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Effect of different organic media on growth and establishment of strawberry (*Fragaria ananassa*) cv. winter dawn under East-Singhbhum (Jharkhand) agro - climatic conditions

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Abstract

Strawberry is a very important aggregate fruit of India. These days, this fruit is happening to be well liked and marketable. Due to imbalanced nutrition, diseases and pest attack and lack of adoption of advanced technology or improved production techniques the productivity of strawberry has become very low. Among these factors, probably nutrition is a key factor affecting the productivity of strawberry plants. Imbalanced and non-judicious use of chemical fertilizers is a common practice adopted by the farmers. The exercise of organic fertilizers with inorganic fertilizers as an additive is a modern approach to keep up a balance, regulate cropping and with a view of getting superior end result.

Hence, a field experiment entitled effect of Different Organic Media on Growth and Establishment of Strawberry (*Fragaria ananassa*) cv. Winter dawn under East-Singhbhum (Jharkhand) Agro - Climatic Conditions'' was conducted during the October 2020 to February 2021, at the Experimental field, Krishi Vigyan Kendra, East-Singhbhum, Jharkhand. The experiment consisted of nine different combinations of treatments of organic manures and inorganic fertilizers which was laid out in Randomized Block Design with three replications. Different proportions of organic manures and inorganic fertilizers viz., Vermicompost (25%, 75%, 100%), Azatobacter (25%, 75%, 100%), Trichoderma (25%, 75%, 100%) and RDF (25%, 75%, 100%) were applied. Result revealed that the treatment T7 (Vermicompost 50%+ NPK 50%+ Trichoderma) was found significantly superior over all other treatments with respect to plant growth and development characteristics including survival percentage. The plant growth parameters like plant height(22.08cm), number of leaves per plant (35.00), number of runners per plant (12.33) and plant spread (35.95cm²), leaf area (29.53cm²) and days to first flowering (24.68 days), survival percentage (100%) increased significantly under T4 treatment in strawberry cv. Winter dawn.

The knowledge regarding the utility of merging these fertilizers in fruit crops is very minimal. Under prevailing circumstances it is the duty of the researchers to give rise to the information on fruitfulness and economics of these organic and fertilizers in temperate fruit crop like strawberry.

Keywords: Strawberry, organic manures, inorganic fertilizers, growth, establishment

Introduction

Strawberry (*Fragaria X ananassa* Duchesne) is one of the most appetizing, revitalizing and nourishing soft fruits of the world. *Fragaria* species belongs to the family Rosaceae with a basic chromosome number of n =7. The cultivated strawberry *Fragaria X ananassa* Duch has chromosome number (2n) of 56. It is a monoecious octoploid hybrid of two largely dioecious octoploid species. It occupies a significant place in fruit growing areas of the world as it has a wide adaptability and can be cultivated in the plains as well as the hills up to an elevation of 3000 meters above mean sea level in both humid and dry regions Darrow and Waldo, (1935). It is assumed that hybridization between *Fragaria chiloensis* and *Fragaria virginiana* had taken place spontaneously in Europe in early seventeenth century when female plants of *Fragaria chiloensis* of Chilean origin were grown in proximity to male *Fragaria* plants of North American origin Gallette and Bringhurst, (1990) ^[10]. It is a short-day plant that can successfully be grown at optimum day temperatures of 22 °C to 25 °C and night temperatures of 7°C to 13°C De and Bhattacharjee, (2012). Due to this wide adaptability to climate and soils, it is available fresh round the year from the tropics to the subarctic regions

It has been widely reported that due to non judicious use of fertilizer there is an occurrence of multi-nutrient deficiencies and overall decline in productive capacity of soil (Chhonkar, 2008) ^[6]. (Sanewski, 1991) suggested that the use of organic fertilizers with inorganic fertilizers

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as a supplement to maintain a balance and to regulate cropping. Nutrient Management involves the judicious use of organic, inorganic and microbial sources in such ways that it sustains optimum yield and improves and maintains the soil physical, chemical and biological properties. According to (Souza, 2016), the plant extracts large amounts of nutrients from the soil. Since nitrogen is the most required nutrient, nitrogen fertilization increases the vegetative and reproductive of custard apple plant (São *et al.*, 2014). An effective, integrated approach employs organic manures, biofertilizers, chemical fertilizers, nitrification inhibitors, coated and long-persisting nitrogen fertilizers, which are the key to sustainable agriculture (Gowarikar, 2005).

