



Effect of different types of mulching on biochemical parameters of tomato (*Solanum lycopersicum*)

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ABSTRACT

Different mulching treatments consisting of two inorganic (black polythene, white polythene) and four organic mulches (FYM, rice straw, dry leaves, sugarcane trash) along with control (without mulching) were used to study their effect of biochemical parameters in two tomato (*Solanum lycopersicum* L.) varieties (Cherry tomato and Marglobe). The experiment was conducted at Research Area, Department of Horticulture, DCAST, Selaqui, Dehradun (Uttarakhand) during 2013-2014. Experiment was laid out in factorial randomized block design with seven treatment combinations and each treatment was replicated thrice. It was observed that among all the treatments black polythene mulch showed significantly higher TSS (6.78 °Brix and 6.64 °Brix) and lycopene content (0.39 mg/kg and 0.38 mg/kg) in Cherry tomato and Marglobe varieties. The pH of immature (4.43, 4.57) and mature fruits (4.23, 4.23) was found higher with sugarcane trash mulch in both the varieties followed by other mulches. Among all the treatments, black polythene mulch was found to be the best for tomato cultivation.

Key words: Cherry tomato, Lycopene, Mulching, pH, Tomato Marglobe

Tomato (*Solanum lycopersicum* L., 2n=2x=24) is one of the most important solanaceous vegetable crop. Scarcity of water resources and competition for water in many sectors reduce its availability for agriculture use. Considering water scarcity more intense in future, the planning and management for this resource for its optimal, economic and judicious use has become very important for sustaining its availability for agricultural use. Now a day application of mulch is becoming very popular and very good results have been achieved. Use of mulches for early crop offers great scope in conserving moisture and reducing soil temperature (Hooda *et al.* 1999). Mulching reduces the deterioration of soil by way of preventing the runoff and soil loss, minimizes the weed infestation and checks the water evaporation. Sharma and Agrawal (2004) investigated the effect of drip irrigation combined with different coloured plastic mulches on the growth, yield and quality of tomato and found maximum total soluble solids, acidity, juice, moisture, pericarp thickness and weight of fruits in plastic mulches as compared to non-mulched treatment. Plastic mulches are used in many horticultural crops to raise soil temperature, suppress weeds and conserve soil water (Brault *et al.* 2002). Beneficial effects of organic and synthetic mulches for crop production have been widely demonstrated by Ravi and Lourduraj (1996).

Pohrib *et al.* (2011) reported that mulching had a positive and significant effect on fruit quality of tomato cv. Amanda F1. Keeping the above factors in view, the present study was carried out to study the effect of mulching on biochemical parameters of tomato.

MATERIALS AND METHODS

A field experiment was carried out at Research Area, Department of Horticulture, DCAST, Selaqui, Dehradun (Uttarakhand) during 2013-14 cropping season. These experiment was consisted of two varieties namely, Cherry tomato and Marglobe and 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. Fruits of two tomato varieties from different treatments were harvested during morning hours and tested in the laboratory for recording the mulching effects on different biochemical parameters like pH of the fruits at green (immature) and red (mature) stage using Digital pH Meter, TSS of the fruits using Erma Hand Portable Refractometer (°Brix 0-32) and lycopene content using spectrophotometer by extraction with hexane/ethanol/acetone and absorbance measurement at 503 nm using the given formula.

Lycopene (mg/kg fresh wt.) = $(A_{503} \times 537 \times 8 \times 0.55) / (0.10 \times 172)$

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where, 537 g/mole is the molecular weight of lycopene, 8 mL was the volume of mixed solvent, 0.55 was the volume ratio of the upper layer to the mixed solvents, 0.10 g was the weight of tomato added, and 172 mM^{-1} was the extinction coefficient for lycopene in hexane. The data was analyzed statistically using ANOVA by using OPSTAT statistical software.

