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Influence of mulching materials on strawberry grown under protected condition

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ABSTRACT

An experiment was carried out at department of fruits and orchard management, BCKV to find out influence of mulching materials M_1 (black polythene mulch), M_2 (saw dust mulch), M_3 (paddy straw mulch), M_4 (paddy husk mulch) and M_5 (control) in Strawberry cv. Winter Dawn. The experiment was laid out in a randomized block design. The results revealed that strawberry is very responsive to the mulching materials. Fruit length (45.31 mm), fruit width (33.05 mm), fruit weight (21.13 g), fruit volume (17.10 cm^3), ascorbic acid content (41.68 mg 100 g^{-1} of berries) and anthocyanin content (63.11 mg 100^{-1} g fruit) were significantly higher in fruits harvested from plants mulched with black polyethylene. These studies indicated that black polythene mulch had the best results in terms of yield, quality and growth of strawberry cv. Winter Dawn. So, black polythene mulch may be recommended under protected condition for strawberry cultivation.

Keywords: Growth, mulching, protected cultivation, quality, strawberry, yield.

Strawberry (*Fragaria x ananassa* Duch.) is one of the most fascinating fruit of the world belong to the family Rosaceae. It has a unique place among cultivated berry fruits. Its fruits are attractive, tasty and nutritious with a distinct and pleasant aroma, and flavour. Adverse weather conditions like occurrence of frost, heavy rains, hails and temperature fluctuations especially during flowering and fruiting are limiting factors in strawberry cultivation. To protect the strawberry crop from adverse weather conditions protected cultivation under polyhouse or poly tunnel is a better option. Mulching is an important cultural practice for cultivation of strawberry. Polythene mulches play a vital role in strawberry cultivation as it helps in conserving moisture, controlling weeds, regulating hydrothermal regimes and protecting the delicate fruits from direct contact with the soil (Hancock, 1999 and Sharma, 2000). Mulches reduce soil evaporation and increase yield through increasing water use efficiency (Adekalu, 2006). At present, use of black polythene sheets for mulching in strawberry is a common practice. Different coloured plastic mulches are also being used and reported to improve the yield and quality of crops by various researchers. Keeping in view the above facts, present investigations were under taken to study the protected cultivation of Strawberry cv. Winter Dawn influence by different mulching materials.

MATERIALS AND METHODS

Experimental site, design and treatments

The present experiment was conducted at Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal during the period from 2013-2014. The healthy tissue cultured plants of cultivar Winter Dawn were collected from KF Bioplants Pvt. Ltd. Pune, Maharashtra. The soil of experiment field was sandy loam in texture having pH: 7.5-8. The soil was thoroughly ploughed and well rotten FYM was applied. The bed sizes 4×0.7×0.20m were prepared at a distance of 45 cm. The healthy uniform size plants were planted at a spacing of 30×35cm on last week of October, 2013. Irrigation was provided with over head sprinkler system during early stage which is later on replaced by watering cane. The experiment was laid out in Randomized Block Design with five treatments *viz*., M_1- Black polythene mulch, M_2 - Saw dust mulch, M_3 – paddy straw mulch, M_4 - Paddy husk mulch, M_5 – Control and cultivar *viz*., Winter Dawn. All the treatments were replicated four times.

Mulching, plant protection and harvesting

The different mulching materials were applied after two weeks of transplanting. The mulch was applied at 75 µ (300 gauge) thickness Black plastic mulch, 2-3 cm in depth in case of saw dust and paddy husks and 10 cm in case of paddy straw. The organic manure @ 200g/ plant was applied 15 days after planting and before mulching to the crops. In order to maintained uniform plant population in each bed, dead planting material was replaced by new ones of same age. The gap filling continued till 15th day of planting. The beds were kept free throughout the growth period by weeding at regular intervals. First weeding was done after 20 days of planting and later on as when required. Immediately after planting a light irrigation was done and later irrigation was done depending upon the moisture requirement of the soil. Irrigation was applied by overhead sprinklers

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Table 1 : Efficacy of different mulching materials on number of leaves plant^{-1}, length of petiole length, leaf length and leaf breadth of strawberry cv. Winter Dawn at different interval

