RESPONSE OF MAIZE TO INTERCROPPING OF SOYABEAN ON *STRIGA HERMONTHICA* CONTROL IN MINNA, NIGER STATE, NIGERIA

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Abstract
Field trial was conducted in 2013 cropping season on a naturally heavily Striga infested field at the research farm of Gidan Kwano campus of Federal University of Technology, Minna (Lat 09^{0}31'15''N and Long 6^{0}26'15''E) to determine the effect of spacing and intercropping soyabean on Strigahermonthica control in two varieties of maize (Striga resistant TZL-Compl-syn-STR-W1 and susceptible SAMMAZ 16). The intercropped with soyabean variety Tam 59 and spacing at0 cm, 40cm, 60 cm and 80cm. The experiment was layout in a randomized complete block design (RCBD) with three replications. The results indicate that there was significant difference (p ≤ 0.05) in the maize varieties in developing Striga shoot emergence, reducing Striga shoot density per stand and per plot, Striga shoot flowering, and maize syndrome action score. The resistant maize variety was significantly taller (104.18cm at 8WAS) and produced greater 100 grain weight (523.0g), although there were no significant difference in the maize cob weight (876.9 and 854.5g), and maize varieties. There was no significant effect of spacingand intercropping (57.64 and 58.38) on number of days from planting of maize to Striga emergence. At 40cm spacing and intercropping there were significant difference on maize shoot density per stand and per plot (0.67 and 2.17 at 6WAS), Striga shoot flowering and severity score by 58 to 60% compared with 0cm (control) and other (60cm and 80cm), the Striga were significantly reduced, hence less damages. There were no significant difference in spacing and intercropping on maize cob weight, maize grain yield and 100 grain weight.

Keywords: Spacing, Soyabean intercropping, *Striga hermonthica* management.

Introduction
Striga hermonthica is a parasite flowering plant that is most serious in sub-Saharan Africa. It is a major constraint to cereal (Maize, sorghum, upland rice and millet) production. The potential production improvements resulting from the use of improved varieties and production techniques were often not realized due to the losses caused by this witch weed (*Strigahermonthica* (Del) Benth).Yield losses caused by the weed are often times significant and complete crop failure could occur. Kanampiu, *et al.,* (2003) reported that the *Striga* problem has continues to increase as a result; farmers are forced to abandon *Striga* infested fields. For now, no control measure has so far been developed that is effective in *Strigahermonthica* control. Several methods of controlling the weed are recommended, but are either incompatible with the cropping system, expensive or unstable and have to be practiced over several cropping seasons. Cost effective alternative control methods that are acceptable to small-scale farmers are needed.

Roda *et al.,* (2002) reported that intercropping has in many instances shown promise as a low-cost method of controlling *Striga*.Aliyu, *et al.,* (2004) also indicated that intercropping can be a

useful alternative to optimize yield and maintaining soil fertility. Kureh, (2006) reported that intercropping of maize with soyabean is a means of suppressing *Striga* in the cereals crops.
Kolo and Mammudu (2008) reported that dressing of maize seed with P. biglobosa pulp gave better maize development both vegetative and in grain yield especially with the resistant varieties. Mamudu (2013) reported that intercrops with trap crops, nitrogen fertilization consistently delayed and reduce *Striga* emergence, caused low *Striga* damage to the crop and increased grain yield.

Gworgwor *et al.,* (2002) reported that soaking millet (*Pennisetum glaucum* (L.) R. Br. Seeds in low urine for about 6-7 hours supported less emergence of *Strigahermonthica* shoots. The objective of this study was to evaluate difference spacing of cover crop (soya bean) for *Striga hermonthica* control under field conditions.

Materials and Methods

A field trial was conducted on fields naturally infested by S. *hermonthica* during the 2013 cropping season in Minna (Lat $09^0$31'15''N and Long $6^0$26'15''E) in the southern Guinea savanna agro-ecological zone of Nigeria. The ridges were manually constructed 75 cm apart with hand hoe. The main plot size was 11m × 31m and subplot size is 3m × 3m with 1.5 m long ridges. Two maize varieties (TZL, Compl-syn-STR-WI) (*Striga* resistant) and (SAMMAZ 16) (susceptible) were intercropped with soyabean (TGM 59) at four levels of spacing, 0, 40, 60 and 80cm. the treatment were randomly laid out in randomized complete block design (RCBD) with three replications.

