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IMPACTS OF SELECTED SEED PRETREATMENTS ON EMERGENCE AND EARLY GROWTH OF *CEIBA PENTANDRA* (L.) GAERTN

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ABSTRACT: *The research work on seed pretreatment methods was carried-out to examine the effects on the emergence and early growth of Ceiba pentandra (Linn) Gaertn. The research was carried out at Forestry Research Institute of Nigeria (FRIN) nursery Jericho, Ibadan. Major pretreatments employed on the seeds of Ceiba pentandra were soaking in water at room temperature, soaking in water at boiling point, soaking in H_2SO_4, and soaking in organic manure (rabbit dung) with untreated seeds as control. Each of the treatments has three levels of administration except control with a single level. The research was laid in a completely randomized design with 20 seeds per treatment and each level of treatment was replicated five times. Growth parameters assessed were germination count, seedling height, seedling girth and number of leaves with germination percentage derived from germination count. Data collected was analyzed using SPSS package. From the table presentation of germination parameters and percentage derivative, Treatment 1 (soaking in water at room temperature for 12 hours) has the highest germination percentage of 100% followed by Treatment 7 (soaking in H_2SO_4 for 10 minutes) 70% and Treatment 13 (control) 70%. ANOVA stated that there was significant difference among the seedling height, seedling girth and number of leaves at 5% level of probability. In overall assessment, Treatment 10 (soaking in rabbit manure for 12h) has the highest mean value of height, 15.67 followed by Treatment 8 (Soaking in H_2SO_4 for 20 minute) with mean value of 15.45 In the area of number of leaves, Treatment 10 has the highest mean value of 18.67 followed by Treatment 2 with 18.02 while Treatment 7 (soaking in acid for 10 minutes) has the highest mean value of 2.77 in stem diameter followed by Treatment 10 with 2.68 mean value. It was concluded based on the result obtained from the research work that Treatment 10 (Soaking in Rabbit Manure for 12 hours) was highly and positively significant in treating seeds of C. pentandra majorly in the areas of seedling height and number of leaves that form the essential parameters of plant growth and development. It is therefore recommended that further research should be carried on other fresh organic manures with various plant species.*

KEYWORDS: pretreatment, organic manure, room temperature, impact, kapok

INTRODUCTION

Forest constitutes one of the principal renewable natural resources of mankind. They are essential in maintaining environmental stability, provision of raw materials for wood based industries and provision of food, livelihood and employment for millions of people in the rural areas [1].

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A tropical tree native to Mexico, Central America and the Caribbean, northern South America, and to tropical west Africa, Kapok Tree or Ceiba pentandra is now a widely cultivated in Southeast Asia for its seed fibre. It is fast growing and reaches up to 70 m in height and 3 m in trunk diameter. The trunk is buttressed and large simple thorns, similar to that of on many of the larger branches, are found on it. The crown is thin and pagoda shaped. The leaves are palmate, with 5 to 9 leaflets each. Kapok produces several pods that contain seeds covered by fibre. Kapok fibre is yellowish in colour, light, very buoyant, water resistant, resilient, but very flammable. It is used as stuffing in mattresses, pillows, etc. The seed of kapok yields oil that is used in making soap and as fertilizer. The seed is edible either raw or cooked (roasted and ground into powder) [2]. It is an emergent tropical forest tree species that can grow up to 60 m height. The wood is very light and is used for preparation of plywood [3], packaging, lumber, light construction, pulp and paper products, match splint, canoes, veneer, block boards, furniture, boxes and aircraft modeling [4]. The seed contains 20-25 percent nondrying oil, used as a lubricant and in soap manufacturing [5]. The young leaf of *Ceiba pentandra* is extremely high in fibre content [6]. Soluble dietary fibres have health-promoting properties as they have been implicated in the lowering of plasma and liver cholesterol concentrations. The high value of carbohydrate and protein suggest that the nutritional quality of the *Ceiba pentandra* leaf is high and this may be a veritable tool for body nourishment [7]

Temperature has been observed to strongly influence seed germination of tropical forest trees, including C. pentandra [8]. It is worth noting that the conditions leading to the germination of seeds may be complex given that several factors including environmental (e.g. temperature, water), seed attributes e.g. size, weight and shape, physiological [9] and seed predation [10] singly or together may affect seed viability and subsequent seed germination ability. Seed pre-treatments have been used to describe ways of treating seeds to increase their vigor for germination. In view of the potentials of *Ceiba pentandra*, its germination and growth rate without seed pretreatment is very slow. Sometimes seeds of *Ceiba pentandra* may fail to germinate under favorable environmental conditions and are therefore said to exhibit some degree of dormancy. Due to excessive temperature around Guinea Savannah Zone, *Ceiba pentandra* seeds get damaged before the pods naturally dehiscent.

