

Combined Effect of Mulch Materials and Organic Manure on the Growth and Yield of Lettuce

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Abstract: The experiment was conducted in the field of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during the period from October 2009 to January 2010 to find out the combined effect of mulch materials and organic manure on the growth and yield of lettuce. Four levels of mulch materials viz. M_0 = No mulching, M_1 = Dry water hyacinth, M_2 = Black polythene and M_3 = Dry rice straw and four levels of organic manure viz. OM_0 = no organic manure, OM_1 = Cow dung (20 t ha⁻¹), OM_2 = Poultry manure (10 t ha⁻¹) and OM_3 = Vermicompost (10 t ha⁻¹) were also used as experimental variables. The results showed that most of the growth parameters were influenced by the mulch materials and organic manure. All the parameters viz. number of leaves plant⁻¹, leaf length (cm), leaf breadth (cm), dry matter accumulation (%), yield (g plant⁻¹) and yield (t ha⁻¹) performed better in case of M_2OM_3 (Black polythene + vermicompost: 10 t ha⁻¹), while the minimum growth and yield parameter were obtained from M_0OM_0 (control) at each observation stage. Although the highest gross and net returns were obtained from the M_2OM_3 and it was apparently from the above results that the treatment combination of M_2OM_3 was more profitable compared with other treatments but from economic point of view (Benefit cost ratio) treatment M_1OM_2 (Dry water hyacinth + poultry manure : 3.37) was more economic than the M_2OM_3 (3.14).

Key words: Mulch materials • Organic manure • Growth and Yield

INTRODUCTION

Lettuce (*Lactuca sativa* L.) belongs to the family Compositae. It is the most popular salad crops in the world. It is popular for its delicate, crispy, texture and slightly bitter taste as fresh condition. It is mainly a cold loving crop. The best temperature range for lettuce cultivation is 18 to 25°C and the night temperature is 10 to 15°C [1]. Lettuce contains protein, carbohydrate and vitamin C and in 100 gram of edible portion of lettuce contains moisture 93.4 g, protein 2.1 g, fat 0.3 g, minerals 1.2 g, fibre 0.5 g, carbohydrates 2.5 g, calcium 310 mg, phosphorus 80 mg, iron 2.6 mg, vitamin A 1650 I.U., thiamine 0.09 mg, riboflavin 0.13 mg and vitamin C 10 mg [2]. It is usually used as salad with tomato, carrot, cucumber or other salad vegetable. It is often served alone or with dressing. Its nutritive value is not spoiled [3].

In Bangladesh, lettuce getting popularity day by day but its production package is not much known to Bangladeshi farmers. Among various factors responsible

for higher yield, supply of nutrient and availability of moisture play vital role in the production and quality of lettuce. Deficiency of soil nutrient is now considered as one of the major constraints to successful upland crop production in Bangladesh [4]. Its production can be increased by adopting improved cultural practices.

Organic farming is appreciated by vegetable consumers as it enhances quality of the produce. Now a days the people are willing to get the vegetable without the inorganic fertilizer, because the people are suffering with some serious disease which are due to the affect of inorganic fertilizer. Being a succulent vegetable, lettuce needs plenty of water for its normal growth and development. Irrigation is, therefore, essential for its successful production. But additional irrigation causes increased cost of production. Under such condition, mulching may be practiced in crop cultivation which can be a substitute of irrigation to minimize cost of production. Mulch is again highly effective in checking evaporation and is hence recommended for most crops of home garden like potato, sweet potato, carrot and

ginger [5,6]. Mulching also suppresses weed infestation effectively. Furthermore, it stimulates microbial activity in soil through increasing soil temperature which improves agro-physical properties of soil. Considering the above factors, the present experiment was undertaken to know the combined effect of organic manure and mulching on growth and yield of lettuce production and identify the best mulch in respect to economic production of lettuce.

