DRESSING OF MAIZE (*ZEA MAYS* L.) SEED WITH *PARKIA BIGLOBOSA* (JACQ) R. BR. EXTRACTS TO CONTROL *STRIGA HERMONTHICA* (DEL.) BENTH.

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ABSTRACT

Field and pot experiments were carried out concurrently during the 2000 and 2001 rainy seasons in Minna (9° 37' and 6° 30'E) to control *Striga hermonthica* (Del.) Benth. using extracts of *Parkia bigblobosa* (Jacq.) R.Br. An equal volume of 2.5 ml of husk methanol extract, husk ash, husk powder, seed coat water extract, seed coat ash, boiled seed coat ash were used to dress 36 g of maize (*Zea mays* L.) seeds (DMR - ESR - W) just prior to sowing. The same quantity of maize seeds were soaked in boiled and cooled *Parkia* seed water for eight hours. The control seeds were not treated with any *Parkia* material. The seeds were then sown at 25 cm intra-row on ridges 75 cm apart in a field heavily infested with *S. hermonthica* or sown in pots (65 cm top diameter) artificially infested with *S. hermonthica* seeds (c. 1960 seeds/pot). The field experiment was laid out in a randomized complete block design with three replicates while the pots were arranged completely randomized. The data were subjected to analysis of variance. Results indicated that the greatest dry matter accumulation were found in maize plants whose seeds were dressed with *Parkia* seed coat ash. In addition, grain yield was 34% and 25% greater than the control in both years respectively although *S. hermonthica* shoot density was relatively high. On the other hand maize seeds soaked overnight in boiled and cooled seed supported the highest *Striga* shoot density both in the field and pots.

Key words: *Parkia biglobosa*, seed dressing, *Striga hermonthica*, control, *Zea mays*.

CITATION

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INTRODUCTION

The plant *Striga* belongs to the family Scrophulariaceae. It is found between latitude 7°N and 14° N in Nigeria where most of the grain cereals and legumes are produced by peasant farmers. Seven *Striga* species affect crop plants in Nigeria, out of which six are parasitic on cereals and of the six *Striga hermonthica* (Del) Benth. is the most important. Often levels of infestation may be so great that cereal production becomes unprofitable and farmers abandon the fields due to yield loses. Oikeh *et al.* (1996) and Lagoke *et al.* (1991) observed that 0 - 46% and 10 - 91% crop yield loss in savanna zones of Nigeria was due to the parasitic weed *Striga* respectively.

There are a wide range of known technologies for *Striga* control which differ in their resource requirement and efficiency in reducing its problem. Despite all efforts to control the weed, the survey of Lagoke *et al.* (1991) indicated that the problem is increasing in terms of spread from farm to farm and ecologically, intensity (population/area) and virulence (crop yield losses). The *Striga* problem is also compounded by multiple infestation with two or more parasitic weeds which infest both cereals and legumes. The control of *Striga* is difficult and involving due to production of large quantities of very small seeds capable of being viable in the soil for up to 20 years. In addition, it is also due to existence of ecologically specific strains, host specificity and occurrence of different strains on the same field. At present there is no single method available to control this very important weed that is both effective and economically useful for the peasant farmers in Nigeria. A more realistic approach is a package of integration of various methods of control.

The dressing of crop seed with chemicals have been observed to reduce *Striga* infestation and increase crop grain yield. Lagoke *et al.* (1991) observed that overnight soaking of maize seeds in extracts of boiled seeds of *Parkia biglobosa* (Jacq) R. Br. effectively increased maize grain yield and reduced the emergence of *S. hermothica*. It was also noted by Anon (1995); Kolo and Nkonchoson (2003) that *P. biglobosa* pod and seed extracts reduced *S. hermonthica* infestation in the field when the seed of the host crop was soaked in them overnight. Gworgwor *et al.* (2002) also observed soaking of millet seeds in cow urine for about 360 and 720 minutes supported less *S. hermonthica* emergence in three varieties of millet which resulted in higher grain yield.

Treatment of host crop seeds with herbicides have also been found to be effective against *Striga*. For example, the work of Ransome *et al.* (1996) with Imidazolinone on maize and Berner *et al.* (1994) with Imazaquine on cowpea. In addition, Kanampiu *et al.* (2003) observed that maize seed coating with Imazapyr and Pyrithiobac gave season-long *Striga* control resulting in a 3-4 fold increased crop yield in high *Striga* density area.

