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Seed Size and Spatial Placement Effects on Emergence Growth and Foliar Yield of Fluted Pumpkin (*Telferia occidentalis* (f.) Hook) in South Eastern Ecological Zone of Nigeria

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Abstract

Field experiments were conducted at the Teaching and Research Farm of the Akwa Ibom State University, Obio Akpa Campus, between May, 2022 and October 2023, to examine the effects of seed size of fluted pumpkin and spatial placement of the seeds in the pod, on the emergence, growth and foliar yield of fluted pumpkin. The experiment consisted of three seed size categories (small, medium and large) and three spatial placement locations in the pod (Proximal section, Distal section and Middle section). The experiment was laid out in a randomized complete block design and replicated four times. Results indicated significant effects of spatial placement of seeds in the pod on some growth and yield parameters. Seeds from the middle section of the pod produced plants with the highest number of leaves (49.27), the widest stem girth (2.15cm) and the highest foliar yield (0.59 tones/ha). The size of seeds also significantly influenced the growth and foliar yield of fluted pumpkin. The large seeds produced plants with highest number of vines (5.10),the highest number of leaves (49.81), the highest seedling vigour index (8.78), the widest stem girth (1.26 cm) and the highest foliar yield (0.52 tons/ha). Farmers who are interested in producing fluted pumpkin vegetables are therefore advised to sow large seeds, and seeds from the middle section of the pod.

Key words: Fluted pumpkin, *Telfairia occidentalis*, Proximal end, Distal end, Middle section of the pod.

1.0 Introduction

Fluted pumpkin (*Telfairia occidentalis* (F.) Hook*)* is a perennial tropical vine grown as leafy vegetable and for its edible seeds. It belongs to the family *Curcubitaceae*, and occurs in the forest zone of West and Central Africa, most frequently in Benin, Ghana and Cameroon (Odiaka *et al.,* 2005). The plant is dioecious and drought-tolerant. It grows vigorously in the warm lowland humid tropics where it is found at elevations below 1000 m. Fluted pumpkin is mainly cultivated in South-eastern Nigeria which is its centre of origin. It is used primarily in soups and

herbal medicines (Okon *et al.,* 2004). The seeds are rich in protein and fat, and can be used in preparing balanced diets.

Fluted pumpkin is cultivated under warm climates with plenty of sunshine and prolonged rainy season (Udoh and Ndon, 2006), The application of organic manure or NPK fertilizer before planting is highly recommended (Akpan *et al.,* 2022, Udounang *et al.,*2022). In the absence of mineral fertilizer, Ekwere and Efetuei (2021) recommended the application of nitrogen-rich soybean meal and other soil amendment materials to the ultisols.

Fluted pumpkin is commonly intercropped with yam, cassava, maize and plantain. Even when intercropped for the purpose of weed control, the local farmers still look forward to harvesting some gourds if only to have seeds for the next season planting (*Ekwere, et al*., 2013). The vegetable has gained popularity in recent years due to the increasing awareness of its nutritional and medicinal values. It plays important roles in human and livestock nutrition. Grubben and Denton (2004) stated that the pumpkin leaf is rich in minerals such as Calcium and Iron which are essential for the building of bones and teeth, hence it is recommended for pregnant women and patients suffering from anemia. The seeds are excellent source of protein and oil and are thus highly beneficial to human health.

However, fluted pumpkin also contain anti nutrients such as phytic acid, tannin and saponin. Its root extracts also contain resins, alkaloids and saponins, and have been shown to be lethal to rats, mice, fish and humans (Ladeji *et al.,* 1995; Ekwere *et al*., 2019). The young leaves contain cyanide at 60mg per 100g dry matter and tannins at 41mg per 100g dry matter, but their concentrations are below toxic levels and may not affect the bioavailability of other nutrients (Akwaowo *et al.,* 2002). Young leaves therefore, should be well cooked to remove the potential toxic effects before consumption.

Female plants of fluted pumpkin are usually more vigorous in growth than the male plants, they also produce robust stems and broader leaves (Ajibade *et al.,* 2006) and are usually preferred by vegetable farmers who may likely suffer heavy losses if after planting, they discover that their field is populated by male plants (Willie and Amaechi, 2016). It is the wish therefore, 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 vines), and this can only be possible if the farmer is able to identify those traits in the seeds that are likely to produce male vines and consequently smaller, fewer leaves.

