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Effect of different doses of potassium for maximized potato production

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Abstract: Experiments were carried out at BINA substation, Comilla and farmer's field, Kaonia, Rangpur during 2003-2004 and 2004-2005 to evaluate the effect of different level K on the yield of potato. The experiments were laid out in a randomized complete block design with five treatments in three replications. The treatment combinations were T_1: K_0, T_2: K_{30}, T_3: K_{60}, T_4: K_{90}, T_5: K_{120}, and T_1: K_0, T_2: K_{24}, T_3: K_{48}, T_4: K_{72}, T_5: K_{96} respectively. The average tuber yield of potato varied from 15.62 to 24.70 t ha^{-1} and the highest yield recorded in the treatment T_5; while lowest in T_1 (control) in Comilla. On the other hand, the average tuber yield of potato ranged from 19.74 to 27.73 t ha^{-1} in Rangpur with the maximum yield observed in T_5 treatment and minimum in control (T_1). In both the locations N, P, K and S uptake by tuber were highest in T_5 and the lowest in T_1 treatment. The highest gross margin of Tk. 83,644 $ha^{-1}$and Tk. 1,31,149 ha^{-1} were obtained in treatment T_5 at Comilla and Rangpur, respectively.
Key words: Potassium, Potato, Soil

Introduction

Potato (*Solanum tuberosum L.*), a member of Solanaceae is one of the most important tuber crops grown widely and intensively all over the world. It is not only a cash crop but also a substitute of food crop next to rice and wheat in Bangladesh. Potato occupied first position in both acreage and production among the vegetable crops grown in Bangladesh (BBS, 2007). The average yield of potato is 12.6 t/ha which is very low compared to other potato growing countries in the world. The main production constraint has been thought to be inadequate and improper fertilization. This is particularly more important in case of potassium because among the three fertilizer nutrients potato has high K demands but unfortunately K fertilization to potato receive very little attention. The deficiency of one element stimulates the absorption of another, which in turn has an unfavorable effect on growth and development of crop plants. For example, a deficiency of K enhances increased absorption of Mg which may become toxic to the plant. On the other hand, application of excess amount of Muriates of Potash (KCI) may led to an excessive accumulation of chloride, which reduces potato yield (Bhattacharyya, 2000). Generally hill, terrace, piedmont and old alluvial soils are predominately deficient in K and are likely to exhibit significant response to K application. On the other hand, increased use of N and P fertilizers due to intensive cultivation are gradually turning K as a limiting factor in such areas which were so far been known as high K zone. So for assessing the response of potato to added K, the recommendation based on soil tests should be taken into account. The present piece of research was conducted to determine the optimum and profitable dose of K fertilizer for potato production at varied K levels soil.

Materials and Methods

The experiments were conducted with potato *var. Diamond* in Rabi season during the period from 4th week of November to 4th week of March 2003-2004 and 2004-2005 for two years at BINA substation, Comilla and farmer's field, Kaonia, Rangpur simultaneously to assess the response of potato as a test crop to added K. The analytical results of initial soil samples are presented in Table1. Fertilizers were applied as soil test basis. The experiments were laid out in a randomized complete block design with five treatments including K control and each replicated thrice. Treatments for comilla location (K deficient soil) were T_1 : Without K + Full dose of NPSZn, T_2: 25% of estimated K (30 kg K) + Full dose of NPSZn , T_3: 50% of estimated K (60 kg K) + Full dose of NPSZn, T_4: 75% of estimated K (90 kg K) + Full dose of NPSZn, T_5: 100% of estimated K (120 kg K) + Full dose of NPSZn and treatments for Rangpur site (medium k level soil) were T_1 : Without K + Full dose of NPSZn, T_2: 25% of estimated K (24 kg K) + Full dose of NPSZn , T_3: 50% of estimated K (48 kg K) + Full dose of NPSZn, T_4: 75% of estimated K (72 kg K) + Full dose of NPSZn, T_5: 100% of estimated K (96 kg K) + Full dose of NPSZn. All fertilizers except N were applied at the time of final land preparation. Nitrogen fertilizer was applied in two equal splits. A blanket doses of fertilizer $N_{130} P_{10} S_{15} Zn_3$ and $N_{130} P_{25} S_{15} Zn_3 B_1$ kg/ha was applied at Comilla and Rangpur sites respectively. In both locations the seed rate of potato was 2000 kg/ha. The seeds of potato were sown in 4th week of November and harvested in 4th week of March. Irrigation and intercultural operations were done as and when necessary.

