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Effect of processing intervals and seed sizes on germination rate of seeds of the *Treculia africana* accessions

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ABSTRACT

The main objective of this study is to investigate the effect of processing intervals and seed sizes on the germination rate of seeds of the *Treculia africana* accessions. Four experiments were conducted in the Laboratory and at the Teaching and Research Farm of the Department of Crop Science, Faculty of Agriculture, University of Nigeria, Nsukka in the 2017 and 2018 planting seasons. Experiment one was a completely randomized design (CRD) replicated three times. The treatment consists of the seven *Treculia africana* accessions. Data were collected on the following parameters: Fresh fruit head colour, Fresh fruit head shape, Fresh fruit body texture, Fruit head weight before processing, Number of seeds per fruit head after processing, Seed weight per head after processing, Seed length, Seed diameter and Seed hull (testa)/Kernel ratio. Experiment 2 Data were collected on the following; Days to the first germination, Days to 50% germination and Total percentage germination. Experiment three was a 2 x 3 x 7 factorial laid out in a completely randomized design (CRD) with three replications. The obtained results revealed that the main effects of characterization of accessions and seed measurements were observed to be significant ($P<0.05$) on the seed weight but in the seed diameter and seed length, there was no varied significant difference in the characterization of the accessions. Across the accessions studied, there was no varied significant difference in the germination percentage. It was concluded that significant differences were observed across the accessions in their growth parameters evaluated, plant height, number of leaves number of nodes, internodes length, germination percentage, leaf emergence, seed sizes, fruit circumference, fruit weight, seed weight, seed length and seed diameter. The performance of the accessions as regards seed length showed that Cross River and Rivers accessions had the longest seed length of (10mm) each.

1.0 Introduction

Treculia africana (African breadfruit) is a large evergreen tropical food species belonging to the Moraceae family which is grown in the forest zone particularly the coastal swamp zone (Agbogidi and Onomeregbor, 2008) with a wider distribution in West Africa, central Africa and Madagascar (Okafor, 2009). It is a traditional important edible fruit tree in Nigeria due to the potential use of its leaves, timber, roots and bark (Okafor, 2009). In the word of Baiyeri and Mba (2006)*Treculia africana* is an important natural resource, which contributes significantly to the dietary intake of the poor. Today many rural dwellers in Nigeria and Cameron commercialized *T. africana* as a means of livelihood by engaging in the collection, processing and sale of the seeds. The seed has an excellent polyvalent dietetic value, whose biological value exceeds even that of soybeans (WAC 2004).

In Africa, it is widely grown in the humid South Eastern ecological zone of Nigeria, and the humid rain forest of Southeast Cameroon (Nwaigwe and Adejumo, 2015). The species grows best in equatorial lowland between 600-1550m above sea level (Nwajiaku,2013). The propagation or reproduction of *Treculia africana* plants is either sexual or asexual. Sexual propagation is by seeds resulting from the fertilization of ovules and often an exchange of genetic material through cross-pollination (Rice et al; 1990). Seed

is either sown directly in the field at the onset of the rainy season or planted in the nursery. Despite the relevance of *T. africana,* studies have reported that it's been underexploited and still harvested from the wild (Baiyeri and Mbah, 2006). *Treculia africana* is currently included in the list of endangered species of southern Nigeria (Meregini, 2005) and this is quite worrisome. Therefore the knowledge of the appropriate set of processing parameter will enhance the use of African breadfruit seed, to be a cheap necessary protein source. This study is, therefore, a response towards the under exploitation and utilization of *Treculia Africana, hence the study* examines the effect of processing intervals and seed sizes on the germination rate of seeds of the *Treculia africana* accessions

2.0 Material and Methods

Seven accessions of *Treculia africana* fruit heads were selected from seven states, two states of South-South and five states of Southeastern Nigeria

2.1 Experimental design and Site

The experimental design was completely randomized (CRD) replicated three times. Treatment consists of seven accessions of the *Treculia africana.* The experiment was conducted in the Laboratory and at the Teaching and Research Farm of the Department of Crop Science, Faculty of Agriculture, University of Nigeria, Nsukka in 2017 and 2018 planting seasons

2.2 Sources of Experimental Materials

Seven accessions of African breadfruit (*Treculia africana*) seeds were used for the study. They included;

