J. Bangladesh Agril. Univ. 2(2): 197–202, 2004 ISSN 1810-3030

Effects of nitrogen and potassium nutrition on growth and yield of autumn grown onions

M.F. Mondal, M.M. Islam and N. Islam[1]
Department of Horticulture, Bangladesh Agricultural University, Mymensingh and
[1]Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka

Abstract

An experiment was conducted at the Horticulture Farm of the Bangladesh Agricultural University, Mymensingh during the period from August, 2001 to March, 2002. It was carried out in split plot design with three replications. Four levels of nitrogen and four levels of potassium were used in the study. The objectives of the study were to evaluate the effects of N and K nutrition on growth and yield of autumn grown onions. The results of the experiment revealed that both N and K showed significant effects on all the parameters studied. The application of 110 kg N and 150 kg K per hectare produced the highest bulb yield (11.25 t/ha) in cv. Taherpuri which was statistically identical with the combinations N70 X K150, N90 X K90, N90 X K150, N110 X K90. But from overall considerations, the treatment combination of N90 X K90 was found to be the best.

Keywords: Onion, Bulb, Autumn, Nitrogen, Potassium, Growth and yield

Introduction

Among the causes for low yield of onion in Bangladesh, judicious application of fertilizer is very important. It is reported that nitrogen promotes the vegetative growth of onion which actually helps in increasing bulb size as well as total production (Singh and Dhankar, 1988; Rizk, 1997). Onion is also known to be a potash loving crop (Singh and Mohanty, 1998). Among the yield enhancing factors, adequate nutrition of nitrogen and potassium is very important. Onion is produced in Bangladesh by several methods such as bulb planting, direct seed sowing and seedling transplanting. Bulb planting is suitable for early production of onion. To catch the early market and to meet the demand in the lean period, onion production using sets is very much effective. This method although involves high cost in the production of bulb, the prevailing high price in the off-season compensates for the high cost involved in this method of production. Onion production through transplanting method has failed to meet the ever increasing demand of onion. For this reason, emphasis on the production of onion through sets should be given due importance to boost onion production in the country.

But information on the effect of nitrogen and potassium in onion production using sets is meagre in Bangladesh. Hence, the present study was carried out to determine the optimum levels of nitrogen and potassium for higher yield of onion grown from sets.

Materials and Methods

The present piece of research work was conducted at the Horticulture Farm of Bangladesh Agricultural University, Mymensingh during the period from August, 2001 to March, 2002 to evaluate the effects of different levels of nitrogen and potassium on the growth and yield of onion. The levels of nitrogen were 0 (N_0), 70 (N_1), 90 (N_2) and 110 (N_3) and the levels of potassium were 0 (K_0), 90 (K_1), 120 (K_2) and 150 (K_3) kg per hectare. The experiment was laid out in split-plot design with three replications. Nitrogen was assigned to the main plots and the potassium to the sub-plots at random.. The size of each unit plot was 1.2m ×1m. The space between two plots was 50 cm and between the blocks was 100 cm. The selected land of the experimental plot was prepared thoroughly to obtain a good tilth. Well decomposed cowdung and triple superphosphate were applied at the rate of 10 tons and 100 kg per hectare, respectively. Total quantities of TSP and potassium and one third of urea were applied to the plots during final land preparation. The rest of the urea was applied as top dressing in two installments after 30 and 60 days of planting. Each top dressing was followed by light irrigation with the help of watering can, and care was taken so that irrigation water could not pass from one plot to the other. Small bulbs of uniform size, each weighing 2.25 g, were planted on 26 October, 2001 at the spacing of 20 cm ×15 cm. Intercultural operations were done as when required and the crop was harvested on 30 January, 2002 (Mondal and Alam, 2003). Data on various parameters under study were collected and were statistically analyzed using statistical package programme (MSTAT). Mean separation was done by DMRT.

Results and Discussion

The plant height was significantly influenced by different levels of nitrogen. It increased with the increase in the levels of nitrogen. The maximum plant height (39.38 cm) was obtained from the plant receiving 110 kg N/ha and the minimum (32.28 cm) was from the plants with control treatment (0 kg N/ha). Similar observations were also made by Singh (1996) who stated that plant height increased significantly with increasing levels of nitrogen (Table 1). Potassium also showed significant variation in plant height. With the increase in potassium levels, the plant height also increased. Maximum plant height (37.94 cm) was recorded from the plants receiving 150 kg K/ha and the minimum plant height (33.59 cm) was from control treatment (Table 2). The plants received more nutrients from the highest dose of potassium which might have promoted the vegetative growth resulting in the maximum plant height. Similar results were also reported by Nasiruddin *et al.* (1993). The interaction effect of nitrogen and potassium on plant height was not significant but the combined effect was significant. The maximum plant height (42.50 cm) was observed from the treatment combination of 110 kg N with 150 kg K per hectare and the minimum plant height (30.50 cm) was recorded from the control plants (Table 3). The findings of Singh and Dhankhar (1988) were in agreement with the present results.

