

Impact of Organic Manures and Biofertilizers on Growth and Quality Parameters of Strawberry cv. Chandler

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Abstract

Pot experiment on growth and quality parameters of strawberry was conducted at Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Faizabad, U.P., India to evaluate the effect organic manure (Farm Yard Manure, vermicompost and press mud) and biofertilizers (Azotobacter, phosphate solubilizing bacteria and Azospirillum). Each treatment combination has shown significant effects on most of the parameters, but the combination of vermicompost and PSB showed highest plant height (23.59 cm), leaves plant⁻¹ (12.67), primary branches plant⁻¹ (10.50), secondary branches plant⁻¹ (27.35), first flowering (61.06 days), flowers plant⁻¹ (15.33), first fruit setting (72.80 days) and fruits plant⁻¹ (8.33). Similarly, the treatments combination of vermicompost and PSB significantly affected the Total Soluble Solids (TSS) (10.75° Brix), titrable acidity (0.82), vitamin C (57.24 mg/100gm fruit), total sugars (5.95 %) and juice content (79.50 %).

Keywords: Biofertilizers, Growth, Organic Manures, Quality, Strawberry

1. Introduction

Strawberry is one of the important temperate fruit of India but also being grown in sub-tropical and tropical climates. It can be grown up to 12,000 feet from sea level in humid and dry regions. Its successful cultivation requires an optimum day temperature of 22-23°C and night temperature of 7-13°C in India. It is excellent sources of natural antioxidants including carotenoids vitamins, phenols, flavonoids, dietary glutathione endogenous metabolites and exhibit a high level of antioxidant capacity against free radical species^{24,31}.

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.

Vermicompost significantly enhance the growth, development and productivity of plants²⁹. It improves the yield of strawberry due to their essential elements, vitamins, enzymes and hormone¹⁷. It contains organic carbon (9.15-17.98 %), nitrogen (0.5-1.5 %), potassium (0.15 %), phosphorus (0.1-0.3 %), calcium and magnesium (22.70 - 70 mg/100 g), zinc (5.7-11.5 ppm), copper (2-9.3 ppm) and sulphur (128-548 ppm)¹². Due to its better physico-chemical and biological characters it serves as easily available organic manure in various farming systems⁷.

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Press mud which is produced from the residue of sugar industries is very beneficial for plant growth and also for the improvement of soil physical and chemical properties. It applied directly from sugar mill to soil as an organic source which results in reduction of chemical fertilizers requirements of crops^{13,22} and may therefore affect soil properties^{10,18,21}. It is whitish-brown, soft, amorphous material with high temperature and waxy substance that limits its direct use in the fields¹¹.

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 plants¹⁶. 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*.

2. Materials and Methods

Experiment "effect of organic manures and bio fertilizers on growth and quality of *Strawberry cv. Chandler*" was conducted at horticulture research farm, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad, UP during the year 2007-08. The experiment was tested in Complete Randomized Design (CRD) with three replications and consisted of ten treatments namely T₁ (FYM + *Azotobacter*), T₂ (FYM + PSB), T₃ (FYM + *Azospirillum*), T₄ (Vermicompost + *Azotobacter*), T₅ (Vermicompost + PSB), T₆ (Vermicompost + *Azospirillum*), T₇ (Pressmud + *Azotobacter*), T₈ (Pressmud + PSB), T₉ (Pressmud + *Azospirillum*) and T₁₀ (Control). The organic manures viz. FYM, Vermicompost and pressmud were applied at the rate of 314 gm plant⁻¹, 250 gm plant⁻¹ and 250 gm plant⁻¹, respectively and bio-fertilizers namely *Azotobacter*, PSB and *Azospirillum* each were applied at the rate of 2 gm plant⁻¹. Observations are recorded on plant height (cm), primary branches plant⁻¹, secondary branches plant⁻¹, first flowering (days), fruit

setting (days), TSS (°Brix), titratable acidity (%), vitamin C (mg/100 g fruit), total sugars (%) and juice content (%).

The plant height was measured with the help of digital vernier calipers. Data were recorded manually by counting leaves plant⁻¹, primary branches plant⁻¹, secondary branches plant⁻¹, flowers plant⁻¹ and fruits plant⁻¹ from each plant kept for observation. First flowering and fruit setting were recorded from the date of planting to first flower opening and first fruiting, respectively. TSS was measured with the help of ERMA hand refractrometer. Titratable acidity (%), vitamin C (mg/100 gm), total sugars (%) and juice content (%) were estimated as per the method suggested by Ranganna²⁰. Statistical analysis was estimated by analysis of variance as per the technique given by Gomez and Gomez⁸.

