**THE EFFECT OF SEED SIZE, WEIGHT, POSITION IN THE POD ON SEX EXPRESSION IN FLUTED PUMPKIN (*Telferia occidentalis Hook f*)**

**A RESEARCH PROJECT**

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**CHAPTER ONE**

**INTRODUCTION**

Fluted pumpkin (*Telferia occidentalis Hook f.*) is known for its freshly leaves which is utilized for consumption purposes. It is a member of the Cucurbitaceae family, is a strong climber and dioecious. The fruits or pods are large, weighing up to 20 kg, and containing 80 seeds on average (Odiaka and Schippers, 2004; Schippers, 2002). The plant is native to Nigeria and also found in the moist coastal areas of West Africa but rarely occurs naturally in East Africa (Ubani and Okonkwo, 2011). Fluted pumpkin can be propagated only by seeds, but their availability for planting is a major problem and cannot satisfy the widespread interest in the cultivation of the plant (Odiaka and Schippers, 2004). The seeds are difficult to conserve during the intervening period between fruit harvesting at the end of one season and seed planting at the beginning of the next. It is because of this short storage life span, Oboh and Akinhahuns, (2004) classified the seeds as recalcitrant, although the water concentration was not quantified. Seeds attain maximum physiological quality in terms of germination, vigour and storage reserve accumulation 9 weeks after fruit set, after which vivipary and seed rot set in the extent of which is related to the duration of fruit storage after harvesting (Sarumi, 2001).

Fluted pumpkin as a member of the *cucurbitacase* family, dioecious and perennial plant, it is characterised by greenish leafy vegetables and fleshy fluted gourds with hard edible seeds (Oyekunle and Abosede, 2012). When cultivated, the plant develops tendrils that usually creeps and spreads on the surface of the ground if left unattended to and coil through stakes (Osadebe *et al.,* 2015). The broad leaves are locally referred to as “ugu” (Igbo) or “ikongubong” (Ibibio) and is used for cooking soups, stews, yam and vegetable sauces and even for medicinal purposes. The seeds are also edible. However, they are to be properly cooked before consumption (Osadebe *et al.,* 2015). The seeds are an excellent source of protein and oil and thus, are highly beneficial to human health. Interestingly, there has been an overwhelming increase in the consumption of fluted pumpkin leaves and seeds over the past years due to all the nutritive benefits obtainable from them (Olaniyi and Akanbi, 2007).

Southern Nigeria is a major producer of this vegetable and it cultivation is by seeds obtained from the pods (Okokon *et al.,* 2007). The seeds are of different sizes, weight and position in the pods. Fluted pumpkin seed sizes ranges from 2-10mm, the seed weight ranges from 0.00-10g while the seeds position in the pod can be either in the blossom end, distal end or mid portion (Willie and Amaechi, 2017). Fluted pumpkin pods are formed in the occurrence of successful pollination of the male and female flowers. Therefore, these flowers are either male or female sex which determines the numbers of pods to be produced (Willie and Amaechi, 2017). Researches postulates that the seed size, weight or position can be a determining factor for the expression of sexes in fluted pumpkin *(Telferia occidentalis)* (Willie and Amaechi, 2017), which gives rise to the number of pods produced.

**1.2 Justification of the Study**

Female plants of fluted pumpkin are usually more vigorous in growth than the male plants, they also produce robust stems and broader leaves (Ajibade, 2006) and are usually preferred by vegetables farmers. Who may likely suffer heavy loses if after planting they discover that their field is populated by male plants (Willie and Amaechi, 2017).

It is therefore the wish of every fluted pumpkin farmer to reduce the population of male vines as much as possible, especially if the objective is to produce vegetable only (through the harvest of leaves and tender stems), and this can only be possible if the farmer is able to eliminate those traits in the seeds that are likely to produce male vines.

