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Effect of mulching on vegetables production in tunnel farming

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Abstract

The study was conducted to compare the productivity of cucumber and bitter-gourd under mulch and non-mulch conditions in tunnel farming. Two treatments were made i.e. furrow irrigation along with bed mulching (T_1) and furrow irrigation without bed mulching (T_2). Beds of 60 cm and furrows of 30 cm were made in six tunnels measuring 4 × 68 m. Nobel variety of cucumber was grown in three tunnels and floragin variety of bitter gourd was grown in the remaining three tunnels. The row to row and plant to plant distance was maintained at 50 cm and 25 cm, respectively for both the crops. Equal dose of recommended fertilizer and similar cultural practices were given to all the plants. Results showed that the average cucumber and bitter-gourd production in mulch conditions was significantly higher than non mulch conditions. There was 39.33% and 23.7% increased in production of cucumber and bitter-gourd, respectively due to bed mulching practice. It was concluded that the bed mulching practice was very useful to control the weeds and conserve soil moisture contents that in turn enhanced the plant growth.

Introduction

The soil and climate of Pakistan supports us to produce many vegetables. Shortage of agricultural land has given the idea of vegetables growing in tunnels. Tunnel farming is more suitable for off-season vegetables and more production. Both winter and summer vegetables can be grown out of their normal growing season. To create an artificial environment for winter vegetables in summer is much costly but the maintenance of an optimum environment for the production of summer vegetables in winter by using plastic sheets in tunnels is profitable. Plastic sheets save the energy of sun and do not allow them to go back and provide enough warmth for vegetable production. Normally the crops grown are cucumber, tomatoes, bitter gourd, bottle gourd, chillies, pepper and sweet pepper. These varieties having characteristics of growing vertical like hanging creeper are preferred, as they need less space to grow and flourish. Secondly, this technology is more suitable for farmers having low land holdings. By producing more vegetables in small area, we can meet our dietary requirements well and can also be able to export them. In last years, we were forced to import many vegetables from India. It is harmful for an agricultural country to import basic necessities rather than to produce itself (Rafique, 2011).

High tunnels are passive solar greenhouses that are used to extend the traditional growing season for many horticultural crops. Growing conditions within a high tunnel are significantly different from growing conditions encountered in field production. Tomatoes (*Lycopersicon esculentum* Mill.) are well suited for high tunnel culture having an upright growth habit and a significant economic premium for precious harvest. Row covers are specifically necessary for frost protection, but can be removed when the risk of frost has decreased (Jett and Read, 2004).

Use of gravel and sand as mulch has been suugesed to improve soil quality as an indigenous farming technique for crop production for over 300 years. The application of straw mulch to organic seed potatoes (*Solanum tuberosum* L.) has been shown to reduce virus incidence (Doringa *et al.*, 2005). Gimeneza *et al*. (2001) found that the air temperature under the cover was higher at the beginning of the cropping season, as compared with open-air growing but differences decreased throughout the crop cycle. Above-ground crop biomass at harvest was not influenced by direct covering (CO) relative to open air (OA) growing conditions. Beet root biomass was significantly higher in the CO plots.

The main objective of this study was to compare the net economic return of greenhouse cucumber and bitter ground in the mulch and non mulch conditions. The study was conducted to create the awareness among the farmers for the adoption of mulching under tunnel farming.

Materials and Methods

The experiment was conducted at Water Management Research Centre, University of agriculture Faisalabad, Pakistan. The soil of experimental site was sandy loam. For land preparation, three ploughs with planking were performed. Half bag of DAP (Di Ammonium phosphate) and one bag of Urea was used at the time of cultural practices. Then using bed planting machine, beds of 60 cm and furrows of 30 cm were made.

Two treatments, furrow irrigation along with bed mulching (T_1) and furrow irrigation without bed mulching (T_2) were prepared. These two treatments were replicated three times. Six tunnels measuring 4 × 68 m were installed. Cucumber was grown in three tunnels i.e. t_1, t_2, t_3 and bitter gourd was grown in the remaining three tunnels i.e. t_2, t_4 and t_6. Partheno carpic seed variety i.e. Nobel of cucumber and floragin variety of bitter gourd were utlized in the experiment. The row to row and plant to plant distance was maintained at 50 cm and 25 cm, respectively for both the crops. Equal dose of recommended fertilizer and similar cultural practices were given to all the plants.

Replications	Treatment T_1 Furrow irrigation along with bed mulching	Treatment T_2 Furrow irrigation without bed mulching
R_1	t_1 = cucumber	t_1 = cucumber
	t_2 = bitter gourd	t_2 = bitter gourd
R_2	t_3 = cucumber	t_3 = cucumber
	t_4 = bitter gourd	t_4 = bitter gourd
R_3	t_5 = cucumber	t_5 = cucumber
	t_6 = bitter gourd	t_6 = bitter gourd

For the collection of data, five plants were tagged in each of the tunnel. The data regarding the production of both the vegetables was collected under mulch and non-mulch conditions. To study the effect of mulching on soil moisture conservation, soil samples were collected at soil depths of 15 cm and 30 cm from three tunnels of each mulch and non-mulch beds as three replications. Soil Moisture Content was calculated using gravimetric method. Both the wet and dry weights of soil samples were measured and their difference was calculated to obtain the moisture percentage. Data was tabulated and analyzed using statistical software Minitab.