Ebonyi accession obtained from the Ebonyi State Agricultural Development Programme Headquarters, Abakaliki.
Enugu accession obtained from the Enugu State Agricultural Development Programme Headquarters, Enugu.
Anambra accession obtained from the Anambra State Agricultural Development Programme Headquarters, Awka.
Imo accession obtained from the Imo State Agricultural Development Programme Headquarters, Owerri.
Abia accession obtained from the Abia State Agricultural Development Programme Headquarters, Umuahia.
Rivers accession obtained from the Rivers State Agricultural Development Programme Headquarters, Port Harcourt.
Cross River accession obtained from the Cross River State Agricultural Development Programme Headquarters, Calabar.

Organic manure was obtained from Ayalogu Poultry Farms Ltd, Enugu

2.3 Experimentation of Collected Materials

The fruit heads were rotted after which the seeds were extracted and processed at intervals of 8 and 14 days. The processed seeds were sorted into three sizes; small (100g per 100 seeds), medium (200g per 100 seeds) and large (300g per 100 seeds) approximately. Ten seeds were randomly selected from each size per accession and germinated in a petri-dish containing moist cotton wool at each processing period. The experiment was replicated three times, Thus, the experimental design was a 2 x 3 x 7 factorial in a completely randomized design (CRD). The treatments consisted of seven accessions of *Treculia africana* (main plot}, two processing intervals (subplot) and three seed sizes (subplot). The germination test lasted for two weeks from 18th April 2017 to 2nd May 2017. Germinated seeds were counted on a daily basis starting from the 8th day.

3.0 Data collection

Data were collected on the following;

Days to the first germination; this is the number of days taken for the first seed to germinate in each petri-dish

Days to 50% germination; the number of days taken for five out of ten seeds planted in each petri-dish to germinate.

Total percentage germination; is derived from the following formular;

$$\text{Total Percentage Germination (TPG)} = \frac{\text{number of germinated seeds}}{\text{Total number of seeds planted.}} \times \frac{100}{1}$$

3.1 Statistical Analysis

The data collected were subjected to the analysis of variance (ANOVA) with split-plot design in CRD using Gen Stat Release 10.3 DE, 2011. Mean separation was done using Fisher's least significant difference at the 5% probability level as described by Obi (2002).

3.2 Land preparation

The experimental site was cleared manually with a machete, stumped with a hoe and the trash removed from the field. The experimental area measured 8m x 52m (416m^2) which was ploughed, harrowed and divided into three blocks. Each block was 2m x 21m (42$m^{2)}$ and the block was sub-divided into twenty-one plots and the plot dimension was 2m x1m (2m^2).

There were four plants in each plot at 50cm between plants. This gave a total of eighty-four (84) plants per block (4 x 21). Footpath of 0.5m was allowed between plots and 1m between blocks.

3.3 Transplanting

Seedlings from experiment three were collected and transplanted at the spacing of 50cm between plants in a plot. Each plot contained four seedlings of the same sizes i.e. large, medium and small and the seedlings of each size relatively had uniform dimensions of height, stem girth and leaf number to reduce bias. These morphological parameters were measured before transplanting the seedlings. Holes were dug at the designated planting distances using a hoe and transplanting was done at one plant per hole with the ball of the earth (conventional method). This gave a plant population of two hundred and fifty-two plants per hectare (252 plants/ Area measured) (84 x3). The plant population was five thousand plants per hectare (5,000 plants/ha). Transplanting was done in October 2017. The plants were watered every other day in the morning using a watering can. The plots were labelled appropriately. The experiment lasted for six months.

4.0 Result Presentation

4.1 The main effect of processing intervals and seed sizes on the germination rate of seven accessions of Treculia africana on days to first, 50% and cumulative germination.

Across the accessions studied, there was no varied significant difference in the germination percentage of the accessions and intervals of processing as indicated in Table 11. At days to the first germination, Ebonyi and Enugu accessions recorded the best germination of the seeds tested (9.33) each followed by Abia, Anambra, and Imo accessions (8.33) each. Cross River and Rivers accessions recorded the lowest (8.00) each. At days to fifty percent germination, Ebonyi, accession produced the best germination of the seeds tested (12.67) followed by Enugu and Imo accessions (12.33) each while

Cross River accession had the least (10.00). At cumulative germination, Cross River accession had the highest cumulative percentage germination (100%) followed by Rivers accession (80%). Enugu accession had the least cumulative percentage germination (70%) as regards to 8th-day interval of processing.

