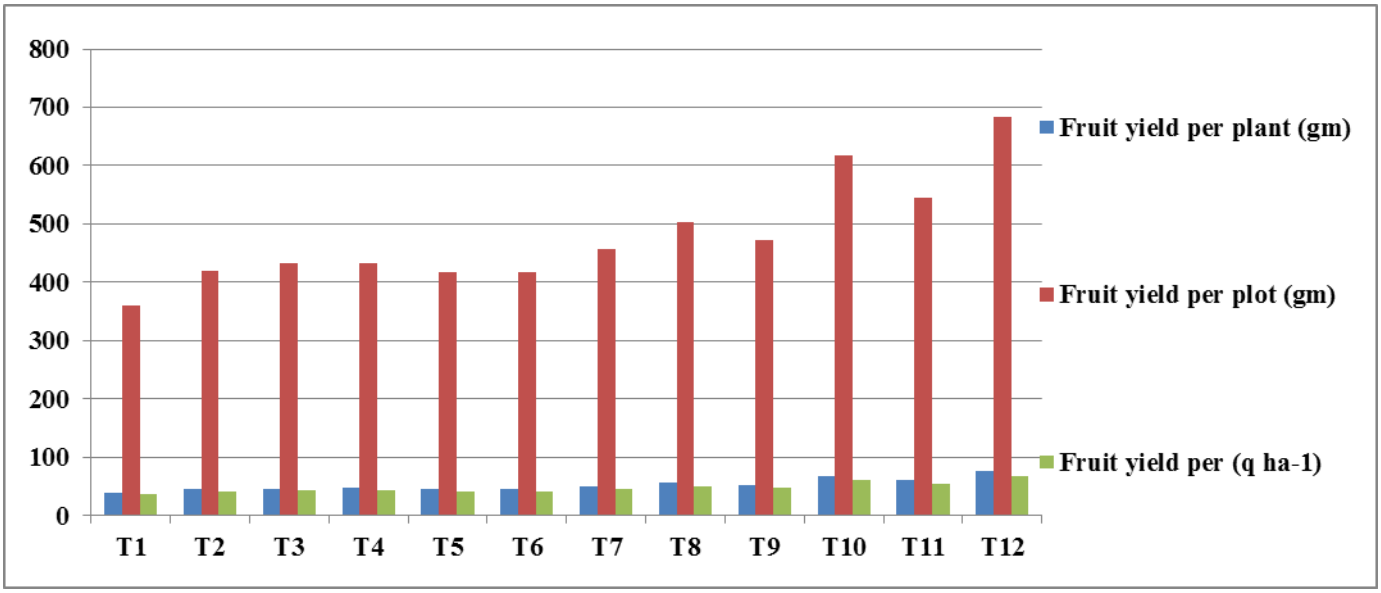
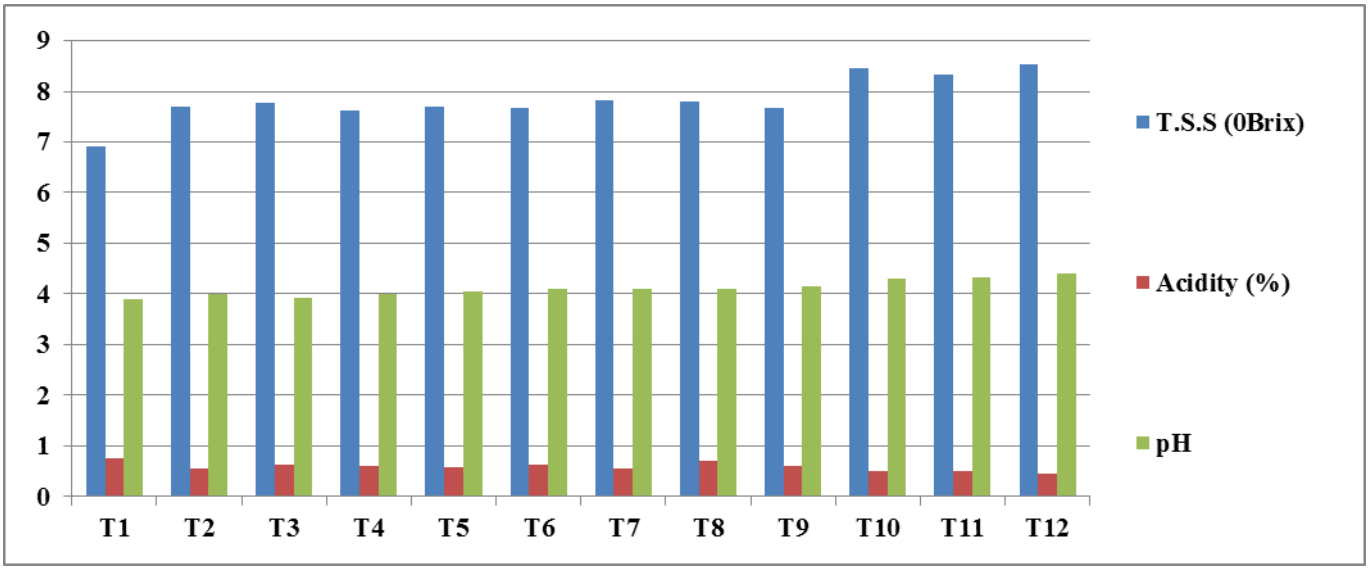
