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Effect of Mulching and Fertilization on Growth and Yield of Garlic at Dinajpur in Bangladesh

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Abstract: To study the effect of mulching and fertilizer management practices on the growth and yield of garlic, an experiment was conducted using three kinds of mulches viz., black polyethylene, straw and water-hyacinth with a control and three types of fertilizer management practices viz., cow dung (F1), urea + TSP + MP (F2) and urea + TSP + MP + cow dung (F3) were compared with no fertilizer/manure. Plants grown under black polyethylene, water hyacinth and straw mulches were produced the yields of 5.80, 5.70 and 5.48 t ha^{-1}, respectively which were 39, 36.6 and 31.41% higher than the control (4.17 t ha^{-1}). The effect of black polyethylene and water hyacinth mulch were almost similar on the growth and yield of garlic. On the other hand, the crops growing with urea + TSP + MP and urea + TSP + MP + cow dung and only cow dung gave yields of 6.36, 6.03 and 5.23 t ha^{-1}, respectively which showed about 80.68, 71.30 and 48.57% increased over the control (3.52 t ha^{-1}). The interaction effects of mulching and fertilizers did not exhibit significant variations. Though the application of black polyethylene mulch is somewhat hazardous, if it is possible to use the water hyacinth and black polyethylene mulch along with F2 and F3 were suitable for increasing production.

Key words: Mulching, fertilization, garlic, bulb, yield

INTRODUCTION

Garlic (*Allium sativum* L.) is an aromatic herbaceous plant belonging to the family Alliaceae and one of the most important spices crop in Bangladesh. The annual production of garlic in Bangladesh is 39,000 tons from 13,000 hectares of land and its per annum requirement is 85,000 tons (FAO, 1994). The scope of increasing its production by bringing more areas under cultivation is very limited. Because it is grown only in winter when other major crops occupy most of the cultivable lands in Bangladesh. Rainfall is scanty during winter season and frequent irrigation increases the cost for successful production. Under such condition, mulching could be a good substitute for irrigation. Mulch checks water loss by evaporation and conserves soil moisture thereby increasing the yield of garlic.

Both manure and fertilizers have a potential role on the growth and development of crops. Mineral fertilizers of balanced doses increased the leaf area, photosynthetic productivity and yield of garlic (Borabash and Kochina, 1989). But indiscriminate use of chemical fertilizer changes the physical, chemical and biological properties of soils, pollutes environment and also creates health hazards due to its toxic residual effects on crop production especially on vegetables. Manures supply all the essential nutrient elements as well as improve physical, chemical and biological properties of soils and may help in boosting up production of garlic leaving a healthy environment at the end. It was observed that different mulching materials highly influenced the plant height and bulb diameter (Iroc *et al*., 1991) as well as the yield (Menezes *et al*., 1974) of garlic. Moreover, mulching alongwith proper fertilizer management practices may bring some promising effects on the bulb production of garlic. With these ideas in mind an attempt was made to study the effect of different mulches and fertilizer management practices on the growth and yield of garlic.

MATERIALS AND METHODS

A field experiment was conducted at Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh during the period from November 2005 to March 2006 to study the effect of mulches and different organic and inorganic fertilizer doses of almost equal cost on the growth and yield of garlic. The soil of the plot was silt loam in texture having pH = 5.8,

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Table 1: Details of the quantity of manures and fertilizers

Manure and fertilizers	Dose/plant (g)	Dose (kg ha^{-1})	Available nutrients (kg ha^{-1}) N: P_2O_5: K_2O	Cost ha^{-1} (Tk.)
Control (F_0)	-	-	-	-
Cow dung (F_1)	2250	25 t ha^{-1}	75:50:25	6875
Urea + TSP +MP (F_2)	19.56+18.75+18.75	217.39+208.33+208.33	98:100:125	6630
Cow dung + urea + TSP + MP (F_3)	1125+9.78+9.37+9.37	12.50 t ha^{-1}+108.70+104.16+104.16	105:89:82	6750

total N, available P and K were 0.05%, 20 ppm and 0.18 me per 100 g of soil, respectively. Four treatments of mulches denoted as no mulch as control (M0), black polyethylene mulch (M1), straw mulch (M2) and water hyacinth (M3). Fertilizer treatment control (F0), cow dung (F1), urea + TSP (Triple superphosphate) + MP (Muriate of potash) (F2) and cow dung + urea + TSP + MP (F3) as shown in Table 1.

