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EVALUATION OF ORGANIC SOURCES OF NUTRIENTS, MICROBIAL INOCULANT COUPLED WITH MULCHING ON GROWTH PARAMETERS OF STRAWBERRY CV. CHANDLER GROWN ON PARTIALLY RECLAIMED ALKALI SOIL OF CENTRAL UTTAR PRADESH

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ABSTRACT
The field experiment was conducted on Strawberry cv. Chandler on partially reclaimed alkali soil during 2017-18 and 2018-19 at the Horticulture Research Farm of the Department of Horticulture Babasaheb Bhimrao Ambedkar University, Vidya Vihar, Rae Bareli Road, Lucknow, UP. India. The runners of strawberry cv. Chandler were planted in the second week of November with a spacing of 30 x 15cm. The study was laid out in RBD with twelve treatments combination including control and replicated thrice. The data recorded on different growth parameters observed at different days after planting *viz.* 30, 45, 60, 75, 90, 105 and 120 are evidently indicate that the application of organics (FYM & MSWC), bio-inoculant (PSB) and mulching (Paddy straw) were significantly influenced on the vegetative growth of the plant. The maximum plant height (5.42cm, 7.57cm, 8.36cm, 9.58, 10.66cm 11.86 cm), at 30, 60, 75, 90, 105 and 120 DAP respectively, number of leaves per plant (6.00 cm, 7.81 cm, 9.19 cm, 10.77 cm, 12.11 cm 14.35 cm and 21.46cm) at 30, 45, 60, 75, 90, 105 and 120 DAP and length of leaf (7.06cm), width of leaf (8.19cm), leaf size (57.79cm^2), length of petiole (5.17cm), plant spread E-W (17.68cm) and plant spread N-S (17.51cm) were recorded maximum in the treatment T_1 -100% NPK + Mulch (Paddy straw) which was statistically significant over control (T_0).

KEY WORDS: Strawberry, Organics, FYM, MSWC, Growth, Soil and Bio-inoculant.

INTRODUCTION

Strawberry is one of the most important temperate fruit but it can also be grown successfully in tropical and sub tropical climate with concerted efforts. During the recent years, it has gained popularity due to its pleasant taste, sweet flavor, deliciousness, softness, pleasant aroma and refreshing nature with rich source of vitamins, minerals and nutrients (Sharma and Sharma, 2003). The cultivated strawberry (*Fragaria* × *ananassa* Duch.) belonging to the family Rosaceae and it was arisen in Europe in the 18th century (Beer *et al.,* 2017) as a chance cross between two American native diploid species *viz*., *Fragaria chilioensis* Duch. and *Fragaria verginiana* Duch (Singh *et al.,* 2015). It is herbaceous crop with prostate growth habit, which behaves as an annual in sub-tropical region and perennial in temperature region. It is cultivated in about 75 countries of the world in plain as well as in the hilly areas up to elevation of 3000 m from MSL in humid or dry cold regions (Singh *et al.,* 2008) with assured irrigation facility.
Modern day intensive crop cultivation results the huge application of chemical fertilizers which are not only in short supply but also expensive and pollute the environment, soil and water too. Therefore, the current emphasis is being given to explore the possibilities of supplementing the chemical fertilizers with organic fertilizers particularly bio-fertilizer of microbial origin *viz. Azotobacter* and *Azospirillum* are fix the atmospheric nitrogen and solubilize phosphorus to increase fertility of soil and biological activities. They become recently, positive alternatives to chemical fertilizers because they help bring down the costs of chemical fertilizers especially N and P and improve soil fertility, crop productivity, quality of fruits, maintaining the physical properties of the soil, availability and uptake of nutrients and stimulating the natural hormones. They are safe for humans, animals and environment and using them is accompanied with reducing the pollution occurring in our environment (Walid *et al.,* 2014). Farmyard manure contains lots of living micro and macro organisms like bacteria, fungi and insects etc used as a supplement of nutrition and improves soil physical conditions. These organisms involved in several oxidation-reduction reactions, which release several useful nutrients and stimulate the production of hormones and enzymes required by the plants for their optimum growth and development
The use of organics such as farmyard manure (FYM), vermicompost, poultry manure, crop residues, spent wash, municipal solid waste compost (MSWC) *etc*. is put forth for sustenance of soil fertility and crop productivity at a satisfactory level (Musa *et al.,* 2015). Also plant growth promoting bio- inoculants are known to enhance growth and yield of crops in eco-friendly manner**.** MSW compost, with high organic matter content and low concentration of inorganic and organic pollutants allow an improvement of physical, chemical, biochemical and microbial characteristics and constitute low cost soil recovery

(Walter *et al.,* 2006). It could accelerate salt leaching; decrease both the exchangeable sodium percentage (ESP) and electrical conductivity (EC), and increase water infiltration, water holding capacity and aggregate stability (Tajada *et al.,* 2006). Furthermore, municipal solid waste compost (MSWC) represents a source of nutrients that can improve soil fertility, may contribute to restoring the productivity of salt affected soils (Lakhdar *et al.,* 2008).