Fluted pumpkin is propagated by seeds, but the seeds are difficult to conserve during the intervening period between fruit harvesting at one season and seed planting at the beginning of the next. It is because of this short storage life span that Oboh and Akinhahuns, (2004) classified the seeds as recalcitrant. It is however difficult to differentiate the male from female plants at the seed and seedling stages of growth (Emeberi and Nwafor, 1996). Ndukwe *et al*. (2005) reported that seeds that germinate into female plants are larger in size than those that germinate into male plants. Large seeds and those that germinate early, are positioned at the peripheral portion of the pod, and germinate to produce mostly female plants (Ndukwe *et al.,* 2005).

The Objectives of this study were to determine:-

- The effect of seed size on emergence, growth and yield of fluted pumpkin.

- The effect of spatial placement of seed in the pod on emergence, growth and yield of fluted pumpkin.

2.0 Materials and Methods

The experiment was conducted at the Teaching and Research Farm of the Akwa Ibom State University, Obio Akpa Campus during the 2022 and 2023 cropping seasons. The area lies between latitude $4^0 30^!$ S and $5^0 30^!$ N and longitudes $7^0 30^!$W and $8^0 00^!$E. The mean annual rainfall is between 2000 mm and 2600mm. The annual temperature range is between 24^0C and 30^0C. Relative humidity ranges from 75–79% (SLUS-AK, 1989).

The experiment consisted of three size categories of fluted pumpkin seeds (small, medium and large) and three spatial placement locations of the seeds in the pod (posterior end, middle portion and anterior end). The pumpkin fruits were purchased from a local farmer at the Cross River Basin Development Authority, Abak Sub-station. There is currently no improved cultivar of fluted pumpkin in this location. The fruits were carefully opened with machete and the seeds extracted, cleaned of the tissues and air dried under shade for two days to enhance germination. The seeds were planted at 1.0 x 1.0m corresponding to 10,000 stands per hectare.

Each experimental unit measured 4.0 x 4.0m and was separated from each other by a path measuring 1.2 m, while the replicates were separated from each other by an alley measuring 1.5 m wide. The total experimental plot measured 594.72 m^2 (41.3 × 4.4). The experiment was laid out in a randomized complete block design and replicated four times.

2.1 Data Collection

Five plants per experimental unit were randomly selected and tagged for the purpose of data collection. Data were collected on emergence percentage, vine length, number of vines, number of leaves / plant, seedling vigour index and total foliar yield.

Data collected were subjected to ANOVA and means that showed significant differences were compared using Duncan Multiple Range Test (DMRT) at 5% probability.

3.0 Results

The size of seeds had no significant effects on seedling emergence and vine length of fluted pumpkin (Table (3.1a), but the effects of spatial deployment of seeds in the pod was significant (Table 3.1b). Seeds from the proximal section of the pod recorded the highest seedling emergence (93.34% in 2022, and 91.00% in 2023). Seeds from the distal section of the pod recorded the lowest percentage emergence (91.03% in 2022, and 90.25% in 2023). The rate of emergence of seedlings from the distal section of the pod was not significantly different from those of the middle section.

The effects of seed size on vine length of fluted pumpkin was not significant in 2022, but in 2023, the large seeds produced plants with the longest vines (90.52 cm) compared to 89.31 cm long vines produced on plants from medium sized seeds. The small seeds however, produced plants with the shortest vines (87.96 cm). Spatial deployment of seeds in the pod significantly influenced the vine length of fluted pumpkin (Table 3.1b); seeds from the proximal section of the pod had the longest vines (91.82 in 2022 and 90.85 cm in 2023). The shortest vines (88.30 in

2023, and 87.70cm in 2022) were produced on plants from seeds of the middle section of the pod.

