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Allelopathic Effect of Aqueous Extract of *Parkia Biglobosa* (L.) on Some Weeds in Gombe State, Nigeria

Jedidah Akawu Jacob[1,a*], Bappah-yaya Usman[1,b], Cleophas Billah Ajiya[1,c]

[1]*Department of Botany, Gombe State University, Gombe State, Nigeria*
[*]*Corresponding author*

A R T I C L E   I N F O

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A B S T R A C T

This study examined the allelopathic effect of different concentration of aqueous extracts of Parkia biglobosa stem bark on the germination and growth of weed seeds species. Seeds of *Eragorastis tenella, Eragorastis atrovirens, Pannicum pedicellata, Pennisetum sub albidum, Hypharrhenia rufa and Brcichiaria brizantha* were tested for plumule germination and radicle growth with three different concentrations of 1%, 5%, 10% plant extract while ordinary water was used as control. Growth parameters including germinated weeds population were measured; the highest germinated weeds population was at the control (8.06±3.97) and the least was obtained from the 10% concentration with the mean of (4.42±2.59). Weeds population decreased as the concentration increased. The highest mean of weeds height was recorded from 1% concentration (11.46±7.08) which is statistically significant while the least mean was recorded from 10% concentration (7.69±6.70) statistically not significant. The family emergence by concentration indicated that, the experiment under control had (4 families) for 1% (2 families), 5% (2 families) and 10% (4 families) emerged. The germination, radicle and plumule length were inhibited when compare with control and the inhibition was statistically not significant at.

[a] jedidahakawu@gmail.com https://orcid.org/0000-0002-3379-4906
[b] usmanbappahyaya90@gmail.com https://orcid.org/0000-0001-6078-8360
[c] cleophasbillah1@gmail.com https://orcid.org/0000-0001-9310-1844

Introduction

Weeds are a major constraint to the production of food in sub-Saharan Africa, particularly for economically important crops, maize, rice, millet, and sorghum (Yonli et al., 2010; Ibrahim et al., 2014). In West Africa, weeds have caused huge losses ranging from 40 – 90% (Gressel et al., 2004) less of average crop yield. Most weeds can produce large amount of seeds that can remain viable in contaminated soils for a significant period (Adesoji, 2004). Several methods of control against different weed species have been recommended ranging from chemical, biological, cultural and physical methods. For example, crop rotation, use of fertilizer, herbicides, trap cropping and use of ethylene gas have been recommended for the control of Striga species (Radi, 2007; Yonli et al., 2010). Unfortunately, most adapted control techniques are ineffective and rarely adopted by resource-poor African farmers (Hess and Grarf, 2000). Often, the use of chemicals like herbicides, pesticides and more seems effective, however, chemical compounds are expensive and ill-fated for humans (Alan et al., 2011). Often at times, the application of chemicals damages the host crop and causes environmental pollution.

An alternative approach to weed control is the use of natural products that would inhibit the germination of weed seeds or foliage growth. Allelopathy have been exploited for weed control in agriculture around the world (Bayala and Teilalehaimant, 2008; Alamu and Olabode, 2014). A number of plants species have been reported to possess phytotoxins or chemicals with inhibitory (allelopathic) effects on the growth and development of other plant species. The allelochemicals are released into soil either from living or dead plants through root exudation, leaching, volatilization and decomposition of plant residue (Kayode and Ayeni, 2009). Then the toxins, act by blocking hydrolysis of nutrient reserve and cell division (Irshad and Cheema, 2004) and cause huge reduction in the growth of plumule and radical of various crops (Ashrafi et al., 2007; Dhole et al., 2013).

