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*RESEARCH PAPER*

# Influence of mulching materials on growth and yield of strawberry (*Fragaria ananassa* duch.) cv. CAMAROSA under shadenet conditions of coastal Andhra Pradesh

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**Abstract :** Studies were carried out to evaluate the effect of different mulching materials on growth and yield of strawberry cv. CAMAROSA having eight treatments with three replications in Randomized Block Design duing the year 2015-2016. The treatments comprised of coconut husk, black polyethylene, paddy straw, card board sheets, dried banana leaves, paddy husk, silver polyethylene and no mulch (control). All the mulching treatments significantly contributed in improving the vegetative growth and yield of strawberry over unmulched plants. Paddy straw mulch gave the best results in terms of increasing plant spread (46.06 cm), number of runners per plant (28.36), number of leaves per plant (42.56), leaf area per plant (7621.08cm$^2$), number of flowers per plant (61.66), number of days taken for fruiting (51.48 d), number of fruits per plant (35.46), fruit weight (5.00 g), fruit diameter (2.77 cm) and fruit yield (5.82 tonnes per ha). Silver polythene mulch also performed well and showed at par result with that of paddy straw for all the parameters. Black polythene mulch showed the minimum values under hot and humid climate of Andhra Pradesh Thus mulch treatment with paddy straw was proved to be the best for cultivation of strawberry under shade net conditions for tropical regions especially coastal Andhra Pradesh conditions.

**Key Words :** Strawberry, Growth, Yield, Shadenet conditions, Tropical climate, Mulching

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## INTRODUCTION

Strawberry *(Fragaria ananassa* Duch.) belongs to the family Rosaceae and is native of France. The cultivated strawberry, *Fragaria ananassa* is an octaploid (2n=56) and is a cross between two American species *i.e Fragaria chiloensis* × *Fragaria virginiana*. Strawberry fruit is very nutritious with a sweet flavor and pleasant aroma. It is rich in vitamin-C and minerals particularly iron (Bhat *et al.,* 2005). Compared with other

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fruit crops, it gives early and high net returns per unit area, as it is ready for harvesting within 2 months after planting (Kumar *et al*., 2012). USA is the leading producer of strawberry followed by Poland and Spain. In India, it is being mainly cultivated in Himachal Pradesh, Uttar Pradesh, Maharashtra, West Bengal, Delhi, Haryana, Punjab and Rajasthan in an area of one million hectare with a production of 8 million tonnes (National Horticultural Board, 2015-2016). Basically, it is herbaceous perennial plant, grows predominantly in the temperate climate. The strawberry is a short day plant and requires an optimum day temperature of $22^0$C to 23 $^0$C and night temperature of $7^o$C to $13^0$C for its maximum growth and flowering. Even though different strawberry cultivars like Chandler, Sweet Charlie, Tioga, Selva, Pusa early dwarf and Kalimpong Local are available in India, Camarosa cultivar which was recently introduced from California is highly productive, tolerant to thermal stress and produce flowers even at 32°C temperature and it allows transit of berries to more distant market places, because of its firm flesh (Fernandez *et al.*, 2001). Among different production practices followed in strawberry, mulching is considered as one of the most common and important cultural practice to keep the fruit clean (Abbott and Gough, 1992) and to protect fruit from its contact with the soil to avoid fruit rot besides, it plays an essential role in soil moisture conservation, weed control, regulation of soil hydrothermal regime. As strawberry is a temperate fruit, its availability and production in tropical region is low resulting in higher market price. Keeping this above facts, the present studies were carried out to study the impact of different mulching materials which can increase its production as well as quality and provide opportunity to the farming community to grow it commercially in tropical climatic conditions like coastal Andhra Pradesh.

