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COMPARATIVE EVALUATION OF BIODEGRADABLE AND POLYETHYLENE MULCHES ON GROWTH, YIELD AND PRODUCTIVITY OF STRAWBERRY (*Fragaria* × *Ananassa* DUCH.)

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ABSTRACT

Strawberry (*Fragaria* × *ananassa* Duch.) is an economically important fruit crop valued for its nutritional and medicinal properties. The extensive use of polyethylene mulches in strawberry cultivation has improved crop productivity, however, concerns regarding plastic waste accumulation and environmental pollution have necessitated the evaluation of sustainable alternatives. The present study was conducted to assess the effect of different biodegradable and conventional mulch materials on the growth and yield of strawberry. The experiment comprised eight treatments, viz., T₁: Black biodegradable mulch (25 µm), T₂: White biodegradable mulch (25 µm), T₃: Silver biodegradable mulch (25 µm), T₄: Red biodegradable mulch (25 µm), T₅: Black polyethylene mulch (25 µm), T₆: Silver polyethylene mulch (25 µm), T₇: Paddy straw mulch and T₈: Control, laid out in a Randomized Block Design with three replications. Observations were recorded on plant height, plant spread (E–W and N–S), runners per plant, fruit set, number of fruits per plant, yield per plant and yield per hectare. The results revealed significant differences among the mulch treatments. Black polyethylene mulch (T₅) recorded the maximum plant height (22.55 cm), plant spread in E–W (31.81 cm) and N–S (30.65 cm), fruit set (91.40%), number of fruits per plant (24.86), yield per plant (374.83 g), yield per plot (8.84 kg) and yield per hectare (22.19 t ha⁻¹). Paddy straw mulch (T₇) produced the highest number of runners per plant (5.16). The minimum values for most parameters were observed under the control treatment (T₈). The enhanced performance of black polyethylene mulch was attributed to improved soil moisture conservation, favorable soil temperature, efficient nutrient uptake and reduced weed competition. The study concluded that black polyethylene mulch (25 µm) is the most effective mulch material for improving vegetative growth and yield of strawberry under the prevailing agro-climatic conditions. However, biodegradable mulches, particularly black biodegradable mulch, demonstrated comparable performance and may serve as environmentally sustainable alternatives for strawberry production.

Key words: Strawberry, biodegradable mulch, polyethylene mulch, yield, plant growth, sustainable agriculture.

Introduction

Strawberry (*Fragaria* × *ananassa* Duch.) is an important fruit crop cultivated throughout the world for its nutritional, economic and medicinal importance. It

belongs to the family Rosaceae and possesses a chromosome number of 2n = 8x = 56. The cultivated strawberry originated from the hybridization of *Fragaria virginiana* and *Fragaria chiloensis* (Edger et al.,

2019). The fruits are highly appreciated for their rich content of vitamin C, folates and phenolic compounds with antioxidant properties. These bioactive compounds are known to exhibit anti-inflammatory, anti-cancer and anti-microbial activities (Giampieri *et al.*, 2012). Strawberries are consumed fresh and are also extensively utilized in the preparation of processed products such as jams, juices, ice-creams and desserts. Owing to increasing consumer preference and advancements in production technologies, strawberry cultivation has expanded considerably across the globe. China ranks first in strawberry production, followed by the United States and Egypt, while Maharashtra, Haryana and Jharkhand are the major strawberry-producing states in India (Anonymous, 2024).

Mulching has become an integral component of modern strawberry production due to its beneficial effects on crop growth and productivity (Singh *et al.*, 2007). Plastic mulch films are widely used in agriculture to conserve soil moisture, regulate temperature, suppress weeds and improve nutrient use efficiency (Scarascia-Mugnozza *et al.*, 2011). However, the large-scale use of conventional polyethylene mulches has created significant environmental concerns because of their non-biodegradable nature. Disposal of these materials through burning or field dumping contributes to pollution and adversely affects soil health (Kyrikou *et al.*, 2007). Although methods such as recycling, incineration and landfilling are practiced, they are associated with economic and practical constraints.

