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EFFECT OF SORGHUM VARIETIES, CROPPING SYSTEM, PRIMING WITH *PARKIA* PULP AND SOWING DATES ON *STRIGA HERMONTHICA MANAGEMENT*

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ABSTRACT
Striga can do much damage to the host crop before emerging above the ground , the available control measures (cultural, mechanical, chemical and biological) can't provide effective control and it is necessary to use a combination of these methods (integrated control) most relevant to the farming system. The objective of this study is to determined the effectiveness of seed priming, date of planting and intercropping system in Striga hermonthica control in sorghum. The experiment was conducted at the Federal University of Technology Minna. Treatments comprised of two varieties of sorghum (resistance ICSV 1002 and susceptible Gwari Local variety), three different concentrations of parkia pulp powder (0 g/l, 66g/l and 100 g/l), soyabean variety TGX 1448-2E and two sowing dates (15 June and 21 July) in two cropping season (2012 and 2013). These were evaluated in a randomized complete block of three replicates. Data collected on Striga plant were days to first Striga emergence and Striga count per plot, on sorghum plant ,were severity score, sorghum plant height and grain yield, were collected in both years. The results showed that resistant sorghum variety significantly reduced striga attack and had higher grain yield. Parkia pulp at 66g/l concentration reduced striga attack on sorghum. Intercropping sorghum with soyabean reduced striga seed bank in the soil. Sorghum sown in July suffered less Striga attack compared to earlier sowing in June.

Key words: Sorghum grain, *Striga hermonthica*, control methods.

INTRODUCTION
Nigeria is the leading sorghum producer in Africa followed by Sudan, Ethiopia and Burkina-Faso. Sorghum account for 34% of total cereal production in Nigeria (AKintayo and Sedgo 2001). Sorghum (*Sorghum bicolor* L. Moench) is the fifth most important staple food crop after wheat, rice, maize and barley (FAO,2012). Sorghum is consumed by more than 70% of the population (IITA,2004).The plant's capacity to produce respectable yields under unfavorable growing situations has made it a well-liked crop for many growers. However, the crops production is constrained by many biotic and abiotic factors amongst *Striga hermonthica*[Del.] Benth. *Striga* is the most tenacious, prolific and destructive pests of sorghum. *Striga hermonthica* is the largest and most destructive of the *Striga* species and considered as one of the most serious weeds in Africa [Oswald, 2005].In Africa, 21 million hectares of cereal were estimated to be infested by *S. hermonthica*, leading to an estimated annual grain loss of 41 million tons (Griessel *et al.*, 2004). The incidence and severity of *S. hermonthica* are exceptionally high on sorghum, pearl millet, and maize, (Scholes and Press, 2008). However, the impact of *Striga* damages depends on ecological condition, cropping system, local cultural practices and farmers' skills on the ecology (IITA, 2002). Methods commonly used in some locality in controlling *Striga* include hand pulling, root digging, early planting and crop seed dressing with salt before planting. Unfortunately, these methods do not lead to any significant reduction in the

density of *S. hermonthica* in affected fields (IITA, 2002). The growing of sorghum in intercropping with legumes in the same field is a common cultural practice with the outlook for *S. hermonthica* control. Nowadays, the approach of integrated management for controlling *S. hermonthica* is more favoured. There is report of genetic resistance differences to *S. hermonthica* in sorghum but Botanga *et al*., (2003) emphasized that the major problem associated with the use of resistant cultivars is the lack of universal resistance, he also reported that the use of trap crop which induce the germination of *Striga* seeds but without being parasitized, is one of the most promising methods and culturally acceptable. This study investigated the integrated *Striga* control package combing resistance and susceptible varieties, *parkia* pulp concentration seed treatment, intercropping sorghum with a trap crop (soyabean) and sowing at different dates under field conditions.