In the 14th day interval of processing at days to the first germination, Ebonyi accession recorded the best germination of the seeds tested (9.00) followed by Anambra accession (8.67). Abia, Cross River, Imo and Rivers accessions recorded the lowest (8.00) each. At days to fifty percent germination, Ebonyi, Enugu and Imo accessions recorded the best germination of the seeds tested (11.33) each while Cross River accession had the least (9.00). At cumulative percentage germination, Cross River accession had the highest cumulative percentage germination (100%) followed by Rivers accession (90%). Anambra and Ebonyi accessions had the least cumulative percentage germination (83.33) each.

On the other hand, there was no varied significant difference in the seed sizes and the accessions as indicated in Table 12. The small seed size at days to the first germination showed that Anambra, Ebonyi and Enugu accessions had the best germination (9.50) each followed by Abia and Imo accessions (8.50) while Cross River and Rivers accessions had the least (8.00) each. In the days to fifty percent germination of the small seeds, Ebonyi, Enugu and Imo accessions had the best germination (12.50) each, followed by Abia and Anambra accessions (11.50) each while Cross River accession had the least (9.50). The cumulative percentage germination of the small seed showed that Cross River accession had the best (100%) followed by Rivers accession (85.00%) and Enugu accession had the least (70%). The days to first germination of the medium-sized seeds indicated that Ebonyi accession had the best (9.50) followed by Enugu accession (8.50) while Abia, Anambra, Cross River, Imo and Rivers accessions had the least (8.00) each. Also at days to fifty percentages germination of the medium sized seeds, Ebonyi, accession had the best (12.00) followed by Anambra, Enugu and Imo accessions (11.50) each while Rivers accession had the least (9.50). The cumulative percentage germination of the medium-sized seeds indicated that Cross River accession had the best (100%) followed by Abia, Imo and Rivers accessions (85%) each while Anambra accession had the least (75%).

The large seeds of the accessions showed that Ebonyi and Enugu accessions had the best germination at days to first germination (8.50) each. Abia, Anambra, Cross Rivers, Imo and Rivers accessions had an equal percentage of (8.00) each. At days to fifty percent germination of the large seeds, Anambra, Ebonyi, Enugu and Imo accessions had the best (11.50) each followed by Abia accession (10.50) while Cross River and Rivers accessions had the least (9.50) each. The cumulative percentage germination of the large seeds showed that Cross River accession had the best (100%) followed by all the other accession (85%) each.

However, there was no varied significant difference in the interaction effect of processing intervals, seed sizes, and the accessions as indicated in Table 13. At days to the first germination, the 8th day and 14th day interval of the seed sizes processed showed that Cross River and Rivers accessions had the same percentage of (8%) at a small size. Ebonyi and Enugu accessions had (10%) each at 8th interval and (9%) each at 14th interval. Abia, Anambra and Imo accessions had (9%) at 8th interval and (8%, 10%, 8%) respectively at 14th interval.

Also at days to first germination, 8th day and 14th-day intervals of the seed sizes processed showed that Abia, Anambra, Cross River, Imo and Rivers accessions had the same percentages of (8%) each at medium size. Ebonyi and Enugu accessions had (9%) at 8th interval and (10%, 8%) respectively at 14th interval. In the same vein, at days to first germination, 8th day and 14th-day intervals of the seed sizes processed showed that Abia, Anambra, Cross River, Imo and Rivers accessions had the same percentage (8%) at the 8th interval each while Ebonyi and Enugu accessions had (9%) each. On the 14th day of processing interval, the large seeds had (8%) in all the accessions.

