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Comparative study of various mulches on growth, yield and quality attributes of strawberry (*Fragaria* × *ananassa* Duch.) cv. Winter Dawn

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Abstract

The present investigation entitled “Comparative Study of Various Mulches on Growth, Yield and Quality Attributes of Strawberry (*Fragaria* × *ananassa* Duch.) cv. Winter Dawn” was carried out during 2025-26 at the Horticulture Experimental Field, Department of Horticulture, School of Advanced Agriculture Sciences and Technology (SAAST), Chhatrapati Shahu Ji Maharaj University, Kanpur, Uttar Pradesh. The experiment was conducted to evaluate the influence of different mulching materials on growth, yield, quality attributes and soil properties of strawberry cv. Winter Dawn. The experiment consisted of seven treatments viz., T₁ Control (No mulch), T₂ Paddy straw mulch, T₃ Wheat straw mulch, T₄ Saw dust mulch, T₅ Cut grass mulch, T₆ Black polythene mulch and T₇ Transparent polythene mulch. Various observations were recorded for vegetative growth, flowering, fruit development, yield, fruit quality and soil parameters. The results revealed that different mulching treatments significantly influenced the growth and yield performance of strawberry. Among all treatments, T₆ (Black polythene mulch) showed superior results with maximum plant height (36.22 cm), plant spread (39.75 cm), number of leaves per plant (31.83), number of flowers per plant (26.37) and fruit diameter (41.85 mm). Black polythene mulch also resulted in early flowering and fruiting compared to other treatments. The maximum yield per plant (493.00 g), yield per plot (12.16 kg) and yield per hectare (121.42 q/ha) were recorded under T₆ Black polythene mulch, while the minimum yield was obtained under control treatment. Quality parameters were also improved with black polythene mulch, recording highest total sugars (7.28%) and total soluble solids (8.54 °Brix). The economic analysis indicated that T₆ Black polythene mulch recorded the highest gross return (₹12,14,200 ha⁻¹), net return (₹8,44,200 ha⁻¹) and benefit-cost ratio (2.28:1), making it the most profitable treatment. It may be concluded that application of black polythene mulch was found most effective for improving growth, yield, quality and profitability of strawberry cv. Winter Dawn under the agro-climatic conditions of Kanpur, Uttar Pradesh.

Keywords: Strawberry, Winter Dawn, Mulching, Black polythene, Growth, Yield, Quality, B: C ratio

1. Introduction

Strawberry (*Fragaria* × *ananassa* Duch.) is one of the most popular and economically important soft fruit crops of the world. It belongs to the family Rosaceae and is an octoploid plant (2n=56). The fruit is highly appreciated due to its attractive red colour, pleasant aroma, delicious taste and rich nutritional value. Strawberry contains vitamins, minerals and antioxidants which make it valuable for fresh consumption as well as processing into products like jam, juice, ice cream and beverages. The strawberry plant is herbaceous and shallow rooted, therefore proper soil moisture and temperature management are very important for better growth and production. Due to the delicate nature of fruits and their close contact with the soil surface, fruit quality may be affected by soil-borne pathogens and unfavourable environmental conditions. Among different cultural practices, mulching plays an important role in successful strawberry cultivation. Mulching is the process of covering the soil surface around plants with organic or inorganic materials. It helps to conserve soil moisture, regulate soil temperature, suppress weed growth, improve nutrient availability and protect fruits from direct soil contact. Organic mulches such as straw, dry grass, dry leaves and saw dust improve soil health by increasing organic matter and microbial activity, while inorganic mulches like plastic films are effective in moisture conservation and weed control.

Black plastic mulch is widely used in strawberry production because it maintains favourable soil conditions, reduces weed competition and promotes better plant growth and yield. Mulching also improves fruit cleanliness, size, quality and market value. Therefore, selection of suitable mulching material is essential for obtaining higher productivity and quality fruits in strawberry cultivation.

Materials and Methods

Experimental Site

The experiment was conducted during *Rabi* season 2025-26 at the Horticulture Experiment Field, Department of Horticulture (Fruit Science), School of Advanced Agriculture Sciences and Technology (SAAST), Chhatrapati Shahu Ji Maharaj University, Kanpur-208024 (U.P.). Kanpur is situated at 26.44° N latitude, 80.33° E longitude, approximately 126 m above sea level, in the

North Indo-Gangetic Plain under India's Semi-Arid agro-climatic zone (Zone IV). The crop was grown from October 2025 to March 2026 under cool, dry *Rabi* season conditions with temperatures ranging from 5-35 °C and relative humidity between 28-96 B %.

Soil

The experimental soil was sandy loam in texture (52.2 % sand, 25.3 % silt, 22.5 % clay) with a water-holding capacity of 26.0% and bulk density of 1.50 mg/m³. Soil pH was 6.15, organic carbon 1.41 g/kg, and available N, P₂O₅, and K₂O were 180.4, 14.93, and 129.4 kg/ha, respectively. The collected soil samples were analyzed for their basic physical and chemical properties using standard analytical procedures. The results pertaining to the physical and chemical characteristics of the soil are presented separately in Table 3.2 and Table 3.3.

Table 3.2: Physical properties of the soil

Particulars	Value	Method used
I. Mechanical composition		Hydrometer method (Bouyoucos, 1962)
1. Sand (%)	52.2	
2. Silt (%)	25.3	
3. Clay (%)	22.5	
Texture	Sandy loam	
II. Soil moisture constants		
Water holding capacity (%)	26.0	Keen-Raczowski box method (modified by Coutts, 1929)
Bulk density (mg/m ³)	1.50	Core Sampler (Black, 1965)
Moisture content (%) at field capacity (0.033 MPa)	2.25	Pressure Membrane Plate Apparatus (Loveday, 1974)

Table 3.3: Chemical properties of the soil.