RESULTS AND DISCUSSION

A significant effect on pH of immature/green fruits was found for varieties, mulches and their interaction as shown in Table 1. The maximum value was found in Marglobe (4.18) variety which was significantly higher than Cherry tomato (4.12). Maximum value was found in sugarcane trash mulch (4.50) which was at par with rice straw mulch and dry leaves mulch. However, minimum was observed in control (4.08). Maximum value was observed in both dry leaves mulch (4.57) and sugarcane trash mulch (4.57) in Marglobe variety which was at par with rice straw mulch and found significantly higher than other treatments. However, minimum pH was found in control (4.04) in Cherry Tomato which was at par with black polythene mulch in the same variety.

It is clear from the Table 2 that non-significant results were obtained among the cultivars w.r.t pH of mature/red fruits. Significant results were found among the mulches in which maximum pH was found in sugarcane trash mulch (4.23) which was at par with all the mulching treatments

except control (4.16) in which minimum value was observed. Non-significant effect was observed with interaction between varieties and mulches. Organic mulches lead to better quality and higher pH due to higher uptake of potassium, higher moisture regime, maintenance of optimum level of soil temperature, reduction in temperature fluctuation, stimulation of surface rooting, efficient exploitation of surface soil and utilization of soluble potassium. Organic mulching increased the pH of pulp of tomatoes as compared to plastic mulches and non mulched treatments. Similar findings were found by Borthakur and Bhattacharya (1992) and Cozzolino *et al.* (2010). According to Sharma and Agrawal (2004) and Aruna (2007) among all the treatments of mulching, minimum acidity was observed in sugarcane trash mulching followed by polythene mulches over control. These are also in accordance with Parmar *et al.* (2013).

Table 3 shows significant results w.r.t TSS of mature/red tomatoes among cultivars, mulches and their interaction. Maximum TSS was found in Marglobe variety (6.19 °Brix) which was higher than Cherry tomato (6.00 °Brix). Comparison of different mulches showed that maximum value (6.71 °Brix) was found with black polythene mulch which is significantly higher than other mulching treatments, whereas minimum value was found in control (5.52 °Brix). Maximum value was found in Cherry Tomato (6.78 °Brix) with black polythene mulch which was at par with similar mulching treatment in Marglobe variety and

Table 1 pH of immature/green fruits of cultivars Cherry tomato and Marglobe

Variety	Mulches							Mean
	BPM	WPM	FYM	RSM	DLM	STM	Control	
Cherry	4.17	4.21	4.33	4.40	4.30	4.43	4.04	4.12
Marglobe	4.30	4.37	4.40	4.53	4.57	4.57	4.09	4.18
Mean	4.24	4.29	4.37	4.47	4.43	4.50	4.08	
<i>Treatments</i>	<i>CD (P=0.05)</i>			<i>SE (d)</i>		<i>SE (m)</i>		
Varieties	0.04			0.02		0.02		
Mulches	0.07			0.05		0.03		
Varieties × Mulches	0.13			0.07		0.05		

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 pH of mature/red fruits of cultivars Cherry tomato and Marglobe

Variety	Mulches							Mean
	BPM	WPM	FYM	RSM	DLM	STM	Control	
Cherry	4.18	4.19	4.20	4.22	4.21	4.23	4.15	4.18
Marglobe	4.18	4.19	4.19	4.21	4.20	4.23	4.17	4.20
Mean	4.18	4.19	4.19	4.21	4.20	4.23	4.16	
<i>Treatments</i>	<i>CD (P=0.05)</i>			<i>SE (d)</i>		<i>SE (m)</i>		
Varieties	NS			0.07		0.01		
Mulches	0.06			0.03		0.02		
Varieties × Mulches	NS			0.04		0.03		

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 TSS of mature/red fruits of cultivars Cherry tomato and Marglobe

