

Original Research Article

EFFECT OF DIFFERENT SOIL AMENDMENT ALONG WITH MULCHING MATERIAL UNDER POLYHOUSE CONDITION IN STAWBERRY (*Fragaria x ananassa* Duch) cv. Winter Dawn

ABSTRACT

An investigation was carried in experimental field of Department of Horticulture, SHUATS (October 2021- March 2022). The experiment was laid out in Randomized Block Design (RBD) with 19 treatments and each treatment replicated 3 times. The treatments comprised of: T₀-Control (Soil without amendment), T₁ (Soil without amendment + Paddy straw), T₂ (Soil without amendment + Plastic mulch), T₃ (Soil without amendment + Dry grass), T₄ (Leaf mould + Paddy straw), T₅ (Leaf mould + Plastic mulch), T₆ (Leaf mould + Dry grass), T₇ (Paddy husk + Paddy straw), T₈ (Paddy husk + Plastic mulch), T₉ (Paddy husk + Dry grass), T₁₀ (Cocopeat + Paddy straw), T₁₁ (Cocopeat + Plastic mulch), T₁₂ (Cocopeat + Dry grass), T₁₃ (FYM + Paddy straw), T₁₄ (FYM + Plastic mulch), T₁₅ (FYM + Dry grass), T₁₆ (Vermicompost + Paddy straw), T₁₇ (Vermicompost + Plastic mulch), T₁₈ (Vermicompost + Dry grass).

The study revealed that maximum plant height (18.16 cm), number of leaves (15), maximum plant spread in N-S (21.11 cm) and E-W (20.11cm), minimum days taken to first flowering (36 days), maximum number of flowers per plant (20), minimum number of days to fruit setting (5.88), maximum total number of fruit per plant (16), berry length (42.27mm), berry width (37.11 mm), berry weight (25.32g), maximum yield per plant (371.95g), maximum yield (q/ha) (165.31 g), lowest acidity (0.8 %) , highest vitamin-c (55mg/100g) and maximum benefit cost ratio (4.15) were observed under T₁₇ (Vermicompost + Plastic mulch)

Comment [M1]: Summarize this section.

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Keywords: Strawberry; Soil amendment; Mulching material; Polyhouse

1. INTRODUCTION

Strawberry (*Fragaria × ananassa* Duch.) is one of the most economically important berry fruits consumed due to its well nutritional value, aroma, attractive and juicy fruit. It is a short day herbaceous perennial plant that grow well in temperature ranging from 22°C -25°C during the day and 7°C - 13°C night [1].

Strawberry cultivation has recently gained popularity in India due to very high returns per unit area in a short period of time. Strawberry production and area have increased dramatically over the decades, with the majority of it being grown under protected structures. Strawberry is grown commercially in India viz., Maharashtra, Punjab, Haryana, Delhi, Himachal Pradesh, J & K, Uttarakhand, U.P, and West Bengal (Hills of Darjeeling) as well as Rajasthan [2].

Botanically, strawberry is an aggregate fruit with having seeds on the outer surface of a red fleshy receptacle [3]. Since plants grown from seeds are not true forms, commercial strawberry transplants are vegetatively propagated [4]. Strawberry transplants are primarily produced by vegetative propagation using runner plants [5].

Organic amendments have been shown to be an efficient way to improve soil structure, pH, bio-physical conditions and the availability of essential nutrient [6] which leads to increased crop yields and improved soil fertility. Various organic and synthetic mulches are being used in different parts of the country for the production of strawberry. The growing of strawberry on raised beds using plastic mulches is a practice commonly followed worldwide. The yield, quality of the fruit and duration of fruit harvesting is mainly influenced by the mulching [7]. Applying organic mulch (straw, leaves, compost, or similar), further benefits achieved are the increase of organic matter in soil and the stimulation of development of soil micro and macro-flora.