MATERIALS AND METHODS

The present experiment was carried out in the farm of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka, Bangladesh. During the period from October 2009 to January, 2010. The soil of the experimental area belongs to the Madhupur Tract under AEZ No. 28. It had shallow red brown terrace soil. The climate of experimental site was under the subtropical climate. Four mulch materials viz. M_0 = No mulching (Control), M_1 = Dry water hyacinth, M_2 = Black polythene and M_3 = Dry rice straw were used as a mulch materials and four levels of different organic manure such as OM_0 = No organic manure (Control), OM_1 = Cowdung (20 t ha⁻¹), OM_2 = Poultry manure (10 t ha⁻¹) and OM_3 = Vermicompost (10 t ha⁻¹) were used for the investigation of combined effect on lettuce and the sixteen combined treatments were M_0OM_0 , M_0OM_1 , M_0OM_2 , M_0OM_3 , M_1OM_0 , M_1OM_1 , M_1OM_2 , M_1OM_3 , M_2OM_0 , M_2OM_1 , M_2OM_2 , M_2OM_3 , M_3OM_0 , M_3OM_1 , M_3OM_2 and M_3OM_3 . Green Span was used in the experiment as planting material which was sown 29 October, 2009. The experiment was laid out Randomized Complete Block Design (RCBD) with three replications and size of the each unit plot was 2.0 m × 2.0 m. The seedlings were raised at the SAU Farm, SAU, under special care in a 3 m × 1 m size seed bed. The soil of the seed bed was well ploughed with a spade and prepared into loose friable dried masses and to obtain good tilth to provide a favorable condition for the vigorous growth of young seedlings. Lettuce seed were soaked in water for 48 hours and then seeds were mixed with soil and sown in seed bed at October 29, 2009. The experimental plot was partitioned into the unit plots in accordance with the experimental design cowdung; poultry manure and vermicompost were applied as per treatments during the final land preparation. The soil was treated with fungicide cupravit against the fungal attack. Mulches of dry water hyacinth, black polythene sheet and dry rice straw were applied immediately before seedling transplanting while small holes were made on black polythene sheet at proper spacing before seedling transplanting. Healthy and

uniform sized seedlings were transplanted in the main field on November 29, 2009. The seedlings were uprooted carefully from the seedbed to avoid any damage to the root system. To minimize the roots damage of the seedlings the seedbed was watered one hour before uprooting the seedlings. Transplanting was done in the afternoon. During transplanting a spacing of 40 cm × 25 cm between row to row and plant to plant were maintained. A number of seedlings were also planted in the border of the experimental plots for gap filling if necessary later on. Over-head irrigation was provided with a watering can to the plots once immediately after transplanting in every alternate day in the evening up to 1st harvest. Further irrigation was done and when needed. Weeding was done to keep the plots free from weeds; Harvesting was done at different growth stage. First harvesting was done at 20 days after transplanting. Second, third and forth harvesting were done 30, 40 and 50 days after transplanting, respectively. Different yield contributing data have been recorded from the mean of five harvested sample plants which was selected at random from each unit plot of every harvesting. The data obtained for different parameters were statistically analyzed to find out the significance difference of mulching and organic manure on yield and yield contributing characters of lettuce. The mean values of all the characters were calculated and analysis of variance was performing by the 'F' (variance ratio) test. The significance of the difference of means among the treatment combinations was estimated by the Duncan's Multiple Range Test (DMRT) at 5% level of probability [7]. The cost of production was analyzed in order to find out the most economic treatment of mulch material and organic manure. All input cost included the cost for lease of land and interests on running capital in computing the cost of production. The interests were calculated @ 13% in simple rate. The benefit cost ratio (BCR) was calculated as follows:

$$\text{Benefit cost ratio} = \frac{\text{Gross return per hectare (Tk.)}}{\text{Total cost of production per hectare (Tk.)}}$$

