EFFECTS OF MULCHES ON FLOWERING, FRUITING, YIELD AND PEST - DISEASE INCIDENCE OF TOMATO (LYCOPERSICON ESCULENTUM MILL.)

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INTRODUCTION

Tomato (Lycopersicon esculentum Mill.) is one of the world’s most popular vegetable crops and is available round the year. The total area under tomato cultivation in India is 880 (000’ha) with annual production of 18227(000’Mt) and productivity of 20.7 Mt/ha (Annony, 2013). Inspite of its wide cultivation, the average yield is rather low because little attention is paid towards scientific methods of production. In Marathwada region of Maharashtra state, cold winter is the main hindrance for planting tomato in winter to get early spring crop. Therefore, there was an urgent need to develop proper technology for getting early yield and consequently higher profits. Under such circumstances, use of mulches has been found beneficial (Hooda et al., 1999). Surface-applied mulches provide several benefits to crop production through improving soil moisture content, regulating soil temperature, improving nutrient status in soil, preventing soil and water loss, and weed control (Bu et al., 2002). Mulches may be composed of plant materials or they may be synthetic mulches consisting of plastic sheets (Anonymous, 2000). They also observed that mechanical furrow mulching decreased runoff, increased infiltration, increased irrigation efficiency, and decreased sediment load. Mulching was reported to have effect on growth characteristics such as height and girth. Significant increase in plant height and plant girth was observed when mechanical loosening of soil was used as mulching treatment (Chaudhry et al., 2004).

However, little information is available regarding different types of mulches used to increase flowering, fruiting, yield and incidence of pest and diseases of tomato. Such knowledge is needed for developing new strategies for early production of tomato. Therefore, the present experiment was conducted to study the effects of different types of mulches on flowering, fruiting, yield and incidence of pest and diseases of tomato.

MATERIALS AND METHODS

A field experiment was conducted during winter season of 2010-11 at Instructional cum Research Farm, Department of Horticulture, College of Agriculture, Latur (M.S.). Treatments consisted of eight mulch materials, viz. T1 i.e. black colour on silver polythene mulch (BSPM) (25 microns); T2 i.e. silver colour on black polythene mulch (SBPM) (25 microns); T3 i.e. transparent polythene mulch (TPM) (30 microns); T4 i.e. blue polythene mulch (BPM) (30 microns); T5 i.e. sugarcane trash mulch (STM) (10 cm thickness); T6 i.e. soybean straw mulch (SM) (10 cm thickness); T7 i.e. dry grass mulch (DGM) (10 cm thickness) and T8 i.e. no mulch (control). The experiment was laid out in randomized block design and replicated thrice. Transplanting of tomato var. Dhanashree was done as per treatment at spacing of 60x45 cm. Fertilizers were applied by method of fertigation. The mulches were spread manually and holes of 5 cm diameter were made on the polythene films for planting. Data was recorded for days required for initiation of flowering was recorded by counting the days from trans-
planting to occurrence of flowering. Number of flowers per
plant was recorded by counting the number of flowers of
plant. Days to first picking was recorded by counting the days
from fruit setting to fruit maturity. Number of fruits per plant
was counting by the fruits at each harvest. Weight of fruit
measured on a pan balance. Volume of fruit was determined
by using measuring cylinder and it was calculated by follow-
ing formula given by Mazumdar and Majumder (2003). For
recording the fruit set on observational plants, the number of
flowers born on each tagged shoots and number of fruit set on
same shoot counted and calculated, fruit drop calculated in
percentage by using flower per shoot, fruit set and final reten-
tion of fruit on plant. Naturally, dropped fruits were collected,
collected. Yield per plant was calculated by the fruits at each
harvest and weighed for each tree on a pan balance and yield
per ha was calculated by following formula. Yield per ha
\((MT) = \text{yield per tree (kg) x no. of trees per ha} / 1000\).
Incidence of pest-disease were calculated by number of affected
plants divided by total number of plants per treatment into
hundred. The data was analyzed by the method advocated by
Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

Among different mulching treatments, polythene mulches viz.
black colour on silver polythene mulch, silver colour on black
polythene mulch and transparent polythene mulch were able
to increase flowering, fruiting, yield and decrease incidence of
pest-disease parameter significantly as compared to organic
mulches viz. dry grass mulch, soybean straw mulch and control.

