STUDIES ON THE SEED GERMINATION OF *Parkia clapertoniana*[1]

*E. O. ETEJERE**
*M. O. FAWOLE**
*A. SANI**

Resumen

Las vainas de Parkia clapertoniana *contienen dos tipos de semilla denominadas Pardo Rojizo (RB) y Pardo Oscuras (DB), las cuales se presentan en una relación 1 : 10. Las semillas RB germinan de inmediato mientras que las DB presentan dormancia debida a recubrimiento de la semilla. Más del 90% de las semillas RB germinó a una temperatura óptima de 30°C.*

Las semillas DB germinaron en forma sucesiva cuando se les aplicó varios métodos para romper la dormancia. El mejor método fue la escarificación con H_2SO_4 concentrado por 15 minutos, con el cual se logró una germinación del 97%.

La pulpa de la fruta inhibió en forma total la germinación de las semillas RB y no estimuló en absoluto la germinación de las semillas DB.

Introduction

Parkia clapertoniana also known as African locust bean tree abound in Nigeria especially in the guinea savanna regions. It is one of the protected economic tree crops in the savanna belt.

The trees fruit during the months of December to March and they bear numerous leguminous pods. The pods contain a yellow powdery pulp which is rich in carbohydrate (Purseglove, 8). The seeds are embedded in the pulp.

In Nigeria the seeds are very important to the Yorubas because they are used in preparing a form of spice known as **'Iru'**. The spice adds flavour to soup and also makes it thick. The seeds thus serve as a good and cheap source of spice. Cattle and other livestock are fed with the pods. The leaves when ploughed into the soil serve as a good source of manure.

Although the tree crop seems to be protected by natives, some factors contribute to the low population of the plant in the field. One of these is uncontrolled bush burning which is a common feature in the savanna areas during the dry season. Bush burning destroys the young seedlings and reduces the population density. One other factor is excessive grazing by cattle and other domestic stock. These animals not only eat up the young and tender seedlings but may also physically destroy them during movement within the vegetation. Perhaps a more important factor is the fact that only a small percentage of the seeds germinate in the field; a lot more are dormant. Dormancy of seeds has also been reported for *Musanga cecropioides, Bosquiea angolensis, Ficus* sp and *Antiaris africana* which are common tree species found in Nigeria (Aramide, 1).

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* Department of Biological Sciences, University of Ilorin, Ilorin, Nigeria

The present investigation is part of a more elaborate one on the biology of the plant. It is directed at studying the germination of the seeds of *Parkia*. The study revealed that a high percentage of the seeds are dormant; data are presented aimed at breaking such dormancy.

Materials and methods

Sampling procedure

Ripe pods containing viable seeds collected from 20 randomly selected trees in the field during the fruiting period were used for the study. The number of pods estimated per tree from which the samples were selected ranged from 500 to 3000. Sixty randomly selected pods were opened and the seed distribution per pod was observed.

Seeds collected from the pods were soaked, washed free of the pulp and dried at room temperature before they were used for germination studies. Careful observation however revealed that two types of seeds were present in each pod on the basis of their testa colours. These were designated red brown (RB) and dark brown (DB) respectively. Seed collections used for this study were thus separated into these two groups.

Germination studies

Randomly selected RB or DB seeds were surface sterilised with 0.1% mercuric chloride solution for approximately 30 seconds, rinsed in several changes of sterile distilled water and plated in 9.0 cm sterile Petri dishes. Ten seeds were broadcast on each plate containing two sterile filter papers soaked with sterile distilled water. The plates prepared in replicates of ten were incubated at 30°C for 15 days.

A second batch of RB or DB seeds were later plated as earlier described and subjected to various temperature ranges of −10°C, 15°C, 25°C, 30°C, 35°C and 40°C. Ten replicates were also used.

Dormancy studies

Heat Treatment. The DB seeds which were found to exhibit dormancy were subjected to heat treatment in order to break their dormancy. The seeds were subjected to 80°C or 100°C for 1, 2 or 5 minutes. The heat treatment was carried out by emersing seeds in water at the specified temperature.

