Int.J.Curr.Microbiol.App.Sci (2018) *7*(7): 2774-2782

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 7 Number 07 (2018)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2018.707.324

Impact of Mulching Material on the Growth, Yield and Quality of Watermelon (*Citrullus lonatus*)

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Keywords

Watermelon, Mulch, Growth and yield parameter

Article Info

Accepted:
20 June 2018
Available Online:
10 July 2018

A B S T R A C T

The field experiment was conducted on watermelon (*Citrulluslonatus thumb*) cv. sugar baby at Krishi Vigyan Kendra, Bhilwara, MPUAT, Udaipur during summer season of 2014 to study the impact of mulching material on the growth, yield and quality of watermelon cv. sugar baby in randomized block design (R.B.D.) in three replications. 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.

Introduction

Vegetable crop production is on the increase all over the world both in urban, peri-urban and rural areas. Water melon (*Citrullus lonatus* thumb) is one important cucurbits vegetables crop grown extensively in India and in tropical and sub-tropical countries of the world. India has favorable ecological condition for enough production of vegetable for growing human population but the resource poor farmers are facing serious problems of price fluctuation, inclement weather condition such as dry spell, moisture shortage, high temperature and solar radiation regimes, glut due to poor storage conditions, biotic and abiotic stresses, pest incidence and physiological disorder, all of which affect vegetable crop production in India. In view of this, some cultural practices such as mulching is used to regulate the soil temp, moisture content, weeds, pest and disease control. It is known that plant development and yield increases occur with balance of soil temperature which there are differences between night and day time temperature, in which mulching play great role to increase yields, promote early harvest, reduce fruit defects, reduce evaporation from the soil surface, prevent weed growth, modify soil temperature and reduce insect number in vegetable production (Splilittstoesser, 1990), the effective of which depends on the type of mulching material used.

Development of new technologies and especially application of polyethylene film as mulch have enhanced yield (Brinen, 1979). The greatest benefit from plastic mulch is that the soil temperature in the planting bed is raised, promoting faster crop development and earlier harvest. Black plastic mulch can give a harvest earlier by some 7-14 days, while clear plastic may advance the harvest date by 21 days. Soil water loss is reduced under plastic mulch. As a result, 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 un-mulched soil. Because larger plants will require more water, mulching is not a substitute for irrigation. Black and white on black mulches will reduce light penetration to the soil. Weeds cannot generally survive under such mulch. Fertilizer beneath the mulch is not lost by leaching so that fertilizers are optimally used and not wasted. The soil under plastic mulch remains loose, friable and well aerated. Roots have access to adequate oxygen and microbial activity is enhanced. Soil mulching with plastic film is very beneficial because cucurbits, watermelon being one of them are very shallow rooting and do not like being hoed (Messiaen, 1992). Plastic mulch has been reported to increase watermelon stem growth early and total yield (Bhella, 1988). The effect of mulch color on crop yield has been studied on several crops including tomato and pumpkin (White, 2002).

Therefore, considering the importance of different mulching in various vegetable crops, the present investigation was carried out to study the effect of different mulching material on growth, yield and quality of watermelon.

Materials and Methods

The field experiment was conducted on watermelon belongs to cucurbitaceae family cv. sugar baby at Krishi Vigyan Kendra, Bhilwara (MPUAT, Udaipur) Soils of the experimental site are classified as sandy loam soil. The annual rainfall in the region is about 600 mm. The experiment was laid out in randomized block design with three replications. There were total eight treatment of mulching materials viz. Control (T_1), Wheat Straw (T_2), Grasses (T_3), Black Mulch (T_4), Silver Mulch (T_5), Red Mulch (T_6), Blue Mulch (T_7) and Yellow Mulch (T_8).

Plant growth beds were prepared 1.5 m apart from each other. Different color polyethylene mulches were laid down on the beds and holes were opened at 1m x 1m for planting the seedlings. Thirty days old seedlings prepared in protrays were transplanted in the first week of January in experimental plots. The required cultural practices were made during the growing period. Mulching applied upto 50 cm both the side from the stem of watermelon. Temperature and moisture content will be carried out at 10 cm and 15 cm depth. The thickness of all polyethylene mulch was 30 microns While Grasses and Wheat Straw was applied at 6 inch thick. The fertilizers were applied @ 100:50:50 NPK kg/ha. Full dose of P_2O_5 and K_2O was applied as basal dose and nitrogen was given in two equal split as basal and top dressing at 30 DAS. The farm yard @ 20 tons per hectare was mixed in soil uniformly to all the treatments. Water soluble fertilizer such as 19:19:19 were also applied.

Five plants were randomly selected from each experimental plot for recording observations on growth, flowering, yield and quality parameter and subjected to statistical analysis of variance technique as described by Panse and Sukhatme (1985).