The maize varieties (TZL-Compl-syn-STR-WI and SAMMAZ-16) were sown at a depth of about 3 to 4cm on the ridges at different spacing (0, 40, 60 and 80cm). Soyabeans were intercropped with maize at recommended spacing 75 cm intra-row spacing. Manual weeding was carried out at 4 and 6 weeks after sowing.Handpulling of weeds other than *Strigahermonthica* was adopted in order to avoid damage to *Striga* shoots. Compound fertilizer (NPK 15-15-15) was applied at three weeks (WAS) at low rate of 14-6-11 kg/ha as side placement 5 cm away from the maize stand to avoid damage to *Striga* shoots.

Data were taken on days to *Striga* shoot emergence, *Striga* shoot density per m^2 and per stand of maize at 6, 8 and 10 WAS, number of *Striga* shoots flowering at 8 WAS. Severity score (on a scale of 1, where 1 indicated no plant damage by *Striga* and 9 indicated almost complete maize plant damage), maize plant height at 6 and 8 WAS, maize cob weight, maize grain yield and 100 grain weight were also recorded. The data collected were subjected to analysis of variance and treatment means separated by Duncan's Multiple Range Test (DNMRT) at $P \leq 0.05$.

Results

The result in Table 1shows that there was no significant difference ($p \leq 0.05$) in*Striga* shoot emergence when soyabeans was intercropped at different spacing with maize. However there was a significant difference ($p \leq 0.05$)in the number of *Striga* shoot emergence between two maize varieties (TZL- Compl-syn-WI (57.64) and SAMMAZ 16 (58.38) when intercropped with maize. The interaction effect of maize variety and intercropping soyabean and different spacing were not significant (Table 1).

The effect of spacing and intercropping on *Striga* shoot density varied significantly throughout the sampling periods (Table 2). At 6WAS,*Striga hermonthica* shoot density per maize stand was lowest at 40cm spacing of maize (0.67) compared to other spacing 60, 80 and control (1.67, 2.67 and 3.00 respectively). The highest *Striga* (2,67 and 3.00 respectively). The same trend was observed at 8 and 10 WAS (Table 2). There were significant differences between the two maize varieties throughout the sampling periods. The resistant variety (TZL-Compl-syn-STRWI) significantly lower in number of *Striga* shoot per stand (1.17) than the susceptible SAMMAZ 16 (2.83). the same trend was observed at 8 and 10 WAS. The interaction effect of maize variety and intercropping soyabean at different spacing were not significant (Table 2). The effect of spacing and intercropping on *Strigahermonthica* shoot density per plot showed the same trend with that observed per stand. Also the *Striga*shoot per plot was significant between the two maize varieties throughout the sampling period with the resistant maize variety (TZL-Compl-syn-STR-WI) supported fewer *Striga* shoot than (SAMMAZ 16) susceptible variety (Table 3). The table also shows that the interaction effect of maize variety and intercropping soyabean at different spacing were not significantly different (Table 3).

Table 1: Effect of spacing and intercropping soya bean on days to *Striga* shoot emergence on *Striga hermonthica* control in maize

Treatment	First *Striga* shoot emergence
Maize variety (MV)	
TZL-Compl-syn-STR-WI	57.64[b]
SAMMAZ 16	58.38[a]
+ SEM	0.20
Spacing (cm)	
0 (control)	58.50[a]
40	58.00[a]
60	58.00[a]
80	57.67[a]
+ SEM	0.30
Interaction	
MV × S	NS

Means having the same letter (s) within a column are not significantly different (DMRT) at 5% level of probability. SEM (+) = Standard error of mean. NS = Not significant. MV = Maize variety. S = Soyabean

Table 2: Effect of spacing and intercropping soyabean on *Striga* shoot per stand on *Striga hermonthica* control in maize

