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Influence of Mulching and Pressurized Irrigation System on Cost Economics of Grafted Brinjal (*Solanum. melongena* L.)

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***Abstract*:- Field studies were conducted at PFDC farm, of Tamil Nadu Agricultural University, Coimbatore to evaluate the influence of plastic mulching on cost economics (returns from the field interms of 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 the results showed that total water requirement for the growth period under drip irrigation has saved 16.17 per cent of water with mulch compared to without mulch condition. It's observed that the 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 with benefit cost ratio of 8.68 compared to all other treatments 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 advance irrigation technologies like drip irrigation combined with mulch can play a important role in increasing the productivity hence the net returns can be increased.**

Key words: Drip irrigation, Mulching, Fertigation, Benefit cost ratio.

1. INTRODUCTION:

Water is considered as liquid gold and land is one of the platforms for survival of many living things for performing several activities. Both are the important factors for the survival of life. Agriculture is the source for the Indian belly and its productivity and value is dependent on health of land/soil and timely availability of water source which are declining day by day in very rapid rate at the same time demand interms of crop yield is growing for every second. So it is necessary to go for the adaptation of technologies which puts hand in conserving and managing scarce resources in agriculture by giving more importance to production quality as well as quantity. To achieve this with available scarce quantity of water it is necessary to increase the water use efficiency which can be achieved through the adaptation of micro irrigation system.

Micro irrigation technology is rapidly expanding all over the world, especially in the water scarce areas of developed countries. Due to the decreasing availability of water resources and increasing competition for water between different users, improving agricultural water use efficiency is vitally important in many parts of the world that have limited water resources. It has been estimated that the irrigated area in the world is 253 m ha. The gross irrigated area of India in 2005-2006 had increased to 82.6 m ha from 22.6 m ha in 1951-52 and increase being more than 250 per cent during the last five decades. Efficient use of water through scientific irrigation management is of utmost importance in providing the best insurance against weather induced fluctuations in food production **(**Agarwal and Khanna, 1983). Drip irrigation is an effective tool for conserving water resources and studies have revealed significant water saving ranging between 40 per cent and 70 per cent by drip irrigation compared with surface irrigation (Sidhu *et al.*, 2007; Kubota, 2008; Rouphael *et al*., 2010 and Frank *et al*., 2010).).

Productivity can be increased by adopting improved package of practices, particularly *in situ* moisture conservation applying plastic mulch by achieving earlier and larger yields of commercial vegetables (Ilyas, 2001). 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 so that soil moisture is preserved and consumed by the crop (Akbari *et al.*, 2009, Ashworth and Harrison, 1983). Sweet corn, tomatoes, cucumber, straw berry, lettuce, watermelon, okra, and grapes are the primary crop target to 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 and through fertigation 40 to 50 per cent of nutrient could be saved.

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. So, the study was conducted on Grafted Brinjal was explained.

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2. MATERIAL AND METHODS:

The experiment was conducted to study the influence of plastic mulching along with pressuiresed irrigation system (Drip irrigation) on yield thereby on cost economics of grafted brinjal (*Solanum. melongena* L.). The materials used, crop and experimental techniques and analytical methods adopted in the investigations are enumerated.

2.1 Study area:

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.

2.2 Crop details:

Crop	: Grafted brinjal (*Solanum. melongena* L.)
Species	: *S. torvum* (Turkey berry)
Rootstock	: COBH2
Scion	: Ravaiya
Spacing	: 1.2 m x 1.2 m
Treatments	: 27
Replication	: 3
Gross plot size	: 583.2 m^2
Design	: Strip Plot Design
Factors	: 3
Levels	: 3

2.3 Statistical analysis

The data were analyzed in AGRESS package for Strip Plot Design (SPD) for crop grown in various experimental plots. Wherever the treatment differences were found significant ('F' test) critical differences were worked out at 5 per cent probability level and the values are furnished.

The factor and level details are as below.

Factor I - Mulching with three levels M_1 with 25 micron thickness LLDPE, M_2 with 50 micron thickness LLDPE and M_3 with no mulch.

