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Influence of Temperature Differentials on Germination and Growth of *Terminalia ivorensis* (A. Chev)

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Abstract: This experiment was conducted at the Teaching and Research Farm of Oyo State College of Agriculture, Igboora to assess the influence of temperature differential on germination and early growth of Terminalia ivorensis. The *Terminalia ivorensis* seeds that were used were procured from Centre for Environmental Renewable Natural Resources Management Research and Development (CENRAD, Ibadan). A total of nine buckets were arranged in 3 treatments with 3 replicates and watering was done. Five kilogramme soils were poured in each perforated bowl of 7kg capacity. One seed of *Terminalia ivorensis* was planted in each bowl. Weeding was done on each bucket manually by handpicking. The parameters assessed were number of germinated plant, number of leaves, height of plant, length of internode. Data collected were subjected to analysis of variance and significant means were separated using Duncan Multiple Range Test at 5% probability level. *Terminalia ivorensis* seed treated with T_3 (98.4^0C) at boiling point has the highest effect on the seeds, followed by T_2 (25^0C) lukewarm water, the seeds planted with cold water did not germinate at all, that is the control T_1. In conclusion, *Terminalia ivorensis* seeds need to be in boiling water before planting. This will help in further propagation of this threatened tree species.

Keywords: Temperature Differentials, Growth, *Terminalia ivorensis*, Lukewarm

1. Introduction

There is increasing demand for forest trees for nutritional, medicinal and socio economic uses. This is in turn affecting the availability of such forest tree species and the natural process of regeneration cannot address this ever increasing demand hence the need for their artificial regeneration.

Maideen *et. al*.; (1990) reported that forest trees' seeds always exhibit some degree of dormancy which result in delayed and irregular germination in the nursery or forest floors, hence the need for pre-sowing treatments of seeds. Viability and vigour are the two important characters of seed quality. Viability can be expressed by the germination percentage which indicates the number of seedlings produced by a given number of seeds. Germination can be measured by germination percentage and germination rate (Guerke, 2005).

*Terminalia ivorensis, (*A.Chev) trees are bi-sexual or hermaphroditic with male and female flowers carried on the same plants. These flowers are small, and cream to pale, bright yellow or greenish-white. The stalked male flowers tend to be grouped towards the apex and the bisexual flowers towards the base of the inflorescences (Coates-Palgrave, 1977). *Terminalia* spp. has an effective system of self-incompatibility. Although male and female flowers are in the same plant, self-pollination cannot produce viable zygotes (Newbegin *et. al.;* 1994). The flowers are pollinated by various insects (*Coleoptera, Diptera, Hemiptera, Hymenoptera and Lepidoptera* (Uzoechina, 1978). The flowering-to-fruiting period may last about 4 months, depending on the species and the locality where it is grown (Coates-Palgrave, 1977; Keay, 1989).

Terminalia ivorensis (also called Idigbo, Black afara, Framire, Emen and various other names) is a species of tree in the family combretaceae. It is found in Cameroon, Ivory Coast, Ghana, Guinea, Liberia, Nigeria and Sierra Leone. It is threatened by habitat loss. The wood, used as lumber, has a density of about 560kg per cubic metre. The wood is pale yellow-brown in colour, seasons well with little movement in 'working' but is generally at low strength in appearance frequency in countries where it used to be abundant. The durable heartwood is used in joinery and high-class furniture.

As a fast growing tree, it coppices well, even to an advanced age but it is normally managed on a coppice rotation. A very fast rate of growth, straight stem and self-pruning habit even at an early age makes this an ideal species for the creation of large-scale, even-aged plantations. *Terminalia ivorensis* is a large deciduous forest tree ranging in height from 15m to 46m, branchless for up to 30m, dbh 2-4.75m. *Terminalia ivorensis* can withstand short periods of inundation though it is usually sensitive to water logging. For optimum development, it requires high, well-distributed rainfall. It is very vulnerable to fire. Selection and breeding started in the 1960s in Africa since then, trees with superior growth rate have been selected and clone banks have been established.