S.no.	Particulars	Value	Method used
1.	Soil pH (1:2.5, soil: water ratio)	6.15	Glass electrode pH meter (Jackson, 1973)
2.	Organic Carbon (g/kg)	1.41	Walkley and Black, 1934
3.	Available N (kg/ha)	180.4	Kjeldahl Method (Jackson, 1973)
4.	Available P ₂ O ₅ (kg/ha)	14.93	Bray's P-1 (Jackson, 1973)
5.	Available K ₂ O (kg/ha)	129.4	Ammonium acetate method (Hanway and Heidal, 1952)

Treatments and Experimental Design

The experiment comprised seven mulching treatments arranged in a Randomized Block Design (RBD) with three replications and 21 plots (plot size 1.0 × 1.0 m²):

Results and Discussion

Total Soluble Solids (TSS, °Brix)

The data regarding Total Soluble Solids (TSS) of strawberry fruits as influenced by different mulching treatments are presented in Table 4.3.2. The analysis of variance revealed significant differences among the treatments. Among all the mulching treatments, Black polythene mulch (T₆) recorded the maximum TSS (8.537 °Brix), followed by Transparent polythene mulch (T₇) with 8.067 °Brix. However, the minimum TSS (6.800 °Brix) was observed under Control (T₁). Among organic mulches, Paddy straw mulch (T₂) showed higher TSS (7.447 °Brix), followed by Wheat straw mulch (T₃) with 7.183 °Brix and Cut grass mulch (T₅) with 7.103 °Brix.

The higher TSS under black polythene mulch might be due to better conservation of soil moisture, favourable soil temperature and improved nutrient availability, which enhanced photosynthetic activity and accumulation of sugars in strawberry fruits. The mulch reduced weed

competition and maintained a suitable root-zone environment, resulting in better translocation of carbohydrates towards developing fruits. Similar findings have also been reported by Singh *et al.* (2015)^[16], Sharma and Kumar (2016)^[11] and Yadav *et al.* (2018)^[17].

Titrateable Acidity (%)

The titrateable acidity of strawberry fruits was significantly influenced by different mulching treatments as presented in Table 4.3.3. The minimum titrateable acidity (0.744%) was recorded under Black polythene mulch (T₆), followed by Transparent polythene mulch (T₇) with 0.775%. The maximum acidity (0.915%) was observed in Control (T₁). Among organic mulches, Paddy straw mulch (T₂) recorded lower acidity (0.810%), followed by Wheat straw mulch (T₃) with 0.828% and Cut grass mulch (T₅) with 0.841%. The reduction in acidity under black polythene mulch may be attributed to improved nutrient uptake, especially potassium availability, which plays an important role in the conversion of organic acids into sugars during fruit development. The favourable micro-climatic conditions created by mulching enhanced fruit ripening and quality parameters. Organic mulches also improved fruit quality by increasing soil biological activity and nutrient availability.

TSS: Acid Ratio

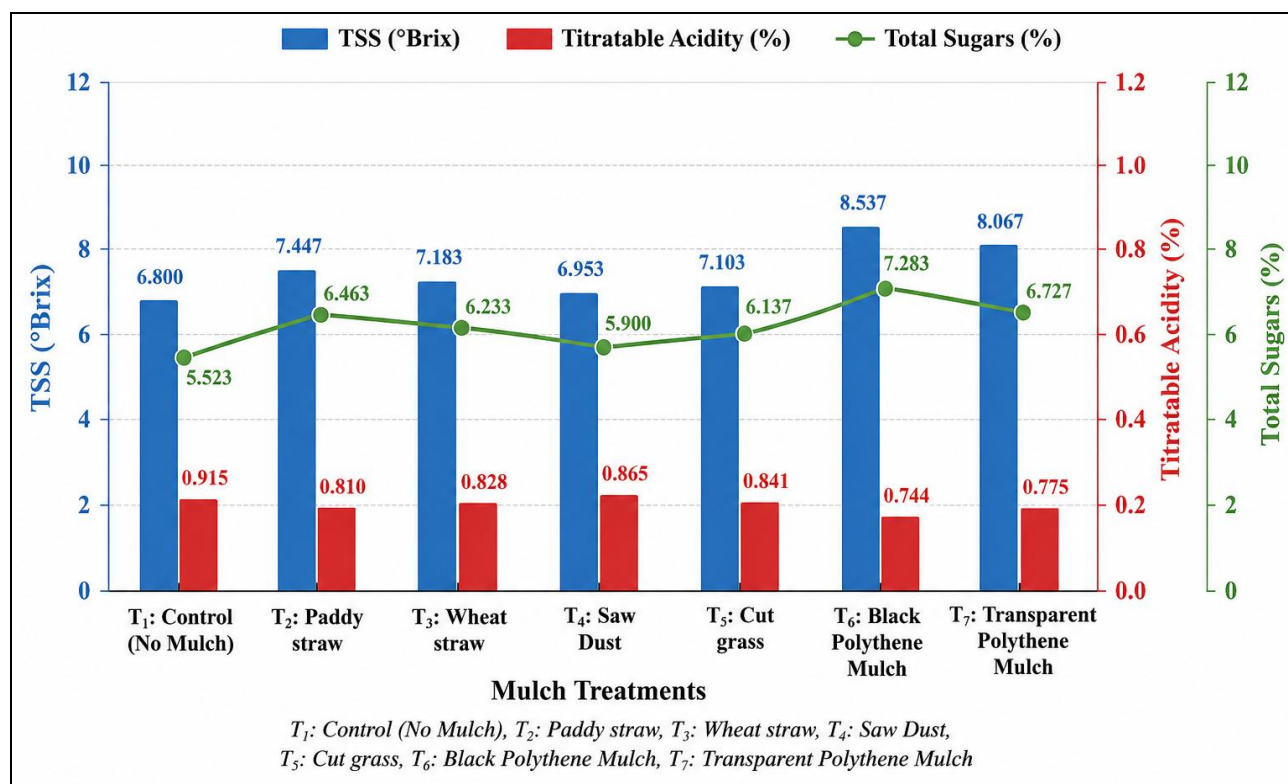
The TSS: Acid ratio showed significant variation among different mulch treatments. The highest TSS: Acid ratio (11.47) was recorded under Black polythene mulch (T₆), followed by Transparent polythene mulch (T₇) with 10.41. The lowest ratio (7.43) was observed in Control (T₁). Among organic mulches, Paddy straw mulch (T₂) showed

better performance with a TSS: Acid ratio of 9.19. The higher TSS: Acid ratio under black polythene mulch indicates improved sweetness, flavour and overall fruit quality of strawberry cv. Winter Dawn. This improvement might be due to increased sugar accumulation and decreased acid content under favourable soil moisture and temperature conditions provided by mulching.

