Indian Journal of Agronomy **46** (4) : 742–746 (December 2001)

Influence of nitrogen and potassium application on growth, yield and nutrient uptake by onion (*Allium cepa*)

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Received : December 2000

ABSTRACT

A field experiment was conducted during spring season of 1996 and 1997 to study the influence of nitrogen and potassium on the onion (*Allium cepa* L.) cultivar 'Pusa Madhavi', at Indian Agricultural Research Insitute, New Delhi. The enhancement in dry weight of tops and bulbs was recorded up to 120 kg N/ha. Similarly, yield attributes like bulb diameter and 100-bulb weight also improved up to 120 kg N/ha. The average increase in bulb yield over the control was 18.3 and 29.6% with the application of 60 and 120 kg N/ha respectively. The onion bulb yield significantly responded to nitrogen application up to 120 kg/ha. There was significant increase in nitrogen uptake up to 120 kg N/ha and in potassium uptake up to 60 kg N/ha. Potassium application significantly increased the dry weight of tops and bulbs, bulb diameter, 100-bulb weight and bulb yield up to 40 kg K_2O/ha. The potassium uptake enhanced up to 80 kg K_2O/ha application during both the years and nitrogen uptake was affected significantly only in the second year.

Key words : Onion, Nitrogen, Potassium, Bulb yield, Nutrient uptake

Onion is one of the most commercially valuable crops of India. Although India ranks first among the major onion-growing countries of the world, its productivity is very low (106.7 q/ha) compared to its productivity in other countries. The productivity of onion can be enhanced through the adoption of improved agronomic technologies and balanced use of fertilizers is one of them. Onion removes 73 kg N, 36 kg P_2O_5 and 68 kg K_2O/ha for producing 30 tonnes of bulbs (Sharma and Rana, 1993). The onion responds to nitrogen application up to 40 kg N/ha (Shukla *et al.* 1992), 75 kg N/ha (Kumar and Sharma, 1991), 90 kg N/ha (Patel and Patel, 1990) and 150 kg N/ha (Vachhani and Patel, 1993). Potassium also plays an important role in the production of bulbous crops like onion. Vachhani and Patel (1993) reported the response to potassium application not beyond 50 kg K_2O/ha. Keeping these factors in consideration, the present investigation was undertaken to find out the optimum levels of nitrogen and potassium for onion (*Allium cepa* L.) under the conditions of Delhi.

MATERIALS AND METHODS

The field experiment was conducted during the spring season of 1996 and 1997 on sandy-loam soil of the research farm of Division of Agronomy, Indian Agricultural Research Institute, New Delhi. The surface soil layer of the experimental field had organic carbon 0.41%, total N 238 kg/ha, available P 13.4 kg/ha and available K_2O_5 kg/ha. The mean monthly minimum and maximum temperature during the crop season varied from 10.1 to 23.8°C and 23.7 to 39.7°C in 1996; and 7.75 to 23.2°C and 23.6 to 37.9°C in 1997 respectively. The rainfall of 19.8 and 25.4 mm was received during crop season in 1996 and 1997 respectively. The treatment combinations of 3 levels of each N (0, 60 and 120 kg/ha) and potassium (0, 40 and 80 kg K_2O/ha), were replicated 4 times in randomized-block design. During 1996, only 2 levels of potassium (40 and 80 kg K_2O/ha) were taken with all 3 nitrogen levels.

Seedlings of 20 days 'Pusa Madhavi' onion were transplanted on 8 February 1996 and 29 January 1997 at a spacing of 15 cm × 10 cm. The crop received basal dose of 22 kg P/ha. The crop was harvested on 27 May 1996 and 5 June 1997.

After recording the height and number of leaves from 5 plants, the top and bulb samples of these plants of onion were collected at 90 days after transplanting. These samples were dried at 70°C in oven, till a constant weight is obtained for the determination of dry-matter accumulation. These dried samples were also used for the estimation of N and K contents. The nutrient uptake was computed as:

Nutrient uptake = % nutrient content × yield/100

Ten bulbs were selected randomly from each plot at harvest stage for observing the yield attributes, viz. bulb diameter and 100-bulb weight.

RESULTS AND DISCUSSION

Dry-matter accumulation in tops

Nitrogen application had significant effect on dry/matter accumulation in tops in

Table 1. Influence of nitrogen and potassium application on growth parameters of onion

Treatments	Plant height (cm)		Leaves/ plant		Dry-matter accumulation (g/plant)			
					Tops		Bulbs	
	1996	1997	1996	1997	1996	1997	1996	1997
Nitrogen (kg/ha)								
0	22.7	21.5	5.7	4.6	2.65	2.01	3.70	2.28
60	23.8	23.6	6.4	5.8	2.98	2.71	4.65	3.81
120	24.4	24.2	6.6	6.3	3.11	2.94	5.21	4.31
CD (P=0.05)	11.5	1.8	0.7	0.5	NS	0.23	0.40	0.39
Potassium (kg K_2O/ha)								
0		21.0		4.4		1.92		2.19
40	23.0	23.7	6.2	6.0	2.88	2.79	4.45	3.95
80	24.3	23.9	6.3	6.3	2.95	2.95	4.59	4.26
CD (P=0.05)	NS	1.8	NS	0.5	NS	0.23	NS	0.39

1997 only (Table 1). The dry weight of tops/plant enhanced markedly with each increment of N level from 0 to 120 kg/ha. The increase in dry matter in tops/plant at higher N levels can be attributed to the reason that increa- sed N level recorded higher vegetative growth in terms of plant height and leaves/plant (Table 1). The potassium application of 40 kg/ha increased dry matter in tops over the control in 1997, whereas dry-matter accumulation at 40 and 80 kg K_2O/ha remained similar during both the years.