Results and Discussion

Effect on growth and yield

The result showed that different types of mulching material significantly influenced the growth parameters of watermelon viz- number

of branches per vine, main vine length and number of nodes per vine over control. Among different mulching treatments, treatment (T_5) silver mulch resulted higher number of branches per vine, increased main vine length and number of nodes per vine. However, control recorded the minimum growth. The increase in growth parameters was attributed to sufficient soil moisture near root zone and minimized the evaporation loss due to mulching. The extended retention of moisture and availability of moisture also leading to higher uptake of nutrient for proper growth and development of plants, resulted higher growth of plant as compared to control. The changes in soil temperature below plastic mulch could be attributed to different manners of heating and heat transfer to soil and also to heat accumulation during day and loss during night. Similar findings have also been obtained by Deanban *et al.*, (2004), Ansary and Roy (2005) in watermelon, Al Majali and Kasrawi (1995) in muskmelon and Alemayehu-Ambaye and Joseph (2002) in melon (Table 1).

The result indicated that the effect of different mulching material on fruit length of watermelon was significantly increased than control. Maximum fruit length was observed in treatment silver mulch, whereas the minimum fruit length of watermelon was noted in control. The highest fruit length under silver mulch was due to congenial soil moisture result higher uptake of nutrition for better growth of fruit and the reduction in evaporation losses of soil moisture caused by mulches covered the soil surface in row of watermelon. The above results were in consonance with those of Johnson *et.al.* (2000), Ansary and Roy (2005) in watermelon and Sharma and Agarwal Narendra (2004) in tomato and Suresh and Ashok Kumar (2006) in pointed gourd.

Silver polyethylene mulch was found to have significantly better effect on the extent of fruit set than other mulching material tried. This mulch consistently increased higher fruit set than other mulch and no mulch. This might have been influenced by favorable soil temperature, moisture conditions and pest disease control as influenced by silver mulch.

The present finding was in accordance with Andino and Motsenbocker (1998), Johnson *et al.*, (2001), Ansary and Roy (2005) in watermelon and Hanna (2000) in cucumber.

It was found that all treatments of mulching material were significantly increased the average fruit weight (kg) of watermelon than control. Among all mulching treatments, maximum average fruit weight was recorded in treatments silver mulch.

It appears that silver mulch might have induced favorable conditions conducive to attainment of fruits with higher weight. The above resultswere in agreement with those of Ansary and Roy (2005), Arancibia and Motsenbocker (2008) in water melon and Angrej Ali and Gaur (2007) in strawberry.

It was found that all the treatment of mulching material was significantly increased the fruit yield of watermelon. Among all mulching treatments, maximum fruit yield recorded in treatment silver mulch which was higher as compare to other mulch and no mulch.

Plants under polyethylene (Silver mulch) produced larger fruit and have higher fruit yield per vine because of better plant growth due to favorable hydrothermal regime of soil and complete weed free environment.

The above results were in consonance with those of Qadir (1992), Al-Majali and Kasrawi (1995), Johanson *et al., (*2000) and Ansary and Roy (2005) and Cenobio *et al.*, (2007) in watermelon. Ibarra *et al.*, (2001) in musk melon (Table 2).

Table.1 Effect of different mulching materials on growth and yield of watermelon cv. Sugar baby

Treatment	No. of branches/ vine	Vine length (cm)		No. of Node	M/F (Sex) Ratio	Fruit Length (cm)	Fruit girth (cm)	No. of Fruit/ Vine	Fruit Wt. (kg)	Fruit Yield T/ha
		45 DAS	Harvest							
Control	7.40	104.56	158.67	41.78	5.97	27.03	14.59	2.17	2.80	21.59
Wheat Straw	11.07	111.68	184.26	43.33	5.43	29.01	15.32	2.24	2.83	21.37
Grasses	10.67	117.14	185.67	44.62	5.07	29.14	15.07	2.30	2.97	24.56
Black Mulch	13.63	132.11	205.62	56.86	4.93	34.35	17.62	2.97	3.56	32.52
Silver Mulch	14.90	146.37	223.97	58.58	4.57	36.45	17.68	3.23	3.61	34.37
Red Mulch	13.43	131.61	189.00	51.34	4.63	32.13	16.57	2.73	3.35	29.37
Blue Mulch	12.83	119.48	188.67	48.16	5.20	30.12	15.08	2.46	3.05	28.26
Yellow Mulch	11.00	122.03	177.23	48.07	5.31	31.90	16.19	2.45	3.04	25.30
SEM +	0.590	1.79	2.77	0.70	0.297	0.45	0.770	0.121	0.132	0.39
C.D. at 5%	1.82	5.30	8.24	2.07	NS	1.33	NS	0.37	0.40	1.15
CV	8.74	7.54	7.62	7.37	10.01	7.45	8.33	8.18	7.23	7.37

Table.2 Effect of different mulching materials on fruit quality of watermelon cv. Sugar baby