Table 1. Effect of different mulch treatments on quality traits of strawberry cv. Winter dawn

Treatment	TSS (°Brix)	Titrateable Acidity (%)	Total Sugars (%)
T ₁ : Control (No Mulch)	6.800	0.915	5.523
T ₂ : Paddy straw	7.447	0.810	6.463
T ₃ : Wheat straw	7.183	0.828	6.233
T ₄ : Saw Dust	6.953	0.865	5.900
T ₅ : Cut grass	7.103	0.841	6.137
T ₆ : Black Polythene Mulch	8.537	0.744	7.283
T ₇ : Transparent Polythene Mulch	8.067	0.775	6.727
CD(P=0.05)	0.028	0.023	0.029
SE (m) ±	0.009	0.007	0.009

Values are means of three replications; SEM ± = Standard Error of Mean; CD = Critical Difference at 5% level of significance

**Fig 1: Effect of Different Mulch Treatments on Quality Traits of Strawberry cv. Winter Dawn****Plant height (cm)**

The data obtained on plant spread after application of different mulching treatments during plant growth and development of strawberry cv. Winter Dawn were recorded after planting and are presented in Table 4.1.1. The results revealed significant variation among different treatments. Among the various treatments, maximum plant spread was observed in treatment T₆ (Black polythene mulch), followed by treatment T₂ (Paddy straw mulch). However, minimum plant spread was recorded under treatment T₁ (Control - No mulch). The improved plant spread under black polythene mulch might be due to better soil moisture conservation, optimum soil temperature, and reduced weed competition,

which enhanced vegetative growth of strawberry plants.

Table 2: Plant height (cm)

Treatment	Plant Height (cm)		
	60 Days	90 Days	120 days
Control (No mulch)	15.093	19.830	23.647
Paddy straw	19.827	25.760	31.477
Wheat straw	18.903	24.667	30.137
Saw dust	17.437	22.837	27.940
Cut grass	18.177	23.917	29.250
Black polythene	22.357	29.483	36.220
Transparent polythene	20.743	27.163	33.447
CD(P=0.05)	0.060	0.033	0.034
SE (m) ±	0.019	0.011	0.011

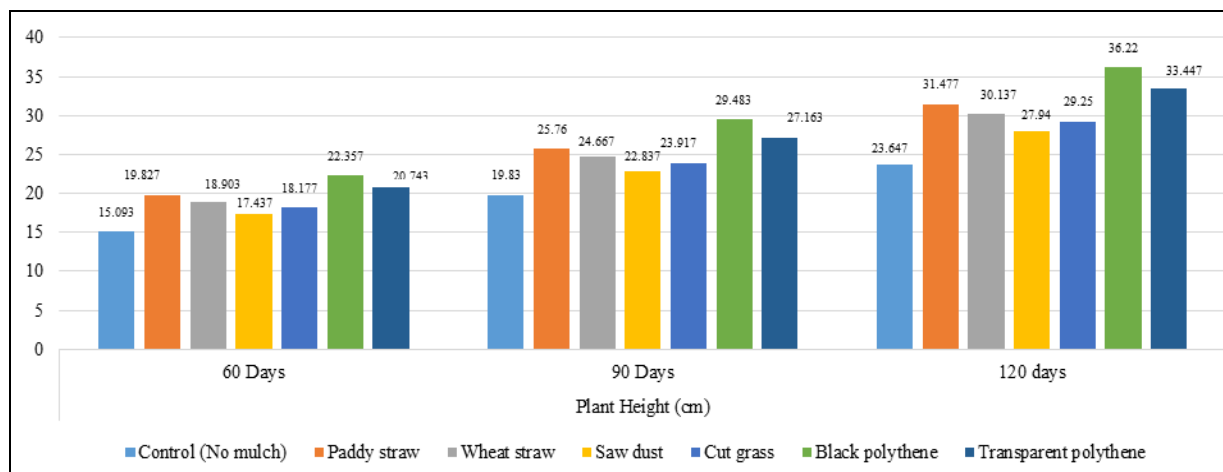


Fig 2: Influence of mulches on Plant height (cm)

Plant spread (E-W and N-S direction) (cm)

Plant spread were recorded at 60, 90 and 120 days after planting (DAP) in both directions, i.e., E-W and N-S, and are presented in Table 4.1.2 and depicted in Fig. 4.2. The data recorded on plant spread at different growth stages showed significant variation among the mulch treatments under the present investigation.

At 60 DAP on E-W direction, the treatment T₆ (Black polythene mulch) recorded the maximum plant spread (25.00 cm), followed by T₇ (Transparent polythene mulch) with 21.50 cm. Moreover, treatments T₂ (Paddy straw mulch) and T₃ (Wheat straw mulch) recorded plant spread of 20.33 cm and 18.00 cm, respectively, while treatments T₄ (Saw dust mulch) and T₅ (Cut grass mulch) recorded 18.20 cm and 18.00 cm, respectively, and were found statistically at par with each other. However, the minimum plant spread (14.66 cm) was recorded under treatment T₁ (Control - No mulch). At 90 DAP on E-W direction, treatment T₆ (Black polythene mulch) recorded the maximum plant spread (26.66 cm), followed by T₇ (Transparent polythene mulch) with 22.13 cm. The remaining mulch treatments showed moderate improvement in plant spread compared to control.

