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Evaluation of Eight Soybean Varieties (*Glycine max* (L) Merill) For Yield and Other Agronomic Traits

Ibrahim, A.K[1]*, Dawaki, K. D[2], and Abdullahi, M.B[1]

1. Department of Agronomy, Bayero University, Kano, Nigeria. PMB 3011.
2. Department of Crop Science, Kano University of Science and Technology, Wudil, PMB 3244 Kano State, Nigeria.

*Corresponding author: *aikurawa.agr@buk.edu.ng (+2348068079917)

Abstract

The study was conducted at Teaching and Research Farm, Faculty of Agriculture, Bayero University, Kano ($11^0$59N; $8^0$25E; 466M above sea level) during 2016 raining season. The treatment consists of eight soybean varieties, laid out in Randomized Complete Block Design (RCBD) and replicated four times, and was tested for fifteen characters to evaluate their performance. Results indicated a significant difference ($P \leq 0.05$) for almost all the parameters tested which indicate the presence of substantial variability among the varieties, with the exception of TDM/plot, TDM/ha, GWP and GW/ha. TGx 1448-2E recorded the highest FW/ha (7000), PW/ha (3833.30) and GWP (207.50). However, the highest GW/ha was recorded in TGx 1987-62E (1416.70), followed by TGx 1448-2E (1383.30), these varieties performed better than other varieties and therefore recommended and can be selected for hybridization program to come up with new improved cultivars.

***Keywords**: Agronomic, Soybean varieties, Traits, and variability, Yield, and performance*

INTRODUCTION

Soybean (*Glycine max* (L.) Merrill), is a versatile species of the grain food legume with chromosome number 2n=40 (Singh *et al*., 1987). It is a member of the family leguminoceae, sub-family papilonaceae, and the genus Glycine Max (L) Merril, has been receiving attention as a source of food capable of increasing the available protein supplies. Consequently, interest in the production, processing, and utilization of the crop has been growing (Osho, 1991). Soybean grows in tropical, subtropical, and temperate climates. Soybean (G. max) was domesticated 5000 years ago from the wild soybean (Glycine soja Sieb and Zucc), found in China. More than 216 million tons of soybeans were produced worldwide in 2007, of which 1.5 million were in Africa. Africa imports nearly as much soybean as it produces. Africa exports about 20,000 tons annually. Nigeria is the largest producer of soybean in Sub-Saharan Africa (SSA), followed by South Africa. Low yields (<1 t/ha in tropical Africa) and a shortage of fertilizer constrain the ability of some countries to increase production. The strategies towards the increasing yield of soybean would be improved by an understanding of how to yield components interact with one another in affecting yield at both the phenotypic and genotypic levels (Board *et al.,* 1999) and effective variability for selection. Average grain yield ranged from 1117 kg ha–1 for the variety released in 1980 (TGx 1019-2EB) to 1710 kg ha–1 for the variety released in 1996 (TGx 1904-6F). Generally, grain yield showed an increase from old to new varieties during the two decades of soybean breeding at IITA, and TGx 1904-6F exceeded TGx 1019-2EB by 53%. The average rate of increase in grain yield per year of release was 24.2 kg /ha-yr^{-1}.