**1.3 Objectives of the Study**

The Objective of this Study is;

1. To determine the effect of seed sizes on sex expression in fluted pumpkin (*Telferia occidentalis*)
2. To determine the effect of seed weights on sex expression in fluted pumpkin (*Telferia occidentalis*)
3. To determine the effect of seed position on sex expression in fluted pumpkin (*Telferia occidentalis*)

**CHAPTER TWO**

**LITERATURE REVIEW**

* 1. **Origin and Distribution of Fluted Pumpkin *(Telfairia occidentalis)***

Fluted pumpkin *(Telferia occidentalis)* is traditionally used by an estimated 30 to 35 million people and this plant is indigenous to the people in Nigeria, including the Efik, Ibibio, and Urhobo (Aderi *et al.,* 2011). Common names for the plant include fluted gourd, fluted pumpkin, ugu (in the Igbo language), and Ikong-ubong (in the Efik and Ibibio languages). However, it is predominantly used by the Igbo ethnic group, who continue to cultivate the gourd for food and traditional medicines (Oyekunle and Abosede, 2012). Fluted pumpkin is an asset to international food trades of the Igbo ethnic group (Ogbonna, 2009).

Fluted pumpkin *(Telfairia occidentalis)* is a tropical vine grown in West Africa as a leaf vegetable and for its edible seeds (Aderi *et al.,* 2011). *Telferia occidentalis* is a member of the family *Cucurbitaceae* and is indigenous to southern Nigeria (Aderi *et al.,* 2011; Odiaka and Schippers, 2004). The fluted gourd grows in many nations of West Africa, but is mainly cultivated in south-eastern Nigeria. It is used primarily in soups and herbal medicines (Okon *et al.,* 2004). Although the fruit is inedible, the seeds produced by the gourd are high in protein and fat, and can, therefore, contribute to a well-balanced diet. The plant is a drought-tolerant, dioecious perennial that is usually grown trellised (Okokoh, 2005).

Fluted pumpkin also occurs in the forest zone of West and Central Africa, most frequently in Benin, Ghana and Cameroon (Okokoh, 2005; Odiaka, 2001). Although the plant is rare in Uganda, and absent in the rest of East Africa. It has been suggested that it originated in south-east Nigeria and was distributed by the Igbos, who have cultivated this crop since time immemorial (Odiaka, 2001). It is, however, equally possible that fluted pumpkin was originally wild throughout its current range, but that wild plants have been harvested to local extinction and are now replaced by cultivated forms (Odoiaka *et al.,* 2008).

* 1. **Botany and Cultivars of Fluted Pumpkin *(Telfairia occidentalis)***

Fluted pumpkin *(Telferia occidentalis)* is classified in the tribe *Joliffieae* is an herbaceous plant that climbs by the use of axillary tendrils, belongs to the dicotyledonous family, *cucurbitaceae*, and is among the three species that make up the genus *Telferia*, the other two being *Telferia pedata* (osyternut), found in East Africa, and *Telferia batesii* (FAO, 2016). Fluted pumpkin *(Telferia occidentalis)* is a native of West Africa notably South Eastern Nigeria, Ghana, Cameroon and Sierra Leone (FAO, 2016). Cultivars of *Telfairia occidentalis* are distinguished by seed colour, thickness of vine, size of leaf, growing vigour, days to flowering and succulence (Akwaowo *et al.*, 2000).

In Nigeria, the two known cultivars are ‘*ugu-ala’* and *‘ugu-elu’* (Ajayi *et al.,* 2004). *‘Ugu-ala’* is characterized by succulent, broad leaves, small black seeds, thick stem and slow growth, and *‘ugu-elu’* which has a high growth rate, large brownish seeds with high viability, and thin stem with small leaves (Ajayi *et al.,* 2004). The large succulent leaves of ‘ugu-ala’ make this cultivar a commercial vegetable in high demand, while the fast emergence and high growth rate of ‘ugu-elu’ is preferred by farmers because of quick returns (Ajayi *et al.,* 2004). The seed is often polyembryonic, which is useful for multiplication and in breeding (Fanuryi, 2006).

Fluted pumpkin *(Telferia occidentalis)* is perennial, dioecious herb climbing by coiled, often branched tendrils to a height of more than 20 m; the root system ramifying in the top surface of the soil; the stem is angular, glabrous, becoming fibrous when old (FAO, 2016; Fashina *et al.,* 2002). Fluted pumpkin leaves are arranged spirally, pedately compound with 3–5 leaflets; stipules are absent; petiole is about 15 cm long; it has leaflets with petiolules 0.5–3.5 cm long (Navarine and Kodithuwakku, 2009).

