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Effect plastic mulching on fertigation of grafted brinjal under drip irrigation system

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■ **ABSTRACT :** Field studies were conducted at PFDC farm, of Tamil Nadu Agricultural University, Coimbatore to evaluate the effect of plastic mulching and fertigation on 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 recommended dosage of fertilizer (RDF) which were replicated thrice. The results showed that the plastic mulch suppress the population of weeds as compared to without mulch treatments. The highest fertilizer use efficiency (416.5 kg ha^{-1}.kg of N, 555.3 kg ha^{-1}.kg of P and 833.00 kg ha^{-1}.kg of K) was recorded in treatment under 25µ plastic mulch at 80 per cent ET_0 with100 per cent RDF. The use of mulch increased the yield of the grafted brinjal as compared to the treatments without mulch.

■ **KEY WORDS :** Fertigation, Drip irrigation, Mulching, Grafted brinjal

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Agriculture is the source for the Indian belly and also to fulfill the needs of human beings, its 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 is growing for every second. 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. 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. Drip irrigation helps to increase fertilizer use efficiency. 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. 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 minimizes losses of expensive nutrients fertilizer ensures higher and quality yield along with saving in time and labour and energy resulting in reduced cost of cultivation. Experiments have already indicated that through fertigation 40 to 50 per cent of nutrient could be saved. Fertigation can be injected into drip system by

selecting appropriate applications for a wide assessment of available pumps, tanks, valves, venturies and aspirators. Among these venturies is the cheap and economic one though it creates high pressure loss.

METHODOLOGY

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

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.

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 co-efficient. Morning time was preferred for irrigation since evaporation was less at that time 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.

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 upto a depth of 10 cm and holes were punched.

Fertilizer requirement:

The quantity of fertilizer required for the study area of 584 m^2 is calculated based on quantity recommended for per hectare. The recommended dose of fertilizers was 200:150:100 kg ha^{-1} and basal dose of 75 per cent (112.5 kg) phosphorus.75 per cent phosphorus was applied as single super phosphate of 703 kg ha^{-1}, 25 per cent phosphorus as water soluble fertilizer, urea of 340 kg ha^{-1}, 19:19:19 of 79.00 kg ha^{-1}, muriate of potash of 189 kg ha^{-1} and potassium nitrate of 37 kg ha^{-1} were applied simultaneously in a combined form to the plant root zone.

Fertigation:

Water soluble fertilizers were used in this experiment. The fertilizers were dissolved in water in the ratio of 1:5 and the solution was diluted in fertigation tank. The fertilizer is applied at weekly intervals during vegetative stage, flowering stage and during fruiting stage.

Fertilizer use efficiency:

Fertilizer use efficiency (FUE) was calculated separately for N, P and K for each treatment, which is the ratio of yield of the crop in kgha^{-1} and total nitrogen, potassium and phosphorus applied in kg ha^{-1}.

$$FUE = \frac{Y}{F.A} \quad ...(1)$$

where,

FUE = Fertilizer use efficiency

Y = Yield of the crops, kg ha^{-1}

F.A = Total fertilizer applied.

RESULTS AND DISCUSSION

The results of the study on evaluation of plastic mulching and fertigation on grafted brinjal under drip irrigation are presented and discussed here.

Fertilizer requirement of grafted brinjal:

The quantity of fertilizer required for the study area of 584 m^2 is calculated based on quantity recommended for per hectare. The recommended dose of fertilizers was 200:150:100 kg ha^{-1}. Water soluble fertilizers were used in this experiment. The total amount of fertilizer applied under different treatments at various crop growth stages of grafted brinjal were calculated by using recommended dose of fertilizer ratio and are presented in Table 1.

The results indicated that the treatment T_5 with 100 per cent RDF under 25 µ thickness at 80 per cent ET_0 level was best when compared with all other different treatments. This is in conformity with Dalvi *et al*. (1999) that improved water and fertilizer management by drip fertigation at 96 per cent of recommended level dose resulted in maximum yield of tomato. Aujla *et al*. (2005) had studied the effect of various levels of water and nitrogen application through drip irrigation on seed cotton yield and water use efficiency.

