NUTRIENT UPTAKE BY POTATO IN HUMID SUB-TROPICAL CONDITION OF CHITWAN

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ABSTRACT

A field study was conducted on sandy loam soil of humid sub-tropical condition at Rampur, Chitwan, Nepal during November 1999 to February 2000 to assess the response of potato cultivars, Kufri Sinduri and Desire to different levels of N, P and K with respect to nutrient uptake at different stages of growth and development. Distinct difference was marked in N, P and K uptake by tubers between cultivars. The uptake of NPK nutrients by tubers was increased up to 90 days after planting (DAP) in Kufri Sinduri whereas it was only up to 75 DAP in Desire. The N, P and K-uptake by haulms and tubers of Kufri Sinduri were significantly higher to Desire at different growth stages. Response of potato crop to different levels of NPK in respect to their uptake by haulms and tubers was observed up to 75 DAP in both cultivars. At this stage the accumulation of nitrogen in haulms and tubers was significantly higher at 100:75:50 kg NPK ha^{-1} compared to the lowest dose (50:50:50) of NPK. Significantly higher amount of P uptake by haulms and tubers was obtained at the same treatment and growth stage (75 DAP) of potato crop compared to the control. At this stage application of N, P and K at the rate of 100:100:100 kg NPK ha^{-1} increased the potassium uptake by haulms significantly as compared to that of minimum level of 50:50:50 kg NPK ha^{-1} treatment. But in case of tubers it was at 100:75:50 kg NPK ha^{-1}. This indicates the need of NPK nutrients throughout the growing period of potato crop.

Key words: Desire, haulms, Kufri Sinduri, NPK uptake, tubers

INTRODUCTION

Nutrient concentration and assimilation by plants are the results of total plant growth rates and nutrient availabilities (Westermann and Kleinkopf, 1985). Plant nutrients are important components of the intensive potato production system (Westermann and Davis, 1992). Several studies described the relationship between fertilizer applications, nutrient concentrations in different parts of potato plant and tuber yield (Rykbost *et al.*, 1993; Chaurasia and Singh 1995; Krishnappa and Gowda, 1988). Nitrogen, phosphorus and potassium are the major plant nutrients that play an important role in the potato production. Nitrogen plays a regulatory role in promoting cell elongation and vegetative growth, crop duration and quality of tubers (Dubetz and Bole, 1975; Kleinkopf *et al.*, 1981; Chaurasia and Singh, 1995) whereas P is involved in root cell division and elongation (Sharma, 1992). Plants require potassium for the translocation of sugar and synthesis of starch (Rhue *et al.*, 1986)

Yield in potato is influenced by cultivar and NPK availability (Morena *et al.*, 1994). The uptake of nutrients depends on many factors like cultivars, soil type, fertility status, geographical location, length of growing period and other environmental factors (Sharma *et al.*, 1978; Singh and Grewal, 1979). Nutrient concentrations in the plants generally change with

their age (Westermann et al., 1994). The uptake of N, P and K by potato plants was found to increase significantly with the increase in the application of nutrients (Sharma and Sharma, 1989). Optimum NPK requirements of potato are not well established, especially for the humid sub-tropical sandy loam soil belt of Chitwan, Nepal. Information about the uptake of nutrients (N, P and K) by specific cultivar of potato is also insufficient. Therefore the experiment was conducted on Kufri Sindhuri and Desire to study the nutrient uptake and their agronomic performances under sub tropical humid condition of Chitwan with different levels of major nutrients (NPK).

MATERIALS AND METHODS

The released cultivars namely; Desire and Kufri Sinduri were selected for the studies. Seven nutrient combinations were 0:0:0, 50:50:50, 100:50:50, 100:75:50, 100:75:100, 100:100:100 and 150:100:100 kg ha of N: P_2O_5: K_2O. Cultivars were treated as main plot and nutrient levels as sub plot in the trial. The experiment was conducted at Horticulture Farm, Institute of Agriculture and Animal Science, Rampur, Chitwan during November 1999 to February 2000 in a split plot design with four replications. The area of sub plot was 10.5 m^2 (4.2 m x 2.5 m) with seven rows and 10 plants in each row. Half dose of N and full dose of P and K were applied in furrows and mixed thoroughly in the soil at planting time. The remaining half dose of N was applied at the time of earthing up i.e. after 5 weeks of planting. The sources of fertilizers were diammonium phosphate, urea and muriate of potash. Disease free tubers of Kufri Sinduri and Desire weighing approximately 40-50 g were planted as a seed maintaining plant-to-plant distance of 25 cm and row-to-row distance of 60 cm.

