EFFECT OF SALINITY ON EARLY GROWTH STAGE OF IRRIGATED FLUTED PUMPKIN (*Telfairia occidentalis*).

Chinedu Felix Amuji* and Ernest Ifeanyi Nweke
Department of Crop Science, Faculty of Agriculture, University of Nigeria Nsukka, Enugu State, Nigeria
*Corresponding author's email: felix.amuji@unn.edu.ng

ABSTRACT
Fluted pumpkin (*Telfairia occidentale* Hook. F.) is of a great economic importance in Nigeria. The young shoots and leaves of fluted pumpkin are harvested and can be consumed either raw or cooked. Despite the high nutritional value of fluted pumpkin and its importance, there is dearth of information on its methods of production and their constraints under certain conditions. It is necessary to determine how this plant responds to salinity with an aim to improve crop productivity under such condition. The objective of this research was to study the effects of salinity on early growth stage of irrigated fluted pumpkin. Completely randomized design (CRD) with ten replicates was used in this experiment to study the effect of three levels of salt (Sodium chloride-NaCl) on the early growth stage of this crop. The treatments were T1= 0g of NaCl as control (topsoil growth medium without added NaCl); T2= 10g of NaCl (10g of NaCl added to the 10 litre bowl of topsoil growth medium); and T3 = 20g of NaCl (20g of NaCl added to the 10 litre bowl of topsoil growth medium). The results of this study showed that effect of the NaCl on the irrigated early stage growth and yield of fluted pumpkin had no significant difference ($p>0.05$) in the parameters studied; although T3 gave the highest values for the parameters throughout the period of observation. Therefore, a continued cultivation of Fluted Pumpkin in Nsukka or areas with similar topsoil is encouraged in the event of climate change associated with increase in sodium chloride or related salt level.

Keywords: Early growth, Fluted pumpkin, Salinity stress, yield.

INTRODUCTION

Fluted pumpkin (*Telfairia occidentale* Hook. f.) is consumed for its edible shoots and leaves (Odiaka *et al*., 2008). Young shoots and leaves of fluted pumpkin are harvested and can be consumed either raw or cooked. The plant is of a great economic importance in Nigeria. It belongs to the family, *Cucurbitaceae* (Irvine, 1969). It is a source of vitamins and minerals (Akwaowo *et al*., 2000). Fluted pumpkin is grown in home gardens in urban and peri-urban areas of Nigeria to supplement income (Parthasarathy *et al*., 2004). Fluted pumpkin production can generate a steady income during the dry season when most other crops have stopped producing (Akpabio *et al*., 2008; Phillip *et al*., 2009). Fluted pumpkin is an important component of trade in countries bordering Nigeria (Ajayi, 2009). The increasing demand for Fluted pumpkin and the high yielding capacity has led to increased production (Ayinde *et al*., 2010).

Among the important indigenous vegetables, fluted pumpkin seems to be widely eaten in Nigeria and cultivated for its edible succulent shoots and leaves as a backyard crop mainly by the Igbo tribe. With the spread of Igbos to other parts of Nigeria, Fluted pumpkin is now cultivated in almost all the parts of the country (Akoroda *et al*., 1990). In the middle belt, which is in the Guinea savannah region of Nigeria, Fluted pumpkin is now being cultivated not only as backyard crop but also as commercial crop during the wet and dry season. The seeds are used as propagating materials, eaten roasted, boiled or ground to paste as soup thickener. Fluted pumpkin leaves are rich in Mg, Fe and fibres (Taylor *et al*., 1983) and are used as food supplements. The nutritional value of the fluted pumpkin seeds (53% fat and 27%) crude protein justifies the wide consumption as reported (Taylor *et al*., 1983). The seed has an excellent pattern of amino acids 93.7% which contains higher levels of most essential amino acids (except lysine) than soya bean meal with 94.9%. Even the K and Na availability are higher in Fluted pumpkin seed (58.8%) than that of soyabean seed cake (54.9%) (Esuoso *et al*., 1998). This indicates that Fluted pumpkin seed cake may be suitable to fortify foods, and the seed oil serves as food oil for making magarine. The high oil content makes it a potential source of raw material for the vegetable oil industries in Nigeria. These justify the apparent increase in its production in Nigeria. In some cases, Fluted pumpkin provides an appreciable cash income to small farm families (Akoroda *et al*., 1990). Despite the high nutritional value of Fluted pumpkin and its importance, there is dearth of information on its methods of production and their constraints.

