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EVALUATION OF WEED SUPPRESSING ABILITY OF EIGHT IMPROVED SOYBEAN VARIETIES UNDER DIFFERENT SOWING METHODS

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ABSTRACT

Field trial were conducted during the 2005 and 2006 cropping seasons at National Cereals Research Institute, Badeggi, Niger State to determine weed suppressing ability of eight improved soybean (Glycine max (L.) Merr.) varieties under different sowing methods. The design of experiment was a split plot. The treatments were two sowing methods (drilling and dibbling) assigned to main plot and eight soybean varieties (Samsoy 2, TGX 1448-2E, TGX 1440-1E, TGX 1740-2E, TGX 1840-18E, TGX 1019-2EB, TGX 1019-2EN and TGX 923-2E) were assigned to subplots. The treatments were replicated three times in each year of the study. The results indicated that drilled method of sowing soybean produced lower weed density and dry matter weight and gave highest grain yield in both two years of study. Higher number of branches per plant was obtained in soybean variety TGX 1448 – 2E .Also, dibbled soybean produced higher number of branches per plant while taller plants were found in those drilled. The soybean variety Samsoy-2 suppressed weed most, while they grew most in TGX 1019-2EB. Soybean TGX 1019-2EB gave the lowest grain yield and parameters measured, while Samsoy-2 and TGX 1448-2E significantly out yielded the other varieties except TGX 923-2E in 2006

Keywords: soybean varieties; sowing methods; weed suppressing; yield.

INTRODUCTION

Weed interference is the major limitation to soybean production in Nigeria. An average of 53% yield reduction has been reported if weeds are left uncontrolled in the crop (Onwueme and Sinha, 1991; Ayeni *et al.*, 1993). Weeds differ in their ability to compete with soybean, and the major weeds in soybean are annual broad leaf weeds, annual grasses and perennials weeds (James and Morris, 1988a). Irawat *et al.* (2003) found that soybean varietal differences occurred in response to different weed species and that all weed species at all densities reduced soybean growth and seed weight Sodangi *et al.* (2006) found significant weed interference on soybean plant height, number of pods per plant and grain yield of soybean. Response of soybean grain yield to row spacing varies, while increase were recorded by some workers, others did not observe any significant effect of row spacing (Sodangi *et al.*, 2006). Chiezey (1990) reported that high plant density reduced growth, development and yield of individual plant, and production per unit area increased. Stivers and Swearingin (1980) found that soybean made wide adjustment to available space either in the row or between rows and that uniform plant distribution produced the highest yield. They also reported a decrease in number of pods per plant as both spacing between and within rows decreased. Responses of soybean to planting density and row spacing depended on genotype and environment (Olufajo and Pal 1991). The grain yield of soybean generally increased as the spacing between rows decreased. (Dumbili, 1991). Generally, height at first pod and height at maturity decreased with increase in row spacing (Adeyemo and Bello, 2002). Jannink *et al.* (2002) observed that early weed suppression helps to decrease the soil weed seed bank and therefore reduces weed infestation in subsequent years. Olafare (1985) found that the highest soybean yield was obtained with hoe weeding and there were no significant differences between the yields of early, medium and late maturity soybean varieties. Andrew and Michael (2007) observed that planting soybeans in narrow spacing allow the crop to form canopy over the soil earlier and shade the soil surface sooner than soybean planted in wider spacing. This can reduce late

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season weed germination. The more uniform distribution of the soybean plants in drilled fields helps to minimize the use of resources for the crop, while maximizing the competitive ability of the crop against weeds. In determining the soybean varieties that can suppress weeds, Dan (2005) found that the most promising varieties were Taru and Tyrone that produced the highest biomass and were more able to suppress weeds than the other varieties tested. James and Morris (1988a) observed that a uniform stand provides competition needed to suppress weed growth. One of the agronomic manipulations of soybean for weed control is row spacing (Busari, 1996). Ferrell *et al.* (2006) observed that crop competition is one of the most important, but often one of the most over looked tool in weed control. They further observed that less emphasis was paid to soybean cultivars and intra - row spacing in the management of weeds in soybean fields. It was observed by Wax (1973) that the use of companion crops in weed management has never gained acceptance since the discovery and development of more effective herbicides. However the management and cost of herbicides has made its application infeasible to the farmers. Thus there is need to develop a sound and low cost technology, such as crop density and use of cultivar characteristics in managing weed in soybean field.The objective of this study therefore is to determine the yield performances and suppressive ability of improved soybean varieties in weed management under different sowing methods

