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EFFECTS OF NITROGEN AND POTASSIUM ON BULB TO BULB ONION PRODUCTION

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ABSTRACT

The experiment was conducted at the research farm in the Department of Agronomy and Agricultural Extension at Rajshahi University, Bangladesh during 2015-16 growing season to find out the performance of nitrogen and potassium level on bulb to bulb onion production. The experiment was laid out Randomized Complete Block Design (RCBD) with four replications. Two different factors were considered, factor: (A) Nitrogen level (0, 50, 100, 150) kg/ha, (B) Potassium level (0, 30, 60, 90 kg/ha).The results showed that plant height, leaf length, number of leaf per plant, length of the bulb, the diameter of the bulb, single bulb weight and bulb yield were significantly influenced by different treatments. The yield of onion increased with increased levels of different treatment combination. Synergistic effects of nitrogen and potassium at different days after sowing that 150 kg N with 90 kg K per hectare gave the tallest plant (34.64cm), maximum number of leaves (7.87) per plant, the highest individual bulb weight (26.93g), bulb length (6.30 cm) as well as bulb diameter (4.33cm) of the onion among varying dose level either applied in combined or separate manners. The highest bulb yield 18.43 t/ha found in N150 K90 treatment. The treatment with 150kg N with 90kg K per hectare is most suitable a preferable dose for maximum production of the bulb to bulb onion

1. Introduction

Onion (*Allium cepa* L.) is one of the important spice crops grown in Bangladesh as well as in the world. It is known as the "queen of kitchen". It belongs to the family Alliaceae. Primary center of origin of onion is central Asia. The leading onion producing countries are Korea, USA, Spain, Japan, Turkey, Syria, Iran, Lebanon, Australia, Netherland, India, Egypt and Israel (FAO, 1999). In Bangladesh, onion bulbs are grown moreover in all districts, but in the greater Faridpur, Pabna, Jessore, Rajshahi, Dhaka, Mymensingh, Comilla and Rangpur cultivated in commercial scale(Anonymous, 1977).

Onion is generally used as a spice. The main edible portion of onion is the bulb which is constituted by the fleshy sheath a stem plate. Onion bulb is rich with phosphorus, calcium, carbohydrates etc. It

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also contains protein and vit- C. The yearly requirement of onion is about 5 lakh tones, but the domestic production is only about 1.5 lakh tones. The yield of onion in Bangladesh is meager in comparison with other countries like China, India, and Pakistan where per hectare yields are respected to be 15.22, 10.43 and 12.17 tons, respectively(FAO, 1994). To fulfil the increasing demand of onion requires large-scale imports every year onion from different countries. More research is needed on onion production to develop high yielding variety for our environment.

Onion is high nitrogen demanding vegetables. Its productivity depends on use of optimum fertilizer rates and if not adequately fertilized, considerable yield losses are apparent (Balemi*et al*., 2007). For using excessive chemical fertilizers, the soil is losing its productivity, and the beneficial microorganisms are also being destroyed. The applications of inorganic fertilizers for the major requirements of nitrogen, potassium and phosphorus are often obvious for onion production.

Potassium and nitrogen are the elements present in the highest percentage in the onion dry matter (Resend and Costa, 2014).Nitrogen plays an important role on vegetative growth of onion which increases the bulb size. Nitrogen increases the green color of plants. Onion is a potash loving crops (Rai, 1981). Potassium helps to develop root and photosynthetic efficiency of leaves. Potassium shows a blanching role on the effects of both nitrogen and phosphorus; consequently it is especially important in a nutrient fertilizer application. (Brady and N.C., 1995).The present research work was undertaken to study the effect nitrogen and potassium level on bulb to bulb production of onion.

2. Materials and methods

The research work was carried out atthe research farm in the Department of Agronomy and Agricultural Extension at Rajshahi University in the winter season. The land was ploughed and cross-ploughed several times by a power tiller to obtain a good tilt.