These and other benefits of *Ceiba pentandra* necessitate the silvicultural operation of overcoming the species dormancy for sustainable growth and development in order to enhance the ethnobotanical importance of the species to mankind. [11] reported that without any pre-treatment, seeds germinate slowly (less than 10% one month after sowing) and germination may continue for 3 - 4 months. On the dormancy nature of C. pentandra seeds, [12] also made contributions that in view of the potentials of *Ceiba pentandra*, its germination and growth rate without seed pretreatment is very slow. Sometimes seeds of *Ceiba pentandra* may fail to germinate under favorable environmental conditions and are therefore said to exhibit some degree of dormancy. Therefore, a research work in this direction studying the impacts of selected pretreatment methods on germination and early growth of *Ceiba pentandra* is timely valuable.

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MATERIALS AND METHODS

EXPERIMENTAL SITE

The experiment was carried-out during the raining season at Forestry Research Institute of Nigeria, Plant nursery. The Institute is situated at Jericho hill Ibadan North West local Government area of Oyo state. The area experiences two distinct seasons, dry season usually from November-March and raining season usually from April-October. The area is tropically dominated by mean annual rainfall with average temperature of about 32^0C, relative humidity of 80-85%. The experimental site lies between Latitude 7^0 23^1 S and Longitude 3^0 51^1 N

TABLE 1: MATERIALS AND THEIR USES

MATERIALS	USES
1. *Ceiba pentandra* seeds	260 seeds were sown in different levels of treatments.
2. Polythene pots	Filled with top soil for transplanting of seedlings
3. Top soil	Polythene pots were filled with topsoil to raise *Ceiba pentandra* seedlings
4. Vernier caliper	For measuring the stem and root girth of *Ceiba pentandra* seedlings
5. Thermometer	For taking temperature during seed pretreatment.
6. Watering can	For the daily watering of plant samples.
7. Tags	For identification of plant samples.
8. River sand	Soil medium for raising seeds to germination stage.
9. Graduated ruler	For taking plant height.
10. Note book & pen	For taking record of research work.
11. H_2SO_4 Acid	Acid used as seed treatment.
12. Organic Manure	Manure used as seed pre-treatment

SEED COLLECTION

Ceiba pentandra seeds were collected from Seeds Store of Forestry Research Institute of Nigeria [FRIN], Headquarters, Ibadan.

METHODS USED FOR THE RESEARCH

SEED VIABILITY TEST - Three hundred and fifty seeds of *Ceiba pentandra* were acquired for the research. The seeds were then poured into a bowl containing pure water for viability test. Seeds that floated on the water were considered as non-viable while those that wholly or partially immersed were considered viable.

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RIVER SAND COLLECTION AND STERILIZATION - River sand was collected from the stream along FRIN-College road. The sand was thoroughly washed with clean water and sterilized using impoverished method of fuel wood and pot. The washed sand was poured into a pot and placed on the fire. The content was stirred with a wooden stirrer to distribute the heat evenly. The sand was heated to dryness. The sand was then poured out and spread evenly for aeration. After cooling, the sand was filled into the clean germination baskets.

SOWING OF THE SEED - Twenty seeds each of *Ceiba pentandra* were planted in thirteen germination baskets at the sowing depth of 1cm containing sterilized river sand making a total of two hundred and sixty seeds sown. The experimental units were watered twice daily; early in the morning (between 7a.m and 8a.m) and in the evening (between 5p.m and 6:30pm).
The germination count was observed and taken daily. The seedlings were pricked when two first true leaves emerged and transplanted into polythene pots filled with topsoil. Watering continued. The seedlings were left for one week to overcome the shock after transplanting before growth parameters (agro-morphological parameters) assessment commenced.

PARAMETERS ASSESSED
The followings are the parameters assessed; germination count, seedling height, seedling girth and leaf number. Germination count was counted daily while the other parameters were measured bi-weekly.

