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Efficacy of Potassium Fertilizer Levels on the Growth and Yield of Sweet Potato (*Ipomoea Batatas L*) on the Jos Plateau

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Abstract :- The field experiment was carried out during the 2018 growing season at the Federal College of Forestry, demonstration farm to determine the efficacy of potassium fertilizer levels on the growth and yield of the sweet potato (*Ipomoea batatas L*). The treatments comprises of five levels of potassium fertilizer (0, 50, 100, 150 and 180 kg/ha) that were laid in a Randomized Complete Block Design (RCBD) replicated four times. The application of 200 kg /ha of potassium fertilizer produced the longest vines (70.60cm), the highest number of leaves (284.60), branches (16.40), number of flowers (12.20), number of tubers (13.20), and larger diameter tubers (6.42cm), while the application of 150Kg/ha produce the highest yield (23.47tons/ha). To achieve high yield of sweet potato, higher doses of potassium fertilizer should be applied by the farmers in the study area.

Keywords:- *Sweet potato, Potassium fertilizer, Growth, Yield components.*

I. INTRODUCTION

Root and tuber crops are staple foods in some countries in the tropics and contribute to the daily carbohydrate intake for large populations. Production of most of these crops requires a relatively long growing period (at least nine months), except for sweet potato and is limited to warmer climatic regions (Wayne and Wendy-Ann, 2012). Sweet potato (*Ipomoea batatas L.*) belongs to the family Convolvulaceae. It is a dicotyledonous plant with creeping perennial vines and adventitious roots. It originated in Central America and the North - Western part of South America and its production has stretched throughout the tropics (Pravin *et al*., 2017).

Sweet potato tubers are eaten fresh, boiled, canned, fried, baked or roasted by humans and can be fed to livestock as a source of energy. The leaves especially when young, make a good pot herb. The heavier yielding, coarser varieties are a useful source of fodder but cattle will only eat them fresh. The fresh dried stems and leaves makes excellent hay for all kinds of livestock. Flour, starch and alcohol are made from sweet potato. The sweet potato flour is used in sweetening local beverages such as "*Kunu-zaki"*, " *burukutu*", and pounded yam (fu-fu) in Nigeria (Tewe et al., 2003).

Macronutrients such as NPK are essential for the growth and development of all plants. These essential elements are found to be very vital for the production of sweet potato although it has rarely been reported to respond to phosphorus (Norman et al., 1995 as cited by Saraswati and Antonius, 2015), this may be as a result of its high phosphorus use efficiency. Potassium (K) is thought of to be one of the most important nutrients needed in the growth of sweet potato as its application increases yield and number, size, quality of tubers. Potassium is essential in the synthesis and translocation of carbohydrates from the leaves to the roots of the plant (Dumbuya et al,. 2017). According to Uwah et al. (2013), the yield of sweet potato is significantly reduced if potassium (K) is deficient, but reducing the phosphorous (P) does not seem to affect the yield of the crop.. Farmers in the tropics especially at subsistence level apply little or no fertilizer to sweet potato. Therefore, this study was aimed at determining the efficacy of potassium fertilizer levels on the growth and yield of sweet potato on the Jos plateau.

II. MATERIALS AND METHODS

➢ *The Study Site*

This study was carried out between July to November, 2018 at the Federal College of Forestry demonstration farm located in Jos, Plateau state. Jos, plateau is a region of the middle belt of Nigeria and located between latitude 7° and 11° North, longitude 7° and 25° East at an altitude of about 1200km above sea level. The area lies in the northern guinea savanna of Nigeria with an annual rainfall of 1460mm and a temperature of 19°C to 32°C, (Olowolafe et al., 2004).

➢ *Soil Analysis*

Soil samples from the study area were collected randomly at a depth of 0cm to 30cm to determine the physical and chemical properties. A soil analysis was carried out at ASTC (Agricultural Services and Training Center) KASSA, VOM, Jos, Plateau sate.

