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Response of brinjal to FYM, mulch and irrigation under Palam valley conditions

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ABSTRACT

An investigation was conducted during kharif season of 2014 on silty clay loam soil of Palampur, Himachal Pradesh to study the effect of different levels of FYM, mulch and irrigation on growth, yield, root parameters and economics of brinjal. The result of the study indicated that preplanting incorporation of FYM at the rate of 10 t ha^{-1} and plastic mulching followed by surface irrigation of 4 cm depth at five day interval resulted in significant improvement in growth, root parameters and fruit yield of brinjal as compared to other treatments. Incorporation of 10 t ha^{-1} FYM and irrigation of 4 cm depth resulted in improvement in net returns and net returns per rupee invested. Although higher gross returns were obtained with use of plastic mulch but net returns and net returns per rupee invested were higher in organic mulch.

Keywords: Brinjal, economics, FYM, irrigation, mulching and yield

Brinjal or eggplant (*Solanum melongena*), a member of Solanaceae family, is one of the most commonly grown vegetable crops in India and other parts of the world. The crop is widely grown both in rainy and summer seasons. It is often planted at the onset of rainy season. The growth and development of this crop is affected by many edaphic factors, however, optimum soil temperature and moisture are most crucial. Several factors control soil temperature and moisture, but, only soil cover and FYM incorporation can manipulate both the regimes to some extent. A surface mulch of organic residues protect the soil against splashing action of rain drops and protect the surface soil from aggregate destruction, thus keep the soil surface open and enhances infiltration of water.

Now a day's people have started using alternate sources of mulching as they often confronted with problem of limited availability of organic material for use as mulch. Polythene is commonly used as mulch in agriculture as it provides wide spread functions through capturing solar heat, moreover it is resistant to chemicals, more durable and flexible, free from any odour (Lament, 1993). Mulches are used to yield solar heat to alter micro climate which could be lost through radiation to atmosphere when black mulch are used. Plastic mulch allows solar radiation to enter but does not permit to comeback thereby it helps to alter micro climate which ultimately reflected into crop production. More than 114 million pounds of plastic mulch is used annually in United States (Ennis, 1987).

The productivity of vegetables can be significantly improved by irrigation. Further, irrigation requirements can be significantly reduced by reducing loss of water from the soil surface. It is well known that soil water conservation practices such as FYM incorporation increases crop yield by increasing water holding capacity and infiltration of water from the rains as well as from the surface irrigation, thus increasing the profile water storage. Optimum soil moisture regime plays a significant role in the germination and development of well developed root system which in turn improves vegetable growth and ultimately fruit production. Keeping this view an experiment was undertaken to study the effect of different levels of FYM, mulch and irrigation on productivity of brinjal.

MATERIALS AND METHODS

The study was carried out at Experimental Farm of Choudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur during *kharif* season of 2014. Geographically experimental site is situated at 32°6´ N latitude and 76°3´ E longitude at an elevation of 1290 m mean sea level in North Western Himalayas. The soil of experiment at site was silty clay loam in texture, acidic in nature (pH 5.1), high in organic carbon (11.10 g kg^{-1}), low in available nitrogen (234.6 kg ha^{-1}), high in available phosphorus (38.08 kg ha^{-1}) and medium in available potassium (131.4 kg ha^{-1}). The experiment was laid out in randomized block design with three replications. The experiment consisted twelve treatment combinations of two FYM levels (FYM @ 5 and 10 t ha^{-1}), three mulch levels (organic mulch @ 10 t ha^{-1}, plastic mulch and no-mulch,) and two irrigation levels (irrigation of 2 and 4 cm depth). Application of farm yard manure was done on fresh weight basis and organic material as mulch was applied on dry weight to

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respective treatments, while, irrigation was applied as surface method of irrigation. As per treatments, FYM was band placed before sowing in 10-15 cm deep furrows and thoroughly mixed with soil. Basal dose of recommended NPK was applied before planting. Top dressing of nitrogen was done twice at an interval of one month. Plastic mulch was applied before transplanting and organic mulch was applied after transplanting @ 10 t ha^{-1} taking care that plants were not covered with mulch material. After transplanting, surface irrigation with a low pressure plastic pipe was applied at an interval of five days from May to June to full fill the water requirement. The variety H-8 of brinjal was transplanted on 1st week of May with the spacing of 50 x 50 cm. Various root growth parameters were determined at the time of crop harvest. Root length under each monolith section was measured using a modified line intercept method (Tennant, 1975). Root volume was determined by water displacement method. Fresh root samples were oven dried at 72°C till constant weight was obtained in each treatment. The gross return, net return and net return per rupee invested of different treatments was computed based on cost of various inputs and price of output.