GERMINATION COUNT – Number of seeds germinated

SEEDLING HEIGHT – This was carried out with the aid of a graduated ruler

SEEDLING GIRTH – This was carried out with the aid of a Vernier caliper

LEAF NUMBER – This was carried out by counting the number of leaves on each seedling.
Germination percentage was derived as the ratio of seedlings germinated to the total number of seeds planted multiplied by 100.

$$\text{Germination \%} = \frac{\text{Number of seeds germinated}}{\text{Total Number of Seeds planted}} \times 100$$

TREATMENTS ALLOCATION
Seeds were sown in 13 germination baskets filled with 2kg each of sterilized river sand according to treatments studied. The sampling units were watered twice daily.
T1– Soaking in water at room temperature for 12 hours (SWRT12h)
T2 – Soaking in water at room temperature for 24 hours (SWRT24h)
T3 – Soaking in water at room temperature for 36 hours (SWRT36h)
T4 – Soaking in water at boiling point 100^0C – 90^0C (SWBP100^0)
T5 – Soaking in water at boiling point 90^0C – 80^0C (SWBP90^0)
T6 – Soaking in water at boiling point 80^0C – 70^0C (SWBP80^0)
T7 – Soaking in H_2SO_4 for 10 minute (SA10m)
T8 – Soaking in H_2SO_4 for 20 minute (SA20m)

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T9 – Soaking in H_2SO_4 for 30 minute (SA30m)
T10– Soaking in Organic Manure (Rabbit dung) for 12 hours (SOM12h)
T11– Soaking in Organic Manure (Rabbit dung) for 24 hours (SOM24h)
T12– Soaking in Organic Manure (Rabbit dung) for 36 hours (SOM36h)
T13 – Control (Untreated seeds) (CTL)

EXPERIMENTAL DESIGN Four treatments at three levels each with single level control (Water at room temperature, Hot water, Acid, Organic manure and Control) were used in the research work on the emergence and early growth study of *Ceiba pentandra* (Linn) Gaertn making a total of 13 treatments.
The seedlings were arranged in a Completely Randomized Design (CRD) with 5 replicates

TABLE 2: PARAMETERS/DERIVATION AND METHODS OF MEASUREMENT

S/NO	PARAMETERS	METHODS OF MEASUREMENT
1.	Germination count	Counting of emerged seedlings (Counting)
2.	Germination percentage	Number of germinated seeds/total number of seedsPlanted×100 (Calculated)
3.	Seedling height	Height of each seedling was taken from the soil surface to the tip of the seedling with the aid of a graduated ruler (Measuring)
4.	Seedling diameter	Diameter of each seedling was taken from the base of the first leave with the aid of a Vernier caliper. (Measuring)
5.	Number of leaf	this was done by counting of leaf emerged of each seedling. (Counting)

DATA COLLECTION

The parameters assessed are germination count (counting), seedling height (measured in cm with graduated ruler), seedling girth (measured with Vernier caliper) and leaf number (counting).
Germination percentage was calculated as ratio of emerged seedlings to number of seeds planted multiplied by 100.

DATA ANALYSIS

Data collected were analyzed using SPSS package. Germination count at emergence, total emergence and germination percentage were presented in a table form. Analysis of Variance (ANOVA) was computed to show the significant difference among the parameters (height, girth and leaf number) taken. Beta coefficient was used to show the significant relationship among the parameters measured.

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RESULTS AND DISCUSSION

Table 3: Emergence count and Germination Percentage of *Ceiba pentandra* (Linn) Gaertn Seedlings under selected Pretreatment Methods

Trt.	WK 1	WK 2	WK 3	WK 4	WK 5	Total	Germination%
1	0	20	0	0	0	20	100%
2	0	11	2	0	0	13	65%
3	0	7	2	0	0	9	45%
4	0	0	0	0	0	0	0%
5	0	2	0	0	0	2	10%
6	0	0	0	0	0	0	0%
7	3	10	1	0	0	14	70%
8	4	7	1	0	0	12	60%
9	3	5	0	0	0	8	40%
10	0	7	3	0	0	10	50%
11	1	11	1	0	0	13	65%
12	1	7	1	0	0	9	45%
13	0	7	7	0	0	14	70%

Source: Field survey, 2018
Trt. – Treatment, Wk - Week

Table 3 showed the germination count per week of *Ceiba pentandra*, the total germination and germination percentage. At the first week, only Treatments 7, 8, 9, 11 and 12 emerged with Treatment 8 having the highest count of 4. The seeds germination was seen to be active within two weeks and ceased majorly in week 4. Treatment 1 (SWRT12h) has the highest germination count of 20 with 100% followed by Treatments 7 (SA10m) and 13 (CTL) with 70% appease. Treatments 4 (Soaking in Water of 100^0C – 90^0C) and 6 (80^0C – 70^0C) recorded no emergence, hence 0%. This may be as a result of cotyledons being dead due to higher temperature subjected to. The highest percentage of Treatment 1 may be due to the fact that the Treatment is pure water without impurity which would make it to be absorbed directly and easily by seeds for germination to begin.

