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INTEGRATED IMPACT OF FYM, MSWC AND MULCHING WITH BIO-INOCULANT (PSB) ON FLOWERING, YIELD AND QUALITY PARAMETERS OF STRAWBERRY CV. CHANDLER GROWN ON PARTIALLY RECLAIMED ALKALI SOIL UNDER LUCKNOW CONDITIONS

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ABSTRACT
The field experiment was conducted at the Horticulture Research Farm of the Department of Horticulture, Babasaheb Bhimrao Ambedkar University, Vidya Vihar, Rae Bareli Road, Lucknow (UP), India during 2017-18 and 2018-19 on Strawberry *cv*. Chandler grown under Lucknow conditions on partially reclaimed alkali soil of central Uttar Pradesh. All the doses of organics (FYM and MSWC) and bio-inoculant (PSB) were applied at time of planting. The runners were planted with a spacing of 30 x 15cm in the second week of November 2017-18 and 2018-19. The trials were laid out in RBD with twelve treatments combination along with control with replicated thrice. The data recorded on flowering, fruiting, yield and quality attributes observed are evidently indicate that the application of organics (FYM & MSWC), bio-inoculant (PSB) and mulching (Paddy straw) were significantly influenced on flowering, fruiting, yield and quality attributes in strawberry. The data of both the years of experiment were pooled and analyzed. The maximum number of flowers (12.29), minimum days to first flowering taken (46.91) while maximum was scored under control, days to first fruit set (6.09) maximum number of fruits/ plant (10.10), maximum percentage of fruit setting/ plant (85.53) were recorded in the treatment T_9: 75% NPK + MSWC + Mulch (Paddy straw) + Bio-inoculant (PSB), which were statistically significant over control (T_0). The minimum fruits were recorded under control. The maximum fruit yield/ plant (131.49g) fruit yield/plot (2.63kg) fruit yield/ha. (194.81q) were recorded in the treatment T_9: 75% NPK+MSWC + Mulch (Paddy straw) + Bio-inoculant (PSB) However, maximum quantity of total sugars (8.27%), reducing sugar (4.70 %) sugar non-reducing (3.58%) were recorded in the treatment T_8: 75% NPK+FYM + Mulch (Paddy straw) + Bio-inoculant (PSB). The minimum was recorded under control (T_0) respectively.

KEY WORDS: Strawberry, Organics, FYM, MSWC, growth, flowering, yield and Bio-inoculant.

INTRODUCTION

The Strawberry (*Fragaria x annanassa* Duch.), a member of the rose family, is not really a berry but a false fruit and consists of many tiny individual fruit embedded in a fleshy scarlet receptacle. The brownish or whitish specks, commonly considered seeds, are the true fruits known as achenes. It was arisen in Europe in the 18th century (1714 and 1759) as a chance cross between two American native diploid species *viz*., *Fragaria chilioensis* Duch. and *Fragaria verginiana* Duch. (Singh *et al.,* 2015) and (Beer *et al.*, 2017). All the cultivated varieties of strawberry are octaploid (2n = 8x = 56) in nature (Anonymous, 1956) yet Indian strawberry (*Fragaria* × *vesca* Duch.) is diploid (2n =28) in nature and it is the most widely planted strawberry. Two other species *viz*., *F. vesca* Duch. (2n=14) and *F. moschata* Duch. (2n =42) are also grown commercially but on a much smaller scale (Graham *et al.,* 1996). It is herbaceous crop with prostate growth habit, which behaves as an annual in sub-tropical region and perennial in temperature region.

Strawberry is used as fresh fruit being rich in vitamin C and ellagic acid, which anti cancerous property. It is a valuable food in the diet of millions of people around the globe. It is worthy to note that among all the fruits, strawberry gives high returns in the short time. Fruits are attractive with distinct pleasant aroma and flavor and a sweet taste, deliciousness, softness and rich source of vitamins, minerals and nutrients. (Sharma and Sharma, 2003 and Sharma *et al.,* 2006), consumed as dessert and also have a special demand by the fruit processing industries for the preparation canned strawberries, jam, jelly, ice-cream and beauty products (Hughes *et al.,* 1969). The taste of fruit mainly depends on three different compounds *viz*. sugars, acids and aromatic compounds. For good quality strawberry, its cultivation is affected by many factors namely, soil, soil pH, climate, irrigation, nutrition, mulching, growth regulators etc. Among the various methods to enhance the flowering, yield and quality of strawberry- organics, bio-inoculant and mulching are the most important aspects it has direct bearing on crop production (Umar *et al.,* 2010). The application of synthetic fertilizers has improved yield per unit area manifold but these fertilizers are expensive and hamper the ecological balance of the soil. Excessive and unbalanced use of synthetic fertilizers leads to degradation of physico-chemical properties and microbial status of

soil. The balanced application of organic manures, bio-fertilizers and inorganic fertilizers will enable to higher production of quality berries and runners. Therefore, an alternate source of nutrition is needed to sustain productivity of land.

