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Effect of different mulching materials on growth and phonological parameters of strawberry (*Fragaria × ananassa* Duch)

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Abstract

The current research was carried out on 10 treatments of different mulching materials, and were replicated in three times, the design was used for analysis is Randomized Block Design, Data pertaining to various criteria used for treatment evaluation were analyzed statistically to test their significance and analysis of variance for these data. The research trail was carried on strawberry crop for observed the growth and phonological parameters of strawberry, the ten treatments applied in the treatments. The results revealed that the maximum plant height (21.60), number of leaves per plant (23.80), plant spread (32.20), number of crowns per plant (5.40), number of runners per plant (16.30), number of flowers per plant (49.40), and the minimum days to first flowering (55.00 days), indicating the earliest flowering, were recorded under T₁₀ (Transparent/White Polyethylene Mulch, 200 Gauge), except for the maximum number of runners per plant (16.30) and maximum number of flowers per plant (49.40), which were recorded under T₄ (Dry Banana Leaf Mulch @ 5 t ha⁻¹). On the other hand, the minimum plant height (16.80 cm), number of leaves per plant (16.20), plant spread (22.17 cm), number of crowns per plant (2.78), number of runners per plant (8.18), number of flowers per plant (18.50), and the maximum days to first flowering (68.00 days), indicating delayed flowering, were observed under the control treatment (T₁).

Keywords: Strawberry, *Fragaria × ananassa* Duch, mulching materials, polyethylene mulch and growth parameters

Introduction

Strawberry (*Fragaria × ananassa* Duch.) is one of the most important and widely appreciated soft fruit crops of the world. It belongs to the family Rosaceae and is popularly known as the “queen of fruits” because of its unique aroma, attractive colour, delicious taste and high nutritive value. The fruit is rich in vitamins, minerals, antioxidants and organic acids, particularly vitamin C, anthocyanins and flavonoids, which are beneficial for human health. Due to its excellent flavour and nutritional properties, strawberry is consumed both as fresh fruit and in processed forms such as jam, jelly, ice cream, juice, syrup and bakery products.

The productivity and quality of strawberry fruits are greatly influenced by environmental conditions, cultivar selection and crop management practices. Among the various cultural practices, mulching plays an important role in successful strawberry cultivation. Mulching refers to covering the soil surface around plants with organic or inorganic materials in order to conserve soil moisture, regulate soil temperature, suppress weed growth and improve soil health. It also helps in reducing evaporation losses, minimizing soil erosion and preventing direct contact of fruits with soil, thereby reducing fruit rot and improving fruit quality. Different mulching materials such as black polyethylene mulch, silver-black plastic mulch, paddy straw, dry grasses and organic residues are commonly used in strawberry cultivation. Plastic mulches are highly effective in controlling weeds and conserving moisture, while organic mulches improve soil structure and microbial activity. The effect of mulching varies depending upon climatic conditions, soil type and cultivar response. Proper mulching practices can significantly enhance vegetative growth, flowering, fruit set, yield and quality attributes of strawberry.

Materials and Methods

The present investigation entitled “Effect of Different Mulching Materials on growth and phonological parameters of Strawberry (*Fragaria* × *ananassa* Duch.)” conducted was carried out in a subtropical climatic region at Agriculture Research and Farm Development Centre, Sakatpura, School of Agriculture Science, Vikrant University, Gwalior, Madhya Pradesh; the experimental field had sandy loam soil with good drainage, and moderate fertility level. The current research was carried out on 10 treatments of different mulching materials, and were replicated in three times, the design was used for analysis is Randomized Block Design, Data pertaining to various criteria used for treatment evaluation were analyzed statistically to test their significance and analysis of variance for these data. The research trail was carried on strawberry crop for observed the growth and phonological parameters of strawberry, the ten treatments applied in the treatments are T₁-Control (No Mulch), T₂-Wheat Straw Mulch @ 5 t ha⁻¹, T₃-Paddy Straw Mulch @ 5 t ha⁻¹, T₄-Dry Banana Leaf Mulch @ 5 t ha⁻¹, T₅-Sawdust Mulch @ 5 t ha⁻¹, T₆-Coconut Husk Mulch @ 5 t ha⁻¹, T₇-Black Polyethylene Mulch (200 Gauge), T₈-Silver-Black Polyethylene Mulch (200 Gauge), T₉-White Polyethylene Mulch (200 Gauge) and T₁₀-Transparent Polyethylene Mulch (200 Gauge). The growth and phonological parameters observed such as Plant height (cm), Number of leaves per plant, Plant spread (cm), Number of crowns per plant, Number of runners per plant, Days to first flowering, Number of flowers per plant.