It is necessary to determine how plants respond to high salinity with an aim to improve crop productivity under saline conditions. Biomass production/yield are considered valuable parameters when studying plant responses to salinity (Radwan *et al*., 2000). In this context, measuring the productivity parameters of Fluted pumpkin under saline conditions is a useful tool for adjusting the saline agriculture management practices. The objective of this research was to study the effects of salinity on early growth stage of irrigated Fluted pumpkin. The emphasis was on determining the plant response with respect to salinity level to which the plants were exposed.

MATERIALS AND METHOD

The experiment was carried out at the Department of crop science teaching and research farm, Faculty of Agriculture, University of Nigeria Nsukka between May to June, 2021. The agro-ecology of the experimental site is the derived savannah, located at latitude 6^0 51" E, longitude 7^0 29" N and altitude 477 meters above sea level (Anikwe, 2006). The relative humidity ranges from 69% to 79%. The mean annual rainfall ranges from 1155-1955 mm with mean annual temperature of 29^0C to 31^0C (Uguru *et al*., 2011). The soil's textural class is sandy loam with iso-hyperthermic soil temperature regime (Anikwe, 2006). The soil is classified as an Ultisol (Asiegbu, 1989).

Materials used for the study include: 10litre plastic buckets, topsoil, Fluted pumpkin '*ugu*' fruit, organic manure, permanent maker, measuring tape, meter rule, micrometre screw gauge. The fruits were procured from Orie Igbo-Eze market in Iheaka Town, Igbo Eze South L.G.A, Enugu state, Nigeria. The seed were sown directly into buckets filled with top soil and decomposed organic manure. Watering was done uniformly as the need arose.

Completely randomized design (CRD) with ten replicates was applied in the experiment: i.e. 10 plants per treatment × 3 NaCl levels; total of 30 plants. NaCl salinity was applied in the respective topsoil growth medium. The treatments were as follows: T1 = 0g of NaCl as control (topsoil growth medium without added NaCl), T2 = 10g of NaCl (10g of NaCl added to the topsoil growth medium), and T3 = 20g of NaCl (20g of NaCl added to the topsoil growth medium). These treatments were applied at the third week after planting of the fluted pumpkin seeds.

Data Collection: The following data were collected on weekly basis beginning from 4 weeks after planting (WAP) and ending at 6 WAP. Data were collected on: number of leaves; number of leaflets; vine length (cm). The number of leaves and leaflets were obtained by counting while the vine length was measured with a measuring tape in cm.

Data analysis: Analysis of variance (ANOVA) was performed on the collected data following the procedure for completely randomized designs (CRD) using GenStat Release 10.3 DE (2011). Mean separation across the treatments was done using Fisher's least significant difference (F-LSD) at 5% probability level as outlined by Obi (2002).

RESULTS

At 4 WAP the number of leaflets produced by the plants ranged from 24.4 to 30.5 with a mean of 26.7, while the number of leaves of the plants ranged from 9 to 13 with a mean of 11.3. The vine length in cm of the plants at this same period ranged from 23 cm to 29.8 cm with a mean of 26.1 cm. There were no significant differences ($p>0.05$) among the treatments in all these parameters measured at 4 WAP. There were no significant differences ($p>0.05$) among the treatments on the Fluted Pumpkin growth and yield parameters measured at this 5WAP. However, T3 i.e. NaCl at 20g levels, had the highest number of leaflets (33.7), number of leaves (14.1) and vine length (46.5 cm). Also, the control T1 i.e. NaCl at 0g levels, had the least values of 33.1, 11.8, and 33.7 cm for the number of leaflets, number of leaves and vine length, respectively. At 6 WAP the number of leaflets of the plants ranged from 42 to 47.1 with mean of 44.4, while the number of leaves of the plants ranged from 14.7 to 16.9 with a mean of 15.9. The vine length of the plants ranged from 40.5 cm to 49.3 cm with a mean of 44.6 cm. There were no significant differences ($p>0.05$) among the treatments at this 6 WAP. However, in all the parameters measured, the T3 i.e. NaCl at 20g levels had the highest values, followed by T2 i.e. NaCl at 10g levels. The control T1 i.e. NaCl at 0g levels, consistently had the values in all the parameters measured at this 6 WAP.

