

Original Research Article

<https://doi.org/10.20546/ijcmas.2017.605.183>

Effect of Graded Levels of Nitrogen and Potassium on Yield and Quality of Sweet Potato (*Ipomoea batatas* L.)

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ABSTRACT

Aim of work is to investigate increasing yield and quality of sweet potato (*Ipomoea batatas* L.) under the condition of semi arid region. The experiment was laid in Factorial Randomized Block Design with three replications and twelve treatments. The field experiment was conducted in College of Agriculture, Latur farm during the *kharif* season 2015-2016. The experiment consist of 4 levels of nitrogen (0, 75, 100 and 125 kg ha⁻¹) and 3 levels of potassium (0, 75 and 100 kg ha⁻¹). Yield contributing and quality characteristics of sweet potato were significantly increased with increased levels of nitrogen and potassium levels. Application of 125 kg N ha⁻¹ along with 100 kg K₂O ha⁻¹ recorded significantly higher tuber yield and quality parameters of sweet potato. The application of nitrogen @ 125 kg per ha recorded highest tuber yield (22,398 kg ha⁻¹) and yield contributing characters viz. tuber diameter (6.24 cm), tuber length (18.58 cm), number of tubers per plant (9.36 plant⁻¹) and quality characters viz., fresh tuber weight (451.49 g), dry tuber weight (40.57 g), tuber dry matter, (75.10 %), reducing sugar (0.268%), non reducing sugars (6.58 %), total sugar(6.85 %), TSS (13.37 %), carbohydrates (18.01 %) and protein (9.87 %) than over the control. But specific gravity (1.14 g ml⁻¹) of tuber is increased with decreased nitrogen level. Graded levels of potassium application is significantly increases tuber yield (19,597 kg ha⁻¹) and yield contributes are tuber diameter (5.96 cm), tuber length (17.94 cm), number of tubers per plant (9.0) are recorded in the application of 100 kg K₂O ha⁻¹ and quality attributes are fresh tuber weight (410.26 g), reducing sugar (0.231 %), non reducing sugars (6.23 %), total sugar (6.46 %), TSS (12.69 %), carbohydrates (17.29 %), protein (8.70 %) and specific gravity (1.12 g ml⁻¹) of tuber was found @ 100 kg K₂O ha⁻¹ over control application (K₀).

Keywords

Sweet potato,
Nitrogen,
Potassium,
Quality,
Specific gravity.

Article Info

Accepted:
17 April 2017
Available Online:
10 May 2017

Introduction

Tuber crops are the third important food crops in the world after cereals and legumes. It is dicotyledonous plant belongs to the family convolvulaceae. Sweet potato is a starchy root crop grown in tropical and subtropical countries like China, USA, India, Japan, Indonesia, Philippines, Thailand, Vietnam, and Nigeria. In India it is cultivated in almost

all the states. Sweet potato is considered as a 'poor man's rich food' in many parts of India. In India sweet potato is largely grown in three states Orissa, Uttar Pradesh, and West Bengal. Sweet potato is a vegetative propagated crop and it is excellent source of complex carbohydrates, high antioxidants, vitamins A, C and rich in several essential macro and

micronutrients. Considerable efforts have been made recently to promote sweet potato and to create awareness among the farming communities. The crop is known as a highly tolerant tuberous root crop to high temperatures, poor soils Uwah *et al.*, (2013).

Sweet potato production can be increased substantially through the proper use of fertilizer. Nitrogen is most important major plant nutrient; it helps for growth and development of crop, most important macronutrients in the formation of yield and quality of vegetables, great importance as a constituent of numerous organic molecules in plant such as proteins, nucleic acids and alkaloids, enzymes, chlorophyll-a, chlorophyll-b, certain acid of nucleus and certain hormones and its content is associated with the leaf relative chlorophyll content which affects photosynthesis. Nitrogen is the "Motor of plant growth". Unbalanced excess fertilizers in crops will decrease quality of crops particularly storage ability (FAO and IFA, 2000). Nitrogen is an important factor in determining the yield and nutrient composition of root tubers, especially sweet potato Ukom *et al.*, (2009).

