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Effect of organic manure, NPK and mulching on better growth, yield and quality of strawberry (*Fragaria ananassa* Duch.) cv. Camarosa

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Abstract
Strawberry is an attractive, luscious tasty and nutritious fruit with a distinct and pleasant aroma, and delicate flavour. It is an man made hybrid. The present experiment entitled "Effect of organic manure, NPK and mulching on yield and fruit quality of strawberry". The experiment was conducted at farm of Agriculture and Allied Industries, Rama University Mandhna Kanpur in the year 2018-2019. It was carried out in Randomized Block Design with 10 treatments and each treatment replicated thrice. It is a basically temperate crop but these days the crop is being grown in all kind of climate. This area lies under the upper gangetic plains region of Uttar Pradesh at an elevation of 126 m above mean sea level. This research aim was effect of the combination between organic manure (FYM & Vermicompost), NPK and mulching (White polythene & Black polythene) for better growth, yield and quality of strawberry and effect of organic manure, NPK and mulching on physico chemical quality of strawberry. The investigation revealed that minimum time of flower first (49.75days), maximum canopy spread per plant (51.52), maximum number of crowns per plant (3.25), maximized the number of stolen per plant (2.53), maximum fruit yield (358.8 q/ha), Longest berries (3.78 cm), heaviest berry (11.90g), while tallest plant (24.65cm), maximum number of leaves (22.66), maximum juice percent (93.83%) were recorded in Vermicompost 2.5 kg/plot + NPK 15:8:6 gm/plot + black polythene mulch (T9) treated plants,. But the berries of maximum width (2.517 cm) were recorded in FYM 10 kg/plot + black polythene mulch (T7) treated plants.

Keywords: Strawberry, mulching, polythene, berries, vermicompost, yield

Introduction
Strawberry (*Fragaria x ananassa* Duch.) is belongs to family rosaceae with octapolid in nature having 2n = 8x = 56 chromosome number. The modern cultivated (*Fragaria x ananassa* Duch.) is one of the most delicious and refreshing soft fruit of the world, which can be cultivated in temperate, subtropical and tropical climates, wherever irrigation facilities exists. This crop behaves as an annual in subtropical regions and perennial in temperate regions (Sharma and Badiyala, 1980) [14]. Worldwide, it is the most widely distributed fruit crop due to its genotypic diversity, highly heterozygous nature and broad range of environment adaptations. All the cultivars of strawberry have been evolved artificially through hybridization by man. The cultivated strawberry (*Fragaria x ananassa* Duch.) was originated from the hybridization of two American species *viz.*, *F. chillioensis* Duch. And *F. verginiana* Duch. in France in the 17th century. Now strawberry is available as fresh fruits during the entire year rather than being a traditionally seasonal crop.

Strawberry is basically a temperate crop but these days the crop is being grown in all kinds of climates including temperate, Mediterranean, subtropical and taiga zones. It can be grown up to an elevation of 3000 meters above MSL in humid and dry region. Being a quick growing crop, it is also suitable for kitchen garden. The leading strawberry producing country is China followed by USA (FAO, 2017) [3]. In India, it is grown in Jyolikot, Dahradun and Nainital (Uttarakhand), Solan and Kullu (H.P.), Srinagar (J&K) and Hills of Darjeeling (W.B.).

According to (Aykroyed *et al.*, 1966), 100g edible portion contents moisture (87.8%), protein (0.7%), fat (0.2%), fiber (1.1%), carbohydrates (9.8%), minerals (0.4%), Vitamin A (30 IU/100g), thiamine (0.03mg/100g), riboflavin (0.07mg/100g), nicotinic acid (0.2mg/100g), ascorbic acids (55mg/100g), calories (44mg/100g). Strawberry is good source of Anthocyanin. It is a short day plant and propagation is done through one year old runners. Botanically fruit of strawberry is aggregate, called esterio of achenes and the edible portion is succulent

thalamus. The principal use of mulch on strawberry are to protect the plant during the winter from extreme cold from heaving, to conserve moisture, to protect flowers from frost and to provide cleaner berries and better harvest condition. Pine needles, wild hay, rye straw, oat straw wood shavings and wheat straw are generally used for mulching. Besides these, nowadays poly ethylene mulches are being used whose beneficial effect has been reported by many workers. Mulch reduces weed growth and fungal infection. It minimizes water use because it prevents the sun from hitting the soil, which reduces water evaporation. It also improves soil quality as it decomposes.