RESULTS AND DISCUSSION

Combined Effect of Mulch Materials and Organic Manure on Leave Characters of Lettuce: Both mulch materials and organic manure significantly influenced the number of leaves plant⁻¹, leaf length and breadth of lettuce at 20 days after transplanting (DAT). Among the treatments MOM (Black polythene mulch + vermicompost) produced highest number of leaves,

Table 1: Combined effect of mulch materials and organic manure on leaf characters of lettuce

Treatments	Number of leaves plant ⁻¹ at				Leaf Length (cm)				leaf breath (cm)			
	Days after transplanting											
	20	30	40	50	20	30	40	50	20	30	40	50
M ₀ OM ₀	9.440	14.330	17.780	21.110	11.040	16.100	17.760	19.790	7.130	11.270	13.200	16.050
M ₀ OM ₁	10.000	16.330	21.220	24.670	12.270	20.370	22.970	24.530	7.830	13.180	16.730	19.010
M ₀ OM ₂	10.220	16.560	21.220	24.440	12.560	20.630	22.990	23.900	8.170	13.130	16.620	19.430
M ₀ OM ₃	10.890	17.220	21.780	24.890	13.840	22.060	24.270	25.460	9.370	14.010	17.180	20.830
M ₁ OM ₀	11.220	16.560	21.110	23.220	14.440	20.750	21.060	22.720	9.310	13.950	14.960	17.670
M ₁ OM ₁	11.440	17.330	23.560	26.220	14.790	21.710	26.040	29.410	8.940	14.360	19.420	22.110
M ₁ OM ₂	11.780	17.560	23.780	27.220	15.050	22.420	26.250	31.160	9.500	14.750	20.310	22.470
M ₁ OM ₃	12.560	18.000	24.000	27.110	16.690	23.460	26.780	31.020	10.370	15.060	20.110	24.220
M ₂ OM ₀	9.560	14.780	19.560	22.110	11.420	17.130	18.230	21.040	6.740	11.910	13.790	17.070
M ₂ OM ₁	11.890	18.560	24.330	26.440	15.610	24.470	26.920	29.510	9.950	15.820	19.310	22.890
M ₂ OM ₂	12.560	19.000	24.560	27.440	16.860	25.060	28.140	31.560	11.100	16.520	20.370	24.320
M ₂ OM ₃	13.560	19.780	25.000	27.780	18.300	26.430	28.990	32.600	11.940	17.180	20.960	25.880
M ₃ OM ₀	10.450	16.890	22.110	24.000	12.940	21.120	23.730	25.230	7.600	13.150	16.950	19.410
M ₃ OM ₁	11.000	17.220	22.330	24.440	13.940	21.880	23.680	26.070	8.590	14.100	17.210	20.710
M ₃ OM ₂	12.330	18.330	23.670	26.110	16.530	23.960	26.320	28.920	10.800	15.930	18.830	22.570
M ₃ OM ₃	11.890	17.780	23.780	26.890	15.510	22.440	26.260	30.430	9.65b	14.710	19.960	22.990
LSD _(0.05)	1.137	1.603	1.562	1.287	2.083	3.043	3.330	2.982	1.554	1.652	1.990	1.893
CV (%)	6.040	9.570	8.170	6.060	8.630	8.340	8.180	6.600	10.140	6.920	6.680	5.380

Table 2: Combined effect of mulch materials and organic manure on the dry matter content and yield of lettuce