Dry-matter accumulation in bulbs

The influence of N on dry-matter accumulation in bulbs was significant during both the years. The increase in N level from 0 to 60 and 60 to 120 kg/ha recorded marked increase in dry weight of bulbs. This increase in dry weight of bulb at higher N doses might to due to efficient translocation of photosynthates to bulbs and thereby an increase in bulb diameter at higher N dose. The results confirm the findings of Patel and Vachhani (1994). With regards to the effect of K, dry weight of bulbs/plant appreciably increased up to 40 kg K_2O/ha in 1997. The application of 80 kg K_2O/ha did not show the significant increase in bulb weight over 40 kg K_2O/ha during both the years.

Yield attributes

The diameter of bulb and 100-bulb weight were influenced significantly by N during both the years (Table 2). Each successive increase in N from 0 to 120 kg/ha increased the bulb diameter and 100-bulb weight. Dry-matter production and translocation of photosynthates contributed to the swelling of bulbs which resulted in increased diameter and weight of bulbs at higher N level. Mehla *et al.* (1996) also reported similar findings. The potassium 40 kg K_2O/ha recorded statistically higher bulb diameter and 100-bulb weight than 0 kg/ha in 1997. However, the onion in respect of bulb diameter and 100-bulb weight did not respond markedly to 80 kg K_2O/ha than 40

Table 2. Influenced of nitrogen and potassium application on yield attributes and bulb yield of onion

Treatment	Bulb diameter (cm)		100-bulb weight (kg)		Bulb yield (q/ha)	
	1996	1997	1996	1997	1996	1997
Nitrogen (kg/ha)						
0	5.01	4.48	4.60	4.41	281.6	229.1
60	5.60	4.89	5.81	5.57	315.5	285.2
120	5.75	5.10	6.30	6.10	336.8	319.9
CD (P=0.05)	0.11	0.20	0.44	0.42	21.1	22.5
Potassium (kg K_2O/ha)						
0		4.33		4.40		215.5
40	5.42	4.99	5.43	5.71	306.1	303.1
80	5.48	5.15	5.71	5.97	316.5	316.0
CD (P=0.05)	0.09	0.20	NS	0.42	NS	22.5

kg K_2O/ha during both the years. It confirms that results of Patel and Vachhani (1994).

Bulb yield

The bulb yield was influenced significantly by the application N during both the years (Table 2). In general, the increase in bulb yield due to application of 60 and 120 kg N/ha was 12.07 and 19.60% in 1996 and 24.49 and 39.63% in 1997 over the control respectively. These increases in yield of bulbs were at the significance level. Increased N level enhanced the dry-matter weight, bulb diameter and 100-bulb weight, which consequently raised the bulb yield of onion at higher N level. The results of Mehla *et al.* (1996) were in close conformity to these findings. The significant effect of K application on bulb yield was observed in 1997 only. In general, the increase in the bulb yield was 40.64 and 46.63% due to 40 and 80 kg K_2O/ha over the control in 1997. The bulb yield increased significantly up to application of 40 kg K_2O/ha. However, the difference between the bulb yield at 40 and 80 kg K_2O/ha was not at the significance level during both the years. It confirms the findings of Patel and Vachhani (1994).

Nitrogen uptake

The uptake of N in the tops and bulbs of onion was influenced significantly (Table 3). The uptake of N in tops land bulbs imporved appreciably with each successive increment in N from 0 to 120 kg/ha during both the years. Potassium level showed the significant changes in N uptake in tops and bulbs in 1997 only (Table 3). The marked increase in N uptake in both tops and bulbs was observed up to 40 kg K_2O/ha and the further increase to 80 kg K_2O/ha enhanced the N uptake by bulbs in 1997 only. In

Table 3. Influence of nitrogen and potassium application on the uptake of nitrogen and potassium by onion

Treatment	N uptake (kg/ha)				P uptake (kg K_2O/ha)			
	1996		1997		1996		1997	
	Tops	Bulbs	Tops	Bulbs	Tops	Bulbs	Tops	Bulbs
Nitrogen (kg N/ha)								
0	12.40	46.36	10.80	39.29	16.75	70.80	14.48	60.02
60	15.12	51.33	12.76	46.68	20.21	77.73	17.00	72.02
120	16.83	54.08	14.41	50.70	21.91	81.56	18.80	77.56
CD (P=0.05)	1.60	2.61	1.58	2.58	2.00	4.01	1.83	4.72
Potassium (kg K_2O/ha)								
0			10.79	38.70			14.43	59.04
40	14.36	49.71	13.23	46.90	19.30	75.48	17.60	72.09
80	15.20	51.47	13.89	50.97	19.94	77.91	18.24	79.41
CD (P=0.050	NS	1.81	1.58	2.58	NS	2.33	1.83	4.72

1996, the differences in N uptake by tops and bulbs between 40 and 80 kg K_2O/ha were not significant. Patel and Vachhani (1994) also found the higher N content in bulbs at higher N levels.

Potassium uptake

The K uptake in tops and bulbs was influenced significantly (Table 3). An application of 60 kg N/ha recorded the marked increase in K uptake by tops and bulbs over 0 kg/ha. Further increase in N beyond 60 kg/ha did not increase the K uptake significantly during both the years except K uptake by bulbs in 1997, where the increase was recorded up to 120 kg N/ha. Regarding the effect of K level on K uptake by bulbs, the marked increase was recorded with each successive increase in K up to 80 kg K_2O/ha during both the years. The K uptake by tops was markedly improved up to 40 kg K_2O/ha during 1997 only. Higher K content in bulb was also recorded earlier due to K fertilization by Patel and Vachhani (1994).

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