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Original Article

EVALUATION OF STAGES OF MATURITY AND SCARIFICATION ON RATE OF GERMINATION OF SEEDS OF *Parkia biglobosa* (Jacq.) Benth.

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ABSTRACT

Seeds of *Parkia biglobosa* (Jacq) Benth., collected from three states of the semi-arid zone of Nigeria; Sokoto, Katsina and Borno states, and at three stages of their development; green, light brown and brown (ripe) were assessed for germination factorially, in a complete randomized design (CRD) with five replications. The brown (fully ripe) seeds obtained from Katsina were significantly more viable than the brown, light brown and green seeds obtained from the other locations including same colour from Katsina. Percentage germination of the seeds at the different stages of maturity increased with number of days. At 5 days after planting, the green seeds from all the locations had 0% germination. At 10 days, the green seeds had 1.25% from the locations; and at 15 days, the green seeds had 1.87%, 3.75% and 2.66% germination, respectively, from Shuni, Katsina and Maiduguri. Mechanical scarification of the seeds at the circumference induced earlier and higher percentage germination than those scarified at the micropylar and distal ends irrespective of the collection sites of the seeds. However, the ripe matured seeds scarified at the circumference from Katsina gave significant increase in percentage germination of the seeds of *P. biglobosa.*

Keywords: Maturity, *Parkia biglobosa*, Scarification, Seed germination.

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INTRODUCTION

Parkia biglobosa (Jacq) Benth, commonly known as African locust bean (dawadawa in Hausa; ogiri in Igbo, iru in Yoruba, une in Ebira), is one of the tropical trees that grow wild. It is a legume that is recognized as a multipurpose tree used for firewood, medicine, food, timber, ecosystem stabilization and anti-desertification in semi-arid areas (Sadiyama *et al*., 2005). In an attempt to integrate *P. biglobosa* with other semi-arid tree species in the control of desertification, some of its ecophysiological traits should be studied. By this, a large number of seedlings may be produced in the nursery for distribution in the anti – desertification and afforestation programmes in Nigeria. Similarly, in order to enhance rapid establishment of *P. biglobosa*, there is need to make available to resource poor farmers affordable technologies that will enhance the viability of the seeds (Okpara, 1989).

In some tree species with hard seed coat such as *Acacia senegal,* a sulphuric acid treatment is commonly needed to scarify and break open the seed coat, to make it permeable to water, the inhibitors are leached out and germination occurs (Okunsanya and Ovbiovbio, 2009). When the seed coat is impervious to oxygen and water, the seed can also be scarified either by rubbing or tumbling with abrasives (Danladi, 2011). *P. biglobosa* is used in food, pharmaceuticals, paper, textile, cosmetics and other relevant industries (Oyun and Danladi, 2008). The bark of the tree is a major constituent of artificial blood serum used for treatment of renal diseases, regulation of diuretic activity as well as a dietary supplement (Anon, 1999). The wood is a good source of fuel and the pods are eaten by man and herbivores. The leaf fall is mineralized to build up the fertility of sandy soil and very effective in erosion control while the flowers are relished by honeybees (Bello and Ambursa, 2011). *P. biglobosa* is known to be endowed with features that give it potentials for ecosystem stabilization and for desertification control. It stabilizes sand dunes, fixes atmospheric nitrogen and it is a source of firewood and fodder (Abdullahi, 2002). The objective of this study was to investigate the effect of maturity and scarification on the germination of the seeds of *P. biglobosa.* Although, it is known that the seed coat of most legumes are hard (Ovcharou, 2002; Adamu, 2012) and that stage of seed maturity and scarification influence seed germination (Duguma *et al.,* 1998), these are yet to be tested on the seeds of *P. biglobosa.* The specific objective of the study is to determine the rate of germination under the factors inorder to assess the appropriate germination technique most suited to raise large number of seedlings of *P. biglobosa* for our resource poor farmers.

