Effects Of Pre Germination Treatments On The Germination And Early Seedling Growth Of Tetrapleura Tetraptera (Schum. & Thonn.)

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Abstract: This study assessed the effect of pre-germination treatments on the germination and early growth of Tetrapleura tetraptera (Schum. & Thonn.). The seeds were extracted and subjected to the following treatments: Soaking in cold water for 24hrs (T_1), dipping in hot water for 1minute (T_2), soaking in coconut water for 30 minutes (T_3), soaking in coconut milk for 30 minutes (T_4), dipping in hydrogen peroxide for 1 minute (T_5) and for the control (T_6). The results showed that T_3 had the highest germination value of 60% while T_2 had the least of 25%. There was significant difference ($p \leq 0.05$) in germination percentage between the treatments at 95% probability level. The seed treated with T_3 had the highest mean seedling height of 44.54cm follow by mean seedling height (40.35cm) of both T_1 and T_6 (the control) while T_5 had the lowest mean seedling height of 39.84cm. The ANOVA of the stem-collar diameters shows that there was no significant difference ($P > 0.05$) between the effects of the different treatment on the seedlings stem-collar diameter. The seedlings subjected to treatment T_3 had the highest mean leaf number of 22 while the seedlings subjected to T_1 and T_6 had same lowest leaf number of 18. It was observed in this study that coconut water (T_3) significantly did better in terms of seedling growth and development when used as a pre germination treatment for T. tetraptera seeds. However, the seeds when dipped in hot water for 1 minute (T_2) as pre germination treatment did not significantly improve germination and growth of T. tetraptera seeds.

Index Terms: Tetrapleura tetraptera, pre-germination treatment, seedling growth, germination

INTRODUCTION

Tropical rainforests are stocked with many tree species that produce copious edible, highly nutritious and medicinal fruits, seeds, leaves, twigs nuts and bark which are of socio-economic importance (Oni and Gbadamosi, 1998). The benefits of forest in the provision of arrays of products and services of great importance to man's survival and balanced development have been recognized. The world's forests play an important role in maintaining fundamental ecological processes, as well as in pro--viding livelihoods and supporting economic growth (UNEP, 2007; FAO, 2009). However, the over exploitation of forest resources has endangered the population of these forest resources, such as Tetrapleura tetraptera (Schum. & Thonn.). And this could be attributed to anthropogenic and genetic factors. T. tetraptera (Schum and Thonn), commonly known in Nigeria as aridan (Yoruba); ighimiaka (Edo); oshosho (Igbo) and apapa (Ijaw). It is a tropical rainforest species belonging to the family Fabaceae. The aqueous fruit extract has also been shown to possess hypoglycaemic properties (Ojewole and Adewunmi, 2004). The fruit is used to prepare soup for nursing mothers from the first day of birth to prevent post-partum contraction (Enwere, 1998).

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The fruits and seeds add good flavour and aroma to food, which increases the desire of food consumption (Aladesanmi, 2007). It is also useful for the management of rheumatism, convulsions, inflammation, leprosy (Ojewole and Adesina, 1983), flatulence, jaundice, and fevers (Bouquet, 1971). Its bark is active against cough, bronchitis and used as a decoction in drinks. When put into vapour bath, the bark is used against rheumatism and fever. The leaves possess strong molluscicidal activity (Adewunmi et al, 1991) and are important for the treatment of epilepsy (Akah and Nwaibie, 1993). The root is used for the treatment of gastrointestinal clinical problems (Aladesanmi, 2007). T. tetraptera is equally valued in timber as fairly hard heartwood (Orwa et al, 2009). In spite of the economic usefulness of T. tetraptera, the population of the plant is declining at a disturbing rate due to factors like seed dormancy (Onyekwelu, 1990), over-exploitation (Nya et al, 2000) and inadequate information on silvicultural techniques (Lemmens, 2008). The potentials of the plant have virtually not been improved, and many of them are on the verge of extinction. The essential ecological and silvicultural information needed on the trees includes flowering and fruiting patterns, seed germination and growth requirement to facilitate domestication and improvement of their potentials. Some studies on the germination characteristics of some plant species has been carried out by some scientist, for example Asiyire et al, (2008), Chauhan and Johnson (2009) and Santana et al, (2010). Onyekwelu (1990) reported that in spite of several germination problems, T. tetraptera regenerate from seeds and dormancy of this species is due to hard seed coat. Seed dormancy is a temporary failure of a mature viable seed to germinate under environmental conditions that would normally favour germination (Hilhorst, 1995; Li and Foley, 1997). Nya et al, (2000) also reported that T. tetraptera exhibits poor germination when freshly collected. A research carried out by Alaba et al, (2006) on T. tetraptera shows that subjection of the seeds to absolute sulphuric acid, heat treatment at 100^0C and mechanical scarification using sand paper for 7 minutes resulted in 90%, 16% and 80% germination respectively. This research is therefore aimed at investigating the effects of pre

germination treatments on the germination and early seedling growth of T. tetraptera.

