

Effect of Nitrogen and Potassium Levels on Growth and Yield of Potato (*Solanum tuberosum* L.) Under Indo-Gangetic Plain Zone of Bihar

Shantanu Kumar, Dharmendra Kumar Dwivedi,
 Ravikant Kumar, Nitish Kumar

Received 4 March 2016; Accepted 7 April 2016; Published online 29 April 2016

Abstract A field experiment was conducted on sandy loam soil during *rabi* season of 2014-15 to study the effect of three levels of nitrogen (75, 150, 225 kg/ha) and four levels of potassium (50, 100, 150 and 200 kg/ha) on growth attributes, tuber yield and tuber population of potato. Tuber yield was significantly increased with increased N and K application. Maximum tuber yield was recorded under treatment with 225 kg N/ha and 200 kg K₂O/ha (30.45 t/ha) which at par to treatment with 225 kg N/ha and 150 kg N/ha (30.21 t/ha) and minimum tuber yield of 12.31 t/ha was recorded under control plot (N₀K₀). Tuber size was also influenced by increasing potassium levels under all potato grades i.e. 25-50g, 50-75g and >75 g.

Keywords Nitrogen, Potassium, Growth attributes, Yield.

Introduction

Potato production depends on many factors, among them judicious application of N and K plays vital role. Nitrogen is first limiting nutrient in potato production that greatly influences crop growth and tuber yield. A mature crop of potato yielding 25-30 t/ha removes 120-140 kg N/ha [1]. Nitrogen is an essential constituent of various amino acids, proteins, nucleic acids, enzymes and play important role in plant metabolism. Therefore, application of N in the form of fertilizers becomes indispensable to meet nitrogen requirement of crop. In contrast to N, potassium application has been neglected by majority of farmers in our country resulting in continual depletion of soil K. Although, potassium is also known as “Quality element” because of influence on size, shape, texture of potato. Potassium removal from crop is also high. Potato often acts as indicator crop for potassium deficiency and it play a important role in enzyme activation, water regulation, translocation of assimilates, protein and starch synthesis [2]. Keeping in view the significance of nitrogen and potassium on productivity of potato, experiment was conducted to study the effect of nitrogen and potassium levels on potato yield and economics.

Materials and Methods

A field experiment was conducted on sandy loam soil of TCA, Dholi farm during *rabi* season of 2014-15.

S. Kumar^{1*}, D. K. Dwivedi², R. Kumar¹, N. Kumar¹
¹MSc (Ag), Agronomy, ²Sr Scientist & Associate Professor
 Department of Agronomy, R. A. U, Pusa, Samastipur 848125,
 Bihar, India
 e-mail : shantanusingh416@gmail.com
 ravikant.kumar96@gmail.com
 nitish.urs@gmail.com
 dkdagro@rediffmail.com

*Correspondence

The experiment was laid out in randomized block design with three replications and thirteen treatments. Three levels of nitrogen (75, 150 and 225 kg N/ha) and four levels of potassium (50, 100, 150 and 200 kg K₂O/ha) were in all combination to make up all thirteen treatments along with an absolute control treatment in which no fertilizers were used. Phosphorus was used as per recommended dosage i.e. 90 kg P₂O₅/ha for all treatments except control plot. Nitrogen was supplied through use of urea in three split applications 50% basal + 25% at 30 DAP + 25% at 60 DAP and potassium and phosphorus were supplied by using fertilizer muriel of potash and di-ammonium phosphate as basal application. The soil of experimental plot was alkaline in reaction having a pH of 8.32, low in organic carbon content 0.47%, available nitrogen 207 kg N/ha, available K₂O 18.52 kg K₂O/ha and available P₂O₅ 107.74 kg/ha. Well sprouted tuber of potato cv *Kufri Ashoka* of uniform size weighing 30-40g were planted during second week of November. Tuber was covered with 10-12 cm soil layers after planting. Dehauling was practiced in all plots at 80 DAS and crop was harvested at 08-10 days after dehauling. The observations on growth and yield were recorded following the standard procedures. Yield parameters, aggregate and grade-wise tuber yield and tuber numbers of all grades namely very small (<25 g), small (25-50g), medium (50-75g) and large (>75g) size tubers were recorded separately at

harvest.

