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Genetic evaluation of some newly developed soybean (*Glycine max*) genotypes in Benue State of Nigeria

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ABSTRACT

A field experiment was conducted during 2008–09 at Yandev in Benue state of Nigeria to evaluate 56 soybean (*Glycine max* L. Merrill) genotypes for genotypic and phenotypic variances, coefficient of variance, heritability, genetic advance for yield and its contributing traits. Significant variations among the genotypes, year and year × genotypes were observed for days to maturity, plant height, shattering, pods/plant, lodging. High heritability (broad sense) along with moderate genetic advance in per cent of mean was observed for shattering, days to 50% flowering and seed yield indicating that these characters would be best for phenotypic selection. The study indicated that there is appreciable variability with the genotypes under consideration for genetic advance. The genotypes TGx 1987-64F, TGx 1987-37F, TGx 1987-10F with relatively higher yield for two years are promising varieties for Yandev location.

Key words: Genetic variability, Heritability, Soyabean, Yield

Soybean (*Glycine max* L. Merrill), a native of Eastern Asia had attracted the attention of the people of the world over for its oil and protein content. Soybean contains about 40% protein and 20% fat (Ferrier 1975). Therefore, soybean is used in more than hundred food products, feed and industrial outputs. Soybeans are especially used in the developing countries where the amount of protein for human consumption is insufficient. Due to its high content of protein and amino acids, the use of soybean approaches the optimum level of consumption recommended by the Food and Agriculture Organization of the United Nation (Ferrier 1976).

The establishment and understanding of genetic variability, heritability and prediction of genetic advance are very valuable in all breeding stages or cycles. Information on nature and magnitude of variability present in a population owing to genetic and non-genetic causes is an important prerequisite for a systematic breeding programme to improve the yield potential of genotypes. Frankel (1950) stressed the need for collection of wide broad-spectrum material to form a wide base from which selection could be made for introduction and choice of donor parents for further utilization in breeding programmes.

As a means of increasing and ensuring reasonable high yield, the newly developed lines needed to be evaluated to identify high-yielding ones for genetic improvement of the crop. To achieve a meaningful selection for improved agronomic traits, information on variability of the newly developed lines is therefore necessary. Hence, the objective of this study is to obtain information on the genetic variability existing among different maturity groups of soybean genotypes and to identify superior genotypes that will serve as parent in a systematic breeding programme.

MATERIALS AND METHODS

On-Station field experiment was carried out during the cropping seasons of 2008 and 2009 at experimental farm of Akperan Orshi College of Agriculture, Yandev, Nigeria. Fifty-six (56) soybean genotypes obtained from International Institute of Tropical Agriculture (ITTA) were laid in a randomized complete block design with three replications. Each plot consisted of four rows of 3m length with a row-to-row distance of 50cm maintaining 20 plants/m in length. The experimental area was ploughed and harrowed twice. Seeds were hand drilled and latter thinned to one seedling per stand at three weeks after planting. Fertilizer was applied at the rate of 200 kg/ha of Single Super Phosphate SSP (0-18-0), two weeks after planting. Weeds were controlled using Pendilin (500EC) a pre-emergence selective herbicide sprayed within 24 hr after sowing at the rate of 1.5 litres/ha. Supplemental weeding was manually carried out as weeds occurred.

Observations were recorded from five randomly selected

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plants taken from the two middle rows from each plot. Data were recorded for number of pods/plant (PPP), days to 50% flowering (DTF), days to maturity (DTM), plant height (Ht), number of shattered pods (Shat), nodulation score (Nodu), 300 seed weight (Sdwt300), and grain yield in tonnes/ha (Ydha). Data collected were subjected to analysis of variance using general linear model (GLM) procedure of SAS (SAS 1997). Genotypic and phenotypic coefficient of variations, heritability and genetic advance were estimated according to Singh and Chaudhury (1985)

RESULTS AND DISCUSSION

The analysis of variance (ANOVA) showed highly significant difference among genotypes for all traits except for lodging. Differences among years were also significant for all the traits except for days to 50% flowering, nodulation, and 300-seed weight. The year × genotype interaction was also significant for the traits except for nodulation, lodging, and 300-seed weight. (Table 1) Considerable range of variation was expressed for characters such as Height (cm), Shattering, nodulation score, pods/plant and yield (Table 2). These indicated that selection based on these traits could give better scope for genetic improvement.

Days to 50% flowering ranged from 39–58 days. The result is in line with the findings of Faisal *et al.* (2008), who recorded a range of 49–56 days to 50% flowering. Akande *et al.* (2007) also obtained similar results in his studies. The range for days to 50% maturity was between 75–106 days. The results are well supported by the findings of Whigham (1975) and Malik *et al*. (2008).

Plant height was observed to range from 23.60cm to 95.8cm. This results corroborates the findings of Rasaily *et al*. (1986), who reported high variability in plant height Malik *et al.* (2008) and Whigham (1975) recorded plant height in the ranges of 47.67cm to 90.27cm and 22 – 98cm respectively. Pods/plant showed highly significant differences among treatments. TGx 1485-1D had the highest mean number of pods/plant (62.42) followed by TGx 1986-3F (38.40) while TGx 1984-24F had the least pods per plant (22.10). These results are in line with Malik *et al,* (2008), and Rasaily *et al.* (1986), who obtained considerable genotype variability for number of pods/plant. The range in 300-seed weight was from 31.13g to 52.22g among genotypes. Dadson (1976) evaluated different cultivars of soybean and revealed highest seed yields of 2.0–2.46 tonnes/ha. Akande *el al.* (2007) recorded a range of 1017.24 to 2133.01kg/ha, whereas

Table 1 Mean squares from analysis of variance (ANOVA) for yield and yield components of soybean grown at Yandev, Nigeria

