EVALUATION OF SOYBEAN GENOTYPES IN GUINEA SAVANNAH LACATION OF NIGERIA

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ABSTRACT

A field trial was conducted in 2016,to evaluate the new soybean genotypes for their agronomic performance against the local check. The experiment was conducted in two locations namely Makurdi(lat. 7.73'N, long. 8.53'E,) and Wukari(lat. 7.88''N, long. 9.78E,) in each location a triplicated trial involving ten genotypes of soybeans were implemented. The effects of genotype, location and genotype x environment interaction under combined analysis on agronomic yield, and soybean yield were found significant at P<0.05. The highest mean yield was found from TGX 1835-10F and TGX 1985-10F in all locations. Correlations coefficient for seed yield revealed a positive and significant association with all agronomic yield except 100 seed weight in all locations. The Eigen value and percent variation estimates were significant for days to first flowering (5.45 /0.41), while 100 seed weight had the lowest values (0.03/100) The finding also revealed that the differences between the eigen values and percent variation were significantly lower for ,number of branches (0.13), and number of pod per plant (0.05),. The result suggests that the environment had less effect on the expression of these traits. Therefore, selection based on these traits might increase soybeans performance in all locations. The findings have demonstrated the stability of traits in different locations which is useful information in soybean breeding. TGX-, 1448-2E, and TGX-1945-4E had yields above the grand means, and the yield were stable, TGX 1987-10F, TGX 1835-10F and TGX-1945-4E had better performance compared To TGX-1485-1D

Keywords: Soybeans, genotype, yield component, yield.

INTRODUCTION

Soybean (Glycine max (L) Merrill) is a legume produced worldwide, and its production has increased .In Africa, total soybean production rose from 0.574 million MT in 1994 to1.59 million MT in 2009; representing 0.7 of the world production *(Hartman et al., 2011).* Soybean is among the major industrial food crops grown in every continent. The crop can be successfully grown in many states in Nigeria using low agricultural input. Soybean cultivation in Nigeria has expanded as a result of its nutritive and economic importance and diverse domestic usage. It is also a prime source of vegetable oil in the international market. Soybean has an average protein content of 40% and is more protein-rich than any of the common vegetable or animal food sources found in Nigeria. Soybean seeds also contain about 20% oil on a dry matter basis, and this is 85% unsaturated and cholesterol-free (Singh *et al*., 2008). Although soybean production has increased in Nigeria, the yield has remained low; Yield on growers' farms is often lower than 1000kg ha-1 compared to yields > 2500 kg ha-1 in the USA Modali, (2004), 3000 kg ha-1 in Brazil and >3500 kg ha-1in Turkey FAO/ STAT, (2012). The low yields are as a result of several challenges which include a biotic, socioeconomic and biotic constraint (Kawuki *et al*., 2003b). Among the biotic constraints, Asian Soybean Rust is the major cause of low yields in many areas of the world Hartman *et al*., (2011). Number of management options has been recommended to mitigate the effects of soybean rust disease. Chemical control, cultural practices and deployment of resistant varieties have been widely used in areas where the disease is prevalent. Fungicide applications have not been effective in improving yield because, timing of fungicide application is critical. There are rapid spread of wind-borne urediniospores and large number of host species which increases chances of soybean rust survival making cultural practices relatively ineffective (Hartman *et al*., 2005).

After deployment, single resistance genes succumb to certain isolates of the pathogen (Obua., 2013. Hartman *et al.*, 2005) Due to their multiple virulence factors, the rust pathogen whose resistance is based on single genes will not be durable given the polycyclic nature of the pathogen but If the deployment of durable resistance genes will remain effective for a long time then it is required that the diversity of the pathogen is known. The inability to assess and develop superior soybean varieties with either wide adaptation or specific adaptation to different regions, and in addition resistant to rust, therefore it is required that evaluation and identification of varieties according to the location they adapt to and are most stable be conducted. Among the soybean cultivars recommended for host-plant resistance against soybean rust, none has enough level of immunity yet to dispense the use of fungicides to control rust (Miles *et al*.,2007, Juliatti *et al* 2011). However, the previously identified rust resistant varieties will be revalidated at different environments to confirm their status and see the possibility of obtaining resistant varieties specific to particular location(s). Screening to identify completely immune resistant varieties will help control rust infection in soybean. Also, the assessment of the cultivar performance of Soybean at different environment will aid in the identification of high yielding cultivars that are more suitable to specific locations of rust occurrence. The aim of the study is to develop high yielding rust-resistant soybean genotypes that are stable in soybean producing areas of southern and north east ecological zone. The Specific objectives were to: evaluate soybean genotypes for specific rust resistance and select stable and high yielding genotypes for advanced yield evaluation.

