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INFLUENCE OF MULCHING ON PHYSICO-MORPHOLOGICAL CHARACTERISTICS AND YIELD OF STRAWBERRY *(Fragaria sp.)*

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Abstract

An experiment was conducted to study the effect of different mulches on physio-morphological characteristics, yield contributing characters, and yield of strawberry at the Research field and Laboratory of the Department of Horticulture, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Salna, Gazipur, during November 2008 to April 2009. Variabilities were recorded among the treatments in respect of days to flower initiation, number of flowers per truss, number of flowers per plant, flower disk diameter, individual fruit weight, fruit length, number of fruits per plant, weight of fruits per plant, yield per hectare, and fruit TSS (%). Days to flower initiation, number of flowers per truss, number of flower trusses per plant, number of flowers per plant, and flower diameter, and flower disk diameter ranges from 83.46 to 87.01, 6.20 to 7.83, 5.51 to 8.41, 30.09 to 45.72, 2.80 cm to 3.00cm, 0.73cm to 1.06cm, respectively. The heaviest (20.55g) and the lightest (16.54g) fruits were obtained from the treatments T_2 (straw mulch) and T_5 (no mulch), respectively. Number of fruits per plant, weight of fruits per plant, and fruit TSS (%) ranged from 20.11 to 30.22 and 300.00g to 500.00g and 8.60 to 12.30, respectively. The treatment T_3 (straw mulch) gave maximum fruit yield (25.08 t/ha), while T_5 (no mulch) gave the minimum (16.30 t/ha). Straw mulch was found to be the most suitable for growth, yield, and quality.

Keywords: Strawberry, mulch, yield and quality.

Introduction

Strawberry (*Fragaria sp.*) is a fruit of America and Europe (Hossain, 2009). It belongs to the family Rosaceae, which is a native of the temperate regions (Singh, 2002).The garden strawberry (*Fragaria ananassa*) known as pineapple strawberry or ananas strawberry was first bred in Brittany, France in the 1750s via a cross of *Fragaria virginiana* from eastern North America and *Fragaria chiloensis* from

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Chile. Cultivars of *Fragaria ananassa* have replaced the woodland strawberry (*Fragaria vesca*), which was the first strawberry species cultivated in the early 17th century.The strawberry is, in technical terms, an aggregate accessory fruit, meaning that the fleshy part is derived not from the plant's ovaries but from the receptacle that holds the ovaries. Each apparent "seed" (achene) on the outside of the fruit is actually one of the ovaries of the flower with a seed inside it. In both culinary and botanical terms, the entire structure is considered as fruit.This fruit is widely appreciated for its characteristic aroma, bright red colour, juicy texture, and sweetness. Strawberries are grown throughout Europe, in every state of the United States, as well as in Canada, and South America.The wide variation in climates within these regions and the wide adaptation of the strawberry plant permit harvesting and marketing the fruit during greater part of the year. Strawberry has a tremendous scope for cultivation near towns and canning units where the produce can be utilized immediately after harvest. It is more profitable in the shortest possible time as compared to other fruits (Singh, 2002). Strawberry is a delicious fruit taken fresh in several ways. It also makes excellent ice cream and jam on account of its pleasant aroma and delicate flavour. It is also nutritious and beneficial to anemic persons. One cup (236g) of strawberries contains approximately 45 calories (188 kJ) and other nutrients as water 132g, protein 0.88g, fat 0.53g, carbohydrate 10.10g, fiber 3.3g, calcium 20.00 g, iron 0.55g, vitamin C 82μg, thiamin 0.03μg, riboflavin 0.1μg, vitamin B-6 0.09mg, folate 25μg and vitamin A (IU) 39.

The study on the influence of cultivation techniques on the strawberry has been an important issue in the last decades. The influence of different mulches on yield and quality of strawberry is often inconstant and effects of mulches seem to be related to the changes in the microclimates. Strawberries can be grown in black or transparent polythene to control weeds and to conserve soil moisture, it is unnecessary in the soil to make strawing round the plants. Pires *et al.* (2007) reported that strawberry plants grown with clear plastic mulch provided the best yields. Black polythene gives a complete control of weeds but delays ripening, because under it, the soil remains cold. Singh *et al.* (2006) found that strawberry plants mulched with black polyethylene had the best growth, fruit weight, yield, and quality compared with those mulched with clear polyethylene or paddy straw mulch. Kirnak*et al.* (2001) reported that mulching, especially black polyethylene mulch (BPM) and wheat straw mulch (WSM) together substantially decreased electrolyte leakage and moreover, mulching, especially BPM and WSM together enhanced the concentrations of different nutrients. They also stated that mulching mitigated the negative effects of water stress on plant growth and fruit yield in the field-grown strawberry, particularly in the semi arid situations. In strawberries, mulch keeps the fruits detached from the soil, reduces decay of fruits, conserves soil