The crop was irrigated after 45 days of planting through furrow method. Two sprays of Moncozeb (Dithane M-45) and one spray of Metalaxyl (Krilaxyl) were alternatively used to control the late blight disease during first fortnight of January when the environment was conducive for late blight pathogens. Weeding, earthing up and other cultural practices were carried out as per the recommendations. The cultivars, Desire, and Kufri Sinduri were harvested on Feb 3 and 28 of 2000, respectively. The outer most two rows in each side of the sub plot served as boarder rows. The central three rows were used as net harvest area.

One kg surface soil sample (top 20 cm) from each sub plot before planting collected was air dried at room temperature and sieved through 2-mm sieve. Soil was analyzed for total nitrogen, available phosphorus and available potassium by modified distillation, modified Olsen's method and flame photometer, respectively (Anonymous, 1980)

For plant analysis, three plants were randomly selected from the central three rows of each sub-plot. First sampling was done at 45 days after planting (DAP) and subsequent samplings at 15 days interval up to 90 DAP. The haulms and tubers were separately dried at 70^0C for 72 hours and weighed. They were ground finely to pass through a 40-mesh screen. The content of N, P and K in the samples were also determined by modified Olsen's and Flame photometer methods, respectively. By following James et al. (1994) the uptake of N, P and K by different parts of potato (haulms and tubers) was calculated in kg ha^{-1}. The results were statistically analyzed as described by Gomez and Gomez (1984).

RESULTS AND DISCUSSIONS

The texture of the soil in the experimental plot was sandy loam. The soil pH ranged from 4.8 to 5.2 and organic matter content from 2.55 to 3.22 percentage. The content of N, P and K in the

up to 20-cm layer of soil was 2475-3141, 452-503 and 271-390 kg ha^{-1} respectively at planting time.

Haulms and Tuber N Uptake

Haulms

The accumulation of N in haulms was found to increase up to 60 days after planting (DAP) in both Kufri Sinduri and Desire (Table 1). The N-uptake at 75 DAP was observed insignificant as compared to 60 DAP and sharply declined at 90 DAP as a result of drying and shedding of leaves. Such declination in the accumulation of N by haulms at maturity stage of the crop was also reported earlier by Krishnappa and Gowda, 1988 and Sharma *et al.*, 1978.

The N-uptake by haulms was found significantly higher in Kufri Sinduri than Desire in all stages of crop growth and developments i.e. from 45 to 90 DAP. Kufri Sindhuri showed good response to the application of fertilizer as compared to Desire. Similarly, application of NPK fertilizer at different levels was significantly effective in increasing N uptake by haulms compared with control at 45 and 60 DAP. At the end of crop vegetation (75 to 90 DAP) the treatments with 100 and 150 kg N ha^{-1} were only significantly different with control in N uptake by haulms of potato.

The treatments with higher levels of P (75kg ha^{-1}) and K (100kg ha^{-1}) were statistically similar. The interaction between different levels of fertilizers and potato varieties was significant only at the stage of 45 DAP. The N- Uptake by haulms was significant only in Kuftri Sinduri at the level of 50:50:50 and 100:50:50 kg NPK ha^{-1} (table 1)

Table 1: Effect of NPK levels on nitrogen uptake (kg ha^{-1}) by haulms at Rampur, Chitwan, 1999/2000