MATERIALS AND METHODS

The experiment was conducted at the Federal University of Technology Minna, (09^o 39' N and 06^o 28' E) in the Southern Guinea Savannah ecological zone of Nigeria with mean annual rainfall of 1300 mm. The experiment was carried out in a field with a history of high *Striga hermonthica* infestation. The soil was characterized as an acidic (pH 5.2) sandy clay loamy (640 g/kg sandy 100g/kg silt and 260g/kg clay) with organic matter content of 8.9g/kg. Total nitrogen was 0.5g/kg, phosphorus of 4.2 mg/kg and cation exchange capacity of 6.09cmol/kg. The experimental design was a randomized complete block with three replicates. Three concentrations of *Parkia biglobosa* pulp at 0, 66 and 100g/l was used to primed two sorghum cultivars and two sowing dates (15 June and 21 July), soyabeans TGX 1448-2E was used for the intercrop. Planting distance was 75cm between rows and 30cm between plants. Seed were soaked for 16 hours and sown two to two years. The ICSV 1002 sorghum variety significantly (p<0.05) recorded fewer *Striga* shoots per plot in 2012 and 2013 throughout the sampling periods of 10 and 14 Weeks After Sowing (WAS) compared to the local varieties (Table 1). Sorghum intercropped with soyabean significantly reduced *Striga* shoots in both years with 5.00 and 7.94 shoots respectively at 10 and14 WAS in 2012 and 3.56 and 5.36 shoots respectively at 10 and 14 WAS in 2013 compared sole sorghum with 7.72 and 12.39 shoots respectively at 10, and14 WAS in 2012 and 5.81 and 7.94 shoots respectively at 10 and14 WAS in 2013 (Table 1). Sorghum seeds soaked with 66 g/l *Parkia* concentration significantly reduced number of *Striga* shoots in three seeds of sorghum per hill on the chosen dates and stand with excess seedling were thinned to two plants per hill at two weeks after sowing. Hand pulling of weeds other than *S . hermonthca* seedling was done at four weeks and second weeding was carried out at 8weeks after sowing . Harvesting of sorghum panicles was done at 22 and 23 weeks after sowing for June and July sowing dates respectively, and were dried, threshed and grain yield determined.

Data collection

Data collected include days to first *Striga* emergence, *Striga* count per plot , severity score of maize using a scale of 1-5, where 1 indicate no *Striga* damage and 5 severe damage. Plant height from tagged stand using tape rule and measuring from the soil surface to neck of last leaf, grain yield per plot using weighing balance.

Statistical analysis

The data were statistically analysed using the analysis of variance (ANOVA) using the computer software Genstat (2010). Statistically differences between variables means were compared using least significant difference (P < 0.05).

RESULTS

Effect of sorghum varieties, soyabean intercropping, *Parkia* concentrations and sowing dates on days to *Striga* emergence and *Striga* shoot count per plot shows that, irrespective of year of planting, sorghum variety, ICSV 1002 significantly (p < 0.05) delayed the emergence of *Striga* in the field compared to the local variety (Table 1). Similarly, sorghum intercropped with soyabean generally delayed the emergence of *Striga* compared to sole sorghum in the two years. Furthermore, dressing sorghum seeds with 66 g/l of *Parkia* pulppowder significantly (p < 0.05) delayed *Striga* emergence compared to 0 g/l *Parkia. Striga* infestations were significantly (p < 0.05) lower in June plantings compared to July plantings for the both years compared to those primed with 100 g/l or 0 g/l irrespective of the year of planting. Planting in July did not significantly reduce *Striga* count (6.06 shoots and 10.11shoots for 2012) and (3.40 shoots and 5.53 shoots for 2013) compared to those planted in June (6.67 shoots and 10.22 shoots for 2012) and (5.97 shoots and 7.78 shoots respectively for 2013) (Table 1). Effects of sorghum varieties, soyabean intercropping, *Parkia* concentration and sowing dates on severity score, plant height and grain yield shows that, ICSV1002 variety suffered significantly(p<0.05) less *Striga* damage (2.64 in 2012 and 2.39 in 2013) compared to the Local sorghum variety (5.00 in 2012 and 4.50 in 2013) (Table 2). Sorghum intercropped with soyabean suffered significantly ($p<0.05$) less attack in both years (3.22 in 2012 and 3.72 in 2013) compared to those planted without soyabean (4.42 in 2012 and 4.28 in 2013). The ICSV 1002 ($p < 0.05$) produced taller plants compared to sole cropping (Table 2). Seed priming with *Parkia* powder at 66 g/l significantly ($p < 0.05$) produced taller plants in both years compared to those soaked in 100 g/l or 0 g/l .Planting in July significantly ($p < 0.05$) produced taller plants (42.64 cm and 51.58 cm for 10 and 14 WAS respectively in 2012 and 50.58 cm for 14 WAS in 2013). (Table 2). Irrespective of year of planting, sorghum variety ICSV 1002 significantly ($p < 0.05$) produced higher grain yield compared to local sorghum variety (Table 2). Similarly, sorghum intercropped with soyabean produced higher grain yield compared to sole sorghum in 2012 and 2013 (Table 2). Grain yield was significantly ($p < 0.05$) higher with 66 g/l *Parkia* treatment compared to 100 g/l or 0 g/l concentrations in 2013 (Table 2). Grain yield was significantly ($p < 0.05$) higher in July planting compared to June planting of the two years.

