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Response of Brinjal to different levels of Drip Irrigation with and without Mulch on Growth, Yield and Water Use Efficiency

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ABSTRACT

The combination of drip irrigation with plastic mulch enables better plant micro climate and contributes to higher yields. Field experiment was carried out at Precision Farming Development Centre (PFDC), College of Agriculture, Rajendranagar, Hyderabad on a sandy loam soil having adequate drainage during *Kharif*- 2004, 2005 and 2008 to evaluate the response of different levels of irrigation with and without black LDPE mulch film. Brinjal crop irrigated with drip at 0.80 PE (Pan Evaporation) combined with plastic mulch (T_6) recorded the highest benefit cost ratio which was recorded 47.59 % more yield than the conventional method of irrigation and it was recorded the better Water Use Efficiency than the conventional method of irrigation as 2.92 t/ha-cm. Hence treatment drip irrigation at 0.8 PE with plastic mulch can be recommended.

Key words : Brinjal, Drip irrigation, Plastic mulching.

Water is the crucial input for agriculture and the scarcity of water resource is increasing at an alarming rate due to increasing cropping intensity, industrial expansion and domestic needs. Agriculture sector consumes about 83% of the water. Where as, about 50-70% of water is wasted through conveyance, evaporation, field application and distribution losses in conventional method of irrigation. These losses can be reduced by adopting efficient water management practices. Mulching is covering the soil around the plant with any material viz straw, grass, hay, Paddy straw, Ground nut shell powder or with Plastic film etc. It acts as a barrier between the soil and atmosphere. Drip irrigation along with mulching is the best alternative for economic use of water and improvement in water use efficiency. Hence a field experiment was carried out on Brinjal crop to assess the effect of drip along with plastic mulch. Since Brinjal (*solanum melongena L.*) is said to be native crop of India, with the secondary centre at China. Brinjal is grown commercially in almost all parts of the country. Brinjal is popular for the preparation of various dishes in different regions of the country. It is supposed to contain medicinal properties and is used in Ayurvedic medicines.

MATERIAL AND METHODS

A field experiment was conducted at Precision Farming Development Centre (PFDC), College Farm, College of Agriculture, Rajendranagar, Hyderabad on a sandy loam soil having adequate drainage during *Kharif* for the years 2004, 2005 and 2008 to evaluate the response of different levels of irrigation with and without black LDPE mulch film and to find out appropriate irrigation levels which lead to higher water use efficiency. The irrigation water was applied at 1.00 PE, 0.80 PE and 0.60 PE on plots with and without plastic mulch. The results were compared with traditional method.

35 days old seedlings of Brinjal (Hybrid Ravaiah) were transplanted in the main field with a spacing of 40 x 45 cm, in paired row drip system. The planting was done at 20 cm away from the lateral on both sides with 40cm row spacing and 45 cm plant spacing within the row having lateral spaced 1.2 m apart.

The treatments consisted of three drip irrigation regimes based on PE and one conventional method of irrigation (flood irrigation) as control and with and without mulch. The experiment was laid out in a Randomized block design with three replications. The details are given below.

Details of Treatments:

Plot size: 11 x 4.8 m each plot
T1: Drip irrigation at 1.00 PE
T2: Drip irrigation at 0.80 PE
T3: Drip irrigation at 0.60 PE
T4: Conventional method of irrigation *i.e.* flood irrigation (control)
T5: T1 + Plastic mulch (25 micron)

Table1. Effect of different levels of irrigation with and without mulch on Brinjal (Hybrid Raviah) plant height

Treatment	Plant height (cm)			
	2004	2005	2008	Pooled
T_1	34.46	50.25	55.27	46.66
T_2	35.98	52.30	51.04	46.44
T_3	35.63	46.78	47.09	43.12
T_4	35.49	43.22	40.00	39.57
T_5	35.98	47.24	65.00	49.41
T_6	36.43	49.52	58.00	47.98
T_7	35.22	45.55	54.00	44.92
T_8	35.42	45.98	48.00	43.13
S.Em±	0.257	0.365	0.242	2.480
CD at	0.787	1.119	0.742	N.S
CV	1.251	1.329	0.802	9.510