MATERIALS AND METHODS

The present study was carried out during the winter season of 2017-18 and 2018-2019 at the Horticulture Research Farm of the Department of Horticulture Babasaheb Bhimrao Ambedkar University, Vidya Vihar, Rae Bareli Road, Lucknow (UP), India. The experimental field is located at geographically situated in the subtropical tract of Central U.P. at 26o 46' North latitude and 80o 55 ' East longitudes. The soil of experimental farm was partially reclaimed soil alkali with pH 8.0, electrical conductivity (EC) is about 0.312 and sodium exchangeable percentage approx. 15.0.Twelve treatment combinations 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(PSB), T_9 - 75% NPK + MSWC + Mulch (Paddy straw) + Bio-inoculant(PSB), T_{10} - 50% NPK + FYM + Mulch (Paddy straw) + Bio-inoculant (PSB) and T_{11} - 50% NPK + MSWC+ Mulch (Paddy straw) + Bio-inoculant (PSB) were tested in randomized block design with three replications. The strawberries runners are uniform size were transplanted on ridges at a spacing of 30 x 15cm in second week of November during both 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 Phosphate solubilizing bacteria (PSB) @ (10^9 cfu/ml). The recommended dose of organics viz., farm yard 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 1 hour. and then planting 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 flowering, yield and bio-chemical attributes (Table 1,2 and 3) were observed clearly indicate that the application of integrated sources of nutrients viz., farmyard manure (FYM), municipal solid waste compost (MSWC) and bio-inoculant (PSB) were significantly affect on flowering, yield and bio-chemical attributes. Application of inorganic fertilizers and bio-fertilizers along with organic manures increased the availability of NPK status, organic carbon content and microbial biomass and dehydrogenase activity and hence they help in increasing physiology of the plant that's by enhance the reproductive phase of the plant.

TABLE 1: Integrated impact of FYM, MSWC and mulching with bio-inoculant(PSB) on flowering parameters of strawberry cv. Chandler(pooled data of 2 years).

Treatments	Days taken to first flowering	Number of flowers /plant	Days to first fruit set	Number of fruits/ plant	Percentage of fruit setting/ plant
T_0 Control	57.97	8.63	9.99	6.01	69.75
T_1:100% NPK + Mulch (Paddy straw)	50.40	11.22	8.79	9.20	71.85
T_2: 75% NPK + Mulch (Paddy straw)	53.87	10.15	7.99	8.56	74.19
T_3:50% NPK + Mulch (Paddy straw)	53.59	8.69	9.44	7.20	79.59
T_4:75% NPK + FYM + Mulch (Paddy straw)	51.09	11.61	8.30	9.70	82.00
T_5 :75% NPK + MSWC + Mulch (Paddy straw)	51.17	11.39	7.41	9.83	82.90
T_6 :50% NPK + FYM + Mulch (Paddy straw)	53.31	11.27	8.18	8.83	78.35
T_7 :50% NPK + MSWC + Mulch (Paddy straw)	50.88	11.32	8.93	9.50	80.82
T_8 : 75% NPK + FYM + Mulch (Paddy straw) + Bio-inoculant (PSB)	48.45	11.76	6.88	9.94	83.11
T_9 : 75% NPK+MSWC + Mulch (Paddy straw)+ Bio-inoculant(PSB)	46.91	12.29	6.09	10.10	85.53
T_{10} : 50% NPK+ FYM + Mulch (Paddy straw) + Bio-inoculant(PSB)	49.11	11.35	7.73	9.74	81.96
T_{11} : 50% NPK + MSWC + Mulch (Paddy straw) + Bio-inoculant(PSB)	47.35	11.44	6.58	9.89	84.09
CD at 5%	3.701	1.107	1.280	1.258	8.926
SEm±	1.254	0.375	0.434	0.426	3.024

TABLE 2: Integrated impact of FYM, MSWC and mulching with bio-inoculant(PSB) on flowering and yield parameters of strawberry cv. Chandler(pooled data of 2 years).

Treatments	Duration of fruit harvesting	Fruit yield/ plant (g)	Fruit yield/ plot (kg)	Fruit yield/ ha. (q)
T_0 Control	48.27	35.40	0.71	52.45
T_1:100% NPK + Mulch (Paddy straw)	62.44	86.05	1.72	127.48
T_2: 75% NPK + Mulch (Paddy straw)	56.42	77.72	1.55	115.14
T_3:50% NPK + Mulch (Paddy straw)	50.89	58.53	1.17	86.71
T_4:75% NPK + FYM + Mulch (Paddy straw)	55.60	98.56	1.97	146.01
T_5 :75% NPK + MSWC + Mulch (Paddy straw)	56.38	104.83	2.10	155.30
T_6 :50% NPK + FYM + Mulch (Paddy straw)	50.39	82.87	1.66	122.78
T_7 :50% NPK + MSWC + Mulch (Paddy straw)	51.28	84.53	1.69	125.23
T_8 : 75% NPK + FYM + Mulch (Paddy straw) + Bio-inoculant (PSB)	58.32	125.65	2.51	186.15
T_9 : 75% NPK+MSWC + Mulch (Paddy straw)+ Bio-inoculant (PSB)	61.76	131.49	2.63	194.81
T_{10} : 50% NPK+ FYM + Mulch (Paddy straw) + Bio-inoculant(PSB)	48.76	116.35	2.33	172.37
T_{11} : 50% NPK+MSWC+Mulch (Paddy straw) + Bio-inoculant(PSB)	50.57	123.42	2.47	182.84
CD at 5%	4.642	20.652	0.412	30.596
SEm±	1.572	6.996	0.140	10.365

TABLE 3: Integrated impact of FYM, MSWC and mulching with bio-inoculant(PSB) on quality parameters of strawberry cv. Chandler(pooled data of 2 years).