MATERIALS AND METHODS

Field experiment was conducted during the cropping seasons of 2005 and 2006 at National Cereals Research Institute, Badeggi (LAT.9^{0}45N, LOG 60^{0}7E, ALT.70.57M) in the Southern Guinea Savannah zone of Nigeria with the following metrological data as shown in Table 1

Table 1 : Metrological data at the experimental site in 2005 and 2006

	2005				2006			
Month	**Rainfall (mm)**	**Temperature**		**R/H**	**Rainfall (mm)**	**Temperature**		**R/H**
		Min°C	**Max°C**	**%**		**Min°C**	**Max°C**	
June	166.5	24	33	83	187.9	24	32	85
July	330.5	24	31	88	225.3	24	32	85
August	188.9	24	30	83	331.6	24	32	85
September	194.0	24	32	87	138.0	24	32	85
October	122.4	23	32	84	37.6	23	32	84
November	0.0	20	35	71	0.0	18	32	60
December	0.0	17	35	65	0.0	14	32	51

A composite soil sample was taken from 15 cm depth from the experimental field and bulked, shade dried and processed for physical and chemical properties. The land was thereafter ploughed and harrowed by tractor on 5 July, 2005 and 2006. The treatments consisted two sowing methods (drilling and dibbling), assigned to main plots and eight soybean varieties (SAMSOY-2, TGX 1448-2E, TGX 1440-1E, TGX 1740-2E, TGX 1840-18E, TGX 1019-2EB, TGX 1019-2EN and TGX 923-2E) assigned to sub-plots. The treatments were laid out in a split design and replicated three times in each year of study.. The inter-row spacing used in both sowing methods was 60 cm and while seeds were drilled at 5 cm (1,666,666.7 plants / ha), they were dibbled at 20 cm and thinned to two plants per stand at two weeks after sowing (416,667 plants / ha). The seeds were sown on 29 July, 2005 and 19 July 2006. The field was hand weeded at six weeks after sowing (WAS) in each cropping season, and fertilizer was applied at 22 kg P and 50 kg K per hectare immediately after weeding. Harvesting was done as the crop mature (when the pods turned golden brown) by uprooting plants manually and dried in the sun on platform for five days. Threshing was done by putting the plants in sacks and beaten with a stick after which they were winnowed manually. Data collected were weed density and dry matter, number of branches and pods / plant, plant height and grain yield of soybean. All data collected were subjected to Analysis of Variance (ANOVA) using statistical package M-Stat-C Version 1.3 (Snedecor and Cochran 1967) and the significant means were separated using the Duncan Multiple Range Test (Duncan, 1955) at 5% probability.

RESULTS

Soil properties

Analysis of soil of experimental site showed that it was texturally sandy with low clay, low organic matter and nitrogen content (Table 2)

Weed growth

Results showed that sowing method has significant effect on weed density. Higher weed density recorded in dibbled than drilled soybean seeds in the two cropping seasons. The results showed that soybean variety TGX 1019-2EB produced the highest weed density in both years and TGX 1740 – 2E, TGX1840-18E and TGX 1019EN in 2006. The variety SAMSOY-2 produced similar weed density to those in TGX 1448 -2E, TGX 1440-1E and TGX 1740-2E though varieties produced significant lower weed density only 2005. Similarly, SAMSOY-2 produced significantly lower weed density than other soybean varieties, except TGX 923-2E in 2006. The combined effect of the two seasons showed that SAMSOY – 2 maintained a significant lower weed density which was at par with those of TGX 1448 -2E and TGX 1440-1E (Table 3). The weed dry matter was found significantly higher by 24.2% and 34.4% in the dibbled soybean seed than drilled in both 2005 and 2006 respectively (Table 4). The variety TGX 1019-2EB had highest weed dry matter which was at par with those of TGX 1019-2EN and TGX 923-2E in 2005. Also in 2005 SAMSOY-2 had similar weed dry matter with TGX 1448-2E, TGX 1440-1E and TGX 1740-2E. In 2006 cropping season SAMSOY-2 produced lowest wed dry matter, was similar with those of TGX 1448-2E and TGX 923-2E (Table 4). The mean data showed that SAMSOY-2 and TGX 1448-2E produced significantly the lowest weed dry matter while TGX 1019-2EB and TGX 1019-2EN had the highest. The interaction between soybean sowing method and variety was significant only in 2006 (Table 5), the variety Samsoy-2, TGX 1448-2E and TGX 923-2E did not show any significant interaction with method of sowing. Conversely, varieties TGX 1019-2EN, TGX 1019-2EB, TGX 1840-18E and TGX 1740-2E produced significantly more weed dry matter when dibbled than drilled.