Fluted pumpkin male inflorescence is an axillary raceme up to 3–5.5 cm long, on a peduncle up to 25 cm long, with base of peduncle one long-pedicellate flower flowering long before the others (Modupeola *et al.,* 2014). The female flowers are solitary in leaf axils. Flowers 5-merous, cream coloured, pedicel up to 4 cm long, receptacle campanulate, sepals triangular, up to 5 mm long, petals free, oblong, fringed; male flowers with 3 stamens, two 4-locular and one 2-locular, with large reddish connective; female flowers similar to male flowers but with inferior, cylindrical, 3-celled ovary and 3 large, heart-shaped stigmas (Odiaka, and Schippers, 2004). Fluted pumpkin fruit is a drooping, ellipsoid berry 40–95 cm × 20–50 cm, weighing up to 6 kg, with 10 prominent ribs, pale green and covered with white bloom wax, fruit pulp yellow, many-seeded. The Seeds compressed ovoid, up to 4.5 cm long, black or brown-red (Odoiaka *et al.,* 2008). Seedling with hypogeal germination, developing first a taproot and then numerous, spreading axillary roots; epicotyl 5–12 cm long; cotyledons planoconvex, fleshy (Schippers, 2002).

**2.3 Nutritional and Proximate Composition of Fluted Pumpkin *(Telfairia occidentalis)***

Fluted pumpkin *(Telfairia occidentalis Hook f.)* is nutritious and comprises of different compounds and minerals. Its proximate composition is anchored on different parts of the plant; the leaves and seed (Nyong *et al.,* 2021). Additionally, its proximate composition of either the leaves or seeds shows large variations as a function of cultivar, plant age, ecological conditions and cultural practices (Nyong *et al.,* 2021; Eseyin *et al.,* 2005). The composition of the leaves is comparable to that of other dark green leafy vegetables (Esuoso *et al.,* 2000). The leaf composition per 100 g edible portion include: moisture 86.4 g, energy 147 kJ (47 kcal), protein 2.9 g, fat 1.8 g, carbohydrate 7.0 g, fibre 1.7g (Ehiagbnare, 2008). The high content of mineral nutrients, especially of Mg, Fe and K, carotene and vitamin C make the leaves potentially useful as food supplements (Ehiagbnare, 2008). Young leaves contain the anti-nutrients cyanide at 60 mg per 100 g dry matter and tannins at 41 mg per 100 g dry matter, but their concentrations are below toxic levels and may not affect the bioavailability of the minerals (Aletor *et al.,* 2002; Akwaowo *et al.,* 2002). Young leaves should be well cooked to remove the potential toxic effects before consumption (Aletor *et al.*, 2002; Ehiagbnare, 2008).

Akwaowo *et al.,* 2002 concluded that the composition of the seed per 100 g edible portion is: water 6.2 g, energy 2280 kJ (543 kcal), protein 20.5 g, fat 45.0 g, carbohydrate 23.5 g, fibre 2.2 g, Ca 84 mg, P 572 mg. Other sources recorded a protein content of 28–37% and an oil content of 42–56% of the dry matter (Aletor *et al.,* 2002). The mineral content of the seed is reported to be high (Akwaowo *et al.,* 2002). The seeds are high in essential amino acids (except lysine) and can be compared with soya bean meal with 95% biological value (Giami *et al.,* 2004). The fruit pulp has a protein content of about 1.0% (Nyong *et al.,* 2021).

Considered an “oil seed”, the fluted gourd is high in oil (30%) (Nyong *et al.,* 2021). Shoots of *Telferia occidentalis* contains high levels of potassium and iron, while seeds are composed of 27% crude proteins and 53% fats (Oboh, and Akinhahuns, 2004). The leaves contain a high amount of antioxidants and hepatoprotective and antimicrobial properties (Oboh, and Akinhahuns, 2004). The main constituents of the seed oil are oleic acid (37%), stearic and palmitic acid (both 21%), linoleic acid (15%) (Giami and Isichei, 1999). Giami *et al.,* (2004) reported that fermenting fluted pumpkin seeds for seven days increased crude protein and in vitro protein digestibility while decreasing the levels of two anti-nutrients, polypherol and phytic acids.

