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Original Research Article

Quality Assessment of Sweetpotato Roots (*Ipomoea batatas* L.) as Influenced by Ridge Height, Vine Cutting and Vine Orientation

*[1]Yakubu, Haruna, [2]Kabir Kauthar and [3]Sambo Banake Elisha

[1]Department of Crop Science, Federal University Dutse, Jigawa State, Nigeria
[2]Department of Agronomy, Faculty of Agriculture, Federal University Dutsin-Ma, Katsina State, Nigeria.
[3]Department of Crop Production and Protection, Faculty of Agriculture, Federal University Wukari, Taraba State, Nigeria.
*Corresponding Author's email: hyakubu2@gmail.com Phone: +2348036828215

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ABSTRACT
Sweetpotato in sub-saharan Africa is presently receiving attention as it is a cheap source of calories and helps in the fight against malnutrition. In view of these, two field trials were conducted during the 2016 and 2017 rainy seasons at the Research Farm Federal University Dutse (11°70' N, 9°34' E, and 460 m above sea level, in the Sudan savannah zone of Nigeria to determine effect of ridge height, vine cutting and vine orientation on nutritional quality of sweetpotato. The treatments consisted of ridge heights (0 cm (flat ground), 30 cm, 40 cm, 50 cm and 60 cm), vine cuttings (apical, mid and basal) and vine orientations (45°, 90° and 180°) laid out in a split plot design, with the ridge heights and vine cuttings in the main plot and vine orientations in the sub plot and replicated three times. Ridging had significant effects on quality attributes with higher quantities of nutrient elements in higher ridges. Carbohydrate content was higher in the apical vine cutting, calcium and crude fibre contents were higher in the base than in other vine cuttings. In conclusion it can be recommended that for better plant establishment and subsequent root yield and better quality attributes ridging from 30cm, apical vine cuttings should be used. For higher fibre content the basal vine cutting should be used.

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INTRODUCTION

Sweetpotato (*Ipomoea batatas* L. Lam) is an important untapped food crop in many parts of the world (Woolfe, 1992). It is a cheap source of calories and has a long history to stave off famine (Adam, 2005). Due to its higher productivity per unit area, low level of agricultural input requirement, good nutritional value and drought tolerance, the crop can play a vital role in achieving self-sufficiency in food production of the Sub-Saharan African countries (Amara *et al.*, 2014). Besides simple starches, sweet potatoes are rich in complex carbohydrates, dietary fiber, beta carotene (vitamin A equivalent nutrient), calcium, iron, zinc, vitamin C, and vitamin B6. According to FAO 1990, sweet potato leaves and shoots are good sources of vitamins A, C, and B2 (Riboflavin) and lutein. Sweet potato root vegetable qualified as an excellent source of vitamin A (in the form of betacarotene), a very good source of vitamin C and manganese, and a good source of copper, dietary fiber, vitamin B6, potassium and iron .

The crop's ability to adapt to marginal environments has made it popular with resource-poor farmers as good yields have been obtained with minimum use of fertilizers, sufficient moisture and a combination of other appropriate cultural practices (Parwada *et.al*, 2011). When compared with other root and tuber crops, sweet potato yields produce considerably high amount of energy per unit area such that it comes third to the potato (*Solanum tuberosum*) and cassava (*Manihot esculenta*) in production across the world. Within the African cropping systems, sweet potato has several advantages. It produces food in a relatively short time, gives reliable yields in sub-optimal growth conditions, requires lower labour inputs (appropriate for vulnerable households) than other staples, serves as an alternative food source for urban populations, facing increasing prices of cereals, provides a potential option to reduce vitamin A deficiency (Andreas *et al.*, 2009). Orange fleshed sweet potato (OFSP) varieties also provide vitamins A and C (Laban *et al.*, 2015). As with all crops, the nutritional composition of roots and tubers varies from place to place depending on the climate, the soil, the crop variety and other factors. Ash, carotenoid, carbohydrate, crude protein, crude fibre, calcium, iron and zinc contents of sweetpotato were seen to be varying based on the different treatments. Akinboye *et al*. (2015) and Parwada *et al*. (2011), observed that such could be as a result of ridge and mound with loosened and rich top soil around the planting zone making better use of production elements (water, light, nutrient solution) in the soil leading to increased photosynthetic efficiency thereby increasing photosynthates storage in the roots. The nature of the cutting and angle of planting might also influence the quantity of nutrient elements (Belehu, 2003; Nedunchezhiyan *et al.,* 2012). In view of this, the need to establish the best ridge height to enhance reliable, vine cutting and vine orientations to influence higher amounts of these nutrients in the edible roots.