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MATERIALS AND METHODS

Seed collection

Sample trees of *P. biglobosa* were chosen for seed collection from Shuni in Sokoto state; Katsina in Katsina State and Maiduguri in Borno state; located between Latitudes $11^0 30'$ to $13^0 50'$ N and Longitude 4^0 – 6^0E (Federal Surveys, 2012). The pods were collected at three stages of maturity, the green at 6 weeks; light brown at 10 weeks and brown (ripe) at 14 weeks. The pods were harvested with a cutlass from the sampled trees and later separated by hand. The pods from Shuni were tied with rope and packed in polythene bags and labelled Shuni Green (SG), Shuni Light Brown (SLB) and Shuni Brown (SB) for green, light brown and brown (ripe) fruit pods respectively. Those from Katsina were labeled Katsina Green (KG), Katsina Light Brown (KLB) and Katsina Brown (KB). The ones collected from Maiduguri were labeled Maiduguri Green (MG), Maiduguri Light Brown (MLB) and Maiduguri Brown (MB). All the pods were taken to the Botanical Garden of Usmanu Danfodiyo University, Sokoto where the experiments were carried out.

Experimental set up

The seeds from three locations were removed from the pods with a scapula and collected in three different plastic basins, washed cleaned and dried at room temperature for a week to reduce the moisture content of the seeds. An average of ten seeds were obtained from each pod per location. Damaged and immature seeds were separated from the matured healthy ones. These healthy seeds were treated with insecticides and stored in plastic containers at about 4^0C before experimentation. Twenty of such matured and viable seeds of each maturity stage were spatially arranged on moist sterilized cotton wool in 14.5cm diameter Petridish. Petri – dishes were randomly arranged on the laboratory bench and observed. The number of seeds in each set that germinated per day in each petridish were counted and recorded from which the percentage seed germination was later calculated after 5 days sampling intervals. Ten seeds of *P. biglobosa* collected from the three locations were scarified using a sharp knife. Ten seeds were clipped 2mm off the micropyle, ten were clipped 2mm off at distal end ten clipped around the seed circumference. The scarified seeds were placed petri dishes as described above and observed for germination. The experiment was laid out in a completely randomized design with five replicates per treatment. A seed was said to have germinated when both the coleorhizae and coleoptiles, extended from the embryo of the seed.

Data Analysis

Data obtained from the locations, maturity and scarifications were subjected to analysis of variance (ANOVA) using statistical package for agricultural research (AGRES). Significant difference in the treatments were further subjected to least significant difference (LSD) for the separation of means.

RESULTS

At five days of planting, the green seeds from Shuni, Katsina and Maiduguri did not germinate at all. While at the same period, the light brown seeds from Shuni had 3.75%, Katsina was 3.89% and Maiduguri had 3.94% germination, and the fully ripe seeds (brown) from Katsina had 12.5%, followed by those from Shuni (8.16%) and 7.98% germination was recorded from Maiduguri (Table 1). At 10 days of planting, germination of 1.25%, 1.86% and 1.98% were recorded with the green seeds from the three locations respectively. The light brown seeds sourced from Shuni had 5.07% germination while it was 6.77% and 6.89% with those from Katsina and Maiduguri, respectively (Table 2). At 15 days, the percentage germination of the green seeds from Shuni was 1.87%

while those from Katsina and Maiduguri increased to 3.75% and 2.66%, respectively (Table 3). Germination of 36.35%, 53.76% and 39.78% were obtained with the brown (ripe) seeds from Shuni, Katsina and Maiduguri, respectively. Significant increase in percentage germination were recorded in the scarified seeds at the circumference three days of planting for Shuni, Katsina and Maiduguri (27.0%, 37.5%, and 25.0%) respectively. Similarly, significant increase in percentage germination were also recorded in the seeds scarified at the distal end at three days of planting from the three locations with 25.0%, 26.67% and 13.88% respectively. Also, significant increase in percentage germination were equally recorded in the seeds scarified at the micropyle but with the least percentage germination at three days of planting for the same locations (7.5%, 21.25% and 7.5%) (Table 4). By the 6th day of planting the seeds scarified at the circumference still had the highest germination of 30.50%, 70.06% and 52.67% from the three locations, followed by the distal cut with 31.82%, 48.89% and 36.39% then micropyle scarification with 20.0%, 46.35% and 22.59% (Table 5). At the 9th day as shown in Table 6, the seedlings scarified at the circumference increased to 93.69%, 96.44% and 80.69% from the three experimental sites, followed by the distal cut with 66.37%, 80.26% and 47.89% respectively while the micropyle scarification of the seeds had 56.27%, 58.78% and 28.73%. At the 9th day of planting, there was no significant increase in percentage germination of the scarified seeds. The analysis of variance table showed that all the treatments were significantly different as a result of scarification, all the matured seeds germinated early and also showed significant difference in their percentage germination.