## MATERIAL AND METHODS

An experiment was conducted in Horticultural College and Research Institute, Venkataramannagudem during the year 2015-16 to elucidate information on the influence of mulching on growth and yield of strawberry (*Fragaria ananassa* Duch.) cv. CAMAROSA under shadenet conditions. Bare rooted runners of strawberry cv. CAMAROSA at four leaf stage were procured from Kurukshetra Agro Pvt Ltd, Satara (district), Maharashtra for the present study. The treatments comprised of coconut husk, black polyethylene, paddy straw, card board sheets, dried banana leaves, paddy husk, silver polyethylene and no mulch (Control). The experiment was laid out in a Randomized Block Design (RBD) with eight treatments including control and replicated thrice. The treatments were randomized in each replication. Raised beds of 30 cm height with 1m width at the bottom and 75 cm at the top were prepared with a walking space of 65 cm between the beds. The beds were incorporated with well decomposed farmyard manure and treated cocopeat in the ratio of 2:1. *Neem* cake and vermicompost were applied as basal @ 2.5kg and 892.85 g/ $m^2$, respectively. Bare rooted runners of cv. CAMAORSA planted on 1$^{st}$ November 2015, in two rows per each bed in a zigzag manner with spacing of 60 × 60 cm under shade net conditions. The beds were irrigated with rose can to maintain optimum soil moisture condition immediately after planting and the gap filling was done within a week after transplanting. Five plants were selected and tagged for recording the following observations.

**Plant spread (cm):**

The plant spread was measured in two directions (NS and EW) at right angles to each other for five tagged plants, the average was worked out and expressed in centimeters.

**Number of runners per plant:**

Number of runners produced in five tagged plants were counted and the mean number of runners produced per plant were worked out.

**Number of leaves per plant:**

Number of leaves produced in five tagged plants were counted and the average number of leaves per plant were worked out.

**Leaf area per plant ($cm^2$):**

Leaf area was measured for five tagged plants in each treatment by using an electric leaf area meter model (LI-3100) and the mean leaf area was expressed in square centimeters.

**Number of flowers per plant:**

Number of flowers produced per plant were recorded for five tagged plants during crop growth period and the average was worked out.

**Number of days taken for 50 per cent flowering:**

Numbers of days taken from planting to 50 per cent plants flowered in each plot were counted and the average was worked out.

**Number of days taken for fruiting:**

Numbers of days taken from planting to fruiting (First fruit harvest) were counted for five tagged plants during crop growth period and the average was worked out.

**Number of fruits per plant :**

Numbers of fruits produced per plant were recorded for five tagged plants at the time of fruit maturity and the average was worked out.

**Fruit shape:**

Strawberry fruits were observed physically for its shape and expressed in different shapes *viz*., heart shape, ovoid, oblong, round, globular, conical and short wedge etc.

**Fruit weight (g):**

Ten berries were collected from five tagged plants and ascertained the weight of individual fruit with the help of electrical balance, the average fruit weight was worked out and expressed in grams.

**Fruit diameter (cm):**

The fruit diameter was recorded individually for ten berries collected from five tagged plants in each treatment with the help of verniercaliperse and the average was worked out and expressed in centimeters.

**Fruit yield (kg/plot and t/ha):**

The total fruit production in each treatment was recorded from five tagged plants per plot and the average fruit yield was calculated and estimated the average fruit yield/ hectare was expressed in kilograms.

The data recorded on various characters studied during the investigation was statistically analyzed by adopting the procedures outlined by Panse and Sukhatme (1967). Critical differences values were calculated at 5 per cent level of probability, wherever the 'F' test was found to be significant.

## RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

**Effect of mulching on vegetative growth parameters of strawberry under shade net conditions of tropical climate:**

Among the different mulching, paddy straw and silver polythene mulches showed superior performance on all the growth parameters over other treatments. The results presented in Table 1 clearly indicate that, the plants mulched with paddy straw recorded the maximum plant spread (46.06), number of runners (28.36) number of leaves (42.56) and leaf area per plant (7621.08 $cm^2$) which was followed by silver polythene mulch but it was statistically at par with paddy straw mulch (Table 1).

Better growth performance of strawberry plants when paddy straw was used as mulch could be primarily due to the presence of favourable microclimate like

**Table 1: Effect of mulching on vegetative growth and flowering parameters of strawberry cv. CAMAROSA grown under shadenet condition of coastal Andhra Pradesh conditions**

