

Impact of Different Mulching Materials on the Growth and Yield of tomato (*Solanum lycopersicum*) in Dehradun region of Uttarakhand

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Abstract— Field trials were carried out in 2013-2014 cropping seasons to assess the impact of different mulching materials on the growth and yield of tomato (*Solanum lycopersicum*) in Dehradun (Uttarakhand) region of India. The crop growth and fruit yield were studied for two cultivars namely Cherry Tomato and Marglobe under two inorganic mulches (black polythene, white polythene) and four organic mulches (FYM, rice straw, dry leaves, sugarcane trash) and compared with unweeded control. Four competitive plants were randomly selected from each treatment to record data on various parameters. The experiment comprising these treatments was laid out as factorial randomized block design with three replications. It was observed that among all the treatments black polythene mulch showed significantly higher plant height (89.92 cm, 59.17 cm) and (97.17 cm, 63.42 cm) after 30 and 45 days respectively, number of trusses per plant (109 and 6.33), number of fruits per truss (14.50 and 6.42) and weight of immature and mature fruits (4.59 gm and 6.73 gm) and (42.08 gm and 54.25 gm) in Cherry Tomato and Marglobe varieties. Among all the treatments, black polythene mulch was found to be the best for tomato cultivation in Dehradun (Uttarakhand) region of India.

Keywords— Tomato, Truss, Growth, Yield, Organic mulch, Plastic mulch.

I. INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is one of the most important vegetable crop belongs to the family Solanaceae. It is rich source of vitamin A, B and iron. It is mostly used for fresh vegetable, salad and processing products like puree, ketchup, sauce etc. It is an important off season crop of Uttarakhand area. Due to terrace cultivation and rainfed irrigation system water is a major constraint and there is a need to conserve moisture. Moreover, labour is a big constraint in this area. Therefore, use of mulches is imperative to conserve soil moisture, reduce weed growth, improves the fruit yield,

productivity as well as reducing production cost. Since, the land holdings are very small in this region; therefore, there is a need of conservation farming and sustainable agriculture to improve the environment. There are several organic and inorganic mulches, but due to the property of reflectance of plastic mulches, they are used more or much beneficial to minimize the incidence of viral diseases and deter the approach to some species of insect-pests. The potential of mulches to improve soil structure, increase organic matter, and establish patterns of nutrient cycling more similar to natural ecosystems has been recognized. Polyethylene mulches have induced large increases in growth and yields for tomato. (Samih M. Abubaker, 2013). However, it is also needed to find out which mulch is good. Use of mulches for crop offers great scope to plant growth by improving water infiltration, retention, and reducing runoff. It reduces and controls soil erosion by providing a cover on the soil surface (Erenstein, 2002).

Keeping in view, the present investigations were carried out with the objective of studying the “Impact of different mulching materials on the growth and yield of tomato (*Solanum lycopersicum*) in Dehradun region of Uttarakhand”.

II. MATERIALS AND METHODS

A field experiment was carried out at Research Area, Department of Horticulture, DCAST, Selaqui, Dehradun (Uttarakhand) during 2013-2014 cropping season. This experiment was consisted of two varieties namely Cherry tomato and Marglobe with seven mulching treatment combinations viz. black polythene mulch (BPM), white polythene mulch (WPM), farmyard manure mulch (FYM), rice straw mulch (RSM), dry leaves mulch (DLM), sugarcane trash mulch (STM) and no mulch (control). The experimental design was factorial RBD and each treatment was replicated thrice. Plants height, were measured with the help of measuring tape after 30 and 45 days of transplanting from four plants in each replication

of different treatments. Numbers of trusses per plant, number of fruits per truss were counted manually and carefully after the onset of fruiting stage in both the varieties. The tomatoes were harvested at two different stages of development i.e. green (immature) and red (mature) and weighed using an electronic weighing machine. Harvested tomatoes used for weighing were uniform, healthy and free from insect-pests, diseases and bruises. The data was analyzed at 5% level of significance statistically by using OPSTAT statistical software of Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana.