Table 1: Effect of maturity on percentage seed germination of *P. biglobosa* at five (5) days of planting

Location Maturity	Shuni	Katsina	Maiduguri
Green	0.00a	0.00b	0.00c
Light brown	3.75a	3.89b	3.94c
Brown	8.16a	12.5b	7.98c
LSD	0.16	0.14	0.13

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

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Table 2: Effect of maturity on percentage seed germination of *P. biglobosa* at 10 days of planting.

	Location		
Maturity	Shuni	Katsina	Maiduguri
Green	1.25a	1.86b	1.98c
Light brown	5.07a	6.77b	6.89c
Brown	18.75a	38.95b	29.06c
LSD	0.18	0.19	0.19

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

Table 3: Effect of maturity on percentage seed germination of *P. biglobosa* at 15 days of planting.

	Location		
Maturity	Shuni	Katsina	Maiduguri
~~Green~~	~~1.87a~~	~~3.75b~~	~~2.66c~~
Light brown	10.55b	10.69b	13.75b
Brown	36.35a	53.76a	39.78a
LSD	0.21	0.26	0.23

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

Table 4: Effect of mechanical seed scarification on percentage of *P. biglobosa* at 3 days of planting

	Location		
Site of scarification	Shuni	Katsina	Maiduguri
Micropyle	7.5c	21.25c	7.5c
Circumference	27.0b	3.75a	25.06
Distal	25.0b	26.67a	13.88b
LSD	0.42	0.45	0.47

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

Table 5: Effect of mechanical seed scarification on percentage germination of *P. biglobosa* at 6 days of planting

	Location		
Site of scarification	Shuni	Katsina	Maiduguri
Micropyle	20.0c	46.35a	22.59c
Circumference	30.50b	70.06a	52.67a
Distal	31.82b	48.89a	36.39b
LSD	0.57	0.59	0.58

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

Table 6: Effect of mechanical seed scarification on percentage germination of *P. biglobosa* at 9 days of planting.

	Location		
Site of scarification	Shuni	Katsina	Maiduguri
Micropyle	56.27b	58.78b	28.73c
Circumference	93.69a	96.44a	80.69a
Distal	66.37b	80.26a	47.89b
LSD	0.81	0.89	0.80

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

DISCUSSION

The results showed that stage of maturity influenced the percentage germination of the seeds of *P. biglobosa.* The poor germination of the green and light brown seeds suggests that the endosperms and the embryos were not properly developed for germination. This is in agreement with earlier findings of Singh and Nasir (2009) who observed that immature seeds of *Tamarindus indica* do not germinate at all at 20 days of planting. The brown (ripe) seeds germinated best, probably because their embryos and the endosperms have physiologically developed well for germination. This is in conformity with the works of Ajala and Ahmed (2011) on dormancy and germination of seeds of *Prosopis africana.* The radicules, plumules and the cotyledons must be matured enough to establish the young seedlings. As the seeds matured, the relative moisture content reduced and the colour gradually changed from green to brown, as an index of seed maturity (Bello and Ambursa, 2011). Higher percentage germination of mature seeds over immature ones had been reported in the separate studies by Duguma *et al.* (1998), Awodola and Shinkafi (2008) on the germination of *Tamarindus indica* and *Leucaenia leucocephala,* respectively. Irrespective of source of seed, brown (ripe) seeds had consistently higher germination potential (Singh and Nasir, 2009).

