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Effect of Plastic Mulching on Yield of Grafted Brinjal under Drip Irrigation

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A B S T R A C T

Field studies were conducted at PFDC farm, of Tamil Nadu Agricultural University, Coimbatore to evaluate the effect of plastic mulching on yield of grafted brinjal under drip irrigation. The experiments were laid in Strip Plot Design with twenty seven treatments which included three mulching levels such as 25 µ thickness plastic mulch, 50 µ thickness plastic mulch and control; three Irrigation levels at 60 per cent ET_0, 80 per cent ET_0 and 100 per cent ET_0 and three fertigation levels with 80 per cent, 100 per cent and 120 per cent RDF which were replicated thrice. Daily water requirement was calculated based monthly average evaporation. Its observed that treatment gave highest yield of 83.3 $t.ha^{-1}$ under 25 µ thickness plastic mulch at 80 per cent ET_0 level and 100 per cent RDF and lowest yield of 18.1 $t.ha^{-1}$ in control plot with 60 per cent ET_0 and 80 per cent RDF. It can be concluded that the use of mulch increased the yield of the grafted brinjal as compared to the treatments without mulch condition under drip irrigation.

Introduction

The plastic mulch was first adopted in United States of America. Even with the rapid growth in production and use of plastics in our country, the per capita consumption of plastics is only 2.2 kg which is very low as compared to consumption in developed countries like United States of America, Germany and Japan where per capita consumption is above 60 kg. World average of per capita consumption of plastic is 16.2 kg (Ilyas, 2001). Sweet corn, tomatoes, cucumber, straw berry, lettuce, watermelon, okra, and grapes are the primary crop target to plastic mulch.

The notable advantage of the use of plastic mulch is its impermeability which prevents direct evaporation of moisture from the soil and thus cuts down the water losses (Akbari *et al.*, 2009). Plastic like HDPE, LDPE and LLDPE has been used as plastic mulch. In the above types plastic LDPE mulches are most commonly used. Recently LLDPE has been scoring over LDPE as a mulch material due to its two associated characteristics of better down gauging and puncture resistance, and checks weeds growth.

The use of plastic mulch to achieve earlier and larger yields of commercial vegetables is

increasing. This is especially true for warm season species such as peppers, corn, tomatoes and the vine crops. Water that evaporates from the soil under the plastic film condenses on the lower surface of the film and falls back to the soil droplets. So that soil moisture is preserved and consumed by the crop (Ashworth and Harrison, 1983). The mulch film prevents the direct impact of rain on the soil and maintains a porous soil structure. Thus better moisture movement and gaseous exchange takes place in mulched soils. This process increases the concentration of carbon dioxide around the mulch film and improves photosynthesis.

The technology of vegetable production with grafts was originated in Japan and Korea to avoid serious loss caused by soil borne diseases aggravated by successive cropping (Lee *et al*, 2010). Grafting is also high effective in ameliorating crop losses caused by adverse environmental conditions (Dimitrios *et al*., 2010). Cultivation of vegetable grafts is widely recognized and has advantages of disease tolerance and high crop yields (Sakata *et al*, 2007; Lee *et al*., 2010). This practice is now rapidly spreading and expanding over the world. The number and size of commercial vegetable seedling and grafted plants producers have increased among the farmers (Rouphael *et al*., 2010).

The use of grafting as an integrated pest management tool to manage biotic stress will be most successful when complemented with sustainable farming system practices (Kubota, 2008; Frank *et al*., 2010). Grafting of brinjal cultivars on perennial and wild species increased the yield and availability period of the fruits.

Materials and Methods

The experiment was conducted to study the effect of plastic mulching on yield of grafted brinjal (*Solanum. melongena* L.) under drip irrigation system. The materials used, experimental techniques and analytical methods adopted in the investigations are enumerated.

Location

The experiment was conducted at PFDC research farm in the Eastern block of Tamil Nadu Agricultural University, Coimbatore at 11.0183^0 N latitude and 76.9725^0 E longitude with mean altitude of 426 m above the mean sea level, topography of the experimental plot was uniform.

Climate

The mean annual rainfall of the study area is 720 mm. About 55 per cent of annual rainfall is received during North-East monsoon season and 30 per cent during South-West monsoon. The annual maximum and minimum mean temperatures were 32.50 ºC and 20.10 ºC respectively and the average relative humidity of the area is 56.8 per cent the mean daily evaporation ranges from 3.14 mm to 7.05 mm.

The monthly average climatic data of significant weather parameters as maximum and minimum temperature, maximum and minimum relative humidity, pan evaporation (E_{pan}) and rainfall of last 22 years from 1991 to 2013 were collected from Agro Climate Research Centre, Tamil Nadu Agricultural University, Coimbatore.