The new strawberry, named 'Winter Dawn', is renowned by high November through February producing fruit that are medium to large in size and comparatively resistant to Botrytis and anthracnose fruit rot diseases when grown in Dover, Florida or other areas that have a subtropical climate similar to that of Dover. which have its origin from seed developed by a hand pollinated cross between FL 93-103 and FL 95-316.

The information on the utility of combining these fertilizers in fruit crops is very scanty. Under prevailing conditions it is the need of the day to generate the information on effectiveness and economics of these organic and fertilizers in dry land fruit crop like strawberry (Solanke, 2019). The present investigations were undertaken to study the effect of different organic media on growth and establishment of strawberry (*Fragaria ananassa*) cv. winter dawn under East-Singhbhum (Jharkhand) agro - climatic conditions with a view to obtain information regarding the quantitative changes in growth attributes of strawberry cv. Winter dawn.

Materials and Methods

The field experiment was conducted at the Experimental field, Krishi Vigyan Kendra farm, Darisai, East Singhbhum district, Jharkhand during 2020-2021, situated at a latitude 22°12'N to 23°01'N and longitude of 84°04' to 86°54' East at an altitude of 244 meters above mean sea level (MSL). It is situated in the south eastern extreme of Jharkhand in the mineral rich Chhotanagpur range. The climate of the region is sub-tropical with mild to high summer, good rainfall and cold winter. The average rainfall ranges from 1350 mm to 1400mm in a year with maximum downpour during June- August months and occasional showers in winters. The climate is distinctively divided into three seasons *viz.* summer, rainy and winter. The winter season starts from November and continues up to the first week of March with mean temperature ranging from 15 – 25 °C. The summer prevails from April to June, May usually being the most scorching month of the year. The temperature during summer is intense and recorded a little below 45 °C.

After analyzing the soil chemical properties, it revealed that soil was red soil, acidic in reaction (pH 6.84) medium in organic carbon (0.38%) and potassium (87.37 kg ha⁻¹), low in available phosphorus (136.7 kg ha⁻¹). The electrical conductivity of the soil was 0.47 ds m⁻¹.

The experiment was planned in Randomized Block Design (RBD), with 9 treatments replicated threefold. Treatment was randomly arranged in each replication, divided into 16 plants, with plot size of (2m×1m) each. nine treatments combinations, comprising (i) T₀ (Control) (ii) T₁ [VERMICOMPOST (100%)] (iii) T₂ [VERMICOMPOST (75%) + NPK (25%)] (iv) T₃ [Vermicompost (50%) + NPK (50%)] (v) T₄ [VERMICOMPOST (100%) +

TRICHODERMA] (vi) T₅ [VERMICOMPOST (100%) + AZATOBACTER] (vii) T₆ [VERMICOMPOST (50%) + NPK (50%) + AZATOBACTER] (viii) T₇ [VERMICOMPOST (50%) + NPK (50%) + TRICHODERMA] (ix) T₈ [VERMICOMPOST (50%) + NPK (50%) + AZATOBACTER + TRICHODERMA]

Crop variety 'Winter dawn' was transplanted manually on 22nd of October, 2020. The crop geometry was maintained as per the spacing prescribed for the particular treatments. The combinations of the mentioned treatments were applied at 20, 40, 60, 80, 100 and 120 days after planting.