Two different factors were considered, factor: (A) Nitrogen level (0, 50, 100, 150) kg/ha, (B) Potassium level (0, 30, 60, 90 kg/ha). The experiment consisting of 16 treatments combination was laid out in randomized complete block design (RCBD) with four replications. The size of each unit plot was 1.0 m^2, plot to plot distance 30cm, row to row 25cm and plant to plant 15cm, block to block distance is 50cm. Taherpuri were planted as treatment and layout. Urea and Muriate of potash (MOP) were used to supply nitrogen and potassium applied as top dressing in three instalments after 20, 40 and 60 days of planting as per treatment. The whole amounts of triple superphosphate were applied in main plot during final land preparation. All the required cultural operations were given when necessary. Harvest was done by hand when most of the leaves become yellow color. Data were recorded on plant height, a number of leaves per plant, bulb length, bulb diameter, individual bulb weight and bulb yield. The recorded data were analyzed and meant values were adjusted and separated by Duncan's Multiple Range Test (DMRT) according to Gomez and Gomez (1984).

3. Results and Discussion

3.1 Plant height of onion

Plant height of onion was increased continuously up to 60DAS. Maximum plant height 33.54 cm was found in N_{150} treatment at 60DASand control N_0 treatment produce shortest plant 27.27 cm. The tallest plant was uptaken more nitrogen which enhances vegetative growth. In case of potassium treatment, maximum plant 30.16 cm was found in K_{90} and K_0 treatment produced shortest one

(29.02cm). Effect of combined nitrogen and potassium treatment is non-significant at 20 DAS. At 60 DAS, the highest plant height (34.64 cm)was found in $N_{150}K_0$ treatment. Control treatment produced the shortest plant (Figure1).The increased plant height at the highest level of nitrogen was probably due to the availability of more nutrients, which helped, in the maximum vegetative growth of onion plant. (Nandpuri *et al*., 1968)

3.2 Number of leaves per plant

The combined effect on leaf number per plant wasnon-significant by nitrogen and potassium fertilizer application at all DAS. In N_{150} treatment found the maximum number of leaves per plant (8.23) at 60 DAS. At the same DAS, the lowest leaf number per plant (6.66) was obtained in N_0 treatment. (Figure3).In K_{90} treatment founded the maximum number (7.81) of leaf per plant. The lowest number of leaf per plant was obtained in K_0 treatment (7.41). Potassium increases the nutrient uptake of the plant which helps to increase the leaves number of the plant (Figure 4). In case of combined treatment $N_{150,}$ K_0 showed the highest leaf number 8.30at 60 days after showing where lowest leaves 6.27 per plant was given by control treatment (Table 2).Higher dose of nitrogen the vegetative growth of onion plant was increased which helped to increase the number of leaves per plant. (Rahim *et al*.,1997)

Table 1. **Combined effects of nitrogen and potassium on plant height of onion**

Treatment combination	Plant height at		
	20 DAS	40 DAS	60 DAS
N_0K_0	19.67	24.80	27.00
N_0K_{30}	20.00	25.10	27.15
N_0K_{60}	20.17	25.17	27.40
N_0K_{90}	20.40	25.38	27.55
$N_{50}K_0$	20.49	25.53	27.77
$N_{50}K_{30}$	20.71	25.72	27.93
$N_{50}K_{60}$	20.94	26.84	28.01
$N_{50}K_{90}$	21.45	26.97	28.24
$N_{100}K_0$	22.51	27.09	28.91
$N_{100}K_{30}$	22.57	27.15	29.44
$N_{100}K_{60}$	22.65	27.25	29.63
$N_{100}K_{90}$	22.84	27.44	30.23
$N_{150}K_0$	23.28	29.31	32.40
$N_{150}K_{30}$	23.76	29.87	33.13
$N_{150}K_{60}$	24.53	30.20	34.00
$N_{150}K_{90}$	25.13	31.97	34.64
Level of significance	NS	NS	NS
LSD	-	-	-