MATERIALS AND METHODS

Location and experimental sites

Three locations within eastern agro-ecological zones were used as experimental sites. The names of the locations are Makurdi (lat. 7.73'N, long. 8.53'E,) .The location falls within the southern Guinea agro-ecological zone of Nigeria and Wukari (lat. 7.88''N, long. 9.78E,) the location falls within the north-east agro-ecological zone of Nigeria. The research was implemented during 2016 growing season from July to November. Ten genotypes (Table 2) were evaluated for grain yield in two growing environments varying mainly in their month rain fall A variety called *TGX-1485-1D* was used as a local check as it has been grown in eastern agro-ecological zone since 1978 (Malema, 2005).

The experiment was laid out in a randomized complete bock design with three replications in each location. The plot size was 2.5 m x 2 m while the spacing used was 50 cm x 10 cm between and within the rows respectively. Each treatment was sown in four rows per plot. Data were collected from the net area of 1.5 m x1.8 m of each plot excluding two border rows. The harvested net plot area was 2.7 m.

All agricultural practices recommended for soybeans production were applied during the course of experimentation in all 2 locations. Before maturity, all the agronomical yield components traits (days to 50% flowering, days to 95% maturity, plant height, number of pods per plant, number of seeds per plant) were recorded and at maturity, ten plants were randomly collected from each sub-plot to measure quantitative traits for example, seed weight per plant (g). Seed yield (t ha- 1) was calculated based on the plot area Seed yield (t ha- 1) was calculated based on the plot area.

Data analysis

STATISTICA version 10 was used to compute Analysis of variance (ANOVA) for bean yield, and yield components, content, data were subjected to ANOVA separately for each location and over combined locations. The statistical model applied for this ANOVA are:

Single location

Single location analysis was carried out as described by Gomez and Gomez (1984) for randomised complete block design (RCBD).

$Yij = \mu + Bi + Gj + \varepsilon ij$ (1)

Combined location analysis

$Yijk = \mu + Bi + Gj + Lk + GLjk + \varepsilon ijk$ (2)

Where, Yijk = observed value of genotype j in block i of location k, μ=grand mean, Bi=block effect, Gj=effect of genotype, Lk= Location effect, GLjk = the interaction effect of genotype j with location k, Ɛijk = error (residual) effect of genotype j in block i of environment k. Means among each character were compared by least significant difference (LSD) test at 5% levels of significance. The combined component of variance and correlation coefficient was calculated as described by Al-Jibouri et al. (1958). The observed mean squares obtained in the combined ANOVA was used to separate out the effects of genotype, environments, and their interaction.

RESULT AND DISCUSSION

Effects of genotypes on yield and yield components in Makurdi

The result in Table 3 shows that the effects of genotypes on yield and yield component in Makurdi was significant ($P < 0.05$) In this study, the genotypes TGX 1485-1D, TGX-1904-6F and TGX 1945-1F had the highest mean in days to flowering were TGX-1835-10E had lowest. Days to maturity, TGX-1448-2E (102.01) outperformed TGX-1987-10F with the lowest 84.66; TGX-1935-3F had highest plants of 59.13m compared to TGX-1987-10F which has 40.13m and ranked the lowest. In terms of number of branches, number of seed per plant and 100 seed weight TGX-1987-10F outperformed the local check TGX-1485-1D with mean yield of 1337.7kg/ha .