III. RESULTS AND DISCUSSION

A significant effect on plant height at 30 days after transplanting was found for varieties, mulches and their interaction as shown in Table 1. The maximum value was found in Cherry Tomato (77.33 cm) which was significantly higher than Marglobe Variety (53.52 cm). Maximum value among mulches, plant height was found in black polythene mulch (74.77 cm) which was at par with farmyard manure mulch and higher than all other treatments, whereas minimum was observed in control (51.78 cm). The interaction data reveals that tallest plants (89.92 cm) were observed with black polythene mulch in Cherry Tomato variety which was at par with farmyard manure mulch in the same variety and found higher with all the treatment combinations. However, minimum plant height (40.89 cm) was observed with control in Marglobe Variety.

Comparison of data in Table 2 reveals that significant variations were found on plant height at 45 days after transplanting for varieties, mulches and their interaction. Maximum value was observed in Cherry tomato (84.57 cm) which was significantly higher than Marglobe variety (56.78 cm). Tallest plants were found in black polythene mulch (80.29 cm) which was at par with farmyard manure mulch and higher than all other treatments, whereas shortest was observed in control (56.25 cm). Interaction effect of varieties with mulches reveals that tallest plants were found with black polythene mulch (97.17 cm) in Variety Cherry tomato which was at par with farmyard manure mulch in the same variety and found higher with all the treatment combinations. However, minimum plant height (42.92 cm) was observed with control in Marglobe variety. Maximum plant height was recorded with polythene mulch due to their warming effect of polythene mulch as compare to other organic mulch or control (Ham *et al.*, 1993). Higher soil temperatures increase nutrient availability, enhance nutrient uptake by roots, increase the number and activity of soil microorganisms, and speed up plant germination and growth (Larios *et al.*, 1998). Similar results were obtained by Kayum *et al.* (2008), that

mulching had significant effects on plant growth components.

Significant effects were found on number of trusses per plant for varieties, mulches and their interaction (Table 3). Maximum value was observed in Cherry tomato (75.80) which was significantly higher than Marglobe variety (5.20). Maximum value w.r.t mulches were found in black polythene mulch (57.67) which was higher than all other treatments, whereas minimum was observed in control (32.88). Interaction effect of varieties with mulches reveals that maximum trusses were found with black polythene mulch (109.00) in Cherry tomato which was found higher than all the treatment combinations. However, minimum value (4.57) was observed with control in Marglobe variety. This might be due to inherent genetic characteristics. However, maximum number of trusses/plant was recorded with polythene mulch due to increase the moisture content of the soil through decreased evaporation and surface runoff with consequent increase in yield and crop yield components (Gudugiet *al.*, 2012).

Table 4 shows significant results w.r.t number of fruits per truss among cultivars, mulches and their interaction. Maximum fruits were found in Cherry tomato (12.33) which was higher than Marglobe variety (4.64). Comparison of different mulches showed that maximum value (10.46) was found with black polythene mulch which was significantly higher than other mulching treatments, whereas minimum value was found in control (6.58). Maximum value (14.50) was observed with black polythene mulch in Cherry tomato which was at par with white polythene mulch in the same variety and found higher with all mulches in both the varieties. However, minimum number of fruits per truss was observed with control (3.25) in Marglobe variety. Similar results were obtained by Hedau *et al.* (2010) that among mulches, black polyethylene treatment produced significantly higher fruit yield and number of fruits per plant than organic mulches and no mulch this might be the result of weed free field, less nutrient loss through leaching favourable soil temperature and moisture, these findings are in agreement with and Kashyap *et al.* (2009). Nikolic *et al.* (2012) have also reported similar results that highest number of fruits per plant was recorded in the plants grown on the plastic mulch than those on organic mulches and control (no mulch). Similar findings were also obtained mulched and non-mulched plots by Hudu *et al.* (2002), Rajbir Singh (2005), Aruna *et al.* (2007), Nagalakshmi *et al.* (2002).

