



Studies on performance of nitrogen and potassium on growth, nutrient content and uptake of Sweet potato (*Ipomoea batatas*. L.) in Vertisols of Maharashtra

ABSTRACT

An investigation was carried out to ~~asses~~^{assess} nutrient content and uptake of sweet potato under application of nitrogen and potassium. Sweet potato is a high input intensive tuber crop which requires an efficient cropping management to ensure adequate nutrient content and uptake to attain growth and development of crop. The experiment was conducted with four levels of nitrogen (0, 75, 100 and 125 kg/ha) and three levels of potassium (0, 75 and 100 kg/ha) ~~in region for optimum productivity in~~ in a factorial randomized block design with three replications and twelve treatments. A field Experiment was conducted in *kharif* season during the year 2015-2016 on fine texture Vertisols. Data was recorded on length of main vine, length of subsidiary vine, leaf area index and nutrient content and uptake. The results indicated clearly that main vine ~~ans~~^{and} subsidiary vine length, LAI and concentration of nutrients in leaf ~~stem~~^{and} tubers of sweet potato were significantly higher under ~~dose of~~ 125 kg N from urea + 100 kg K from MOP ha⁻¹. In general, ~~the~~ higher N, P, K, and S content in tuber were found as compared to stem and leaf. The higher N, P, K and S content and uptake were recorded by application of 125 kg N and 100 kg K ha⁻¹ in block soils of Marathwad region of Maharashtra.

Key words: N, K, LAI, Nutrient content and uptake, Sweet potato;

Introduction

Knowledge of growth patterns and nutrient uptake of sweet potato is very important for understanding the optimum dose of fertilizer requirements for producing high yields of quality tubers. Sweet potato is an important starchy crop of the country. Among the

different practices, the fertilization plays significant role in enhancing the growth and uptake of nutrients in tubers. Inefficient nutrient management results in reduction in tuber quality, yield, and environmental degradation (Pehrson *et al.*, 2011). Nutrient supply plays a major role in growth and development of plants as well as yield because nitrogen is an essential constituent of protein and chlorophyll. Among fertilizers, nitrogen is second most important nutrient after potassium. Nitrogen is essential for maintaining higher vine growth, increased bulking rate, quality of tuber and more dry matter production (Roy and Jaiswal, 1998). Nitrogen is an important factor in determining the yield and nutrient composition of root tubers, especially sweet potato (Ukom *et al.* 2009). On the other hand, potassium is responsible for translocation of carbohydrates and increased resistance to withstand drought and frost stresses.

Material and method

The field experiment was conducted in College of Agriculture Latur farm during the *kharif* season 2015-2016. These experiment was laid out in factorial randomized block design with three replications and 12 treatments. Factors includes nitrogen fertilizer levels (0, 75, 100, 125 kg/ha) potassium fertilizer levels (0, 75, 100 kg/ha) with 3 replication of different combination of levels. Size 3 x 2 m² with spacing 60 cm x 20 cm with local variety. Application of fertilizer at time of planting, full dose of potassium and P of phosphorous was given and half dose of nitrogen is given to time of planting and reaming was give at 30 DAP. The initial soil sample was taken before planting, neutral to alkaline pH with low organic carbon content (3.8 g/kg) and available nutrients like low nitrogen 275.98 kg/ha, low available P 15.75 kg/ha, and high in available K 559.58 kg/ha and low available S 12.30 mg/kg and also exchangeable Ca 20.10 meq/100 g and Mg 10.18 meq/100 g. Growth parameters were recorded at different growth stages and plant samples were collected for nutrient analysis at the time of harvesting of sweet potato.