The days to fifty percent germination of the small seeds indicated that Ebonyi, Enugu and Imo accessions took the longest Enugu and Imo accessions took the longest time to reach fifty percent germination at the interval of 8th day (13.00) each, closely followed by Abia and Anambra accessions (12.00) each and Cross River accession had the least (10.00). whereas at 14th-day interval, Ebonyi, Enugu and Imo accessions took more days to reach fifty percent (12.00) each followed by Abia and Anambra accessions (11.00) each while Cross River accession had the least (9.00). The days to fifty percent germination of the medium seeds indicated that Ebonyi accession took the longest time to reach fifty percent germination (13.00) followed by Anambra, Enugu and Imo accessions (12.00) each while Cross River and Rivers accessions had the least (10.00) each as it concerns 8th day interval whereas at 14th day interval of medium seeds showed that Anambra, Ebonyi, Enugu and Imo accessions took the longest time to reach fifty percent germination (11.00) each followed by Abia accession (10.00) while Cross River and Rivers accessions had the least (9.00) each. The days to fifty percent germination of the large seeds indicated that Anambra, Ebonyi, Enugu and Imo accessions took the longest time to reach fifty percent germination (12) each followed by Abia accession (11.00) while Cross River and Rivers accessions had the least (10) each as it concerns 8th day interval whereas at 14th day interval of the large seeds showed that Anambra, Ebony, Enugu and Imo accessions took the longest time to reach fifty percent germination (11) while Cross River and Rivers accessions had the least (9) each.

The cumulative percentage germination of the small seeds indicated that Cross River accession has the highest percentage germination at the intervals of 8th day (100%) followed by Rivers accession (80%) whereas Enugu accession has the least (60%). Whereas at the 14th-day intervals, Cross Rivers accession also had the highest percentage germination (100%) followed by Rivers accession (90%) while Abia, Anambra, Ebonyi, Enugu and Imo accessions had the least (80%) each. The cumulative percentage germination of the medium seeds indicated that Cross River accession had the highest percentage germination at the interval of 8th day (100%) followed by Abia, Ebonyi, Imo and Rivers accessions (80%) each while Anambra and Enugu accessions had the least (70%) each. Whereas at 14th-day interval of the medium seeds showed that Cross River accession had the highest percentage germination (100%) followed by Abia, Enugu, Imo and Rivers accessions (90%) each while Anambra and Ebonyi accessions had the least (80%) each. The cumulative percentage of the large seeds indicated that the Cross River accession of the 8th-day interval had the highest percentage germination (100%) followed by the other accessions (80%) each while at the 14th interval of the large seeds, Cross River accession also had the highest percentage germination (100%) followed by all other accessions (90%) each.

Table 1: Main effect of processing intervals on germination rates of seven accessions of *T. africana*

	8th Day			14th Day		
Accession	1st	50%	Cum	1st	50%	Cum
Abia	8.33	11.33	76.67	8.00	10.33	86.67
Anambra	8.33	12.00	73.33	8.67	11.00	83.33
Cross river	8.00	10.00	100	8.00	9.00	100
Ebonyi	9.33	12.67	76.67	9.00	11.33	83.33
Enugu	9.33	12.33	70.00	8.33	11.33	86.67
Imo	8.33	12.33	76.67	8.00	11.33	86.67
Rivers	8.00	10.33	80.00	8.00	9.33	90.00
F-LSD	ns	ns	ns	ns	ns	ns

Table 2: Main effect of seed sizes on germination rates of seven accession of *T. africana*

Seed Sizes	**Small**			**Medium**			**Large**		
	Days to			Days to			Days to		
Accession	1st	50%	Cum	1st	50%	Cum	1st	50%	Cum
Abia	8.50	11.50	75.00	8.00	10.50	85.00	8.00	10.50	85.00
Anambra	9.50	11.50	75.00	8.00	11.50	75.00	8.00	11.50	85.00
Cross River	8.00	9.50	100	8.00	9.50	100	8.00	9.50	100
Ebonyi	9.50	12.50	75.00	9.50	12.00	80.00	8.50	11.50	85.00
Enugu	9.50	12.50	70.00	8.50	11.50	80.00	8.50	11.50	85.00
Imo	8.50	12.50	75.00	8.00	11.50	85.00	8.00	11.50	85.00
Rivers	8.00	10.50	85.00	8.00	9.50	85.00	8.00	9.50	85.00
F-LSD	ns	ns	ns	ns	ns	ns	ns	ns	ns

Table 3: Interaction effect of processing intervals and seed sizes on germination rates of seven accessions of *T. africana*