Table 1. Initial soil nutrient status of the experimental sites

Location	P^H	OM (%)	Total N (%)	Available nutrients (ppm)				Exchangeable cations (meq %)		
				P	S	Zn	B	K	Ca	Mg
Farmer's field, Kaonia, Rangpur	5.9	1.20	0.11	14	15	2.00	0.15	0.15	1.40	1.12
Interpretation	Acidic	Low	Low	Low	Low	High	Very low	Low	Low	Optimum
BINA substation,Comilla	6.0	1.07	0.10	25	14	1.50	1.00	0.10	3.74	0.93
Interpretation	Acidic	Low	Low	Optimum	Low	Optimum	Very high	Low	Medium	Medium

Results and Discussion

Tuber yield: Tuber yield significantly increased with increase of potassium levels up to its highest rate (120 kg/ha) in both years in low K level soils of Comilla (Table 2). At Rangpur, tuber yield significantly increased up to 72 kg K/ha in 2003-04 while in 2004-05 yield increased with the increase of highest level of K tested (Table 2). The average highest tuber yield was obtained with the highest level of K application (96 kg K/ha) at Rangpur. The findings of Zakir *et al.* (2001) also recorded similar yield when used different level of K in Bangladesh Agricultural University campus field, Mymensingh. Tuber yield was increased linearly in both locations.

Table 2. Effect of different levels of potassium on tuber yield (t/ha) of potato

BINA substation, Comilla				Farmer's field, Kaonia, Rangpur			
K dose (kg/ha)	2003-04	2004-05	Mean	K dose(kg/ha)	2003-04	2004-05	Mean
0	16.10e	15.13e	15.62	0	14.48d	24.99d	19.74
30	19.70d	17.58d	18.64	24	17.43c	27.28cd	22.36
60	21.39c	19.85c	20.62	48	19.12b	29.50bc	24.31
90	24.22b	22.64b	23.43	72	22.28a	30.22b	26.25
120	25.54a	23.85a	24.70	96	21.88a	33.58a	27.73
A blanket doses of $N_{130} P_{10} S_{15} Zn_3$ kg/ha were applied				A blanket doses of $N_{130} P_{25} S_{15} Zn_3 B_1$ kg/ha were applied			

Table 3. Nutrient uptake (kg/ha) by potato as affected by different levels of potassium

Potassium rate (kg/ha)	BINA substation, Comilla				Potassium rate (kg/ha)	Farmer's field, Kaonia, Rangpur			
	N	P	K	S		N	P	K	S
0	171	34	138	20	0	164	49	90	17
30	248	59	221	26	24	219	53	162	22
60	314	56	292	29	48	274	55	238	25
90	443	53	378	35	72	397	51	339	29
120	483	50	445	38	96	398	58	385	29

Table 4. Cost and return analysis for potato

Treatment	Gross return (Tk./ha)	Variable Cost(Tk./ha)	Gross margin (Tk./ha)	Marginal gross margin (Tk./ha)	Marginal Variable Cost (Tk./ha)	MBCR
BINA substation, Comilla						
T1	75650	33266	42382	-	-	-
T2	87900	33806	54094	11712	540	21.68
T3	99250	34406	64844	22462	1140	19.70
T4	113200	35006	78194	35812	1740	20.58
T5	119250	35606	83644	41262	2340	17.63
Farmer’s field, Kaonia, Rangpur						
T1	124950	34831	90119	-	-	-
T2	136400	35311	101089	10970	480	22.85
T3	147500	35791	111709	21590	960	22.49
T4	151100	36271	114829	24710	1440	17.16
T5	167900	36751	131149	41030	1920	21.37

Price of N as urea = Tk. 14.0/kg, P as TSP = Tk.77.0/kg, K as MP = Tk. 18.0/kg, S as gyupsum = Tk. 2.0/kg, Potato seed = Tk. 20.0/kg, Price of potato tuber = Tk. 10,000.0/t, Labour wage= Tk. 70.0/day

Nutrient uptake: The amounts of N, P, K and S uptake by potato as affected by different rates of potassium are presented in Table 3. Nutrients uptake increased with increase of yield. Potassium application remarkably increased uptake of potassium and other nutrients in both test locations. Almost similar information was made by Taya *et al.* (1994). The uptake ranges from N (171-483), P (34-59), K (138-445), S (20-38), at Comilla and N (164-398), P (49-58), K (90-385), S (17-29) at Rangpur respectively.

Cost and return analysis of fertilizer use: Economics of fertilizer uses have been calculated on the total products of two locations following partial budget analysis and marginal analysis as described by Perrin *et al*. (1979). In Comilla, result demonstrated that the highest gross margin of Tk. 83,644/ha was obtained in treatment T_5 followed by Tk. 78,194/ha in T_4 (Table 4). Another attempt has been made to find out the marginal benefit cost ratio (MBCR) of the treatments (Table 4). The highest MBCR (21.68) was obtained in T_4 followed by 19.70 and 20.58 in T_3 and T_5 treatments. In Rangpur, the highest gross return of Tk. 1,31,149/ha was obtained in treatment T_5 followed by Tk. 1,14,829/ha in T_4 and Tk. 1,11,709/ha in T_3 respectively (Table 4). The highest MBCR (22.85) was obtained in T_2 followed by 22.49 in T_3 and 21.37 in T_5 treatments.

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