International Journal of Agricultural Research

ISSN 1816-4897

Academic Journals Inc.

www.academicjournals.com

International Journal of Agricultural Research 5 (6): 430-435, 2010
ISSN 1816-4897 / DOI: 10.3923/ijar.2006.85.90

Influence of Nitrogen and Potassium on Yield Contributing Bulb Traits of Onion*

[1]S. Dilruba, [2]M.M.Alam, [3]M.A. Rahman and [4]M.F. Hasan
[1]BRAC Agricultural Research and Development Center, Joydevpur, Gazipur, Dhaka, Bangladesh
[2]Department of Genetics and Plant Breeding, [3]Department of Entomology, [4]Department of Horticulture, Patuakhali Science and Technology University, Dumki, Patuakhali-8602, Bangladesh

Abstract: The experiment was conducted to investigate the effect of different levels of nitrogen and potassium on yield contributing bulb traits of onion cv BARI Peaj-1. All the bulb traits in the experiment were influenced significantly by the individual treatment of different doses of nitrogen and potassium except dry matter content for nitrogen and showed a positive linear relationship. In the experiment, fresh weight of bulb, bulb dry weight, bulb diameter and yield per plot gave almost two times higher performance (35.29 g, 3.21g, 3.98 cm and 1.68 kg, respectively) by the treatment of 100 kg N ha^{-1} than that of no nitrogen application (18.93 g, 1.48 g, 2.02 cm and 0.95 kg , respectively). The performance of the doses of potassium (0 kg K_2O ha^{-1} to 120 kg K_2O ha^{-1}) on bulb characters and yield of onion was less than that of nitrogen. There was no interraction between nitrogen and potassium in the influence of the expression of the characters. Among the combinations, the treatment 100 kg N with 120 kg K_2O ha^{-1} was found to be the best from overall considerations.

Key words: Nitrogen, ptassium, yield, bulb traits, onion

Introduction

Onion (*Allium cepa* L.) is one of the most important bulb and spice crops of the world (Jones and Mann, 1963) belonging to the family Alliaceae. In Bangladesh, it is mainly used as spice crop in all Bangladeshi curries and thus have a large scale of requirements. The annual requirement of onion in Bangladesh is about 450 thousand tons (Rahim, 1992), where as the total production is only 134 thousand tons. As well, it has an average yield of only 4.026 t ha^{-1} (BBS, 2001), which is very low as compared to that of many other countries (FAO, 1999). As the cultivable land area is limited in Bangladesh, it is not possible to extend the land under onion cultivation. So, emphasis must be given to increase the productivity of this crop on yield context, which can be made possible with the efficient use of fertilizers namely nitrogen and potassium. Judicious application of fertilizers may enhance bulb yield significantly. Among the yield promoting factors, application of proper doses of nitrogen and potassium is of great importance. Nitrogen plays the most important role for the vegetative growth of the crop, which ultimately helps in increasing bulb size and total yield (Singh and Kumar, 1969; Rai, 1981). Delvin (1966) stated that, nitrogen imparts

Corresponding Author: Mohammad Mobashwer Alam, Department of Genetics and Plant Breeding, Patuakhali Science and Technology University, Dumki, Patuakhali-8602, Bangladesh

**Originally Published in International Journal of Agricultural Research, 2006*

greenness to plants by enhancing chlorophyll synthesis and induces more photosynthate production per unit photosynthetic area. Potassium helps in root development and increases the photosynthetic efficiency of leaves. Potassium exerts a balancing role on the effect of both nitrogen and phosphorus, consequently, it is especially important in a multi nutrient fertilizer application (Brady, 1995). Keeping view of the above situation, the present study was undertaken to determine the optimum level of nitrogen and potassium affecting on different bulb characters to get maximum yield of onion cv. BARI Peaj-1

