Effects of Variety and Seed Size on Seedling Emergence Characteristics of Soybean (Glysine max (L.)Merrill) in Makurdi

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Abstract- Seed size is a component of seed quality which has impact on the performance of crop and variations exist in seed size among variations. Seed size is a key factor in crop improvement. However, scarce information is available on relationship between seed size, variety and seedling emergence characteristics of soybean. Therefore, the study was initiated to determine the effects of variety and seed size on seedling emergence involving four varieties of soybean viz: TGX 1955-4F, TGX 1945-1F, TGX 1448-2E, and TGX 1951-4F. Seeds of each variety were graded into large, medium, and small. 100-seed weight was taken and the same seed lot was grown on the field and evaluated for seedling emergence characteristics. The experiment was a 4 x 3 factorial laid out in a Randomized Complete Block Design (RCBD) with three replications. Maintenance practices were kept at unform level to chech any form of bias. Data showing emergence characteristics described in the above experiment set-up were collected. The Data were then subjected to Analysis of Variance (ANOVA) at 5 % level of probability ($P < 0.05$). Variety exerted significant effect on all the emergence parameters evaluated, but the effect of seed size was only significant on Emergence Rate Index. The results showed that increase in seed size resulted in decrease in emergence percentage. The degree of emergence of seeds may not necessarily be based on the superiority of size of seeds planted. The variety TGX 1945- 1F consistently displayed superiority in all the seedling emergence parameters evaluated ; it is, therefore, recommended for fast and uniform seedling emergence.

Index Terms- effects, variety, seed size, seedling emergence, characteristics, soybean.

I. INTRODUCTION

Soybean is the world's largest single source of vegetable oil. In 2007, the total cultivated area of soybean in the world was 90.19 million hectares and the total production was 220.5 million tonnes (FAO, 2009). Remarkable increases in soybean production have occurred in the United States of America, Brazil, China and Argentina, the four countries accounting for 90-95% of the world total production.

About 85% of the world's soybeans are processed annually into soybean meal and oil. Approximately 98% of the soybean meal is crushed and further processed into animal feed with the balance used to make soy flour and proteins. Of the oil fraction, 95% is consumed as edible oil; the rest is used for industrial products such as fatty acids, soaps, and biodiesel. According to a survey report by IITA (1989), Benue State is the major producer of soybean in Nigeria. Nigeria is the largest producer of the crop for human and livestock feeds in West and Central Africa and has great potentials for substituting soy oil for some imported vegetable oils. The current domestic demand and home consumption have made the crop a versatile and multipurpose agricultural product that could be processed in almost 365 ways for human, livestock and industrial purposes.

Soybean has high quality protein content of about 40% on dry weight basis, with an oil content of about 20% and high grain yield per hectare. It also contains about 30% of insoluble carbohydrates which are stachyose, Vaffinose, and sucrose. These sugars play a significant role in determining viability and germinating ability of soybean seeds. The yield of soybean at 1,700 kg/ha on research plots in Nigeria compares favourably with the United States yields of 2,000 kg/ha and Brazil yields of 1,800 kg/ha. However, there is a gap between the yield on farmer's field and research plots. To a large extent, soybean cultivation in Nigeria has grown over the years, as a result of awareness of its economic benefits. During the oil boom of 1970's, production of the crop slumped from over 30,000 tones to less than 15,000 tones in the early 1980's. The Nigerian soybean scientists were concerned about the decline in local production and started a comparative national effort in 1980 aimed at finding solutions to some of the problems facing improved soybean production in the country. Among the many problems identified were: lack of improved varieties, pod shattering, threshing difficulties, cropping system and seed viability resulting in poor seedling emergence from varying seed sizes, after a short period of storage.

The objectives of this study were therefore: to determine the effects of variety and seed size on seedling emergence characteristics of soy bean; and to identify appropriate variety and seed size for soybean production.

II. MATERIALS AND METHODS

Experimental Location

The study was conducted at the Teaching and Research Farm, University of Agriculture, Makurdi. The site is located at latitude 7.41^0N and longitude 8.35^0E and at an altitude of about 97m above sea level, within the Southern Guinea Savannah agro-ecological zone of Nigeria. The soil at the site was well drained sandy loam.

Materials

The experimental materials consisted of seeds of four varieties of soybean namely: TGX 1955- 4F, TGX 1945- 1F, TGX 1448- 2E and TGX 1951-4F all sourced from the Molecular Laboratory of the University of Agriculture,Makurdi. A cutlass and hoe were used for land clearing and preparation, respectively.

