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## **Origin and Seed Positional Effect on Sex Ratio of *Telfairia occidentalis* Hook. F. Grown in Savanna Agro-ecology**

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### **ABSTRACT**

Female telfairia produce succulent and fleshy leafy vegetables with higher nutritional values than male type and therefore preferred at groceries. There is difficulty in identifying this female telfairia at seed and seedling stages. This research identified effect of seed position and fruit origin on the vigor performance and sex ratio of *Telfairia occidentalis*. Three seed positions of anterior, middle and posterior sections of fruits sourced from four origins of growth were studied in the nursery and field plots at the teaching and research farm of Ladoké Akintola University of Technology, Ogbomoso, Nigeria. Vigor index and percentage emergence were highest for seedlings from the anterior portions with fruits sourced from Imo and Ibadan origins. Genotypic Coefficient of Variation (GCV) and Heritability estimate in the broad sense ( $H_B$ ) for branching, foliage, vine length and diameter traits were also high for plants developed from anterior seed positions and therefore can be reliably selected. More female plants were sighted to have developed from the anterior positions with 3:1 and 2:1 female to male proportions for fruits sourced from Imo and Ogbomoso origins. There were difficulties in obtaining exact genetic sex ratios. This is attributed to differences in flowering time in the male and female plants. Fruits sourced from humid environment of Imo state and seeds extracted from anterior position, recorded highest seedling vigor performance and high female to male proportions for the field established plants. These findings affirm the postulation that more female plants develop from anterior seed positions if sourced from humid agro-ecologies.

**Key words:** Origin, seed position, sex-ratio, vigor, telfairia, traits

### **INTRODUCTION**

Fluted pumpkin *Telfairia occidentalis* is an important dioecious vegetable crop belonging to the family Cucurbitaceae (Akoroda, 1990; Ogar and Asiegbu, 2005). The vegetable is widely grown in the tropics majorly in eastern part of Anambra, Imo, Abia and Ebonyi States of Nigeria. The crop is now gaining prominence in South Western Nigeria (Schippers, 2002).

As a pot herb, the leaves are rich sources of protein, carbohydrate, iron, saponin, tannins and phytic acid and therefore a good food and medicinal source (Akwaowo *et al.*, 2000; Akanbi *et al.*, 2007). The vegetables are succulent with vigorous yield when grown in fadama or irrigation environment. Asiegbu (1984) reported female plant to produce more vigorous plant than male plant. Native farmers harvest the males for leaves and remain the females to produce fruits for edible seeds and for future planting. In the groceries, vegetables from the male plant suffer discrimination

as housewives prefer leaves of the female plant which have vigorous and succulent appearance. Ndukwu *et al.* (2005) suggested need to ascertain sex proportion in different portions of *Telfairia* fruits. Few researchers have determined sex ratio in the field of *Telfairia* plants. Asiegbu (1984) and Akoroda and Adejoro (1990) using plant morphological traits; Ajibade *et al.* (2006) used seed biochemical content and Ogbonna (2008) considered pod portion with focus on number of sprout per portion. Sparse literatures are available on the proportion of female to male seeds in the fruit. Exploring seed position to determine sex ratio in *Telfairia* plant population remains a dearth in *Telfairia* research. Identification of female *telfairia* seeds prior to planting would enhance better land area utilization to produce more *telfairia* leaves with better nutritional quality acceptable to consumers (Schippers, 2000). These female *telfairia* are only recognized on field plots after plant establishment at anthesis. The objective of this study was to determine the effect of fruit origin and seed position on vigor performance and sex proportion of *Telfairia occidentalis*.

## MATERIALS AND METHODS

**Nursery operations:** Two experiments comprising of nursery and field operations were carried out during the planting season of April to November 2009 at the Department of Agronomy Teaching and Research farm Ladoke Akintola, University of Technology, Ogbomoso. Thirty six wooden boxes of 75×45 cm diameter each were used for the nursery plantings. Three large sized fluted pumpkin fruits were sourced from each of four origins of Ogbomoso, Enugu, Ibadan and Imo. The fruits were cut linearly at both ends of the stigmatic scar and stalk joint. Seeds from anterior, middle and posterior positions were carefully removed from the fruit and seeds in each position sown in the wooden boxes filled with top soil. There were variations in number of seeds from each position. Three replications were used and seeds germinated and grew in the nursery for 28 days. Seedling data were recorded on four characters, viz, mean days to germination, percentage (%) emergence, seedling vigor index and emergence index. Pod origin and agro-ecology distribution is shown in Table 1.

