

Available online at [GSC Online Press Directory](https://www.gsconlinepress.com/)

GSC Biological and Pharmaceutical Sciences

e-ISSN: 2581-3250, CODEN (USA): GBPSC2

Journal homepage: <https://www.gsconlinepress.com/journals/gscbps>

(RESEARCH ARTICLE)



## Seed dormancy breakage, enhance germination and growth performances of *Parkia biglobosa* seeds using concentrated H<sub>2</sub>SO<sub>4</sub>

Dauda Muhammed <sup>1</sup>, Adegbola Gbolagade Adeyemi <sup>1</sup>, Babatunde Richard O <sup>2</sup> and Alawode Rahmatallah Adenike <sup>1,\*</sup>

<sup>1</sup> Forestry research institute of Nigeria-Southern Guinea Research Station, Mokwa, Niger State, Nigeria.

<sup>2</sup> Federal College of Forestry, Jericho, Ibadan, Nigeria.

Publication history: Received on 01 September 2019; revised on 05 September 2019; accepted on 10 September 2019

Article DOI: <https://doi.org/10.30574/gscbps.2019.8.3.0168>

### Abstract

The present study investigated the effectiveness of H<sub>2</sub>SO<sub>4</sub> pretreatment on seed dormancy breakage and growth parameters of *Parkia biglobosa* seedling. *Parkia biglobosa* seeds were soaked in 100% concentrated H<sub>2</sub>SO<sub>4</sub>, 2 to 10 minutes at an interval of 2 minutes and from 15 to 185 minutes at an interval of 5 minutes. Data including germination rate of the seed for each treatment were recorded and percentage germination were computed. Seedling parameters including numbers of leaves, stem height and stem girth were also recorded at 2 weeks intervals. H<sub>2</sub>SO<sub>4</sub> pretreatment of *P. biglobosa* enhanced seed emergence with maximum effect (90 % and 100% emergence) at 20- and 40-minutes treatment. A progressive decrease in seed emergence were however recorded from 60 minutes of pretreatment onward. The stem girth, stem height and leaf counts of H<sub>2</sub>SO<sub>4</sub> pretreated *P. biglobosa* increases with H<sub>2</sub>SO<sub>4</sub> pretreatment time from 2 minutes and peaked up maximally at 40 minutes after which a progressive decrease were recorded from 60 minutes of pretreatment onward. The stem height and leaf count also increase with increase day of germination with maximal effect occurring between 14 and 70 days. In conclusion, H<sub>2</sub>SO<sub>4</sub> pretreatments of the seeds of *P. biglobosa* may be effective for breaking dormancy and improving the seedling growth which can enhance the domestication and cultivation of these valuable seeds in the environment.

**Keywords:** *Parkia biglobosa*; H<sub>2</sub>SO<sub>4</sub>; Seedling; Seed dormancy; Seed germination

### 1. Introduction

Forest resources are being depleted owing to the increasing demand for forest products by increasing global population [1]. The rapid rates of forest loss and degradation across the tropics have continued to increase both the fragmentation of many populations and the risk of species' extinction. Chandel and Shulka [2] also reported that the unprecedented demand for productive land for agriculture use has also contributed to this problem.

The current trend of interest in agro forestry are geared towards environmental rehabilitation and poverty alleviation through the domestication of the local tree species that have commercial potentials in local, regional or even international markets [3]. The propagation of most tropical tree species however, is constrained by recalcitrant seed germination as a result of dormancy [4]. The degree of dormancy makes it difficult for seed to germinate evenly and adequately.

*Parkia biglobosa* (Jacq.) Benth popularly known as the African locust bean belongs to the family leguminosae-mimosoideae (MIM). It is widely distributed in the savannah and some parts of the tropical rainforest, and often grows to a height of 20 m. The tree plays a very vital role as a food tree in the rural economics of West African

\* Corresponding author

E-mail address: [rahmatallahadenike@gmail.com](mailto:rahmatallahadenike@gmail.com)

countries; where virtually every part of the tree is highly valued as fodder or food [5]. The seed which is surrounded by a yellow pulp is rich in fat (54%) and proteins (30%) calcium, potassium and phosphorus [6], are made into condiments (iru), which are commonly used as flavoring agent in soups and stews.