MATERIALS AND METHODS

Experimental site

The experiments were carried out during the 2016 and 2017 rainy seasons at Faculty of Agriculture Research Farm, Federal University Dutse (11°70' N, 9°34' E, and 460 m above sea level, within the Sudan savannah zone of Nigeria.

Treatments and experimental design

The experiment consisted of ridge heights (flat, 30cm, 40cm, 50cm and 60cm), vine cuttings (apical, mid and basal portions) and vine orientations (45°, 90° and 180°). The treatments were laid out in a split plot design, with the ridge heights and vine cuttings in the main plot and vine orientations in the sub plot and replicated three times.

Soil sampling

Before planting soil samples were collected randomly from 5 points each at the two experimental sites, at a depth of 0-30 cm using an auger and then bulked according to site, dried and processed. The physico-chemical properties of the soils were determined using standard procedures as described by Black (1965).

Cultural practices

Variety used is Dan China (Skin Colour- cream; Flesh colour- white; maturity period; 3 months). The experimental field was cleared, ploughed, harrowed and ridged to create a favourable condition for plant establishment. Sweet potato vines 30 cm long were planted (one third of the length will be buried in the soil) on the flat (0cm), ridges 30cm, 40cm, 50cm and 60cm according to the field layout at spacing of 75cm × 30cm.
Twelve (12) bags of NPK 15:15:15 fertilizer was applied per hectare at 4 weeks after planting (WAP) as recommended for the region (Chude *et. al.,* 2011). Weed control was carried out manually using hoe at 3 and 6 weeks after planting. After each weeding, the ridges were earthened up to maintain the ridge height for each plot. The roots were manually harvested using hoe when the sweetpotato roots were mature.

Data collected

Crude fibre content, Carbohydrate content, Calcium content which were determined using the official methods of analysis described by Association of Official Analytical Chemist (AOAC) (2005).

Data analysis

Data collected were subjected to analysis of variance as described by Snedecor and Cochran (1976), using JMP Pro 14 statistical software. Mean separation was carried using the Student–Newman–Keuls (SNK) method.

RESULTS AND DISCUSSION

Crude Fibre Content (%)

The effects of ridge height, vine cutting and vine orientation on crude fibre content during the 2016 rainy seasons at Dutse respectively is shown in Table 1. Significant differences ($P<0.001$) were observed among the different ridge heights in 2016. Sixty (60 cm) ridge had the highest crude fibre content while lowest crude fibre content was observed from 50 cm ridge which was at par with flat (0cm) and 40cm.
Vine cuttings showed significant differences ($P<0.029$) in 2017 where the base had the highest crude fibre content though statistically at par with the apical vine cutting, while the middle had the lowest crude fibre content. There was no significant difference among the vine orientations.
Interaction between ridge height and vine cutting were significant ($P<0.001$) in 2016 (Table 1). In 2016, 60 cm ridge and apical vine cutting had highest crude fibre content, while 40 cm and apical vine cutting had lowest crude fibre content (Table 2).

