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M Jayalalitha
Department of Soil and Water Conservarion Engineering, AEC&RI, Kumulur, Tamil Nadu, India

M Rajeswari
Department of Agrl. Engineering, AC&RI, Madurai, Tamil Nadu, India

R Lalitha
Department of Soil and Water Conservarion Engineering, AEC&RI, Kumulur, Tamil Nadu, India

T Ragavan
Department of Agronomy, ARS, Paramakudi, Tamil Nadu, India

P Saravanapandian
Department of Soils & Environment, AC&RI, Madurai, Tamil Nadu, India

Corresponding Author:
M Jayalalitha
Department of Soil and Water Conservarion Engineering, AEC&RI, Kumulur, Tamil Nadu, India

Effect of colored plastic mulch and drip irrigation regimes on weed count, root length and root spread of tomato (*Solanum Lycopersicum*)

M Jayalalitha, M Rajeswari, R Lalitha, T Ragavan and P Saravanapandian

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Abstract
Field investigation was carried out during 2017 at Agricultural College and Research Institute, Madurai, to study the effect of colored plastic mulch and drip irrigation regimes on weed dry weight, root length and root spread of tomato. A factorial randomized block design with three colour mulches (white on black, silver on black and black on silver) and three irrigation regimes with control (without mulch) was laid to conduct the field experiment. The highest weed count of 27.3 was found in 100 per cent ET_c and the lowest weed count of 21.4 in 60 per cent ET_c. Among the mulches minimum weed count (4.9) was found in white on black plastic colour mulch. Plastic mulches were effective in repressing the weed infestation. The maximum root length was observed under treatment 60 per cent ET_c without mulch (48.2 cm). The maximum root spread was found in 80 per cent ET_c level with white on black colour mulch (41.1cm). The results showed that using colored plastic mulches control the weeds resulting in more root spread of the crop due to less competition for soil moisture and nutrients. Therefore, plastic mulch can be one of the weed control strategy in tomato production.

Keywords: weed count, root length, irrigation regimes, plastic mulches

1. Introduction
Tomato is the second most important vegetable crop next to potato in the world. In India tomato is cultivated under 0.86 M ha area. Mulches alter microenvironments around plants depending upon the colour of the mulch and local climate conditions which are beneficial for crop growth and yield. Use of dark colour mulches increases soil temperature than light colour mulches. Plastic mulch application is effective in increasing soil temperature, conserving soil moisture and weed control [1]. In recent years, polyethylene mulches are widely used in vegetable production and have contributed significantly to reduction of losses due to weed antagonism [2]. Mulches decrease the temperature fluctuations at first 20-30cm depth of soil and promote the root development that reduces vegetative competition at rooting zone and fertilizer leaching, and soil compaction. Ham *et al.* [3] reported that mulches also help in hygienic vegetable production, since no soil is splashed onto the plants or fruits. Black colour plastic mulches are used for weed suppression in wide range of crops grown under the organic growing system [4]. Weed growth not only affects production but also hinder the application of pest and disease chemicals that are usually necessary in the production of tomatoes.
The volume and pattern of root development are mainly important for crops since they supply the required amount of water and nutrient in time and space. Besides the development of deep green leaves, blossom, and flowers, development of roots suggest that the plant is in good condition as reported by Kishore *et al.* [5]. Hence root length and spread are also important factors along with the weed count. Therefore, the present study was undertaken to evaluate the effects of colored plastic mulch and different irrigation regimes on weed count, root length and root spread of tomato crop.

2. Material and methods
2.1. Site specification
A field experiment was conducted at Agriculture College and Research Institute, Madurai. The experimental farm is geologically located at 9º 54' N latitude and 78º 80' E longitude at an altitude of 147 m above mean sea level in the southern part of Tamil Nadu.

2.2. Experimental design
The experiment was laid out in Factorial Randomized Block Design with three colour mulches and three irrigation regimes with control (without mulch) and total 12 treatment combinations. The polythene sheet used for mulching was 25-micron thickness. The treatment combinations were black on silver plastic mulch with 60% ET_c (I1M1), white on black plastic mulch with

60% ET_c (I1M2), silver on black plastic mulch with 60% ET_c (I1M3), no mulch with 60% ET_c (I1M4), black on silver plastic mulch with 80% ET_c (I2M1), white on black plastic mulch with 80% ET_c (I2M2), silver on black plastic mulch with 80% ET_c (I2M3), no mulch with 80% ET_c (I2M4), black on silver plastic mulch with 100% ET_c (I3M1), white on black plastic mulch with 100% ET_c (I3M2), silver on black plastic mulch with 100% ET_c (I3M3), and no mulch with 60% ET_c (I3M4).