DISCUSSION

The observed difference in the days to first *Striga* shoot emergence between varieties ICSV 1002 (resistant) and Local sorghum variety (susceptible) could be due to low germination stimulant production commonly found in *Striga* resistant sorghum genotypes as observed by Rubiale *et al.,* (2003), This account for fewer *Striga* count in ICSV1002 (resistant) sorghum compared to Local (susceptible) sorghum in 2012 and 2013 and translated into less *Striga* damage, taller plant height and higher grain yield. This is in agreement with the finding of Rodenburg *et al.,* (2006) that in *Striga* infested areas cultivation with resistant crops results in fewer *Striga* plants and higher crop yield than a non-resistant genotype of the cultivated plant would do. The delayed *Striga* emergence in sorghum intercropped with soyabean relative to sole sorghum could be due to the ability of soyabean to increase soil moisture and reduce soil temperature by the ground covering effect of the leaves which prevent evaporation and direct sunray from heating the ground needed for the *Striga* seed sorghum variety significantly ($p < 0.05$) produced taller plant height in 2012 and 2013 across the sampling periods compared to the Local variety. Sorghum intercropped with soyabean significantly to germinate. A similar observation was made by Oswald *et al.,* (2002) that intercropping maize with cowpea and sweet potato can significantly affect *Striga* germination. This interference due to intercropping could be responsible for the fewer *Striga* count in sorghum intercropped with soyabean relative to sole sorghum, less *Striga* damage, taller plant height and higher grain yield. Babiker *et al.,* (1987) reported that intercropping sorghum with Dolichos lab-lab (labia) suppressed *Striga* emergence and growth and increased number of heads and straw yield of sorghum in the Sudan. The delayed *Striga* emergence found in priming of sorghum with 66 g/l *Parkia* concentration compared to 100 and 0 g/l in 2012 and 2013 might be due to allelochemical in the *Parkia* pulp which inhibited *Striga* development at that concentration or level. A similar observation was made by Kolo and Mamudu (2008) that dressing of maize seed with P. *biglobosa* pulp gave better maize development both vegetative and in grain yield especially with the resistant varieties. The fewer *Striga* count, less *Striga* damage, taller plant height and higher grain yield at 66 g/l *Parkia* concentration compared to 100 and 0 g/l could be as a result of the delayed *Striga* emergence. Sorghum planted in July delayed *Striga* emergence compared to those planted in June could probably be due to high soil moisture which caused *Striga* seeds to undergo wet dormancy. Delayed planting caused the *Striga* seeds to be unable to germinate and the seedlings failed to attach to host due to unfavorable low soil temperatures during the middle of the rainy season as reported by Odhiambo and Arieja, (2004). This is also in agreement with work of Dugje *et al.,* (2008) that sowing maize in mid-July reduced *Striga* infestation compared to sowing in mid-May or mid-June in parts of the Northern and Southern Guinea Savanna of Nigeria. This could also be responsible for the best performance in *Strga* count, severity score, plant height and grain yield in July.