The factorial experiment was laid out in a randomized complete block design with three replications. The whole field was divided into three blocks each containing 16 plots. The plot size was 1×0.9 m. The space between the blocks and plots were 50 and 30 cm, respectively. The 16 treatment combinations were assigned randomly to the unit plot of each block so as to allot one treatment combination only once in each block. Planting of a local garlic was done by placing cloves at a depth of 2 cm in the soil with the use of a pointed stick. The spacing was 22×15 cm. Planting was done on November 10, 2005. Ten days before the clove planting, the entire quantity of well decomposed cow dung, TSP and MP were applied in the unit plot as per treatment and thoroughly mixed with the soil. Mulching was done immediately after planting with water hyacinth and fresh rice straw. Black polyethylene sheet with small holes at proper spacing was spread over the plot and then the cloves were placed in soil at the required depth. Ten plants were selected randomly from each unit plot for the collection of data. Weeding were done throughout the growth period. After attaining maturity, garlic was harvested. The data on different yield components were statistically analyzed and were evaluated by LSD test (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Effect of mulching: Plant height of garlic due to the effect of mulching showed a significant variation (Table 2). The tallest plant (55.08 cm) was obtained from black polyethylene mulch followed by water hyacinth (54.41 cm) and straw mulches (52.86 cm), respectively. Black polyethylene mulch gave the maximum number of leaves (10.99) and highest fresh weight of leaves (5.30 g) which was followed by the effect of water hyacinth and straw mulch. Maximum fresh weight of pseudo-stem (6.05 g) and individual bulb weight (17.40 g) were obtained from black polyethylene mulch which were statistically similar to that of water hyacinth and straw mulch treatments. Water hyacinth mulch produced the highest dry matter of leaves per plant (1.5 g) followed by straw mulch (1.49 g) and black polyethylene mulch (1.47 g) and all were statistically similar. Maximum dry matter of pseudo-stem (1.18 g) was obtained from the plants raised with black polyethylene mulch and the lowest from the control. Similar results were also reported by Hossain *et al.* (1998).

Highest dry weight of bulb (4.28 g) produced from the black polyethylene mulch was statistically similar with that of water hyacinth mulch (4.15 g), whereas non-mulched treatment produced the minimum (2.97 g). Number of cloves per bulb did not differ significantly due to the effect of mulching, but there was an increasing trend. The highest diameter of bulb (3.22 cm) was recorded from the black polyethylene mulch and statistically similar with that of water hyacinth and straw mulch. Non-mulched plants produced the minimum bulb diameter (Table 2). Water hyacinth mulch influenced to produce maximum (1.03 g) weight of fresh roots per plant. This was identically followed by straw mulch (1.00 g) and black polyethylene (0.99 g) treatments. The plants grown without mulch gave minimum weight of roots (0.90 g) per plant. The highest yield 5.80 t ha^{-1} was obtained from the polyethylene mulch and the lowest 4.17 t ha^{-1} from the control, whereas the plants with water hyacinth and straw mulches gave yields of 5.70 and 5.48 t ha^{-1}, respectively. Mulching showed overall better performance than non-mulch treatments. Mulches conserved more soil moistures enhancing vegetative growth and yield contributing characters. This finding was in agreement with Chung (1987), Menezes *et al.* (1974) and Aliudin (1986).

Effect of manure and fertilizers: The maximum plant height (55.95 cm) was recorded from the treatment of urea + TSP +MP (F2) and was identically followed by the treatment of cow dung + urea + TSP + MP (F3). The highest number of leaves per plant (11.87), fresh weight of leaves per plant (5.61 g), fresh weight of pseudo-stem (6.37 g), fresh weight of bulb (19.08 g), dry weight of pseudo-stem (1.23 g) and dry weight of bulb (4.60 g) were recorded from the treatment of F2, which were followed by F3 and F1 and the minimum was produced by the control (Table 3). This finding was similar to that of Abbas *et al.* (1994). Highest dry matter of leaves per plant

Table 2: Effects of different mulching treatments on the growth and yield of garlic

Treatments	Plant height (cm)	Total No. of leaves/ plant	Fresh weight (g) Leaf/ plant	Pseudostem	Bulb	Dry weight (g) Leaf/ plant	Pseudostem	Bulb	No. of clove/bulb	Diameter of bulb (cm)	Fresh root wt./plant (g)	Yield (t ha^{-1})
M0	45.25c	9.35b	4.46b	4.7b	12.5b	1.2b	0.94b	2.97c	13.85	2.77b	0.9b	4.17bc
M1	55.08a	10.99a	5.3a	6.05a	17.4a	1.47a	1.18a	4.28a	14.95	3.22a	0.99ab	5.80a
M2	52.86b	10.62a	5.12a	5.9a	16.43a	1.49a	1.16a	3.98b	14.81	3.14a	1.0a	5.48b
M3	54.41ab	10.81a	5.2a	6.04a	17.1a	1.5a	1.15a	4.15ab	15.09	3.19a	1.03a	5.70ab
LSD (5%)	1.82	0.86	0.57	0.27	1.84	0.05	0.06	0.22	1.74	0.12	0.09	1.08
Level of significance	**	**	**	**	**	**	**	**	NS	**	**	**