The treatments had no significant effect ($p<0.05$) on the parameters measured at 4,5 and 6 WAP. Furthermore, the T3 i.e. 20g levels of NaCl added to the topsoil growth medium, had the highest values in all the parameters measured at all these periods of observation. However, the least values of all the parameters were observed on the control i.e. 0g levels of NaCl. These findings were clearly shown in figures 1 to 3.

Table 1: Effect of salinity on the growth parameter of the Fluted pumpkin at 4th week after planting

Treatments	Number of leaflets	Number of Leaves	Vine length (cm)
0g of NaCl	24.4	9	23
10g of Nacl	25.3	12	25.5
20g of NaCl	30.5	13	29.8
Mean	26.7	11.3	26.1
cv	36	24.7	57.6
$LSD_{(0.05)}$	NS	NS	NS

cv= Coefficient of Variation

$LSD_{(0.05)}$ = Least significant difference (F-LSD) at 5% probability level.

NS = Not significantly different

Table 2: Effect of salinity on the growth parameter of the Fluted pumpkin at 5th week after planting

Treatments	Number of leaflets	Number of Leaves	Vine length (cm)
0g of NaCl	33.1	11.8	33.7
10g of NaCl	33.5	13.5	39
20g of NaCl	33.7	14.1	46.5
Mean	33.4	13.1	39.7
cv	20.7	20.7	30.4
LSD $_{(0.05)}$	NS	NS	NS

cv= Coefficient of Variation
LSD $_{(0.05)}$ = Least significant difference (F-LSD) at 5% probability level.
NS = Not significantly different

Table 3: Effect of salinity on the growth parameter of the Fluted pumpkin at 6th week after planting

Treatments	Number of leaflets	Number of Leaves	Vine length (cm)
0g of NaCl	42	14.7	40.5
10 of NaCl	44.2	16.1	44
20 of NaCl	47.1	16.9	49.3
Mean	44.4	15.9	44.6
cv	19.6	21.8	23.8
LSD $_{(0.05)}$	NS	NS	NS

cv= Coefficient of Variation
LSD $_{(0.05)}$ = Least significant difference (F-LSD) at 5% probability level.
NS = Not significantly different