Seed decoating. Partial decoating of seeds was achieved by partly removing the coat from either the micropyle or non-micropyle end of the seed. This was done by a careful surgical operation involving the use of sterilised scapel and forceps. Total decoating involved the removal of the entire seed coat. Ten replicates of partial or total decoated seeds were then surface sterilised and plated as described earlier.

Scarification. The DB seeds were scarified by immersing in different types of concentrated acids for various periods. Acids used were H_2SO_4, HCl, and HNO_3 each for 1, 2, 5, 10 or 15 minutes. Seeds were placed in beakers and the acid poured in the beakers just enough to cover the seeds. Seeds were later soaked in running tap water for 3 hours after the acid had been poured off. They were later rinsed generously in sterile water before plating as usual. Unscarified seeds were plated as control.

Five herbicides and one fungicide (Table 6) were also tested on the dormancy of the DB seeds. The seeds were exposed to the concentrated commercially formulated herbicides or fungicide as was described for acid scarification. The seeds were then plated as earlier described.

Effect of fruit pulp on seed germination. The effect of the fruit pulp on the germination of both the RB and DB seeds was studied. Fresh seeds from the pods with the pulp still intact were surface sterilised and plated as described earlier. After the germination period the seeds were washed free of the pulp to determine their colours. In a second treatment, washed DB or RB seeds were plated in Petri dishes containing sterile distilled water with the fruit pulp sprinkled on the filter papers. Attempts to prepare a suspension of the pulp in sterile water failed.

Results

The total number of seeds per pod was found to range from 7-23. As already stated, washed seeds revealed that two types of seeds occur in the pods on the basis of the colours of their seed coat. These are the redbrown (RB) and darkbrown (DB). The ratio of occurrence of RB to DB seeds was found to be approximately 1:10 per pod (Table 1).

Germination studies showed that RB seeds germinate readily (Figure 1) while DB seeds do not (Table 2). The optimum temperature for germination of RB seeds is 30°C with little or no germination at 40°C (Table 3). That germination of RB seeds in inhibited at low temperature of −10 and high temperature of 40°C (Table 3). The DB seeds did not germinate during the exposure to any of the temperatures tested. The DB seeds therefore appear to be dormant. Exposure of DB seeds to 80°C heat treatment gave low germination while those subjected to 100°C

Table 1. Distribution of Red Brown (RB) and Dark Brown (DB) seeds in randomly selected pods.

Samples of 10 pods	Total number of seeds in 10 pods	Average number of seeds per pod (± 1 S.E.)[1]	Number of RB seeds in 10 pods	Average number of RB seeds per pod (± 1 S.E.)[1]	Number of DB seeds in 10 pods	Average number of DB seeds per pod (± 1 S.E.)[1]	Ratio of RB DB seeds in pods
A	187	18.7 ± 0.60	17	1.7 ± 0.21	170	17.0 ± 0.49	1:10
B	146	14.6 ± 1.19	12	1.2 ± 0.13	134	13.4 ± 1.13	1:11
C	153	15.3 ± 1.47	13	1.3 ± 0.15	140	14.0 ± 1.36	1:11
D	156	15.6 ± 1.59	14	1.4 ± 0.16	142	14.2 ± 1.47	1:10
E	146	14.6 ± 1.21	11	1.1 ± 0.14	135	13.5 ± 1.20	1:12
F	126	12.6 ± 1.14	12	1.2 ± 0.13	114	11.4 ± 1.11	1:10

1 S.E. = Standard Error.

showed no germination (Table 4). A maximum germination of 20% was observed when the DB seeds were exposed to 80°C for 1 or 2 minutes. Untreated seeds (the control) did not germinate.

Partial or total decoating of DB seeds showed improved germination over the heat treatment. Seeds which were partially decoated at the micropyle end gave 83% germination; those decoated at the non-micropyle end gave 73% while those totally decoated gave 91% germination (Table 5).