**2.4 Economic Importance of Fluted Pumpkin *(Telfairia occidentalis)***

Fluted Pumpkinleaves, stems, and seeds, have high food value and provide a source of food, oil and raw material for a variety of products (Akwaowo *et al.,* 2000, Giami *et al.,* 2004). Fluted pumpkin is also used by the Igbos in their ‘*Ofeugu’*, and the Ibibios in their ‘*Edikan* *ikong’* soups (Willie and Ameachi, 2017). The leaves are used solely or in combination with other leaves, fruits or seeds of other plants species, it is cooked with leaves of water leaf *(Talinum triangulare),* African Gnetum *(Gnetum africanum),* immature fruits of okra *(Abelmoschus esculentus),* seeds of Dika *(Irvingia gaboneensis)* and seeds of Egusi melon *(Cucumeropsis mannii Naud.)* in preparing soups used in eating starchy roots, tubers and cereals (Willie and Ameachi, 2017). The oil rich seeds maybe eaten boiled, roasted or fermented and are high in essential amino acids (except lysine and methionine) and can be compared with soybean meal, with 95% biological value (Aderi *et al.,* 2011; Odiaka and Schippers, 2004; Nyong *et al.,* 2021).

The fluted gourd has been traditionally used by indigenous tribes as a blood tonic, likely due to its high protein content (Aletor *et al.,* 2002). Flour produced from the seeds can be used for high-protein breads (Giami, 2004; Akwaowo *et al.,* 2002). Furthermore, *Telferia occidentalis* leaves is prepared for herbal medicine, it is used to treat sudden attack of convulsion, malaria, and anaemia; it also plays a vital and protective role in cardiovascular diseases (Nwanna and Oboh, 2007; Okokon *et al.,* 2007).

Conclusively, aside from it utilization as food sources, it is also a major source of income, measure of employment for producers and sources of revenue for the government (Odoiaka *et al.,* 2008).

**2.5 Fluted Pumpkin *(Telfairia occidentalis)* Production in Nigeria**

Fluted pumpkin leaves are common in the markets of lowland areas in Benin, Nigeria and Cameroon. During the dry season in Nigeria intensive trade develops in areas along river banks for sale to urban areas where major food-crop markets develop (Odiaka, 2001). In Nigeria, the leaves are also transported by road from the south over a long distance to the big cities in the North (Odiaka and Schippers, 2004). The cultivation of fluted pumpkin is developing around cities as a way of reducing the high transportation costs. No statistical data are available on the total production (Odiaka, 2001). In Nigeria, demand from different parts of the country has raised the price of the leaves and fruits. The average price per fruit in Nigeria is US$ 0.70–1.00 and the leaves US$0.20-0.50 (FAO, 2016).

* 1. **Constraints of Fluted Pumpkin Production in Nigeria**

According to Odiaka, 2001 and Okon *et al.,* 2004, the major constraints to the production of fluted pumpkin can be highlighted as follows;

* High prices of fluted pumpkin fruits and seeds which determine continued productivity.
* Poor storage facilities of fluted pumpkin fruits, leaves and seeds (i.e., short shelf-life)
* High cost of transportation to urban markets.
* Low soil fertility leading to low productivity
* Poor irrigation facilities during dry seasons
* Lack of technicality to grow fluted pumpkin
* Lack of credit facilities and support from agricultural agencies or government.