Materials and Methods

Source of plant material

Dried, mature fruits of T. tetraptera were collected from FRIN (Forestry Research Institute of Nigeria) arboretum in Benin City, Edo State, South South Nigeria which lies between latitude 6^0 11′ 0″ N and longitude 5^0 22′ 0″ E.

Seed Processing and Viability Test

Processing was done manually to get the seed lot which were used for the study. The pods of the species were carefully broken manually using hammer. The processed seeds were subjected to viability test through the flotation method. The seeds that float in the water after few minutes of soaking were considered unviable and discarded. The seeds that sank in the pale were collected and regarded as viable and used for the study.

Methods

The fruits were cracked open and seeds extracted. The extracted seeds were subjected to the following treatments: Soaking in cold water for 24hrs (T_1), dipping in hot water for 1minute (T_2), soaking in coconut water for 30 minutes (T_3), soaking in coconut milk for 30 minutes (T_4), dipping in hydrogen peroxide for 1 minute (T_5) and for the control (T_6), the seeds were extracted and sown immediately without any pre-germination treatment. After the pre-germination treatment, seeds were rinsed with distilled water before they were sown in a germination baskets filled with sterilized river sand. Forty seeds were randomly collected from the seed lot of each treatment and sown in each basket. The germination baskets were kept in a humidified propagator. Each treatment and the control had three replicates and the experiment was laid in Completely Randomized Design (CRD).

Data Collection and Analysis

Data collected were based on germination percentage, trend of germination and early growth of the seedlings. Total germination was obtained by visual counting of the number of germinated seedling from the first day of seedling emergence up to six weeks and mean germination computed. Mean germination was expressed as follow:

Mean germination percentage $= \frac{x}{y} \times 100$,

where x = total number of germinated seeds per treatment

y = total number of seeds sown per treatment

After six weeks, seedlings growth attributes like seedling height, collar diameter and leaf production were determined and recorded for six months. The data generated were subjected to One-way analysis of variance (ANOVA) using SPSS software package version 17.0. Duncan's New Multiple Range Test (DNMRT) was used to determine significant means at 0.05 probability levels.

Results and Discussion

The effectiveness of pre-germination treatments on the seeds of T. tetraptera is shown in Table 1. T_3 had the highest germination value of 60% while T_2 had the least of 25% (Table 1). There was significant difference ($p \leq 0.05$) in germination percentage between the treatments at 95% probability level. The significantly high percentage germination of T. tetraptera as influenced by T_3 is attributed to the chemical composition of coconut water which includes auxins, various cytokinins, gibberellins, abscisic acid and ethylene as they play crucial role in regulating plant growth in wide range of development. This is in accordance with the study carried out by Mariat (1951) on the effects of coconut water on orchid seed germination. It was shown that coconut water improves germination of seed orchid with 60%. Similarly, Mauney et al, (1952) purified a growth factor from the aqueous extract of coconut, which was found to be very potent in promoting growth of tissue cultured plants. The effectiveness of pre-germination treatment of T_2 on the germination of T. tetraptera is less significant due to very poor percentage germination (Table 1). Onyekwelu (1990) reported similar result on the germination study of T. tetraptera. The result indicated that hot water is not effective as other pre-germination treatment like mechanical or acid scarification in breaking dormancy of T. tetraptera. The reason is because, its seed coat is not permeable by hot water due to short duration of soaking in hot water. Several research have been done on seed germination in many tropical forest plants (for example, Sajeevukumar et al, 1995; Dachung and Vennumbe, 2006; Alaba et al, 2006; Durmusali and Khalid, 2007; Hossain et al, 2007; Agbogidi et al, 2007; Michael et al, 2008).

Table 1: Effectiveness of pre-germination treatments on the seeds of T. tetraptera.

Pre germination treatment	No of seeds treated and sown	No of seed germinated	Germination %
T_1	120	58	48^b
T_2	120	30	25^c
T_3	120	72	60^a
T_4	120	60	50^b
T_5	120	61	50.8^b
T_6	120	32	26.7^c

Means followed by different superscripts are significantly different at 0.05 level of significance.

