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Full Length Research Paper

Effects of tillage, plant spacing and soybean genotypes on speargrass (*Imperata cylindrica* L.) Reauschel suppression

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Soybean genotypes differed significantly in their ability to suppress speargrass due to their inherent traits to compete with speargrass under different management practices. Soybean genotypes and velvet bean (control) were sown in tilled and slashed at two different row spacing of 75 × 10 cm and 50 × 10 cm. The result showed that soybean plants were taller with thicker canopy cover in the tilled plots than in the slashed plots. There was lower speargrass dry matter and higher grain yield in the tilled plots than the slashed plots. Taller soybean plants with thicker canopy cover were found in narrow row (50 cm). However, the grain yield was similar in both rows. Speargrass shoot dry matter was lower in the narrow row than the wide row (75 cm). There was significant reduction in speargrass dry matter (shoot and rhizome) at harvest in the plots sown to velvet bean compared to the plots sown to soybean genotypes. This accounted for 98% reduction in speargrass dry matter in velvet bean plots and about 70% reduction in soybean plot compared with the initial speargrass dry matter content before planting. TGX1844-18E gave highest grain yield of 985.65 kg/ha, which was similar to TGX144-2E (896.82 kg/ha). There was significantly negative correlation between soybean shoot height (-0.51 and -0.57); canopy cover (-0.68 and -0.73) and speargrass shoot and rhizome dry matter respectively. The result showed that the soybean genotypes can suppress speargrass with tall shoot, dense canopy with considerable grain yield.

Key words: Tilled, slashed, speargrass, soybean genotypes, canopy cover.

INTRODUCTION

Speargrass (*Imperata cylindrica* (L.) Reauschel) is a rhizomatous perennial plant which is considered one the world's worst weeds (Chris et al., 2005), and has become a major problem in tropical and sub tropical regions of Africa. According to Chikoye et al. (1999), it covers between 9 to 97% of farmers' field in West Africa and 260 million ha of cultivated areas of the moist savanna and humid rain forest zones in Nigeria. It affects 73 countries and had been a major inhibitory force in the cultivation of 35 annual and perennial crops including rubber, coconut, oil palm, coffee, date palm, tea and citrus. Field crops such as rice and maize were also seriously affected (Brook, 1989; Waterhouse, 1999). The devastating effects of speargrass in agriculture range from direct yield reduction in crops to physical damage to harvestable portions of roots and tuber crops (Anoka et al., 1991). In West Africa, both arable and plantation crops are adversely affected by speargrass infestation (Oriade et al., 1989; Chikoye et al., 2001). This accounts for between 62 and 90% yield reduction in Maize, and 28.5 and 52.6% yield reduction in soybean in middle belt of Nigeria (Oriade et al., 1989; Koch et al., 1990; Udensi, 1994; Avav, 2000). Generally, speargrass management

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usually increases the cost of crop production and reduces the revenue generated from cropping production. This in turn has its toll on the cropping activities of the subsequent years as farmlands are abandoned in speargrass endemic locations.

Soybean (*Glycine max*) is a crop that is higher in protein and is widely grown throughout the world (Anon., 1990). Its products have high plant protein of 40% and oil of 18%, making it an important component of feeds in livestock and fishery industries (Davis et al., 1999). Cultivars of soybean have been found to differ in competitive ability against weeds as a result of seedling establishment (McLaughlin, 1978; Burnside, 1979) and canopy development (Teasdale and Frank, 1983; Newcomer et al., 1986). Planting of soybean has been found to restrict weed growth through canopy formation and reduction of light reaching the soil surface (Yelverton and Cable, 1991). According to Busari (1996), growing soybean in close inter-row spacing of 50 cm apart may be an effective weed control method for the first six weeks.

Speargrass is difficult to control and various methods earlier applied for the management of this weed did not guarantee season long weed control. The use of velvet bean (*Mucuna cochinchinensis*), as a cover crop, which is being recommended as a control method (Udensi, 1994; Udensi et. al., 1999) has problem of adoption because it has no direct economic benefit to farmers, since it cannot be consumed like other grain legume. Therefore, soybean could be an adoptable alternative in reclaiming lands that are lost to speargrass infestation because of the suppressive ability of soybean and early canopy formation compared to other cover leguminous crops. Economic return is also assured from the cultivation of soybean. The objectives of this study were: (1) to evaluate the response of speargrass to soybean genotypes and crop management, and (2) to determine those physiological traits in soybean genotypes for effective suppression of weeds in the guinea southern savanna of Nigeria.