N:P:K	45 DAP			60 DAP			75 DAP			90 DAP		
(kg ha^{-1})	KS	De	Mean	KS	De	Mean	KS	De	Mean	KS	De	Mean
0:0:0	36.84	31.89	34.36	68.74	31.01	49.88	87.94	33.37	60.65	53.01	12.31	32.66
50:50:50	59.97	41.34	50.65	107.86	47.40	77.63	103.83	39.61	71.72	62.08	21.09	41.59
100:50:50	79.62	44.46	62.04	116.09	54.48	85.29	120.32	58.87	89.60	81.07	29.61	55.34
100:75:50	80.11	42.66	61.38	139.77	55.75	97.76	130.23	56.17	93.20	77.30	28.58	52.94
100:75:100	69.52	46.06	57.79	133.26	56.67	94.97	127.52	58.77	93.14	78.23	29.73	53.98
100:100:100	71.25	46.23	58.75	127.52	56.54	92.03	125.74	62.04	93.89	75.84	28.84	52.34
150:100:100	78.12	44.05	61.08	139.36	59.16	99.26	141.98	61.33	101.66	83.80	32.99	58.40
Mean	67.92	42.53	55.22	118.95	51.72	85.33	119.65	52.88	86.27	73.05	26.16	49.61
LSD (0.05)												
Variety			11.05			37.44			33.46			21.23
Fertilizer			10.10			22.02			18.10			12.96
Variety x fertilizer			14.29			NS			NS			NS

KS = Kufri Sinduri, De = Desire, LSD = Least significant difference, NS = Non significant

Tubers

The Nitrogen-uptake by potato tubers was found to increase up to 90 DAP in Kufri Sinduri whereas it was maximum at 75 DAP in Desire (Table 2). Nitrogen accumulation in tubers was much higher than the corresponding decrease in the haulms, revealing that the plants continuously absorb N from the soil up to maturity. Application of phosphorus and potash with higher levels of nitrogen (100-150 kg ha^{-1}) observed to increase N uptake by tubers significantly as compared to control at all stages of growth and development. The tubers at the higher N level

took up and stored more N (Lauer, 1981). Similar finding was also reported by Sud *et al.*, (1991). Instead of this, the increment in N uptake by tuber was not significant due to increase in the each level of N, P and K.

Table 2: Effect of NPK levels on nitrogen uptake (kg ha^{-1}) by tuber at Rampur, Chitwan, 1999/2000.

N:P:K	45 DAP			60 DAP			75 DAP			90 DAP		
(kg ha^{-1})	KS	De	Mean	KS	De	Mean	KS	De	Mean	KS	De	Mean
0:0:0	7.95	9.75	8.82	56.33	35.56	45.95	82.20	48.31	65.24	91.87	41.82	66.84
50:50:50	9.34	10.09	9.72	67.98	42.39	55.19	90.94	60.30	75.62	110.07	47.03	78.55
100:50:50	12.99	12.37	12.68	66.27	50.41	58.34	110.84	67.59	89.21	134.19	61.74	97.97
100:75:50	13.38	14.73	14.06	70.83	51.16	61.00	118.85	66.95	92.90	127.72	58.70	93.21
100:75:100	12.33	10.77	11.55	74.15	47.35	60.75	113.92	65.20	89.56	127.69	55.82	91.76
100:100:100	13.09	12.73	12.91	65.12	56.68	60.90	106.10	85.14	95.62	122.40	62.52	92.46
150:100:100	13.68	12.20	12.94	65.68	48.23	56.95	119.66	79.14	99.40	143.09	62.57	102.83
Mean	11.82	11.80	11.81	66.62	47.40	57.01	106.07	67.52	86.80	122.43	55.75	89.09
LSD (0.05)												
Variety			4.91			12.41			9.58			14.93
Fertilizer			3.59			NS			21.95			22.80
Variety x Fertilizer			NS			NS			NS			NS

KS = Kufri Sindhuri, De = Desire, LSD = Least significant difference NS = Non significant

Tubers accumulated significantly higher (14.06 kg ha^{-1}) amount of nitrogen with the increase in the level of both nitrogen and phosphorus i.e., at 100:75:50 compared to 50:50:50 kg NPK ha^{-1}. Thus, for significant increment in N uptake by haulms a ratio of 1:0.5 between N and P was effective but in case of tubers it was higher i.e., 1:0.7 between N and P. The N-uptake at the end of the crop vegetation (90 DAP) by tubers was significantly higher in 100-150 kg ha^{-1} N as compared to the control. Similarly, as compared to the treatment with lowest dose i.e. 50:50:50 kg NPK ha^{-1} the N uptake by tubers was significantly higher at the highest level of NPK (150:100:100 kg NPK ha^{-1}) and was found to be significant in its effect. Such trend was also observed at 75 DAP. It means that the requirement of potato crop for major nutrients was higher. Difference between two cultivars of potato in N uptake by tubers was found significant from 60 to 90 DAP. The tubers of the cultivar Kufri Sinduri accumulated significantly greater amount of nitrogen compared to Desire.

