EFFECT OF SELECTED NON-HOST CROP PLANT FOR INDUCTION OF *STRIGA HERMONTHICA* SEEDS GERMINATION

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Abstract

Striga (witchweed) is one of the most important pests that affect food production in the tropics. *Striga* prodigious seed production, prolonged viability of the seeds and the subterranean nature of the early stages of parasitism may result in complete crop loss under the worst of conditions.The parasite seeds are stimulated to germinate by root exudates from the host and non-host plants, however, legume cultivars vary in their ability to stimulate germination of *S. hermonthica* seed of same or different populations. A two year trial was conducted to evaluate the *Striga hermonthica* seeds germination stimulants from three non-host crop (soyabean, cowpea and groundnut) for control efficacy. Results in the 2013 and 2014 combined analysis interaction effect showed that Soyabean varieties TGX 1448-2E , Cowpea varieties IT04K-217-55 and Groundnut variety RMP-91 gave the best performance , They supported fewer *Striga* count, produced taller sorghum plant height and higher grain yield compared to other varieties. It could be concluded that *Striga* control and higher grain yield could be achieve if the above trap crops are use in intercropping system.

Keyword: Trap crops, Root exudates, Suicidal germination, *Striga* control

INTRODUCTION

Parasitic weeds are a serious problem in agriculture, causing large crop losses in many parts of the world, the seeds of parasitic plants of the genera *Striga* will only germinate after induction by a chemical signal exuded from the roots of their host. *Striga hermonthica* is particularly harmful to sorghum, maize and millet, but is also increasingly being found in sugarcane and rice fields (Atera and Itoh, 2011). The adaptation of obligate parasitic weeds to respond to host plant excreted germination stimulants provide them with an evolutionary benefit that ensures the seeds only germinate in the vicinity of active, viable host plant roots. More recent studies have shown that germination of *Striga* is not host specific but showed that not only do wild ancestors of sorghum and millet induce *Striga* seed germination (Van Mourik, 2007), but also non-host plants, including some tree species (Yonli *et al*., 2010). Most of these non-host plants do not permit attachment of the parasite to their roots with consequence that germinated *Striga* seeds are not able to survive and reproduce. This process, often referred to as suicidal germination, contributes to the reduction of the *Striga* seed population in the soil. Despite many control methods have been already proposed, the infestation by this parasitic weed continues (Andrianjaka*et al*.; 2007). The wide use of trap crops, used in intercropping, and catch crops is a control measure partly based on the (suicidal) induction of germination (Chittapur *et al*., 2001). Trap crops are nonhosts which stimulate germination o f the *Striga* seeds without being attacked by the seedlings. When seedlings do not find a suitable host they use up their endosperm and die within 3-7 days. Trap crops can be cultivated alone or they can be rotated with a susceptible host crop, thus eliminating the parasitic weed seeds that would otherwise germinate and attack the susceptible host crop. This control approach is a promising method and is economically advantageous for the farmer (Musselman, 1987). Legume food crop including cowpea, soyabean and groundnut and some other non-host crop plants including cotton were reported to stimulate *Striga* seeds germination. Gbehounuou and Adango, (2003) reported that root exedates of some soyabean, cowpea and groundnut cultivars stimulate the germination of S. *hermonthica*. Bontanga *et al*., (2003) also reported 13.3 to 50.0 stimulation of *Striga* seed germination by cotton varieties. Kureh *et al*., (2000) found that sole hybrid Maize supported significantly higher Striga incidence and infestation than when intercropped with selected soyabean varieties TGX1019-2E and TGX 1440-1E in Northern Guinea of Nigeria. Studies have shown that there is variability among non-host crops and within crop cultivar in their ability to stimulate *Striga* seed germination and between *Striga hermonthica* population to respond to germination stimulant (Kureh *et al*., 2000). This study aimed at evaluating the ability of ten soyabeans genotype, cowpea genotype and groundnut genotype each for their ability to stimulate *Striga* suicidal germination in 2013 and 2014 cropping seasons.