Table 1: Effects of Ridge Height (cm), Vine Cutting and Vine Orientation (˚) on Crude Fibre Content (%) of Sweetpotato during the 2016 and 2017 Rainy Seasons at Dutse

	Crude Fibre	
Treatment	**2016**	**2017**
Ridge Height		
0	1.037c	1.466
30	1.130b	1.581
40	1.040bc	1.329
50	1.034c	1.347
60	1.314a	1.653
SE±	0.030	0.107
Vine Cutting		
Apical	1.097	1.588a
Middle	1.126	1.238b
Base	1.110	1.599a
SE±	0.022	0.083
Vine Orientation		
45	1.151	1.437
90	1.092	1.600
180	1.090	1.389
SE±	0.022	0.120
Interaction		
RH×VC	**	NS
RH×VO	NS	NS
VC×VO	NS	NS
RH×VC×VO	NS	NS

Means followed by the same letter(s) are not significantly different at 5% level of probability using SNK.

Table 2: Interaction between Ridge Height (cm) and Vine Cutting on Crude Fibre Content (%) of Sweet potato during the 2016 Rainy Season at Dutse

	Vine Cutting		
Ridge Height	**Apical**	**Middle**	**Base**
0	0.899h	0.992g	1.220cd
30	1.147de	1.092ef	1.151c-e
40	0.786i	1.113ef	1.221c
50	1.018g	1.041fg	1.042fg
60	1.638a	1.392b	0.913h
SE (±)	0.025		

Means followed by the same letter(s) are not significantly different at 5% level of probability using SNK.

Carbohydrate Content (%)

The effects of ridge height, vine cutting and vine orientation on carbohydrate content during the 2016 and 2017 rainy seasons at Dutse is shown in Table 3. There was significant difference (P<0.001) among the ridge heights in 2016 and 2017. Sixty (60 cm) ridge had the highest carbohydrate content in 2016 and 2017, and were statistically similar with 30cm ridge, while 50cm ridge had the lowest carbohydrate content.

Significant differences (P<0.001) were also observed among the vine cuttings. The apical vine cutting had the highest carbohydrate content in 2016 and 2017, while the lowest carbohydrate content was from base. No significant difference was observed among vine orientations.

There was significant interaction (P<0.001) between ridge height and vine cutting. In both 2016 and 2017, 60 cm ridge and apical vine cutting had the highest carbohydrate content while the lowest carbohydrate content was observed from 40cm ridge and middle and at par with 50cm ridge and base (Tables 4 and 5). No significant interaction was observed between vine cutting and vine orientation in 2016 and 2017.

Table 3: Effects of Ridge Height (cm), Vine Cutting and Vine Orientation (˚) on Carbohydrate Content (%) of Sweetpotato during the 2016 and 2017 Rainy Seasons at Dutse

	Carbohydrate	
Treatment	**2016**	**2017**
Ridge Height		
0	68.69b	69.25b
30	70.27ab	70.70ab
40	61.60d	61.50d
50	64.92c	61.45c
60	71.47a	71.75a
SE±	0.832	0.511
Vine Cutting		
Apical	69.58a	69.88a
Middle	67.56b	67.85b
Base	65.04c	65.45c
SE±	0.593	0.396
Vine Orientation		
45	69.58	67.38
90	67.56	67.77
180	65.04	68.04
SE±	0.593	0.852
Interaction		
RH×VC	**	**
RH×VO	NS	NS
VC×VO	NS	NS
RH×VC×VO	NS	NS

Means followed by the same letter(s) are not significantly different at 5% level of probability using SNK.

Table 4: Interaction between Ridge Height (cm) and Vine Cutting on Carbohydrate Content (%) of Sweetpotato during the 2016 Rainy Season at Dutse

	Vine Cutting		
Ridge Height	**Apical**	**Middle**	**Base**
0	69.44b-e	67.52c-g	69.11b-f
30	69.58b-e	72.83b	68.41b-g
40	64.38g	55.51h	64.92fg
50	66.40d-g	71.34bc	57.03h
60	78.12a	70.59b-d	65.71e-g
SE (±)	1.550		

Means followed by the same letter(s) are not significantly different at 5% level of probability using SNK.

