Vinuta. M. B *et al*, International Journal of Advances in Agricultural Science and Technology,
Vol.3 Issue.7, December- 2016, pg. 01-11 **ISSN: 2348-1358**
Impact Factor: 6.057

INFLUENCE OF PLASTIC MULCHING AND FERTIGATION LEVELS ON GROWTH AND YIELD OF GRAFTED BRINJAL (*Solanum melongena* L.) UNDER DRIP IRRIGATION

Vinuta. M. B[1], Rajasekar. M[2], Kottiswaran. S. V[3]

[1]PG Scholar, [2]Research Associate, [3]Professor and Principle Investigator
Precision Farming Development Centre (PFDC)
Agricultural Engineering College and Research Institute
Tamil Nadu Agricultural University, Coimbatore – 641 003
Corresponding Author: ***rajahorts@gmail.com***

Abstract: ***Investigation were carried out to study the influence of plastic mulching and fertigation levels on growth and yield parameters of grafted brinjal under drip irrigation system. There were 27 treatments replicated thrice in a Strip Plot Design with three factors viz., plastic mulching, irrigation levels and fertigation levels. The result revealed that, application of plastic mulching and fertigation treatments showed significantly increased plant height, number of branches, fruit weight, number of fruits and yield.***

Keywords: Grafted Brinjal, Plastic mulching, Fertigation, Drip irrigation, Yield.

Introduction

Brinjal (*Solanum melongena* L.) is a staple vegetable also known as Eggplant (Kantharajah and Golegaonkar, 2004). India is the second largest producer of brinjal after China with the production of 11.89 million tons production from an area of 0.68 m ha. In Tamil Nadu, it is grown over an area of 12,400 ha with 0.2 million tons during the year 2010-2011. Furthermore, continuous use of the same field for the cultivation of brinjal or related hosts susceptible to a number of pathogens leads to an increase in the soil inoculum. Hence to overcome the problems as difficulties in chemical control measures, absence of crop rotation the only short term practical solution is to graft susceptible eggplant cultivars onto rootstocks possessing biotic and abiotic stress resistance (Bletsos *et al*., 2003; Khah *et al*., 2011). Grafting is also high effective in ameliorating crop losses caused by adverse environmental conditions (Dimitrios *et al*., 2010).

The application of irrigation water by traditional method causes 27 to 42 per cent loss of water through deep percolation depending on the soil type **(**Agarwal and Khanna, 1983). Due to depletion of water sources and non availability of labour, micro irrigation has a significant adaptability all over the world. Drip irrigation is an effective tool for conserving water resources and studies had revealed significant water saving ranging between 40 per cent and 70 per cent compared with surface irrigation. Drip irrigation helps to increase water use efficiency by reducing soil evaporation and drainage losses, maintain soil moisture conditions that are favorable to crop growth and helps to sustain the productivity of the land.

Plastic mulch was first adopted in United States of America. Even with the rapid growth in production and use of plastics in India, the per capita consumption of plastics is only 2.2 kg which is very low as compared to developed countries like United States of America, Germany and Japan where it is above 60 kg. The notable advantage of the use of plastic mulch is its impermeability which prevents direct evaporation of moisture from the soil and thus reduces down the water losses (Akbari *et al.*, 2009). Plastic like HDPE, LDPE and LLDPE materials has been used as plastic mulch.

Fertigation offers the best solution for intensive and economical crop production where both water and fertilizers are delivered to crop through drip system. It provides essential elements directly to active root zone thus minimizing loss of expensive nutrients. Higher and quality yield is ensured along with saving water, labour and energy resulting in reduced cost of cultivation.

Grafting of brinjal cultivars on perennial and wild species increases the yield and also the crop duration. Standardization of cultural practices, irrigation and nutritional requirements under different soils and climatic conditions helps in better crop stand (Sidhu *et al.*, 2007). By keeping these facts in mind an attempt was made to study the effect of plastic mulching under different irrigation and fertigation levels.

