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Research Article

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Effects of Seed Orientation at Sowing on Seedling Emergence and Early Seedling Performance in Fluted Pumpkin (*Telfairia occidentalis* hook. F.)

Willie ES*, Waya A

Department of Agronomy, College of Crop and Soil Sciences, Michael Okpara University of Agriculture, Umudike, PMB 7267, Umuahia, Abia State, Nigeria

Abstract A pot experiment was conducted in the Michael Okpara University of Agriculture, Umudike, Southeastern Nigeria, to determine the effect of seed orientation at sowing on seedling emergence and early seedling performance in fluted pumpkin (*Telfairia occidentalis* Hook. f.). The trial was carried out on a completely randomized design (CRD), with four treatments replicated five times. The four treatments were made up of four seed sowing orientations, namely, Treatment 1 (T1) – sowing with the micropyle pointing down, Treatment 2 (T2) - sowing with the micropyle pointing up, Treatment 3 (T3) - seeds sowed flat, and Treatment 4 (T4) - seeds sowed sideways. The treatments were evaluated in respect of seven agronomic characteristics, namely, days to first emergence, days to 75% emergence, percentage emergence, establishment count, shoot length, number of leaves per plant, and number of branches per plant. There were no significant differences among seedlings raised from seeds sown following the four seed sowing orientations in respect of all the seven characteristics studied. The observation that the four different seed sowing orientations did not differ from each other in their effects on seedling emergence and early seedling performance in the crop plant was due to the gravitropic response of the hypocotyls and epicotyls of the germinating seeds. It was concluded that seed orientation at sowing does not affect seedling emergence and early seedling performance with respect to days to first emergence, days to 75% emergence, percentage emergence, establishment count, shoot length, number of leaves per plant, and number of branches per plant, in fluted pumpkin. This means that as far as seedling emergence and these early seven seedling parameters are concerned, fluted pumpkin farmers need not be concerned as to seed sowing orientation. This would translate into a reduction in the time spent during sowing, thereby saving money on man hours, as there would be no need to spend time trying to identify the parts of a given seed before planting, in order to sow it in any particular orientation

Keywords Fluted pumpkin, seed sowing orientation, early seedling performance, gravitropism

1. Introduction/Background

Fluted pumpkin (*Telfairia occidentalis*, Hook F) is a perennial herb in the dicotyledonous Family, Cucurbitaceae, and it originated from tropical West Africa [1]. Found in the forest zone of West and Central Africa [2], the crop plant is a popular vegetable in Nigeria especially in the Southsouth and Southeast where it is relished as a vegetable in a variety of traditional cuisines. Its use as food has attracted a lot of research interest [3-5]. Presently, the crop is propagated exclusively by the sowing of seeds. Attempts have been made to find ways of circumventing the absolute dependence on seeds for the cultivation of the crop, such as the rooting of vine cuttings [6] and propagation through the use of tissue culture [7-11], but for now, no other method has been found to be as good as planting seeds, and so planting by use of seeds remains the only method available to farmers, for its cultivation. Whereas it is possible to obtain multiple stands from single seeds of fluted pumpkin though polyembryony [12], planting whole seeds gives a better crop than planting seed fractions [13].

Farmers in Southeastern Nigeria believe that fluted pumpkin seeds planted with the pointed (*i.e.*, micropylar) end of the seed pointing down, will emerge earlier, and also give rise to plants that perform agronomically better than those raised from seeds planted following other seed sowing orientations.

The effect of seed (*i.e.*, embryo) orientation on early plant growth and regeneration has drawn the interest of many researchers. [14] studied the effect of embryo orientation on the developmental sequence of adventitious organogenesis in jack pine (*Pinus banksiana* Lamb.). The developmental sequence of adventitious organogenesis in the embryos of the plant was analyzed depending on two explant orientations. Embryos were placed vertically (cotyledons downward) or horizontally, on half-strength Schenk and Hildebrandt medium containing µM6-benzylaminopurine. It was observed that embryo orientation influenced both the spatial and time sequence organogenesis in the plant. In the vertical position, organogenesis started 14 days after culture initiation and eventually ended up with a crown of needles and buds circling the upper part of the hypocotyls outside the medium. The horizontally oriented embryos produced needles more rapidly (day 11) and had a larger organogenic area.