Fertilizer use efficiency:

Fertilizer use efficiency of nitrogen, phosphorus and potassium were calculated by using eq, showed highest in treatment T_5 under 25µ thickness plastic mulch at 80 per cent ET_0 level with 100 per cent RDF (416.5 kg ha^{-1}.kg of N, 555.3 kg ha^{-1}.kg of P and 833.00 kg ha^{-1}. kg of K), followed by T_6 and T_{14} under 50µ thickness plastic

Table 1 : Details of quantity of fertilizer applied for the study area (kg)

Stage	Name	80 per cent RDF	100 per cent RDF	120 per cent RDF
Basal dose	Single super phosphate	32.80	41.00	49.20
Transplanting to plant	NPK 19:19:19	0.616	0.770	0.924
establishment	Muriate of potash 13:0:45	0.087	0.108	0.13
(1-10 days)	Urea	0.399	0.498	0.598
	KNO_3 12:61:0	0.383	0.478	0.574
Vegetative stage	Muriate of potash 13:0:45	1.384	1.73	2.076
(11-40 days)	Urea	2.215	2.768	3.322
Flower initiation	NPK 19:19:19	0.616	0.770	0.924
to first picking	Muriate of potash 13:0:45	0.784	0.98	1.176
(41-70days)	Urea	1.555	1.944	2.333
	KNO_3 12:61:0	0.192	0.240	0.288
Harvesting stage	Muriate of potash 13:0:45	0.692	0.864	1.039
(71-180days)	Urea	1.108	1.384	1.661

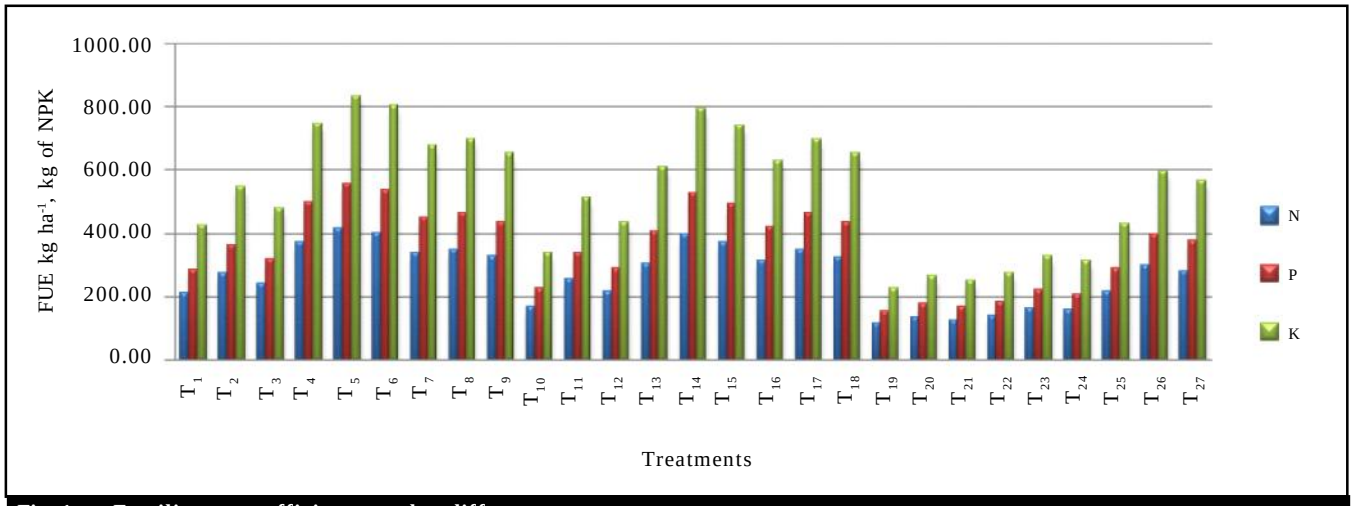

Fig. 1 : Fertilizer use efficiency under different treatments

mulch at 80 per cent ET_0 level with 100 per cent RDF and the lowest was noted in T_{19} with 60 per cent ET_0 and 80 per cent RDF under without mulch condition. The variation in FUE is shown in Table 2 and Fig 1. Statistically all the three factors mulching, irrigation and fertilizer levels and interactions showed highly significant effect on fertilizer use efficiency. According to Anitta *et al.* (2011), fertigation is a recent innovative cultural method by which fertilizers are applied along with irrigation water through drip system to get higher fertilizer

