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Effects of Five Different Staking Methods on Growth and Yield of Fluted Pumpkin (Telfairia occidentalis) in Asaba Area of Delta State

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Abstract: *A study was carried out in the Teaching and Research Farm of Delta State University, Asaba Campus in 2005 to evaluate the effects of five different staking methods on the growth and development of Telfairia occidentalis. Five treatments involving different staking methods were replicated three times in a randomized complete block design. Data collected were subjected to analysis of variance. The result indicated a positive or significant influence of staking on the yield and yield component of T. occidentalis: Plant growth and yield were better under staking than when allowed to creep on the ground. Raised platform proved to be the best method of staking and was recommended with a view to exploiting the great economic potentials of crop.*
Keywords: *Staking Methods, Fluted Pumpkin, Growth and Yield, Asaba Nigeria.*

I. Introduction

Fluted pumpkin (Telfairia occidentalis) is one of the most popular cucurbitaceous leaf and seed vegetables grown for human consumption. It is a high climbing perennial with partial drought tolerance and perenating root system (Egun, 2007). It is native to West Africa but occurs mostly in its cultivated form in various parts of Southern Nigeria where the leaves (which produce strong aroma), succulent shoots and seed kernel constitute valuable ingredients in soups (Akoroda et al., 1990) Nwanguma (1990) reported that Telfairia occidentalis (Ugu) is an important vegetable noted for its nutrient and flavour components.

In spite of the increasing relevance and high demand for Telfairia occidentalis in Nigeria, there is no standard practice with respect to staking. In large farms and near the cities, the crop is often left to creep on the ground with its attendant problems of pest and disease infestation, and splash of sand on the marketable yield due to torrential rains. Traditional farmers stake Telfairia occidentalis for increased yield. Some researchers also stake the crop for better exposure to sunlight, ventilation and good yield. Egun (2007) recommended staking of Telfairia occidentalis for enhanced marketable leaf yield. Borget (1992), Kwarteng and Towler (1994) suggested that the climbing species such as Telfairia occidentalis should be supported with bush sticks to enhance growth and development. Okonmah (2011), recommended raised platform staking method for increase pod yield, enhanced market value, higher estimated revenue for such climbing vegetables as cucumber and Telfairia occidentalis. Amina et al., (2012) recommended staking of tomatoes and other fruit crops for higher yield, and good quality fruits with higher market value. Akoroda et al., (1990) suggested staking of crops to facilitate harvesting of vegetables and pods, and exposure of leaves for effective light reception. FAO (2007) reported that staking increases fruit yield, reduces the proportion of unmarketable fruit, enhances the production of high quality fruits, prevents disease and fruit rot, allows better aeration and exposes better exposure of the foliage to sunlight and photosynthetic activities. However, unavailability of staking materials and high cost of staking around cities necessitates research work into the most economical method of achieving highest yield at reduced cost. The objectives of this study therefore were to assess the influence of various types of staking methods on the growth and yield of Telfairia occidentalis.

II. Materials and Methods

Site Description: The experiment was carried out in the Teaching and Research Farm of Delta State University, Asaba Campus from March to July, 2005. Asaba is located at 06°l4'N of the equator. It lies in the tropical rainforest zone and is characterized by rainy season between April and October with annual mean rainfall of 1500 to 3000 mm (FOS, 1996).

Land preparation: The gross area (540 m^2) was cleared using cutlass, and burnt in the month of March, 2005. Tillage was carried using hoe while plots measuring 5 m x 5 m (25 m^2) were marked out. The net area used for the experiment was 375 m^2, while discards totaled 165 m^2.

Pre-planting soil Analysis: Surface sols (10-15cm) were sampled with a tabular sampling auger. Representative soil samples were taken and then bulked together from the replicate. The samples were air-dried at room temperature for 5 days and crushed to pass through a 2mm mesh tube. Sub-samples from the bulked soil sample were further ground to pass through 100-mesh sieve for the determination of organic matter. The rest samples were then analyzed to determine the physical and chemical properties of the soil. The analysis was done at Nigeria Institute for Oil Palm Research (NIFOR), Benin City, Edo State.