**Seedling data collection:** At five days after sowing (5 DAS) emerged seeds were counted as having germinated and percentage emergence and mean days to germination determined.

**Seedling length:** At four weeks after sowing (4 WAS) seedling data were collected following the method of Ellis and Roberts (1980) and Kharb *et al.* (1994) as:

$$\text{Seedling emergence index (SEI)} = \frac{\sum(Dn)}{\sum n}$$

where, n are number of seeds that emerged and D are days from sowing to emergence:

$$\text{Seedling vigor index (SVI)} = \text{SL} \times \text{Emergence\%}$$

where, SL = seedling length (cm):

$$\text{Emergence} = \left( \frac{\text{No. of seedling emergence}}{\text{No. of seeds shown}} \right) \times 100\%$$

% emergence were calculated only for seeds with radicles emerging through the testa and greater than 2 mm (>2 mm).

Table 1: Pod origin and agro-ecology distribution

Pod origin	Agro-ecology
Ogbomoso	Guinea savanna
Enugu	Humid
Ibadan	Humid
Imo	Humid

**Fields operations:** Seedlings in the nursery were transplanted on the twenty fifth day after sowing (2 5DAS) to beds each measuring 7×2 m with 1 m spacing between beds. Randomised complete block design with three replications were used. A seedling was placed per hole to give 16 plant stands per plot. A total of 576 plant stands were on the field prior to data collection. Plant irrigation and other cultural practices were carried out when necessary. At 110 days after seed sowing, growth, flowering and sex data were noted and collected on the established plant stands. Field data included date to 50% flowering, number of branch per plant, vine length (cm) vine width (cm), internode distance (cm) number of foliage and foliage width (cm).

**Data analysis:** Analysis of variance test performed using SAS, 2000 2.0 package of 2000. Genotypic and phenotypic coefficients of variation were calculated following the methods outlined by Falconer and Mackay (1996) as follows:

$$\delta^2g = (mg-me)/r$$
$$\delta^2p = \delta^2g + \delta^2e$$

Where:

- $\delta^2g$  = Genotypic coefficient of variance
- $\delta^2p$  = Phenotypic coefficient of variance
- mg = Genotype mean square
- me = Error mean square
- $\delta^2e$  = Error variance
- r = No. of replications

## RESULTS

Telfairia nursery trial recorded differences in the seedling traits for the three seed positions across the fruit origin (Table 2). Fruits sourced from Imo gave high percentage of emergence and vigor index for seedlings extracted from anterior position (89%; 11.0). This was closely followed by Ibadan (85%, 7.7) and Ogbomoso (70.2%; 7.5) anterior seed positions, respectively. Mean germination time was shortest for seeds in the middle position of Enugu origin (5.5) which germinated within 6 days after sowing. Following the seed positions in the fruits (Table 3), there were wide and significant variations in the performance of the seven traits evaluated. The seeds from each of the three positions and origins flowered at different time as the days to flowering differed significantly using treatment variation source (118.6). The established plants from the three seed positions and origins recorded wide variations in their vine thickness and leaf wideness (0.51; 5.2). Vine nodal distance did not show significant variation. Comparatively, effect of seed position on trait performance recorded somewhat higher genotypic than phenotypic variation.

