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Review Article

A Review on Effect of Organic Manure and Bio-fertilizers on Growth, Yield and Quality of Strawberry

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ABSTRACT

A study was carried out to review the effect of organic manure and bio-fertilizers on growth, yield and quality of strawberry. The number of experiments reviewed and found that the best result to increase the number of leaves per plant, length of leaves, plant spread, width of leaves, length of petioles, height of plants, total number of fruits, numbers of runners, weight of fruit per plant, weight of fruit per berry, T.S.S. content of fruits, whereas produced maximum Ascorbic acid, maximum of fruits and maximum acid content.

Keyword: *Organic manure, Bio-fertilizers, Growth, Yield and Strawberry.*

INTRODUCTION

The cultivated strawberry (*Fragaria* X *ananassa* Duch.) originated from the hybridization between two American species (*Fragaria chilionensis* Duch. X *Fragaria virginiana* Duch.). It belongs to family Rosaceae and is octaploid in nature having 56 somatic chromosome numbers. Strawberry is one of the most important temperate berry fruit, which can also be cultivated in sub-tropical and tropical regions. It can be grown up to 3000 meters above mean sea level in humid and dry regions. Being a quick growing crop, it is also suitable for kitchen garden. In India strawberry cultivation is mainly confined in Dehradun, Nainital (Uttaranchal), Solan and Kullu Valley (H.P.), Srinagar (J&K), Hills of Darjeeling (W.B.) and in Gurgaon (Haryana) and Muzaffar Nagar (U.P.). The fruits of strawberry are attractive with distinct aroma and pleasant flavor. The fresh- ripe fruits of strawberry are a fairly good source of vitamin A (60 IU/100g of edible portion) and vitamin C (30-120 mg/100 g of edible portion) and minerals like P, K, Ca and Fe. Strawberry can be grown on a wide range of soil ranging from heavy clay to light sand. The plant has fibrous root system and most of its roots are confined to the top15-20 cm layer of the soil, and it grows best in the light porous soil that is rich in humus. The plant is a surface feeder therefore fertility, moisture, drainage and microbial status of the upper layer of soil have great impact on growth, development, fruit, quality and production of runners.

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Among various aspect that contributed on growth, development and quality of strawberry, nutrition is one of the important element of crop production. Organic manures *viz.*, FYM, vermicompost and press mud improves the physical properties of soil (water holding capacity, soil aeration drainage and water retention capacity), prevent soil degradation and increase important beneficial micro organism population. Biofertilizers are naturally occurring products with living microorganisms which are resulted from the roots or cultivated soil and don't have any ill effect on plants, soil health and environment. Besides, their role in fixing atmospheric nitrogen and phosphorous solubilisation, these are also helpful in stimulating the plant growth hormones. Biofertilizer *viz.* Azotobacter, PSB and Azospirillum fix atmospheric nitrogen and solubilize phosphorus to increase fertility of soil and increases number and biological activities. Biofertilizer are the derived product of living microorganism that are capable to fixing atmospheric nitrogen and also convert insoluble phosphorus to soluble phosphorus for uptake of plants. Keeping this fact in view the present study was conducted to find out the effect of organic manures and bio fertilizers on growth and quality of Strawberry cv. Chandler.