Particle Size: The analysis was done by the hydrometer method of Bouyoucos (1951) after destroying the organic matter with hydrogen peroxide and dispersing the soil with sodium hexarnetaphosphate.

pH: This was determined in distilled water and in INKCL in a 1:1 soil-to-solution suspension using a pH meter.

Organic Matter: This was determined from the result of organic carbon as follows: % organic mailer in the soil % organic carbon x 1.79. The total nitrogen (N) content of the soil then calculated from the result of the % organic matter as follows:

Total N = 5% of result organic matter content in the soil (Kamprath, 1970).

Exchangeable Bases: The soil was extracted with neutral NH.OAC. K and Na in the extracts were determined by flame photometry and Mg by the atomic absorption spectrophotorneter.

Total Exchangeable Acidity: This was extracted with INKCL and estimated in the extracts by titration method (McClean. 1965).

Effective Cation Exchange Capacity (ECEC): This was taken as the sum of the exchangeable bases and exchange acidity (E.A) (Brady and Weils, 1999).

1. Seed Collection, Planting, Staking And Manure Application

Seeds of Telfairia occidentalis were obtained from pods collected from proven varieties among farmers, and pre-germinated in well-decomposed seedbed nursery with good topsoil to enhance field establishment. The seedlings were transplanted to the plots after 2 weeks from sowing in the nursery. One seedling was planted per stand at a spacing of 1m apart, which gave plant population of 25 plants per plot. Two weeks after transplanting, the seedlings were staked according to the treatments. Well-decomposed organic manure was applied at the rate of 0.0005 ton per plant.

Experimental Design

The experiment was set up in a Randomized Complete Block Design (RCBD) replicated three times with five treatments involving different staking methods: (i) Without Staking (ii) Raised Platform (iii) Erect (3 m) Staking (iv) Dwarf (1m) Staking (v) Bamboo tip staking.

Data Collection and Analysis

Fifteen plants were sampled per treatment of 25 stands and about 50 cm length harvested from each. Using a weighing scale, edible yield (the leaf and the succulent stem) of the treatments were also weighed at fortnight intervals starting from the 12^{th} week after planting. At maturity (33 weeks old), the pod yields of each treatment were determined. The results obtained were subjected to analysis of variance. Treatment means were separated using Least Significant Difference (L.S.D).

III. Results

Physico-chemical properties of the experimental site

The phvsico-chemical properties of the study area are shown in Table 1. The soil was predominantly sandy. The surface had more sand than the subsurface. Texturally, the experimental site was classified as sandy clay. The soil is generally acidic with a pH of 5.7. The organic matter and total nitrogen content were low with values of 0.12 gkg^{-1} and 0.05 gkg^{-1}, respectively. The available P was equally low with a value of 9.3 mgkg. The exchangeable cations were low in status with values of 1.86 $cmolkg^{-1}$ for Ca and 1.42 $crnolkg^{-1}$ for Mg. The values obtained for K (0.07 $cmolkg^{-1}$) and ECEC (8.45 $cmolkg^{-1}$) were low. This could be attributed to low activity clay of the study area while the low values obtained Organic C, Total Nitrogen and P were as a result of erosion that is predominant in the area and subsequent leaching of the nutrient beyond the root zone.

Table 1: Physico-chemical properties of the experimental site

Soil properties	Value
Particles size distribution (%)	
Sand	66.3
Silt	26.3
Clay	7.4
Textural class sandy clay	
Soil pH (H_20)	5.7
Org. C (g Kg^{-1})	0.05
Total N (gkg^{-1})	0.12
Available P ($mgkg^{-1}$ soil)	9.3
Exchangeable cations (cmol kg^{-1})	
Ca	1.86
Mg	1.42
K	0.07
Na	0.12
ECEC (cmol kg^{-1})	8.45
Base saturation (%)	41.1

Legend: % = Percentage, H_20 = Water, Org. C = Organic carbon, gkg^{-1} = gram per kilogram, N = Nitrogen, P = Phosphorus, $mgkg^{-1}$ =Milligram per kilogram, cmol kg^{-1} = centimole per kilogram, Ca = Calcium, Mg = Magnesium, K = Potassium, Na = Sodium, ECEC = Exchangeable Cation Exchange Capacity.