At 120 DAP on E-W direction, treatment T₆ (Black polythene mulch) again recorded the maximum plant spread (28.10 cm), followed by T₇ (Transparent polythene mulch) with 23.50 cm. The minimum plant spread was observed in T₁ (Control - No mulch).

Overall, the application of mulch treatments significantly improved plant spread of strawberry plants compared to control, with black polythene mulch proving to be the most effective treatment throughout the growth period.

Table 3: Plant spread (E-W and N-S direction) (cm)

Treatment	Plant spread(cm)		
	60 days	90 days	120 days
Control (No mulch)	18.520	24.800	28.600
Paddy straw	22.440	29.733	34.543
Wheat straw	21.813	28.927	33.840
Saw dust	20.600	27.240	31.630
Cut grass	21.227	28.127	32.427
Black polythene	25.313	33.847	39.747
Transparent polythene	23.740	31.523	36.220
CD(P=0.05)	0.029	0.035	0.053
SE (m) ±	0.009	0.011	0.017

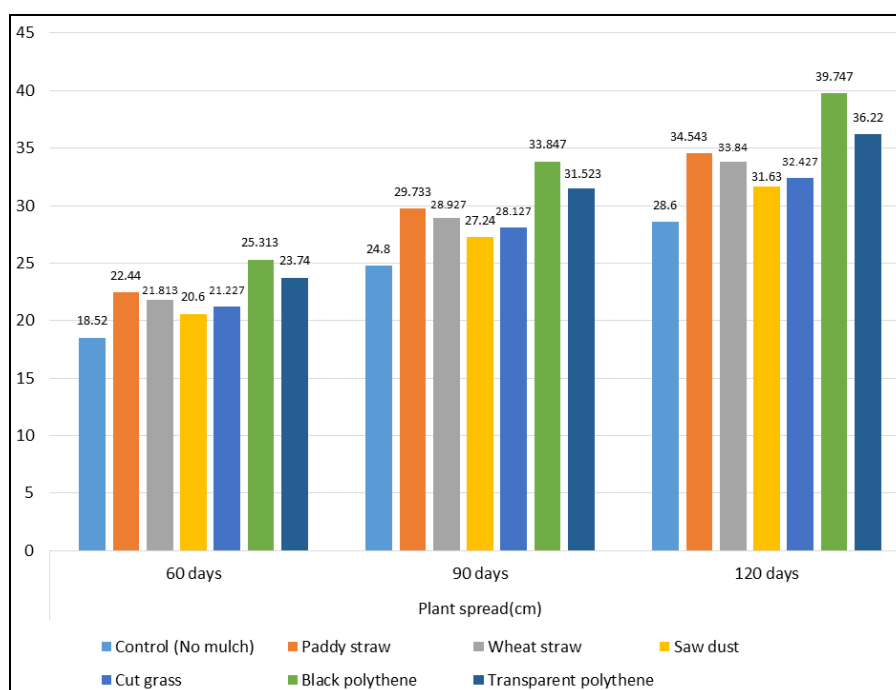


Fig 3: Influence of different mulches on Plant spread

Number of leaves per plant

The data on the effect of various mulching treatments on number of leaves per plant are presented in Table 4.1.3. Among different treatments, maximum number of leaves per plant was recorded in T₆ (Black polythene) treated plants, which was statistically at par with T₇ (Transparent polythene), T₂ (Paddy straw) and T₃ (Wheat straw). However, the minimum number of leaves per plant was observed in T₁ [Control (No mulch)]. The increased number of leaves under black polythene mulch might be due to better soil moisture conservation, favourable soil temperature and improved nutrient availability, which enhanced vegetative growth of strawberry plants.

Table 4: Number of leaves per plant

Treatment	Number of leaves per plants		
	60 days	90 days	120 days
Control (No mulch)	12.413	18.510	22.123
Paddy straw	15.827	22.120	27.420
Wheat straw	15.217	21.813	26.903
Saw dust	14.120	19.420	24.323
Cut grass	14.613	20.210	25.123
Black polythene	18.527	25.313	31.827
Transparent polythene	16.213	23.050	28.510
CD(P=0.05)	0.026	0.021	0.019
SE (m) ±	0.008	0.007	0.006