2.3. Data collection
The weed growth was recorded in experimental plot at 45th day after transplanting. The quadrate was placed randomly in three times at different locations in each treatment separately; the weeds falling within the frames of the quadrate were collected and counted.

At the time of final harvest, five plants from each treatment were removed carefully for the assessment of root spread and length. Thereafter, the roots bunch of the selected plants were dug out, washed smoothly to remove the soil, cleaned thoroughly and observations of root length and root spread were taken. Crop root length was recorded from base of the plant to root tip with the help of measuring scale. The lateral spread was measured from the centre of the stem horizontally at various vertical intervals.

2.4. Statistical analysis
From the experiment, data on weed count, weed dry weight, root length and root spread were recorded and statistically analyzed using AGRES software. The graphs were plotted using Microsoft excel.

3. Results and Discussion
3.1. Weed count
The weed count in the experimental plot at 45th DAT was recorded in Table 1 and presented in Fig.1. The different levels of irrigation regimes, plastic mulches and their interactions significantly influenced the weed counts. At different irrigation regimes, the maximum weed count of 27.3 recorded at 100 per cent ET_c level and minimum weed count of 9.0 recorded in 60 per cent ET_c level. Control (without mulch) treatment recorded the highest weed count (51.3) and the lowest weed count (4.90) was recorded in the treatment white on black plastic mulch.

From the results, it was found that the interactive effect of mulches and irrigation levels had a positive influence on the weed count and values ranged from 3.4 to 87.3. The highest weed count of 87.3 was registered in the control treatment with 100 per cent ET_c level (M_2I_2) and the lowest weed count (3.4) was registered in the treatment white on black plastic mulch with 60 per cent ET_c. The reduction of weeds might be due to the reflection and the interception of direct solar radiation by the plastic mulches that hampers the germination of weed seeds. Weeds observed in mulched plot were only through opening of planting holes. The results are in concordance with those obtained by Shrestha[6] and Ashrafuzzaman *et al.* [7].

Table 1: Effect of colored plastic mulch and irrigation regimes on weed count

Weed count (Nos)				
Treatment	**Irrigation levels**			
Plastic mulches	**I1**	**I2**	**I3**	**Mean**
Black on silver color (M1)	5.5	5.9	7.5	6.3
White on black color (M2)	3.4	4.3	7.0	4.9
Silver on black color (M3)	5.9	6.2	7.6	6.6
Control (M4)	21.4	45.1	87.3	51.3
Mean	9.0	15.4	27.3	17.3
	I	M	I x M	
SED	0.41	0.48	0.83	
CD(0.05)	0.86**	0.99**	1.71**	

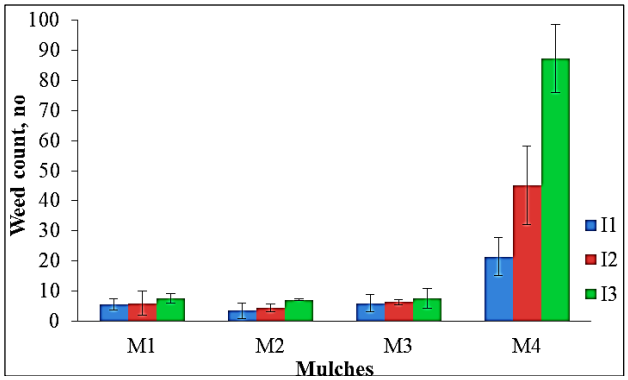

Fig 1: Effect of colored plastic mulch and irrigation regimes on weed count

3.2. Crop root parameters
3.2.1. Root length
Irrigation regimes and different coloured plastic mulching significantly influenced the crop root length as shown in Table 2 and fig. 2. The maximum root length of 51.9cm was registered under without mulch condition and minimum root length was recorded in mulch treatments due to the effect of plastic mulches. This might be due to the higher amount of soil moisture available in the top layer of soil due to less evaporation in mulched plots which helped the roots to concentrate in the shallow depth of soil. The root length at different irrigation regimes were recorded maximum root length in drip irrigation with 60 per cent ET_c (48.2 cm) followed by drip irrigation with 80 per cent ET_c (45.0).

