The Journal of Animal & Plant Sciences, 24(2): 2014, Page: 600-605
ISSN: 1018-7081

INFLUENCE OF FRUIT CHARACTERISTICS ON SEEDS AND SEEDLING EMERGENCE OF FLUTED PUMPKIN (*Telfairia occidentalis* Hook F.)

U. P. Chukwudi and C. U. Agbo

Department of Crop Science, University of Nigeria, Nsukka
*Corresponding author: uchechukwu.chukwudi@unn.edu.ng

ABSTRACT

The positive influence of fruit characteristics on seed and seedling emergence in fluted pumpkin will increase productivity and enhance selection of fruits for sowing. A study was carried out to determine the relationships between the fruit characteristics and seed quality in fluted pumpkin. Three different sizes of fluted pumpkin fruits were obtained from six localities in Enugu state, Nigeria. The study was a 3×6 factorial in completely randomized design (CRD) replicated three times. Analysis of variance was carried out on the fruit and seed characteristics as well as seedling emergence. Pearson's correlation coefficients and Path coefficients analysis were also determined on the data collected. Large sized fruits were significantly ($P<0.05$) higher in all the parameters measured except in the number of unfilled seeds and seedling emergence percentage. Fruits from Ibagwa-aka gave significantly ($P<0.05$) higher seedling emergence (86.8 %) than other accessions. Lowest seed weight and seed size were obtained from Ozalla accessions which also gave the highest number of filled seeds/fruit. All the traits showed positive and highly significant correlation with fruit length, fruit circumference and fruit cavity diameter except number of unfilled seeds which showed negative correlation. Fruit cavity diameter had the highest and positive significant correlation of 0.34 with seedling emergence. Total number of seeds/fruit had the highest direct positive effect of 0.667 on the seedling emergence followed by fruit cavity diameter. It was conclusive from the study that large sized fruits gave higher seed sizes but medium sized fruits gave higher emergence rate and should be selected in favour of the small sized fruits.

Keywords: Fruit size, seedling emergence, seeds, selection, *Telfairia*.

INTRODUCTION

Telfairia occidentalis Hook F. commonly known as fluted pumpkin, *ugu, iroko, ubong, umee* and *umeke* (Akoroda, 1990a) is a member of the Cucurbitaceae family. Several authors have implicated tropical Africa, as the centre of origin of fluted pumpkin (Synge, 1974; Oyolu, 1978; Esiaba, 1982, and Uguru and Onovo, 2011). Fluted pumpkin is a facultative perennial (Akoroda, 1990a) but is cultivated as an annual crop under the traditional farming system of West Africa (Ogbonna, 2008).

Fluted pumpkin is one of the most widely cultivated leaf vegetables in Nigeria. The leaves are rich sources of protein, oil, vitamins and minerals (Aregheore, 2007). Relative to most common vegetables, its protein content is high (Okoli and Mgbeogu, 1983; Ladeji *et al*. 1995). Protein and oil content of the seed are 30.1 % and 47 %, respectively (Asiegbu, 1987). The essential amino acid contents compared favourably with those of important legumes (Asiegbu, 1987). It has been suggested that the ability of the plant to combat certain diseases may be due to its antioxidant and antimicrobial properties and its mineral (especially iron), vitamins (especially Vitamins A and C) and high protein contents (Kayode and Kayode, 2011).

Telfairia is propagated principally by seed (Okoli and Mgbeugu, 1983). Seed size, a characteristic of seed quality, has been reported to influence seedling growth and establishment in crops (Nik *et al*., 2011). Studies in wheat showed that seed size not only influenced emergence and establishment but also affected yield components and ultimately grain yield (Baalbaki and Copeland 1997; Singh 2003). Willenberg *et al*. (2005) reported that germination was increased with increasing seed size in oat (*Avena sativa* L.). There is an association between seed physical parameters and seed quality (Nerson, 2002). PekÕen *et al*. (2004) showed that pea (*Pisum sativum* L.) cultivars with low 100 seed weight had higher germination percentage than those with higher 100 seed weight. Odiaka *et al.* (2008) identified size of fruit, seed, leaf and thickness of vine as trait indicators for quality seed for fluted pumpkin.

