

Short Communication

Effect of black plastic mulch on soil temperature and tomato yield in mid hills of Garhwal Himalayas

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The effect of soil mulching with black plastic sheets on soil temperature and tomato yield was evaluated in the temperate region of Uttarakhand. The experiment was carried out from May to September, of the year 2006, 2007 and 2008 in a 5 × 1.8 m size plot with ten replications. Highest soil temperature was obtained under the black plastic mulch during the early growth season due to less shade on the surface. The difference in temperature between mulched and bare soil was 2.2 to 3.4°C. Black plastic mulch significantly affects the tomato yield. The yield increased with black plastic mulch from 20.7 to 29.8% as compared to bare soil.

Key words: Tomato, soil temperature, black plastic mulch, yield.

INTRODUCTION

Tomatoes are an important solanaceous vegetable that belongs to the nightshade family of plants, a family that includes potato, tomato, and tobacco. Tomatoes play a vital role in Indian diet by virtue of its nutrients, delicious taste and various modes of consumption and uses. It is popular used in the process of preparing food such as: soup, ketchup and it gives flavor to the food. Various factors affect the quality and yield of tomatoes, among which are inadequate use of available moisture and nutrients, and inhospitable temperature. Plastic mulches are used in many horticultural crops to raise soil temperature, suppress weeds and conserve soil water (Brault et al., 2002). Traditionally, plastic mulches are black and white. Black plastic mulch is often used to warm soil early in the season. Soil mulching not only reduces the soil evaporation and weed growth but also improves the aerial environment around the plants which facilitate plant growth and yield. Use of mulches for early crop offers great scope in such a situation because of conserving moisture and improving soil temperature (Hooda et al., 1999). The high market price is attributed to the heavy demand from the urban consumers and has

become money spinner for the hill farmers wherein ideal climatic conditions facilitate its off-season production during the period (June-October) when the crop does not grow well in the adjoining plains on account of unfavorable temperature. The objective of this experiment was to determine the effects of black plastic mulch on soil temperature and yield for tomato plants in mid hills of the Garhwal Himalayas.

MATERIALS AND METHODS

Location and materials used

The present experiment was carried out at the farm of Krishi Vigyan Kendra in Jakhdhar, Rudraprayag (an altitude of 1718 m and Northern latitude of 30°19'), during three summers seasons of 2006, 2007 and 2008. High yielding indeterminate tomato hybrid, that is, Naveen 2000⁺ was planted and 100 µm thick black recycled. Low Density Polyethylene (LDPE) sheet was used for mulch in this experiment.

Experimental design and fertilizer treatments

After preparing the field, the raised beds, measuring 5 × 1.8 × 0.15 m were arranged in a Randomized Complete Block Design (RCBD) with ten replications. Full doses of Farmyard Manure (FYM) at 250 quintal/hectare (q/ha) and 50 kg N/ha, 60 kg P/ha and 60 kg K/ha were applied before laying the black plastic mulch on the bed. Each

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Table 1. Effect of black plastic mulch on soil temperature.

Month	Soil temperature (°C) at 10 cm depth					
	2006		2007		2008	
	Bare soil (without mulch)	Mulched with black plastic	Bare soil (without mulch)	Mulched with black plastic	Bare soil (without mulch)	Mulched with black plastic
May	31.4	34.1	30.9	33.8	31.9	34.4
June	31.1	33.7	30.8	33.2	31.7	33.9
July	30.8	33.4	30.1	32.3	29.8	32.2
August	29.4	32.8	28.9	31.8	29.1	31.8
September	28.3	31.2	27.8	30.4	28.8	31.4

Average of monthly soil temperature taken in °C.

plot had three rows with ten tomato plants (30 plants). Seedlings of 4 leaf stage were planted using 60 × 50 cm plant spacing. Then 10 kg of N/ha were applied as foliar spray by dividing it into two equal parts during the plant growth.

Soil characteristics and yield measurements

Soil temperature was measured throughout the plant growth period using mercury-in-glass geothermometers in one plot of each mulching treatment. Geothermometers were buried at 10 cm depths in the mulched plots within rows of tomato plants. Daily soil temperature measurements were taken at 11: 00 am local standard time. Crop yield was determined on the basis of area per plot and converted into quintals (100 kg/ha).

RESULTS AND DISCUSSION

Effect of black plastic mulch on soil temperature

Soil Temperature and yield of tomato was significantly improved with mulching over control. The highest soil temperature occurred under black polyethylene which was 2.2 to 3.4°C more than the bare soil (Table 1). In general, this effect was more evident during the early crop season when tomato plants shaded less soil surface. Black

plastic mulches are more effective in increasing soil temperature due to a greater net radiation under the mulch compared to bare soil (Streak et al., 1994). Consequently, the soil heat flux is substantially greater under mulch. The effect of mulching material on soil temperature obtained in this study is in agreement with those reported by other researchers (Haynes, 1987).