Treatments	Number of leaves			Length of petiol (cm)			Leaf length (cm)			Leaf breadth (cm)		
	30 DAP	60 DAP	90 DAP	30 DAP	60 DAP	90 DAP	30 DAP	60 DAP	90 DAP	30 DAP	60 DAP	90 DAP
M_1	7.6	9.3	18.2	10.13	11.25	13.10	5.16	5.32	6.98	5.44	5.82	7.35
M_2	7.35	8.65	16.5	9.35	9.98	12.63	5.12	5.23	6.56	5.23	5.44	6.92
M_3	7.05	8.05	14.75	9.15	9.93	12.40	5.09	5.20	6.20	5.21	5.42	6.47
M_4	6.8	7.85	13.9	8.60	9.80	12.44	4.87	5.18	6.10	5.11	5.31	6.32
M_5	6.2	7.05	13.05	8.08	9.20	11.93	4.52	4.89	5.67	4.74	5.07	5.83
SEm(±)	0.18	0.24	0.41	0.14	0.14	0.377	0.08	0.174	0.14	0.07	0.13	0.10
LSD (0.05)	0.56	0.74	1.28	0.45	0.44	NS	0.23	NS	0.43	0.23	0.39	0.30

Note : M_1- Black polythene mulch, M_2 - Saw dust mulch, M_3 - Paddy straw mulch, M_4 - Paddy husk mulch, M_5 –Control.

Table 2 : Efficacy of different mulching materials on plant height, crown size, number of crown and plant spread of strawberry cv. Winter Dawn at different interval

Treatments	Plant height (cm)			Crown size (cm)			Number of crown			Plant spread (N-S) (cm)			Plant spread (E-W) (cm)		
	30 DAP	60 DAP	90 DAP	30 DAP	60 DAP	90 DAP	30 DAP	60 DAP	90 DAP	30 DAP	60 DAP	90 DAP	30 DAP	60 DAP	90 DAP
M_1	16.24	17.75	20.18	1.28	1.40	2.26	1.20	1.30	1.80	25.33	23.90	31.15	23.23	24.15	33.125
M_2	14.86	17.03	19.15	1.16	1.23	1.96	1.15	1.25	1.65	23.35	23.35	30.1	22.33	23.88	32.275
M_3	14.82	17.40	18.73	1.18	1.22	1.84	1.10	1.20	1.50	17.33	23.15	33.00	21.70	23.25	31.025
M_4	14.18	16.10	17.66	1.21	1.26	1.82	1.05	1.15	1.30	20.85	22.80	27.78	19.93	22.35	30.425
M_5	11.71	12.63	15.41	1.02	1.11	1.50	1.00	1.00	1.20	18.46	21.55	24.95	18.68	21.90	28.825
SEm(±)	0.18	0.20	0.17	0.01	0.11	0.13	0.20	0.3	0.06	1.498	0.789	1.225	0.358	0.525	0.85
LSD (0.05)	0.51	0.58	0.50	0.03	0.31	0.08	0.06	0.10	0.18	4.96	NS	3.815	1.114	1.635	2.647

Table 3 : Efficacy of different mulching material on reproductive growth of strawberry cv. Winter Dawn

Treatments	Days required			No. of flower produced plant^{-1}	No. of fruits plant^{-1}	Fruit set (%)	No. of runners produced plant^{-1}
	Planting to flowering	Flowering to fruit set	Fruit set to maturity				
M_1	32.88	4.28	22.15	26.60	22.35	84.01	4.55
M_2	36.03	4.70	24.00	22.55	16.3	72.25	5.30
M_3	39.15	5.33	26.68	18.03	13.85	76.78	5.48
M_4	37.08	5.70	24.75	18.35	12.85	69.87	5.28
M_5	41.93	6.30	27.58	16.75	11.10	66.43	3.88
SEm(±)	0.25	0.05	0.11	0.29	0.54	2.32	0.11
LSD (0.05)	0.77	0.14	0.33	0.92	1.67	7.22	0.35

Note : M_1- Black polythene mulch, M_2 - Saw dust mulch, M_3 - Paddy straw mulch, M_4 - Paddy husk mulch, M_5 – Control