Soybean growth and yield

Drilling produced taller plants than dibbling in both years and the mean (Table 6). The soybean varieties differ in height in which TGX 1019-2EB produced the tallest plant and these were taller than plants in all the other varieties, except TGX 1840 – 18E and TGX 1019 – 2EN. Higher branches per plant were recorded in the dibbled than the drilled crop in both years and the mean. When considering the varietal and sowing method effect on soybean branching habit, it was found that both set of treatments had significant ($P < 0.05$) effects on branching habit of soybean (Table 6). The highest branches per plant was obtained in TGX 1448-2E soybean variety in 2005, 2006 and the mean, and TGX 1448 – 2E, TGX 1440-1E and TGX 1740-2E in the mean. These treatments were superior to varieties TGX 1019 – EN, TGX 1019 2EB and TGX 923 – 2E in both years and the mean. As observed with branches, the greater numbers of pods / plant were found in dibbled soybean than that drilled in both in 2005 and 2006 (Table 7). No significant differences were observed among the varieties were observed among the varieties in 2005 cropping season (Table 7). However, only TGX 1019-2EB produces significantly lower pods/plant than all other varieties. The interaction between sowing method and variety was not statistically significant. The grain yields obtained from the dibbled plants were consistently significant lower than those drilled in two years of the study (Table 7). The varietal effect on grain yield was significant in 2005. However, soybean varieties Samsoy-2, TGX 1448-2E and TGX 923-2E produced similar grain yield, which were significantly greater than others in 2006. The mean values of the two seasons showed that only varieties Samsoy-2 and TGX 1448-2E, which had similar yield were significantly greater than others (Table 7). The interaction between soybean sowing method and variety was not significant.

DISCUSSIONS

Soil analysis

The chemical and physical properties of the soil of the experimental site indicated that it contained higher percentage of sand and was slightly acidic. The soil need of soybeans were described by Sigmund and Gustav (1991) as slight acidic, with pH value of 6.0 - 6.5 as being optimal. There are however, cultivars which thrives well on acid (pH 5.5) or alkaline (pH 7.5) soils. Calcium is important for nodule formation. Onwueme and Sinha

(1991) stated that soybean can be grown on a wide range of soil types, but thrives best on sandy or clay loam and alluvial soils with good fertility.(Table 2)

Weed growth

The least weed number and dry matter recorded in drilled soybean crop might be due to closer soybean plants, which gave least space for weed growth (Table 3 and 4). This is in line with FAO (1980), who reported that weeds are usually kept under control through close seeding or thick sowing thereby allowing the least space for weeds to grow. Jeffrey (2005) and Omafra (2002) also reported that weed control in soybean crop is influenced by narrow rows and higher plant populations which can increase crop canopy and reduce the growth of weeds. James and Morris (1988b) reported that a uniform plant stand provides competition and suppress weed production. The result also agrees with the findings of Andrew and Michael (2007), who reported more uniform distribution of soybean plants in drilled field and this helps to minimize the use of resources for the crop, while maximizing the competitive ability of the crop against weeds. Weed density and dry matter was significantly affected by soybean varieties (Table 3 and 3), the least weed populations and dry matter obtained in plots where Samsoy - 2 while this was highest in TGX 1019-2EN, and TGX 1019-2B were planted by an average of 45.7% and 68.8% weed density and dry matter, respectively. Samsoy-2 was one of the early released varieties in Nigeria (Idowu *et al* 2005) and is bushier than other recently released varieties. The ability of soybean varieties to suppress weed growth is therefore genetic based on their morphological an architectural make up and this contrasted observation by Jannink *et al.* (2000), who reported that earlier flowering soybean varieties were more successful at suppressing weed growth. The result therefore agreed with the work of Monks and Oliver (1988), who have suggested that later maturing varieties confers greater competitive ability against weeds because the genotype that remain vegetative grow to be taller. This result is also comparable to that of Dan (2005), who reported variability in weed suppressing ability of different soybean varieties.