Table 1: Effects of sorghum varieties, soyabean intercropping, *Parkia* concentration and sowing dates on first *Striga* shoot emergence and *Striga* shoot count per plot of sorghum.

Treatment	DFE	SCP		DFE	SCP	
Sorghum variety		10	14		10	14
ICSV 1002	62.22	3.56	6.69	63.31	2.93	4.86
Local variety	57.72	9.17	13.64	59.5	6.44	8.44
Mean	59.97	6.37	10.17	61.41	4.69	6.65
LSD $_{(0.05)}$	0.33	0.70	0.92	0.47	0.5	0.65
Cropping system						
Sole sorghum	59.19	7.72	12.39	60.69	5.81	7.94
Sorghum + Soyabean	60.75	5	7.94	62.11	3.56	5.36
Mean	59.97	6.36	10.17	61.4	4.69	6.65
LSD $_{(0.05)}$	0.34	0.7	0.92	0.47	0.5	0.65
Parkia concentration (g/l)						
0	58.33	8.08	5.94	60.33	6.00	8.21
66	61.13	4.79	0.61	62.04	3.20	5.25
100	60.46	6.21	10.29	61.83	4.86	6.50
Mean	59.97	6.36	5.61	61.4	4.69	6.65
LSD $_{(0.05)}$	0.41	0.86	5.83	0.58	0.62	0.79
Sowing dates						
June	58.67	6.67	10.22	56.33	5.97	7.78
July	61.28	6.06	10.11	62.47	3.4	5.53
Mean	59.96	6.37	10.17	59.4	4.69	6.66
LSD $_{(0.05)}$	0.34	NS	NS	0.47	0.5	0.65

DFE: Day to first *Striga* emergence, SCP: *Striga* shoot count per plot, WAS: Weeks After Sowing NS: Non significant

Table 2: Effect of sorghum varieties, soyabean intercropping, *Parkia* concentration and sowing dates on severity score, plant height, and grain yield of sorghum

Treatment	SC	PH Weeks After Sowing		GY	SC	PH Weeks After Sowing		GY
		10	14			10	14	
Sorghum variety								
ICSV 1002	2.64	47.94	56.81	1543.10	2.39	49.86	57.64	1645.90
Local variety	5.00	33.19	42.28	1210.50	4.50	40.78	45.69	1213.00
Mean	3.82	40.57	49.55	1376.80	3.50	45.32	51.67	1429.50
LSD $_{(0.05)}$	0.17	1.67	1.57	25.95	0.29	1.32	1.02	27.73
Cropping system								
Sole sorghum	4.42	36.11	45.31	1313.00	4.28	43.00	48.81	1369.00
Sorghum + Soyabean	3.22	45.03	53.78	1440.60	3.72	47.64	54.53	1489.90
Mean	3.82	40.57	49.55	1376.80	4.00	45.32	51.67	1429.50
LSD $_{(0.05)}$	0.17	1.67	1.57	25.95	0.29	1.32	1.02	27.73
Parkia concentration (g/l)								
0	4.79	34.83	43.88		4.50	42.92	49.67	
66	2.38	44.62	53.12	1252.90	2.50	48.29	53.38	1378.00
100	3.29	42.25	51.62	1437.70	3.00	44.75	51.96	1494.40
Mean	3.82	40.57	49.54	1439.80	3.33	45.32	51.67	1416.00
LSD $_{(0.05)}$	0.21	2.05	1.93	1376.80	0.35	1.61	1.25	1429.50
Sowing dates				31.78				33.96
June	4.33	38.50	47.50		4.14	45.83	52.27	
July	2.31	42.64	51.58	1288.80	2.86	44.81	50.58	1356.90
Mean	3.32	40.57	49.54	1464.80	3.50	45.32	51.43	1502.10
LSD $_{(0.05)}$	0.17	1.67	1.57	1376.8	0.29	NS	1.02	1429.5

SC: Severity Score, PH: Plant height, GY: Grain yield, NS: Non significant

CONCLUSION

It was observed from the result obtained that resistant sorghum varieties did not support *Striga* infestation. In addition it was also observed that *Parkia* pulp product at 66g/1 concentration reduced *Striga* attack on sorghum. The study also revealed that intercropping soyabean with sorghum reduced capacity of increasing *Striga* seed bank in the soil. It can be seen that the trial revealed that integrated *Striga* control package used in this study could be used to reduce the effect of *Striga hermonthica* infestation on sorghum production.