Result and discussion

Growth attributes

Length of main vine and subsidiary vine, leaf area index of sweet potato (Table 1) increased significantly due to application of N @ 125 kg ha⁻¹ along with 100 kg K ha⁻¹ statistically at par with 100 kg N ha⁻¹ and 75 kg K ha⁻¹. Increases in vine length number of leaves and leaf area index of sweet potato significantly more in the early growth stages and middle growth stages were observed with increased application of nitrogen and potassium

fertilizer levels, this might be due to the nitrogen fertilizer increased the vegetative growth of plants and increases the number of leaf and leaf area under the different levels of nitrogen application. Similar findings were also reported by Sandhu *et al.*(2014).

Table 1 : length of main vine subsidiary vine and leaf area index influenced by nitrogen and potassium fertilizer

Treatments	Length of subsidiary vine (cm)		Length of main vine (cm)		leaf area index (LAI)	
	60 DAP	120 DAP	60 DAP	120 DAP	60 DAP	120 DAP
Nitrogen Levels (N)						
N ₀ : 0 kg N ha ⁻¹	19.64	46.19	67.43	123.23	0.50	1.34
N ₁ : 75 kg N ha ⁻¹	22.82	51.18	74.91	132.05	0.88	1.83
N ₂ : 100 kg N ha ⁻¹	26.29	58.18	77.71	150.58	0.96	2.09
N ₃ : 125 kg N ha ⁻¹	29.57	63.18	82.63	157.92	1.03	2.14
SE (m) ±	0.79	1.28	1.85	2.92	0.033	0.071
CD at 5%	2.31	3.76	5.44	8.56	0.096	0.207
Potassium Levels (K)						
K ₀ : 0 kg K ₂ O ha ⁻¹	21.32	53.28	71.16	137.75	0.72	1.53
K ₁ : 75 kg K ₂ O ha ⁻¹	24.85	53.81	76.90	138.56	0.86	1.87
K ₂ : 100 kg K ₂ O ha ⁻¹	27.58	56.96	78.96	146.52	0.94	1.90
SE (m) ±	0.68	1.11	1.61	2.53	0.028	0.061
CD at 5%	2.00	3.26	4.71	7.42	0.083	0.18
Interaction (N x K)						
SE (m) ±	1.36	2.22	3.21	5.06	0.056	0.12
CD at 5%	NS	NS	NS	NS	NS	NS

DAP- days after planting, NS- non significant

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70 Nitrogen, Phosphorus and Potassium content in different parts of plants

71 Among the different levels of nitrogen and potassium, the application of N@
 72 125 kg ha⁻¹ and K@ 100 kg ha⁻¹ recorded significantly higher N, P, K, and S concentration
 73 in leaf, stem and tuber. Among the different parts of sweet potato plants under these tuber
 74 shows higher concentration of nutrients than leaves and stem due to increases the fertilizes

75 which increases the concentration of nutrients in different parts and also more accumulation
 76 photosynthates and sugars in tubers and more translocation from ~~sink to sources~~. Lower
 77 accumulation of nutrient ~~content~~ in application of 0 kg ha⁻¹ N and 0 kg ha⁻¹ K over rest of
 78 treatments. Similar ~~results~~ were found by Roghayyeh *et al.* (2010) and Ukom *et al.* (2009).
 79 Nitrogen ~~per cent~~ of tuber was significantly influenced by N @ 150 kg/ ha also reported by
 80 Mehran and Samod (2013) in different parts of sugar beet. Phosphorous content of tuber was
 81 affected by nitrogenous fertilizers, the highest ~~per cent~~ of tuber phosphorous was observed at
 82 100 kg N ha⁻¹ was reported by Mojtaba *et al.* (2013).

83 Interaction effect of both application of nitrogen and potassium ~~were show~~
 84 non significant difference in different parts of plants.

