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Effects of varying levels of *Parkia biglobosa* pulp for the control of *Striga genesnerioides* (WILD) in cowpea *Vigna unguiculata* (L) WALP.

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ABSTRACT

Field trials were conducted in 2012 and 2013 at the Teaching and Research Farm of the Department of Agricultural Technology, Plateau State College of Agriculture, Garkawa ($08^0$52'N, $69^0$24'E) to evaluate the effect of different *Parkia* pulp levels in the control of *Striga gesnerioides* in the Southern Guinea Savannah of Nigeria. The treatments consisted of different *Parkia* rates, applied per hole before planting, thus: 1.0, 2.0, 3.0, 4.0 g/ hill, seed coated with *Parkia* pulp before planting and control (no *Parkia* pulp). These treatments were laid out in a Randomized Complete Block Design and replicated three times. The result indicated general delay in the emergence of *Striga* when *Parkia* pulp was applied. Similarly, application of 2, 3 and 4 g/ hill of *Parkia* pulp before planting significantly reduced the number of crop plants infested with *Striga* and *Striga* shoot count while crop vigour was increased. Generally, application of *Parkia* products significantly delayed flowering of *Striga* and reduced number of capsules per *Striga* plant. Crop maturity was earliest in the no *Parkia* treatment. Number of pods per net plot, pod weight and grain yield were not significantly affected by the *Parkia* treatments though the general trend showed increase with increase in the *Parkia* pulp up to 3.0 g/hill: however the use of 4.0 g/hill and the seed coated treatments did not show increase in grain yield. The application of *Parkia* pulp reduced significantly the number of capsules per plant of *Striga*. The implication of this is that there will be depletion of seed bank build up for future infestation, thereby ensuring control of *Striga* over time.

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Key words: *Parkia* pulp, Control, *Striga gesnerioides*, Cowpea.

INTRODUCTION

Cowpea, *Vigna unguiculata* (L) Walp is one of the most important and widely grown legume crops in the savannah and Sahel regions of Africa (Steele, 1976). The relatively high protein content (23%) makes cowpea an important supplement to the diet of many African people (Bressani, 1985) who consume cereals, roots and tubers which are high in carbohydrates and low in protein. The cowpea haulm provides valuable animal feed during the dry season. An important feature of cowpea is that it fixes atmospheric nitrogen through symbiosis with nodule bacteria (*Bradyrhizobium* sp), thereby increasing N levels in the soil for the benefit of the following crop in a rotation. However, despite the economic importance of cowpea in Sub-Saharan Africa and its widespread high potential, its growth and yield are constrained by several biotic and abiotic factors. These include insect pests and diseases, parasitic flowering plants and nematodes. Among these biotic constraints, *Striga gesnerioides* (Wild) Vatke, an obligate, root-parasitic flowering plant of the family Orobanchaceae is a formidable constraint to cowpea production, especially in the dry savanna. Cowpea yield losses associated with *Striga gesnerioides* have been reported to range between 83 and 100% (Cardwell and Lane, 1995). On susceptible local varieties, Emechebe *et al.* (1991) reported 100% yield losses on farmers' fields in the Northern Guinea Savanna of Nigeria. In a survey of the level of *Striga gesnerioides* infestation on farmers fields, Dugje *et al.* (2006) reported that more than 81% of the fields grown to cowpea in North Eastern Nigeria were infested with *S. gesnerioides* and subjected to serious crop losses. Various control measures, including cultural practices, chemical and biological control measures and host plant resistance have been suggested (Boukar, 2004) but no single field method seems to be fully adequate. There is therefore the need to explore other means of controlling this noxious parasitic weed that can be afforded by the resource poor cowpea producers in the sub-Saharan region.

Several workers have reported on the use of plant materials to control *Striga* spp. Kambou *et al.* (1997) reported the use of *Parkia* products *(Parkia biglobosa)* powder to control *S. hermonthica.* They reported that *Parkia* products improved the soil agrochemicals of the soil. According to Field and Latinga (1989), tannins are the main secondary exudates in *Parkia* and are toxic to animals especially in aquatic areas. Lane *et al.* (1991) reported the presence of triterpenes carotenoids, tannins and polyphenolic compounds in *Parkia* fruits. Kambou *et al.* (1997) reported germination inhibition of 97-100% and 92% when untreated powder extract and decorticated powder of *Parkia* were used respectively. Marley *et al.* (2004) reported 29.1 and 38.8% reduction of *Striga* emergence under a field and screen house conditions when fruit and fruit powder of *Parkia* were used respectively. Yonli *et al.* (2010) conducted a study to evaluate the allelopathic properties of endogenous plant species against *S. hermonthica* (Del) Benth and reported that *Parkia biglobosa* peels completely inhibited *Striga* seed germination. Magani *et al.* (2010) reported great advantage in using *Parkia* based products as pre-sowed treatments and thereafter followed by post emergence application of 2-4-D or Triclopyr (herbicides) at the rate of 0.36kg ai/ha to control *S. hermonthica.* Therefore this study was undertaken to evaluate the effect of varying levels of *Parkia* fruit pulp in controlling *S. gesnerioides* infesting cowpea.