3. Result and Discussion

3.1 Effect on Plant Growth

The growth of strawberry plant was significantly influenced by FYM, Pressmud, *Azotobacter*, PSB and *Azospirillum* in combination (Table1).

Maximum plant height (23.95 cm), leaves plant⁻¹ (12.67), primary branches plant⁻¹ (10.50), secondary branches plant⁻¹ (27.35), first flowering (61.06 days), flowers plant⁻¹ (15.33), first fruit setting (72.80 days) and fruits plant⁻¹ (8.33) were recorded by the application of cent per cent vermicompost + PSB (T₅) followed by treatments comprising of vermicompost + *Azospirillum* (T₆) where plant attained height (23.50 cm), leaves plant⁻¹ (11.67), primary branches plant⁻¹ (10.25), secondary branches plant⁻¹ (26.95), first flowering (63.06 days), flowers plant⁻¹ (14.67), first fruit setting (73.50 days) and fruits plant⁻¹ (7.67). T₅ was found to be statistically at par with T₆. The utmost augment in vegetative growth attributes of Chandler strawberry under these treatments combination is supported by nitrogen supply through vermicompost. Vermicompost is the builder of protein and is the main constituent of protoplasm in plants thus; the increase in nitrogen supply accelerates synthesis of amino acids which might have indirectly exhibited increase in plant height of strawberry plant. Further, PSB also helpful in cell elongation and cell division in meristmatic region of plant, this was due to the production of plant growth substances (IAA and GA) by PSB. Application of biofertilizers such PSB helps to increase the biological nitrogen

Table 1. Effect of organic manures and biofertilizers on growth of *Strawberry cv. Chandler*

Treatment	Plant Growth							
	Plant Height (cm)	Leaves Plant ⁻¹	Primary Branch Plant ⁻¹	Secondary Branch Plant ⁻¹	First Flowering (Days)	Flowers Plant ⁻¹	Fruit Setting (Days)	Fruits Plant ⁻¹
T ₁ (FYM + <i>Azotobacter</i>)	21.75	8.33	8.25	24.35	79.60	11.33	89.60	4.67
T ₂ (FYM + PSB)	21.25	7.67	8.75	24.25	69.40	10.67	83.20	6.00
T ₃ (FYM + <i>Azospirillum</i>)	21.50	9.33	9.25	25.50	74.20	10.33	78.40	6.33
T ₄ (Vermicompost + <i>Azotobacter</i>)	22.75	10.67	9.75	26.50	67.01	12.67	80.20	6.67
T ₅ (Vermicompost + PSB)	23.95	12.67	10.50	27.35	61.06	15.33	72.80	8.33
T ₆ (Vermicompost + <i>Azospirillum</i>)	23.50	11.67	10.25	26.95	63.06	14.67	73.50	7.67
T ₇ (Pressmud + <i>Azotobacter</i>)	21.75	10.33	9.25	25.25	67.70	11.67	82.20	7.33
T ₈ (Pressmud + PSB)	21.95	9.67	9.35	25.75	73.70	9.67	81.60	5.33
T ₉ (Pressmud + <i>Azospirillum</i>)	22.95	8.67	10.35	24.95	68.40	9.33	84.20	5.67
T ₁₀ (Control)	19.75	6.67	6.50	17.92	84.40	7.67	91.70	4.33
SEM ±	0.680	0.497	0.412	0.828	2.902	0.843	3.462	0.577
CD at 5%	2.006	1.469	1.217	2.443	8.56	2.488	10.213	1.703

fixation and availability of phosphorus which is required for strong vegetative growth⁴. Similar results have been reported by Arancon et al.^{1,2} in strawberry and Ustad et al.³⁰ in banana. Increase in plant growth might be due to the improvement in physio-chemical properties of soil; increase in enzymatic activity, microbial population and also increase in plant growth hormones by application of vermicompost^{3,5,25,26}. Herencia et al.⁹ reported that composts contained nitrogen and phosphorus which enhanced vegetative growth and flower bud initiation. Singh et al.²⁸ found significant increase in fruit yield and flowering of strawberry with vermicompost based fertilizer.

3.2 Effect on Fruit Quality

The Total Soluble Solids (TSS), total sugars and juice percentage were recorded highest by the application of vermicompost + PSB (T₅) followed by treatment comprising of vermicompost + *Azospirillum* (T₆) as shown in Table 2.