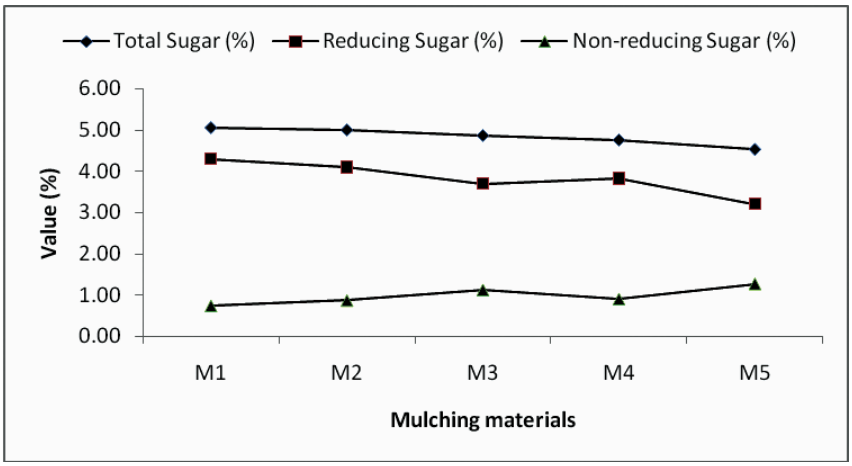
Table 4 : Efficacy of different mulching materials on physical character and yield of strawberry cv. Winter Dawn

Treatments	Weight of fruit (g)	Fruit length (mm)	Fruit width (mm)	Volume of fruit (ml or cm^3)	Yield plant^{-1} (g)
M_1	21.13	45.31	33.05	17.10	459.78
M_2	17.77	41.33	32.70	15.50	434.55
M_3	17.09	42.68	31.23	14.50	407.64
M_4	16.33	43.43	27.52	14.20	445.46
M_5	14.03	40.65	26.12	13.75	297.42
SEm(±)	0.70	0.64	0.54	1.058	13.66
LSD (0.05)	2.17	2.00	1.69	NS	42.55

Note : M_1- Black polythene mulch, M_2 - Saw dust mulch, M_3 - Paddy straw mulch, M_4 - Paddy husk mulch, M_5 – Control

Table 5: Efficacy of different mulching materials on TSS, titratable acidity, TSS : acidity ratio and ascorbic acid of strawberry cv. Winter Dawn

Treatments	Total soluble solids (Brix)	Titratable acidity (%)	TSS/acidity ratio	Ascorbic acid content (mg/100g fruit wt.)	Anthocyanin content (mg/ 100 g fruit wt.)
M_1	7.30	0.47	15.62	41.68	63.11
M_2	6.65	0.54	12.29	39.00	62.09
M_3	5.58	0.58	9.57	36.43	58.02
M_4	6.18	0.52	11.85	35.63	52.93
M_5	5.38	0.59	9.16	32.90	43.77
SEm(±)	**0.09**	**0.00**	**0.19**	**0.12**	**0.02**
LSD (0.05)	**0.29**	**0.01**	**0.58**	**0.38**	**0.05**



M_1- Black polythene mulch, M_2 - Saw dust mulch, M_3 - Paddy straw mulch, M_4 - Paddy husk mulch, M_5 – Control.

Fig. 1: Efficacy of different mulching material on total sugar, reducing sugar and non-reducing sugar of strawberry cv. Winter Dawn.

and Rose cane. Initially the plants shown dryness and observed red termites in soil. To make free red termites from the field, neem oil and and chlorpyriphos of recommended dose was sprayed two times. To protect plants from fungal attack Blitox @ 0.2% and Bavistin @ 0.2% were sprayed alternatively at the initial stages of growth. Fruits harvesting was done when the fruits attained more than 75% color.

Data collection and observation recording

Observations on plant growth parameters such as Leaf parameters [Number of leaves plant^{-1}, Length of petiole, Leaf length, Leaf breadth] has been recorded at 30 days interval up to 90 days, Plant growth parameters [Plant height, crown collar diameter, number of crown plant^{-1}, number of runners produced plant^{-1}] has been also recorded at 30 days interval up to 90 days. Phenological parameters such as bloom duration, flowering duration, flower per plant as well as fruit set were also recorded. Different physical parameters of fruits such as fruit length, diameter and weight, and biochemical parameters such as total soluble solids, total sugars, anthocyanin content, ascorbic acid determined by weight of fruits harvested.

Determination of bio-chemical properties

The total soluble solid was estimated using digital refractometer (ATAGO, RX 5000, Tokyo, Japan) and was expressed as °Brix. Titrable acidity was determined by titrating 5 ml of juice against 0.1 N NaOH and expressed as % value. TSS: Acidity ratio was calculated by dividing the TSS with their respective titrable acidity (Khan *et al.*, 2009). Total sugars, reducing sugars and non-reducing sugars were determined according to the

method explained by Khan *et al.* (2009) and expressed as percentage.