Vine production in fluted pumpkin was significantly influenced by the size of seeds, (Table 3.2a). The large seeds produced plants with the highest number of vines (4.90 in 2022 and 5.10 in 2023). Medium size seeds produced 4.70 vines in 2022, and 4.92 vines in 2023. The least number of vines (4. 36 in 2022, and 4.77 in 2023) were produced on plants from small seeds. Spatial deployment of seeds in the pod had no significant influence on vine production (Table 3.2b) except at 4 WAP when seeds from the middle section of the pod produced plants with the longest vines (3.20cm in 2022, and 3.39cm in 2023). Leaf production in fluted pumpkin was significantly influenced by size of seeds (Table 3.3a). Plants raised from the large seeds produced the highest number of leaves (49.36 in 2022, and 49.81 in 2023). The least number of leaves (42.99 in 2022, and 43.60 in 2023) were produced on plants raised from small seeds. Similarly, there were spatial deployment effects of seeds on leaf production (Table 3.3b). Seeds from the middle section of the pod produced the highest number of leaves.

(49.27 and 48.98) in 2022 and 2023 respectively. The least number of leaves (43.88 in 2022 and 45.16 in 2023) were produced on plants raised from seeds of the proximal section of the pod. There were no significant differences in leaf production between plants of the distal section of the pod and those from the middle section.

Table 3.1 (a): Effect of seed size on seedling emergence and vine length (cm) of fluted pumpkin for 2022 and 2023 experiments

					2022
Treatment	**Emergence (%)**	**4WAP**	**6WAP**	**8WAP**	**10WAP**
Seed size					
Small seed (1.6cm – 2.5cm)	93.84[a]	56.34[a]	66.05[a]	66.74[a]	86.31[a]
Medium seed(2.6cm – 3.5cm)	91.14[a]	56.92[a]	66.49[a]	67.54[a]	86.97[a]
Large seed (3.6cm – 4.5cm)	91.61[a]	56.27[a]	67.53[a]	62.36[a]	89.49[a]
P< 0.005					
					2023
Seed size					
Small seeds (1.6cm – 2.5cm)	94.19[a]	56.09[a]	63.08[a]	67.49[a]	87.96[a]
Medium seed(2.6cm – 3.5cm)	89.70[a]	56.43[a]	68.13[a]	67.14[a]	89.31[a]
Large seeds(3.6cm – 4.5cm)	93.49[a]	56.48[a]	69.14[a]	72.61[a]	90.52[a]
P< 0.005					

Table 3.1 (b): Effect of spatial deployment of seeds in the pod on emergence and vine length (cm) of fluted pumpkin for 2022 and 2023 experiments

2022

Treatment	Emergence (%)	4WAP	6WAP	8WAP	10WAP
Seed position in the pod					
Proximal (anterior) section	93.34[a]	57.34[a]	66.51[a]	75.45[a]	91.82[a]
Distal (posterior) section	91.03[b]	56.55[ab]	64.65[ab]	74.26[a]	89.65[a]
Middle section	91.96[b]	55.34[b]	62.49[b]	73.16[b]	87.70[b]
P< 0.005					

2023

Seed position in the pod					
Proximal (anterior) section	91.00[a]	58.29[a]	67.83[a]	78.10[a]	90.85[a]
Distal (posterior) section	90.25[b]	57.22[a]	65.38[ab]	76.13[a]	89.47[ab]
Middle section	90.75[b]	54.40[b]	63.40[b]	75.98[b]	88.30[b]
P< 0.005					

Table 3.2 (a): Effect of seed size on number of vines/plant of fluted pumpkin

2022

Treatment	4WAP	6WAP	8WAP	10WAP
Seed size				
Small seed (1.6cm – 2.5cm)	1.97[b]	2.90[b]	3.11[c]	4.36[b]
Medium seed(2.6cm – 3.5cm)	2.15[ab]	3.06[b]	3.48[b]	4.70[ab]
Large seeds(3.6cm – 4.5cm)	2.46[a]	3.60[a]	3.71[a]	4.90[a]
P< 0.005				

2023

Seed size				
Small seed (1.6cm – 2.5cm)	2.27[a]	2.92[b]	4.41[a]	4.77[b]
Medium seed(2.6cm – 3.5cm)	2.30[a]	3.26[ab]	4.74[a]	4.92[ab]
Large seeds (3.6 – 4.5cm)	2.96[a]	3.67[a]	4.91[a]	5.10[a]
P< 0.005				

Table 3.2 (b): Effect of spatial deployment of seeds in the pod on number of vines/plant of fluted pumpkin

