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*Full Length Research Paper*

# Genetic variability and correlation studies in the fluted pumpkin (*Telfairia occidentalis* Hook F.)

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**Thirty-five genotypes of the fluted pumpkin (*Telfairia occidentalis*) collected from seven states in Southern Nigeria were evaluated for ten agronomic characters. The results obtained showed considerable variation among the genotypes for all characters studied. Low level of environmental influence was observed in the expression of all the characters studied except number of branches per plant and internode length. High heritability estimates were accompanied by high expected genetic gain in vine length, fresh leaf weight, vine weight, number of leaves per plant and marketable leaf yield. Vine length had the highest broad sense heritability and number of branches had the least value (75.00 and 29.28%, respectively). Correlation analysis showed significant and positive association among all the ten characters. Direct selection for improvement of these traits may be carried out on these characters, as their phenotypic expression would be good indicators of their genotypic potentials.**

**Key words:** Coefficients of variation, genetic advance, heritability, *Telfairia occidentalis*.

## INTRODUCTION

The fluted pumpkin, *Telfairia occidentalis* Hook. F. is a member of the family Cucurbitaceae. It is native to West Africa and the other species of this genus, *Telfairia pedata* (oyster nut) is found in East Africa (Okoli, 1987). It is a perennial crop but often cultivated as an annual (Ogbonna, 2009). It is grown widely in the forest zones of Nigeria for its edible parts which include the young vines, leaves, petioles and seeds (Odiaka et al., 2008). Often, it is more economical for farmers to grow fluted pumpkin either as a sole crop or mixed crop. This is because it provides appreciable cash to small farm families (Akoroda, 1990). Consumers prefer it because of its ability to remain green and its better texture in soup for longer time compared with others. Its nutritional composition and medicinal uses are of great importance.

Its seed is rich in oil and leaf is rich in protein, magnesium, iron and fibre (Akoroda, 1990; Ehiagbonare, 2008). The leaf extract is believed to serve as a remedy to anaemia, high blood pressure, convulsion and diabetes (Okoli and Mgbeogu, 1983; Ehiagbonare, 2008). In spite of these desirable attributes exhibited by *T. occidentalis*, little is known about attempts to improve the crop. Also, attempts to improve the crop can only be possible if there is sufficient genetic variability in characters that are of economic interest. Therefore, the starting point for the improvement programme of the fluted pumpkin is to determine the amount, cause and nature of variation that is present within the population. Presence of morphogenetic variation in agronomic characters of a crop would be of considerable importance in determining the best method needed to improve the yield of that crop (Ojo et al., 2006). Collection of germplasm of *T. occidentalis* to obtain as much variation as possible is thus desirable. This will form the basis for developing a breeding programme. The objectives of this study are to determine the magnitude of genetic variation among the *T. occidentalis* genotypes from the major area of cultivation and the extent of association among the

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characters.

## MATERIALS AND METHODS

This study was conducted at the Teaching and Research Farm of the Federal University of Technology, Akure (7°16’ N, 5°12’ E), located in the rainforest area of South-western Nigeria. The location is characterized by a bimodal pattern of rainfall with an annual mean of about 1300 mm with a mean temperature of 27°C and the climate is of the sub-humid type. Mature fluted pumpkin fruits of 35 genotypes were obtained from seven states in Southern Nigeria (five fruits per state) – Anambra, Edo, Ekiti, Delta, Imo, Ondo and Osun. The experimental plot was manually cleared and seeds were planted directly on flat ground. The experimental design used was randomized complete block design (RCBD) with four (4) replications. The 35 fruits of fluted pumpkin from the seven states were randomized within the plots. The experimental area measured 35 m × 40 m (1400 $m^2$). Each replication measured 35 m × 10 m (350 $m^2$). Single row plots were used, resulting in 35 plots per replication. Plots were spaced 1 m each between and within rows. Alleys of 1 m were created among replications.

