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Utilizing Polyembryony in Fluted Pumpkin (*Telfairia occdentalis* Hook F.) Seed Multiplication

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Abstract: An experiment was conducted at the Western Farm of the Michael Okpara University of Agriculture, Umudike, Southeastern Nigeria to investigate the prospect of taking advantage of the phenomenon of polyembryony in obtaining more than one stand from single seeds of fluted pumpkin (*Telfairia occidentalis* Hook f.) and also to compare the agronomic performance of plants raised from whole, half and quarter seeds. Results obtained shows that it is possible to obtain multiple seedlings from single seeds of fluted pumpkin through exploiting the phenomenon of polyembryony in the crop. Whole seed plants were, however, consistently better than both half and quarter seed plants ($p<0.05$). The treatments were evaluated in respect of eight agronomic characters, namely days to shoot emergence, establishment count, number of branches per plant, number of leaves per plant, length of shoot, stem girth, leaf area,and fresh vegetable weight at harvest. Whereas, it is possible to obtain multiple stands from single seeds of fluted pumpkin through polyembryony, whole seeds gave a better crop than either half or quarter seeds.

Key words: *Telfairia occidentalis* · Whole seeds · Half seeds · Quarter seeds · Polyembryony

INTRODUCTION

Fluted pumpkin (*Telfairia occidentalis* Hook f.), a cucurbit leaf and vegetable crop native to tropical Africa is well known for its high nutritional, medicinal and economic value. It ranks among the three most widely eaten vegetables at home and restaurants across Nigeria [1]. Young, succulent shoot and leaves of fluted pumpkin are used singly or in combination with other vegetables such as Okra (*Albelmoschus esculentus*) in the preparation of soups for eating starchy foods such as gari and fufu, made from cassava (*Manihot esculenta*) and yam (Dioscorea spp), respectively and "tuwo", made from cereals [2-4]. A concoction made from fresh fluted pumpkin leaves is drunk as a tonic for the treatment of acute anaemia [5, 6]. In Southern Nigeria, immature seeds are eaten, cooked or roasted [7]. The cotyledons are processed into seasonings, high- protein cakes, snacks, marmalade, infant weaning foods and flour bread of supplements [8-11]. Seeds are believed to have lactation-promoting properties and therefore in high demand by nursing mothers [6]. The seed is also a source of edible unsaturated oil [12, 13]. Fluted pumpkin roots have high alkaloid content and their extracts which have high mammalian toxicity are used in controlling rodents, as well as in killing fish [14, 15]. Seeds have anti-nutrients, the concentration of which increased with maturity and as a result of this, immature seeds are preferred for food over mature ones [6].

Fluted pumpkin is propagated mainly by seeds. At present, an attempt to root vine cuttings *in vitro* as a way of circumventing the absolute dependence on seed for the cultivation of the crop is yielding fruit. [16] Demonstrated *in vitro* shoot induction from meristem and shoot tip culture of *Telfairia occidentalis* and observed that both explants induced shoots but those from shoot tip developed earlier and responded better than those from meristem. They suggest that *in vitro* culture procedures would be useful for developing uniform clones or micropropagation and could also form the basis for *in vitro* storage of explants and subsequent regeneration of plantlets after long term conservation in this species.

There are several difficulties associated with the propagation of fluted pumpkin by seeds. First, the crop sets few pods [6], usually one per vine, each containing sixty to seventy seeds on average, then, of the few seeds

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produced, many germinate and rot inside the fruits even before harvesting and those that are lost this way cannot be stored for long periods because they are recalcitrant, - sensitive to both desiccation as well as chilling [4]. Added to this is the high demand for the seed for food use, which competes stiffly for its use as planting material. The result of all these is the scarcity of planting material during the planting season, which naturally leads to increase in cost of production on the crop.

Fluted pumpkin is one of those crops with a characteristic feature of polyembryony. The occurrence of multiple seedlings in fluted pumpkin through polyembryony has been demonstrated by Odiyi and Uzo [17]. According to Odiyi [18], polyembryony is natural and that multiple seedlings were observed to develop in two areas of the crop. Also Esiaba [19] observed that multiple seedling occur in the embryonic axis as well as cotyledons of the seed which makes it possible to obtain more than one plants from one seed of fluted pumpkin. The present experiment was carried out to investigate the prospect of obtaining increased number of planting materials by exploiting polyembryony in the crop.

MATERIALS AND METHODS

The study was carried out at the Western research Farm of the Michael Okpara University of Agriculture, Umudike, between March and October, 2006. Umudike is found between latitude 05^0 29'N and longitude 07^0 32'E and an elevation of 122m above sea level [20]. It was conducted on a randomized complete block design (RCBD) having three treatments, namely, (Treatment 1) – plants raised from whole seeds, (Treatment 2) – plants raised from half seeds and (Treatments 3) – plants raised from quarter seeds. By whole seed is meant, an intact, full seed, with the two cotyledons in place. By half seed is meant, a single seed cut longitudinally into two halves, each half having one cotyledon and a longitudinal half-section of the embryonic region. A whole seed therefore produced two half seeds. Similarly, a quarter seed was obtained by longitudinally cutting through a cotyledon so that each half had a quarter of the embryonic region. Thus, a whole seed produced four quarter seeds. In other words, half seed produced a two-fold increment in the number of planting materials over the whole seeds and quarter seeds yielded a four-fold increment in the number of planting materials over the whole seeds and a two-fold increment over the half seeds. There were five replications, each made up of three plots of dimensions, 3mx 2m. Six seeds were planted per plot at a spacing of 1m x 1m.