Table 5: Interaction between Ridge Height (cm) and Vine Cutting on Carbohydrate Content (%) of Sweetpotato during the 2017 Rainy Season at Dutse.

	Vine Cutting		
Ridge Height	**Apical**	**Middle**	**Base**
0	69.82c-e	68.24e-g	69.68c-f
30	70.17c-e	73.03b	68.91d-f
40	63.98i	55.52j	64.99h-i
50	67.12f-h	71.56bc	57.68j
60	78.33a	70.92b-d	66.00g-i
SE (±)	0.886		

Means followed by the same letter(s) are not significantly different at 5% level of probability using SNK.

Calcium Content (mg/kg)

The effects of ridge height, vine cutting and vine orientation on calcium content during the 2016 and 2017 rainy seasons at Dutse is shown in Table 6. There were significant differences (P<0.001) among means. Thirty (30 cm) ridge height had the highest calcium content in 2016 and 2017, but was statistically at par with 60 cm ridge and flat (0cm). The lowest calcium content was observed from 50 cm ridge height in 2016 and 2017. Statistical differences (P<0.001) were observed among vine cuttings. Base had the highest calcium content, while apical vine cuttings had the lowest calcium content but was at par with middle in 2017. There was no significant difference among vine orientations during the entire period of the experiment.

Significant interaction (P<0.001) was observed between ridge height and vine cutting in 2016 and 2017. Thirty (30cm) ridge and base had the highest calcium content in 2016 and 2017, while 40cm ridge and apical vine cutting had the lowest calcium content in 2016, Fifty (50cm) ridge and the base had the lowest calcium content at Dutse 2017 (Tables 7 and 8). Vine cuttings and vine orientation also had significant interactions (P=0.038) in 2016 and 2017 (Table 9 and 10). Base and 90° had the highest calcium content even though having similarities statistically with middle and 45°, middle and 90° and base and 180°, while apical vine cutting and 45° had the lowest calcium content. Base and 90° had the highest calcium content but statistically similar to middle and 45°, base and 45°, and base and 180°. Apical vine cutting and 45° had lowest calcium content though statistically similar to apical vine cutting and 90°, apical vine cutting and 180°, and middle and 90°.

Interactions between ridge height, vine cutting and vine orientation was significant (P<0.001) in both 2016 and 2017 (Tables 11 and 12). Thirty (30cm) ridge, base and 90° had the highest calcium content. The lowest calcium content was observed from 40cm ridge, apical vine cutting and 45° but was statistically at par with 50cm ridge, base and 45°.

Table 6: Effects of Ridge Height (cm), Vine Cutting and Vine Orientation (˚) on Calcium Content (mg/kg) of Sweet Potato during the 2016 and 2017 Rainy Seasons at Dutse

	Calcium	
Treatment	**2016**	**2017**
Ridge Height		
0	343.3a	346.0a
30	350.4a	350.9a
40	314.4b	314.9b
50	295.2c	295.8c
60	348.2a	349.5a
SE±	4.208	4.245
Vine Cutting		
Apical	319.2c	320.9b
Middle	329.7b	330.1b
Base	342.0a	342.7a
SE±	2.977	3.017
Vine Orientation		
45	327.8	328.3
90	330.5	331.2
180	332.6	334.2
SE±	2.977	3.017
Interaction		
RH×VC	**	**
RH×VO	NS	NS
VC×VO	*	*
RH×VC×VO	**	**

Means followed by the same letter(s) are not significantly different at 5% level of probability using SNK.