Traditionally, *Parkia biglobosa* is widely used for curing toothache, treating stomach upset and diarrhea [7]. Pharmacologically *Parkia biglobosa* has been cited among the plants with significant antioxidants, hepatoprotective and antiparasitic activities [8-10]. *Parkia biglobosa* is also used in agroforestry because of its ability to fix atmospheric nitrogen in soil and the seeds are reported to retain viability for long time [11]. However, *P. biglobosa* possesses an exogenous dormancy in which the hard seed coat prevents its germination hence posing silvicultural problems that discourages farmers from raising the plant at nursery stage [12]. This problematic basis despite its numerous economic importance of plant makes it imperative to intervene in its domestication and conservation to save this important tree from extinction. Thus, this study is set up to devise an easier and faster means towards the propagation of *Parkia biglobosa*.

## 2. Material and methods

### 2.1. The study area

The study was conducted in Mokwa Local Government Area of Niger state, Nigeria. Niger State of Nigeria lies between Latitudes 8° 20'N and 11° 30'N and Longitudes 3° 30'E and 7° 20'E with twenty-five local government area councils. It is located in the North central part of Nigeria, sharing boundaries with Zamfara State in the North, Kebbi State and Republic of Benin in the Northwest, Kwara State in the Southwest, Kogi State in the South, and Federal Capital Territory (FCT) and Kaduna State in the Southeast and Northeast, respectively (Niger State Ministry of Land and surveys, Minna, 2001). Niger State is underlain by sedimentary and basement complex rocks which have different capacity of retaining water all year round.

### 2.2. Seed collection

*Parkia biglobosa* pods were collected under matured trees of the species in the field in Mokwa local Government Area of Niger State in March 2016. The seeds were extracted and air dried for a period of 5 days under room temperature and stored in a cool dried place.

### 2.3. Treatments

*Parkia biglobosa* seeds were extracted, washed and air dried for a period of 5 days under room temperature and stored in a cool dried place. The seeds were randomly selected and soaked in 100% concentrated H<sub>2</sub>SO<sub>4</sub>, 2 to 10 minutes for the first five treatments at an interval of 2 minutes. While the other part of the treatment ranged from 15 to 185 minutes at an interval of 5 minutes. The seed was immediately air dried before sowing according to Aleiro [13]. The experiment was laid out in a completely randomized design and replicated three times.

### 2.4. Data collection

#### 2.4.1. Germination rate (%)

This was evaluated as the proportion of germinated seed expressed as germination percentage of the total number of seeds sown on a daily basis from day 1 to day 14, after sowing that is,

$$\left( \frac{\text{No of germinated seed}}{\text{No of planted seed}} \right) \times 100 \quad [7].$$

#### 2.4.2. Seedling parameters

Seedling assessment was carried out at 2 weeks intervals beginning from the day 14. Parameters assessed include: numbers of leaves (counted manually), stem height ((using meter rule) and stem girth (using veneer caliper).

### 2.5. Data analysis

The data collected were analyzed using the SPSS data package and presented as Mean±SEM of triplicate determination. Duncan Multiple Range Test (DMRT) was used to separate the means found to differ significantly at p<0.05. Graphs were drawn using excel package.

### 3. Results

#### 3.1. Seed emergence

The emergence of seeds of *P. biglobosa* presoaked in 100% H<sub>2</sub>SO<sub>4</sub> increase with increase day of germination from day 1 to day 14. The seed had no emergence at day 1 and 2. Similarly, the seed emergence increases with H<sub>2</sub>SO<sub>4</sub> pretreatment time from 2 minutes and peaked up maximally at 20 and 40 minutes were 90 % and 100% emergence were recorded after day 6 and 8. A progressive decreases in seed emergence were however recorded from 60 minutes of pretreatment onward.