Table 4:-PHYSICAL AND CHEMICAL COMPOSITION OF THE SOIL USED
Sample of the experiment soil were taken to the laboratory is order to determine their physical and chemical composition.

Constituent	Quantity
% O.C	2.04
%O.M	3.51
%Nitrogen	0.26
Particle size (mg/kg)	5.04
Magnesium (mg/kg)	23.7
Ion (mg/kg)	26.0
Copper (mg/kg)	5.3

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Zinc (mg/kg)	2.2
Sodium (Cmol/kg)	1.9
Potassium (Cmol/kg)	0.05
Manganese (Cmol/kg)	3.0
Calcium (Cmol/kg)	7.8
Sand (%)	87.4
Clay (%)	9.1
Silt (%)	3.5

Textural class: - Sandy loam.
Source: Laboratory Test Analysis

Table 5: ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	1872.186	2	936.093	215.034	.000[a]
	Residual	561.568	129	4.353		
	Total	2433.753	131			

a. Predictors: (Constant), MEAN STEM DIAMETER mm, MEAN HEIGHT cm
b. Dependent Variable: MEAN LEAF NUMBER

Table 5 shows the Analysis of Variance with mean leaf number as dependent variable and predictors as mean stem diameter and mean height. It shows that there is significant difference among the three parameters. This conforms to the work of [12] that the result of regression shows that there was a significant difference in the growth of the seedlings.

Table 6: COEFFICIENTS

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.795	.907		-.877	.382
	MEAN HEIGHT cm	.987	.086	.717	11.530	.000
	MEAN STEM DIAMETER mm	.341	.104	.204	3.281	.001

a. Dependent Variable: MEAN LEAF NUMBER

Table 6 above shows the beta coefficient of growth parameters considered. The beta coefficient of height of *Ceiba pentandra* is 0.987 and is statistically significant.
However, the implication is that for each 1% increase in the height of *Ceiba pentandra*, the leaf number of *Ceiba pentandra* will increase by 98.7%.

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The beta coefficient of stem diameter of *Ceiba pentandra* is 0.341 and is statistically significant. However, the implication is that for each 1% increase in the stem diameter of *Ceiba pentandra*, the leaf number of *Ceiba pentandra* will increase by 34.1%.

Table 7: MEAN HEIGHT (CM) OF *Ceiba pentandra* (Lin) Gaertn seedlings

Treatments	Week2	Week4	Week6	Week8	Week10
T1	8.83b	10.03ab	11.71b	14.92ab	15.23b
T2	8.38b	8.81c	12.16ab	14.94ab	15.37ab
T3	9.81ab	11.25b	12.79ab	15.00a	15.32a
T4	0c	0c	0c	0c	0c
T5	9.00ab	10.9bc	11.50b	14.15ab	14.64ab
T6	0c	0c	0c	0c	0c
T7	9.85ab	11.23b	12.88 ab	15.00a	15.43a
T8	9.69ab	11.37b	13.28b	15.20a	15.45a
T9	9.00ab	11.46b	12.69ab	14.43ab	14.67ab
T10	9.96ab	11.70b	13.31a	15.23a	15.67a
T11	9.85ab	11.26b	12.41ab	14.43ab	14.57ab
T12	8.48b	10.08a	11.44b	13.49b	13.86bc
T13	9.51ab	10.73bc	12.78ab	14.56ab	14.78ab
LSD	1.24	2.32	2.61	1.47	2.46
%CV	8.1	10.4	9.8	6.4	10.6

Note: Means with the same letter are not significantly different from each other.

Table 7 shows the mean height of the seedlings under the different treatments. At the end of the research, Treatments 1, 2, 5, 9, 11, and 13 are not significantly different but significantly different from Treatments 3, 7, 8, 7 and 12 which are not significantly different to one another except Treatment 12. Treatment 10 (soaking in rabbit manure for 12h) has the highest value of height, 15.67 followed by Treatment 8 (Soaking in H_2SO_4 for 20 minute) with 15.45. This may be due to the fact that apart from the acidic content couple with generated heat of the manure that may be responsible for dormancy breaking, there are still constituents within the treatment that enhance the species growth as well. This supports the report of [13] that rabbit manure is packed with nitrogen, phosphorus, potassium, and many minerals, lots of micro-nutrients, plus many other beneficial trace elements such as calcium, magnesium, boron, zinc, manganese, sulfur, copper, and cobalt just to name a few