Effect of Organic Manure and Bio-fertilizers on Strawberry

Nowsheen et al. (2006) studies the effect of various organic nutrient combinations and reported that plant height (23.39 cm), plant spread (24.21 cm) and runners (13.03) plant^{-1} recorded maximum in poultry manure + *Azotobacter* + wood ash + PSB + oil cake treated plant of strawberry cv. Senga Sengana. Rajbir et al. (2010) studied the effect of Vermicompost on strawberry cultivar chandler supplemented with inorganic fertilizers to balance fertilizer requirement and results revealed that Vermicompost application at 10 t ha^{-1} increased plant spread (16.1%) and leaf area (31.4%) as compare to control. Singh and Singh (2009**)** found that nitrogen fixing bacteria and bio-regulators exhibit significant effect on strawberry plant. The maximum growth in terms of plant height (27.29 cm), number of leaves (26.92) and leaf area (123.29cm^2) plant^{-1} were observed in treatment consisting of *Azotobacter* + *Azospirillum*+ 60 kg N ha-1 spray with 100 ppm GA_3. Tripathi et al. (2010) applied 5, 6 and 7 kg each of *Azotobacter, Azospirillum*and PSB on strawberry cv. Chandler and reported that application of 7 kg ha^{-1} *Azotobacter*, significantly increased the plant height (16.05 cm), number of leaves (54.75 g) and number of runners (4.39) plant^{-1}. Singh et al. (2012) studies the effect of integrated nutrient management on strawberry and observed that maximum runners (7.45) plant^{-1} were obtained with the application of FYM at 10 t ha^{-1} +*Azotobacter*+ PSB + AMF treated plant. Mishra and Tripathi (2011) studies the effect of biofertilizers on strawberry cv. Chandler and reported that *Azotobacter* (6 kg ha^{-1}) along with PSB (6 kg ha^{-1}) results the maximum fruit length (4.63 cm), width (2.64 cm), weight (8.48 g) and volume (6.14 cc). Mishra and Tripathi (2012) reported that TSS (10.30 0B), total sugars (9.54%) and ascorbic acid (57.55 mg/100 g) were found maximum in *Azotobacter* (6 kg ha^{-1}) along with PSB (6 kg ha^{-1}) treated plant of strawberry. Rajbir et al. (2008) conducted an experiment on strawberry of various doses of vermicompost and found that minimum acidity (1.09%) and maximum ascorbic acid (51.1 mg/100 g) recorded in vermicompost at 10.0 t ha^{-1} however, highest TSS (7.42 ^{0}B) was obtained in vermicompost at 7.5 t ha^{-1} treated plants. Umar et al. (2009) studies on strawberry cv. Chandler and reported that total soluble solids (6.8^{0}B) was recorded highest in treatment 25% nitrogen through FYM +75% nitrogen through urea + *Azotobacter* treated plants. Highest acidity (0.77%) was found in treatment cent per cent nitrogen applied through urea + *Azotobacter* treated plant. Ahmad et al. (2010) applied PGPB strains (Pseudomonas BA-8, *Bacillus* OSU-142 and *Bacillus* M-3) alone and combination in strawberry and reported that number of fruits plant^{-1} significantly increased by the application of M3 + BA-8 (91.73) and M3 (81.58) treated plants of strawberry.

Ahmad et al. (2012) investigated the influence of different organic nutrient combinations on strawberry and reported that maximum diameter of fruit (3.11 cm), length (3.95 cm), volume (20.397 cm^3) and weight (11.11 g) were found in 75% recommended dose of NPK through chemical fertilizer + 25% FYM fertilized plants of tomato. Turemis (2002) studies the effect of various plant composts and manures on strawberry cv. Dorit-216 and reported that highest yield was obtained from the banana compost treatment (595.4 g $plant^{-1}$), followed by wheat straw (WS) + poultry manure (PM) 490.2 g $plant^{-1}$, tobacco + PM (464.6 g $plant^{-1}$), banana + farm yard (FY) 456.9 g $plant^{-1}$.

Wang and Lin (2002) reported that fruit yield was recorded more than 70% in both the cv. All-star and Honeoye, when treatment was given by adding half strength of peter nutrient solution (50% fertilizer) with a mixture of 50% soil + 50% compost in strawberry. Sahoo and Singh (2005) studied the effect of different levels of biofertilizers, *Azotobacter* and *Azospirillum* and reported that yield (242.30g) $plant^{-1}$ was found maximum by application of *Azotobacter* (6 kg ha^{-1}) + *Azospirillum* (6 kg ha^{-1}) fertilized plants of strawberry cv. Sweet Charlie. Pesakovic et al. (2013) studies on cv. Senga Sengana of strawberry and reported that plants treated with liquid inoculum of diazotrophic bacteria *Klebsiellaplanticola* have significantly highest yield (0.52 kg) $plant^{-1}$. Yadav et al. (2010b) that maximum growth in terms of plant height (16.65 cm), plant spread (34.52 cm) and leaf area (108.32 cm^2) were observed in 100% inorganic fertilized treatments i.e. ½ N as basal and remaining ½ N before flowering (all through inorganic sources) + Azotobacter inoculated plants. Arancon et al. (2004) applied vermicompost in strawberries and observed the improvement in plant growth and fruit yield. They observed a partial to full scale increase in soil microbial biomass too, leading to the production of hormones and humors independently to the soil. Kirad et al. (2009) reported that highest number of leaves (18.73) $plant^{-1}$ recorded in treatment 75% N through RDF + 25% N through vermicompost along with rhizosphere bacteria culture, whereas maximum plant height (185.35 cm) was found with 100% RDF alone treated plants of strawberry. Soni et al. (2018) application of organic manure and biofertilizer in strawberry results revealed that the treatment T8 - 50% Vermicompost + 50% Poultry Manure + Azotobacter was found to be the best among the various treatment and recorded maximum plant height (19.61 cm), number of leaves (21.11), plant spread (24.54), number of flowers (30.41 $plant^{-1}$), number of fruit (12.41 $plant^{-1}$), fruit length (3.70 cm), fruit width (3.20 cm), fruit weight (11.83 g). The treatment also recorded the maximum fruit yield (144.77 g $plant^{-1}$, 2.32 kg $plot^{-1}$ and 7.72 t ha^{-1}) which was followed by T9-50% Vermicompost+ 50% FYM + Azotobacter.