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Sample	PH	N (%)	P PPM	K PPM	Ca PM	MgPPM	O.M(%)	H+ mMol/ 100g	Clay (%)	Silt (%)	Sand (%)	Textural Class
0-30cm	5.9	0.036	6.2	95.9	532	102	115	157x10	10.88	12	77.12	Sandy loam

Table 1:- Physical and Chemical Properties of Soil in the Study Area (Source: - Agricultural Services and Training Center KASSA/VOM, 2018.)

The physical and chemical properties of the soil as presented in Table 1 showed that the soil PH was 5.9 which is slightly acidic. It is the preferred soil PH range for good growth and development of most crops. Organic matter had an average value of 115%, while the respective nutrient constituents of nitrogen, phosphorus, potassium, calcium and magnesium were 0.036%, 6.2, 95.9, 532 and 102ppm were in average quantities for optimum production of most crops. The soil can be classified as sandy loam. The percentage composition of sand, silt and clay (10.88% clay, 12% silt, and 77.12% sand) confirms that the presences of organic matter, which make the soil good for crop production.

Sweet potato cuttings (30cm vines containing 5 – 6 nodes) were obtained from National Root Crop Research Institute (NRCRI), Vom. Potassium (60% K_2O) fertilizer in the form of muriate of potash was used. The experiment was laid in randomised complete block design with five treatments (0, 50, 100, 150 and 200Kg/ha) replicated four times. The cuttings were planted at an angle of 45^o with at least 3 nodes buried at a spacing of 30cm between plants. Growth and yield characteristics were recorded on vine length, vine girth, number of branches, number of leaves, number of tubers per plant, weight of tuber per plant, diameter of tuber, length of tuber, yield per plot, yield per hacter and dry matter.

III. RESULTS AND DISCUSSIONS

Potassium (Kg/ha)	Vine Length (cm)	Number of Leaves	Number of Branches
0	36.80a	165.80a	10.60a
50	65.40b	224.80c	12.40b
100	67.40c	238.60c	13.00bc
150	65.80b	201.20b	13.80c
200	70.60d	284.60d	16.40d
SE±	0.55	7.38	0.41
LS	*	*	*

Table 2: Efficacy of Potassium Fertilizer Levels on the Growth Characteristics of Sweet Potato (*Ipomoea batatas L*) **(**Source: Field Experiment 2018)

Means within a column having same letters are not significantly different at $P \leq 0.05$.
LS = level of significance at 0.05
* = Significant

➢ *Vine Length:*

The result from table 2 indicate that the application of 200Kg/ha of potassium fertilizer produce the highest (70.60cm) mean vine length followed by the application of 100Kg/ha (67.40cm), then 50Kg/ha and 150Kg/ha (65.40cm and 65.80cm) respectively. The least was obtained with the application of no potassium 0Kg/ha (36.80cm). The mean separation shows that there is significant difference of vine length at different level of potassium application at 5% level of probability.

➢ *Number of Leaves:*

Significant difference was observed at 5% level of probability on number of leaves. The application of 200Kg/ha shows the highest (284.60) number of leaves, 50Kg/ha and 100Kg/ha produces (224.80 and 238.60) leaves respectively. While the control (0Kg/ha) produces (165.80) the least number of leaves.

➢ *Number of Branches:*

The number of branches on different application levels showed significant differences at 5% level of probability. On the application of 200Kg/ha, 16.40 branches were obtained, 150Kg/ha produces 13.80 branches, 100Kg/ha produces 13.00 branches, 50Kg/ha produces 12.40 branches and no application (0Kg/ha) produces 10.60 branches.

The significant effect of potassium fertilizer levels on growth characteristics (vine length, number of leaves and number of branches) corroborates the report by (Uwa et al., 2013) that there was a significant increase in vine length, number of leaves and branches per plant following the application potassium fertilizer to sweet potato. Njoku et al. (2001) opined that nitrogen (N) and potassium (K) were critical to sweet potato production, while Trehan et al. (2009) was of the view that the application of potassium (K) increases vine length, crop vigour, leaf expansion particularly at early stages of growth and extended leaf area duration. This effect might be attributed to the importance of potassium in the nutrition of sweet potato. Potassium also increases the photosynthetic rates in the leaves and CO_2 assimilation which facilitates carbon movement and improves the amount of potassium in the soil which in turn enhances nitrogen uptake by the plant (Dunbuya et al., 2017).