Potassium plays an important role in relation to water, energy, translocation of assimilates, photosynthesis, protein and starch synthesis, metabolic processes, grain yield or seed formation, improving quality vegetable in terms of size, shape, color, taste, shelf life and fiber quality. Imparting resistance against environmental stresses and resistant to pest and diseases. Potassium deficiencies can limit the accumulation of crop biomass. This is attributed to that, potassium increases the photosynthetic rates of crop leaves, carbon dioxide assimilation and facilitates carbon movement (Abd El-Baky *et al.*, 2010). Potassium expedites the transport of carbohydrates from the leaves to the tubers. Higher shoot: tuber ratios were found for

plants treated with KCl. The chloride functions as an osmotic ion as well as essential plant nutrient. Both potassium and nitrogen fertilization can influence tuber yield and quality.

Materials and Methods

The field experiment was conducted in College of Agriculture, Latur farm during the *kharif* season 2015-2016. This experiment was laid out in factorial randomized block design with 3 replications and 12 treatments. Experimental factors includes nitrogen fertilizer levels (0, 75, 100, 125 kg/ha) potassium fertilizer levels (0, 75, 100) with 3 replications of different combination of levels. Total number of plots is 12, size 3 x 2 sq. m with spacing 60 x 20 cm with local variety. Graded levels of potassium and nitrogen was applied at the time planting and recommended dose of phosphorous was applied in the same time but graded levels of N was split in to half at time of planting and reaming half at the 30 days after planting.

Random Selection of five plants per plots for recorded the yield and yielding attributing, characters like tuber diameter, tuber length, number of tuber at the time of harvesting and quality parameters like fresh and dry weight of tubers, carbohydrates, reducing, non reducing and total sugar content, TSS, specific gravity, protein content was recorded at the harvesting stage of sweet potato by selected the five random tuber per plot. Data recorded on yield and quality parameter was subjected to analysis of variance (ANOVA, $p \leq 0.05$) and means comparisons were done at $P \leq 0.05$. Percentages were computed using the least square means from respective ANOVA and tables and figures were drawn using MS excel 2010 program.

$$\text{Specific gravity} = \frac{\text{Weight of tuber in air} - \text{Weight of tuber}}{\text{Weight of tuber in air}}$$

Results and Discussion

Yield attributes

The tuber yield of sweet potato was recorded highest (22398 kg ha⁻¹) in 125 kg/ha N₃ and it was on par with N₂ (100 kg/ha) and lowest tuber yield was recorded in N₀ (11411 kg/ha). The tuber length of sweet potato (18.58 cm), diameter of tuber (6.41 cm) and number of tubers (9.36 plant⁻¹) was found significantly highest in the level of N₃ @ 125 kg/ha and it was on par with N₂ level @ 100 kg/ha over control @ 0 kg/ha N (Table 1). This fertilizer effect might be due to application of higher dose of nitrogen would have helped in increases growth and higher supply of photosynthesis may increases the tuber weight, length diameter and number of tubers. Similar results were also observed by Sanjana *et al.*, (2014) and Alfred *et al.*, (2000).

Different levels of potassium fertilizer application, among this K₂ @ 100 kg/ha K₂O was recorded significantly highest sweet potato tuber yield (19597 kg/ha) and it was on par with K₁ @ 75 kg/ha and lowest tuber yield noticed in control. The yield parameters like tuber length (17.94 cm), tuber diameter (5.96 cm) and number of tuber (9.0 plant⁻¹) was found significantly highest in the level of K₂ @ 100 kg/ha and it was on par with the K₁ @ 75 kg/ha over control showed in (Table 1). This might be due to positive response shown by yield characters to K could be directly linked by well development of photosynthetic and increased physiological activities leading to more assimilates and improved the translocation accumulation of sugars in development of tubers this was reported by Moniruzzamman *et al.*, (2013).