** Indicates significant at 1% level of probability, Mean values with same letter(s) are not significantly different, NS = Not significant

Table 3: Effect of fertilizer management practices on the growth and yield of garlic

Treatments	Plant height (cm)	Total No. of leaves/ plant	Fresh weight (g) Leaf/ plant	Pseudostem	Bulb	Dry weight (g) Leaf/ plant	Pseudostem	Bulb	No. of clove/bulb	Diameter of bulb (cm)	Fresh root wt./plant (g)	Yield (t ha^{-1})
F0	45.22c	8.63c	3.90b	4.37b	10.57b	1.10b	0.85b	2.60c	13.67	2.70c	0.80b	3.52d
F1	50.83b	9.90b	5.20a	5.85b	15.70b	1.50a	1.15b	3.79c	14.26	3.10b	1.01a	5.23c
F2	55.95a	11.87a	5.61a	6.37a	19.08a	1.55a	1.23a	4.60b	15.37	3.24a	1.07a	6.36a
F3	54.42ab	11.37a	5.30a	6.15a	18.10a	1.50a	1.20ab	4.31b	15.40	3.17a	1.05a	6.03b
LSD (5%)	1.82	0.86	0.57	0.27	1.84	0.05	0.06	0.22	1.74	0.12	0.09	0.08
Level of significance	**	**	**	**	**	**	**	**	NS	**	**	**

** Indicates significant at 1% level of probability, Mean values with same letter(s) are not signiicantly different, NS = Not significant

Table 4: Combined effects of mulches and fertilizers on the growth and yield of garlic

Treatments	Plant height (cm)	Total No. of leaves/ plant	Fresh weight (g) Leaf/ plant	Pseudostem	Bulb	Dry weight (g) Leaf/ plant	Pseudostem	Bulb	No. of clove/bulb	Diameter of bulb (cm)	Fresh root wt./plant (g)	Yield (t ha^{-1})
M0F0	42.67	8.16	3.50	3.32	7.46	0.89	0.65	1.77	12.63	2.38	0.74	2.49
M0F1	44.53	8.86	4.80	5.21	13.40	1.31	1.03	3.15	13.98	2.91	1.00	4.47
M0F2	48.43	10.06	4.60	5.27	14.76	1.31	1.09	3.28	14.30	2.99	0.96	4.92
M0F3	45.40	10.33	4.90	5.10	14.43	1.29	1.00	3.70	14.50	2.95	0.90	4.81
M1F0	45.56	8.86	4.66	4.30	11.56	1.07	0.97	3.16	14.16	2.95	0.76	3.85
M1F1	54.36	10.36	5.10	6.07	17.00	1.58	1.18	4.09	13.44	3.24	0.96	5.67
M1F2	60.30	12.90	5.56	6.87	21.90	1.64	1.23	5.75	16.20	3.41	1.13	7.30
M1F3	60.10	11.86	5.72	6.37	18.66	1.58	1.33	4.57	16.00	2.28	1.10	6.22
M2F0	45.80	8.60	3.53	4.81	10.76	1.19	0.92	2.61	13.90	2.86	0.80	3.56
M2F1	49.33	10.06	5.50	6.27	16.00	1.56	1.23	3.93	14.34	3.15	1.07	5.33
M2F2	58.66	12.26	5.50	6.74	19.70	1.63	1.28	4.85	15.80	3.29	1.08	6.57
M2F3	57.60	11.56	5.80	6.40	19.30	1.59	1.22	4.20	15.21	3.29	1.06	6.43
M3F0	46.80	8.90	4.00	4.96	12.10	1.23	0.85	3.03	14.00	2.85	0.86	4.03
M3F1	55.10	10.30	5.60	5.87	16.43	1.52	1.15	4.09	15.28	3.20	1.01	5.48
M3F2	56.43	12.26	5.70	6.62	20.00	1.62	1.34	4.79	15.18	3.34	1.11	6.67
M3F3	59.33	11.70	5.60	6.70	20.00	1.65	1.25	4.78	15.89	3.36	1.13	6.67
LSD (5%)	3.65	1.71	1.15	0.55	3.69	0.14	0.13	0.44	2.59	0.25	0.17	1.12
Level of significance	*	NS	NS	NS	*	NS	NS	*	NS	NS	*	*

NS = Not significant, * Indicates significant at 5% level of probability

(1.55 g) was recorded from the treatment of F2 and was identically followed by F1 and F3. The largest bulb diameter (3.24 cm) was found by the F2 treatment, while the smallest bulb produced from the control. Fresh weight of root showed the similar pattern of increments. Number of cloves per bulb was found statistically insignificant among the treatments. It may be due to inherited character of garlic.