| Treatments | Plant spread (cm) | Number of runners per plant | Number of leaves per plant | Leaf area per plant ($cm^2$) | Number of flowers per plant | Number of days to 50% flowering (d) |
|---|---|---|---|---|---|---|
| $T_1$: Coconut husk | 39.92 | 24.14 | 31.55 | 4888.95 | 44.23 | 78.33 |
| $T_2$: Black polyethylene mulch | 34.25 | 20.44 | 29.16 | 4039.31 | 34.18 | 71.0 |
| $T_3$: Paddy straw | 46.06 | 28.36 | 42.56 | 7621.08 | 61.66 | 87.00 |
| $T_4$: Card board sheets | 37.94 | 23.43 | 31.47 | 4879.09 | 41.59 | 80.00 |
| $T_5$: Dried banana leaves | 36.86 | 21.89 | 30.31 | 4589.84 | 38.32 | 81.66 |
| $T_6$: Paddy husk | 40.65 | 24.88 | 34.89 | 5932.06 | 47.85 | 74.33 |
| $T_7$: Silver polyethylene mulch | 43.24 | 25.66 | 37.13 | 6433.47 | 52.39 | 72.33 |
| $T_8$: Control | 36.27 | 21.43 | 30.09 | 4369.53 | 36.31 | 85.33 |
| S.E.± | 2.17 | 0.91 | 1.46 | 302.57 | 1.43 | 3.12 |
| C.D. (P=0.05) | 6.66 | 2.81 | 4.46 | 926.64 | 4.40 | 9.57 |

regulation of soil temperature by forming a buffer layer on soil surface ( Haynes, 1980) which helped in better development of fine roots in upper strata of the soil rich in oxygen (Trisdal, 1989). Further early decomposition of paddy straw might have added organic matter to the soil, thereby improving the supply of sufficient quantities of water and nutrients to the plants throughout the crop growth period. These results are in conformity with Das *et al.* (2010) in guava, Ali and Gaur (2013) and Singh *et al.* (2012) in strawberry.

On the other hand black polythene when used as mulch recorded minimum plant spread (34.25), number of runners (20.44) and leaf area per plant (4039.31 $cm^2$). This might be due to maintenance of high soil temperatures which restricted the root growth as well as absorption of water and nutrients from soil. These results are in contrast with Singh *et al.* (2007) in strawberry. This might be attributed to different agro-climatic regions of the strawberry crop grown.

Other treatments like coconut husk, paddy husk, dried banana leaves and card board had shown the intermediate results when used as mulch in strawberry (Table 1).

**Effect of mulching on flowering parameters of strawberry under shade net conditions of tropical climate:**

In strawberry, flowering was started from 30 DAP under agroclimatic conditions of West Godavari District in Andhra Pradesh due to an increase in atmospheric temperature leading to an accumulation of heat units, there by increased the number of flowers per plant.

Among the treatments, paddy straw mulch increased the number of flowers per plant (61.66) (Table 1). The paddy straw mulch upon decomposition supply organic matter to the soil and also provide nutrients throughout the crop growth period there by increased the number of flowers per plant. It could be evident from the present results that paddy straw mulch recorded the maximum number of leaves and leaf area per plant which helps in production and accumulation of more carbohydrates in plants also increased the number of flowers per plant. These results are in conformity with the earlier findings of Kumar *et al*. (2012). Less number of flowers was recorded when black polythene was used as mulch which might be due to increased the soil temperature, reduced reserve carbohydrates and supply of nutrients throughout the crop growth period. These findings are in contrast with Singh *et al.* (2007) in strawberry. The reason might be that, black polyethylene mulch has an advantage of frost protection and soil temperature regulation in temperate regions, thus it might have increased number of flowers in strawberry.

Regarding time taken for 50 per cent flowering, inorganic mulches showed a different response (Table 1). Black polythene mulched plants took only 71.00 days to reach 50 per cent flowering which was followed by silver polythene (72.33) and are significantly superior over organic mulches and control. This might be due to accumulation of more heat units which in turn induced early flowering under tropical conditions. But it was as many as 87.00 days in plants mulched with paddy straw. These results are in conformity with the earlier findings of Singh and Asrey (2005) in strawberry cv. CHANDLER and Singh *et al.* (2007) in strawberry.

**Table 2: Effect of different types of mulches on fruit weight, fruit diameter and fruit yield in strawberry cv. CAMAROSA grown under shade net condition of coastal Andhra Pradesh**

