Original Research Article

EFFECT OF PLASTIC MULCHING AND IRRIGATION LEVELS ON YIELD OF TOMATO CROP (*Solanum lycopersicum*)

Abstract

Plastic mulches are widely used for cultivation of vegetables. An experiment was conducted to observe the impact of plastic colour mulches on soil temperature, water use efficiency (WUE) and produce of tomato (*Solanum* l*ycopersicum)* under drip irrigation from 2015-2016. The treatments were laid out in split plot design with three replications. The plastic coloured mulches used were white on black, silver on black and black. 60, 80, 100 and 120% evapotranspiration (ET) used as irrigation levels and a non-mulched treatment as control. Due to the interaction effects, treatment white colour on black plastic mulch with 80% ET i.e., I_2M_1 recorded the maximum yield (93.54 t ha^{-1}) followed by silver colour on black plastic mulch with 80% ET (I_2M_2) produced 87.65 t ha^{-1}. Plastic colour mulching improved production compared to bare soil. as the plants grown in white colour on black plastic colour mulch resulted 40 to 54% increase in yield compared to control treatment.

Key words: Bare soil, plastic mulch, irrigation levels, evapo-transpiration

1. Introduction

With a growing population and limited horticultural area, there is a strong need to enhance the yield and quality of fruits and vegetables. In general, consumers do not opt for low-quality produce that trades for a cheaper price. Protected cultivation, such as mulching, green houses and low tunnels, high density planting, and so on, is one of the finest ways to increase yield for the high quality vegetables, fruits as well as off season crops. Mulching is the process of covering the plant basin with organic waste, black polyethylene strips, or emulsions. Mulch is a material that is placed across a field to block direct sunlight from reaching the soil. Mulching slows water evaporation by interfering with the radiation falling on the soil surface, delaying soil drying and lowering the temperature regime of the soil during the day (Atif, 2014). By enhancing the environment around the root zone, it also reduces weed population and increases microbial activity in the soil. The usage of mulches on a regular basis helps to improve the soil's water holding capacity.

Plastic colour mulch is a product similar to mulch that is used to control weeds and save water in crop cultivation. These plastic mulches also act as a barrier to prevent methyl bromide, a potent fumigant and ozone depleter, out of the soil (Ghosh and Bera 2015). Plastic mulching allows crops to grow through slits or holes in thin plastic sheets. To maximize WUE, plastic mulch is frequently utilized in conjunction with drip irrigation. It boosts plant growth by raising soil warmth and keeping soil moisture stable (Jimenez et al., 2004). However, it is now necessary to determine the correct plastic colour mulch for a specific crop. As a result, in 2015-16, an experiment was planned to investigate the influence of various plastic coloured mulches, such as black, white on black, and silver on black, on the growth and yield of tomato plants.

Tomato (Solanum Lycopersicum), a South American native from Peru, Ecuador, and Bolivia. It is the world's and India's most widely produced vegetable crop. Tomatoes are a type of solanaceous vegetable that belong to the night shade family of plants, which also contains

potatoes, tomatoes, and tobacco. Tomatoes are an important source of vitamin C and A in the Indian diet due to their nutrients, wonderful taste, and a variety of ways to consume and use them. It is well-known for preparing processed foods such as soup and ketchup, as well as adding flavor to the dish. Tomatoes are grown on 0.90 million hectares in India, with a production estimate of 19.10 million tonnes. Karnataka accounts for an area of 0.06 million hectares with 1.99 million t production (Anon., 2007). The present investigation was planned to assess the effect of colour mulch and yield of tomato under various irrigation levels and to analyse the economic feasibility in relation to mulch used in tomato production. It's also one of India's most popular vegetable crops, and it's well-suited to drip watering and plastic colour mulch. The impact of mulching with black plastic sheets on soil temperature and tomato productivity was studied by (Kamal and Singh 2011). When compared to bare soil, the output increased from 20.7 to 29.8% with black plastic mulch. The modifying influence of black plastic mulch on the growing environment of the crop, crop growth, and yield of cassava varieties (TMS 30572 and TMS 4(2) 1425) was investigated by (Aniekwe et al., 2004). Cassava cultivars' fresh root tuber yields were raised to 40.7 percent (TMS 30572) and 48 percent (TMS 4(2) 1425). As a result, an experiment was conducted to determine the influence of double-layered mulches on tomato crops under various conditions.

2. Material and Methods

Two-season field experiment was conducted to compare the effects of different plastic colour mulches on tomato (F1-Hybrid US-800) growth and yield against no mulch. This location is located at 16 15' N latitude and 77 20′ E longitude in Raichur Zone II region-1 of Karnataka state, at an elevation of 389 m above mean sea level (MSL). The soil in the experimental field is clay-textured, has a pH of 7.9, and has an excellent electrical conductivity (EC) of 0.98 dS m^{-1}. Three replications were used to test the treatments in a split plot design. There are 16 beds in each experimental plot. Irrigation levels (60 percent, 80

percent, 90 percent, and 120 percent ET) were the major plots, whereas varied plastic colour mulches were the sub main plots.

The seedlings of tomato were transplanted into 5 m × 1 m experimental plots. Plant-to-plant spacing was 0.60 m and row-to-row spacing was 0.45 m. The diverse plastic colour mulches of 25-micron thickness, such as white on black, silver on black, and black, were cut and spread out according to the size of the plots.