It is clear from the Table 5 that significant variations were observed on weight of immature/ green tomatoes w.r.t cultivars, mulches and their interactions. Maximum value of fruits weight was observed by Marglobe variety

(36.86g) which was higher than Cherry tomato (3.64g). Maximum value w.r.t mulches was found in black polythene mulch (23.34g) which was at par with all other treatments except sugarcane trash mulch and control, whereas minimum value was observed in control (14.74g). The interaction data reveals that maximum weight of immature fruits (42.08g) were observed with black polythene mulch in Marglobe variety which was at par with white polythene mulch and farmyard manure mulch in the same variety and found higher with all the treatment combinations. However, minimum value of fruits weight (3.03g) was observed with control in Cherry tomato variety.

Significant effects were found on weight of mature/ red tomatoes w.r.t cultivars, mulches and their interactions (Table 6). Maximum value was observed in Marglobe variety (49.25g) was significantly higher than Cherry tomato variety (4.35g). Maximum value w.r.t mulches were found in black polythene mulch (30.48g) which was at par with white polythene mulch and found higher than all other treatments, whereas minimum was observed in control (23.64g). Interaction effect of varieties with mulches reveals that maximum weight of fruits was found with black polythene mulch (54.25g) in Marglobe variety which was at par with white polythene mulch and dry leaves mulch in the same variety. However, minimum value (3.29g) was observed with control in Cherry tomato. Agrawal *et al.* (2010) observed that weight of fruits under mulch conditions was found to be highest and same characters were lowest in control or no mulch treatments. This increase in tomato yield may be due to the better development of roots and vegetative growth, better nutrients uptake in mulched plots, and less normal leaching of nitrogen. Similarly Nikolic *et al.* (2012) reported the highest weight of fruits was achieved by mulching the soil with the plastic mulch and the lowest with cultivation on the soil (control). Similarly, Baye (2011) reported that tomato grown under plastic mulches resulted in significant increase in yield, earliness and fruit quality.

IV. CONCLUSION

Significant effects of soil mulches on the investigated tomato cultivars parameter including plant height, number of trusses per plant, number of fruits per truss, weight of immature/ green tomatoes and weight of mature/ red tomatoes under Dehradun (Uttarakhand) region of India. Due to hilly area some parameters like soil erosion and cultural practices may be very difficult to control soil and plant ecosystem and weeds control, so there is need to conserve the soil and plant environment by using mulches. From the results of this study, it could be concluded that black polythene mulch showed the general

desirable impacts under this region on tomato growth and yielding performance.

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Table. 1: Effect of mulches on Plant height after 30 days of transplanting (cm) of cultivars Cherry tomato and Marglobe

Variety	Mulches							Mean
	BPM	WPM	FYM	RSM	DLM	STM	CONTROL	
Cherry	89.92	81.21	85.25	73.50	79.67	69.08	62.67	77.33
Marglobe	59.17	56.75	61.25	61.25	54.50	49.67	40.89	53.52
Mean	74.77	68.99	73.25	62.96	67.08	59.38	51.78	
Treatments	CD (P=0.05%)			SE(d)			SE(m)	
Varieties	1.77			0.86			0.61	
Mulches	3.32			1.61			1.14	
Varieties x Mulches	4.69			2.28			1.61	

Where, **BPM** = black polythene mulch, **WPM** = white polythene mulch, **FYM** = farmyard manure mulch, **RSM** = rice straw mulch, **DLM** = dry leaves mulch, **STM** = sugarcane trash mulch and **CONTROL** = no mulch.

Table. 2: Effect of mulches on Plant height after 45 days after transplanting (cm) of cultivars Cherry tomato and Marglobe

Variety	Mulches							Mean
	BPM	WPM	FYM	RSM	DLM	STM	CONTROL	
Cherry	97.17	88.58	93.42	81.00	86.75	75.50	69.58	84.57
Marglobe	63.42	60.50	65.92	55.58	56.83	52.33	42.92	56.78
Mean	80.29	74.54	79.67	68.29	71.79	63.92	56.25	
Treatments	CD (P=0.05%)			SE (d)			SE (m)	
Varieties	1.72			0.84			0.59	
Mulches	3.23			1.57			1.11	
Varieties x Mulches	4.56			2.22			1.57	

Where, **BPM** = black polythene mulch, **WPM** = white polythene mulch, **FYM** = farmyard manure mulch, **RSM** = rice straw mulch, **DLM** = dry leaves mulch, **STM** = sugarcane trash mulch and **CONTROL** = no mulch.