Materials and Methods

The experiment was conducted at the Horticulture Farm of Bangladesh Agricultural University, Mymensingh, during the period from November 2000 to August 2001 to investigate the effect of different levels of nitrogen and potassium on the bulb characters of onion variety BARI Peaj-1. The crop was raised during November 2000 to April 2001. The experiment consisted of two factors, namely, nitrogen (factor -A) and potassium (factor-B). The different levels of nitrogen were I. 0 kg N ha^{-1} (N_0) ii. 50 kg N ha^{-1} (N_{50}) iii. 75 kg N ha^{-1} (N_{75}) iv. 100 kg N ha^{-1} (N_{100}) and that of potassium were I. 0 kg K_2O ha^{-1} (K_0) ii. 40 kg K_2O ha^{-1} (K_{40}) iii. 80 kg K_2O ha^{-1} (K_{80}) iv. 120 kg K_2O ha^1 (K_{120}). The two-factor experiment consisting of 16 treatment combinations was laid out in the Randomized Complete Block Design (RCBD) with 3 replications. Each plot received a treatment combination of the experiment. The size of a unit plot was 1.5 m × 1m with a 75 cm spacing between the replications or blocks, 50 cm between the adjacent unit plots and border was 50 cm. The selected land for seedbeds was well prepared before sowing. The seeds were sown in the seedbeds on 1 November 2000. Then the seeds were covered with light soil and Heptachlor 40WP was dusted over the seedbeds to avoid the attack of ants. Germination was completed within seven days. All the intercultural operations were done as and when necessary. In addition with the treatments consisting of nitrogen and potassium, TSP was applied at the rate of 180 kg ha^{-1}. Well decomposed cowdung was applied at the rate of 15 t ha^{-1} just after opening of the land. The entire amount of TSP was applied at final land preparation. Urea and MP were applied in two equal splits as top dressing at 20 and 50 days after transplanting. Healthy and disease free uniform sized 55 days old seedlings were transplanted in the main field on 25 December 2000. Pesticides like Dursban 20 EC at the rate of 7.41 L ha^{-1} and Ridomil MZ at the rate of 2 g L^{-1} were applied to protect plants from mole cricket insect and purple leaf blotch disease, respectively. The flowering stalks were broken whenever appeared in plants. The crop was harvested on April 10, 2001 when the plants showed the sign of maturity by drying out most of the leaves and by bending of necks of the bulbs. Care was taken to avoid injury of onion bulbs during harvesting. Data were recorded on fresh weight of bulb per plant, dry weight of bulb per plant, diameter of bulb per plant, dry matter content of bulb, splitting of bulb per plot and yield of bulb (t ha^{-1}). The calculated data on various parameters under study were statistically analyzed (using statistical package programme). The means for all the treatments were calculated and analyses of variances for all the characters were performed by F test. The significance of the differences among the pairs of treatment means were evaluated by the Least Significance Difference (LSD) test for the interpretation the results.

Results and Discussion

Different levels of nitrogen and potassium individually exhibited significant variations in respect of all the bulb traits under study except the percentage of dry matter content of bulb (Table 1). For the production of dry matter contents in the bulb, the variations were non-significant in case of nitrogen but significant for potassium. But the interraction between the factors (N and K_2O) was non-significant for those characters.

Influence of Nitrogen on Bulb Traits of Onion

The study of the effect of nitrogen on bulb characters (Table 2) revealed that there was a positive linear relationship between the expression of the traits and the doses of nitrogen. Increased levels of nitrogen increased the fresh weight of bulbs. Similar results were also observed in case of all other traits. Maximum weight of bulb per plant was (35.29 g) at fresh condition were obtained with the application of 100 kg N ha^{-1}, which showed significant different results from all other treatments. For the traits-dry weight of bulb, bulb diameter and yield, the highest dose of nitrogen (100 kg ha^{-1}) also exhibited best performance in comparison to all other treatments. On an average, the highest nitrogen levels, which is perhaps to be optimum, produced bulbs of 3.21 g dry weight, 3.9 cm diameter and 1.68 kg yield per plot.

The bulb weight (fresh) was higher with the application of nitrogen dose, may be, due to higher synthesis of carbohydrates in the leaf and their translocation to the bulb, which comparatively helped in the increased weight, diameter, yield of onion bulb. The results were also in agreement with the findings of Vachhani and Patel (1993) for bulb weight, Maier *et al.* (1990) for bulb diameter and Amin *et al.* (1995) for yield.

The maximum dry matter content of the bulb (%) was obtained from the highest nitrogen dose. But statistically similar results were also observed from the treatments of 75 kg N ha^{-1} and 50 kg N ha^{-1}. Treatment without nitrogen gave lowest drymatter content (8.36%). Thus, for this trait, 75 kg N ha^{-1} and 100 kg N ha^{-1} would be considered as the highest performer. From the economic point of view, the optimum dose of nitrogen for getting best performance in dry matter content of bulb is 75 kg N ha^{-1}. Contrary to this, Maier *et al.* (1990) reported that dry matter of bulbs was not affected by nitrogen.

Though the highest dose of nitrogen gave maximum splitting of bulb (25.3%), but it also produced statistically similar results with the treatment of 75 kg N ha^{-1}. So, 75 kg N ha^{-1} may the optimum dose for getting better splitting, as found in the experiment. The above result indicated that the higher levels of nitrogen caused more vegetative growth along with tillering that resulted in higher percentage of bulbs splitting.