Potassium (Kg/ha)	Number of Flowers	Number of Tubers/Plant	Diameter of Tuber (cm)	Length of Tuber (cm)	Weight of Tuber (Kg)	Yield (Kg/Plot)	Yield (tons/ha)	Dry matter (tons/ha)
0	7.40a	7.80a	4.24a	15.50a	9.32a	5.54a	13.7a	5.14a
50	8.60ab	8.40a	5.46c	18.36c	12.40b	6.92b	17.34b	6.91b
100	10.60c	10.80b	4.58ab	16.90b	16.02c	8.34c	21.23c	6.77b
150	9.80bc	12.40c	5.30bc	19.64d	19.92d	9.28d	23.47d	4.62a
200	12.20d	13.20c	6.42d	17.56bc	22.18e	8.36c	21.45c	7.17b
SE±	0.43	0.42	0.25	0.33	0.62	0.20	3.53	4.54
LS	*	*	*	*	*	*	*	*

Table 3: Efficacy of Potassium Fertilizer Levels on the Yield Characteristics of Sweet Potato (*Ipomoea batatas L*)
(Source: Field Experiment 2018)

Means within a column having same letters are not significantly different at $P \leq 0.05$.
LS = level of significance at 0.05
* = Significant

➢ *Number of Flowers:*

Table 3 shows the result obtained on yield and yield components of cassava as produced by different levels of potassium fertilizer application. The findings indicate that significant difference exist between the different application levels of potassium on the number of flowers. The highest (12.20) flowers were obtained on the application of 200Kg/ha, 10.60 flowers for 100Kg/ha application, 9.80 flowers for 150Kg/ha, 8.60 flowers for 50Kg/ha and 7.40 flowers for the control (no application).

➢ *Number of Tubers/Plant:*

The results also reveal that there is significant difference in the number of tubers produced at different level of potassium fertilizer application. 200Kg/ha and 150Kg/ha produce 13.20 and 12.40 tubers of sweet potato respectively. The application of 100Kg/ha produces 10.80 tubers while 50Kg/ha and the control produces 8.40 and 7.80 tubers respectively.

➢ *Diameter of Tuber:*

Significant difference was observed on diameter of the tubers at different potassium level. The highest (6.40cm) tuber diameter was obtained at the application of 200Kg/ha potassium fertilizer followed by the application of 50Kg/ha (50.46cm), then 150Kg/ha (50.30cm), the lowest (4.58cm and 4.24cm) tuber diameter was obtained at 100Kg/ha and 0Kg/ha potassium fertilizer application respectively.

➢ *Length of Tuber:*

The application of 150Kg/ha produces the longest (19.64cm) sweet potato tuber, then 50Kg/ha (18.36cm), 200Kg/ha (17.56cm), 100Kg/ha (16.90cm) while the application of 0Kg/ha produce the shortest (15.50cm) tuber.

➢ *Weight of Tuber:*

Significant increase in weight (22.18Kg) of sweet potato tuber was obtained on the application of 200Kg/ha of potassium fertilizer as against the application of 150Kg/ha (19.92Kg), 100Kg/ha (16.02Kg), 50Kg/ha (12.40Kg) and 0Kg/ha (9.32Kg).

➢ *Yield:*

Sweet potato yield was significantly higher at the application of 150Kg/ha (23.47tons/ha) than the application of 200Kg/ha and 100Kg/ha (21.45tons/ha and 21.23tons/ha) respectively. The application of 50Kg/ha and 0Kg/ha yielded 17.34tons/ha and 13.7tons/ha respectively.

➢ *Dry matter:*

The result of analysis on dry matter weight indicates significant difference between the different levels of potassium fertilizer application. The application of 200Kg/ha (7.17tons/ha), 100Kg/ha (6.77tons/ha) and 50Kg/ha (9.91tons/ha) are not significantly different. Likewise, the application of 150Kg/ha (4.62tons/ha) and 0Kg/ha (5.14tons/ha) shows no significant difference between them.

