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Impact of PSB and Vermicompost on Growth, Yield and Quality of Strawberry

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ABSTRACT: A trial was done during 2019-20 to study the impact of PSB and vermicompost on growth, yield and quality of strawberry. Nine treatments including two levels each of vermicompost (25 and 30 t/ha) and PSB (6 and 7 kg/ha) and their mixes along with one control, replicated thrice in randomized block design were used for the experimentation work. The cultivar used was Chandler. Five kg of well rotten FYM was supplied as a basal portion in every one of the treatments including control. Every one of the dosages of vermicompost and PSB were supplied when planting was done in the field. The consolidated use of vermicompost at 30 t/ha + PSB at 7 kg/ha significantly expanded the height of plant (14.91 cm), number of leaves (57.00), crown (6.09) and runners (4.57) per plant, though the most extreme number of flowers (35.01), fruits set (37.12) per plant with an expanded duration of harvesting (69.37 days) and the minimum number of days taken to produce first flower (62.01 days) with significantly more yield (256.24 g/plant) were recorded with vermicompost at 30 t/ha + PSB at 7 kg/ha supplied plants. Plants supplied with vermicompost at 30 t/ha + PSB at 7 kg/ha additionally produced the berries with the most extreme length (4.23 cm), width (2.68 cm), weight (9.72 g), TSS (9.06°Brix), total sugars (8.19%) and ascorbic acid (56.40 mg/100g edible portion) with least titratable acidity (0.60%) in contrast with different treatments under plains of central Uttar Pradesh.

Keywords: Strawberry, PSB, Vermicompost, Vegetative growth, Flowering, Quality, Yield.

INTRODUCTION

Strawberry (*Fragaria* × *ananassa* Duch.) is a herbaceous and perennial plant of the family Rosaceae which is an octaploid in nature having a chromosome number of 2n = 8x = 56. This is one of the well-known delicate fruit which is cultivated in plains and slopes up to a rise of 3000 meters with guaranteed irrigation facilities. The fruits are attractive with distinct lovely smell and flavor and are very nutritious, which gives the high return within shortest time than other berry fruits. In addition to fresh consumption, it has an extra ordinary demand by the fruit processing units for preparing jams, ice-cream and syrups and for fast freezing and canning.

Advanced intensive crop production brings about the enormous usage of chemical fertilizers which are not only in short supply but also costly and pollute the surroundings as well assoil and water too. Nitrogen-fixing and phosphate solubilizing micro organisms and vermicompost are basic bio-fertilizers for horticultural crops. These bio-composts having miniature organic entities that are either free-living in soil or harmonious with plants and contribute straight forwardly or in a roundabout way towards nitrogen and phosphorus nourishment of plants. The likewise produce chemicals, nutrients, and other developmental factors needed for the development and improvement of plants. Therefore, keeping in view, the importance of fruits and the enormous rate of phosphate solubilizing bacteria and vermicompost an experiment was planned to infer concrete information on the effect of these in respect of vegetative growth, fruiting and yield of strawberry.

MATERIALS AND METHODS

One-year-old runners of strawberry cv. Chandler was planted at 45 × 45cm spacing on 8-10 cm raised beds of 135 × 90 cm dimension in the garden, Department of Fruit Science, C.S. Azad University of Agriculture and Technology, Kanpur-208002 (U.P.), India on 24th October, during 2019. Nine treatments including two levels each of vermicompost (25 and 30 t/ha) and PSB (6 and 7 kg/ha) and their blends along with one control, replicated thrice in RBD were used for the experimentation work. Five kg of FYM was supplied as a basal portion in all the treatments including control. Every one doses of vermicompost and PSB were supplied at the time of planting in the field. The information recorded on different parameters during experimentation was statistically analyzed.