Influence of Potassium on Bulb Traits of Onion

Doses of potassium showed a positive linear relationship for all the traits under study (Table 3). Though the highest dose of potassium (120 kg K_2O ha^{-1}) exhibited best bulb trait performance among the treatments, but 80-kg K_2O ha^{-1} was found to be optimum, in case of bulb dry weight and percentage of dry matter content. The treatment of 120 kg K_2O ha^{-1} produced on an average 32.58 g fresh weight of bulb, 2.92 g bulb dry weight, 3.76 cm bulb diameter, 9.75% dry matter content, 26.75% splitting of bulbs and yield of 1.53 kg $plot^{-1}$. The minimum results were obtained from the application of 0 kg K_2O ha^{-1} for these characters. Similar results were obtained by Jasa and Robtkova (1965) forbulb weight, Chroboczek (1936) for bulb size, Singh and Dhankhar (1989) for dry matter content and Rahman *et al.* (1976) for yield.

As an essential element of photosynthesis potattium plays a vital role in increased starch formation, which resulted in increased weight and bulb diameter. As well, the increased dry matter accumulation in the bulb may be attributed to more synthesis and translocation of photosynthates

Table 1: Analysis of variance of the data on six bulb characters of onion as influenced by different doses of nitrogen and potassium

		Mean square					
Sources of variation	df	Fresh weight of bulb (g)	Dry weight of bulb (g)	Bulb diameter (cm)	Dry matter content (%)	Splitting of bulb (%)	Yield kg plot^{-1}
Replication	2	7.573	0.113	0.046	0.260	4.563	0.003
Treatments	15	14.279**	14.606**	79.581**	2.553*	5.312**	107.4**
Factor A (N level)	3	589.820**	6.559**	8.249**	1.580	60.556**	1.147
Factor B (K level)	3	576.494**	3.196**	3.731**	6.883**	137.056**	0.431
Interaction (A X B)	9	3.308	0.084	0.118	0.085	3.056	0.011
Error	30	12.273	0.137	0.031	0.683	7.785	0.003

* significant at 5% level, ** significant at 1% level

Table 2: Effect of nitrogen on six bulb characters of onion*

Treatments	Fresh weight of bulb (g)	Dry weight of bulb (g)	Bulb diameter (cm)	Dry matter content (%)	Splitting of bulb (%)	Yield kg plot^{-1}
N_o	18.93^{d}	1.48^{d}	2.02^{d}	8.36^{b}	20.00^{c}	0.95^{d}
N_{50}	24.88^{c}	2.21^{c}	2.84^{c}	8.96^{ab}	22.17^{bc}	1.16^{c}
N_{75}	30.08^{b}	2.70^{b}	3.37^{b}	9.09^{a}	23.5^{ab}	1.38^{b}
N_{100}	35.29^{a}	3.21^{a}	3.98^{a}	9.16^{a}	25.3^{a}	1.68^{a}
CV (%)	12.83	15.43	5.80	9.29	12.26	4.00

* Measured at 5% level

Table 3: Effect of potassium on six bulb characters of onion

Treatments	Fresh weight of bulb (g)	Dry weight of bulb (g)	Bulb diameter (cm)	Dry matter content (%)	Splitting of bulb (%)	Yield kg plot^{-1}
K_o	21.58^{d}	1.77^{c}	2.48^{d}	8.06^{b}	18.58^{c}	1.08^{d}
K_{40}	25.46^{c}	2.21^{b}	2.76^{c}	8.50^{b}	22.17^{b}	1.21^{c}
K_{80}	29.57^{b}	2.69^{a}	3.21^{b}	9.26^{a}	23.50^{b}	1.34^{b}
K_{120}	32.58^{a}	2.92^{a}	3.76^{a}	9.75^{a}	26.75^{a}	1.53^{a}
CV (%)	12.83	15.43	5.80	9.29	12.26	4.00

from the leaf to the bulb and also due to the availability of more nutrients from the soil. Similarly higher rate of photosynthesis due to higher doses of potassium enhanced the vegetative growth and accumulated more food, which perhaps encouraged the rate of splitting of bulbs and increased yield.