RESULTS AND DISCUSSION

Growth and yield

The growth attributes of brinjal like plant height and number of branches per plant at 50% flowering stage were significantly influenced by levels of FYM, mulch and irrigation. Among FYM levels, plants were taller when FYM was incorporated @ 10 t ha^{-1} as against 5 t ha^{-1}. The increase in plant height might be due to improvement in soil moisture status in turn more nutrients available to crop which reflected into taller plants. Similar observation was also recorded by Rana *et al*. (2007). Likewise, plastic mulch significantly increased the plant height over other treatments *i.e.* organic mulch and no mulch which were at par among themselves. Improvement in micro climate in respect of moisture and nutrient availability might be responsible for increase in shoot height. Similarly, Panigrahi and Sahu (2007) observed better effect of mulches in various vegetables. Plant height was significantly better in those plots where irrigation of 4 cm was applied compared to irrigation of 2 cm depth, due to better nutrient-moisture status.

Number of branches per plant was significantly more when FYM was incorporated @ 10 t ha^{-1} than when FYM was incorporated @ 5 t ha^{-1} which might be due to better nutrient and moisture availability. Plastic mulch significantly increased the number of branches per plant over organic mulch and no mulch which were statistically at par to each other. Higher number of branches per plant in mulch plot can be attributed to favorable microclimate which improved nutrient and water uptake. The results are in agreement with the findings of Singh *et al*. (2005) who reported about positive effect of mulches on different vegetables. Number of branches per plant was significantly more where irrigation of 4 cm depth was imposed than 2 cm depth. This increase in number of branches per plant can be attributed to significant improvement of soil moisture.

Table 1: Effect of levels of FYM, mulch and irrigation on growth and yield of brinjal

Treatment	Plant height (cm)	Number of branches $plant^{-1}$	Fruit diameter (cm)	Fruit yield (Mg ha^{-1})
FYM level				
5 t ha^{-1}	53.7	7.6	5.36	9.47
10 t ha^{-1}	57.5	8.4	5.62	10.25
SEm (±)	0.6	0.3	0.07	0.21
LSD (0.05)	1.8	0.8	0.20	0.60
Mulch source				
Organic	54.8	8.0	5.45	10.00
Plastic	58.4	8.7	5.96	10.77
No mulch	53.7	7.3	5.06	8.81
SEm (±)	0.8	0.3	0.08	0.25
LSD (0.05)	2.2	0.9	0.24	0.74
Irrigation level				
2 cm	54.1	7.5	5.32	9.34
4 cm	57.1	8.5	5.66	10.38
SEm (±)	0.6	0.3	0.07	0.21
LSD (0.05)	1.8	0.8	0.20	0.60

There was significant increase in fruit diameter with increase in FYM incorporation into soil and the highest diameter was obtained when FYM was incorporated @ 10 t ha^{-1}. It might be due to the effect of FYM on moisture and nutrient availability, which was improved with increasing level of FYM incorporation into the soil. Application of plastic as well as organic mulch significantly increased the fruit diameter over no mulch treatments. The plastic mulch proved significantly superior to organic in this respect. Higher fruit diameter in mulch plot can be attributed to favorable microclimate which improved nutrient and water uptake. Similarly, Awasthi *et al*. (2006) established superiority of mulches**.** Irrigation level of 4 cm resulted in significantly higher fruit diameter than irrigation level of 2 cm which might be due to the direct effect of more availability of water which improved photosynthetic area.

There was significant increase (8.24 %) in fruit yield of brinjal with increase in FYM incorporation into the soil from 5 to 10 t ha^{-1}. This increase in yield can be attributed to improvement in yield attributes like number of branches per plant which might have resulted in more number of fruits simultaneously better fruit diameter with higher levels of FYM support the significant better effect on fruit. This result is partially in conformity with the result of Rana *et al*. (2007). Farm yard manure provides nutrients for longer period as organic ions released slowly after decomposition results in higher yield components and fruit yield. Application of either organic or plastic mulch resulted in significantly higher brinjal fruit yield than no mulch. Further, the increase in fruit yield was more under plastic mulch (22.25 %) than under organic mulch (13.51 %). Plastic mulch was significantly superior to organic mulch in term of fruit yield of brinjal and resulted in 7.70 % more yield. Improvement in physical properties coupled with supply of nutrients and water under mulch might be responsible for this increase in fruit yield. Saroch *et al*. (2014) also reported increase in yield with use of organic mulch. Irrigation with water depth of 4cm resulted in significantly higher fruit yield than irrigation with water depth of 2 cm due to significant improvement in fruit size and more number of branches per plant.

Interaction

The interaction between FYM and mulch levels showed non-significant effect on fruit yield of brinjal.

Table 2: Interaction effect of mulch and FYM level on yield of brinjal (Mg ha^{-1})

Mulch	**FYM**	
	5 t ha^{-1}	**10 t ha^{-1}**
Organic	10	10
Plastic	10	11
No mulch	8	9
SEm (±)	0.4	
LSD (0.05)	NS	

Similarly, the interaction effect between FYM and irrigation levels was also found non-significant in respect of fruit yield.

The interaction effect between mulch source and irrigation levels was significant in respect of fruit yield. The results revealed that at lower (2 cm) level of irrigation, plastic mulching was significantly superior to organic mulching which in turn was superior to no mulching in respect of fruit yield of brinjal crop. But at higher level of irrigation, only organic mulch was significantly superior to no mulching. Under organic and no mulching conditions, irrigation of 4 cm resulted in significantly higher fruit yield than irrigation of 2 cm. But under plastic mulch, irrigation had no effect on fruit yield of brinjal. The maximum fruit yield was obtained with incorporation of 2 cm irrigation water under plastic mulch condition.