Methods

Land Preparation

The land which measured 150m^2 (15m x 10m) was cleared manually using cutlass and later ridged manually with hoe to show the various row spacings.

Land Preparation and Planting

Two hundred grams of clean seeds of each variety were separated into three sizes: small, medium, and large. Seeds were graded into small size by retaining on 5.00 mm sieve, medium by retaining on 5.30-6.00 mm sieve and large size by retainig on 6.30 mm sieve using the laboratory model of Civil Engineereing Department, University of Agriculture, Makurdi.

In all, twelve (12) grades of the four varieties were categorized. One hundred (100) seeds visually considered as best were counted out from each of the twelve categories and weighed. They were enveloped and labelled appropriately as shown in Table 1.

After land and seed preparations, three seeds were sown per hole at 3 cm depth and spaced 10 cm x 75 cm. Thinning to one plant per stand was done at two weeks after sowing (2 WAS) to give a population density of 133,333 plants per hectare. Sowing was done on October 4, 2014. Weeding was done manually twice, at 4 WAS and after flowering to control weed infestation.

Experimental Design

The experiment was a 4 x 3 factorial (four varieties and three seed sizes) laid out in a Randomized Complete Block Design (RCBD) with three replications.

Data Collection

Observations recorded from the study included Days to Emergence (DTE), Emergence Percentage (E%), Emergence Index (EI) and Emergence Rate Index (ERI). Formulae used in calculating emergence parameters were those adopted by Fakorede and Ayoola (1980) as follows:

$$E\% = \frac{Number\ of\ seedlings\ emerged}{Total\ number\ of\ seeds\ sown} = 100$$

$$EI = \frac{Number\ of\ seedlings\ emerged\ on\ a\ day\ x\ Days\ after\ planting}{Total\ number\ of\ seedlings\ emerged}$$

$$ERI = \frac{Emergence\ Index\ (EI)}{Emergence\ Percentage\ (E\%)}$$

Data Analysis

All the data collected were analyzed statistically using the Analysis of Variance Procedure described by Singh and Chaudhary (1979), Steele and Torrie (1980).Treatment effects were compared by the Fisher's Least Significance Difference Procedure (F-LSD) at 5% level of significane as described by Little and Hill (1978) and Steele and Torrie (1980. The GensStat software was used for the analysis.

III. RESULTS

Days to Emergence

Results on effects of variety and seed size on seedling emergence characteristics of soybean are summarized in Table 2. The varieties had significant effect on days to emergence (DTE). Variety TGX 1945- 1F had the least number of DTE (5.00), while TGX 1448-2E had significantly higher DTE (6.67) than TGX 1945-1F. Seed size had no significant effect on DTE. Also, the interaction between seed size and variety did not significantly affect DTE.

Emergence Percentage

The four varieties significantly affected emrgence percentage (Table 2). TGX 1945- 1F recorded significantly higher emergence percentage than other varieties, folled by TGX 1951-4F while TGX 1448- 2E had lower emergence percentage of 49.20. Although seed size had no significant effect on emegence percentage, increase in seed size from small to medium to large reduced emergence percentage by 1.3% and 7.6% respectively. The highest emergence percentage was observed with small seeds.

Emergence Index

The varieties significantly affected emergence index at 5% level of probability (Table 2). Variety TGX 1448-2E gave a significantly higher emergence index of 5.63 when compared to TGX 1945-1F which recorded the least emergence index (4.30). Emergence index of TGX 1955-4F and TGX 1951-4F were statistically the same. The three seed sizes (large, medium,and small) did not differ significantly in emergence index, but the small seed size recorded higher emergence index. Although the interaction effect was not significant on emergence index, the best emergence index was observed with the small, medium and large seed size of TGX 1945-1F. The longest number of days to

obtaining 100% emergence was observed with the small, medium and large seed sizes of TGX 1448-2E.

Emergence Rate Index

The results showed that variety significantly affected Emergence Rate Index (Table 2). TGX 1448- 2E recorded a higher Emergence Rate Index (0.11) than TGX 1945- 1F which gave the least ERI (0.04). Emergence Rate Index of TGX 1955-4F and TGX 1951- 4F were statistically the same. Seed size had significant effect on Emergence Rate Index; large seed size had the highest ERI (0.09) while small seed size recorded the least ERI (0.06).