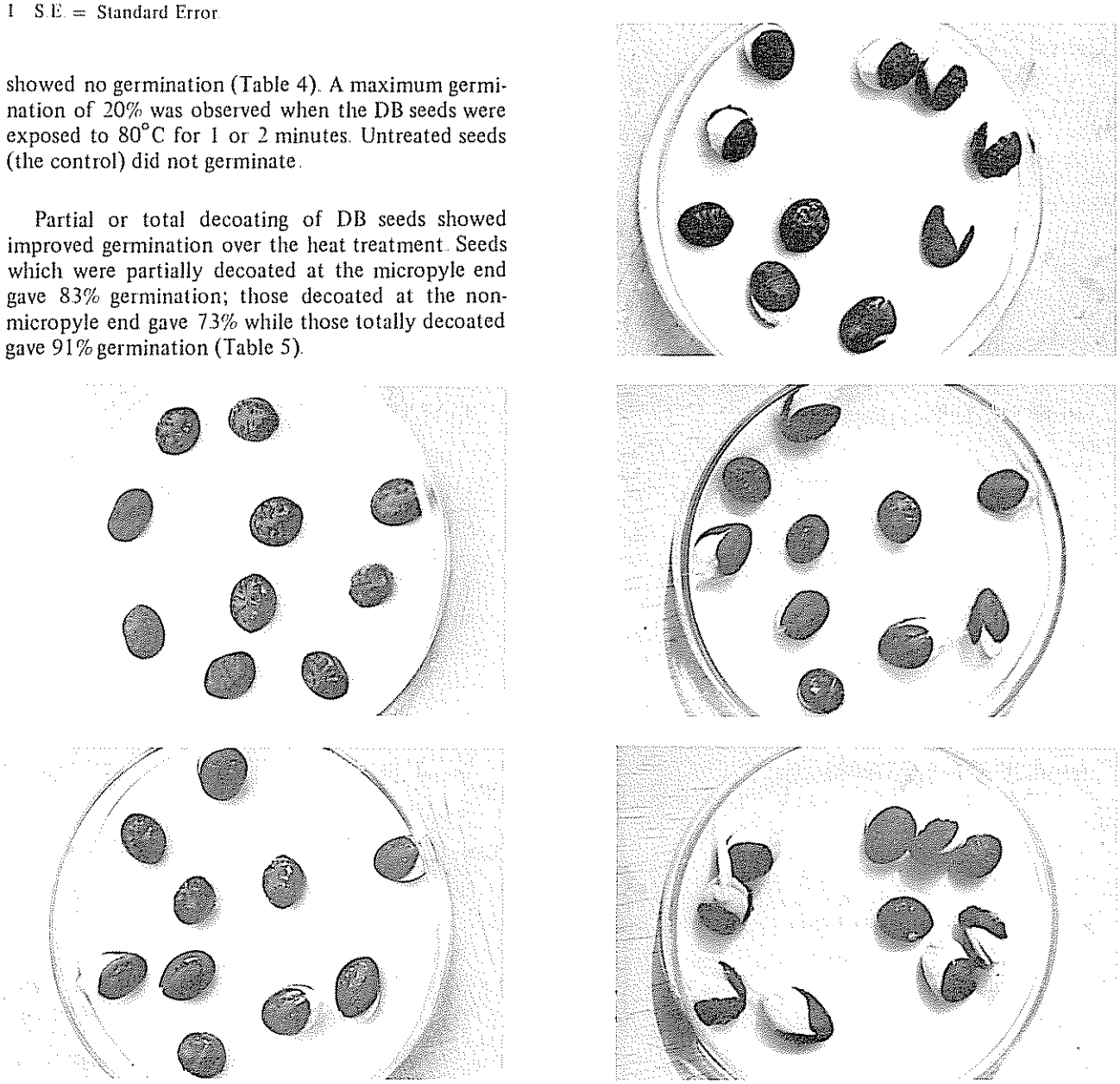

Fig. 1. Germination stages of RB seeds of *Parkia clapertoniana*.