Consequently, biodegradable mulches have emerged as promising alternatives for sustainable crop production. These materials can be incorporated into the soil after use, where they are decomposed by naturally occurring microorganisms (Kasirajan *et al.*, 2012). Nevertheless, their degradation behavior is influenced by environmental

conditions such as temperature, humidity, solar radiation, irrigation and agrochemical applications (Sivan, A. 2011). Previous studies have reported differences in the degradation rates of biodegradable films and have highlighted their potential for weed suppression and yield enhancement. Therefore, evaluating the performance of biodegradable and conventional mulches is essential for identifying environmentally sustainable practices in strawberry cultivation.

Material and Methods

The experimental site was at the conducted at Post Graduate Institute of Horticultural Sciences, Sri Konda Laxman Telangana Horticultural University (SKLTGHU), Mulugu, Siddipet (D), Telangana (State), India. Rabi season (2025-2026). It is situated in the subtropical zone, with a latitude of 17° 7' N, a longitude of 78° 37' E, and an altitude of 526 meters.

The observations record is Plant height which was measured from the crown to the tip of the tallest fully expanded leaf using a measuring scale at 30, 60, 90 and 120 days after planting (DAP) and expressed in centimeters (cm). Plant spread was measured in two perpendicular directions, East–West (E–W) and North–South (N–S), using a measuring scale at 30, 60, 90 and 120 DAP on five randomly selected and tagged plants from each treatment in every replication. The mean of the two measurements was calculated and expressed in centimeters (cm). The number of runners produced was recorded at 30-day intervals from 30 to 120 DAP by counting the runners on five randomly selected and tagged plants from each treatment in every replication. After each observation, the runners were removed to avoid repeated counting, and the mean number of runners was expressed as the average number of runners per plant. Fruit set was recorded at five-day intervals by counting the total number of flowers and fruits set on five randomly

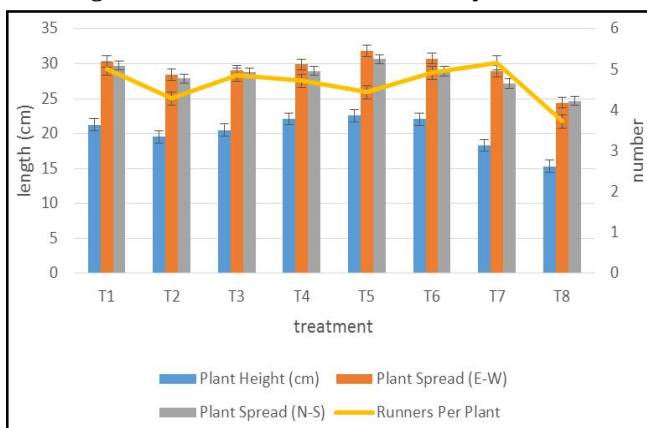


Fig. 1: Effect of different types of mulches on Plant Height (cm), Plant Spread (E-W), Plant Spread (N-S), Runners Per Plant in strawberry.

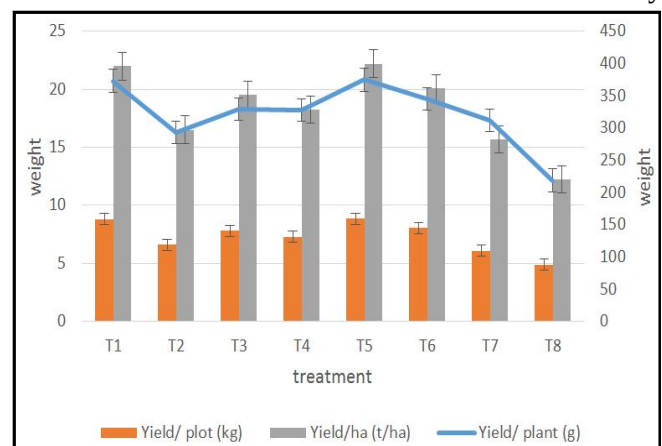


Fig. 2: Effect of different types of mulches on Yield (kg/plot), Yield (t/ha) in strawberry.

Table 1: Effect of different types of mulches on Plant Height (cm), Plant Spread (E-W), Plant Spread (N-S), Runners Per Plant in strawberry.