The number of leaves per plant was significantly influenced by different levels of nitrogen. It augmented gradually with the increase in the rate of nitrogen. The results clearly exhibited that the number of leaves per plant increased with increasing level of nitrogen (Table 1). This result has got support of Rizk (1997) who observed that the increasing levels of N increased the number of leaves per plant. The number of leaves was also significantly influenced by potassium. It increased with the increase in potassium dose(Table 2). Singh and Mohanty (1998) observed that the highest number of leaves was produced by the plants receiving 80 kg K/ha. The interaction effect of nitrogen and potassium on the production of leaf number per plant was not significant, but their combined effect was significant. The maximum number of leaves per plant (9.23) was recorded from the treatment combination of 110 kg N with 150 kg K while the minimum number per plant (5.83) was given by the treatment combination of 0 kg N with 0 kg K per hectare (Table3). The results pointed out that the number of leaves per plant was higher with the treatment containing higher doses of nitrogen and potassium. Singh *et al.* (1996) reported to have obtained the higher number of leaves per plant from a combination of 120 kg N and 50 kg K per hectare.

The splitting of bulb was significantly influenced by the application of nitrogen. The maximum percentage of single bulb (71.46 %) was obtained from N_0 (0 kg N/ha) treatment, which was statistically similar with that of N_1 level (110 kg N/ha). The minimum percentage of single bulb (58.96 %) was noticed from N_3 treatment, which on the contrary, produced the maximum number of split bulbs (41.04 %) (Table 1).

Table 1. Main effects of nitrogen on plant height, leaf number and splitting, diameter, mean weight, DM content and yield of bulb

Levels of nitrogen (kg N/ha)	Plant height (cm)	No. of leaves/ plant	Splitting of bulb		Diameter of bulb (cm)	Mean bulb weight (g)	DM of bulb (%)	Bulb yield (t/ha)
			Single (%)	Split (%)				
0	32.28d	6.33d	71.46 a	28.54 c	3.55 c	29.85 c	11.50 d	7.54 c
70	35.13c	7.03c	69.38 ab	30.63 bc	3.79 b	34.76 b	12.30 c	8.58 b
90	37.58b	7.81b	65.63 b	34.38 b	4.02 a	35.85 ab	12.76 b	9.42 ab
110	39.38a	8.03a	58.96 c	41.04 a	4.07 a	38.79 a	13.26 a	10.25 a

Means bearing the same letter(s) in a column do not differ significantly at the 5 % level of probability.

Table 2. Main effects of potassium on plant height, leaf number and splitting, diameter, mean weight, DM content and yield of bulb

Levels of potassium (kg K/ha)	Plant height (cm)	No. of leaves/ plant	Splitting of bulb		Diameter of bulb (cm)	Mean bulb weight (g)	DM of bulb (%)	Bulb yield (t/ha)
			Single (%)	Split (%)				
0	33.59d	6.59c	71.04 a	28.96 b	3.49 c	30.50 b	11.43 c	7.67 c
90	35.51c	7.02b	66.88 b	33.13 ab	3.84 b	34.93 a	12.40 b	8.58 b
120	36.32b	7.68ab	64.79 b	35.21 a	3.96 ab	36.43 a	12.70 b	9.58 a
150	37.94a	7.98a	62.71 b	37.29 a	4.12 a	37.38 a	13.29 a	10.00 a

Means bearing the same letter(s) in a column do not differ significantly at the 5 % level of probability.

The above results indicated that the increase in nitrogen level accelerated the vegetative growth along with tillering which resulted in more splitting of bulbs. Splitting of bulb was also significantly influenced by potassium nutrition. Potassium at zero level (K_0) gave the maximum percentage of single bulbs (71.04 %). The maximum percentage of split bulb (37.29 %) was found at the K_3 treatment. On the other hand, K_3 produced the minimum vegetative growth and more accumulation of food materials that resulted in more splitting of bulbs. There was no significant interaction effect of nitrogen and potassium on the splitting of bulb but the combined effect was significant. The maximum splitting bulb (48.33 %) was recorded from the treatment of N_3K_3, while the lowest splitting bulb (26. 67 %) was obtained from N_0K_0 (Table 3).