Observations on plant height, number of leaves, crowns and runners per plant were recorded at the end of the fruiting season, whereas days taken to produce the first flower, fruit set and duration of harvesting were recorded as suggested by Kidmose and Vang (1996). The number of flowers per plant was counted at five days period during the entire cropping season. At each picking, data on berry weight and yield per plant were recorded. The length and width of ten randomly selected berries were measured with a vernier caliper.

The TSS of berries was recorded with the assistance of an Erma hand refractometer. The titratable acidity, total sugars and ascorbic acid substance were determined by the techniques as recommended by AOAC (1980).

RESULTS AND DISCUSSION

A. Height of plants and number of leaves per plant

The maximum height of plant (14.91 cm) and the number of leaves (57) per plant was obtained in the plants treated with PSB 7 kg/ha + vermicompost 30 tonnes/ha (Table 1). The height of plants and number of leaves per plant get reduced with the reduction in doses of vermicompost and PSB and they are minimum under control (11.00 cm and 27, respectively). The increment in tallness of plant and number of leaves per plant with PSB and vermicompost treatment throughout examination get support with the revelations of Negi *et al*., (2021); Kumar *et al.,* (2020) who found that the sole application of *Azospirillium* and *Azotobacter* and in mix with PSB altogether influenced the plant height and leaf size contrasted with control. Comparable results were observed by Kumar and Tripathi (2020); Tripathi *et al.,* (2015); Mishra and Tripathi (2011); Rana and Chandel (2003) in strawberry and Tripathi *et al.,* (2013) in Isabgol. This augmentation in vegetative development boundaries may be because of the creation of more ATP with immunization of PSB. The other justification for expanded vegetative development is possible in view of the creation of plant development controllers by microbes in the rhizosphere, which is consumed by the roots. Subsequently, expanded vegetative development might be credited to the better advancement of the root framework and the conceivable blend of plant developmental chemicals.

B. number of runners and crowns per plant

During the present examination, the greatest number of crowns (6.09) and runners (4.57) per plant were produced from the plants treated with PSB 7 kg with vermicompost 30 tonnes/ha, whereas the minimum number of runners (3.01) and crowns (2.82) were produced from the plants kept as untreated (Table 1). These discoveries are in complete agreement with that of Kumar and Tripathi (2020); Bhagat and Panigrahi (2020); Tripathi *et al.,* (2015); Mishra and Tripathi (2011); Singh and Kaur (2020); Negi *et al.,* (2021); Tripathi *et al.,* (2010) in strawberry. This augmentation in the quantity of crown and runners per plant perhaps in light of the extended improvement of plants as stature and number of leaves, which assembled more photosynthates and subsequently expanded runners and crown per plant.

Floral Characters:

Days taken to produce first flower: The minimum number of days taken to produce first flower (62.01 days) was recorded in the plants which were supplied with PSB 7 kg/ha and vermicompost 30 tonnes/ha (Table 1). However, the most outrageous number of days (71.99 days) taken to produce first flower was recorded in the plants kept under control. This phenomenon might be by virtue of the postponed advancement of plants with the utilization of PSB and vermicompost. These outcomes have supported by the findings of Singh and Kaur (2020) who found that vegetative characters, floral characters and yield were increased with the utilization of biofertilizers in combination with vermicompost. Singh *et al*., (2020) also discovered that flowering and yield of strawberry was significantly expanded with various combinations of vermicompost and PSB.

Number of Flowers: The maximum number of flowers per plant (35.01) was recorded in PSB at 7 kg/ha and 30 tonnes of vermicompost per ha treated plants, though the minimum number of flowers (14.00) was found in untreated plants (Table 1). It may conceivably be a direct result of the way that PSB and vermicompost application accelerated the improvement of inflorescence, leaf number in pre-winter, which are decidedly related to the number of flowers and fruits in the accompanying spring. An expanded number of flowers might have also resulted because of an increase in the number of crowns per plant. Similar perceptions were also announced by Tripathi *et al.,* (2010), Kumar and Tripathi (2020) in strawberry, who found that a higher portion of *Azotobacter* and PSB (7 kg/ha) expanded the number of flowers per plant.

