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Research Article

Effect of pretreatments on germination of seeds of the timber plant, *Terminalia ivorensis* and *Mansonnia altissima* (A. Chev.)

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Abstract

Terminalia ivorensis and *Mansonnia altissima* is an important tropical timber tree plant, but poor germination is an important factor militating its regeneration. Effects of pretreatments on germination of seeds of *Terminalia ivorensis* and *Mansonia altissima* were studied. Four hundred and eighty matured seeds of *Terminalia ivorensis* and three hundred and sixty seeds of *Mansonia altissima* were obtained from Forest Reserve Institute of Nigeria (FRIN), Ibadan. The seeds were divided into twenty-one equal portions of 10 seeds each. Twelve pretreatments were investigated on *Terminalia ivorensis* and nine pretreatments on *Mansonia altissima*. The seeds were sown inside plastic basket containing sterilized river sand under high humidity propagator with four replicates each. Germination counts were taken daily for eighty days. Percentage germination was computed for each treatment and the data were subjected to analysis of variance. Germination was first observed among the scarified *Terminalia ivorensis* seeds at 14 days after sowing (DAS) and this treatment group had the highest percentage germination of 82.5%, while seeds soaked in hot water recorded the least germination. Germination was first observed in decoated *Mansonia altissima* and this treatment group had the highest percentage germination of 45%, whereas the least was observed among the treatments with H_2SO_4. The effect of pretreatment was highly significant ($p \leq 0.05$) on the germination of both species. It is therefore recommended that mechanical scarification of *Terminalia ivorensis* and decoating seed of *Mansonia altissima* will enhance the germination of the two species.

Keywords: germination; gibberrelic acid; *Mansonia altissima*; pretreatment; *Terminalia ivorensis*

Introduction

The increasing demand for forest products as a result of rapid population increase as well as deforestation activities associated with expansion of infrastructural facilities all combine to erode the genetic base of most medicinal plants (Gbadamosi, 2002). Most tropical forest tree species exist in the wild state. However, the resources are continuously eroded through deforestation and subsequent changes in land use pattern, over exploitation and destructive collection of forest resources as well as inappropriate and illegal timber and wood harvesting practices. Human have been exploiting forest from time immemorial as they need to use forest species as sources of food, fuel and timber; or to clear forested land for agricultural and urban purposes (Young *et al.*, 2000). On a global scale, world forests are declining at an extreme alarming rate due to increase in human

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population growth, which has doubled in the last 50 years. From 1990 to 2005, the world lost 30% of its total area of forested land, an average decrease of some 0.2% per year (FAO, 2007). The regeneration and long-term conservation of these species are therefore at the mercy of the vagaries of nature and conservation-shy but profit-driven herb collectors (Gbadamosi, 2002). Many species have been harvested to near extinct status such as *Enantia chlorantha* (Gbadamosi, 2002) and according to *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. Traditional medicine using plant extracts continues to provide health coverage for over 80% of the world's population, especially in the developing world (Igbinosa *et al.*, 2009).

Quite a number of tree species have medicinal and economic potentials being propagated by seeds, but their seed germination information as well as growth rate information are limited and baseline information are necessary for their domestication, ecosystem restoration and their genetic conservation. The exploitation of these trees species serves either as a medicine or timber which have negative impact on their availability and therefore becoming threatened or endangered (IUCN, 2011)

The upsurge in ethno-botanical studies and scientific research into the use of plant species has further enhanced the pressure on populations of medicinal forest species as more people now use plants' parts for treating various body ailments. Eloff (1998) reported that two out of three people on earth use plants for primary health care. Iwu (1992) showed that more than 70% of the Nigerian population depends on folk medicine for their health.

Terminalia ivorensis A. Chev (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 a tree species found in lowland rainforest zone in Nigeria but is predominantly a tree of seasonal forest zones (Keay, 1989), being threatened by habitat loss (Alamu *et al.*, 2015).

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).

The tropical rainforest in Nigeria contains some other general utility species; these include *Mansonia altissima, Milicia excelsa* and *Parkia biglobosa* among others. *Mansonia altissima* belongs to the family Sterculiaceae (Irvine, 1961). It is a semi - deciduous forest species growing up to 37 m high, trunk to 2½ m girth, cylindrical to tapering with plank buttresses up to 2⅔ m, bearing a dense crown, deciduous in the dry season (Irvine, 1961).