Effects of genotypes on yield and yield components in Wukari

The genotype TGX-1835-10E was earlier (41.66) in terms of days to flowering and significantly different from the other varieties (Table 4). The late maturing variety TGX 1949-10F flowered later with significant difference in days compared to other varieties except TGX-1935-3E.The genotype TGX-1448-2E was earliest (100.66) in terms of days to maturity and significantly different from the other varieties. The late maturing variety TGX 1949-10F matured later with significant difference in days from the other varieties.The trend in plant height was least in TGX-1945-1F (31. 20m) and highest in TGX 1935-3F (43.80m). The variety TGX 1935-3F was significantly taller at harvest compared to all the other varieties. The genotype TGX-1949-10F recorded the least number of pods per plant (18.2) while TGX 1945-1F produced the highest number of pods per plant (41.20).Variety TGX-1448-2E(11.76g) recorded the highest weight in terms of 100 seed weight while TGX-1949-10Fwas the least with 5.10g. The 100 seed weight for TGX 1448-2E was significantly different from that of other varieties except for TGX-1835-10E. The late maturing variety, TGX-1835-10Erecorded the highest grain yield of841.2kg/ha and was closely followed by an early maturing variety, TGX-1448-2E, with 703.0kg/ha (Table 5).

Effects of Environment on yield and Yield Component

The agronomic yield performance and yield across the 2 locations are presented in Table 5. Plant height, Number of pods per plant, number of seed per plant, and 100 seed weight were significantly high at Makurdi compared to other site. It was established from this study that, yield and yield components varied significantly ($P < 0.05$) with locations. The mean yield was significantly high at Makurdi (960.97kg/ha). These agronomic performances attribute to high yield performances recorded at Makurdi site (Table 5). The seed yield performance across the two locations showed that the performances of all genotypes are consistent under varying agro-ecological zones.

Table 1: Effect of Genotype on yield and yield component in Makurdi

Genotypes	**DFF**	**DYSM**	**PLT(m)**	**NOB**	**NPPLT**	**SPPLT**	**HSW**	**YIELD (kg/ha)**
TGX-1949-10F	40.00^{a}	89.66^{dc}	46.43^{dec}	2.16^{d}	43.33^{ba}	1.63^{ba}	10.20^{ba}	696.32^{bc}
TGX-1987-10F	40.33^{a}	84.66^{d}	40.13^{e}	2.30^{dc}	31.93^{b}	2.10^{a}	12.46^{ba}	1334.7^{a}
TGX-1448-2E	40.00^{a}	102.01^{a}	55.66^{ba}	3.36^{ba}	40.80^{ba}	1.76^{ba}	12.13^{ba}	1023.0^{bac}
TGX-1485-1D	41.00^{a}	96.66^{bac}	50.96^{bdac}	2.72^{bdc}	42.23^{ba}	1.30^{b}	7.96^{b}	469.31^{c}
TGX-1835-10E	39.33^{a}	86.33^{d}	49.16^{bdc}	2.50^{bdc}	38.00^{b}	1.97^{a}	11.52^{ba}	1157.7^{ba}
TGX-1904-6F	41.00^{a}	99.01^{ab}	50.26^{bdac}	2.66^{bdc}	41.67^{ba}	1.76^{ba}	14.23^{a}	1201.3^{ba}
TGX-1935-3F	40.33	91.66^{bdc}	59.13^{a}	3.63^{a}	38.33^{b}	1.63^{ba}	10.33^{ba}	832.0^{bac}
TGX-1945-1F	41.00^{a}	97.00^{bac}	46.46^{dec}	2.20^{d}	43.73^{ba}	1.90^{a}	11.63^{ba}	1019.7^{bac}
TGX-1945-4E	40.33^{a}	91.33^{bdc}	52.60^{bac}	3.16^{bac}	63.73^{a}	1.90^{a}	12.43^{a}	1062.3^{ba}
TGX-1951-4F	40.66^{a}	94.66^{bac}	42.73de	2.42^{dc}	41.80^{ba}	1.76^{ba}	13.56^{a}	813.3^{bac}
Mean	40.40	93.3	49.35	2.71	42.55	1.77	11.69	960.96
SE	0.91	2.62	2.98	0.30	8.45	0.19	1.54	185.42
Cv(%)	3.24	4.87	10.84	19.52	34.41	18.23	22.15	34.23