Materials and Methods

The field experiment was conducted during 2015 at PFDC research farm in the Eastern block of Tamil Nadu Agricultural University, Coimbatore, to find out the suitable mulching, irrigation and fertigation levels on growth and yield of grafted Brinjal planted at a spacing of 1.2 x 1.2 m. The experiment was laid out in strip plot design with three factors. 1. Mulching levels *viz.*, 25 micron black plastic mulch, 50 micron and no mulch. 2. Irrigation levels *Viz.*, 60 per cent, 80 per cent and 100 per cent. 3. Fertigation levels *Viz.*, 80 per cent, 100 per cent and 120 percent RDF. There were 27 treatments and replicated thrice. 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, Number of fruits, fruit weight and yield were recorded and analyzed. The data recorded on plant height under different treatments at 15, 30, 60 and 90 days are presented in Table 1. The height of the crop recorded at 15 days after transplanting (DAT) showed that the maximum plant height of 17 cm was under 25 µ thickness plastic mulch at 80 per cent ET_0 level with 100 per cent RDF (T_5) and 120 per cent RDF (T_6) and lowest height of 13 cm was recorded in the control treatment T_{19}. The statistical analysis depicts that there is statistical significance in mulched plots as compared to no mulch. Interaction effect of irrigation, fertilizer and mulching showed significance as compared to control through the 25µ and 50µ were in par with each other. Irrigation and fertilizer levels on the plant height and they are significant in their interaction. Mulching levels of 25µ and 50µ were on par with each other.

The results indicated that at 30 days after transplanting, the mulch treatment was significantly maximum (35.00 cm) as in case of 15 DAT than the without mulch treatments. The minimum height (18.67 cm) was observed in control treatment at irrigation level of 60 per cent ET_0 with fertigation level of 100 per cent RDF.

Similar trend were observed in 60 DAT and at the time of harvest and also they were significant in their interactions. The better plant growth was due to favorable moisture conditions

and these results are in agreement with the findings of Muthuchamy *et al.* (1993). This was due to more transpiration from the broader leaf area in plastic mulch and even it suppress the evaporation of water (Zhong-kuiXie *et al.*, 2005). Also the mulch plots showed less weed growth and soil moisture was maintained throughout the crop period thus reducing quantum of water.

The most important growth parameters which determined the productivity was directly related to canopy of crops. The treatments under mulch had higher plant height, number of leaves and Leaf Area Index than the without mulch plot under different levels of irrigation and fertilizer. Thus the mulch treatment exhibited better plant growth parameters. These results were in agreement with the findings of Ashrafuzzaman *et al.* (2011).

Table 1.Plant height under different treatments.

Treatments	Plant height (cm)			
	15 DAT	30 DAT	60 DAT	90 DAT
T_1	14.00	26.33	38.67	47.00
T_2	15.00	28.33	45.00	80.33
T_3	14.67	27.33	42.33	76.00
T_4	16.67	32.67	53.00	90.67
T_5	17.00	30.33	51.67	93.33
T_6	17.00	35.00	55.33	93.33
T_7	16.00	31.00	50.00	87.33
T_8	16.00	32.33	51.00	89.33
T_9	16.00	30.67	49.33	86.67
T_{10}	14.00	25.67	37.00	45.67
T_{11}	15.00	27.33	42.67	78.67
T_{12}	14.33	27.00	41.00	73.67
T_{13}	15.00	29.00	46.67	83.67
T_{14}	16.67	33.67	53.67	91.67
T_{15}	16.33	32.33	52.00	89.33
T_{16}	15.33	29.33	47.67	84.00
T_{17}	16.00	31.33	50.33	88.00
T_{18}	15.67	30.33	48.67	86.00
T_{19}	12.67	18.67	32.00	37.33
T_{20}	13.67	23.67	35.33	40.00

T_{21}	13.00		22.67		33.33		38.00	
T_{22}	13.67		24.33		35.67		41.33	
T_{23}	14.00		25.33		36.67		43.33	
T_{24}	14.00		25.00		36.33		42.33	
T_{25}	14.00		26.67		39.00		49.67	
T_{26}	15.00		29.00		46.00		81.00	
T_{27}	15.00		28.33		45.33		81.00	
Mean	29		44		71		71	
Effects	**S.Ed**	**CD (0.05)**	**S.Ed**	**CD (0.05)**	**S.Ed**	**CD (0.05)**	**S.Ed**	**CD (0.05)**
M	**0.15**	**0.42****	**0.26**	**0.71****	**0.41**	**1.13****	**0.52**	**1.45****
I	**0.12**	**0.36****	**0.33**	**0.92****	**0.63**	**1.75****	**0.59**	**1.63****
M x I	**0.17**	**0.39****	**0.42**	**0.97****	**0.54**	**1.26****	**1.00**	**2.31****
F	**0.11**	**0.22****	**0.31**	**0.63****	**0.29**	**0.60****	**0.40**	**0.81****
M x F	**0.19**	**0.32****	**0.53**	**0.68****	**0.51**	**1.04****	**0.69**	**1.40***
I x F	**0.19**	**0.32****	**0.53**	**0.68****	**0.51**	**1.04****	**0.69**	**1.40****
M x I x F	**0.32**	**0.61 ^{NS}**	**0.92**	**1.87****	**0.89**	**1.81****	**1.20**	**2.44****

