

RESEARCH PAPER

Effect of colour plastic mulching at different drip irrigation levels on growth and yield of brinjal (*Solanum melongena* L.)

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Abstract: A field experiment was carried out during 2017 at Research Farm, Department of Soil and Water Engineering, College of Agricultural Engineering, Raichur to study the effect of different colour plastic mulching at different drip irrigation levels on growth and yield of brinjal crop. The experiment was laid out in split plot design with 12 treatment combination with 3 main plot with irrigation levels viz., I_1 -Drip irrigation at 60 per cent ET, I_2 - Drip irrigation at 80 per cent ET, I_3 - Drip irrigation at 100 per cent ET and subplot with mulch treatment viz., without mulch, white on black colour mulch, silver on black colour mulch and black plastic mulch. The results revealed that 80 per cent ET with silver colour mulch enhanced the plant height, number of branches, leaf area index, fruit length, fruit size, fruit weight, number of fruits and crop yield at 5 per cent level of significance.

Key words: Brinjal, Drip irrigation, Evapotranspiration, Plastic mulch

Introduction

Water scarcity is the major constraint in increasing the area for production of most of crops including brinjal. Water is a prime resource in agriculture. It is becoming a limiting factor due to increased competition in demand for various sectors. In order to get rid of these constraints, an efficient irrigation system with the use of appropriate mulching and irrigation level is the most suitable option which can save water and increase productivity of brinjal with advance technology for brinjal cultivation.

As the world becomes increasingly dependent on the production of irrigated lands, irrigated agriculture faces serious challenges that threaten its suitability. It is prudent to make efficient use of water and bring more area under irrigation through available water resources. This can be achieved by introducing advanced and sophisticated methods of irrigation and improved water management practices. In order to maximize water use in agricultural fields, mulching is very important in agricultural production.

Plastic mulches provide many positive advantages such as increased yields, earlier-maturing, higher-quality produce, insect management, and weed control. It also allows other components such as drip irrigation to achieve maximum efficiency.

Brinjal (*Solanum melongena* L.) also termed as eggplant or aubergine in India and worldwide, is one of the most common and principal vegetable crop grown in India and other parts of the world. It is one of the widely used vegetable crops and is popular in many countries of central, south East Asia, some part of Africa and Central America. It is a perennial plant but grown as annual. It is adapted to a wide range of climatic conditions. It is used in stuffing food, cooking and pickles. It is an important vegetable due to its nutritive value, consisting of minerals like iron, phosphorus, calcium and vitamins like A, B and C. Unripe fruits are used primarily as vegetable. It is an excellent remedy for those suffering from liver complaints. It is

used in ayurvedic medicine for curing diabetes and also as a good appetizer. It is good aphrodisiac, cardioprotective, laxative, mutant and reliever of inflammation.

India is the largest producer of fruits and the second largest producer of vegetables in the world after China. Globally brinjal occupies an area of 1.72 Mha with annual production of 43.17 Mt. The area under brinjal cultivation in India is 0.711 Mha producing 13.55 Mt yield with an average national productivity of 19.06 t ha⁻¹. The area under brinjal cultivation in Karnataka accounts for an area of 16.50 thousand ha producing 427.20 thousand Mt with productivity of 26.17 t production per ha (Anon., 2015).

Material and methods

The field experiment was conducted during summer, 2017 at Research plot in College of Agricultural Engineering, Raichur. The soil in the experimental area is clay soil. To find out the suitable mulching and irrigation levels on growth and yield of brinjal crop. The experiment was laid out in split plot design with 12 treatment combinations with three replications. Main treatment with irrigation levels viz., Drip irrigation at 60 per cent ET (I_1), Drip irrigation at 80 per cent ET (I_2), Drip irrigation at 100 per cent ET (I_3) and sub treatment with mulch colours viz., without mulch, white on black colour mulch, silver on black colour mulch, black plastic mulch. Plants were tagged in each treatment for biometric observation and the data were statistically analyzed and interpreted.

Results and discussion

Based on the study, data on plant height, number of branches, LAI, fruit length, fruit size, number of fruits, fruit weight and yield were recorded and analyzed. The data recorded on plant height, number of branches, LAI are recorded at 30 days interval.

Plant height

The results revealed that plant height was progressively and markedly affected by different irrigation levels and plastic colour mulches.