RESULTS AND DISCUSSION

Effect of different mulches on vegetative character of strawberry cv. Winter Dawn

The results revealed that the mulched plots showed significant improvement in growth and yield over unmulched treatments. All the vegetative parameters of the plant which were studied *viz*., plant height, number of leaves, leaf length, leaf width, number of leaves, number of runners of strawberry cv. Winter Dawn was observed to be significantly affected by all the mulching treatments. Regarding data from table-1 revealed that, black polythene mulch has the maximum number of leaves (7.6, 9.3 and 18.2 plant^{-1}), length of petiole (10.13, 11.25 and 13.10 cm), leaf length (5.16, 5.32 and 6.98 cm), Leaf breadth (5.44, 5.82 and 7.35 cm) at 30, 60 and 90 days after planting were significantly higher in plants mulched with black polyethylene (M_1) than other mulched. The plant height (16.24, 17.75 and 20.18 cm), crown size (1.28, 1.40 and 2.26 cm), number of crown (1.20, 1.30 and 1.80) and plant spread in both N-S (25.33, 23.90 and 31.15 cm) and E-W (23.23, 24.25 and 33.13 cm) was maximum at 30, 60 and 90 days after planting respectively in black polyethylene (M_1) mulched plants. The minimum vegetative growth of plants showed under unmulched (M_5) plots. Plants mulched with black polyethylene had better growth than those mulched with saw dust, paddy straw and paddy husk mulch (Table 2). It may be attributed to better soil hydrothermal regimes, better soil moisture conservation and check the growth of weeds in plants mulched with black polyethylene than other mulches (Gupta and Acharya, 1993; Hassan *et al.*, 2000; Pollard *et al.*, 1999; Tarara, 2000).

Efficacy of different mulches on reproductive, physical characteristics and yield of strawberry

The data from table-3 revealed that significant difference in the days taken to flowering (32.88), flowering to fruit set (4.28) and fruit set (22.15) to maturity was earlier in black polythene mulch compare to other mulches. The number of flower (26.60) plant^{-1}, number of fruits (22.35) plant^{-1}, fruit set (84.01%) and number of runners (4.55) plant^{-1} was highest in plants mulched with black polyethylene (M_1) than other mulches like saw dust mulch (M_2), paddy straw mulch (M_3) and paddy husk mulch (M_4). In the table-4, all physical parameters like, fruit weight (21.13 g), fruit length (45.31 mm), fruit width (33.05 mm), Volume of fruit (17.10 ml) were maximum in plants mulched with black polyethylene (M_1), The larger fruit size under black polythene mulch was attributed to more plant growth and development under micro-climatic condition resulting in better nutrient uptake by the plant under protected cultivation. Increase in fruit size due to mulching had also been reported by Nagalakshmi *et al.* (2002). Yield is an important attribute of fresh fruits and mulches significantly increased yield plant^{-1} (Table 4). The yield (459.78 g) also highest in plants mulched with black polyethylene (M_1) followed by saw dust mulched plants. Similar observation on increased yield with larger fruit size using black polythene mulch has also been reported by Singh and Ahmed (2008) and Kher *et al.* (2010).

Efficacy of mulching materials on biochemical parameters of strawberry

In table 5 the data depicts that maximum TSS (7.30°Brix), titrable acidity (0.47%), TSS/ Acidity ratio (15.62), ascorbic acid (41.68 mg/100 g) and anthocyanin content (63.11 mg/ 100 g) was found in plants mulched with black polyethylene (M_1) followed by saw dust mulch (M_2). In fig. 1, the highest total sugar (5.78%), reducing sugar (4.31%) and non-reducing sugar (1.40%) was found under black polyethylene (M_1) mulched plants followed by saw dust mulch and the minimum was found in control (M_5) or unmulched plants. The good fruit quality is related to higher moisture conservation in soil, free of weed, and maximum nutrient uptake under black polythene mulch treatment. These results are satisfied with the findings of Mathad and Jholgiker (2005) and Singh *et al.* (2007).

The present investigation was carried out to improve the growth, yield and quality parameters by using different mulching materials in strawberry cultivation under protected condition. From the results it can be concluded that of various organic as well as inorganic mulches was better than control. However, black polythene mulch resulted in maximum growth, yield and quality as well as reduction in weed population.

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