Use of ideal soil amendments and mulching materials have remained an important component in horticulture from time immemorial because they help in increasing crop growth, rooting percentage, yield and quality of the fruit and even provide a reservoir for water holding, nutrient holding and exchange for the plant root system and anchorage for plant roots. Especially mulching is one of the essential cultural practices in strawberry cultivation to protect the fruits from fungal decay and conserve soil moisture for better crop and productivity. Application of chemical fertilizers lead to the health and ecological hazards, depletion of physico-chemical properties of the soil and ultimately poor crop yield. Hence, there is need of alternate source of safe fertilizers which may enhance crop yield without having adverse effects on soil properties. Thus keeping in view above, an experiment on "Effect of different soil amendment along with mulching material under polyhouse condition in strawberry cv. Winter Dawn" was carried out with the following objectives.

OBJECTIVES:

1. To study the influence of soil amendments and suitable mulch on plant growth, yield and fruit quality.
2. To find out the economic of different treatment.

Comment [M3]: Add appropriate new citation such as:
Mehdizadeh et al., 2019
Mehdizadeh M, Izadi-Darbandi E, Naseri Pour Yazdi M.T, Rastgoo M, Malaek-Nikouei B, Nassiri H. Impacts of different organic amendments on soil degradation and phytotoxicity of metribuzin. *Int J Recycl Org Waste Agricult* 8, 113–121 (2019). <https://doi.org/10.1007/s40093-019-0280-8>

Comment [M4]: Add appropriate citation such as:
Mehdizadeh et al., 2013
Mehdizadeh M, Darbandi EI, Naseri-Rad H, Tobeh A (2013) Growth and yield of tomato (*Lycopersicon esculentum* Mill.) as influenced by different organic fertilizers. *Intl J Agron Plant Prod* 4:734-738.

2. MATERIAL AND METHODS

Comment [M5]: Add the soil properties.

The experiment was conducted at Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (UP) during 2021-2022. Prayagraj is located at 25.45°N 81.84°E in the southern part of the Uttar Pradesh at an elevation of 98 meters (322 ft) and stands at the confluence of two, the Ganges and Yamuna. The planting material (runners) were planted at spacing of 30 cm x 30 cm on raised bed 27th October, 2021. From transplanting till maturity and harvest, observations were recorded on plant height (cm), number of leaves per plant, plant spread in cm (N-S & E-W), number of Days to first flowering, number of flowers per plant, no. of fruit set, number of Days to fruit setting, no. of fruits per plant, fruit length (mm), fruit diameter (mm), fruit weight (g), yield per plant (g), yield (q/ ha), economic cost, benefit: cost ratio, total soluble solid (%), acidity (%), ascorbic acid (mg/100 gm).

3. RESULTS AND DISCUSSION

A. Growth Parameters

Plant Height

At 30 DAP, maximum plant height (8.33cm) was recorded under the treatment T₁₇ (Vermicompost + Plastic mulch) and the minimum plant height (4.22 cm) was observed under the treatment T₀. At 60 DAP, treatment T₁₇ (Vermicompost + Plastic mulch) showed maximum plant height (10.88 cm) while T₀ recorded minimum plant height (6.72 cm). At 90 DAP, the maximum plant height (14.5cm) was recorded under the treatment T₁₇ (Vermicompost + Plastic mulch). However the least plant height (9.55 cm) was confirmed under T₀. At 120 DAP, the superiority of treatment T₁₇ (Vermicompost + Plastic mulch) registered maximum plant height (18.16 cm). Nevertheless minimum plant height (12.55 cm) was recorded under the treatment T₀. Similar findings were reported by Hazarika [8], Ali and Gaur [9].