Table 2. Effect of different levels of irrigation with and without mulch on Brinjal (Hybrid Raviah) yield

Treatments	Yield (t/ha)				
	2004	2005	2008	Pooled mean	% increase in yield
T_1	60.26	25.02	37.95	41.08	37.48
T_2	57.96	25.58	36.70	40.08	34.14
T_3	53.96	24.30	34.21	37.49	25.47
T_4	40.00	20.14	29.50	29.88	—
T_5	65.32	26.97	43.23	45.17	51.12
T_6	63.02	27.43	41.85	44.10	47.59
T_7	55.20	24.92	35.60	38.57	29.08
T_8	51.52	23.64	32.70	35.95	20.31
S.Em±	1.208	0.299	1.736	1.736	
CD at	3.699	0.917	5.316	5.316	
CV	3.742	0.365	7.701	7.701	

Table 3. Effect of different levels of irrigation with and without mulch in saving of water (%) and Water Use Efficiency (WUE) on Brinjal (Hybrid Raviah)

Treatments	Depth of water applied (cm)				Saving of water (%)				Water use efficiency (t/ha-cm)			
	2004	2005	2008	Pooled Mean	2004	2005	2008	Pooled Mean	2004	2005	2008	Pooled Mean
T_1	21.09	14.14	18.23	17.82	32.2	43.44	37.84	37.83	2.85	1.77	2.08	2.23
T_2	18.19	11.31	14.58	14.69	43.15	54.76	48.76	48.89	3.18	2.26	2.52	2.65
T_3	14.32	8.48	10.94	11.25	55.26	66.08	60.76	60.70	3.77	2.86	3.13	3.25
T_4	32.00	25.00	29.00	28.67	-	-	-	-	1.25	0.81	1.02	1.03
T_5	21.69	14.14	18.23	17.82	32.2	43.44	37.84	37.83	3.01	1.91	2.37	2.43
T_6	18.19	11.31	14.58	14.69	43.15	54.76	48.76	48.89	3.46	2.43	2.87	2.92
T_7	14.32	8.48	10.94	11.25	55.26	66.08	60.76	60.70	3.85	2.94	3.25	3.35
T_8	32.00	25.00	29.00	28.69	-	-	-	-	1.61	0.95	1.12	1.23

T6: T2 + Plastic mulch (25 micron)
T7: T3 + Plastic mulch (25 micron)
T8: T4 + Plastic mulch (25 micron)

1/3 of Nitrogen (40 kg/ha) together with complete P_2O_5 and K_2O 60 Kg P_2O_5 and K_2O was applied prior to transplanting as basal dose. The remaining 2/3 of N was top dressed in two splits at 45 days and 60 days after transplanting.

Mature fruits were picked at regular intervals and the total yield was computed. The drip irrigation treatments were scheduled every day for 1 ½ hr, 1.0 hr and ½ hr to T_1, T_2 and T_3 treatments respectively. Conventional method of irrigation (T_4) was given as and when the cumulative pan evaporation reached to 40 mm and to a depth of 4 cm. These drip irrigation levels in combination with plastic mulching forms T_5 to T_8 treatments.

RESULTS AND DISCUSSION

The irrigation water was applied at 1.00 PE, 0.80 PE and 0.60 PE both with and without plastic mulching. The results were compared with traditional method. The data revealed that among the irrigation treatments, in combination with mulching treatment T_5 with Drip at 1.0 PE + plastic mulch has recorded highest plant height of 49.41 cm.

All the drip irrigation treatments with mulch T_5, T_6, T_7 recorded significantly higher yields (45.17, 44.10 and 38.57 t//ha) compared to that of T_8 conventional method of irrigation with mulch, which recorded (35.95 t/ha).

Among the drip treatments in combination with plastic mulching T_7 (T_3+ plastic mulch) has recorded highest W.U.E. of 3.35 t/ha - cm followed by T_3 which was recorded 3.25 t/ha-cm.

Plant Height (cm)

The pooled data revealed that all drip treatments (three irrigation regimes) have shown better plant height over that of conventional method of irrigation.

Among the drip irrigation levels, Brinjal crop irrigated with 1.0 PE has recorded maximum plant height over that of 0.8 PE and 0.6 PE (Table 1).