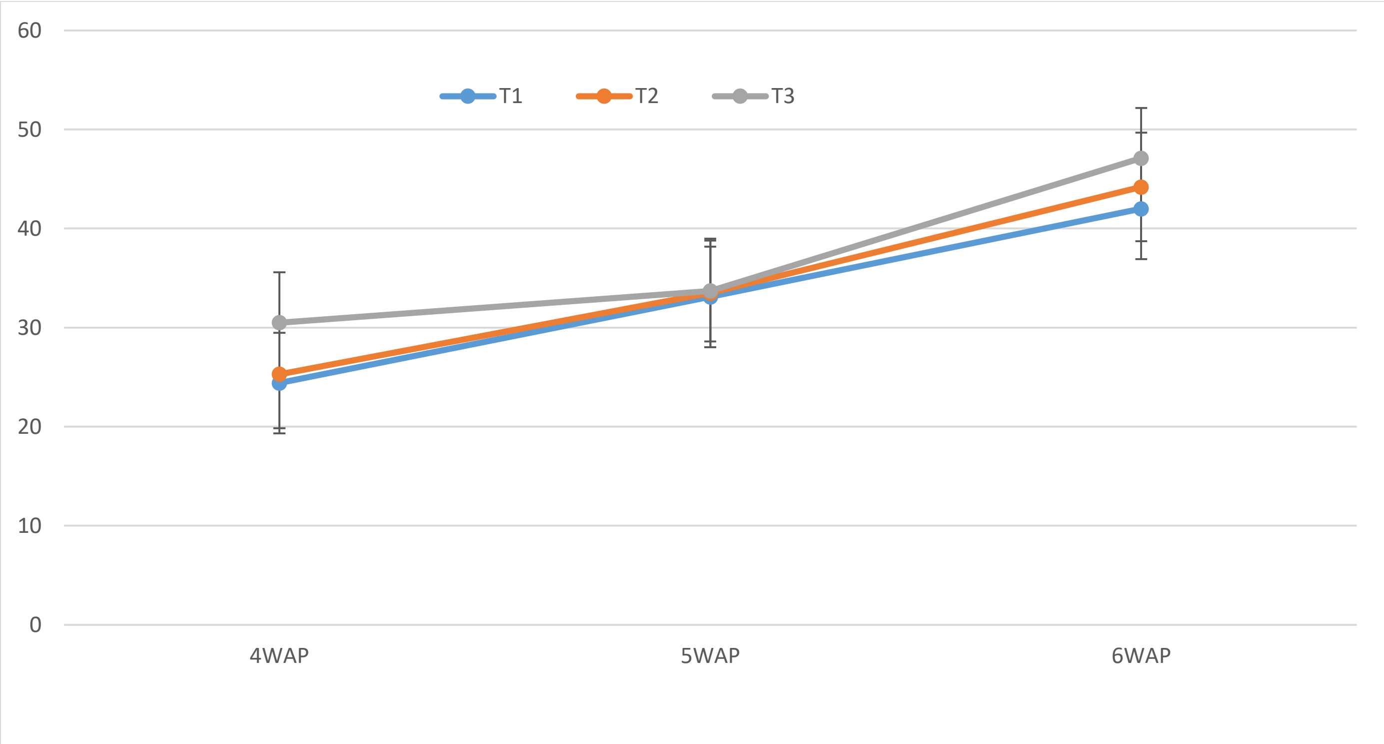

Figure 1: Trend of the effects of NaCl treatments on the number of leaflets produced by the Fluted Pumpkin at 4, 5 and 6 WAP.

Where T1 = 0g of NaCl as control (topsoil growth medium without added NaCl)
T2 = 10g of NaCl (10g of NaCl added to the topsoil growth medium)
T3 = 20g of NaCl (20g of NaCl added to the topsoil growth medium)