Table 1: Impact of PSB and vermicompost on vegetative growth and flowering parameters of strawberry cv. Chandler.

Treatment	Plant height (cm)	Number of leaves/ plant	Number of crowns/plant	Number of runners/ plant	Days taken to produce first flower	Number of flowers/plant	Number of fruits set/ plant	Duration of harvesting (days)
Vermicompost 25 tonnes/ha	12.00	33	4.01	3.42	65.01	18.01	19.49	61.64
Vermicompost 30 tonnes/ha	12.50	30	5.02	4.01	65.02	21.99	23.98	63.87
PSB 6 kg/ha	14.15	36	4.00	4.23	68.01	16.00	25.29	66.25
PSB 7kg/ha	14.25	42	4.31	3.58	64.01	21.01	23.94	64.94
Vermicompost 25 tonnes/ha + PSB 6 kg/ha	14.59	48	5.07	3.84	66.03	24.15	21.99	66.26
Vermicompost 30 tonnes/ha + PSB 6 kg/ha	14.60	45	6.07	4.29	70.00	27.83	27.67	66.19
Vermicompost 25 tonnes/ha + PSB 7 kg/ha	14.75	54	5.01	3.65	61.99	33.00	31.96	66.74
Vermicompost 30 tonnes/ha + PSB 7 kg/ha	14.91	57	6.09	4.57	62.01	35.01	37.12	69.37
Control (untreated)	11.00	27	3.01	2.82	71.99	14.00	17.94	52.85
CD at 5% level	1.29	4.03	1.15	1.32	4.77	2.98	1.28	2.42

Number of Fruits set and Duration of Harvesting: The most extreme number of fruits set per plant (37.12) with the greatest duration of harvesting (69.37 days) was recorded from the plants which were inoculated with vermicompost at 30 tonnes/ha and PSB at 7 kg/ha, whereas the minimum number of fruits set (17.94) per plant with a minimum duration of harvesting (52.85 days) was recorded in untreated plants (Table 1). These outcomes are in comparability with the reports of Tripathi *et al.,* (2014); Wange *et al.,* (1998); Mishra and Tripathi (2011), who additionally noticed that an increment in PSB concentration, resulted in heavier fruiting. PSB is expected to hasten plant development and thereby play some role in promoting fruit production.

Table 2: Impact of PSB and vermicompost on physio-chemical parameters of strawberry cv. Chandler fruits.

Treatment	Berry length (cm)	Berry width (cm)	Berry weight (g)	T.S.S. (ºBrix)	Total sugars (%)	Titratable acidity (%)	Ascorbic acid (mg/ 100g edible portion)
Vermicompost 25 tonnes/ha	3.42	1.88	9.38	8.00	7.04	0.65	51.70
Vermicompost 30 tonnes/ha	3.59	2.04	9.45	8.08	7.17	0.64	51.93
PSB 6 kg/ha	3.63	2.14	9.57	8.10	7.72	0.63	52.30
PSB 7kg/ha	3.76	2.23	9.65	8.55	7.62	0.6	53.10
Vermicompost25 tonnes/ha + PSB 6 kg/ha	3.93	2.29	9.70	8.65	7.61	0.62	54.17
Vermicompost30 tonnes/ha + PSB 6 kg/ha	4.08	2.55	9.33	9.05	8.13	0.62	55.66
Vermicompost25 tonnes/ha + PSB 7 kg/ha	4.14	2.38	9.72	9.06	8.16	0.60	55.57
Vermicompost30 tonnes/ha + PSB 7 kg/ha	4.23	2.68	9.72	9.1	8.19	0.60	56.40
Control (untreated)	2.35	1.18	9.12	7.65	6.72	0.68	51.57
CD at 5% level	0.11	0.07	0.06	0.37	0.05	0.12	1.84

