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Effect of organic manure and bio-fertilizers on vegetative growth, yield and Quality of Strawberry (*Fragaria × ananassa* Duch.) cv.Chandler

Lalit Kumar, Sanjay Kumar and Shatrunjay Yadav

Department of Horticulture, Babasaheb Bhimrao Ambedkar University, Vidya-Vihar, Rae Bareli Road, Lucknow 226 025, U.P., India

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ABSTRACT

Studies were carried out to evaluate the effect of organic manure and bio-fertilizers on vegetative growth, yield and quality of Strawberry (*Fragaria × ananassa* Duch.) cv. Chandler having twelve treatments with three treatments replications during the year 2015-16. The treatments T_2 R.D.F. 100% was found better over the all treatments. This treatment recorded maximum height of plant (15.24 cm), number of leaf (15.55 cm), length of leaf with petiole (28.39 cm), length of leaf (13.62 cm), length of petiole (14.93 cm), width of leaf (13.16 cm), total number of fruit (16.77), length of fruit (52.82 mm), width of fruit (30.93 mm), weight/fruit (22.05 g), weight of fruit/plant (369.82 g) and weight of fruit/plot 8.15 kg).

Key words : *Organic manure, Bio-fertilizers, Strawberry*

Introduction

The cultivated strawberry (*Fragaria xananassa* Duch.) originated from the hybridization between two American species (*Fragaria chilionensis* Duch. X *Fragariavirginiana* Duch.) in France in the 17th century. It belongs to family Rosaceae and is octaploid in nature having 56 somatic chromosome numbers. At least sixteen species of wild strawberry are believed to occur all over the world but in India only four species of Fragaria have been reported viz. *F. chiloensis, F. daltoniana, F. nilgerrernsis* and *F. vesca* (Anon, 1956). Strawberry is herbaceous and perennial fruit plant. It has a short stem of about 2.5 cm height known as "Crown". The crown produced leaves at very close interval along the stem axis and flower as terminal position on the stem axis. Presently, availability of good quality of planting material of a required cultivar in large quantity is the major limitation in expansion of strawberry cultivation in India. The strawberry required an optimum day temperature of 22 ^{0}C to 23 ^{0}C and night temperature of 7 ^{0}C to 13 ^{0}C for maximum growth and development. In cold climate, frost damage as well as winter injury seriously reduces yield of strawberry. Frost may damage center of the open flowers, causing the characteristic "Black eye". Flowers before opening and after set are slightly more resistant to frost damage. Strawberry can be grown on a wide range of soils from heavy clays to light sand and gravels.Vermi-compost and bio-fertilizer significantly enhance the growth, development and productivity of plants. It improves the yield of strawberry due to their essential elements, vitamins, enzymes and hormone. 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 (5.7-11.5ppm), copper (2–

9.3ppm) and sulphur (128–548 ppm). Bio-fertilizer viz. Azotobacter, PSB and Azospirillum fix atmospheric nitrogen and solubilise phosphorus to increase fertility of soil and increases number and biological activities. However, very little information is yet available regarding the effect of organic manure and bio-fertilizers on vegetative growth, yield and quality of strawberry under different climatic conditions.