Factor II - Irrigation with three levels I_1 at 60 per cent ET_0, I_2 at 80 per cent ET_0 and I_3 at100 per cent ET_0.

Factor III - Fertigation with three levels F_1 at 80 per cent RDF, F_2 at100 per cent RDF and F_3 at 120 per cent RDF.

2.4 Treatment Details:

T_1- 25 µ plastic mulch @ 60 % ET_0 + 80 % RDF
T_2-25 µ plastic mulch @ 60 % ET_0 + 100 % RDF
T_3-25 µ plastic mulch @ 60 % ET_0 + 120 % RDF
T_4-25 µ plastic mulch @ 80 % ET_0 + 80 % RDF.
T_5-25 µ plastic mulch @ 80 % ET_0 + 100 % RDF.
T_6-25 µ plastic mulch @ 80 % ET_0 + 120 % RDF.
T_7-25 µ plastic mulch @ 100 % ET_0 + 80 % RDF.
T_8-25 µ plastic mulch @ 100 % ET_0 + 100 % RDF.
T_9-25 µ plastic mulch @ 100 % ET_0 + 120 % RDF.
T_{10}-50 µ plastic mulch @ 60 % ET_0 + 80 % RDF
T_{11}-50 µ plastic mulch @ 60 % ET_0 + 100 % RDF
T_{12}-50 µ plastic mulch @ 60 % ET_0 + 120 % RDF
T_{13}-50 µ plastic mulch @ 80 % ET_0 + 80 % RDF.
T_{14}-50 µ plastic mulch @ 80 % ET_0 + 100 % RDF.
T_{15}-50 µ plastic mulch @ 80 % ET_0 + 120 % RDF.
T_{16}-50 µ plastic mulch @ 100 % ET_0 + 80 % RDF.
T_{17}-50 µ plastic mulch @ 100 % ET_0 + 100 % RDF.
T_{18}-50 µ plastic mulch @ 100 % ET_0 + 120 % RDF.
T_{19}- No mulch @ 60 % ET_0 + 80 % RDF
T_{20}- No mulch @ 60 % ET_0 + 100 % RDF
T_{21}- No mulch @ 60 % ET_0 + 120 % RDF
T_{22}- No mulch @ 80 % ET_0 + 80 % RDF
T_{23}- No mulch @ 80 % ET_0 + 100 % RDF
T_{24}- No mulch @ 80 % ET_0 + 120 % RDF

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T_{25}- No mulch @ 100 % ET_0 + 80 % RDF
T_{26}- No mulch @ 100 % ET_0 + 100 % RDF
T_{27}- No mulch @ 100 % ET_0 + 120 % RDF

2.5 Cost economics

Economics of grafted brinjal production under plastic mulching with drip irrigation system was worked out in terms of total expenditure. The total cost of cultivation was calculated which is the sum of mulching sheet cost, irrigation drip lines cost, land preparation and management and other input cost like fertilizer, harvesting, planting material cost etc. The net returns per hectare were worked out for all treatments by subtracting the cost of cultivation from the gross returns. The return per rupee invested (B: C) ratio was also calculated as follows.

$$\text{Benefit Cost Ratio} = \frac{\text{Gross income ha}^{-1}}{\text{Total cost of cultivation ha}^{-1}} \quad \ldots\ldots (3.1)$$

3. RESULTS AND DISCUSSION:

In order to study the feasibility of cultivation of grafted brinjal under plastic mulching cost of cultivation, fixed cost, net income and Benefit Cost ratio for different treatments were worked out and the results of the stated objective are discussed here.