RECOMMENDATONS

Farmers in *Striga* affected areas are urged to use *Parkia* pulp powder at 66g/1 concentrate and soyabean intercropped with sorghum in addition to resistance sorghum variety for effective *Striga* control.

REFERENCES

Akintayo I, Sedgo J (2001). Towards sustainable sorghum production, utilization, and commercialization in West and Central Africa. In Akintayo I, Sedgo J (eds) Proceedings of a Technical Workshop of the West and Central African Sorghum Research Network, 19-22 April 1999, Lomé, Togo. Bamako, BP 320, Mali: West and Central Africa Sorghum Research Network, and Patancheru 502 324, Andra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics, 162pp. ISBN 92-9066-4330-9. Order code CPE 131.

Babiker A.G.T., Hamdoun,K A.M. and Mansi N.G. (1987). Influence of some soil environmental factors on response of *Striga hermonthica* (Del.) Benth. Seeds to selected germination stimulants. In: Webers, H and forest renter weeds. *Parasitic flowering plants.proceeding of the4th international symposium on parasitic flowering plants, Marburg. Germany*. Pp. 53-66.

Botanga C.J., S.O., Alabi, C.A., Echekwu and S.T.O. Lagoke, (2003). Genetics of suicidal germinationof *Striga hermonthica* (Del.) benth by cotton. Crop Sci., **43,** 483-488.

Dugje I.Y., Kamara A.Y., Omoigui L.O. (2008). Influence of farmers' crop management practices on *Strigahermonthica* infestation and grain yield of maize (Zea mays L.) in the savanna zones of northeast *Nigeria. J. Agron.* **7 (1),** 33-40.

FAO. 2012. Database of agricultural production. FAO Statistical Databases (FAOSTAT). *http://faostat.fao.org/default.aspx* IITA (2004) *Nigeria Food Consumption and Nutrition Survey* (2001-2003) Assessed

Gressel J., Hanafi, A., Head G., Marasa W., Obilana A.B., Ochanda J., Souissi T. andTzotzos G., (2004). Major heretofore-intractable biotic constraints to African food security that may be amenable to novel biotechnogical solutions. *Crop Protection 2:, 661-689.***1 (4),** *375-380.*

IITA (2004) *Nigeria Food Consumption and Nutrition Survey* (2001-2003) Assessed International Institute of Tropical Agriculture (2002). Community workshop on *striga* and imperata management: Tarka local Government, Benue State, Nigeria, 18-21 March, 2002.

TA (2002). *Striga* biology and control strategies for African farmers. *IITA/DFIDIbadan, nigeria (CD Room).* p.111

Kolo, M.G. `and Mamudu A.Y. (2008). Water Treatment of *parkia biglobosa* pulp dressed maise (*Zea mays* L.) seeds for *Striga hermonthica*control at Minna, Nigeria.*Agricultural Subtropica*, **48 (3),** 96-106.

Oswald A., *Crop Protection* **24(4),** (2005) 333-342.

Rodenburg J., Bastiaan L., Kropff M. J., Ast Van A. (2006): Effects of host plant genotype and seedbank density on *Striga* reproduction. Weed Research, **46,** 251-263.

Rubiales D., Perez-de-Luque A., Joel M.D., Alcantara C., and Silero J.C. (2003). Charactization of resistance in chickpea to crenate broomrape (*Orobanche crenata*). *Weed Science*, **51**, 702-707.

Scholes D.J. and C.M. Press. (2008). *Striga* infestation of cereal crops-unsolved problem in resource limited agriculture. Curr. Opin. Plant Biol., **11,** 180-186.