Keeping in view, the importance of strawberry the present investigation entitled "Effect of organic manure, NPK and mulching on yield and fruit quality of strawberry (*Fragaria annanasa* Duch.) cv. Camarosa" with following objectives:-

1. Effect of the combination between organic manure, NPK and mulching for better growth of the plant.
2. Effect of organic manure, NPK and mulching on physical quality parameters of the strawberry fruits
3. To find out the best treatments for growth and physical quality of strwabwrry fruit.

Material and Method

The experiment was conducted in the Horticulture Garden of Rama University, Mandhana, Kanpur during 2018-19. The effect of organic manure, NPK and mulching on yield and fruit quality of strawberry was carried out at Kanpur agro climatic condition at the research farm. As the strawberry plants are small in height mulches was placed under and around the plants to keep fruit from touching the soil, to retain soil moisture and to keep weeds down. Recommended dose of N, P & K and FYM was applied to get proper growth and higher yield of better quality fruits. For experiment well established healthy & disease free 120 plants of strawbwerry cv. Camarosa were taken for the present experiment and uniform cultural practices were done timely. The data obtained on each aspect on each treatment were statistically computed in factorial RBD design with 10 treatments and each treatment thrice replicated by which making the total number of 30 plots. Each plots planted 4 plants with spacing row to row 45×45 cm and plant to plant 30×30 cm. The observations regarding height of plant, number of leaves per plant, number of crown per plant, canopy spread, number of stolon per plant, time of first flowering, fruit dimension, fruit weight, yield per plant, juice percent were recorded. Statistical analyses of the data obtained in the different sets of experiments were calculated as suggested by Panse and Sukhatme and results were evaluated at 5% significance.

Treatment and notations

Symbols used	Treatment	Doses
T_1	Control	Recommended Doses
T_2	FYM	10 kg/plot + White polythene
T_3	Vermicompost	2.5 kg/plot + White polythene
T_4	Vermicompost + NPK	2.5 kg/plot + 15:8:6 gm/plot + White polythene
T_5	FYM + NPK	10 kg/plot + 15:8:6 gm/plot + White polythene
T_6	Recommended Doses	Black polythene
T_7	FYM	10 kg/plot + Black polythene
T_8	Vermicompost	2.5 kg/plot + Black polythene
T_9	Vermicompost + NPK	2.5 kg/plot + 15:8:6 gm/plot + Black polythene
T_{10}	FYM + NPK	10 kg/plot + 15:8:6 gm/plot + Black polythene

Result & Discussion

Average height of plant

The Average height of plant was measured from the crown level to the primary leaf apex and the relevant data are presented in Table-1. The data obtained were subjected to statistically analysis. In this regards The maximum plant height (24.65 cm) was recorded in the plants treated with Vermicompost 2.5 kg/plot + NPK 15:8:6 gm/plot + black polythene mulch (T_9), followed by Vermicompost 2.5kg/plot +NPK 15:8:6 gm/plot + white polythene mulch (T_4) treated plants (22.74 cm), whereas the minimum plants height was obtained in control (14.44cm) during the course of investigation get the support the findings of M. Abulsoud *et al*., (2015) [7]; Reinaldo F. Medeiros *et al*., (2015) [10]; Shubash Soni el al., (2018) [12]; Anil Kumar *et al*., (2018) [2] who obtained increase in petiole length of strawberry when treated with combination of Vermicompost + NPK + black polythene. This increase in vegetative growth parameters might be due to production of more chlorophyll content with inoculation of N_2 and reduction in Weed competition. Increased chlorophyll content may have increased the rate of photosynthesis and therefore increased carbohydrates could be expected to increase the vegetative growth. Better response in plant growth with black polythene mulching may also be due to insured higher soil temperature, reduced weed growth and better moisture availability that increased root activities which might have resulted better nutrient uptake. This result finds the support of the finding of S. Sujatha, *et al*., (2018) [13]; Holger Daugaard (2012) [4].