Results and Discussion

Growth parameters

Plant emergence (%) was not influenced by different nitrogen and potassium levels. Percent plant emergence ranged from 93.02 to 98.07%. Application of nitrogen and potassium has significant effect on plant height, number of leaves per plant and LAI at different growth stages. Increased N and K₂O levels promoted plant height, increased the number of leaves per plant and consequently LAI at different growth stages as compared to control (00 kg N/ha + 00 kg K₂O/ha). Highest plant height, maximum number of leaves, LAI was recorded under treatment with highest level of N and K₂O. i.e. treatment T₁₃ and it was at par with treatment T₁₂ (Table 1).

This might be due to effect of nitrogen on promoting growth to enhanced synthesis of protein, amino acids and enzymes which are responsible for cell division and cell elongation. Potassium also plays important role in tissue water relationship, aids in photosynthesis resulting in better foliage growth [3].

Tuber yield and tuber population

Nitrogen and potassium application had significant

Table 1. Effect of different treatments on growth parameters and yield attributing characters.

Treatments	Plant emergence (%)	Plant height (cm)	Shoots/plant (No.)	Leaves/plant (No.)	Leaf area index		Bulking rate		Dry matter accumulation (g/plant)
					At 60 DAP	At 75 DAP	At 60-75 DAS	At 75-harvest	
T ₁ = N ₀ +K ₀	93.02	31.42	3.07	28.87	1.98	2.21	3.95	1.22	47.63
T ₂ =N ₇₅ +K ₅₀	93.40	32.36	3.22	30.05	2.41	2.49	4.92	1.69	52.27
T ₃ =N ₇₅ +K ₁₀₀	93.80	34.27	3.59	31.90	2.53	2.54	5.10	1.75	52.85
T ₄ =N ₇₅ +K ₁₅₀	93.56	35.68	3.78	33.40	2.59	2.65	5.54	1.78	53.71
T ₅ =N ₇₅ +K ₂₀₀	92.67	37.99	3.90	34.19	2.60	2.74	5.77	1.83	55.11
T ₆ =N ₁₅₀ +K ₅₀	93.88	39.04	4.10	35.53	2.67	2.93	7.03	1.87	59.94
T ₇ =N ₁₅₀ +K ₁₀₀	93.19	39.10	4.63	36.07	2.70	3.01	7.25	1.93	60.67
T ₈ =N ₁₅₀ +K ₁₅₀	94.62	39.78	4.97	36.98	2.89	3.09	7.49	2.01	61.95
T ₉ =N ₁₅₀ +K ₂₀₀	96.57	40.47	5.11	37.41	3.09	3.45	7.76	2.12	63.04
T ₁₀ =N ₂₂₅ +K ₅₀	95.84	41.25	5.85	38.15	3.23	3.77	8.87	2.31	68.88
T ₁₁ =N ₂₂₅ +K ₁₀₀	96.87	41.52	5.90	39.00	3.61	4.01	8.92	2.39	69.74
T ₁₂ =N ₂₂₅ +K ₁₅₀	97.65	42.09	6.25	41.10	3.73	4.13	9.09	2.54	71.65
T ₁₃ =N ₂₂₅ +K ₂₀₀	98.07	44.16	6.37	41.55	3.99	4.47	9.27	2.68	72.86
SEM ±	1.80	1.72	0.16	0.87	0.05	0.09	0.11	0.04	0.43
CD (p = 0.05)	NS	5.05	NS	2.56	0.14	0.28	0.33	0.12	1.27

Table 2. Effect of different treatments on grade-wise tuber yield (t/ha) and tuber number (per plant) of potato.