Treatment	*Striga* shoot count per stand		
	6 WAS	8 WAS	10 WAS
Maize variety (MV)			
TZL-Compl-syn-STR-WI	1.17[b]	2.08[b]	3.50[b]
SAMMAZ 16	2.83[a]	3.67[a]	6.00[a]
+ SEM	0.16	0.18	0.19
Spacing (cm)			
0 (control)	3.00[a]	4.33[a]	6.67[a]
40	0.67[c]	1.50[d]	2.67[d]
60	1.67[b]	2.33[c]	4.17[c]
80	2.67[a]	3.33[b]	5.50[b]
+ SEM	0.22	0.25	0.30
Interaction			
MV × S	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 mean. NS = Not significant. MV = Maize variety. S = Soyabean

Table 3: Effect of spacing and intercropping soyabean on *Striga* shoot per plot on *Striga hermonthica* control in maize

Treatment	*Striga* shoot count per stand		
	6 WAS	8 WAS	10 WAS
Maize variety (MV)			
TZL-Compl-syn-STR-WI	3.82[b]	4.55[b]	6.55[b]
SAMMAZ 16	5.38[a]	7.46[a]	9.38[a]
+ SEM	0.20	0.40	0.36
Spacing (cm)			
0 (control)	6.67[a]	8.50[a]	11.33[a]
40	2.17[d]	3.00[c]	4.33[d]
60	4.17[c]	5.33[b]	7.00[c]
80	5.67[a]	7.67[a]	9.67[b]
+ SEM	0.30	0.59	0.53
Interaction			
MV × S	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 mean. NS = Not significant. MV = Maize variety. S = Soyabean

The effect of spacing and inter cropping with soyabean significantly produced the lowest number of *Striga* shoots with flowers at 40cm spacing that other treatments, while spacing at 80cm and control produced the least number with flowers (Table 4). This was due to due to close canopy which reduces the light intensity, increases the soil moisture and lowers the soil temperature thereby creating unfavourable condition for *Striga* seed germination. However, the reverse was the case with spacing at 80cm and control. (Table 4)

The effect of maize varieties on the number of flowering *Striga* shoot were significantly different with the resistant maize variety (TZL-Compl-syn-STR-WI) which significantly reduced number of flowering *Striga* shoot than susceptible SAMMAZ 16 by 50% (Table 4).

The interaction effect of intercropping soyabean and different spacing was not significant (Table 4). The effect of *Strigahermonthica* on maize damage severity score was more in 80cm spacing and control (that is normal spacing) than those with 40cm and 60cm spacing intercropped with soyabean (Table 5).

It was observed that the closer the spacing with intercropped the better the ground cover and lesser that *Striga* attack. Table 5 show that the effect of *Striga* damage on maize increased as the spacing increased. The maize varieties significantly influence maize damage severity score with the resistant maize variety (TZL-Compl-syn-STR-WI) showed least maize damage than susceptible (SAMMAZ 16) variety (Table 5). The interaction effect of soyabean intercropping and different spacing was not significant (Table 5).

Table 4: Effect of spacing and intercropping soyabean on *Striga* shoot flowering on *Strigahermonthica*control in maize

Treatment	*Striga* shoot flowering
Maize variety (MV)	
TZL-Compl-syn-STR-WI	2.45[b]
SAMMAZ 16	4.54[a]
+ SEM	0.32
Spacing (cm)	
0 (control)	5.17[a]
40	1.50[c]
60	3.17[a]
80	4.50[a]
+ SEM	0.46
Interaction	
MV × S	NS

Means having the same letter (s) within a column are not significantly different (DMRT) at 5% level of probability. SEM (+) = Standard error of mean. NS = Not significant. MV = Maize variety. S = Soyabean

Table 5: Effect of spacing and intercropping soya bean on maize plant height on *Strigahermonthica* control in maize at 6 WAS and 8 WAS

Treatment	Severity score
Maize variety (MV)	
TZL-Compl-syn-STR-WI	3.00[b]
SAMMAZ 16	5.92[a]
+ SEM	0.30
Spacing (cm)	
0 (control)	6.33[a]
40	3.00[b]
60	3.83[b]
80	5.17[a]
+ SEM	0.44
Interaction	
MV × S	NS