Ten seeds were selected randomly from each fruit containing an average of 60 seeds and planted on the plots allocated to each fruit. This was done for each replicate. Planting was done on 16$^{th}$ April, 2010. Manual weeding was carried out at 3 weekly intervals. Data were collected on the following quantitative characters at harvest which was 8 weeks after planting on the field: Vine length, Vine girth (measured at the base of the plant), Number of leaves, Number of branches, Leaf length, Petiole length, Internode length. For Marketable leaf yield, the vine of each sample plant was cut at length of 1 meter from the base and weighed. After this, the leaves were separated from the vine. Vines and leaves were weighed separately to give vine weight and leaf fresh weight. The data obtained were subjected to analysis of variance using PROC GLM of SAS (SAS, 2000). Genotypic and phenotypic coefficients of variation were computed according to Singh and Chaudhury (1985) as follows:

Genotypic coefficient of variation (GCV) = $\frac{\sqrt{\sigma_g^2}}{\mu} \times 100$

Phenotypic coefficients of variation (PCV) = $\frac{\sqrt{\sigma_p^2}}{\mu} \times 100$

where, $\sigma_g^2$ is the Genotypic variation; $\sigma_p^2$ is the phenotypic variation; $\mu$ is the mean of the character.

Broad sense heritability was estimated as the ratio of genetic variance to the phenotypic variance and was expressed in percentage according Singh and Chaudhury (1985) as:

Heritability (H) = $\frac{\sigma_g^2}{\sigma_g^2 + \sigma_e^2} \times 100$

$\sigma_p^2 = \sigma_g^2 + \sigma_e^2$ ;

where, $\sigma_g^2$ is the genotypic variance; $\sigma_p^2$ is the phenotypic variance; $\sigma_e^2$ is the environmental variance. Genetic advance (GA) and genetic gain ($G_S$) were computed according to the formula given by Singh and Chaudhury (1985):

GA = $\frac{\sigma_g^2}{\sqrt{\sigma_p^2}} \times K$

where, K = 2.06 (selection differential at 5%); $\sigma_g^2$ is the genotypic variance; $\sigma_p^2$ is the phenotypic variance and $\sqrt{\sigma_p^2}$ is the square root of phenotypic variance.

The expected genetic gain ($G_S$) was determined from genetic advance (GA) expressed as a percentage of the population mean;

$G_S = \frac{GA}{\mu} \times 100$

where, $\mu$ is the mean of the character. Simple correlation coefficients were obtained between all possible combinations of traits using Pearson correlation analysis.

## RESULTS

The mean squares from analysis of variance (ANOVA) of the characters are presented in Table 1. The 35 genotypes showed wide variation for most of the characters studied and differences were significant (P<0.01). Estimates of genetic coefficient of variation, phenotypic coefficient of variation, genotypic variance, phenotypic variance, environmental variance, heritability, and expected genetic gain for ten agronomic characters in 35 genotypes of *T. occidentalis* are presented in Table 2. The genotypic coefficient of variation ranged from 16.57 for vine girth to 60.92 for vine weight, while phenotypic coefficient of variation ranged from 13.34 to 187.96 for the same trait, respectively. Genotypic variances varied from 0.09 for vine girth to 20,549.1 for marketable leaf yield, while phenotypic variances varied from 0.12 for vine girth to 31,313.04 for marketable leaf yield. Genotypic variances for the characters under study were more than environmental variance except for number of branches per plant and internode length. Heritability estimates ranged from 29.28% for number of branches per plant to 75% for vine girth.

High heritability estimates (>50%) were observed for vine girth, vine length, number of leaves per plant, leaf length, petiole length, leaf fresh weight, vine weight and marketable leaf yield. Number of branches per plant and internode length had moderate heritability estimates. Genetic advance was high for vine length, number of leaves per plant, leaf fresh weight, vine weight and marketable leaf yield while other traits had comparably low values. The highest expected genetic gain of 98.81% was obtained for leaf fresh weight and lowest of 20.30% was obtained for internode length. High heritability estimates were accompanied by high genetic advances for marketable leaf yield, leaf fresh weight, vine weight, number of leaves per plant, vine length. Other traits were accompanied by low values.