The effect of nitrogen was significant on the diameter of bulb. The maximum diameter of bulb (4.07 cm) was recorded at the plants grown with N_3 (110 kg N/ha). The minimum diameter of bulb (3.55 cm) was observed at the control (Table 1). It increased with the increase in the level of nitrogen. It was apparent that the diameter of the bulb increased with increasing rates of potassium (Table 2) and the highest diameter of bulb per plant (4.12 cm) was obtained from K_3 (150 kg K/ha). Nasiruddin *et al.* (1993) reported to have obtained the highest bulb diameter from the plants grown with 100 kg potash and 30 kg sulphur/ha. No significant interaction effect of nitrogen and potassium on bulb diameter of onion was observed. However, it appeared that N_3K_3 (110 kg N × 150 kg K/ha) produced the largest bulb (4.36 cm). The minimum diameter of bulb (3.16 cm) was recorded from N_0K_0 treatment (Table 3). Nasiruddin *et al.* (1993) found that increasing levels of NPKS increased the diameter of bulb. Application of different levels of nitrogen exhibited significant effect on the mean weight of onion bulb. The weight ranged from 29.85 to 38.79 g. The maximum bulb weight (38.79 g) was obtained from 110 kg N/ha which was statistically identical with those of the plants grown with 90 kg N/ha whereas the minimum (29.85 g) was recorded at the control treatment (Table 1). The maximum mean bulb weight per plant (37.38 g) was obtained from the plants receiving 150 kg K/ha and the minimum bulb weight (30.50 g) was obtained from the application zero potassium. The interaction effect of nitrogen and potassium on mean bulb weight per plant was not significant but the combined effect was significant. The present results were in agreement with the findings of Jitendra *et al.* (1989). Application of nitrogen exhibited wide variations in respect of dry matter content of bulb. The highest dry matter content (13.26 %) was obtained from the highest dose of nitrogen and the lowest (11.50 %) was produced by the plants raised without nitrogen fertilizer (Table 1). The dry matter content of bulb was significantly influenced by potassium. The highest dry matter content of bulb (13.29 %) was measured with the highest level of potassium, while the lowest was recorded (11.43 %) at control (Table 2). Higher dose of potassium produced higher dry matter content of bulb which encouraged higher photosynthesis and thereby higher food accumulation. This finding is in agreement with the findings of Singh and Dhankar (1988). The interaction effect of different levels of nitrogen and potassium in respect of dry matter content of bulb was statistically not significant but the combined effect was significant.

Table 3. Combined effects of nitrogen and potassium on plant height, leaf number and splitting, diameter, bulb weight, DM contents and yield of onion bulb

Treatment N×K	Plant height(cm)	No. of leaves/ plant	Bulb type		Bulb dia. (cm)	Mean bulb weight (g)	DM of bulb (%)	Bulb yield (t/ha)
			Single (%)	Split (%)				
0 x 0	30.50 g	5.83 g	73.33 a	26.67 e	3.16 e	26.53 l	9.99 f	6.33 f
0 x 90	31.50 fg	6.33 fg	71.67 ab	28.33 de	3.42 de	29.05 hi	11.5 e	6.83 ef
0 x 120	33.35 defg	6.40 fg	70.83 abc	29.17 de	3.66 cd	31.29 fghi	12.00 de	8.25 de
0 x 150	33.75 defg	6.73 defg	70.00abc	30.00 cde	3.90 abcd	32.53 defghi	12.50 bcde	8.75 cde
70 x 0	32.85 efg	6.53 efg	71.67 ab	28.33 de	3.41 de	30.40 ghi	11.50 e	7.08 ef
70 x 90	34.00 dfeg	6.60 efg	70.00 abc	30.00 cde	3.76 bcd	35.38 bcdefg	12.20 cde	8.50 cde
70 x 120	35.10 cdef	7.67 bcde	68.33 abcd	31.67 cde	3.97 abc	36.28 abcdefg	12.50 bcde	9.33 bcd
70 x 150	37.00 bcde	7.83 bcd	67.50 abcd	32.50 cde	4.00 abc	36.98 abcdef	13.00 bcd	9.59 abcd
90 x 0	34.00 defg	6.97 cdefg	70.83 abc	29.17 de	3.68 bcd	31.48 efghi	12.00 de	8.30 de
90 x 90	36.00 bcde	7.13 bcdef	66.67 abcd	33.33 bcde	4.08 abc	35.89 abcdefg	12.72 bcd	9.14 bcd
90 x 120	37.38 bcd	7.87 bcd	63.33 bcde	36.67 bcde	4.10 abc	37.53 abcde	12.90 bcd	9.92 abcd
90 x 150	38.50 abc	8.13 b	61.67 cde	38.33 abcd	4.20 ab	38.48 abcd	13.42 ab	10.33 abc
110 x 0	37.00 bcde	7.03 bcedf	68.33 abcd	31.67 cde	3.71 bcd	33.58 cdefgh	12.25 cde	9.00 bcd
110 x 90	38.50 bc	7.87 bcd	59.17 def	40.83 abc	4.09 abc	39.41 abc	13.17 bc	9.83 abcd
110 x 120	39.50 ab	7.97 bc	56.67 ef	43.33 ab	4.10 abc	40.63 ab	13.40 ab	10.83 ab
110 x 150	42.50 a	9.23 a	51.67 f	48.33 a	4.36 a	41.53 a	14.23 a	11.25 a