Mansonia altissima is used for general and high-class joinery, cabinet work, furniture, turnery, decorative veneer and handicrafts (Ohene, 2008). It is also used in construction for doors and windows, in railway coaches and shop fittings, and for boxes and crates. Well-coloured wood resembles American black walnut and is commonly used as a substitute, e.g. for gun stocks and grips, musical instrument and loudspeaker enclosures (Ohene, 2008). In Nigeria and Ghana products from the bark have been used in the treatment of leprosy. A bark extract is drunk or an infusion of the root is applied as enema as an aphrodisiac. A root decoction is given as enema against leprosy. A decoction of the twig bark is applied as a bath against yaws, scabies and syphilis (Ohene, 2008).

In spite the versatility and their enormous usage of these tree species, there has not been much documentary evidence on how to raise their seedlings for proper domestication, plantation establishment and forest restoration. Therefore, the objective of this research work is to break seed dormancy of *Terminalia ivorensis* and *Mansonia altissima* by the use of different pretreatments and determine the best pretreatments that enhance the germination of both species.

Materials and Methods

Sources of seed samples

The seeds of *Terminalia ivorensis* and *Mansonia altissima* were collected from the Forestry research institute of Nigeria Ibadan (7.3913 °N and 3.8628°E). Four hundred seeds were extracted, washed and dried under room temperature. The fruits were thoroughly mixed together and divided into four equal portions of eighty seeds for each treatment.

Seed germination

The following pretreatment methods will be investigated for both species;

a) The seed left intact (control) without treatment before sowing.

b) Physical scarification before sowing.

c) Soaking in concentrated sulphuric acid (tetraoxosulphate VI acid) for 5, 10, 15, 20 minutes

d) Use of GA_3 as a growth factor at three concentration of 0.005 g/l, 0.015 g/l, 0.03 g/l

Medium for germination

The seeds were rinsed several times in running tap water and sown with four replicates each in a well-labelled germination rubber basket filled with washed and sterilized river sand. The baskets were kept under tree shade at the Department of Botany Obafemi Awolowo University Ile-Ife. Watering was done daily in the morning using a fine meshed watering can. Germination counts were taken daily for each treatment for fifty days.

Germination parameter

Germination will be taken to have occurred when the radicle has emerged. Germinations will be taken to have been completed when no additional germination took place in after two weeks.

Percentage germination

The percentage germination was calculated using: (x/y) *100%

Where: x = number of seeds germinate

y = number of seed sown

Results

Commencement of germination and percentage germination varied with type of pretreatments and duration of treatment. Seeds mechanically scarified with sandpaper commenced germination first, at 14 days after sowing (DAS) and had highest germination of 83.3%. Control seeds (No treatment) commenced at 38 days after sowing (DAS) and a final germination percentage of 50% were recorded. Germination was recorded first among the seeds pre-treated with conc. sulphuric acid for 15 minutes at 22DAS, followed by seeds pretreated with the same acid for 20 minutes at 22DAS. Seeds pre-treated with acid for 5 and 10 minutes were the last batch to germinate, they commenced germination at 27 and 26(DAS) with percentage germination of 40% and 72.5% respectively. Percentage germination of *T. ivorensis* seeds varied substantially due to duration of acid pretreatment.

The seed soaked in cold water for and percentage 96 hrs recorded germination first at 26DAS with germination percentage of 30% followed by 72 hrs with percentage germination (12.5%).

The lowest germination percentage (5%) was obtained among seeds pretreated with cold water for 24 hours and 48 hours and commenced germination at 69 and 65(DAS) respectively. The effect of hot water treatment on germination of *T. ivorensis* seeds was negative; a dismal 0% was recorded (Table 1).

Table 1. *Terminalia ivorensis* germination duration and its percentage with respect to different treatments

Treatments	Time of germination (das)	Mean germination (%) ± SEM
Control	38	50.00 ± 1.00 d
Physical scarification	14	83.30 ± 0.55 g
5 min H_2S0_4	27	40.00 ± 0.55 e
10 min H_2SO_4	26	72.50 ± 0.84 c
15 min H_2SO_4	22	30.00 ± 0.71 a
20 min H_2SO_4	22	25.00 ± 0.55 a
5 min hot water	0	0.00 ± 0.00 a
24 hrs cold water	69	5.00 ± 0.55 a
48 hrs cold water	65	2.50 ± 0.71 b
72 hrs cold water	65	12.50 ± 0.84 b
96 hrs cold water	26	30.00 ± 0.89 c

Key: DAS = Days after sowing

Seeds of *M. altissima* manually decoated recorded germination first at 8DAS and had highest percentage germination of 45%. Seeds lot treated with hormone (gibberelic acid) at concentration of 0.3 g/l recorded germination at 15DAS with percentage germination 25% followed by the seed treated with the same hormone at concentration of 0.15 g/l with percentage germination (15%) while those treated with 0.05g/l were the last to germinate at 19DAS with percentage germination 5%. Seeds treated with concentrated H_2SO_4, duration of treatment affected germination largely, seeds soaked in conc. H_2SO_4 for 5 mins, 10 mins and 15 mins germinated at 10DAS with germination percentage 2.5% and those seeds treated with the same acid for 20 mins failed to germinate (Table 2 and Figure 1).

