Original Research Article

Effect of Different Mulching Material on Watermelon [*Citrullus lanatus* (Thunb.)] Hybrid Under Prayagraj Agro-Climatic Condition

ABSTRACT

The present field experiment was carried out during 2021-2022, the experiment was laid out in Randomized Block Design with three replications. The investigation was carried out with a view to study the effect of different mulching material on growth, yield and quality of watermelon. All the plant growth, yield and quality characters were superior with silver mulch while plants without mulch (control) resulted poor growth and yield. With economic point of view, silver mulch resulted in the highest net return and found to be more economical with highest cost: benefit ratio.

Keywords*:* Plastic mulch, Watermelon

1. Introduction

Watermelon is a warm, long-season crop. This fruit mostly cultivated for its fresh juice and sweet flesh. Commercial cultivation of watermelon takes place on larger scale in summer season in most of the Asian countries. Watermelon belongs to the family of "Cucurbitaceae" and genus of "*Citrullus*". Watermelons are native to the Kalahari Desert of southern Africa and the first recorded watermelon crop was found in Egypt. Farmers can make good profits from cultivation of watermelon, if proper cultivation methods and farm management practices are followed. Individual watermelon plants produce both male and female flowers. The fruit size varies from 2 to 15 kg, depending on variety. However, seedless varieties need pollinators. Watermelon can be successfully grown in pots, containers, indoors, greenhouses and poly houses.

Watermelon is believed to have originated from indigenous tropical Africa. Its growth is favoured by long period of warm, dry weather. A temperature of 25°C to 30°C is ideal for growth and 25°C is the best temperature for fruit setting of watermelon. Environment significantly influences the flavour and sweetness of watermelon.

The process of covering the open surface of the ground by a layer of some external material is called mulching & the material used for covering is called as 'Mulch.' Mulching is usually practiced when cultivating commercially important crops, fruit trees, vegetables, flowers, nursery saplings, etc. Mulching in general is a beneficial practice for crop production. Mulch conserves soil moisture, retained heat as well as it suppresses weed growth (**Ahmad et al., 2007, Sharfuddin and Ssiddique, 1985**). The greatest benefit from plastic mulch is that the soil temperature in the planting bed is raised, promoting faster crop development and earlier harvest. silver plastic mulch can give a harvest earlier by some 7-14 days, while black plastic may advance the harvest date by 21 days. Soil water loss is reduced under plastic mulch. As a result, a more uniform soil moisture is maintained and irrigation frequency can be reduced. The growth of plants on mulch can be twice that of plants in unmulched soil. Because larger plants will require more water, mulching is not a substitute for irrigation.

The edible product from a mulched crop is cleaner and less subject to rot, since no soil is splashed on to the plants or fruit. To keep plants, clean, they should be grown in a raised bed

that is firm and slightly convex, with the highest point down the center of the row, while the plastic should be stretched light to encourage the run-off of water. Mulch film is nearly impervious to carbon dioxide, which is necessary for photosynthesis. Research has shown that high levels of carbon dioxide may build up under the plastic. Because the film does not allow the gas to penetrate, it has to escape through the holes punched for the plants and a “chimney effect" is created, resulting in abundant CO, for the actively growing leaves. This study aimed to evaluate the effect of different mulches on growth, yield and quality of watermelon and to estimates the economics of various treatments under Prayagraj agro-climatic condition.

2. Materials and Method

The experiment was conducted at Vegetable Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (UP) during Prayagraj during the *Zaid* season of 2022. Soils of the experimental site are classified as rich loam soil. The annual rainfall in the region is about 1042 mm. The experiment was laid out in randomized block design with three replications. There were total eight treatment of mulching materials viz. T_0 (control). T_1 (paddy straw), T_2 (paddy husk), T_3 (coconut husk), T_4 (dry leaves), T_5 (saw dust mulch), T_6 newspaper mulch) and T_7 (black plastic mulch), T_8 (silver plastic mulch).