Haulms and Tuber P–Uptake

Haulms

Phosphorus uptake by potato haulms was found to increase from 45 to 60 DAP in Kufri Sinduri and up to 75 DAP in Desire after which it declined in both cultivars (Table 3). This decrease may be due to decrease in P content in the haulms. Decrease in P content of haulms has is also reported by Sharma *et al.*, (1978), and Soltanpour (1969). The uptake of phosphorus by haulms of Kufri Sinduri was significantly higher as compared to Desire at all growth stages (45-90 DAP). At early stages (45 DAP), application of NPK at different levels supported to increase phosphorus uptake significantly over control. The finding corroborates those of Chaurasia and Singh (1995). Even, at maturity stage (75-90 DAP) the treatments with higher level (100-150 kg ha-1 50: 50: 50 NPK Kg ha-1) of nitrogen were found significantly effective to increase phosphorus uptake by haulm compared to control. However, at 45 DAP the mutual increase in

the level of nitrogen and phosphorus assisted to increase phosphorus uptake by haulm as compared to the lowest dose. In other words, the phosphorus uptake (3.98 kg ha^{-1}) by haulms of potato in the treatment of 100:75:50 kg NPK ha^{-1} was significantly higher to 50:50:50 kg NPK ha^{-1} (3.09 kg ha^{-1}). Such trend was also observed at 75 DAP whereas at 60 DAP all treatments with NPK were statistically similar with respect to phosphorus uptake by haulm. In addition to it, an increase in the level of NPK @ 50 kg ha^{-1} was also significantly effective in the uptake of phosphorus by haulms of potato. Thus, at 75 DAP, the maximum (5.89 kg ha^{-1}) phosphorus accumulated by haulms in the treatment with 150:100:100 NPK kg ha^{-1} was significantly higher to the minimum (50:50:50 kg NPK ha^{-1}) dose (4.33 kg ha^{-1}), but similar with 100 N kg ha^{-1}. P-uptake by potato haulms was influenced by the increase in the level of N and P or N, P and K together.

Moreover, the interaction between fertilizer and variety for phosphorus uptake by potato haulms was significant only at 45 DAP. At this stage, the effect of different levels of N, P and K on phosphorus uptake by potato haulms was found significant only in Kufri Sinduri. In this cultivar, the amount of phosphorus accumulated by haulms was significantly increased with the increase in level of N as well as N and P together. Amount of phosphorus uptake (5.14 and 5.43 kg ha^{-1}) by haulms of Kufri Sinduri obtained with 100:50:50 and 100:75:50 kg ha^{-1}, respectively was significant compared to 50:50:50 NPK kg ha^{-1}. This indicates that in order to achieve higher uptake of phosphorus by haulms the ratio between N and P should also be optimum (1:0.7).

Table 3. Effect of NPK levels on phosphorous uptake (kg ha^{-1}) by haulms at Rampur, Chitwan, 1999/2000

N:P:K	45 DAP			60 DAP			75 DAP			90 DAP		
(kg ha^{-1})	KS	De	Mean	KS	De	Mean	KS	De	Mean	KS	De	Mean
0:0:0	2.36	1.87	2.12	4.07	1.78	2.93	4.73	2.25	3.49	2.24	0.62	1.43
50:50:50	3.64	2.25	3.09	6.38	2.66	4.52	6.03	2.63	4.33	3.02	1.21	2.12
100:50:50	5.14	2.51	3.83	7.53	2.91	5.22	6.00	3.52	4.76	3.81	1.50	2.66
100:75:50	5.43	2.53	3.98	7.67	3.09	5.38	7.53	3.57	5.55	3.72	1.72	2.72
100:75:100	4.54	2.71	3.62	7.94	3.10	5.52	7.50	3.78	5.64	3.94	1.78	2.86
100:100:100	4.49	2.75	3.12	6.77	3.22	5.00	7.35	4.06	5.71	3.77	1.72	2.74
150:100:100	4.59	2.61	3.60	7.80	3.18	5.49	7.91	3.87	5.89	4.00	1.86	2.93
Mean	4.31	2.50	3.41	6.88	2.85	4.64	6.72	3.38	5.05	3.50	1.49	2.49
LSD (0.05)												
Variety			0.71			1.95			2.04			0.91
Fertilizer			0.77			1.18			1.07			0.71
Variety x fertilizer			1.08			NS			NS			NS