The observations on survival percentage and growth parameters *viz.* plant height, plant spread, number of leaves per plant, number of runners per plant, leaf area, days taken to 1st flowering, days taken to 50% of flowering and number of flowers per plant were taken at 20, 40, 60, 80, 100 and 120 days after planting

Results and Discussion

Effect of Different Organic Media on Growth and Establishment of Strawberry (*Fragaria ananassa*) cv. Winter dawn under East-Singhbhum (Jharkhand) Agro - Climatic Conditions

Survival Percentage

The data pertaining to survival percentage indicates that the differences were significant only due to variations in sources of nutrition. Data enumerated in Table 4.1 revealed that the effect of different organic media on survival percentage of Strawberry (*Fragaria ananassa*) cv. Winter Dawn. The findings of the present investigation showed that maximum percentage of establishment of strawberry was recorded in T7(100%) followed by T4, which were at par with each other and the rest are significantly superior over the minimum values *viz.* T1 and T6. The maximum percentage of establishment was recorded in T7 followed by T4, T1, T6, T8, T2, T5, T3 and T0. This was the growth trend observed during the research in strawberry. The maximum percentage of establishment in T7 might be due to favourable environmental conditions for better growth of the plant, particularly for good development of a root system, also due to holding ample of aeration and optimum soil moisture status for better growth of the seedling, particularly for good development of a root system, ultimately the overall establishment of the plants. These results keep up with Jain *et al.* (2017) and Dwivedi and Agnihotri (2018) [8].

Effect of Different Organic Media on Growth and Establishment of Strawberry (*Fragaria ananassa*) cv. Winter dawn under East-Singhbhum (Jharkhand) Agro - Climatic Conditions

Plant Height

The perusal of the data in Table 4.2.1 revealed the significant effect of different Organic Media on Plant height (cm) of Strawberry (*Fragaria ananassa*) cv. Winter Dawn at different days interval (20, 40, 60, 80, 100, 120 days after planting).

The data pertaining to plant height of strawberry indicates that the differences were significant when the CD value was greater than the treatment differences. The maximum value (T7) was found significantly superior over all the treatments when the CD value was subtracted from the same, followed by T1, T2, T4 and T5 at 20, 40, 60, 80, 100 and 120 days after planting of strawberry. The maximum increase in plant height was recorded in T7 followed by T4, T1, T2, T8, T5, T3, T6

and T0. This was the growth trend observed during the research in strawberry. The maximum increase in plant height in T7 might be due to the favourable environmental condition, more water holding capacity of organic manure and supply of one or more plant nutrients by vermicompost. The supply of nitrogen by vermicompost increased the nitrogen content by cell sap in the form of protein, amides and amino acids which resulted in the cell elongation and multiplication which ultimately increased the plant height of the strawberry plants. Similar results were obtained by Akanbi *et al.*, (2002), Karthikeyan *et al.*, (2006) ^[14] and Mary *et al.*, (2018).

Plant Spread

The perusal of the data in Table 2 revealed the data pertaining to plant spread of strawberry indicates that the differences were significant when the CD value was greater than the treatment differences. The maximum value (T7) was found significantly superior over all the treatments when the CD value was subtracted from the same, followed by T3 and T4 at 20, 40, 60, 80, 100 and 120 days after planting of strawberry. The maximum plant spread was recorded in T7 followed by T4, T8, T5, T3, T6, T1, T2 and T0. This was the growth trend observed during the research in strawberry. The maximum plant spread in T7 might be due to application of sufficient amount of vermicompost improves the aeration and water holding capacity of media and helps in better absorption of soil nutrients this is directly related with photosynthesis and accumulation of high carbohydrates. Similar findings were reported by Kumar *et al.*, (2017) ^[16] and Dwivedi and Agnihotri (2018) ^[8].