2.1 Statistical Analysis

The Data recorded throughout the course of investigation was subjected to Statistical analysis by using analysis of variance (ANOVA) for randomized block design (RBD) by Fischer and Yates (1963). Whenever ‘F’ test was found significant for comparing the means of two treatments, a critical difference (C. D. at 5%) was worked out.

Results and Discussion

Growth parameters: Data pertaining to growth parameters which are Days of germination, Number of leaves, Vine length (cm), Number of branches per vine.

3.1 Days of germination

The data presenting to days of germination as affected by various treatments of mulching are presented in Table 1. Results indicated that the effect of different type of mulching material on days of germination was found to be significant over control. Earliest days of germination (2.97) was recorded in treatment T_8 (Silver plastic mulch) followed by T_7 (Black plastic mulch) (2.80). While the treatment control recorded significantly late days of germination (1.69).

3.2 Number of leaves

The data related to the number of leaves are given in Table1. The various mulching treatments have significant effect on no of leaves. At harvesting time, maximum no of leaves (33.33) was recorded in mulching treatment (T_8) (Silver plastic mulch), followed by (Black plastic mulch), However, minimum (26.67) no of leaves was recorded in (T_0) (control) which were significantly different.

3.3 Vine length (cm)

The data related to the length of main axis of vine are given in Table1. The various mulching treatments have significant effect on length of main axis of vine. At harvesting time, maximum vine length (237.97 cm) was recorded in mulching treatment (T_8) (Silver plastic mulch), followed by (Black plastic mulch), However, minimum (166.05 cm) vine length was recorded in (T_0) (control) which were significantly different.

3.4 No of branches per vine

The results obtained on the effect of different mulching treatments on number of branches per vine have been presented in Table1. The results revealed that various treatments significantly influenced the number of branches per vine. The perusal of data revealed that all mulching treatments were found significantly superior in sense of a greater number of branches per vine as compared to control. The maximum number of branches per vine (14.25) was recorded in (T_8) silver plastic mulch treatment, followed by black plastic mulch (13.33). However, (T_0) control treatment recorded significantly the lowest number of branches per vine (9.08).

Flowering parameters: Data pertaining to flowering parameters which are Days of 1st male flower, Days of 1st female flower, Node at 1ast male flower emergence, Node at 1st female flower emergence, No of male flowers, No of female flowers, Sex ratio.

3.5 Days of 1st male flower

The data related to Days of 1st male flower is given in Table 2. The various mulching treatments have significant effect on Days of 1st male flower. Minimum days to emergence of first male flower were recorded in Silver plastic mulch (19.32) followed by black plastic mulch, while maximum days to, male of first male flower were recorded in No mulch (control) (23.85).

3.6 Days of 1st female flower

The data related to Days of 1st female flower is given in Table 2. The various mulching treatments have significant effect on Days of 1st female flower. minimum days to emergence of first female flower were recorded in Silver plastic mulch (24.17) followed by Black plastic mulch (20.11), while maximum days to emergence of first female flower were recorded in No mulch (control) (30.08).

3.7 Node number at which first male flower

The data related to Node number at which first male flower is given in Table2. The various mulching treatments have significant effect on node number at which first male flower. earliest number of node at first male flower was recorded in No mulch (control) (8.48) followed by Newspaper mulch, while maximum number of node at first male flower was recorded in silver plastic mulch (11.14).

3.8 Node number at which first female flower

The data related to Node number at which first female flower is given in Table2. The various mulching treatments have significant effect on node number at which first female flower. Minimum days to emergence of first female flower were recorded in Silver plastic mulch (24.17) followed by Black plastic mulch (20.11), while maximum days to emergence of first female flower were recorded in No mulch (control) (30.08).

3.9 Node at 1ast male flower emergence

The data related Node at 1ast male flower emergence is given in Table 2. The various mulching treatments have significant effect on node at 1ast male flower emergence. Earliest number of node at first male flower was recorded in No mulch (control) (8.48) followed by Newspaper mulch, while late number of node at first male flower was recorded in silver plastic mulch (11.14).