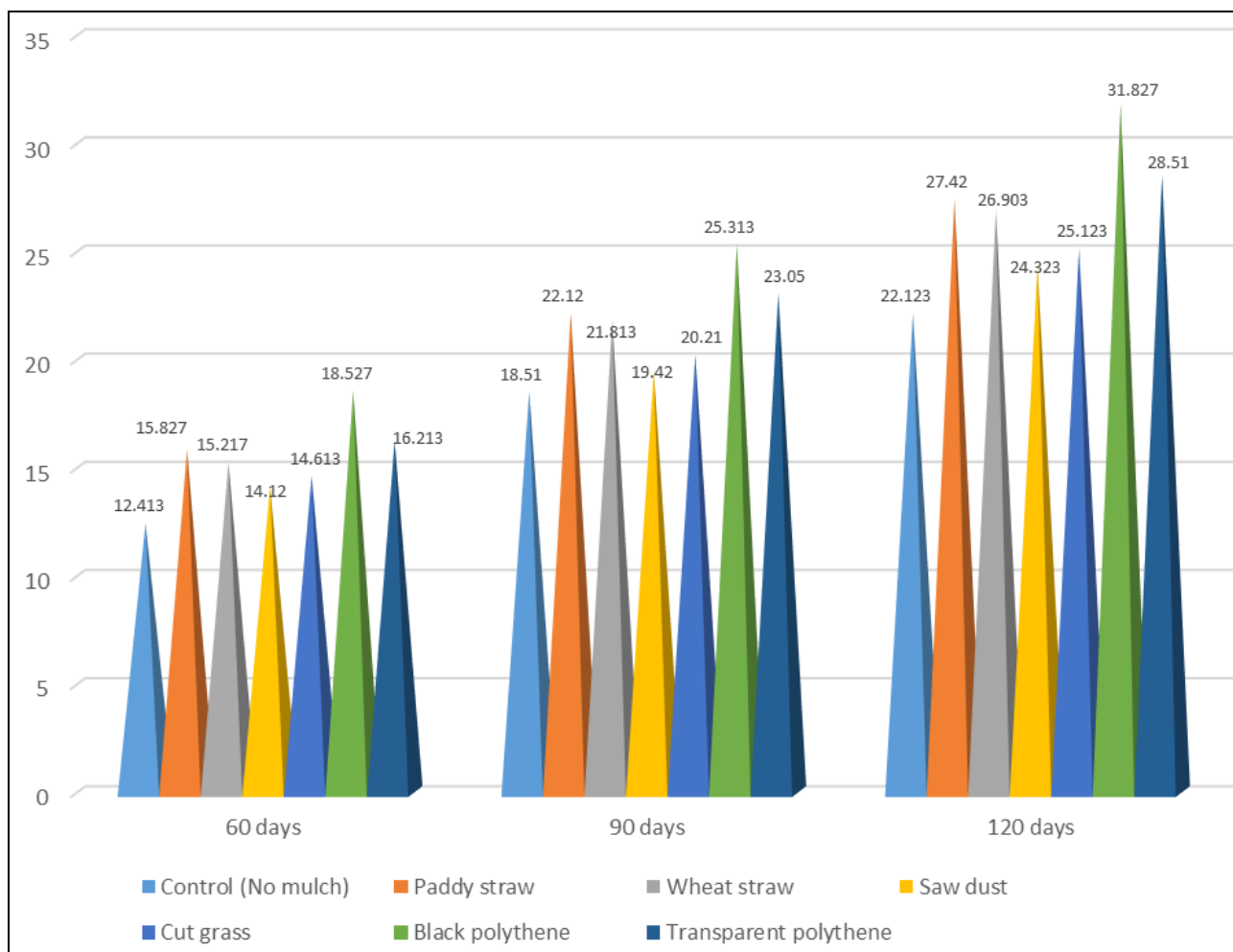


Fig 4: Influence of different mulching material on Number of leaves per plants at 60, 90 and 120 DAT

Days to first flowering

A perusal of data on the number of days taken after planting for the first flowering clearly showed significant variations among different mulching treatments (Table 4.1.4). As compared to control (T₁), all the mulch-treated plants took a significantly lower number of days for the first flowering. However, the first flower appeared significantly earlier in Black polythene (T₆) treated plants (52.80 days), which was statistically at par with transparent polythene (T₇) (55.70 days) and Paddy straw (T₂) (58.20 days). The maximum number of days taken for first flowering was recorded under Control (No mulch) treatment (T₁). Similar findings have

also been reported by Sharma and Kumar (2016)^[1].

Table 5: Days to first flowering

Treatment	No. of days to first flowering
Control (No mulch)	68.533
Paddy straw	58.223
Wheat straw	59.417
Saw dust	62.130
Cut grass	60.833
Black polythene	52.807
Transparent polythene	55.727
CD(P=0.05)	0.038
SE (m) ±	0.012

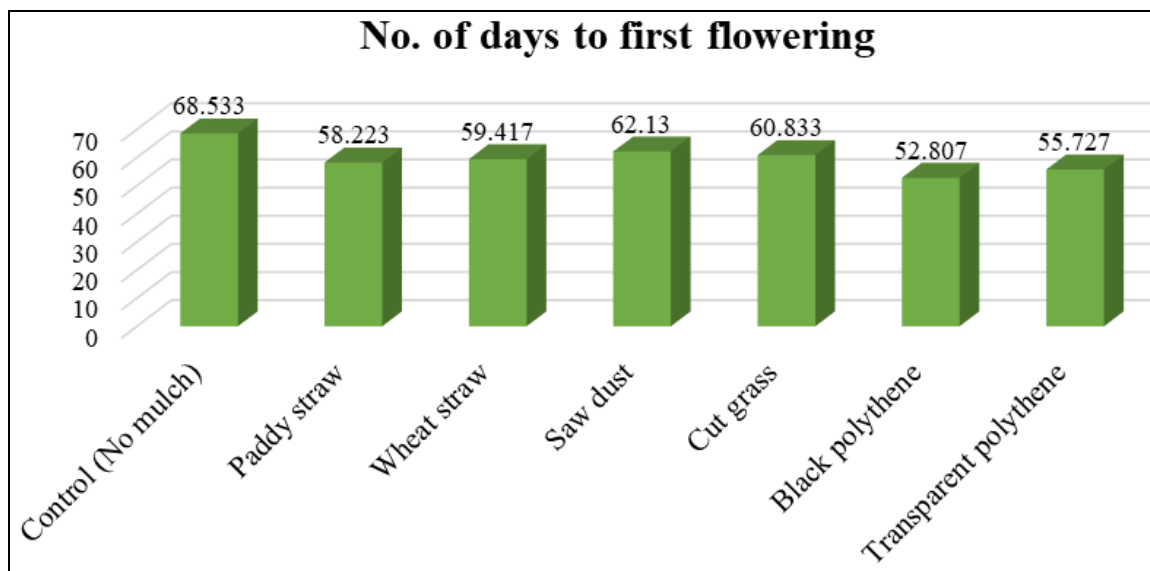


Fig 5: Influence of different mulches on Number of days to first flowering.

