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INFLUENCE OF SEED LOCATION IN THE FRUIT POD OF FLUTED PUMPKIN (*TELFAIRIA OCCIDENTALIS* HOOK. F.) AND POULTRY WASTES ON PLANT SEX RATIO

N. L. Aniekwe[1†] --- M.C. Mbah[2]

[1,2]Department of Crop Production & Landscape Management, Ebonyi State University, Abakaliki, Nigeria

ABSTRACT

The influence of seed location in the fruit pod of fluted pumpkin and inorganic fertilizers and poultry wastes on the plant sex ratio was investigated in 2009 and 2010 in a randomized complete block design in three replications. In 2009, a mean of 25:75 male: female plants per pod resulted from seeds in the head region producing a ratio of 38:62 male: female plants, the middle, 24:76 and in the tail region, 14:86. In 2010, a mean of 30:70 male: female plants per pod were obtained, 33:67 male: female plants from seeds in the head, 24:76 in the middle and 34:66 in the tail. A total plant sex ratio of 1: 3 per fruit pod occurred in the two trials, while more female plants occurred in middle and tail regions (1:3 or 24:76) than in the head region (1:2 or 35.5: 64.5). Fertilizer sources showed no significant influence on the male: female plant ratio, but on the leaf area. Poultry wastes influenced the highest (78.8 cm^2), NPK (15:15:15) 57.3 cm^2 and the least 48.4 cm^2 from control. Plants in the middle region had the highest leaf area (65.8 cm^2), Coefficient of variation for male plants was wide in 2009 (52.3) and in the mean of the years (25.4). Smallholder female farmers can increase their business and income by selecting seeds from the middle and tail locations and by augmenting soil fertility with cheap and affordable poultry wastes.

Keywords: Seed location, Plant sex ratio, Fruit pod, Poultry wastes, Inorganic fertilizers, Fluted pumpkin.

Contribution/ Originality

This study is one of very few studies which have investigated answers to the worrisome sights of preponderance of male plants characterized by tiny vines and leaves and no pods from a pod of fluted pumpkin. The farmer wants to know what to do to raise her income and livelihood.

+ Corresponding author

1. INTRODUCTION

The fluted pumpkin also known as the fluted gourd (*Telfairiaoccidentalis* Hook. f.) belongs to the *Cucurbitaceae* family and classified in the tribe *Joliffieae* of the subfamily *Cucurbitoideae* being among the three species *T. pedata*, *T. batesii* that make up the genus *Telfairia*. Fluted pumpkin is suggested to have originated in the Southeastern area (between latitude 5° - 6° N and longitude 7° - 8° E) of Nigeria being cultivated and distributed by the Igbo people who have cultivated the crop ('Ugu', Igbo tribal name for *Telfairia*) since time immemorial, essentially as a leafy vegetable [1]. *T. occidentalis* is a perennial crop but is cultivated as an annual. Outside Nigeria, where it is frequently eaten by up to 35 million people, and apart from west Cameron, it is far less well known as a leafy vegetable but its immature edible seeds enjoy profuse localized utility [2, 3]. The leaves are used alone or together with okra (*Abelmoschusesculentus*), dika nuts (*Irvingiagabonensis*), egusi melon seeds (*Citrulluslanatus*), eru or 'okazi' (*Gnetumafricanum*), 'utazi' (*Gongronemalatifolia*) or 'ora' (*Pterocarpussoyauxii*) as soups for 'fufu', boiled yam or rice. However, *Telfairia* root extracts can be very poisonous and is used to kill rats and fishes and is lethal when consumed by people [2].

Nutritionally, the leaves and the seeds are valuable sources of food components and mineral elements. Pregnant women and patients suffering from anemia drink the juice extracted from the leaves to strengthen blood because of the high content of mineral nutrients especially magnesium, iron, potassium, carotene and vitamin C as food supplements [1]. The nutritional content of the leaves is comparable to that of other dark green leafy vegetables per 100 g edible portion: water 86.4 g, energy 147 KJ (47 Kcal), protein 2.9g, fat 1.8g, carbohydrate 7.0g, fibre 1.7g, while that of the seeds per 100 g edible portion is water 6 g, energy 2280 KJ (543 Kcal), protein 20.5 g, fat 45 g, carbohydrate 23.5 g, fibre 2.2 g, calcium 84 mg, phosphorus 572 mg, potassium 1824 mg, magnesium 535 mg, sodium 280 mg. The seeds are also high in essential amino acids (except lysine) and can be compared with soybean meal with 95 % biological value [4-6].