The phenotypic correlation as computed for all the ten

**Table 1.** Mean squares from analysis of variance (ANOVA) for ten agronomic characters of thirty five fluted pumpkin genotypes.

| Source | D.F | Characters | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Vine length (cm) | Vine girth (cm) | Number of leaves | Number of branches | Leaf length (cm) | Petiole length (cm) | Internode length (cm) | Leaf fresh weight (cm) | Vine weight (g) | Marketable leaf yield (g) |
| Rep | 3 | 8623.22 | 0.11 | 2246.67 | 439.63 | 73.37 | 18.85 | 56.4 | 20958.16 | 22321.48 | 86593.34 |
| Genotype | 34 | 13577.78** | 0.37** | 2474.14** | 60.00** | 70.60** | 15.20** | 20.20** | 34255.83** | 15119.06** | 92960.32** |
| Error | 102 | 1342.93 | 0.03 | 422.00 | 22.59 | 7.57 | 2.09 | 5.48 | 3570.05 | 2503.20 | 8.64 |

**significant at P< 0.01.

**Table 2.** Estimates of coefficients of variation, genotypic, phenotypic and environmental variances, heritability, genetic advance and expected genetic gain for ten characters in *T. occidentalis*.

| Character | Genotypic coefficient of variation (%) | Phenotypic coefficient of variation (%) | Genotypic variance | Phenotypic variance | Environmental variance | Heritability (%) | Genetic advance | Expected genetic gain (%) |
|---|---|---|---|---|---|---|---|---|
| Vine length (cm) | 26.77 | 32.11 | 3058.71 | 4401.64 | 1342.93 | 69.49 | 94.97 | 45.97 |
| Vine girth (cm) | 16.57 | 19.14 | 0.09 | 0.12 | 0.03 | 75.00 | 5.35 | 29.57 |
| Number of Leaves per plant | 35.38 | 47.77 | 512.54 | 934.54 | 422.00 | 54.84 | 34.54 | 51.56 |
| Number of branches per plant | 31.51 | 58.23 | 9.36 | 31.97 | 22.59 | 29.28 | 3.41 | 35.12 |
| Leaf length (cm) harvest | 16.71 | 20.33 | 15.76 | 23.33 | 7.57 | 67.55 | 6.72 | 28.29 |
| Petiole length (cm) | 20.91 | 26.76 | 3.28 | 5.37 | 2.09 | 61.08 | 2.92 | 33.67 |
| Internode length (cm) | 15.49 | 24.35 | 3.69 | 9.12 | 5.43 | 40.46 | 2.52 | 20.30 |
| Leaf fresh weight per plant (g) | 58.06 | 70.29 | 7671.45 | 11241.50 | 3570.05 | 68.24 | 149.05 | 98.81 |
| Vine weight per plant (g) | 60.92 | 81.59 | 3153.97 | 5657.17 | 2503.20 | 55.75 | 86.38 | 93.70 |
| Marketable leaf yield per plant (g) | 58.99 | 72.82 | 20549.10 | 31313.04 | 10763.94 | 69.49 | 239.22 | 98.44 |

characters is presented in Table 3. Significant correlations were observed between number of branches on one hand and, internode length and vine girth on the other. All other relationships between the characters under study were very highly significant. In addition, all correlation coefficients were positive.

## DISCUSSION

The observed significant variation among the genotypes in this study is implicative of the difference among the genotypes under study and the existence of possible genetic divergence in *T. occidentalis*. This finding is contrary to the claim of Ajayi et al. (2006) that the genetic diversity is narrow. The high level of variability in this population suggests that heterosis could be utilized to produce superior hybrids, which can further be used in breeding programme to develop superior genotypes (Makinde, 1988). Furthermore, the significant and comparably large genotypic and phenotypic variance among the genotypes for all characters except number of branches per plant implies that there would be adequate gains in selecting these characters. Similar findings were reported in okra (Makinde, 1988) and in cucumber (Afangideh and Uyoh, 2007). However, estimates of environmental variance were larger than genotypic variances in characters like number of branches per plant and internode length, indicating that these characters were to a large extent influenced by the environment unlike the other traits. Such has also been reported by Rakhli and Rajamony (2005) in culinary melons (*Cucumis*