#### 3.2. Seedling parameters

##### 3.2.1. Stem girth

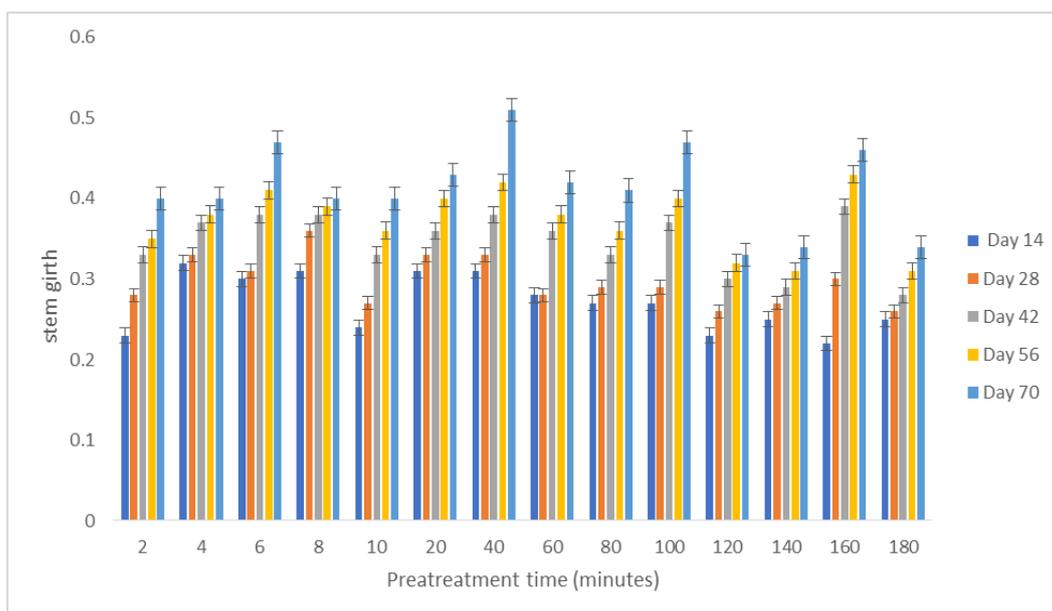
The stem girth of H<sub>2</sub>SO<sub>4</sub> pretreated *P. biglobosa* increase with increase day of germination from day 14 to day 70. The stem girth also increases with H<sub>2</sub>SO<sub>4</sub> pretreatment time from 2 minutes and peaked up maximally at 40 minutes after which a progressive decrease in stem girth were recorded from 60 minutes of pretreatment onward.

##### 3.2.2. Stem height

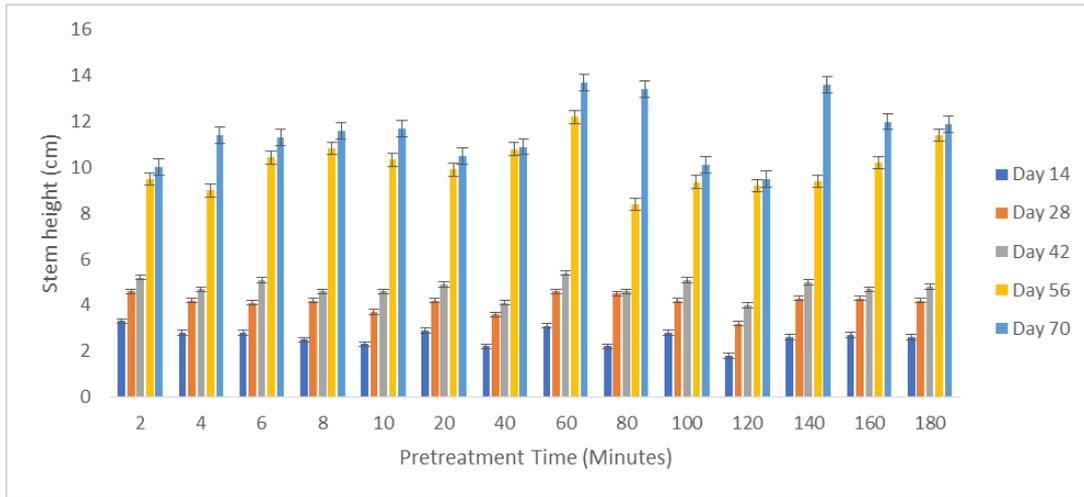
The stem height of H<sub>2</sub>SO<sub>4</sub> pretreated *P. biglobosa* increase with increase day of germination from day 14 to day 70. The stem height also increases with H<sub>2</sub>SO<sub>4</sub> pretreatment time from 2 minutes and peaked up maximally at 60 minutes after which a progressive decrease in stem height were recorded onward.