Treatments	Dry matter content (%) per plant				Yield (g plant ⁻¹)				Yield (t ha ⁻¹)			
	Days after transplanting											
	20	30	40	50	20	30	40	50	20	30	40	50
M ₀ OM ₀	5.140	7.450	7.650	9.760	170.42	241.50	286.57	310.85	11.640	17.820	29.43	32.470
M ₀ OM ₁	5.700	8.550	8.660	10.950	187.03	311.88	350.89	427.47	15.710	27.290	35.13	36.530
M ₀ OM ₂	6.230	9.350	9.350	11.200	196.48	317.55	360.25	418.14	17.420	28.520	37.04	36.650
M ₀ OM ₃	6.600	9.720	9.680	11.760	214.54	335.30	370.03	458.41	20.380	28.530	36.40	39.200
M ₁ OM ₀	5.760	9.100	9.820	11.660	210.64	313.46	359.83	397.86	14.860	21.650	31.65	33.610
M ₁ OM ₁	6.390	9.000	9.780	11.770	214.40	332.09	402.69	471.90	18.280	28.420	38.22	43.270
M ₁ OM ₂	6.180	9.370	9.860	11.870	218.89	338.91	399.26	527.11	19.720	31.150	40.16	48.760
M ₁ OM ₃	6.780	9.540	10.410	13.260	241.68	350.13	405.96	504.37	18.940	28.540	37.81	46.210
M ₂ OM ₀	5.230	8.330	8.810	10.620	168.38	264.45	325.93	392.25	12.610	19.210	28.71	32.270
M ₂ OM ₁	8.110	10.810	11.720	13.950	233.34	362.42	434.08	477.85	20.300	33.080	41.73	42.830
M ₂ OM ₂	8.850	12.020	12.740	15.640	251.33	371.43	434.68	555.45	22.070	33.950	42.19	49.590
M ₂ OM ₃	9.220	12.770	13.340	15.780	272.30	386.85	428.18	584.22	23.160	35.540	45.17	50.000
M ₃ OM ₀	6.320	9.230	9.640	11.970	183.99	318.59	374.45	398.86	15.630	27.200	37.52	39.160
M ₃ OM ₁	6.800	9.730	10.190	12.580	201.50	329.46	343.86	353.42	16.880	24.530	33.42	38.020
M ₃ OM ₂	7.880	11.320	11.940	14.280	240.70	358.48	373.02	454.99	18.120	26.830	33.68	42.080
M ₃ OM ₃	6.480	9.290	9.860	12.360	225.86	339.72	410.63	507.15	18.460	31.280	40.38	45.980
LSD _(0.05)	1.434	1.650	1.547	1.950	29.56	25.48	41.63	52.73	3.094	5.542		4.254
CV(%)	12.790	10.180	9.080	9.380	8.27	7.64	6.59	6.99	10.450	11.990	8.15	6.220

Table 3: Cost and return of lettuce cultivation as influenced by mulch materials and organic manure

Treatments	Cost of production (Tk. ha ⁻¹)	Yield (t ha ⁻¹)	Gross return (Tk. ha ⁻¹)	Net return (Tk. ha ⁻¹)	Benefit cost ratio
M ₀ OM ₀	81233	32.47	227290	146057	2.80
M ₀ OM ₁	103598	36.53	255710	152112	2.47
M ₀ OM ₂	98007	36.65	256550	158543	2.62
M ₀ OM ₃	98007	39.20	274400	176393	2.80
M ₁ OM ₀	84588	33.61	235270	150682	2.78
M ₁ OM ₁	106953	43.27	302890	195937	2.83
M ₁ OM ₂	101361	48.76	341320	239959	3.37
M ₁ OM ₃	101361	46.21	323470	222109	3.19
M ₂ OM ₀	94652	32.27	225890	131238	2.39
M ₂ OM ₁	117017	42.83	299810	182793	2.56
M ₂ OM ₂	111426	49.59	347130	235704	3.12
M ₂ OM ₃	111426	50.00	350000	238574	3.14
M ₃ OM ₀	84588	39.16	274120	189532	3.24
M ₃ OM ₁	106953	38.02	266140	159187	2.49
M ₃ OM ₂	101361	42.08	294560	193199	2.91
M ₃ OM ₃	101361	45.98	321860	220499	3.18