Means having the same letter (s) within a column are not significantly different (DMRT) at 5% level of probability. SEM (+) = Standard error of mean. NS = Not significant. MV = Maize variety. S = Soyabean

The 40cm spacing of maize with soya bean intercropping significantly resulted in taller plants than all other treatment at 6 and 8 WAS (Table 6). However, maize plant height was significantly reduced by effect of *Striga* as the spacing increased to 80cm with soyabean intercropping and the control (Table 6). The taller plant height observed at 40cm spacing with soyabean intercropped treatment was as a result of good protection produced by the treatment compared to other treatment. The *Striga* resistant maize variety (TZL-Compl-syn-STR-WI) significantly produced taller plants than SAMMAZ 16 (susceptible variety) (Table 6). The interaction effect of maize variety and intercropping soyabean and different spacing were not significant (Table 6). The maize cob weight was heavier at 40cm spacing compared to other treatment (Table 7). The resistant variety (TZL-Compl-syn-STR-WI) produced the heaviest maize cob weight than the susceptible SAMMAZ 16 (Table 7). The interaction effect of maize variety, intercropping soya bean and spacing was not significant (Table 7).

Table 6: Effect of spacing and intercropping soyabean on maize plant height on *Strigahermonthica* control in maize at 6 WAS and 8 WAS

Treatment	Plant height (cm)	
	6 WAS	8 WAS
Maize variety (MV)		
TZL-Compl-syn-STR-WI	87.09[a]	104.18[a]
SAMMAZ 16	56.46[b]	85.23[b]
± SEM	1.74	2.27
Spacing (cm)		
0 (control)	57.50[c]	80.33[b]
40	81.83[a]	104.00[a]
60	76.33[a]	96.17[a]
80	66.33[b]	95.17[a]
± SEM	2.56	3.35
Interaction		
MV × S	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 mean. NS = Not significant

Table 7: Effect of spacing and intercropping soya bean on maize Maize cob weight on *Striga hermonthica* control in maize

Treatment	Maize cob weight (g)
Maize variety (MV)	
TZL-Compl-syn-STR-WI	876.9[a]
SAMMAZ 16	854.5[a]
± SEM	147. 40
Spacing (cm)	
0 (control)	700.0[a]
40	1133.3[a]
60	916.7[a]
80	716.7[a]
± SEM	216.97
Interaction	
MV × S	NS

Means having the same letter (s) within a column are not significantly different (DMRT) at 5% level of probability. SEM (±) = Standard error of mean. NS = Not significant. MV = Maize variety. S = Soyabean

There were no significant difference in maize grain yield throughout the spacing, also the interaction effect of maize variety, intercropping soya bean with maize and spacing was not significantly different. (Table 8).

The maize grain weight was not significantly difference between the two maize varieties (Table 8), although the result indicates that the resistance maize (TZL-Compl-syn-STR-WI) was recorded highest grain weight than the susceptible variety (SAMMAZ 16) (Table 8).

The maize grain weight obtained from both the resistance and susceptible variety were not significantly different (Table 8). The resistance maize variety (TZL-Compl-syn-STR-WI) significantly gave higher 100 grain weight than the susceptible (SAMMAZ 16) (Table 8).

The interaction effect of maize variety, intercropping soyabean, and different spacing level was not significant. (Table 8)

Table 8: Effect of spacing and intercropping soyabean on maize grain yield on *Striga hermonthica* control in maize

Treatment	Maize grain weight (g)
Maize variety (MV)	
TZL-Compl-syn-STR-WI	523.0[a]
SAMMAZ 16	502.2[a]
± SEM	79.67
Spacing (cm)	
0 (control)	395.6[a]
40	660.4[a]
60	561.0[a]
80	436.9[a]
± SEM	117.30
Interaction	
MV × S	NS

Means having the same letter (s) within a column are not significantly different (DMRT) at 5% level of probability. SEM (±) = Standard error of mean. NS = Not significant. MV = Maize variety. S = Soyabean