Terminalia ivorensis provide economical, medicinal, spiritual and social benefits. The wood of *Terminalia ivorensis* is highly appreciated as constructional timber. It is currently used for light construction, door and window frames, coffin boards, moldings, beams, rafters, joists, flooring, furniture, carts, tool handles, spindles, shuttles, picker sticks walking sticks, bowls, boat building, masts, mine props, foundation piles, veneer and plywood (Irvine, 1961; Lemmens *et al.,* 1995; Schmidt *et al.,* 2002; Smith *et al.,* 2004). It is similar in weight to mahogany. The wood is acid and corrosive if placed in contact with some metals, especially iron. The density of the pale yellow to pale greenish – brown wood is 450 – 675kg/m^3 at 12%mc. Wood of *Terminalia ivorensis* resists fungi and is moderately resistant to termites. The tree provides good shade and is planted with coffee, banana and cocoa.

Seeds of *Terminalia ivorensis* germinate with great difficulty and the inability to germinate is caused by the seed-coat, most probably because this is thick and lignified. (Corbineau and Come, 1986). Among the weather factors that seeds are subjected to the most factors that influence optimum plant population are day length and temperature (Sadler *et al,* 2000).

Seeds of *Terminalia* specie undergo a period of dormancy before germination occur. There are two types of dormancy in plants, namely physical and physiological dormancy (Weber and Stoney, 1986). Several methods of pre-treatment can be used to overcome the two types of dormancy in seeds of *Terminalia* spp. Most often, for some species of *Terminalia,* seeds are pre-treated by soaking in water for 12-48 hours, by manual scarification or in the case of *Terminalia ivorensis,* by alternate soaking and drying for one week (Lamb and Ntima, 1971). This research is to assess the influence of differential temperatures on the germination and early growth of *Terminalia ivorensis*.

2. Materials and Methods

The experiment was carried out at the Teaching and Research farm of Oyo State College of Agriculture, Igboora; Nigeria.

Soil Collection: The soil used was collected at the Teaching and Research farm of Oyo State College of Agriculture, Igboora, at a depth (0-15cm) – sandy loams. The soil was crushed and sieved. Five kilogrammes (5kg) of soil was put in each perforated plastic pot of 7kg capacity and then moistened. One seed of *Terminalia ivorensis* was planted in each pot. A total of nine buckets were arranged in a Completely Randomized Design (CRD) with three treatments replicated three times and watering was done. Weeding was done on each bucket manually by handpicking.

Data Collection: The following parameters were considered for data collection;

Number of Germinated Plant

This was achieved by direct counting of germinated plant of *Terminalia ivorensis*.

Number of Leaves

This was achieved by counting of leaves on each seedling of *Terminalia ivorensis* and all leaves starting from the base to the last prominent leaf on the tip were included.

Height of Plant

This was done by placing a transparent meter rule beside the seedling to measure it. The reading started from the base of the plant (soil level) and stretched to the tip of the plant.

Length of Internodes

A transparent meter rule was used in measuring the distance between one branch and the preceding one on the same plant and then recorded.

Data Analysis

The data collected were subjected to Analysis of Variance (ANOVA) and significant means separated at 5% probability level.

Treatments: T_1= Control, T_2 = 25^0 C and T_{3} = 98.4^0 C.

Experimental Layout

T_1.	T_2.	T_3
T_2.	T_3.	T_1
T_3.	T_1.	T_2

3. Results and Discussion

Table 1. *Effect of temperature differential on number of germinated seed.*

Treatment	Wk 1	Wk2	Wk3	Wk4	Wk5	Wk6	Wk7	Wk8	Wk9	Wk10
T_1	0.00^b	0.00^b	0.00^b	0.00^b	0.00^b	0.00^b	0.00^b	0.00^b	0.00^b	0.00^b
T_2	2.33^a	2.33^a	2.33^a	2.33^a	2.33^a	2.33^a	2.33^a	2.33^a	2.33^a	2.33^a
T_3	2.67^a	3.00^a	3.33^a	3.33^a	3.33^a	3.33^a	3.33^a	3.33^a	3.33^a	3.33^a