Undoubtedly, Soya bean is one of nature's most efficient protein producers. According to Ryan et a1. (1986), it yields more protein per acre than any other commonly cultivated crop, at least three times more than rice, wheat or maize. Sachel and Litchfield (1965) measured about 40 percent high-quality protein in Soya bean and that while most plant protein sources are seriously deficient in one or more of nine essential amino acids, Soya bean is an exception. According to them, Soya bean is an excellent source of unsaturated oil with most varieties averaging a content of about 20 percent. Onochie (1965) discussed the potential value of Soya bean as a protein supplement in the Nigerian diet. He observed that Soya bean has a higher total digestible nutrient percentage of (91. 99%) than cowpea (79.52%) and therefore more metabolizable energy and a higher content of lysine (6.0 to 6.5%) than all other common vegetable protein sources. Soya bean nutritional values account for the various ways it is used in human diets today. It is used as a soup condiment especially for thickening purposes, There is Soymilk, Soya drink, *Soyagari, Soyaeba,* and *Nune* or "*Dawadawa*". The chaff obtained after threshing can be fed to animals and the cake after extracting oil is widely used in the production of livestock feed. Soya bean is also very important in the treatment of some sicknesses. Naganawa et a1. (1988) observed that it would be helpful to give a diet with Soya bean protein to patients with Cirrhosis to prevent protein malnutrition. Increasing food production, however, is vital for enhancing future food security in the country as this is no longer debatable but a necessity. To achieve this, good knowledge of the current efficiency or inefficiency inherent in the crop production sub-sector as well as factors responsible for the level of efficiency and inefficiency must be critically examined. Rapid population growth and crippling economic problems in many African countries including Nigeria and most recently the global economic meltdown have reduced living standards and adversely affected eating habits causing widespread malnutrition (Ugwu and Nnaji, 2010). In addition, the high cost of livestock and poultry feeds derived from cereal and leguminous plant, had made it economically imperative that soya bean production and its economic and nutritive values should be developed further in Africa since its proteinous sources of about 40% and 20% oil content make it more nutritive to use in the formation of poultry feeds compared to maize grain (Dashiell, 1998).

Soybean contained higher essential vitamins and proteins which play an important role in our daily life, it can also be an important cash crop for our industry Hartman et al. (2011). The genetic variability among different germplasm can be studied by measuring the differences or similarity among different Soybean germplasm Ojo et al. (2012). Therefore, genetic diversity study plays a key role to study variability among different germplasm for improvement program Jan et al. (2017). Various researchers have characterized different Soybean genotypes like Khan et al. (2005), studied grain yield potential of eight mid duration varieties of Soybean, and reported the existences of variability among the average values for days to flowering, days to maturity, plant height, pods/plant, 100-grain weight, and grain yield were statistically significant.

Soybean is gaining prominence in Nigeria, as over 200,000 ha of land was devoted to its cultivation as far back as 1992. Soya is farmed extensively, mainly by small scale farmers, which may account for its low yields. Despite this, Nigeria's experiment in the use of Soya as a food crop offers a lot of promise. Low yields (<1 t/ha in tropical Africa) and a shortage of fertilizer constrain the ability of some countries to increase production. In addition, the high cost of livestock and poultry feeds derived from cereal and leguminous plant, had made it economically imperative that soya bean production and its economic and nutritive values should be developed further in Africa since its proteinous sources of about 40% and 20% oil content make it more nutritive to use in the formation of poultry feeds compared to maize grain (Dashiell, 1998). The development of superior varieties is based on the presence and extent of the genetic variability for the desirable characters for an

effective selection. Thus, present work aims at evaluating and selecting the best performing variety for effective selection for hybridization program.

MATERIALS AND METHOD

Experimental site

The experiment was conducted at the Research and Teaching Farm, Department of Agronomy, Faculty of Agriculture, Bayero University, Kano (Lat $11^0$59`N, Long $8^0$25`E and 466m above sea level) during 2016 rainy season. The materials used for the experiment were eight soybean varieties sourced from IITA. Brief descriptions of the varieties are presented in Table 1.

Table 1. Description of varieties used for the studies

VARIETIES	COAT COLOUR	TEXTURE
TGX1987-10F	Pale green and yellow	Smooth
TGX 1945-1F	Pale, green, white, yellow	Smooth
TGX 1987-62E	Pale, green, yellow	Smooth
TGX 1955 -4F	White brown patches, yellow	Smooth
TGX 1448-2E	Light brown, yellow	Smooth
TGX 1740	White, light yellow	Smooth
TGX 1448-1D	Pale green, white	Smooth
TGX 1835-10E	Light brown	Smooth

Experimental design

The land used for the experiment was plough, harrowed and ridge. An area of $99m^2$ (12m by 8.25m) was selected for this study. Eight plots of 2m length each were made and replicated four times. The treatments consist of eight soybean varieties, laid out in Randomized Complete, Block Design, replicated four times, the one-row plot of 2m long spaced 0.75m apart was used as a plot. Three seeds were planted at intra row spacing of 10cm and later thinned to two plants per hill. Weeding was manually carried out using hoe at three and six weeks after sowing. The recommended fertilizer used was 40kg P/ha (single super phosphate per hectare) and 20kg K/ha (muriate of potash per hectare), all recommended agronomic activities were dully followed (IITA, 2015). Data were collected for: Number of Days to 50% flowering (NDF), Number of days to 95% at maturity (NDM), Plant height (PH), Total dry matter (TDM), Total dry matter (kg) per hectare (TDMha), No of pods per plot (NPP), No of pods per hectare (NPha), Pod weight (g) per plot (PWP), Pod weight (g) per hectare (PWha), Grain weight (g) per plot (GWP), Grain weight (g) per hectare (GWha), Fodder weight per plot (FWP), Fodder weight (kg) per hectare (FWha), Chlorophyll content (CHL) and Harvest index (HI).