Discussion

The results presented indicate that the 40cm spacing with soya bean intercropping offered significant control of *Strigahermonthica* in all the parameters measured in this study which was achieved by reducing *Striga* shoot density which in agreement with the findings of Ghadiri and Bayat (2004). *Striga* shoot density was reduced by 56-60% compared with spacing of 80cm and control. The intercropping with soyabean also helps in suppressing *Striga* in the maize which is also in agreement with the finding of Kureh (2006). The lower the *Striga* shoot density, the lower the number of flowering, hence the lower the soil seed bank for future infestation. The increase in *Striga* shoot density in 60 cm and 80cm could be due to competitive ability of weeds which is more at wider cropping spacing, because of less crop canopy closure which allows for red light to be received by the weed which could give the weed better growth opportunity. The little shading in wider spacing also gave the weed opportunity to sufficient resources required for their germination, emergence and growth.

The effect of *Striga hermonthica* attack on maize with 40cm spacing with soyabean intercropping because the *Striga* shoot density was fewer (Table 5) in this treatment, this could be due to inability of the *Striga* seeds to properly germinate and/or attach to the host maize root. Consequently maize plant spacing at 40cm and intercropped with soyabean developed taller and maize grain yield was higher. Ghadiri and Bayat 2004; reported that manipulating agronomic factors such as row and plant spacing may provide a non-chemical approach to reducing the impact of weed interference on crop yields. Row spacing and plant population influence the ability of the crop to compete with weeds for resources (Ghadiri and Bayat 2004).

Conclusion

Resistant varieties are strongly recommended for sowing in *Striga* infested field. *Striga hermonthica* can be controlled by 40cm spacing and intercropping with soya bean as a component of integrated *Striga* management package.

References

Aliyu, L., Lagoke, S. T. O., Carsky, R. I., Kling, J., Omotayo, O. & Shebayan, J. Y. (2004). *Technical and economic evaluation of some Striga control packages in maize in the Northern Guinea Savanna protection.* Elsevier LTD. p. 66.

Ghadiri, H. & Bayat, M. L. (2004). Effect of Row and plant spacing on weed competition with pinto Beans (Phaseolus vulgaris L.). *Journal of Agricultural Science and Technology,* 6,1 - 9.

Gworgwor, N. A., Shall, S. D. & Abba, A. (2002). Preliminary evaluation of effectiveness of cow urine in controlling *Striga hermonthica* (Del.) Benth. In the semi-arid zone of Nigeria. *Journal of Sustainable Tropical Agricultural Research,* 4,50 - 55.

Kanampiu, F. K., Kabambe, V., Massawe, C., Jasi, L., Friensen, D., Ransom, J. K. & Gressel, J. (2003). Multisite, multi-season field tests demonstrate that herbicide seed coating herbicide-resistance maize control *Striga* spp. and increases yields in several African countries. *Crop Protection,* 22, 697 - 706.

Kolo, M. G. M. & Mamudu, A. Y. (2008). Water treatment of parkia biglobosa pulp dressed maize (Zea mays L.) Seeds for *Striga hermonthica* control at Minna, Nigeria. *Agricultural Tropica et Subtropica,* 41(3).

Kureh, A. A. (2006). Promoting Integral *Striga* Management Practice in Northern Nigeria. *Nigerian Journal of Weed Science,* 8(10), 33 - 34.

Mamudu, A. Y. (2013). Intercrops with trap crops, Nitrogen Fertilization for *Striga hermonthica* (Del.) Benth control at Niger State. *International Journal of Humanities and Social Science Invention,* 2, 64 - 69.

Reda, F., Woldewahi, G., Zemichael, B. & Bayou, W. (2002). Integrated cropping system approach for the control of *Striga hermonthica* in sorghum. In: S. T. O. Lagoke & M'boob, S. S. (Eds). *Integrated Striga management tech from research to farmers.* Proceedings of the fourth general workshop of the Pan Africa control network (PASCON), 28 October- 1st November 1996, Bamako, Mali. FAO/PASCON; Pp 190-194