Market price of lettuce @ Tk. 7000 t⁻¹

length and breath (Table 1) and which were pick up, no of leaves plant⁻¹; 13.56, 19.78, 25.00 and 27.78; leaf length; 18.30, 26.43, 28.99 and 36.60 cm; breath 11.94, 17.18, 20.96 and 25.88 cm, respectively at five observation stages (at 20, 30, 40 and 50 DAT) followed by M₂OM₂ (Black polythene mulch + poultry manure) whereas M₀OM₀ (control) produced lower number of leaves plant⁻¹, leaf length and leaf breath at each observation stage except 20 DAT. On the other hand, the rest of the treatments showed a similar trend. Increasing growth and development of carrot due to the polythene mulch and organic manure was reported by Rodrigues and Casali [8] and Akand [9] in carrot.

Combined Effect of Mulch Materials and Organic Manure on Dry Matter Accumulation and Yield of Lettuce: Treatment M₂OM₃ (Black polythene mulch + vermicompost) resulted in more accumulation of dry matter in plant than other mulch materials with other organic matter combination at each growth stages (Table 2) which accounted up to 9.22, 12.77, 13.34 and 15.78 % at 20, 30, 40 and 50 DAT, respectively. The second highest dry matter plant⁻¹ was recorded from M₂OM₂ and the lowest dry matter percentage per plant were recorded from M₀OM₀ (No mulch materials and no organic manure). Similar trend of dry matter distribution of lettuce due to organic manure was reported by Tisselli [10] and Johannessen *et al.* [11]. Incase of yield plant⁻¹, the maximum yield plant⁻¹ 272.30 386.85 and 584.22 g were harvested at 20, 30 and 50 DAT, respectively when crop

field were covered by the black polythene and vermicompost was applied (10 t ha⁻¹) but at 40 DAT the maximum yield plant⁻¹ was found from M₂OM₂ which is statistically similar with M₂OM₁ (Black polythene mulch + Dry water hyacinth). On the other, hand the maximum yield t ha⁻¹ was recorded from M₂OM₃ at 20, 30, 40 and 50 DAT) which were 23.16, 35.54, 45.17 and 50.00 t ha⁻¹, respectively and this trend was similar with treatment M₂OM₂ (Black polythene + poultry manure). It might be due the mulch materials (Black polythene) and vermicompost influenced the plant to have good production of dry matter and eventually maximum production was obtained from black polythene and vermicompost treated plots. These results were consistent with the results of Islam *et al.* [12] and Shrivastava *et al.* [13].

Economic Analysis: The highest gross return (Tk. 350,000 ha⁻¹) was recorded from M₂OM₃ (black polythene mulch + vermicompost: 10 t ha⁻¹) (Table3) and the second highest gross return (Tk. 347,130 ha⁻¹) was recorded from M₂OM₂ (black polythene mulch + poultry manure: 10 t/ha). The lowest gross return (Tk. 227,290/ha) was recorded from M₀OM₀ (no mulch and no organic manure), in case of the highest net return (Tk. 239959 ha⁻¹) was recorded from M₁OM₂ (Dry water hyacinth + poultry manure: 10 t ha⁻¹) and the second highest net return (Tk. 238574 ha⁻¹) was recorded from M₂OM₃. The lowest net return (Tk. 131, 238 ha⁻¹) was obtained from M₂OM₀ (Black polythene + no organic

manure). The highest benefit cost ratio (3.37) was recorded from M_1OM_2 and the lowest benefit cost ratio (2.39) was recorded from M_2OM_0 , although black polythene + vermicompost (M_2OM_3) treatment gave the highest yield (50 t ha^{-1}) and gross return (Tk. 350,000). But from the economic point of view, use of polythene mulch was more expensive than those of other mulching treatment used.

CONCLUSION

Considering the situation of the present experiment, all mulch materials and organic manure were beneficial to obtain high yield especially black polythene mulch and vermicompost was more beneficial for production more yield but economic point of view dry water hyacinth with poultry manure was the best to produce lettuce which was economically acceptable than others.

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