				2022
Treatment	**4WAP**	**6WAP**	**8WAP**	**10WAP**
Seed position in the pod				
Proximal (anterior) section	2.68[b]	3.76[a]	4.58[a]	5.40[a]
Distal (posterior) section	2.72[b]	3.47[a]	4.62[a]	5.46[a]
Middle section	3.20[a]	3.62[a]	4.65[a]	5.52[a]
P< 0.005				
				2023
Seed position in the pod				
Proximal (anterior) section	2.54[b]	3.36[a]	4.24[a]	5.01[a]
Distal (posterior) section	2.85[b]	3.56[a]	4.71[a]	5.12[a]
Middle section	3.39[a]	3.73[a]	5.33[a]	6.18[a]
P< 0.005				

Seedling vigour index and stem girth of the fluted pumpkin seedlings were significantly influenced by the size of seeds (Table 3.4a). Fluted pumpkin seedlings raised from large seeds gave plants with highest seedling vigour index (8.45 in 2022 and 8.78 in 2023) and the widest seedling stems girth (1.23cm in 2022 and 1.26cm in 2023). The smallest stem girth (0.76cm and 0.74cm) in 2022 and 2023 respectively, were produced on plants from the small seeds. Foliar yield of fluted pumpkin was not affected by the size of seeds in 2023 (Table 4a), but in 2022, the large seeds produced plants with the highest foliar yield (0.46 tons/ha) this was followed by the medium size seeds which produced 0.44 tons/ha foliar yield. The least foliar yield (0.37tons/ha) were however produced on plants that germinated from small seeds.

There were significant spatial deployment effects of fluted pumpkin seeds on seedling emergence, seedling vigour index, stem girth and foliar yield of fluted pumpkin (Table 4b). Seeds from the middle section of the pod germinated into plants with the highest seedling vigour index (8.42 in 2022, and 8.83 in 2023). Seeds from the distal end of the pod also produced plants with seedling vigour of 7.89 in 2022, and 7.85 in 2023. The lowest seedling vigour (7.32 in 2022 and 6.28 in 2023) were produced on plants that germinated from seeds in the proximal end of the pod.

The highest foliar yield (0.44 tons/ ha in 2022 and 0.59 tons/ha in 2023) were produced on plants which germinated from seeds of the middle section of the pod, while seeds from the distalsection produced plants with the lowest foliar yield (0.37 in tons/ha in 2022 and 0.41tons/ha in 2023).

Table 3.3 (a): Effect of seed size on number leaves of Fluted pumpkin

				2022
Treatment	**4WAP**	**6WAP**	**8WAP**	**10WAP**
Seed size:				
Small seed (1.6cm – 2.5cm)	25.77[b]	35.35[a]	42.30[b]	42.99[c]
Medium seed(2.6cm – 3.5cm)	26.82[b]	36.80[a]	42.82[b]	45.90[b]
Large seed (3.6cm – 4.5cm)	36.82[a]	36.89[a]	46.16[a]	49.36[a]
P< 0.005				
				2023
Seed size:				
Small seed (1.6cm – 2.5cm)	25.58[b]	34.76[b]	42.59[b]	43.60[c]
Medium seed(2.6cm – 3.5cm)	27.13[b]	37.08[a]	43.09[b]	46.57[b]
Large seed (3.6cm – 4.5cm)	36.40[a]	37.17[a]	46.76[a]	49.81[a]
P< 0.005				

Table 3.3 (b): Effect of spatial deployment of seeds in the pod on number of leaves of fluted pumpkin

				2022
Treatment	**4WAP**	**6WAP**	**8WAP**	**10WAP**
Seed position in the pod				
Proximal (Anterior) section	29.09[b]	34.64[b]	46.61[a]	43.88[b]
Distal (Posterior) section	32.15[a]	37.90[a]	47.02[a]	48.24[a]
Middle section	33.93[a]	38.11[a]	47.32[a]	49.27[a]
				2023
Seed position in the pod				
Proximal (Anterior) section	29.55[b]	35.52[a]	44.68[a]	45.16[b]
Distal (Posterior) section	31.82[b]	37.48[a]	47.68[a]	48.52[a]
Middle section	34.36[a]	38.11[a]	47.79[a]	48.98[a]
P< 0.005				