##### 3.2.3. Leaf counts

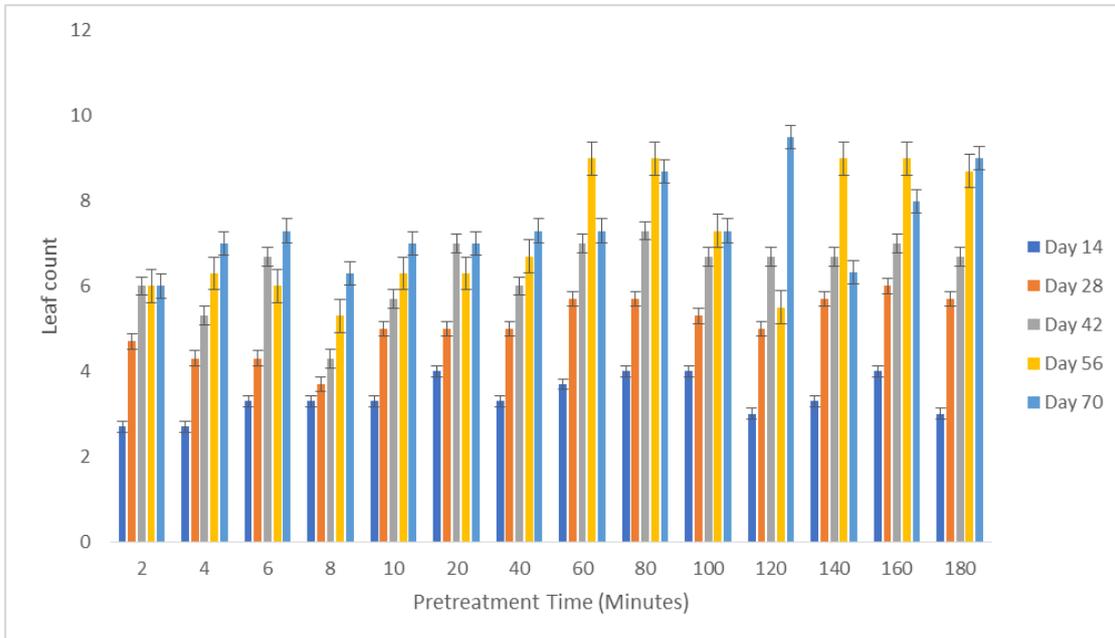
The leaf counts of H<sub>2</sub>SO<sub>4</sub> pretreated *P. biglobosa* increase with increase day of germination and treatment period up to 40 minutes of soaking. Day of germination and treatment period independent fluctuations in leaf counts were however observed between 60 minutes and 180 minutes treatments duration.



**Figure 1** Effect of H<sub>2</sub>SO<sub>4</sub> pre-treatment on stem girth of *P. biglobosa* plant



**Figure 2** Effect of H<sub>2</sub>SO<sub>4</sub> pre-treatment on stem height of *P. biglobosa* seed



**Figure 3** Effect of H<sub>2</sub>SO<sub>4</sub> pre-treatment on leaf counts of *P. biglobosa* plant

**Table 1** Effect of H<sub>2</sub>SO<sub>4</sub> pretreatment on emergence of *P. biglobosa* seed

	Treatment Period (Minutes)													
	2	4	6	8	10	20	40	60	80	100	120	140	160	180
1	-	-	-	-	-	-	-	-	-	-	-	0.00	0.00	0.00
2	-	-	-	-	-	-	-	-	-	-	-	0.00	0.00	0.00
4	-	-	-	-	-	-	-	20.0	0.0	10.0	10.0	30.0	10.0	0.00
6	-	50.0	30.0	50.00	60.0	90.0	90.0	80.0	70.0	70.0	30.0	80.0	40.0	30.0
8	30.0	70.0	70.0	100.0	90.0	100.0	100.0	80.0	80.0	70.0	50.0	80.0	40.0	30.0
10	30.0	80.0	70.0	100.0	100.00	100.0	100.0	80.0	80.0	70.0	50.0	80.0	40.0	30.0
12	40.0	90.0	70.0	100.0	100.0	100.0	100.0	80.0	80.0	70.0	50.0	80.0	40.0	30.0
14	50.0	90.0	70.0	100.0	100.0	100.0	100.0	80.0	80.0	70.0	50.0	80.0	40.0	30.0

Data are mean of duplicate determination

#### 4. Discussion

Different approaches of breaking seed dormancy, in order to enhance germination rate and to increase germination process were argued by many authors [14-16]. However, acid treatment methods is widely used to overcome physical seed dormancy [17]. The emergence of seeds of *P. biglobosa* presoaked in 100% H<sub>2</sub>SO<sub>4</sub> increase with increase day of germination from day 1 to day 14. This enhanced seed germination with increasing time was also reported by Awodola [18], Aduradola and Shinkafi [19], for *Parkia biglobosa* (Jacq) Don. and *Tamarindus Indica* Linn. In addition, this is also similar to the report by Duguma *et al.* [20] that germination percentage increased with longer treatment time of acid.