There is paucity of information on the relationships between fruit characteristics, seeds and seedling emergence of *T. occidentalis*. This study was carried out to evaluate the possible relationships among fruit characteristics, number of seeds and seedling emergence capacity to guide farmers in fruit selection for cultivation and consumption.

MATERIALS AND METHODS

This study was carried out in 2011 and 2012 at the Department of Crop Science Teaching and Research Farm and Laboratory, University of Nigeria, Nsukka, (07 ^{0} 29 N, 06 ^{0} 51 E, and 400 m.a.s.l.). Three different fruit sizes (large, medium, and small) of *T. occidentalis* were obtained from six localities including Obukpa, Iheaka, Orba, Ibagwa-aka, Ogbede, and Ozalla in Enugu state, Nigeria. The study was a 3×6 factorial in completely randomized design (CRD) replicated three times. The accessions were named according to the location (source) and size.

The following parameters were measured or counted; fruit length (cm), fruit circumference (cm), fruit cavity diameter (cm), ridge length (cm), total number of seeds, number of filled and unfilled seeds, seed height (cm), seed width (cm), seed thickness (mm), 10-seed weight (g) and seedling emergence (%). The seeds from each accession were planted in sawdust medium for seedling emergence data.

Statistical Analysis: The data collected were subjected to analysis of variance (ANOVA) using GenStat Release 10.3DE (2011) statistical software. The means were compared using Fisher's least significant difference (F-LSD) as described by Obi (2002). Pearson's correlation coefficients and Path coefficients analysis were performed using SPSS 16.0 (Statistical Package for Social Sciences) and Dewey and Lu (1959) approach, respectively.

RESULTS

Accessions from Ibagwa-aka gave significantly (P<0.05) higher percentage of seedling emergence (86.8 %) and number of unfilled seeds (17.5) than other accessions (Table 1). A significantly (P<0.05) high fruit cavity diameter (14.9 cm) and 10-seed weight (158.3 g) were obtained from Iheaka accessions. Accessions from Obukpa produced the lowest fruit cavity diameter of 13 cm and a significantly (P<0.05) higher ridge length (5.4 cm) than other accessions. Significantly (P<0.05) high fruit circumference (78.9 cm), and total number of seeds of 98.5 were obtained from Ogbede accessions. Orba accessions had a significantly (P<0.05) lower fruit circumference (70 cm) and total number of seeds (63.3) than other accessions. Ozalla accessions were significantly (P<0.05) lower in seed width, seed thickness and 10-seed weight than other accessions. It also produced the highest number of filled seeds (91.8) that was significantly (P<0.05) higher than other accessions with the exception of Ogbede accessions.

Large sized fruits were significantly (P<0.05) higher in all the parameters measured except in the number of unfilled seeds and seedling emergence percentage, where the small and medium sized fruits were significantly (P<0.05) higher, respectively (Table 2).

Large sized fruits from Ibagwa-aka gave a significantly (P<0.05) higher seedling emergence of 92.8 % than the other accessions (Table 3). Small sized fruits from Ibagwa-aka gave the lowest fruit circumference, ridge length, and seed height. It was also significantly (P<0.05) higher in number of unfilled seeds (24.5) than other accessions with the exception of medium sized fruits from Ibagwa-aka (22.7). Large sized fruits from Iheaka were significantly (P<0.05) higher in fruit circumference (92.4 cm) and fruit cavity diameter (16.8 cm) than the other accessions. Small sized fruits from Obukpa gave a significantly (P<0.05) lower percentage of seedling emergence of 43.0 %. Large sized fruits from Ogbede gave a significantly (P<0.05) higher total number of seeds of 129.3 and number of filled seeds of 120.3 than the other accessions. Small sized fruits from Orba gave a significantly (P<0.05) lower number of filled seeds of 17.2 than the other accessions. Large sized fruits from Orba gave seed thickness and weight of 20.2 mm and 179.4 g, respectively that were significantly (P<0.05) higher than others.