According Ummar and Moinuddin (2001), application of potassium up to 120 kg K_2O/ha led to increased tuber yield. Moinuddinet al. (2005) also reported similar result at the application of potassium 150 kg K_2O /ha. Saraswati and Antonius (2015) reported that decline on sweet potato yield was observed as a result of reduce potassium rate application. Significant increase in tuber yield per plot and tuber yield per hactre were observed with increase in levels of potassium up to 120 kg K_2O ha^{-1} (Pravin et al., 2017). Potassium has an important role in improving sweet potato yield as indicated by Abd EI-Baky et al. (2010). He observed that the maximum estimated sweet potato yield was obtained with combination of the rate of 120 kg K2O/fed applied to the application of 30 ppm zinc.

IV. CONCLUSION

This research study revealed that the application of 200Kg/ha of Potassium fertilizer produced the highest growth (vine length, number of leaves and number of branches) and yield (number of flowers, number of tubers, weight of tubers and yield) characteristics of sweet potato. For optimum sweet potato production, 200kg/ha is recommended for the study area.

REFERENCE

[1]. Abd El-Baky, M.M.H., Ahmed, A.A., El-Nemr, M.A. and Zaki, M.F. (2010) Effect of Potassium Fertilizer and Foliar Zinc Application on Yield and Quality of Sweet Potato. Journal of Agriculture and Biological Sciences, 6(4):386-394.

[2]. D. F. Uwah, U. L. Undie, N. M. John and G. O. Ukoha(2013) Growth and Yield Response of Improved Sweet Potato (Ipomoea batatas (L.) Lam) Varieties to Different Rates of Potassium Fertilizer in Calabar, Nigeria. Journal of Agricultural Science; Vol. 5, No. 7; ISSN 1916-9752 E-ISSN 1916-9760 Published by Canadian Center of Science and Education

[3]. Dumbuya, G., Sarkodie-Addo J., Daramy, M. A., Jalloh, M. (2017) Effect of Vine Cutting Length and Potassium Fertilizer Rates on Sweet Potato Growth and Yield Components. International Journal of Agriculture and Forestry, 7(4): 88-94 DOI: 10.5923/j.ijaf.20170704.02

[4]. Njoku, J. C., Okpara, D. A., & Asiegbu, J. E. (2001) Growth and yield response of sweet potato to inorganic nitrogen and potassium in a tropical Ultisol. Nigerian Agricultual Journal, 32, 30-41.

[5]. Pravin, S., Kavita, A., Maurya, I. B. Jitendra, S., Bhim, S. and. Sharma, M. K (2017) Effect of potassium and zinc on growth, yield and economics of sweet potato (*Ipomoea batatas L.*) cv. CO-34 Journal of Applied and Natural Science 9 (1): 291 – 297

[6]. Saraswati, P. and Antonius, S. (2015) Water Use Efficiency and Yield of Sweet Potato as Affected by Nitrogen and Potassium Application. Journal of Agricultural Science; Vol. 7, No. 7; ISSN 1916-9752 E-ISSN 1916-9760 Published by Canadian Center of Science and Education.

[7]. Tewe, O. O., Abu, O. A., Ojeniyi, E. F., & Nwokocha, N. H. (2003). In M. O. Akoroda, & J. M. Ngere (Eds.), Proceedings of the Triennial Symposium of the International Society for Tropical Root Crops (pp. 65-74). African Branch (ISTRC – AB).

[8]. Trehan, S. P., Pandey, S. K., & Bansal, S. K. (2009). Potassium Nutrition of Potato Crops – The Indian Scenario (pp. 2-9). e-ife No. 19.

[9]. Uwah, D. F., Undie U. L., John N. M. and Ukoha G. O. (2013). Growth and yield response of improved sweet potato (Ipomoea batatas (L.) Lam) varieties to different rates of potassium fertilizer in Calabar, Nigeria. Journal of Agricultural Science 5(7) pages 61 – 69.

[10]. Wayne, G. G. and Wendy-Ann, P. I. (2012) Sustainable Food Production Practices in the Caribbean. Ian Randy Publishers, 11 Cunningham Avenue, Kingston 6. Pp129, ISBN978-637-624-6.