Treatment	Fruit pulp wt (kg)	TSS (%)	Acidity (%)	Reducing sugar (%)	NR (%)	Total Sugar	Av Soil Temp.	Mositure (%)
Control	1983.33	10.07	0.44	1.27	2.90	4.17	33.70	47.50
Wheat Straw	2101.33	10.20	0.41	1.53	3.20	4.73	31.60	46.30
Grasses	2065.33	10.24	0.40	1.57	3.31	4.88	32.10	44.70
Black Mulch	2308.67	10.24	0.37	1.76	3.61	5.37	31.70	46.80
Silver Mulch	2418.67	10.43	0.36	1.80	3.67	5.47	30.90	48.10
Red Mulch	2185.00	10.18	0.41	1.63	3.56	5.19	31.60	46.00
Blue Mulch	2148.67	10.24	0.38	1.59	3.19	4.78	32.20	47.20
Yellow Mulch	2115.00	10.27	0.40	1.60	3.50	5.10	32.20	45.00
SEM +	31.47	0.378	0.017	0.099	0.158	0.07	-	-
C.D. at 5%	93.49	NS	0.05	0.30	0.48	0.22	-	-
CV	7.55	6.40	7.22	10.77	8.61	7.61	-	-

Table.3 Effect of different mulching material on economics of water melon cv. Sugar baby

Treatment	Yield (t/ha)	Gross realization (Rs/ha)	Total Expenditure (Rs/ha)	Net realization (Rs/ha)	CBA	CBA
Control	21.59	215900	199770	16130	0.075	1.08
Wheat Straw	24.37	243700	200120	43580	0.179	1.22
Grasses	24.56	245600	199790	45810	0.187	1.23
Black Mulch	32.52	325200	204480	120720	0.371	1.59
Silver Mulch	34.37	343700	204480	139220	0.405	1.68
Red Mulch	29.37	293700	204480	89220	0.304	1.44
Blue Mulch	28.36	282600	204480	78120	0.276	1.38
Yellow Mulch	25.30	253000	204480	48520	0.192	1.24
SEm±				1111	0.004	0.02
CD at 5%				3301	0.011	0.06
CV				8	7.767	7.44

Effect on quality

The data indicated that the effect of various treatments of mulching material on quality parameters viz. total soluble solid, fruit pulp weight (g), acidity (%), reducing sugar, total sugars and non-reducing sugar was found significant in fruit of watermelon. It was found that all treatments of mulching material were significantly increased the fruit pulp weight of watermelon but it was unable to exert significant influence on number of seeds per fruit than control. Among all treatments of mulching, maximum fruit pulp weight was recorded in treatment silver mulch. An increase in fruit pulp weight in mulched plants may further attributed to the reason that plants remain physiologically more active to build up sufficient food stock for the developing fruits. The above result were in agreement with those of Suresh and Ashok Kumar (2006) in pointed gourd, Angrej –Ali and Gaur (2007) in strawberry, Aruna and Roy (2005) in water melon.

It was found that application of mulching material had produced a significant effect on acidity percent in fruit of watermelon than control. Among all treatments of mulching, maximum fruit pulp weight was recorded in treatment silver mulch. An increase in fruit pulp weight in mulched plants may further attributed to the reason that plants remain physiologically more active to build up sufficient food stock for the developing fruits. The above result were in agreement with those of Suresh and Ashok Kumar (2006) in pointed gourd, Angrej-Ali and Gaur (2007) in strawberry, Aruna and Roy (2005) in water melon.

It was found that application of mulching material had produced a significant effect on acidity per cent in fruit of watermelon than control. Among all the treatments of mulching significantly minimum acidity were observed in treatment silver mulch over control. The present findings were in accordance with Sharma and Agarwal, Narendra (2004) and Aruna (2007) in tomato. The total soluble solids (%), reducing sugar (%), total sugars (%) and non-reducing sugar (%) were significantly increased that the control. Among all treatments of mulching, maximum TSS, reducing sugars, total sugar and non-reducing sugar of water melon were observed in treatment silver mulch. While, the minimum sugar content of watermelon fruit was observed in control treatment. The present findings were in close confirmation with Ansary and Roy (2005) in watermelon, Sharma and Agarwal, Narendra (2004) and Aruna *et al.,* (2007) in tomato.

It was observed from Table 3 that highest net return with maximum CBR was obtained with treatment silver mulch followed by black mulch. The lowest net return with minimum CBR was obtained in control (no mulch). The net realization was increased due to different mulches as compared to control treatment. The treatment of silver mulch recorded higher fruit yield through higher net realization. These findings are in close agreement with the results of Singh *et al.,* (2006) in cabbage, Suresh and Ashok Kumar (2006) in pointed gourd and Balraj Sing *et al.,* (2007) in bitter gourd.

It is concluded that application of mulches over control is beneficial to farmers. Higher the CBR, needs to be adopted first by farmers based on availability of mulch material and other priority criteria.

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How to cite this article:

Dadheech, S., Ramawtar and Yadav, C.M. 2018. Impact of Mulching Material on the Growth, Yield and Quality of Watermelon (*Citrullus lonatus*). *Int.J.Curr.Microbiol.App.Sci.* 7(07): 2774-2782. doi: https://doi.org/10.20546/ijcmas.2018.707.324