moisture, lowers soil temperature in hot weather, protects flowers from frost in mild climates and protects plant from freezing injury in cold climates. Several kinds of mulches are used, but the commonest one is straw mulch. Considering the stated facts, the present investigation was, therefore, undertaken to find out suitable mulching material(s) for better growth and yield of strawberry.

Materials and Method

Source of the planting materials: Six accessions of strawberry viz., FA001, FA002, FA003, FA004, FA005, and FA006 were used in this study. The accession FA002 was selected from the previous studies as it came out with largest fruit size, maximum fruit TSS(%) and highest fruit yielding potential (Rahman, 2007). The accessions FA002 and FA003 were collected from Rajshahi University and Bangladesh Agricultural University (BAU), respectively. Rests of four were collected from different reputed nurseries of the country.

Experimental site and land preparation

The experiment was conducted at the Horticulture Research Farm, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Salna, Gazipur during the period from November 2008 to April 2009. The experimental site is located at the center of Madhupur Tract (24.09 degree North latitude and 90.26 degree East longitude) at 8.5m above the sea level and about 40km north of Dhaka. The land was deep ploughed with disc plough followed by harrowing and laddering up to a good tilth. Weeds and stubbles were removed. The plots were prepared with drains which were made around each plot and the excavated soil was used for raising the plots about 10cm from soil surface. Ridges were made around each plot to restrict the lateral run-off of irrigation water. Well decomposed cowdung, DAP, and MP were applied @ 37 tons, 640 kg, and 333 kg per hectare in general (Hossain, 2009). Full dose of cowdung and DAP, and half of MP were applied at final land preparation and rest of MP in two installments. Immediately after manuring and fertilizing, and preparing the field for planting, solarization was done by laying transparent plastic mulch on moist soil so that heat was trapped under the plastic raising the soil temperature, killing or debilitating pests. This solarization took about six weeks and after that, mulch was removed before planting strawberry saplings.

Design and layout: The experiment was laid out in a Randomized Complete Block Design (RCBD) with four replications. The experimental field was divided into four blocks representing four replications. Each block was further subdivided into five unit plots. The application of five mulches represented as treatments of the experiment and was allotted to the five unit plots per block. Treatments were T_1= Transparent polyethylene mulch (TPM), T_2 = Black polyethylene mulch (BPM), T_3= Straw mulch (SM), T_4 = Water hyacinth mulch (WHM), T_5 = No mulch (control). The plots

were raised by 15cm from the ground level. The unit plot size was 1.75m × 1.10m accommodating 10 plants per row. The unit plots and blocks were separated by 0.6m and 0.75m, respectively.

Planting of saplings: Saplings were transplanted on 6 November 2008 with the spacing of 55cm × 35cm (Rahman, 2007) and inserted the sapling in the soil in such a way that the level of soil and level of soil of polyethylene pots remain equal. Immediately after transplanting, watering was done.

Fig.1. Growing stage of strawberry plants under black polyethylene mulch.

Fig. 2 . Flowering and fruiting of strawberry under black polyethylene mulch.

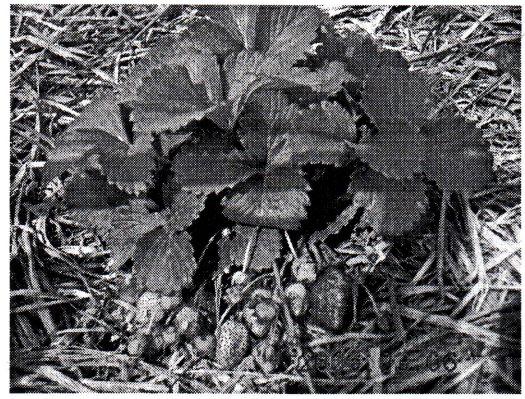

Fig. 3. Showing strawberry plants with profuse flowers and fruits under straw mulch.

Statistical analysis: The data on various parameters recorded in the experiment were compiled and statistically analyzed through partitioning the total variance with the help of computer MSTAT-C programme. Analysis of variance was done according to Gomez and Gomez (1984). Means were separated using Duncan's Multiple Range Test (DMRT).