Data on number of primary branches were collected on 30th, 60th and 90th DAT of crop period and it is presented in the Table 2. Mulching had a significant effect on the number of primary branches per plant. The number of structural branches increased with plant age. All mulch treatments had positive effect on generating and retaining higher number of branches per plant. Highest number of branches were found in T_5 (6, 13, 22) i.e. 25µ thickness plastic mulch at 80 per cent ET_0 with 100 per cent RDF followed by T_6 (5, 10, 18) under 25µ thickness plastic mulch at 120 per cent RDF and T_{14} (5, 9, 13) i.e. 50µ thickness plastic mulch at 100 per cent RDF. Least number of primary branches was found in control (2, 4, 6). Interaction of all as irrigation, fertilizer and mulching the three factors showed highly significant effect on the number of primary branches per plant.

The highest number of structural branches per plant was observed in treatments under 25µ plastic mulch followed by 50µ plastic mulch. Favorable environmental conditions and higher moisture of soil are the important parameters affecting the number of branches per plant. It was in

concurred with the studies as reported by Srivastava *et al.* (1994) that mulched plants had more branches than without mulch.

Table 2. Number of branches per plant under different treatments.

Treatments	30 DAT	60 DAT	90 DAT
T_1	2	5	8
T_2	3	6	9
T_3	3	6	9
T_4	4	8	12
T_5	6	13	22
T_6	5	10	18
T_7	3	7	10
T_8	4	8	11
T_9	3	7	10
T_{10}	2	5	8
T_{11}	3	6	9
T_{12}	2	6	9
T_{13}	3	7	10
T_{14}	5	9	13
T_{15}	4	8	11
T_{16}	3	7	10
T_{17}	4	7	10
T_{18}	3	7	10
T_{19}	2	4	6
T_{20}	2	4	7
T_{21}	2	4	7
T_{22}	2	4	7
T_{23}	2	5	8
T_{24}	2	4	8
T_{25}	2	5	8
T_{26}	3	7	10
T_{27}	3	6	9
Mean	3	6	10

Effects	S.Ed	CD (0.05)	S.Ed	CD (0.05)	S.Ed	CD (0.05)
M	**0.06**	**0.17****	**0.33**	**0.93****	**0.23**	**0.64****
I	**0.16**	**0.43****	**0.21**	**0.57****	**0.31**	**0.85****
M x I	**0.13**	**0.30****	**0.27**	**0.61****	**0.57**	**1.32****
F	**0.06**	**0.13****	**0.13**	**0.27****	**0.16**	**0.33****
M x F	**0.11**	**0.22****	**0.22**	**0.44***	**0.28**	**0.57****
I x F	**0.11**	**0.22****	**0.22**	**0.44****	**0.28**	**0.57****
M x I x F	**0.19**	**0.39****	**0.38**	**0.77****	**0.48**	**0.98****

The data regarding highest individual fruit weight (83.00g) was found in T_5 i.e., 25µ plastic mulch at 80 per cent ET_0 level with 100 per cent RDF which was followed by T_6 (77.33g) and T_{14} (65.33g) and the lowest individual fruit weight was recorded in T_{19} (34.67g). Statistical analysis showed that all the three factors had a significant effect on the individual fruit weight in there interaction. The treatment T_5 significantly higher as compared to other treatments.

A maximum of 263 fruits per plant (T_5) were obtained for the treatment 25µ thickness at 80 per cent ET_0 level with 100 per cent RDF followed by T_6 (25µ thickness 120 per cent RDF), followed by T_{14} (50µ thickness at 80 per cent ET_0 level with 100 per cent RDF) and the least number of fruits per plant (57) was recorded in control at 60 per cent ET_0 with 80 per cent RDF. Treatments under mulch produced more fruits per plant compared to control.