Such an increase in total sugars, TSS and juice percentage have arisen due to synergistic effect of nitrogen due to vermicompost, potassium due to PSB on the effect use of these nutrients as well as other in the sugar metabolism of strawberry fruits reported by El-Hamid et al.⁶. All the nutrients significantly reduced the acid content of strawberry fruits over control. However, the maximum reduction was noted with the combined application of

Table 2. Effect of organic manures and bio fertilizers on quality of *Strawberry cv. Chandler*

Treatments	TSS (°Brix)	Titratable Acidity (%)	Vit-C (mg/100 g fruit)	Total Sugars (%)	Juice Content (%)
T ₁ (FYM + <i>Azotobacter</i>)	9.25	0.97	53.54	5.50	77.25
T ₂ (FYM + PSB)	9.50	0.92	53.50	5.75	73.25
T ₃ (FYM + <i>Azospirillum</i>)	9.25	0.91	53.25	5.89	73.50
T ₄ (Vermicompost + <i>Azotobacter</i>)	9.85	0.95	53.75	5.91	75.75
T ₅ (Vermicompost + PSB)	10.75	0.82	56.95	5.95	79.50
T ₆ (Vermicompost + <i>Azospirillum</i>)	10.25	0.88	55.24	5.93	78.50
T ₇ (Pressmud + <i>Azotobacter</i>)	10.15	0.88	54.74	5.65	75.50
T ₈ (Pressmud + PSB)	10.10	0.93	53.95	5.25	77.25
T ₉ (Pressmud + <i>Azospirillum</i>)	9.75	0.92	53.90	5.85	74.30
T ₁₀ (Control)	9.02	0.98	53.20	4.02	70.50
SEM ±	0.329	0.29	0.889	0.209	1.201
CD at 5%	0.971	0.085	2.621	0.615	3.543

vermicompost + PSB (T_5) followed by vermicompost + *Azospirillum* (T_6). The similar findings were also reported by Sahu and Singh²³, Singh and Singh²⁷ in strawberry and Kumari et al.¹⁴ in banana.

A significant increase in ascorbic acid content was recorded in control with respect to the all treatments. However, the maximum values were recorded with the application of vermicompost + PSB (T_5) followed by vermicompost + *Azospirillum* (T_6). The similar findings were also reported by Lucka et al.¹⁵ and Rana¹⁹ in fruits of strawberry.