Number of Leaves per Plant

The perusal of the data in Table 2 revealed the data pertaining to number of leaves per plant of strawberry indicates that the differences were significant when the CD value was greater than the treatment differences. The maximum value (T7) was found significantly superior over all the treatments when the CD value was subtracted from the same, followed by T4, T1, and T2 at 20, 40, 60, 80, 100 and 120 days after planting of strawberry. The maximum number of leaves per plant was recorded in T7 followed by T4, T6, T2, T1, T8, T5, T3 and T0. This was the growth trend observed during the research in strawberry. The maximum number of leaves per plant in T7 might be due to application of sufficient amount of vermicompost improves the aeration and water holding capacity of media and helps in better absorption of soil nutrients this is directly related with photosynthesis and accumulation of high carbohydrates. The results obtained are in confirmation with the findings of Yadav *et al.*, (2010) who reported that combined application of biofertilizers, vermicompost with inorganic fertilizers significantly increased the number of leaves and leaf area of strawberry and Nowsheen *et al.*, (2006) found that the application of P.S.B. significantly increased the number of leaves.

Number of runners per plant

The perusal of the data in Table 2 revealed the data pertaining to number of runners per plant of strawberry indicates that the differences were significant when the CD value was greater than the treatment differences. The maximum value (T7) was found significantly superior over all the treatments when the CD value was subtracted from the same, followed by T4, T1, and T2 at 20, 40, 60, 80, 100 and 120 days after planting of Strawberry. The maximum number of branches per plant was

recorded in T7 followed by T4, T6, T2, T1, T5, T3, T8, and T0. This was the growth trend observed during the research in strawberry. The maximum number of runners per plant in T7 might be due to prevalence of better growing conditions till first week of December followed by cessation of growth with winter during December January and resumption of speedy growth on onset of spring during February-March. Mahmud *et al.*, (2018) stated that the use of vermicompost produced pineapple plants with excellent growth performance, compared to other chemical fertilizer. In agreement of this statement, similar findings of the present investigation were reported. Grzyb *et al.*, (2012) and Gupta *et al.*, (2019) reported the same.

Leaf Area

The data pertaining to Leaf area of strawberry indicates that the differences were significant when the CD value was greater than the treatment differences. The maximum value (T7) was found significantly superior over all the treatments when the CD value was subtracted from the same, followed by T4, T2, and T5 at 20, 40, 60, 80, 100 and 120 days after planting of strawberry. The maximum leaf area in strawberry plant was recorded in T7 followed by T4, T5, T1, T2, T3, T6, T8 and T0. This was the growth trend observed during the research in strawberry. The maximum leaf area in T7 might be due to the use of increased volume of vermicompost with combination of other inorganic fertilizers enhances the vegetative growth of strawberry (in T7). The results obtained are in confirmation with the findings of Yadav *et al.*, (2010) who reported that combined application of biofertilizers, vermicompost within organic fertilizers significantly increased the leaf area of strawberry was also significantly influenced by the integrated nutrient management. Vermicompost is considered as a richer source of available plant nutrients, growth regulators, enzymes, antifungal and antibacterial compound Arancon *et al.*, (2003 and 2004) ^[2]. Similar discussions were reported by Verma *et al.* (2010), Singh *et al.* (2011) and Kamatyanatti *et al.* (2019).

Days Taken TO 1st Flowering

The data pertaining to days taken to 1st flowering of strawberry indicates that the differences were significant when the CD value was greater than the treatment differences. The minimum value (T7) was found significantly superior over all the treatments when the CD value was subtracted from the same, followed by T4, T2, and T6 at 120 days after planting of strawberry. The minimum days taken to first flowering of strawberry plant was recorded in T7 followed by T4, T6, T2, T8, T1, T3, T5 and T0. This was the growth trend observed during the research in strawberry. The least days taken to 1st flowering in T7 might be supported realistically that vermicompost enlarges the surface area, absorbability and stimulates the hormonal activity in crops. These results are in the line with the findings in strawberry Nazir *et al.*, (2006), Zargar *et al.*, (2008) ^[33] and Yadav *et al.*, (2010). The vermicompost and poultry manure might have an indirect role for early flowering and more flower duration through better uptake of nutrients.