Yield: The significantly most extreme yield per plant (256.24 g) was recorded in the plants supplied with vermicompost 30 tonnes/ha and PSB at 7 kg/ha, followed by vermicompost at 25 tonnes/ha + PSB 7 kg/ha (235.60 g) treated plants, while least yield per plant (90.43 g) was recorded in plants kept under control (Fig. 1). The current findings are in accordance with the discoveries of Singh and Kaur (2020); Kumar *et al.,* (2020); Tripathi *et al.,* (2014) in strawberry. This expansion in yield might be a result of the expanded fruit set per plant, berry length and width as well as berry weight and might be because of the way that nitrogen fixers and phosphorous solubilizers not simply expanded the accessibility of nitrogen and phosphorous to the plants yet additionally expanded their movement from root to flower through plant foliage.

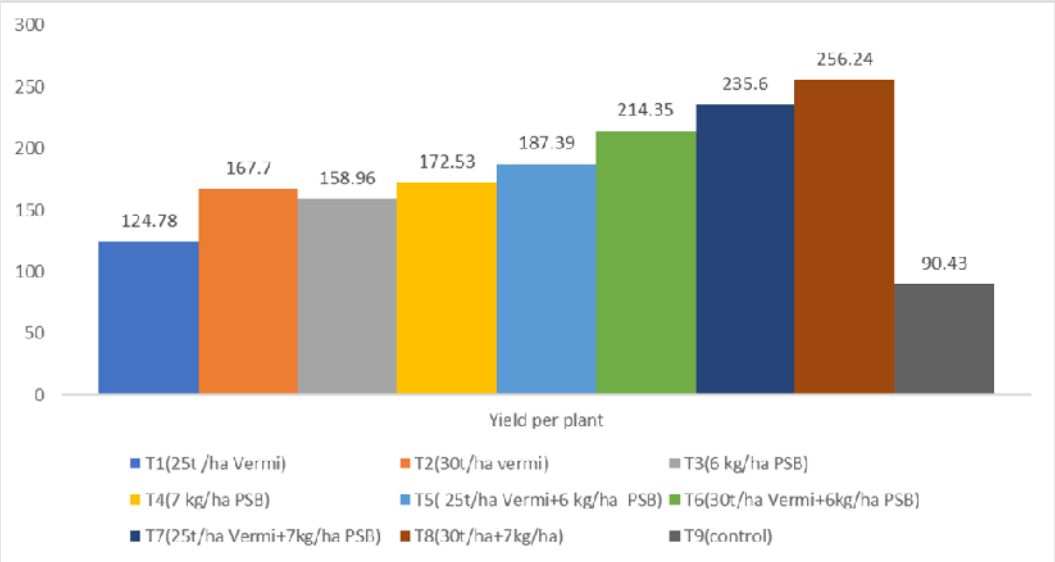

Fig. 1. Impact of different levels of vermicompost and PSB on yield per plant (g).

Physical Fruit Characters: The significantly maximum berry length (4.23 cm), width (2.68 cm) and weight (9.72 g) were recorded in the plants treated with PSB 7 kg/ha with vermicompost at 30 tonnes/ha followed by PSB at 7 kg/ha + 25 tonnes/ha of vermicompost (4.14 cm, 2.38 cm and 9.72, respectively), whereas, the minimum berry length (2.35 cm), width (1.18 cm) and weight (9.12 g) were recorded in fruits which were produced from the plants kept under control (Table 2). Comparable outcomes were obtained by Kumar *et al.,* (2020); Srivastav *et al.,* (2019), Tripathi *et al.,* (2014), Mishra and Tripathi (2011) and Tripathi *et al.,* (2010) in strawberry. This expansion in berry size and weight during the current examination is perhaps due to the extended photosynthetic capacity of plants supplied with PSB

and vermicompost, which in turn may have supported an expanded accumulation of dry matter.