In a related study, [15], observed that the orientation of the cotyledonary leaf explants determine the efficiency of *de novo* plant regeneration in *Jatropha curcas* L. They reported that cotyledonary leaf segment explants cultured with their abaxial surface placed in the medium showed significantly better regeneration response as compared to explants with their adaxial surface in culture medium.

It is often not very easy to determine the pointed end of fluted pumpkin seeds and so, during planting, farmers who wish to sow seeds following a particular orientation of the pointed end may have to spend a lot of time in their effort to identify it. This experiment was planned to answer the question of whether seed orientation during sowing affects seedling emergence and early seedling performance in fluted pumpkin, in order to see if the time and effort expended on identifying the pointed end of seeds and making sure seeds are planted with the pointed end pointing downwards, are justified or not. In other words, the objective of this study was to determine the effect of seed orientation at sowing on seedling emergence and early seedling performance in fluted pumpkin (*Telfairia occidentalis*).

2. Materials and Methods

2.1. Description of Site and Location of Experiment

The study was conducted at the Western Research farm of the Michael Okpara University of Agriculture, Umudike, during the 2017 planting season. Umudike is located in the Southeastern part of Nigeria, at an altitude of 122m above sea level. It is found between latitude 05° 29'N and longitude 07° 32'E, and has a mean soil temperature of 12.1 °C [16]. The fluted pumpkin pods used were obtained from a local market in Ndoro, Ikwunao L.G.A of Abia State.

2.2. Treatments and Design

The experiment comprised of four treatments, namely, four seed sowing orientations, viz: i) Treatment 1 (T1) - the micropylar (*i.e.*, pointed) end pointing down while planting, ii) Treatment 2 (T2) - the micropylar (*i.e.*, pointed) end pointing up while planting, iii) Treatment 3 (T3) - the seed was planted flat, and iv) Treatment 4 (T4) - the seed was planted sideways. Seeds were planted directly in pots in a completely randomized design (CRD) experiment in which the four treatments were replicated five times. Each pot was planted with five seeds and each treatment was assigned five pots. This means that a total of 4 treatments x 5 replications x 5 seeds, giving 100 seeds were planted. The treatments were assigned randomly to the pots. The pots were watered and kept weed –free (manually) throughout the duration of the experiment.

2.3. Data Collection and Analysis

Data were collected in respect of i) Days to first emergence, which was obtained as the number of days from planting to first emergence of a shot in a pot, ii) Days to 75% emergence, which was obtained as the number of days from planting to the emergence of three out of the expected five shoots, in a pot, iii) Percentage emergence (%), which was obtained as the percentage of the plants that emerged four weeks after planting (4WAP), iv) Establishment Count, which was obtained as the number of seedlings established five weeks after planting, v)

Shoot length, which was obtained as the length of the longest branch in a given plant from the stem base to the shoot tip, using a measuring tape, 8 WAP, vi) Number of Leaves per plant, which was obtained as the mean number of fully expanded leaves per plant per pot, 8 WAP, and viii) Number of branches per plant. Treatment means were subjected to analysis of variance applicable to a completely randomized design

3. Results and Discussion

Table 1: Effect of seed sowing orientation on some early growth parameters in fluted pumpkin