The data related to the effect of different irrigation levels with plastic mulch on plant height of brinjal crop are given in Table 1. The highest plant height was recorded at 80 per cent ET with silver mulch (59.10 cm) and lowest was recorded at 60 per cent ET with control treatment. The effect of irrigation levels was significant between all four levels of mulch treatments. However, interaction effect of irrigation levels and mulch treatments on plant height was non-significant at 5 per cent level of significance. The silver on black plastic colour mulch on plant height is influenced positively because it provide sufficient soil moisture near root zone and minimized the evaporation loss due to mulching. The extended retention of moisture and availability of moisture are also leading to higher uptake of the nutrient for proper growth and development of the plants, resulted higher growth of plant, as compared to control. Similar findings have also been obtained by Sharma and Narendra (2004), Ali and Gaur (2007), Aruna *et al.* (2007), Rajablariani *et al.* (2012), Parmar *et al.* (2013), Kahangi *et al.* (2014) and Dattatraya (2014).

Number of branches

Mulching significantly increased the number of branches compare to control treatment. The highest number of branches was found at 80 per cent ET with silver colour mulch (11.47) and lowest was recorded in control treatment with 60 per cent ET. Table 2 reveals that effect of irrigation levels was significant between all four levels of mulch treatments. However, interaction effect of irrigation levels and mulch treatments on number of branches is non-significant at 5 per cent level of significance. Favourable weather conditions and moisture of the soil were important parameters affecting the number of branches per plant. They reported that plants in mulched plots had more branches than that of unmulched plants, which confirms the results of Ocharo *et al.* (2016).

Leaf area index

The leaf area index (LAI) is influenced by different irrigation levels and plastic mulch. Significantly LAI was found highest in 80 per cent ET with silver colour mulch (2.94) and lowest in 60 per cent ET with control treatment. Table 3 reveals that effect of irrigation levels is significant between all four levels of mulch treatments. However, interaction effect of irrigation levels and mulch treatments on leaf area index was significant at 5 per cent level of significance. The variation in LAI was due to the variation with the branches of plant and with the expansion of leaves. The highest LAI were found in silver on black polyethylene mulched plants could be attributed for higher soil temperature and availability of adequate soil water that might enhanced leaf growth. The results obtained from this study were also consistent with the results of Awal *et al.* (2016).

Fruit length

The data related to the effect of different irrigation levels with plastic mulch on fruit length are given in Table 4. Markedly average higher fruit length was recorded under drip irrigation at 80 per cent ET with silver colour mulch (5.61 cm), while it was minimum in drip irrigation at 60 per cent ET with control treatment (4.56 cm). Table 4 reveals that effect of irrigation levels is significant between all four levels of mulch treatments. However, interaction effect of irrigation levels and mulch treatments on fruit length is non-significant at 5 per cent level of significance. Silver on black plastic mulch was found most effective and recorded more fruit length followed by white on black plastic mulch, and it was minimum under control. The highest fruit length under silver on black mulch was due to congenial soil moisture results higher uptake of nutrition for better growth of fruit, the reduction in evaporation losses of soil moisture caused by mulches covered the soil surface. The above results were in consonance with those of Sharma and Narendra (2004), Ansary and Roy (2005), Suresh and Kumar (2006), Parmar *et al.* (2013) and Dattatraya (2014).

Fruit size

Data pertaining to fruit size are showed in Table 5. Significantly higher fruit size was recorded under drip irrigation at 80 per cent ET (36.75 mm), and while it was minimum in drip irrigation at 60 per cent ET (33.97 mm). Silver on black plastic mulch was most effective and recorded average maximum fruit size (37.57 mm) followed by white on black plastic mulch (36.96 mm), while it was minimum under control (33.22 mm). As regards the interactions, drip irrigation at 80 per cent ET with silver on black plastic mulch (38.78 mm) produced higher fruit size as compared to control. Table 5 reveals that effect of irrigation levels is significant between all four levels of mulch treatments. However, interaction effect of irrigation levels and mulch treatments on fruit size is non-significant at 5 per cent level of significance.

Number of fruits per plant

The data related to the effect of different irrigation levels with plastic mulch on number of fruits are given in Table 6. The data on number of fruits per plant revealed that significantly maximum number of fruits were recorded under drip irrigation 80 per cent ET with silver colour mulch (30.43). While, lowest was recorded in control plot without mulch (15.82). Table 6 reveals that effect of irrigation levels was significant between all four levels of mulch treatments. However, interaction effect of irrigation levels and mulch treatments on number of fruits per plant is significant at 5 per cent level of significance. This increase in the number of fruits of mulched plot was probably associated with the conservation of moisture, reduced in number of weeds and improved microclimate both beneath and above the soil surface. The suitable conditions enhanced the plant growth and development and produced increased fruit bearing nodes compared to the control. The above results were in agreement with the findings of Awodoyin *et al.* (2007), Ashrafuzzaman, *et al.* (2011) and Parmar *et al.* (2013).

