ISSN 2347-6893

Effect of Parkia Biglobosa (JACQ) G. Don. Pod Extracts on its Seed Germination and Seedling Development.

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ABSTRACT

The pod extracts at different concentrations influenced the seed germination and seedling vegetative growth of twenty-six different *Parkiabiglobosa*(JACQ) G. Don Samples. Aqueous *Parkia* pod extracts of various concentrations (5, 10, 15 and 20g in 100ml of water) were used for the planting of the *Parkia* seeds and water as control. Significant (at p=0.05) reduction was observed in concentration of 20g of *Parkia* pod. The seed germination, epicotyl and hypocotyl lengths of the seedlings of the different *Parkia* trees exhibited varying responses to the extracts at various concentrations among the twenty-six *Parkia biglobosa* tree seeds used for the germination study within the three weeks of the experiment. The retardation in the seedlings vegetative growth was suspected to influence by the allelopathic components in the pod extracts. The varied responses of the *Parkia* seedlings to these extract concentrations were assumed to be either from the pod used which were selected from all the tree samples or that the seedlings were sensitive to an allelophatic chemicals of their own pod extracts or to other pods extracts.

Keywords*:* allelopathic influence; concentration; epicotyls; hypocotyls; *Parkia biglobosa*; vegetative growth,

Academic Discipline And Sub-Disciplines

Plant **Biology**

SUBJECT CLASSIFICATION

Plant Physiology

TYPE (METHOD/APPROACH)

Experimental

Council for Innovative Research
Peer Review Research Publishing System
Journal: JOURNAL OF ADVANCES IN BIOLOGY
Vol 4, No.3
www.cirjab.com , editorsjab@gmail.com

INTRODUCTION

Parkia biglobosa was recorded by Adanso in 1757, during his collection trips to Senegal and Gambia. The valid binomial name was later published formally by Nicolas Jacquin in 1763 as the name *Mimosa biglobosa*. The renaming and reclassifying of the plant was done under the genus *Parkia* to commemorate Mungo Park by Robert Brown in 1826 and included in Asia form by Benthom in 1842 (Shao, 2002). *Parkia* numbered twenty-four in species: ten species occur in tropical South America, ten species in tropical Asia and four species in Africa (Hall *et al.,* 1997). *Parkia biglobasa* (Jacq) Benth, a perennial legume tree belongs to the family Leguminosae and the subfamily Mimosoideae (Hopkins, 1983). It is popularly known as the African Locust bean (Osundina, 1995). It occurs in diverse agro-ecological zones, ranging from tropical forest with high and well-distributed rainfall to arid zones and can be found on rocky slopes, stony ridges or sand stone hills. It has the capacity to withstand drought conditions because of its deep taproot system and an ability to restrict transpiration. It forms a crown so it is often grown as shade tree (Daziel, 1937; Hutchinson, 1959).

The interaction of plants through chemical signals (allelopathy) has many possible agricultural applications in crop yield, cropping and agro-forestry system in recent years and has been attributed to allelopathic effects (Nelson 1996). Allelopathy is a biological phenomenon by which plant produces one or more biochemical(s) that influences the growth, survival, and reproduction of other organisms. This biochemical is known as allelochemicals and can have beneficial (positive allelopathy) or detrimental (negative allelopathy) effects on the target organisms (Stamp, 2003). It is subset of secondary metabolites (Duke *et al*., 2000) which are not required for metabolism (i.e. growth, development and reproduction) of the allelopathic plant. Allelochemicals with negative allelopathic effects are an important part of plant defense against herbivore (Stamp, 2003; Fraenkel, 1959). The effects of these allelopathic compounds are often observed to occur early in the life cycle causing incubation and modification in the growth and development of plant which when released to their surrounding inflict either deleterious or beneficial effect on other plants (El- Khawas and Sheheata, 2005).

The allelochemical inhibits plant growth by affecting many physiological processes which include germination by blocking hydrolysis of nutrient reserve and cell division (Irshad and Cheema, 2004), nutrient uptake, photosynthesis and specific enzymes function (James and Bala, 2003), and cause significant reductions in the growth of plumule and radicle lengths of various crops (Ogbe *et al.,* 1994). The degree of inhibition depends on their concentrations. The plumule and radicle lengths of cowpea were reduced after been treated with aqueous leaf extract of *P. biglobosa* (Kayode 2005). Lisanework, and Michelsen (1993) also reported that *Cupressus lusitanica, Eucalyptus globules, E. camaldulensis and E. Saligna* aqueous leaf extracts significantly reduce seed germination, radicle and plumule length (using three concentrations) of *Ciser arietinum, Zea, mays, Pisum sativum and Eragros tisteff*. Many allelochemical compounds produced by plants are regulated by environmental factors such as water potentials of the environment, temperature, light intensity, soil, moisture, soil micro-organisms and perhaps others (Duke *et al*; 2000).

Although many studies have been carried out on *Parkia biglobosa*, No study has yet been reported on the germination and vegetative growth characteristics among different *Parkia* tree samples, as well as the allelopathic effects of its pod extracts on its seed germination and seedling development. Therefore, this research work is aimed at examining allelopathic property of the pod at different concentrations of aqueous pod extract on the seed germination and seedling vegetative growth among the selected *Parkia biglobosa* trees. It is important economically, even though a non timber tree which is widely utilized in Nigeria.

MATERIALS AND METHODS

Twenty-six *Parkia biglobosa* samples were selected in this research. Thus, the influence of different concentration of *Parkia* pod extracts on the germination and vegetative growth of these selected samples was determined. The germination count, epicotyl and hypocotyl lengths, and the numbers of secondary roots were the factors measured and recorded.

Materials used

The materials used were Petri-dishes, serviette paper, water, pods of *Parkia,* Weighing balance, Measuring cylinder, Funnel, Plastic sieve, transparent polyethylene bags, Scissors, Cotton wool, seeds from 26 *Parkia* trees.

Collection of samples

The fruits of the *P. biglobosa* were collected from twenty-six different trees during the harvesting period at the permanent site of the University of Ilorin, Ilorin, (8.32^{o}N and 4.34^{o}E) Kwara State, Nigeria.

