



## **Effect of Seed Size on Yield and Yield Parameters of Four Tropical Soybean (*Glycine max* L. Merrill) Varieties in Nsukka, South-Eastern Nigeria**

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### **Authors' contributions**

*This work was carried out in collaboration between both authors. Authors AEA and UEU designed the study and wrote the protocol. Author AEA managed the experimental process, and performed the data analysis. Author UEU wrote the first draft of the manuscript, managed the literature searches, and prepared the manuscript for publication. Both authors read and approved the final manuscript.*

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### **ABSTRACT**

Field studies were conducted to determine the growth response of soybean to seed size at the Teaching and Research Farm of the Department of Crop Science, Faculty of Agriculture, University of Nigeria, Nsukka, Nigeria during the cropping season, June, 2008 to June, 2009. In this study, four soya bean varieties (TGX 1448- 2 E, TGX 1455-2 E, TGX 1458-2 E and TGX 1497-ID) were used. The micrometre screw gauge was used to sort out the seeds of each of these varieties into three sizes of small (9.6 g /100seeds), medium 13.3 g/100 seeds and large (16.3g/100seeds) on the basis of seed weight and mean diameter. The experiment was laid out as a split-plot in randomized complete block design (RCBD) with three replicates. The four soybean varieties represented the main plot, while the seed sizes represented the subplots. Our result shows that with the exception of plant height at maturity, seed size was important in the performance of the varietal attributes measured. Plant establishment was  $\geq 60\%$  for plants that grew from medium and large seed sizes while small seed size plants had  $\leq 55\%$  establishment. Days to 50% flowering and

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50 % maturity were 55 days and 122 days for small seed size plants and 50 days and 113days for medium and large seed size plants. Number of nodules /plant averaged 12 nodules for plants that grew from small size seeds, and 15 and 18 nodules for medium and large seed size plants respectively. Number of pods/plant was significantly higher in medium and large seed size plants (43pods/plant) compared to small seed size plants (37pods/plant). An average number of seeds per pod were two seeds for medium and large seed size plants and one seed for small seed size plants. Seed weight per 100 seeds was 10 grams for small seed size plants and 12 and 16 grams for medium and large seed size plants respectively. Seed yield averaged one ton per hectare for medium and large seed size plants and less than one ton (600 kilograms) for small seed size plants. In conclusion, seed size accounted for more than 80 % performance of all the varietal attributes measured in this study. Therefore, in selecting planting material consideration should be given not only to variety but seed size of the planting material.

**Keywords:** Soybean; seed weight; variety; flowering; nodulation; establishment.

## INTRODUCTION

Soybean *Glycine max* (L) Merrill plant is one of the oldest crops in cultivation [1], and it is the world's leading source of oil and protein [2]. Presently, it occupies an important position among the grain legumes due to its high protein content (averaging 40 %) [3]. It has the highest protein content of all food crops and comes after groundnut in terms of oil content among legumes[4,5]. The United States of America (USA) is a leading producer of soybean together with Brazil, Argentina and China [6]. In Nigeria soybean is widely grown in the Middle Belt or the savannah zones of Nigeria [7]. However, the production of soybean has in recent time been extended to the southern part of the country that was otherwise considered marginal for its production [8]. The recent popularity of soybean in Nigeria has been as a result of its high quality protein and its increasing demand as a source and food and forage [5]. Yields of some crops are influenced by various components of a plant trait. Seed size is one of these components and most important characteristics of seed that can affect the seed development duration. Seed size has a great influence on cultivar adaptation to different conditions which may affect the vigour [9]. There have been a lot of studies on seed size in various plant species. The effect of seed size on germination, ground cover and performance of plant has been confirmed. The effect of seed size on crop improvement has attracted the attention of researchers for many years. [10] observed that seed size in cereals and legumes appears to influence the grain yield. Higher seed yield per plant from plants grown from large seeds was reported by [11] in *Brassica*. In contrast, high yields from plants grown from small seeds were reported by [12] in soybean and [13] in wheat. [14], observed that soybean