Means with the same letter are not significantly different. DF = Days to 50% flowering, DM = Days to 50% maturity, PH = Plant height (m) NPP = Number of pods per plant SDW = 100 seed weight, (g) SPPLT=seed number per plant(g) GYLD = Grain yield (kg/ha)

Table 2: Effect of Genotype on yield and yield component in Wukari

GENOTYPES	DFF	DYSM	PLT(m)	NOB	NPPLT	SPPLT	HSW	YIELD (kg/ha)
TGX-1949-10F	44.23[a]	86.33[ef]	35.03[bc]	1.66[bac]	18.20[d]	0.70[e]	5.10[c]	315.0[bc]
TGX-1987-10F	43.00[bac]	86.33[ef]	34.84[cb]	1.46[ba]	21.33[dc]	0.96[edc]	7.06[bc]	582.0[ba]
TGX-1448-2E	42.66[bc]	100.66[a]	38.60[ab]	1.90[ba]	22.06[dc]	1.66[ba]	11.76[a]	703.0[a]
TGX-1485-1D	42.33[bc]	93.00[dc]	35.15[bc]	1.60[bac]	30.33[bc]	0.93[ed]	7.63[bc]	166.0[c]
TGX-1835-10E	41.66[c]	84.67f	37.13[bc]	1.70[bac]	28.20[dc]	1.76[a]	10.52[ba]	841.2[a]
TGX-1904-6F	43.00[bac]	99.33[ba]	36.00[bc]	1.46[ba]	25.53[dc]	1.63[bac]	9.20[ba]	675.3[a]
TGX-1935-3F	43.33[ba]	92.66[dc]	43.80[a]	2.23[a]	40.50[ba]	1.00[ebdc]	7.06[bc]	631.3[ba]
TGX-1945-1F	43.00[bac]	98.66[bdc]	31.20[c]	1.80[ba]	41.20[a]	1.26[ebdac]	9.43[ba]	604.3[ba]
TGX-1945-4F	42.66[bc]	92.00[ed]	38.33[ba]	1.90[ba]	28.73[dc]	1.40[ebdac]	9.07[ba]	794.0[a]
TGX-1951-4F	42.33[bc]	94.66[bac]	37.40[bc]	1.03[c]	30.53[bc]	1.40[bdac]	8.43[bac]	585.3[ba]
Mean	42.83	92.76	36.80	1.67	28.66	1.28	8.59	589.75
SE	0.47	2.07	2.12	0.23	3.58	0.24	1.33	120.38
Cv(%)	1.92	3.86	10.08	24.08	21.68	30.43	26.89	35.35

Table 3: Effects of Environment on yield and yield component of soybean

Location	DFF	DYSM	PLT(cm)	NOB	NPPLT	SPPLT	HSW	YIELD (kg/ha)
Makurdi	42.8[b]	93.30[a]	49.35[a]	2.71[a]	42.55[a]	1.77[a]	11.69[a]	960.97[a]
Wukari	40.40[a]	92.75[b]	36.80[b]	1.67[b]	28.66[b]	1.28[b]	8.59[b]	589.75[b]
Mean	44.36	92.75	43.08	3.55	35.61	1.51	10.14	775.36
SE(+_)	0.19	0.76	0.84	0.09	2.03	0.06	0.47	49.25
CV(%)	2.60	13.22	10.78	22.72	31.43	23.26	25.26	34.79

Means with the same letter are not significantly different. DFF = Days to first flowering, DM = Days to 50% maturity, PH = Plant height (m) NPP = Number of pods per plant SDW = 100 seed weight, (g) SPPLT=seed number per plant (g) YLD = Grain yield (kg/ha)

Table 4: Eigen values and yield percent contribution of 9 characters of 10 soybean Genotypes

Characters	Eigen value	Percentage variation	Cumulative %Percentage variation
Days to 50% flowering	5.45	0.41	41.97
Days to 95% maturity	2.92	0.22	64.50
Rust score	1.84	0.14	78.67
Plant height	1.41	0.10	89.56
Number of branches	0.85	0.06	96.11
Number Of pods/ plant	0.27	0.02	98.22
Yield per hectare	0.13	0.01	99.28
Seed number per plant	0.05	0.00	99.71
100 Seed weight	0.03	0.00	100.00