The life of the pipe materials were taken as five years. Interest at twelve per cent of fixed cost was taken into consideration to work out the cost economics. The used 25 µ plastic sheet has degraded within one crop season and 50 µsheet was good even after the crop period so it can be used for the next crop, so it is taken for two crop use. The economics of the system of mulching and fertigation under study was worked out in Rs ha^{-1} and Benefit-cost ratio for treatments is calculated by using equation 3.1. It can be seen from the results that among all the treatments the highest benefit was obtained from treatment T_5 i.e., 25 µ mulch at 80 per cent ET_0 with 100 RDF with highest water use efficiency and yield per hectare followed by the treatment T_6 and the lowest net return was obtained in control treatment without mulch i.e., T_{19} at 60 per cent ET_0 with 80 per cent RDF are shown in figure 1 and figure 2. In terms of benefit: cost ratio which fallowed the same trend was highest in treatment T_5 (8.68) and lowest in Treatment T_{19} (1.41) as presented in the figure 3. All the drip irrigation treatments with mulch recorded higher cost benefit ratio (7.78 to 8.68) compared to without mulch treatments (1.41 to 2.41) are presented in Table 1.

The performance of mulch and without mulch under drip irrigation system can be valued both in terms of biological and economical returns (Sakata *et a.l*, 2007; Lee *et al.*, 2010; Dimitrios *et al*., 2010). However, it was important that a technically feasible proposal should be financially complete for its successful adoption (Bletsos *et al*., 2003; Khah *et al*., 2011). One of the main constraints under mulch and drip irrigation was its high initial investment. Mulch require plastic sheet and drip irrigation requires mains, sub mains, laterals, filter, and other accessories to design the unit. The economic analysis of grafted brinjal crop under mulch and without mulch with drip irrigation was made by considering fixed cost, cost of cultivation, water used and yields obtained.

The initial cost of installing the plastic sheet and drip irrigation system for vegetable crops was high but over a period of time the cost could be recovered and the benefits derived would be higher interms of increased yield from the field with high quality products as shown in plate 1. Even during the first year itself the drip irrigation system showed maximum net returns. Similar results of increase in net returns with saved water for brinjal crop under drip irrigation with different ET levels were in line with Bhogi *et al.* (2011).