For number of germinated seeds, at wk1 T_1 did not germinate as the week increases T_2 had the least number of seed that germinated while T_3 had the highest number of seed that germinated at wk2, T_2 had the least number of seed that germinated while T_3 had the highest number of seed that germinated at wk3, T_2 had the least number of seed that germinated while T_3 had the highest number of seed that germinated while T_3 had the highest number of seed that germinated, at wk4 T_2 had the least number of seeds that germinated while T_3 had the highest number of seed that germinated at wk5 T_2 had the least number of seeds that germinated while T_3 had the highest number of seed that germinated at wk6 T_2 had the least number of seed that germinated while T_3 had the highest number of seed that germinated at wk7 T_2 had the least number of seed that germinated while T_3 had the highest number of seed that germinated at wk8 T_2 had the least number of seed that germinated while T_3 had the highest number of seed that germinated at wk9 T_2 had the least number of seed that germinated while T_3 had the highest number of seed that germinated at wk10 T_2 had the least number of seeds that germinated while T3 had the highest number of seed that germinated. The least significant different (LSD) procedure shows that the test was not significantly different.

Table 2. *Effect of temperature differential on Numbers of leaves per pot.*

Treatment	Wk 1	Wk2	Wk3	Wk4	Wk5	Wk6	Wk7	Wk8	Wk9	Wk10
T_1	0.00^b	0.00^b	0.00^b	0.00^b	0.00^b	0.00^b	0.00^b	0.00^b	0.00^b	0.00^b
T_2	7.00^a	11.33^a	13.33^a	16.33^a	19.33^a	22.67^a	25.33^a	28.00^a	31.00^a	33.67^a
T_3	8.33^a	12.67^a	16.00^a	20.33^a	25.00^a	29.33^a	31.33^a	36.67^a	39.67^a	42.67^a

For number of leaves at wk1 there are no leaves at T_1 as the week increases, T_2 had the least number of leaves while T_3 had the highest number of leaves at wk2 T_2 had the least number of leaves while T_3 had the highest number of leaves at wk3 T_2 had the least number of leaves while T_3 had the highest number of leaves at wk4 T_2 had the least number of leaves while T_3 had the highest number of leaves at wk5 T_2 had the least number of leaves while T_3 had the highest number of leaves at wk6 T_2 had the least number of leaves while T_3 had the highest number of leaves at wk7 T_2 had the least number of leaves while T_3 had the highest number of leaves at wk8 T_2 had the least number of leaves while T_3 had the highest number of leaves at wk9 T_2 had the least number of leaves while T_3 had the highest number of leaves at wk10 T_2 had the least number of leaves while T_3 had the highest number of leaves. The least significant (LSD) procedure shows that the test was not significantly different.

Table 3. *Effect of temperature differential on height of plant.*

Treatment	Wk 1	Wk2	Wk3	Wk4	Wk5	Wk6	Wk7	Wk8	Wk9	Wk10
T_1	0.00^b	0.00^b	0.00^b	0.00^b	0.00^b	0.00^b	0.00^b	0.00^b	0.00^b	0.00^b
T_2	2.51^a	3.60^a	4.66^a	5.67^a	6.97^a	8.18^a	9.83^a	10.73^a	11.63^a	14.13^a
T_3	2.71^a	3.57^a	4.22^a	4.63^a	6.03^a	7.43^a	8.80^a	10.07^a	10.83^a	12.63^a

For plant height at wk1, T_2 had the shortest height while T_2 had the tallest height at wk2 T_2 had the tallest height while T_3 had the shortest height at wk3 T_2 had the tallest height while T_3 had the shortest height at wk4 T_2 had the tallest height while T_3 had the shortest height at wk5 T_2 had the tallest height while T_3 had the shortest height at wk6 T_2 had the tallest height while T_3 had the shortest height, at wk7 T_2 had the tallest height while T_3 had the shortest height at wk8 T_2 had the tallest height while T_3 had the shortest height at wk9 T_2 had the tallest height while T_3 had the shortest height at wk10 T_2 had the tallest height while T_3 had the shortest height. The least significant different (LSD) procedure shows that there were no significant different among treatments.

