

Effect of Black Plastic Mulching on Yield of Tomato

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Abstract

The use of polyethylene mulch has increased dramatically in the last few years because they have many benefits viz., increase in soil temperature especially in early spring, reduced weed problem, moisture conservation and increased crop yields. Field experiments were conducted to maximize total yield of tomato (*Lycopersicon* Mill.) using black polyethylene mulch (BPM). Tomato variety *Arka Rakshak* having triple disease resistance against tomato leaf curl virus, bacterial wilt and early blight. Unmulched treatments under recommended N:P₂O₅:K₂O dose of 120:200:200 yielded an average of 47.74 t/ha for 'Arka Rakshak' which was significantly higher than the widely cultivated var. 'Rocky' (32.20 t/ha) in the study area. With BPM, highest yield was recorded as 55.3 t/ha in var. *Arka Raksha* which was significantly higher than cultivar *Rocky* (37.2 t/ha). A significant increase in yield was recorded over control (no mulch) in both the cultivars.

Keywords: Tomato, Black plastic mulch, Unmulch, Triple disease resistance, Cultivars.

Introduction

Tomato (*Solanum lycopersicum* L.) belongs to the family *Solanaceae* is one of the most popular and widely grown vegetables in the world second to potato. China is the leading producer of tomato in the world with a production of 418.8 lakh MT in an area of 8.7 lakh ha with a productivity of 48.1 MT/ha during 2010-11 (Anon., 2011). India stands second in the production of tomato with a production of 168.3 lakh MT in an area of 8.6 lakh ha and with a productivity of 19.5 MT/ha (Anon., 2011). The productivity in India as compared to China is very low due to less adoption of hybrids, biotic and abiotic factor. . So, improvement in yield of tomato is necessary. Among biotic factors, diseases like Tomato Leaf Curl Virus (ToLCV), Bacterial wilt (BW) and early blight (EB) have become very serious

causing considerable yield loss up to 70-100 per cent in major tomato growing areas of the country if uncontrolled associated with high rainfall & relative humidity particularly in Assam condition, since chemical control in fresh market fruits faced with limitations. Due to ToLCV, yield loss has been reported up to 70-100% depending on the stage of attack, bacterial wilt has been reported to cause yield loss up to 70%, whereas, early blight has become very serious on foliage and fruits causing yield loss up to 50-60% (Anon., 2011). However, in early spring, abiotic factors like low temperature and in summer, water deficit often limit growth and development of tomato. Hence, the use of Black plastic mulch becomes predominates in vegetable production system in recent years as it induces large increases in growth and yields for a variety of crops, including tomato (Emmert, 1957; Takotori *et al*, 1964; Vandenberg & Tiessen, 1972; MULLINS *et al.*, 1992; LAMONT Jr., 1993). These growth and yield increases have been attributed to changes in soil and air temperature near the cover, soil water balance, and nutrient availability compared to unmulched soil (CLARKSON & FRAZIER, 1957; CLARKSON, 1960; BRUNINI *et al.*, 1976; HAYNES, 1987), less soil compaction and hence improved aeration under mulched soil have also contributed to increased plant growth (EKERN, 1967; LAMONT Jr., 1993), soil moisture and weed control (Lamont, 2005; Zhang *et al.*, 2007; Brault *et al.*, 2002). Under these circumstances, the present study was undertaken to evaluate the role of black plastic mulch in growth and yield of tomato grown under low temperature in early spring and semi-arid conditions in winter along with a triple disease resistant tomato variety *Arka Rakshak* Assaam conditions.

Materials and Methods

The experiment was conducted consecutively in two years during the *rabi* season of 2015-16 and 2016-17 in farmers field of two different villages namely Punioni and Baghchung, Sonitpur, Assam to determine the effect of black plastic mulch on total yield and fruit weight of two fresh-market, field-grown tomato cultivars with four treatments. Before conducting the experiment technological gaps between actual and potential productivity were analyzed by interviewing the farmers. The experiment was carried out Factorial Randomized Block Design in an area of 0.26 ha. The factors were mulch treatment (mulching and without mulching), cultivars (*Arka Rakshak* and *Rocky*), with four replications. The site was fertilized with a recommended N: P₂O₅: K₂O dose of 120:200:200 kg/ha. Plots were divided into 1m × 30m on 15 cm high raised beds. Mulched plot were laid with black plastic mulch of 1.5 m wide and 30 mm density by hand, one day before transplanting of seedlings. 25 days old healthy seedlings were planted into 6-cm-diameter holes as a single row in the centre of mulched and non-mulched beds with a spacing of 1.2 m row to row and 90 cm plant to plant. Staking was provided to each plant. Watering was done when felt required.