Processing of the Seeds

After harvesting, the fruits were packed in bunches and labeled according to the trees from which they were collected, as tree A, B, C………to Z.

The outer shells or husks (Hall *et al*., 1997) of the pods, that is, the dry brown indehiscent pods (Sacande and Clethero, 2007) were opened up along the suture manually, removing the seeds together with the yellow pulp. The seeds with pulp were washed with water severally (in a big plastic sieve) to get rid of the pulp completely. The seeds were sorted through floating method, sun-dried and packed in an air tight transparent polyethylene bag, labeled and stored in a dry cool place.

The pulps were thoroughly washed off from the seeds because the seeds germinate better when clean as reported by Sacande and Clethero, (2007).

Study Site

The research work was carried out in the Plant Physiology Laboratory of the Department of Plant Biology, University of Ilorin, Ilorin, Kwara State, Nigeria.

Preparation of Materials

The serviette papers were trimmed to the size of the Petri-dishes with a pair of scissors, which served as the planting medium. They were then placed in each of the Petri-dishes.

The pods of *Parkia* were collected among the samples and were thoroughly washed to prevent contamination and fungal growth, sun dried and grinded into powder. 5, 10, 15 and 20grams were weighed out from the powdered pod and soaked in 100ml of water respectively for 52 hours.

The mixtures were then filtered through cotton wool. The filtrates (extracts) were poured in containers, labeled as C_5, C_{10}, C_{15}, C_{20} and kept in a dry cool place.

Two (2) ml of C_5 concentrate was used to moisten the serviette papers in the 26 Petri-dishes before planting. The same process was carried out on C_{10}, C_{15}, and C_{20} respectively. Five (5) seeds from the twenty six samples of *P. biglobosa* were planted in each Petri-dish in three replicates. All the Petri-dishes (312 in number) were kept in an aerated Plant Physiology laboratory at room temperature. Water was used for the control experiment.

Germination count was recorded on daily basis while the epicotyls/hypocotyl lengths and number of secondary roots were recorded cumulatively on weekly bases for three weeks.

Statistical Analysis

To determine the effect of different concentrations of pod extract on the seed germination and seedling vegetative growth of the twenty-six *Parkia biglobosa* samples, percentage germination was calculated, Analysis of variance (ANOVA) was used at 5% level of significance and the Duncan Multiple Range Test (DMRT) was used to separate the means. A statistical package on SPSS 15.0 was used.

RESULTS AND DISCUSSIONS

The results of the experiments carried out on the twenty six (26) different tree samples of *P. biglobosa* shows unique variations. The different concentration of the pod extracts shows some inhibitory effects on the seed germination and seedling development of *P. biglobosa* within the three weeks of the experiment.

Table 1: % seed germination on the effect of *P. biglobosa* pod extract at 1WAP

1WAP					
Tree /conc	**C_5**	**C_{10}**	**C_{15}**	**C_{20}**	**Control**
A	47	13	80	33	27
B	100	53	67	67	73
C	53	0	0	0	13
D	13	0	7	13	20
E	67	53	67	53	47
F	7	0	0	7	20
G	33	20	0	7	33
H	33	27	53	73	33
I	27	53	27	47	47
J	0	7	13	0	7
K	27	7	7	20	47
L	0	13	7	7	7
M	33	0	40	7	73
N	67	67	60	40	60
O	0	0	7	0	7
P	33	40	7	7	27
Q	7	20	7	0	0
R	33	13	0	0	60

S	0	0	20	0	7
T	67	53	20	27	73
U	27	27	73	53	73
V	40	53	93	87	67
W	53	53	93	93	60
X	27	13	13	20	33
Y	93	67	60	60	53
Z	7	7	0	0	0

WAP= Week after planting; conc = concentration

C_5= 5g concentrate, C_{10} = 10g concentrate, C_{15} = 15g concentrate, C_{20}= 20g concentrate.

Table 2: Effect of *P. biglobosa* pod extract on its seed germination at 2WAP

2WAP					
Tree /conc	**C_5**	**C_{10}**	**C_{15}**	**C_{20}**	**Control**
A	13	13	7	7	33
B	0	0	0	0	13
C	20	0	0	0	13
D	27	13	13	0	13
E	20	7	27	7	13
F	0	0	7	7	13
G	7	7	20	13	7
H	20	7	33	7	33
I	33	7	7	7	20
J	0	0	7	0	0
K	47	40	40	7	33
L	13	7	7	20	13
M	20	47	20	0	20
N	13	27	0	0	13
O	33	33	60	20	27
P	7	7	13	0	7
Q	0	7	0	0	0
R	7	7	33	0	7
S	0	7	0	0	7
T	0	0	20	0	7
U	60	20	20	27	13
V	47	20	0	7	7
W	20	13	0	0	7
X	27	33	7	0	20
Y	0	0	0	7	27
Z	0	20	7	0	20

WAP= Week after planting; conc = concentration

C_5= 5g concentrate, C_{10} = 10g concentrate, C_{15} = 15g concentrate, C_{20}= 20g concentrate.

Table 3: Effect of *P. biglobosa* pod extract on its seed germination at 3WAP

3WAP					
Tree /conc	**C_5**	**C_{10}**	**C_{15}**	**C_{20}**	**Control**
A	7	13	7	7	7
B	0	0	0	0	0
C	7	0	0	0	13
D	27	13	0	20	7
E	0	7	0	0	7
F	13	0	0	0	20
G	20	40	0	20	7
H	0	0	0	7	7
I	7	7	20	7	13
J	7	0	0	0	0
K	0	27	7	13	13
L	7	0	7	7	7
M	0	7	7	27	0
N	7	0	0	0	7
O	27	27	13	20	27
P	13	20	7	27	7
Q	20	13	0	0	7
R	13	13	13	40	0
S	20	0	7	7	7
T	0	13	0	7	0
U	1	13	0	0	0
V	1	0	0	7	0
W	1	13	7	0	7
X	27	20	7	7	20
Y	0	0	0	0	7
Z	27	53	40	27	7

WAP= Week after planting; conc = concentration

C_5= 5g concentrate, C_{10} = 10g concentrate, C_{15} = 15g concentrate, C_{20}= 20g concentrate.