Number of Leaves

At 30 DAP, maximum number of leaves per plant (8.11) was recorded under the treatment T₁₇ (Vermicompost + Plastic mulch) and the minimum number of leaves per plant (4.44) was recorded under the treatment T₀. At 60 DAP, maximum number of leaves per plant (10.55) was recorded in T₁₇ (Vermicompost + Plastic mulch), which was found statistically at par with T₁₆ having average number of leaves (9.88). However the minimum number of leaves per plant (6.44) was observed under the treatment T₀. At 90 DAP, the superiority of treatment T₁₇ (Vermicompost + Plastic mulch), registered maximum number of leaves per plant (12.7). However the lowest number of leaves per plant (8.44) was recorded under the treatment Control T₀. At 120 DAP, T₁₇ (Vermicompost + Plastic mulch) produced maximum number of leaves (15), which was significantly differing from rest of the treatment and minimum was recorded in treatment T₀. Similar findings were reported by Bhagat and Panigrahi [10], Kaur and Kaur [11].

Plant Spread (N-S & E-W)

At 30 DAP, maximum plant spread was observed in North-South (18.22 cm) and East-West (17.38 cm) in treatment T₁₇ (Vermicompost + Plastic mulch) and least plant spread was found in North-South (13.71 cm) and East-West (12.95 cm) in T₀. The maximum plant spread

Table 1. Mean performance of growth parameters in Strawberry

Treatments	Plant height (cm)				Plant Spread								Days to first flowering	Number of flowers	Days to first fruit set					
	No. of leaves				N-S				E-W											
	30	60	90	120	30	60	90	120	30	60	90	120								
T0	4.22	6.72	9.55	12.6	4.44	6.44	8.44	10.33	13.71	14.88	15.85	17.04	12.95	13.95	14.95	15.95	54.33	10.88	10	
T1	4.61	7.33	10.33	13.2	4.66	6.66	8.66	10.66	14.14	15.16	16.24	17.3	13.67	14.61	15.63	16.65	51.77	12.11	9.66	
T2	4.77	7.44	10.44	13.4	4.88	6.88	8.88	10.88	14.35	15.35	16.48	17.41	13.85	14.85	15.85	16.85	50.66	12.55	9.55	
T3	4.5	7.17	10.16	12.9	4.55	6.55	8.55	10.55	13.84	15	16.11	17.2	13.38	14.4	15.46	16.31	52.66	11.44	9.77	
T4	5.66	8.17	11.16	14.2	5.22	7.22	9.22	11.22	14.66	15.81	16.81	17.81	14.21	15.21	16.11	17.22	48.33	13.44	9.11	
T5	5.83	8.33	11.33	14.3	5.33	7.44	9.44	11.44	14.86	16	17.37	18.37	14.35	15.35	16.33	17.46	47.44	13.77	9.33	
T6	5.33	7.84	10.83	13.8	5	7	9	11	14.4	15.55	16.64	17.64	14.03	15.01	16	17.06	49.77	13.33	9.33	
T7	7.38	9.88	13.11	16.5	7	9.44	11.9	13.88	16.53	17.53	18.83	20.27	16.23	17.23	18.23	19.23	39.66	17.22	7.22	
T8	7.66	10.2	13.55	16.9	7.33	9.66	12	14	16.73	17.75	19.02	20.44	16.56	17.56	18.56	19.56	39.11	17.8	6.88	
T9	7.11	9.61	12.94	16.2	6.88	9.22	11.6	13.55	16.37	17.37	18.6	20.04	15.91	16.91	17.91	18.91	40.66	16.88	7.55	
T10	6.44	8.94	11.94	14.9	5.66	7.88	10.1	12.11	15.32	16.3	17.76	18.76	14.73	15.73	16.77	17.77	45.77	14.44	8.77	
T11	6.66	9.16	12.16	15.2	5.77	8	10.2	12.22	15.55	16.5	17.81	18.81	14.97	15.97	16.97	17.97	44.77	14.77	8.44	
T12	6.22	8.72	11.72	14.7	5.44	7.66	9.77	11.77	15.11	16.16	17.61	18.61	14.56	15.56	16.58	17.55	46.55	14.11	8.88	
T13	6.94	9.44	12.55	15.9	6.11	8.88	11	12.88	15.96	17	18.05	19.5	15.41	16.41	17.41	18.41	42.55	15.88	7.88	
T14	7	9.5	12.77	16	6.33	9	11.2	13	16.12	17.12	18.24	19.76	15.6	16.6	17.6	18.6	41.44	16.44	7.66	
T15	6.88	9.38	12.38	15.5	5.88	8.44	10.8	12.66	15.72	16.87	18.01	19.26	15.22	16.22	17.27	18.27	43.33	15.33	8.11	
T16	8.16	10.7	14.05	17.7	7.44	9.88	12.2	14.22	17.61	18.74	19.88	20.96	17.05	18.05	19.05	20.05	37.44	19.44	6.55	
T17	8.33	10.9	14.5	18.2	8.11	10.55	12.7	15	18.22	19.22	20.11	21.11	17.38	18.38	19.11	20.11	36	20	5.88	
T18	7.83	10.3	13.83	17.3	7.77	10.11	12.8	14.77	17.27	18.27	19.66	20.88	16.88	17.88	18.88	19.88	38.11	18.44	6.44	
F-Test	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
SE.d (±)	0.55	0.56	0.57	0.52	0.7	0.54	0.55	0.55	1.3	1.28	1.18	1.2	1.28	1.3	1.28	1.3	0.96	0.59	0.58	
C.D at 5%	1.13	1.14	1.17	1.06	1.43	1.11	1.12	1.13	2.66	2.62	2.42	2.44	2.61	2.66	2.61	2.65	1.96	1.2	1.19	