Effects of staking plant height of Telfairia occidentalis

The response of plant height of Telfairia occidentalis to staking from 8 - 12 weeks after sowing is shown in Table 2. At 8 weeks after sowing, plants grown on raised platform had the highest plant height (127 cm), followed by plants grown on erect (3 m) staking with bush sticks (108cm). Plants without stacking had the smallest height (80 cm). During 10th week, plants that had highest height (157 cm) were those grown on raised platform, followed by plants grown on both erect (3 m) stacking and dwarf (1.5 m) staking which had equal height of 147cm. Plants that crept on the ground had smallest height of 110cm. At 12th weeks after sowing, plants grown on raised platform were also superior in height (203 cm), followed by plants grown on dwarf (1.5 m) staking. Plants without sticking had the smallest height (153 cm).

Table 2. Effects of staking on plant height of Telfairia occidentalis (cm)

	WAS		
Treatment	**8**	**10**	**12**
Without staking	80	110	153
Raised Platform	127	157	203
Erect (3m) staking	94	127	167
Dwarf (1.5m) staking	108	147	197
Bamboo tip staking (2m)	107	147	183
Mean	103	138	180
LSD (0.05)	38	44	55

Legend: WAS = Week After Sowing

Effects of staking on fresh weight (edible yield) of leaves

The effect of staking on fresh weight of leaves of Telfairia occidentalis from 12-16 weeks after sowing is shown in Table 3. During the 12th week, plants grown on raised platform had the highest fresh weight of leaves (44.8 g/m^2). Plants that had the smallest fresh weight of leaves were those grown on erect (3 m) staking (32.0 g/m^2). At 14 weeks after sowing, plants staked on raised platform had the highest weight of leaves (57.2 g/m^2), followed by plants grown on bamboo tip staking (46.0 g/m^2). Plants that had lowest fresh weight were those grown on (28.8 g/m^2). During the 16th week, plants grown raised platform had the highest fresh weight of leaves (60.0 g/m^2), followed by plants staked with bamboo tips (43.2 g/m^2). Plants grown on erect (3 m) staking had the smallest fresh weight of leaves (31.2 g/m^2). Total fresh weight of leaves followed this trend.

Table 3. Effects of staking on fresh weight (edible yield) of leaves (g/m^2)

	WAS			
Treatment	**12**	**14**	**16**	**Total weight**
Without staking	40.8	33.2	34.8	108.8
Raised Platform	44.8	57.2	60.0	162.0
Erect (3m) staking	32.0	288	31.2	92.0
Dwarf (1.5m) staking	40.0	42.0	42.0	124.0
Bamboo tip staking (2m)	34.8	46.0	43.2	124.0
Mean	38.48	41.44	41.44	122.16
LSD (0.05)	0.48	0.65	0.68	1.81

Legend: WAS = Week After Sowing

Effects of staking dry weight of harvested leaves (g/m^2)

The effect of staking on dry weight of harvested leaves is shown in Table 4. There was steady increase in the leaf yield of plants grown on platform. Dry weight of plants that crept on the ground was similar or equal to plants on dwarf staking at 12weeks after sowing ($9.2g/m^2$) but there was a gradual decline of the former from the 14th week. Plants on bamboo tips attained peak dry weight at 14weeks after sowing ($10.8g/m^2$) but gradually declined at the 16th week ($8.8g/m^2$). However, apart from erect staking method with total dry weight of $19.6g/m^2$, total dry weight of leaves obtained from staked plants were higher than those from unstaked plants.