It was observed from Tables 1-3 above that seed germination varies among the seeds planted (A - Z) with the same pod extract concentrate. Variations in germination also occur between the different concentrate (C_5, C_{10}, C_{15}, and C_{20}) within the three weeks of the experiment.

In 1WAP, the pod extract of C_5 concentrations seem to favour seed germination in tree B which records 100% germination (Tab 1). Tree N also records an appreciable % of seed germination throughout the different concentration, having 67% in C_5; 67% in C_{10}; 60% in C_{15} 40% in C_{20} and 60% in control. Other tree seeds that did well in terms of germination 1WAP include tree T, U. V, W and Y. Majority of the seeds have low % germination all through the concentrate as there are no much differences observed in there germination rate, including the control experiment. This shows that the seed germination of the samples of *Parkia biglobosa* was not determined by the concentration of the *Parkia* pod (Tab 1).

The rate of seed germination by the 2nd week after planting was observed to be slower than week 1, as most seeds in some trees have already germinated and some did not (Tab 2). At the 3rd week, the increase in seed germination followed the same trend as in week 2. The control experiment was observed to have the highest values of seed germination at the end of the 3rd week as seen in trees F, K, M, R, T, and X (Tab 1). Germination was not observed in some of the seeds at all concentration level. They are tree C, D, F G, J, L, M, O, Q, S, and Z (Tab 1).

The result shows that there were variations in the germination and vegetative growth (epicotyl and hypocotyl lengths, and secondary roots) among the selected *Parkia biglobosa* samples used. This agrees with Olorunmaiye *et. al.,* (2011) in which it was reported that there are variations in fruit and seed characteristics of selected *Parkia* samples.

The seeds that shows no difference in their germination, irrespective of different pod concentrates and the control experiment can be attributed to seed dormancy (Etejere *et. al,* 1982; Sucande and Clethero 2007), the nature of the seeds of *P. biglobosa;* as two types were observed, one with brown colour seed coat and the other with a dark-black colour seed coat (Hopkins 1983), or the effect of pod extract concentrate on the seeds. It was observed that some seeds germinate very well at 1WAP in the four level concentrations of pod extract used.

For the vegetative growth (epicotyl and hypocoty1 lengths), there were significant difference at P= 0.05 from one tree to another in the *Parkia* samples. At 1WAP, epicotyl growth was enhanced by pod extract concentrations. C_{15} and C_{20} seem to support increase in epicotyl length in seedlings of tree A, K, W and Y compared with the control. The highest epicotyl length of 5.13cm was recorded in tree T under the control (Tab 4).

Table 4: Effect of *P. biglobosa* pod extract on epicotyl length development at 1WAP

1WAP					
Tree no/conc	**C_5**	**C_{10}**	**C_{15}**	**C_{20}**	**Control**
A	1.53^{a-c}	2.68^{ab}	3.88^{ab}	2.42^{b-e}	0.00^{h}
B	2.33^{a-c}	2.95^{a}	2.98^{a-d}	2.55^{a-d}	3.54^{bc}
C	1.67^{a-c}	0.00^{c}	0.00^{f}	0.00^{g}	0.00^{h}
D	0.33^{bc}	0.00^{c}	0.00^{f}	0.00^{g}	0.00^{h}
E	0.79^{bc}	1.48^{a-c}	1.94^{a-f}	2.22^{b-e}	1.91^{ef}
F	0.67^{bc}	0.00^{c}	0.00^{f}	1.17^{d-g}	2.28^{de}
G	1.98^{a-c}	0.87^{bc}	0.00^{f}	0.00^{g}	2.41^{c-e}
H	2.28^{a-c}	0.57^{bc}	1.81^{b-f}	1.15^{d-g}	1.47^{e-g}
I	0.85^{a-c}	0.35^{c}	2.87^{a-d}	1.81^{c-f}	3.13^{b-d}
J	0.00^{c}	0.40^{c}	0.00^{f}	0.00^{g}	0.00^{h}
K	1.73^{a-c}	0.00^{c}	1.43^{c-f}	3.27^{a-c}	0.84^{f-h}
L	0.00^{c}	0.00^{c}	0.40^{ef}	0.00^{g}	0.70^{gh}
M	3.37^{a}	0.33^{c}	2.10^{a-f}	0.47^{fg}	2.62^{c-e}
N	1.32^{a-c}	1.50^{a-c}	2.78^{a-e}	2.63^{a-d}	1.82^{e-g}
O	0.00^{c}	2.99^{a}	0.53^{d-f}	0.00^{g}	0.00^{h}
P	1.78^{a-c}	1.92^{a-c}	1.3^{c-f}	0.00^{g}	2.31^{de}
Q	1.17^{a-c}	1.27^{a-c}	0.00^{f}	0.00^{g}	0.00^{h}
R	1.52^{a-c}	0.00^{c}	1.47^{b-f}	0.00^{g}	3.96^{b}
S	0.00^{c}	0.00^{c}	2.82^{a-e}	0.00^{g}	0.00^{h}
T	2.64^{ab}	2.98^{a}	2.93^{a-d}	1.56^{d-g}	5.13^{a}
U	1.28^{a-c}	0.00^{c}	1.69^{b-f}	0.00^{g}	3.39^{b-d}
V	1.07^{a-c}	1.17^{a-c}	3.09^{a-c}	2.04^{b-e}	3.25^{b-d}
W	1.34^{a-c}	1.03^{a-c}	4.33^{a}	3.99^{a}	3.58^{bc}
X	0.87^{a-c}	1.80^{a-c}	1.00^{c-f}	0.87^{e-g}	3.52^{bc}
Y	0.98^{a-c}	0.87^{a-c}	2.65^{a-e}	3.48^{ab}	1.76^{e-g}
Z	1.67^{a-c}	0.00^{c}	0.00^{f}	0.00^{g}	0.00^{h}

Values with the same letter(s) along the same column are not significantly different at p=0.05.