The interaction effect (Table 2) of N and K was significant in the tuber diameter and yield of sweet potato. The N₃ x K₂ interaction

shows significant effect on both tuber yield (2326 kg/ha) and tuber diameter (6.56 cm) on par with N₃ x K₁, N₂ x K₂, N₂ x K₁ but significantly superior over rest of the interactions.

Lowest yield observed in N₀ x K₀ this might be due to the positive interaction between nitrogen and potassium in soil. Potassium influence on the crop yield can also be indirect as a result of its positive interaction with other nutrients especially nitrogen. Potassium along with nitrogen plays a major role in growth and yield as it is involved in assimilation, transport and storage at the time of photosynthesis and the effect of N: K interaction in cassava yield was reported by (Susan Johan *et al.*, 2013). The increase in yield and size of tuber could not only by the effect of K fertilizer but also the combination of N, P₂O₅ and high dose of organic manure was reported by Sridevi and Ramakrishna (2013).

Quality attributes

Regarding quality parameter of sweet potato the effect of different graded levels of nitrogen was significantly higher quality parameter (Table 3) like fresh tuber weight (451.49 g), dry tuber weight (40.57 cm), TSS (13.37 %), reducing sugar (0.268 %) non reducing sugar (6.58 %) and total sugar (6.85 cm), carbohydrates (18.01 %) was recorded in N₃ @ 125 kg/ha followed by the rest of the treatments over the control N₀. This might be due to nitrogen significantly increases sucrose contents, recoverable sugar yield adding to the highest level of nitrogen and association exists between uptake and accumulation of nutrient in tuber and also between their combined role in enhancing the synthesis of sucrose content and accumulation in tubers, similar results were reported by Patil *et al.*, (1990) in sweet potato.

Table.1 Effect of graded levels of nitrogen and potassium on yield attributes and yield of sweet potato

Treatments (levels)	Length of tuber (cm)	Diameter of tuber (cm)	Number of tubers per plant	Weight of tuber plot (kg ha ⁻¹)	Yield (kg ha ⁻¹)	Dry matter tuber yield kg ha ⁻¹
Nitrogen levels						
N₀	14.03	4.13	7.98	6.85	11411	4662.98
N₁	16.90	4.92	8.42	9.91	16518	5916.24
N₂	17.68	6.07	8.99	12.89	21496	7116.97
N₃	18.58	6.24	9.36	13.44	22398	6737.65
SE±	0.46	0.13	0.25	0.24	407	216.08
CD @ 5%	1.35	0.38	0.73	0.72	1193	633.70
Potassium levels						
K₀	16.49	4.37	8.24	9.27	15447	5418.33
K₁	17.47	5.70	8.81	11.30	18825	6277.81
K₂	17.94	5.96	9.0	11.76	19597	6629.24
SE±	0.40	0.11	0.21	0.21	352	187.14
CD@ 5%	1.17	0.33	0.63	0.62	1033	548.80
Interaction (NxK)						
SE±	0.80	0.22	0.43	0.42	705	374.27
CD@ 5%	NS	0.65	NS	1.24	S	NS

NS = Non significance, S = Significance

Table.2 Interaction effects of graded levels of nitrogen and potassium on tuber yield of sweet potato

Levels	K₀	K₁	K₂	Mean
N₀	6944	12977	14311	11411
N₁	13983	17277	18294	16518
N₂	20044	21922	22522	21496
N₃	20811	23122	23261	22398
Mean	15445	18825	19597	
	SE±	C.D. @ 5 %		
N	407	1193		
K	352	1034		
Interaction (NxK)	705	2067		

NS = Non significance, S = Significance

Table.3 Effect of graded levels of nitrogen and potassium on quality parameters of sweet potato