Data Analysis

Data collected were analyzed using Statistical Application Software (SAS) version 9, (2002). Means were differentiated using Student-New-Keuls (SNK).

RESULTS

Mean Performance

The mean performance for yield and other agronomic traits of the eight soybean varieties is presented in table 2, the result indicated that TGx 1484-1D was the first to attain 50% flowering at 43days, followed by TGx1955-4F (48days), whereas TGX1987-10F attain 50% flowered late at (57 days). TGX1448-2E and TGx1945-1F had the highest plant height of 64cm, while TGx1835-10E had the least plant height of 43.90cm. TGx 1484-1D was the first to mature (91 days after planting). While varieties TGx1955-4F, TGx 1987-62E and TGX1740 were late

maturing (107 days after planting). The chlorophyll content range from 14.7-32.38(SPAD VALUE) where TGx1945-1F had the highest CH content of 40.30 and TGx 1935-10E had the lowest CH of (14.73). The variety TGX1448-2E (954) counted the highest number of pods per plot and TGX1987-10F (112) had the least number of pods per plot and similarly the highest pod weight per plot was obtained from TGx1448-2E (575g) and the least pod weight per plot in TGX1987-10F (48.75g). Total dry matter per hectare ranged from 2167- 6917/ha. TGx1987-10F recorded the highest harvest index (40.00) while TGx 1448-2E recorded the least (9.88). TGx 1448-2E also recorded the highest fodder weight per hectare (7000) and pod weight per hectare (3833.30). However, TGx 1987-10F recorded the least pod weight per hectare of (325.00) and grain weight per plot of (47.50). It also indicated that the highest grain weight per hectare was observed in TGx 1987-62E (1416.70/ha), followed by TGx 1448-2E (1383.30/ha) and the least was recorded in TGx 1945-1F (283.30/ha).

DISCUSSION

The highly significant difference in varieties observed for yield and all the other agronomic traits is an indication that the studied population is genetically diverse for all the traits studied. Thus the varieties evaluated lend themselves to possible selection for production within the Sudan Savannah ecology of Nigeria. The results indicated that there are some significant differences among the varieties in all the parameters analyzed except in the plant height per plot which showed no significant differences ($p>0.05$) among the varieties. The variety TGx1484-1D was the first to attain 50% flowering at 43days after planting and matured (91 days after planting), and this coincides with IITA which classify TGx1484-1D as an early maturing variety. Chlorophyll content shows a highly significant difference among the varieties ranging from (14.00-40.30).

A significant difference exists in a number of pods per plot with TGx1448-2E having the highest pod number of (954.50) while TGx 1987-10F (112) had the least number of pods. A significant difference in a number of pod and seed in soybeans found in this study were in line with the studies of (Aduloju *et al*., 2009) who reported that significant value in a number of pod and seed yield could be attributed to genetic variability. There was no significant difference among the varieties in terms of total dry matter and grain yield. This is contrary to several studies in which significant variations exist in yield of soybeans (Adeniyan and Ayoola 2006; Adeniyan and Ayoola 2007) and could be attributed to the environmental condition.

Varieties also showed a highly significant difference for fodder yield in contrast with grain yield.TGx1448-2E had the highest fodder weight per plot of 1.05g and 7000kg per hectare. Varieties also did show a significant difference for harvest index (the ratio of grain yield to above ground biomass) Dugje et al. (2009) reported similar results in soybean varieties studied. The lowest harvest index was obtained from TGx1448-2E (9.88), this is in accordance with (IITA) which state that Increasing harvest index would be at the expense of fodder yield, so Selection in the IITA's soybean breeding program for dual-purpose varieties is performed both for grain and fodder yields and as a result harvest index has not been modified much in absolute terms (Dugje *et al.*, 2009).