Results and Discussion

The present investigation was conducted on flowering behavior, fruit retention, yield and fruit quality of plants. The experimental observation made during the study were analysed statistically in Randomized Block Design (RBD) and the obtained result is presented and discussed in this chapter. Growth, flowering, yield and quality parameters differed significantly between the treatments for most of them. Plant height (cm): The maximum plant height (21.60 cm) was recorded under T₁₀ (White Polyethylene Mulch, 200 Gauge), followed by T₇ (Coconut Husk Mulch @ 5 t ha⁻¹) with 21.20 cm, T₈ (Black Polyethylene Mulch, 200 Gauge) with 20.95 cm, T₄ (Paddy Straw Mulch @ 5 t ha⁻¹) with 20.45 cm, and T₉ (Silver-Black Polyethylene Mulch, 200 Gauge) with 20.30 cm.

The increased plant height under mulched treatments may be attributed to improved soil moisture conservation, favorable soil temperature, reduced weed competition, and enhanced nutrient uptake, which promoted vigorous vegetative growth. Polyethylene mulches create a favorable microenvironment around the root zone by reducing moisture loss and maintaining optimum soil conditions for root development and plant growth. Conversely, the minimum plant height (16.80 cm) recorded under the control treatment may be due to greater soil moisture depletion and weed competition, which adversely affected plant growth. The findings of the present investigation are in agreement with those of Sharma and Sharma (2003) [15], who reported increased plant height in strawberry under polyethylene mulch owing to improved soil hydrothermal conditions. Similar results were reported by Singh and Ahmed (2008) [7], who observed enhanced vegetative growth and greater plant height in mulched strawberry plants compared to without mulched plants. Kumar and Dey

(2011) [11] also found that black polyethylene mulch significantly improved plant height by conserving soil moisture and improving nutrient availability. Likewise, Maji *et al.*, (2017) [9] reported that both organic and plastic mulches promoted vegetative growth in strawberry through better soil moisture retention and favorable root-zone conditions. Das *et al.*, (2018) [9] further observed that mulched strawberry plants exhibited superior growth attributes, including plant height, due to improved soil microclimate and efficient utilization of water and nutrients. No. of Leaves/Plant: The maximum number of leaves per plant (23.80) was recorded under T₁₀ (White Polyethylene Mulch, 200 Gauge), followed by T₇ (Coconut Husk Mulch @ 5 t ha⁻¹) with 23.40 leaves, T₈ (Black Polyethylene Mulch, 200 Gauge) with 22.90 leaves, T₄ (Paddy Straw Mulch @ 5 t ha⁻¹) with 22.60 leaves, and T₉ (Silver-Black Polyethylene Mulch, 200 Gauge) with 22.20 leaves per plant. The increased number of leaves under mulched treatments may be attributed to improved soil moisture conservation, better nutrient availability, optimum soil temperature, and reduced weed competition, which enhanced vegetative growth and leaf production. Mulching creates favorable conditions for root development and nutrient absorption, resulting in increased photosynthetic activity and the production of more leaves. In contrast, the minimum number of leaves per plant (16.20) was observed under the control treatment (T₁), which may be due to greater moisture loss and less favorable soil conditions in the absence of mulch. The findings of the present study are in conformity with those reported by Sharma and Sharma (2003) [15], who observed a significant increase in the number of leaves per plant in strawberry under polyethylene mulch. Similar results were reported by Singh and Ahmed (2008) [7], who found that mulching improved vegetative growth and leaf production by maintaining favorable soil moisture and temperature conditions. Kumar and Dey (2011) [11] also reported a higher number of leaves in strawberry plants grown under plastic mulch compared to unmulched plants. Likewise, Maji *et al.*, (2017) [9] observed enhanced leaf production in strawberry under both organic and inorganic mulches due to improved soil microclimate and nutrient utilization. Das *et al.*, (2018) [9] further reported that mulched strawberry plants produced a greater number of leaves owing to better moisture retention and reduced weed competition, which promoted vigorous vegetative growth.