This finding could be attributed to the fact that sulphuric acid is thought to disrupt the seed coat and expose the lumens of the macrosclereids cells, permitting imbibition of water [15] which triggers germination. The seed emergence increases with H<sub>2</sub>SO<sub>4</sub> pretreatment time from 2 minutes and peaked up maximally at 20 and 40 minutes were 90 % and 100% emergence were recorded after day 6 and 8. This finding implies that the maximum effect of H<sub>2</sub>SO<sub>4</sub> on emergence of *P. biglobosa* seed occur when soaked between 20 and 40 minutes.

Dormancy in seeds is usually associated with the factors of the protective covering, the seeds coat or the enclosed embryo. From the investigations carried out, application of sulphuric acid were found to induce germination of seeds of *Parkia biglobosa*. From the above one can infer that dormancy of the seeds of parkia was probably associated with the seeds coat, since pretreatment with H<sub>2</sub>SO<sub>4</sub> induce germination by disruption of the seed coat. The results of the present study is in accordance to the study of Levitt [21], who reported that immersion of seed in highest concentrated sulphuric acid disrupts the seed coat. Aliero [13], also reported that 98% concentrated sulphuric acid gave the highest percentage of germination and within the shortest period as compared 90%, 70% and 50% respectively, indicate that the more rapidly the seed coat is ruptured the faster the rate of germination. The progressive decreases in seed emergence recorded from 60 minutes of pretreatment onward, is an indication that prolong emersion of seed in H<sub>2</sub>SO<sub>4</sub> may be injurious to the seeds as the acid may rapture vital parts of the embryo. In agreement with the present study Aliero, [13] who also reported that long pretreatment of *P. biglobosa* in H<sub>2</sub>SO<sub>4</sub> results in decrease seed emergence

From the results, it is evident that seedlings raised from seeds soaked in sulphuric acid with increasing exposure regime from 2 to 40 min had the best vegetative characters (stem girth, stem height and leaf counts) which concurred with the result of El-Juhany *et al.* [22] on the seedlings of *Juniperus procera*. Success of seedlings production depends on germination capacity from damping off, survivorship and increase in size. Therefore, dormancy in *P. biglobosa* seeds can be removed by pre- treatment with sulphuric acid (2 to 40 min) with enhanced percentage germination and growth performances.

## 5. Conclusion

The result from the study showed that seeds soaked in H<sub>2</sub>SO<sub>4</sub> improved seed germination and seedling growth of *P. biglobosa*. It is therefore recommended that H<sub>2</sub>SO<sub>4</sub> pretreatments of the seeds of *P. biglobosa* may be effective for breaking dormancy and improving the seedling growth which can enhance the domestication and cultivation of these valuable seeds in the environment.

## Compliance with ethical standards

### Acknowledgments

This study acknowledges the entire technical crew of the Southern Guinea Research Station, Mokwa for the assistance rendered during collection of samples and provision of pots and potting mixtures used in carrying out this experiment.

### Disclosure of conflict of interest

This work is a collaboration of all the authors. All authors read and approved the final manuscript. The authors declare that they have no competing interests.