WAP= Week after planting; Tree no= Tree number; conc = concentration

C_5= 5g concentrate, C_{10} = 10g concentrate, C_{15} = 15g concentrate, C_{20}= 20g concentrate.

By 2WAP, there were increase in the epicotyl growth in some seedlings when compared to the ones in 1WAP, especially those that were planted with C_{10} and C_{15}. These was observed in seedlings of tree O, U, V and W.

At the end of this experiment, it was observed that the rate of the epicotyl length elongation reduced compared with the control experiment. Some of the seedlings recorded zero epicotyl length while some have the same value of epicotyl length throughout the three weeks. This agreed with the work of Chou and Lin (1976), Chema (2000), Chema and Kaliq (2000), Singh *et. al.,*(2003) and Lawan (2010). Some seeds with no record of vegetative growth was as a result of no germination and dead of seedlings after germination. This may be likening to the allelopathic effect of the pod extract on the seedlings development or might be linked to the presence of Tannins which is one of the secondary compounds that cause allelopathic effect on the germination and vegetative growths (Hall *et. al.,* 1999). These compounds when released inhibit plant growths by affecting many physiological processes which include cell division, nutrient uptake, photosynthesis and specific enzymes function.

Table 5: Effect of *P. biglobosa* pod extract on its epicotyl length development 2WAP

	2WAP				
Tree no/conc	**C_5**	**C_{10}**	**C_{15}**	**C_{20}**	**Control**
A	2.23^{b-e}	6.05^{a-d}	3.88^{a-d}	3.85^{a-d}	3.77^{a-d}
B	2.34^{b-e}	4.99^{b-e}	2.98^{a-d}	2.55^{a-d}	3.54^{a-d}
C	8.30^{a}	0.00^{e}	0.00^{d}	0.00^{d}	0.00^{d}
D	4.95^{a-c}	1.33^{c-e}	2.89^{a-d}	2.00^{a-d}	4.37^{a-c}
E	3.00^{b-e}	5.86^{a-d}	4.27^{a-d}	4.28^{a-d}	5.14^{a-c}
F	0.67^{de}	0.00^{e}	0.00^{d}	1.17^{b-d}	3.58^{a-d}
G	1.98^{b-e}	2.50^{c-e}	3.87^{a-d}	0.67^{d}	2.41^{cd}
H	5.12^{a-c}	2.51^{c-e}	1.81^{b-d}	5.32^{ab}	5.63^{a-c}
I	4.95^{a-c}	2.73^{c-e}	2.87^{a-d}	3.18^{a-d}	6.60^{ab}
J	0.00^{e}	0.04^{e}	0.00^{d}	0.00^{d}	1.84^{cd}
K	4.300^{b-d}	1.87^{c-e}	5.18^{a-c}	5.10^{a-c}	4.98^{a-c}
L	1.40^{c-e}	3.80^{b-e}	0.87^{cd}	3.92^{a-d}	3.13^{b-d}
M	4.48^{b-d}	4.27^{b-e}	5.55^{ab}	0.93^{cd}	7.67^{a}
N	4.92^{a-c}	4.68^{b-e}	2.78^{a-d}	4.17^{a-d}	2.54^{cd}
O	2.83^{b-e}	6.09^{a-c}	2.71^{a-d}	3.20^{a-d}	3.30^{b-d}
P	2.18^{b-e}	4.27^{b-e}	2.83^{a-d}	1.97^{a-d}	2.31^{cd}
Q	1.17^{c-e}	1.27^{c-e}	0.00^{d}	0.00^{d}	0.00^{d}
R	2.65^{b-e}	0.67^{de}	2.72^{a-d}	0.00^{d}	3.96^{a-d}
S	0.00^{e}	1.93^{c-e}	2.82^{a-d}	0.00^{d}	0.00^{d}
T	2.64^{b-e}	3.58^{b-e}	2.93^{a-d}	1.56^{a-d}	5.13^{a-c}
U	4.43^{b-d}	3.44^{b-e}	6.43^{a}	5.87^{a}	5.65^{a-c}
V	5.55^{ab}	8.02^{ab}	3.09^{a-d}	2.04^{a-d}	5.39^{a-c}
W	4.58^{a-d}	10.23^{a}	4.33^{a-d}	3.99^{a-d}	5.22^{a-c}

X	0.87[b-e]	4.05[b-e]	1.97[b-d]	1.90[a-d]	5.44[a-c]
Y	3.31[b-e]	2.87[c-e]	4.98[a-c]	5.53[a]	3.79[a-d]
Z	0.67[de]	1.03[c-e]	0.00[d]	0.00[d]	1.85[cd]

Values with the same letter(s) along the same column are not significantly different at p=0.05.

WAP= Week after planting; Tree no= Tree number; conc = concentration

C_5= 5g concentrate, C_{10} = 10g concentrate, C_{15} = 15g concentrate, C_{20}= 20g concentrate.

Table 6: Effect of *P. biglobosa* pod extract on its epicotyl length development 3WAP