Soybean Growth

Drilled plant produced taller plants than dibbled (Table 5) and contrasted the results of Sodangi *et al.* (2006) who found no significant inter-row spacing effect on soybean height. Olufajo and Pal (1991) also reported increase in soybean plant height as plant spacing decreased. The taller plants obtained from drilled soybean than those dibbled agreed with the reports by Bello *et al.* (1986); Dumbili (1991) and Idumajogwu (1992) that taller plants were obtained from narrow rows. Adeyemo and Bello (2002) reported that height to first pod and height at maturity decreased with increase in row spacing. The plant height of soybean which was not significantly affected by variety in 2005, but was affected in 2006, agrees with the findings of Wax (1973) who found that soybean varieties vary greatly in their growth habit. The highest branching per plant recorded in dibbled soybean could be that they were adjusting to space available in between plants, as because reported by Stiver and Swearingin (1980) that soybean makes wide adjustment to available space either in the row or between rows or the higher number of branches obtained in dibbled sown variety might be due, in part to increased light interception by the canopy since enriching the canopy with the artificial light has been reported to increase branching (Adeyemo and Bello.,. 2002). Several studies have shown that branching in soybean increased with increase in inter-row spacing (Adeyemo and Bello (2002), Olufajo and Pal (1991). The significant effects of variety and sowing method on soybean branching habit showed that soybean varieties vary in branching habit (Table 6). The result agrees with the findings of Wax (1973) who reported that soybean varieties vary greatly in growth habit. Similarly, Leuscher and Hicks (1997) reported that soybean cultivars differs' in the degree of branching and branching response to spacing. The ability of varieties to branch more is principally due to their inherent characteristics. Plants should therefore be bred to posses characteristics, like branching, that will improve grain yield. The highest number of pods / soybean plant was recorded in dibbled plant than drilled, the result contrasts with the findings of Sodangi *et al* (2006) who reported insignificant interaction between inter-row spacing and weed interference on pod number per plant. Adeyemo and Bello (2002) also reported pod production increase with increase in row spacing, but increase was not significant. Row spacing of 0.25 and 0.50 m produced fewer pods than 0.75 m. Though the result is similar to that of Stivers and Swearingin (1980), who reported a decrease in number of pods per plant as both spacing between rows and within rows decreased. Olufajo and Pal (1991) reported that pod increased significantly as plant density increased (Table 7).

The highest number of pods was obtained in Samsoy – 2, TGX 1448 – 2E, TGX 1440 – 1E and TGX 923 – 2E, and in the dibbled crop. This agrees with the findings of Adeyemo and Bello (2002) who reported that distribution of pods is influenced by genotype and other factors such as plant spacing. It was observed that dibbling the seeds resulted in significantly lower grain yield by 36.4% and 55.6% in 2005 and 2006 respectively than those drilled (Table 7), a consequence of greater number of plants per area. It has been reported by Chiezey (1990) and Adeyemo and Bello (2002) that high crop density reduced yield of individual plants, but increased production per unity area. In addition, dibbled soybean crops provided more space for early season weed growth and hence greater competition with crop than those drilled thereby contributing to grain yield reduction in the farm than the latter method of sowing. The grain yield of soybean obtained in this study generally fell below the potential of 1.5 – 2.0 tones per hactare because as asserted by Idowu *et al*,(2005). The grain yield potential of any given soybean variety is rather dependent on genetic characteristics.

CONCLUSIONS

While dibbled soybean was found to be more weed suppressive, produced higher number of branches and pods, drilled soybean out yielded it. We therefore recommended that soybean be drilled to optimize grain yield since that is utmost desire of farmers. Soybean varieties Samsoy-2 followed by TGX 1448=2E was recommended for both weed suppression and grain yield in this ecological zone.