## References

- [1] Kayode J. (2006). Conservation in Nigeria Perspective, 50.
- [2] Chandel PS and Shulka RS. (2002). A Textbook of Plant Ecology Including Ethnobotany and Soil Science, 549.
- [3] Simons AJ and Leakey RRB. (2004). Tree domestication in tropical agroforestry. *Agrofor. System*, 61, 167-181.
- [4] Olatunji D, Maku JO and Odumefun OP. (2013). The effect of pre-treatments on the germination and early seedlings growth of *Acacia auriculiformis* Cunn. Ex. Benth. *African Journal of Plant Science*, 7(8), 325-330.
- [5] Gbadamosi AE, Faboye OO and Oni O. (2005). Seed morphological traits, germination and early seedling growth of *Parkia biglobosa* (Jacq.) R. Br.Ex.G.don from four provenances in Nigeria. *Nigeria Journal of Agriculture*, 35(2), 129–137.
- [6] Aliero BL. (2004). Effects of sulphuric acid, mechanical scarification and wet heat treatment on germination of seeds of African locust bean tree *Parkia biglobosa*. *African. Journal of Biotechnology*, 3(3), 179–181.
- [7] Okunlola AI, Adebayo RA and Orimogunje AD. (2011). Methods of braking seed dormancy on germination and early seedling growth of African locust bean (*Parkia biglobosa*) (JACQ.) Benth. *Journal of Horticulture and Forestry*, 3(1), 1- 6
- [8] Lawal B, Shittu OK, Kabiru AY, Jigam AA, Umar MB, Berinyuy EB and Alozieuwa BU. (2015). Potential antimalarials from African natural products: A review. *Journal of intercultural ethnopharmacology*. 4(4), 318-343.
- [9] Lawal, B, Shittu OK, Oibiokpa FI, Berinyuy EB and Muhammed H. (2017). African natural products with potential antioxidants and hepatoprotectives properties: a review, *Clinical Phytoscience*, 2(23), 1-66.
- [10] Bashir L, Shittu OK, Sani S, Busari MB and Adeniyi KA. (2015). African Natural Products with Potential Antitrypanosoma Properties: A Review. *International Journal of Biochemistry Research & Review*. 7(2), 45-79.
- [11] Gbadamosi AE. (2005). Genetic variation in *Enantia chlorantha* (oliv). A medicinal plant. *Journal of Food Agriculture Environments*, (JFAE), 3(1), 153-156.
- [12] Hall TTJ, Ikeneboneh MJ, Kok R, Ingram JM, Antai SP and Ibrahim MH. (1997). Distribution, Conservation and use of *Parkia biglobosa* in Western Africa: *Journal of Science Food Agriculture*, 42, 253-262.
- [13] Aliero BL. (2004). Effects of sulphuric acid, mechanical scarification and wet heat treatment on germination of seeds of African locust bean tree *Parkia biglobosa*. *African Journal of Biotechnology*, 3(3), 179–181.
- [14] Alamgir M and Hossain M. (2005). Effect of pre-sowing treatments on *Albizia procera* (Roxb.) Benth seeds and initials development of seedlings in the nursery. *Journal of Forest. Environment*, 3, 53-60.

- [15] Airi S, Bhatt ID, Bhatt A, Rawal RS and Dhar U. (2009). Variations in seed germination of *Hippophae salicifolia* with different presoaking treatments. *Journal of Forest. Research*, 20(1), 27-30.
- [16] Azad MS, Musa ZA and Matin A. (2010). Effect of pre-sowing treatments on seed germination of *Melia azedarach*. *Journal of Forest. Research*, 21(2), 193- 196.
- [17] Pipinis E, Milios E, Smiris P and Gioumousidis C. (2011). Effect of acid scarification and cold moist stratification on the germination of *Cercis siliquastrum* L. seeds *Turkish Journal of Agriculture*, 35, 259-264.
- [18] Awodola AM. (1994). Aspects of germination in seeds of African locust bean tree *Parkia biglobosa* (Jacq) Don. *Journal of Tropical Forestry Resources*, 10, 82- 91.
- [19] Aduradola AM and Shinkafi MA. (2003). Aspects of seed treatment for germination in *Termarindus indica* Linn. *ASSET Series A*. 33(4), 29- 34.
- [20] Duguma B, Kaiw BT and Okali DUU. (1988). Factors affecting germination of *Leucaenia leucocephala*. *Seed Science and Technology*, 16, 489-500.
- [21] Levitt J. (1974). *Introduction to plant physiology*. CV Mosby Company USA, 277-286.
- [22] El-Juhany LL, Aref IM and Al - Ghamdi MA. (2009). Effects of different pre- treatments on seed germination and early establishment of the seedlings of *Juniperus procera* Trees. *World Applied Science Journal*, 7(5), 616- 624.

---

### How to cite this article

Dauda M, Adegbola GA, Babatunde RO and Alawode RA. (2019). Seed dormancy breakage, enhance germination and growth performances of *Parkia biglobosa* seeds using concentrated H<sub>2</sub>S<sub>04</sub>. *GSC Biological and Pharmaceutical Sciences*, 8(3), 53-59.

---