Combined Effect of Nitrogen and Potassium on Bulb Traits of Onion

Significant combined effect of nitrogen and potassium showed the maximum fresh weight of bulb per plant (40.50 g) from the treatment combination of 100 kg N ha^{-1} and 120 kg K_2O ha^{-1} (Table 4). Statistically similar results were exhibited by the treatment conbination of 100 kg N/ha and 80 kg K2O ha^{-1}. While, the minimum fresh weight of bulbs/plant (15.33g) was recorded in 0 kg N/ha and 0 kg K_2O ha^{-1} treatment combination. The results indicated that the fresh weight of bulb was higher with the treatment containing higher doses of nitrogen and potassium. Singh and Dhankhar (1988) reported similar role of nitrogen and potassium on fresh weight of onion bulb.

With the increase in nitrogen and potassium doses, dry weight of bulbs was increased (Table 4) and the maximum dry weight of bulb per plant (3.90 g) was observed from the treatment combination of 100 kg N with 120 kg K_2O ha^{-1}, which showed statistically similarity with the treatments of 100 kg N with 80 kg K_2O ha^{-1} and 75 kg N with 120 kg K_2O. Though, the minimum dry weight of bulb (1.15 g) was found in the lowest dose of nitrogen (0 kg N ha^{-1}) with the lowest dose of potassium (0 kg K_2O ha^{-1}), but statistically similar results were observed in all combination of K_2O with the lowest dose of nitrogen. The highest bulb diameter per plant (4.63 cm) was noticed from the treatment combination of 100 kg N and 120 kg K_2O ha^{-1} and the lowest (2.28 cm) was

Table 4: Combined effect of nitrogen and potassium on six bulb characters of onion*

Treatment combination	Fresh weight of bulb (g)	Dry weight of bulb (g)	Bulb diameter (cm)	Dry matter content (%)	Splitting of bulb (%)	Yield kg plot^{-1}
N_0K_0	15.33^{h}	1.15^{e}	2.28^{g}	8.21^{b}	18.00^{e}	0.93^{h}
N_0K_{40}	16.47^{h}	1.28^{e}	2.44^{fg}	8.69^{ab}	22.00^{cd}	1.15^{g}
N_0K_{80}	20.10^{h}	1.73^{de}	2.94^{e}	9.20^{ab}	22.67^{bcd}	1.26^{e}
N_0K_{120}	23.83^{fg}	1.75^{de}	3.71^{c}	9.74^{a}	26.00^{abc}	1.31^{e}
$N_{50}K_0$	18.50^{g}	1.54^{de}	2.30^{g}	8.25^{b}	18.40^{de}	0.95^{h}
$N_{50}K_{40}$	23.03^{fg}	2.00^{cd}	2.65^{f}	8.78^{ab}	22.07^{cd}	1.19^{fg}
$N_{50}K_{80}$	28.00^{ef}	2.53^{bc}	2.98^{e}	9.30^{ab}	22.87^{bcd}	1.28^{e}
$N_{50}K_{120}$	30.00^{de}	2.75^{b}	3.71^{c}	9.84^{a}	26.15^{abc}	1.39^{cd}
$N_{75}K_0$	24.00^{fg}	1.98^{cd}	2.62^{f}	8.25^{b}	20.33^{cde}	1.20^{fg}
$N_{75}K_{40}$	28.33^{def}	2.54^{bc}	2.95^{e}	8.77^{ab}	22.67^{bcd}	1.28^{ef}
$N_{75}K_{80}$	32.00^{cde}	2.94^{b}	3.68^{c}	9.57^{ab}	24.00^{bc}	1.35^{de}
$N_{75}K_{120}$	36.00^{abc}	3.92^{a}	4.23^{b}	9.76^{a}	27.00^{ab}	1.68^{b}
$N_{100}K_0$	28.50^{def}	2.40^{bc}	3.36^{d}	8.27^{b}	22.00^{cde}	1.43^{d}
$N_{100}K_{40}$	34.00^{bcd}	3.00^{b}	3.69c	8.81^{ab}	24.00^{bc}	1.58^{c}
$N_{100}K_{80}$	38.17^{ab}	3.85^{a}	4.23^{b}	9.57^{ab}	25.33^{bc}	1.75^{b}
$N_{100}K_{120}$	40.50^{a}	3.90^{a}	4.63^{a}	9.99^{a}	30.00^{a}	1.95^{a}
CV%	12.83	15.43	5.80	9.29	12.26	4.00

* measured at 5% level of significance

found in 0 kg N and 0 kg K_2O ha^{-1} treatment combinations. Singh and Dhankhar (1988) reported that a combination of 120 kg N and 40 kg K_2O ha^{-1} gave the highest bulb diameter. The highest percentage of dry matter (9.99%) was observed from 100 kg N and 120 kg K_2O ha^{-1}. Statistically similar results were found in all highest dose combinations of N and K_2O. It was surprisingly found that most of the dose combinations gave statistically similar results for bulb dry matter percentage though there was an increasing trend of dry matter percentage with the increased doses of N and K_2O. The lowest percentage of dry matter (7.50%) was showed at 0 kg N and 0 kg K_2O ha^{-1} treatment combination (Table 4). Higher dry matter production enhance the uptake of other nutrient elements like N, P, K, Ca and Mg (Hedge, 1988) and thus takes part in higher yield.