Effect on flowering and fruiting

The statistically analyzed data on flowering and fruiting
attributes of tomato is presented in Table 1. The significantly
lowest number of days for initiation of flowering of tomato
(30.40 days) and maximum number of flowers per plant (39.86)
was observed in treatment \(T_1\) i.e. black colour on silver
polythene mulch. This was followed by treatments \(T_2\) i.e. silver
colour on black polythene mulch and \(T_3\) i.e. transparent
polythene mulch with respect to number of days for initiation
of flowering (33.26 days and 34.73 days, respectively) and
number of flowers per plant (37.66 and 36.13, respectively).
Minimum number of days to first picking of tomato (83.40
days), maximum per cent of fruit set (70.36 %) and minimum
per cent of fruit drop (12.51 %) was observed in treatment \(T_1\)
i.e. black colour on silver polythene mulch. This was followed
by treatments \(T_3\) i.e. silver colour on black polythene mulch
and \(T_5\) i.e. transparent polythene mulch with respect to number
of days to first picking (83.66 days and 84.53 days, respectively),
fruit set percentage (66.93 % and 62.49 %, respectively) and fruit drop percentage (15.98 % and 16.26 %, respectively).

The beneficial effect of black polythene mulches as compared
to other mulch material might be due to higher soil temperature
and more availability of moisture. The increased soil
temperature under plastic beds had enhanced the plant growth
and development which has led to early flowering. As black
colour absorbs more solar radiation; maximum temperature
was recorded under black polythene mulch. Hence plants
took minimum days to flowering. These findings are in
agreement with those of Igbal et al. (2009), Parmar et al. (2013)
and Hooda et al. (1999). Black polythene mulch had least
competition from weeds as higher temperature under black
polythene mulch affected weed growth adversely and uniform
moisture conservation throughout the growing season might
be responsible for better performance leading to higher
flowering and fruiting. These findings are in agreement
The earliest fruit maturity under black polythene mulch was
due to better growth of plants, as a result of high soil
temperature and moisture which helped in early flowering,
fruiting and fruit ripening. These findings are in agreement
with those of Pierce and Crispi (1989) and Decoteau et al.
(1989). The highest soil temperature under black polythene
mulch which improved the plant micro-climate, thus helping
in maximum plant growth and fruit setting in tomato. These
findings are in agreement with those of Singh et al. (2005) and
Chakraborty and Sadhu (1994).

Effect on yield and yield contribution characters

The statistically analyzed data on yield attributes is presented
in Table 2. The significantly maximum number of fruits per
plant (26.66), maximum weight (72.40 g), volume (77.33 ml)
of fruit, maximum yield per plant of tomato (1.63 kg) and
maximum yield per hectare (60.61 Mtha) was observed in
treatment \(T_3\) i.e. black colour on silver polythene mulch. This
was followed by treatments \(T_1\) i.e. silver colour on black
polythene mulch and \(T_5\) i.e. transparent polythene mulch
with respect to number of fruits per plant (22.93 and 20.53,
respectively), weight (69.59 g and 67.94 g, respectively) and
volume (74.19 mL and 72.50 ml, respectively) of fruit, yield
per plant (1.50 kg and 1.40 kg, respectively) and yield per