KS = Kufri Sindhuri, De = Desire and LSD = Least significant difference, NS = Non significant

Tubers

The mean value of phosphorus uptake by potato tubers indicates that it was increasing up to 90 DAP in Kufri Sinduri whereas in Desire such trend was observed only up to 75 DAP and thereafter it declined (Table 4). At maturity the accumulation of phosphorous in tubers was higher than in the haulms, which indicates its translocation from source to sink. This is in line with the findings of earlier workers (Krishnappa and Gowda, 1988 and Trehan and Grewal, 1984). The difference between two cultivars of potato in uptake of phosphorus by tubers was found significant from 60 to 90 DAP and the amount of phosphorus accumulated by tubers of Kufri Sinduri was significantly higher than that of Desire.

The effect of fertilizer application on phosphorus uptake by potato tubers was found significant as compared to the control only in the treatment with 100:100:100 NPK kg ha^{-1} at 45 DAP. Similarly, at 75 DAP, an increase in the level of nitrogen from 50 to 100 kg ha^{-1} and phosphorus from 50 to 75 kg ha^{-1} with 50 kg ha^{-1} of potash assisted to increase phosphorus uptake by tubers significantly over control. An increment in the level of phosphorous and potash was not effective but an increase in nitrogen level from 100 to 150 kg ha^{-1} with 100 kg ha^{-1} each of phosphorus and potash assisted to accumulate phosphorous in tubers significantly over control. Such trend was also observed at the end (90 DAP) of crop vegetation. The results showing positive effect of N on P-uptake is in an agreement with the findings of Sharma and Sharma (1990). Positive effect of N on P-uptake might be attributed to increased physiological activity of root to absorb P (Duncan and Ohlrogge, 1958).

Table 4. Effect of NPK levels on phosphorous uptake (kg ha^{-1}) by tuber at Rampur, Chitwan, 1999/2000.

N:P:K	45 DAP			60 DAP			75 DAP			90 DAP		
(kg ha^{-1})	KS	De	Mean	KS	De	Mean	KS	De	Mean	KS	De	Mean
0:0:0	0.85	1.08	0.97	5.96	3.81	4.89	8.22	4.80	6.51	8.37	3.70	6.04
50:50:50	1.21	1.09	1.15	7.15	4.99	6.07	9.96	6.40	8.18	10.60	4.51	7.55
100:50:50	1.12	1.38	1.25	7.52	5.58	6.55	10.75	6.88	8.81	12.30	5.69	9.01
100:75:50	1.13	1.50	1.31	8.70	5.97	7.34	12.60	6.87	9.74	12.10	5.64	8.88
100:75:100	1.27	1.31	1.29	8.92	5.75	7.34	12.60	6.54	9.57	12.70	5.18	8.94
100:100:100	1.59	1.57	1.58	8.03	5.73	6.88	11.15	7.94	9.54	12.90	6.03	9.46
150:100:100	1.14	1.33	1.24	8.47	5.59	7.03	12.68	8.13	10.4	15.00	5.83	10.41
Mean	1.19	1.32	1.26	7.82	5.34	6.58	11.21	6.79	8.96	12.01	5.22	8.62
LSD (0.05)												
Variety			0.52						1.37			1.33
						1.24						
Fertilizers			0.46			NS			3.11			2.94
Variety x Fertilizers			NS			NS			NS			NS

KS = Kufri Sindhuri, De = Desire, LSD = Least significant difference, NS = Non significant