Chou and Lin (1976) found aqueous extracts of decomposing rice residue in soil inhibited the growth of lettuce and rice seedlings. Also, Cheema and Kaliq (2000) found aqueous extracts from sorghum to suppress weed populations in wheat, maize and bean. Syngeta, (2004), asserted the root of *Callistemon citrinus* (Curtis) Skeels produce a toxic substance (Callisto) of which the active compound (mesotrione) inhibits the growth of foliage, roots and seed germination of numerous weeds. The products of *Parkia biglobosa* (Jacq.) G.Don and *Azadirachta indica* A.Juss. effectively reduced the emergence of *Striga hermonthica* (Delile) Benth. (Marley et al., 2004). An ethnobotanical survey by Traore and Yonli (2001) in Burkina Faso reported the traditional use of endogenous plants to control the infestation of Striga species. Thus, the promotion of plant substances from local species to control weeds will contribute to the development of new perspective for crops protection by saving annual yield losses worth billions of dollars and decrease the importation of chemicals to Africa.

In Nigeria, allelopathic studies reported so far had focused on allelopathic potentials of weeds and agricultural crops (Kayode, 2006). Others reported on the allelopathic potentials of crop residues on weeds (Kayode and Ayeni, 2009). Consequently, this study aims to examine the allelopathic effect of aqueous extracts from endogenous *P. biglobosa* on the germination of six weeds species, namely; *Eragrostis amabilis, Eragorastis atrovirens, Panicum pedicellatum, Pennisetum subalbidum, Hyparrhenia rufa*, and *Brachiaria brizantha* which are a major weed of important cereal crops that are widely cultivated in Nigeria. Findings from this study will form a basis for the development of plant-based protection method that would be available for resource-poor farmers.

Materials And Methods

Study Area

The study was carried out in Gombe State University, Gombe state. Gombe is located Northeastern part of Nigeria. The state has an area of 20, 265 km 2 and a population of around 2,365,000 people as of 2006. It has two distinct climates, the dry season (November- March) and the raining season (April-October) with an average rainfall of 850nm.The vegetation and land cover of the state revealed that 33.06% and 34.81% of the land area of Gombe state comprise of the river Basin and plains respectively while 26.65% and 5.48% are of upland and highland areas respectively.

Collection of Plant Material

Weed Seeds

Seeds of six weed species namely; *Eragrostis amabilis, Eragorastis atrovirens, Panicum pedicellatum, Pennisetum subalbidum, Hyparrhenia rufa,* and *Brachiaria brizantha* were harvested within Gombe State University environs, air dried and stored at ambient temperature (30°C).

Parkia biglobosa Stem Bark

Fresh *P. biglobosa* stem bark was collected from different trees on farmlands in Dukku. The samples were washed and air dried in the dark at room temperature for a week. The air-dried sample of *P. biglobosa* was grounded using mortar and pestle into fine powder (<1mm). The Parkia powder was packed in a polyethene bag and stored at room temperature before used for the experiment.

Preparation of Aqueous Extract from P. biglobosa Stem Bark

Aqueous extracts at 1%, 5% and 10% concentrations were obtained by soaking 10g, 50g and 100g respectively of the *P. biglobosa* stem bark powder with 100 mL of sterile distilled water in a 250 mL glass beaker for 24hrs at room temperature. Each suspension was then filtered through a double lined cheese cloth to set a homogenous solution. Ordinary sterile distilled water was used as control.

Data Collection and Analysis

Germinated Weeds Population

Germinated weeds were counted among the treatments every week and average of weeds germinated was also calculated.

Weeds Height

weeds height was measured using meter rule from the base of the plant (top soil) to the top most of the plant. The average height was recorded every week for six weeks.

Plumule and Radicle Elongation

length of the plumule and radicle was measure using meter rule and the average was calculated. The percentage inhibition of the plumule and radicle were calculated by

$$\text{Percentage inhibition} = \frac{\text{diameter of control-diameter of conc.}}{\text{diameter of control}} \times 100$$

Statistical Analysis

The data obtained were subjected to analysis of various (ANOVA) where differences were observed, Duncan Multiple Range Test (DMRT) was used to compare the differences in the treatment means

Results

Weed Germination

Table 1 shows the mean and standard deviation for the number of weeds that germinated for each treatment after the six (6) weeks of experiment. The control treatment had the highest weed germination rate (8.06±3.97) while the least was obtained from the 10% aqueous concentration with the mean value of (4.42±2.59). The weeds population decreased as the extract's concentration increased.