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Table 1: Effect of different types of mulches on flowering and fruiting of tomato.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Type of mulch</th>
<th>Days to flowering</th>
<th>Number of flowers per plant</th>
<th>Days to first picking</th>
<th>Fruit set (%)</th>
<th>Fruit drop (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(T_1)</td>
<td>BSPM</td>
<td>30.40</td>
<td>39.86</td>
<td>83.40</td>
<td>70.36</td>
<td>12.31</td>
</tr>
<tr>
<td>(T_2)</td>
<td>SBPM</td>
<td>33.26</td>
<td>37.66</td>
<td>83.66</td>
<td>66.93</td>
<td>13.98</td>
</tr>
<tr>
<td>(T_3)</td>
<td>TPM</td>
<td>34.73</td>
<td>36.13</td>
<td>84.53</td>
<td>62.49</td>
<td>16.26</td>
</tr>
<tr>
<td>(T_4)</td>
<td>BPM</td>
<td>37.33</td>
<td>34.66</td>
<td>85.46</td>
<td>59.24</td>
<td>17.47</td>
</tr>
<tr>
<td>(T_5)</td>
<td>STM</td>
<td>36.13</td>
<td>35.00</td>
<td>84.93</td>
<td>59.74</td>
<td>16.39</td>
</tr>
<tr>
<td>(T_6)</td>
<td>SSM</td>
<td>37.93</td>
<td>33.53</td>
<td>86.20</td>
<td>58.05</td>
<td>18.12</td>
</tr>
<tr>
<td>(T_7)</td>
<td>DGM</td>
<td>39.33</td>
<td>31.33</td>
<td>86.60</td>
<td>54.61</td>
<td>20.05</td>
</tr>
<tr>
<td>SE</td>
<td>Control</td>
<td>41.46</td>
<td>28.73</td>
<td>88.06</td>
<td>52.53</td>
<td>22.99</td>
</tr>
<tr>
<td>CD at 5%</td>
<td></td>
<td>0.24</td>
<td>0.32</td>
<td>0.11</td>
<td>0.96</td>
<td>1.90</td>
</tr>
</tbody>
</table>

\(T_1\): BSPM - Black colour on silver polythene mulch; \(T_2\): SBPM - Silver colour on black polythene mulch; \(T_3\): TPM - Transparent polythene mulch; \(T_4\): BPM - Blue polythene mulch; \(T_5\): STM - Sugarcane trash mulch; \(T_6\): SSM - Soybean straw mulch; \(T_7\): DGM - Dry grass mulch; SE: Control - No mulch.
Increased weight of fruit and yield under drip irrigation and polythene mulch resulted due to better water utilization, higher uptake of nutrients and excellent soil-water-air relationship due to better water utilization. Higher weight of fruit (g) fruit (ml) plant (kg) hectare (55.79 Mt/ha and 55.09 Mt/ha, respectively).

Table 2: Effect of different types of mulches on yield and yield contribution characters of tomato.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Type of mulch</th>
<th>Number of fruits per plant</th>
<th>Weight of fruit (g)</th>
<th>Volume of fruit (ml)</th>
<th>Yield per plant (kg)</th>
<th>Yield per hectare (Mt/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>BSPM</td>
<td>26.66</td>
<td>72.40</td>
<td>77.33</td>
<td>1.63</td>
<td>60.61</td>
</tr>
<tr>
<td>T2</td>
<td>SBPM</td>
<td>22.93</td>
<td>69.59</td>
<td>74.19</td>
<td>1.50</td>
<td>55.79</td>
</tr>
<tr>
<td>T3</td>
<td>TPM</td>
<td>20.53</td>
<td>67.94</td>
<td>72.50</td>
<td>1.40</td>
<td>55.09</td>
</tr>
<tr>
<td>T4</td>
<td>BPM</td>
<td>19.20</td>
<td>65.91</td>
<td>70.23</td>
<td>1.17</td>
<td>45.33</td>
</tr>
<tr>
<td>T5</td>
<td>ST</td>
<td>20.33</td>
<td>67.85</td>
<td>72.41</td>
<td>1.32</td>
<td>48.80</td>
</tr>
<tr>
<td>T6</td>
<td>SMM</td>
<td>18.33</td>
<td>63.25</td>
<td>67.45</td>
<td>1.02</td>
<td>43.35</td>
</tr>
<tr>
<td>T7</td>
<td>DGM</td>
<td>16.46</td>
<td>61.78</td>
<td>66.49</td>
<td>0.95</td>
<td>41.97</td>
</tr>
<tr>
<td>T8</td>
<td>Control</td>
<td>14.53</td>
<td>58.05</td>
<td>62.39</td>
<td>0.88</td>
<td>40.59</td>
</tr>
<tr>
<td>SE</td>
<td></td>
<td>0.35</td>
<td>0.40</td>
<td>0.48</td>
<td>0.08</td>
<td>0.37</td>
</tr>
<tr>
<td>CD at 5%</td>
<td></td>
<td>1.08</td>
<td>1.23</td>
<td>1.46</td>
<td>0.02</td>
<td>1.14</td>
</tr>
</tbody>
</table>