Main treatments:	**Sub treatments:**
I_1: Irrigation at 60 % ET using drip irrigation	$M_{0:}$ Without mulch condition
I_2: Irrigation at 80 % ET using drip irrigation	M_1: White on black plastic mulch
I_3: Irrigation at 100 % ET using drip irrigation	M_2: Silver on black plastic mulch
I_4: Irrigation at 120 % ET using drip irrigation	M_3: Black plastic colour mulch

Recommended cultural practices were followed during the crop growing period. Data was collected at 30, 60, 90, and 120 days after transplantation (DAT). The observations were observed on five plants in each plot that were chosen at random. The daily crop water requirement (CWR) was computed using data from the Main Agricultural Research Station (MARS)-Raichur's evapotranspiration (ET).

2.1 Assessment of crop water requirement

The water requirement of a plant was determined for drip irrigation using one of the numerous irrigation scheduling algorithms (Jadhav et al., 2002).

$$WR = \frac{A \times B \times C}{E} \qquad \ldots (2.1)$$

Where,

WR = Water requirement of a plant, (mm/day)

A = Evaporation, (mm) = Pan coefficient (0.7) × Pan evaporation

B = Amount of area covered with foliage (canopy factor), fraction

C = Crop co-efficient, fraction

E = Efficiency of drip irrigation, (considered as 90 per cent)

The water requirement for each irrigation level was calculated using the aforementioned equation, and the same was used to determine irrigation supply.

2.2 Crop *yield per plant*

The crop yield obtained from selected five plants were weighed separately. The data from these plants was averaged to workout yield per plant at once-over harvest, in kg.

2.3 Crop yield per plot

Fruits were picked plot wise, treatment wise and then weighed and stated in kg.

2.4 Crop yield per hectare

Yield per hectare was computed from the fruit yield per net plot.

2.5 Statistical analysis

The data from the observations and characters evaluated were statistically analyzed using Split Plot Design, and the critical difference at the 5% level was calculated and shown wherever the results were significant. The analysis of the data was done using the Microsoft Excel software.

3. Results And Discussions

3.1 Crop yield per plant

Plastic colour mulches, irrigation levels and their interactions shown significant effect on crop yield per plant are shown in Table 1. Among the interaction effects the treatment I_2M_1 (3.90 kg) recorded the maximum yield per plant followed by I_2M_2 (3.65 kg) and I_3M_1 (3.48 kg). The minimum yield per plant was reported in I_4M_3 (2.34 kg), the other interaction effects has showed significant yield per plant.

Table 1. Effect of levels of irrigations and plastic colour mulches on yield per plant (gm)

Treatment	M_0	M_1	M_2	M_3	Mean
I_1	2.52	2.68	2.56	2.35	2.53
I_2	2.93	3.90	3.65	3.05	3.38
I_3	2.97	3.48	3.14	2.55	3.03
I_4	2.44	2.62	2.43	2.34	2.46
Mean	2.71	3.17	2.94	2.57	
		SEM ±		CD at 5 per cent	
Main treatment		0.06		0.22	

Sub treatment	0.06	0.18
I at same M	0.12	0.39
M at the same or different I	0.47	1.43

3.2 Crop yield per plot

Table 2. Effect of levels of irrigation and plastic colour mulches yield per plot (kg

Treatment	**M_0**	**M_1**	**M_2**	**M_3**	**Mean**
I_1	45.37	48.29	46.07	42.30	45.51
I_2	52.74	70.16	65.74	54.87	60.88
I_3	53.41	62.70	56.44	45.89	54.61
I_4	43.86	47.13	43.69	42.20	44.22
Mean	48.84	57.07	52.98	46.32	
		SEM ±		CD at 5 per cent	
Main treatment		1.15		3.98	
Sub treatment		1.09		3.19	
I at same M		2.18		6.73	
M at the same or different I		2.42		7.85	

The results of crop yield per plot due to effect of irrigation levels and plastic colour mulches were recorded as shown in Table 2. Among the interaction effects the treatment I_2M_1 (70.16 kg) recorded the maximum yield per plot followed by I_2M_2 (65.74 kg) and I_3M_1 (62.70 kg). The minimum yield per plot was recorded in I_4M_3 (42.20 kg), the other interaction effects significantly differed in case of yield per plot.

3.3 Crop yield per hectare

Due to the interaction effects, treatment I_2M_1 (93.54 t ha^{-1}) recorded the maximum yield per hectare followed by I_2M_2 (87.65 t ha^{-1}) and I_3M_1 (83.60 t ha^{-1}) as shown in Table 3. The minimum yield per hectare was recorded in I_4M_3 (56.27 t ha^{-1}), the other interaction effects differed significantly in case of yield per hectare. The abovementioned findings are consistent with those of (Yohannes et al., 1998), (Mukherjee et al., 2010).

Eighty percent ET delivered through drip with white on black plastic colour mulch, both separately and together, resulted in a 54 percent increase in tomato yield over the control plot.

Table 3. Effect of levels of irrigation and plastic colour mulches on yield per hectare (t ha^{-1})

Treatment	M_0	M_1	M_2	M_3	Mean
I_1	60.49	64.39	61.42	56.40	60.88
I_2	70.31	93.54	87.65	73.16	81.17
I_3	71.21	83.60	75.25	61.18	72.81
I_4	58.47	62.84	58.26	56.27	58.96
Mean	65.12	76.09	70.65	61.75	

	SEM ±	CD at 5 per cent
Main treatment	1.53	5.31
Sub treatment	1.46	4.25
I at same M	2.91	8.61
M at the same or different I	3.01	9.10

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