Table 2. Percentage germination of untreated RB and DB seeds plated in Petri dishes at 30°C for 15 days. Data are averages from 10 replicates.

Days of germination	Cumulative %age germination of RB seeds	Cumulative %age germination of DB seeds
3	10	0
6	80	0
9	80	0
12	90	0
15	90	0

Acid scarified DB seeds showed higher germination than seeds subjected to heat treatment or which were decoated. This was especially true of seeds scarified with concentrated HNO_3 or H_2SO_4. Seeds scarified with concentrated HNO_3 for 15 minutes gave 86% germination; those scarified with concentrated HCl for 12 minutes gave 68% while those scarified with concentrated H_2SO_4 for 15 minutes gave 97% germination (Table 5). DB seeds even when treated with various herbicides and fungicide did not germinate (Table 5).

The fruit pulp did not break the dormancy of the DB seeds; indeed it inhibited the readily germinating RB seeds (Table 6).

Discussion

Two types of seeds have been identified in the pods of *Parkia clapertoniana*. These have been designated red brown (RB) and dark brown (DB) seeds, based on colour of their testa. This occurrence of two coloured seed coats could be an attribute of genetic influence. Germination of *Parkia clapertoniana* seeds is limited to the RB seeds which unfortunately occur in very low proportion in the pods. The DB seeds which occur in very high proportion in the pods exhibit seed coat dormancy. The dormant DB seeds were successfully germinated after various treatments

Table 3. Percentage germination of RB and DB seeds under various temperatures for 15 days. Data are averages of 10 replicates.

Seed Type	Percentage germination					
	−10°C	15°C	25°C	30°C	35°C	40°C
RB	0	36	76	92	76	2
DB	0	0	0	0	0	0

Table 4. Percentage germination of DB seeds subjected to heat treatment. Data are averages of 10 replicates.

Temperature °C	Exposure time (min.)		
	1	2	5
Control	0	0	0
80	20*	20*	10*
100	0	0	0

* Significantly different from control at 95% probability level.

ranging from heat to herbicide treatments. Treatments which resulted in dormancy break were acid scarification, removal of seed coat and heat treatment. The treatment which gave the highest germination was scarification with H_2SO_4 for 15 minutes. Coutinho and Struffaldi (3) also observed seed coat impermeability with seeds of *Parkia auriculata* although they did not report the occurrence of different types of seeds in the pods. Borthwick and Robbins (2) found that germination at high temperatures did not occur in mature lettuce seeds unless the innermost of the three seed membranes is removed. It is also reported that the removal of a small portion of the rice husk breaks dormancy of the seed. Aramide (1) observed that seeds of *Antiaris africana*, *Bosquea angolensis*, *Musanga cecropioides* and *Ficus* sp showed dormancy problems but only *Antiaris africana* had dormancy due to seed coat impermeability.

Usually the number of *Parkia* trees in any vegetation is low compared with other plants. The low per-

Table 5. Percentage germination of DB seeds after scarification with various chemicals. Data are averages of 10 replicates.

Chemicals	Exposure time (min.)				
	1	2	5	10	15
Control	0	0	0	0	0
HCl	23*	34*	46*	60*	66*
HNO_3	52*	64*	78*	80*	86*
H_2SO_4	64*	70*	87*	91*	97*
Atrazine	0	0	0	0	0
2, 4–D	0	0	0	0	0
EPTC	0	0	0	0	0
Molinate	0	0	0	0	0
Monuron	0	0	0	0	0
Gammalin '20	0	0	0	0	0

* Significantly different from control at 95% probability level

Table 6. Percentage germination of seeds plated with or without fruit pulp. Data are averages of 10 replicates.

