

Evaluation of Six Cultivars of Soybean under the Soil of Rainforest Agro-Ecological Zones of Nigeria

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Abstract: A field experiment was conducted to evaluate the performance of six soybean cultivars (TGx 1148-2E, TGx 1440-1E, TGx 1485-1D, TGx 1910-14F, TGx 1889-12F and TGx 1903-5F) under the soil conditions of Anwai (rainforest agro-ecological zone). The experiment was arranged in a randomized complete block design and replicated three times in two cropping seasons. Parameters measured at different growth stages (4, 6, 10 and 12 weeks after planting) include plant height (cm), leaf area (cm²), number of flowers, number of pods, dry weight of 100 seeds (g), weight of seeds (g) / plant and total dry weight of seeds. Also determined was the percentage emergence. The results showed that there were significant differences ($P < 0.05$) among the six cultivars of soybean tested for percentage emergence. Cultivar TGx 1889-12F had the highest percentage emergence while the lowest was observed for TGx 1485-1D. Flower first appeared on TGx 1485-1D at 5 weeks after planting (WAP). There were gradual increases in plant height and leaf area with plant age. Also, significant differences were observed among cultivars for plant height and leaf area at 4, 6 and 10 WAP whereas no significant differences ($P < 0.05$) were recorded for number of flowers, number of pods and dry weight of 100 seeds per plant at 4, 6 and 10 WAP. Significant differences ($P < 0.05$) were observed among the cultivars for total dry weight of seeds (t/ha) at 12 WAP. TGx 1903-5F and TGx 1910-14F had the highest mean values of 10.44 and 8.21 t/ha of total dry weight of seeds, respectively. The result of this study showed that there were cultivar differences among the IITA hybrids in response to soil conditions of the rainforest agro-ecological zone and cultivar TGx 1903-5F performed better than other cultivars evaluated. This cultivar can be made available to the farmers in this area or be utilized for future breeding programmes.

Key words: Soybean cultivars • Dry weight • Agro-ecological zones

INTRODUCTION

Soybean *Glycine max* (L) Merr. is a member of the family papilionaceae, [1]. It is a herbaceous annual legume, usually erect, bushy and rather leafy which originated in China [1,2]. The crop has a relatively short growth duration due to its sensitivity to short day length in the tropics [2,3]. Soybean is widely distributed in most parts of the world; the crop has a lot of potential in Africa [4,5]. It is frost sensitive, thrive best on sandy or clay loams and alluvial soils of good fertility and the optimum soil pH for soybean cultivation ranges from 6.0-6.5 [6,7].

It is generally known that the seed of soybean contains the highest and richest protein among all cultivated legumes [8,1]. Worldwide interest and attention in soybean is mainly due to its high nutritional value and seed protein content [9]. Soybean has a composition of protein content of over 40%, edible vegetable oil content

of 20%, carbohydrates content of about 30%, a total sugar content of about 10% and an ash content of about 5% [1]. The protein content is twice as much protein content in cowpea [10,11]. The nutritional quality of protein in soybean, as indicated by its amino acid distribution is nearly as good as meat proteins [1,3,12]. The soybean meal is rich in minerals, particularly calcium, phosphorus and iron [8,12]. It has good content of the vitamins, thiamins, riboflavin and niacin [9,13]. The meal and flour with their low content of starch, are used to prepare food for people with diabetes [4]. The oil content (20%) of soybean is rich in essential fatty acids and devoid of cholesterol. About 50% of the world's edible vegetable oil trade comes from soybean [14]. The oil is also used industrially in the manufacture of paints, linoleum, oil cloth, printing inks, soap, insecticides and disinfectants [6]. Recent data indicate that soybean can contribute to the control of cereal pests such as *Pratylenchus* nematode species [1].

The bulk of soybeans produced in Nigeria come from the southern guinea savanna but production has also extended to the northern guinea savanna and forest belts [11]. There is inadequate information on the best yielding cultivar under rainforest agro-ecological zones of Nigeria. There is need to extend soybean production to all agro-ecological zones in order to bridge the present gap between production and domestic / industrial demand. Thus, the aim of this study is to evaluate the performance of six cultivars of soybean in response to soil conditions of Anwai in rainforest agro-ecological zone of Nigeria.