Materials and Methods

The present experiment entitled "Effect of organic manure and bio-fertilizers on vegetative growth, yield and quality of Strawberry (*Fragaria xananassa* Duch.) cv. Chandler. The runners of Chandler variety of strawberry were taken from the Dr Y. S. Parmar University of Horticulture & Forestry, Nauni, Solan (H. P.) in the month of October, 2016. The runners were kept for two days in shade for hardening before transplanting in well- prepared beds under open field condition plots which were distributed randomly in three replications. Standard cultural practices were followed during the period of the experiment for maintaining the runners. There were twelve treatments consisted of control (T_1), T_2-(R.D.F 100%), T_3-(Vermi-compost 100%, T_4-Azotobacter 100%, T_5-P.S.B. 100%), T_6-(R.D.F.+Vermi-compost 50%+50%), T_7- (R.D.F.+Azotobacter 50%+50%), T_8-(R.D.F.+P.S.B. 50%+50%), T_9-(Vermi-compost+ Azotobacter 50%+50%), T_{10}- (Vermi-compost+P.S.B. 50%+50%), T_{11}-(Azotobacter+P.S.B. 50%+50%), T_{12}-(R.D.F+Vermicompost+Azotobacter+P.S.B. 25%+25%+25%+25% each). The nitrogen, phosphorus and potassium were supplied through urea, single super phosphate and Murate of potash, respectively. Full dose of phosphorus, potassium and half of nitrogen were applied as basal dose remain half of nitrogen applied 60 days after planting. Therefore, bio-fertilizer were applied throw basal dose at 30 day after planting. Two hand weeding were done before application of bio-fertilizer. Observation were recorded on plant height (cm), number of leaves, length of leaf with petiole (cm), length of leaf (cm), length of petiole (cm), width of leaf (cm) at the 30,60,90 days after planting and observation recorded total number of fruit,length of fruit(mm), width of fruit(mm), weight/fruit(g) and weight of fruit/plot(kg).

Results and Discusion

Vermi-compost and bio-fertilizers results the pronounced effect on growth characters of strawberry. On the basis of present investigation, it is reported that the plant height, number of leaves per plant were increased significantly with the use of bio-fertilizers and Vermi-compost at different treatment combinations. The maximum plant height (15.24 cm) and maximum number of leaf (15.55) observed treatment T_2 (R.D.F.100% 15.24 cm) followed by plant height and number of leaves per plant were obtained in T_4treated with Azotobacter 100%.

This increase in height of plant, plant spread and number of leaves per plant with the application biofertilizers and vermi-compost during the course of investigation get the support of Ingle *et al.* (2008) in okra, Poniker *et al.* (2006) in turmeric, Marathe and Bharambe (2005) in sweet orange, Nowsheen *et al.* (2006) and Tripathi *et al.* (2010) in strawberry.

The length of leaf with petiole, length of leaf, length of petiole and width of leafpresented in Table 1 & 2. The maximum length of leaf with petiole (28.39 cm), maximum length of leaf (13.62 cm), maximum length of petiole (14.93 cm) and maximum width of leaf (13.16 cm) were recorded treatment T_2application of (R.D.F. 100%) after that maximum length of leaf with petiole (28.06 cm), maximum length of leaf (13.30 cm), maximum length of petiole (14.64 cm) and maximum width of leaf (12.88 cm) recorded T_4 (Azotobacter 100%).

The increase in vegetative growth and other parameters might be due to the production of more chlorophyll content with inoculation of nitrogen fixers. The other reason for increased vegetative growth may be the production of plant growth regulators by microorganism in rhizosphere which are absorbed by the roots. Therefore increased vegetative growth may be attributed to the increased biological nitrogen fixation (Mohandas, 1987). Better development of root system and the possibly synthesis of plant growth hormones like IAA, GA and Cytokinins (Martinez *et al.*, 1993) and direct influence of bio-fertilizers (Gajbhiye *et al.*, 2003) might have caused increase in plant growthparameters.

These findings are in complete agreement with Nowsheen *et al.* (2006) and Umar *et al.* (2009) in strawberry who narrated highest runners per plant in strawberry with PM + *Azotobacter* + wood ash + vermicompost + oil cake application. Increase in

number of runners per plant might be due to increased growth of plant in the form of height and number of leaves, which accumulated more photosynthates and thereby increased runners and leaf area perplant.

The data clearly represented in Table 2, that the maximum number of fruit 16.77 treatment T_2 – (R.D.F.100%) followed by under treatment T_7 – (R.D.F.50% + Azotobacter 50%) 29.76 (Tripathi *et al.*, (2004).