This study was carried out as a contribution to integrated management of *Striga* through host crop seed treatment. Since frequently reported work of this nature had focused on overnight soaking of host crop seed in extracts of boiled *P. biglobosa* seed or husk, we have expanded the scope of extracts in this study. The objectives of this study therefore was to evaluate the different forms of *P. biglobosa* seed or husk extracts for the control of *S. hermonthica*.

METHODS

Two experiments were carried out simultaneously in the field and pots in 2000 and 2001 rainy seasons to evaluate the potential of *P. biglobosa* extracts on S. *hermonthica* control. The extracts which constituted the treatments were obtained as described below.

Husk methanol extract: *P. biglobosa* husk was air dried and milled with a blender. A quantity (50 g) of the milled husk was put in a 157 cm^3 thimble which was then put in a 1 L soxhlet extractor and extracted with petroleum ether (40°C-60°C) for 12 hours. The defatted marc was air dried and further extracted for 48 hours. The methanolic extract was concentrated in the oven at 45°C for 72 hours after which the caked concentrate was milled into powder with laboratory mortar and pistle.

Husk ash: The husk of *P. biglobosa* was dried and milled with a blender. A known quantity (50 g) of the milled sample was put in a 1 L conical flask and 600 ml of distilled water added to it. It was thoroughly shaken after which the flask was set on a thermostat hot plate and brought to boil for four hours. It was allowed to cool and the substrate oven dried at 45°C for 24 hours. The oven dried substrate was thereafter ashed in muffle furnace at 500°C for four hours.

Husk powder: The husk of *P. biglobosa* was milled with a blender after it had been sun dried. The milled substance constituted husk powder.

Seed coat water extract: The seed coat of *P. biglobosa* was removed from the endosperm using a plier. The seed coat was thereafter pounded in laboratory mortar and pistle after which it was milled with a blender. The powder was then extracted following the procedures described above for husk methanol extract to obtain the marc. However, the dried marc was extracted with distilled water by maceration and the aqueous extract was concentrated over a water bath.

Seed coat ash: The seed coat was removed from the endosperm with a plier, milled and processed as described previously for husk ash.

Boiled seed coat ash: Whole *P. biglobosa* seeds were put in a 1 L conical flask, water was added to cover the content and brought to boil on a hot plate for two hours. The seed coat was hand removed on cooling, air dried and 50 g was ashed in a muffle furnace at 500°C for four hours.

Boiled seed water: Whole seeds of *P. biglobosa* was boiled as described for boiled seed coat ash treatment. The boiled material was allowed to cool and its water decanted into an empty flask for use later.

Control: The control treatments were non- dressing of maize seed with *P. biglobosa* for both field and pot studies.

The studies were carried out in Minna, Niger State (9° 37' N, 6° 33' E) in a *S. hermothica* infested field and artificially infested pots. Ridges 75 cm apart were manually constructed on 6 July, 2000 and 18 July, 2001 and each plot had five ridges each 4 m long. The eight treatments were laid out in a randomized complete block design in the field and replicated three times. Downy mildew resistant, early maturing and streak resistant white seeded maize (DMR - ESR - W) were dressed with equal quantity (2.5 ml) of various *P. biglobosa* extracts.

Two maize seeds were sown per hill at 25 cm intra - row on 7 July, 2000 and 19 July, 2001 and thinned to one plant per stand at two weeks after sowing (WAS). The first hoe weeding was carried out on 31 July, 2000 and 14 August, 2001; thereafter weeds other than *S. hermonthica* were hand pulled at 3 and 6 weeks after the first hoe weeding.

The experiment described above was also set up in 4 L pots with 65 cm top diameter. The pots reduced the emergence of *S. hermothica*. It was also noted by Anon (1995), Kolo and Nkonchoson (2003) that *P. biglobosa* pod and seed extracts reduced *S. hermonthica* infestation in the field when the seed of the host crop was soaked in them overnight. Gworgwor *et al.* (2002) also observed soaking of millet seeds in cow urine for about 360 and 720 minutes supported less *S. hermonthica* emergence in three varieties of millet, which resulted in higher grain yield.