The statistical analysis depicted that all the three factors i.e., mulching, irrigation and fertilizer levels and there interaction showed highly significant effect on the total number of fruits. This increase in the number of fruits per plant was probably associated with the conservation of moisture, reduced in number of weeds and improved microclimate both beneath and above the soil surface. These results were similar to studies conducted by Awodoyin *et al.* (2007) and Narendra Agrawal *et al.* (2010) where the yield attributing characteristics like number of fruits per plant, fruits per cluster, diameter of fruits and weight of fruits under polythene mulch were found to be highest and same characters were lowest in control.

The maximum yield was observed in the treatment T_5 (12.00 kg) followed by T_6 (11.68 kg) and T_{14} (11.41 kg). Lowest fruit yield of 2.6 kg was observed in T_{19} i.e., control at 60 per cent ET_0 with 80 per cent RDF. The three factors and interactions showed highly significant effect on the fruit yield per plant. Among the treatments at different irrigation levels the 80 per cent ET_0 with 100 per cent RDF was recorded the maximum yield and the minimum yield was recorded in control plot at irrigation level 60per cent ET_0 and fertigation level of 80 RDF. The complimentary soil moisture which was easily available through drip directly to the root zone, improves growth of the plant leading to the increase in yield of the crop. The results are in line with the findings of Jinhui *et al.* (1999).

Table 3.Fruit weight, Number of fruits and yield per plant under different treatments.

Treatments	Fruit weight (g)	No. of fruits per plant	Yield per plant (kg)
T_1	45.00	134	6.11
T_2	49.00	170	7.76
T_3	47.00	159	7.25
T_4	62.67	233	10.63
T_5	**83.00**	**263**	**12**
T_6	**77.33**	**256**	**11.68**
T_7	58.00	206	9.4
T_8	61.33	219	9.99
T_9	57.00	202	9.22
T_{10}	44.67	118	5.38
T_{11}	48.00	164	7.48
T_{12}	46.33	153	6.98
T_{13}	53.00	181	8.26
T_{14}	**65.33**	**250**	**11.41**
T_{15}	61.33	224	10.22
T_{16}	55.00	188	8.58
T_{17}	59.67	213	9.72
T_{18}	55.67	193	8.8
T_{19}	34.67	57	2.6
T_{20}	38.33	83	3.79
T_{21}	36.67	69	3.15

T_{22}	41.00		94		4.29	
T_{23}	43.33		106		4.84	
T_{24}	41.33		101		4.61	
T_{25}	46.33		136		6.2	
T_{26}	52.00		176		8.03	
T_{27}	50.67		172		7.85	
Mean	52		167		8	
Effects	**S.Ed**	**CD (0.05)**	**S.Ed**	**CD (0.05)**	**S.Ed**	**CD (0.05)**
M	**2.17**	**6.02****	**6.79**	**18.86****	**0.26**	**0.73****
I	**0.64**	**1.77****	**8.34**	**23.17****	**0.32**	**0.88****
M x I	**0.72**	**1.66****	**11.9**	**27.47****	**0.62**	**1.42****
F	**0.36**	**0.74****	**4.25**	**8.64****	**0.18**	**0.36****
M x F	**0.63**	**1.28****	**7.37**	**13.00****	**0.31**	**0.90****
I x F	**0.63**	**1.28****	**7.37**	**13.00****	**0.31**	**0.90****
M x I x F	**1.09**	**2.21****	**12.7**	**36.11****	**0.54**	**1.60 ****

The drip fertigation treatments with 100 per cent RDF showed a statistically significant higher yield compared with other drip fertigation treatment. This can be explained by the fact that water and nutrients are supplied directly to the root zone of the crop in drip fertigation. Hence leaching is reduced thereby increasing the availability of nutrients to the plants. Hagin *et al*. (2002) had reported that in a fertigation system, the timing, amount, concentration and ratio of the nutrients are easily controlled and higher crop yield is achieved than those produced by conventional fertilizer application and irrigation. Studies by other investigators had reported on different crops higher yields in drip fertigation on comparison with conventional irrigation and fertigation.

The yield from plants grown in control was significantly lower than those from plants grown with black plastic mulch. Increased temperature inside the soil and efficient utilization of water, fertilizers and nutrients resulting from the use of the plastic mulch may be an important reason for higher yield. The results are in corroboration with the studies conducted by Mukherjee *et al.* (2010).