IV. DISCUSSION

The seed size effect on days to emergence which was not significant indicates that seed size may not necessarily be a measure of seedling emergence as reported by Onwueme and Sinha (1991). This is emphasized by the weak negative correlation between seed size and days to emergence. Although Bardbeer (1992) had observed that seed size enhanced uniform germination, it was discovered that variety had more significant effect on days to emergence and produced uniform seedlings. Variety may, therefore , be a better determinant of early emergence.

The effect of seed size on emergence percentage was not significant and this further confirms the work of Pearson and Ison (1987), who observed that surface crust and seal reduced emergence percentage. Odiaka (1997) reported that medium to large seeds of the fluted pumpkin gave a higher emergence percentage than small seeds. Onwueme and Sinha (1991) affirmed that seedling emergence might be affected by adverse germination environment and the presence of pathogens in the soil. However, variety had significant effect on emergence percentage which further shows that variety may be a better determinant of emergence percentage.

The effect of seed size on emergence index shows no significant difference and this conforms with the work of Thomison (1993), who pointed out a weak correlation between seed size and emergence in soybean. However, variety displayed significant effect on emergence index indicating that variety responded better to emergence index than seed size. Variety and seed size significantly affected Emergence Rate Index. This implies that ERI, otherwise referred to as speed of germination, is influenced by both variety and seed size in soybean.

V. CONCLUSION

The experiment to determine the effects of variety and seed size on seedling emergence characteristics of soybean was conducted at the Teaching and Research Farm, University of Agriculture, Makurdi. Four varieties of soybean were used for the study: TGX 1955- 4F, TGX 1945-1F, TGX 1448-2F and TGX 1951-4F. Also, three seed sizes were used : large, medium and small. Results showed that variety exerted significant effects on seedling emergence characteristics. The results obtained showed that variety TGX 1945-1F consistently displayed superiority in all the seedling emergence parameters evaluated.

However, the effect of seed size was only significant on Emergence Rate Index. The interaction between variety and seed size was not significant. It indicates that variety influenced seedling emergence and proved to be useful in determining seedling emergence characteristics of soybean.

Table 1: Table showing the sizes of seeds of four soybean varieties and their weights

Variety	Seed sizes	100-Seed Weight (g)
TGX 1955-4F	Small	10.7
	Medium	13.0
	Large	18.9
TGX 1945-IF	Small	10.4
	Medium	13.0
	Large	16.7
TGX 1448-2E	Small	10.9
	Medium	12.6
	Large	17.5
TGX 1951-4F	Small	9.8
	Medium	11.9
	Large	17.2

Table 2: Effects of variety and seed size on seedling emergence charcteristics of soybean

Treatment	Days to Emmergence	Emergence Percentage	Emergence index	Emergence Rate Index
Variety				
TGX 1955-4F	6.00	61.20	5.14	0.07
TGX 1945-IF	5.00	85.00	4.30	0.04
TGX 1448-2E	6.67	49.20	5.63	0.11
TGX 1951-4F	6.33	65.30	5.41	0.07
LSD (0.05)	0.42	8.83	0.37	0.02
Seed Size				
Large	6.00	59.70	5.08	0.09
Medium	6.00	67.30	5.13	0.07
Small	6.00	68.60	5.15	0.06
LSD (0.05)	**NS**	**NS**	**NS**	**NS**

NS = Not Significant

Table 3: Interaction effect of variety and seed size on seedling emergence characteristics of Soybean

Variety x Seed	Size	Days to Emergence	Emergence Percentage	Emergence Index	Emergence Rate Index
TGX 1955-4F	Large	6.00	50.90	5.06	0.09
	Medium	5.00	61.20	5.13	0.07
	Small	6.00	71.60	5.23	0.06
TGX 1945-IF	Large	5.00	90.00	4.23	0.04
	Medium	5.00	83.90	4.23	0.04
	Small	5.00	81.10	4.23	0.05
TGX 1448-2E	Large	6.67	41.10	5.53	0.14
	Medium	6.67	48.90	5.60	0.10
	small	6.67	57.70	5.77	0.09
TGX 1951-4F	Large	6.33	57.00	5.30	0.08
	Medium	6.33	75.00	5.57	0.06
	small	6.33	63.90	5.37	0.07
LSD (0.05)		**NS**	**NS**	**NS**	**NS**

NS = Not Significant

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