Table 7: Interaction between Ridge Height (cm) and Vine Cutting on Calcium Content (mg/kg) of Sweetpotato during the 2016 Rainy Season at Dutse

	Vine Cutting		
Ridge Height	**Apical**	**Middle**	**Base**
0	354.7c	340.6e	334.7f
30	328.4gh	313.8i	408.9a
40	261.6k	333.3fg	348.2d
50	303.3j	333.0fg	249.4l
60	348.0d	327.7h	368.8b
SE (±)	1.74		

Means followed by the same letter(s) are not significantly different at 5% level of probability using SNK.

Table 8: Interaction between Ridge Height (cm) and Vine Cutting on Calcium Content (mg/kg) of Sweetpotato during the 2017 Rainy Season at Dutse

	Vine Cutting		
Ridge Height	**Apical**	**Middle**	**Base**
0	361.5c	341.1de	335.5ef
30	328.6f	314.4g	409.7a
40	262.3i	333.7ef	348.5d
50	304.0h	333.2f	250.3j
60	348.0d	328.3f	369.4b
SE (±)	2.60		

Means followed by the same letter(s) are not significantly different at 5% level of probability using SNK.

Table 9: Interaction between Vine Cutting and Vine Orientation (˚) on Calcium Content (mg/kg) of Sweetpotato during the 2016 Rainy Season at Dutse

	Vine Orientation		
Vine Cutting	**45**	**90**	**180**
Apical	308.1f	325.9b-f	323.7c-f
Middle	342.2ab	313.5df	333.4b-d
Base	333.1a-e	352.2a	340.7a-c
SE (±)	6.24		

Means followed by the same letter(s) are not significantly different at 5% level of probability using SNK.

Table10: Interaction between Vine Cutting and Vine Orientation (˚) on Calcium Content (mg/kg) of Sweetpotato during the 2017 Rainy Season at Dutse

	Vine Orientation		
Vine Cutting	**45**	**90**	**180**
Apical	308.4e	326.3b-e	328.0b-e
Middle	343.0ab	313.8ce	333.6bc
Base	333.5a-d	353.5a	341.0ab
SE (±)	6.24		

Means followed by the same letter(s) are not significantly different at 5% level of probability using SNK.

Table 11: Interaction between Ridge Height (cm), Vine Cutting and Vine orientation (˚) on Calcium Content (mg/kg) of Sweetpotato during the 2016 Rainy Season at Dutse

		Vine Orientation		
Ridge Height	**Vine Cutting**	**45**	**90**	**180**
	Apical	364.3b-i	347.3c-l	352.3b-k
0	Middle	374.8b-e	306.6m-r	340.5d-o
	Base	301.1o-s	322.9j-q	380.2bc
	Apical	313.6k-q	330.1h-p	341.5c-m
30	Middle	322.1j-q	265.9s-u	353.5b-j
	Base	365.6b-h	490.5a	370.6b-g
	Apical	231.8u	269.6r-u	283.5q-t
40	Middle	342.3c-m	335.1f-o	322.4j-q
	Base	372.5b-f	326.9f-p	345.2c-m
	Apical	295.5p-s	302.4n-s	312.0l-q
50	Middle	343.0c-m	331.7g-p	324.4j-p
	Base	237.9u	254.3tu	255.9tu
	Apical	335.0d-o	379.9b-d	329.0h-p
60	Middle	328.6h-p	328.5h-p	326.1i-p
	Base	388.4b	366.1b-h	351.8b-k
SE (±)	13.96			

Means followed by the same letter(s) are not significantly different at 5% level of probability using SNK.