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The experiment described above was also set up in 4 L pots with 65 cm top diameter. The pots which were perforated at the bottom for free water drainage were filled with *Striga* - free top soil. Each pot was infested with 0.02 g of *S. hermonthica* seeds (c. 1960 seeds) and arranged in complete randomized design with four replicates each year. The pots were left under rain on a plat form for three weeks to pre-condition the *Striga* seeds. The *P. biglobosa* extracts used for field experiment were also used to dress the same maize variety and sown two per plot on 7 July, 2000 and 20 July, 2001. The plants were later thinned to one per pot at 2 WAS. The maize was harvested at 15 WAS in both years of study. Data were taken on both *Striga* and maize plant and subjected to analysis of variance (ANOVA) using computer statistical package. Means of data were separated using Duncan Multiple Range Test (DMRT).

RESULTS

Maize plant height: This was not significantly affected by the treatments and the results did not follow a particular trend in both years of study in the field (Table 1). For instance, while maize dressed with *Parkia* husk ash and boiled seed water extract produced the tallest plants (1.8 m) in 2000, reverse was the case in 2001 rainy season. While height of maize plants grown in pots differed significantly in 2000 rainy season, it did not in 2001 and like field study, there was no trend of behaviour in the two years of study (Table 1). For example, maize seeds dressed with *Parkia* seed coat ash or seed coat water extract gave rise to the tallest (58. 6 cm) plants in 2000, the latter was almost the shortest (73.7 cm) in 2001 rainy season. The plants dressed with boiled seed water was significantly shorter (47.9 cm) than those dressed with either seed coat ash in the rainy season of 2000.

Table 1: Effect of *Parkia biglobosa* extracts maize seed treatment on maize plant height at harvest in a *Striga hermonthica* infested field and pot.

Parkia extract	Field (m)		Pot (cm)	
	2000	2001	2000	2001
Husk methanol	1.6ᵃ	1.3ᵃ	56.4ᵃᵇ	95.5ᵃ
Husk ash	1.8ᵃ	1.1ᵃ	51.9ᵃᵇ	87.3ᵃ
Husk powder	1.7ᵃ	1.2ᵃ	54.8ᵃᵇ	71.4ᵃ
Seed coat water	1.7ᵃ	1.3ᵃ	58.6ᵃ	73.8ᵃ
Seed coat ash	1.7ᵃ	1.4	58.6ᵃ	76.3ᵃ
Boiled seed coat ash	1.7ᵃ	1.5ᵃ	55.9ᵃᵇ	81.9ᵃ
Boiled seed water	1.8ᵃ	1.2ᵃ	47.9ᵇ	74.0ᵃ
Control (no seed dressing)	1.7ᵃ	1.2ᵃ	52.2ᵃᵇ	98.4ᵃ

Means with common letter(s) in the same column are not significantly different at the 5% level of significance by DMRT.

Maize shoot dry matter: The shoot dry matter of maize grown in the field did not show any significant differences among the treatments during 2000 rainy season (Table 2). However, in 2001 maize dressed with seed coat ash was highly significantly greater (1.8 t/ha) than those obtained from all other treatments. The shoot dry matter of maize grown in pots in 2000 rainy season indicated that the treatments differed significantly, however that was not the case in 2001 (Table 2). The seed coat ash treatments though not different statistically from the control it significantly produced plants with greater dry matter than those dressed with either husk ash or soaked overnight in boiled seed water.

Maize grain yield: The results of maize grain yield are shown in Table 3. There were no significant differences between the treatments in both years of field study. Maize grown in pots could not produce grain.

Table 2: **Effect of *P. biglobosa* extracts maize seed treatment on maize shoot dry matter in a *S. hermonthica* infested field and pot.**

Parkia extract	Field (kg/ha)		Pot (g/plant)	
	2000	2001	2000	2001
Husk methanol	500.0^{a}	642.9^{acd}	1.8^{abc}	4.2^{a}
Husk ash	428.6^{a}	714.3^{cd}	1.2^{bc}	3.7^{a}
Husk powder	500.0^{a}	428.6^{ad}	1.7^{abc}	3.9^{a}
Seed coat water	642.9^{a}	1071.4^{bc}	2.3^{ab}	3.9^{a}
Seed coat ash	914.3^{a}	1785.7^{b}	2.5^{a}	5.4^{a}
Boiled seed coat ash	357.2^{a}	857.1^{acd}	2.6^{a}	2.7^{a}
Boiled seed water	785.7^{a}	571.4^{acd}	1.0^{c}	3.2^{a}
Control (no seed dressing)	714.3^{a}	928.6^{ad}	2.9^{a}	5.7^{a}

Means with common letter(s) in the same column are not significantly different at the 5% level of significance by DMRT.