3.3 Length of Bulb

Effect of nitrogen and potassium on the bulb lengths was significant. The highest bulb length 6.23cm was found in N_{150}treatment. The N_0 gave the lowest length of bulb 4.69cm per (Table 3).In case of potassium, treatment bulb was maximum 5.72 cm at 90 DAS found in K_{90}treatment. The K_0 gave the lowest bulb length 5.35cm. (Table 4)

In combined N_{150} K_{90} treatment, the highest bulb length 6.30cm was founded. The N_0K_0 gave 4.33cm which is the lowest length of the bulb. The effects were non-significant (Table5). Proper doses of nitrogen are needed to produce to maximum bulb length. Nitrogen causes the cell elongation which increases the length of the bulb. (Yadav *et al*., 2003)

Table 2.Combined effects of nitrogen and potassium on number of leaves per plant of the onion

Treatment combination	Number of leaves per plant at		
	20 DAS	40 DAS	60 DAS
N_0K_0	3.10	5.73	6.27
N_0K_{30}	3.22	5.91	6.60
N_0K_{60}	3.32	6.00	6.67
N_0K_{90}	3.44	6.14	7.10
$N_{50}K_0$	3.50	6.26	7.47
$N_{50}K_{30}$	3.55	6.38	7.57
$N_{50}K_{60}$	3.61	6.57	7.72
$N_{50}K_{90}$	3.67	6.65	7.71
$N_{100}K_0$	3.73	6.82	7.75
$N_{100}K_{30}$	3.79	6.92	7.91
$N_{100}K_{60}$	3.84	7.02	7.97
$N_{100}K_{90}$	3.96	7.13	8.01
$N_{150}K_0$	4.07	7.32	8.15
$N_{150}K_{30}$	4.26	7.54	8.21
$N_{150}K_{60}$	4.35	7.72	8.27
$N_{150}K_{90}$	4.71	7.87	8.30
Level of significance	NS	NS	NS
LSD	-	-	-

Table 3. Effects of nitrogen on bulb length, bulb diameter and yield of onion

Nitrogen levels (kg/ha)	Bulb length (cm)	Bulb diameter (cm)	Individual bulb weight (g)	Yield (t/ha)
N_0	4.692	2.515	13.217	13.158
N_{50}	5.549	2.758	16.046	14.817
N_{100}	5.907	3.235	22.692	15.975
N_{150}	6.232	3.842	26.283	17.225
Level of significance	**	**	**	**
LSD	0.1588	0.1040	0.794	0.517

3.4 Bulb Diameter

The diameter of the bulb was found statistically significant due to the application of nitrogen and potassium. The height bulb diameter 3.84cm was obtained from N_{150} treatment. The lowest 2.51cm diameter was obtained in control N_0 treatment (Table3). The highest bulb diameter 3.28cm was obtained from K_{90} treatment and lowest diameter 2.97 cm was obtained in control K_0 treatment (Table 4). Bulb diameter was highly significant for combined nitrogen and potassium treatment. Highest bulb diameter 4.33cm was obtained from $N_{150}K_{90}$ treatment. Lowest diameter 2.39cm was obtained in control N_0K_0treatment. (Table5). Sufficient supply of nitrogen was needed for larger bulbs in respect of diameter (Nasreen *et al*.,2007). These results were confirmed by (Madan and Sandhu, 1985) who mentioned that maximum bulb diameter was obtained.

Table 4. Effects of potassium on bulb length, bulb diameter and yield of onion

Potassium levels (kg/ha)	Bulb length (cm)	Bulb diameter (cm)	Individual bulb weight (g)	Yield (t/ha)
P_0	5.35	2.97	18.84	14.71
P_{30}	5.55	3.01	19.41	15.03
P_{60}	5.67	3.09	19.88	15.37
P_{90}	5.72	3.28	20.10	16.07
Level of significance	**	**	**	**
LSD	0.1588	0.104	0.794	0.517