Uptake of Potassium by Haulms and Tuber

Haulms

The mean value of potassium uptake by potato haulms indicates that the K-uptake increased from 45 to 75 DAP and thereafter declined in Kufri Sinduri and Desire cultivars (Table 5). This decline can be attributed to decrease in the K content of haulms. Krishnappa and Gowda (1988) also reported similar results. The amount of potassium accumulated by haulms of Kufri Sinduri was significantly higher as compared to the Desire in all growth stages and development. Application of NPK at different levels was found significantly effective in increasing the K-uptake by haulms at 45 and 60 DAP as compared to the control. In the later stages (75 to 90 DAP), the treatments with higher levels of nitrogen (100-150 kg ha^{-1}) were only significant to control. This indicated that nitrogen helps to increase the uptake of potassium in potato. Beukema and Van der Zaag (1990) reported similar argument. Moreover, an increase in the level of N, P and K from 50 to 100 kg ha^{-1} helped to increase potassium uptake by haulms significantly at 60 and 75 DAP. In other words, the values of potassium uptake by haulms obtained by the application of NPK @ 100:100:100 kg ha^{-1} at 60 and 75 DAP were significantly higher than that of 50:50:50 NPK kg ha^{-1}. However, an increase in the nitrogen level from 100 to 150 kg ha^{-1} with 100 kg ha^{-1} each of phosphorus and potassium had also significant effect in increasing the potassium uptake by haulms as compared to 50:50:50 kg NPK ha^{-1} at both stages

(60 and 75 DAP). Increased K-uptake by potato haulms due to N and P fertilization is also reported by some workers (Krishnappa and Gowda, 1988; Jaggi *et al.*, 1995; Sharma and Sharma, 1992), which may be due to better growth of haulms and root enabling the plant to absorb K from greater areas and depth.

Table 5. Effect of NPK levels on potassium uptake (kg ha^{-1}) by haulms at Rampur, Chitwan, 1999/2000

N:P:K	45 DAP			60 DAP			75 DAP			90 DAP		
(kg ha^{-1})	KS	De	Mean	KS	De	Mean	KS	De	Mean	KS	De	Mean
0:0:0	29.58	24.89	27.23	60.04	29.63	44.84	81.87	42.08	61.98	48.81	15.62	32.22
50:50:50	47.28	34.69	40.99	87.88	41.08	64.48	98.24	46.92	72.58	59.46	26.78	43.12
100:50:50	63.13	34.12	48.62	104.09	44.40	74.25	108.25	60.63	84.44	77.47	32.33	54.90
100:75:50	65.81	33.33	49.57	110.62	44.93	77.78	117.14	57.02	87.08	71.55	32.73	52.14
100:75:100	57.99	37.43	47.71	109.43	47.54	78.49	111.79	60.73	86.26	77.68	34.49	56.09
100:100:100	58.24	39.10	48.67	107.84	58.00	82.92	113.01	66.04	89.53	76.76	36.47	56.61
150:100:100	60.33	35.88	48.10	118.52	52.10	85.31	135.73	61.21	98.47	78.53	36.52	57.53
Mean	54.62	34.21	44.41	99.77	45.39	72.58	109.43	56.38	82.90	70.04	30.71	50.37
LSD (0.05)												
Variety			10.48			26.11			30.00			18.94
Fertilizer			9.78			14.97			16.61			14.71
Fertilizer X Variety			NS			21.17			NS			NS

KS = Kufri Sindhuri, De = Desire and LSD = Least significant difference, NS = Non significant

The interaction between fertilizer and varieties was found significant only at 60 DAP. At this stage, all combinations of NPK were significant as compared to control in respect to potassium uptake by haulms of Kufri Sinduri whereas in Desire it was observed only at higher levels (100-150 kg ha^{-1}) of nitrogen with 100 kg ha^{-1} each of phosphorus and potash. Moreover, the mutual increase in the level of nitrogen and phosphorus was found significantly effective in the increment of potassium uptake by haulms of Kufri Sinduri only. Thus, the significantly higher amount of potassium uptake (110.62 kg ha^{-1}) was obtained in the treatment of 100:75:50 kg NPK ha^{-1} as compared to minimum (50:50:50 kg NPK ha^{-1}). Instead of this, in Kufri Sinduri, the accumulation of K in haulms was significantly increased (118.52 kg ha^{-1}) at the maximum level of N, P and K (150:100:100 kg ha^{-1}) compared with the minimum (60.14 kg ha^{-1}).