Variety	Mulches							Mean
	BPM	WPM	FYM	RSM	DLM	STM	Control	
Cherry	6.78	6.49	6.18	5.77	6.00	5.53	5.28	6.00
Marglobe	6.64	6.40	6.25	6.03	6.18	6.10	5.75	6.19
Mean	6.71	6.44	6.22	5.90	6.09	5.82	5.52	
<i>Treatments</i>	<i>CD (P=0.05)</i>			<i>SE (d)</i>			<i>SE (m)</i>	
Varieties	0.13			0.06			0.04	
Mulches	0.24			0.12			0.08	
Varieties × Mulches	0.34			0.17			0.01	

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.

with white polythene mulch in Cherry Tomato itself. However, minimum value was found with control (5.28 °Brix) in Cherry Tomato. This may be due to the reason that black mulch warms the soil by absorbing light then transferring heat by conduction to the underlying soil. Temperature has direct influence on metabolism and thus, indirectly affects cellular structure and other components which determine fruit texture (Sams 1999). Similarly Rashidi and Gholami (2011), Hedeau *et al.* (2010), Sharma and Agarwal (2004) and Agarwal (2010) reported that maximum TSS of fruits was found in plastic mulches as compared to other mulches.

Non-significant results were shown within the cultivars w.r.t lycopene content of mature/red tomatoes as shown in Table 4. Significant results were shown among the different types of mulches. Maximum lycopene content was found in black polythene mulch (0.39 mg/kg) which was at par with white polythene mulch and was higher than other mulching treatments. However, minimum content was observed in control (0.25 mg/kg). Maximum lycopene content was found in Cherry Tomato (0.39 mg/kg) with black polythene mulch which was at par with white polythene mulch, farmyard manure mulch itself and black polythene mulch and white polythene mulch in Marglobe and significantly higher than other interaction treatments. However, minimum content was found in Marglobe (0.25 mg/kg) with control. This may be due to the reason that black polythene mulches prove to be better for increase in

lycopene content. As lycopene is one of the biochemical precursors of β -carotene. It would be reasonable to conclude that weed interference would have similar effect on antioxidants from which β -carotene is synthesized. Thus lack of effective weed management may responsible for significant differences measured in lycopene concentrations. Similar findings were observed by Horvat *et al.* (2010) and Pohrib *et al.* (2011). Worthington (1998) speculated that higher the soluble solids in tomato could be the indicative of higher concentrations of ascorbic acids and total phenolics but the correlation between soluble solids and antioxidants is not well established. Further investigation on the role that water content plays in eventual concentrations of nutritional compound would be useful in establishing causative relationships. The variation in the redness is mainly due to a difference in levels of lycopene accumulated in their skin.

Comparison of the treatments revealed the fact that the black polythene mulch shows significantly higher TSS and Lycopene content in both the varieties (Cherry tomato and Marglobe). pH of immature and mature fruits was found higher with sugarcane trash mulch in both the varieties followed by polythene mulches in both the varieties, respectively. Among all the treatments, mulching proved better as compared to non-mulched treatments with all the parameters and black polythene mulch is best for tomato cultivation as these enhance the plant growth and development, increase yield, decrease soil evaporation and

Table 4 Lycopene content of mature/red fruits of cultivars Cherry tomato and Marglobe

Variety	Mulches							Mean
	BPM	WPM	FYM	RSM	DLM	STM	Control	
Cherry	0.39	0.38	0.35	0.34	0.30	0.33	0.26	0.34
Marglobe	0.38	0.37	0.34	0.32	0.31	0.32	0.25	0.33
Mean	0.39	0.37	0.35	0.33	0.31	0.32	0.25	
<i>Treatments</i>	<i>CD (P=0.05)</i>			<i>SE (d)</i>			<i>SE (m)</i>	
Varieties	0.02			0.01			0.01	
Mulches	0.03			0.01			0.01	
Varieties × Mulches	0.04			0.02			0.01	

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.

nutrient leaching, reduce incidence of pests, weeds, and also improve fruit cleanliness and quality. Plastic mulches have the potential to alter soil temperatures, reduce crop water use, improve crop quality and control weeds, thereby improving crop development and increase yields.

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