varieties grown from large seeds flowered and matured earlier and produced large seeds, high yield and high harvest index. This superiority may be attributed to the high seedling vigour resulting from extra food reserves present in large seed [15]. However, [16] in bean (*Phaseolus* sp.) and [14] in soybean reported non- significant effect of seed size on yield. There are lots of conflicting results with respect to the effect of seed size on varietal performance, in cereals and grain legumes. However, [17] reported that large seed size of elite maize had higher seed quality and higher seed yield compared to other medium and small sizes. Soybean yield has been reported to be characterized with high instability within and between species at different sites and among seasons [18,19]. In Nigeria, soybean seed yield has been erratic during the past few years, Low yield and sometimes crop failure have been attributed to several causes, some of which are poor seed quality, inadequate breeding efforts and environmental conditions among others [20,21,22]. However, solutions to some of these problems can be obtained with good seed characteristics and appropriate field management practices. [23,24], reported that there is a negative correlation between soybean tolerant to climatic factors and its seed size; because large seed require more water resources for their vital activities and consequently they can be damaged by reduction of osmotic potential. The effect of seed size on other crops has also been reported. Large seeds of chickpea have been reported to have high germination percentage, more seedling dry weight when compared with small seeds [25].

Therefore the importance of seed size on the growth and development of many crops cannot be overemphasised, and the effect of seed size

on soybean needs to be explored further as there is scanty literature on this. Therefore, the objective of the present study was to further evaluate the effect of seed size on the yield and yield parameters of selected soybean varieties in moist savannah of South-eastern Nigeria.

## 2. MATERIALS AND METHODS

### 2.1 Study Site

The experiment was carried out at the Teaching and Research Farm of the Department of Crop Science, Faculty of Agriculture, University of Nigeria, Nsukka. Nsukka is situated in a derived savanna ecological zone at latitude 060 52' N, longitude 07° 24E and with an altitude of 447.25 meters above sea level.

### 2.2 Land Preparation

A parcel of land about 65m by 20 m (1200 m<sup>2</sup>) was cleared and hoe-tilled, and an area of 62 m x 18 m marked out for the trial.

### 2.3 Soil Analysis

The soil samples of the study area were collected at random from twenty locations of the field using soil auger to a depth of 0-15cm. The samples were bulked together to form a composite sample. The soil samples were air dried at room temperature and was prepared for analysis by passing it through 2 mm sieve. The soil characteristics of the experimental site and analysis type are presented in Table 1.

### 2.4 Plot layout, Treatment and Experimental Design

The plot was marked out into three blocks each measuring 62 m by 4 m, which was separated by three meter path-way. Each of the three blocks was divided into four main plots with 3 subplots each making a total of 12 subplots of 4m x 4m each.

The experiment comprised four soybean varieties: TGX 1448-2E, TGX 1455-2E, TGX 1458-2E and TGX 1497-1D categorized into three planting seed sizes as follows: small (9.6g/100 seeds=[8.02-11.25g/100 seeds]); medium (13.3g/100 seeds=[11.14-15.45g/100 seeds]) and large (16.3g/100 seeds=[13.01-19.58g/100 seeds]); based on their diameters (Fig. 1). The seed diameter was taken by the use of micrometer screw gauge.



**Fig. 1. Represents the classification of the seed sizes of the soybean varieties. From Right (V<sub>1</sub>a, V<sub>1</sub>b and V<sub>1</sub>c -front to back row of dish) represents small, medium and large size seeds of TGX 1448-2E, TGX 1455-2E, TGX 1458-2E and TGX 1497-1D respectively)**

The trial was laid out as a split-plot in a randomized complete block (RCB) with three replications, with variety as the main plots (14 m x 4m), and seed sizes as the sub-plots (4 m x 4m) The alleyway between main plot was 2 m and alleyway between sub-plot was 1m.

### 2.5 Cultural Practices

Planting was done on flat seedbeds, on August 9, 2008 and August 20, 2009 at the trial location. The varieties were planted at 50 cm x 5 cm, inter and intra row spacing respectively (400,000 plants/ha). Two seeds of each variety were planted per hill at depth of between 3 and 5cm, and later thinned to one plant per hill at two weeks after planting (WAP). A mixture of single superphosphate and NPK 15:15:15 compound fertilizers was applied at the recommended rates of 200kg/ha and 150 kg/ha respectively was incorporated into the soil after land preparation at planting. These fertilizer types and rates were recommended for soybean by the Nationally Co-ordinated Research on soybean in Nigeria. Weeds were managed by the use of pre-emergence herbicide after planting [Galex 500EC at 3 kg a.i/ha= (1.5 kg/ha metolachlor + 1.5 kg/ha metobromuron)]. The seeds were treated with Apron Plus (fungicide) at the rate of 1 sachet/8 kg of seeds before planting for protection against soil- borne fungal diseases.