The cultivation and distribution of fluted pumpkin leaves and pods are is strongly gender polarized in favour of the female farmers who account for 75% of the labour force in agriculture in the sub-Saharan Africa [7]. Women specifically constitute the majority of smallholder farmers, provide most of the labour, manage their small-scale farmsteads, are managers of community and households, traders, and about 30% of them are family caretakers or rural household heads in sub-saharan Africa [7, 8]. Mwanamwambwa [9] suggests that the knowledge of the women's various roles provides the basis for identifying the constraints and opportunities for promoting their welfare and aspirations, including engagement in income generation activities. One major constraint among others to the production of fluted pumpkin is the ratio of the number of seeds that turn out male plants to female plants per fruit pod, which has been put as being large [2]. This is a serious worry to the female farmers who prefer female

fluted pumpkin plants to males because of their vigorous shoot growth, larger leaves and fruit pod production since it generates more income to the farmer in two main ways (sale of leaves and fruits).

Soon after the seeds are sown about 4-5 months, there seems to be a profusion of male flowers sticking out all over the farm but this occurs at least 3 months earlier than female flowers. Farmers are not too sure of male or female plants in early days of growth before 3 months hence, have to wait before they can harvest the leaves to avoid harvesting from female plants that would produce fruit pods. There is a strong belief among the smallholder female farmers that harvesting leaves from female plants earlier before fruiting prevents them from fruiting in future (personal communication). Research need to be conducted to establish this assumption or quash it with enough evidence. Schippers [2] reported a somewhat large ratio of male to female plants in *Telfairia*, (more male than female plants) which is difficult to establish because approximately 15% of the plants do not produce any flower during the first year of its growth, but the plant is grown as annual. Most female plants show distinct stronger and vigorous shoots and larger leaves than the male plants, yet, it takes three months from sowing for this characters to manifest clearly and some male plants can show the same characters (depending on the growing conditions), while some weak looking plants may turn out to be females eventually [2], if the growing environment is favourable.

Many unsuccessful efforts have been made to determine the number of male to female plants in a fruit pod, even the use of hormone (ethephon) spray showed that only at 500 parts per million doses were capable of giving the highest female to male ratio Olufalaji and Denton [10]. Onwubiko [3] suggested many issues in the production of this crop which require accelerated research attention among which is the development of agro-techniques for increased female to male ratio in fluted pumpkin since female plants are preferred to males because of their larger leaves and fruit pod production. Akoroda, et al. [11], stated that artificial or hand pollination can increase fruit set from 15% to 35% in female plants. They observed that despite the high ratio of 800 male flowers to one female flower, there is still a very high inefficient pollination mechanism in fluted pumpkin. A chemical analysis of poultry manure revealed that the following nutrient elements 1.45 % N, 0.81 % P, 0.36 % K, 47.00 % dry matter and 53.00 % moisture were available Khaliq, et al. [12], which can be utilized in vegetable crops production. The major objective of the experiment was therefore, to determine the influence of seed location in the fruit pod and the application of poultry manure (wastes) on the male: female plant ratio of fluted pumpkin (*Telfairiaoccidentalis*).

2. METHODS

The study was conducted on the research farm of Ebonyi State University, Abakaliki located at latitude 06^0 19′ 407′′ N, longitude 08^0 07′ 831′′ E and at an altitude of 447m above sea level,