Plant Spread (cm): The maximum plant spread (32.20 cm) was recorded under T₁₀ (Transparent Polyethylene Mulch, 200 Gauge), followed by T₇ (Black Polyethylene Mulch, 200 Gauge) with 31.50 cm, T₈ (Silver-Black Polyethylene Mulch, 200 Gauge) with 30.80 cm, T₉ (White Polyethylene Mulch, 200 Gauge) with 30.10 cm and T₄ (Dry Banana Leaf Mulch @ 5 t ha⁻¹) with 29.80 cm. The treatments T₅ (Sawdust Mulch @ 5 t ha⁻¹) and T₆ (Coconut Husk Mulch @ 5 t ha⁻¹) recorded plant spreads of 28.50 cm and 27.20 cm, respectively, whereas T₃ (Paddy Straw Mulch @ 5 t ha⁻¹) and T₂ (Wheat Straw Mulch @ 5 t ha⁻¹) produced plant spreads of 25.40 cm and 24.80 cm, respectively. The minimum plant spread (22.17 cm) was observed under T₁ (Control-No Mulch). The present findings are in close agreement with those of Sharma and Sharma (2003) [15], who reported a significant increase in plant spread of strawberry under polyethylene mulch due to improved hydrothermal

conditions of the soil. Singh and Ahmed (2008) ^[7] also observed greater plant spread in mulched strawberry plants compared to the unmulched control and attributed this improvement to better moisture conservation and nutrient availability. Similar findings were reported by Kumar and Dey (2011) ^[11], who recorded maximum canopy spread under black polyethylene mulch. Maji *et al.*, (2017) ^[9] found that both plastic and organic mulches enhanced plant spread by improving the soil microenvironment and reducing moisture stress. Das *et al.*, (2018) ^[9] also reported increased vegetative growth and canopy development in strawberry under mulching treatments. The results are further supported by Rana *et al.*, (2014) ^[14], who observed significantly higher plant spread in strawberry under plastic mulch owing to better soil moisture retention and enhanced nutrient uptake. Tripathi *et al.*, (2016) ^[19] reported that mulching improved vegetative growth parameters, including plant spread, by maintaining favorable soil temperature and reducing weed competition. Similarly, Bana *et al.*, (2012) ^[6] found that black polyethylene mulch resulted in greater plant spread and vegetative vigor in strawberry compared with organic mulches and the control treatment. Yadav *et al.*, (2018) ^[20] also reported enhanced plant spread under polyethylene mulch due to improved root growth and efficient utilization of soil moisture and nutrients. No. of Crowns/Plant: The maximum number of crowns per plant (5.40) was recorded under T₁₀ (Transparent Polyethylene Mulch, 200 Gauge), followed by T₇ (Black Polyethylene Mulch, 200 Gauge) with 5.20 crowns, T₄ (Dry Banana Leaf Mulch @ 5 t ha⁻¹) and T₈ (Silver-Black Polyethylene Mulch, 200 Gauge) with 5.00 crowns each, and T₉ (White Polyethylene Mulch, 200 Gauge) with 4.80 crowns per plant. The increased crown production under mulched treatments may be attributed to improved soil moisture conservation, favorable soil temperature, enhanced nutrient availability, and reduced weed competition. These conditions promote vigorous vegetative growth and greater accumulation of photosynthates, which support the formation and development of crowns. Polyethylene mulches, in particular, create a favorable microclimate around the root zone, resulting in better root growth and increased crown formation. In contrast, the minimum number of crowns per plant (2.78) was recorded under the control treatment (T₁),