**Table 3.** Correlation coefficients among the ten agronomic characters in *T. occidentalis* genotypes.

| Parameter | Vine girth (cm) | Number of leaves | Number of branches (cm) | Leaf length (cm) | Petiole length (cm) | Internode length (cm) | Leaf fresh weight (g) | Vine weight (g) | Marketable leaf yield (g) |
|---|---|---|---|---|---|---|---|---|---|
| Vine length (cm) | 0.72** | 0.62** | 0.39** | 0.80** | 0.74** | 0.76** | 0.81** | 0.83** | 0.84** |
| Vine girth (cm) | | 0.47** | 0.27* | 0.71** | 0.64** | 0.62** | 0.64** | 0.61** | 0.64** |
| Number of leaves | | | 0.68** | 0.55** | 0.51** | 0.34** | 0.81** | 0.68** | 0.77** |
| Number of branches | | | | 0.35** | 0.33** | 0.21* | 0.52** | 0.47** | 0.51** |
| Leaf length (cm) | | | | | 0.89** | 0.79** | 0.76** | 0.73** | 0.77** |
| Petiole length (cm) | | | | | | 0.72** | 0.75** | 0.69** | 0.75** |
| Internode length (cm) | | | | | | | 0.62** | 0.69** | 0.66** |
| Leaf fresh weight(g) | | | | | | | | 0.90** | 0.98** |
| Vine Weight (g) | | | | | | | | | 0.96** |

*, ** Significant at P= 0.05 and P=0.01, respectively.

*melo* L.). The predominant effect of environment on number of branches per plant may have been caused by environmental hazards such as mechanical breakage during weeding and pest attack (rodents and insects) which could have led to the loss of apical dominance. A consequence of this loss is profuse branching of the crop.

The phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) values are useful for comparing the relative amount of phenotypic and genotypic variation among different characters. In this study, high PCV was observed for characters such as vine weight, leaf fresh weight, marketable leaf yield, number of leaves and number of branches. Therefore, greater potential could be expected in selection for these characters. The comparably low PCV observed in vine girth, leaf length and internode length respectively suggests the highly stable nature of these characters among the different genotypes studied and is indicative of less scope for improvement (Okoye and Eneobong, 1992). Similar trends have also been reported in cucumber (Afangideh and Uyoh, 2007) and African yam bean (Okoye and Eneobong, 1992). The magnitude of heritability (H) was moderate for all the characters except number of branches per plant and internode length. This suggests the low influence of environment on all characters under study except number of branches per plant and internode length. It also suggests that the genotypic variance and genetic variability components were at least moderately high (Borojevic, 1990).

According to Ojo and Amanze (2001), high heritability strongly suggests that there is potential for large genetic determination for these characters which can be exploited for improvement of marketable leaf yield of the fluted pumpkin. In this study, high heritability estimates were accom-0panied by high genetic advance in marketable leaf yield, leaf fresh weight, vine weight, number of leaves per plant and vine length, an indication that the characters have high selection value with less environmental influence. Therefore, improvement by direct phenotypic selection is possible. According to Idahosa et al. (2010), if a high heritability value is accompanied by high genetic advance, it may be governed by additive gene action and improvement with respect to these characters could be brought about by phenotypic selection. Similar observations have been reported for vine length on cucurbits such as the sponge gourd *Luffa cylindrical* (Prasad and Singh, 1990) and pointed gourd *Trichosanthes dioica* Roxb (Singh et al., 1996).

Significant and positive correlation between two characters suggests that these characters can be improved simultaneously in a selection programme (Hayes et al., 1955). This is because it shows mutual relationships among characters and selection for one will translate to selection and improvement of the other. For the improvement of marketable leaf yield in fluted pumpkin, it was necessary to determine the magnitude and the direction of relationship between the marketable leaf yield and its components. Studies on the character associations showed that vine length, number of leaves per plant and number of branches per plant and leaf fresh weight were positive and correlated with the marketable leaf yield. Similar findings have been reported on *Cucumis sativus* (Saika et al., 1998), and the pointed gourd *T. dioica* Roxb (Singh et al., 1996). The significant and positive correlation between leaf fresh weight and marketable leaf yield may be explained by the greater photosynthate accumulated in each leaf, which accounted for the high marketable leaf yield (Ariyo, 1987).

Consequently, number of leaves could provide a good selection index for high marketable leaf yield in fluted pumpkin genotypes. This study reveals that large variability exists in a number of characters of the fluted pumpkin. However, it may be worthwhile to conduct multilocational trials in order to reaffirm this finding. In addition, direct selection will be effective in improving the traits under study. Also, with the significant correlation between the characters, there is the likelihood of simultaneous improvement of two or more characters.

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