**2.7 Soil and Climatic Requirements of Fluted Pumpkin *(Telfairia occidentalis)***

Fluted pumpkin *(Telfairia occidentalis)* grows vigorously in the warm lowland humid tropics where it is found at elevations up to 1000 meters, producing edible leaves in the rainy season and at the beginning of the dry season, for a period of 6–10 months (Okon *et al.,* 2004; Odiaka and Schippers, 2004). It grows best in areas where annual daytime temperatures are within the range of 21-39oC but can tolerate 19-38oC (Odoiaka *et al.,* 2008). The plant can survive temperatures down to about 5oC (Ubani and Okonkwo, 2011). In traditional agriculture, it is a rain fed crop and water deficiency during the dry season reduces its productivity (Ubani and Okonkwo, 2011). Although it is fairly drought tolerant, rainfall appears to be the major factor in its productivity as it prefers a mean annual rainfall in the range of 1900-2200mm but tolerates 1500-2700mm (Schippers, 2002). The best leaf and fruit yield and highest plant survival rate occur when the plants are irrigated 2–3 times per week during the dry season (Schippers, 2002). Fluted pumpkin can be grown under a wide range of soil conditions though a humid rich soil. It can be managed as a short-term perennial when grown on well-drained soils, slightly shaded and mulched (Oyekunle and Abosede, 2012).

**2.8 Agronomic Characteristics**

Fluted pumpkinis typically grown and it spreads flat on a field (Ajayi *et al.,* 2004). A beneficial outcome of growing the gourd flat is the suppression of weeds, especially when intercropped with a tall, upright plant such as maize. The growing period begins in April or May when seeds are planted; the first leaves and shoots can be harvested after a month and can be collected every 2–4 weeks thereafter (Ajayi *et al.,* 2004; Aderi *et al.,* 2011). Seeds are planted directly in the soil, typically in groups of three to increase output in a case of a failed germination (Odiaka, 2001). The seeds are subsequently collected and dried; a portion of them are consumed, while the remainder are stored for the following planting season (Odiaka, 2001). Although dependent upon soil type, the fluted gourd is able to ratoon and subsequently produce many flushes of fruit over long periods. It is able to ratoon with the highest degree of success in well-drained soils (Aderi *et al.,* 2011). Fluted pumpkin is propagated using the seeds. Its seed is housed in another greater covering or hard shell which protects it from harm. It survives drought and can retain its life in the root even after many years. It is a creeping plant and grows well if staked with bamboo sticks (Odoiaka *et al.,* 2008).

Fluted pumpkin seeds are viviparous (germinating in the fruit). Since seeds are recalcitrant they cannot be stored for more than 3 days once they are extracted from the fruit (Udoh, 2005). Fluted pumpkin can be sowed commercially as a sole crop or intercropped with other vegetables and food crops such as cassava, yams and maize, among others (Osadebe *et al.*, 2015).The conventional method of propagation is by seed, sown directly at a rate of 30,000–70,000 seeds/ha and spaced at 0.3–1 m × 0.3–1 m. Densely spaced stands are best for leaf production, while the wider spacing is best for fruit production when staked (Oyekunle and Abosede, 2012). Depending on the soil type, rainfall and cropping pattern, fluted pumpkin can be planted on the flat, or on ridges or mounds (Olaniyi and Odedere, 2009).

During the rainy season, staking is commonly practiced to reduce disease infection. Plants are staked individually or, for fruit production, with bamboo trellis (Udoh, 2005). During the dry season staking is not needed for crops for leaf production because there is less disease attack. Staking does not have a significant effect on the yield of leaves (Aderi *et al.,* 2011; Udoh, 2005).

Due to the prolific nature of the plant, weeds are not troublesome. Planting on flat land is the best method of weed suppression (Sarumi, 2001). Three weeding interval may be required in a staked crop during the rainy season. During the dry season when plants are not staked, two weeding interval are needed before the leaf canopy smothers most weeds (Udoh, 2005).

Mulching can be used as a method of weed control and to retain soil moisture (Udoh, 2005; Sarumi, 2001). The first pruning is 4 weeks after emergence to stimulate branching and increase the growth (Adebayo and Adeyemo, 2020). Irrigation is necessary for high leaf or fruit production especially under sole cropping in the dry season. Watering is done once every 3 days (Aderi *et al.,* 2011).

Organic manure or inorganic fertilizers are used in traditional systems, but for an optimal leaf yield the recommended fertilizer application is 100 kg K2O and 50 kg P2O5 per ha. In Southern Nigeria, application of Phosphorus was found to be especially important, as Nitrogen and potassium only increased yields in combination with application of Phosphorus (Aro and Agwu, 2005).