with about 1700mm -2060mm annual rainfall, spread between April and October. The design of the experiment was a 3 x 3 factorial arranged in a randomized complete block design (RCBD) in three replications covering an area of 108m^2. Factor A was three apparent locations on the pod (the head, the middle and the tail), while factor B was three fertilizer sources (NPK (15:15:15) at 30 kg ha^{-1}, poultry droppings at 20 tons ha^{-1} and a control), which gave rise to nine treatment combinations. The oval-shaped fruit pods used in the experiment each time were obtained from a local market in Ebonyi State from the smallholder female farmers who usually bring the pods to sell at the beginning of the rains. The fluted pumpkin is grown as annual crop and therefore, new pods are used every planting season. The pods were carefully cut open longitudinally from head to tail to expose the segmented seeds. A meter ruler was used to measure the length of the pod (from the point where seeds begin to where it ended) and thereafter marked out with a coloured marker into three equal sections designated as the head, the middle and the tail. Care was taken to separate and collect the seeds as marked with the help of a blunt flat metal object which cuts through the fibrous segments without wounding the seeds and shifting the seeds sideways through each pod beginning from one end, while extracting and keeping the seeds separately for all heads, middles and tails for sowing as such in designated plots. New fruit pods were obtained and these procedures repeated each year of the experiment. Randomization was achieved using numbered paper cards. A total of 27 plots of 2 m x 2 m were involved and were manually constructed with west African dwarf hoe (the large blade type), one meter between blocks and 0.5 m between plots. Using the 0.5 m x 0.5 m plant spacing recommended by Olufalaji and Denton [10] and Schippers [2], eight plant stands per plot at one seed per hole gave 216 plant stands in the experiment which were allowed to creep freely on the ground without staking. Weeding was done regularly as weeds appeared. Data were collected from the number of plants established per plot on the number of male and female plants (male plants are identified by the characteristic tall slender stalked flowers which were traced to its plant base and recorded). The counting of male flowers continued until female flowers appeared such that the number of plants without male flowers and primordial pods were taken as female plants. However, the experiment did not take number of pods into account as the major concern was the determination of male: female plant ratio. The ratio was therefore calculated according to the three locations. Leaf area data were calculated using the graph paper method. Four leaves each from four middle plants per plot were selected from the middle of the plant vine (destructive sampling) and were placed on a graph paper as flat as possible, whereby all squares not completely covered up to ½ were approximated and analyzed using the analysis of variance (ANOVA) procedure, while mean separation for detecting significant differences between means was performed using Fisher's least significant difference (F-LSD) according to Carmer and Swanson [13]. Percentages of the number of male and female plants were calculated.

3. RESULTS AND DISCUSSION

In Table 1, the mean number of males in the head location was more (25.0) than it was in both middle (16.5) and tail sections (16.5). However, the mean number of females in 2009 and 2010 were equal (49.0) but higher than males contrary to observations from literature [2, 3], that male plants are always more than female plants in a pod, which informed the reason for this investigation. However, the head section in 2009 appeared to produce more males (27) than in 2010 (23), but the tail section produced 24 males in 2010 more than in 2009 (9) while the middle produced low number of males consistently in both years, nevertheless, female plants still dominated. It appears then that this reported higher number of males was as a result of the influence of the head and tail locations. Could it be that what is usually observed in yam applies in fluted pumpkin, whereby both ends of a yam tuber are potential points of sprouting if the head region develops any problem [14]. The mean number of males to females was 17.3 and 49.3 in 2009, and 21.3 and 48.7 in 2010, while the mean for the two years was 19.3 male plants and 49 female plants. The coefficient of variation of male plants in 2009 was widest (52.3) showing more males in head location (27) and the least in the tail location (9), but narrower in 2010. Generally, the coefficient of variation for female plants was least in both years and in the mean of the years.

Table 2 presents the percentage of male and female plants in the three locations of the fruit pod. The ratio was 1 male to 3 females in 2009 and 1 male to 2 females in 2010, that is, 25.3% were males and 74.7% females in 2009 while it was 30.3% males and 69.7% female in 2010. The result showed an average of 1 male to 3 females per fruit pod in the following order. In the head, the relationship was 35.5 males and 64.5 females and in both middle and tail, 24 males and 76 females were observed. The observed variations in the three locations of the pod justified the reason for this study to fill the information gap among the smallholder female farmers in this zone. Schippers [2] reported that the ratio of male to female plants is somewhat large and is difficult to establish because approximately 15% of the plants do not produce any flowers during the first year of its growth. At least the farmer can predict to a reasonable extent the ratio of male: female plants that can result from a pod if care is taken to group the seeds into these three locations which was not an easy task until then. The fertilizer sources used did not have any significant influence on the male and female plant ratio as indicated in Table 4 with almost equal number of male plants, but under NPK (15:15:15) males were slightly higher (28.7) though not significant. However, there was significant ($p<0.05$) interaction effect of seed location and fertilizer sources on plant sex which concentrated on the head location with the highest number of male plants (38) obtained under the poultry manure. The number of female plants (76) was significantly ($p<0.05$) concentrated on the middle and tail locations of the fruit pod. This shows that the occurrence of male or female plants from the seeds in any part of the fruit pod may not depend on the environment of the seeds but on the nature of the seeds. Genetic studies can reveal the cause of these results.

