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Growth, Flowering, Yield and Quality of Strawberry Cv. Winter Down Influenced by Organic, Inorganic and Bio-Fertilizers Under Deoria District

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A B S T R A C T

An experiment was conducted at farmer's field, Deoria, Uttar Pradesh to evaluate the influence of organic, inorganic fertilizers and bio-fertilizers on growth, flowering, yield and quality of strawberry c.v. Winter Down during 2019-20 and 2020-21 respectively. The experiment comprised eleven treatments and three replications under randomized block design (RBD). Organic (Vermicompost) and Bio-fertilizer (Azotobacter) was directly applied in the soil @5 kg/ha and 6 kg/ha respectively during both year of investigation. Inorganic fertilizer are applied in the form of urea, SSP and MOP, respectively. The data of both the years of studies were pooled and analysed. The plant height, number of crown per plant, number of runner per plant, number of leaves per plant were proliferated under T_{11} (Vermicompost 30 tonnes/ha + Azotobacter 6 kg/ha + NPK 60:60:60 kg/ha). The minimum number of days to flower was recorded under T_{11} followed by T_{10}. The size (length and width), volume (cc) and TSS (^{o}Brix) of strawberry fruit were observed maximum under T_{11}. It is obvious from the data presented in Table 1 that T_{11} give highest yield plant $^{-1}$ exhibition 205 g more yield than control during both years of studies respectively.

Introduction

Strawberry is one of the most important soft and attractive fruits of the world. Basically it is temperate fruit but can be grown in subtropical region. It is a rich source of vitamin C and minerals. The flavour of this fruit is due to presence of volatile esters. The mature soft fruit contains about 0.5 per cent total sugar and 0.90 to 1.85 per cent acidity (Mitra, *et al.*, 1991).

The cultivated strawberry *Fragaria ananasa* is a result of hybridization of two amercian species, *Fragaria chiloensis* and *Fragaria virgiana*. The strawberry is belong to

Rosaceae family (Mitra, *et al.,* 1991). There is lack of agreement with regard to strawberry fertilization with organic and inorganic manure alone. The plant growth and fruit yield are reported to be influenced favourably by organic manures (Ljones, 1960; Marchel *et al.,* 1982).

A bio-fertilizer is a substance which contains living micro-organism which applied to seeds, soil and promotes growth by increasing the supply or availability of primary nutrients to the host plants. Bio-fertilizers add nutrients through the natural process of nitrogen fixation solubilizing phosphorus and stimulating plant growth through the synthesis of growth promoting substances. The micro-organism in bio-fertilizer restore the soil` natural nutrient cycle and build soil organic matter. Bio-fertilizer can be expected to reduce the use of synthetic fertilizers.

The scattered information of the benefits of bio-fertilizer with strawberry crop still need further investigation. It is with this idea the present experiment was conducted to the study of growth, flowering, yield and quality of strawberry c.v. Winter Down influenced by organic, inorganic and bio-fertilizers under Deoria district.

Materials and Methods

The experimental was conducted with Winter Down variety of strawberry during 2019-20 and 2020-21 at farmer`s field in Deoria district, Uttar Pradesh.

Deoria is situated in tarai region of northern Uttar Pradesh. The soil of experiment field was sandy loam in texture with pH 7.1, medium organic carbon (0.54%), phosphorous (16kg/ha), potassium (164kg/ha) and available nitrogen (215kg/ha). The variety Winter Down was chosen for present investigation. The runner of this variety were procured from Dr. YS Parmer Horticulture University, Nauni, Solan, Himachal Pradesh. All the weeds, grass and plant residues were removed by manually.

Raised beds of 35 cm in height were prepared for planting of strawberry runners at plant to plant 20 cm and row to row 30 cm. Weeding and hoeing was done regularly by Khurpi.

The experiment field was well prepared by three times ploughing (one time heavy and two time light) followed by planking to obtain a fine tilth.