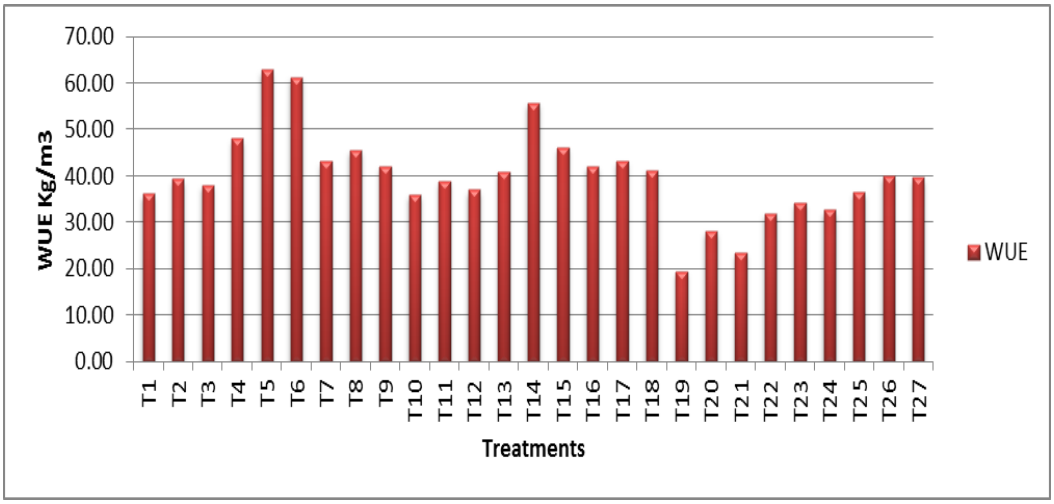

Fig. 1 Water Use Efficiency under different treatments

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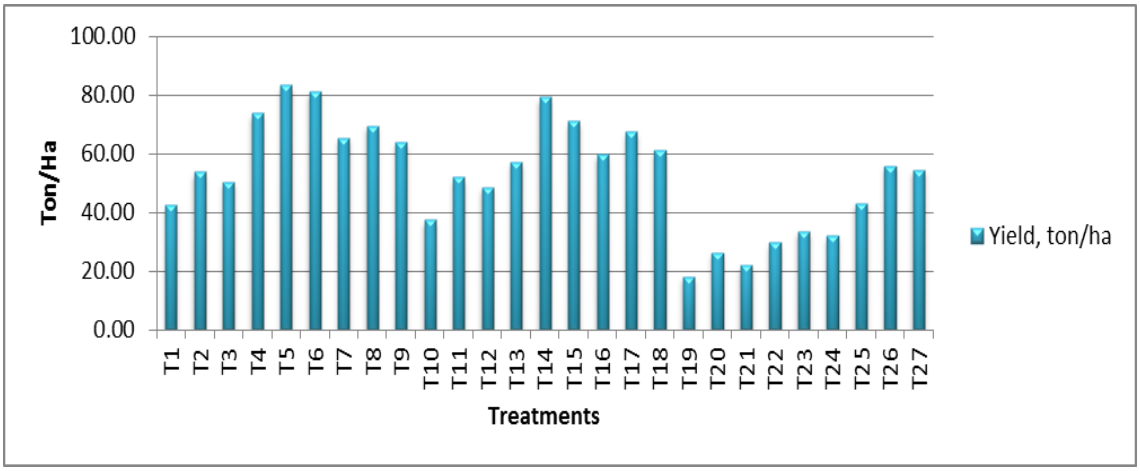

Fig. 2 Yield per hectare under different treatments

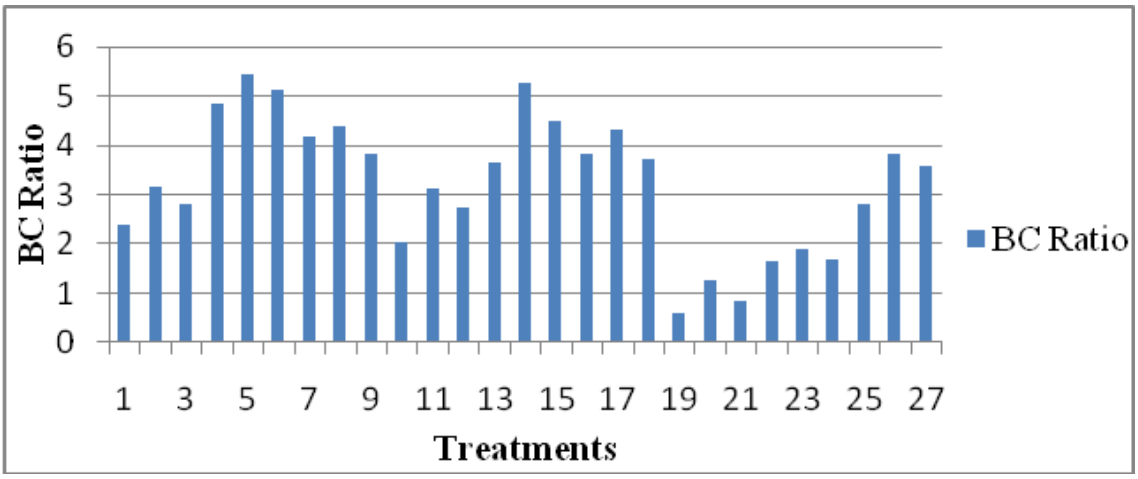

Fig. 3 Benefit cost Ratio under different tretments

Plate. 1 Yield of Grafted Brinjal under mulching and drip irrigation system

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Table 1 Cost benefit ratio for grafted brinjal cultivation under different treatments