| Treatments | Number of fruits per plant | Fruit weight (g) | Fruit diameter (cm) | Fruit yield (kg/plot) | Fruit yield (t/ha) |
|---|---|---|---|---|---|
| $T_1$: Coconut husk | 27.00 | 3.37 | 1.83 | 1.33 | 2.66 |
| $T_2$: Black polyethylene mulch | 20.16 | 2.34 | 1.26 | 0.856 | 1.71 |
| $T_3$: Paddy straw | 35.46 | 5.00 | 2.77 | 2.91 | 5.82 |
| $T_4$: Card board sheets | 25.20 | 3.11 | 1.66 | 1.28 | 2.56 |
| $T_5$: Dried banana leaves | 24.00 | 3.06 | 1.48 | 1.16 | 2.32 |
| $T_6$: Paddy husk | 29.40 | 4.32 | 2.11 | 2.14 | 4.28 |
| $T_7$: Silver polyethylene mulch | 30.37 | 4.58 | 2.59 | 2.17 | 4.34 |
| $T_8$: Control | 23.00 | 2.42 | 1.34 | 1.15 | 2.28 |
| S.E. $\pm$ | 2.80 | | 0.13 | 0.05 | 0.07 |
| C.D. (P=0.05) | 8.60 | | 0.39 | 0.15 | 0.21 |

**Effect of mulching on fruiting parameters of strawberry under shade net conditions of tropical climate:**

Plants mulched with paddy straw, showed earliness in fruiting (51.48 days) followed by silver polythene, paddy husk and coconut husk mulches which are at par with paddy straw mulch. Plants mulched with black polyethylene took 64.44 days. Paddy straw, paddy husk and coconut husk created congenial atmospheric conditions for early fruit setting in strawberry. Earliness in silver polythene might be due to reflective properties of silver polyethylene mulch which increased light interception into inner canopy might have resulted in early flowering and fruiting in strawberry. The number of days taken for fruiting was more in black polyethylene mulch due to poor fruit set due to unfavourable micro-environment. The similar results were reported by Ravinder kumar and Srivastava (1998) in tomato and Norman *et al*. (2002) in sweet corn.

Mulching had a positive response on fruiting parameters. Among all the treatments paddy straw had resulted in more number of fruits (35.46), maximum fruit weight (5.0 g) fruit diameter (2.77 cm) and fruit yield (5.82 tonnes/ha). Silver polythene mulch also showed at par performance with paddy straw mulch in relation to all fruiting parameters and found to be significantly superior over control. Better performance of paddy straw as mulch could be due to production of more photosynthates, because the same treatment recorded the more number of leaves and leaf area per plant throughout the crop growth period and also due to better partitioning of photo assimilates and nutrients into the fruits. Better performance of silver polyethylene mulch might be due to reflection of light into the lower canopy of the plant increased the photosynthetic rate, there by increased the number of fruits per plant. Whereas black polythene mulch recorded minimum number of fruits (20.16), fruit weight (2.34 g) fruit diameter (1.26 cm) and fruit yield (1.71 tonnes/ha). Reduced performance with black polythene in tropical climate like coastal Andhra Pradesh could be due to an increase in soil temperature and unfavourable micro climate. Plants showed less vigour (In terms of number of leaves, leaf area per plant) and failure of flowers to set into fruits. Similar results are reported by Singh *et al.* (2010) in aonla cv. NA-7.

The fruit shapes in strawberry were determined according to Darrow (1966). The fruits harvested from plants mulched with paddy straw showed short wedge, globose conic, round, oval and conical shapes. In other treatments the fruit shapes were almost similar to that of the fruit shapes observed in plants mulched with paddy straw but slightly differed in plants mulched with dried banana leaves (Pear shape), silver polyethylene mulch (Heart shape) and control (Heart and pear shapes).

Significant differences were observed among the treatments for fruit yield (Table 2). Among all the treatments paddy straw recorded maximum fruit yield (5.82 t/ha) followed by silver polyethylene (4.34 t/ha) and paddy husk (4.28t/ha) mulches. Minimum fruit yield was observed in black polyethylene mulch (1.71t/ha).

The positive influence of mulching on fruit parameters by paddy straw, silver polyethylene and paddy husk is due to better conservation of moisture, regulation of temperature, suppression of weeds and nutrient supply. Black polyethylene was observed to record low fruit production because of increased soil temperature and pest infestation especially flower thrips which prevailed in hot summer. Similar results are reported by Moor *et al.* (2004) in strawberry.

This study provided the data that described the positive effect of mulching on strawberry growth and yield under shadenet conditions of tropical climate like coastal Andhra Pradesh where hot and humid climate prevail. Paddy straw and silver polythene mulches were found to be promising in increasing the yield. This information could be used as phenological base line for developing more efficient plant management strategies in tropical climatic conditions especially coastal Andhra Pradesh.

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