### 2.6 Data Collection and Analysis

Data were collected from the four middle portions, and a net plot of 8 square meters in

each plot. The data collected were as: Plant establishment (%), Plants that remained at harvest as per cent of proposed plant density. Data on first flowering days (number of days at first flowering emergence). Days to 50% flowering (number of days at least 50% flowering) and days to 50% maturity (total number of flower heads in the plots) was done by counting. Nodulation was assessed 60 days after emergence; variety height was taken from ground level to the tip of main stem at maturity. Pods/plants were estimated at maturity from six plants selected randomly per plot by counting all the pods per plant for the six plants and average pooled to represent the mean pod yield/plant. Number of seeds/pod was expressed by dividing the total number of seeds by the number of pods that produced those seeds. Weight of 100 seeds (g) was taken from 4 replicates of 100 seeds weight of each variety and average was taken to represent 100 seed weight for each variety. Total grain yield (tons/ha) at 14% moisture content was recorded from the net plot of 8 m<sup>2</sup>.

**Table 1. Physical and chemical properties of the experimental site**

Soil Properties	Value
Sand (%)	80
Silt (%)	4.6
Clay (%)	15.4
Soil Texture	Sandy loam
Organic Carbon (g/kg)	4
pH(H <sub>2</sub> O 1:1 )	4.65
Total Nitrogen ( % )	0.03
K(cmol/kg)	0.02
Na(cmol/kg)	1.1
Available P (mg/kg)	19.8

### 2.7 Statistical Analysis

Data collected were subjected to analysis of variance (ANOVA) as split-plot in randomized complete block design (RCBD) using GENSTAT 5 Release 3.2 [26]. Means were compared using Fischer LSD at 5% level of probability.

## 3. RESULTS

### 3.1 Soil Characterization

The physico-chemical analysis conducted on the experimental soil site showed that the textural class of the soil was sandy loam, organic matter was low (0.62%) and the soil was acidic with an average pH of 4.65(pH (H<sub>2</sub>O) =5.2 and pH (KCl) =4.1) (Table 1).

### 3.2 Effect of Seed Size on Variety Establishment, Days to First Flowering and Days to 50% Flowering

The highest plant establishment (68.1%) was recorded among the large size seeds with the lowest (49.9%) resulting from the small size seeds. On account of variety x seed size interaction on plant establishment, it was observed that plant establishment was highest among the large size seeds in all the varieties except in TGX 1458-2E, where the highest occurred in the small size seeds (Table 2). The highest score (71.7 %) in plant establishment was in the large size seeds of TGX 1455-2E. Incidentally, the same variety (TGX 1455-2E) recorded the least plant establishment score of 39.0 % with the small size seeds.

Significant differences were observed among the varieties with respect to days to first flowering. It was longest in TGX 14552E (55 days) and shortest (about 44 days) in TGX 1448-2E (Table 2). Other varieties days to first flowering were between 55 and 44 days. Plants raised from the small size seeds took longer days (55) to produce flowers while plants raised from large and medium and small seeds took 48 days to flower. There was a significant effect of variety x seed size interaction on days to first flowering, which was, however, inconsistent. While flower production was earliest among the large size seeds of TGX 1458-2E and TGX 1497-ID, it was the plant from the medium size seed of TGX 1455-2E that flowered earliest, with plants from both the small and medium size seeds of TGX 1448-2E being the earliest to produce flowers (Table 2). Of all the seed sizes under study; plants raised from the small and medium size seeds of TGX 1448-2E were the earliest to produce flowers, it took plants from the small and medium size seeds of TGX 1448-2E 43 days to produce flowers. Flower production was the longest in TGX 1455-2E and most especially from the plants that resulted from the small size seeds.

On the average days to 50% flowering was longest in 1455-2E and it took the variety about 57 days to attain 50% flowering status (Table 2). On the other hand, TGX 1448-2E was the variety to attain 50 % flowering earliest (46 days). TGX 1497-ID and TGX 1458-2E took 51 and 53 days respectively to attain 50% flowering level. Seed size significantly influenced the varietal attainment of 50% flowering level. The period to 50% flowering status was longest with plants

raised from the small size seeds. It was about 55 days for this treatment (Table 2). It took plants from both the medium and large size seeds about the same day to reach 50% flowering level. On variety x seed size interaction on days to 50% flowering, it was observed that plants which developed from large size seeds of soybean varieties: TGX 1455-2E, TGX 1458-2E and TGX 1497-1D attained 50% flowering status earlier than those from the medium and small sizes of the soybean varieties in question( Table 2). The only exception was in TGX 1448-2E where plants from the medium size seeds attained 50% flowering stage earlier than plants from the small and large size seeds of the same variety (Table 2). It took plants raised from the medium size seeds of TGX 1448-2E 45 days to reach 50% flowering stage. Plants from the small and large size seeds of the same variety (TGX 1448-2E) took 47 and 46 days respectively to reach 50% flowering stage.