The experiment was carried out on healthy "Winter Down" variety of strawberry plant. The experiment comprised twelve treatments and was laid out in randomized block design (RBD) with three replication. *Azotobacter* (Bio-fertilizer) and Vermicompost (Organic manure) was directly applied in the soil @5kg ha^{-1} and 6 kg ha^{-1} and 20 tonnes ha^{-1} and 25 tonnes ha^{-1} respectively during both the year of investigation.

A different dose of nitrogen, phosphorus and potassium was supplied in the form of Urea, SSP, and MOP respectively with bio-fertilizer and organic manure.

Treatment details of eleven different treatments combined with organic, inorganic, bio-fertilizer and mulching are T_1: Control, T_2: Mulching and *Azotobacter* (5 kg ha^{-1}), T3: Mulching +*Azotobacter* (6 kg ha^{-1}), T4: Mulching + Vermicompost (20 ton ha^{-1}), T5: Mulching + Vermicompost (25 tonne ha^{-1}), T6: Mulching + NPK (60:60:60 kg ha^{-1}), T_7: *Azotobacter* (5 kg ha^{-1}) + Vermicompost (20 tonne ha^{-1}), T8: *Azotobacter* (6 kg ha^{-1}) + Vermicompost (25 tonne ha^{-1}), T_9: *Azotobacter* (5 kg ha^{-1}) + NPK (50:60:60 kg ha^{-1}), T_{10}: Vermicompost (25 tonne ha^{-1}) + NPK (60:60:60 kg ha^{-1}), T_{11}: Vermicompost (30 ton ha^{-1}) + *Azotobacter* (6 kg ha^{-1}) + NPK (60:60:60: kg h^{-1}).

Statistical Analysis

Statistical analysis of the data recorded was done by the technique of "Analysis of Variance" as outlined by Panse and Sukhatme (1985) testing the data from Randomised Block Design with 11 treatments and three replications. In order to ascertain the significance of treatment effect, the appropriate standard error of mean and the critical difference (CD) were calculated at 5% of probability.

Results and Discussion

Growth attributes

It is evident from the data given in Table-1 that organic, inorganic fertilizer and bio-fertilizer had a significant promotive influence on plant height and number of leaves. The maximum plant height (22.93 cm) and number of leaves per plant (64.26) were obtained in T_{11} (Vermicompost 30 tonne ha^{-1} + *Azotobacter* 6 kg ha^{-1} + NPK 60:60:60 kg ha^{-1}) followed by T_{10} (Vermicompost 25 $tonha^{-1}$ + NPK 60:60:60 $kgha^{-1}$).

The lower value was recorded under control. Azatobacter bacteria utilized atmospheric nitrogen gas for their cell protein synthesis is then mineralized in soil after the death of Azorobacter cells there by contributing towards the nitrogen availability to the crop plant. These findings are in accordance with the result of Karma Beer *et al.,* (2017) and Tripathi *et al.,* (2010) in strawberry Hazarika (2011) in banana.

Runner and Crown $^{-1}$ plant were showing maximum under T_{11} (Vermicompost 25 ton ha^{-1} + *Azotobacter* 6 kg ha^{-1} + NPK 60:60:60kg ha^{-1}) followed by T_{10} (Vermicompost 25 ton ha^{-1} + NPK 60:60:60 $kgha^{-1}$) in table 1 increase in number of crown and runners $plant^{-1}$ might be due to increased growth of plant in the form of height and number of leaves, which accumulated more photosynthates. Similar findings were reported by Karma Beer *et al.,* (1917), Umar *et al.,* (2009). The number of days required for flowering under each treatment was influenced by vermicompost, *Azotobacter* and chemical fertilizers during two years of study (Table-1) of strawberry. The data regarding days to flowering showed that the minimum number of days to flowering (50.31 days) was recorded under T_{11} (Vermicompost 30 tonne ha^{-1}+*Azotobacter* 6 kg ha^{-1}+NPK 60:60:60 kg ha^{-1}.The plant under T_{11} followed 15.92 days earlier than those of control.

The earlier flowering may be due to balance supply of plant nutrients which increase the vegetative growth and ultimately more photosynthesis. The results of present experiment support the observation of Karma Beer *et al., (*2017) in tomato.