MATERIALS AND METHODS

Field trials were conducted in 2012 and 2013 at the Teaching and Research Farm of the Department of Agricultural Technology, Plateau State College of Agriculture, Garkawa ($08^{0}52$'N; $09^{0}24$'E) in the Southern Guinea Savannah where sandy loam is the dominant soil type. The trials were established in a field that has previously been observed to be heavily infested with *Striga gesnerioides*. The land was ploughed, harrowed and ridged at 0.75 m apart.

Preparation of the *Parkia* pulp

Matured and well dried *Parkia* fruits were purchased from producers in Garkawa town. The fruits were peeled, air dried for 3 days and then pounded in a mortar to separate the pulp from the seeds. The fruit pulp was then ground into fine powder (<1mm) and stored in a dry place until when needed.

Plat material

A local genotype (land race) Gazum known to be susceptible to *S. gesnerioides* was used as a test material.

Experimental design and cultural practices

The treatments consisted of six levels of *Parkia* pulp (1.0, 2.0, 3.0 and 4.0g seed coated and no *Parkia* control).The treatments were laid out in a Randomized Complete Block Design with three replications. Each plot consisted of four rows, 4m long at spacing of 0.02m intra row and 0.75m inter row. The land was ploughed, harrowed and ridged at 0.75m apart. Three cowpea seeds were planted per hole on 26th August and 25th August 2012 and 2013 respectively. Thinning was done at two weeks after sowing (WAS) to give two plants per stand. *Parkia* Powder was applied in each hole before planting the seed at the rate of 0, 1, 2, 3, and 4g per hole, according to the treatments. Seed coating was done by adding cowpea seeds to slurry of *Parkia* pulp and mixed properly to ensure that the *Parkia* product was properly coated on the seeds. The seeds were then removed from the slurry and spread on wire mesh for two hours under the sun to dry before planting. Weed control was done manually at 3 and 4 WAS. Thereafter hand pulling was employed to avoid damage to *Striga* plants. Fertilizer was applied by band method at 2 WAS at the rate of 100 kg ha^{-1} of NPK (15:15:15) compound fertilizer to give an equivalent of 15kg a.i. ha^{-1}N, $P_{2}05$ and $K_{2}0$ respectively. Insects were controlled with chemical insecticides by spraying at 5% flower initiation and at 2 weeks intervals thereafter with BEST Action Cypermethrin plus Dimethoate at rate of 1.5 litres/ha, using a knapsack sprayer. The trials were established in a field that had previously been observed to be heavily infested with *S. gesnerioides*.

Data collected and analysis

Data were taken on number of days to first *Striga* emergence, number of crops infested with *Striga* at 9 and 12 WAS, crop damage score at 9 and 12 WAS, number of days to first flowering of *Striga*, number of capsules/*Striga* plant, pod number, pod weight and grain yield Kg^{-1} of cowpea from the net plot. All data were subjected to an Analysis of Variance using PROC user's manual, version 9.1 SAS Institute (2002) and means were compared using Least Significance Difference (LSD).

RESULTS AND DISCUSSION

The result of varying levels of *Parkia* pulp on days to first emergence of *Striga* is presented in Table 1. The result showed that application of 4 grams per hill of *Parkia* powder significantly delayed the emergence of *Striga* by 8 and 6 days when compared with the no *Parkia* check in 2012 and 2013 respectively. In 2012 and also the average of the two years, the result showed no significant difference when *Parkia* pulp was applied at the rate 1, 2, 3 and 4 grams per hill. In 2013 however, there was significant difference between the highest number of days to *Striga* emergence obtained at 4.0 grams *Parkia* pulp per hill and the other *Parkia* rates. The lowest number of days to first *Striga* emergence was recorded at the no *Parkia* check throughout the period of the observation. Kolo and Mamudu (2008) had reported delayed emergence of *Striga* shoot when concentrated seed pulp of *Parkia* was applied. Delayed emergence of *Striga* seeds with application of more *Parkia* seed pulp could be as a result of higher concentration of allelochemicals in the *Parkia* pulp. Magani *et al*. (2009) had reported the strong allelopathic potential of *Parkia* based products. had significantly the highest number of crops infested with *Striga* in 2012, 2013 and the average of the two years. Generally, the lowest number of crops infested with *Striga* was at 4.0g *Parkia* pulp per hill, though not significantly different when compared with those obtained at 2.0 and 3.0 grams