3WAP					
Tree no/conc	**C_5**	**C_{10}**	**C_{15}**	**C_{20}**	**Control**
A	5.89[a-d]	10.43[a]	5.38[a-c]	4.85[a-c]	6.83[a-f]
B	2.34[a-d]	4.99[a-d]	2.98[a-d]	2.55[bc]	9.09[a-f]
C	8.30[a]	0.00[d]	0.00[d]	0.00[c]	2.57[d-f]
D	0.48[a]	3.98[a-d]	2.89[a-d]	5.09[ab]	5.62[b-f]
E	3.00[a-d]	9.26[ab]	4.27[a-d]	4.28[a-c]	9.64[a-e]
F	1.80[b-d]	1.10[cd]	0.00[d]	1.17[bc]	11.62[a-c]
G	4.75[a-d]	5.70[a-d]	6.73[ab]	3.70[a-c]	8.79[a-f]
H	5.12[a-d]	2.51[b-d]	2.54[b-d]	7.72[a]	10.67[a-c]
I	4.95[a-d]	3.09[b-d]	4.50[a-d]	4.11[a-c]	12.38[ab]
J	1.67[b-d]	0.40[d]	1.70[b-d]	0.00[c]	5.72[b-f]
K	4.63[a-d]	5.28[a-d]	7.68[a]	5.23[ab]	9.83[a-d]
L	1.40[cd]	3.80[a-d]	1.53[cd]	4.78[a-c]	8.30[a-f]
M	4.48[a-d]	8.03[a-c]	5.55[a-c]	4.90[a-c]	13.91[a]
N	7.92[ab]	5.40[a-d]	2.78[a-d]	4.17[a-c]	12.06[ab]
O	7.72[a-c]	9.26[ab]	3.97[a-d]	5.55[ab]	7.88[a-f]
P	2.85[a-d]	4.27[a-d]	4.25[a-d]	3.03[a-c]	8.26[a-f]
Q	1.17[d]	1.27[cd]	0.00[d]	1.50[bc]	1.43[f]
R	3.78[a-d]	2.90[b-d]	5.10[a-c]	3.04[a-c]	7.93[a-f]
S	4.63[a-d]	1.93[cd]	3.75[a-d]	2.50[bc]	1.73[ef]
T	2.64[a-d]	3.58[a-d]	2.93[a-d]	1.56[bc]	10.26[a-d]
U	7.10[a-d]	4.83[a-d]	6.43[a-d]	7.63[a]	10.56[a-c]
V	8.28[a]	8.02[a-c]	3.09[a-d]	4.00[a-c]	10.70[a-c]
W	6.61[a-d]	10.50[a]	4.93[a-d]	3.99[a-c]	10.67[a-c]
X	3.63[a-d]	6.61[a-d]	3.60[a-d]	1.90[bc]	11.00[a-c]
Y	3.31[a-d]	2.87[b-d]	4.93[a-d]	5.53[ab]	5.55[b-f]
Z	5.13[a-d]	3.31[b-d]	1.86[b-d]	1.11[bc]	3.55[c-f]

Values with the same letter(s) along the same column are not significantly different at p=0.05.

WAP= Week after planting; Tree no= Tree number; conc = concentration

C_5= 5g concentrate, C_{10} = 10g concentrate, C_{15} = 15g concentrate, C_{20}= 20g concentrate.

Table 7: Effect of *P. biglobosa* pod extract on its hypocotyl lengths at 1WAP

1WAP					
Tree no/conc	**C_5**	**C_{10}**	**C_{15}**	**C_{20}**	**Control**
A	2.36^{a-c}	3.57^{ab}	5.46^{a}	2.43^{a-d}	0.00^{h}
B	4.20^{a}	4.23^{a}	3.45^{a-d}	3.23^{a-c}	4.64^{ab}
C	3.54^{ab}	0.00^{c}	0.00^{f}	0.00^{g}	0.00^{h}
D	1.27^{a-c}	0.00^{c}	0.53^{ef}	0.50^{fg}	0.00^{h}
E	2.46^{a-c}	3.23^{a-c}	2.68^{a-f}	2.29^{b-e}	4.23^{a-d}
F	1.50^{a-c}	0.00^{c}	0.00^{f}	1.23^{d-g}	2.49^{ef}
G	3.15^{ab}	1.74^{a-c}	0.00^{f}	0.00^{g}	4.94^{a}
H	3.72^{ab}	1.19^{a-c}	3.00^{a-e}	2.14^{b-f}	2.01^{fg}
I	1.01^{bc}	1.79^{a-c}	3.80^{a-c}	3.10^{a-c}	3.71^{a-e}
J	0.00^{c}	0.43^{bc}	0.00^{f}	0.00^{g}	0.00^{h}
K	2.98^{ab}	1.17^{a-c}	1.67^{b-f}	3.73^{ab}	2.09^{fg}
L	0.00^{c}	0.00^{c}	0.70^{d-f}	0.00^{g}	1.67^{gh}
M	2.93^{ab}	0.83^{bc}	3.00^{a-e}	0.77^{d-g}	3.55^{a-e}
N	2.53^{a-c}	2.40^{a-c}	2.93^{a-e}	3.33^{a-c}	2.90^{d-f}
O	0.00^{c}	1.40^{a-c}	1.00^{c-f}	0.00^{g}	0.00^{h}
P	2.97^{ab}	3.42^{a-c}	1.80^{b-f}	0.00^{g}	3.27^{c-f}
Q	1.33^{a-c}	2.15^{a-c}	0.00^{f}	0.00^{g}	0.00^{h}
R	3.18^{ab}	2.35^{a-c}	1.78^{b-f}	0.00^{g}	4.15^{a-d}
S	0.00^{c}	1.27^{a-c}	3.50^{a-d}	0.00^{g}	0.00^{h}
T	2.71^{a-c}	2.74^{a-c}	1.88^{b-f}	1.86^{c-g}	4.65^{ab}
U	3.90^{ab}	2.23^{a-c}	2.64^{a-f}	0.53^{e-g}	3.53^{a-e}
V	2.87^{a-c}	2.14^{a-c}	4.25^{ab}	3.22^{a-c}	2.86^{d-f}
W	3.74^{ab}	2.84^{a-c}	4.36^{ab}	4.13^{a}	3.80^{a-e}
X	2.58^{a-c}	2.07^{a-c}	1.50^{b-f}	1.27^{d-g}	4.40^{a-c}
Y	2.46^{a-c}	2.03^{a-c}	3.68^{a-c}	3.22^{a-c}	3.17^{c-f}
Z	1.87^{a-c}	0.00^{c}	0.00^{f}	0.00^{g}	0.00^{h}

Values with the same letter(s) along the same column are not significantly different at p=0.05

WAP= Week after planting; Tree no= Tree number; conc = concentration

C_5= 5g concentrate, C_{10} = 10g concentrate, C_{15} = 15g concentrate, C_{20}= 20g concentrate.