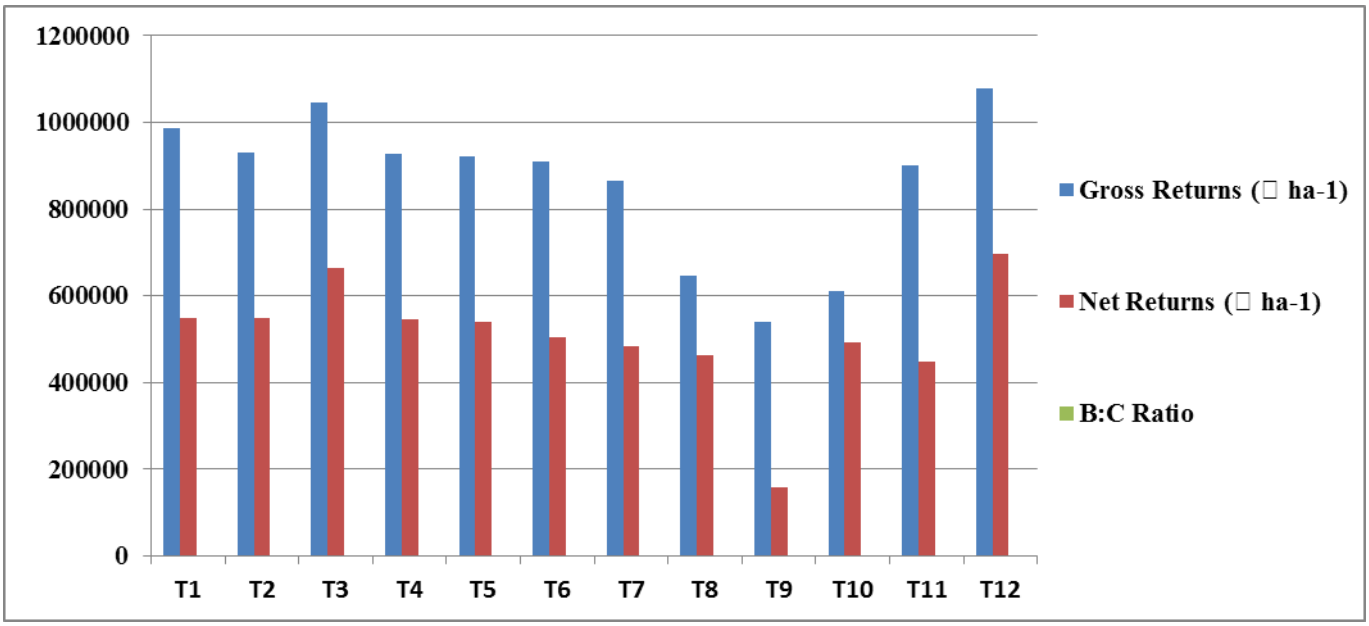