Fruit length showed high positive and significant correlation with ridge length (r=0.85, n=108) (Table 4). All the traits showed positive and highly significant correlation with fruit length, fruit circumference and fruit cavity diameter, except for number of unfilled seeds which showed negative correlation. Fruit cavity diameter had the highest and positive significant correlation of 0.34 with seedling emergence. Fruit length, fruit circumference, fruit cavity diameter, ridge length, total number of seeds and number of filled seeds showed positive and significant correlation with seedling emergence.

Total number of seeds/fruit had the highest direct positive effect of 0.667 on the seedling emergence (Table 5). It had indirect positive effect of 0.182, 0.175, 0.024, 0.006 and 0.004 through fruit cavity diameter, ridge length, 10-seed weight, fruit circumference and unfilled seeds, respectively. Fruit circumference, fruit cavity diameter, ridge length, and 10-seed weight had direct positive effect on the seedling emergence. Fruit length, filled seed, unfilled seed, seed height, seed width, seed thickness had direct negative effect on the seedling emergence. Total number of seeds/fruit, fruit circumference, fruit cavity diameter, ridge length, and 10-seed weight had indirect positive effect on the seedling emergence through other fruit and seed parameters measured except unfilled seeds. Fruit length, filled seeds, seed height, seed width and seed thickness had indirect negative effect on the seedling emergence through other fruit and seed parameters measured except unfilled seeds.

Table 1: Main effect of fruit source on fruit characteristics of *T. occidentalis*

Fruit Source	FL (cm)	FC (cm)	FCD (cm)	RL (cm)	TNS	FS	US	ST (mm)	SH (cm)	SW (cm)	SWt (g)	SE (%)
Ibagwa-aka	43.9	70.7	13.3	4.7	78.1	60.6	17.5	16.54	3.24	3.78	130.3	86.8
Iheaka	44.8	75.8	14.9	4.8	80.8	75.4	5.4	15.38	3.42	3.90	158.3	83.2
Obukpa	42.5	72.3	13.0	5.4	76.9	72.2	1.2	16.42	3.32	3.84	124.3	71.9
Ogbede	48.4	78.9	14.2	5.2	98.5	89.9	8.8	16.81	3.40	3.77	130.1	76.4
Orba	43.9	70.0	14.1	4.6	63.3	56.8	5.9	16.73	3.35	3.94	144.1	72.5
Ozalla	43.4	74.9	14.1	4.6	95.4	91.8	3.7	14.42	3.31	3.64	109.1	78.6
F-LSD(P=0.05)	0.7	1.0	0.4	0.2	2.3	5.4	3.7	0.65	0.11	0.10	7.1	0.9

FL= fruit length, FC=fruit circumference, FCD= fruit cavity diameter, RL= ridge length, TNS= total number of seeds, FS= number of filled seeds, US=number of unfilled seeds, SH=seed height, SW=seed width, ST= seed thickness, SWt.= 10 seed weight and SE=seedling emergence.

Table 2: Main effect of fruit size on fruit characteristics of *T. occidentalis*

Fruit Size	FL (cm)	FC (cm)	FCD (cm)	RL (cm)	TNS	FS	US	ST (mm)	SH (cm)	SW (cm)	SWt (g)	SE (%)
Large	59.1	87.8	15.8	6.3	97.6	92.8	4.8	17.9	3.5	4.1	155.6	80.5
Medium	41.9	74.6	14.5	4.9	83.4	76.6	5.2	16.2	3.4	3.9	139.3	83.2
Small	32.5	58.9	11.6	3.4	65.5	53.9	11.3	14.0	3.1	3.5	103.1	70.9
F-LSD(P=0.05)	0.4	0.6	0.2	0.1	1.3	3.1	2.1	0.4	0.1	0.1	4.1	0.5

FL= fruit length, FC=fruit circumference, FCD= fruit cavity diameter, RL= ridge length, TNS= total number of seeds, FS= number of filled seeds, US=number of unfilled seeds, SH=seed height, SW=seed width, ST= seed thickness, SWt= 10 seed weight and SE=seedling emergence.