Table 1. Effect of various aqueous extracts of *Parkia biglobosa* stem bark on weed germination

Sn	Treatment	Mean/SD
1	Control	8.06±3.97
2	1%	7.34±3.97
3	5%	5.55±3.09
4	10%	4.42±2.59
	Mean/ SD	6.34±3.73
	P-Value (<0.05)	0.00

SD: Standard Deviation

Table 2. Effect of various aqueous extracts of *Parkia biglobosa* stem bark on the weed's height

s/n	Treatment	Mean/SD
1	Control	9.95±11.16
2	1%	11.46±7.08
3	5%	9.60±7.36
4	10%	7.69±6.70
	Mean/ SD	9.67±8.35
	p-value (>0.05)	0.25

SD: Standard Deviation

Table 3. Radicle length (cm) of the weed seeds grown under various Concentration of aqueous extracts of *Parkia biglobosa* stem bark

Species Name	Control	1%	5%	10%
E. amabilis	2.20	0.87(60.46)	0.17(92.27)	0.15(93.18)
E. atrovirens	1.40	1.23(12.14)	1.27(9.29)	1.39(0.71)
P. pedicellatum	1.41	0.00(100)	0.00(100)	0.00(100)
P. subalbidum	2.93	1.30(55.63)	1.11(62.11)	0.87(70.31)
H. rufa	1.43	1.00(31.97)	0.00(100)	0.00(100)
B. brizantha	2.30	0.57(75.22)	0.00(100)	0.00(100)

Note: Values in the bracket are the percentage inhibition

Table 4. Plumule length (cm) of the weed seeds grown under various aqueous extracts from *Parkia biglobosa* stem bark

Species Name	Control	1%	5%	10%
E. amabilis	1.93	1.37(29.02)	1.26(58.55)	1.13(22.28)
E. atrovirens	1.67	1.42(16.17)	1.33(22.16)	1.18(10.18)
P. pedicellatum	1.03	0.00(100)	0.00(100)	0.00(100)
P. subalbidum	5.73	8.10(45.80)	8.63(3.49)	9.17(02.13)
H. rufa	2.73	1.63(40.29)	0.80(70.70)	0.00(100)
B. brizantha	2.70	0.50(81.48)	0.00(100)	0.00(100)

Note: The values in the bracket are the percentage inhibition

Table 5. Effect of various aqueous extracts from *Parkia biglobosa* stem bark on the percentage germinated weed seeds

Species name	Control	1%	5%	10%
E. amabilis	85.0	85.0	68.0	62.0
E. atrovirens	75.0	61.0	67.0	70.0
P. pedicellatum	12.0	0.0	0.0	0.0
P. subalbidum	40.0	44.0	33.0	29.0
H. rufa	15.0	15.0	13.0	8.0
B. brizantha	25.0	23.0	0.0	0.0

Weed Height

Highest mean of weed height was recorded at 1% concentration (11.46±7.08) while the least mean was recorded from 10% concentration (7.69±6.70) as shown in Table 2. From the result obtained, lower concentrations of *P. biglobosa* stem bark extract favors increase in weed height than higher concentrations.

Plumule and Radicle Elongation

The result of the test conducted on the effect of the different concentrations of the aqueous extracts of *P. biglobosa* stem bark on the plumule and radicle length of weed seeds are shown in table 3 and 4 respectively. The result revealed that the plumule length of weed seeds were retarded and the retardation increased with increased in the extract concentrations.

There was 100% inhibition in the plumule length of *P. pedicellatum* in all the concentrations while the least percentage inhibition was recorded from *P. subalbidum* on 5% concentration (3.49) on the other hand, growth of the radicle in the extract-treated seeds were retarded also from *P. pedicellatum* 100% inhibition, the least percentage inhibition was recorded from *E. atrovirens* under 10% concentration (0.71).

The degree of retardation increased with increased in the aqueous extracts statistically, there was no significant different between the plumule length of the weed seeds at P>0.05 and no significant difference between the concentrations. There was significant difference between the radicle length and no significant between the species of the weed seeds. In general, radicle length is more affected than the plumule length.