Source	d.f	Days to 50% flowering	Days to Maturity	Plant height (cm)	Nodulation Score	Pod Shattering (No/plot)	Loading Score	Pod/ Plant (no.)	300 Seed weight(g)	Yield (tonnes/ ha)
						Mean squares				
Year (Y)	1	4.53	724.75**	31121.48**	0.34	122.65**	71.50**	70279.1**	0.83	10.54**
Genotypes (G)	16	146.18**	67.27**	115.47**	0.28**	26.50**	0.39	213.5**	68.34**	0.39**
Replication	2	0.45	47.45	158.37	0.004	47.74	1.09	177.4	23.65	0.03**
Y × G	16	2.41*	23.50**	93.11**	0.128	27.19**	0.38	229.5**	2.02	0.39**
Error	66	1.54	14.11	52.65	0.121	13.19	0.43	109.5	8.74	0.13

* $P<0.05$, ** $P < 0.01$

Table 2 Basic Statistic Parameters for yield and yield components of soybean grown at Yandev, Nigeria

Trait	Mean	Standard error	Coefficient of variation	Range	
	(x)		(CV%)	Minimun	Maximun
Days to 50% flowering	43.50	1.24	2.9	37.00	58.00
Days to maturity	93.13	3.76	4.00	75.00	106.00
Plant height (cm)	43.67	7.26	16.6	23.60	95.80
Nodulation score	1.23	0.35	28.3	0.00	2.60
Pod shattering (no./plot)	1.87	3.63	194.0	0.00	40.00
Lodging score	1.50	0.66	43.7	1.00	4.00
Pods/plant (no.)	29.54	10.47	35.4	6.00	129.8
300-seed weight (g)	43.25	2.96	6.8	31.13	52.22
Yield (tonnes/ha)	1.35	0.37	27.2	0.18	3.00

Table 3 Estimate of components of variance, heritability, coefficient of variance and genetic advance of 56 genotypes of soybean grown at Yandev, Nigeria

Traits	Mean	Genotype variance	Phenotypic variance	Environmental variance	Broad sense heitability (%)	Genotypic coefficient of variability (%)	Phenotypic coefficient of variation (%)	Genetic advance as % of mean
Days to 50% flowering	43.5	48.21	49.75	1.54	0.97	15.96	16.22	32.37
Days to maturity	93.13	17.72	31.83	14.11	0.56	4.52	6.06	6.95
Plant height (cm)	43.67	20.94	73.59	52.65	0.28	10.48	19.64	11.51
Nodulation score	1.23	0.05	0.17	0.12	0.31	18.78	33.85	21.45
Pod shattering (nos/plot)	1.87	4.44	17.63	13.19	0.25	112.64	224.51	116.41
Pods/plant (no.)	29.54	34.67	144.17	109.5	0.24	19.93	40.65	20.13
300-seed weight (g)	43.25	19.87	28.61	8.74	0.69	10.31	12.37	17.69
Yield (tonnes/ha)	1.35	0.09	0.22	0.13	0.39	21.89	34.85	28.33

in this study, a range of 0.18 – 3.00t/ha was recorded on plot basis. TGx 1987-64F had the highest mean yield (2.09 tonnes/ha) followed by TGx 1987-10F (1.85 tonnes/ha) while TGx 1984-22F had the least yield of 0.96 tonnes/ha. TGx 1987-64F, TGx 1987-37F, TGx 1987-10F with relatively higher yield for two years are promising varieties for Yandev location.

Yields for the combine years (Table 2) was similar to the findings of Akande *et. al*, (2007). According to IITA (2008), the average yield of soybean in West African countries is equivalent to 1.1 tonnes/ha.

The estimates of the phenotypic coefficient of variation (CV) were generally larger than those of the genotypic coefficient of variation for all the traits.

The partitioning of variances (Table 3) revealed that high heritability was recorded in days to 50% flowering. 300-seed weight and days to 50% maturity respectively indicating the additive type of genes action. Days to 50% flowering, 300-seed weight and days to maturity on the basis of heritability (broad sense) was high, indicating the possibility of selection based on the phenotypic performance of these characters (Table 3). These results are comparable to the results reported by various scientists including Malik *et al.* (2008), Jain and Ramgiry (2000), and Rasaily *et al.* (1986).

Moderately high genotypic coefficient of variation (CV%) was evident in pod shattering (112.64), yield (21.89), pods/plant (19.93) and nodulation (18.78), respectively. This indicated that genetic variability exit within the genotypes. High phenotypic coefficient of variation was observed in pod shattering (224.51), pods/plant (40.65), yield (34.85) and nodulation (33.85), respectively, (Table3). These suggested that there is scope for improvement of these characters through selection from the considerable amount of variability present. The magnitude of difference between phenotypic coefficient of variability and genotypic coefficient of variability was small for all the characters under study (Table 3). This indicated that the influence of environment was limited since the genotypic and phenotypic coefficients of variation were similar in magnitude. Hence, the existing variation for the characters was mainly due to the genetic factor.

Broad sense heritability estimates ranged between 0.24 and 0.97. High values of heritability were observed for days to flowering, seed weight and days to maturity. Low heritability values were observed for number of pods/plant, pod shattering, plant height and nodulation (Table 3). Expected genetic advance in percentage of mean at 5% selection was high for pod shattering, days to flowering and yield. Selection for these traits might be more effective than for other traits. This is also similar to the findings of Vange *et al.* (1995).

In conclusion, the study indicated that there is appreciable variability with the genotypes under consideration for genetic advance. TGx 1987-64F, TGx 1987-37F, TGx 1987-10F with relatively higher yield for two years are promising varieties for Yandev location and other locations with similar ecological conditions. However, due to the significant year × genotype interactions, there is need for further extensive evaluation of the genotypes.

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