4. References

1. Arancon NQ, Edwards CA, Beriman P, Welch C, Metzger JD. Influence of vermicomposts on field strawberries: Effect on growth and yields. *Bioresource Technology*. 2004; 93(2):145–53.
2. Arancon NQ, Edwards CA, Beriman P, Metzger JD, Lee S, Weich C. Effect of vermicompost on growth and marketable fruit of field grown strawberry. *Pedbiologia*. 2003; 47(5-6):731–5.
3. Azarmi R, Giglou MT, Taleshmikail RD. Influence of vermicompost on soil chemical and physical properties in tomato field. *Afr J Biotechnol*. 2008; 7(14):2397–401.
4. Deshmukh RP, Nagre PK, Wagh AP, Dod VN. Effect of different bio-fertilizers on growth, yield and quality of cluster bean. *Indian J Adv Plant Res*. 2014; 1(2):39–42.
5. Ekinici M, Dursun A. Effects of different mulch materials on plant growth, some quality parameters and yield in melon (*Cucumis melo* L.) cultivars in high altitude environmental condition. *Pak J Bot*. 2009; 41(4):1891–901.
6. El-Hamid, Aza AS, Abbou AA, Mansour SAA, El-Sayed AAA. Effect of some biofertilizers on yield and fruit quality of strawberry. *Ann Agr Sci*. 2006; 44(10):251–64.
7. Giraddi RS, Radha, Kale D, Biradar DP. Earthworms and organic matter recycling-an overview from Indian perspective. *Karnataka J Agric Sci*. 2014; 27(3):273–84.
8. Gomez AA, Gomez KA. Statistical procedures for agricultural research. New York: John Wiley and Sons, Inc; 1984. p. 680.
9. Herencia JF, Garcia-Galavisa PA, Doradoa JAR, Maqueda C. Comparison of nutritional quality of the crops grown in an organic and conventional fertilized soil. *Sci Hort*. 2011; 129(4):882–8.
10. Jamil M, Qasim M, Zia MS. Utilization of press mud as organic amendment to improve physico-chemical characteristics of calcareous soil under two legume crops. *J Chem Soc Pak*. 2008; 3(1):145–50.
11. Joshi N, Sharma S. Growth and yield of *Zea mays* in sulphitation press mud, its compost, vermicompost and NPK. *Report and Opinion*. 2014; 6(6):80–5.
12. Kale RD. Earthworms in soil fertility. Earthworm cinderella of organic forming. Bangalore, India: Prism Books Pvt. Ltd; 1998. p. 33–9.
13. Khan MJ, Khan MQ, Zia MS. Sugar industry press mud as alternate organic fertilizer source. *Int J Environ Waste Manage*. 2012; 9(2):41–55.
14. Kumari U, Kumari KP, Padamaja P. Efficiency of vermicompost on yield and quality of *banana cv. Poovan*. *South Ind Hort*. 1997; 45(3-4):158–60.
15. Lucka M, Kalon J, Sady W. The effect of organic fertilizers on the yield and chemical composition of the *Strawberry cv. Purpuratka*. W. Krakowie Ogrodnictwo. 1975; 104:129–45.
16. Mahfouz SA, Sharaf-Eldin MA. Effect of mineral vs. biofertilizer on growth, yield and essential oil content of fennel (*Foeniculum vulgare* Mill). *Int Agrophys*. 2007; 21:361–6.
17. Makulec G. The role of *Lumbricus rubellus* Hoffm. In determining biotic and abiotic properties of peat soils. *Polish J Ecol*. 2002; 50(3):301–39.
18. Muhammad D, Khattak RA. Growth and nutrients concentrations of maize in press mud treated saline-sodic soils. *Soil Envir*. 2009; 28(2):145–55.
19. Rana RK. Studies on the influence of nitrogen fixtures and plant bioregulators on growth, yield and quality of *Strawberry cv. Chandler* [PhD Thesis]. Y.S. Parmar University of Horticulture and Forestry; 2001.
20. Ranganna S. Handbook of analysis and quality control of fruit and vegetable products. 2nd ed. Culcutta: Tata Mc. Graw Hill Publishing Co; 1997. p. 279–309.
21. Rangaraj T, Somasundaram EM, Amanullah M, Thirumurugan V, Ramesh S, Ravi S. Effect of agroindustrial wastes on soil properties and yield of irrigated finger millet (*Eleusine coracana* L. Gaertn) in coastal soil. *Res J Agric Biol Sci*. 2007; 3(3):153–6.
22. Rolz C, Leon RD, Cifuentes R, Porres C. Windrow composting of sugarcane and coffee byproducts. *Sugar Technol*. 2010; 12:15–20.
23. Sahu SK, Singh DB. 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):82–5.
24. Singh A, Patel RK, De LC, Periera LS. Performance of strawberry cultivars under subtropics of Meghalaya. *Ind J Agri Sci*. 2008; 78 (7):1–4.
25. Singh BK, Pathak KA, Boopathi T, Deka BC. Vermicompost and NPK fertilizer effects on morphophysiological traits of plants, yield and quality of tomato fruits (*Solanum lycopersicum* L). *Vegetable Crops Res B*. 2010; 73:77–86.

26. Singh BK, Pathak KA, Verma AK, Verma VK, Deka BC. Effects of vermicompost, fertilizer and mulch on plant growth, nodulation and pod yield of French bean (*Phaseolus vulgaris* L). *Vegetable Crops Res B*. 2011; 74:153–65.
27. Singh H, Singh R. Effect of organic manure and GA₃ on yield and quality of strawberry. *Punjab Hort J*. 1979; 19:71–3.
28. Singh R, Sharma RR, Kumar S, Gupta RK, Patil RT. Vermicompost substitution influences the physiological disorders, fruit yield and quality of strawberry (*Fragaria ananassa* Duch). *Bioresource Technol*. 2008; 99:8507–11.
29. Sinha RK, Herat S, Valani D, Chauhan K. Vermiculture and Sustainable Agriculture. *Am-Euras J Agr Envir Sci*. 2009; 5(5):01–55.
30. Ustad AI, Patil CP, Swamy GSK, Athani SI, Patil PB. Effect of different combination of biofertilizers on growth and yield of *banana cv. Rajapuri (Musa AAB)*. *J Maharashtra Agr Univ*. 2005; 30(1):44–6.
31. Wang SY, Jiao H. Scavenging capacity of berry crops on superoxide radicals, hydrogen peroxide, hydroxyl radicals, and singlet oxygen. *J Agr Food Chem*. 2000; 48:5677–86.