1332 Effects of nitrogen fertilizer on cotton as trap-crop to control *striga* infection in maize

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Influence of different levels of nitrogen fertilizer on trap-crop cotton to control striga *hermonthica* in maize was studied at the institute for agricultural research, Samaru, Zaria. The experiment was laid out in complete randomized design with 4 repetitions but the data were analyzed as split-plot. Nitrogen levels (0, 60 and 90 kg N/ha) were in the main plot while three cotton varieties were in the sub-plots. The results showed that all the cotton varieties stimulated striga seed germination. SAMCOT-8 induced highest suicidal germination of striga. SAMCOT-8 at 90 kgN/ha delayed days to *Striga* emergence by 7%, maize damage score was reduced by 29% and total maize dry weight was improved by 26%. Treatment combination of 90 kg N/ha with the cotton varieties enhanced their trap-cropping potentials. Correlation analysis revealed that the test crop that exhibit low striga count and low damage score with high yield would be better suited in rotation, relay and in intercropping cultural management strategy for control of *Striga.*

Key Words: Striga, cotton, maize, suicidal germination, cultural control.

INTRODUCTION

Striga species constitute the most important biotic constraint to food crop production in sub-Sahara Africa, causing serious damage to cereal and grain legume crops on the fields of resource-poor farmers. It is estimated that over 67% of the 73 million hectares of land devoted to cereal crop production in Africa is currently in areas infected by striga (Lagoke *et al*., 1984). The FAO estimates that annual yield losses due to *S. hermonthica* in Africa is about 40%, which amounts to approximately $7 billion US Dollar and are detrimental to the lives of over 100 million farmers in the savanna regions of West Africa (M'boob, 1986).

There are indications that these figures are much higher today. Damage due to striga infestation are often high and heavy and under severe infestation can result in complete loss of the crop and abandonment of otherwise productive fields and oven migration (M'boob, 1986; Salle, 1991; Ejeta *et al*., 1992 and Butler, 1995).

It is technically difficult to control the menace of *Striga* due to the high number of seeds produced, which are viable in the soil for several years. Of the several methods of control, the two most promising and culturally acceptable are trap cropping and the use of resistant crop cultivars, both of which are primarily concerned with manipulating *Striga* seed germination and seedling establishment (Sahai and Shivanna, 1982). Presently, there is no single effective and economically feasible *Striga* control method available. Although several methods have been identified which include land preparation, hand pulling and hoe-weeding, as well as the use of trap and catch crops, use of nitrogen fertilizer, seed treatment, chemical stimulants, biological control, herbicide application and the use of resistant cultivars. Therefore emphasis should be on combinations of several control methods in an integrated approach, e.g. increasing soil fertility with the use of trap crops and resistant cultivars.

Trap crops such as cotton either in rotation or in intercrop with cereals in the traditional farming systems had been shown to reduce *Striga* seeds in the soil (Palleyrand *et al*., 1994, Ariger and Berner, 1995). The use of nitrogen fertilizer has also been shown to be effective in reducing *striga* infestation and consequently increasing the host crop yield (Ogborn, 1984, Magani, 1994 and Showemimo *et al*., 2002. The objective of this study was to investigate the effect and level of nitrogen fertilizer on trap crop potential of cotton varieties and their association with the test crop (maize) performance.

MATERIALS AND METHODS

The experiment was conducted at the horticultural unit of the Institute for Agricultural Research, Samaru (11º 11'N, 07º 38'E) in the Northern Guinea savannah of Nigeria. The plant materials are hybrid maize 8338-1 (test crop), three cotton varieties; SAMCOT-8, SAMCOT-10 and TXCDP-37-HH-1-83 as trap-crops to *Striga hermonthica*. There are three levels of nitrogen fertilizer; 0, 60 and 90 kgN/ha using Urea at 45% of N. The experimental design was Completely Randomized Design (CRD) with 4 repetitions but data were analysed as split-plot, with nitrogen levels as main-plots and cotton varieties (trap-crop) as sub-plot treatments.

Sieved sandy and loamy soils were mixed in a ratio of 1:1 and filled to two-third of 10 kg plastic pots. *Striga* inoculum was prepared by mixing 30 g of *Striga* seeds to 500 g of sieved sand. The *Striga* seed/sieved sand mixture was thoroughly shaken to form the inoculum stock. About 10 g of the inoculum stock was taken and used to inoculate each pot was pre-conditioned by watering to field capacity for 5 days then cotton varieties (trap-crop) were planted. The cotton varieties were thinned down to four plants/pot, two weeks after sowing (2 WAS). All weeds other than *Striga* were removed by hand pulling.