Seed sowing orientation	DTFE	DT75%E	%E	EC	SL	NLPP	NBPP
Seed sown with the micropyle pointing down (T1)	11.2	20.6	72.0	3.60	56.00	13.27	3.21
Seed sown with the micropyle pointing up (T2)	11.0	22.8	44.0	2.20	55.10	16.53	3.88
Seed sown flat (T3)	12.0	18.0	60.0	3.00	42.90	12.80	2.85
Seed sown sideways (T4)	10.6	18.8	68.0	3.20	42.40	15.13	3.50
Mean	11.5	20.1	61.0	3.00	49.10	14.43	3.36
LSD (0.05)	ns	ns	Ns	ns	Ns	ns	ns
Coefficient of variation	10.9	22.3	16.8	16.70	13.20	9.90	18.60

Legend: DTFE = Days to first emergence; DT75%E = Days to 75% emergence; %E = Percentage emergence; NBPP = Number of branches per plant; SL = Shoot length; NLP = Number of leaves per plant; ns = Statistically non-significant

Table 2: Analysis of variance for eight early growth parameters in fluted pumpkin

Parameter	MST	MSE	VR	FP
Days to first emergence	3.783	6.242	0.61	0.624
Days to 75% emergence	22.72	16.38	1.39	0.294
Percentage emergence (4WAP)	766.7	383.3	2.00	0.168
Establishment count (5WAP)	1.733	1.067	1.62	0.236
Shoot length	277.800	405.700	0.680	0.578
Number of leaves per plant	14.840	11.17	1.330	0.311
Number of branches (8WAP)	0.963	1.809	0.53	0.669

MST = Treatment mean square; MSE = Error mean square; VR = Variance ratio; FP = F- probability

Table 1 presents the results of effect of seed sowing orientation on Days to first emergence, Days to 75% emergence, Percentage emergence, Establishment count, Shoot length, Number of leaves per plant, and Number of branches per plant, in the fluted pumpkin materials studied. Table 2 presents the Analysis of Variance results. Both tables show that the four different seed sowing orientations did not differ from each other in their effects on seedling emergence and early seedling performance in the fluted pumpkin seedlings studied.

The observation that the four different seed sowing orientations did not differ from each other in their effects on seedling emergence and early seedling performance in the fluted pumpkin seedlings studied is not surprising. When a seed starts germinating, first, the hypocotyl, at the tip of which is the radicle, starts growing. The radicle is the young root. Following this closely is the growth of the epicotyl, at the tip of which is the plumule, which will eventually develop into the shoot. The growth of the hypocotyl and that of the epicotyl take place irrespective of micropyle orientation. As noted by [17], plant organs are capable of sensing various vectoral stimuli such as light, gravity, touch, and humidity, after which they reorient their growth direction so as to be in a suitable position for absorption of water or nutrients, photosynthesis, and reproduction. Roots may sometimes have to reorient themselves in response to a tilt in order to better anchor the plant to the soil. In plants, gravitropism (also called geotropism), which can be regarded as a posture control triggered by sensing the tilt of organs relative to the direction of gravity [17], is one of the most important directional cues that control growth direction. This phenomenon is what ensures that in general, plant roots (which grow from hypocotyls) grow downwards, exhibiting positive gravitropism, while plant shoots (which grow from epicotyls) grow upwards, exhibiting negative gravitropism. In other words, gravitropism ensures that radicles grow downwards following the pull of gravity, and plumules upwards, against gravity, even if the response requires that they bend or curve. [18] proposed that gravitropism in maize roots require two gravity receptor mechanisms. The first mechanism is without a directional effect and, by itself, cannot give rise to tropism. Its role is quantitative facilitation of the second mechanism, which is directional like the gravitational force itself and provides the impetus for tropic curvature.

4. Conclusion

Clearly, gravitropism was in action in the germinating seeds / seedlings in this study, and it is the phenomenon that ensured that irrespective of seed orientation at sowing, the radicle went downwards, the plumule grew upwards, leading to the observation that seedling emergence together with other early seedling parameters were not affected. Fluted pumpkin farmers therefore do not need to spend time trying to identify the parts of a given seed before planting, in order to sow it in any particular orientation.

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