Remarkable variation in respect to yield was observed due to the manure and fertilizer management practices (Table 3). The higher yield due to fertilizer management practices may be accounted for optimum supply of nutrient resulting in better growth and development of the plants. The maximum yield (6.36 t ha^{-1}) was recorded from the F2 and the lowest (3.52 t ha^{-1}) from the control. The treatment F3 and F1 gave yield of 6.03 and 5.23 t ha^{-1}, respectively. The largest bulb diameter and the highest yield were obtained with the 100 kg N + 50 kg P_2O_5 + 50 kg K_2O ha^{-1} treatment which was closely related to the present study (Setty *et al*., 1989). Vegetative growth and yield (62.07 q ha^{-1}) were maximum for plants receiving N at the rate of 100 kg ha^{-1} (Singh *et al*., 1994).

Among different manurial treatments, the chemical fertilizer treatments showed overall the better performance with respect to yield and yield contributing characters due to the maximum supply of N, P_2O_5 and K_2O (Table 3). Though the highest yield of bulb production have been obtained from the treatment using manures with chemical fertilizers, it can be applied easily and largely for garlic production with a view to minimize environmental degradation and health hazards.

Interaction effect: Interaction of mulches and fertilizer treatments exhibited insignificant variation in almost all the characters except plant height, bulb fresh and dry weight and root fresh weight (Table 4). It was observed that all the manurial and fertilizer treatments under mulched condition showed better performance with respect to the entire yield contributing characters than their respective manurial treatments in non-mulched condition (Table 4). The tallest plant (60.30 cm), total number of leaves per plant (12.9), fresh weight of pseudo-stem (6.87 g) and bulb (21.9 g) were obtained from M1F2 combination while the fresh weight of leaves was maximum (5.8 g) in the M2F3. Highest yield of garlic (bulb) produced by the treatment combination of polyethylene and urea + TSP + MP was found 7.30 t ha^{-1} which was statistically identical with those produced by other combinations. Since the variation in yield among different treatment combination were found insignificant, mulching showed overall better performance than non-mulch treatments.

All the mulches used in the investigation showed better performance than the control on yield and yield contributing characters and their performances were more or less same. Among the treatments of fertilizer management practices, urea + TSP + MP and cow dung + urea + TSP + MP showed more or less similar performance on yield and contributing characters. Therefore, garlic can be cultivated using cheaper water hyacinth and organic manures like cow dung and farm yard manure to get higher yield as well as to avoid environmental pollution and health hazards.

REFERENCES

Abbas, M., S. Rajat, S.S. Tomar and K.K. Sharma, 1994. Effect of nitrogen and potassium on the growth and yield of garlic. J. Potassium Res., 10: 333-342.

Aliudin, T., 1986. Effect of Soil tillage and application of mulch on yield of field grown garlic. Buletin-Penelitian-Hortikultura, 8: 12-15.

Borabash, O. Yu. and T.N.K. Kochina, 1989. The effect of mineral fertilizers on garlic productively. Referantinvyi Zhurnal, 2: 12-16.

Chung, D.H., 1987. Effect of polyethylene film mulching, sulphur application and different levels of nitrogen and potassium on growth, flower stalk elongation, bulbing and leaf tip yellowing of garlic. Allium sativum cv. Enising. J. Korean Soc. Hortic. Sci., 28: 1-8.

FAO., 1994. Report of Food and Agricultural Organisation of the United Nations. Rome, Italy, pp: 48-141.

Gomez, K.A. and A.A. Gomez, 1984. Statistical Procedures for Agricultural Research 2nd Edn., A Wile Interscience Publication, John Wiley and Sons. New York, pp: 680.

Hossain, M.I., S.U. Ahmed, K.S. Alam and S. L. Rahman, 1998. The impact of mulches and manures on growth and yield of garlic. Bangladesh J. Agric. Res., 23: 115-126.

Iroc, A., L.C. Sisson and P.P. Solidum, 1991. Effects of different mulching materials on garlic (*Allium sativum* L.). Buletin Penelitian Hortkultura, 7: 104-108.

Menezes, S.M., D.E. Navais, H.L. Sontos and M.A. Dos, 1974. The effect of nitrogen fertilization, plant spacing and mulching on the yield of garlic cultivar Amarante. Revista Ceres, 21: 203-211.

Setty, B.S., G.S. Sulikeri and N.C. Hulamani, 1989. Effect of N, P and K on growth and yield of garlic (*Allium sativum* L.). Karnataka J. Agric. Sci., 2: 160-164.

Singh, J.V., K. Ajay and H.S. Sirohi, 1994. Effect of different levels of nitrogen on the growth and yield of garlic (*Allium sativum* L.). Agril. Sci. Digest (Karnal), India, 14: 149-152.