After attaining the maturity plant height (cm), fruit weight (gm), number of fruit per plant and total yield/ha were recorded. Means that were significantly different according to an F test were separated by CD (at = 0.05).

Results and Discussion

Mulch and Soil Temperature

Soil temperature at 10 cm depth was different due to the presence of mulch. Temperature under black mulch was 4.3°C higher than that of the bare soil. Due to using plastic mulch soil temperature increased 2 to below 6°C compared to without plastic (Easson and Fearnough, 2000). The Soil warming during winter provided suitable conditions for growth of tomato seedlings.

Average fruit weight, average yield per plant & total yield

There was significant difference in the average fruit weight among mulch treatments (Table 1). Variety *Arka Rakshak* produces average fruit weight of (83.06 g) on black plastic mulch, which was significantly larger than fruit from variety *Rocky* (63.46g) with mulch. Decoteau et al. (1986) obtained the largest fruit on plants in the black plastic mulch treatments.

Application of black plastic mulches in tomato increased the yield per plant and total yield compared to non-mulched plots (Table 1). Higher yields in mulch treatments might be due to its effects on soil temperature, soil moisture and weed suppression. The highest total yield and yield per plant produced on black mulch with the variety *Arka Rakshak* were 55.30 t/ha & 7.33 kg respectively which is significantly higher than the variety *Rocky* with mulch (37.2t/ha, 3.81kg) as well as the unmulched treatments. Sing and Shashi (2012) obtained higher tomato yield with black plastic mulch than with bare soil. In the unmulched treatments also, there were significant differences in total yield of ‘*Arka Rakshak*’ and ‘*Rocky*’ when the treatments were compared. Our results on the effect of black plastic mulch on total yield are similar to those reported by Bhella (1988). Other published data on increases in total yield varied greatly. In other reports, increases in yield under BPM ranged from 13% (Wien and Minotti, 1987) to 69% (Ashworth and Harrison, 1983). Such yield differences in response to BPM have been attributed to environmental factors such as soil temperature and moisture (Taber, 1983).

Table 1. Interaction effect of variety and mulching on yield of tomato**(Mean of 4 replications)**

Sl. No.	Treatment	Average fruit weight (gm)	Average Yield/plant (kg)	Yield (q/ha)
1.	<i>Arkla Rakshak</i> with mulch	83.055	7.33	55.30
2.	<i>Arka Rakshak</i> without mulch	72.515	3.29	47.74
3.	<i>Rocky</i> with mulch	63.455	3.81	37.20
4.	<i>Rocky</i> without mulch	59.945	3.24	32.21
	CV	4.460	5.896	14.14
	CD (0.05)	4.989	0.418	9.471

Our results show that, in both the varieties '*Arka Rakshak*' and '*Rocky*', there was a significant increase in total yield under BPM over the control (Table 1). Plants on both treatments received similar cultural practices, particularly with respect to fertilizer and water applications. Higher soil temperatures under BPM than in unmulched treatments have been reported (Bhella and Kwolek, 1984). Variability in total yields of fresh-market tomato cultivars grown under BPM has been attributed to several factors, such as soil type and fertility, planting date, and cultural practices. Total yields ranged from 40.0 (Perry and Sanders, 1986) to 72.8 t/ha (Wien and Minotti, 1987). Major differences in total yield from year to year were also reported (Decoteau et al., 1989). The high total yields we obtained using BPM (55.30 t/h) are attributed to selecting high-yielding fresh-market cultivars, growing them under BPM, and using irrigation and applications of fertilizer, both of which are known to increase yields (Bhella, 1988)

Conclusion

The Present studies have demonstrated the benefits of black plastic mulching on tomato yield. Mulching resulted in 24 to 65% increase in marketable yield as compared to bare soil. It also increases the soil temperature, which helps in establishing planting of tomato plants in cold conditions. Black plastic mulch dramatically controlled weeds, conserve soil moisture and boost tomato yield. Thus, we recommend use of black mulch rather than bare soil during *rabi* season in Assam conditions.

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