Among the irrigation treatments, in combination with mulching treatment T_5 with Drip 1.0 PE+ plastic mulch, has recorded highest plant height of 49.41 cm. It is higher compared to that of other Drip treatment with mulch. 0.8 PE (47.98/cm) and 0.6 PE (44.92 cm).

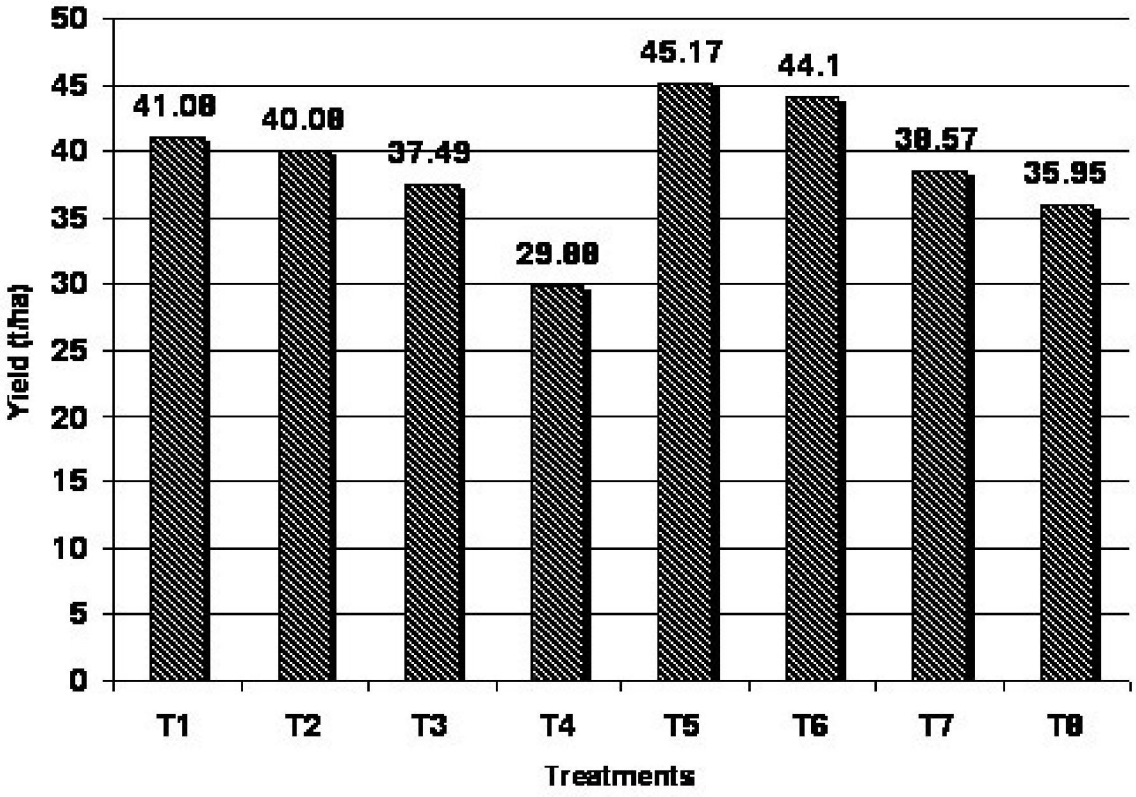
The treatment with conventional method of irrigation with mulch treatment (T_8) has recorded plant height of 43.13 cm over the control 39.57 cm (T_4).

Fruit yield (t/ha):

The pooled data of the three years revealed that the maximum fruit yield was recorded in T_5 with drip irrigation at 1.0 PE + plastic mulch (45.17 t/ha) which was significantly higher by (51.12%) over conventional method of irrigation T_4 (Control) with 29.88 t/ha (Table 2 & Fig. 1).

Treatment T_6 *i.e.* drip irrigation at 0.8 PE with plastic mulch recorded (44.10 t/ha) which is on par with that of T_5. All the treatments with drip alone at different evaporation regimes recorded significantly higher yields than the conventional method of irrigation.