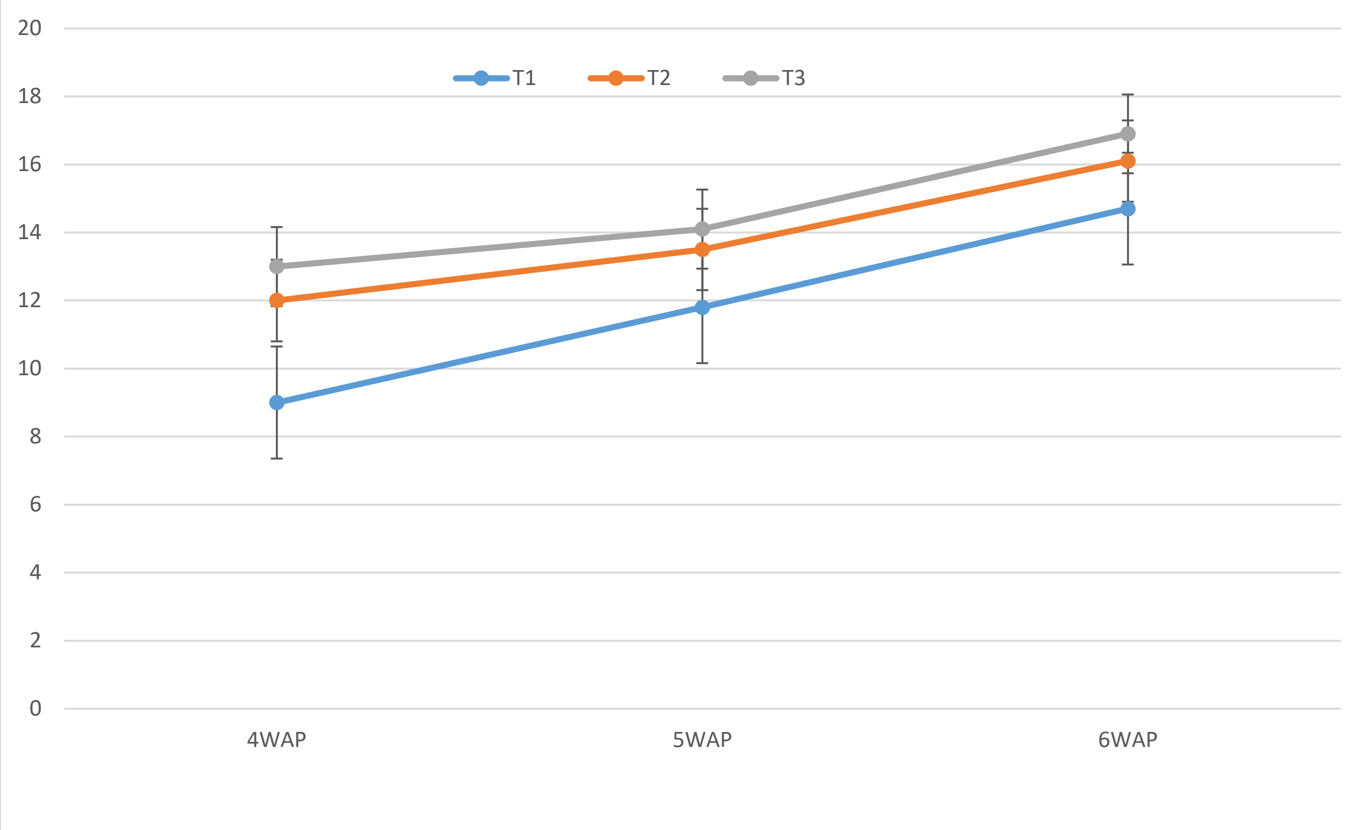

Figure 2: Trend of the effects of NaCl treatments on the number of leaves produced by the Fluted Pumpkin at 4, 5 and 6 WAP.
Where T1 = 0g of NaCl as control (topsoil growth medium without added NaCl)
T2 = 10g of NaCl (10g of NaCl added to the topsoil growth medium)
T3 = 20g of NaCl (20g of NaCl added to the topsoil growth medium)