Table 1: Effect of different combination between organic manure, NPK and mulching on the height of plant (cm)

Symbol	Treatments	Average height of plant (cm)
T_1	Control	14.44
T_2	White polythene + FYM @ 10kg/plot	15.09
T_3	White polythene + vermicompost @ 2.5 kg/plot	15.50
T_4	White polythene + vermicompost @ 2.5kg/plot + NPK @ 15:8:6 gm/plot	22.74
T_5	White polythene + FYM @ 10kg/plot + NPK @ 15:8:6 gm/plot	22.39
T_6	Black polythene + no nutrient	15.70
T_7	Black polythene + FYM @ 10kg/plot	16.19
T_8	Black polythene + vermicompost @ 2.5 kg/plot	16.82
T_9	Black polythene + vermicompost @ 2.5kg/plot + NPK @ 15:8:6 gm/plot	24.65

T_{10}	Black polythene + FYM @ 10kg/plot + NPK @ 15:8:6 gm/plot	22.68
	SE±(m)	0.36
	C.D. at 5%	1.07

Number of leaves per plant

The number of leaves per plant was counted at full grown stage of the plant and the relevant data are presented in table-2. The data recorded were subjected to statistical analysis. In this regards, The maximum number of leaves per plant (22.66) were recorded when plants were treated with vermicompost 2.5 kg/plot + NPK 15:8:6 gm/plot + black polythene mulch (T_9) and followed by FYM 10 kg/plot + NPK 15:8:6 gm/plot + black polythene mulch (T_{10}) treated plants (22.25), while the minimum number of leaves were produce (17.00) under control during the course of investigation get the support the findings of M. Abulsoud *et al*., (2015) [7]; Reinaldo F. Medeiros *et al*., (2015) [10]; Shubash Soni *el al*., (2018) [12]; Anil Kumar *et al*., (2018) [2] who obtained increase in petiole length of strawberry when treated with combination of Vermicompost + NPK + black polythene. This increase in vegetative growth parameters might be due to production of more chlorophyll content with inoculation of N_2 and reduction in Weed competition This result finds the support of the finding of S. Sujatha, *et al*., (2018) [13]; Holger Daugaard (2012) [4].

Table 2: Effect of different combination between organic manure, NPK and mulching on number of leaves per plant

Symbol	Treatments	Number of leaves per plant
T_1	Control	17.00
T_2	White polythene + FYM @ 10kg/plot	18.58
T_3	White polythene + vermicompost @ 2.5 kg/plot	19.91
T_4	White polythene + vermicompost @ 2.5kg/plot + NPK @ 15:8:6 gm/plot	21.66
T_5	White polythene + FYM @ 10kg/plot + NPK @ 15:8:6 gm/plot	20.83
T_6	Black polythene + no nutrient	18.50
T_7	Black polythene + FYM @ 10kg/plot	20.75
T_8	Black polythene + vermicompost @ 2.5 kg/plot	21.75
T_9	Black polythene + vermicompost @ 2.5kg/plot + NPK @ 15:8:6 gm/plot	22.66
T_{10}	Black polythene + FYM @ 10kg/plot + NPK @ 15:8:6 gm/plot	22.25
	SE±(m)	0.29
	C.D. at 5%	0.87

Number of crowns per plant

The data on the average number of crowns per plant were recorded at the end of fruiting season and they are presented in Table-3. The data were subjected to statistical analysis. In this regards, among all the treatment Vermicompost, FYM and NPK with black polythene and white polythene mulch, significantly higher number of crown (3.25) per plant was recorded in FYM 10 kg/plot + NPK 15:8:6 gm/plot + black polythene mulch (T_{10}) treated plants closely followed by Vermicompost 2.5 kg/plot +NPK 15:8:6 gm/plot + black polythene mulch (3.08) and FYM 10 kg/plot + NPK 15:8:6 gm/plot + white polythene mulch (2.91) treated plants. However, the minimum number of crowns (1.33) was recorded in control. Nitrogen from different source might have increased the vigour of strawberry plants including increased crowns, stolen and runners with higher synthesis of assimilates due to enhanced rate of photosynthesis. Such effect have been attributed to increased rate of leaves bearing developing fruits. Such an assumption gains the support from M. Abulsoud *et al*., (2015) [7]; Reinaldo F. Medeiros *et al*., (2015) [10]; Shubash Soni el al., (2018) [12]; Anil Kumar *et al*., (2018) [2].