Days to first fruiting

The observations related to days taken for first fruiting in strawberry revealed noticeable differences among the various mulching treatments used in the present study (Table 4.1.5 & Fig. 4.1.5). Among all the treatments, the earliest fruiting was observed in T₆ (Black polythene mulch), which took only 18.63 days for first fruiting. This was followed by T₇ (Transparent polythene mulch) with 20.34 days and T₂ (Paddy straw mulch) with 22.65 days. The treatments T₃ (Wheat straw mulch), T₅ (Cut grass mulch), and T₄ (Saw dust mulch) recorded 24.02, 25.65, and 27.31 days, respectively. In contrast, the maximum number of days to first fruiting (30.64 days) was noted under T₁ (Control - No mulch). The findings indicate that the use of mulching materials positively influenced early fruiting in strawberry plants. Among the different mulches, black

polythene mulch proved to be the most effective in promoting earlier fruit initiation as compared to the control treatment. Similar findings have also been reported by Singh *et al.* (2015)^[16].

Table 6: Days to first fruiting

Treatment	No. of days to first fruiting
Control (No mulch)	30.643
Paddy straw	22.650
Wheat straw	24.027
Saw dust	27.317
Cut grass	25.657
Black polythene	18.633
Transparent polythene	20.343
CD(P=0.05)	0.027
SE (m) ±	0.009

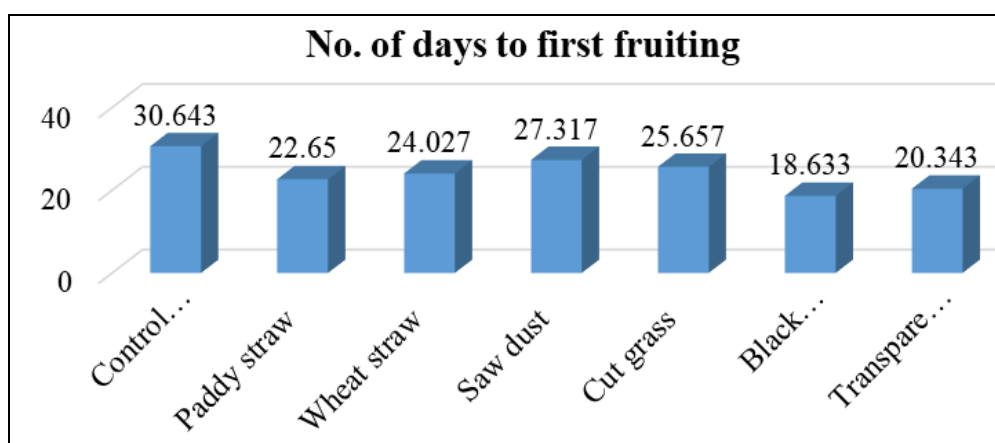


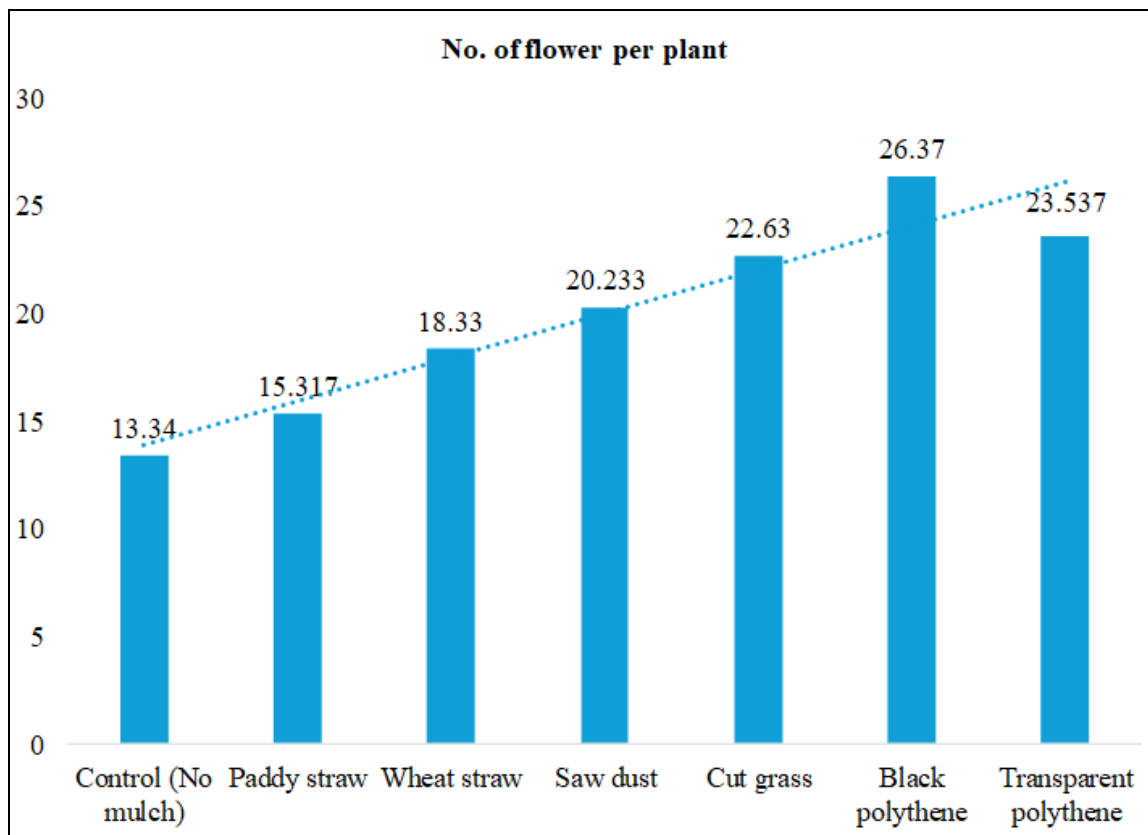
Fig 6: Influence of Different mulches on days to first fruiting

Number of flowers per plant treatments: The data regarding number of flowers per plant are presented in Table 4.1.6 and Fig. 4.1.6. The number of flowers per plant was significantly influenced by different mulch treatments. Maximum number of flowers per plant (26.37) was recorded under treatment T₆ (Black polythene mulch), followed by T₇ (Transparent polythene mulch) with 23.53 flowers per plant. The treatments T₅ (Cut grass mulch), T₄ (Saw dust mulch),

T₃ (Wheat straw mulch), T₂ (Paddy straw mulch) and T₁ (Control - No mulch) recorded 22.63, 20.23, 18.33, 15.31 and 13.3469 flowers per plant, respectively. The increase in flowering under black polythene mulch may be due to better soil moisture conservation, suitable soil temperature and reduced weed competition, which improved plant growth and flowering in strawberry plants. Similar findings have also been reported by Yadav *et al.* (2018)^[17].