MATERIALS AND METHODS

Screen house polybags studies were conducted during 2013 and 2014 cropping season, at the research farm of the Gidan Kwano campus of Federal University of Technology Minna, which has at an altitude of 281.1 meter above sea level, longitude between (09^0 39'N and 06^0 28'E). Minna is located within the southern Guinea savanna ecological zone of Nigeria. The site has well drained sandy clay loam soil. *Striga* free soil was collected and sterilized for two hours. Each polybag was filled with 5kg of sterilized soil and then inoculated with *Striga* seeds whose viability and germination percent had earlier been determined. The study was 3 x 10 x 2 factorial experiment laid out in Completely Randomized Design (CRD) replicated five times. Factor A consists of *Striga* seed at three levels inoculation rate (0, 2.5 and 5g) mixed with 5kg of sterilize soil respectively. Factor B was 10 varieties of soyabean, cowpea and groundnut as trap crops factor C consisted of resistance (ICSV1002) and susceptible (local) sorghum varieties. The polybags were first filled three quarter way with soil, *Striga* seed sprinkled and the remaining soil added hence making the *Striga* seed to be placed at about 8cm below the soil surface. The polybags were watered carefully to avoid leakages from the polybags on the first day of infestation and then later after 5 days in order to condition the *Striga* seeds. Sowing of the soyabean, cowpea and groundnut was carried out one week later. After harvesting the trap crops, two sorghum varieties mention above were planted. Torn polybags at that time was carefully replaced with new one by lifting the old bags into the new ones to avoid losing the soil. The polybags was monitored and watered regularly. The sorghum seedlings were thinned down to two seedlings per bag. The sorghum varieties were repeated again in 2014.

Data that was collected on trap crop i.e. the soyabean, cowpea and groundnut include: days to first *Striga* emergence, trap crop plant height (mean of five plant) and dry mass. Data that were collected on sorghum included: days of first *Striga* emergence, *Striga* count at 6 and 8 WAS per stand of sorghum and per polybag, plant height at 10 and 14 WAS, 1000 grain weight and grain yield. Data were analyzed using computer software Genstat (2010). Statistically difference between variable means were compared using least significant difference ($p < 0.05$).

RESULTS

There were significant ($p < 0.05$) difference in *Striga* count in 2013 and 2014, fewer *Striga* count was observed in 2014 compared to 2013 this could be due to the population of the *Striga* seed in the soil during first trial in 2013, which might have been depleted by 2014 trial (Table 1, 3 and 5). This is in agreement with the finding of De Groote *et al.*, 2010 that soyabean trigger suicidal germination of *Striga* and reduce *Striga* seed bank in the soil (Table 1, 3 and 5).

Plant height and grain yield were significantly ($P<0.05$) different in 2013 and 2014 (Table 1, 3 and5). The taller plant height and higher grain yield was seen in 2014 than 2013, this could be attributed to increase in photosynthetic activity as well as reduction in competition for growth resources as a result of fewer *Striga* emergence and attachment compared to 2013. This confirm the work of Press *et al.,* (1989) that possible reduction in photosynthetic activity as well as competition for growth resources could lead to reduced plant height and yield (Table 1,3 and 5).

There were significant ($P<0.05$) different in *Striga* count in the sorghum resistant variety ICSV1002 compared to Local susceptible variety among the non-host crop varieties (Table 2, 4, and 6). The sorghum resistance variety ICSV1002 in soyabean TGX 1448-2E, Cowpea IT04K-217-55 and Groundnut RMP-91supported fewer *Striga* count compared to local susceptible variety. This might be attributed to the production of lower amounts of germination stimulants to their root exudates, leading to smaller number of attached parasites as suggested by Gurney *et al*., (2002) that the resistant variety produce lower amounts of germination stimulants to their root exudates, leading to smaller numbers of attached parasites and or later attachment of the parasites to the host (Gurney *et al.,* 2002) (Table 2,4and 6).

The taller plant height and higher grain yield was observed in ICSV1002 resistant variety compared to Local susceptible variety could be attributed to the low stimulant production which results in fewer *striga* plant and better sorghum establishment and growth. 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.

Table1: Combined interaction effect of years and varieties on soyabean response to screening.

