Progress. Agric. 21(1 & 2): 39–46, 2010 ISSN 1017-8139

EFFECT OF MULCH AND DIFFERENT LEVELS OF N AND K ON THE GROWTH AND YIELD OF ONION

K. S. Islam, M. H. A. Miah and S. U. Ahmed[1]
Project Co-ordinator, AFIP-Intercooperation, H # 2FNE (D), R # 73G, Gulshan-2
Dhaka, Bangladesh

ABSTRACT

An experiment was conducted to study the effect of mulch (non-mulch and straw mulch) and different levels of nitrogen (0, 40, 80 and 120 kg ha^{-1}) and potassium (0, 37.5, 75 and 112.5 kg ha^{-1}) on the growth and yield of onion. Plants grown with straw mulch gave higher bulb yield (10.89 t ha^{-1}) which showed 13.79% increase over non-mulch. Nitrogen increased the bulb yield significantly. The highest nitrogen level gave the highest bulb yield (12.13 t ha^{-1}), which was 41.54% increase over control. Potassium increased bulb yield compared to control, but its different levels had identical results on yield. Nitrogen and mulch together produced significant variations. The Nitrogen at the highest level (120 kg ha^{-1}) along with straw mulch gave the highest yield (13.31 t ha^{-1}). Potassium together with mulch also exhibited significant variation on yield and yield components. Plants grown with the highest level of potassium (112.5 kg ha^{-1}) along with straw mulch gave the highest bulb yield (11.58 t ha^{-1}). Nitrogen and potassium as 120 kg N ha^{-1} × 75.0 kg K ha^{-1} gave the highest bulb yield (13.07 t ha^{-1}). Nitrogen and potassium at their maximum levels with straw mulch gave the highest bulb yield (14.67 t ha^{-1}).

Key Words: Mulch, Nitrogen, Potassium, Onion

INTRODUCTION

Onion is one of the most important bulb and spice crops in Bangladesh as well in the world, and its use is very common in almost all food preparations (Hossain and Ismail, 1994). Inspite of being a widely used spice crop, its cultivated area and production have not been increased in Bangladesh during the last decade (BBS 1996) and every year a shortage of onion 300 thousands tons has been prevailing in our country (Rahim, 1992). The average yield of onion is only 4.18 tons per hectare, which is quite low in comparison with that of other developed countries of the world (FAO, 1994). The demand of onion is increasing with the ever-increasing population of Bangladesh. The price of onion remains fairly high throughout the year except few months after harvest. Onion is produced in Bangladesh by different methods such as bulb planting, direct-seed sowing and seedling transplanting. Among them, the bulb planting method where crop is raised from bulbs

[1] Department of Horticulture, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

produced in the previous year is most suitable and is mostly practiced to produce early bulb. Although this method is relatively expensive, but early high market-price compensates the cost of production (Rahim, 1991).

Yield of onion is greatly influenced by different cultural practices, among which, conservation of soil moisture and optimization of nutrients especially nitrogen and potassium are important. To have a successful crop, frequent irrigation is needed. But at present in the places where onion is cultivated, irrigation facilities may not be easily available. Moreover, irrigation increases the cost of onion production. So, artificial mulching by using rice straw, water hyacinth, polythene sheet etc. was thought to be helpful to conserve moisture in the soil as an alternative to irrigation. The importance of nitrogen and potassium on the growth of vegetable crops is well known. Nitrogen encourages above ground vegetative growth, and potassium helps in root and stem development. The available information on the effects of mulch and plant nutrients particularly nitrogen and potassium on bulb of onion under Bangladesh condition is not conclusive. The present work was, therefore, undertaken to find out the usefulness of straw mulch and optimum requirements of nutrients particularly N and K for bulb production of onion.

MATERIALS AND METHODS

The experiment was conducted at the Horticulture Farm of Bangladesh Agricultural University, Mymensingh during October 1995 to February 1996 to observe the effect of mulch (non-mulch and straw mulch) and four different levels of nitrogen (0, 40, 80 and 120 kg N ha^{-1}) and potassium (0, 37.5, 75 and 112.5 kg K ha^{-1}) on the growth and yield of onion bulb. The experiment consisting of 32 treatment combinations was laid out in randomized complete block design with three replications. The land was thoroughly ploughed and incorporated with cowdung and triple superphosphate @ 10 ton and 125 kg ha^{-1} respectively. Urea and muriate of potash were used as the sources of nitrogen and potassium, and applies as top dressing in one installment after 15 days of planting. Thirty two treatment combinations were randomly assigned to unit plots in each block. The size of unit plot was 1.2 m × 1.0 m. Small bulbs of (average weight 2.66g) a local onion cultivar 'Taherpuri' were planted on 1 November 1995 maintaining a spacing of 25 cm × 15 cm and accommodating 32 plants in each plot. Straw mulching was done after 20 days of planting in the respective plots as per schedule of the layout.