Table 7: Number of flowers per plant

Treatment	No. of flower per plant
Control (No mulch)	13.340
Paddy straw	15.317
Wheat straw	18.330
Saw dust	20.233
Cut grass	22.630
Black polythene	26.370
Transparent polythene	23.537
CD(P=0.05)	0.1
SE (m) ±	0.030

**Fig 7:** Influence of Different mulches on number of flowers per plant.**Fruit diameter (cm)**

The data observed on fruit diameter as influenced by various treatments have been presented in Table 4.1.7 and graphically depicted in Fig. 4.1.7. Results based on the data indicate that the maximum fruit diameter (41.85 cm) was

observed under the treatment T₆ (Black polythene), which was significantly superior to the rest of the treatments. On the other hand, the minimum fruit diameter (24.60 cm) was recorded under T₁ (Control - No mulch).

Table 8: Fruit diameter (cm)

Treatment	Fruit diameter (cm)
Control (No mulch)	24.600
Paddy straw	32.447
Wheat straw	34.233
Saw dust	29.550
Cut grass	31.813
Black polythene	41.853
Transparent polythene	38.503
CD(P=0.05)	0.021
SE (m) ±	0.007

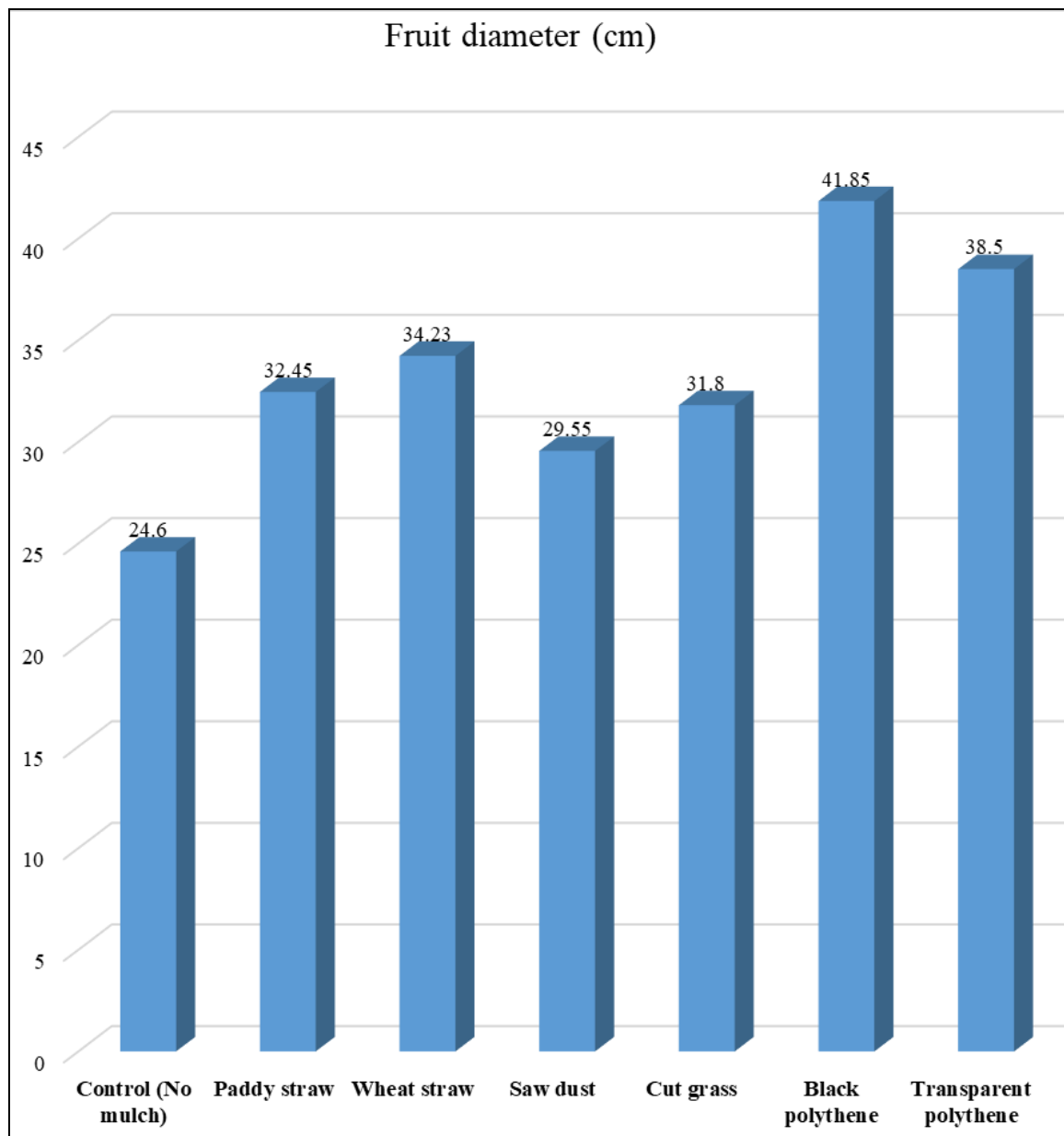


Fig 8: Influence of different mulching materials on fruit diameter.

Yield parameters

The data on yield parameters are presented in Table 4.4.1 and illustrated in Fig. 4.4.1. The findings demonstrated that the crop's yield was greatly impacted by various mulching treatments. The Black polythene treatment had the highest yield per hectare (121.417 q/ha), yield per plot (12.160 kg),

and yield per plant (493.000 g) of all the treatments. Conversely, the Control (No mulch) treatment showed the lowest yield per hectare (81.000 q/ha), yield per plot (8.100 kg), and yield per plant (312.667 g). The findings show that mulching, particularly black polythene, increased crop output in comparison to the control treatment.