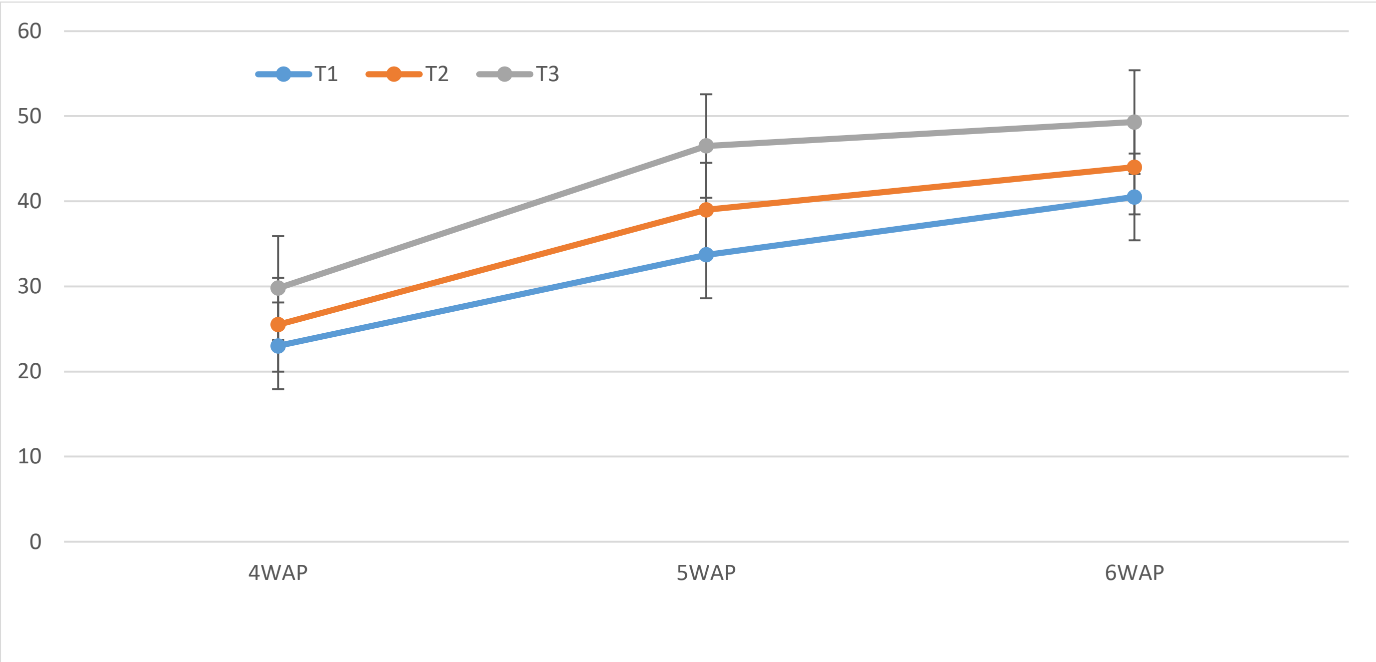

Figure 3: Trend of the effects of NaCl treatments on the vine length (cm) produced by the Fluted Pumpkin at 4, 5 and 6 WAP.
Where T1 = 0g of NaCl as control (topsoil growth medium without added NaCl)
T2 = 10g of NaCl (10g of NaCl added to the topsoil growth medium)
T3 = 20g of NaCl (20g of NaCl added to the topsoil growth medium)

DISCUSSION

From the results of this experiment, it could be observed that the effect of NaCl on the irrigated early growth and yield of the Fluted pumpkin showed no significant difference ($p<0.05$) from 4wap to 6wap. At 4WAP the number of leaflets produced by the plants ranged from 24.4 to 30.5 with a mean of 26.7, while the number of leaves of the plants ranged from 9 to 13 with a mean of 11.3. The vine length in cm of the plants at this same period ranged from 23cm to 29.8 cm with a mean of 26.1 cm. There were no significant differences ($p>0.05$) among the treatments in all these parameters measured at 4WAP (Table 1). This trend continued till the 6WAP where the number of leaflets of the plants ranged from 42 to 47.1 with mean of 44.4, while the number of leaves of the plants ranged from 14.7 to 16.9 with a mean of 15.9. The vine length of the plants ranged from 40.5 cm to 49.3 cm with a mean of 44.6 cm (Table 3). This was contrary to the findings of Filipovic *et al*. (2020) who reported that Faba bean productivity decreased proportionally to the irrigation water salinity level.

However, the increase in the growth and yield parameters of the Fluted Pumpkin as a result of the NaCl salinity application could be as a result of tolerance as reported by Omovbude and Hamadina (2018) or due to beneficial effects (Jennings, 1976). This is because according to Jennings (1976) application of salinity such as NaCl can be beneficial in plant growth and productivity. Jennings (1976) reported that *Beta vulgaris* plant growth increased due sodium chloride addition explained by a sparing effect on potassium. However, growth is still increased when sufficient potassium is available. And that also sodium chloride increases production of dry matter in C4 species of *Atriplex* plants.

CONCLUSION

From this experiment it was observed that the levels of the NaCl added to the irrigated Fluted pumpkin at the early growth stage increased its production and yield. Therefore, a continued cultivation of Fluted Pumpkin in Nsukka area with similar topsoil is encouraged for increased vegetable crops production in the event of climate change associated increases in sodium chloride level. However, we recommend a more detailed study using higher concentrations of NaCl on this topsoil as well as soil nutrient elements analysis to identify the other cations levels in the soil already.

REFERENCES

Ajayi, S.A. (2009). Conserving the fluted pumpkin: A view of Africa and Africans with a focus on entrepreneurship, innovation, technology, practical remedies and other self-sustaining activities. Timbuktu Chronicles. (Timbuktu chronicles. blogspot.com/. . ./conserving-fluted-pumpkin-s-adesola.html).

Akoroda M.O, Ogbechie F. A, Odiaka N.I, Adebayo M.L, Ugwo O.E and Fuwa B (1990). Flowering, pollination and fruiting in fluted pumpkin (*Telfairia occidentalis).* Scientia Horticulturae 43: 197-206.

Akpabio, U.B., Ukpong J.S, and Eka O.U. (2008). Determination of the chemical compo sition, the physicochemical properties of the oil extract and the amino acid profiles of the seeds of *Telfairia occidentalis* (fluted pumpkin). Global Journal of Pure Applied Science 14(3):13–19.