Intercultural operations were done as and when required. The crop was harvested on different dates in different plots starting from 7 to 21 February, 96 when 75% of the tops in each plot had fallen over. Ten plants were randomly selected in each plot to record data on different yield contributing characters and bulb yield. The bulb weight was taken after cutting the pseudostem keeping only 2.5 cm with the bulb. Data were statistically analysed with a computer following MSTAT programme.

RESULTS AND DISCUSSION

Main effect of mulch and different levels of N and K

Most of the parameters studied were significantly influenced by mulching (Table 1). Plants grown with straw mulch took longer period of growth and gave higher bulb yield showing better performance in most of the yield contributing characters like plant height, leaf number, pseudostem diameter and individual bulb weight which was possibly due to higher moisture conservation in soil. Higher yield and better performance were also reported in garlic under mulched condition by Aliuddin (1986); Asandhi *et al.* (1989) and Hossain (1996). Plants grown without mulch matured earlier and produced less tillers resulting in higher number of single bulbs.

Nitrogen played an important role on the growth and bulb yield of onion. Different levels of nitrogen showed significant effect on all the parameters studied (Table 1). Increasing levels of nitrogen showed gradual increase in yield and other yield contributing characters. Plants grown with the highest level of nitrogen took the longest period to complete the vegetative growth, and produced the highest bulb yield by showing the best performance in almost all the yield components. Plants grown without nitrogen was found to complete their vegetative growth in the shortest period and gave the lowest bulb yield, but showed the highest single bulb and dry matter of root. Singh and Sharma (1991) reported that nitrogen application at 80 kg ha^{-1} caused 38% increase in bulb weight over control. Srinivas and Nail (1987) also found an increase of onion bulb yield from 16.51 ton ha^{-1} at zero N to 56.30 ton ha^{-1} at the highest N rate (200 kg ha^{-1}).

Different levels of potassium did not exhibit significant variation in plant height, leaf number per plant and bulb type (Table 1). Application of potassium significantly prolonged the vegetative growth and increased bulb yield compared to control, but its increasing different levels had identical results on yield. Similar trend was also observed in pseudostem and bulb diameter. Application of potassium as K_2O at the rate of 40 kg ha^{-1} gave significantly higher bulb yield compared to control as reported by Sharma (1992) and Deshmukh *et al.* (1984). Potassium at the highest level (112.5 kg ha^{-1}) revealed the highest root dry matter and bulb weight. Jasa and Robtkova (1965) also obtained higher bulb weight from higher doses of potassium.

Combined effect of mulch and nitrogen

Effect of mulch with the combination of different levels of nitrogen produced significant variation in respect of bulb yield and a few yield components (Table 2). Higher nitrogen levels in munched condition influenced the yield contributing characters thus giving rise to higher bulb yield and requiring longer period to bulb harvest than their corresponding nitrogen levels in non-mulched treatments. The highest bulb yield (13.3 t ha^{-1}) was obtained from the plants having received 120 kg N ha^{-1} under straw mulch and the plants grown with control (M_0N_0) yield the lowest amount of bulb (7.86 t ha^{-1}).

Table 1. Main effect of mulch, nitrogen and potassium on the growth and yield of onion