3.1. Effect of Seed Location and Soil Nutrient Sources on Leaf Area

The leaf area was significantly ($P<0.05$) influenced by the seed location and fertilizer sources as shown in Table 3. The head region having shown a preponderance of male plants yielded the least leaf area per plant (57.2 cm^2) in comparison with 65.8 cm^2 in the middle and 61.6 cm^2 in the tail region. This corresponds with the observation of more female plants in the middle and tail regions in this work. As a matter of fact, female *Telfairia* plants produce broader leaves than the male plants which gave rise to the larger leaf area recorded in the middle and tail regions. Poultry wastes influenced larger leaf area growth (78.8 cm^2) than the control (48.4 cm^2) and NPK (15:15:15), second larger leaf area with 57.3 cm^2. This observation is in consonance with the report of Khaliq, et al. [12] that poultry manure contains nutrient elements such as nitrogen (1.45 %), phosphorus (0.81 %), potassium (0.36 %), dry matter (47.00 %) and moisture (53.00 %) which can enhance plant growth and soil fertility. It is therefore obvious that the average high N content of poultry manure was the reason for the observed difference in the leaf area. Leafy vegetables usually respond well to nitrogen application which significantly translates to luxurious vegetative growth which is an advantage to the farmer. It is also expected that a vigorous pumpkin plant growth ensures large fruit pod production, although we did not extend our data collection to fruit pods.It was also observed that there was a significant interaction effect of seed location and fertilizer source on the leaf area of *Telfairia* plants. The largest leaf area (83.0 cm^2) was obtained from plants that originated in the middle region where poultry droppings was applied followed by the plants from the tail region (80.5 cm^2) and the least from the head (73.0 cm^2). The same trend was true with NPK (15:15:15) and the treatment control.

4. CONCLUSION

The most important point from these experiments was that more females were recorded from seeds that originated in the middle and in the tail regions, than was discovered in the head regions. This information is interesting especially to the smallholder female farmers and researchers who would prefer female plants than males for fruit pod production, propagation and higher income generation from the sale of the more attractive flourishing female plant leaves and fruit pods than could be obtained from male plants. With more females obtained in the tail and middle regions than males, farmers can select their seed sources for planting from the middle and tail portions of the fruit pods. Also, the presence of more female plants of *Telfairiaoccidentalis* will translate to more vegetables per fruit pod which invariably means more income to the farmer. Plant breeders should be involved to unravel the background of our observations. On the long run, the much expected food security would be achieved while many more individuals may be attracted to vegetable cultivation for their means of livelihood and income generation. With more income generation, the resource-constrained farmers can come alive again and contribute meaningfully to food production to feed the burgeoning human populations.

Table-1. The mean number of male and female plants in three locations in the fruit pod of fluted pumpkin

	2009		2010		Mean	
Location	**male**	**Female**	**Male**	**female**	**male**	**Female**
Head	27	44	23	45	25	44.5
Middle	16	50	17	53	16.5	51.5
Tail	9	54	24	48	16.5	51.0
Mean	17.3	49.3	21.3	48.7	19.3	49.0
CV	52.3	10.2	17.8	8.3	25.4	8.0

Table-2. The percentage of male and female plants in the three locations of the fruit pod of fluted pumpkin

	2009		2010		Mean	
Location	**male**	**Female**	**Male**	**Female**	**male**	**female**
Head	38	62	33	67	35.5	64.5
Middle	24	76	24	76	24.0	76.0
Tail	14	86	34	66	24.0	76.0
Mean	25.3	74.7	30.3	69.7	27.8	72.2
Ratio	1 : 3		1 : 2		1 : 3	

Table-3. The effect of seed location in the fruit pod and fertilizer types on the leaf area (cm^2) of fluted pumpkin

	Fertilizer type			
Seed location	**NPK (15:15:15)**	**Poultry dropping**	**Control**	**Mean**
Head	52	73.0	46.5	57.2
Middle	64	83.0	50.5	65.8
Tail	56	80.5	48.3	61.6
Mean	57.3	78.8	48.4	

F-LSD (P=0.05) = 2.36 for comparing two location means
F-LSD (P=0.05) = 0.75 for comparing two fertilizer means
F-LSD (P=0.05) = 0.42 for comparing seed location x fertilizer interaction means

Table-4. The effect of seed location in the fruit pod and fertilizer types on the number of male and female plants per pod

	Fertilizer							
	NPK(15:15:15)		**Poultry manure**		**Control**		**Mean**	
Seed location	Male	Female	Male	Female	Male	Female	Male	Female
Head	34.5	65.5	38	62	34	66	35.5	64.5
Middle	25	75	24	66	23	67	24	76
Tail	23	77	24	66	25	75	24	76
Mean	28.7	71.3	27.5	72.5	27.3	72.7		

F-LSD (P=0.05) = 5.5 for comparing two seed location means
= 21.5 for comparing two fertilizer means
= 5.5 for comparing two seed location x fertilizer means

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