Table 2: Chemical and physical properties of soils of experimental site in 2005 and 2006

Soil Characteristics	2005	2006
pH (H_2O)	5.5	6.2
Organic matter (g kg^{-1})	13	11
Total N (g kg^{-1})	0.03	0.02
Available P (ppm)	126.72	136.28
Exchangeable bases ($cmolkg^{-1}$)		
Ca	2.4	2.3
Mg	2.7	4.0
K	1.3	1.5
Exchangeable acidity ($cmolkg^{-1}$)		
CEC ($cmolkg^{-1}$)	9.6	8.6
Texture		
Sand %	92.2	93.4
Silt %	1.6	1.3
Clay %	6.4	5.3
Textural Class	Sandy loam	Sandy loam

Table 3: Effects of soybean variety and sowing method on weed density (m^{-2}) in soybean at 6 WAS in 2005 and 2006 cropping seasons

Treatments	2005	2006	Mean
Sowing method (S)			
Drilling	135.0^{b}	141.9^{b}	138.8^{b}
Dibbling	178.8^{a}	230.2^{a}	204.5^{a}
SE±	4.9	8.1	5.4
Varieties (V)			
Samsoy -2	120.0^{d}	124.0^{f}	116.0^{f}
TGX 1448-2E	135.0^{c}	163.0^{d}	149.4^{e}
TGX 1440-1E	127.0^{d}	171.0^{cd}	149.8^{e}
TGX 1740-2E	156.0^{abc}	212.0^{c}	184.8^{d}
TGX 1840-18E	177.0^{ab}	212.0^{c}	195.0^{c}
TGX 1019-2EB	196.0^{a}	238.0^{a}	217.6^{a}
TGX 1019-2EN	178.0^{ab}	222.0^{b}	200.3^{b}
TGX 923-2E	172.0^{ab}	142.0^{e}	157.8^{d}
SE±	17.8	10.9	10.7
CV%	15.2	21.4	18.3
S x V	NS	NS	NS

Means followed by the same letter(s) within a column are not significantly different at 5% level of probability (DMRT).

N.S. Not significant

Table 4: Effects of soybean variety and sowing method on weed dry matter (kg m^{-2}) at 6WAS in 2005 and 2006 cropping seasons

Treatments	2005	2006	Mean
Sowing method (S)			
Drilling	0.6^{b}	0.9^{b}	0.8^{b}
Dibbling	0.8^{a}	1.6^{a}	1.2^{a}
SE±	0.03	0.5	0.5
Varieties (V)			
Samsoy- 2	0.4^{d}	0.6^{e}	0.5^{d}
TGX 1448-2E	0.5^{d}	0.7^{d}	0.6^{d}
TGX 1440-1E	0.6^{cd}	0.9^{cd}	0.8^{c}
TGX 1740-2E	0.5^{d}	1.1^{c}	0.8^{c}
TGX 1840-18E	0.8^{bc}	1.6^{b}	1.2^{b}
TGX 1019-2EB	1.1^{a}	2.1^{a}	1.6^{a}
TGX 1019-2EN	0.9^{ab}	2.2^{a}	1.6^{a}
TGX 923-2E	1.0^{ab}	0.8^{de}	0.9^{c}
SE±	0.07	0.10	0.9
CV%	21.1	21.1	21.1
S x V	NS	*	0.1

Means followed by the same letter(s) within a column are **not** significantly different at 5% level of probability. (DMRT) NS – Not significant at p ≤ 0.05 *+ significant at p ≤ 0.05

Table 5: Soybean variety and sowing method interaction on weed dry matter (kg m^{-2}) at 6WAS in 2006 cropping seasons

Sowing method	Variety	Weed dry matter (kg m^{-2})
Drilling	Samsoy-2	0.5 [c]
	TGX 1448-2E	0.7 [abc]
	TGX 1440-1E	0.9[ab]
	TGX 1740-2E	0.6[a]
	TGX 1840-18E	1.0[ab]
	TGX 1019 2EB	1.5[a]
	TGX 1019-2EN	1.6[a]
	TGX 923-2E	0.7[abc]
Dibbling	Samsoy-2	0.7[e]
	TGX 1448-2E	0.8[e]
	TGX 1440-1E	1.1[de]
	TGX 1740-2E	1.6 [c]
	TGX 1840-18E	2.2[b]
	TGX 1019 2EB	2.7[a]
	TGX 1019-2EN	2.8[a]
	TGX 923-2E	0.4[f]
SE±		0.1