85 **Table 2: Nitrogen, phosphorus and potassium content (%) in leaves, stem and tuber of**
 86 **sweet potato as influenced by nitrogen and potassium application**

Treatments	N content in leaf (%)	N content in stem (%)	N content in tuber (%)	P content in leaf (%)	P content in stem (%)	P content in tuber (%)	K content in leaf (%)	K content in stem (%)	K content in tuber (%)
Nitrogen									
N ₀ : 0 kg ha ⁻¹	1.037	0.666	1.077	0.19	0.13	0.29	1.04	0.18	1.31
N ₁ : 75 kg ha ⁻¹	1.175	0.822	1.184	0.23	0.14	0.33	1.15	0.21	1.40
N ₂ : 100 kg ha ⁻¹	1.297	1.036	1.351	0.27	0.15	0.37	1.34	0.26	1.56
N ₃ : 125 kg ha ⁻¹	1.446	1.191	1.595	0.28	0.18	0.39	1.37	0.27	1.62
SE±	0.031	0.021	0.036	0.005	0.005	0.005	0.020	0.003	0.020
CD@ 5%	0.092	0.063	0.105	0.014	0.013	0.014	0.059	0.010	0.060
Potassium									
K ₀ : 0 kg ha ⁻¹	1.15	0.88	1.23	0.23	0.14	0.33	1.16	0.22	1.43
K ₁ : 75 kg ha ⁻¹	1.26	0.91	1.28	0.24	0.15	0.34	1.23	0.23	1.48
K ₂ : 100 kg ha ⁻¹	1.31	1.00	1.40	0.25	0.16	0.35	1.27	0.25	1.52
SE±	0.027	0.019	0.031	0.004	0.004	0.004	0.018	0.003	0.018
CD@ 5%	0.080	0.054	0.091	0.12	0.012	0.012	0.052	0.009	0.053
Interaction (N×K)									
SE±	0.054	0.037	0.062	0.008	0.008	0.008	0.035	0.006	0.035
CD@ 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS

87 NS – non significant

89 Nitrogen, phosphorus and potassium uptake in leaf, stem and tuber (kg ha⁻¹)

90 The uptake of nutrients by sweet potato stem leaf and tuber and total uptake
 91 (stem+ leaf + tuber) were affected significantly due to application of nitrogen and potassium
 92 @ 125 kg ha⁻¹ + 100 kg ha⁻¹ respectively.

93 It is evident from results that nitrogen and potassium which receives 125 kg
 94 ha⁻¹ and 100 kg ha⁻¹ recorded significantly higher N, P and K uptake in case of tuber than
 95 leaves and stem of total uptake over rest of treatments. Among stem and leaves, the leaves

show the higher uptake of nutrients than stem due to higher translocation of nutrients from root to leaves, stem acts as mediator between that and also increases higher application of fertilize increased the uptake as well as total uptake of nutrients in plants. Lower uptakes of nutrients were observed in application of nutrient $0 \text{ kg N ha}^{-1} + 0 \text{ kg K ha}^{-1}$. There were no interaction effects between applications of both nutrient fertilizers.

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Table: 3a Nitrogen, phosphorous and potassium uptake (kg ha^{-1}) in leaves, stem, tuber and their total of sweet potato as influenced by nitrogen and potassium application

Treatments	Uptake of N in leaf (kg ha^{-1})	Stem uptake (kg ha^{-1})	Tuber uptake (kg ha^{-1})	Total uptake of N (kg ha^{-1})	Uptake of P in leaf (kg ha^{-1})	Stem uptake (kg ha^{-1})	Tuber uptake (kg ha^{-1})	Total uptake P (kg ha^{-1})
Nitrogen								
N₀ :0 kg ha^{-1}	39.24	36.76	51.41	127.41	6.69	5.95	7.69	19.78
N₁ :75 kg ha^{-1}	46.31	45.39	77.34	169.05	8.46	7.36	9.46	25.29
N₂ :100 kg ha^{-1}	46.99	48.16	86.02	181.19	11.13	10.03	12.13	33.29
N₃ : 125 kg ha^{-1}	51.19	50.29	95.60	197.09	11.87	10.78	12.87	35.52
SE$\pm$	1.25	0.70	3.67	4.29	0.19	0.18	0.19	0.55
CD@ 5%	3.67	2.05	10.76	12.61	0.55	0.53	0.55	1.62
Potassium								
K₀ :0 kg ha^{-1}	43.84	39.08	69.98	152.90	8.77	7.68	9.76	26.22
K₁ : 75 kg ha^{-1}	45.99	45.10	72.74	163.82	9.40	8.30	10.40	28.11
K₂ : 100 kg ha^{-1}	47.98	51.59	90.07	189.34	10.44	9.34	11.44	31.23
SE$\pm$	1.08	0.601	3.17	3.72	0.16	0.15	0.16	0.478
CD@ 5%	3.17	1.78	9.32	10.92	0.48	0.46	0.47	1.402
Interaction (NxK)								
SE$\pm$	2.16	1.21	0.35	7.44	0.33	0.3	0.33	0.96
CD@ 5%	NS	NS	NS	NS	NS	NS	NS	NS