MATERIALS AND METHODS

Location of the Site: A field experiment was conducted during 2004 and 2005 cropping seasons at Delta State University, Asaba Campus-Anwai. Asaba Campus is located at 06° 14' N and 06°49'E of the equator. It lies in the tropical rainforest zone, characterized by seven months of rainy season between April and October, punctuated by a short break in August. An annual rainfall range of 1500 mm to 1849.3 mm [15]. Composite soils (0-15cm depth) samples were taken from the site. It was air dried at room temperature and passed through a 2mm sieve before it was taken to IITA laboratory, Ibadan, Nigeria for analysis. The chemical and physical characteristic of the soil at the experimental site showed that the soil is sandy loam and it had the pH (6.5), available P (10.7ppm), Organic carbon (0.74%), Organic matter (1.28%), Total Nitrogen (0.06%), Sand (69.31%), Silt (22.28%) and Clay (8.41%).

Experimental design: The experimental site was cleared, packed and tilled before planting was done. The experimental design was set up in a randomized complete block design and replicated three times. Each plot measured 1.2m x 1m with 0.5m between plots and 2m between blocks. Soybean was planted on the 14th July, 2004 and 9th of July, 2005, respectively, at the spacing of 40 x 5cm and one seed per hole, giving a plant population of 80 plants/plot. Replacement was done the fourth day after planting. That is after emergence of seedlings. Weed control was by hand weeding and this was done twice.

Planting Materials: The cultivars used were TGx 1148-2E, TGx 1140-1E, TGx 11485-1D, TGx 1910-14F, TGx 1889-12F and TGx 1903-5F. They were early and medium maturing elite cultivars obtained from International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria.

Data Collection and Analysis: Percentage of plant emergence was done by counting the number of emerged seedlings at 7 days after planting. Before sampling commence, 6 plants were randomly selected from the two middle rows in each plot and tagged (with red thread) for data collection at various stages of growth and development. Some of the data collected at 4., 6, 10 and 12 weeks after planting, include: plant height (cm), leaf area (cm²), number of flowers, number of pods, dry weight of 100 seeds (g), weight of seeds (g) / plant and total dry weight of seeds. Statistical Analytical System [16] programme was used for data analyses. Analysis of variance and Duncan's Multiple Range Test were used to evaluate significant differences in data collected.

RESULTS AND DISCUSSION

The percentage emergence of six cultivars of soybean showed significant cultivar differences and TGx 1889-12F had the highest percentage emergence, followed by TGx 1910-14F, TGx 1148-2E and TGx 1440-1E while TGx 1485-1D had the lowest percentage emergence (Table 1). There were gradual increases in plant height with plant age (Table 1). There were significant differences among the cultivars at 4 weeks after planting (WAP), 6 WAP, 10 WAP respectively (Table 1). TGx 1903-5F and TGx 1910-14F had the highest mean values for plant height when compared to other cultivars tested at different sampling periods (Table 1). The result from this study showed that plant height ranged from 54.80cm to 74.45cm at maturity. These results agree with earlier work done by Okpara and Ibiam, [11]; Yusuf and Idowu [10] who observed significant differences among soybean cultivars for plant height.

The leaf area of the six soybean cultivars showed that significant differences were observed at 4 WAP and 6 WAP but 10 WAP, there were no significant differences among the cultivars tested (Table 2). TGx 1903-5F and TGx 1440-1E performed better than other cultivars evaluated (Table 2). Also, the mean values for the number of flowers for the different cultivars of soybean at 7 WAP showed that TGx 1903 – SF produced the highest whereas the lowest was produced by TGx 1889-12F (Table 2). However, the values obtained with different cultivars were not significantly different. Flower first appeared on TGx 1485-1D at 5 WAP followed by TGx 1910-14F and TGx 1903-5F at 6 WAP and TGx 1440-1E, TGx 1148-2E and TGx 1889-12F were the last. Most of these flowers developed into pods while a few fell off. The data showed that there

Table 1: Combined analyses of six soybean cultivars for percentage emergence and plant height (cm) at different growth stages

Cultivar	Percentage Emergence/ plant (7 DAP)	Plant height (cm) /plant (4 WAP)	Plant height(cm) /plant (6 WAP)	Plant height(cm) /plant (10 WAP)
TGx 1148-2E	79.58 ab	24.70 ab	43.54 bc	64.69 ab
TGx 1440-1E	74.17 ab	22.43 b	38.53 c	62.11 ab
TGx 1485-1D	55.42 c	26.96 a	49.19 ab	54.80 b
TGx 1910-14F	80.00 ab	26.96 a	49.58 ab	75.06 a
TGx 1889-12F	88.33 a	22.76 b	38.25 c	60.43 b
TGx 1903-5F	66.25 bc	27.77 a	53.88 a	77.45 a