The percentage germination of seeds from the three seed collection sites was highest in the brown (ripe) seeds. It was also noted that the brown, matured seeds from Katsina, were most viable in this investigation. The mechanical scarification of the seeds at the circumference enhanced earlier and higher germination percent than the scarification at the micropylar and distal ends of the seeds of *P. biglobosa.* This is in agreement with earlier findings of Duguma *et al.* (1998) who observed that mechanical scarification is an efficient way of improving seed coat permeability of *Pterocarpus angolensis* and *Leucaenia leucocephala* seeds. Opening into the cotyledon of *P. biglobosa* especially through the distal end and circumference cut allowed ready imbibition of water, which enhanced early germination. On the other hand, micropylar cut probably wounded the embryo, and this may have retarded physiological process for germination. This probably explained the lower germination percentage observed for micropylar cut compared to the circumference and distal cut in this study. Mechanical scarification of seeds elicits high rate of respiration (Awodola, 1990).

ONCLUSION

It was evident that the seeds of *P. biglobosa* have dormancy and would not germinate early and easily. Therefore, mechanical scarification of the seeds at the circumference before sowing reduced the time taken for the seeds to germinate and gave high percentage germination. The ripe matured seeds from Katsina were significantly more viable than the riped, light brown and green seeds of *P. biglobosa* obtained from the other locations.

REFERENCES

Abdullahi, S. (2002). Improvement of Traditional *Acacia senegal* Agroforestry in Central Sudan. Ph.D. Thesis. University of Helsinki, Finland.

Adamu, S. A. (2012). *A biology of Acacias.* A new source book and bibliography for Biologist and naturalists. University press publication. PP.35 and 47.

Ajala, F. and Ahmed, S. (2011). Some factors affecting germination in seeds of two potential arid zone agro forestry trees. *Nigerian Journal of Basic and Applied Sciences,* 21(2), 41 – 45.

Anon. (1999). *The useful plants of India.* Publication and Information Directorate CSRI New Delhi, India.

Awodola, A. M. (1990). The effect of source of nitrogen and frequency of moisture supply on growth and macronutrient distribution on seedlings of *Parkia biglobosa. Journal of Tropical Forest Sciences,* 8 (1): 136 – 139.

Awodola, A. M. and Shinkafi, M. A. (2008). Germination in seeds of *Tamarindus Indica. Zuru Journal of Agriculture,* 1: 1 – 7.

Bello, A. G. and Ambursa, A. S. (2011). Gum Arabic (*Acacia senegal*) production and management in Northern Western Nigeria. *36th Annual Conference of Forestry Association of Nigeria.*

Danladi, S. A. (2011). Growth variation among seedling progenies of *Moringa oleifera* obtained from three sources in the Guinea savanna of Nigeria. *Nigeria Journal of Botany,* 36:15 – 21.

Duguma, B., Kang, B. T, and Okali, D. U. (1998). Factors affecting germination of *Leucaenia leucocephala* seeds. *Seeds Science and Technology* 16, 489 – 500.

Federal Surveys (2012). Topographical Map Sheet 29 NW Dange. Federal Ministry of Survey.

Okunsanya, P. and J. C. Ovbiovbio (2009). Physiological dimorphic germination in *Acacia senegal. Nigerian Journal of Botany,* 34: 61 – 68.

Ovcharov, K. E. (2002). Physiological basis of seed germination. American Publishing Co. Prt. Ltd. New Delhi, India.

Oyun, M. B. and Danladi, M. (2008). A Study of Establishment Technique for *Balanites aegyptiaca, Parkia biglobosa, Prosopis cineria* in forest reserve in Zamfara State. *Nigeria Journal of Basic and Applied Sciences,* 42(2): 38 – 42.

Sadiyama, M. A. N., Casua, U. N. D., Cansola, A. A, Dasilva, E. A. M. and Dasilva, R. F. (2005). Influence of harvesting time and ripening stage on seed germination of carrot. In *Revista Brasileria de semoenties*, 13 (1) 69 – 71.

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Singh, A. and Nasir, B. (2009). Potential farm trees in Sokoto Local Government. Forest resources development and sourcing of local raw materials in Nigeria. *Nigerian Journal of Basic and Applied Sciences,* 39(1)*: 21- 26.*