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EVALUATION OF SIX SOYBEANS CULTIVARS TO SOWING DATES IN A GUINEA SAVANNAH ZONE OF NIGERIA

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ABSTRACT

Soyabean cultivars respond differently to sowing time. Some cultivars when sown early will grow vegetatively at the expense of pod formation. A field study was conducted at the Teaching and Research Farm, University of Ilorin, Ilorin Nigeria to determine the optimum sowing time for six soybean cultivars during 2017 and 2018 cropping seasons. The experiment was laid out in a split plot arrangement. The main plot was the sowing dates (July and August) while the sub plots was the six cultivars (TGX 1448-2E, TGX 1904-6F, TGX 1951-3F, TGX 1987-10F, TGX 1987-62Fand TGX 1988-5F). These combinations were fitted into a randomized complete block design replicated thrice. Resultsof the experiment showed that the plant height, number of leaves, 1,000 seeds weight and grain yield were significantly ($p< 0.05$) affected by sowing dates but no significant difference ($p>0.05$)wasobserved among the cultivars. The maximum grain yield of 3.91 t ha-[1] was obtained from the July sowing using TGX 1448- 2E cultivar. The result further revealed that all the cultivars evaluated have high yielding attributes but the best sowing date for optimum soybean production in the area where rainfall is erratic is early July.

KEYWORDS:*Sowing date, Soybean cultivar, Grain yield, Cropping season*

INTRODUCTION

The soybean (*Glycine max* [L.] Merill) which belongs to the Fabaceae family is often described as a miracle crop, meat that grows on the vine due to its high protein content (40 - 42 %) and other nutrients such as phosphorus, calcium, vitamins and iron for human nutrition (Adu-Dapaah*et al*., 2004; Antalina, 2009).The crop also helps to improve soil fertility through symbiotic nitrogen fixation (McNeil, 2010).In Nigeria the haulms and post-processed pulp (soybean meal) serve as important sources of animal feed. This soybean residue (haulm) also improves the soil condition, and on decay supplies nutrients to subsequent crops. It also contributes to improvement in cereal based cropping systems in the Guinea savanna zone of Nigeria (Yusuf *et al*.,2006). Soybean is mostly cultivated by small-scale farmers in Africa where it is grown as a minor food crop in sorghum, maize, or cassava intercrop. About 588,201 tons of soybeans was produced in Nigeria in 2016, in a land area of 612,725 hectares (FAOSTAT, 2016). Nigeria is the largest producer of soybean in Sub-Saharan Africa (SSA), followed by South Africa. The low yield of soybean (<1 t ha^{-1} in tropical Africa) and high cost of phosphate fertilizer limits the ability of some countries to increase production. The 30% annual growth in the poultry industry from 2003 to 2008 resulted in an increase in the demand for soybean meal. The poor yield has been attributed to several factors such as time of planting.

Planting date is an important management tool to maximize yield potential, late plantings is likely to result in yield reductions (FAO, 2007). Delayed planting reduce the number of days to flowering and also reduce the number of days to maturity and decrease the length of vegetative and reproductive phases of plant growth (Yaqoub and Hamad, 2013). The growth and yield responses

of soybean to planting dates depend on the environment, variety and production practices. Sowing date for soybean is very hot issues because growing condition at planting time will influence the success of seed germination or seedling vigor and also the plant response to photoperiod.
Extreme in temperature, nutrients, moisture, pest and diseases and planting date are constraint affecting soybean production (Yaqoub and Hamad, 2013). Soybean planted too early may have poor emergence, grow vegetatively or are exposed to day shorter than critical length and results in early maturity. If this occurs before the plant reaches physiological maturity, will lead low yield (Boquet and Clawson, 2007). However, delayed sowing may shorten the vegetative phase, which in turn reduces dry matter accumulation leading to poor partitioning to reproductive parts and ultimately low yield (Naidu *et al.,* 2017). To bridge these gaps, efforts must be made to identify the appropriate cultivars and appropriate time of planting to improve the yield of soybeans. Hence was carried out to evaluate the effects of time of planting on the performance of six cultivars of soyabeans.