Table 3: Effect of different combination between organic manure, NPK and mulching on number of crowns per plant

Symbol	Treatments	Number of crown per plant
T_1	Control	1.33
T_2	White polythene + FYM @ 10kg/plot	2.00
T_3	White polythene + vermicompost @ 2.5 kg/plot	2.41
T_4	White polythene + vermicompost @ 2.5kg/plot + NPK @ 15:8:6 gm/plot	2.91
T_5	White polythene + FYM @ 10kg/plot + NPK @ 15:8:6 gm/plot	2.91
T_6	Black polythene + no nutrient	1.58
T_7	Black polythene + FYM @ 10kg/plot	2.26
T_8	Black polythene + vermicompost @ 2.5 kg/plot	2.66
T_9	Black polythene + vermicompost @ 2.5kg/plot + NPK @ 15:8:6 gm/plot	3.08
T_{10}	Black polythene + FYM @ 10kg/plot + NPK @ 15:8:6 gm/plot	3.25
	SE±(m)	0.08
	C.D. at 5%	0.25

Canopy spread

The relevant data are given in Table -4 and the data were subjected to statistical analysis. In this regards, the maximum canopy spread was observed in T_{10} (51.52) treatments which was significantly higher than T_9 (51.40) treatments. The minimum spread of plant canopy was observed in T_1 (32.02) treatments. It can be derived from the above observation that mulching of black polythene + FYM 10 kg/plot + NPK 15:8:6 gm/plots the source of nutrient produced the largest canopy spread whereas the treatment without mulch or nutrient spread the minimum canopy.

Table 4: Effect of different combination between organic manure, NPK and mulching on canopy spread (cm)

Symbol	Treatments	Canopy spread (cm)
T_1	Control	32.02
T_2	White polythene + FYM @ 10kg/plot	38.36
T_3	White polythene + vermicompost @ 2.5 kg/plot	40.14
T_4	White polythene + vermicompost @ 2.5kg/plot + NPK @ 15:8:6 gm/plot	47.25
T_5	White polythene + FYM @ 10kg/plot + NPK @ 15:8:6 gm/plot	46.64
T_6	Black polythene + no nutrient	36.33
T_7	Black polythene + FYM @ 10kg/plot	40.87
T_8	Black polythene + vermicompost @ 2.5 kg/plot	43.27
T_9	Black polythene + vermicompost @ 2.5kg/plot + NPK @ 15:8:6 gm/plot	51.40
T_{10}	Black polythene + FYM @ 10kg/plot + NPK @ 15:8:6 gm/plot	51.52
	SE±(m)	0.62
	C.D. at 5%	1.86

Number of stolons per plant

The relevant data are given in table -5 and were subjected to statistical analysis. In this regards, the data pertaining to the number of stolons per plant (Table-4.5) was found to be statistically different. The maximum number of stolons per plant was observed significantly maximum than the treatment T_{10} (2.53) while treatment T_4 (2.41) and T5 (2.40) were treatment. However the minimum number of stolons was observed in control plot T1 (0.85). The number of stolons under treatments mulched with black polythene + FYM 10 kg/plot + NPK 15:8:6 gm/plot was significantly higher than other treatments, while the treatments without any mulch or nutrient produced the least number of stolons.

Table 5: Effect of different combination between organic manure, NPK and mulching on number of stolons per plant

Symbol	Treatments	Number of stolen per plant
T_1	Control	0.85
T_2	White polythene + FYM @ 10kg/plot	1,53
T_3	White polythene + vermicompost @ 2.5 kg/plot	1.43
T_4	White polythene + vermicompost @ 2.5kg/plot + NPK @ 15:8:6 gm/plot	2.41
T_5	White polythene + FYM @ 10kg/plot + NPK @ 15:8:6 gm/plot	2.40
T_6	Black polythene + no nutrient	1.18
T_7	Black polythene + FYM @ 10kg/plot	1.76
T_8	Black polythene + vermicompost @ 2.5 kg/plot	1.48
T_9	Black polythene + vermicompost @ 2.5kg/plot + NPK @ 15:8:6 gm/plot	2.33
T_{10}	Black polythene + FYM @ 10kg/plot + NPK @ 15:8:6 gm/plot	2.53
	SE±(m)	0.05
	C.D. at 5%	0.17