Table 2: Seed position on germination and seedling vigor

Seed position	Percentage	Number of seed	Emergence %	Mean days to germination	Seedling vigor index	Seedling emergence index
Ogbomoso	Anterior	46	70.2	8.3	7.5	4.2
	Middle	43	69.7	7.2	6.4	3.8
	posterior	40	41.0	6.9	4.8	3.5
Enugu	Anterior	44	67.8	8.1	6.7	4.5
	Middle	35	59.8	5.5	5.0	2.9
	posterior	41	52.8	6.2	5.3	3.7
Ibadan	Anterior	46	85.0	8.7	7.7	4.8
	Middle	42	71.2	7.2	7.3	3.6
	posterior	39	48.1	6.6	6.9	3.3
Imo	Anterior	43	89.3	8.9	11.0	5.4
	Middle	48	65.2	8.5	6.7	5.2
	posterior	46	58.1	7.2	6.5	4.0

Table 3: Mean square in the analysis of variance of field traits in Telfairia plants

Source of variation	Df	Days to 50% flowering	Number of branch/plant	Vine length (cm)	Vine width (cm)	Internode distance (cm)	Number of foliage	Foliage width (cm)
Block	2	0.72*	0.27	9.4	0.39*	2.7	16.4**	0.06
Treatment	11	118.6**	8.04**	578.6**	0.51**	7.9	2418.1**	5.20**

\* Significant at 5%; \*\* Significant at 1%

Table 4: Positional mean values, genotypic and phenotypic coefficient of variation and heritability estimates in telfairia

Trait	Position	Mean value	Genotypic (CV) %	Phenotypic (CV) %	Broad sense heritability
Days to 50% flower	Anterior	98.3	38.2	57.2	49.2
	Middle	81.2	44.3	50.1	45.2
	Posterior	87.0	42.1	49.2	30.2
Number of branch per plant	Anterior	35.1	41.3	57.2	72.2
	Middle	28.4	51.3	55.6	82.7
	Posterior	20.7	54.2	53.5	40.2
Vine length (cm)	Anterior	3.2	45.7	35.3	80.2
	Middle	2.7	54.4	37.6	85.4
	Posterior	1.9	33.3	28.5	65.2
Vine width (cm)	Anterior	1.4	57.1	16.8	60.3
	Middle	0.9	15.2	16.0	70.4
	Posterior	1.1	17.2	18.7	50.7
Internode distance (cm)	Anterior	10.7	18.1	18.6	69.5
	Middle	7.9	17.2	16.5	30.2
	Posterior	10.1	20.3	21.4	28.2
Number of foliage	Anterior	123.7	67.1	52.1	58.7
	Middle	100.2	51.7	57.6	50.3
	Posterior	120.7	50.2	21.6	29.7
Foliage width (cm)	Anterior	4.7	63.2	21.6	53.6
	Middle	3.9	24.8	16.6	79.2
	Posterior	4.0	22.0	16.9	50.2

Number and wideness of foliage in the anterior seed position (Table 4) were the most genetically variable (67.1 and 63.2%) with moderately high heritability estimates of 58.7; 53.6%, respectively.

Table 5: Positional sex ratio in Four Telfairia origins

Origin and position	Number of plant	Established plant		Sex ratio		Percentage		
		Male	Female	Male	Female	Male	Female	
Ogbomoso	Anterior	48	15	29	1	2	33.3	66.1
	Middle	45	30	21	1	1	47.2	56.8
	Posterior	45	27	15	1	1	46.1	49.7
Enugu	Anterior	46	19	26	1	1	43.5	56.5
	Middle	47	23	24	1	1	56.2	52.7
	Posterior	45	28	15	2	1	68.3	31.8
Ibadan	Anterior	40	15	22	1	1	40.0	60.1
	Middle	47	19	26	1	1	41.5	58.6
	Posterior	45	20	23	1	1	46.5	53.6
Imo	Anterior	45	11	32	1	3	22.5	70.4
	Middle	48	21	24	1	1	48.3	51.8
	Posterior	46	24	19	1	1	57.1	43.1

Even though branching and nodal distance recorded low genetic variation; the associated heritability values were high (72.2 and 69.5%).

Field established plants flowered with different male to female ratios across the seed positions (Table 5). Telfairia seeds sourced from the humid agro-ecologies of Imo and Ibadan (Table 1), recorded calculated male to female trait performance ranges of between 40 and 60% across the seed positions. Anterior seed positions from Ogbomoso and Imo developed two and three times 2:1; 3.1 more female to male plant stands on the field with 66.1 and 70.4% female proportion higher than male established plants of 33.3 and 22.5% values.