Treatments	Fresh tuber weight (g)	Dry weight of tuber(g)	TSS (Brix)	Reducing sugar (%)	Non reducing sugar (%)	Total sugar (%)	Carbohydrates (%)	Specific gravity (gml ⁻¹)
Nitrogen levels								
N0	271.10	32.84	11.52	0.167	4.57	4.74	15.71	1.14
N1	365.51	34.07	11.96	0.192	5.74	5.93	16.01	1.096
N2	422.03	39.18	12.79	0.241	5.83	6.07	17.55	1.065
N3	451.49	40.57	13.37	0.268	6.58	6.85	18.01	1.04
SE±	11.24	0.429	0.189	0.004	0.086	0.085	0.288	0.014
CD@ 5%	32.96	1.26	0.555	0.011	0.253	0.251	0.844	0.040
Potassium levels								
K0	339.74	36.06	12.03	0.202	5.11	5.31	16.33	1.07
K1	375.85	36.55	12.47	0.218	5.70	5.92	16.85	1.07
K2	410.26	37.39	12.69	0.231	6.23	6.46	17.29	1.12
SE±	9.73	0.37	0.164	0.003	0.075	0.074	0.249	0.012
CD@ 5%	28.55	1.090	0.481	0.009	0.219	0.217	0.731	0.035
Interaction (NxK)								
SE±	19.47	0.743	0.328	0.006	0.149	0.148	0.498	0.024
CD@ 5%	NS	NS	NS	NS	NS	NS	NS	NS

NS = Non significance, S= significance

Fig.1 Effect of graded levels of nitrogen and potassium on sweet potato yield (kg ha⁻¹)