Table 3: Fruit source x size interaction on fruit characteristics of *T. occidentalis*

Fruit Source	Fruit Size	FL (cm)	FC (cm)	FCD (cm)	RL (cm)	TNS	FS	US	ST (mm)	SH (cm)	SW (cm)	SWt (g)	SE (%)
Ibagwa-aka	**Large**	60.3	84.5	14.9	5.9	97.8	92.5	5.3	19.5	3.6	4.0	167.0	92.8
Ibagwa-aka	**Medium**	41.2	73.2	14.0	5.0	75.8	53.2	22.7	16.8	3.3	4.0	135.0	91.1
Ibagwa-aka	**Small**	30.2	54.3	10.8	3.2	60.7	36.2	24.5	13.3	2.8	3.4	89.0	76.5
Iheaka	**Large**	60.3	92.4	16.8	6.5	81.7	71.7	10.0	17.7	3.5	4.0	169.3	80.2
Iheaka	**Medium**	41.0	74.3	15.8	4.5	79.3	76.5	2.8	16.3	3.6	4.1	175.4	90.2
Iheaka	**Small**	33.0	60.7	12.1	3.3	81.5	78.0	3.5	12.2	3.2	3.5	130.1	79.2
Obukpa	**Large**	59.5	85.5	15.6	7.2	94.0	90.7	3.3	17.3	3.3	4.2	144.7	84.1
Obukpa	**Medium**	38.4	73.2	12.8	5.7	83.0	72.5	0.0	15.7	3.3	3.6	120.1	88.6
Obukpa	**Small**	29.7	57.8	10.6	3.2	53.7	53.5	0.2	15.9	3.3	3.7	108.0	43.0
Ogbede	**Large**	61.2	90.7	15.6	6.3	129.3	120.3	9.0	17.0	3.6	4.0	148.5	82.0
Ogbede	**Medium**	49.0	84.3	14.7	5.4	85.8	84.2	2.2	17.8	3.4	3.9	140.3	76.4
Ogbede	**Small**	35.2	61.8	12.4	3.8	80.3	65.2	15.2	15.6	3.2	3.4	101.4	70.8
Orba	**Large**	57.0	83.0	15.0	5.9	75.8	75.3	0.5	20.2	3.5	4.3	179.4	59.8
Orba	**Medium**	40.0	67.4	15.2	4.4	78.3	77.8	0.5	15.7	3.3	4.1	144.4	74.6
Orba	**Small**	34.8	59.6	12.0	3.6	35.7	17.2	16.8	14.3	3.2	3.4	108.6	83.2
Ozalla	**Large**	56.0	90.5	16.8	6.0	106.8	106.3	0.5	15.7	3.6	3.8	124.7	84.3
Ozalla	**Medium**	42.0	75.2	14.3	4.7	98.3	95.7	3.0	14.7	3.4	3.8	120.8	78.3
Ozalla	**Small**	32.2	59.1	11.4	3.2	81.0	73.5	7.5	12.9	2.9	3.3	81.8	73.0
F-LSD(P=0.05)		1.2	1.7	0.7	0.4	4.0	9.3	6.4	1.1	0.2	0.2	12.2	1.5

FL= fruit length, FC=fruit circumference, FCD= fruit cavity diameter, RL= ridge length, TNS= total number of seeds, FS= number of filled seeds, US=number of unfilled seeds, SH=seed height, SW=seed width, ST= seed thickness, SWt= 10 seed weight and SE=seedling emergence.

Table 4: Correlation coefficients between fruit and seed characteristics and seedling emergence of *T. occidentalis*

	FL	FC	FCD	RL	TNS	FS	US	SH	SW	ST	SWt	SE
FL	-	.81**	.62**	.85**	.57**	.53**	-.11	.53**	.58**	.62**	.52**	.20*
FC		-	.81**	.86**	.58**	.59**	-.25**	.44**	.50**	.65**	.62**	.30**
FCD			-	.64**	.49**	.52**	-.18	.49**	.54**	.56**	.64**	.34**
RL				-	.55**	.55**	-.24*	.42**	.54**	.60**	.56**	.28**
TNS					-	.89**	-.12	.49**	.40**	.24*	.26**	.30**
FS						-	-.50**	.46**	.40**	.26**	.38**	.20*
US							-	-.06	-.09	-.16	-.35**	.08
SH								-	.75**	.35**	.53**	.15
SW									-	.52**	.69**	.13
ST										-	.60**	.04
SWt											-	.15
SE												-

FL= fruit length, FC=fruit circumference, FCD= fruit cavity diameter, RL= ridge length, TNS= total number of seeds, FS= number of filled seeds, US=number of unfilled seeds, SH=seed height, SW=seed width, ST= seed thickness, SWt= 10 seed weight and SE=seedling emergence.