Table 3.4(a): Effect of seed size on seedling vigour index, stem girth and foliar yield of fluted pumpkin

Treatment	Seedling vigour Index	Stem girth (cm)	Foliar yield (tons/ha)
			2022
Seed size			
Small seed (1.6cm – 2.5cm)	7.52[c]	0.76[b]	0.37[b]
Medium seed (2.6cm – 3.5cm)	7.85[b]	0.87[b]	0.44[a]
Large seed (3.6cm – 4.5cm)	8.45[a]	1.23[a]	0.46[a]
P< 0.005			
			2023
Seed size			
Small seed (1.6cm – 2.5cm)	7.12[b]	0.74[c]	0.49[a]
Medium seed (2.6 – 3.5cm)	8.04[b]	0.91[b]	0.51[a]
Large seed (3.6cm – 4.5cm)	8.78[a]	1.26[a]	0.52[a]
P< 0.005			

Table 3.4(b): Effect of spatial deployment of seeds in the pod on seedling vigour index, stem girth and foliar yield of fluted pumpkin

Treatment	Seedling vigour Index	Stem girth (cm)	Foliar yield (tons/ha)
			2022
Seed position in the pod			
Proximal (anterior) section	7.32[c]	0.76[b]	0.42[a]
Distal (posterior) section	7.89[b]	0.89[b]	0.37[b]
Middle section	8.42[a]	1.39[a]	0.44[a]
			2023
Seed position in the pod			
Proximal (anterior) section	6.28[c]	1.80[b]	0.52[a]
Distal (posterior) section	7.85[b]	1.82[b]	0.41[b]
Middle section	8.83[a]	2.15[a]	0.59[a]

4.0 Discussion

Results indicated significant spatial deployment effects of fluted pumpkin seeds on seedling emergence, vine length, number of leaves, seedling vigour, stem girth and total foliar yield. Seeds from the proximal section of the pod recorded the highest seedling emergence, and also produced the longest vines, while seeds from the middle section produced plants with the longest vines, the highest number of leaves and the highest total foliar yield of fluted pumpkin. The lowest percentage emergence, lowest number of leaves and the lowest foliar yield were however recorded on seeds from the distal portion of the pod. Modupeola *et al.(*2014) stated that fluted pumpkin seeds from the proximal and distal portions of the pod exhibited the highest and lowest percentage of seedling emergence respectively. According to Ndukwe *et al.* (2005), large seeds are positioned at the peripheral portion of the pod, and that they germinate to produce mainly female plants which are usually characterized by large leaves and robust tender stems, but Uwa *et al,* (2016) attributed high foliar yield of fluted pumpkin to the application of inorganic fertilizer. Willie and Ameachi (2016) however, did not find any differences in emergence count and growth parameters as a result of seed position in the pod.

The size of seeds also influenced the growth and foliar yield of fluted pumpkin. The large seeds produced plants with the highest number of vines, highest number of leaves, highest vigour index, widest stem girth and the highest foliar yield. Ndukwe *et al.,*(2005) reported that seeds that germinate into female plants are larger than those that germinate into male plants. Large seeds of fluted pumpkin are usually located in the middle portion of the pod, and are mostly female seeds. Ogbonna (2009) observed that fluted pumpkin plants produced from female seeds are usually robust and are likely to produce higher seedling vigour, wider stem girth, and higher foliage yield. However, Akpan and Odejimi (2006) attributed increase in number of edible shoots of fluted pumpkin to the effect of pruning, while Willie and Ameachi (2016) attributed the differences in growth and foliar yield of fluted pumpkin to environmental factors, such as low N supply, short photoperiod, high moisture availability and the effects of hormones.

5.0 Conclusion

Results from this research indicated that both the size of seed of fluted pumpkin, and their spatial deployment in the pod, had significant effects on the germination, growth and foliar yield of fluted pumpkin. The large seeds and seeds from the middle section of the pod posted the best growth and foliar yield results. Fluted pumpkin farmers are therefore advised to sow big seeds and seeds from the middle section of the pod especially when their aim is to produce vegetables only, and not the fruits.

6.0 References

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