3.10 Node at 1ast female flower emergence

The data related Node at 1ast female flower emergence is given in Table 2. The various mulching treatments have significant effect on node at 1ast female flower emergence. Earliest number of node at first female flower was recorded in No mulch (control) (12.04) followed by Newspaper mulch (13.12) while late number of node at first female flower was recorded in Silver plastic mulch (14.74).

3.11 No of Male flowers

The data related to no of male flowers is given in Table2. The various mulching treatments have significant effect on Days of 1st male flower. Maximum number of male flowers was recorded in Silver plastic mulch (35.85) followed by Black plastic mulch while minimum number of male flowers was recorded in No mulch (control) (16.44).

Table 1. Effect of different mulches on yield of watermelon

Treatments	Days of germination	No of leaves (At harvest)	Vine length (cm) (At harvest)	Number of branches per vine
T_0	6.58	27.67	166.05	9.08
T_1	6.00	30.57	206.42	11.42
T_2	6.17	28.55	196.26	10.08
T_3	5.92	30.45	224.79	12.17
T_4	6.00	29.71	189.28	9.50
T_5	6.25	29.54	223.12	13..33
T_6	5.33	28.72	184.19	9.33
T_7	5.17	32.91	230.71	13.33
T_8	5.08	33.33	237.97	14.25
F-TEST	S	S	S	S
SE(d)±	0.22	0.16	0.46	0.42
CD 5%	0.46	0.34	0.98	0.89

Table 2. Effect of different mulches on flowering of watermelon

Treatments	Days to 1st male flower	Days to 1st female flower	Node at 1st male flower emergence	Node at 1st female flower emergence	No of Male flowers	No of Female flowers	Sex ratio
T_0	23.85	30.08	8.48	12.04	16.44	4.22	3.89
T_1	23.11	26.58	10.72	14.29	28.89	4.69	6.15
T_2	22.82	28.25	9.79	13.36	26.56	5.13	5.18
T_3	22.07	27.25	10.55	14.12	32.19	5.45	5.90
T_4	21.65	29.58	9.55	13.37	19.45	4.08	4.76
T_5	20.04	25.67	10.22	13.79	33.53	5.89	5.69
T_6	21.22	28.58	9.55	13.12	29.55	5.85	5.04
T_7	19.32	25.83	10.97	14.54	33.24	5.19	6.40
T_8	20.11	24.17	11.14	14.74	35.85	5.22	6.86
F-TEST	S	S	S	S	S	S	S
SE(d)±	0.18	0.38	0.38	0.09	0.31	0.09	0.13
CD 5%	0.37	0.80	0.80	0.19	0.66	0.20	0.28

3.12 No of Female flowers

The data related to no of female flowers is given in Table2. The various mulching treatments have significant effect on Days of 1st female flower. Maximum number of female flowers was recorded in Silver plastic mulch (5.22) followed by Black plastic mulch while minimum number of female flowers was recorded in No mulch (control) (4.22).

3.13 Sex ratio

The data related to Sex ratio is given in Table2. The various mulching treatments have significant effect on sex ratio. Maximum number of sex ratio was recorded in Silver plastic mulch (6.86) followed by Black plastic mulch while minimum number of female flowers was recorded in No mulch (control) (3.89).

Yield parameters: Data pertaining to yield parameters which are Fruit length (cm), Fruit diameter (cm), Number of fruit per plant, Fruit weight (kg), Total fruit yield per plot (kg), Fruit yield per hectare (tones).

3.14 Fruit length (cm)

The mean data on fruit length (cm) of watermelon affected by different treatments of mulching are presented in Table3. There was significant difference found in various treatments. The maximum fruit length (29.66 cm) was noted in the treatment T_8 (Silver plastic mulch), followed by (Black plastic mulch), while, the minimum fruit length (25.17 cm) was recorded in treatment T_0 (control).