Days Taken To 50% Flowering

The data pertaining to days taken to 50% flowering of strawberry indicates that the differences were significant when the CD value was greater than the treatment differences. The minimum value (T7) was found significantly superior

over all the treatments when the CD value was subtracted from the same, followed by T4, T6 and T2 at 120 days after planting of strawberry. The minimum days taken to 50% of flowering of strawberry plant was recorded in T7 followed by T4, T6, T1, T8, T5, T2, T3 and T0. This was the growth trend observed during the research in strawberry. The minimum days taken to 50% of flowering in T7 might be supported by the fact that vermicompost increases the surface area, absorbability and stimulates the hormonal activity in plants. These findings are in accordance with Graphelli *et al.*, Ram *et al.*, (2007) and Meena *et al.*, (2017) and Mahmud *et al.*, (2018).

Number of flowers per plant

The data pertaining to number of flowers per plant of strawberry indicates that the differences were significant when the CD value was greater than the treatment differences. The maximum value (T7) was found significantly superior over all the treatments when the CD value was subtracted from the same, followed by T4, T1, and T3 at 40, 60, 80 and 100 days after planting of strawberry. The maximum number of flowers per plant was recorded in T7 followed by T4, T6,

T2, T1, T8, T3, T5 and T0. This was the growth trend observed during the research in strawberry. The maximum number of flowers per plant in T7 might be due to application of sufficient amount of vermicompost improves the aeration and water holding capacity of media and helps in better absorption of soil nutrients this is directly related with photosynthesis and accumulation of high carbohydrates. Number of flowers plant⁻¹ may be due to increased in the number of leaves which worked as an efficient photosynthesis structure and produced high amount of carbohydrates in the plant system. More number of flowers, which resulted higher fruits per plant, under present study due to capability of vermicompost and poultry manure in producing growth hormone, enzymes, antifungal and antibacterial compounds, which in turns enhanced marketable yield over other treatments. Beneficial effects of *Azotobacter* were due to the fixation of atmospheric nitrogen and improvement in these parameters. Similar findings also reported by Wang (1996), Yadav *et al.*, (2010), Umar *et al.*, (2009), Singh *et al.*, (2008), Rana and Chandel (2003) [23], Zargar *et al.*, (2008) [33], Umar *et al.*, (2010) Dadashpour and Jouki (2012) [7] and Verma and Rao (2013).

Table 1: Effect of different organic media on growth and establishment of strawberry (*Fragaria ananassa*) cv. Winter Dawn under East-Singhbhum (Jharkhand) Agro climatic conditions. Survival Percent

Treatment Notations	Treatment Combinations	Percentage of survivability (%)
T ₀	Control	35.42
T ₁	Vermicompost (100%)	81.25
T ₂	Vermicompost (75%) + Npk (25%)	62.50
T ₃	Vermicompost (50%) +Npk (50%)	47.92
T ₄	Vermicompost (100%) + Trichoderma	95.83
T ₅	Vermicompost (100%) + Azatobacter	47.92
T ₆	Vermicompost(50%) + Npk(50%) + Azatobacter	68.75
T ₇	Vermicompost(50%) + Npk(50%) + Trichoderma	100.00
T ₈	Vermicompost(50%) + Npk (50%) + Azatobacter + Trichoderma	64.58
	F-test	S
	S.Ed (±)	5.27
	CD (5%)	11.16

Table 2: Effect of different organic media on growth and establishment of strawberry (*Fragaria ananassa*) cv. Winter Dawn under East-Singhbhum (Jharkhand) Agro climatic conditions. Vegetative Characters