Table 1. Effect of *Parkia* pulp levels on number of days to first *Striga* emergence.

Parkia level	Days to first *Striga* emergence		
Grams/hill	2012	2013	Combined
1.0	41.67a	36.67cd	39.17ab
2.0	35.67ab	40.00b	37.83ab
3.0	39.00ab	38.33bc	38.67ab
4.0	40.33a	42.33a	41.33a
Seed coated	35.67ab	36.00d	35.83bc
Control	32.67b	32.67e	32.67c
LSD 0:05	6.406	2.178	3.877

Means in a column followed by the same letter(s) are not significantly different at 5% level of probability using LSD

Table 2. Effect of *Parkia* pulp levels on number of crops infested with *Striga* at Garkawa in 2012 and 2013 cropping seasons.

Parkia level	Crops infested with *Striga* at 9WAS			Crops infested with *Striga* at 12		
Grams/hill	2012	2013	Combined	2012	2013	Combined
1.0	9.00b	11.67b	10.33c	8.67b	15.33b	12.00c
2.0	8.00b	8.33bc	8.17cd	9.00b	11.33c	10.67d
3.0	6.00b	6.00c	6.00d	7.00bc	8.00d	7.50e
4.0	5.33b	5.33c	5.33d	6.00c	6.67d	6.33e
Seed Coated	16.00a	10.67b	13.33b	20.00a	13.00bc	16.67b
Control	18.67a	20.33a	19.50a	22.00a	21.00a	21.50a
LSD 0:05	3.902	3.811	2.997	2.178	3.316	1.272

Means in a column followed by the same letter(s) are not significantly different at 5% level of probability using LSD.

Table 3. Effect of *Parkia* pulp levels on *Striga* shoot count at Garkawa in 2012 and 2013 cropping seasons

Parkia level	*Striga* shoot count at 9WAS			*Striga* shoot count at 12WAS		
Grams/hill	2012	2013	Combined	2012	2013	Combined
1.0	40.67bc	50.67b	45.67b	76.67ab	65.00b	70.83b
2.0	28.00c	28.00c	28.00c	37.67b	33.00c	35.33c
3.0	23.33c	25.00c	24.17c	32.33b	30.67c	31.50c
4.0	22.00c	22.67c	22.33c	28.00b	28.67c	28.33c
Seed Coated	56.33b	58.33b	57.33b	65.33b	65.33b	65.33b
Control						
	105.67a	102.00a	103.83	123.00a	115.67a	119.33a
LSD 0:05	23.583	10.863	15.386	49.864	12.733	25.593

Means in a column followed by the same letter(s) are not significantly different at 5% level of probability using LSD.

per hill. Fewer number of crops infested with *Striga* at higher concentration of *Parkia* pulp could be attributed to higher dosage of allelochemicals in the *Parkia* pulp which inhibited the attachment and emergence of most of the *Striga* shoots and therefore fewer number of crops infested.

The effect of *Parkia* pulp levels on *Striga* shoot count at 9 and 12 WAS, in 2012 and 2013 as presented in Table 3 shows that *Striga* shoot count was lowest at 4.0g per hill throughout the period of the observation in 2012 and 2013. In addition, the differences between 4.0g, 2.0g and 3.0g were not significant throughout the season during both years of study. *Striga* shoot counts were significantly highest in the control treatment followed by seed coating and the 1.0g pulp treatments. Lower *Striga* shoot counts obtained on plants having *Parkia* pulp treatments confirms the report of Magani *et al*, 2009 that maize seeds soaked in *Parkia* fruit powder had significantly lower number of emerged *Striga*, indicating that *Parkia* based products possess a strong allelopathic potentials and exhibits strong inhibition of *Striga* emergence.