Data were collected from the entire plants plot in respect of eight agronomic characters, namely; days to emergence, establishment count (6WAP), number of branches per plant, number of leaves per plant, length of shoot (cm), stem girth (cm), leaf area (cm^2) and fresh vegetable weight (kg/plot). Data collected were subjected to analysis of Variance and where the F – test indicated significance, mean separation was done by use of Fisher's least significant difference (LSD).

Days to emergence was obtained as the number of days from planting to first emergence of a plumule in a plot. Establishment count (6WAP) was obtained as the number of seedlings established six weeks after planting. Number of branches per plant was obtained as the number of branches in a plot divided by number of plants in that plots for all the three treatments. Data collection on this and subsequent parameters commenced 58 days after planting and were carried out at three-weekly intervals. Number of leaves per plant was obtained as the number fully expanded leaves per plant. Shoot length (cm) was obtained as the length of the longest branch, from base to tip, in a given plant, using a measuring tape. Stem girth (cm) was obtained as the average thickness of the stem obtained at two points, namely, near the tip (shoot apex) and at the middle of the shoot, using a vernier sliding caliper. Leaf area (cm^2) was obtained by tracing leaves on a graph sheet and computing the area as the sum of full and half square covered by the tracing. Fresh vegetable yield (kg/plot) was obtained by using a weighing balanced to weigh harvested fresh vegetables on plot basis.

RESULTS

The results obtained showed that whole seeds, half seeds and quarter seeds all germinated. However, the more seeds were being fragmented, the higher the number of days to shoot emergence. Whole seed, half seed and quarter seed plants emerged after 9.8, 14.0 and 21.0 days, respectively. Equally, number of leaves, number of branches, stem girth, leaf area and fresh vegetable weight, decreased significantly ($p<0.05$) with increasing seed fragmentation. Whole seeds (6) and half seeds (5) did not differ in terms of establishment count but quarter seeds (2.20) differ significantly. Length of shoot did not show any significant difference among the 3 treatments.

The results obtained from CV showed that most of the CV estimates are moderate to high. Stem girth recorded the lowest CV of 7.0%, followed by length of shoot which had 8.2%. However, highest CV was obtained in fresh vegetable weight per plot (18.4%).

Table 1: Effect of longitudinal seed fragments on the agronomic traits and yield parameter of fluted pumpkin

Treatments	Days to emergence	Establishment count (6WAP)	Number of branches/plant	Number of leaves/plant	Length of shoot (cm)	Stem Girth (cm)	Leaf area/ plant (cm^2)	Fresh vegetable weight kg/plot
Whole seed	9.80	6.00[a]	17.88	112.9	266.2	2.814	120.7	10.59
Half seed	14.00	5.00[a]	12.18	89.4	251.8	2.424	78.30	5.41
Quarter seed	21.00	2.20[b]	7.31	77.6	245.4	1.508	27.40	1.73
Mean	14.93	4.40	12.46	93.3	254.5	2.249	75.50	5.91
Variance ratio	17.18**	12.38*	35.72***	9.75*	1.00ns	31.04***	112.94***	52.69***
CV (%)	14.0	13.60	11.5	17.8	8.20	7.00	18.30	18.40
LSD 5%	4.452	1.825	2.886	18.75	34.83	0.3924	14.32	1.999

* - Significant, ** - Highly significant, *** - Very highly significant, ns – Non significant, CV – Coefficient of variation, LSD – Least significant difference.

Plate 1: A – whole seed, B – Half seed, C – quarter seed at 11 days after planting.

DISCUSSION

The observation that germination took place in half seeds and quarter seeds just as in full seeds, is confirmative of polyembryony in fluted pumpkin, had earlier been reported by Odiyi and Uzo [17]. The finding that the more seeds were fragmented, the higher the number of days to shoot emergence could be as a result of stress caused by dividing the food reserve in the cotyledon, meant for one seedling, to two or four more seeds arising from fractions of the embryonic region in seed fragments. Also, cut seeds were exposed to higher risks of pest and pathogenic attack than whole seeds, especially as no treatments (like fungicides and insecticides) were used. Cut seeds are indicate that where as obtaining multiple stands of fluted pumpkin through polyembryony is possible, in terms of agronomic performance including fresh vegetable weight, whole seeds gave a better crop than either half seed or quarter seed. For fluted pumpkin vegetable production, therefore, whole seeds are better than both half seeds as well as quarter seeds Even when the seed is left whole, it has been reported that the larger the seeds, the better the chances of having good germination and establishment [6]. Effect of seed size on growth and fresh vegetable weight may be based on the fact that larger seeds contain more biomass for the seedlings to feed on during early growth [21]. Similarly, seed fragmentation significantly affected the parameters of vegetative growth and yield of *T. occidentalis* in terms of number of branches, Leaf area, stem girth and fresh vegetable weight.

The number of seeds arising from half seed is twice as many as those arising from whole seeds and the number of seeds arising from quarter seeds is four times as many as those arising from whole seeds. Polyembryony can therefore be a way of easily multiplying fluted pumpkin planting materials, especially when a breeder has few seeds of elite line.

Coefficient of Variation (CV) shows the extent of variability in relation to the mean of the population. It compares the degree of Variation from one data series to another even if the means are different from each other. The variation that exists among the treatments in relation to their means (Stem girth and Length of Shoot per plant) was low.

CONCLUSION

These results indicated that, whereas obtaining multiple stands from a single seed of fluted pumpkin through polyembryony is possible, in terms of vegetable production, whole seeds gave a better crop than either half seed or quarter seed.

For breeding, however, it is often desirable to obtain genetically identical materials for use in work requiring homozygosity. Polyembryony, as demonstrated in this study, is one simple way by which such materials can be obtained, thus circumventing the problem brought about by dioecy, in which ordinarily, it is hard to determine the parents of any given two individuals, even if they developed from seeds obtained from the same pod.

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