Treatment Symbols	Treatment Combinations	Plant Height (cm)	No. of Leaves per plant	No. of Runners per plant	Plant spread (cm)	Leaf Area (cm ²)
T ₀	Control	19.60	29.33	10.00	30.37	17.05
T ₁	Vermicompost (100%)	21.60	34.00	10.67	33.77	24.63
T ₂	Vermicompost 75% + NPK 25%	21.57	34.47	11.33	33.43	22.80
T ₃	Vermicompost 50% + NPK 50%	20.27	30.68	10.67	34.23	21.00
T ₄	Vermicompost 100% + Trichoderma	22.02	34.71	11.67	35.23	27.50
T ₅	Vermicompost 100% + Azatobacter	21.29	32.00	10.67	34.33	24.81
T ₆	Vermicompost 50% + NPK 50%+ Azatobacter	19.83	34.67	11.67	33.83	20.19
T ₇	Vermicompost 50%+ NPK 50%+ Trichoderma	22.08	35.00	12.33	35.95	29.53
T ₈	Vermicompost50%+NPK50%+Azatobacter+Trichoderma	20.38	32.00	10.33	34.50	20.62
	F-test	S	S	S	S	S
	S.Ed (±)	0.83	1.27	0.55	0.56	2.15
	CD (5%)	1.76	2.61	1.17	1.18	4.56

Table 3: Effect of different organic media on growth and establishment of strawberry (*Fragaria ananassa*) cv. Winter Dawn under East-Singhbhum (Jharkhand) Agro climatic conditions. Floral Characters

Treatment Symbols	Treatment Combination	Days to first flowering	Days taken to 50% of flowering	No of flowers per plant
T ₀	Control	30.33	55.00	7.67
T ₁	Vermicompost (100%)	28.00	43.67	10.00
T ₂	Vermicompost 75% + NPK 25%	26.67	49.00	10.33
T ₃	Vermicompost 50% + NPK 50%	29.00	50.00	9.67

T ₄	Vermicompost 100% + Trichoderma	25.22	38.33	11.33
T ₅	Vermicompost 100% + Azatobacter	30.00	48.33	9.33
T ₆	Vermicompost 50% + NPK 50%+ Azatobacter	26.00	41.00	11.00
T ₇	Vermicompost 50%+ NPK 50%+ Trichoderma	24.68	38.00	11.67
T ₈	Vermicompost 50%+NPK50%+Azatobacter+Trichoderma	27.67	45.00	9.67
	F-test	S	S	S
	S.Ed (±)	1.12	2.09	1.05
	CD (5%)	2.36	4.43	2.23

Conclusion

On the basis of results obtained, it is concluded that the treatment T₇ [Vermicompost + NPK + Trichoderma] was found best in terms of growth parameters viz., plant height (22.08 cm), plant spread (35.95cm²), number of leaves per plant (35.00), number of runners per plant (12.33), leaf area (29.53cm²), earliest flowering (24.68) days, days taken to 50% flowering (38.00) and no of flowers per plant (11.67). Moreover, the treatment T₇ also showed 100% survival percentage of Strawberry cv. Winter dawn. On the basis of the above findings the best combination of organic manures and inorganic fertilizers was Vermicompost + NPK + Trichoderma as observed in all the parameters of strawberry plant. However, these findings are based on one season trial. Therefore, further evaluation trials are needed to substantiate the findings.

Future Scope

Based on the present investigations it may be concluded that, there is a good interactive effect of different combinations of organic on growth attributes like plant height, plant spread, number of leaves per plant, number of runners per plant, leaf area, days taken to 1st flowering, days taken to 50% flowering and number of flowers per plant as well as establishment of strawberry. These technologies would help in improving survival percentage and vegetative parameters of strawberry seedlings, it also helps in early growth and helps to meet the increasing demand of growers as of strawberry plants.

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Conflict of Interest: As a Corresponding Author, I Kiran Mandal, confirm that none of the others have any conflicts of interest associated with this publication.

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