Treatments	Length of pedicel (cm)	Number of runners/ plant	Total sugars (%)	Reducing sugar (%)	Non-reducing sugar (%)
T_0 Control	5.13	3.48	4.61	2.50	2.13
T_1:100% NPK + Mulch (Paddy straw)	8.67	6.89	5.07	2.84	2.24
T_2: 75% NPK + Mulch (Paddy straw)	7.73	5.39	5.28	3.14	2.14
T_3:50% NPK + Mulch (Paddy straw)	6.87	4.68	5.33	3.22	2.11
T_4:75% NPK + FYM + Mulch (Paddy straw)	7.28	5.56	7.15	4.02	3.14
T_5 :75% NPK + MSWC + Mulch (Paddy straw)	7.54	5.53	6.82	4.58	2.24
T_6 :50% NPK + FYM + Mulch (Paddy straw)	6.64	5.76	5.14	3.01	2.13
T_7 :50% NPK + MSWC + Mulch (Paddy straw)	6.51	5.22	5.17	2.81	2.36
T_8 : 75% NPK + FYM + Mulch (Paddy straw) + Bio-inoculant (PSB)	7.61	6.77	8.27	4.70	3.58
T_9 : 75% NPK+MSWC + Mulch (Paddy straw)+ Bio-inoculant(PSB)	7.90	6.68	7.42	4.19	3.24
T_{10} : 50% NPK+ FYM + Mulch (Paddy straw) + Bio-inoculant(PSB)	7.08	4.73	7.15	4.01	3.13
T_{11} : 50% NPK+MSWC+Mulch (Paddy straw) + Bio-inoculant(PSB)	7.65	5.89	7.01	3.90	3.12
CD at 5%	1.119	0.979	0.543	0.425	0.184
SEm±	0.379	0.331	0.184	0.144	0.062

Floral characters of the plants

It is obvious from the Table-1 that minimum days taken to produce first flowering (46.91days), and maximum (12.29) number of flowers per plant, minimum days to first fruit set (6.09), maximum number of fruits/ plant (10.10), maximum percentage of fruit setting/ plant (85.53) were recorded in T_9 :75% NPK+MSWC +Mulch (Paddy straw) +Bio-inoculant (PSB) treated plants. This phenomenon may be on account of prolonged growth of plant in the presence of organics, inorganic and bio-fertilizers. The earliness may be due to an optimum supply of plant nutrients and plant growth hormones in right amount during the entire crop period which induces the reproductive development of plant and ultimately more photosynthesis. Similar findings were also reported by Anil *et al.* (2015) and Neeraj *et al.* (2015) in strawberry. These results are in conformity with the findings of Tripathi *et al.* (2011) who noted that increase in *Azotobacter* and PSB (each at 6 Kg/ha) doses resulted in minimum number of days taken to emergence first flower, maximum number of fruit set and maximum duration of fruit harvesting in strawberry.

Yield characters of the plants

The maximum fruit yield per plant (131.49g), fruit yield per/plot (2.63kg) and fruit yield per/ha. (194.81q) were recorded in the plants treated with T_9: 75% NPK+MSWC + Mulch (Paddystraw) +Bio-inoculant (PSB) and followed by in treatment T_8: 75% NPK + FYM + Mulch (Paddy straw) +Bio-inoculant (PSB). Greater accumulation of dry matter conferred greater ability to produce higher yield. Similar results were also reported by Kadlag *et al.* (2007) in tomato and Nowsheen *et al.* (2006) in cv. Senga Sengana of strawberry.

Bio-chemical attributes of the fruits

The pH, total soluble solids, acidity, TSS/acid ratio, ascorbic acid and anthocyanin contribute the important chemical constituents for assessing the fruit quality of different treatments of strawberry (Table 3).The total sugars percent in strawberry fruit ranged from 4.61 to 8.27, reducing sugar percent ranged from 2.50 to 4.70 and non-reducing sugar percent ranged from 2.13 to 3.58, respectively. The maximum total sugars percent (8.27), reducing sugar percent (4.70) and non-reducing sugar percent (3.58) in strawberry fruit were recorded in T_8: 75% NPK + FYM + Mulch (Paddy straw) + Bio-inoculant(PSB) followed by T_9: 75% NPK+ MSWC + Mulch (Paddy straw) + Bio-inoculant (PSB) (4.69). The minimum amount of pH was recorded in control (3.83).

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