Treatment	Plant height at harvest (cm)	No. of leaves/ plant at harvest	Pseudostem diameter at harvest (cm)	Bulb diameter at harvest (cm)	Types of bulb (%)		Dry matter of root (%)	Individual bulb weight at harvest (g)	Bulb yield per hectare (ton)	Days to bulb harvest
					Non-splitted	splitted				
Mulch										
Non-mulch (M_0)	24.32 b	9.30 b	1.48 b	4.02	43.12 a	56.88 b	24.48	35.93 b	9.57 b	99 b
Straw mulch (M_1)	28.22 a	9.73 a	1.61 a	4.10	38.54 b	61.46 a	24.28	40.79 a	10.89 a	102 a
Level of significance	**	**	**	NS	*	*	NS	**	**	**
Levels of N										
0 (N_0)	23.88 b	8.49 d	1.49 c	3.64 c	44.17 a	55.83 c	25.59 a	32.19 c	8.57 c	93.52 d
40 (N_1)	25.91 ab	9.13 c	1.55 b	4.14 b	44.17 a	55.83 c	23.96 b	37.94 b	10.09 b	96.33 c
80 (N_2)	27.55 a	9.86 b	1.51 bc	4.19 b	38.33 b	61.67 b	23.96 b	37.97 b	10.12 b	104.84 b
120 (N_3)	27.73 a	10.59 a	1.64 a	4.34 a	36.67 c	63.33 a	24.03 b	45.34 a	12.13 a	109.76 a
Level of significance	**	**	**	**	*	*	**	**	**	**
Levels of K										
0 (K_0)	25.41	9.49	1.48 b	3.84 b	43.33	56.67	23.53 b	35.43 c	9.43 b	98.11 b
37.5 (K_1)	26.10	9.68	1.57 a	3.97 b	38.75	61.25	24.04 b	38.76 b	10.36 a	99.83 c
75 (K_2)	26.12	9.49	1.56 a	4.15 a	42.92	57.08	23.99 b	39.14 ab	10.45 a	102.55 b
112.5 (K_3)	27.53	9.41	1.58 a	4.27 a	38.33	61.67	25.95 a	40.11 a	10.68 a	103.96 a
Level of significance	NS	NS	**	**	NS	NS	**	**	**	**

** Significant at 0.01 level; * Significant of 0.05 level; NS = Non-significant; Means bearing similar letter (s) in a column do not differ significantly

Table 2. Combined effect of mulch and nitrogen on the growth and yield of onion

Treatment combinations Mulch × Levels of N (kg ha^{-1})	Plant height at harvest (cm)	No. of leaves/ plant at harvest	Pseudostem diameter at harvest (cm)	Bulb diameter at harvest (cm)	Types of bulb (%)		Dry matter of root (%)	Individual bulb weight at harvest (g)	Bulb yield per hectare (ton)	Days to bulb harvest
					Non-splitted	splitted				
Non-mulch (M_o)										
0 (N_o)	23.84 b	8.37	1.39	3.67	48.33	51.67	24.49 bc	29.53 f	7.86 f	91.79 g
40 (N_1)	25.26 b	9.03	1.51	4.12	45.00	55.00	23.35 bc	38.88 c	10.32 c	95.41 f
80 (N_2)	23.98 b	9.67	1.46	4.04	40.83	59.17	25.02 ab	34.28 e	9.16 e	103.97 d
120 (N_3)	24.18 b	10.18	1.58	4.28	38.33	61.67	25.04 ab	41.05 b	10.94 b	108.40 b
Straw mulch (M_1)										
0 (N_o)	23.93 b	8.61	1.57	3.63	40.00	60.00	26.63 a	34.85 e	9.28 e	95.24 f
40 (N_1)	26.57 b	9.24	1.58	4.16	43.33	56.67	24.57 bc	37.00 d	9.86 d	97.26 e
80 (N_2)	31.12 a	10.06	1.57	4.20	35.33	64.17	22.90 c	41.67 b	11.10 b	105.72 c
120 (N_3)	31.27 a	11.00	1.71	4.39	35.00	65.00	23.02 c	49.63 a	13.31 a	111.13 a
Level of significance	**	NS	NS	NS	NS	NS	**	**	**	**

** Significant at 0.01 level; NS = Non-significant; Means bearing similar letter (s) in a column do not differ significantly

Table 3. Combined effect of mulch and potassium on the growth and yield of onion

Treatment combinations Mulch × Levels of K (kg ha^{-1})	Plant height at harvest (cm)	No. of leaves/ plant at harvest	Pseudostem diameter at harvest (cm)	Bulb diameter at harvest (cm)	Types of bulb (%)		Dry matter of root (%)	Individual bulb weight at harvest (g)	Bulb yield per hectare (ton)	Days to bulb harvest
					Non-splitted	splitted				
Non-mulch (M_o)										
0 (K_o)	24.04	9.33 b	1.45 b	3.89 de	45.00	55.00	23.28 b	34.13 d	9.08 d	97.15
37.5 (K_1)	23.71	9.19 b	1.49 b	3.98 d	40.83	59.17	23.88 b	36.27 c	9.66 c	98.72
75 (K_2)	23.72	9.38 b	1.50 b	4.06 cd	47.50	52.50	23.43 b	36.60 c	9.76 c	101.31
112.5 (K_3)	25.79	9.34 b	1.49 b	4.17 bc	39.17	60.83	27.31 a	36.74 c	9.77 c	102.39
Straw mulch (M_1)										
0 (K_o)	26.78	9.66 b	1.50 b	3.79 e	41.67	58.33	23.78 b	36.73 c	9.79 c	99.09
37.5 (K_1)	28.32	10.17 a	1.64 a	3.97 d	36.67	63.33	24.19 b	41.25 b	11.05 b	100.94
75 (K_2)	28.53	9.61 b	1.63 a	4.24 ab	38.33	61.67	24.54 b	41.69 b	11.14 ab	103.80
112.5 (K_3)	29.26	9.48 b	1.66 a	4.37 a	37.50	62.50	24.60 b	43.48 a	11.58 a	105.53
Level of significance	NS	*	*	*	NS	NS	**	**	**	NS