Results and Discussion

Effect of different mulches on floral and fruit characteristics of strawberry

Days to flower initiation: Days to flower initiation differed significantly among the treatments of different mulches (Table 1). The maximum days (87.01) required for flower initiation was recorded under control (NM), which was statistically identical to the rest of the treatments except T_1, T_3, and T_4 treatments. The minimum days (83.46) were required by the plants mulched under T_2 (BPM), which was statistically identical to all the treatments except T_5 (NM). Abbott and Gough (1992) reported that plants flowered and fruited earlier than control

plants when polyethylene mulch was used. Days to flower initiation in different treatments varied possibly due to applied treatment effects.

Number of flower trusses per plant: Though the number of flower trusses per plant did not differ significantly among the treatments, the maximum number of flower trusses per plant (8.41) was recorded in the treatment T_2 (BPM) and the minimum (5.51) in the treatment T_5 (NM) (Table 1). Number of flower trusses per plant in different treatments varied possibly due to applied treatment effects.

Number of flowers per truss: A statistically significant variation was found among the treatments of different mulches on number of flowers per plant in strawberry (Table 1). The maximum number of flowers per truss (7.83) was found in the treatment T_4 (WHM), which was followed by the treatment T_2 (BPM) (7.57). The minimum number (6.20) was recorded in the treatment T_5 (NM) (Table 1).

Number of flowers per plant: Number of flowers per plant also differed significantly among the treatments (Table 1). The maximum number of flowers per plant (45.72) was recorded in the treatment T_2 (BPM), which was followed by that of in the treatment T_4 (42.80) (WHM). The minimum (30.09) number was recorded in the treatment T_5 (NM), which was statistically identical to the treatment T_1 and T_3 (Table 1).

Flower diameter: Though flower diameter among the treatments did not differ significantly, the maximum flower diameter (3.00 cm) was recorded in the treatment T_1 (TPM) and minimum (2.80cm) in the treatment T_2 (BPM) (Table 1).

Table 1. Floral characteristics of strawberry under different mulches.

Treatments	Days to flower initiation	No. of flower trusses/ plant	No. of flowers/ truss	No. of flowers/ plant	Flower diameter (cm)	Flower disc diameter (cm)
T_1 (TPM)	84.13ab	7.10a	6.87b	37.10b	3.00a	1.06a
T_2 (BPM)	83.46b	8.41a	7.57a	45.72a	2.80a	0.93b
T_3 (SM)	84.64ab	6.72a	6.30b	35.64b	2.99a	0.83b
T_4 (WHM)	86.05ab	6.08a	7.83a	42.80a	2.91a	0.73b
T_5 (NM)	87.01a	5.51a	6.20b	30.09c	2.81a	0.76b
Mean	85.06	6.76	6.95	38.27	2.90	0.86
CV (%)	0.07	0.53	1.15	0.55	5.12	4.57

In a column, means followed by common letters are not significantly different from each other at 5 % level of probability by DMRT.

T_1= TPM (Transparent Polyethylene Mulch); T_2= BPM (Black Polyethylene Mulch)

T_3= SM (Straw Mulch) T_4= WHM (Water Hyacinth Mulch)

T_5= NS (No Mulch) (Control)

Flower disc diameter: Flower disc diameter differed significantly among the treatments. The maximum flower disc diameter (1.06cm) was recorded in the treatment T_1 (TPM) and the minimum (0.73 cm) in the treatment T_4 (WHM), which was identical to the treatments T_2, T_3, and T_5 (Table 1).

Fruit characteristics of strawberry under different mulches

Individual fruit weight: As regard individual fruit weight, it was observed that it varied significantly and ranged from 16.54g to 20.55g. The maximum (20.55g) individual fruit weight was found in the treatment T_3 (SM) and the minimum (16.54g) in the treatment T_5 (NM), which was statistically identical to the treatment T_4 (WHM) (Table 2).

Fruit length: Fruit length differed significantly among the treatments (Table 2). The longest (3.50 cm) fruit was recorded in the treatment T_2 (BPM), which was statistically identical to the treatment T_1 (TPM), T_3 (SM), and T_5 (NM). The shortest (2.61cm) fruit was recorded in T_4 (WHM). This result agrees with the findings of Singh *et al.* (2006). They found that strawberry plants mulched with black polyethylene had the best growth, fruit weight, yield, and quality compared with clear polyethylene or straw mulch.