Table 3: Effect of different types of mulches on pest-diseases incidence of tomato.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Type of mulch</th>
<th>Fruit borer incidence (%)</th>
<th>Leaf curl incidence (%)</th>
<th>Spotted wilt incidence (%)</th>
<th>Late blight incidence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>BSPM</td>
<td>5.06</td>
<td>6.43</td>
<td>2.26</td>
<td>6.19</td>
</tr>
<tr>
<td>T2</td>
<td>SBPM</td>
<td>5.54</td>
<td>6.90</td>
<td>2.50</td>
<td>9.19</td>
</tr>
<tr>
<td>T3</td>
<td>TPM</td>
<td>9.86</td>
<td>7.14</td>
<td>2.98</td>
<td>10.17</td>
</tr>
<tr>
<td>T4</td>
<td>BPM</td>
<td>12.39</td>
<td>7.41</td>
<td>3.35</td>
<td>11.20</td>
</tr>
<tr>
<td>T5</td>
<td>ST</td>
<td>10.47</td>
<td>7.33</td>
<td>3.17</td>
<td>10.41</td>
</tr>
<tr>
<td>T6</td>
<td>SMM</td>
<td>13.32</td>
<td>7.51</td>
<td>3.33</td>
<td>11.54</td>
</tr>
<tr>
<td>T7</td>
<td>DGM</td>
<td>15.52</td>
<td>7.80</td>
<td>4.66</td>
<td>12.92</td>
</tr>
<tr>
<td>T8</td>
<td>Control</td>
<td>0.05</td>
<td>0.46</td>
<td>0.20</td>
<td>1.20</td>
</tr>
<tr>
<td>SE</td>
<td></td>
<td>0.16</td>
<td>NS</td>
<td>0.61</td>
<td>NS</td>
</tr>
<tr>
<td>CD at 5%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Effect on pest-disease incidence

The statistically analyzed data on incidence of pest and diseases is presented in Table 1. The minimum leaf curl incidence (6.43 %) and minimum incidence of late blight (6.61 %) was observed in treatment T1, i.e. black colour on silver polythene mulch. This was followed by treatments T6, i.e. silver colour on black polythene mulch and T7, i.e. transparent polythene mulch with respect to leaf curl incidence (6.90 % and 7.14 %, respectively) and incidence of late blight (9.19 % and 10.17 %, respectively). The minimum spotted wilt incidence (2.26 %) was observed in treatment T1, i.e. black colour on silver polythene mulch. However, it was at par with treatments T2, i.e. silver colour on black polythene mulch (2.50 %) and T3, i.e. transparent polythene mulch (2.98 %). The minimum fruit borer incidence (5.06 %) was observed in treatment T1, i.e. black colour on silver polythene mulch; however, it was at par with treatment T8, i.e. silver colour on black polythene mulch (5.54 %).

Less incidence of leaf curl might be due to high soil temperature and intensity of light which might have affected white fly population. These findings are in agreement with those of Shehnaz and Kumar (2004). The light effects on the vector, coloured mulches modify root zone temperature (RZT) under the mulch. RZT directly affects plant growth, which influence plant response to spotted wilt incidence. These findings are in agreement with those of Diaz-Perez and Batal (2002) and John et al. (2003). Plastic mulching keeps away the foliage and fruits from soil contact and also cuts down from soil splash on lower canopy as soil often consist disease causing conidial spores. These findings are in agreement with those of Jambhulkar et al. (2012).

REFERENCES

Anonymous 2013. NHB database, Area and production of vegetable crops.