3.5 Weight of single bulb of onion

Effect of nitrogen and potassium on the weight of single bulb was significant. In case of nitrogen treatment highest weight was given 26.28g of single bulb found in N_{150} treatment and lowest weight of bulb 13.22g produced by N_0 treatment (Table3). In K treating plot highest weight of single bulb20.10g found in K_{90} treatment and lowest weight of bulb 18.84gproduced by K_0 treatment (Table4).Nitrogen and potassium when treated combined highest weight 26.93g was obtained in $N_{150}K_{90}$ treatment, and lowest weight of bulb produced 12.94g by N_0K_0 treatment. The combined effect of nitrogen and potassium on the individual weight of onion bulb was non-significant (Table5). The bulb weight was higher with the application of nitrogen might be due to a higher synthesis of carbohydrate in leaves on their translocation to the bulb, which comparatively helped for increasing weight of onion bulb (Singh *et al.*,1991)

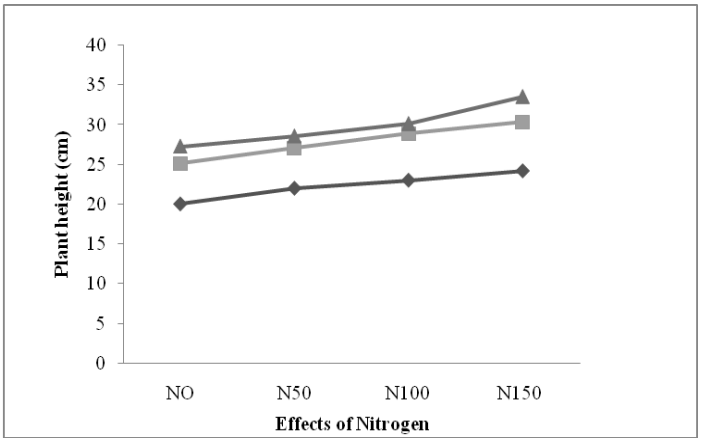

Figure 1. Effect of nitrogen on plant height of onion

Table 5. Combined effects of nitrogen and potassium on Bulb length, bulb diameter and yield characteristics of onion

Treatment combination	Bulb length (cm)	Bulb diameter (cm)	Individual bulb weight (g)	Yield (t/ha)
N_0K_0	4.33	2.39	12.94	12.33
N_0K_{30}	4.60	2.50	13.07	12.93
N_0K_{60}	5.00	2.53	13.37	13.36
N_0K_{90}	4.83	2.64	13.50	14.00
$N_{50}K_0$	5.12	2.74	15.37	14.27
$N_{50}K_{30}$	5.52	2.69	15.88	14.60
$N_{50}K_{60}$	5.53	2.74	16.33	14.96
$N_{50}K_{90}$	5.66	2.85	16.60	15.43
$N_{100}K_0$	5.73	3.15	21.83	15.60
$N_{100}K_{30}$	5.87	3.24	22.37	15.80
$N_{100}K_{60}$	5.93	3.24	23.20	16.10
$N_{100}K_{90}$	6.09	3.30	23.37	16.40
$N_{150}K_0$	6.21	3.60	25.23	16.63
$N_{150}K_{30}$	6.20	3.60	26.33	16.77
$N_{150}K_{60}$	6.21	3.83	26.63	17.07
$N_{150}K_{90}$	6.30	4.33	26.93	18.43
Level of significance	NS	**	NS	**
LSD	-	0.24	-	0.517