** Correlation is significant at the 0.01 level (2-tailed), and * Correlation is significant at the 0.05 level (2-tailed)

Table 5: Direct (Diagonal and bold) and indirect effect of some fruit and seed characteristics on seedling emergence of *T. occidentalis*

	FL	FC	FCD	RL	TNS	FS	US	SH	SW	ST	SWt	SE
FL	**-0.212**	0.008	0.230	0.271	0.380	-0.322	0.004	-0.006	-0.043	-0.158	0.049	0.20
FC	-0.172	**0.010**	0.300	0.274	0.387	-0.358	0.009	-0.005	-0.037	-0.166	0.058	0.30
FCD	-0.132	0.008	**0.371**	0.204	0.327	-0.316	0.007	-0.005	-0.040	-0.143	0.060	0.34
RL	-0.181	0.009	0.237	**0.319**	0.367	-0.334	0.009	-0.005	-0.040	-0.153	0.052	0.28
TNS	-0.121	0.006	0.182	0.175	**0.667**	-0.541	0.004	-0.005	-0.030	-0.061	0.024	0.30
FS	-0.113	0.006	0.193	0.175	0.593	**-0.608**	0.018	-0.005	-0.030	-0.066	0.035	0.20
US	0.023	-0.003	-0.067	-0.077	-0.080	0.304	**-0.037**	0.001	0.007	0.041	-0.033	0.08
SH	-0.113	0.004	0.182	0.134	0.327	-0.279	0.002	**-0.011**	-0.056	-0.089	0.049	0.15
SW	-0.123	0.005	0.200	0.172	0.267	-0.243	0.003	-0.008	**-0.075**	-0.133	0.064	0.13
ST	-0.132	0.007	0.208	0.191	0.160	-0.158	0.006	-0.004	-0.039	**-0.255**	0.056	0.04
SWt	-0.110	0.006	0.237	0.179	0.173	-0.231	0.013	-0.006	-0.052	-0.153	**0.093**	0.15
Residual												0.756

FL= fruit length, FC=fruit circumference, FCD= fruit cavity diameter, RL= ridge length, TNS= total number of seeds, FS= number of filled seeds, US=number of unfilled seeds, SH=seed height, SW=seed width, ST= seed thickness, SWt= 10 seed weight and SE=seedling emergence.

DISCUSSION

The range of fruit length (29.67-61.2 cm) and fruit circumference (54.3-92.37 cm) obtained in this study is similar to earlier reports by Adeyemo and Odiaka (2004) where fruit length and circumference ranged between 39-69 cm and 63-87 cm, respectively and Akanbi *et al.* (2007) where fruit length of 23.7-86.7 cm were obtained. Fruit cavity diameter of 10.6-16.7 cm in the present study is lower than the value of 25 cm reported by Epenhuijsen (1974) but compares favourably with Adeyemo and Odiaka (2004). The total number of seeds/fruit of 35.6-129.3 obtained in this study is similar to the findings of Akanbi *et al.* (2007) where 28.7- 106 seeds were reported.

The significant high percentage of unfilled seeds obtained from small sized fruits is in agreement with the findings of Akanbi *et al.* (2007) where fruit length of 23.7 cm and 35.1 cm gave the highest percent of unfilled seeds. This might be due to lack of nutrients as suggested by Akanbi *et al.* (2007) or early harvest before 6th week after anthesis as reported by Odiaka and Akoroda (2009). Ogbonna (2008) was of the opinion that large sized fruits are more likely to contain more mature seeds than small sized fruits. The significantly ($p<0.05$) high total number of seeds obtained from the large sized fruit is in conformity with the findings of earlier reports (Akanbi *et al.*, 2007; Adeyemo and Odiaka, 2004) where the longest fruits produced the highest total number of seeds/fruit. This may be due to high fruit cavity developed in the large sized fruits.