At 4 WAS, three fertilizer rates were applied (0, 60 and 90 kgN/ha) using urea (46% N). At 8 WAS, cotton plants were cut just above soil level and susceptible maize hybrid 8338-1 was planted as test-crop. The trial was terminated at 6 WAS of maize. The observations recorded include: number of emerged *Striga* at 5 WAS (striga count), days to *Striga* emergence, maize shoot, root and total production dry matter and plant height, crop damage score.

The data obtained were subjected to analysis of variance and correlation coefficient analysis using GENSTAT 5.1 Program (1993).

RESULTS

The results in Table 1 showed highly significant effects ($P<0.01$) of levels of nitrogen on *Striga* count, days to *Striga* emergence, maize total dry weight, plant height and crop damage severity. The effect of trap-crop was significant ($P<0.05$) on maize shoot dry weight and maize root dry weight, and highly significant effects for the rest of the traits. The interaction between nitrogen and cotton variety on the maize was highly significant for all the traits except maize shoot and root weights.

The effects of different treatment combination of nitrogen levels and cotton varieties on maize-*Striga* interaction are presented in Table 2. SAMCOT-8 at 90 kgN/ha significantly affected days to *Striga* emergence, crop damage severity and total dry weight (≃21 days, 3.19 and 18.86 g, respectively. The same cotton variety significantly affected *Striga* count, days to *Striga* emergence and damage score at 60 kg N/ha. SAMCOT-10 significantly affected *Striga* counts and total dry weight of maize at 90 kgN/ha, and damage score at 60 kgN/ha. TXCDP 37HH-1-83 did not significantly affect any trait except *Striga* count at 90 kgN/ha. Maize plant height was not significantly affected irrespective of the cotton varieties and levels of nitrogen fertilizer. SAMCOT-8 at different levels of nitrogen fertilizer application was comparatively lower in magnitude (value) than the remaining combinations for all the traits except total maize dry weight.

The association between all the traits measured is presented in Table 3. Highly significant and positive correlation was expressed between maize shoot dry weight and maize total dry weight (0.77), *Striga* count and damage score (0.69), maize shoot dry weight and plant height (0.64), maize root dry weight and maize total dry weight (0.61), maize shoot dry weight and maize root dry weight (0.59), plant height and maize total dry weight (0.58), and days to *Striga* emergence and maize root dry weight (0.44). Highly significant negative association was obtained between maize total dry weight and *Striga* count and damage score. Similarly, between damage score and maize shoot and root dry weight, and plant height (-0.78, -0.55 and -0.61, respectively). *Striga* count was negative and significantly correlated with days to emergence, maize shoot dry weight, maize root dry weight and plant height.

DISCUSSION

The results showed significant variation in levels of nitrogen fertilizer applied, between the cotton varieties as trap crop and the influence of different levels of nitrogen fertilizer on the trap crop potentials. This is an indication that all the cotton varieties simulated *Striga* germination at varying levels of the treatment combination. This agrees with the reports of Dejongh (1993); Parkinson *et al*. (1996) and Botanga *et al*. (1997) suggesting cotton as trap crop of *Striga.*

High level of nitrogen fertilizer as from 60 kgN/ha affected *Striga*-maize crop performance. SAMCOT-8 at the different nitrogen level combinations produced fewer *Striga* count, *Striga* emergence and damage score on maize, followed by different treatment combination with SAMCOT-10 and TX CDP 37HH-1-83. Thus, SAMCOT-8 has better potential as trap crop of *Striga* than the other cotton varieties. This was further confirmed when all treatment combination involving SAMCOT-8 gave higher total maize dry weight. TX CDP 37HH-1-83 and SAMCOT-10 irrespective of the nitrogen fertilizer levels inhibited *Striga* emergence and encouraged maize crop to reach full height potentials. Meanwhile, the early *Striga* emergence, few *Striga* count and damage score in different treatment combination with SAMCOT-8 was due to suicidal germination of *Striga*. Generally, at 60 kgN/ha the fertilizer inhibited the growth of both *Striga* and cotton for all the treatment combinations, while at 90 kgN/ha for all treatment combinations involving SAMCOT-8 relative to the control; days to *Striga* emergence was reduced by 7%, damage score was reduced by 29%, while total maize dry weight increased by 26%. Treatment combination involving SAMCOT-10 and TX CDP 37HH-1-83 reduced or inhibited days to *Striga* emergence by 13% and 0.4%, respectively, and total maize dry weight increased by 5% and 9%, respectively. Similar study had been reported on other trap crops by Alabi *et al*., 1994; Parkinson *et al*., 1989; Lagoke *et al*., 1996).