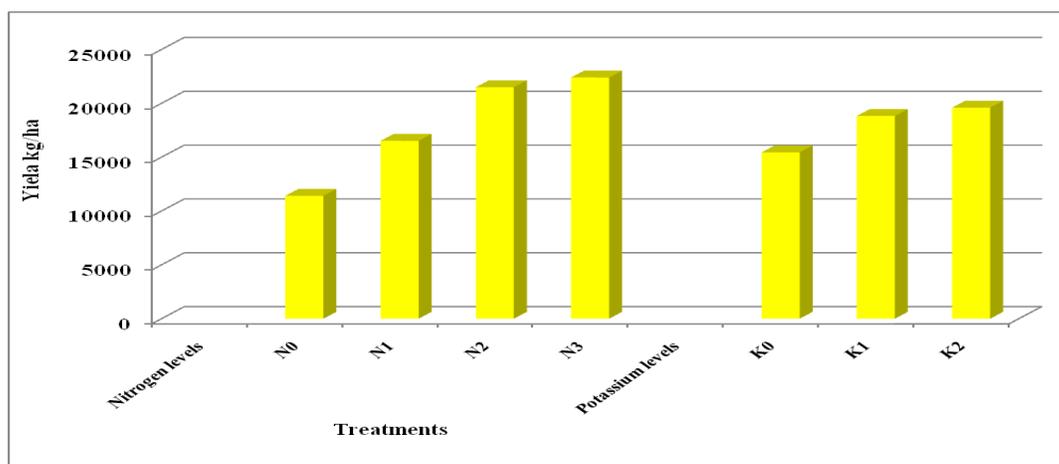


Fig.2 Length of tubers as influenced by graded levels of nitrogen and potassium

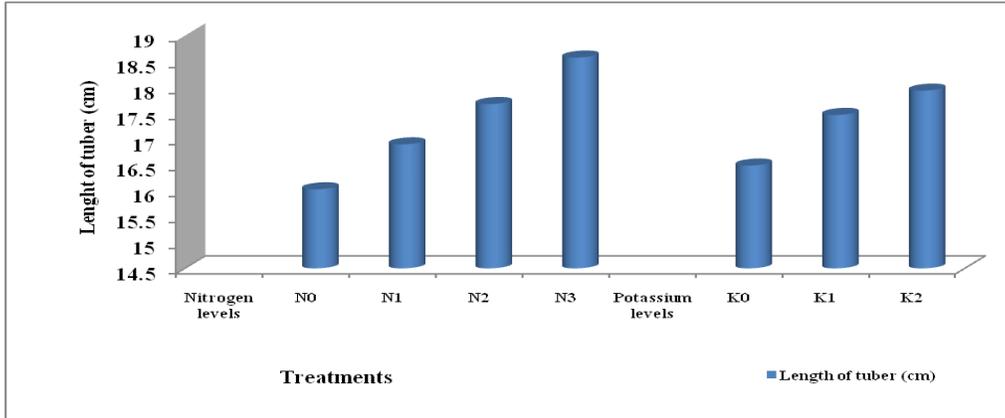


Fig.3 Diameter of tubers as influenced by graded levels of nitrogen and potassium

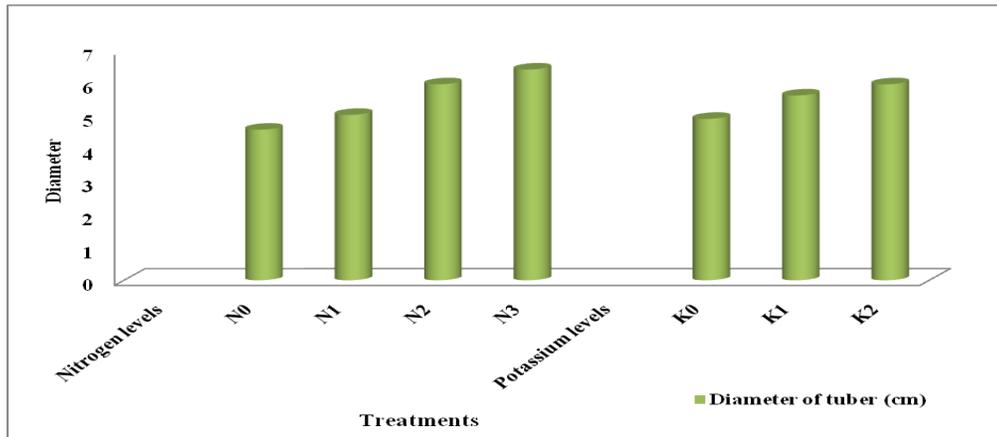


Fig.4 Sugar content of tuber as influenced by graded levels of nitrogen and Potassium (%)