Table 1. Effect of different levels of irrigation and plastic mulch colours on plant height of brinjal

Treatment	30 DAT			60 DAT			90 DAT			120 DAT		
	I ₁	I ₂	I ₃	Mean	I ₁	I ₂	I ₃	Mean	I ₁	I ₂	I ₃	Mean
M ₀	10.03	11.40	10.57	10.67	33.78	35.53	34.5	34.6	44.57	45.48	44.59	44.88
M ₁	14.40	16.23	15.07	15.23	44.77	50.53	49.10	48.13	52.35	55.47	52.73	53.51
M ₂	14.90	17.70	15.43	16.01	46.97	51.17	49.23	49.12	54.78	56.63	55.20	55.54
M ₃	14.17	15.43	15.03	14.88	43.83	50.37	48.01	47.40	52.03	54.05	51.79	52.63
Mean	13.38	15.19	14.03		42.34	46.9	45.21		50.93	52.91	51.08	
	S.E.m±			C.D. at 5 per cent	S.E.m±			C.D. at 5 per cent	S.E.m±			C.D. at 5 per cent
Main treatment	0.35			1.36	0.85			3.35	0.42			1.64
Sub treatment	0.39			1.16	1.08			3.20	0.94			2.78
I at same M	0.68			NS	1.87			NS	1.62			NS
M at same or different I	0.68			NS	1.83			NS	1.47			NS

Table 2. Effect of different levels of irrigation and plastic mulch colours on number of branches of brinjal

Treatment	30 DAT			60 DAT			90 DAT			120 DAT		
	I ₁	I ₂	I ₃	Mean	I ₁	I ₂	I ₃	Mean	I ₁	I ₂	I ₃	Mean
M ₀	1.63	3.13	2.07	2.28	4.93	6.47	5.03	5.48	5.14	6.08	5.67	5.63
M ₁	3.67	5.33	4.47	4.49	6.47	6.93	6.53	6.64	7.04	8.22	7.67	7.64
M ₂	4.20	5.73	4.73	4.89	6.27	7.00	6.93	6.73	7.53	9.03	7.87	8.14
M ₃	3.47	5.07	4.60	4.38	5.93	6.57	6.47	6.32	6.67	7.83	7.56	7.35
Mean	3.24	4.82	3.97		5.9	6.74	6.24		6.59	7.79	7.19	
	S.E.m±			C.D. at 5 per cent	S.E.m±			C.D. at 5 per cent	S.E.m±			C.D. at 5 per cent
Main treatment	0.07			0.29	0.09			0.36	0.24			0.92
Sub treatment	0.07			0.21	0.12			0.36	0.33			0.97
I at same M	0.12			NS	0.21			0.62	0.56			NS
M at same or different I	0.13			NS	0.2			0.6	0.54			NS

Table 3. Effect of different levels of irrigation and plastic mulch colours on leaf area index of brinjal

Treatment	30 DAT			60 DAT			90 DAT			120 DAT		
	I ₁	I ₂	I ₃	Mean	I ₁	I ₂	I ₃	Mean	I ₁	I ₂	I ₃	Mean
M ₀	0.03	0.12	0.08	0.08	1.14	1.33	1.31	1.26	1.62	2.12	1.71	1.82
M ₁	0.08	0.13	0.16	0.12	1.23	2.11	1.60	1.64	1.41	2.71	2.2	2.11
M ₂	0.17	0.20	0.07	0.15	1.51	2.45	1.68	1.88	2.21	2.94	2.36	2.50
M ₃	0.1	0.09	0.10	0.09	1.31	1.72	1.42	1.48	2.03	2.06	1.91	2.00
Mean	0.09	0.14	0.10		1.30	1.90	1.50		1.82	2.46	2.05	
	S.E.m±			C.D. at 5 per cent	S.E.m±			C.D. at 5 per cent	S.E.m±			C.D. at 5 per cent
Main treatment	0.004			0.02	0.04			0.14	0.04			0.16
Sub treatment	0.003			0.01	0.07			0.19	0.05			0.15
I at same M	0.01			0.02	0.11			0.33	0.09			0.26
M at same or different I	0.01			0.02	0.10			0.31	0.09			0.25

Table 4. Effect of different levels of irrigation and plastic mulch colours on fruit length of brinjal

Treatment	I ₁	I ₂	I ₃	Mean
M ₀	4.56	5.00	4.67	4.74
M ₁	5.18	5.56	5.41	5.38
M ₂	5.52	5.61	5.49	5.54
M ₃	4.83	5.55	5.29	5.22
Mean	5.02	5.43	5.22	
	S.Em±		C.D. at 5 per cent	
Main treatment	0.07		0.30	
Sub treatment	0.12		0.34	
I at same M	0.20		NS	
M at same or different I	0.19		NS	

Table 5. Effect of different levels of irrigation and plastic mulch colours on fruit size of brinjal