Crop

The grafted brinjal which was developed by Department of Vegetable Crops at TNAU, Coimbatore by using two *Solanum* species *S. torvum*, known as Turkey berry, was a wild species used as rootstock and the scion was COBH2 and Ravaiya which exhibit the tolerance to shoot and fruit borer incidence and cultivated in all types of soils under water

stress conditions in semi-arid regions, got better yield performances and has a vibrant market potential in domestic market. The harvested crop can be used as ratoon crop for the next season.

Soil

The texture of soil is sandy clay loam soil with mechanical composition of clay 30.8 per cent, silt 28.7 per cent, fine sand 19.5 per cent, and coarse sand 20.5 per cent with pH of 8.07, EC of 0.78 dS m^{-1}, available N of 185.6 kg ha^{-1}, available P of 9.0 kg ha^{-1} and available K of 356.7 kg ha^{-1} with water holding capacity of 39.41per cent, Pore space of 42.73 per cent, hydraulic conductivity 0.38cm hr^{-1} and Infiltration rate of 0.73 cm hr^{-1}.

Water

Bore well water was used for irrigating the crop which was moderately saline with pH of 7.56 and EC of 1.93 dS m^{-1}.

Drip system

The layout was taken up forming 81 strips of 6 m X 1.2 m size and drip system was installed. The drip system was laid out with 75 mm diameter PVC main pipe line and 63 mm diameter PVC sub main with fertigation tank and venturi.

LLDPE laterals of 16 mm diameter were connected to sub main. Each lateral was provided with individual taps for controlling irrigation and fertigation. Along the laterals, online drippers of 4 lph were fixed at the spacing of 1.2 m. Sub mains and laterals were plugged at the end with end caps. After installation, trial run was conducted to assess mean dripper discharge and uniformity coefficient. Morning time was preferred for irrigation since evaporation was less at that time.

Mulching

Black Polythene Mulch (BPM) of 25 µ thickness LLDPE, 50 µ thickness LLDPE were used for the study. Over the drip line, according to the treatment, mulching sheets were spread in each plot and both ends of the plastic sheet were buried into the soil up to a depth of 10 cm and holes were punched.

Results and Discussion

The results of the study on Effect of plastic mulching on yield of grafted brinjal under drip irrigation presented and discussed here.

Number of fruits per plant

A maximum of 263 numbers of fruits were obtained for the treatment T_5 i.e., 25 µ thickness at 80 per cent ET_0 level with 100 per cent RDF followed by T_6 i.e., 25 µ thickness 120 per cent RDF, followed by 50 µ thickness at 80 per cent ET_0 level with 100 per cent RDF and a less number of fruits per plant (57) was recorded for the 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 depicts all the three factors i.e., mulching, irrigation and fertilizer levels and there interaction showed highly significant effect on the total number of fruits. These results are given in Table 1 and Figure 1(a).

From the experiment it was observed that, more number of fruits per plant in mulched treatments than the control. 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. This mulching results were similar with Awodoyin *et al.*, (2007) where deference between treatments in total number of fruits per plant were highly significant (131 fruits) in black plastic mulch as compared to the

other mulched treatments like grass (104 fruits), wood-chip (96 fruits), hand weeded (89 fruits) and un weeded (42 fruits) plots.

Table.1 Number of fruits per plant, yield per plant and total yield under different treatments

Treatments	Number of Fruits per plant		Fruit Yield per plant (kg)		Total yield (t ha^{-1})	
T_1	134		6.11		42.50	
T_2	170		7.76		53.90	
T_3	159		7.25		50.40	
T_4	233		10.63		73.80	
T_5	**263**		**12**		**83.30**	
T_6	**256**		**11.68**		**81.10**	
T_7	206		9.4		65.30	
T_8	219		9.99		69.40	
T_9	202		9.22		64.00	
T_{10}	118		5.38		37.40	
T_{11}	164		7.48		52.00	
T_{12}	153		6.98		48.50	
T_{13}	181		8.26		57.30	
T_{14}	**250**		**11.41**		**79.20**	
T_{15}	224		10.22		71.00	
T_{16}	188		8.58		59.60	
T_{17}	213		9.72		67.50	
T_{18}	193		8.8		61.10	
T_{19}	57		2.6		18.10	
T_{20}	83		3.79		26.30	
T_{21}	69		3.15		21.90	
T_{22}	94		4.29		29.80	
T_{23}	106		4.84		33.60	
T_{24}	101		4.61		32.00	
T_{25}	136		6.2		43.10	
T_{26}	176		8.03		55.80	
T_{27}	172		7.85		54.50	
Mean	167		8		53.05	
Effects	S.Ed	CD (0.05)	S.Ed	CD (0.05)	S.Ed	CD (0.05)
M	6.79	18.86**	0.26	0.73**	1.82	5.07**
I	8.34	23.17**	0.32	0.88**	1.42	3.94**
M x I	11.9	27.47**	0.62	1.42**	2.27	5.24**
F	4.25	8.64**	0.18	0.36**	1.76	3.58**
M x F	7.37	13.00**	0.31	0.90**	3.05	5.08**
I x F	7.37	13.00**	0.31	0.90**	3.05	5.08**
M x I x F	12.7	36.11**	0.54	1.60 **	5.29	9.05**