### **3.3 Effect of Seed Size of Soybean Varieties (V) on Days to 50 % Maturity, Nodules Per Plant and Plant Height**

Across varieties, it took large size seeds shorter days to attain maturity period. Large and medium size seeds of TGX 1497—ID attained maturity earliest of the four varieties investigated. It took the variety 105 days from planting to maturity. The small size seeds of TG X 1458—2 E took the longest period (140 days) to reach maturity (Table 3).

Nodulation differed significantly ( $P=0.05$ ) among the varieties under investigation. Nodule formation was highest in TGX 1458-2E compared to the other varieties across seed sizes. TGX 1458-2E nodulation averaged 20 nodules per plant whereas TGX 1448-2E, TGX, 1497-ID and TGX 1455-2E produced 14, 2, 13.2 and 13.0 nodules/plant, respectively (Table 3). TGX 1455-2E had the least number of nodules/plant with respect to small seed size. Averaged over seed sizes TGX 1497-ID produced the least nodules per plan (9 nodules/plant) (Table 3).

Nodulation was the highest (about 18 nodules/plant) among the large size seeds in comparison with the small size seeds. While plants that developed from the small size seeds produced about 12 nodules/plants, and those from the medium seed size category produced 15 nodules/plant. TGX 1458-2E produced much more nodules than the other three varieties with

the highest nodule production occurring mostly within the plants resulting from large size seeds. Plants that were raised from the large, medium and small size seeds of TGX 1458-2E produced 24, 19 and 15 nodules/plant respectively. While plants that developed from the large size seeds of soybean varieties TGX 1455-2E, TGX 1458-2E and TGX 1497-ID produced 16, 24 and 15 nodules/plant (the highest in these varieties) respectively, it was plant from the small size seed of TGX 1448-2E that gave the highest nodule produced (Table 3). The variety with the least nodule production capacity was TGX 1455 - 2E.

There were significant varietal height differences at maturity. The tallest of the varieties was TGX 1458-2E, with TGX 1455-2E being the shortest. While TGX 1455-2E was about 65 cm, the 1455-2E was only 29.0 cm (Table 3). TGX 1497-ID and TGX 1448-2E were 38.5 and 30.5 cm tall respectively. There was inconsistency in plant heights at maturity on the basis of seed size. In TGX 1458-2E, the tallest plant developed from the small size seed whereas in TGX 1497-ID, it was from the large size seed. In TGX 1448-2E and TGX 1455-2E had the tallest plants from the medium size seed varieties. (Table 3).

### **3.4 Effect of Seed Size of Soybean Varieties (V) on Number of Pods Per Plant and Seed Per Pod**

Number of pods/plant varied with varieties. The variety TGX 1458-2E produced the highest number of pods/plant (67 pods) (Table 4). The variety TGX 1455- 2E produced the least number of pods per plant (25). TGX 1448-2E and TGX 1497-ID varieties gave 58 and 15 pods/plant, respectively. There were significant differences in the number of pods/plant on the basis of seed sizes under study. Number of pods/plant was the highest with plants raised from the medium seed size category. Plants that developed from the small size seeds had the least number of pods/plant (Table 4). The variety with the highest pod production capacity was TGX 1458 — 2E with, 69 pods/plant obtained from large seed size plants. This was followed by TGX 1448-2E in which the highest (62 pods/plant) was obtained from the medium seed size plants. Comparatively, TGX 1497 —1D had the least pod production capacity. Generally, pod production was the least among plants raised from small size seeds. There was a noticeably sharp decline in pod production within the plants from the small size seeds of TGX 1455-2E.