Table 2. Mean performance of Yield and quality parameters in Strawberry

Treatments	Total fruit per plant	Berry length (mm)	Berry width (mm)	Berry weight (g)	Yield per plant (g)	Yield (q/ha)	TSS	Acidity (%)	Ascorbic acid (mg/100g)
T ₀	6.89	31.66	29.63	13.58	153.66	68.29	6.06	1.66	50.66
T ₁	8.11	33.83	30.77	16.43	170.33	75.70	6.13	1.55	51.26
T ₂	8.67	34.72	31.77	15.67	180	79.99	6.23	1.5	51.41
T ₃	7.56	32.24	30.11	14.67	162.68	72.3	6.03	1.6	51
T ₄	9.44	36.33	32.44	17.78	213.38	94.83	6.43	1.38	51.9
T ₅	9.89	38.33	32.77	18.33	220.39	97.95	6.53	1.35	52.16
T ₆	9.33	35.83	32.11	17.17	196.33	87.25	6.33	1.42	51.6
T ₇	13.22	40.66	35.33	22.67	321.53	142.9	7.36	0.93	53.83
T ₈	14	41.77	36.55	23.33	338.67	150.51	7.46	0.9	54.2
T ₉	12.89	40.16	35	22.33	311.66	138.51	7.26	0.96	53.6
T ₁₀	10.11	38.94	33.27	19.32	245	108.88	6.73	1.26	52.6
T ₁₁	10.78	39.11	33.88	20.33	254.63	113.16	6.83	1.21	52.86
T ₁₂	10.11	38.77	33.05	18.83	232.7	103.42	6.63	1.31	52.36
T ₁₃	12.11	39.83	34.55	21.33	285.33	126.81	7.03	1.15	53.23
T ₁₄	12.33	40	34.88	21.86	293.6	130.48	7.13	1	53.42
T ₁₅	11.33	39.44	34.11	20.67	272.47	121.09	6.93	1.18	53.03
T ₁₆	15.44	42.27	36.83	24.33	360.36	160.15	7.8	0.83	54.77
T ₁₇	16	43.3	37.11	25.32	371.95	165.31	7.7	0.8	55
T ₁₈	14.44	42	36.61	23.83	350.36	155.71	7.6	0.86	54.43
F-Test	S	S	S	S	S	S	S	S	S
SE.d (±)	0.62	2.17	1.97	3.34	1.2	0.53	0.04	0.08	0.48
C.D at 5%	1.27	4.42	4.02	6.79	2.44	1.08	0.09	0.17	0.98

