EFFECTS OF WEEDING REGIME AND SOYABEAN INTERCROPPING ON *Striga hermonthica* (DEL.) BENTH. AND PERFORMANCE OF SORGHUM (*Sorghum bicolor*. (L.) MOENCH)

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Abstract

Field trial was conducted during 2015 rainy seasons at the Teaching and Research Farm of the Department of Crop Production, Federal University of Technology Minna, to evaluate the effects of weeding regime and soyabean intercropping on Striga and performance of sorghum. It was a 2 x 5 factorial experiment with ten treatments all laid out in a randomized complete block design and replicated three times. Manual weeding was carried out at 15, 30, 45 and 60 days after sowing. The sorghum varieties used were short kaura (resistant) and local red sorghum (susceptible) with soyabean (TGX 1448-E) for intercrop. Results showed that manual weeding at 15 days after sowing and sorghum-soybean intercropping significantly (p<0.05) delayed days to Striga shoot emergence than other treatments. The resistant varieties significantly delayed Striga emergence compared to the susceptible varieties. Manual weeding at 15 days after sowing and sorghum-soybean intercropping significantly (p<0.05) reduced Striga shoot per plot than all other treatments. The resistant variety (short kaura) significantly (p<0.05) recorded fewer Striga shoot compared to susceptible local red sorghum variety. Manual weeding at 15 days after sowing and sorghum-soybean intercropping had tall sorghum plant than other treatments. The resistant sorghum variety plant height was not statistically different from the local red sorghum (susceptible variety). Manual weeding at 15 days after sowing and 30 days after sowing significantly (p<0.05) suffered less attack by Striga compared to other treatments. Therefore the manual weeding at 15 days after sowing gave the best result in terms of less Striga attack, taller plant height which could translate into higher sorghum yield.

Keywords: Weeding regime, soyabeans, sorghum, intercropping, Striga

Introduction

Sorghum (sorghum bicolor (L) moench) is the fifth most important staple food crop after wheat, rice, maize, and barley (FAO, 2012). The crop is produced for its grain which is used for food and stalks for fodder and building materials. Sorghum is used primarily as animal feed and in the sugar, syrup and molasses industry (Dahlibert *et al.*, 2004). Recent work has shown that sorghum and millet (*Pennisetum glaucum* (L.) R. Br) are rich in antioxidants and gluten-free, which make them an attractive alternative for wheat allergy sufferers (Dahlbert *et al.*, 2004).The livelihoods of millions of subsistence farmers depend on sorghum production. However, its productivity is without constrain (Geremew *et al.*, 2004). This is attributed to a number of abiotic and biotic factors. Yield reducing factors include low soil fertility (nutrient deficiency), drought, *Striga*, stem borers, leaf and panicle diseases and shoot fly (Wortmann *et al.*, 2006). Although these constraints cause a significant loss of grain, the level of losses varies from region to region. *Striga*, is a major production constraint in most sorghum producing areas, the weed limits the productivity of the crop by allelopathy and competition for nutrients hence limiting the expression of the full genetic potential of sorghum plants. Among the major sorghum diseases santhracnose and rust account for substantial yield losses in Africa. However, drought and *Striga* are the most important problems across regions. *Striga* control is more difficult and complicated than the control of other weeds. This is mainly due to its biology, based on its infestation level, sorghum yield loss due to *Striga* damage varies from place to place, on average sorghum yield losses of 65% were estimated in moderate to heavy infestations (Tesso *et al.*, 2007). Over the past years, different control options have been recommended against *Striga hermonthica*. Various control methods such as land preparation, hand-pulling, hoe-weeding, trap cropping have been tried out singly over the years with no conclusive and consistent results for the peasant farmer, partly because of huge amounts of seeds that accumulate over time in the seed bank (Oswald, 2004). Other methods of control such as the use of high levels of chemical fertilizers especially nitrogenous, ethylene gas to induce suicidal germination and herbicides, which give some reasonable results, are prohibitively expensive for the resource poor farmer in *Striga*-stricken areas of Nigeria (Kuchinda *et al.*, 2003).

Despite the high potential of some of these solutions, no single option on its own has proven to be effective and durable for sorghum production for resource poor farmers. The best options for successful *Striga* control lies in an

Integrated *Striga* Management (ISM) approach (Joel, 2000; Schulz *et al.*, 2003; Hearne, 2009). Intercropping is already used in Africa as a low-cost method of controlling *Striga hermonthica* on cereals (Oswald *et al.*, 2002). Intercropping is a potentially viable, low-cost technology, which would enable to address the two important and interrelated problems of low soil fertility and *Striga* (Fasil, 2002). The intercropping of cereal and legumes is widespread among smallholder farmers due to the ability of the legume to cope with soil erosion and with declining levels of soil fertility. Recent result shows that intercropping maize with cowpea and sweet potato can significantly reduce the emergence of *Striga* in Kenya (Oswald *et al.*, 2002)