Effect of black plastic mulch on yield of tomato

The yields from plants grown on bare soil were significantly lower than those from plants grown with black plastic mulch. The yield increase in black plastic mulch was 21.7 to 29.8% as compared to bare soil (Figure1). This is consistent with the observations of Decoteau et al. (1989), who obtained higher tomato yield with black plastic mulch than with bare soil. Black plastic mulch increased pod yield of okra by 29.65% over no mulch (Patel et al., 2009). The difference in tomato yield in the present study appears to be related to the differences in far-red/red (FR/R) ratios received by the plants. In previous investigations, modifications in plant growth patterns by very subtle changes in FR/R ratios have been documented in the field (Bradburne et al., 1989).

Nevertheless, the change in FR/R ratio is not the only factor determining photosynthate partitioning and yield. Higher soil temperature, efficient water utilization, fertilizers and reduction in the competition with weeds are other reasons which may help in increasing the yield (Clarkson, 1960). Black plastic mulch affects the nitrate leaching which is indirectly related to the yield. Some researchers noticed that black plastic mulch is an enduring and impermeable material which protects the bed from nitrate leaching in the rainy season, when the highest nitrate leaching normally occurs on uncovered soil (Romic et al., 2003). The result of the present findings are in accordance with those of the earlier researchers who reported significantly higher yield under black plastic mulch as a result of effective soil temperature, weed control and conservation of soil moisture (Singh et al., 2005; Mehta et al., 2010).

Conclusion

These studies have demonstrated the benefits of black plastic mulching on tomato yield. Mulching resulted in 21.7 to 29.8% increase in fruit yield as compared to bare soil. It also increases the soil temperature which helps in establishing the early planting of tomato plants in cold areas.

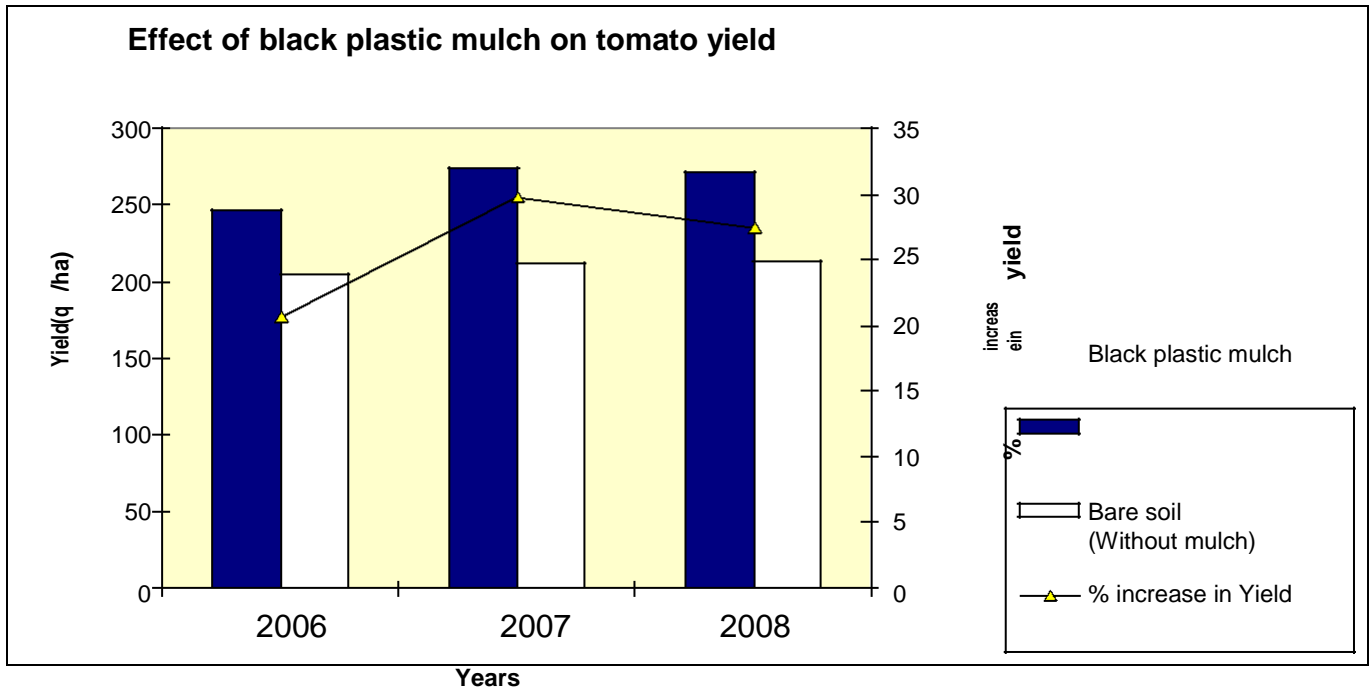


Figure 1. Effect of black plastic mulch on tomato yield.

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