Table 3: **Effect of *P. biglobosa* extracts maize seed treatment on maize grain yield (kg/ha) in a *S. hermonthica* infested field.**

Parkia extract	Season		
	2000	2001	mean
Husk methanol	285.7^{a}	142.9^{a}	214.3
Husk ash	500.0^{a}	142.9^{a}	321.5
Husk powder	357.1^{a}	214.3^{a}	285.7
Seed coat water	428.6^{a}	285.7^{a}	357.2
Seed coat ash	428.6^{a}	428.6^{a}	428.6
Boiled seed coat ash	500.0^{a}	357.1^{a}	428.6
Boiled seed water	500.0^{a}	214.3^{a}	357.2
Control (no seed dressing)	428.6^{a}	214.3^{a}	321.5

Means with common letter(s) in the same column are not significantly different at the 5% level of significance by DMRT.

Striga hermonthica growth: The results of both years of study showed that *S. hermonthica* shoot density at harvest was significantly more in seed coat ash treated maize than all other treatments in 2001 (Table 4). All other treatments whether in the field or in pots did not vary significantly in both years of study.

Table 4: **Effect of *P. biglobosa* extracts maize seed treatment on *S. hermonthica* average shoot density at harvest (15 WAS).**

Parkia extract	Field (*Striga*/m²)		Pot (*Striga*/pot)	
	2000	2001	2000	2001
Husk methanol	2.3^{a}	0.9^{a}	3.8^{a}	3.8^{a}
Husk ash	2.1^{a}	1.0^{a}	2.0^{a}	3.5^{a}
Husk powder	2.4^{a}	1.2^{a}	5.0^{a}	3.8^{a}
Seed coat water	2.8^{a}	0.8^{a}	3.8^{a}	3.3^{a}
Seed coat ash	3.0^{a}	9.0^{b}	1.5^{a}	1.8^{a}
Boiled seed coat ash	2.8^{a}	1.3^{a}	4.0^{a}	4.5^{a}
Boiled seed water	3.2^{a}	1.0^{a}	3.8^{a}	5.0^{a}
Control (no seed dressing)	1.6^{a}	1.1^{a}	1.5^{a}	1.6^{a}

Means with common letter(s) in the same column are not significantly different at the 5% level of significance by DMRT.

DISCUSSION

We noted that none of the different extracts of *P. biglobosa* consistently controlled *S. hermonthica* in the two years of study. This result is similar to that obtained by Gworgwor *et al.* (2002) who did not observe significant difference in *Striga* density and grain yield and their interaction with time of soaking varieties of millet in cow urine for *Striga* control in Maiduguri, Nigeria. In a similar study for *S. hermonthica* control, Gworgwor (2000) did not observe significant difference in sorghum yield whether it was intercropped with groundnut or not. This not withstanding, the study revealed that *P. biglobosa* seed coat ash was generally most effective against *S. hermonthica*. The study showed that seed coat ash produced better maize plants for the latter than that soaked overnight in boiled seed water as previously reported by Lagoke *et al.* (1991); Anon (1995); Kolo and Nkonchoson (2003). Despite the greatest support of *Striga* density, maize seeds dressed with *P. biglobosa* seed coat ash produced the tallest plants, greatest shoot dry matter and grain in consonance with the work of Adagba *et al.* (2003). He observed that FARO 45 and FARO 38 produced grains comparable to the maximum grain yields inspite of support of high *Striga* infestation on dressing upland rice seed with sulfonyl urea herbicide. The ability of seed coat ash treated maize to support *Striga* infestation and yet produced the greatest grain was an indication that such plants exhibited some level of tolerance.

Host crop seed treatment protocol could be used in an integrated programme for *S. hermonthica* control thereby reducing the soil seed bank. This study further increase the array of such seed treatments since the control of the weed has become intractable.

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