Treatments	Grade-wise tuber yield (t/ha)				Total fresh tuber yield (t/ha)	Grade wise number of tubers per plant				Total number of tubers /plant (No.)	Harvest index (%)
	<25g	25-50g	50-75g	>75g		<25g	25-50g	50-75g	>75g		
T ₁ =N ₀ +K ₀	4.29	2.93	2.53	2.56	12.31	2.61	1.40	1.21	0.78	6.00	59.18
T ₂ =N ₇₅ +K ₅₀	4.27	3.54	4.39	4.15	16.35	2.34	1.94	2.16	1.10	7.54	61.98
T ₃ =N ₇₅ +K ₁₀₀	3.94	4.00	4.98	4.93	17.85	2.36	2.10	2.32	1.22	8.00	63.24
T ₄ =N ₇₅ +K ₁₅₀	4.09	4.09	5.28	5.45	18.91	2.41	2.33	2.48	1.34	8.56	64.28
T ₅ =N ₇₅ +K ₂₀₀	4.26	4.22	5.45	5.59	19.52	2.40	2.51	2.78	1.51	9.20	64.91
T ₆ =N ₁₅₀ +K ₅₀	3.77	5.74	6.39	6.75	22.65	2.29	2.97	3.21	2.05	10.52	65.64
T ₇ =N ₁₅₀ +K ₁₀₀	3.64	6.17	6.91	7.49	24.31	2.23	3.08	3.30	2.29	10.90	66.51
T ₈ =N ₁₅₀ +K ₁₅₀	3.71	6.22	7.53	7.51	24.97	2.11	3.26	3.38	2.41	11.16	66.99
T ₉ =N ₁₅₀ +K ₂₀₀	3.75	6.31	7.75	7.63	25.44	2.09	3.42	3.44	2.55	11.50	67.43
T ₁₀ =N ₂₂₅ +K ₅₀	3.34	6.70	8.41	7.68	26.13	2.02	3.51	3.72	3.00	12.25	67.53
T ₁₁ =N ₂₂₅ +K ₁₀₀	3.31	6.95	8.85	8.41	27.52	1.94	3.59	3.79	3.07	12.39	68.48
T ₁₂ =N ₂₂₅ +K ₁₅₀	3.30	8.14	9.48	9.29	30.21	1.92	3.64	3.86	3.12	12.54	70.15
T ₁₃ =N ₂₂₅ +K ₂₀₀	3.34	8.19	9.57	9.35	30.45	1.91	3.73	3.98	3.15	12.77	70.31
SEM ±	0.24	0.41	0.24	0.32	0.79	0.06	0.07	0.06	0.04	0.05	0.58
CD (p=0.05)	NS	1.21	0.69	0.92	2.32	0.17	0.21	0.19	0.12	0.17	1.70

effect on gradewise tuber yield, tuber yield as well as total tuber yield and tuber number (Table 2). The tuber yield increased with increasing levels of nitrogen and potassium. Potato yield was 12.31 t/ha with treatment combination N₀K₀ and 30.45 t/ha with best treatment.

Similarly number of tubers of different grades also increased significantly except for <25g grade size tuber. However higher tuber yield and tuber number was recorded at Nitrogen 225 kg/ha and 200 kg/ha of potassium, which was significantly higher than all treatments except T₁₁ (Table 2).

Nitrogen contributes to the yield by increasing number of tubers and potassium by increasing size of tubers [4]. Similarly Moinuddin et al. [5] also observed increase in potato tuber yield due to potassium application upto 120 kg/ha. It might be due to contribution of potassium to photosynthesis, phloem loading and translocation as well as due stimulating effect of nitrogen on amino acids and protein synthesis [5].

The harvest index increases with increase in nitrogen and potassium levels and was recorded highest under treatment T₁₃-70.31%, which was at par to T₁₂-70.15% and minimum was recorded under control plot (Table 2). Kavvadias et al. [6] also reported increase in harvest index with nitrogen and potassium application over control.

Conclusion

On the basis of experiment result it can be concluded that application of 225 kg N/ha along with 200 kg K₂O/ha can give maximum tuber yield.

References

1. Patel JC, Patel LR (2001) Effect of irrigation and nitrogen on yield attributes in potato. J Ind Potato Assoc 28 : 285—295.
2. Sharma KA, Kumar V (2014) Effect of varying levels of nitrogen and plant density on the production behavior of undersize seed tubers of potato (*Solanum tuberosum*) in north-western hills of India. Ind J Agric Sci 84 : 407—410.
3. Singh SK, Lal SS (2012) Effect of potassium nutrition on potato yield, quality and nutrient use efficiency under varied levels of nitrogen application. Potato J 39 : 155—165.
4. Trehan SP, Kumar P, Singh BP, Rawal S, Khan MA (2008) Precising nitrogen requirement of table potato (*Solanum tuberosum* L.) cultivars for different growth periods. Ind J Agron 53 : 314—317
5. Moinuddin K, Singh Komal, Bansal SK (2005) Influence of graded levels of potassium fertilizer on growth, yield and economic parameters of potato. J Pl Nutr 27 : 239—259.
6. Kavvadias V, Paschalidis C, Akrivos G, Petropoulos D (2012) Nitrogen and potassium fertilization responses of potato (*Solanum tuberosum*) cv Spunta. Commun in Soil Sci and Plant Analysis 43 : 176—189.