Treatment	Plant height (cm)	Plant spread (E-W) (cm)	Plant spread (N-S) (cm)	Runners per plant
T ₁ – Black biodegradable mulch (25 µm)	21.26	30.29	29.73	5.02
T ₂ – White biodegradable mulch (25 µm)	19.53	28.39	27.86	4.29
T ₃ – Silver biodegradable mulch (25 µm)	20.49	28.99	28.75	4.87
T ₄ – Red biodegradable mulch (25 µm)	22.09	29.90	28.95	4.72
T ₅ – Black polyethylene mulch (25 µm)	22.55	31.81	30.65	4.44
T ₆ – Silver polyethylene mulch (25 µm)	22.07	30.73	28.91	4.92
T ₇ – Paddy straw mulch	18.29	28.91	27.15	5.16
T ₈ – Control	15.31	24.42	24.64	3.73
Grand Mean	20.20	29.18	28.33	4.64
SEM (±)	0.62	1.00	0.75	0.18
CD at 5%	1.89	3.04	2.27	0.57
CV (%)	5.35	5.96	4.58	7.05

selected and tagged plants from each treatment in every replication. Fruit set percentage was calculated as: Fruit set (%) = (Number of fruits set / Number of flowers) × 100. The number of fruits harvested was recorded from five randomly selected and tagged plants in each treatment and replication during the fruiting period from 60 to 120 DAP. The cumulative number of fruits from all harvests was calculated and expressed as the average number of fruits per plant. Fruit yield was recorded at each picking using a digital electronic balance, and the cumulative fruit yield from all harvests was calculated and expressed in grams per plant (g plant⁻¹). Fruit yield per hectare was estimated based on the mean fruit yield per plant and the plant population per hectare according to the spacing adopted in the experiment. Yield per hectare was calculated as: Yield per hectare (t ha⁻¹) = Yield per plant (g) × Number of plants per hectare ÷ 1,000,000.

Results and Discussion

The data presented in Tables 1 and 2 revealed that

Table 2: Effect of different types of mulches on Yield (kg/plot), Yield (t/ha) in strawberry.

Treatment	Fruit set (%)	No. of fruits/plant	Yield/plant (g)	Yield/plot (kg)	Yield/ha (t/ha)
T ₁ – Black biodegradable mulch (25 µm)	90.50	24.73	372.99	8.80	22.00
T ₂ – White biodegradable mulch (25 µm)	85.20	20.83	293.03	6.60	16.50
T ₃ – Silver biodegradable mulch (25 µm)	88.60	23.29	329.09	7.81	19.53
T ₄ – Red biodegradable mulch (25 µm)	89.00	22.24	327.54	7.27	18.25
T ₅ – Black polyethylene mulch (25 µm)	91.40	24.86	374.83	8.84	22.19
T ₆ – Silver polyethylene mulch (25 µm)	90.50	23.73	345.26	8.03	20.07
T ₇ – Paddy straw mulch	83.13	20.20	312.10	6.08	15.68
T ₈ – Control	77.73	19.63	218.70	4.89	12.23
Grand mean	87.01	22.44	321.69	7.29	18.31
SEM (±)	1.16	0.64	12.15	0.27	0.69
CD at 5%	3.54	1.96	36.86	0.83	2.09
CV	2.32	5.00	6.54	6.54	6.54

different mulch treatments significantly influenced vegetative growth and yield parameters of strawberry.

Vegetative Growth Parameters

The Vegetative growth parameter are recorded in Table 1, Plant height was significantly affected by the different mulch treatments. The maximum plant height was recorded in T₅ (Black polyethylene mulch, 25 µm) with 22.55 cm, followed by T₄ (Red biodegradable mulch, 25 µm) with 22.09 cm and T₆ (Silver polyethylene mulch, 25 µm) with 22.07 cm. The minimum plant height was observed in T₈ (Control) with 15.31 cm. The increase in plant height under polyethylene mulches may be attributed to improved soil moisture conservation, enhanced nutrient availability and favorable soil temperature, which promoted cell elongation and vegetative growth. Similar findings have been reported by Maroof *et al.*, (2024).

Plant spread in the East–West direction was highest in T₅ (31.81 cm), followed by T₆ (30.73 cm) and T₁ (30.29 cm), while the lowest plant spread was recorded in T₈

(24.42 cm). Similarly, plant spread in the North–South direction was maximum in T_5 (30.65 cm), followed by T_1 (29.73 cm) and T_4 (28.95 cm), whereas the minimum value was observed in T_8 (24.64 cm). The enhanced canopy development under mulched treatments could be due to better moisture retention and reduced competition from weeds, which facilitated greater photosynthetic activity and assimilate production. Similar findings have been reported by Ali *et al.*, (2007) and Weber (2003 in strawberry).