Fig.1(a) Number of fruits per plant under different treatments

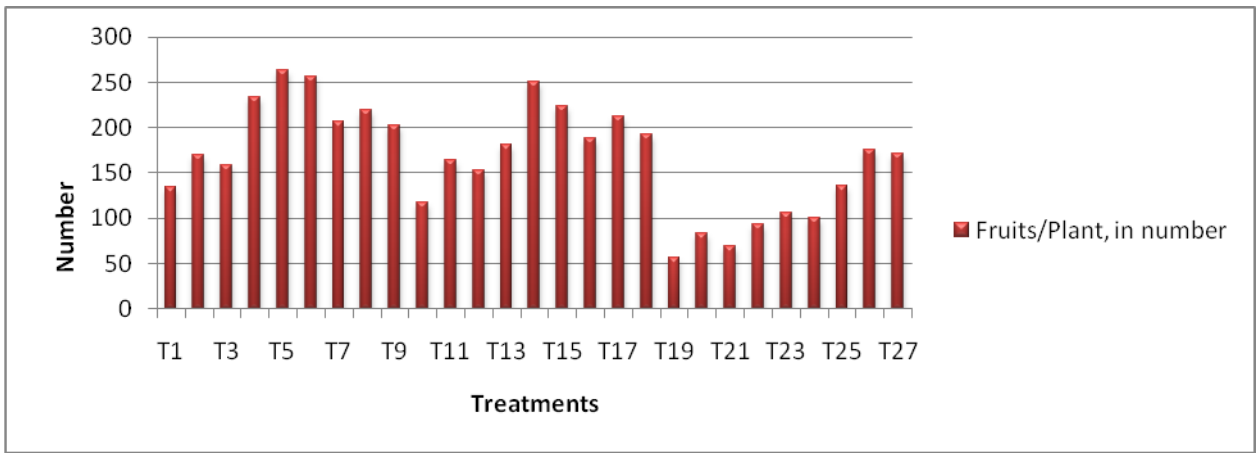


Fig.1(b) Fruit yield per plant under different treatments

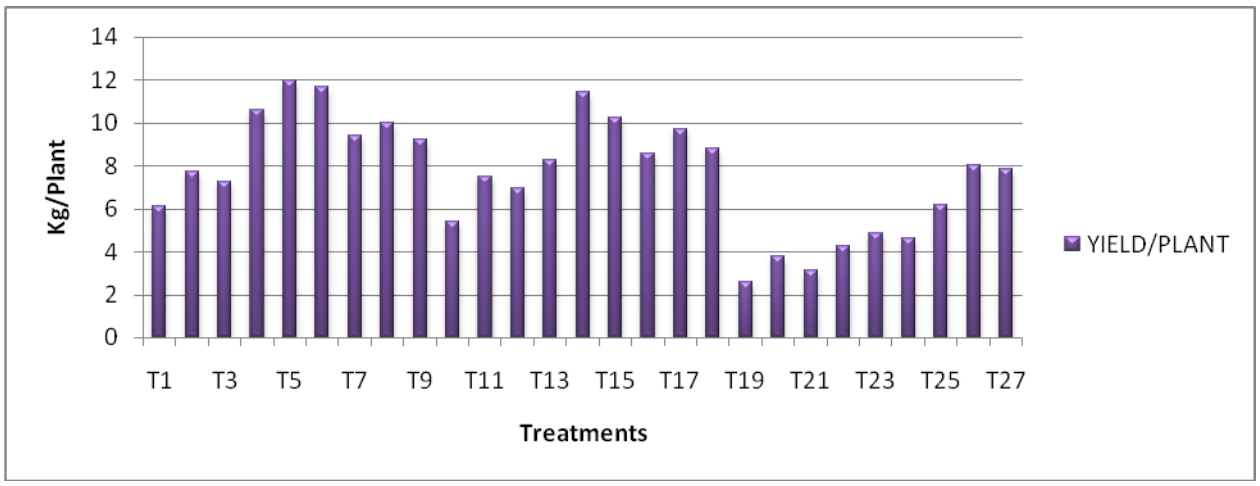
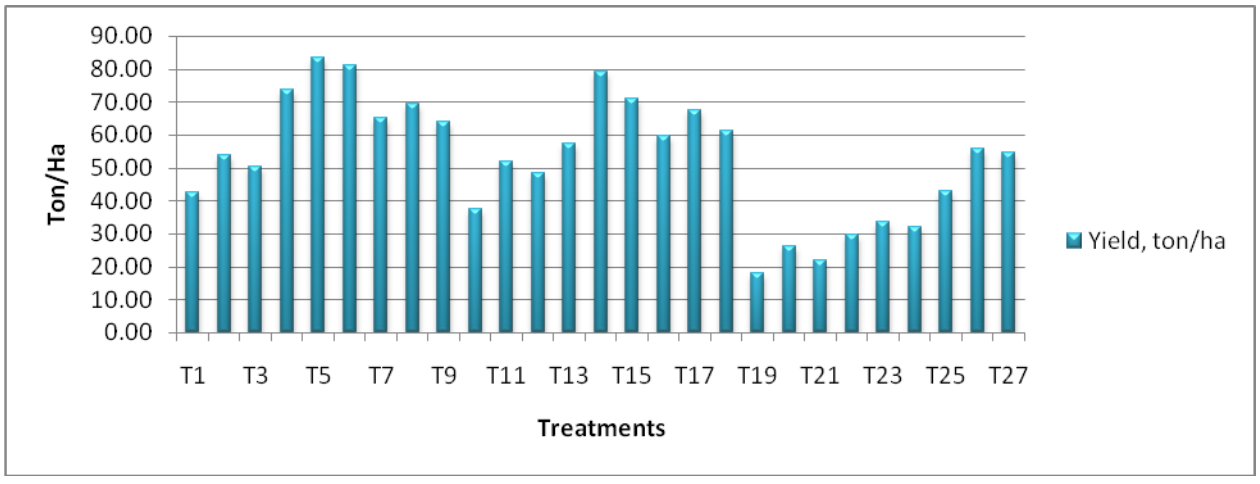