3.15 Fruit diameter (cm)

The mean data on fruit diameter (cm) of watermelon affected by different treatments of mulching are presented in Table3. There was significant difference found in various treatments. The maximum fruit diameter (18.44 cm) was noted in the treatment T_8 (Silver plastic mulch), followed by (Black plastic mulch) while, the minimum fruit diameter (13.27 cm) was recorded in treatment T_0 No mulch (control).

3.16 Number of fruits per plant

The data presenting to number of fruits per plant as affected by various treatments of mulching are presented in Table3. Results indicated that the effect of different type of mulching material on number of fruits per plant was found to be significant over control. Significantly highest number of fruits per vine (2.97) was recorded in treatment T_8 (Silver plastic mulch) followed by T_7 (Black plastic mulch) (2.80). While the treatment control recorded significantly lowest number of fruits per plant (1.69).

3.17 Fruit weight (kg)

The data are presented in Table 3. revealed that various treatments of mulching exerted a significant effect on average fruit weight (kg) of watermelon. It is observed from the data that all the treatments of mulching were found significantly superior in recording higher average fruit weight (kg) over control. The maximum average fruit weight (2.41 kg) was recorded in treatment T_8 (Silver plastic mulch) followed by Black plastic mulch whereas the minimum average fruit weight was recorded in No mulch (control) (1.83 kg).

3.18 Total fruit yield per plot (kg)

The mean data on fruit yield (kg/plot) of watermelon as affected by different type of mulching material are presented in Table 3. It is observed from the data that all the treatments of mulching were found significantly superior in recording higher fruit yield (kg/plot) over control. The maximum yield per plot of watermelon (27.52 kg) was recorded in treatment T_8 (Silver plastic mulch) followed by Black plastic mulch Whereas, the minimum yield per plot was recorded in No mulch (control) (14.32 kg).

3.19 Fruit yield per hectare (tonnes)

The fruit yield (t/ha) of watermelon as affected by various treatments of mulching are presented in Table 3. Results indicated that the effect of different types of mulching material on fruit yield (t/ha) was found to be significant over Significantly the highest fruit yield per hectare of watermelon (66.04 t/ha) was recorded in treatment T_8(Silver plastic mulch) followed by Black plastic mulch while significantly lowest fruit yield per hectare (36.35 t/ha) was noted in the treatment T_0 No mulch (control).

Quality parameters: Data pertaining to Quality parameters which are Vitamin C (mg/100g), Acidity (%), TSS (Brix), Number of seed/fruits, Pulp weight(g).

3.20 Vitamin C (mg/100 g)

The analysis of variance presented in Table 4. showed significant differences among treatments and their interactions for Vitamin C (mg/100g) ranged from 7.57 to 8.12 The mean values for Vitamin C (mg/100g) revealed that the maximum Vitamin C was recorded in the Silver plastic mulch with (8.12 mg/100g)) and Followed by the Black plastic mulch with (8.07 mg/100g)) and Minimum was recorded in the No mulch (control) with (7.57 mg/100g)).

3.21 Acidity (%)

The data showed that the effect of various treatments of mulching on acidity (%) was found significant fruits of watermelon presented in Table 4. In The perusal of the data reveals that the lowest per cent of acidity was found in all the treatment of mulching as compared to control. Minimum acidity of watermelon fruit (0.31%) was observed in silver plastic mulch (T_8) followed by Black plastic mulch, while the maximum acidity (0.43%) was recorded in No mulch (control) (T_0).

3.21 TSS (°Brix)

The mean data on TSS as affected by different type of mulching material are presented in Table 4. Maximum TSS was recorded in the Silver plastic mulch with (9.61)) and Followed by the Black plastic mulch with (9.51) and Minimum was recorded in the No mulch (control) with (8.79).

3.22 Number of seed/fruits

The mean data on number of seeds per fruit in watermelon as affected by different type of mulching material are presented in Table 4. Minimum number of seed/fruits of watermelon (386.15) was observed in No mulch (control) followed by Newspaper mulch, while the maximum number of seed/fruits (485.83) was recorded in Silver plastic mulch (control) (T_8).