Treatment	Total cost of cultivation	Yield kgha^{-1}	Revenue from the field (consider cost of Grafted brinjal at rs. 20/ kg)	Net income (@Rs. 20/ kg)	BC ratio (@ Rs. 20/kg	Revenue from the field (consider cost of Grafted brinjal at rs.25/ kg)	Net income (@Rs. 25/ kg)	BC ratio (@ Rs. 25/kg	Revenue from the field (consider cost of Grafted Brinjal at rs.30/ kg)	Net income (@Rs.30/ kg)	BC ratio (@Rs.30/ kg)
	(b + d) =C	**(e)**	**(e x 20) =R**	**(R-C) =I**	**I/C = BC**	**(e x 25) =R**	**(R-C) =I**	**I/C = BC**	**(e x 30) =R**	**(R-C) =I**	**I/C = BC**
T_1	252187	42500	850000	597813	2.37	1062500	810313	3.21	1275000	1022813	4.06
T_2	258216	53900	1078000	819784	3.17	1347500	1089284	4.22	1617000	1358784	5.26
T_3	264245	50400	1008000	743755	2.81	1260000	995755	3.77	1512000	1247755	4.72
T_4	252187	73800	1476000	1223813	4.85	1845000	1592813	6.32	2214000	1961813	7.78
T_5	**258216**	**83300**	**1666000**	**1407784**	**5.45**	**2082500**	**1824284**	**7.06**	**2499000**	**2240784**	**8.68**
T_6	**264245**	**81100**	**1622000**	**1357755**	**5.14**	**2027500**	**1763255**	**6.67**	**2433000**	**2168755**	**8.21**
T_7	252187	65300	1306000	1053813	4.18	1632500	1380313	5.47	1959000	1706813	6.77
T_8	258216	69400	1388000	1129784	4.38	1735000	1476784	5.72	2082000	1823784	7.06
T_9	264245	64000	1280000	1015755	3.84	1600000	1335755	5.05	1920000	1655755	6.27
T_{10}	247187	37400	748000	500813	2.03	935000	687813	2.78	1122000	874813	3.54
T_{11}	253216	52000	1040000	786784	3.11	1300000	1046784	4.13	1560000	1306784	5.16
T_{12}	259245	48500	970000	710755	2.74	1212500	953255	3.68	1455000	1195755	4.61
T_{13}	247187	57300	1146000	898813	3.64	1432500	1185313	4.80	1719000	1471813	5.95
T_{14}	**253216**	**79200**	**1584000**	**1330784**	**5.26**	**1980000**	**1726784**	**6.82**	**2376000**	**2122784**	**8.38**
T_{15}	259245	71000	1420000	1160755	4.48	1775000	1515755	5.85	2130000	1870755	7.22
T_{16}	247187	59600	1192000	944813	3.82	1490000	1242813	5.03	1788000	1540813	6.23
T_{17}	253216	67500	1350000	1096784	4.33	1687500	1434284	5.66	2025000	1771784	7.00
T_{18}	259245	61100	1222000	962755	3.71	1527500	1268255	4.89	1833000	1573755	6.07
T_{19}	225687	18100	362000	136313	0.60	452500	226813	1.00	543000	317313	1.41
T_{20}	231716	26300	526000	294284	1.27	657500	425784	1.84	789000	557284	2.41
T_{21}	237745	21900	438000	200255	0.84	547500	309755	1.30	657000	419255	1.76
T_{22}	225687	29800	596000	370313	1.64	745000	519313	2.30	894000	668313	2.96
T_{23}	231716	33600	672000	440284	1.90	840000	608284	2.63	1008000	776284	3.35
T_{24}	237745	32000	640000	402255	1.69	800000	562255	2.36	960000	722255	3.04
T_{25}	225687	43100	862000	636313	2.82	1077500	851813	3.77	1293000	1067313	4.73
T_{26}	231716	55800	1116000	884284	3.82	1395000	1163284	5.02	1674000	1442284	6.22
T_{27}	237745	54500	1090000	852255	3.58	1362500	1124755	4.73	1635000	1397255	5.88

4. SUMMARY AND CONCLUSION:

The cultivation under drip irrigation system with mulching has increased the water use efficiency (reducing the volume of water utilized) by reducing the water evaporation losses hence, thereby increased the yield per unit area. The treatment T_5 registered the highest gross income of Rs. 2240784.00 at the rate of Rs.30 kg^{-1} and cost- benefit ratio was also higher 8.68 compared to all other treatments. So T_5 is recommended for the farmers. Among all the mulching, Irrigation and fertigation treatments, the best performance was observed in treatment T_5 under 25 µ thickness mulching at 80 per cent ET_0 with 100 per cent RDF in terms of growth, yield, water use efficiency, fertilizer use efficiency and higher benefit in terms of cost economics.

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