Means followed by the same letter(s) within a column are not significantly different at 5% level of probability (DMRT)

Table 6: Effects of soybean variety and sowing method on plant height and number of branches/ plant in soybean at maturity in 2005 and 2006 cropping seasons

Treatments	**Plant Height (cm)**			**Branches / Plant**		
	2005	**2006**	**Mean**	**2005**	**2006**	**Mean**
Sowing method (S)						
Drilling	65.8 [a]	68.8 [a]	67.3 [a]	7.3 [b]	7.9 [b]	7.6 [b]
Dibbling	63.2 [b]	65.5 [b]	64.4 [b]	8.2 [a]	9.4 [a]	9.1 [a]
SE±	0.5	0.2	0.4	0.2	0.1	0.2
Varieties (V)	65.4	67.2 [bc]	66.3[b]	8.3 [ab]	8.9 [ab]	8.6 [ab]
Samsoy -2						
TGX 1448-2E	65.5	66.9 [bc]	66.2[b]	8.8 [a]	9.3 [a]	9.0 [a]
TGX 1440-1E	61.2	62.8 [d]	62.0[c]	8.5 [ab]	9.0 [ab]	8.8 [a]
TGX 1740-2E	64.0	63.7 [cd]	63.8[c]	8.5 [ab]	9.2 [ab]	8.9 [a]
TGX 1840-18E	63.5	68.9 [ab]	66.2[b]	8.6 [ab]	8.8 [ab]	8.7 [ab]
TGX 1019-2EB	66.4	71.6 [a]	69.0[a]	6.2 [c]	7.4 [c]	6.8 [b]
TGX 1019-2EN	64.7	70.6 [ab]	67.7[b]	61 [c]	7.8 [c]	6.9 [b]
TGX 923-2E	65.1	66.6 [bcd]	65.9[c]	7.3 [bc]	8.6 [b]	7.9 [b]
SE±	N.S	1.2	0.6	0.7	0.2	0.2
CV%	3.8	1.5	2.7	12.9	6.0	9.5
S x V	NS	NS	NS	NS	NS	NS

Means followed by the same letter(s) within a column are not significantly different at 5% level of probability (DMRT).
NS – Not significant at $p \leq 0.05$

Table 7: Effects of soybean variety and sowing method on number of pods / plant and Grain yield of soybeans in 2005 and 2006 cropping seasons

	Pods / Plant			**Grain yield (t/ha)**		
Treatments	2005	2006	Mean	2005	2006	Mean
Sowing method (S)						
Drilling	59.9	62.1 [b]	62.1 [b]	1.1 [a]	1.8 [a]	1.5 [a]
Dibbling	61.9	65.2 [a]	64.3 [a]	0.7 [a]	0.8 [b]	0.8 [b]
SE±	N.S	0.2	0.5	0.08	0.04	0.01
Varieties (V)						
Samsoy -2	62.8	65.1 [a]	63.9	0.9	1.6	1.3
TGX 1448-2E	62.2	64.8 [a]	63.5	1.1	1.5	1.3
TGX 1440-1E	60.2	63.8 [b]	63.0	0.9	1.2	1.1
TGX 1740-2E	61.1	64.2 [a]	62.6	0.9	1.3	1.1
TGX 1840-18E	60.0	63.1 [b]	61.1	0.9	1.2	1.1
TGX 1019-2EB	59.8	60.3 [d]	61.1	0.8	1.1	1.0
TGX 1019-2EN	60.3	63.1 [d]	61.7	0.8	1.3	1.1
TGX 923-2E	61.3	64.7 [a]	63.0	0.9	1.5	1.2
SE±	N.S	18	N.S	NS	NS	NS
CV%	4.5	1.8	3.2	9.1	26.6	17.9
S x V	NS	NS	NS	NS	NS	NS

Means followed by the same letter within a column are not significantly different at 5% level of probability (DMRT). N.S = Not significant

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Note: Those written in blue are corrections, additions and amendments.