Number of runners per plant

The data on the number of runners produced by the plant was recorded during the growing period and finally recorded at the end of fruiting season and average was worked out. The corresponding data are presented in table-6 and subjected to statistical analysis. A perusal of data presented in Table-4.6 clearly revealed that all combination of FYM, Vermicompost and NPK with black Polythene and white polythene mulch showed effect on the production of runners per plant as compared to control. The Plant fertilized with FYM 10 kg/plot + NPK 15:8:6 gm/plot + black polythene mulch (T_{10}) produced maximum number of runner (3.68) per Plant, Which was significantly higher than all other treatments under investigation, whereas the minimum number of runners (1.26) was recorded in the control plants.

Table 6: Effect of different combination between organic manure, NPK and mulching on number of runners per plant

Symbol	Treatments	Number of runner per plant
T_1	Control	1.26
T_2	White polythene + FYM @ 10kg/plot	2.18
T_3	White polythene + vermicompost @ 2.5 kg/plot	2.13
T_4	White polythene + vermicompost @ 2.5kg/plot + NPK @ 15:8:6 gm/plot	3.15
T_5	White polythene + FYM @ 10kg/plot + NPK @ 15:8:6 gm/plot	3.26
T_6	Black polythene + no nutrient	1.61
T_7	Black polythene + FYM @ 10kg/plot	2.53
T_8	Black polythene + vermicompost @ 2.5 kg/plot	2.26
T_9	Black polythene + vermicompost @ 2.5kg/plot + NPK @ 15:8:6 gm/plot	3.16
T_{10}	Black polythene + FYM @ 10kg/plot + NPK @ 15:8:6 gm/plot	3.68
	SE±(m)	0.05
	C.D. at 5%	0.17

Days taken to produce first flower

The period between the date of planting and the first flower opening (10 per cent) was recorded for calculating the days required to produce first flower. The relevant data are presented in table-7. From the perusal of data given in Table-4.7, it is clearly revealed that all combination of FYM, Vermicompost and NPK with black Polythene and white polythene mulch have significant effect on days taken to

produce first flower. Earliest flowering (49.75 days) was recorded with FYM 10kg/plot + NPK 15:8:6 gm/plot + black polythene mulch (T_{10}) treatment closely followed by vermicompost 2.5 kg/plot + NPK 15:8:6 gm/plot + black polythene mulch (50.16 days). However, it was delayed in untreated plants which took maximum days (57.00 days).

Table 7: Effect of different combination between organic manure, NPK and mulching on days taken to produce first flower

Symbol	Treatments	Days taken to produce first flower
T_1	Control	57
T_2	White polythene + FYM @ 10kg/plot	55.53
T_3	White polythene + vermicompost @ 2.5 kg/plot	55.83
T_4	White polythene + vermicompost @ 2.5kg/plot + NPK @ 15:8:6 gm/plot	55.08
T_5	White polythene + FYM @ 10kg/plot + NPK @ 15:8:6 gm/plot	54.08
T_6	Black polythene + no nutrient	56.83
T_7	Black polythene + FYM @ 10kg/plot	50.83
T_8	Black polythene + vermicompost @ 2.5 kg/plot	50.91
T_9	Black polythene + vermicompost @ 2.5kg/plot + NPK @ 15:8:6 gm/plot	50.16
T_{10}	Black polythene + FYM @ 10kg/plot + NPK @ 15:8:6 gm/plot	49.75
	SE±(m)	0.34
	C.D. at 5%	1.03

Physical quality parameter

Average berry weight

To ascertain the average berry weight, the harvest berries were weight and the average weight was calculated. The data are presented in table-1 and statistically analysed. In this regards, It is evident from the data presented in table 8, that average weight of berry was significantly increased by different combination of FYM, Vermicompost and NPK with black Polythene and white polythene mulch. The maximum average berry weight (11.90g) was recorded when plants were treated with FYM 10 kg/plot + NPK 15:8:6 gm/plot + black polythene mulch (T_{10}), which is closely followed by Vermicompost 2.5 kg/plot + NPK 15:8:6 gm/plot + black polythene mulch (10.91g) and FYM 10 kg/plot + NPK 15:8:6 gm/plot + white polythene mulch (10.14g). The minimum berry weight (5.83g) was recorded in untreated control plant.