Year	Varieties	6SSC	8SSC	6PH	8PH	GY
2013	TGX1937-1F	4.93	8.03	23.8	42.0	265.7
	TGX1986-10F	4.16	5.93	24.4	42.9	323.1
	TGX1986-10F	5.47	8.9	23.8	40.1	248.0
	TGX1990-45F	4.70	7.63	24.6	40.3	315.4
	TGX187-62F	4.47	6.7	25.1	41.5	312.2
	TGX1987-96F	4.83	7.63	24.1	40.2	313.5
	TGX1448-2E	2.40	4.23	27.6	44.1	364.9
	TGX1835-10E	4.13	5.27	25.4	42.6	338.6
	TGX1830-20E	3.50	4.90	26.6	45.0	343.2
	TGX1019-2EB	2.57	4.37	27.1	44.9	356.8
2014	TGX1937-1F	4.07	8.03	23.3	36.6	263.2
	TGX1986-10F	4.83	5.93	24.4	43.7	322.8
	TGX1986-10F	4.70	8.90	22.8	35.9	239.2
	TGX1990-45F	4.10	7.63	24.0	40.2	310.8
	TGX187-62F	3.03	6.70	25.5	41.0	315.8
	TGX1987-96F	5.93	7.63	24.2	37.7	309.1
	TGX1448-2E	1.90	3.23	29.6	48.5	378.3
	TGX1835-10E	3.63	5.27	25.3	44.2	339.7
	TGX1830-20E	3.06	4.90	27.7	46.7	351.6

TGX1019-2EB	2.23	4.37	27.9	41.0	362.0
Mean	5.18	6.35	25.36	42.30	318.1
LSD	0.49	NS	0.7	1.73	NS

NS= Not Significant

Table 2: Combined interaction effect of sorghum and Soyabean varieties on soybean response to screening

Sorghum	Variety	6SSC	8SSC	6PH	8PH	GY
ICSV 1002	TGX1937-1F	4.32	6.40	24.0	38.4	277.4
	TGX1986-10F	4.40	4.67	25.1	44.3	336.9
	TGX1986-10F	4.73	6.87	23.7	39.5	253.3
	TGX1990-45F	4.33	5.93	24.7	41.6	325.3
	TGX187-62F	4.83	5.46	25.6	42.7	329.3
	TGX1987-96F	4.10	5.60	24.6	41.7	322.3
	TGX1448-2E	4.13	3.20	29.7	45.9	383.3
	TGX1835-10E	4.93	3.93	26.2	43.9	349.9
	TGX1830-20E	3.87	3.67	27.9	46.5	352.8
	TGX1019-2EB	3.80	3.07	28.0	46.6	366.1
Local	TGX1937-1F	4.77	9.67	23.0	40.2	251.6
	TGX1986-10F	4.53	7.20	23.7	42.3	309.1
	TGX1986-10F	5.43	10.90	22.9	36.5	233.9
	TGX1990-45F	4.47	9.33	23.9	38.9	300.8
	TGX187-62F	7.67	8.00	25.0	39.8	298.1
	TGX1987-96F	6.67	9.67	23.8	36.3	301.2
	TGX1448-2E	7.17	5.27	27.5	46.6	349.9
	TGX1835-10E	6.83	6.60	24.5	42.9	328.3
	TGX1830-20E	6.33	6.13	26.4	45.2	342.0
	TGX1019-2EB	6.40	5.67	27.0	47.3	352.7
Mean		5.19	6.36	25.36	42.36	318.21
LSD		0.49	0	0.7	1.73	NS

NS= Not Significant

Table 3: Combined interaction effect of years and varieties on cowpea response to screening

Year	Varieties	6SSC	8SSC	6PH	8PH	GY
2013	IT04K-217-55	3.53	3.83	27.10	45.90	468.30
	IT04K-227-4	4.80	6.27	25.40	44.80	438.70
	IT07K-210-1	5.47	8.50	25.80	43.30	431.20
	IT07K-25-3-3	3.63	4.20	26.90	45.30	450.50
	IT07K-237.2-1	4.50	8.17	25.70	55.70	430.50
	IT04K-333-2	4.10	5.53	25.90	44.60	447.00
	IT04K-339-1	4.06	5.00	26.30	44.70	434.30
	IT04K-405-5	4.87	8.00	24.60	44.00	411.00
	IT07K-293-3	4.87	7.93	24.60	43.70	433.40
	IT07K-318-2	5.07	8.33	24.60	43.10	391.10
2014	IT04K-217-55	2.27	3.67	27.60	46.30	496.30
	IT04K-227-4	4.50	6.20	24.90	43.30	440.80
	IT07K-210-1	3.90	8.47	25.10	41.20	424.80
	IT07K-25-3-3	2.53	4.10	26.70	46.00	451.30
	IT07K-237.2-1	3.53	8.17	24.00	40.40	423.70
	IT04K-333-2	3.43	5.40	25.60	43.90	449.10
	IT04K-339-1	3.33	5.03	26.30	44.40	454.60
	IT04K-405-5	4.27	7.97	22.30	40.70	399.90
	IT07K-293-3	5.20	8.00	24.00	42.10	431.20
	IT07K-318-2	5.63	8.50	22.20	39.30	376.10
Mean		4.37	6.56	25.28	44.14	437.34
LSD		0.46	NS	1.05	NS	8.12