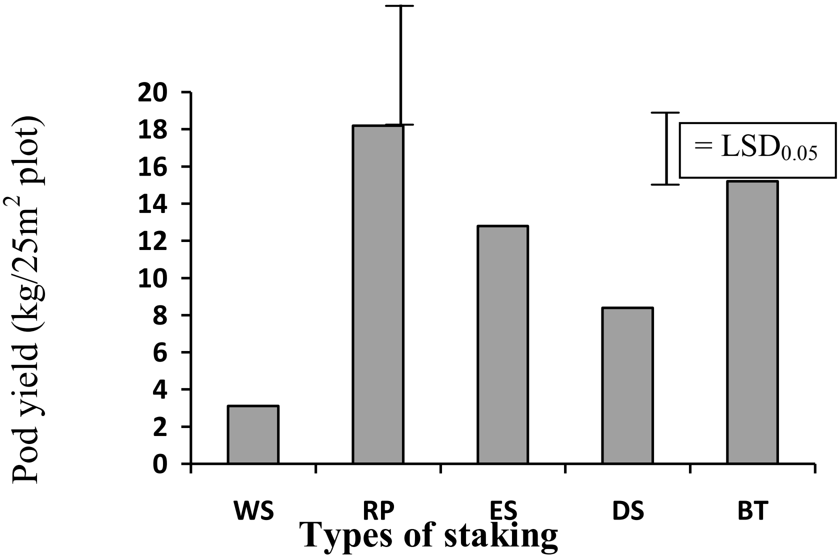
Table 4. Effects of staking on dry weight of harvested leaves (g/m^2)

	WAS			
Treatment	**12**	**14**	**16**	**Total weight**
Without staking	9.2	6.8	6.0	22.0
Raised Platform	10.8	12.0	12.0	34.8
Erect (3m) staking	6.8	6.8	6.0	19.6
Dwarf (1.5m) staking	9.2	9.2	8.0	26.4
Bamboo tip staking (2m)	8.0	10.8	8.8	27.6
Mean	8.8	9.12	8.16	26.08
LSD (0.05)	0.15	0.14	0.15	0.44

Legend: WAS = Week After Sowing

Effects of staking on pod yield of Telfairia occidentalis (kg) at 33 weeks

The response of pod yield of Telfairia occidentalis to different staking methods is shown in Figure 1. Plants grown on raised platform had the highest pod yield of 18.2 kg at 33 weeks after sowing, followed by plants grown on bamboo tips staking (15.2 kg). Plants grown without staking had the smallest pod weight (3.12 kg). The superiority in pod weight of Telfairia occidentalis produced based on staking methods was Raised platform > Bamboo tip staking > Erect (3 m) staking > Dwarf (1.5 m) staking > without staking.



Legend: WS = Without Staking, RP = Raised Platform, ES = Erect Staking, DS= Dwarf Staking, BT = Bamboo Tip Staking.

Fig 1. Effect of Staking on Pod Yield (kg) at 33 weeks.

IV. Discussion

Soil physico-chemical properties ties of the experimental site

The sandy texture of the experimental site may be attributed to the Parent Material (PM) from which the soil was formed and the climate of the area. The soil might be formed from sandstone and quartz parent materials. These impart sandy texture to the soils. The high sand content of the soil could be attributed to high content of quartz in the material (Brady and Weils, 1999). The acidic nature of the soil of the area may be traced to the marked leaching of exchangeable bases resulting from the high rainfall associated with the environment and the dissociation of strong and functional group in the organic matter. This is in harmony with the findings of Esu (2001). The low organic matter status of the experimental site could be attributed to the rapid decomposition of organic matter due to high solar radiation and moisture, this favours optimum microbial activities in the soil, It could also be attributed to the annual seasonal bush burning which tend to deplete organic matter accumulation in the soil (Landon,199l).

The low level of total nitrogen could be due to high temperature. It could also be attributed to leaching of nitrate by torrential rainfall prevalent in the environment (Brady and Weils, 1999). The high level of' Phosphorus may be attributed to either of these reasons: (i) history of land use and cultural practices associated with the land use (that is, cropping of crops that took much P nutrient from the soil and non application of P organic fertilizers (Nnaji et al., 2002). (ii) The parent material from which the soil was formed may not be too rich in P minerals (Brady and Weils, 1999). (iii) The soil may not be highly acidic as to cause high level of fixation (Brady and Weils, 1999, Isirimah et al., 2003). The low values of exchangeable cations may be attributed to the leaching of bases from the solum due to high rainfall characteristics of the area. The low cation exchange capacity could be attributed to the PM from which the soil was formed, and low organic matter (OM) content of the soil. The PM from which the soil was formed may be poor in basic nutrients. FMANR (1990) noted that soils of the study area were dominated by Fe oxide and Kaolinites. These clay minerals are low in basic cations (Brady and Weils, 1999). The results, generally, are in harmony with the findings of Nnaji et al., (2002) which reported that the history of land use and cultural practices affect soil conditions and crop productivity.