Treatment	I ₁	I ₂	I ₃	Mean
M ₀	30.65	35.01	34.01	33.22
M ₁	36.44	37.36	37.09	36.96
M ₂	36.09	38.76	37.87	37.57
M ₃	32.70	35.86	35.04	34.53
Mean	33.97	36.75	36.00	
	S.Em±		C.D. at 5 per cent	
Main treatment	0.52		2.05	
Sub treatment	0.72		2.13	
I at same M	1.24		NS	
M at same or different I	1.19		NS	

Table 6. Effect of different levels of irrigation and plastic mulch colours on number of fruits per plant of brinjal

Treatment	I ₁	I ₂	I ₃	Mean
M ₀	15.82	18.98	18.07	17.62
M ₁	23.76	27.57	26.70	26.01
M ₂	25.99	30.43	24.62	27.01
M ₃	22.43	26.94	23.82	24.40
Mean	22.00	25.98	23.30	
	S.Em±		C.D. at 5 per cent	
Main treatment	0.42		1.64	
Sub treatment	0.42		1.26	
I at same M	0.73		2.18	
M at same or different I	0.76		2.26	

Fruit weight

The fruit weight is influenced by different irrigation levels and plastic mulch. Significantly higher fruit weight was recorded under drip irrigation at 80 per cent ET with silver colour mulch (43.73 g). While, it was minimum in drip irrigation at 60 per cent ET with control treatment (28.11 g). Table 7 reveals that effect of irrigation levels is significant between all four levels of mulch treatments. However, interaction effect of irrigation levels and mulch treatments on average fruit weight is significant at 5 per cent level of significance. The silver on black plastic mulch was most effective and recorded average maximum fruit weight followed by white on black plastic mulch and while it was minimum under control. Plants under polyethylene mulch (silver on black) produced larger fruit and have higher fruit yield because of better plant growth due to

Table 7. Effect of different levels of irrigation and plastic mulch colours on average fruit weight of brinjal

Treatment	I ₁	I ₂	I ₃	Mean
M ₀	28.11	31.18	35.71	31.67
M ₁	35.37	37.39	35.82	36.20
M ₂	40.00	43.73	41.33	41.69
M ₃	30.04	36.67	32.67	33.12
Mean	33.38	37.24	36.38	
	S.Em±		C.D. at 5 per cent	
Main treatment	0.63		2.49	
Sub treatment	0.62		1.84	
I at same M	1.07		3.19	
M at same or different I	1.13		3.34	

Table 8. Effect of different levels of irrigation and plastic mulch colours on crop yield of brinjal

Treatment	I ₁	I ₂	I ₃	Mean
M ₀	9.11	11.44	9.43	10.00
M ₁	17.85	19.89	19.09	18.95
M ₂	17.90	21.07	19.97	19.65
M ₃	16.88	18.15	17.96	17.66
Mean	15.44	17.64	16.61	
	S.Em±		C.D. at 5 per cent	
Main treatment	0.25		0.97	
Sub treatment	0.28		0.83	
I at same M	0.48		NS	
M at same or different I	0.48		NS	

favourable hydro-thermal regime of soil and complete weed free environment. The above results were in line with the findings of Sharma and Narendra (2004), Ansary and Roy (2005), Ali and Gaur (2007), Pedro *et al.* (2007), Aruna *et al.* (2007), Arancibia and Motsenbocker (2008), Jimenez *et al.* (2008) and Parmar *et al.* (2013).

Crop yield

The data related to the effect of different irrigation levels with plastic mulch on crop yield of brinjal crop are given in Table 8. Drip irrigation with 80 per cent ET with silver colour mulch (21.07 t ha⁻¹) produced significantly maximum yield as compared other irrigation levels and yield was minimum in 60 per cent ET with control treatment (9.11 t ha⁻¹). Table 8 reveals that effect of irrigation levels is significant between all four levels of

mulch treatments. However, interaction effect of irrigation levels and mulch treatments on crop yield is non-significant at 5 per cent level of significance

The silver on black plastic colour mulch repels aphids and reduces mosaic virus symptoms, by altering evapotranspiration and root growth by lowering soil temperature and increasing photosynthetic rate through increased light intensity in the plant canopy. These above results were in good agreement with the findings of Shylla and Sharma (2010), Paul *et al.* (2013) and Mehan (2014).

Conclusion

Based on experimental observations and statistical analysis, it is concluded that silver on black colour plastic mulch out of all three colours plastic mulches studied (white on black, silver on black, black on black) was found to be the

best to for brinjal crop and was able to maintain optimum growing conditions that were required for crop to flourish well and results in higher yield of fruit throughout the growing season. Further, brinjal crop responded well positively to drip irrigation with plastic mulches.

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