Table 3. Gross returns, net returns and B:C ratio

Treatments	Total cost of cultivation (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B:C Ratio
T ₀	3,75,550	8,19,480	4,43,930	1.18
T ₁	3,77,050	9,08,400	5,31,350	1.4
T ₂	3,78,550	9,59,880	5,81,330	1.53
T ₃	3,76,550	8,67,600	4,91,050	1.3
T ₄	3,82,050	11,37,960	7,55,910	1.97
T ₅	3,83,550	11,75,400	7,91,850	2.06
T ₆	3,81,550	10,47,000	6,65,450	1.74
T ₇	3,79,550	17,14,800	13,35,250	3.51
T ₈	3,81,050	18,06,120	14,25,070	3.73
T ₉	3,79,050	16,62,120	12,83,070	3.38
T ₁₀	3,82,550	13,06,560	9,24,010	2.41
T ₁₁	3,84,050	13,57,920	9,73,870	2.53
T ₁₂	3,82,050	12,41,040	8,58,990	2.24
T ₁₃	3,79,050	15,21,720	11,42,670	3.01
T ₁₄	3,80,550	15,65,760	11,85,210	3.11
T ₁₅	3,78,550	14,53,080	10,74,530	2.83
T ₁₆	3,83,050	19,21,800	15,38,750	4.01
T ₁₇	3,84,550	19,83,720	15,99,170	4.15
T ₁₈	3,82,550	18,68,520	14,85,970	3.88

in North-South and East-West at 60 DAP was observed in T₁₇ (Vermicompost + Plastic mulch) (19.22 cm)(18.38 cm) and minimum in North-South(14.88 cm) and East-West(13.95 cm) was observed in T₀.At 90 DAP,plant spread in North-South (20.11 cm) and East-West (19.11 cm) was significantly maximum in T₁₇(Vermicompost + Plastic mulch) and minimum in North-South (15.85 cm) and East-West (14.95 cm) was recorded in T₀.At 120 DAP, treatment T₁₇ (Vermicompost + Plastic mulch) recorded the maximum spread in North-South (21.11 cm) and East-West (20.11 cm)while the minimum plant spread North-South(17.04 cm) and East-West (15.95cm) was observed in T₀.

Number of days taken to first flowering and Number of flowers per plant

Earliest flowering (36) was recorded in the treatment T₁₇ (Vermicompost + Plastic mulch), which was at par with (Vermicompost + Paddy straw) T₁₆ (37.44) . However, the treatment T₀ Control (Soil without amendment) was significantly late bloomed (54.33) DAP.The highest number of flowers per plant (20) was noticed under the treatment T₁₇ (Vermicompost + Plastic mulch), followed by the treatment T₁₆ (Vermicompost + Paddy straw) having average number of flowers per plant 19.44 . The least number of flowers per plant (10.88) was recorded under T₀.The results are also line with the findings of, Singh et al.,[12], Soni et al.,[13], Ali and Gaur [9].

Days taken to first fruit set

The minimum days to fruit setting (5.88) was noted under the treatment T₁₇ (Vermicompost + Plastic mulch), which was at par with T₁₆ (Vermicompost + Paddy straw) having days to fruit setting (6.55). The maximum days to fruit setting (10) was observed under the treatment T₀(Soil without amendment),which was at par with T₃ (Soil without amendment + Dry grass) having days to fruit setting (10 days).Similar finding was reported by Khalid et al.,[14], Ali and Gaur [9].

B. Yield attributes

Total fruit per plant

The maximum number of fruits per plant was observed (16) in T₁₇ (Vermicompost + Plastic mulch) followed by (15.44) in T₁₆(Vermicompost + Paddy straw). Whereas minimum number of fruits per plant observed in T₀ Control (Soil without amendment) (6.89) which were statistically at par with T₃ (7.56).Similar finding was reported by Khalid et al.,[14],Ali and Gaur [9].