EIGEN VALUES AND PERCENT VARIATION OF SOYBEAN GENOTYPES

The estimates of the Eigen values and percent variation of soybean genotypes of the mean for eleven traits of soybean are presented in Table 5. Significant differences were recorded for all agronomic traits under study. Indicating that all accessions are promising for breeding programs The estimates were significantly high for their eigen values but the lowest for percent variation for days to flowering (5.45/41.97) followed by days to maturity (2.29/64.50), plant height (1.41/89.16), The lowest eigen values in estimate was revealed in 100 seed weight (0.03). The finding also revealed that the differences between percent variation were significantly for 100 seed weight (100.0), followed by seed number per plant(1.45), Indicating that the environment had less effects on the expression of these traits, thus can be useful in soybean screening programs. (lyimo.et al 2017)

TABLE 5: Pea rson Correlation between Grain Yield and Selected Agronomic Traits

	DAYS TO FLOWERING (D50F)	**DAYS MATURITY (DSYM)**	**RUST SCORE**	**PLANT HEI (CM) (PLHT)**	**NUMBER OF BRANCHES(N**	**NUMBER OF PODS/ PLANT (NPPP)**	**100 SEED WEIGHT(G) (HSW)**	**SEED NUMBER PLANT (SPPLT)**	**YIELD (KG/H**
YIELD (KG/H/	0.8668**	0.3131	0.3180	-0.2181	-0.1412	0.0243	-0.4176	-0.6010	-0.4421
SNPPLT		0.2813	0.4528	-0.1812	-0.1704	-0.3087	-0.4796	-0.6168	-0.5189
NPPP			0.8275**	0.6254*	0.3509	0.3450	0.3905	0.1467	-0.1465
HSW(G)				0.3347	0.2631	0.2508	0.2780	0.2025	0.1151
NOB					0.3971	0.3393	0.0955	0.0560	0.1938
PLTH(CM)						0.9590**	0.0341	-0.0230	-0.1219
RUST SCORE							0.1252	0.0209	0.01825
DYSM								0.9365**	0.7907**
D50F									0.8874**

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Pearson Correlation between Grain Yield and Selected Agronomic Traits

The correlation coefficients of grain yield with selected agronomic traits are presented in Table 6. Yield per hectare was positively correlated with days to flowering (0.8668, P≤0.001), 100 seed weigh had positive and significant associations Days to Maturity and rust score (0.8275, 0.6254 P≤0.001). . However, the degree of correlation varied among traits, with the highest degree of association recorded between number of pods Per plant and plant height (r=0.9590), followed by days to maturity / Seed number per plot (r=0.9365,), and yield per hectare (r=0.7907), P≤0.01). number of pods per plant/ Rust score (r=0.625, P≤0.01), /plant height Days to flowering(r=0.8874, P≤0.01) yield per hectare,100 seed wieght (0.2508, P≤0.01), Number of Branches (r=0.2780), and (r=0.2025, P≤0.01) expressed significant but low positive correlation coefficient. However, these are contrary to the result of Malik et al. (2007) and Srinives and Giragulvattanaporn (1986) who revealed that days to maturity and days to 50% flowering had negative direct effect to yield. This inconsistency in results might be due to the effect of abiotic factors. Several reports (Arshad et al., 2006; Malik et al., 2007; Srinives and Giragulvattanaporn, 1986) documented that correlation coefficient for seed yield revealed a significant association with plant height. Based on the present findings, days to 50% flowering, days to 95% maturity, plant height, number of pods per plant, and number of seed per plant showed a positive and significant correlation across the locations studied. These traits suggested being effective selection criterion in soybean improvement programme

CONCLUSION

The results from the present study therefore conclude that genotype and location interaction had a high positive correlation with all agronomic yields expect 100 seed weight. The LSD mean separation picked all genotypes as the highly adaptable and stable across the two locations as compared to the check

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