The highest number of seeds/pod occurred in (TGX 1448-2E). The number of seeds/pod in this variety averaged 2.23 (Table 4). This was followed by TGX 1497-ID with 1.84 mean seeds/pod. Number of seeds/pod was lowest in TGX 1458— 2E (1.18). Seed size significantly ( $P= 0.01$ ) influenced the number of seeds/pod. The highest seed production resulted from plants that were raised from the large size seeds; with the least (1.40 seeds/pod) occurring in small seed size plants (Table 4). TGX 1448-2E had the highest number of seeds/pod. The highest seeds/pod (2.38 seeds/pod) was produced from plants the developed from the medium size seeds (Table 4). Next to TGX 1448-2E in the number of seeds/pod was TGX 1497-ID (2.10 seeds/pod), and this came from plants grown from the large size seeds. The variety TGX 1455-2E had the least number of seed/pod (0.93seed/pod), which resulted from the small size seeds.

### **3.5 Effect of Seed Size of Soybean Varieties (V) on 100 Seed Weight and Total Seed Yield 100- Seed Weight (g)**

The weight of 100 –seeds varied with varieties. TGX 1448-2E produced the highest 100-seed weight irrespective of seed sizes and across the varieties investigated. It was followed by TGX 1455-2E with a variety means of 13.41 g. The least 100 seed weight was obtained from TGX 1458-2E. It recorded a mean 100 – seed weight of 9.98g (Table 5).

### **3.6 Seed Yield (ton/ha)**

The effect of soybean variety x seed size interaction on total grain yield was statistically significant (Table 5). Of all the three seed sizes under study, plants raised from the large size seeds produced the highest total seed yield irrespective. TGX 1448-2E was the best of the four varieties in terms of seed yield with a total seed yield of 1.11 tons/ha. This was followed by TGX 1455, 2E (0.90 ton/ha), TGX 1497-1 D (0.71 t/ha) and TGX 1458-2E having the least total seed yield of 0.40 t/ha. The three seed sizes of all the varieties showed that the large size seeds gave the highest total seed yield (0.88 ton/ha) with the small size seeds giving the least (0.62 ton/ha).

## **4. DISCUSSION**

Seed size exerted a significant influence on the parameters evaluated except plant height. The

plants that developed from large size seeds were most outstanding in a number of parameters examined compared to the plants raised from medium and small size seeds.

Seed size is related to seed vigor which determines the potential for rapid, uniform emergence and development of seedlings under a wide range of field conditions [27]. Other reports have found that seedling emergence and seedling development in different soybean varieties were related to seed vigor [28]. The results obtained in present study confirmed their report. For instance plant establishment, nodulation, number of pods/plant, number of seeds/pod and total seed yield were highest among the plants that grew from large size seeds. This may be attributed to the greater ability of those plants to exploit environmental resources than the plants raised from the small size seeds. Also extra food reserve in large seed could be another contributing factor. This is in agreement with the result of [29] in Winnipeg, who reported that large seeds of soybean and maize in maize/soybean mixture produced the highest grains in relation to plants that resulted from small size seeds. Corroborating this, [30] found that soybean seed size was correlated with atrazine tolerance even within the same cultivar, with large seed being associated with more tolerance.

Tolerance of soybean varieties to environmental attributes on account of differences in their genotype is useful to breeders in that they can now breed suck genes into other desirable varieties, which may equally be having some undesirable attributes such as low tolerance to herbicide. For example, high pod production capacity inherent in TGX 1458-2E and the desirable height suitable for machine harvesting could be developed into one variety. Since low plant establishment was recorded among the small size seeds of TGX 1455-2E, it may be appropriate to grade seeds for planting to exclude seed size of 2.0 mm or less in diameter in developing future commercial varieties by integrating the good attributes of the varieties into one variety. For instance, integrating high seed yield, high number of seeds/pod and good seed qualities of TGX 1448-2E with high pod production capacity of TGX 1458-2E would be a major break-through in soybean breeding programme. Similarly, the observed significant effect of variety on total grain yield was contributed more by effect of the number of seeds/pod than number of pods/plant,

**Table 2. Effect of seed size of soybean varieties (V) on plant establishment, day to first flowering and days to 50 % flowering**

Seed size(S)	Plant establishment					Days to first flowering					Days to 50 % flowering				
	TGX 1448-2E	TGX 1455-2E	TGX 1458-2E	TGX 1497-1D	Mean	TGX 1448-2E	TGX 1455-2E	TGX 1458-2E	TGX 1497-1D	Mean	TGX 1448-2E	TGX 1455-2E	TGX 1458-2E	TGX 1497-1D	Mean
Small	62.7	39.0	62.1	56.3	55.0	43.5	59.8	51.0	52.7	51.7	47.0	62.3	54.2	55.3	54.7
Medium	65.2	69.9	59.1	60.9	63.7	43.5	52.2	49.8	48.3	48.4	45.0	56.0	51.5	49.8	50.5
Large	69.9	71.7	59.6	67.6	67.2	44.0	54.3	48.8	46.2	48.3	46.7	55.5	51.2	47.8	50.3
Variety mean	65.9	60.2	60.3	61.6		43.6	55.4	49.8	49.0		46.2	57.9	52.8	50.9	
LSD (P=0.05)	7.19				3.87	0.092				0.71	7.19				3.87
LSD V x S	9.21					1.42					1.44				