Effects of staking on Plant height of Telfairia occidentalis (cm)

Staked plants grew taller than unstaked plants. Plants grown on raised platform staking method were superior in height to those grown on other staking methods possibly because they were well exposed to sunlight, had better ventilation and were free from attack of soil-borne organisms. This is in harmony with the reports and recommendations of Kwarteng and Towler (1994) that Telfairia occidentalis be staked for good growth and protection from attack of soil-borne organisms. It is also in consonance with the findings of Borget (1992) who recommended raised platform staking method for Telfairia occidentalis and other climbing species to maximize growth and productivity.

Effects of staking of fresh weight (edible yield) of leaves (g/m^2)

The consistent increase in fresh weight (edible yield) of harvested leaves for plants grown on raised platform and their superiority in weight over other staking methods could be attributed to sufficient sunlight and better photosynthetic activities obtained by plants grown on the platforms. This is in harmony with the reports of Akoroda et al., (1990) and Egun (2007) which recommended that Telfairia occidentalis be staked with bush sticks or raised platform for good exposure to sunlight and better photosynthetic activities to promote high leaf yield. It is also consistent with the recommendations of Borget (1992) and Okonmah (2011) that climbing species such as Telfairia occidentalis, water hyacinth, water melon, cucumber and beans be staked to promote reception of sunlight and enhance both leaf and fruit yield.

Effects of Staking on dry weight of harvested leaves (g/m^2)

Dry weight of harvested leaves from staked plants were higher than dry weight of harvested leaves from unstaked plants. Plants grown on raised platform had highest weight of harvested leaves possible because they had adequate ventilation and were free from attack and spoilage by soil-borne organisms. This is consistent with the recommendation of Kwarteng and Towler (1994) which suggested staking of Telfairia to protect the leaves shoot and fruits from attack by soil-borne organisms. It is also in harmony with the findings of Borget (1992) who recommended platform staking of Telfairia occidentalis, hyacinth water melon and beans to enable them climb freely and maximize production.

Effect of staking on pod yield ($kg/25m^2$ plot) at 33 weeks

Pod yields obtained from staked plants were higher than yield from their unstaked counterparts. Highest pod yield was obtained from plants on raised platform while plants that crept on the ground had the lowest pod yield. This could possibly be because plants on raised platform were better exposed to sunlight which promoted greater photosynthetic efficiency, enhanced flowering, pollination and fruit development. This is similar to the findings of Akoroda et al., (1990) who recommended that Telfairia occidentalis be staked with bush sticks or raised platform to expose the leaves to better photosynthetic activities and enhanced development. It is also consistent with the reports of FAO (2007) and Amina et al., (2012) which recommended staking of fluted pumpkin or tomatoes for better exposure to sunlight to enhance fruit yield. It is also in consonance with the findings of Kwarteng and Towler (1994) and Okonmah (2011) which recommended raised platforms staking method for increased pod yield of cucumber and better fruit development in water melon.

V. Conclusion and Recommendation

The study was carried out to examine the effects of various staking methods on growth and yield of fluted pumpkin (Telfairia occidentalis). Four variables were measured to achieve the objectives of the study: plant height, fresh weight of leaves, dry weight of harvested leaves and pod yield at 33weeks.

Based on the results of the study, the following major findings and conclusions were made:

1) Telfairia occidentalis (fluted pumpkin) grew better and yielded higher when when staked than when allowed to creep on the ground.
2) Raised platform proved to be the best method of staking Telfairia occidentalis since the leaves were better displayed to sunlight, leaf yields were higher and flowering, pollination and fruiting were well enhanced.

In view of the results and findings of the study, it is recommended that farmers adopt raised platform staking method in production of fluted pumpkin.

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