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The N, P, and K uptake in sweet potato increases with increased levels of nitrogen and potassium fertilizers this might be due to increases the growth and development of the plants and luxurious consumption of nutrients by the plants and increases concentration of nutrients in different parts of plant, produces the aerial parts and consequently increases the leaves, stem and tuber dry matter and increases the uptake of nutrients in different parts of plant of sweet potato, this results were agreed with Roghayyeh *et al.* (2010) Haase & Schuler (2007) and Singh and Lal (2012) in potato. Abd *et al.* (2011) reported higher nutrient content at higher levels of fertilizer application together with higher dry matter production.

Table: 3b Potassium uptake (kg ha^{-1}) in leaves, stem, tuber and their total of sweet potato as influenced by nitrogen and potassium application.

Treatments	Uptake of K in leaf (kg ha^{-1})	Stem uptake (kg ha^{-1})	Tuber uptake (kg ha^{-1})	Total uptake of K (kg ha^{-1})
Nitrogen				
$\text{N}_0 : 0 \text{ kg ha}^{-1}$	52.15	26.08	69.54	147.77
$\text{N}_1 : 75 \text{ kg ha}^{-1}$	62.56	31.39	83.71	177.65
$\text{N}_2 : 100 \text{ kg ha}^{-1}$	78.79	39.39	105.06	233.25
$\text{N}_3 : 125 \text{ kg ha}^{-1}$	83.22	41.61	110.95	235.78
SE $\pm$	1.11	0.55	1.49	3.16
@ 5%	3.26	1.65	4.38	9.28
Potassium				
$\text{K}_0 : 0 \text{ kg ha}^{-1}$	64.54	32.31	86.16	182.93
$\text{K}_1 : 75 \text{ kg ha}^{-1}$	68.42	34.21	91.23	193.85
$\text{K}_2 : 100 \text{ kg ha}^{-1}$	74.67	37.33	99.56	211.56
SE $\pm$	0.96	0.49	1.295	2.74
CD@ 5%	2.83	1.43	3.79	8.04
Interaction (NxK)				
SE $\pm$	1.93	0.97	2.59	5.48
@ 5%	NS	NS	NS	NS

Increase in the availability of nutrients from soil, the nutrient uptake by tubers, stem & leaves were found closely linked with productivity and their concentration in plant by Shaheen *et al.* (2013). The differential release pattern of non-exchangeable K from the soil reserve, besides variation in K uptake by the crop will held responsible for such differences in the available K status of the soil by Sivotwa and Jiyane (2007). K uptake recorded highest in stem leaves and tuber due to increases in fertilizer doses (Abd *et al.* 2011). Increase with increasing fertilizer dose was recorded highest stem, leaves and tuber uptake K in potato plants by Sandhu *et al.* (2014).

Conclusion

From the result and discussion of this study, it can be concluded that the maximum uptake of N, P, and K by tubers, leaves and stem was observed in application of N along with K @ 125 kg ha^{-1} + 100 kg ha^{-1} and also over all increases growth parameters of vine length and LAI of sweet potato.

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