The number of runners per plant exhibited a contrasting trend. The maximum number of runners was recorded in T_7 (Paddy straw mulch) with 5.16 runners per plant, followed by T_1 (5.02) and T_6 (4.92), while the minimum number of runners was observed in T_8 (3.73). Paddy straw mulch possibly created a more favorable microclimate around the crown region, encouraging vegetative propagation. The lower number of runners in control plants may be attributed to moisture stress and reduced nutrient uptake. Similar results have been reported by Singh *et al.*, (2007) and Kher *et al.*, (2010).

The present findings are in agreement with earlier reports that mulching improves soil hydrothermal conditions, reduces evaporation losses, suppresses weed growth and enhances nutrient utilization efficiency, ultimately leading to improved vegetative growth in strawberry.

Yield Parameters

The yield parameters are recorded in Table 2. Significant differences were also observed among the treatments with respect to fruit set, number of fruits per plant, yield per plant, yield per plot and yield per hectare.

The highest fruit set was recorded in T_5 (91.40%), followed by T_1 (90.50%) and T_6 (90.50%), whereas the lowest fruit set was observed in T_8 (77.73%). Increased fruit set under polyethylene mulches may be due to the maintenance of optimum soil moisture and temperature during flowering and fruit development, resulting in improved pollination and reduced flower drop. Similar results have been reported by Kumar *et al.*, (2018).

The maximum number of fruits per plant was recorded in T_5 (24.86), followed closely by T_1 (24.73) and T_6 (23.73), while the minimum number of fruits per plant was observed in T_8 (19.63). Higher fruit numbers under mulched treatments could be attributed to increased assimilate partitioning towards reproductive structures owing to improved plant vigor. Similar results have been reported by Semwal *et al.*, (2022).

Yield per plant was significantly influenced by mulch treatments. The highest yield per plant was obtained in

T_5 (374.83 g), followed by T_1 (372.99 g) and T_6 (345.26 g), while the lowest yield per plant was recorded in T_8 (218.70 g). Likewise, the maximum yield per plot was recorded in T_5 (8.84 kg), followed by T_1 (8.80 kg) and T_6 (8.03 kg), whereas the minimum yield per plot was obtained in T_8 (4.89 kg). Similar results have been reported by Ngente *et al.*, (2021).

A similar trend was observed for yield per hectare. The highest yield was recorded in T_5 (22.19 t ha⁻¹), followed by T_1 (22.00 t ha⁻¹) and T_6 (20.07 t ha⁻¹), while the minimum yield was observed in T_8 (12.23 t ha⁻¹). The superior performance of black polyethylene mulch may be attributed to its ability to conserve soil moisture, regulate soil temperature, suppress weed growth and enhance nutrient uptake, thereby improving photosynthetic efficiency and biomass accumulation. In contrast, the absence of mulch in the control treatment resulted in greater moisture loss, weed competition and reduced nutrient availability, leading to poor yield performance. Similar results have been reported Misra *et al.*, (2023).

These findings corroborate previous studies that reported significant improvements in strawberry yield under polyethylene mulch due to favorable soil physical conditions and enhanced resource use efficiency.

Conclusion

Based on the present investigation, it can be concluded that mulch treatments significantly influenced the vegetative growth and yield of strawberry. Among all the treatments, T_5 (Black polyethylene mulch, 25 μ m) proved to be the most effective, recording the maximum plant height (22.55 cm), plant spread (31.81 cm E–W and 30.65 cm N–S), fruit set (91.40%), number of fruits per plant (24.86), yield per plant (374.83 g), yield per plot (8.84 kg) and yield per hectare (22.19 t ha⁻¹). T_1 (Black biodegradable mulch) and T_6 (Silver polyethylene mulch) were the next best treatments for most parameters. Conversely, T_8 (Control) recorded the minimum values for all growth and yield attributes except runner production, indicating the adverse effects of the absence of mulching. However, T_7 (Paddy straw mulch) was found to be superior for runner production (5.16 runners per plant). Therefore, black polyethylene mulch (25 μ m) can be recommended for commercial strawberry cultivation to achieve enhanced growth and higher productivity under similar agro-climatic conditions.

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