TABLE 8: Mean leaf number of *Ceiba pentandra* seedlings

Treatments	Week 2	Week 4	Week 6	Week 8	Week 10
T1	7.3_{ab}	12.56a	12.22ab	16.89ab	17.09a
T2	7.1_{ab}	11.89_{ab}	13.11a	17.22a	18.02ab
T3	6.88_{b}	12.13_{a}	13.75a	17.00a	17.34b
T4	0_{c}	0_{c}	0c	0b	0c
T5	8.00_{a}	12.0_{c}	11.0b	16.00ab	16.21a

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T6	0_{c}	0_{c}	0c	0b	0c
T7	7.1_{ab}	11.70_{ab}	13.80a	17.40a	17.64a
T8	7.89_{ab}	12.56_{a}	13.89a	17.22a	17.53a
T9	7.57_{ab}	12.14_{a}	13.71a	16.57ab	16.86ab
T10	6.40_{ab}	11.50_{ab}	13.33a	17.00a	18.67a
T11	7.40_{ab}	11.40_{ab}	12.78ab	16.33ab	16.56ab
T12	6.78_{b}	11.00_{ab}	13.63a	16.75ab	17.07ab
T13	5.70_{bc}	10.70_{b}	12.22ab	16.67ab	17.04ab
LSD	2.13	1.67	2.44	1.87	2.67
%CV	10.1	13.2	15.6	12.6	16.7

Note: Means with the same letter are not significantly different from each other.

Table 8 shows the number of leaves produced at the end of the research work. At the end of the research work in week 10, Treatment 10 has the highest value of 18.67 followed by Treatment 2 with 18.02. This may be due to the nutritive effects of Treatment 10 as manure. And this will enhance the photosynthetic ability of the seedlings leading to functional growth of the species. This conforms to the work of [14] and [15] that *Ceiba pentandra* is a fast growing indigenous tree species to West Africa and also found in South America.

TABLE 9: Mean stem diameter of *Ceiba pentandra* seedlings

Treatments	Week2	Week4	Week6	Week8	Week10
T1	1.53ab	1.77ab	2.18b	2.40b	2.63ab
T2	1.23ab	1.58ab	2.30b	2.38b	2.52ab
T3	1.34ab	1.7ab	2.13b	2.41b	2.65ab
T4	0c	0c	0c	0c	0c
T5	1.50ab	1.6ab	1.75ab	2.25b	2.36b
T6	0c	0c	0c	0c	0c
T7	1.64ab	1.84ab	3.80d	2.55b	2.77b
T8	1.38ab	1.78ab	2.14b	2.46b	2.61b
T9	1.34ab	1.60ab	2.06b	2.44b	2.51b
T10	1.38ab	1.64ab	2.26b	2.58b	2,68ab
T11	1.54ab	1.77ab	2.12b	2.43b	2.51b
T12	1.48ab	1.78ab	2.03b	2.34b	2.42b
T13	1.57ab	1.82ab	2.04b	2.56b	2.61ab
LSD	0.24	0.26	1.63	1.46	1.72
%cv	15.3	13.7	18.1	14.5	19.2

Note: Means with the same letter are not significantly different from each other.

Table 9 shows the mean diameter (girth) distribution of the seedlings weekly in respect to administered treatment. At the end of the research, Treatment 7 (soaking in acid for 10 minutes) has the highest value of 2.77 followed by Treatment 10 (soaking in rabbit manure 12h) with 2.68. This may be due to the fact that Treatment 7 has fast germination count of 3 and 10 in the 1st and 2nd week of sowing which gave enough room for the seedlings to develop in girth quickly. This

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conforms to the work of [16] that At lower acidity (pH 5.0) the negligible effects on seed germination and plant growth was observed , but its continuous exposure in environment affected the plant growth and its development.

CONCLUSION

The result of the research work concluded that *Ceiba pentandra* responded to every Treatment applied positively and significantly except Treatments 4 and 6 that had negative significant response toward emergence and early growth of the species.
On emergence, it was concluded that Treatment 1 (Soaking in Water at Room Temperature for 12 hours) performed best with 100% in the second week of sowing while further soaking in water at room temperature more than 12 hours performed woefully.
Treatment 10 (Soaking in Rabbit Manure for 12 hours) was highly and positively significant in treating seeds of *C. pentandr*a majorly in the areas of seedling height and number of leaves that form the essential parameters of plant growth and development.
It is therefore recommended that the research work should be extended to other fresh organic manure for dormancy breaking and early growth of *C. pentandra* and other plant species.

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