Material and Method

Field trial was conducted during the 2015 raining season at the Teaching and Research Farm of Federal University of Technology Minna, Gidan Kwano campus (09^0 39□N and 06^0 28□ E) on a sandy loam soil in naturally *Striga* infested land. It was a 2 × 5 factorial in a randomized complete block design with three replications. There were two sorghum varieties used; Short kaura (resistant) and Red sorghum (susceptible), Soybean (TGX-1448-E) for intercrop. The five weeding regimes are: Zero weeding (control), weeding at 15, 30, 45, and 60 days after sowing. The plot size is 36m × 12m and sub-plots size is 3m × 4m, each sub-plot consists of four ridges of 3m long each. Ploughing and harrowing was done mechanically with the use of tractor, ridges was made manually using hoe. Two to three seeds of sorghum varieties were sown at depth of about 3 to 4cm on ridges at 25cm and 75cm intra and inter row spacing respectively and two to three soyabean seeds were sown in between the sorghum stands. The seedlings were later thinned down to two plant per stand at 4 weeks after sowing. Weeding was done manually by handpulling to avoid damaging the *Striga* shoot and weed other than *Striga* were removed. Data collected on *Striga* were : Days to *Striga hermonthica* shoot emergence, and was done by counting days from sowing date to first day *Striga* was sighted on sorghum, Number of *striga hermonthica* shoot count per sorghum stand at 6, 8 and 10 weeks after sowing, Number of *Striga hermonthica* shoot count per m^2 at 6, 8 and 10 weeks after sowing, Number of *Striga hermonthica* shoot flowering at 10 weeks after sowing, *Striga* severity score at 10 weeks after sowing was done on a scale of 1-9, where 1 represent normal sorghum growth (Healthy sorghum) with no visible symptoms and 9 represent almost complete leaf scorching causing severe stunted growth and premature death of leaves. Data collected on sorghum were: Sorghum plant height at 8 weeks after sowing from top soil to flag leaf, Days to booting by counting the number of days to booting of each sorghum variety, Days to ear formation. The data collected was subjected to analysis of variance (ANOVA) using the computer software SAS (2003). Means was separated using Duncan's Multiple Range Test (Duncan 1995). Statistically significant difference between variable means was compared using standard error of difference ($p<0.05$).

Results

Manual weeding at 15 days after sowing and sorghum-soybean intercropping significantly ($p < 0.05$) delayed *Striga* shoot emergence compared to other treatments (Table 1). The resistance sorghum variety (short kaura) significantly ($p < 0.05$) delayed *Striga* shoot emergence compared to susceptible variety (Table 1). The interaction effect of different weeding regimes and sorghum-soybean intercropping was not significant. (Table 1). Manual weeding at 15 DAS and sorghum-soybean intercropping significantly ($p < 0.05$) reduced *Striga* shoot per plot than other treatments. The resistant sorghum variety (short kaura) significantly ($p < 0.05$) reduced *Striga* shoot count per plot than the susceptible variety at 6, 8 and 10 WAS (T able 2). The interaction effect of different weeding regime and sorghum-soybean intercropping was not significant (Table 2). The result of severity of damage (severity score) due to different weeding regime and sorghum-soyabean intercropping shows that manual weeding at 15 DAS and 30 DAS significantly reduced the degree of sorghum plant attack by *Striga hermonthica* compared to other treatment. The control had mostly damage plants (Table 3). The result obtained from manual weeding and sorghum-soybean intercropping shows significant difference in the degree of sorghum plant damage by *Striga* between the two sorghum varieties, the local varieties suffer more *Striga* than the resistance short kaura varieties (Table 3). The interaction effect of different weeding regime and sorghum-soybean intercropping was not significant (Table 3). The sorghum plant height at 8 WAS was significantly different between the two sorghum varieties. The resistant sorghum variety (short kaura) produced taller plant height than local (susceptible variety) throughout sampling period (table 4). Interaction effect of different weeding and sorghum-soybean variety was not significant (Table 4)

Discussion

Striga emergence

The delayed in *Striga* emergence in ICSV1002 resistant variety compared to Local susceptible variety might be due to ability of the resistant variety to delay the release of the stimulant for *Striga* seed germination. This is earlier observed by Gurney *et al.*, (2002) that resistant variety produce lower amounts of germination stimulants to their root exudates, leading to smaller number of attached parasite and/or later attachment of the parasite to the host.

***Striga* count**

Fewer *Striga* shoot observed in weeding at 15 DAS could be attributed to *Striga* population at that time compared to other days. Weeding at 15 DAS and sorghum-soybean intercropping significantly delayed *Striga* emergence and this accounted for lower *Striga* shoot counts. Hand pulling has proved to be effective in reducing *Striga* population (Carsley *et al.*, 1994).