Table 12: Interaction between Ridge Height (cm), Vine Cutting and Vine Orientation (˚) on Calcium Content (mg/kg) of Sweetpotato during the 2017 Rainy Season at Dutse

		Vine Orientation		
Ridge Height	**Vine Cutting**	**45**	**90**	**180**
	Apical	364.3b-k	347.6c-n	372.6b-f
0	Middle	375.b-e	306.6o-t	341.0c-q
	Base	301.9q-u	324.5l-r	380.2bc
	Apical	313.6m-s	330.1i-r	342.1c-p
30	Middle	323.6l-r	266.1u-x	353.5b-l
	Base	366.5b-j	491.9a	370.6b-h
	Apical	233.0x	270.5t-x	283.5s-w
40	Middle	342.3c-p	335.9f-q	323.1l-r
	Base	372.5b-g	327.3g-r	345.6c-o
	Apical	296.2r-v	303.2p-u	312.7n-s
50	Middle	343.4c-o	331.7h-r	324.4l-r
	Base	237.9x	256.9v-x	255.9wx
	Apical	335.0d-r	379.9b-d	329.0i-r
60	Middle	330.3i-r	328.5i-r	326.1k-r
	Base	388.8b	366.8b-i	352.5b-m
SE (±)	13.96			

Means followed by the same letter(s) are not significantly different at 5% level of probability using SNK.

Discussion

As with all crops, the nutritional composition of roots and tubers varies from place to place depending on the climate, the soil, the crop variety and other factors. carbohydrate, crude fibre and calcium contents of sweetpotato were seen to be varying based on the different treatments. The varying quantities of the elements varied among the different ridge heights, with 60 cm having higher crude fibre, carbohydrate and calcium contents. Parwada *et al*. (2011) and Akinboye *et al*. (2015), observed that such could be as a result of ridge and mound with loosened and rich top soil around the planting zone making better use of production elements (water, light, nutrient solution) in the soil leading to increased photosynthetic efficiency thereby increasing photosynthates storage in the roots. Crude fibre and carbohydrate contents were higher in the apical vine cutting, and can be as a result of faster growth and more dry matter accumulation in the apex as compared to the base. Young nodes near the vine apex develop typically healthy performing root primordial and this might be the reason for apical cuttings to be more productive as compared to basal cuttings (Belehu, 2003). Calcium content was higher in the base than in other vine cuttings. The reason could be due to the nature of the cutting, which is older and woody, and might have led to the accumulation of these elements. Belehu (2003) and Nedunchezhiyan *et al.* (2012) mentioned that basal portions of the vines are usually thick and woody. Agyarko *et al.* (2014) noted that, generally the nutrient levels of the sweetpotato tubers could be influenced from nutrient status of the soils. Such observations are not uncommon as previous experiments have shown positive correlations between soil nutrients and plant tissue nutrients content (Radwan and Awad*,* 2002; Agyarko *et al.,* 2006; Ouda and Mahadeen, 2008).

The different treatment interactions observed as they affected the quality of the sweetpotato roots could be attributed to the nature of soil and or weather rather than the varying ridge heights. Such observations are not uncommon as previous experiments have shown positive correlations between soil nutrients and plant tissue nutrients content (Radwan *et al.,* 2002; Agyarko *et al.,* 2006; Ouda and Mahadeen, 2008).

CONCLUSION

Higher ridges resulted in higher crude fibre and carbohydrate and calcium contents. The apical vines resulted in higher carbohydrate content. As such, it can be recommended that farmers in the agro-ecological zone adopt the use of ridges and apical vines for better quality attributes(calcium and carbohydrate contents).

REFERENCES

Adam, K . L. (2005). Sweetpotato Organic Production. Retrieved from http://attra.ncat.org/attrapub/sweetpotato. html.

Agyarko, K., Kwakye, P. K., Bonsu, M., Osei, B. A., and Agyei Frimpong, K. (2006). The Effect of Organic Soil Amendments on Root-knot Nematodes, Soil Nutrients and Growth of Carrot. *Journal of Agronomy* 5:641-646.

Agyarko, K., H.K. Dapaah, S. Buah and K.A. Frimpong, (2014). Sweet potato (*Ipomoea batatas*) yield parameters, soil chemical properties and cost benefit ratios following incorporation of poultry manure and inorganic NPK fertilizers in low nutrient Ghanaian soils. *Int. J. Plant Soil Sci.*, 3: 129-138.