The effect of *Striga gesnerioides* on cowpea damage severity score at 9 and 12 WAS in 2012 and 2013 as given in Table 4 showed significant variation between *Parkia* pulp treatments and the no *Parkia* check. The no *Parkia* control had significantly the most damaged crops throughout the period of observation except at 9 WAS in 2012 when damage score of no *Parkia* crops was at par with those of the *Parkia* treatments. Similarly, crops that were treated with 2, 3 or4grams of *Parkia* pulp and the seed coated plants had similar vigour score, throughout the period of observation in 2012 and 2013.

That most damaged plants were observed in no *Parkia* check is not surprising since it recorded early emergence of *Striga* (Table 1), more crops infested with *Striga* (Table 2) and higher *Striga* shoot count (Table 3). The results suggest that *Striga* seed germination and /or attachment to the host roots were inhibited in the *Parkia* treatments resulting in increased vigour of the crops. Crop damage symptom score scale (1-5) where: 1 = normal crop plant growth; 2 = no chlorosis; 3 =

Table 4. Effect of *Parkia* pulp levels on crop vigour atGarkawa in 2012 and 2013 cropping seasons.

Parkia level	Crop damage score at 9WAS			Crop damage score at 12WAS		
Grams/hill	2012	2013	Combined	2012	2013	Combined
1.0	2.33a	2.67ab	2.50ab	3.00b	3.33ab	3.17b
2.0	2.33a	2.33b	2.33b	2.67bc	2.33c	2.50c
3.0	2.33a	2.00b	2.17b	2.33c	2.67bc	2.50c
4.0	2.33a	2.00b	2.17b	2.33c	2.67bc	2.50c
Seed Coated	2.33a	2.33b	2.33b	2.67bc	2.67bc	2.67c
Control	3.33a	3.33a	3.33a	3.67a	4.00a	3.83a
LSD 0:05	1.102	0.978	0.841	0.636	0.920	0.469

Means in a column followed by the same letter(s) are not significantly different at 5% level of probability using LSD.

no blotching; 4 = no leaf scorching and 5 = total corching or and obviously stunted or dead plants.

WAS = Weeks after sowing Table 5 shows the effect of *Parkia* pulp levels on number of days to first flowering of *Striga* and number of capsules per *Striga* plant in 2012 and 2013. The results revealed significant variations among the treatments in number of days to first flowering of *Striga* and number of capsules per *Striga* plant. Seeds coated with *Parkia* pulp and the non-treated seeds recorded significantly early flowering of *Striga* plants compared with those treated with the other *Parkia* levels in 2012, 2013 and the average of the two years. *Striga* flowering was delayed most with application of 1, 2 and 3 grams of *Parkia* pulp per hill in 2012; 2, 3 and 4 grams in 2013 and 2 and 3 grams in the average of the two years.

Similarly there were significant differences among the *Parkia* pulp treatments in the number of capsules per *Striga* plant. The no *Parkia* check produced significantly the highest number of capsules per *Striga* plant, though the difference was not significant compared with the seed coated plants and those treated with 1, 2 and 3 grams *Parkia* pulp per hill. 4 grams *Parkia* pulp per hill had significantly the lowest number of capsules per plant of *Striga* though similar with those obtained at 1, 2 and 3 grams *Parkia* pulp per hole and the seed coating treatment. This shows that application of *Parkia* pulp reduced significantly the number of capsules per plant of *Striga*. The implication of this is that there will be depletion of seed bank build up for future infestation, thereby ensuring control of *Striga* over time.

Table 6 shows the effect of *Parkia* pulp levels on days to crop maturity and number of pods per net plot in 2012 and 2013. There was significant variation in number of days to crop maturity among the *Parkia* treatments. In 2012, 4g pulp per hill had the highest number of days to crop maturity, though significantly similar compared with the no *Parkia* control and other *Parkia* treatments except seed coated which had significantly lower number of days to crop maturity. In 2013 and the average of the two years however, there was significant delay in maturity of crops treated with *Parkia* pulp compared with the no *Parkia* check. 4g*Parkia* pulp per hil had significantly the highest number of days to crop maturity, followed by 3g and 2g *Parkia* pulp per hill. Seed coated with *Parkia* pulp and the no *Parkia* check recorded significantly, the lowest number of days to crop maturity. It is interesting to note that these treatments with plants that matured earlier recorded early *Striga* emergence (Table 1), more crops infested with *Striga* (Table 2) and more *Striga* shoot count (Table 3). Probably, the early maturity recorded by these heavily infested plants was the result of stress and not due to biological maturity. Although not significant, the number of pods per net plot was highest at 3g *Parkia* pulp per hole in 2012 (Table 7). In 2013 and average of two years, the highest number of pods per net plot was recorded at 2g *Parkia* pulp per hole, though not significant when compared with the other *Parkia* treatments. The effect of *Parkia* pulp levels on pods weight and grain yield as presented in Table 7 did not show significant differences among the treatments.