Plant height

The lower *Striga* shoot population or infestation in manual weeded at 15 DAS might explain why sorghum plants were taller. The taller plant height from this treatment could be due to less parasitism by *Striga*. This is in agreement with the finding of Ayongwa *et al.*, (2010) that *Striga* competes for water and nutrients as a result crop growth is stunted and yield is generally reduced.

The resistant sorghum variety short kaura exhibit good resitance as translated in the taller over local sorghum variety (susceptible). This is in agreement with the finding of Rodenburg *et al.*, (2006) that in *Striga* infested areas cultivation with resistance crops results in fewer *Striga* plants and higher crop yield than a non-resistance genotype.

Conclusion

Manual weeding and intercropping sorghum with soybean was effective in suppressing *Striga* in a *Striga* infested field. The resistant sorghum variety (short kaura) showed delayed *Striga hermonthica* shoot emergence than susceptible. Thus reduce *Striga* shoot count, shoot flowering and severity score compared to susceptible variety (local).

In this study, weeding at 15 DAS gave the best result. It significantly reduces *Striga* shoot count, shoot flowering, and severity score.

Recommendation

The resistant variety (short kaura) shows reduced parasitism by *Striga* and recommended for planting in *Striga* infested field. For efficient use of manual weeding in *Striga* control, weeding at 15 DAS should be use to reduce *Striga* population in a *Striga* infested field.

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Table1: Effect of Weeding Regimes and Sorghum- Soybean Intercropping on Days to *Striga* Shoot Emergence

Treatment	First *Striga* shoot emergence
Weeding (W)	
O (control)	50.17[e]
15 DAS	60.00[a]
30 DAS	58.33[b]
45 DAS	57.17[c]
60 DAS	55.67[d]
SE±	0.49
Variety (v)	
Short Kaura	59.40[a]
Local	55.13[b]
SE±	0.92
Interaction(W × V)	NS

Means having the same letter (s) within a column are not significantly different (DMRT) at 5% level of probability SEM (±) = Standard error of the mean. NS = Not significant. DAS = Days after sowing.

Table 2 Effect of Weeding Regimes and Sorghum- Soybean Intercropping on *Striga* Shoot Count Per Plot

Treatments	*Striga* shoot count per plot (g/plot)		
	6WAS	**8WAS**	**10WAS**
Weeding (W)			
O (control)	15.83[a]	20.67[a]	38.83[a]
15 DAS	1.83[e]	3.00[e]	5.67[d]
30 DAS	3.67[d]	4.17[d]	6.50[d]
45 DAS	5.00[c]	5.33[c]	7.33[b]
60 DAS	6.00[b]	6.33[b]	7.83[b]
SE±	0.33	0.33	0.30
Variety (v)			
Short Kaura	6.00[b]	7.33[b]	13.13[a]
Local	6.93[a]	8.47[a]	13.33[a]
SE±	1.32	1.74	3.43
Interaction (W × V)	NS	NS	NS

Means having the same letter (s) within a column are not significantly different (DMRT) at 5% level of probability SEM (±) = Standard error of the mean. NS = Not significant. DAS = Days after sowing.

Table 3: Effect of Weeding Regime and Sorghum- Soybean Intercropping on *Striga* Severity Score on *Striga hermonthica* Control in Sorghum

Treatment	Severity score
Weeding (W)	
O (control)	9.00[a]
15 DAS	3.33[e]
30 DAS	4.17[d]
45 DAS	5.33[c]
60 DAS	6.33[b]
SE±	0.19
Variety (v)	
Short Kaura	5.40[b]
Local	5.89[a]
SE±	0.54
Interaction (W × V)	NS

Means having the same letter (s) within a column are not significantly different (DMRT) at 5% level of probability SEM (±) = Standard error of the mean. NS = Not significant. DAS = Days after sowing.

Manual weeding at 15 DAS and sorghum-soybean intercropping has the highest sorghum plant height than other treatment at 8WAS. (Table 4)

Table 4 : Effect of Weeding Regime and Sorghum- Soybean Intercropping on sorghum Plant Height 8 WAS on *Striga hermonnthica* Control in Sorghum

Treatment	Plant height(cm)
Weeding (W)	
O (control)	73.50[d]
15 DAS	84.83[a]
30 DAS	83.17[b]
45 DAS	82.33[b]
60 DAS	81.33[c]
SE±	0.37
Variety (v)	
Short Kaura	81.53[a]
Local	80.53[b]
SE±	1.07
Interaction (W × V)	NS

Means having the same letter (s) within a column are not significantly different (DMRT) at 5% level of probability SEM (±) = Standard error of the mean. NS = Not significant. DAS = Days after sowing.