Percentage Germination of the Weed Seeds

The highest percentage germination of the weed seeds in the laboratory after 7 days of experiment was observed in the control and 1% concentration in *E. amabilis* (85%) while the least percentage germination was observed in *P. pedicellatum* (0.0). Statistically, there was no significance difference between the species of weed seeds germinated.

Discussion

The study shows that *P. biglobosa* possess significant allelopathic effects on the germination and growth of the studied weed seeds. For all the weed species, the degree of inhibition increased with increase in the concentration of the aqueous extract. This suggest that the effects of the extract are concentration dependent. This affirms the reports of Folarin et al., (2015), Marley et al., (2004), Cheema (2000), and Kolawole et al., (2018) who found the effects of some tree species on vegetables and crops to be concentration dependent with significant difference between treatments.

The growth of radicle and plumule lengths in the extract treated seeds were retarded when compared to control and the degree of retardation increased with increase in concentration of the extracts. This is agreeing with the findings of Kayode and Ayeni, (2009) who recorded higher concentrations of extracts derived from sorghum stem and rice husk to retard the growth of both radicle and plumule of maize. Also, Kayode (2005) found the allelopathic influence of Parkia biglobosa on the radicle of cowpea appeared to be more pronounced with increase in extract concentration. Jadhar and Gayanar

(1992) found *Acacia auriculiformis* Benth. leaf leachates to reduce the germination percentage, radicle and plumule length of cowpea and rice. The degree of phytotoxicity inference is species-specific and can even vary within species (Prati and Bossdorf, 2004).

The plumule and radical length showed considerately slight reduction of weed seed during the experiment at the different concentrations in the laboratory the reduction in the plumule length was higher in *Panicum pedicellatum* Vasey which showed 100% inhibition throughout the concentration the least percentage inhibition was obtained in *P. subalbidum* under 5% concentration (3.49) while in the radicle length, the highest percentage inhibition was also obtained in *P. pedicellala* though out the concentrations. The radicle length was totally inhibited (100%), then the least percentage inhibition was obtained in *E. tenellela* under 10% concentration (2.14) the reduction in both plumule and radicle length was an indication of response of the weed seeds to allelopathic effect of the aqueous extracts from *P. biglobosa* stem bark. And for those species that have least inhibition responses, it showed that they might need special treatment before they are subjected to allelopathic experiment. There was no significant difference in the plumule and radicle length at $P>0.05$. This is in agreement with kayode, (2005) who examined the allelopathic effect of *P. biglobosa* using leaf leachates both in the laboratory and filed conditions on radical and plumule growth of cowpea. He showed that, the leaf extract slowed down the rate of growth radicle and plumule when compared to the control both this inhibition was not significant at 0.05 level. Weed plant comparism according to species families showed that the family *Poaceae* and *Fabaceae* has the highest number of germinated weed species compared to other families where they have least germinated number of weed species, this shows the two families. *Poaceae* and *Fabaceae* the dominant weed families in the area where the soil sample was collected, and are least response to the various extracts from *P. biglobosa* stem bark.

Conclusion

The findings from this research indicates that *P. biglobosa* stem bark exhibits strong allelopathic effect and possesses notable growth inhibitory ability on *E. amabilis, E. atrovirens, P. pedicellatum, P. subalbidum, H. rufa,* and *B. brizantha.* These results suggest that *P. biglobosa* like some studied species could contain allelochemicals that can be useful natural resources for developing biological agrochemicals for crop cultivation with no detrimental effects to the soil and environment as in the case of synthetic agrochemicals. However, the degree of inhibition differs within plant species and growth stages (Chang et al., 2004; Benachour, 2008; Cheema and Khaliq, 2000). For instance, allelochemicals can inhibit seed germination but other growth parameters might be unaffected. Therefore, more studies are needed to understand in details the allelopathic influence of such species so as to determine the compatibility of trees with crops as well as their suitability as natural products for weed control in an agroforestry system (Alan et al., 2011)

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