Mean with the same letters are not significantly different at P =0.05 using Duncan Multiple Range Test. DAP = days after planting, WAP = Weeks after planting

Table 2: Combined analyses of six soybean cultivars for number of flowers and Leaf area (cm²) at different growth stages

Soybean cultivars	Number of flowers /plant (7 WAP)	Leaf area(cm ²) /plant (4 WAP)	Leaf area(cm ²) /plant (6 WAP)	Leaf area(cm ²) /plant (10 WAP)
TGx 1148-2E	45.83a	163.13c	1088.40ab	2829.34b
TGx 1440-1E	48.45a	190.04bc	1158.40ab	3299.29a
TGx 1485-1D	61.72a	331.82ab	1103.27ab	2084.64b
TGx 1910-14F	55.67a	355.75a	1436.90a	3368.58a
TGx 1889-12F	38.11a	163.51c	810.92b	2236.03b
TGx 1903-5F	70.56a	396.63a	1465.21a	3585.05a

Mean with the same letters are not significantly different at P =0.05 using Duncan Multiple Range Test. WAP = Weeks after planting

Table 3: Combined analyses of six soybean cultivars for number of pods / plant, weight of 100 seeds (g) / plant, weight of seeds (g) / plant and grain yield (t/ha) at 12 weeks after planting

Soybean cultivars	Number of pods / plant (12 WAP)	Weight of 100 seeds (g) /plant (12 WAP)	Weight of seeds (g) /plant	Grain yield (t/ha)
Tgx 1148-2E	45.61a	15.17a	13.77b	6.88b
TGx 1440-1E	53.06a	14.24a	15.28b	7.64b
TGx 1485-1D	51.28a	13.95a	14.33b	7.16b
TGx 1910-14F	60.72a	15.55a	16.41b	8.21b
TGx 1889-12F	43.94a	15.44a	13.58b	6.79b
TGx 1903-5F	65.67a	15.89a	20.87a	10.44a

Means in the same column with the same letters are not significantly different at P =0.05 using Duncan Multiple Range Test. WAP = Weeks after planting

were gradual increases in leaf area with plant age till the 6 WAP and decrease at 10 WAP. This result was due to the fact that more smaller leaves were produced during the branching stage as well as during flowering and pod formation. All these were due to the number of branches developed by the different cultivar which is based on their genetic make-up. This finding agrees with the work of Okpara and Ibiem, [11]; Adetiloye *et al.* [7] who reported significant differences among soybean cultivars.

The results revealed that there were no significant differences (P<0.05) for number of pods, dry weight of 100 seeds (Table 3). Cultivar TGx 1903-5F gave the highest number of pods at 12 WAP. This was followed by cultivar TGx 1910-14F and the least number of pods occurred in

TGx 1889-12F (Table 3). Also, the highest dry weight of 100 seeds was obtained in TGx 1903-5F, followed by TGx 1910-14F. At 12 WAP, there were significant differences (P<0.05) among the cultivars for weight of seeds (g)/plant and total dry weight of seeds (t/ha) (Table 3). TGx 1903-5F and TGx 1910-14F had the highest mean values of 10.44 and 8.21 t/ha of total dry weight of seeds (Table 3). Data revealed that the highest plant height, leaf area, number of pods and dry weight of 100 seeds, weight of seeds (g) / plant and total dry weight of seeds (t/ha) were recorded for TGx 1903-5F and TGx 1910-14F (Tables 1-3). The cultivar TGx 1903-5F performed better than other cultivars evaluated. The result of this study showed that there were cultivar differences among the IITA hybrids in response

to soil conditions of the rainforest agro-ecological zones. The difference among soybean cultivars observed in this study showed that soybean has a broad genetic base with a tremendous variability, which can be utilized by plant breeders that are searching for means of improving soybean production in rainforest agro-ecological zones.

In conclusion, the study showed that cultivar TGX1903-5F was consistently significant higher for all the parameters measured when compared to other cultivars tested. Therefore, this cultivar has great potential of producing the highest pod numbers and seed dry weight and it is recommended for planting in this location.

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