The correlation result showed a positive and significant correlation of total number of seeds/fruit with fruit circumference (r=0.58) and fruit length (r=0.53). This implies that total number of seeds will increase with increase in fruit size (circumference and length). The highest positive and significant correlation (r=0.81) between fruit circumference and fruit cavity diameter is aligned with the findings of Adeyemo and Odiaka (2004) where r=0.9606 was reported for the same parameters. This finding indicates that the fruit circumference will increase with an increase in the internal space (cavity diameter) of the fruit. The highly and positive significant correlation of fruit length, fruit circumference, fruit cavity diameter and ridge length with most of the other traits (Table 4) showed that they may be potential traits for fruit characterization. This was exemplified by the path analysis result where fruit circumference, fruit cavity diameter and ridge length showed positive direct effect on the seedling emergence. The path analysis further revealed that the total number of seeds/fruit contributes the highest direct positive effect on the seedling emergence followed by fruit cavity diameter. This result of higher fruit cavity diameter increasing the seed size (seed girth and width) leading to more seed weight may be due to a genetic character of accessions with minor environmental influence as it was consistent for the two years of study.

Fruit cavity diameter showed a positive and significant correlation (r=0.49) with total number of seeds/fruit. This finding runs contrary to the report of Adeyemo and Odiaka (2004) where negative non-significant correlation (r=-0.0331) was obtained for the same parameters.

The significant higher seedling emergence (83.2 %) obtained from medium sized fruits is in line with the findings of PekÕen *et al*. (2004) where cultivars with low 100 seed weight had higher germination percentage than those with higher 100 seed weight. Earlier reports by Khare *et al*. (1995) and Singh *et al.* (1998) showed rapid emergence in small and medium seeds of soybean and groundnut, respectively, when compared with the large seeds. Adeyemo and Odiaka (2004) reported that *Telfairia* seeds of medium weight class gave a better emergence than the large weight class seeds. There was fruit-source effect on the parameters measured. This agrees with the report of Aremu and Adewale (2012) where fruit origin accounted for variation in the performance of *Telfairia*. This may be due to genetic diversity in the accessions as reported by Agbo (2010) on *Utazi* (*Gongronema latifolia* Benth.) sourced from the same zone.

Conclusion: It was conclusive from the study that large sized fruits gave higher seed sizes and number but medium sized fruits performed better in seedling emergence of *T. occidentalis*. The relationship that exists between fruit cavity diameter and seedling emergence may not be of practical importance to farmers who may not measure this trait without opening the fruit. Fruit circumference that exhibited highest positive strong indirect effect on fruit cavity diameter is recommended as a guide for fruit selection in field establishment of *T. occidentalis*. The large and medium sized fruits should be selected in favour of small sized fruits for number of seeds and viability, respectively.

REFERENCES

Adeyemo, M. O. and N. I. Odiaka (2004). Early seeding growth of fluted pumpkin as affected by seed and pod sizes under nursery and field conditions. Nigerian J. Hort. Sci. 9: 35-42.

Agbo, C. U. (2010). Genetic diversity in vegetative traits of *Utazi* (*Gongronema latifolia* Benth) grown for two cropping seasons in Nsukka. J. Crop Sci. and Biot. 13(3): 169-175.

Akanbi, W. B., C. O. Adebooye, A. O. Togun, J.O. Ogunrinde and S. A. Adeyeye (2007). Growth, Herbage and seed yield and quality of *Telfairia occidentalis* as influenced by cassava peel compost and mineral fertilizer**.** World J. Agri. Sci. 3 (4): 508-516.

Akoroda, M. O. (1990a). Ethnobotany of *Telfairia occidentalis* (Cucurbitaceae) among Igbos of Nigeria. Econ. Bot. 44:29-39.

Aregheore, E. M. (2007). Voluntary intake, nutrient digestibility and nutritive value of foliage of fluted pumpkin (*Telfairia occidentialis*) - haylage mixtures by goats. Livestock Research for Rural Development. 19, Article #56. Retrieved from http://www.lrrd.org/lrrd19/4/areg19056.htm

Aremu, C. O. and D. B. Adewale (2012). Origin and seed positional effect on sex ratio of *Telfairia occidentalis* Hook. F. grown in Savanna Agro-ecology. International J. Plant Breeding and Genetics. 6: 32-39.