Materials and Methods

The Experimental Site

The field experiment was conducted at the Teaching and Research Farm of the University of Ilorin, Ilorin, Nigeria during the 2017 and 2018 cropping seasons. The study area is situated in the southern Guinea savannah on (Latitude 04°35N and Longitude 08°29E, 307m above sea level). The average rainfall of the area is between 1000-1540mm.

Experimental lay out and treatments

The experiment was laid out in a split plot arrangement fitted in a randomized complete block design (RCBD) replicated thrice. The size of each plot measured 3 x 3 m with a 0.5 m alleyway between blocks and plots. The spacing between the plants (intra and inter row spacing) was 30cm. Seeds were sown on the prepared seed beds on 5th July and 5th August, 2017. The soybean varieties used were *TGX 1448-2E, TGX 1904-6F, TGX 1951-3F, TGX 1987-10F, TGX 1987-62F* and *TGX 1988-5F*.

Data collection and Analysis

Data were collected on growth parameters (plant height, number of leaves, leaf area and leaf area index) and yield parameters (The plant height was assessed by measuring the plant from the ground level to the terminal point using a measuring tape, while the number of leaves was assessed visually by counting the green leaves of the five tagged plants in the net plot whereas the leaf area was calculated based on the work of Silva *et al.*(2002) using $S = 0.3552 * C^2$ (where S = leaf area in cm^2 and C = leaf longitudinal length x breadth while the leaf area index was estimated as leaf area / ground cover.Data on yield components were collected on 1000 seed weight, seed weight per net plot and seed weight per hectare. Data on 1000 seed weight per plot was assessed by counting the seeds from the net plot, while the yield per plot was carried out by measuring the weight of seeds from the net plot by using a sensitive balance whereas the yield per hectare was extrapolated from the yield per net plot and the data collected were subjected to general analysis of variance (ANOVA) using GENSTAT statistical software (17th edition). Treatment differences were compared using the Least Significant Difference (LSD) at 5% level of probability.

RESULTS AND DISCUSSION

Planting date is an essential factor affecting soybean growth and yield due to its response to day length. In this study the effect of sowing date on the growth parameters are presented in Tables 1, 2, 3 and 4.

Table 1: Effects of time of planting and cultivars on the plant height (cm) of soybeans at 4, 6, 8 10 weeks after sowing

Treatments	2017 Weeks After Sowing (WAS)				2018 Weeks After Sowing (WAS)			
	4	6	8	10	4	6	8	10
Time of Planting(T)								
Early Planting	7.81	12.29	22.01	32.89	9.54	17.21	29.3	32.09
Late Planting	5.74	12.22	19.21	23.86	7.08	13.7	26.0	30.45
LSD(0.05)	NS	NS	NS	6.44	1.311	2.147	NS	NS
Cultivars (C)								
TGX 1448-2E	5.96	11.04	17.96	27.33	7.76	16.03	28.6	31.47
TGX 1904-6F	7.47	13.27	23.75	31.97	8.02	14	26.4	30.61
TGX 1951-3F	6.75	12.08	19.93	28.7	8.98	17.28	31.7	37.17
TGX 1987-10F	7.02	12.93	21.65	29.12	8.9	16.72	26.5	29.11
TGX 1987-62F	5.93	10.44	18.42	26.17	7.84	13.83	25.2	28.45
TGX 1988-5F	7.5	13.75	21.94	26.95	8.87	14.88	27.6	30.83
LSD(0.05)	0.86	2.36	5.31	5.14	NS	NS	NS	7.14
T x C	NS	NS	NS	NS	NS	NS	NS	NS

LSD= Least Significant Difference, T x C=Interaction

Table 2: Effects of time of planting and cultivars on the number of leaves at 4, 6, 8 and 10 weeks after sowing