** Significant at 0.01 level; NS = Non-significant; Means bearing similar letter (s) in a column do not differ significantly

Combined effect of mulch and potassium

Different levels of potassium along with mulch treatments showed significant variations in most of the characters (Table 3). When plants were raised with higher levels of potassium along with straw mulch then the leaf number, pseudostem and bulb diameter and individual bulb weight increased due to the supply of more available potassium and conserved soil moisture thus giving rise to higher bulb yield per hectare than their corresponding potassium levels in non-mulched condition. The maximum root dry matter was obtained at the highest potassium level (112.5 kg ha^{-1}) in non-mulched condition.

The combined effect of nitrogen and potassium treatments revealed significant variations in bulb yield and all the yield components except bulb diameter and types of bulb. N_3K_2 combination produced the highest bulb yield (13.07 t ha^{-1}).

The combined effect of mulch, nitrogen and potassium produced significant variation in the number of leaves per plant, pseudostem diameter, root dry matter, individual bulb weight, bulb yield and days to harvest. Plants grown with nitrogen and potassium at their maximum levels (120 kg N ha^{-1} × 112.5 kg K ha^{-1}) with straw mulch showed the highest bulb yield (14.67 t ha^{-1}).

REFERENCES

Aliuddin, T. 1986. Effect of soil tillage and application of mulch on yield of field grown garlic. Bull. Penelitian. Hortikultura, 14(1): 23-37. [Cited form Hort. Abst., 59(4): 319, 1989]

Asandhi, A. A., Djatnika, I., Pasetriyani, N. and Mulyaningsih, F. 1989. The effect of several types of mulch and cabbage waste on garlic. Bull. Penelitian Hortikultura, 18(1): 11-16. [Cited from Hort. Abst., 61(3): 240, 1991]

BBS. 1996. Monthly (May) Statistical Bulletin of Bangladesh. Statistics Division, Ministry of planning. Govt. of the people's Republic of Bangladesh, Dhaka. p. 53.

Deshmukh, V. A., Patel, M. M. and Nagare, P. K. 1984. Field study on response of onion to phosphorus, potash and iron in vertisol. Research Journal, Punjabrao Krishi Vidyapeeth, 8(2): 1-8.

FAO. 1994. Reports of Food and Agricultural Organization of the United Nations, Rome, Italy. 48: 139-140.

Hossain, M. I. 1996. Effect of mulches and different manurial practices involving equal cost on the growth, yield and storability of garlic. M. S. Thesis, Dept. of Horticulture, BAU, Mymensingh. pp. 64-65.

Jasa, B. and Robtkova, B. 1965. The effect of potash fertilizing on the emergence and over wintering on onion. Sborn. Vys. Sk. Zemed. Vbrace, Roda A. 2: 299-307. Bibl. 37 [Cited from Potato Abst., 36(2): 351, 1966]

Rahim, M. A. 1991. Onion situation in Bangladesh: Problems, research and future prospects. Allium Improvement Newsletter (USA), Vol. 1: 1-14.

Rahim, M. A. 1992. Spices and plantation crop in National Economy. Proceeding of the sixth national Horticulture convention and symposium held at BAU during 16-17 April 1992. pp. 24-29.

Sharma, R. P. 1992. Effect of planting material, nitrogen and potash on bulb yield of rainy season onion. *Indian J. Agron*., 37(4): 868-869.

Singh, D. and Sharma, R. P. 1991. Effect of soil moisture regimes and nitrogen fertilization on onion. *Indian J. Agron*., 36(1): 125-126.

Srinivas, K. and Nail, L. B. 1987. Growth and yield of onion (*Allium cepa* L.) cultivars in relation to nitrogen fertilization. *Prog. Hort*., 19(1-2): 22-26.