Table 8: Effect of different combination between organic manure, NPK and mulching on average berry weight (g)

Symbol	Treatments	Berry weight
T_1	Control	5.83
T_2	White polythene + FYM @ 10kg/plot	7.73
T_3	White polythene + vermicompost @ 2.5 kg/plot	8.44
T_4	White polythene + vermicompost @ 2.5kg/plot + NPK @ 15:8:6 gm/plot	9.64
T_5	White polythene + FYM @ 10kg/plot + NPK @ 15:8:6 gm/plot	10.14
T_6	Black polythene + no nutrient	5.82
T_7	Black polythene + FYM @ 10kg/plot	8.80
T_8	Black polythene + vermicompost @ 2.5 kg/plot	8.50
T_9	Black polythene + vermicompost @ 2.5kg/plot + NPK @ 15:8:6 gm/plot	10.91
T_{10}	Black polythene + FYM @ 10kg/plot + NPK @ 15:8:6 gm/plot	11.90
	SE±(m)	0.34
	C.D. at 5%	1.03

Average berry length

For the berry length, mature, maximum and minimum berries selected were measured with varnier calipers than calculated average berry length. The relevant data are presented in Table-9. The data were subjected to statistically analysis. A perusal of data presented in table-9 clearly revealed that the length of berry was significantly increased by different combination of FYM, Vermicompost and NPK with black Polythene and white polythene mulch. The berries of maximum length (3.78 cm) were produced from the plants treated with FYM 10 kg/plot + NPK 15:8:6 gm/plot + black polythene mulch (T_{10}) followed by FYM10 kg/plot + NPK 15:8:6 gm/plot + white polythene mulch (T_5) (3.64 cm), whereas the minimum berry length (2.96 cm) was recorded in untreated plant.

Table 9: Effect of different combination between organic manure, NPK and mulching on average berry length (cm)

Symbol	Treatments	Average berry length (cm)
T_1	Control	2.96
T_2	White polythene + FYM @ 10kg/plot	3.46
T_3	White polythene + vermicompost @ 2.5 kg/plot	3.40
T_4	White polythene + vermicompost @ 2.5kg/plot + NPK @ 15:8:6 gm/plot	3.53
T_5	White polythene + FYM @ 10kg/plot + NPK @ 15:8:6 gm/plot	3.64
T_6	Black polythene + no nutrient	3.44
T_7	Black polythene + FYM @ 10kg/plot	3.57
T_8	Black polythene + vermicompost @ 2.5 kg/plot	3.36
T_9	Black polythene + vermicompost @ 2.5kg/plot + NPK @ 15:8:6 gm/plot	3.60
T_{10}	Black polythene + FYM @ 10kg/plot + NPK @ 15:8:6 gm/plot	3.78
	SE±(m)	0.01
	C.D. at 5%	0.04

Average berry width

The width of berry was measured with varnier calipers and the relevant data are presented n table-10 and were subjected to statistical analysis. From the data presented in table-10, it is clearly revealed that width of berries was significantly altered by different combination of FYM, Vermicompost and NPK with black polythene and white polythene mulch. The minimum berry width (2.51 cm) was produced from the plants treated with FYM 10kg/plot + black polythene mulch (T7) same as (2.51 cm) treated with FYM 10 kg/plot + NPK 15:8:6 gm/plot + white polythene mulch (T_5). However, the minimum berry width (2.33cm) was recorded in untreated control plants.