Table 3: Interaction effect of irrigation and FYM level on yield of brinjal (Mg ha^{-1})

Irrigation	**FYM**	
	5 t ha^{-1}	**10 t ha^{-1}**
2 cm	9	10
4 cm	10	11
SEm (±)	0.3	
LSD (0.05)	NS	

Table 4: Interaction effect of mulch and irrigation level on yield of brinjal (Mg ha^{-1})

Mulch	Irrigation level	
	2 cm	4 cm
Organic	9.1	10.9
Plastic	11.0	10.5
No mulch	7.9	9.7
SEm (±)	0.4	
LSD (0.05)	1.0	

Root parameters

Incorporation of FYM at higher levels effected root parameters significantly, where, higher values of each parameter were recorded under incorporation of FYM @ 10 t ha^{-1}. Singh *et al*. (2011) also reported that FYM incorporation increased root length and root volume over control in brinjal crop**.** The values of all root parameters were significantly higher under plastic mulch than under organic mulch. Likewise the values of all parameters were significantly higher under organic mulch than under no mulch. The root length as well as root dry weight were significantly lower under irrigation of 4 cm in comparison to irrigation of 2 cm, might be due to better soil moisture status which restricted root growth.

Table 5: Effect of levels of FYM, mulch and irrigation on root parameters of brinjal

Treatment	Root length (cm)	Root volume (cc)	Root dry weight (g)
FYM level			
5 t ha^{-1}	33.8	3.42	1.16
10 t ha^{-1}	31.7	3.69	1.25
SEm (±)	0.6	0.09	0.03
LSD (0.05)	1.8	0.26	0.09
Mulch source			
Organic	32.7	3.47	1.18
Plastic	35.6	4.12	1.40
No mulch	29.9	3.08	1.05
SEm (±)	0.8	0.11	0.04
LSD (0.05)	2.2	0.31	0.11
Irrigation level			
2 cm	34.1	3.78	1.29
4 cm	31.3	3.33	1.13
SEm (±)	0.6	0.09	0.03
LSD (0.05)	1.8	0.26	0.09

Economics

There was increase in gross as well as in net returns with increase of FYM incorporation. Application of FYM @ 10 t ha^{-1} gave higher gross (8.21 %) and net returns (12.18 %) than incorporation of it at the rate of 5 t ha^{-1}, due to significant increase in fruit yield of brinjal. However, differences in net returns per rupee invested obtained with incorporation of either 5 or 10 t FYM ha^{-1} were not significant because the effect of increased yield by later treatment was compensated by increase in cost of cultivation. More evident from fruit yield data of brinjal, plastic mulch resulted in significantly higher (7.67 %) gross returns than organic mulch and organic mulch in turn resulted in significantly higher (13.53 %) gross returns than no mulch. However, trend changed in case of net returns, where, organic mulch while remained at par with no mulch obtained significantly higher (25.62 %) net returns than that obtained with plastic mulching. It may be due to increase in cultivation cost because of higher price of plastic mulch. For the same reason, in spite of higher yield under plastic mulch, net returns obtained with plastic mulch were at par with net returns obtained without mulch. No mulch resulted in significantly higher net returns per rupee invested than organic mulch because of its minimum cost of

cultivation and organic mulch resulted in significantly higher net returns per rupee invested than the plastic mulch because of higher cost of cultivation of the later. Irrigation up to 4 cm soil depth resulted in higher gross as well as net returns in comparison to irrigation up to 2 cm soil depth due to improvement in fruit yield of brinjal. Net returns per rupee invested also followed the same trend as that of net returns.

Table 6: Effect of levels of FYM, mulch and irrigation on economics of brinjal

Treatment	Cost of cultivation	Gross return (Rs ha^{-1})	Net return (Rs ha^{-1})	Net return per rupee invested
FYM level				
5 t ha^{-1}	64703	142042	77339	1.20
10 t ha^{-1}	66953	153708	86756	1.30
SEm (±)		3090	3090	0.05
LSD (0.05)		9063	9063	NS
Mulch source				
Organic	59286	150000	90714	1.53
Plastic	89286	161500	72214	0.81
No mulch	48911	132125	83214	1.70
SEm (±)		3785	3785	0.06
LSD (0.05)		11100	11100	0.17
Irrigation level				
2 cm	65828	140042	74214	1.13
4 cm	65828	155708	89881	1.37
SEm (±)		3090	3090	0.05
LSD (0.05)		9063	9063	0.14

The results in the present experiment indicated that application of 10 t ha^{-1} FYM, plastic mulch before planting followed by irrigation of 4 cm depth resulted in higher productivity of brinjal. Incorporation of 10 t ha^{-1} FYM and irrigation of 4 cm depth resulted in improvement in net returns and net returns per rupee invested.

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