3.23 Pulp weight (g)

The data are presented in Table 4 revealed that various treatments of mulching exerted a significant effect on average pulp weight (g) of watermelon. It is observed from the data that all the treatments of mulching were found significantly superior in recording higher average pulp weight (kg) over control. The maximum average pulp weight (1225.79 g) was recorded in treatment T_8 (Silver plastic mulch) followed by Black plastic mulch whereas the minimum average pulp weight was recorded in No mulch (control) (925.56 g).

Treatments	Fruit diameter (cm)	Fruit length (cm)	Number of fruits per plant	Fruit weight (kg)	Total fruit yield per plot (kg)	Fruit yield per hectare (tonnes)
T_0	25.17	13.27	1.69	1.83	14.32	36.35
T_1	26.53	15.61	2.22	2.01	18.18	43.62
T_2	26.03	14.27	2.47	1.91	19.06	45.73
T_3	27.42	16.36	2.64	2.11	21.70	52.07
T_4	25.20	13.69	1.80	1.89	16.16	38.77
T_5	28.85	17.52	2.64	2.26	22.19	53.25
T_6	27.14	13.52	2.55	1.94	20.15	48.36
T_7	29.02	17.44	2.80	2.30	26.69	64.06
T_8	29.66	18.44	2.97	2.41	27.52	66.04
F-TEST	S	S	S	S	S	S
SE(d)±	0.56	0.09	0.05	0.04	0.24	0.58
CD 5%	1.19	0.20	0.10	0.09	0.52	1.23

Table 3. Effect of different mulches on yield of watermelon

Treatments	Vitamin C (mg/100 g)	Acidity (%)	TSS (◦Brix)	Number of seed/fruits	Pulp weight (g)
T_0	7.57	0.43	8.79	386.15	925.56
T_1	7.78	0.38	9.37	437.00	986.37
T_2	7.61	0.41	9.33	403.64	981.59
T_3	7.83	0.36	9.40	410.79	1065.72
T_4	7.64	0.42	9.32	399.90	976.40
T_5	8.04	0.33	9.52	450.42	1155.97
T_6	7.69	0.41	9.31	407.03	1008.60
T_7	8.07	0.33	9.51	480.68	1182.23
T_8	8.12	0.31	9.61	485.83	1225.79
F-TEST	S	S	S	S	S
SE(d)±	0.04	0.00	0.05	3.37	29.70
CD 5%	0.08	0.01	0.11	7.15	62.96

Table 4. Effect of different mulches on Quality of watermelon

Cost benefit analysis

Considering all the economics of different treatment It can be seen from the Table 5 that highest net returns were obtained in different mulches as compared to control or no mulch condition. Watermelon under silver colored mulch film recorded higher net monitory returns (Rs 241992) and lowest net monitory return under no mulch condition (Rs 513892). The maximum cost benefit ratio was obtained with treatment silver mulch (4.51) as compared to no mulch (2.99).

Treatments	Gross return (Rs. /ha)	Cost of cultivation (Rs. /ha)	Net return (Rs. /ha)	B:C Ratio
T_0	363500	1,21,508	2,41,992	2.99
T_1	436200	1,23,008	3,13,192	3.55
T_2	457300	1,26,058	3,31,242	3.63
T_3	520700	1,33,508	3,87,192	3.90
T_4	387700	1,21,858	2,65,842	3.18
T_5	532500	1,26,308	4,06,192	4.22
T_6	486300	1,27,508	3,56,092	3.79
T_7	640600	1,49,508	4,91,092	4.28
T_8	660400	1,46,508	5,13,892	4.51

Table 5. Effect of different mulching material on economics of watermelon.

Conclusion

From the present investigation, it is concluded that, Silver plastic mulch (T8) performed best in terms of growth viz., vine length (237.97cm), yield (66.04 t/ha) and quality viz, Pulp weight (g) (1225.79).

The maximum benefit cost ratio was also observed in Silver plastic mulch (T8) with 4.51.

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