Table 2 : Fertilizer use efficiency under different treatments

Treatments	Total yield (kg ha^{-1})	FUE (kg ha^{-1}/ kg of N)	FUE (kg ha^{-1}/ kg of P)	FUE (kg ha^{-1} / kg of K)
T_1	42500	212.33	283.11	424.67
T_2	53900	272.50	363.33	545.00
T_3	50400	238.75	318.33	477.50
T_4	73800	372.50	496.67	745.00
T_5	83300	416.50	555.33	833.00
T_6	81100	400.00	533.33	800.00
T_7	65300	337.92	450.56	675.83
T_8	69400	347.72	463.63	695.44
T_9	64000	326.50	435.33	653.00
T_{10}	37400	168.00	224.00	336.00
T_{11}	52000	254.58	339.44	509.17
T_{12}	48500	216.53	288.70	433.06
T_{13}	57300	303.33	404.44	606.67
T_{14}	79200	396.00	528.00	792.00
T_{15}	71000	369.00	492.00	738.00
T_{16}	59600	315.00	420.00	630.00
T_{17}	67500	347.00	462.67	694.00
T_{18}	61100	324.79	433.06	649.58
T_{19}	18100	113.13	150.83	226.25
T_{20}	26300	132.92	177.23	265.84
T_{21}	21900	124.03	165.37	248.06
T_{22}	29800	136.88	182.50	273.75
T_{23}	33600	164.38	219.17	328.75
T_{24}	32000	155.69	207.59	311.39
T_{25}	43100	215.33	287.11	430.67
T_{26}	55800	295.97	394.63	591.94
T_{27}	54500	281.39	375.19	562.78
Mean	53052	268.10	357.47	536.20

Effects	S.E.±	C.D. (P=0.05)	S.E.±	C.D. (P=0.05)	S.E.±	C.D. (P=0.05)	S.E.±	C.D. (P=0.05)
M	1832.14	5086.92**	11.8	32.79**	15.74	43.72**	23.62	65.58**
I	1425.83	3958.81**	7.65	21.34**	10.2	28.33**	15.3	42.49**
M x I	2286.86	5273.57**	13.58	31.33**	18.11	41.77**	27.17	62.66**
F	1766.82	3583.67**	8.32	16.88**	11.09	22.51**	16.64	33.77**
M x F	627.85	5955.55*	14.4	26.87**	19.22	35.95**	28.83	52.9**
I x F	2627.85	5955.55*	14.4	26.87**	19.22	35.95**	28.83	52.9**
M x I x F	5024.79	10749.43*	24.97	38.73**	33.29	61.28**	49.94	95.39**

* and ** indicate significance of values at P=0.05 and 0.01, respectively

use efficiency besides increasing the crop yields. Highest fertilizer use efficiency was found in 100 per cent RDF. It indicates that, the fertigation applied in 100 per cent RDF treatments was fully taken up by the plants for their growth and yield. The results are in accordance with Bharambe *et al.* (2001) who reported N use efficiency was considerably increased with the application of N through drip over soil application and it was highest under 75 kg N ha^{-1} applied through drip application in a Parbhani clayey soil at Maharashtra. This can be due to improved distribution of fertilizer with minimum leaching beyond the root zone or runoff. Response of hybrid cotton to split application of NPK through fertigation application of 10 per cent of RDF as basal and 90 per cent of RDF through fertigation in 19 equal splits at five days interval from 30 to 120 DAS recorded 35 per cent higher yield than soil application of RDF (Patil, 2002).

Conclusion:

Increased fertilizer use efficiency (416.5 kg ha^{-1}. kg of N, 555.3 kg ha^{-1}.kg of P and 833.00 kg ha^{-1}.kg of K) was found in treatment T_5 with 100 per cent RDF under 25µ plastic mulch at 80 per cent ET_0. The lowest fertilizer use efficiency was noted in treatment (T_{19}) under control plot with 60 per cent ET_0 with 80 per cent RDF.

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