MATERIALS AND METHODS

The experiment was conducted at the International Institute of Tropical Agriculture (IITA), in 2002 and 2003 at Ijaye experimental site (20 km west of Ibadan; 198.1; Lat. 7° 24' N Long. 3° 48' E), Nigeria. The experiment was conducted to evaluate the effect of land preparation methods, inter-row spacing and soybean genotype effects on the growth of speargrass. The experiment was laid out in a split-split plots design. The main plot treatments were two land preparation methods: the tilled and slashed. The subplot treatments were two inter-row spacing: 50 and 75 cm, while the eight soybean genotypes (TGX1448-2E, TGX1440-1E, TGX1844-4E, TGX1864-17F, TGX1910-8F, TGX1910-14F, TGX1910-17F, TGX1844-18E, and velvet bean (control) were assigned to the sub-subplots. The sub-subplot size was 6 × 5 m. The sub-sub plot treatment were completely randomized within the main plot and replicated three times. The experiment was established in an abandoned speargrass infested farmland. The tilled plot was ploughed and harrowed twice before planting, while the slashed plot was slashed manually with cutlass. Planting was done on 10th and 8th June in 2002 and 2003, respectively. Weeding was done 4 and 7 weeks after planting (WAP) manually.

Data collection on soybean growth and speargrass parameters

Speargrass shoot and rhizome dry matter content was taken before land preparation. Ten quadrant (50 cm × 50 cm) samples were taken randomly from the experimental site before planting. Shoot was cut at the ground level and rhizome was dug to 30 cm depth. These were oven dried at 80°C for 48 h and weighed.

Soybean plant height was taken from ten plant samples from each plot. The height was measured with a meter rule. Soybean canopy was rated visually and expressed in percentage. Soybean grain was determined at maturity by harvesting an area of 6 m^2 within the middle portion of the plots. The grain moisture content was measured using digital moisture tester (DICKEY-John Corporation Auburn, IL. 62615 USA). The soybean grain yield was determined at 13 to 14% moisture content using weighing Scale (Denver Instrument Company Model-XD-4K). Speargrass biomass (shoot and rhizome) samples were taken from each plot diagonally at soybean maturity and were treated as described before. Data were analyzed using the General Linear Mode (GLM) of Statistical Analysis System (SAS) and the means separated with least significant difference (LSD) and Duncan's multiple range test (DMRT).

RESULTS

Soybean plants at flowering were found to be considerably taller in the tilled plots than the slashed plots (Table 1). Plants were also taller in the narrow than wide rows. The shoot heights were comparable among the soybean genotypes with the exception of TGX1440-1E that had the lowest shoot height.

Canopy cover was influenced by tillage practices, with higher canopy cover recorded in tilled plot. The spacing effect did not affect the canopy cover. Canopy cover was however significantly different among soybean genotypes evaluated, with genotype, TGX1844-4E having the least canopy covers (38.75%). The highest canopy cover was recorded in plots sown to velvet bean (96.45%). This of course was notably higher than values recorded in soybean genotypes. Soybean grain yield was significantly higher in the tilled plots than the slashed plots, but with no significant differences in grain yield under different soybean planting spacing. Genotypes of soybean differed considerably in grain yield. TGX1844-18E had the highest grain yield (985.65 kg/ha) among the soybean genotypes and TGX1844-4E had the least grain yield (618.41 kg/ha).

Speargrass dry shoot weight (before sowing soybean) was 3207.80 kg/ha while rhizome dry weight was 5180.10 kg/ha. There was a reduction in speargrass dry weight at soybean maturity across the treatments. In the tilled plots, the speargrass dry weight was significantly lower than slashed plots (Table 1). Speargrass shoot was significantly lower in narrow rows than the wide rows.

There was no significant difference in the speargrass shoot dry matter across the soybean genotypes. Plots sown to velvet bean had lowest speargrass shoot and

Table 1. Effects of interactions of land preparation, spacing and soybean genotypes on speargrass.

Treatments	Soybean plant height (cm)	Canopy cover	Grain yield (kg/ha)	Speargrass shoot (kg/ha)	Speargrass rhizome (kg/ha)
TILLED	40.61[a]	63.14[a]	1243.44[a]	647.00[b]	298.00[b]
SLASHED	29.48[b]	34.44[b]	239.21[b]	1277.00[a]	925.00[a]
LSD <0.005	1.79	3.71	109.93	107.50	83.30
SE	0.64	1.32	40.90	40.00	29.80
Wide row (75cm)	34.05[b]	47.22[a]	746.45[a]	1018.00[a]	643.40[a]
Narrow row (50cm)	36.03[a]	50.37[a]	707.52[a]	905.40[b]	578.00[a]
LSD <0.005	1.79	3.71	109.93	107.5	83.30
SE	0.64	1.32	39.86	39.00	29.80
TGX1448-2E	35.66[abc]	46.66[b]	896.82[ab]	1064.30[a]	750.10[a]
TGX1440-1E	32.05[bc]	43.33[bc]	666.38[cd]	1081.00[a]	695.90[a]
TGX1844-4E	37.08[c]	38.75[bc]	618.41[d]	1183.50[a]	709.30[a]
TGX186417E	35.31[bc]	41.66[bc]	692.21[bcd]	1071.00[a]	655.20[a]
TGX1910-8F	34.32[bc]	42.08[bc]	817.64[bc]	1125.00[a]	668.60[a]
TGX191014F	34.30[bc]	41.25[bc]	800.77[bc]	972.10[a]	618.80[a]
TGX191017F	32.62[bc]	43.33[bc]	792.14[bc]	1038.90[a]	652.20[a]
TGX1844-18E	39.02[a]	45.62[bc]	985.65[a]	1128.00[a]	674.00[a]
Velvet bean	0.00	96.45[a]	0.00	45.90[b]	80.80[b]
SE genotype	1.28	2.82	82.31	80.50	63.30
SE T*S	0.91	1.88	57.84	56.60	42.20
SE T*G	1.84	3.98	116.41	113.90	89.50
SE S*G	1.82	1.82	116.41	113.90	89.50
SE T*S*G	2.57	5.64	164.62	161.00	126.60