Akwaowo, E.U., Ndon, B.A. and Etuk E.U. (2000). Analytical, nutritional and clinical methods section. Minerals and antinutrients in fluted pumpkin *(Telfairia occidentalis* Hook f.) Food Chemistry 70:235–240.

Anikwe, M.A.N. (2006). Soil Quality Assessment and Monitoring: A Review of Current Research Efforts. New generation books, New Generation Ventures Ltd, Enugu Southeast, Nigeria pp. 1 - 208.

Asiegbu, J.E. (1989). Response of onion to lime and fertilizer N in a tropical Ultisol. Tropical Agriculture 66:161-166.

Ayinde A.I., Akerele, D. and Ojeniyi, O.T. (2010). Resource Use Efficiency and Profitability of Fluted Pumpkin Production Under Tropical Conditions. International Journal of Vegetable Science 17:75–82. DOI: 10.1080/19315260.2010.514979

Esuoso K.O, Lutz H, Kutubuddin M, and Bayer E., (1998). Chemical composition and potential of some underutilized tropical biomass, Fluted pumpkin (*Telfairia occidentalis).* Food Chemistry 6(4):487-492.

FAO (1992). Minor oil crops. FAO Agricultural service bulletin No 94, Rome. http://www.fao.org/do crop/x 5043Eoo.htm

Filipović L., Romić D., Ondrašek G., Mustać I. and Filipović V. (2020). The effects of irrigation water salinity level on faba bean (Viciafaba L.) productivity. Journal of Central European Agriculture 21(3):537-542

GenStat, (2011). GenStat Release 10.3DE (PC/Windoiw 7) 23 August2012 09:45:52 Copyright 2011, VSN International Ltd. Rothamsted Experimental Station, UK.

Irvine F.R. (1969). West African Crop, Oxford University Press. 272

Jennings B.D. (1976). The effects of sodium chloride on higher plants. Biological reviews 51(4):453-486. https://doi.org/10.1111/j.1469-185X.1976.tb01064.x

Obi, I.U. (2002). Statistical Methods of dictating Differences between treatment means and Research Methodology Issues in laboratory and field experiments. AP Express Public Comp. Nsukka, Nigeria.

Odiaka, N.I, Akoroda M.O, and Odiaka E.C (2008). Diversity and production methods of fluted pumpkin (*Telfairia occidentalis* Hook F.). African Journal of Biotechnology 7(8): 944-954.

Omovbude, S. and E.I. Hamadina (2018). Effect of Sodium Chloride on Seed Germination and Seedling Growth of Yellow Fluted Pumpkin (*Telfairia occidentalis*) in the Niger Delta, Nigeria. Advances in Life Sciences 8(1): 26-31.

Parthasarathy, R., Birthal, P Joshi; K. and Kar, D. (2004). Agricultural diversification in India and role of urbanization. International Food Policy Research Institute, Markets, Trade and Institutions Division, Washington, DC. USA.

Phillip, B. Shittu, A.M., Aiyelelaagbe, I.O.O. and Adedokun,T.(2009). Economic potentials of plantain and fluted pumpkin intercropping as a poverty reduction strategy in south-western Nigeria. World Journal of Agricultural Science 5(5):525–534.

Radwan, U. A., Springuel, I., Biswas, P. K., Huluka, G. (2000) The effect of salinity on water use efficiency of *Balanitesa egyptiaca* (L.) Del. Egyptian Journal of Biology 2: 1-7.

Schippers, R.R (2002). African Indigenous vegetables, an overview of the cultivated species. Revised edition on CD-ROM. National Resources International Limited Aylesford, United Kingdom.

Taylor, O.O.A, Futuga B.L and Oyenuga V.A (1983) Accumulation of mineral elements in five tropical leafy vegetables as influenced by Nitrogen fertilization and age. Scientia Horticulturae 18: 313 – 322.

Uguru, M. I., Baiyeri, K. P., and Aba, S. C. (2011). Indicators of climate change in the derived savannah Niche of Nsukka, South-Eastern Nigeria. *Agro-Science*, 10(1): 17-26