Means bearing the same letter(s) in a column do not differ significantly at the 5 % level of probability.

The variation in bulb yield of onion was observed to be highly significant due to the application of different levels of nitrogen. The maximum yield (10.25 t/ha) was recorded from the plants supplied with 110 kg N/ha and the minimum yield (7.54 t/ha) was obtained from control plants. The bulb yield increased with the increase in nitrogen level (Table 1). Similar findings were reported by Sharma (1992) and Khan *et al.* (1977). The yield of bulb also increased significantly due to application of potassium. The maximum yield (10.00 t/ha) was obtained from 150 kg K/ha which was statistically similar with that of K_2 (120 kg K/ha) and the minimum (7.67 t/ha) was recorded at the control treatment. The above result indicated that high rates of potassium increased the bulb yield. Similar result was also reported by Katwale *et al.* (1996) who mentioned that increased levels of potassium augmented the yield of bulb. No significant interaction effect was found between nitrogen and potassium on bulb yield per hectare but their combined effect was significant. The yield increased with the increasing rates of nitrogen and potassium (Table 3). The highest yield (11.25 t/ha) was obtained from N_3K_3, which was statistically identical with those of N_3K_2, N_3K_1, N_2K_2 and N_1K_3 and the lowest yield (6.33 t/ha) was produced by N_0K_0. The result is in agreement with the findings of Rizk (1997) who reported that increased NPKS increased bulb yield. Mondal and Alam (2003) also reported similar bulb yield of onion grown from sets..

Acknowledgement

The financial assistance of the BAURES for conducting the experiment is gratefully acknowledged.

References

Jitendra, S., B.S. Dhankar and J. Singh. 1989. Effect of nitrogen, potassium and zinc on growth and yield of onion. Veg. Sci., 16(2): 136-144.

Katwale, T. R. and R. K. Saraf. 1994. Studies on response of onion to varying levels of fertilizer doses during monsoon season in Satpura Plateau. Orissa J. Hort., 22(1-2): 13-18.

Khan, A. H., Inayatullah and F. Lodhi. 1977. Effect of fertilizer on the yield and bulb size of onion. J. Sci. Tech., 1(1): 24-26.

Maier, N. A., A. P. Dahlenburg and T. K. Twigden. 1990. Effect of nitrogen on the yield and quality of irrigated onion (*Allium cepa* L.) cv. Cream Gold grown on siliceous sands. Aust. J. Hort., 30(6): 845-851.

Mondal, M. F. and M. S. Alam. 2003. Effects of set size and growth regulators on growth and yield of onion. J. Bangladesh Agril. Univ., 1(1):7-12.

Nasiruddin, K. M., M. F. Mondal, A. M. Farooque and M. A. Baten. 1993. Effect of potassium and sulphur on growth and yield of onion. Bangladesh J. Agril. Sci., 20(1): 35-40.

Rizk, F. A. 1997. Productivity of onion plant (*Allium cepa* L.) as affected by method of planting and NPK application. Egyptian J. Hort., 24(2): 219-238.

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

Singh, H., S. Singh and V. Singh. 1996. Response of onion (*Allium cepa* L.) to nitrogen and sulphur. Ann. Agril. Res., 17(4):141-144.

Singh, J. and B. S. Dhankar. 1988. Effect of nitrogen, potash and zinc on growth, yield and quality of onion. Indian Agric., 32(3): 163-170.

Singh, S. P. and C. R. Mohanty. 1998. A note on the effect of nitrogen and potassium on the growth and yield of onion. Orissa J. Hort., 26(20): 70-71.