Akinboye, O. E., Oyekale, K. O., Aiyelari, E. A. (2015). Effects of Land Preparation Methods on the Growth and Yield of Sweet Potato (*Ipomoea Batatas* LAM). *International Journal of Research in Agriculture and Forestry,* 2(1): 33-39.

Ali, A., S. A. Ayuba and S. O. Ojeniyi. 2006. Effect of tillage and fertilizer on soil chemical properties, leaf nutrient content and yield of soyabean in the guinea savanna zone of Nigeria. Niger. J. Soil Sci. 16:126-130.

Amara, B., Abay, F. and Tsehaye, Y. (2014). Evaluation of Sweetpotato (*Ipomea batatas* L.) Varieties for Total Storage Root Yield in South and South East Zones of Tigray. *Ethiopia. Am. J. Trade Policy*. 1: 74-78.

Andreas, O., Kapinga, R., Lemaga, B., Ortiz, O. Kroschel, J., and Lynam, J. (2009). Unleashing Potential of Sweetpotato in Sub-Saharan Africa. Challenge theme paper 5: Integrated Crop Management, International Potato Center (CIP), Social Sciences Working Paper 1. Pp 134-136.

Association of Official Analytical Chemist (AOAC) (2005). Official methods of analysis. Washington, D.C. *in Journal of AOAC International* 92(1):61-73·

Belehu, T. (2003). Effect of Planting Density and Cultivar on Yield and Yield Components of Sweetpotato in Ethiopia. University of Pretoria etd. Chapter 8: pp 174-185.

Black, C. A. (1965). Method of Soil Analysis, Part 2, Chemical and Microbiological Properties, American Society of Agronomy, Inc, Publisher, Madison, Wisconsin USA. Pp 776.

Chude, V. O., Olayiwola, S. O., Osho, A. O. and Daudu, C. K. (2011). Fertilizer Use and Management Practices for Crops in Nigeria 4th Edition, produced by Federal Fertilizer Department, Federal Ministry of Agriculture and Rural Development, Abuja, Nigeria. Pp 112-113.

Climate Charts (2016). Retrieved from http:// https://www.climate-charts.com/Countries/NIGERIA.html.

Laban, T. F., Peace, K., Robert, M., Maggiore, K., Hellen, M. and Muhumuza, J. (2015). Participatory Agronomic Performance and Sensory Evaluation of Selected Orange-Fleshed Sweetpotato Varieties in South Western Uganda. *Global J. Sci. Frontier Res.,* 15: 25-30.

Nedunchezhiyan M., G. Byju and S.K. Jata. (2012). Sweet Potato Agronomy. In: Nedun-chezhiyan M, Byju G (Eds) Sweet Potato. Fruit, Vegetable and Cereal Science and Biotechnology 6 (Special Issue 1), pp 1-10.

Ouda, B. A. and Mahadeen, A.Y. (2008). Effect of fertilizers on growth, yield, yield components, quality and certain nutrient contents in broccoli (Brassica oleracea). *International Journal of Agriculture and Biology,* 10(6): 627-632.

Parwada, C., Gadzirayi, C.T. and Sithole, A. B. (2011). Effect of Ridge Height and Planting Orientation on

Sweetpotato (*Ipomea batatas* L.) Production. *Journal of Agricultural Biotechnology and Sustainable Development* 3: 72-76.

Radwan, S. M. A. and Awad, N. M. (2002). Effect of Soil Amendment with Various Organic Wastes with Multi-Biofertilizer on Yield of Peanut Plants in Sandy Soil. *Journal of Agricultural Sciences of Mansoura Univ*.; 27:3129-3138.

Snedecor, G. W. and Cochran, W. G. (1976). Statistical Methods. The Iowa State University, 6th edition, Ames, Iowa, U.S.A. pp 593.

Woolfe, J. A. (1992). Sweetpotato: "An Untapped Food Resource'', Cambridge University Press. Pp 118-179.