which may be due to moisture stress and poor soil conditions in the absence of mulch. The findings of the present investigation are in agreement with those reported by Sharma and Sharma (2003) ^[15], who observed a significant increase in crown production in strawberry under polyethylene mulch due to improved soil hydrothermal conditions. Singh and Ahmed (2008) ^[7] also reported that mulched strawberry plants produced more crowns than unmulched plants owing to better moisture conservation and nutrient uptake. Similar results were obtained by Kumar and Dey (2011) ^[11], who found that black polyethylene mulch significantly enhanced vegetative growth and crown formation in strawberry. Maji *et al.*, (2017) ^[9] reported that both organic and inorganic mulches improved crown production by creating a favorable root-zone environment and reducing moisture stress. Likewise, Das *et al.*, (2018) ^[9] observed higher numbers of crowns in mulched strawberry plants compared with the control treatment.

The present findings are further supported by Rana *et al.*, (2014) ^[14], who reported enhanced crown development under plastic mulch due to improved soil moisture retention and nutrient availability. Tripathi *et al.*, (2016) ^[19] also found that mulching significantly increased crown formation by promoting vegetative growth and improving plant vigor. Similarly, Yadav *et al.*, (2018) ^[20] reported that polyethylene mulch resulted in a greater number of crowns per plant due to favorable soil temperature and moisture conditions. The results of the present study therefore confirm that mulching plays an important role in improving crown production and overall vegetative growth of strawberry plants. No. of Runners/Plant: The maximum number of runners per plant (16.30) was recorded under T₄ (Dry Banana Leaf Mulch @ 5 t ha⁻¹), followed by T₁₀ (Transparent Polyethylene Mulch, 200 Gauge) with 16.00 runners, T₇ (Black Polyethylene Mulch, 200 Gauge) with 15.80 runners, T₈ (Silver-Black Polyethylene Mulch, 200 Gauge) with 15.20 runners, and T₉ (White Polyethylene Mulch, 200 Gauge) with 14.90 runners per plant.

The findings of the present investigation are in agreement with those of Albregts and Howard (1978) ^[5], who reported that mulching improved vegetative growth and runner production in strawberry by maintaining favorable soil moisture and temperature conditions.

Table 1: Effect of different Mulching Materials studies on growth and phonological parameters of Strawberry

Treatment	Plant Height (cm)	No. of Leaves/Plant	Plant Spread (cm)	No. of Crowns/Plant	No. of Runners/Plant	Days to first flowering	Number of flowers per plant
T ₁	16.80	16.20	22.17	2.78	8.18	68.00	18.50
T ₂	18.25	18.50	24.80	3.25	10.50	65.00	21.80
T ₃	18.60	19.10	25.40	3.40	11.20	64.00	23.50
T ₄	20.45	22.60	29.80	5.00	16.30	58.00	49.40
T ₅	19.85	21.80	28.50	4.60	14.80	60.00	40.50
T ₆	19.10	20.40	27.20	4.10	13.20	61.00	34.80
T ₇	21.20	23.40	31.50	5.20	15.80	56.00	45.20
T ₈	20.95	22.90	30.80	5.00	15.20	57.00	43.60
T ₉	20.30	22.20	30.10	4.80	14.90	58.00	42.00
T ₁₀	21.60	23.80	32.20	5.40	16.00	55.00	46.50
S.Em.±	0.044	0.071	0.175	0.029	0.081	0.123	0.326
CD at 5%	0.129	0.212	0.519	0.085	0.242	0.366	0.970