Table 5. Effect of *Parkia* pulp levels on number of days to first flowering of *Striga* and number of capsules per *Striga* plant at Garkawa in 2012 and 2013 cropping seasons.

Parkia level	Days to First Flowering of *Striga*			Number of capsules per *Striga* plant		
Grams/hill	2012	2013	Combined	2012	2013	Combined
1.0	47.33a	42.33b	44.83b	293.00ab	304.00ab	298.50ab
2.0	47.00a	48.00a	47.50a	252.33ab	300.67ab	276.50ab
3.0	47.33a	47.67a	47.50a	245.00ab	299.00ab	272.00b
4.0	43.00b	47.00a	45.00b	227.33b	281.33b	254.33b
Seed Coated	41.67b	42.00b	41.83c	293.00ab	301.67ab	297.33ab
Control	42.67b	41.00b	41.83c	310.00a	329.00a	319.50a
LSD 0:05	2.678	2.594	2.133	81.338	34.422	46.494

Means in a column followed by the same letter(s) are not significantly different at 5% level of probability using LSD.

Table 6. Effect of *Parkia* pulp levels on number of days to crop maturity and number of pods per net plot at Garkawa in 2012 and 2013 cropping seasons.

Parkia level Grams/hill	Days to Maturity			Number of pods per net plot		
	2012	2013	Combined	2012	2013	Combined
1.0	63.00ab	63.00c	63.00c	214.33a	169.33a	191.83a
2.0	64.33ab	64.00bc	64.17b	239.33a	174.33a	206.83a
3.0	64.67a	65.00b	64.83b	248.67a	115.00b	181.83a
4.0	65.00a	67.00a	66.00a	191.67a	142.33ab	167.00a
Seed Coated	62.33b	63.00c	62.67c	196.67a	157.00ab	176.83a
Control	63.00ab	62.67c	62.83c	205.33a	162.33a	183.83a
LSD 0:05	2.144	1.747	0.830	149.50	42.116	72.58

Means in a column followed by the same letter(s) are not significantly different at 5% level of probability using LSD

The general trend however showed that grain yields were higher when *Parkia* pulp was applied with increase of the *Parkia* pulp up to 3.0 g/hill: however the use of 4.0g/hill and the seed coated treatments did not show increase in grain yield. In 2012, the highest yield was obtained at 3g *Parkia* pulp followed by 2g *Parkia* pulp per hole. In 2013, the highest yield was at 2.0g *Parkia* pulp followed by 3.0g *Parkia*pulp per hill while the average of the two years showed that the highest yield was obtained at 3g *Parkia* pulp per hill. Magani *et al.* (2010) had reported significant increase in grain yield of maize when seeds were soaked in *Parkia* based products before planting.

The results revealed potential in *Parkia* pulp for the control of *S. gesnerioides* parasitizing cowpea. The application of *Parkia* pulp reduced significantly the number of capsules per plant of *Striga*. The implication of this is that there will be depletion of seed bank build up for future infestation, thereby ensuring control of *Striga* over time. *Parkia* pulp is a by-product of *Parkia* fruit processing which is cheap and can be obtained from local markets. It is therefore recommended for inclusion by farmers in integrated *Striga* management strategy.

Table 7. Effect of *Parkia* powder levels on pod weight per net plot and grain yield at Garkawa in 2012 and 2013 cropping seasons.

Parkia level	Pod weight (Kg/ha)ne plot			Grain yield (Kg/ha)		
Grams/hill	2012	2013	Combined	2012	2013	Combined
1.0	247.70a	212.58a	230.54a	176.38a	158.02a	167.20a
2.0	237.92a	227.67a	232.79a	187.50a	163.06a	175.28a
3.0	239.04a	222.04a	230.54a	195.83a	158.67a	177.25a
4.0	217.09a	229.93a	223.51a	168.74a	148.52a	158.63a
Seed Coated	237.00a	227.43a	232.22a	160.17a	150.00a	155.08a
Control	246.96a	233.03a	240.00a	150.50a	144.83a	147.67a
LSD 0:05	174.92	37.768	87.78	121.37	29.015	64.865

Means in a column followed by the same letter(s) are not significantly different at 5% level of probability using LSD

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