Results and Discussion

Data regarding the soil moisture content in mulch and non mulch conditions is shown in Table 1 & 2, respectively. The data pertaining to the production of cucumber and bitter gourd is shown in Table 3 & 4, respectively.

It was observed (Table1) that bed mulching practice was very useful to conserve moisture contents which in turn results in increase in the plant growth. The recorded results showed that there was significant increase in production rate of both cucumber and bitter gourd production in mulching over non mulching conditions in tunnels. The average cucumber production in mulch condition (T_1) was significantly higher 296 Kg, 370 Kg and 333Kg in the tunnel-1 (t_1), tunnel-3 (t_3) and tunnel-5 (t_5), respectively as compared to valued obtained in control treatments. Similarly, Bitter gourd production in mulch condition (T_1) in the tunnel-2 (t_2), tunnel-4 (t_4) and tunnel-6 (t_6) was 155 Kg, 132 Kg and 142 Kg over control (128 Kg, 104 Kg and 98 Kg), respectively. Taking Mean Square values (Table 4) it was cleared that the vegetables sown in tunnels showed significant results in moisture conservation and production in mulch conditions. Production of cucumber and bitter gourd under mulch condition was calculated as 666 kg and 287 kg from 2 kanals which was increased by 39.33% and 23.71% than non-mulch condition, respectively (Table 5).

Similar results of mulching with straw and sand were obtained in previous findings (Masato, 2005). Hydrological process could be altered by mulching these results in improving soil productivity along with dropping evaporation and runoff, improving infiltration and soil temperature, as well as enhancing biological activity and soil fertility (Li, 2003). Likewise, Brown and Butcher (2000) found that the black plastic mulch induced the highest yield, an increase of 112% in okra in some areas of United States. Increase in yield along with other outcomes of mulching may further help farmer to grow short season crop in the dry season.

Table 1: Soil moisture contents in case of mulch condition.

Sample	Soil Sample Depth (cm)	MULCH			
		Wet Weight (g)	Dry Weight (g)	%	TUNNEL
S_1	15	60	54	11.11	1
	30	95	87	9.20	1
S_2	15	71	63	12.70	1
	30	127	112	13.39	1
S_1	15	69	62	11.29	3
	30	99	90	10.00	3
S_2	15	53	48	10.42	3
	30	109	97	12.37	3
S_1	15	61	54	12.96	5
	30	91	82	10.98	5
S_2	15	54	48	12.50	5
	30	106	92	15.22	5

Table 2: Soil moisture contents in case of non mulch condition.

Sample	Soil Sample Depth (cm)	Wet Weight (g)	Dry Weight (g)	%	TUNNEL
S_1	15	60	55	9.09	2
	30	100	90	11.11	2
S_2	15	67	60	11.67	2
	30	80	71	12.68	2
S_1	15	67	62	8.06	4
	30	101	91	10.99	4
S_2	15	67	61	9.84	4
	30	89	80	11.25	4
S_1	15	72	65	10.77	6
	30	95	87	9.20	6
S_2	15	62	56	10.71	6
	30	93	83	12.05	6

Table 3: Production of cucumber (Kg).

Date	Mulch (kg)t_1	Non-Mulch (kg) t_1	Mulch (kg)t_3	Non-Mulch (kg) t_3	Mulch (kg)t_5	Non-Mulch (kg) t_5
15.03.07	39	28	41	25	40	27
20.03.07	134	98	206	87	170	92
26.03.07	64	31	54	32	59	32
31.03.07	32	39	26	46	29	35
05.04.07	27	37	43	55	35	36
Total	296	233	370	245	333	222

Table 4: Production of bitter gourd (Kg).

Date	Tunnel-2 Mulch (kg)	Tunnel-2 Non-Mulch (kg)	Tunnel-4 Mulch (kg)	Tunnel-4 Non-Mulch (kg)	Tunnel-6 Mulch (kg)	Tunnel-6 Non-Mulch (kg)
23.04.07	23	17	12	8	17	13
28.04.07	15	12	17	9	16	10
04.05.07	11	9	-	5	7	7
08.05.07	-	-	18	10	8	-
13.05.07	12	5	3	-	7	3

18.05.07	21	19	5	10	13	14
24.05.07	9	9	7	6	8	8
29.05.07	7	5	7	6	**8**	**4**
04.06.07	18	17	17	13	**16**	**15**
08.06.07	20	18	13	12	**18**	**16**
16.06.07	14	13	23	17	**17**	**14**
21.06.07	5	3	10	8	**7**	**4**
Total	**155**	**128**	**132**	**104**	**142**	**98**

Table 5: ANOVA for comparison of vegetables production under mulch and non- mulch conditions in tunnel farmin.

S.O.V	D.F	Plant height	No. of nodes	No of fruits	Moisture content	Yield
METHOD	1	75.076**	25.600**	152.100**	16.039**	12640**
ERROR	8	2.783	2.300	9.60	1.724	20.8

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