MATERIALS AND METHODS

The present investigation was carried out at the Horticulture Research Farm of the Department of Horticulture Babasaheb Bhimrao Ambedkar University, Vidya Vihar, Rae Bareli Road, Lucknow, UP- 226025 during the winter season of 2017-18 and 2018-2019 respectively. Twelve treatments combination namely T_0 - Control (Without fertilizers, Organics, Bio-inoculant and mulching), T_1 -100% NPK + Mulch (Paddy straw), T_2- 75% NPK + Mulch (Paddy straw), T_3 - 50% NPK + Mulch (Paddy straw), T_4 - 75% NPK + FYM + Mulch (Paddy straw), T_5 - 75% NPK + MSWC + Mulch (Paddy straw), T_6 - 50% NPK + FYM + Mulch (Paddy straw), T_7 - 50% NPK + MSWC + Mulch (Paddy straw), T_8 - 75% NPK + FYM + Mulch (Paddy straw) + Bio-inoculant, T_9 -75% NPK + MSWC + Mulch (Paddy straw) + Bio-inoculant, T_{10} - 50% NPK + FYM + Mulch (Paddy straw) + Bio-inoculant and T_{11} - 50% NPK + MSWC + Mulch (Paddy straw) + Bio-inoculant were tested in Randomized Block Design with three replications.The runners of cv. Chandler of strawberry were brought from ICAR-Central Institute of Temperate Horticulture, Srinagar (J&K) in both years. The strawberries runners are uniform size were transplanted on ridges at a spacing of 30 x 15cm on 10/11/2017 and 15/11/2018 the year of experimentation. Strawberry was fertilized with recommended dose of fertilizers *viz*., 100% NPK, 75% NPK and 50% NPK of integrated sources of nutrients *viz*., FYM @ 20 tonnes/ha, Municipal Solid Waste Compost (MSWC) @ 10 tonnes/ha and bio-inoculant Phosphorus Solubilizing Bacteria (PSB) @ (10^9 cfu/ml). The recommended dose of organics *viz*., farmyard manure (FYM) and municipal solid waste compost (MSWC) as per treatment combination was applied at the time of land preparation. Nitrogen was applied in two split dozes first at the time planting and second at flowering stages while the full doze of phosphorus and potash was taken at the time of planting. Bio-inoculant (PSB) solution was made by dissolving in of water. The roots of the strawberry runners were thoroughly dipped in the solution for about one hour and then plantings were done. Other cultural practices like weeding, hoeing, irrigation, insect pest and disease management were done as per required. The observations were recorded on five randomly selected plants from each treatment and data were analyzed statistically.

RESULTS AND DISCUSSION

The data regarding the different growth parameters (Table –1, 2 and 3) were recorded after planting clearly indicated that the application of integrated sources of nutrients *viz*., farmyard manure (FYM), municipal solid waste compost (MSWC) and bio-inoculant (PSB) are significantly affected the growth parameters. The data also showed a continuous increasing the plant height, number of leaves, length of leaf, width of leaf, leaf size, length of petiole, plant spread E-W and plant spread N-S are continuously increasing. The data also exhibited continuous fast increases in vegetative growth up to 75 DAP and after that the vegetative growth increased slowly as the reproductive phase of the plant started.

TABLE 1: Evaluation of organic sources of nutrients, microbial inoculant coupled with mulching on growth parameters of strawberry cv. Chandler (pooled data of 2 years).

Treatments	Plant height (cm)						
	30DAP	45DAP	60DAP	75DAP	90DAP	105DAP	120DAP
T_0	2.89	3.78	4.18	4.95	5.88	6.80	7.80
T_1	5.42	6.27	7.57	8.36	9.58	10.66	11.86
T_2	4.42	5.38	5.61	7.25	8.62	8.33	9.71
T_3	3.16	5.14	4.94	5.97	6.84	8.00	8.70
T_4	3.79	5.47	6.30	6.33	7.77	9.82	10.75
T_5	5.06	5.93	6.03	5.97	6.69	7.90	10.00
T_6	3.90	5.12	6.05	5.94	6.84	8.98	10.42
T_7	4.31	5.23	5.76	5.88	6.61	7.99	9.60
T_8	5.19	6.05	6.27	6.50	7.04	8.64	10.18
T_9	4.78	6.29	6.63	7.42	7.80	10.09	11.44
T_{10}	5.01	5.98	6.01	6.27	6.99	8.83	10.70
T_{11}	4.82	6.11	6.18	6.61	7.06	8.77	10.93
CD at 5%	0.750	0.848	0.702	0.668	1.041	1.638	1.116
SEm±	0.254	0.287	0.238	0.226	0.353	0.555	0.378

Where DAP – Days after planting

TABLE 2: Evaluation of organic sources of nutrients, microbial inoculant coupled with mulching on growth parameters of strawberry cv. Chandler (pooled data of 2 years).