**Fig 1:** Effect of different biofertilizers and organic manures on yield and attributes of strawberry






## Conclusion

Considering the result presented in experiment investigation. It is concluded that treatment combination of Phosphobacter 5 kg $ha^{-1}$ + Azatobacter 5 kg $ha^{-1}$ + FYM 6 t $ha^{-1}$ + Vermicompost 3 t $ha^{-1}$ + Poultry Manure 3 t $ha^{-1}$ was the best treatment combination for obtaining fruit yield, fruit quality and net income and maximum benefit cost ratio in strawberry crop. Since the findings are based on the research done in one season it may be repeated for conformation.

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## References

1. Sharma RR, Sharma VP. The Strawberry. ICAR, New Delhi, India, 2004.
2. Sharma RR, Krishna H, Patel VB, Dahuja A, Singh R. Fruit calcium content and lipoxygenase activity in relation to albinism disorder in strawberry. Sci. Hortic. 2006; 107:150-154.
3. Mitra SK. Strawberries in Temperate fruit. Bose. T. K. Mitra S. K. and Rathore, T. S. (Eds), Horticulture and Allied Publisher, Calcutta, 1991, 549-596.
4. Mahadeen AY *et al*., Influence of organic and chemical fertilization on fruit yield and quality of plastic house grown strawberry. Jordan J Agric. Sci. 2009; 5(2):167-177.
5. Lakpale R, Srivastava GK, Choubey NK, Singh AP, Joshi BS, Pandey RL. Response of gram (*Cicer arietinum*) to integrated nutrient management in vertisols of Chhattisgarh plains. Indian J Ag. Sci. 2003; 73(3):162-163.
6. Rosati A. *et al.* Organic farming in Europe. Livestock Production Sci. 2005; 90(1):41-51.
7. Rana MC, Rana SS, Sharma SK, Kumar S, Sharma GD. Influence of FYM and fertility levels on the productivity, economics and nutrient use efficiency of French bean (*Phaseolus vulgaris* L.) under high altitude of north-western Himalayas. Himachal J Agri. Res. 2007; 33(1):4-6.
8. Chavez MG, Ferrera R. Effect of vesicular arbuscular mycorrhizae on tissue culture-derived plantlets of strawberry. Hort. Science. 1990; 25:903-905.
9. Rana RK, Chandel JS. Effect of biofertilizer and nitrogen on growth, yield and fruit quality of strawberry. Prog. Hort. 2003; 35(1):25-30.
10. Subba Rao NS. Biofertilizers in agriculture and forestry 3rd Rev. Ed. oxford publishing Co. Pvt. Ltd. Series New Delhi, 1993, 72-73.
11. Sahoo SK, Singh DB. Effect of different levels of biofertilizers on growth, yield and quality of strawberry (*Fragaria ananassa* Duch) cv. Sweet Charley. Orissa Journal of Horticulture. 2005; 33(2):82-85.
12. Umar I, Wali VK, Rehman M, Mir MM. Banday SA, Bisati IA. Effect of subabul (*Leucaena: leucocephala*). Applied Biological Research. 2010; 2(12):50-54.
13. Heerendra Prasad, Paramjeet Sajwan, Meena Kumari, SPS Solanki. Effect of Organic Manures and Biofertilizer on Plant Growth, Yield and Quality of Horticultural Crop: A Review. International Journal of Chemical Studies. 2017; 5(1):217-221
14. Yusuf A, Masood I, Shah SZA, Ahmed MJ. Effect of different combinations of nitrogen, phosphorous and farm yard manure on yield and quality of strawberry. Sarhad J of Agriculture. 2004; 2:19:185-188.
15. Singh SR, Zargar MY, Najar GR, Ishaq MI, Hakeem SA. Effect of integrated nutrient supply on yield, fertility and quality of strawberry under rainfed temperate conditions. J Indian Soc. Soil Sci. 2012; 60(1):79-82.
16. Akath Singh, Singh JN. Effect of biofertilizers and bioregulators on growth, yield and nutrient status of strawberry CV. Sweet Charlie. Indian Journal of Horticulture. 2009; 66(2):220-224.