** = Significant at 1% level of probability * Significant at 5% level of probability

LSD= Least Significant Difference NS= Non significant

P_0 = 0 kg potassium per hectare P_{30} = 30 kg potassium per hectare

P_{60} = 60 kg potassium per hectare P_{90} = 90 kg potassium per hectare

N_0 = 0 kg nitrogen per hectare N_{50} = 50 kg nitrogen per hectare

N_{100} = 100 kg nitrogen per hectare N_{150} = 150 kg nitrogen per hectare

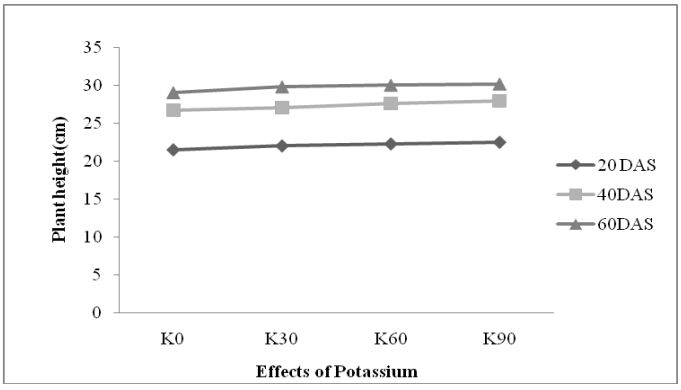

Figure 2. Effect of potassium on plant height of onion

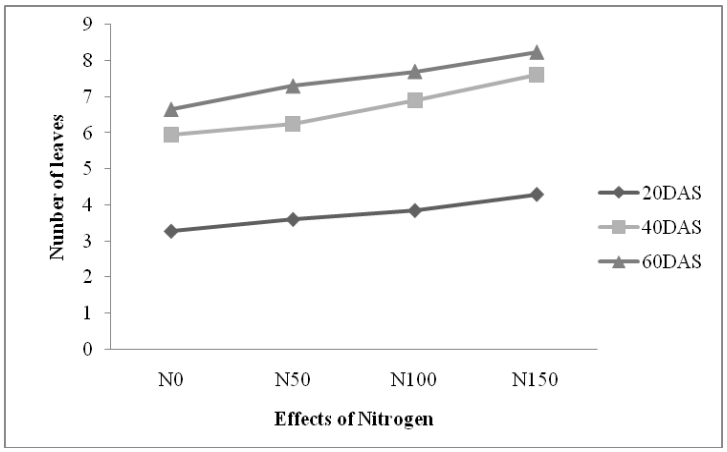

Figure 3. Effect of nitrogen on number of leaves per plant of the onion

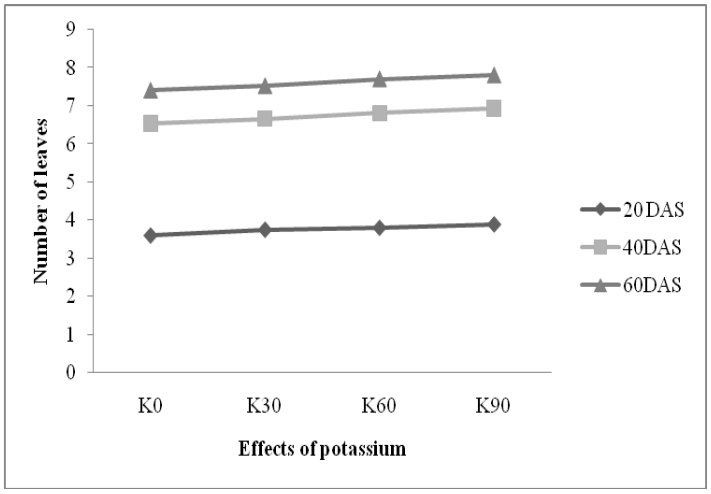

Figure 4. Effect of potassium on number of leaves per plant of the onion

3.6 Yield of the bulb in a hectare

Bulb yield was found significant variation due to the application of nitrogen and potassium. The yield of bulb was increased due to different nitrogen levels. In case of N_{150} treatment highest 17.22 ton per hectare bulb was produced lowest value found from N_0 treatment 13.15 ton/ha. (Table 3). At potassium treating field highest value was obtained 16.07 t/ha from K_{90} treated plot and lowest value 14.71 t/ha obtained from control treatment (Table 4).Interaction of nitrogen and potassium also effect significantly. In case of combined treatment $N_{150}K_{90}$ produce 18.43 ton per hectare onion bulb which is highest and lowest yield 12.33 t/ha was given by N_0K_0 treatment (Table 5) (Gaviola *et al*., 1998).

4. Conclusions

Growth and yield increased with increasing nitrogen and potassium application dose. The combined application of N and K increases the yield and quality of onion. Application of nitrogen at the rate of 150 kg/ha and potassium 90 kg/ha was the suitable combination which produced the highest yield of onion experiment.

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