**CHAPTER THREE**

**MATERIALS AND METHODS**

**3.1 Study Area**

This study will be carried out at the Teaching and Research farm of faculty of Agriculture, Akwa Ibom State University. Obio Akpa Campus, Oruk Anam Local Government Area, Akwa Ibom State. The area lies between latitude 4030’N and 50 00’N and longitudes 700 30’E and 800 00’E (SLUS-AK, 1989). It records annual rainfall of about 2500mm. the rainfall lasts between April and November usually with a break in august which last for about 2 weeks (termed “August break”). Temperature range is between 22.5-30.7OC. The Relative Humidity is about 78%. The soil is sandy loam (SLUS-AK, 1989).

**3.2 Experimental Design and Treatments**

The experiment will be laid out in a randomized complete block design (RCBD) with three 3 replications. The experiment will consist of three weight categories of fluted pumpkin seeds (0-3g, 4-6g and 7-9g), three size (diameter) categories of seeds (0-4mm, 5-7mm, 8-10mm), three positions of seeds in the pod (blossom end, distal end and middle portion). Fluted pumpkin seeds will be planted at 1m x 1m corresponding to 10000 stands per hectare. Each experimental unit will measure 4m x 4m. the experimental units will be separated from each other by a path measuring 1.2m, while the replicates will be separated from each other by an alley measuring 1.5m wide.

The total experimental plot will measure 45.6m x 15m (684m).

**15 m**

**Rep. I Rep. II 1.5m Rep. III**

0-4mm

**1.2m**

Distal end

5-7mm

4-6g

Middle portion

0-3g

Blossom end

8-10mm

7-9g

0-4mm

Distal end

0-3g

4-6g

Middle portion

5-7mm

**45.6m**

8-10mm

7-9g

Blossom end

Blossom End

0-4mm

0-3g

5-7mm

4-6g

Distal End

8-10mm

7-9g

Mid-portion

**4m**

**4m**

**Figure 1: The Layout of the Experimental Treatments and Design**

**3.3 Soil Sampling**

Prior to planting the soil will be randomly sampled at the depth of 0-15cm at three different location or spots. The soil samples will be bulked together to obtain a representative sample, the representative sample will be air dried and sieved with 2mm sieve before it is taken to the laboratory for analysis.

**3.4 Agronomic Practices**

**3.4.1 Land Preparation**

The field will be cleared manually using cutlass and tilled with spade. Stumping will also be done manually through the use of spade.

**3.4.2 Planting**

Planting material will be Telferia seeds. The fluted pumpkin pods will be purchased at local market (Udua Abak). Telferia seeds will be extracted from the pods, depulped and grouped according to specifications allowed to dry under shed for about 24 hours, the dried seeds will be planted on the flat ground and buried 5cm deep at a planting distance of 1m x 1m (Intra and inter rows)

**3.4.3 Fertilizer application**

Organic manure in the form of poultry dung will be used alongside Compound Fertilizer (N: P: K 15:15:20) will be applied at the rate of 50 g/vine (500 kg/ha) by ring application, 4 weeks after planting.

**3.4.4 Weeding**

Weeding will be done manually.

**3.4.5 Harvesting**

Harvesting will be done manually using sharp knife at 4, 6, 8 and 10 weeks intervals.

**3.5 Data collection**

Data will be collected on emergence count, which will be obtained as the number of plants that emerged 12 days after planting; plant vigor, which will be obtained by visually observing plants and giving them a ranking of 1-10, 10 being the most vigorous; number of leaves per plant, which will be obtained as the number of fully expanded leaves per plant; number of branches per plant; vine length, obtained as the length of the longest vine in the plant; vine diameter, measure as the base of the plant using Vanier calipers; harvestable vegetable yield, which will be obtained as the weight (kg) of the total vegetable yield of plants, the vine of each sample plant being cut at the length of 1m from the base and weighed; edible vegetable yield, obtained as the weight (kg) of the edible portion of the harvestable yield, made up of the leaves and tender portions of the shoot; days to emergences of first male flower; days to emergence of first female flower and male: female flowerless plant ratio.

**3.6 Data Analysis**

All the data obtain will be subjected to One Way Analysis of Variance (ANOVA) of Randomized Complete Block Design (RCBD). Means that shows significant differences will be compared using Duncan multiple range test (DMRT) at 5% probability interval.

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