The data presented in Table 2. Significant response of the treatments to fruit length and width. The maximum length of fruit (52.82 mm) and width of fruit (30.39 mm) under treatment T_2(R.D.F.100%) followed by length of fruit (47.84 mm) and width of fruit (29.76 mm) under treatment T_7 (R.D.F.50% + Azotobacter 50%). Fruit size, weight and Berry volume are highly correlated with dry matter content and balance level of hormone and nitrogen fixers are known for accumulation of dry matter and their translocation (Kachot *et al*., 2001) as well as synthesis of different growth regulators (Awasthi *et al*., 1998).

The data regarding weight/fruit, weight of fruit/plant and weight of fruit/plot showed in Table 2. Maximum weight/fruit (22.05 g), weight of fruit/plant (369.89 g) and weight of fruit/plot (8.15 kg) was recorded in T_2 fertilized with (R.D.F.100%) where as followed by weight/fruit (21.01 g), weight of fruit/plant (335.99 g) and weight of fruit/plot (7.05 kg) was recorded from T_7 treated with (R.D.F.50%+Azotobacter 50%). These findings are in line with the Poniker *et al.* (2006) in turmeric, Wange *et al.* (1998) in strawberry, Kadlag *et al.* (2007) in tomato and Tripathi *et al.* (2010) in strawberry.

Summary

The present experiment entitled "Effect of organic manure and bio-fertilizer on vegetative growth, yield and quality of Strawberry (*Fragaria* × *ananassa* Duch.) cv. Chandler" was carried out at the Horticulture Research Farm of the Department of Applied Plant Science (Horticulture) Babasaheb Bhimrao Ambedkar University ,Vidya Vihar, Rae Bareli Road, Lucknow -226025 during the year 2015-2016. The application of different organic manure and bio-fertilizers doses with different treatment combinations significantly increase T_2 (R.D.F.100%) plant height, number of leaf, length of leaf with petiole, length of leaf, length of petiole, width of leaf,

Table 1. Effect of organic manure and bio-fertilizers on vegetative growth, yield and quality of Strawberry (Fragaria×ananassa Duch.) cv. Chandler

Treatments	Plant height (cm)			Number of leaves			Length of leaf with petiole (cm)			Length of leaf (cm)		
	30DAT	60DAT	90DAT	30DAT	60DAT	90DAT	30DAT	60DAT	90DAT	30 DAT	60 DAT	90 DAT
T_1 Control	2.87	6.90	11.09	2.66	5.44	11.55	11.01	17.21	26.23	4.82	7.52	12.54
T_2 R.D.F(100%)	4.46	10.64	15.24	4.11	7.66	15.55	13.81	19.63	28.39	7.45	8.43	13.62
T_3Vermi- compost(100%)	4.12	9.70	14.04	3.89	7.66	14.11	13.13	19.02	27.51	5.93	8.25	13.11
T_4 Azotobacter(100%)	4.31	10.19	14.52	4.00	7.44	14.55	13.41	19.49	28.06	6.01	8.36	13.30
T_5 P.S.B. 100%	3.85	8.85	13.33	3.55	6.66	13.67	12.38	18.32	26.96	5.56	7.91	12.87
T_6R.D.F.+Vermi-compost (50%+50%)	4.02	9.33	13.65	3.66	7.00	13.89	12.86	18.73	27.44	5.73	8.11	13.04
T_7R.D.F.+Azotobacter 50%+50%	4.19	10.01	14.23	3.89	7.33	14.44	13.25	19.19	27.66	6.00	8.19	13.17
T_8R.D.F.+P.S.(B50%+50%)	3.59	8.66	13.21	3.44	6.66	13.44	12.31	18.27	26.87	5.56	7.95	12.81
T_9Vermi-compost+Azotobacter (50%+50%)	3.90	9.10	13.37	3.66	6.77	13.67	12.67	18.53	27.21	5.66	7.94	12.99
T_{10}Vermi-compost+P.S.B. (50%+50%)	3.43	7.98	12.31	3.22	6.22	12.78	11.60	17.91	26.53	5.19	7.82	12.65
T_{11}Azotobacter+P.S.B.50%+50%	3.51	8.25	12.54	3.33	6.44	13.22	12.14	18.14	26.70	5.49	7.94	12.71
T_{12}R.D.F.+Vermi-compost+Azotobacter+ P.S.B. (25%+25%+25%+25%)	3.27	7.30	11.44	3.11	5.88	12.44	11.27	17.78	26.45	4.78	7.76	12.61
SEM (±)	0.115	0.241	0.399	0.106	0.127	0.183	0.171	0.062	0.107	0.084	0.047	0.066
C.D.(P=0.05)	0.338	0.712	1.176	0.312	0.374	0.541	0.505	0.183	0.315	0.247	0.140	0.194