Table 10: Effect of different combination between organic manure, NPK and mulching on average berry width (cm)

Symbol	Treatments	Average berry width (cm)
T_1	Control	2.33
T_2	White polythene + FYM @ 10kg/plot	2.44
T_3	White polythene + vermicompost @ 2.5 kg/plot	2.40
T_4	White polythene + vermicompost @ 2.5kg/plot + NPK @ 15:8:6 gm/plot	2.46
T_5	White polythene + FYM @ 10kg/plot + NPK @ 15:8:6 gm/plot	2.51
T_6	Black polythene + no nutrient	2.36
T_7	Black polythene + FYM @ 10kg/plot	2.51
T_8	Black polythene + vermicompost @ 2.5 kg/plot	2.43
T_9	Black polythene + vermicompost @ 2.5kg/plot + NPK @ 15:8:6 gm/plot	2.49
T_{10}	Black polythene + FYM @ 10kg/plot + NPK @ 15:8:6 gm/plot	2.51
	SE±(m)	0.01
	C.D. at 5%	0.03

Yield per plant

At the time of each harvesting the berries were weighted and the cumulative yield was expressed as the yield of berries. The average yield per plant was worked out from this figure. The relevant data are presented in table-11and the statistical analysis of these data was done. From the perusal of data given in table-11, clearly revealed that fruit yield per plant was significantly increased by different combination of FYM, Vermicompost and NPK with black Polythene and white polythene mulch. The maximum yield per plant (109 gm) was recorded in the plant treated with FYM 10kg/plot + NPK 15:8:6 gm/plot + black polythene mulch (T_{10}) closely followed by Vermicompost 2.5 kg/plot +NPK 15:8:6 gm/plot + black polythene mulch (107 gm). The minimum yield per plant (75 gm) was recorded under control plants.

Table 11: Effect of different combination between organic manure, NPK and mulching on yield per plant

Symbol	Treatments	Yield/plant (g)
T_1	Control	75.00
T_2	White polythene + FYM @ 10kg/plot	92.00
T_3	White polythene + vermicompost @ 2.5 kg/plot	88.00
T_4	White polythene + vermicompost @ 2.5kg/plot + NPK @ 15:8:6 gm/plot	95.00
T_5	White polythene + FYM @ 10kg/plot + NPK @ 15:8:6 gm/plot	98.00
T_6	Black polythene + no nutrient	85.00
T_7	Black polythene + FYM @ 10kg/plot	94.00
T_8	Black polythene + vermicompost @ 2.5 kg/plot	97.00
T_9	Black polythene + vermicompost @ 2.5kg/plot + NPK @ 15:8:6 gm/plot	107.00
T_{10}	Black polythene + FYM @ 10kg/plot + NPK @ 15:8:6 gm/plot	109.00
	SE±(m)	2.70
	C.D. at 5%	8.03

Juice percent

The relevant data are given in table -12 and were subjected to statistical analysis. The maximum juice recovery (93.83%) was recorded under T_9 in combination with black polythene + Vermicompost 2.5 kg/plot + NPK 15:8:6 gm/plot treatment. While lowest juice percent (73.96%) was observed under T1 treatment (Table-4.12). The treatment with black polythene + Vermicompost 2.5 kg/plot + NPK 15:8:6 gm/plot, treatment with white polythene + Vermicompost 2.5 kg/plot + NPK 15:8:6 gm/plot and black polythene + no nutrient were significantly higher than the treatment using black polythene + FYM 10 kg/plot + NPK 15:8:6 gm/plot. However the minimum juice percent was recorded in control treatment. The present findings are in line with the findings of M. Abulsoud *et al*., (2015) [7]

Table 12: Effect of different combination between organic manure, NPK and mulching on juice percent

Symbol	Treatments	Juice%
T_1	Control	73.96
T_2	White polythene + FYM @ 10kg/plot	77.97
T_3	White polythene + vermicompost @ 2.5 kg/plot	78.93
T_4	White polythene + vermicompost @ 2.5kg/plot + NPK @ 15:8:6 gm/plot	89.85
T_5	White polythene + FYM @ 10kg/plot + NPK @ 15:8:6 gm/plot	84.15
T_6	Black polythene + no nutrient	87.93
T_7	Black polythene + FYM @ 10kg/plot	80.81
T_8	Black polythene + vermicompost @ 2.5 kg/plot	81.18

T_9	Black polythene + vermicompost @ 2.5kg/plot + NPK @ 15:8:6 gm/plot	93.83
T_{10}	Black polythene + FYM @ 10kg/plot + NPK @ 15:8:6 gm/plot	72.86
	SE±(m)	4.20
	C.D. at 5%	12.50

Conclusion

On the basis of these observations this can be suggested that for getting substantial higher yield of quality berries with more propagating materials the plants of strawberry cv. Camarosa should be treated with FYM 10 kg/plot + NPK 15:8:6 gm/plot + black Polythene mulch (T_{10}) is recommend in the plains of central Uttar Pradesh, India.