Table 8: Effect of *P. biglobosa* pod extract on its hypocotyl lengths at 2WAP

2WAP					
Tree no/conc	**C_5**	**C_{10}**	**C_{15}**	**C_{20}**	**Control**
A	3.50^{b-f}	7.13^{a-c}	5.46^{a-c}	4.20^{a-d}	2.78^{f-g}
B	4.20^{b-f}	6.03^{a-d}	3.45^{a-d}	3.23^{a-d}	4.64^{b-g}
C	9.36^{a}	0.00^{f}	0.00^{d}	0.00^{d}	0.00^{h}
D	5.27^{a-e}	1.90^{c-f}	4.53^{a-c}	2.33^{a-d}	4.51^{c-g}
E	5.07^{a-e}	8.18^{ab}	4.71^{a-c}	3.63^{a-d}	6.20^{a-e}
F	1.50^{ef}	0.00^{f}	0.00^{d}	1.83^{a-d}	3.93^{c-g}
G	3.15^{d-f}	1.75^{c-f}	2.90^{a-d}	0.93^{cd}	6.04^{a-e}
H	6.87^{a-d}	4.34^{b-f}	3.00^{a-d}	5.89^{a}	5.68^{a-f}
I	5.03^{a-e}	3.99^{b-f}	3.80^{a-d}	4.37^{a-d}	8.18^{ab}
J	0.00^{f}	0.43^{ef}	0.00^{d}	0.00^{d}	1.41^{gh}
K	5.43^{a-e}	3.95^{b-f}	5.35^{a-c}	5.67^{ab}	7.42^{a-c}
L	1.58^{ef}	4.17^{b-f}	1.43^{cd}	3.45^{a-d}	4.17^{c-g}
M	5.12^{a-e}	5.84^{a-e}	6.02^{ab}	2.17^{a-d}	8.36^{a}
N	6.53^{a-d}	6.39^{a-d}	2.93^{a-d}	5.00^{a-c}	3.33^{d-h}
O	3.92^{b-f}	5.27^{a-f}	4.09^{a-d}	4.20^{a-d}	3.40^{d-f}
P	4.07^{b-f}	6.91^{a-d}	3.57^{a-d}	1.40^{b-d}	3.27^{d-h}
Q	1.33^{ef}	2.15^{c-f}	0.00^{d}	0.00^{d}	0.00^{h}
R	4.51^{b-e}	2.35^{c-f}	3.88^{a-d}	0.00^{d}	4.15^{c-g}
S	0.00^{f}	3.33^{b-f}	3.50^{a-d}	0.00^{d}	0.00^{h}
T	2.71^{d-f}	3.61^{b-f}	1.88^{b-d}	1.86^{a-d}	4.66^{b-g}
U	7.33^{a-c}	6.95^{a-d}	6.48^{a}	5.13^{a-c}	6.72^{a-d}
V	6.92^{a-d}	8.24^{ab}	4.25^{a-c}	3.22^{a-d}	5.34^{a-f}
W	7.79^{ab}	10.06^{a}	4.36^{a-c}	4.13^{a-d}	5.82^{a-f}
X	2.58^{d-f}	4.11^{b-f}	3.03^{a-d}	3.55^{a-d}	6.083^{a-e}
Y	5.00^{a-e}	4.83^{b-f}	5.28^{a-c}	3.96^{a-d}	5.00^{a-f}
Z	1.87^{ef}	1.60^{d-f}	0.00^{d}	0.00^{d}	2.37^{f-h}

Values with the same letter(s) along the same column are not significantly different at p=0.05

WAP= Week after planting; Tree no= Tree number; conc = concentration

C_5= 5g concentrate, C_{10} = 10g concentrate, C_{15} = 15g concentrate, C_{20}= 20g concentrate.

Table 9: Effect of *P. biglobosa* pod extract on its hypocotyl lengths at 3WAP

3WAP					
Tree no/conc	**C_5**	**C_{10}**	**C_{15}**	**C_{20}**	**Control**
A	7.23^{a-c}	11.60^{ab}	7.46^{ab}	6.20^{a-c}	6.21^{a-e}
B	4.20^{a-c}	7.12^{a-f}	3.45^{a-d}	3.23^{a-e}	6.58^{a-e}
C	9.36^{a}	0.00^{g}	0.00^{d}	0.00^{e}	2.67^{c-e}
D	9.00^{ab}	3.33^{d-g}	4.53^{a-d}	6.23^{a-c}	6.47^{a-e}
E	5.07^{a-c}	10.78^{a-c}	4.71^{a-d}	3.63^{a-e}	8.79^{a-c}
F	3.23^{a-c}	1.53^{e-g}	0.00^{d}	1.83^{c-e}	8.58^{a-c}
G	6.23^{a-c}	6.42^{a-g}	5.73^{a-c}	3.57^{a-e}	9.13^{a-c}
H	6.78^{a-c}	4.34^{c-g}	4.47^{a-d}	7.55^{a}	9.23^{ab}
I	5.03^{a-c}	4.82^{b-g}	5.53^{a-c}	5.53^{a-c}	10.66^{ab}
J	1.50^{c}	0.43^{fg}	1.60^{cd}	0.30^{de}	5.47^{a-e}
K	5.96^{a-c}	8.15^{a-e}	8.4^{a}	6.11^{a-c}	10.91^{ab}
L	1.58^{c}	4.17^{c-g}	3.00^{b-d}	4.58^{a-e}	7.83^{b-e}
M	5.12^{a-c}	8.94^{a-d}	6.02^{a-c}	5.58^{a-c}	11.82^{a}
N	9.53^{a}	6.85^{a-g}	2.93^{b-d}	5.00^{a-e}	9.71^{ab}
O	8.68^{ab}	9.70^{a-d}	5.87^{a-c}	7.08^{ab}	7.28^{a-e}
P	6.07^{a-c}	6.91^{a-f}	4.83^{a-d}	3.18^{a-e}	6.23^{a-e}
Q	1.33^{c}	3.02^{d-g}	0.00^{d}	1.67^{c-e}	1.27e
R	6.54^{a-c}	4.85^{b-g}	7.25^{ab}	3.09^{a-e}	4.53^{b-e}
S	4.30^{a-c}	3.33^{d-g}	5.27^{a-c}	2.33^{b-e}	2.07^{de}
T	2.71^{c}	3.61^{d-g}	3.06^{b-d}	1.83^{c-e}	4.66^{b-e}
U	9.29^{a}	8.85^{a-d}	6.48^{a-c}	6.66^{a-c}	8.67^{a-c}
V	8.76^{ab}	8.24^{a-e}	4.25^{a-d}	5.29^{a-d}	7.24^{a-e}
W	8.99^{ab}	12.82^{a}	4.36^{a-d}	4.13^{a-e}	7.79^{b-e}
X	4.72^{a-c}	7.58^{a-e}	4.47^{a-d}	3.55^{a-e}	8.87^{a-c}
Y	5.00^{a-c}	4.48^{c-g}	4.28^{a-c}	3.96^{a-e}	5.50^{a-e}
Z	7.18^{a-c}	6.33^{a-g}	3.32^{b-d}	3.57^{a-e}	5.33^{b-e}