NS= Not Significant

Table 4: Combined interaction effect of sorghum and varieties on cowpea response to screening

Sorghum	Varieties	6SSC	8SSC	6PH	8PH	GY
ICSV 1002	IT04K-217-55	2.33	3.27	27.90	47.20	481.20
	IT04K-227-4	3.97	5.30	26.50	44.90	447.50
	IT07K-210-1	4.47	7.70	26.00	43.10	434.90
	IT07K-25-3-3	2.50	3.03	27.50	46.70	458.30
	IT07K-237.2-1	3.27	7.10	25.50	42.30	426.20
	IT04K-333-2	3.10	4.93	26.20	45.10	460.20
	IT04K-339-1	2.90	4.17	26.80	45.70	497.60
	IT04K-405-5	4.17	6.97	24.00	43.60	413.50
	IT07K-293-3	4.17	6.83	24.90	43.60	435.60
	IT07K-318-2	4.33	7.33	23.80	41.90	391.30
Local	IT04K-217-55	3.47	4.23	26.70	45.00	456.30
	IT04K-227-4	5.33	7.17	23.80	43.30	432.00
	IT07K-210-1	6.90	9.27	24.80	41.30	421.20
	IT07K-25-3-3	3.67	5.27	26.10	44.60	443.50
	IT07K-237.2-1	5.77	9.23	24.20	53.80	428.10
	IT04K-333-2	4.43	6.00	25.30	43.50	435.80
	IT04K-339-1	4.43	5.87	25.70	43.40	481.30
	IT04K-405-5	5.97	9.00	23.00	41.00	397.40
	IT07K-293-3	5.90	9.10	23.70	42.20	429.00
	IT07K-318-2	6.37	9.50	23.00	40.50	375.90
Mean		4.37	6.56	25.27	44.14	437.34
LSD		0.46	0.40	NS	NS	8.12

NS= Not Significant

Table 5: Combined interaction effect of year and varieties on groundnut response to screening

Year	Varieties	6SSC	6PH	8PH	GY
2013	TE3	3.73	23.93	45.06	461.43
	CHICO	5.13	23.70	44.46	462.32
	KH 241D	5.57	22.93	43.73	441.52
	QH 243C	4.46	24.43	43.96	474.36
	CN 94C	5.46	23.83	43.00	452.80
	RRB	5.96	23.10	42.26	430.89
	RMP-12	3.46	24.50	45.46	487.67
	RMp-91	2.66	25.50	46.50	489.25
	Groundnut-23	4.90	24.40	44.63	450.09
	Groundnut-11	6.36	22.17	42.56	410.69
2014	TE3	3.63	24.43	44.33	470.22
	CHICO	3.43	23.80	43.23	461.37
	KH 241D	3.53	22.20	42.00	450.42
	QH 243C	4.10	24.96	43.93	485.44
	CN 94C	3.13	23.70	42.20	451.38
	RRB	4.30	22.67	40.83	428.71
	RMP-12	2.53	25.63	44.80	489.97
	RMp-91	1.86	26.83	46.50	494.22
	Groundnut-23	4.00	24.26	43.30	469.67
	Groundnut-11	4.30	21.73	40.53	430.09
Mean		5.16	23.89	43.66	463.33
LSD		NS	0.70	0.83	NS

NS= Not Significant

Table 6: Combined interaction effect of sorghum and varieties on groundnut response to screening