Reference

1. Aykroyd WR, Gopalan C, Balasubramanyam SC. The nutritive value of India foods and planting of satisfactory dietes. I.C.M.R. New-Delhi. 1996, 74
2. Anil Kumar, Prasad VM, Devi Singh, Vijay Bahadur. Effect of Bio-Fertilizers, Vermicompost and Trichoderma on Yield and Economics of Strawberry (*Fragaria* x *annanasa* Duch.) cv. Sweet Charlie. International Journal of Current Microbiology and Applied Sciences. 2018; 7(06):1534-1538.
3. FAO. Food and Agriculture Organization of the UNO. Rome, Italy. Production year book. 2007; 48:168-169.
4. Holger Daugaard. The Effect of Mulching Materials on Yield and Berry Quality in Organic Strawberry Production. Int. J for Sustainable Production Systems.; 2012, (26).
5. Karma Beer, Santosh Kumar, Alok K Gupta, Syamal MM. Effect of organic, inorganic and bio-fertilizer on growth, flowering, yield and quality of strawberry (*Fragaria* × *ananassa* Duch.) cv. Chandler. Int. J Curr. Microbiol. App. Sci. 2017; 6(5):2932-2939.
6. Kidmose U, Andersen H, Vang-Petersen O. Yield and quality attributes of strawberry cultivars grown in Denmark 1990-1991. Fruit Var. J. 1996; 50(3):160-167.
7. Abulsoud M, Emam M, Noha El-Rahman. The potential use of vermicompost in soilless culture for producing strawberry. International journal of plant and soil science. 2015; 8(5):1-15.
8. Martinsson M, Kwast A, Cieslinski G, Treder W. Impact of Production Systems and Fertilizer Application on Yield and Quality of Strawberries. International Society for Horticultural Science. 2006; 708(4): 59-64.
9. Parshant Bakshi, Deep Ji Bhat, Wali VK, Akash Sharma, Mudasir Iqbal. Growth, yield and quality of strawberry (*Fragaria* x *ananassa* Duch.) cv. Chandler as influenced by various mulching materials. African J of Agri. Res. 2014; 9(7):701-706.
10. Reinaldo F Medeiros, Walter E Pereira, Rummenigge de M Rodrigues, Ronaldo do Nascimento, Janivan F Suassuna, Tony AG Dantas. Growth and yield of strawberry plants fertilized with nitrogen and phosphorus. Revista Brasileira de Engenharia Agrícola e Ambiental. 2015; 19(9):865-870.
11. Rayees A Wani, Jahangeer Ahmad Baba, Hakeem SA, Sabahat Rafiq Qazi, Yusra Ali Basu, Umer I *et al*. Influence of Differential Combinations of Fertilizer and Manure Combinations on Vegetative Growth, Yield and Quality of Strawberry (*Fragaria* x *annanassa* Duch.) cv. Douglas. Int. J Curr. Microbiol. App. Sci. 2017; 6(11):3396-3404.
12. Shubash Soni, Amit Kanawjia, Rajkumar Chaurasiya, Praval Singh Chauhan, Rahul Kumar, Saurabh dubey. 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. 2018; 2:128-132.
13. Sujatha S, Suchitra V, Swami DV, Subbaramamma P, Uma Krishna K, Saravanan L. Influence of mulching materials on growth and yield of strawberry (*Fragaria ananassa* duch.) cv. CAMAROSA under shadenet conditions of coastal Andhra Pradesh. Int. J. of Agri. Sci. 2018; 14(1):219-224.
14. Sharma RL, Badiyala D. A study of some strawberry cultivar in the mid wilt region of North India. Prog. Hort. 1980; 12(2):17-23.