Conclusion

The application of plastic mulching and fertigation levels increases the yield and yield attributing characters of grafted Brinjal. Irrigation at 80% ET_0 level, 100% RDF and 25µ plastic mulch are higher plant height, number of branches, number of fruits, fruit weight and yield of grafted Brinjal. Highest water use efficiency was achieved in mulched condition and low in without mulched condition. This was due to the fact that under mulched treatment, evaporation losses were prevented which resulted in higher soil moisture availability for plant use than the without mulch treatment. The fertilizer use efficiency was increased considerably under drip fertigation than in direct application. This can be due to improved distribution of fertilizer with minimum leaching beyond the root zone.

References

[1] Agarwal, M.G. and S.S.,Khanna. 1983. Efficient soil and water management in Haryana Agricultural University, Hisar. Bull., pp. 118.

[2] Akbari, M., H. Dehghanisanij and S. M. Mirlatifi. 2009. Impact of irrigation scheduling on agriculture water productivity. Iranian J. Irrigation and Drainage, 1: pp. 69-79.

[3] Ashrafuzzaman, M., A. Halim, M. Razi Ismail, S. M. Shahidullah and M. AlamgirHossain. 2011. Effect of plastic mulch on growth and yield of chilli (*Capsicum annuum*L.). *Brazilian archives of Biol. Technol.*, 54 (2):pp. 321-330.

[4] Awodoyin, F.I., Ogbedide and OlufemiOluwole. 2007. Effects of three mulch types on growth and yield of tomato and weed suppression in Ilbadan, Rainforest-savanna transition zone of Nigeria.

[5] Bletsos, F., C. Thanassoulopoulos and D. Roupakias. 2003. Effect of grafting on growth, yield, and *Verticillium*wilt of eggplant. Hort. Sc., 38: pp. 183-186.

[6] Dimitrios, S., G. Colla., R. Youssef and S. Dietmar. 2010. Amelioration of heavy metal and nutrient stress in fruit vegetables by grafting. Sc. Hort., 127: pp. 156-161.

[7] Hagin, J., M. Sneh and A. Lowengart. 2002. Fertigation: Fertilization through irrigation research Topic No. 23. International Potash Institute, Basel, Switzerland.

[8] JinhuiXie, E. S. Cardenas, T. W. Sammis, M. M. Wall, D. L. Lindsey and L. W. Murray. 1999. Effects of irrigation method on chile pepper yield and phytophthoraroot rot incidence. *Agril. Water Mgmt.*, 42: pp. 127-142.

[9] Kantharajah A.S. and P.G. Golegaonkar. 2004. Somatic embryogenesis in eggplant. *Rev. J. Sci. Hortic.*, 99: pp. 107-117.

[10] Khah, E.M., N. Katsoulas, M. Tchamichian and C. Kittas. 2011. Effect of grafting on eggplant leaf gas exchange under Mediterranean greenhouse conditions. *Int. J. Pl. Prod.*, 5 (2): pp. 121-134.

[11] Mukherjee, A., M. Kundu and S. Sarkar. 2010. Role of irrigation and mulch on yield, evapotranspiration rate and water use pattern of tomato (*Lycopersiconesculentum*L.). *Agril. Water Mgmt.*, 98: pp. 182–189.

[12] Muthuchamy, I., S Mani and D. Chandrashekaran. 1993. Effect of drip irrigation on cotton using sodic water in sodic soil. *Madras Agril. J.*, 80(3): pp. 142-145.

[13] NarendraAgrawal, H.K. Panigrahi and D. Sharma.2010.Effect of different colour mulches on the growth and yield of tomato under Chhattisgarh region.*Indian J. Hort. 67(Special Issue):* pp. 295-300.

[14] Sidhu, A.S. and A.S. Dhatt. 2007. Current Status of Brinjal Research in India. *Acta Hort.*, 752: pp. 243-247.

[15] Srivastava, P.K., M.M. Parikh, N.G. Sawani and S. Raman. 1994. Effect of drip irrigation and mulching on tomato yield. *Agric. Water Manage*. 25: pp. 179-184.

[16] Zhong-kuiXie, Ya-jun Wang, L. Feng-min. 2005.Effect of plastic mulching on soil water use and spring wheat yield in arid region of northwest China.*Agril. Water Mgmt.*,75: pp.71–83.