Table 2: Effect of Irrigation levels and colored plastic mulches on root length (cm)

Treatment	**Irrigation levels**			
Plastic mulches	**I1**	**I2**	**I3**	**Mean**
Black color (M1)	46.2	42.9	39.7	42.9
White on black color (M2)	44.9	41.8	38.6	41.8
Silver on black color (M3)	47.8	43.0	40.6	43.8
Control (M4)	54.0	52.2	49.5	51.9
Mean	48.2	45.0	42.1	
	I	M	I x M	
SED	1.75	2.02	3.5	
CD(0.05)	3.62**	4.19**	NS	

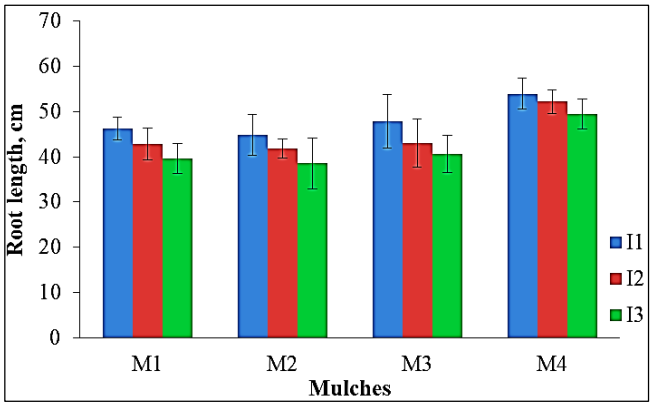

Fig 2: Effect of Irrigation levels and colored plastic mulches on root length (cm)

However, the interaction effect of irrigation levels and colored plastic mulches did not have significant impact on crop root length. Root length was minimum under the treatment 80 per cent ET_c using drip irrigation with white on black plastic colour mulch (41.8cm). The longest root length in 60 per cent ET_c drip irrigation treatment could be attributed due to less soil moisture availability at top soil resulting in the penetration of roots vertically to deeper layers. Similar results were also reported by [8].

3.2.2. Root spread

The results indicated that the colour of mulches and the irrigation regimes increased the crop root spread (Table 3). The mean value ranged from 21.5 to 41.1 cm and it is depicted in figure 3. The root spread (34.2 cm) was more in the white on black color mulch (M_2) followed by silver on black color mulch (31.6 cm) as compared to control. Among the irrigation levels, more root spread (34.2 cm) was observed in treatments receiving 80 per cent ETc followed by 29.4 cm in 100 per cent ET_c level and it was minimum (25.4 cm) in the treatment 60 per cent ET_c using drip irrigation.

In interaction effect, maximum root spread was observed under drip irrigation at 80 per cent ET_c with white on black color mulch (41.1 cm) followed by 80% ET_c with silver on black color mulch (32.8 cm). The results are in concordance with those obtained by [5].

Table 3: Effect of Irrigation levels and colored plastic mulches on root spread (cm)

Treatment	Irrigation levels			
Plastic mulches	**I1**	**I2**	**I3**	**Mean**
Black color (M1)	25.0	34.3	29.7	29.7
White on black color (M2)	28.6	41.1	32.8	34.2
Silver on black color (M3)	26.4	38.2	30.2	31.6
Control (M4)	21.5	23.1	24.7	23.1
Mean	25.4	34.2	29.4	
	I	M	I x M	
SED	0.86	1.0	1.73	
CD(0.05)	1.8**	2.08**	3.60**	

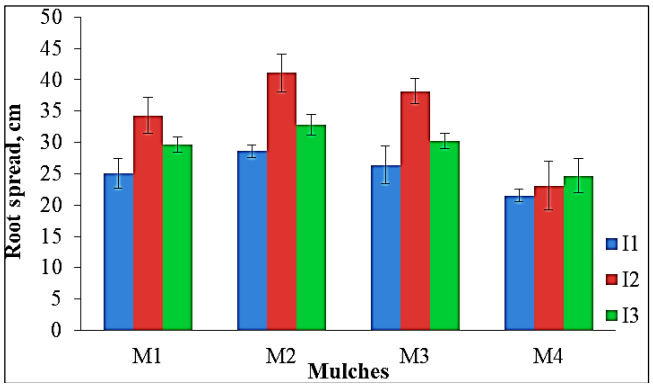

Fig 3: Effect of Irrigation levels and colored plastic mulches on root spread (cm)

4. Conclusion

White on black color mulch had a significant influence in the reduction of weeds and among the irrigation regimes, less irrigation level (60 per cent ET_c) recorded less weed count. The results reveal that highest efficiency of weed control could be achieved with plastic mulches and optimum irrigation levels, thus reducing the cost of weeding in a non-chemical manner paving the way for sustainable income. Moreover, plastic mulches induce lateral spread of roots which might results in enhancing the water use efficiency of the crop.

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