Fruit diameter: As regard fruit diameter, though there was no significant effect among the treatments, the maximum fruit diameter (2.97cm) was recorded in the treatment T_3 (SM) and the minimum (2.60 cm) in T_4 (WHM) (Table 2).

Table 2. Fruit characteristics of strawberry under different mulches.

Treatments	Individual fruit wt (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit TSS%
T_1 (TPM)	20.21a	2.95ab	2.85a	12.30a
T_2 (BPM)	18.51b	3.07ab	2.81a	10.04b
T_3 (SM)	20.55a	3.50a	2.97a	9.55b
T_4 (WHM)	16.82c	2.61b	2.60a	9.26b
T_5 (NM)	16.54c	3.06ab	2.82a	8.60b
Mean	18.53	3.04	2.81	9.95
CV(%)	5.76	2.70	1.17	3.84

In a column, means followed by common letters are not significantly different from each other at 5 % level of probability by DMRT.

T_1= TPM (Transparent Polyethylene Mulch), T_2= BPM (Black Polyethylene Mulch)

T_3= SM (Straw Mulch) T_4= WHM (Water Hyacinth Mulch)

T_5= NS (No Mulch) (Control)

Total soluble solids (TSS): A significant variation was recorded regarding TSS (%) among the treatments. The highest TSS (12.30 %) was recorded in the treatment T_1 (TPM), which was followed by the treatment T_2 (BPM). In the case of transparent polyethylene mulch, sun shine directly entered into the bed that increased, heat which probably responsible for maximum total soluble solids. The lowest fruit TSS (8.60 %) was recorded in the treatment T_5 (NM). In this context, Marumoto *et al.* (1991) reported that plastic mulches considerably increased fruit sugar content.

Number of fruits per plant: Number of fruits per plant is one of the most important yield contributing characters in all fruits as well as in strawberry. A significant variation among different mulches on the number of fruits per plant.was found. The highest number (30.22) of fruits per plant was recorded in the treatment T_3 (SM) followed by that in T_2 (BPM) (25.50) and the lowest (20.11) was recorded in the treatment T_5 (NM) (Table 3). This result agrees with the findings of Anon., 2010. They found that strawberry plants mulched with straw had the best growth, fruit weight, and quality as compared to black polyethylene or clear polyethylene mulch.

Weight of fruits per plant: Weight of fruits per plant is also one of the most important yield contributing characters in all fruits as well as in strawberry. The treatments significantly influenced the weight of fruits per plant (Table 3). The maximum weight (500.00g) of fruits per plant was recorded in the treatment T_3 (SM) and the minimum (300.00g) in T_5 (NM) (Table 3). This result agrees with the findings of Anon., 2010. They found that

Table 3. Yield contributing characters and fruit yield of strawberry under different mulches.

Treatments	No. of fruits/plant	Wt of fruits (g/plant)	Yield of fruits (t/ha)
T_1 (TPM)	22.00cd	401.75d	18.30cd
T_2 (BPM)	25.50b	450.11c	22.30ab
T_3 (SM)	30.22a	500.00a	25.08a
T_4 (WHM)	23.60bc	457.37b	20.20bc
T_5 (NM)	20.11d	300.00e	16.30d
Mean	24.29	421.85	20.44
CV(%)	2.70	1.17	3.84

In a column, means followed by common letters are not significantly different from each other at 5 % level of probability by DMRT.

T_1= TPM (Transparent Polyethylene Mulch); T_2= BPM (Black Polyethylene Mulch)

T_3= SM (Straw Mulch) T_4= WHM (Water Hyacinth Mulch)

T_5= NS (No Mulch) (Control)

strawberry plants mulched with straw had the best growth, fruit weight, and quality compared to clear polyethylene or black polyethylene mulch.

Fruit yield: Fruit yield was significantly influenced by the treatments. The maximum yield (25.08 t/ha) was recorded in the treatment T_3 (SM), which was statistically identical to the treatment T_2 (BPM) (22.30 t/ha) and the minimum (16.30 t/ha) was recorded in control. This result agrees with the findings of Anon., 2010. They found that strawberry plants mulched with straw had the best growth, fruit weight, yield, and quality compared to black or clear polyethylene mulch.

Conclusion

From the findings of the study, it may be concluded that among the mulches, straw mulch is the best for growth, yield, and quality of strawberry as compared to that of other mulches like black polyethylene, transparent polyethylene, and water hyacinth mulch.

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