Fig.1(c) Yield per hectare under different treatments



These results are also in agreement with the findings of Narendra Agrawal *et al.,* (2010) where he found out that 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.

Yield per plant

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. More yield was found in mulched treatments compared to control. The three factors and interactions showed highly significant effect on the fruit yield per plant. These results are given in Table 1 and Figure 1(b).

Yield per hectare

The highest yield was recorded in T_5 (83.3t ha^{-1}) i.e., in 25 µ thickness plastic mulching at 80 per cent ET_0 level with 100per cent RDF followed by treatment T_6 and T_{14} (81.10 t ha^{-1}) and (79.2 t ha^{-1}) respectively. These results are given in Table 1 and Figure 1(c) and lowest yield was recorded in T_{19} (18.1t ha^{-1}) i.e., control. The statistical analysis depicts that all the three factors i.e., mulching, irrigation and fertilizer levels and there interaction showed highly significant effect on the total yield.

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, will improve growth of the plant. This leads to the increase in yield of the crop. The present results are in line with the findings of Jinhui *et al.,* (1999).

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 with drip fertigation the root zone is simultaneously supplied with water and nutrients, and nutrients are abundantly available as compared to others. Hagin *et al.,* (2002) reported that in a

fertigation system, the timing, amounts, concentrations and ratios of the nutrients are easily controlled. Due to this improved control, crop yields are higher than those produced by a conventional fertilizer application and irrigation. A number of other investigators report higher yields in different crops when fertilizers were injected through the drip system in comparison with conventional application of fertilizers.

The yields from plants grown on bare soil were significantly lower than those from plants grown with black plastic mulch. Increases of temperature inside the soil and efficient utilization of water, fertilizers and nutrients resulting from the use of the plastic mulch might be an important reason for the highest yield. A similar result has been reported by Mukherjee *et al.,* (2010).

In conclusion, treatments under mulch recorded more yield per plant compared to control is associated with the conservation of moisture and improved microclimate both beneath and above the soil surface. A maximum of 263 numbers of fruits were recorded for the treatment T5 under mulch condition with 25 µ thickness at 80 per cent ET_0 with 100 per cent RDF fallowed by T6 with 256 fruits per plant and a less number of fruits per plant (57) was recorded under the

treatment T19 without mulch at 60 per cent ET_0 with 80 per cent RDF. The highest yield of 83.34 t ha-1 was recorded for the treatment T5 under mulch condition with 25 µ thickness at 80 per cent ET_0 with 100 per cent RDF which was followed by T6 and T14 (81.10 t ha^{-1}) and (79.2 t ha^{-1}) respectively. Low yield values were recorded under treatment without mulch at 60 per cent ET_0 and 80 per cent RDF (18.1 t ha^{-1}). Increase of temperature and efficient utilization of water, fertilizers and nutrients resulting from the use of the plastic mulch be an important reason for the highest yield.

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