	% germination		
	Unwashed – intact seeds	Washed RB seeds	Washed DB seeds
With pulp	0	0*	0
Without pulp (control)	not applicable	75	0

* Significantly different from control at 95% probability level.

centage of viable RB seeds (Table 1) in the pods therefore confirms the suspicion that only a small percentage of the seeds germinate in the field. Even RB seeds with their pulp still intact cannot germinate unless the pulp is removed completely. The pulp therefore appears to inhibit the seeds from germinating. Several workers have also observed this phenomenon in seeds especially for tomato (Juel 4; Koves *et al.* 6; Konis 5 and Ozoriode *et al.* 7). Seeds obtained from pods should therefore be thoroughly washed-free of their pulp before sowing. A large scale breaking of dormancy of the DB seeds by concentrated H_2SO_4 for 15 minutes is suggested. Sowing of viable seeds should be carried out in a controlled environment of 30°C in order to obtain high germination.

Removal of the pulp of *Parkia* seeds under field conditions could occur either through splashing by water, fermentation, decay or by animals. These processes, apart from that of water, expose the seeds to possible destruction with a consequent reduction in the number of seedlings that would have established in the field. With the success already obtained in germinating the dormant DB seeds, there seems to be rays of hope in increasing the population of the species. This increase in population will thus supply the much needed spice 'Iru' which apart from its flavouring qualities also serve as a good source of protein to man.

Abstract

The pods of *Parkia clapertoniana* contain two seed types designated Red Brown (RB) and Dark Brown (DB), which occur in the ratio of about 1:10. The RB seeds germinate readily while DB seeds exhibit seed coat dormancy. The RB seeds gave more than 90% germination at an optimum temperature of 30°C.

The DB seeds were successfully germinated after various methods had been used to terminate the seed coat dormancy. The most successful method was scarification with concentrated H_2SO_4 for 15 minutes which gave 97% germination.

The fruit pulp completely inhibited the germination of RB seeds and did not stimulate dormant DB seeds to germinate.

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Unidades básicas del SI*

Especie	Unidad	Simbolo	Especie	Unidad	Simbolo
Longitud	metro	m			
Masa	kilogramo	kg	Temperatura	kelvin	K
Tiempo	segundo	s	Intensidad luminosa	candela	cd
Corriente eléctrica	ampere	A	Cantidad de sustancia	mole	mol

Unidades suplementarias

Angulo plano	radián	rad	Angulo sólido	steradián	sr

Unidades derivadas que tienen nombres y simbolos aprobados por el SI:

Especie	Unidad	Símbolo	Fórmula	Especie	Unidad	Símbolo	Formula
Frecuencia	hertz	Hz	1/S	Conductancia eléctrica	siemens	S	A/V
Fuerza	newton	N	Kg m/s^2	Flujo magnético	weber	Wb	V s
Presión	pascal	Pa	N/m^2	Densidad de flujo	tesla	T	Wb/m^2
Trabajo	joule	J	N m	Inductancia	henri	H	Wb/A
Potencia	watt	W	J/s	Flujo luminoso	lumen	lm	cd/sr
Cantidad electricidad	coulomb	C	A s	Iluminación	lux	lx	lm/m^2
Potencial eléctrico	volt	V	W/A	Radiactividad	bequeral	Bq	1/s
Capacidad eléctrica	farad	F	C/V	Dosis absorbida	gray	Gy	J6kg
Resistencia eléctrica	ohm	*W*	V/A				

Definiciones de las unidades básicas del SI*

El metro. Es la longitud equivalente a 1 650 763.73 longitudes de onda en el vacío de la radiación electromagnética emitida por el átomo de criptón 86, correspondiente a la transición entre $2p_{10}$ y $5d_5$ (su simbolo es m).

El kilogramo. Corresponde a la masa del kilogramo prototipo adoptado internacionalmente (su símbolo es kg).

El segundo. Es la duración de 9 192 631 770 periodos de la radiación electromagnética correspondiente a la transición entre dos niveles hiperfinos del estado base en el átomo de cesio 133 (su simbolo es s).

El ampere. Es la corriente eléctrica constante en dos conductores paralelos de longitud infinita y de sección transversal insignificante que, colocados a un metro de distancia entre sí en el vacío, se atraen con fuerza igual a 2×10^{-7} newton por metro de longitud (su simbolo es A).

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