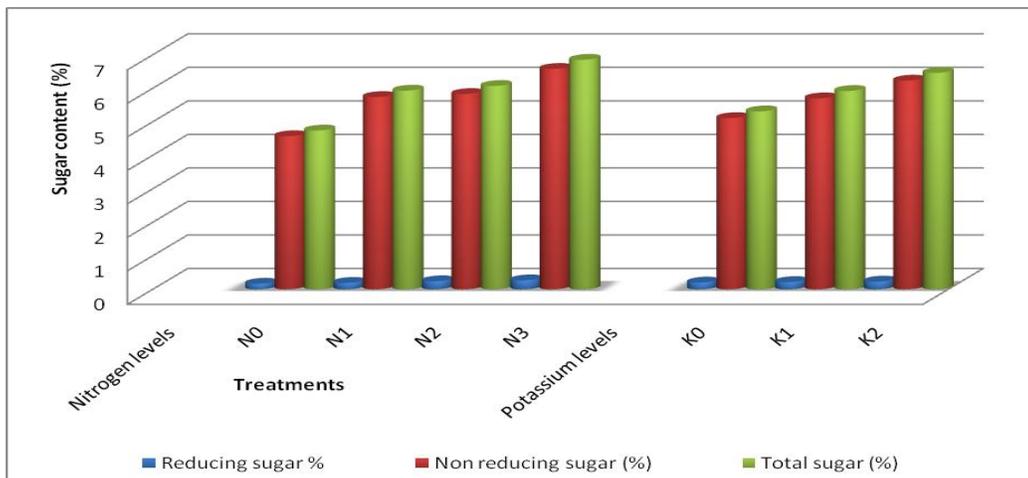
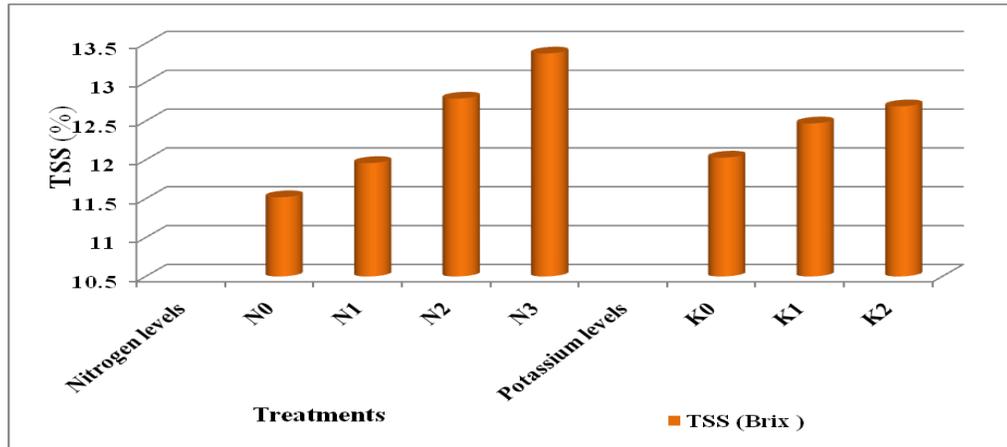


Fig.5 TSS content of tuber as influenced by graded levels of N and K



Effect of graded levels of potassium were significantly influenced on quality parameters (Table 3) viz. fresh tuber weight (410.26 g), dry tuber weight (37.39 cm), TSS (12.69 %), reducing sugar (0.232 %) non reducing sugar (6.23 %) and total sugar (6.46 cm), carbohydrates (17.29 %) was found in K₂ @ 100 kg/ha K₂O followed by rest of the treatments over the control K₀. Specific gravity of sweet potato tuber was significantly increase with decreases the levels of nitrogen fertilizer may be due to effect of higher dose of graded levels of nitrogen reduces the specific gravity of tubers influence of N on gibberellins biosynthesis and other phyto-hormonal activities which have direct influence on plant growth and dry matter accumulation same result was recorded by Mehran and Samod (2013), they observed that, the nitrogen significantly increases sucrose contents, recoverable sugar yield adding to the highest level of nitrogen (285 kg N ha⁻¹) in sugar beet crop. Potassium application there is significant increases with increases the specific gravity of tubers. The interaction between the different levels of fertilizers doesn't show any significant interaction in quality parameters (Figs 1–5).

In conclusion, from the result and discussion of this study can be concluded that the

achieving higher yield and yield attributing characters and improved quality parameters of sweet potato crop should be fertilized with 125 Kg N ha⁻¹ and 100 Kg K₂O ha⁻¹. But in specific gravity of sweet potato was observed increases the nitrogen fertilization decrease the specific gravity of sweet potato.

Acknowledgement

The work was supported by department of Soil Science and Agricultural Chemistry and Department of Horticulture, College of Agriculture Latur, Vasanth Roa Naik Marathwad Krishi Vidyapeet, Parbani (M H), India. We are thankful to Dr. P.H. Vaidy, and P.B. Adsul, for their assistance in the completion of this research work.

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How to cite this article:

Pushpalatha, M., P.H. Vaidya and Adsul, P.B. 2017. Effect of Graded Levels of Nitrogen and Potassium on Yield and Quality of Sweet Potato (*Ipomoea batatas* L.). *Int.J.Curr.Microbiol.App.Sci*. 6(5): 1689-1696. doi: <https://doi.org/10.20546/ijcmas.2017.605.183>