The highest percentage of split bulb was recorded from the treatment combination of 100 kg N ha^{-1} with 120 kg K_2O ha^{-1} having 30% splitting, which was statistically similar with the treatment combination of 75 kg N and 120 kg K_2O ha^{-1}. Whereas, the lowest percentage of split bulb was found at 0 kg N with 0 kg K_2O ha^{-1} treatment combination having 14% splitting. The above result indicated that the higher level of potassium resulted in the maximum splitting of bulb. The treatment combination of 100 kg N and 120 kg K_2O ha^{-1} gave the highest yield (13 t ha^{-1}), as it showed significant different results than other treatments. While the lowest yield (5.13 t ha^{-1}) was achieved from 0 kg N and 0 kg K_2O ha^{-1} treatments. Similar result was also obtained by Rizk (1997) who reported that increased N P K S increased bulb yield.

From the above discussion, it was found that doses of N and K_2O have significant influence on bulb traits of onion showing a positive linear relationship up to the highest level. Highest dose of nitogen and potassium gave three times or above bulb weight in comparison with no fertilizer application. While in other cases, it was almost double except for dry matter content where little variation was observed due to the differences in doses of nitrogen and potassium. Though the higher doses of both fertilizers gave maximum performance, but better role of nitrogen than potassium was found in most of the traits except bulb dry matter content.

References

Amin, M.M.U., M.A. Rahim and M.A. Hashem, 1995. influences of plating time and nitrogen on the growth and yield of onion. Bangladesh J. Sci. Ind. Res., 30: 275-279.

BBS, 2001. Monthly Statistical Bulletin, Bangladesh, May 2001. Bangladesh Bureau of Statistics. Statistics Division, Ministryof Planning. Govt. of the People's Republic of Bangladesh, Dhaka. pp: 54.

Brady, N.C., 1995. The Nature and Properties of Soils. Prentice Hall of India Pvt., New Delhi. pp: 369.

Chroboczek, E., 1936. Study of some problems connected with growing and storage of onion. Ann. Sci. Hortic., 3: 57-137.

Delvin, R.M., 1966. Plant Physiology. Reinhold Pub. Co., New York. pp: 342.

FAO, 1999. Production Yearbook. Food and Agriculture Organization of the United Nations. 53: 147-148.

Hedge, D.M., 1988. Effect of irrigation and nitrogen fertilization on yield, quality, nutrient uptake and water use of onion (*Allium cepa* L.). Singapore J. Primary Ind., 16: 111-123.

Jasa, B. and B. Robtkova, 1965. The effect of potash fertilizing on the emergence and over wintering on onion. Sborn. Vsy. Sk. Zemed. Vbrace, Roda A. 2: 299-307.

Jones, H.A. and L.K. Mann, 1963. Onion and their Allies. Leonard Hill [Books] ltd., New York. pp: 169.

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. Hortic., 30: 845-851.

Rahim, M.A., 1992. Spices and plantation crop in national economy. Proceeding 6th National Horticulture Convention and Symposium held at BAU during 16-17 April 1992. pp: 24-29.

Rahman, S., M.R. Talukder and A.M. Muih, 1976. Effect of nitrogen, phosphoric acid and potash on the bulb size and yield of onion. Bangladesh Hortic., 4: 7-11.

Rai, M.M., 1981. Principles of Soil Science. MacMillan India Limited, Calcutta. pp: 179-182.

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

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

Singh, J. and B.S. Dhankhar, 1989. Effect of nitrogen, potash and zinc on growth, yield and quality of onion. Veg. Sci., 16: 136-144.

Singh, K. and S. Kumar, 1969. Effect of nitrogen and phosphorus fertilization on the growth and yield of onion (*Allium cepa* L.). J. Res., Ludhiana, 6: 764-8

Vachhani, M.U. and Z.G. Patel, 1993. Growth and yield of onion (*Allium cepa* L.) as influenced by nitrogen, phosphorus and potash under South Gujrat Condition. Prog. Hortic., 25: 166-167.