CONCLUSION

Conclusively, from this study, it showed that TGX-1987-62E, TGX-1935-10E and TGX-1448-2E varieties relatively had the highest yields over others evaluated.TGX1448-2E is presumably the high yielding variety for both grain and fodder; though the variety exhibited a delay in maturity and this also indicates that late maturing varieties higher yielding. Base on this finding the variety

has greater potentials of vegetative growth which leads to higher yields. The positive relationships and contributions of pod weight, number of pods plot^{-1} to soybean yield plot^{-1} irrespective of the maturity date can be considered as good indices for variety selection during the breeding program and at farmer's field level.

RECOMMENDATIONS

- TGx1448-2E is recommended, to be selected for dual purpose (grain and fodder yield) in a breeding program.
- Pod weight, number of pods per plant and the total dry matter should be the most important traits to concentrate on when selecting for high yielding varieties.
- Further evaluation of these varieties across locations is needed to validate the findings.
- TGx 1448-2E and TGx 1987-62E can be hybridized to come up with improved cultivars for the benefit of mankind.

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Table 2. Mean Performance for yield and other agronomic traits of soybean varieties under study

VARIETIES	NDF	PLNTH	CHL,CN	NDM	NPP	NPha	TDM	TDMha	H(index)	FWP	FWha	PWP	PWha	GWP	GWha
TGX1955-4f	48.25b	55.03a	31.30b	107.00bc	587.50ab	391666ab	0.71a	4750a	12.71b	0.51b	3417b	312.50b	2083.30b	120.00a	800.00a
TGX1987-10f	57.00a	53.13a	17.48b	113.00a	112.00b	746667b	0.97a	6417a	40.00a	0.34b	2267b	48.75b	325.00b	47.50a	316.70a
TGX1987-62E	51.75b	48.15a	17.84b	107.00bc	634.00ab	4226667ab	1.04a	6917a	28.67ab	0.25b	1667b	187.50b	1250.00b	212.50a	1416.70a
TGX1935-10E	50.00b	43.90a	14.73b	104.00c	259.80b	1731667b	0.43a	2833a	22.75ab	0.17b	1125b	68.75b	458.30b	207.50a	366.70a
TGX1484-1D	43.00c	51.65a	20.34b	91.00d	630.00ab	4200000ab	0.34a	2250a	28.22ab	0.24b	1583b	212.50b	1416.70b	180.00a	1200.00a
TGX1740	53.50ab	56.08a	23.06b	107.00bc	425.00b	2833333b	0.38a	2500a	25.00ab	0.21b	1417b	162.50b	1083.30b	100.00a	666.70a
TGX1448-2E	53.50ab	64.00a	32.38ab	114.00a	954.50a	6363333a	0.54a	3583a	9.88b	1.05a	7000a	575.00a	3833.30a	207.50a	1383.30a
TGX1945ll-1F	50.00b	64.00a	40.30a	108.00b	134.00b	893333b	0.33a	2167a	15.25b	0.19b	1258b	73.75b	491.70b	42.50a	283.30a
Mean	50.875	54.556	24.678	106.375	467.093	311395	0.589	3927.083	22.809	0.37	2466.667	205.516	1367.708	120.625	804.116
SE ±	1.208	4.48	4.054	0.854	122.466	816440	0.362	2413.149	5.25	0.181	1205.842	65.9	439.338	60.313	318.697
CV	4.747	16.422	32.853	1.605	52.437	52.437	122.897	122.897	46.039	97.77	97.77	64.244	64.244	76.261	79.261

KEY: NDF: Number of Days to 50% flowering, PLNTH: Plan height, CHL,CN: Chlorophyll content, NDM: Number of days to 95% at maturity, NPP: No of pods per plot, NPha: No of pods per hectare, TDM: Total dry matter(kg) per plot , TDMha: Total dry matter (kg) per hectare, HI: Harvest index, FWP: Fodder weight (kg) per plot, FWha: Fodder weight (kg) per hectare, PWP: Pod weight (g) per plot, PWha: Pod weight (kg) per hectare, GWP: Grain weight(g) per plot, GWha: Grain weight (kg) per hectare.