Table 4. *Effect of temperature differential on Length of Internode.*

Treatment	Wk 1	Wk2	Wk3	Wk4	Wk5	Wk6	Wk7	Wk8	Wk9	Wk10
T_1	0.00^b	0.00^b	0.00^b	0.00^b	0.00^b	0.00^b	0.00^b	0.00^b	0.00^b	0.00^b
T_2	0.00^b	0.00^b	1.30^a	1.77^a	2.10^a	2.17^a	2.23^a	2.10^a	2.03^a	2.10^a
T_3	0.00^b	0.00^b	1.53^a	1.60^a	1.67^a	1.73^a	1.90^a	2.03^a	2.10^a	1.97^a

There were no internode lengths at wk1 and wk2, at wk3 T2 had the shortest internode length while T_3 had the longest internode length at wk4 T_2 had the longest internode length while T_3 had the shortest internode length at wk5 T_2 had the longest internode length while T_3 had the shortest internode length at wk6 T_2 had the longest internode length while T_3 had the shortest internode length at wk7 T_2 had the longest internode length while T_3 had the shortest internode length at wk8 T_2 had the longest internode length while T_3 had the shortest internode length at wk9 T_2 had the shortest internode length while T_3 had the longest internode length at wk10 T_2 had the longest internode length while T_3 had the shortest internode length. Although the least significant different (LSD) procedure shows that the test was not significantly different.

Interaction Effect of Treatment by weeks on plant

Number of seed that germinated

The result on number of seeds that germinated shows that seed treated with T_3 (98.4^{0}C) performed best with highest number of seed that germinated followed by seed treated with T_2 (25^{0}C) T_1 which is the control is not treated did not germinate as the week increases. The result on the number of seed that germinated justified that *Terminalia ivorensis* seed have to be treated before planting (Lamb and Ntima, 1971).

Leaves

Terminalia seeds treated with T_3 (98.4^{0}C) performed best with the highest number of leaves followed by T_2 (25^{0}C). The control did not performe as the result in number of seed germinated shows.

Height

Seed treated at T_2 (25^{0}C) has the highest response on height of the plant recorded followed by seed treated at T_3 (98.4^{0}C) has the least number of height recorded.

Internode

There was no internode until 3weeks after germination. T_2

had the shortest internode length while seed treated T_3 had the longest internode length at wk4 to the last week T_2 had the shortest internode length. The table shows that the internode is not significantly different in both treatments statistically.

4. Summary and Conclusion

The effect of temperature differentials on germination and early growth of *Terminalia ivorensis* at different treatments was investigated at the Teaching and Research farm of Oyo State College of Agriculture, Igboora with focus on three temperature differentials namely: T_1 – Control, T_2 – 25^0C and T_3 – 98.4^0C. Parameters considered were: plant germination, number of leaves, plant height and length of internode respectively.

Result showed that the seeds treated with T_3 98.4^0C has the highest effect on the seed of *Terminalia ivorensis* followed by T_2 - 25^0C. The seeds (T_1 Control) planted with cold water did not germinate at all.

Results showed that T_3 performed excellently well in all the parameters observed and can conclude that *Terminalia ivorensis* seeds need to be thoroughly heated in hot water under water bathe supervision before sowing in the nursery. Generally in hot water treatment, the volume of water has to be four to five times the volume of seed. The seeds have to be planted within a few days after hot water treatment. This condition was strictly followed in this research. In general terms, silvicultural practices that introduce a high or optimal temperature level to seeds during pre-planting operations will ultimately enhance a favourable germination.

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