T*S = tillage x spacing interaction, T*G = tillage x genotypes interaction, S*G = spacing x genotypes interaction, T*S*G = tillage, spacing and genotypes interactions.

rhizome dry matter. Across treatments, speargrass rhizome dry matter content was lower compare to the rhizome dry. Matter content recorded before tillage.

DISCUSSION

The gross performance of soybean genotypes was significantly influenced by land preparation. Tillage effectively reduced the initial competitive effect of speargrass through fragmentation of speargrass shoots and rhizomes and exposure to harsh conditions which leads to decomposition. This gave a better start to soybean genotypes in the tilled plots unlike the slashed plots that had undisturbed rhizome with numerous auxiliary shoots arising from rhizome nodes as a result of the breaking of apical dominance by slashing. Thus, speargrass in slashed plot had initial critical competition with soybean seedlings and retarded establishment. However, initial land preparation in the tilled plot may have been responsible for early establishment, taller plants, early canopy cover, higher grain yield and lower speargrass dry matter. According to Sweet and Minotti (1980), crops are as harmful to weeds as weeds are to crops, depending to a large extent on the one that establishes first. Early establishment of speargrass in slashed plots and soybean in the tilled plots favored competition in each agronomic setting.

The suppression of weeds by crops in crop-weed interaction depends on the amount of light intercepted by the canopy, which is a function of the thickness of the canopy formed over the other plant in competition. This is in line with Sweet and Minotti (1980), that the most predictable and manageable form of competition is early shade. Soybean had higher canopy cover in the tilled plots. This resulted into relatively lower speargrass dry matter content as a result of early shading of speargrass plants. This affirmed the fact that speargrass is intolerant to shade. This is of significance in weed suppression as plant canopy cover was negatively related with speargrass dry matter content, which consequently brought about higher soybean grain yield in the tilled plots than slashed plots.

Taller soybean plants with thicker canopy cover observed in narrow row may be due to higher plant population effect in soybean. Busari (1996), earlier suggested close spacing of 50 cm for weed management in soybean within six weeks of plant establishment, this was also intended to enhance early canopy formation and weed smothering. However, similarity in grain yield between different spacing may be as a result of yield compensatory effects on low density of soybean in wide row.

Table 2. Soybean - Speargrass relationship.

Parameter	Soybean height	Canopy cover	Soybean grain yield	Speargrass shoot	Speargrass rhizome
Soybean height	-				
Canopy cover	0.73**	-			
Soybean grain yield	0.62**	ns	-		
Speargrass shoot	- 0.51**	- 0.68**	ns	-	
Speargrass rhizome	- 0.57**	- 0.72**	ns	0.68**	-

** represent $p < 0.01$.

The variation in grain yield parameters across soybean genotypes showed different responses of soybean genotypes to speargrass interference (Table 2). This agrees with previous works (Irawati et al., (2003); Mc Laughlin, 1978; Burnside, 1979) that soybean response to weed interference differently.

TGX1448-2E and TGX1844-18E yielded high and gave comparable values of 896.82 and 985.65 kg/ha respectively. Higher canopy cover in velvet bean over soybean might be due to large seed size. This reflected in significantly lower speargrass dry matter compared to soybean plots. This confirmed the effectiveness of velvet bean on speargrass by Udensi (1994). However, the exhibition of allelopathy in soybean cannot be over ruled in the suppression of speargrass.

The significantly negative correlation between soybean plant height, canopy cover and speargrass dry matter, further suggested that, speargrass is shade intolerant. Speargrass can be easily managed under early and prolonged canopy cover of taller soybean genotypes. This is in line with Avav (1997), that suggested rapid canopy closure through appropriate plant population densities and row spacing will enhance maximum shading of weeds.

Cultural practices that will enhance early establishment of crops, early canopy formation and planting of cultivars with tall plants or runners for smothering of weeds should be encouraged and emphasized in speargrass infested areas. Therefore research should be intensified in the development of soybean genotypes with early establishment and dense canopy formation.

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