Values with the same letter(s) along the same column are not significantly different at p=0.05

WAP= Week after planting; Tree no= Tree number; conc = concentration

C_5= 5g concentrate, C_{10} = 10g concentrate, C_{15} = 15g concentrate, C_{20}= 20g concentrate.

The hypocotyl lengths of the seedlings from the different samples of *Parkia biglobosa* followed the same pattern with the epicotyl growth. Some seedlings were observed to have longer hypoctyl length than its epicotyl length and vice versa (Tabs 7 - 9). The effect of the different pod extract concentrate studied on the germination and vegetative growth shows that there is inhibition of epicotyl and hypocotyl lengths in some of the selected *Parkia* tree seed compared to the control experiment.

Table 10: Effect of *P. biglobosa* pod extract on its numbers of secondary root at 1WAP

	1WAP				
Tree no/conc	C_5	C_{10}	C_{15}	C_{20}	Control
A	0.00^a	7.67^a	9.58^a	3.00^b	0.00^a
B	3.67^a	2.00^c	0.00^c	1.67^{bc}	4.17^a
C	2.83^a	0.00^c	0.00^c	0.00^c	0.00^a
D	0.00^a	0.00^c	0.00^c	0.00^c	0.00^a
E	1.00^a	1.67^c	0.00^c	0.00^c	3.67^a
F	0.00^a	0.00^c	0.00^c	0.00^c	5.67^a
G	0.00^a	0.00^c	0.00^c	0.00^c	4.33^a
H	3.67^a	0.00^c	4.67^{bc}	0.00^c	7.67^a
I	0.00^a	0.00^c	0.00^c	0.00^c	3.00^a
J	0.00^a	0.00^c	0.00^c	0.00^c	0.00^a
K	3.00^a	0.00^c	1.67^c	0.00^c	3.00^a
L	0.00^a	0.00^c	0.00^c	0.00^c	2.67^a
M	2.00^a	0.00^c	0.00^c	0.00^c	5.00^a
N	2.67^a	0.00^c	2.00^c	1.33^{bc}	0.00^a
O	0.00^a	0.00^c	0.00^c	0.00^c	0.00^a
P	0.00^a	0.00^c	0.00^c	0.00^c	0.00^a
Q	0.00^a	0.00^c	0.00^c	0.00^c	0.00^a
R	1.33^a	0.00^c	0.00^c	0.00^c	2.67^a
S	0.00^a	0.00^c	8.00^{ab}	0.00^c	0.00^a
T	3.00^a	4.67^b	4.00^{bc}	1.67^{bc}	4.67^a
U	0.00^a	0.00^c	4.33^{bc}	0.00^c	4.00^a
V	0.00^a	0.00^c	4.67^{bc}	1.33^{bc}	0.00^a
W	0.00^a	0.00^c	6.67^{ab}	7.17^a	0.00^a
X	0.00^a	0.00^c	0.00^c	0.00^c	3.67^a
Y	0.00^a	0.00^c	0.00^c	0.00^c	0.00^a
Z	2.33^a	0.00^c	0.00^c	0.00^c	0.00^a

Values with the same letter(s) along the same column are not significantly different at p=0.05

WAP= Week after planting; Tree no= Tree number; conc = concentration

C_5= 5g concentrate, C_{10} = 10g concentrate, C_{15} = 15g concentrate, C_{20}= 20g concentrate.

Table 11: Effect of *P.biglobosa* pod extract on its numbers of secondary root at 2WAP

2WAP					
Tree no/conc	**C_5**	**C_{10}**	**C_{15}**	**C_{20}**	**Control**
A	0.00^{d}	8.00^{bc}	9.58^{ab}	6.00^{a-d}	0.00^{b}
B	3.67^{cd}	5.00^{bc}	0.00^{d}	1.67^{cd}	8.83^{ab}
C	16.00^{a}	0.00^{c}	0.00^{d}	0.00^{d}	0.00^{b}
D	1.00^{d}	0.00^{c}	2.50^{cd}	3.33^{b-d}	2.33^{ab}
E	1.00^{d}	6.67^{bc}	4.33^{b-d}	4.33^{a-d}	3.67^{ab}
F	0.00^{d}	0.00^{c}	0.00^{d}	0.00^{d}	5.67^{ab}
G	0.00^{d}	0.00^{c}	2.33^{cd}	0.00^{d}	4.33^{ab}
H	9.67^{a-c}	6.33^{bc}	4.67^{b-d}	9.67^{ab}	9.56^{ab}
I	11.67^{ab}	2.67^{bc}	0.00^{d}	0.00^{d}	3.00^{ab}
J	0.00^{d}	0.00^{c}	0.00^{d}	0.00^{d}	0.00^{b}
K	5.67^{b-d}	2.67^{bc}	13.83^{a}	0.00^{d}	9.50^{ab}
L	1.67^{cd}	9.00^{bc}	0.00^{d}	4.00^{a-d}	2.67^{ab}
M	2.00^{cd}	2.33^{c}	5.67^{b-d}	0.00^{d}	5.00^{ab}
N	7.00^{b-d}	2.33^{c}	2.00^{cd}	1.33^{cd}	4.67^{ab}
O	2.33^{cd}	5.00^{bc}	2.67^{cd}	0.00^{d}	1.33^{ab}
P	0.00^{d}	0.00^{c}	2.67^{cd}	0.00^{d}	0.00^{b}
Q	0.00^{d}	0.00^{c}	0.00^{d}	0.00^{d}	0.00^{b}
R	1.33^{d}	1.00^{c}	0.00^{d}	0.00^{d}	5.00^{ab}
S	0.00^{d}	0.00^{c}	8.00^{a-c}	0.00^{d}	3.67^{ab}
T	3.00^{cd}	4.67^{bc}	4.00^{b-d}	1.67^{cd}	10.72^{a}
U	6.00^{b-d}	7.00^{bc}	5.67^{b-d}	10.50^{a}	4.00^{ab}
V	6.50^{b-d}	11.39^{ab}	4.67^{b-d}	1.33^{cd}	0.00^{b}
W	3.50^{cd}	17.67^{a}	6.67^{b-d}	7.17^{a-c}	2.33^{ab}
X	0.00^{d}	5.67^{bc}	0.00^{d}	0.00^{d}	7.33^{ab}
Y	8.00^{b-d}	1.33^{c}	2.333^{cd}	2.00^{cd}	0.00^{b}
Z	2.33^{cd}	0.00^{c}	0.00^{d}	0.00^{d}	0.00^{b}