Treatments	2017 Weeks After Sowing (WAS)				2018 Weeks After Sowing (WAS)			
	4	6	8	10	4	6	8	10
Time of Planting(T)								
Early Planting	2.33	6.92	14.85	33.89	3.4	8.27	20.67	29.9
Late Planting	3.32	5.78	12.24	21.18	3.9	7.13	19.41	29.1
LSD(0.05)	0.15	NS	1.37	9.89	0.45	NS	NS	NS
Cultivars (C)								
TGX 1448-2E	3.38	6.55	12.05	27.33	3.83	8.44	23.83	35.9
TGX 1904-6F	2.7	6.45	14.83	30.33	3.16	6.54	19.5	30.2
TGX 1951-3F	2.88	6.1	12.33	27.33	3.72	8.49	19.72	30.9
TGX 1987-10F	2.93	6.23	12.97	26.95	3.94	8.05	19.28	26.6
TGX 1987-62F	2.12	5.72	13.33	25.22	3.72	7.0	16.72	23.7
TGX 1988-5F	2.93	7.05	15.75	28.07	3.66	7.66	21.17	29.8
LSD(0.05)	0.58	2.18	NS	NS	0.773	NS	6.17	8.92
T x C	NS	NS	NS	NS	NS	NS	NS	NS

LSD= Least Significant Difference, NS=Not Significant, T x C=Interaction

The data indicated that there were significant differences observed in the plant height and numbers of leaves between the early and late sowing and among the various cultivars used but no significant differences were observed among other growth parameters in 2017 cropping season while significant differences were observed among all the growth parameters in 2018 cropping season.

Plant heights were recorded significantly higher (32.89 cm and 32.02 cm) with Early sowing at all plant growth stages as compared to late sowing (23.86 cm and 30.45 cm) during the 2017 and 2018 cropping seasons respectively. The higher plant height in early sown crop may be due to sufficient sunshine availability and supply of majors and micronutrients to plants for their better growth and adequate light photoperiod. Similar, results has been reported by Motta *et al.* (2000) and Medida *et al.* (2006). Date of sowing also caused a marked variation in number of leaves as highest value (33.89 and 29.9) was produced by early sowing as compared to late sowing which produced the least value (21.18 and 29.1) from week 4 throughout the growth stages during the 2017 and 2018 cropping seasons respectively.

Table 3: Effects of time of planting and cultivars on the leaf area (cm^2) at 4, 6, 8 and 10 weeks after sowing

Treatments	2017 Weeks After Sowing (WAS)				2018 Weeks After Sowing (WAS)			
	4	6	8	10	4	6	8	10
Time of Planting(T)								
Early Planting	122.4	168.1	227.1	256.3	44.8	158.8	210.8	236
Late Planting	53.4	118.5	53.4	152.5	63.9	117.4	170.5	185
LSD(0.05)	NS	NS	NS	NS	7.57	31.09	26.56	42.6
Cultivars (C)								
TGX 1448-2E	76.8	116.4	113.6	196.1	54.3	161.3	203.9	230
TGX 1904-6F	112.4	151.7	170.8	203.7	61.4	126.7	188.1	205
TGX 1951-3F	88	153.8	143.6	183.3	57.7	170.3	187.6	216
TGX 1987-10F	79.3	139.9	146.5	230.8	53.3	121.6	208.4	218
TGX 1987-62F	64.8	122.5	122.7	195.9	50.9	113.7	170.2	186
TGX 1988-5F	105.9	175.5	144.3	216.9	48.7	135.1	185.7	208
LSD(0.05)	NS	NS	NS	NS	NS	53.85	NS	NS
T x C	NS	NS	NS	NS	NS	NS	NS	NS

LSD= Least Significant Difference, NS=Not Significant, T x C=Interaction

Table 4: Effects of time of planting and cultivars on the leaf area index at 4, 6, 8 and 10 weeks after sowing