Tubers

The K-uptake by potato tubers was increased up to 75 DAP in both cultivars but it declined at 90 DAP in case of Desire which may be related to its short duration (Table 6). The uptake of potassium by tubers of Kufri Sinduri was significantly higher than Desire from 60 to 90 DAP. The effect of fertilizer application on potassium uptake by tubers was found insignificant only at 60 DAP. Thus, at 45 DAP, a high dose of nitrogen and phosphorus was needed to increase potassium uptake significantly. In other words, the uptake of potassium (14.51 kg ha^{-1}) obtained in the treatment with 100:75:50 kg NPK ha^{-1} was significantly higher to control. The increment of potassium dose from 50 to 100 kg ha^{-1} was not effective for the accumulation of potassium by tubers. On the other hand, an increase in phosphorus dose from 75 to 100 kg ha^{-1} with 100 kg ha^{-1} each of nitrogen and potassium also helped to improve potassium uptake (13.37 kg ha^{-1}) by tubers significantly over control. As in 45 DAP, significantly higher amount of potassium (95.8 kg ha^{-1}) was utilized by tubers at 75 DAP with 100:75:50 kg NPK ha^{-1} compared with control. It indicates that for better tubers growth and uptake of potassium by them application of nitrogen maintaining a ratio of 1:0.7 with phosphorus was essential for these stages. It was also significantly higher to other treatment except those where phosphorous was applied@100 kg ha^{-1}

Table 6. Effect of NPK levels on potassium uptake (kg ha^{-1}) by tuber at Rampur, Chitwan, 1999/2000.

N:P:K (kg ha^{-1})	45 DAP			60 DAP			75 DAP			90 DAP		
	KS	De	Mean	KS	De	Mean	KS	De	Mean	KS	De	Mean
0:0:0	8.47	9.45	8.96	57.44	36.31	46.87	83.90	49.31	66.60	93.39	42.74	68.07
50:50:50	10.84	9.34	10.09	68.74	43.86	56.30	92.50	62.06	77.28	111.59	47.97	79.78
100:50:50	10.49	12.87	11.68	71.77	53.16	62.46	92.45	68.69	80.57	134.95	62.98	98.97
100:75:50	14.53	14.48	14.51	73.85	53.16	63.51	122.60	69.02	95.81	128.48	59.95	94.22
100:75:100	10.71	11.27	10.99	75.13	48.10	61.62	115.14	66.80	96.56	128.94	57.06	93.00
100:100:100	13.72	13.03	13.37	73.87	50.93	62.40	107.36	85.77	91.57	124.74	63.76	94.25
150:100:100	10.22	11.70	10.96	76.40	49.73	63.07	120.93	81.21	101.07	145.82	65.07	105.45
Mean	11.28	11.73	11.51	71.03	47.90	59.46	104.98	69.00	86.98	123.99	57.08	90.53
LSD (0.05)												
Variety			NS			6.23			10.04			15.18
Fertilizer			3.84			NS			2.62			22.89
Variety x fertilizer			NS			NS			NS			NS

KS = Kufri Sindhuri, De = Desire and LSD = Least significant difference, NS = Non significant

Moreover, the increase in nitrogen dose from 50 to 100 kg ha^{-1} with lowest level of phosphorous and potassium (50 kg ha^{-1} each) and from 100 to 150 kg ha^{-1} with their highest level (100 kg ha^{-1} each) was found significantly effective to increase K uptake by tubers.

The highest (101.07 kg ha^{-1}) amount of K uptake obtained at 150:100:100 kg NPK ha^{-1} was significantly higher to all the treatments at 75 DAP. This indicates that the level of nitrogen, phosphorous and their combinations influenced accumulation of potassium by tubers. At the end of crop vegetation (90 DAP) all treatments with higher (100-150 kg ha^{-1}) level of nitrogen were significant as compared to the control, but in comparison to the lowest dose (50:50:50 NPK kg ha^{-1}) the treatment with 150:100:100 NPK kg ha^{-1} was only significant.

Thus, the statistical analysis of the data indicates that the uptake of the major nutrients (N, P and K) by potato crop was found to be different with the difference in variety. The optimum level and ratio of N, P and K for their uptake by haulms and tubers was found to be different at the stage of their maximum utilization which should be taken into consideration while planning about nutritional management of this crop.

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