Fig.1. Brinjal yield (t/ha) as influenced by irrigation levels with and without mulch



All the drip irrigation levels with mulch T_5, T_6 and T_7 records significantly higher yields (45.17, 44.10 and 38.57 t/ha) compared to control *i.e* T_8 conventional method of irrigation with mulch (35.95 t/ha). Between the two treatments with surface irrigation with and without mulch on T_4 and T_8, T_8 recorded significantly higher yield of 35.95 t/ha

Water Use Efficiency:

Pooled data of three years revealed that all the drip irrigation treatments at 1.0 PE (T_1), 0.8 PE (T_2) and 0.6 PE (T_3) have shown higher W.U.E. of 2.23, 2.65 and 3.25 t/ha-cm over that of conventional method of irrigation (T_4), which recorded 1.03 t/ha-cm. All the other treatments of combination of drip irrigation and crop mulching recorded higher W.U.E. (Table 3 & Fig. 2).

Among the drip irrigation levels, T_3 has recorded maximum W.U.E. of 3.25 t/ha-cm, followed by T_2 with 2.65 t/ha- cm. Among the drip treatments in combination with plastic mulching, T_7 (T_3+ plastic mulch) has recorded highest W.U.E. of 3.35 t/ha - cm compared to that of T_6 (T_2 + plastic mulch), which recorded 2.92 t/ha - cm followed by T_5 (T_1+ Plastic mulch) which recorded 2.43 t/ha-cm.

The treatments with conventional method of irrigation with mulch (T_8) recorded 1.23 t/ha-cm which is higher than conventional method of irrigation without mulch recorded 1.03 t/ha-cm.

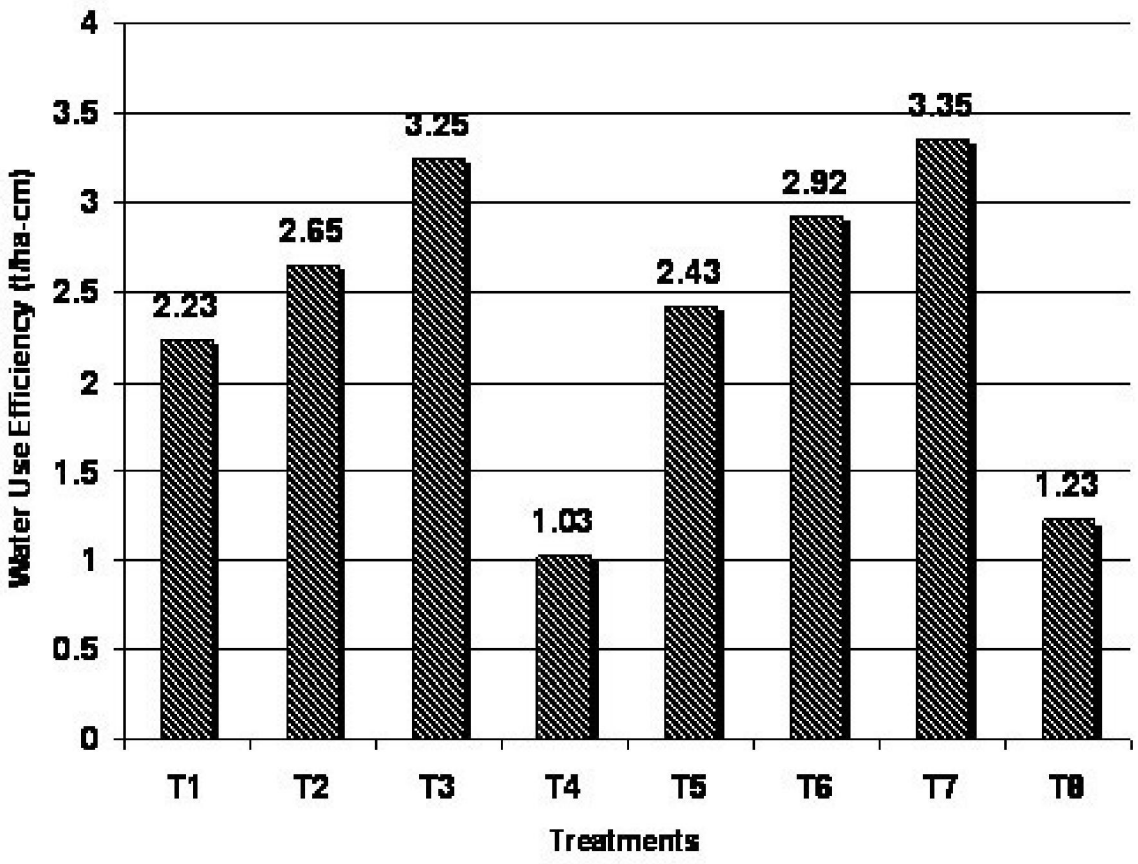
Quantity of water applied:

Year wise and pooled water application details are given in table 3. The pooled data revealed that amount of water was applied through conventional method (control T_4) a depth of 28.67 cm where as in drip irrigation treatments T_1, T_2 and T_3, the amount of water was applied at depth of 17.82, 14.69 and 11.25 cm respectively. The data indicates that maximum water saving obtained in treatment (T_3) i.e. drip Irrigation at 0.6 PE is 60.70%, followed by 0.8 PE with 48.76% and 1.0 PE with 37.83% (Table-3)

Cost Economics:

The Net seasonal income from Drip+Mulch at 1.0 PE (T_5) was maximum i.e Rs. 3,14,360 followed by T_6 with Rs. 3,07,800 where as control (T_4) recorded net seasonal income of Rs. 1,93,040 (Table 4).

Fig. 2. Influence of Water Use Efficiency in Brinjal by irrigation levels with and without mulch



Highest cost benefit ratio was recorded with T_6 i.e Drip irrigation at 0.8 PE with Plastic mulch 6.84, followed by 6.82 with T_2 drip irrigation at 0.8 PE alone. Lower benefit cost ratio of 4.19 was recorded with conventional method of irrigation without mulch T_4 (Table 4).

These results are in confirmation with Krishna Manohar et.al. (2005) and Swarajya lakshmi et.al (2005). In drip irrigation with mulch continuous application of low quantity of water facilitated the aeration in soil with optimum soil temperatures for most of its growth period. The conveyance and application losses were reduced in drip with mulch which resulted in higher Water Use Efficiency over the conventional method. The increase in Water Use Efficiency haslead to increase in additional area under cultivation and increase the gross income and net profit.

Drip irrigation system along with mulch will create favorable microclimate around the plant root zone and ensure sufficient moisture availability throughout the crop growth period for healthy plant growth and higher yields.

Based on the study of three years, Brinjal crop irrigated with drip at 0.8 PE combined with plastic mulch recorded the highest benefit cost ratio which was recorded 47.59 % more yield than the conventional method of irrigation and it was recorded the better Water Use Efficiency than the conventional method of irrigation as 2.92 t/ha-cm. Based on the benefit cost ratio, yield and water use efficiency, the 0.8 PE combined with plastic mulch can be recommended.

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Table 4. Cost economics of Brinjal Drip + Mulch Experiment

S.No	Particulars	T1	T2	T3	T4	T5	T6	T7	T8
1	Annual cost of Drip irrigation system per ha (includes depreciation, interest, repairs and maintenance)	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
2	Cost of cultivation (Rs./ ha)	23,000	21,000	19,000	26,000	27,000	25,000	23,000	28,000
3	Seasonal Total Cost (1+2) (Rs./ha)	43,000	41,000	39,000	46,000	47,000	45,000	43,000	48,000
4	Water used (mm)	178.20	146.9	112.5	286.7	178.2	146.9	112.5	286.7
5	Yield of produce (t/ha)	41.08	40.08	37.49	29.88	45.17	44.1	38.57	35.95
6	Selling price (Rs./t)	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000
7	Income from produce (5x6) Rs.	3,28,640	3,20,640	2,99,920	2,39,040	3,61,360	3,52,800	3,08,560	2,87,600
8	Net seasonal income (7-3) Rs	2,85,640	2,79,640	2,60,920	1,93,040	3,14,360	3,07,800	2,65,560	2,39,600
9	Benefit cost ratio (8/3)	6.64	6.82	6.69	4.19	6.69	6.84	6.18	4.99
10	Net profit per mm of water used (8/4)	1,603	1,904	2,319	673	1,764	2,095	2,361	836
11	Water use efficiency (5/4x100) t/ha-mm	2.23	2.65	3.25	1.03	2.43	2.92	3.35	1.23

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