Values with the same letter(s) along the same column are not significantly different at p=0.05

WAP= Week after planting, Tree no= tree number, Conc= concentrations

C_5= 5g concentrate, C_{10} = 10g concentrate, C_{15} = 15g concentrate, C_{20}= 20g concentrate.

Table 12: Effect of *P.biglobosa* pod extract on its numbers of secondary root at 3WAP

3WAP					
Tree no/conc	**C_5**	**C_{10}**	**C_{15}**	**C_{20}**	**Control**
A	5.33^{a-c}	14.33^{ab}	9.58^{ab}	6.00^{ab}	0.00^{b}
B	3.67^{a-c}	5.00^{a-c}	0.00^{c}	1.67^{b}	8.83^{ab}
C	16.00^{a}	0.00^{c}	0.00^{c}	0.00^{b}	0.00^{b}
D	7.33^{a-c}	12.00^{a-c}	2.50^{bc}	3.33^{ab}	5.67^{ab}
E	1.00^{c}	12.33^{a-c}	4.33^{bc}	4.33^{ab}	3.67^{ab}
F	0.00^{c}	0.00^{c}	0.00^{c}	0.00^{b}	5.67^{ab}
G	3.00^{bc}	5.67^{a-c}	2.33^{bc}	0.00^{b}	4.33^{ab}
H	9.67^{a-c}	6.33^{a-c}	4.67^{bc}	9.67^{a}	11.56^{ab}
I	11.67^{a-c}	2.67^{bc}	0.00^{c}	0.00^{b}	3.00^{ab}
J	2.33^{bc}	0.00^{c}	0.00^{c}	0.00^{b}	0.00^{b}
K	5.67^{a-c}	6.83^{a-c}	15.17^{a}	1.33^{b}	13.00^{a}
L	1.67^{c}	9.00^{a-c}	3.33^{bc}	7.33^{ab}	5.67^{ab}
M	2.00^{c}	10.33^{a-c}	5.67^{bc}	0.00^{b}	10.83^{ab}
N	8.67^{a-c}	2.33^{bc}	2.00^{bc}	1.33^{b}	11.00^{ab}
O	15.00^{ab}	5.00^{a-c}	2.67^{bc}	0.00^{b}	4.17^{ab}
P	0.00^{c}	0.00^{c}	4.67^{bc}	2.00^{b}	6.67^{ab}
Q	0.00^{c}	0.00^{c}	0.00^{c}	0.00^{b}	0.00^{b}
R	2.67^{bc}	1.00^{c}	2.67^{bc}	0.00^{b}	8.67^{ab}
S	5.33^{a-c}	0.00^{c}	8.00^{bc}	0.00^{b}	3.67^{ab}
T	3.00^{bc}	4.67^{a-c}	4.00^{bc}	1.67^{b}	10.72^{ab}
U	11.67^{a-c}	12.00^{a-c}	5.67^{bc}	10.50^{a}	6.67^{ab}
V	10.17^{a-c}	11.39^{a-c}	4.67^{bc}	1.33^{b}	2.67^{ab}
W	$^{-c}$	17.67^{a}	6.67^{bc}	7.17^{ab}	4.00^{ab}
X	3.17^{bc}	9.33^{a-c}	3.33^{bc}	3.33^{ab}	8.00^{ab}
Y	8.00^{a-c}	1.33^{bc}	2.33^{bc}	2.00^{b}	4.00^{ab}
Z	4.00^{a-c}	2.67^{bc}	0.00^{c}	0.00^{b}	0.00^{b}

Values with the same letter(s) along the same column are not significantly different at p=0.05

WAP= Week after planting, Tree no= tree number, Conc= concentrations

C_5= 5g concentrate, C_{10} = 10g concentrate, C_{15} = 15g concentrate, C_{20}= 20g concentrate.

Most of the seedlings at 1WAP did not produced secondary roots in the different concentrations but a reasonable number of seedlings were seen to have secondary root in the control experiment. By the 2WAP, majority of the seedlings have developed secondary root which increase in 3WAP. The C_{20} setup did not support secondary root formation among the seedlings (Tabs 10 -12). Seedlings from tree F and Q did not have secondary root in all the concentrations while seedlings from trees C and J have secondary root only in C_5 The variations observed in Tables 1-12 on seed germination and vegetative growth respectively may also be that, member of the same sample were sensitive to an allelophatic chemical of its own pod extracts or other pod extract, since the pod used were randomly selected among the *Parkia* samples used. This is similar to the report of Knise, 2000 as demonstrated in the response of *Avena Sativa* and *Averna fatia* to rye alellochemicals. Some plants have allelopathic effect against other plants which themselves have been reported to be allelopathic (Wardle *et. al.,* 1996).

CONCLUSION

This study has revealed that the seed germination and seedlings growth characteristics are different among the *P. biglobosa* samples. The seeds from different *Parkia* samples responded differently to allelopathic potentials of extracts from *Parkia* pod at different level. Some of the seedlings grow well in different concentrations of *Parkia* pod extract; some have slow growth rate while some are insignificant to the different concentrations of the pod extract.

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