Table 2. Effect of organic manure and bio-fertilizers on vegetative growth, yield and quality of Strawberry (*Fragaria×ananassa* Duch.) cv. Chandler

Treatments	Length of petiole (cm)			Width of leaf (cm)			Total No. of fruit	Length of fruit (mm)	Width of fruit (mm)	Weight /fruit (g)	Weight of fruit/ plant(g)	Weight of fruit/ plot (kg)
	30DAT	60DAT	90DAT	30DAT	60DAT	90DAT						
T_1 Control	6.19	9.69	13.59	4.48	7.07	12.20	12.44	37.29	24.44	12.24	141.28	1.72
T_2 R.D.F (100%)	7.63	11.20	14.93	5.57	7.94	13.16	16.77	52.82	30.93	22.05	369.89	8.15
T_3 Vermi- compost (100%)	7.20	10.77	14.47	5.54	7.71	12.72	14.66	47.40	29.28	16.96	243.75	4.13
T_4 Azotobacter (100%)	7.40	11.13	14.64	5.69	7.90	12.88	14.77	49.40	30.10	17.80	260.53	4.63
T_5 P.S.B. (100%)	6.82	10.41	14.25	5.21	7.53	12.71	13.11	44.30	27.18	14.47	185.43	2.68
T_6 R.D.F.+Vermi-compost (50%+50%)	7.13	10.62	14.36	5.44	7.62	12.58	13.22	46.16	28.35	15.14	200.99	3.04
T_7 R.D.F.+Azotobacter (50%+50%)	7.25	11.00	14.56	5.65	7.74	12.74	15.89	47.84	29.76	21.01	335.99	7.05
T_8 R.D.F.+P.S.B(50%+50%)	6.75	10.32	14.04	5.12	7.51	12.45	15.33	43.62	26.41	20.73	317.43	6.58
T_9 Vermi-compost+Azotobacter (50%+50%)	7.01	10.59	14.28	5.42	7.51	12.49	15.22	45.12	27.65	19.42	294.24	5.71
T_{10} Vermi-compost+P.S.B. (50%+50%)	6.41	10.09	13.80	5.01	7.13	12.34	14.44	39.47	25.63	16.52	239.45	3.95
T_{11} Azotobacter+P.S.B.(50%+50%)	6.65	10.20	13.95	5.10	7.44	12.61	13.77	41.01	26.03	16.12	227.09	3.66
T_{12} R.D.F.+Vermi-compost+Azotobacter+ P.S.B. (25%+25%+25%+25%)	6.49	10.02	13.70	4.74	7.23	12.25	12.66	38.59	25.37	13.13	165.79	2.17
SEM(±)	0.128	0.076	0.044	0.069	0.078	0.099	0.198	1.220	0.472	0.627	13.282	0.845
C.D.(P=0.05)	0.377	0.224	0.131	0.203	0.229	0.291	0.586	3.601	1.394	1.851	39.207	1.712

total number of fruit and width of fruit and maximum yield of strawberry.

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