The high and positive significant association between maize shoot, root, total dry weight and plant height indicated that improving one trait will also improve the associated trait(s). An inverse and highly significant association was established between damage score and maize shoot, root, total dry weight and plant height. Similar inverse association was established between *Striga* count and the rest of the traits except damage score that was high and positively significant. Thus, the susceptible maize cultivar used as test crop was better suited to test N enhancement potential of trap cropping ability of cotton. It is therefore recommended that maize can be used in rotation, intercrop or relay cropping with trap crop(s) as integrated cultural measure for *Striga* control.

CONCLUSION

The results of this study implied that all the cotton varieties used as trap crop stimulated *Striga* germination. SAMCOT-8 had better trap-crop potentials than the rest cotton varieties. The trap crop potential was better enhanced at 90 kgN/ha of urea fertilizer application than other levels evaluated. The treatment combinations especially at 90 kgN/ha with all the cotton varieties delayed days to *Striga* emergence, reduced damage score and increased total maize dry weight.

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Table 1. Mean squares and significant levels of eight traits in the control of *Striga*

	Rep.	Nitrogen	Error a	Variety	Nitrogen x Var	Error b
Trait	(3)	(2)	(6)	(2)	(4)	(8)
Striga count	9.24	14.64**	0.66	39.15**	30.22**	0.88
Days to *Striga* emergence	71.66	168.88**	4.32	360.08**	299.51**	3.13
Maize shoot dry weight	29.04	49.13*	6.41	75.64*	62.35*	20.23
Maize root dry weight	10.09	31.11*	5.03	58.17*	50.72*	15.31
Maize total dry weight	23.81	58.72**	1.97	88.94**	71.08**	2.57
Plant height	79.23	213.56**	17.55	408.53**	337.23**	62.45
Damage score	4.45	18.25**	1.18	31.02**	26.44**	4.76

*,** are significant at 5% and 1% probability levels.

Figures in parenthesis are degree of freedom.

Table 2. Effects of different treatment combination on maize-*Striga* interaction

	SAMCOT 8				SAMCOT 10				TXCDP 37HH-1-83				
Trait	0*	60	90		0	60	90		0	60	90		LSD 1%
Striga count (5 WAP)	4.53A	6.97NS	7.10		7.83NS	8.12S	11.11		8.20NS	8.64S	11.76		1.91
Days to Striga emergence	22.34S	25.98S	20.52		23.61NS	24.02	21.27		26.00	26.40	25.92		3.60
Plant height (cm)	24.53NS	26.35NS	26.29		23.30NS	25.12NS	25.07		25.01NS	26.83NS	26.78		2.02
Damage score	4.53S	6.75S	3.19		4.71S	6.93NS	5.57		5.99N	6.21NS	6.65		2.11
Total dry weight (g)	15.42NS	15.34S	18.86		14.82NS	1s.71S	15.15		14.20NS	15.13NS	15.35		3.26
CV (%)	7.4	11.6	10.1		9.8	12.7	13.0		8.6	9.9	12.1		

Table 3. Correlation matrix between *Striga* infestation and some maize traits

Traits	*Striga*[1] count	Days to *Striga* emergence	Maize shoot dry weight	Maize root dry weight	Plant height	Damage score	Maize total dry weight
Striga count	1.00						
Days to *Striga* emergence	-0.29*	1.00					
Maize shoot dry weight	-0.36*	-0.18	1.00				
Maize root dry weight	-0.41**	0.44**	0.59**	1.00			
Plant height	-0.30*	-0.21	0.64**	0.66**	1.00		
Damage score	-0.69**	0.05	-0.48**	-0.55**	-0.61**	1.00	
Maize total dry weight	-0.75**	-0.11	0.77**	0.61**	0.58**	-0.64**	1.00

*, ** Significant at 5% and 1% probability level respectively.

1 = Striga count at 5 weeks after planting.