Treatments	Number of leaves						
	30DAP	45DAP	60DAP	75DAP	90DAP	105DAP	120DAP
T_0	3.84	4.83	6.66	7.81	8.70	9.33	10.91
T_1	6.00	7.81	9.19	10.77	12.11	14.35	21.46
T_2	5.17	6.36	7.56	9.00	10.30	12.63	16.92
T_3	4.73	5.71	6.74	8.48	9.56	10.10	13.15
T_4	5.32	6.27	6.82	9.20	10.13	12.01	18.05
T_5	5.84	6.02	6.74	8.00	10.04	10.92	16.67
T_6	5.24	5.27	6.36	7.41	8.80	10.85	14.33
T_7	5.46	5.64	6.64	7.76	8.83	10.89	13.50
T_8	5.78	7.55	7.96	9.93	10.71	12.13	17.38
T_9	6.00	7.81	8.62	10.01	10.73	13.16	18.00
T_{10}	5.37	5.35	7.07	8.60	9.40	11.50	15.39
T_{11}	5.82	5.85	7.35	9.49	10.00	11.69	16.53
CD at 5%	0.810	1.073	1.065	0.826	1.149	1.715	1.760
SEm±	0.274	0.363	0.361	0.280	0.389	0.581	0.596

Where DAP – Days after planting

TABLE 3: Evaluation of organic sources of nutrients, microbial inoculant coupled with mulching on growth parameters of strawberry cv. Chandler (pooled data of 2 years).

Treatments	Length of leaf (cm)	Width of leaf (cm)	Leaf size (cm^2)	Length of petiole (cm)	Plant spread E-W (cm)	Plant spread N-S (cm)
T_0	3.98	4.25	16.91	3.66	12.00	11.91
T_1	7.06	8.19	57.79	5.17	17.68	17.51
T_2	5.69	6.61	37.96	4.83	15.74	15.42
T_3	4.52	4.97	22.37	4.30	14.98	13.89
T_4	5.56	5.81	32.45	5.00	16.03	15.88
T_5	5.09	5.54	28.32	4.61	15.22	14.78
T_6	4.53	4.86	22.03	4.75	16.31	16.00
T_7	4.89	5.42	26.48	5.15	14.89	14.95
T_8	5.77	6.80	39.66	4.59	15.76	16.28
T_9	6.66	7.20	48.10	5.08	16.48	16.55
T_{10}	4.73	4.90	23.15	4.78	15.59	15.28
T_{11}	5.89	5.98	35.16	5.03	15.74	15.44
CD at 5%	0.701	0.790	6.471	0.742	1.211	0.686
SEm±	0.237	0.267	2.192	0.251	0.410	0.232

Where DAP – Days after planting

The maximum plant height (5.42cm, 7.57cm, 8.36cm, 9.58, 10.66cm 11.86 cm), at 30, 60, 75, 90, 105 and 120 DAP respectively, number of leaves per plant (6.00cm, 7.81 cm, 9.19 cm, 10.77 cm, 12.11 cm 14.35 cm and 21.46cm) at 30, 45, 60, 75, 90, 105 and 120 DAP respectively length of leaf (7.06cm), width of leaf (8.19cm), leaf size (57.79cm^2), length of petiole (5.17cm), Plant spread E-W (17.68cm) and plant spread N-S (17.51cm) were maximum recorded in the treatment T_1 - 100% NPK + Mulch (Paddy straw) which was statistically significant over control (T_0) while the minimum height of the plant (2.89cm,3.78 cm, 4.18 cm, 4.95 cm, 5.88 cm, 6.80 cm and7.80 cm), number of leaves per plant (3.84, 4.83, 6.66, 7.81, 8.70, 9.33 and 10.91) length of leaf (3.98cm), width of leaf (4.25cm), leaf size (16.91cm^2), length of petiole (3.66cm), plant spread E-W (12.00cm) and plant spread N-S (11.91cm) were recorded in treatment control (T_0). The increase in these vegetative growth parameters may be due to impact of *i.e*. organics, mulching and bio-inoculant (PSB) sources of nutrients. The addition of organic manures might have helped in N-fixation and bio-inoculant (PSB) is solubulizing the phosphorus and its quick release for plants absorption. The increase in the plant height, plant spread and number of leaves might be due to the production of more chlorophyll content with inoculation of phosphorus solubulizers. The other reason for increased vegetative growth may be due to the production of plant growth promoters by organic manures in the rhizospheric & non-rhizospheric area which are absorbed by the roots. Better development of root system and the possibly synthesis of plant growth hormones like IAA, GA and cytokinins and nutrients solubulizers they direct influence of organic manures might have increased in plant's vegetative growth parameters (Lata *et al.*,2013).

According to this study the results obtained regarding vegetative growth parameters, it can be concluded that the combined application of different nutrients sources which was better than alone application. Treatment T_1-100% NPK + Mulch (Paddy straw) performed better than other treatments in respect of plant growth parameters which was followed by the treatment T_9 - 75% NPK + MSWC + Mulch (Paddy straw) + Bio-inoculant (PSB), and thus, these combination of treatments are beneficial regarding

growth parameters of strawberry grown under partial reclaimed alkali soil of central Uttar Pradesh .

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