Fruit characters

It is evident from the data given in Table-1 that organic, inorganic and *Azotobacter* had a significant promotive influence on size of fruit (length and width). It was affected by application inorganic, organic fertilizers and *Azotobacter* (T_{11}) exhibiting 4.56 cm and 2.65 cm expressing 31 and 30 per cent greater size of fruit when compared with control during study period. Similar findings were reported by Karma Beer *et al.,* (1977), Yaday *et al.,* (2010) in strawberry and Shukla *et al.,* (2009) in tomato.

The maximum volume (Table-1) of fruit (cc) was observed under T_{11} (Vermicompost + 30 tonne (Vermicompost 30 tonne ha^{-1}+6 Kg ha^{-1}+NPK 60:60:60 Kg ha^{-1}). The lowest fruit volume (3.11cc) was recorded under control. These findings are in conformity with the reports of Karma Beer *et al.,* (1917) and Tripathi (2015) in strawberry.

Table.1 Growth, flowering, yield and quality of strawberry influenced by organic, inorganic and bio fertilizer (Pooled data two year

Treatments	Plant height(cm)	No. of leaves plant^{-1}	Runner plant^{-1}	Crown plant^{-1}	Days to producing Ist flower	Berry length (cm)	Berry width (cm)	Berry Volume (cm)	TSS(^{0}B)	Yield plant^{-1}
T_1	11.18	36.20	3.15	3.06	66.13	2.03	2.03	3.10	6.12	115.22
T_2	13.36	40.11	4.22	4.11	65.10	2.11	2.10	3.22	6.24	129.40
T_3	14.20	38.77	4.53	4.27	65.18	2.27	2.22	3.45	6.16	141.28
T_4	15.16	40.34	4.58	4.36	63.77	2.75	2.32	4.80	6.42	151.60
T_5	17.70	45.23	5.33	5.20	64.17	3.20	2.45	4.45	6.45	165.50
T_6	20.64	50.17	5.10	4.87	64.10	3.60	2.78	5.62	7.30	231,80
T_7	21.32	56.24	5.41	5.23	63.27	3.92	2.11	5.66	7.38	241.16
T_8	21.62	62.87	5.76	5.54	66.11	3.83	2.23	5.72	7.62	270.76
T_9	21.98	63.16	6.13	5.86	64.37	4.23	2.54	5.77	7.88	287.77
T_{10}	22.42	63.62	6.90	6.38	52.27	4.44	2.60	5.90	8.60	307.18
T_{11}	22.93	64.26	7.12	7.04	50.31	4.56	2.65	5.97	8.92	320.23
CD at 5%	2.26	2.48	1.17	0.94	4.86	0.33	1.40	0.30	1.02	9.26

Quality characters

The data recorded on TSS (^{O}B) have been epitomized in Table-1. It is obvious that application of organic, inorganic and bio fertilizer caused remarkable variation in respect of TSS content of fruits. Application of Organic, inorganic and bio fertilizer registered maximum TSS 8.92^{0}B followed by vermicompost (25 tonne ha^{-1}) +NPK (50:60:60 Kg ha^{-1}), *Azotobacter* (5 Kg ha^{-1}) +NPK (50:60:60 Kg ha^{-1}). An increase in TSS of fruit juice might be due to the quick metabolic transformation of starch and pectin into soluble compounds and rapid translocation of sugars from leaves to the developing fruits. Similar findings were reported by Karma Beer, Singh *et al.*, (2009) in ber and Attia *et al.*, (2010) in banana.

Yield per plant (kg plant^{-1})

It is evident from the data given in Table-1 that organic, inorganic and biofertilizer caused significant promotive influence on yield plant^{-1}.It is obvious from Table that the yield plant^{-1} was maximum 3020.23 g under T_{11} (Vermicompost 30 tonne ha^{-1}+*Azotobacter* 6 kg ha^{-1}+NPK60:60:60 kg ha^{-1}) was close to T_{10} (Vermicompost 25 tonne ha^{-1}+NPK 60:60:60 kg ha^{-1}).These findings corroborate reports of Karma Beer *et al.*, (2017) and Tripathi *et al.*, in strawberry.

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