Accession	**Seed size**	**Processing intervals**	**Days to germination**		
			1st	50%	Cumulative
Abia	Small	8	9.00	12.00	70.00
	Medium		8.00	11.00	80.00
	Large		8.00	11.00	80.00
	Small	14	8.00	11.00	80.00
	Medium		8.00	10.00	90.00
	Large		8.00	10.00	90.00
Anambra	Small	8	9.00	12.00	70.00
	Medium		8.00	12.00	70.00
	Large		8.00	12.00	80.00
	Small	14	10.00	11.00	80.00
	Medium		8.00	11.00	80.00
	Large		8.00	11.00	90.00
Cross River	Small	8	8.00	10.00	100
	Medium		8.00	10.00	100
	Large		8.00	10.00	100
	Small	14	8.00	9.00	100
	Medium		8.00	9.00	100
	Large		8.00	9.00	100
Ebonyi	Small	8	10.00	13.00	70.00
	Medium		9.00	13.00	80.00
	Large		9.00	12.00	80.00
	Small	14	9.00	12.00	80.00
	Medium		10.00	11.00	80.00
	Large		8.00	11.00	90.00
Enugu	Small	8	10.00	13.00	60.00
	Medium		9.00	12.00	70.00
	Large		9.00	12.00	80.00
	Small	14	9.00	12.00	80.00
	Medium		8.00	11.00	90.00
	Large		8.00	11.00	90.00
Imo	Small	8	9.00	13.00	70.00
	Medium		8.00	12.00	80.00
	Large		8.00	12.00	80.00
	Small	14	8.00	12.00	80.00
	Medium		8.00	11.00	90.00
	Large		8.00	11.00	90.00
Rivers	Small	8	8.00	11.00	80.00
	Medium		8.00	10.00	80.00
	Large		8.00	10.00	80.00
	Small	14	8.00	10.00	90.00
	Medium		8.00	9.00	90.00
	Large		8.00	9.00	90.00
LSD			ns	ns	ns

4.2 Effects of accessions on the processing intervals on days to first, 50% and 100% germination

The Cross River accession performed better than other accessions in the cumulative assessment of the accessions at the 8th and 14th interval, reaching 100% seedling emergence in small, medium and large seeds as evaluated. This indicated that the Cross River accession could be better used for seed establishment during planting of *Treculia africana* followed by Rivers accession than the other accessions. This indicates accessional differences among the seeds. The variation observed in the growth performance of the accession when there was no clear accessional difference in their morphology supported the report of Simon et al. (1990) that the taxonomy of Ocimum species is complicated by the existence of chemotypes or chemical race within the species that do not differ significantly in morphology. The observed variation in the accessions could also be as a result of the inherent genetic trait and environment. On the other hand, Enugu and Anambra accessions performed poorest in small and medium seeds respectively in the traits studied. The large seed of the accessions showed higher performance of seedling emergency at first, 50% and cumulative seedling emergence. This indicates that large seeds have higher vigour than medium and small seeds. This affirms the findings of Ojeifo and Denton (1993) which according to them was associated with higher carbohydrate reserve in the stumps of the older plants than the younger plants. William (2004) inferred that germination rates below 70% were associated with poor seed vigour. In comparison, the number of seedlings per each of the accessions in their sizes at various levels indicated that the best result was obtained in Cross River accession across the accessions (100,100,100). As expected, the medium had the medium values while the small recorded the poorest in the two intervals in all the levels of seedling emergence

5.0 Conclusion

Significant differences were observed across the accessions in their growth parameters evaluated, plant height, number of leaves number of nodes, internodes length, germination percentage, leaf emergence, seed sizes, fruit circumference, fruit weight, seed weight, seed length and seed diameter. The performance of the accessions as regards seed length showed that Cross River and Rivers accessions had the longest seed length of (10mm) each. This trait enhanced their germination percentage in the nursery. Enugu accession had the shortest seed length even though their germination percentage was also a little high. Seeds separated into large size showed higher performance of seedling emergence and germination at first, 50% and cumulative germination percentage than those of medium and small sizes. This indicates that large seeds have higher vigour than medium and small seeds.

6.0 Recommendation

Cross River and Rivers gave the longest seed length, performed better in germination such seeds could be used in the establishment of *Treculia africana* to enhance efficient take and survival of plants.

The choice of seed size should equally be considered since large seeds showed higher performance of seedling emergence at first, 50% and cumulative leaf emergence than those of medium and small seeds.

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