Asiegbu, J. E. (1987). Some biochemical evaluation of fluted pumpkin seeds. J. Sci Food Agric. 40: 151-155.

Baalbaki, R. Z. and L. O. Copeland (1997). Seed size, density and protein content effect on field performance of wheat. Seed Sci. Technol. 25: 511-21.

Dewey, D. R. and K. H. Lu (1959). A correlation and path coefficients analysis of components of created wheat grass seed production. Agronomy J. 75: 153-155

Epenhuijsen, Van C. W. (1974). Growing native vegetables in Nigeria. FAO, Rome

Esiaba, R. O. (1982a). Cultivating the fluted pumpkin in Nigeria. World Crops. 34(2): 70-72.

Kayode, A. A. A. and O. T. Kayode (2011). Some medicinal values of *Telfairia occidentalis*: A Review. Am. J. Biochem. Mol. Biol. 1(1): 30-38.

Khare, D., N. D. Raut, S. Rao and J. P. Lakhani (1995). Effect of seed size on germination and field emergence in soybean. Seed Research India. 23 (2): 75-79.

Ladeji, O., Z. S. C. Okoye and T. Ojobe (1995). Chemical evaluation of the nutritive value of leaf of fluted pumpkin (*Telfairia occidentalis*). Food Chemistry. 53:353-355.

Nerson, H. (2002). Relationship between plant density and fruit and seed production in muskmelon. J. Am. Soc. Hortic. Sci. 127(5): 855-859.

Nik, M. M., M. Babaeian and A. Tavassoli. (2011). Effect of seed size and genotype on germination characteristic and seed nutrient content of wheat. Scientific Research and Essays. 6(9): 2019-2025.

Obi, I. U. (2002). Statistical methods of detecting difference between treatment means for field and laboratory experiments. AP Publishers co. Nig. Ltd; Enugu (Nigeria). 117 p

Odiaka , N. I., M. O. Akoroda and E. C. Odiaka (2008). Diversity and production methods of fluted pumpkin (*Telfairia occidentalis* Hook F.): Experience with vegetable farmers in Makurdi, Nigeria. Afr. J. Biotechnol. 7 (8): 944-954.

Odiaka, N. I. and M. O. Akoroda (2009). Effect of stage of pod development and storage period on seed viability of fluted pumpkin. African Crop Science Conference Proceedings. 9: 81-86.

Ogbonna, P. E. (2008). Pod portion and type effects on sex growth and yield in fluted pumpkin. African Crop Science J. 16: 185-190.

Okoli, B. E., and C. M. Mgbeogu (1983). Fluted pumpkin, *Telfairia occidentalis:* West African vegetable crop. Econ.Bot. 37: 145-149.

Oyolu, C. (1978). Relative unknown vegetables: Fluted pumpkin (*Telfairia occidentalis*). Horticultural society of Nigeria Conference proceeding. 1: 106-177.

PekÕen, E., A. PekÕen, H. Bozolu and A. Gülümser (2004). Some seed traits and their relationships to seed germination and field emergence in (*Pisum sativum* L.). J. Agric. 3: 243-246.

Singh, A. L., P. C. Nautiyal and P. V. Zala (1998). Growth and yield of groundnut varieties as influenced by seed size. Tropical Science (UK). 38(1): 48-56.

Singh, N. D. (2003). Seed size and adventitious (nodal) roots as factors influencing the tolerance of wheat to waterlogging. Australian J. Agric. Res. 54: 969-977.

Synge, P. M. (1974). Dictionary of Gardening. Royal Horticultural Society. PT-2Y. Oxford Press London. 4: 2087.

Uguru, M. I. and J. C. Onovo (2011). Evidence of polyploidy in fluted pumpkin (*Telfairia occidentalis* Hook F.). African J. Plant Sci. 5(5): 287-290.

Willenborg, C. J., J. C. Wildeman, A. K. Miller, B. G. Rossnaged and S. J. Shirtliffe (2005). Oat germination characteristics differ among genotypes, seed sizes, and osmotic potentials. Crop Sci. 45: 2023-2029.