TSS, Total Sugars and Titratable Acidity: The maximum total soluble solids (9.13ºBrix) and total sugars (8.19%) contents were recorded in the berries produced from the plants treated with PSB 7 kg/ha with 30 tonnes/ha vermicompost followed by 9.06 ºBrix and 8.16 %, respectively with PSB at 7 kg/ha + 25 tonnes of vermicompost per ha treated plants (Table 2). An expansion in TSS and total sugars with PSB and vermicompost application might be attributed on account of the quick metabolic difference in starch and pectin into dissolvable mixtures and speedy movement of sugars from leaves to the developing fruits. These discoveries are simultaneous with the reports of Kumar *et al.,* (2020); Kumar and Tripathi (2020); Tripathi *et al.,* (2014); Umar *et al.,* (2009); Tripathi *et al.,* (2010) in strawberry.

The greatest titratable acidity (0.68%) contents were recorded in the berries which were produced from the untreated plants, while the least amount of titratable acidity *i.e.,* 0.60% was recorded with PSB 7 kg/ha + 30 tonnes vermicompost per ha. The views get supported by the perceptions of Kumar and Tripathi (2020) and Mishra and Tripathi (2011) in strawberry. This reduction in titratable acidity content of fruits through application of different organic manure and bio-fertilizers might be due to the positive influence of various micro-organisms in conversion of acids into sugar and their de-relatives by the reaction involving in glycolytic pathway or be used in respiration or in both (Singh *et al.,* 2010).

Ascorbic Acid: The maximum amount of ascorbic acid (56.40 mg/100g of pulp) was recorded in the berries produced from the plants fertilized with PSB 7 kg/ha + 30 tonnes vermicompost per ha closely followed by PSB 7 kg/ha + 25 tonnes vermicompost per ha (55.57 mg/100g of pulp), whereas, the minimum amount of ascorbic acid (51.57 mg/100g of pulp) was recorded in control plants (Table 2). The respective expansion in ascorbic acid content might be a result of the expanded effectiveness of microbial inoculants to fix atmospheric nitrogen, expansion in the accessibility of phosphorous and emission of growth-promoting substances which speeds up the physiological interaction like carbohydrates synthesis, and so on. Kumar *et al.,* (2020), Tripathi *et al.,* (2014); Umar *et al.,* (2010) and Mishra and Tripathi (2011) in strawberry, also reported that inoculation with various portions of vermicompost and PSB in soil resulted in higher vitamin C content in strawberry.

CONCLUSION

From the current experimentation, it is securely presumed that joined use of vermicompost at 30 t/ha + PSB at 7 kg/ha fundamentally expanded the tallness of plant (14.91 cm), number of leaves (57.00), crowns (6.09) and runners (4.57) per plant, while the greatest number of flowers (35.01), fruits set (37.12) per plant with an expanded span of harvesting (69.37 days) and the minimum number of days taken to produce first flower (62.01 days) with significantly higher yield (256.24 g/plant) were recorded with vermicompost at 30 t/ha + PSB at 7 kg/ha fertilized plants. Plants treated with vermicompost at 30 t/ha + PSB at 7 kg/ha also produced the berries with the greatest length (4.23 cm), width (2.68 cm), weight (9.72 g), TSS (9.06°Brix), total sugars (8.19%), ascorbic acid (56.40 mg/100g edible part) with least titratable acidity (0.60%) in contrast with different other treatments under north Indian plains.

FUTURE SCOPE

The use of biofertilizers and organic manure assumes a significant part in the higher yield of quality fruit which is free from toxic residues of harmful chemicals. Since strawberry is now becoming an important fruit crop all over the world in the temperate and sub-tropical climate. That's why in the future, more studies can be carried out on other cultivars alone or in the combination of both *i.e.,* biofertilizers and organic manure on more parameters to standardize techniques according to specific regions.

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Conflict of Interest: Authors have declared that no competing interests exist.

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