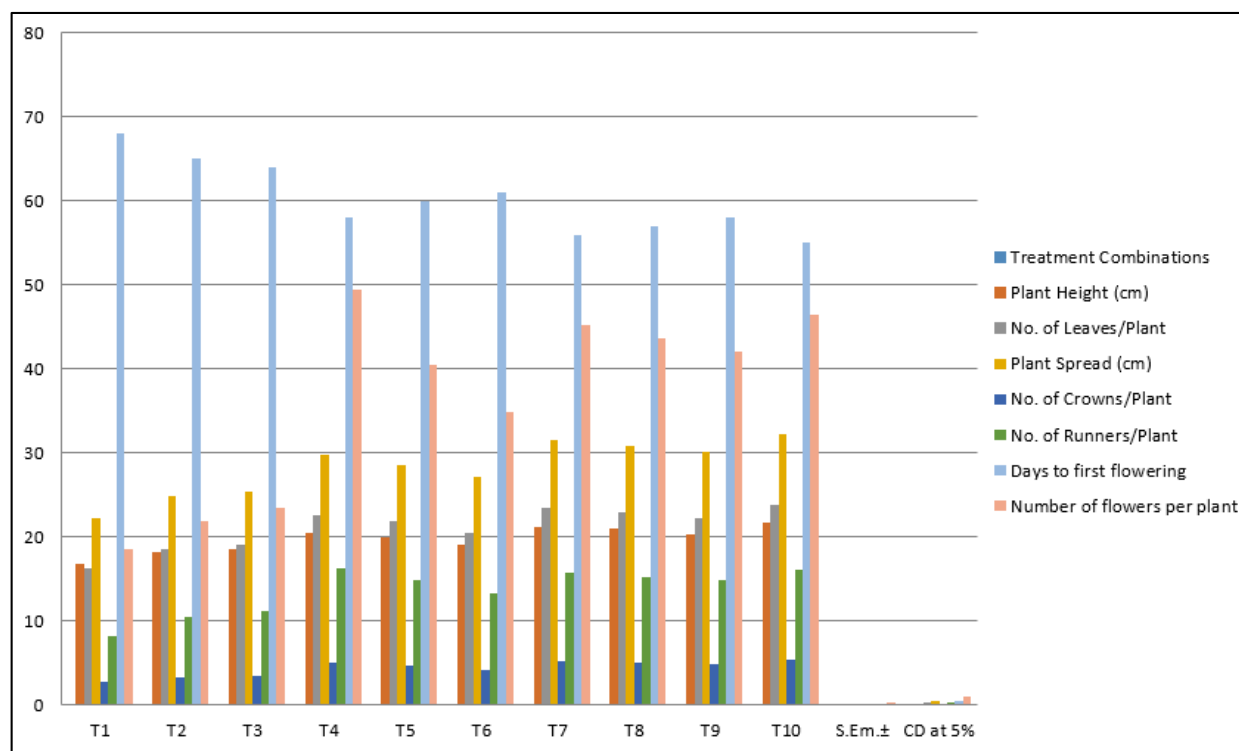


Fig 1: Effect of different Mulching Materials studies on growth and phenological parameters of Strawberry

Sharma and Sharma (2003) ^[15] also observed increased runner production under polyethylene mulch owing to improved soil hydrothermal regimes. Similar results were reported by Singh and Ahmed (2008) ^[7] and Kumar and Dey (2011) ^[11], who found that mulching significantly enhanced vegetative growth and runner formation in strawberry plants. Maji *et al.*, (2017) ^[9] further reported that organic and plastic mulches increased runner production through improved root growth and nutrient uptake. The present results are also supported by Kher *et al.*, (2010) ^[10], who reported that black polyethylene mulch significantly increased the number of runners per plant by providing favorable soil moisture and temperature conditions. Rahman *et al.*, (2016) ^[13] observed greater runner production in mulched strawberry plants compared to unmulched plants and attributed the improvement to enhanced vegetative growth and carbohydrate accumulation. Bana *et al.*, (2012) ^[6] reported that mulching materials improved strawberry growth and runner development by reducing moisture loss and weed competition. Likewise, Chauhan *et al.*, (2014) ^[8] found that plastic mulch increased the number of runners per plant due to better soil physical conditions and improved nutrient utilization. Yadav *et al.*, (2018) ^[20] also observed significantly higher runner production under polyethylene mulch compared with control plots. Number of days to first flowering: The minimum number of days to first flowering (55.00 days), indicating earliest flowering, was recorded under T₁₀ (Transparent Polyethylene Mulch, 200 Gauge), followed by T₇ (Black Polyethylene Mulch, 200 Gauge) with 56.00 days. In contrast, the maximum number of days to first flowering (68.00 days) was observed under T₁ (Control-No Mulch), indicating delayed flowering. Early flowering under mulched treatments may be attributed to improved soil moisture conservation, favorable soil temperature, enhanced nutrient availability, and better root development, which accelerated vegetative growth and promoted early initiation of reproductive phases.