Singh et al. (2015) application of Vermicompost+ Azotobacter + PSB + AM produced maximum plant height (20.26 cm), plant spread (25.64 cm), number of leaves (54.30) and leaf area (97.87cm) plants, whereas all the growth characters were found minimum in control. Earliest flowering (50.39 days) and maximum number of runners (7.12) $plants^{-1}$ were reported in Vermicompost + AM, while minimum runners (3.27) were recorded in Vermicompost alone treated plants. Duration of harvesting (66.80 days) was highest in treatment (Vermicompost + PSB + AM), while number of flowers (64.23) and number of fruit set (50.63) $plant^{-1}$ were recorded highest in Vermicompost + Azotobacter + PSB + AM treatment. Days to fruit set (6.30 days) were minimum in Vermicompost + Azotobacter. All the characters were found minimum in control. Maximum yield (311.26 g) $plant^{-1}$ was recorded with Vermicompost + Azotobacter + PSB + AM, and minimum in control (136.59 g).

Changotra et al. (2017) the present study revealed that plant treated with 2.80 t/ha vermicompost showed significant increase in plant height, leaf area, number of leaves per plants, number of flowers, number of fruit per plant and fruit set per cent in strawberry.

Similarly plant treated with 2.80 t/ha vermicompost also showed significant effect on physico- chemical properties of fruits. Fruits showed maximum fruit weight, fruit size, TSS, TSS: acid, total sugars, reducing sugars, ascorbic acid content, organoleptic rating, and minimum acidity with application of 2.80 t/ha vermicompost. Hence it was concluded that vermicompost has significant effect on the vegetative growth and quality of strawberry.

Malusa et al. (2016) different kinds of soil micro-organisms belonging to several taxa of the bacteria, fungi, and possibly, protozoa kingdoms, colonizing the rhizosphere or the plant tissues and promoting plant growth (PGPM), can be utilized for the production of microbial based fertilizers (bio-fertilizers). However, their application in agricultural practice is still hindered by several factors. Huil et al. (2008) the effect of bio-fertilizer on the growth, yield and fruit quality/of replanted strawberry were discussed. The results can be summarized as following the bio-fertilizer could significantly improve vegetating growth, yield and fruit quality of successive strawberry. The yield of strawberry was most significantly improved applying 37.5 kg/hm^2 bio-fertilizer in all treatments. The prophase and total yield respectively increased 14.82 and 6.74% compared with the soil without biofertilizer (control).Applying bio-fertilizer could significantly promoted the quality of strawberry, including sugar/acid ratio, soluble solids and VC content of fruit of strawberry. Its sugar/acid ratio, soluble solids and VC content were respectively improved 11.50 o, 20.00 o, 17.2% and 30.2% compared with control.

Rana and Chandel (2003) used bio-fertilizers and nitrogen to strawberry cv. Chandler and found that Azotobacter inoculated plants attained maximum plant height (24.92 cm), number of leaves (26.29), leaf area (96.12 cm) and number of runners (18.70) per plant as compared to other treatments. They further observed that the application of Azotobacter in combination with 60 kg N/ha produced maximum Leaf area (102.50 cm^2) over all other treatments. Sara et al. (2013) studies were conducted using six different organic amendments on strawberry (*Fragaria ananassa* Duch.) cv. Chandler which included T_1= planting media (soil + silt + farm yard manure); T_2 = planting media + 400 mg^{-1} humic acid, T_3 = planting media + 200 g kg^{-1} leaf manure; T_4 = planting media + 200 4g kg" Vermicompost; T_5 = planting media + 200 g kg^{-1} plant fertilizer and T_6= 2 planting media+ 200 g kg^{-1} bio-compost during 2011-12 at PMAS-Arid Agriculture University, Rawalpindi. Treatment T_1 (soil + silt + FYM) induced positive influence on plant height (15.21 cm), canopy spread (20.37 cm),crown diameter (1.47 cm), fresh weight of plant (10.71 g), number of runners per plant (2), total number of flowers (58), total number of fruits (42), fruit size (3.04 cm), fruit weight per berry (8.82 g) while T (soil + silt + 4200 g-l kg Vermicompost) improved fresh leaf weight (0.92 g), number of leaves (667), leaf area (43.07 cm^2) and days required for first bloom (96.67). Leaf manure based treatment (T) enhanced root length (20.11 cm) T_3, T_4 improved quality parameters like total solid soluble (TSS) (8.88) and ascorbic acid contents (64 mg) while T improved total sugar contents in fruits (6.82%).

CONCLUSION

From the investigation with organic manure and bio-fertilizers on strawberry it can safely be concluded that significantly increase the number of leaves per plant, length of leaves, plant spread, width of leaves, length of petioles, height of plants, total number of fruits, numbers of runners, weight of fruit per plant, weight of fruit per berry, T.S.S. content of fruits, whereas produced maximum Ascorbic acid maximum of fruits and maximum acid content.

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