Berry length (mm) and Berry width (mm)

The maximum fruit length (43.3mm) was noticed under the treatment T₁₇ (Vermicompost + Plastic mulch) at par with treatment T₁₆(Vermicompost + Paddy straw) (42.27 mm) and the minimum fruit length (31.66 mm) was recorded under the treatment T₀(Soil without amendment).The maximum berry width (37.11 mm) was noticed under the treatment T₁₇(Vermicompost + Plastic mulch) which was found at par with T₁₆berry width of 36.83 mm respectively. The least berry width (29.63 mm) was recorded under Control T₀.Similar results were obtained by Soni et al.,[13], BJ Sahana et al.,[15].

Berry weight (g)

Heaviest fruit was harvested from treatment T₁₇ (Vermicompost + Plastic mulch) (25.32 g) which was followed by treatment T₁₆ (24.33 g). The lightest fruits were produced by the treatment T₀ (Soil without amendment) having weight (13.58 g) which were found statistically at par with T₃ & T₂ (14.67 g) & (15.67 g).

Yield per plant (g) and Yield (q/ha)

Highest yield per plant (371.95 g) recorded in the treatment T₁₇ (Vermicompost + Plastic mulch) followed by T₁₆ (Vermicompost + Paddy straw) having a yield of 360.36 g and lowest yield (153.66 g) recorded in the treatment T₀. The highest yield (165.31 q/ha) was recorded under the treatment T₁₇ (Vermicompost + Plastic mulch), followed by T₁₆ (Vermicompost + Paddy straw) having an average fruit yield of (160.15 q/ha) and the minimum fruit yield (68.29 q/ha) was recorded under the treatment T₀ (Soil without amendment). Similar observations have been reported by Bhagat and Panigrahi [16].

C. Quality attribute

Total Soluble Solids (%)

The maximum total soluble solids (7.8 %) was observed under the treatment T₁₆ (Vermicompost + Paddy straw), which was found significantly superior with rest of the treatments and was followed by T₁₇ (7.7 %). The lowest total soluble solid (6.06 %) was registered under T₀ (Soil without amendment) T₀. Similar findings were reported by Singh et al., [12].

Acidity (%) and Vitamin- C (mg/100g)

The minimum acidity (0.8%) was recorded under the treatment T₁₇ (Vermicompost + Plastic mulch), was found significantly different from rest treatments and the maximum acidity (1.66 %) was registered under T₀ (Soil without amendment). The maximum ascorbic acid (55 mg/100gm) was recorded under the treatment T₁₇ (Vermicompost + Plastic mulch), superior over rest of the treatments. The minimum ascorbic acid (50.66 mg/100gm) was registered under the treatment T₀ (Soil without amendment). In conformity of these observations were analyzed by Kumar et al., [17], Kour and Singh [18].

4. CONCLUSION

From the present investigation, it can be concluded that the treatment T₁₇ (Vermicompost + Plastic mulch) gave the best result with respect to almost all the parameters observed like plant growth, yield and quality of fruit. While highest TSS was recorded in treatment T₁₆ (Vermicompost + Paddy straw). And among all the treatments, maximum economic cost was recorded in treatment T₁₇ i.e. Vermicompost + Plastic mulch.

Comment [M6]: Rewrite the conclusion section: The conclusion paragraph should restate your thesis, summarize the key supporting ideas you discussed throughout the work, and offer your final impression on the central idea.