Sorghum	Varieties	6SSC	6PH	8PH	GY
ICSV 1002	TE3	3.73	24.80	45.76	497.26
	CHICO	5.13	24.53	44.76	467.56
	KH 241D	5.56	23.43	43.96	445.05
	QH 243C	4.47	25.50	44.93	479.85
	CN 94C	5.47	24.56	43.90	458.09
	RRB	5.97	23.10	42.86	434.11
	RMP-12	3.47	24.50	46.20	495.04
	RMp-91	2.67	25.50	47.46	503.42
	Groundnut-23	4.90	24.40	44.90	472.85
	Groundnut-11	6.37	22.16	41.96	431.57
Local	TE3	4.63	23.56	43.63	484.38
	CHICO	6.43	22.96	42.93	456.12
	KH 241D	6.53	21.70	41.76	436.89
	QH 243C	5.70	23.90	42.96	469.95
	CN 94C	6.13	22.96	41.30	446.09
	RRB	4.27	22.66	40.23	425.49
	RMP-12	4.53	25.63	44.06	480.61
	RMp-91	3.87	25.83	45.53	486.04
	Groundnut-23	6.00	24.26	43.03	466.91
	Groundnut-11	7.30	21.73	41.13	429.21
Mean		5.16	33.88	43.66	463.32
LSD		0.45	NS	NS	4.69

NS= Not Significant

Conclusion and Recommendations

From the Polybags trap crops screening experiment, between the two cropping seasons (2013 and 2014) and the two sorghum varieties used as test crops (ICSV1002 and Local), soyabean variety TGX 1448 -2E, Cowpea varieties IT04K - 217- 55 and Groundnut variety RMP - 91 resulted lower *Striga* count, higher plant height and increased grain yield. This shows that integrating the above mention varieties could help in reducing the capacity of increasing the

Striga seed bank. Among the soyabean, cowpea and groundnut trap crops screen, soyabean variety TGX 1448 – 2E, cowpea variety IT04k – 217-55 and groundnut variety RMP-91 are recommended as best varieties for use to control *Striga* under intercropping system, but the varieties should be further verified under field conditions.

REFERENCES

Atera E, Itoh K (2011). Evaluation of ecologies and severity of striga weed on ice in sub-saharan. Africa. *Agric. Biol.J.N. AM*. 2:752-760.

Kureh, I., Chiezey, U.F. and Tarfa, B.D.,2000. On-station verification of the use of soybean trapcrop for the control of *Striga* in maize. *Afr. Crop Science Journal* 8 (3): 295-300.

Botanga CJ, Alabi SO, Echekwu CA, Lagoke STO, 2003. Genetics of suicidal germination of Striga hermonthica (Del.) Benth by cotton.Crop Science, 43: 483-488.

Gbehounou, G., and Adango, E., 2003. Trap Crops of *Striga hermonthica*: In-vitro identification and effectiveness in situ. *Crop Protection 22: 395-404*

Rodenburg J, Bastiaans L, Kropff MJ (2006). Characterization of host tolerance to *Striga hermonthica*. Euphytica, 147: 353-365.

De Groote, H., Rutto, E., Odhiambo, G., Kanampiu, F., Khan, Z., Coe, R., &Vanlauwe, B. (2010). Participatory evalutaion of integrated pest and soil fertility management options using ordered categorical data analysis. *Ag.Sys., doi*:10.1016/j.agsy.2009.12.005.

Gurney, A.L., Press, M.C., and Scholes, J.D. (2002). Can wild relatives of sorghum provide new sources of resistance or tolerance against *Striga* species? *Weed Research* 42: 317-324.

Press, M.C., J.J. Nour, F.F. Bebawi, and G.R. Stewart. 1989. Antitranspirant-included heat stress in the parasitic plant-*a* novel method of control. *J. Exp. Bot. 40:*585-591.

Proceeding first joint National workshop of NAFPP. 10 – 15 January 1983, Ibadan, Nigeria.

Van Mourik, T., (2007).“*Strigahermonthica*seed bank dynamics process quantification and modeling”.*Ph.D thesis*, *Wagering University*.

Yonli, D., Traore, T., Sereme, P. and Sankara, P. (2010). Use of Local Plant Aqueous Extracts as Potential Bioherbicides against *Striga* hermonthica (Del.) Benth. In Burkina Faso.