**Table 3. Effect of seed size of soybean varieties (V) on days to 50 % maturity, nodules per plant and plant height**

Seed size(S)	Days to 50 % maturity					Number of nodules per plant					Plant height at maturity (cm)				
	TGX 1448-2E	TGX 1455-2E	TGX 1458-2E	TGX 1497-1D	Mean	TGX 1448-2E	TGX 1455-2E	TGX 1458-2E	TGX 1497-1D	Mean	TGX 1448-2E	TGX 1455-2E	TGX 1458-2E	TGX 1497-1D	Mean
Small	115	120	140	113	122	15.3	8.8	15.0	10.5	12.4	29.3	25.6	65.6	38.6	39.7
Medium	112	112	124	105	113	12.5	13.5	19.3	14.0	14.8	32.1	30.9	64.2	38.2	41.3
Large	112	112	122	105	113	14.7	16.7	24.5	15.3	17.8	30.2	30.5	64.6	38.7	41.0
Variety mean	113	115	129	108		14.1	13.0	19.6	12.2		30.5	29.0	64.8	38.5	
LSD (P=0.05)		0.27			0.44		1.95			1.18		2.29			1.18
LSD V x S	0.51					2.64					2.89				

**Table 4. Effect of soybean varieties (V) seed size on average number of pods per plant and average number of seed per pod**

Seed size(S)	Number of pods/plant					Number of seeds/pod				
	TGX 1448-2E	TGX 1455-2E	TGX 1458-2E	TGX 1497-1D	Mean	TGX 1448-2E	TGX 1455-2E	TGX 1458-2E	TGX 1497-1D	Mean
Small	56.0	16.7	64.7	12.5	37.4	2.01	0.93	1.00	1.65	1.39
Medium	62.8	27.8	67.3	16.3	43.5	2.38	1.79	1.16	1.77	1.77
Large	55.3	29.3	69.3	17.5	42.8	2.30	1.94	1.38	2.10	1.93
Variety mean	58.0	24.6	67.1	15.4		2.23	1.55	1.18	1.84	
LSD (P=0.05)		3.62			2.272		0.284			0.113
LSD V x S	5.55					0.327				

**Table 5. Effect of seed size of soybean varieties (V) on 100 seed weight and seed yield**

Seed size(S)	100 seed weight(g)					Soybean seed yield( ton/ha)				
	TGX 1448-2E	TGX 1455-2E	TGX 1458-2E	TGX 1497-1D	Mean	TGX 1448-2E	TGX 1455-2E	TGX 1458-2E	TGX 1497-1D	Mean
Small	12.66	10.72	8.53	9.08	10.25	1.08	0.59	0.33	0.50	0.63
Medium	14.71	12.47	9.76	11.48	12.11	1.14	1.05	0.42	0.72	0.83
Large	19.23	17.05	11.65	15.61	15.89	1.12	1.07	0.76	0.89	0.96
Variety mean	15.53	13.41	9.98	12.06		1.11	0.90	0.50	0.70	
LSD (P=0.05)	1.73				1.14	0.084				0.045
LSD V x S	0.327					0.108				

seed yield/plant or seed size (100-seed weight) This is exemplified in TGX 1458-2E (noted for high pod production capacity) and TGX 1448-2E (noted for high number of seeds/pod). Therefore, number of seeds/pod was an important determinant of total seed yield in this study. Seed size significantly influenced more than 83% of the parameters measured. This further illustrates the importance of seed size for planting materials, especially for rapid and uniform seedling emergence [27].

## 5. CONCLUSIONS

On account of the seed sizes examined in this study, it was found that large size seeds excelled more than both the medium and small size seeds in almost all the parameters measured.. Conclusively, it would be emphasized based on the results obtained that consideration be given not only to variety but seed size, within the variety used as planting material.

## 6. COMPETING INTERESTS

Authors have declared that no competing interests exist.

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