REFERENCES

1. De LC and Bhattacharjee SK. 2012. Handbook of Edible Fruits. Aavishkar Publishers, Jaipur 302003 (Rajasthan), India. 312p.
2. Rana RK and Chandel JS. 2003. Effect of biofertilizers and nitrogen on growth, yield and fruit quality of strawberry. *Progressive Horticulture* 35: 25-30.
3. Darnell R. 2003. Strawberry growth and development. In: *The Strawberry: A Book for Growers and Others*, held at Florida, Gainesville, 2003 (Childers NFed). Institute of Food and Agricultural Sciences, University of Florida, Gainesville, USA.
4. Bish, E.B., D.J. Cantliffe, and C.K. Chandler. 2000. Strawberry daughter plant size alters transplant growth and development. *Acta Hort.* 533:121-125.
5. Hartmann, H.T., D.E. Kester, F.T. Davies, and R.L. Geneve. 1997. *Plant propagation: Principles and practices*. Prentice-Hall, Upper Saddle River, N.J. p. 21.
6. Atiyeh, R.M., Lee, S., Edwards, C.A., Arancon, N.Q. and Metzger, J.D., 2002. The influence of humic acids derived from earthworm-processed organic wastes on plant growth. *Bioresource technology*, 84(1), pp.7-14.
7. Bakshi, P, Bhat, D.J, Wali, V.K, Sharma, A. and Iqbal, M. 2014. Growth, Yield and quality of strawberry (*Fragaria x ananassa* Duch.) cv. Chandler as influenced by various mulching materials. *African Journal of Agriculture Research*. 9 (7): 701-706.
8. Hazarika, T.K., Ralte, Z., Nautiyal, B.P. and Shukla, A.C., 2015. Influence of biofertilizers and bio-Regulators on growth, yield and quality of strawberry (*Fragaria x ananassa*). *Indian Journal of Agricultural Sciences*, 85(9), pp.1201-5.
9. Ali, A. and Gaur, G.S. 2007. Effect of mulching on growth, fruit yield and quality of strawberry (*Fragaria x ananassa* Duch). *The Asian Journal of Horticulture*. 2 (1): 149-151.
10. Bhagat, P. and Panigrahi, H., 2020. Effect of bio-fertilizers on growth, yield and quality of strawberry (*Fragaria x ananassa* Duch.) cv. Nabila under net tunnel (Doctoral dissertation, Indira Gandhi Krishi Vishwavidyalaya, Raipur).
11. Kaur, P. and Kaur, A. 2017. Effect of various mulches on the growth and yield of strawberry cv. chandler under sub-tropical conditions of Punjab. *International Journal of Recent Trends in Science And Technology*. 25(1) pp 21-25.
12. Singh, A.K., Beer, K. and Pal, A.K., 2015. Effect of vermicompost and biofertilizers on strawberry growth, flowering and yield. *Annals of Plant and Soil Research*, 17(2), pp.196-99.

Comment [M7]: Add the suggested references to enrich the paper.

13. Soni, S., Amit, K., Rajkumar, C., Praval, S.C. and Rahul, K.S.D., 2018. Effect of organic manure and biofertilizers on growth, yield and quality of strawberry (*Fragaria x ananassa* Duch) cv. Sweet Charlie. Journal of Pharmacognosy and Phytochemistry, 2, pp.128-132.
14. Khalid, S., Qureshi, K.M., Hafiz, I.A., Khan, K.S. and Qureshi, U.S., 2013. Effect of organic amendments on vegetative growth, fruit and yield quality of strawberry. Pakistan Journal of Agricultural Research, 26(2).
15. Sahana, B.J., Madaiah, D., Shivakumar, B.S., Sridhara, S., and Pradeep, S.2020. Influence of organic manures on growth, yield and quality of strawberry (*Fragaria x ananassa* Duch.) under naturally ventilated polyhouse. Journal of Pharmacognosy and Phytochemistry. 9(5): 3284-3287.
16. Bhagat, P. and Panigrahi, H., 2020. Effect of bio-fertilizers on growth, yield and quality of strawberry (*Fragaria x ananassa* Duch.) cv. Nabila under net tunnel (Doctoral dissertation, Indira Gandhi Krishi Vishwavidyalaya, Raipur).