Polyethylene mulches are known to create a favorable microclimate around the root zone, resulting in enhanced physiological activities and earlier flowering. The findings of the present study are in agreement with those of Kher *et al.*, (2010) ^[10], who reported earlier flowering in strawberry plants grown under polyethylene mulch due to improved soil temperature and moisture conditions. Similar observations were made by Sharma and Sharma (2003) ^[15] and Singh and Ahmed (2008) ^[7], who found that mulching advanced flowering in strawberry by creating favorable soil hydrothermal conditions. Kumar and Dey (2011) ^[11] also reported reduced days to flowering under plastic mulch treatments compared with unmulched plants. Likewise, Rahman *et al.*, (2016) ^[13] observed that mulching significantly hastened flowering in strawberry due to enhanced vegetative growth and improved nutrient uptake. Number of flowers per plant: The maximum number of flowers per plant (49.40) was recorded under T₄ (Dry Banana Leaf Mulch @ 5 t ha⁻¹), followed by T₁₀ (Transparent Polyethylene Mulch, 200 Gauge) with 46.50 flowers and T₇ (Black Polyethylene Mulch, 200 Gauge) with 45.20 flowers per plant. The increased flower production under these treatments may be due to enhanced vegetative growth, greater photosynthetic efficiency, improved nutrient absorption, and favorable soil moisture conditions. Mulching reduces moisture stress and weed competition, allowing plants to allocate more resources towards flower production and reproductive growth. The minimum number of flowers per plant (18.50) was recorded under the control treatment, which may be attributed to less favorable soil conditions and reduced plant vigor. These findings are in conformity with the results of Bana *et al.*, (2012) ^[6], who reported a significantly higher number of flowers per plant under mulched conditions compared with the control. Similar findings were reported by Maji *et al.*, (2017) ^[9] and Das *et al.*, (2018) ^[9], who observed enhanced flowering in strawberry under both organic and plastic mulches due to

improved soil moisture retention and nutrient availability. Yadav *et al.*, (2018) [20] also reported that polyethylene mulch significantly increased flower production by providing favorable growing conditions throughout the crop growth period. The results are further supported by Chauhan *et al.*, (2014) [8], who observed increased flowering and improved reproductive performance of strawberry plants under mulching treatments.

Conclusion

Based on the findings of the present investigation, it may be concluded that the application of different mulching materials significantly influenced the growth and phenological parameters of strawberry (*Fragaria × ananassa* Duch.). Among the different treatments, Transparent Polyethylene Mulch (200 Gauge) (T₁₀) proved to be the most effective in enhancing plant height, number of leaves per plant, plant spread, number of crowns per plant, and promoting early flowering. The treatment recorded the maximum plant height (21.60 cm), number of leaves per plant (23.80), plant spread (32.20 cm), number of crowns per plant (5.40), and the earliest flowering (55.00 days), indicating its superiority in improving vegetative growth and accelerating reproductive development. Dry Banana Leaf Mulch @ 5 t ha⁻¹ (T₄) performed exceptionally well by producing the highest number of runners per plant (16.30) and the maximum number of flowers per plant (49.40), demonstrating its effectiveness in enhancing vegetative propagation and flowering potential. In contrast, the control treatment (T₁) consistently recorded the lowest values for most growth parameters and the maximum days to first flowering (68.00 days), indicating delayed flowering and comparatively poor plant performance.

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