Treatments	2017 Weeks After Sowing (WAS)				2018 Weeks After Sowing (WAS)			
	4	6	8	10	4	6	8	10
Time of Planting(T)								
Early Planting	4.08	5.6	7.57	8.54	1.49	5.29	7.03	7.87
Late Planting	1.78	3.95	4	5.08	2.13	3.91	5.69	6.17
LSD(0.05)	NS	NS	NS	NS	0.253	1.037	0.885	1.421
Cultivars (C)								
TGX 1448-2E	2.56	3.88	5.05	6.54	1.81	5.38	6.8	7.66
TGX 1904-6F	3.75	5.06	6.46	6.79	2.04	4.22	6.27	6.83
TGX 1951-3F	2.93	5.13	5.54	6.11	1.92	5.68	6.26	7.21
TGX 1987-10F	2.64	4.66	6.32	7.69	1.78	4.06	6.95	7.26
TGX 1987-62F	2.16	4.08	5.02	6.52	1.7	3.79	5.67	6.21
TGX 1988-5F	3.53	5.85	6.33	7.23	1.62	4.5	6.19	6.94
LSD(0.05)	NS	NS	NS	NS	NS	NS	NS	NS
T x C	NS	NS	NS	NS	NS	NS	NS	NS

LSD= Least Significant Difference, NS=Not Significant, T x C=Interaction

Higher number of leaves in the early sown crop may be due to adequate supply of rainfall, optimum use of all nutrients and sunshine for better growth while declined in plant height and number of leaves in late sown maybe due to shorter season length, slow growth weight associated with short days and low temperature and radiation. Similar, finding was reported by Calvino *et al.* (2003).

The data presented in (Table 5) indicated that there were significant differences observed at ($p<0.05$) in weight of seeds per plot and yield per hectare while significant differences were observed among the cultivars in 2018 cropping season. Early sowing produced the highest weight of seeds per plot (126.9 g and 89.8 g) and yield per hectare (2818 kg and 3325 kg) as compared to late sowing gave the lowest values, seed weight per plot (22.6 g and 51.7 g) and yield per hectare (508 kg and 1914 kg) during the 2017 and 2018 cropping seasons respectively. *TGX 1448-2E* produced the highest weight of seed per plot (105.7 g) and yield per hectare (3914 kg) while *TGX 1987-62F* produced the lowest weight of seeds per plot (45 g) and yield per hectare (1667 kg).
The early sown crop produced the highest yield and yield components. The difference in the yield and yield components may be attributed the length of growing period before the onset of flowering (photoperiod) which influences the yield and yield components of the crop. This was similar result with Woong and Yamakawa (2006) who reported that the number of pods and seed per plant decreased as sowing dates were delayed.

Table 5: Effects of time of planting and cultivars on the yield per plot and yield per hectare

Treatments	2017		2018	
	Yield/Plot (g)	Yield/Hectare (kg/ha)	Yield/Plot (g)	Yield/Hectare (kg/ha)
Time of Planting(T)				
Early Planting	126.9	2818	89.8	3325
Late Planting	22.6	508	51.7	1914
LSD(0.05)	22.95	528.8	22.72	841.6
Cultivars (C)				
TGX 1448-2E	72.6	1613	105.7	3914
TGX 1904-6F	88.1	1958	65	2407
TGX 1951-3F	78.1	1754	69	2556
TGX 1987-10F	66.4	1475	58.7	2173
TGX 1987-62F	70.3	1562	45	1667
TGX 1988-5F	72.8	1615	81	3000
LSD(0.05)	NS	NS	39.36	1457.6
T x C	NS	NS	NS	NS

LSD= Least Significant Difference, NS=Not Significant, T x C=Interaction

CONCLUSION

This study revealed that all the soybean cultivars used are not significantly difference with early sowing date during the 2017 cropping season while in 2018 cropping season *TGX1448-2E* statistically produced the highest yield per hectare. The Grain yield differences between early sown and late sown plants have been attributed to decreased dry matter partitioning to grain resulting in decreased grain weight. It can be concluded that *TGX1448-2E* cultivars can be planted during early July to avoid drastic reduction in yields of soybean in region with erratic rainfall.

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