Table 9: Yield parameters

Treatment	Yield/plant(gm)	Yield/plot (kg)	Yield/ha (q)
Control (No mulch)	312.667	8.100	81.000
Paddy straw	416.333	10.163	101.633
Wheat straw	395.000	9.863	98.813
Saw dust	360.333	9.033	90.043
Cut grass	382.000	9.547	95.510
Black polythene	493.000	12.160	121.417
Transparent polythene	450.333	11.210	112.333
CD(P=0.05)	2.898	0.035	1.049
SE (m) ±	0.930	0.011	0.337

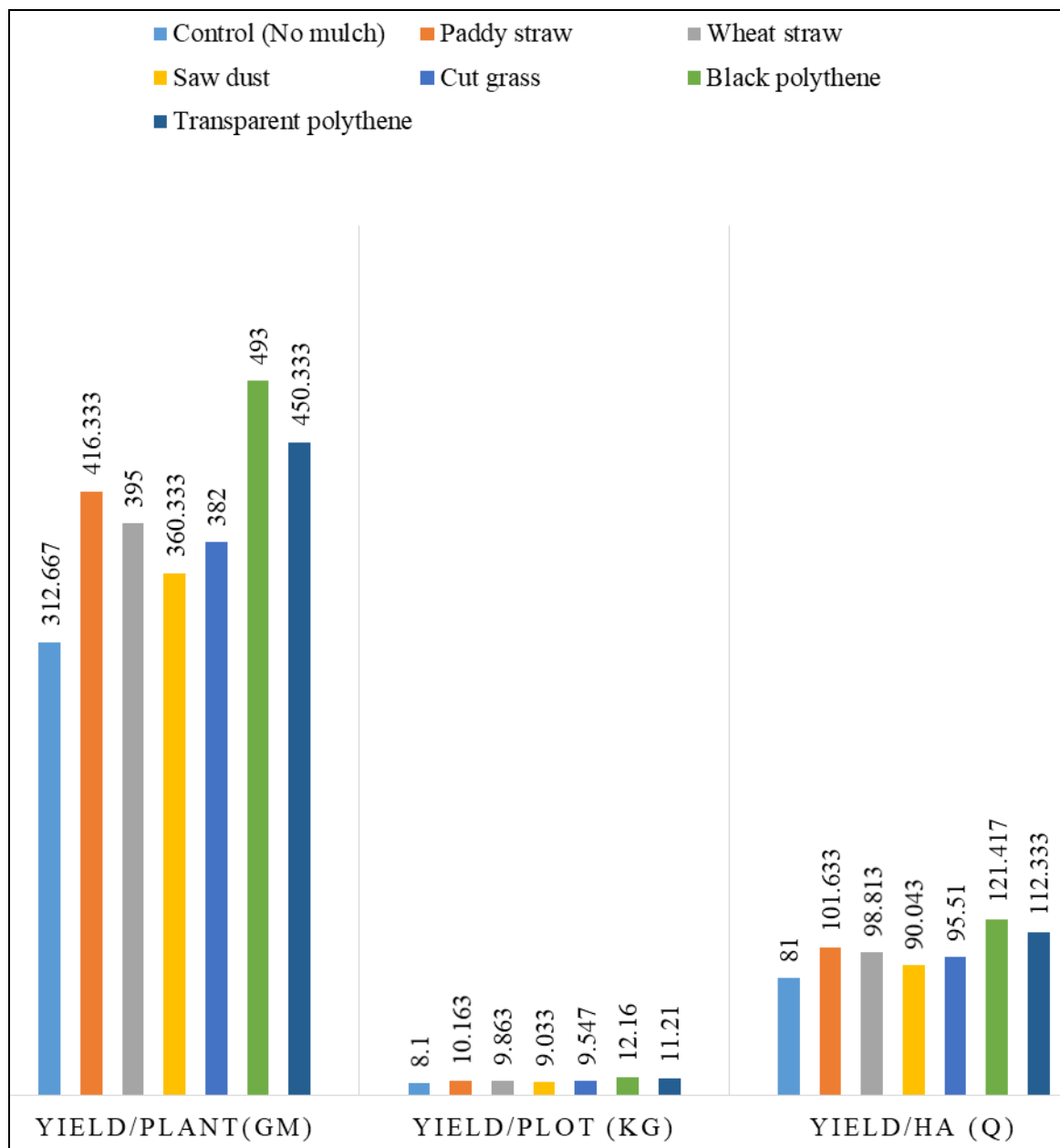


Fig 9: Influence of different mulches on Yield

Conclusion

The present study was conducted to evaluate the effect of different mulching materials on the growth, yield and quality of strawberry cv. Winter Dawn. The results clearly showed that mulching significantly improved plant growth, flowering, fruit yield and fruit quality compared to the control treatment.

Among all the treatments, Black Polythene Mulch proved to be the most effective. It produced the tallest plants, maximum plant spread, highest number of leaves and flowers, earliest flowering and fruiting, largest fruit diameter and highest fruit yield. It also improved fruit quality by increasing total sugars and TSS content.

Transparent Polythene Mulch was the second-best treatment and showed good performance for most growth and yield parameters. Organic mulches such as Paddy Straw, Wheat Straw and Cut Grass also improved plant growth and soil health compared to the control treatment. These mulches can be considered environmentally friendly and sustainable alternatives.

The control treatment (No mulch) recorded the lowest values for most parameters, indicating the importance of mulching in strawberry cultivation.

Based on the findings of the present investigation, Black Polythene Mulch is recommended for commercial cultivation of strawberry cv. Winter Dawn under the Central Plain Zone of Uttar Pradesh, as it provides better growth, higher yield and superior fruit quality.

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