## DISCUSSION

Seeds in the anterior positions numbered more split testas at the time of fruit splitting than seeds in the middle and posterior ends. This could have accounted for the highest emergence proportion and vigor performance index recorded in the seedlings from anterior position. Better still, the fruit stalk linearly closer to the anterior end of the Telfairia fruit, may have allowed release of more photosynthase accumulate from the leaves to the anterior positioned seeds. Early seed germination in telfairia can be achieved using seeds extracted from the anterior seed position. This finding contradicts the work of Akoroda and Adejoro (1990) that seed split in telfairia can be achieved using sawdust growth medium. According to Stefano *et al.* (2004), many factors affect Telfairia seed quality and seedling vigour. Odiyi, (2003) identified multiple seedling from one seed to affect seedling vigor. Yamauchi and Winn (1996) identified soil condition as an indicator of seedling vigor in rice. Again level of accumulation of biochemical content in the cotyledonous seeds may have justified the variation in the number of seeds that emerged and the seedlings that recorded vigorous performance. This assertion was opinionated by Ajibade *et al.* (2006), in their study on effect of biochemical qualities on sex proportions in telfairia crop and runs contrary to the findings of this research.

The Phenolic variations in the trait performance with respect to foliage, branching and vine traits can be attributed to the proportion of male to female plant numbers present in the established Telfairia field crop. Wilman and Asiegbu (1982) identified vine diameter and fresh leaf weight as

contributors of yield variation in both male and female plants of *Telfairia* and runs contrary to this research which identified more specifically that genetic differences in traits associated with each of the seed positions and origins accounted for the yield variations in the male and female sexes. This report also disagrees with the findings of Ogbonna (2008), that sex and yield variations in *telfairia* are imposed by female plant correlation with vine length at flower initiations. On the other hand, diverse genetic background of the *Telfairia* origin used in these findings may have reposed the variations observed in the Phenolic and selection parameters. This is in agreement with the work of Ariyo (1995) that high genotypic variation for flowering and branching traits and that such variation is caused by wide genetic background of the cowpea genotypes used. High heritability estimates associated with foliage number and wideness as well as vine and branching traits suggest the reliability in selecting for these traits developing from anterior positions of *Telfairia* fruits sourced from humid environments. This is supported by Karthikeyan *et al.* (2010) and Ullah *et al.* (2011) that high heritability values in traits make for effective superior genotype selection. That germination number and vigor index were high for seedlings emerging from anterior position are suggestive that seedling from anterior position could produce more female than male plants stands on a given *Telfairia* field plots. The postulation of Asiegbu (1984), that sex population of field *Telfairia* plants be adjusted to accommodate more female than male plants for grocery acceptance, is justified by the findings of this research. However, this finding runs contrary to the work of Ogbonna (2008) that seeds from middle position produced more female plants.

The difficulty in obtaining exact sex proportion as evident in the calculated differences in the male to female percentages is as a result of variations in the flowering periods of both male and female *Telfairia* plants. During the cropping season, the male flowered between 90-96 days with the staminate flowers borne in a racemose inflorescence. Whereas, the single flutes (female flowers) were observed between 105-115 days after planting and borne on the leaf axils. Sexes are only identified with certainty at flowering; however, better information on sex proportion could also be obtained especially at the seed level if investigations incorporate more fruit origins and more seed positions to include each longitudinal row in a given fruit.

## CONCLUSION

This study sufficiently informed that fruit origin and seed position accounted for variations in the performance of *Telfairia occidentalis*. And that breeding for increased number and wideness of foliage could be successful in Guinea Savanna agro-ecology. The possibility is because foliage and vine branching performance of plants that developed from anterior positions gave high genetic variation with high selection parameter estimates. High seedling vigor in addition to high proportion of female to male plants in plants from anterior position strongly affirm that female seeds are located in the anterior positions of seeds sourced from humid environments.

Seed origin and positions are further investigated to accommodate more of such origins and positions so as to provide more sufficient and richer literature on improving female proportion in vegetable field crop of *Telfairia*.

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