Table 2. *Mansonia altissima* germination duration and its percentage with respect to different treatments

Treatments	Time of germination (das)	Mean germination (%) ± SEM
Control	21	5.00 ± 12 bc
Decoated	8	45.00 ± 0.55 g
5 min H_2S0_4	10	2.50 ± 0.55 b
10 min H_2SO_4	10	2.50 ± 0.55 b
15 min H_2SO_4	10	2.50 ± 0.55 b
20 min H_2SO_4	0	0.00 ± 00 a
Ga_3 0.3 (g/ml)	15	25.00 ± 0.55 a
Ga_3 0.15 (g/ml)	15	15.00 ± 0.71 d
Ga_3 0.05 (g/ml)	19	5.00 ± 0.84 b

Key: DAS = Days after sowing

Figure 1. Three weeks old *Terminali ivorensis* (a) and *Mansonia altissima* (b)

Discussion

Most tropical forest tree species have recalcitrant seeds which do not germinate readily even under favourable conditions (Chin *et al.*, 1989); hence the need for improved methods of pre-treating seeds (Olayode and Gbadamosi, 2009). Eyob (2009) submitted that enhancement of seed germination is important in propagation and breeding programme as well as for testing and using germplasms. The physical scarification of *Terminalia ivorensis* had the highest rate of germination and percentage, this is supported by the findings of Nainar *et al.* (1999) who showed that mechanical scarification gave the highest germination percentage (60%) in *Terminalia chebula.* Decoating of *Mansonia altissima* had the highest rate of germination and percentage, which agrees with the report of Tomlinson *et al.* (2000) that seed dormancy resulting from an impermeable seed coat may be overcome by peeling off the coat. Germination must have occurred as a result of the partial exposure of the cotyledons of the seeds which permits the process of hydrolysis whereby hormones such as auxins and ethylene which could increase nucleic acid metabolism and protein synthesis are released (Uwaegbute, 1996). Pretreatment of *Terminalia ivorensis* seeds with H_2SO_4 for 10 minutes also gave high rate of percentage germination. Aleiro (2004) supported this, that 98% concentrated sulphuric acid gave the highest percentage germination within the shortest period on *Parkia biglobossa.* However, pretreatment with H_2SO_4 for 20 minutes gave the lowest rate of percentage germination. This fact was also confirmed by McDonald *et al.* (2002) *on Tamarindus indica* and *Prosopis africana* where immersion of seed in sulphuric acid for more than 60 min increased the number of damaged seeds hence tremendously reducing germination percentage. On the other hand, Pretreatment of *Mansonia altissima* seeds with H_2SO_4 for 5, 10, 15 and 20 minutes gave low percentage germination. This is contrary to the findings of Olayode and Gbadamosi (2009) where the soaking of the seeds of *Dialium guineense* in conc. H_2SO_4 for longer periods was more effective in hastening germination in the species.

Germination percentage of *Terminalia ivorensis* seeds pretreated with cold water increase with duration soaked from 24 hrs to 96 hrs. The effect of this treatment is similar with the placing of seeds of *Parkia biglobossa* in a beaker containing tap water for 24 hrs (Aleiro, 2004).

The germination percentage of *Mansonia altissima* increased with increase in the concentration of gibberelic acid hormone. This was corroborated by the work of Corbineau and Côme (1993) who recommended that gibberellic acid improves the germination rate of *T. ivorensis.*

Hot water treatment resulted in mortality of the seeds. This agreed with the findings of Diallo *et al.* (1996) on *Faiderbia albida.* The study concluded that the freshly collected seeds of *Terminalia ivorensis* show dormancy as a result of hard seed coat. Pre-treatments of *Terminalia ivorensis* seeds with physical scarification and decoated *Mansonia altissima* improved their germination and gave the highest percentage germination and therefore recommended. This may be the vital key to the mass production of seedlings of the species for forest establishment.

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Conflict of Interests

The authors declare that there are no conflicts of interest related to this article.

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