Table.3: Effect of mulches on Number of trusses/plant of cultivars Cherry tomato and Marglobe

Variety	Mulches							Mean
	BPM	WPM	FYM	RSM	DLM	STM	CONTROL	
Cherry	109.00	101.00	75.08	64.83	67.33	61.18	52.13	75.80
Marglobe	6.33	6.00	5.67	5.08	5.33	4.57	3.42	5.20
Mean	57.67	53.50	40.38	34.96	36.33	32.88	27.76	
Treatments	CD (P=0.05%)			SE (d)			SE (m)	
Varieties	1.75			0.85			0.60	
Mulches	3.28			1.59			1.13	
Varieties x Mulches	4.64			2.26			1.59	

Where, **BPM** = black polythene mulch, **WPM** = white polythene mulch, **FYM** = farmyard manure mulch, **RSM** = rice straw mulch, **DLM** = dry leaves mulch, **STM** = sugarcane trash mulch and **CONTROL** = no mulch.

Table.4: Effect of mulches on Number of fruits/truss of cultivars Cherry tomato and Marglobe

Variety	Mulches							Mean
	BPM	WPM	FYM	RSM	DLM	STM	CONTROL	
Cherry	14.50	14.08	13.67	11.75	12.17	10.67	9.92	12.33
Marglobe	6.42	5.17	4.75	4.25	4.67	4.00	3.25	4.64
Mean	10.46	9.63	9.21	8.00	8.42	7.33	6.58	
Treatments	CD (P=0.05%)			SE (d)			SE (m)	
Varieties	0.27			0.13			0.93	
Mulches	0.51			0.25			0.17	
Varieties x Mulches	0.71			0.35			0.24	

Where, **BPM** = black polythene mulch, **WPM** = white polythene mulch, **FYM** = farmyard manure mulch, **RSM** = rice straw mulch, **DLM** = dry leaves mulch, **STM** = sugarcane trash mulch and **CONTROL** = no mulch.

Table.5: Effect of mulches on Weight of immature (green) tomatoes (g) of cultivars Cherry tomato and Marglobe

Variety	Mulches							Mean
	BPM	WPM	FYM	RSM	DLM	STM	CONTROL	
Cherry	4.59	4.17	3.70	3.27	3.48	3.21	3.03	3.64
Marglobe	42.08	40.37	39.01	37.00	41.12	31.96	26.45	36.86
Mean	23.34	22.27	21.36	20.14	22.30	17.59	14.74	
Treatments	CD (P=0.05%)			SE (d)			SE (m)	
Varieties	1.23			0.59			0.42	
Mulches	2.30			1.12			0.79	
Varieties x Mulches	3.26			1.58			1.12	

Where, **BPM** = black polythene mulch, **WPM** = white polythene mulch, **FYM** = farmyard manure mulch, **RSM** = rice straw mulch, **DLM** = dry leaves mulch, **STM** = sugarcane trash mulch and **CONTROL** = no mulch.

Table.6: Effect of mulches on Weight of mature (red) tomatoes (g) of cultivars Cherry tomato and Marglobe

Variety	Mulches							Mean
	BPM	WPM	FYM	RSM	DLM	STM	CONTROL	
Cherry	6.73	4.89	4.12	3.74	3.99	3.67	3.29	4.35
Marglobe	54.25	51.98	48.68	48.65	52.26	44.98	43.98	49.25
Mean	30.48	28.44	26.40	26.20	28.13	24.33	23.64	
Treatments	CD (P=0.05%)			SE (d)			SE (m)	
Varieties	1.15			0.56			0.39	
Mulches	2.16			1.05			0.74	
Varieties x Mulches	3.06			1.49			1.05	

Where, **BPM** = black polythene mulch, **WPM** = white polythene mulch, **FYM** = farmyard manure mulch, **RSM** = rice straw mulch, **DLM** = dry leaves mulch, **STM** = sugarcane trash mulch and **CONTROL** = no mulch.