The mean monthly seedling growth attributes of T. tetraptera for height (cm), collar diameter (mm) and number of leaf are shown in Figures 1, 2 and 3 respectively. The height of the seedlings tends to do better with pre-germination treatment of T_3. And also, T_3 produces more number of leaves when compared with other treatments. The seed treated with T_3 had the highest mean seedling height of 44.54cm follow by mean seedling height (40.35cm) of both T_1 and T_6 (the control) while T_5 had the lowest mean seedling height of 39.84cm (Table 2). The analysis of variance (ANOVA) showed that the height of the seedlings developed under T_3 is significantly higher ($P < 0.05$) than other treatments (Table 2). Seedlings subjected to T_3 had the highest mean stem- collar diameter of 0.488 mm and lowest was in T_4. The ANOVA of the stem-collar diameters shows that there was no significant difference ($P > 0.05$) between the effects of the different treatment on the seedlings stem-collar diameters (Table 2). The seedlings subjected to treatment T_3 had the highest mean leaf number of 22 while the

seedlings subjected to T_1 and T_6 had same lowest leaf number of 18 (Table 2). The ANOVA of leaf number was significant ($p < 0.05$). It was observed in this study that coconut water (T_3) significantly did better in terms of seedling growth and development when used as a pre germination treatment for T. tetraptera seeds considering the growth attributes measured in this study. This is in agreement with the work of Overbeek et al., (1992) who reported that the use of coconut water on centrosema seed resulted in improved height of plants. Coconut water contains a variety of nutrients including cytokinins that regulate growth and development of plants. The work of Shakeel (2010) also confirmed the influence of coconut water on plant seeds who researched on the effect of coconut water on callus growth of Cyamopsis tetragonolobust. However, the seeds of T. tetraptera dipped in hot water for 1 minute (T_2) as pre germination treatment did not significantly improve germination and growth of T. tetraptera seeds. The work of Hossain et al, (2007), reported low germination percentage when the seed of Terminalia chebula (Retz.) was depulped and soaked in hot water for 2 minutes. This study also revealed that soaking the seeds of T. tetraptera in cold water for 24hrs did not actually do well when compare to coconut water treatment. Tree seedlings are generally raised during the dry season in the tropics for planting out shortly after the onset of the following rain season. In many places, water is a limiting factor for raising tree seedlings. It has also been found that frequent watering of the seedlings of some tropical rainforest tree species reduced their growth rates and encouraged damping-off (Oni and Bada, 1991; Jimoh and Okali, 1999). However, this present study is at variance with the work of Olajide et al., (2014) that Dialium guineense seeds soaked in cold water for 24 hours did very well as against other pre-germination treatments. It was observed that the seeds of some Albizia species soaked in cold water for 24 hours started germinating four days ahead of other seeds subjected to different pre-germination treatments Kanna et al., (1996). Several other studies like Manonmani and Vananagamudi (2003), Offiong et al., (2010) opined that soaking the seeds of Teak (Tectona grandis) in cold water for between 24 hours and 48 hours was the cheapest and best pre-germination treatment that shortened the number of days naturally required for germination to occur in a sown seeds of Teak. The most effectiveness of breaking dormancy according to this study is by soaking in coconut water for 30 minutes which could be attributed to the fact that cytokinnins exert various roles in the different aspects of plant growth and development.

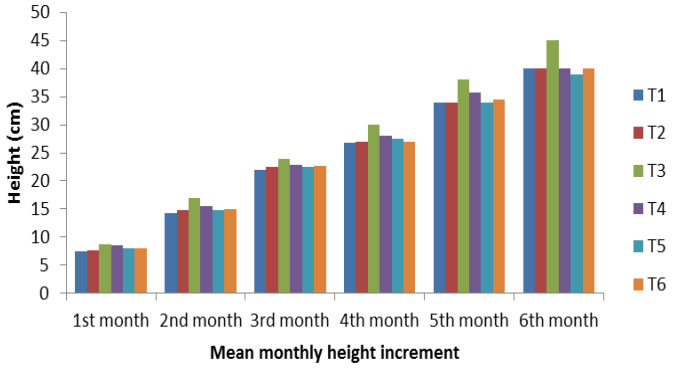

Figure 1: *Graphical display of mean monthly height increment of T. tetraptera after different pre-germination application*

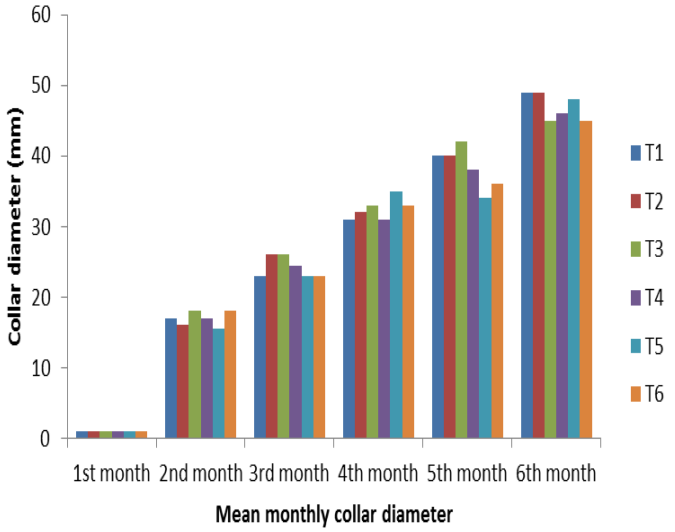

Figure 2: *Graphical display of mean monthly collar diameter increment of T. tetraptera after different pre-germination application*

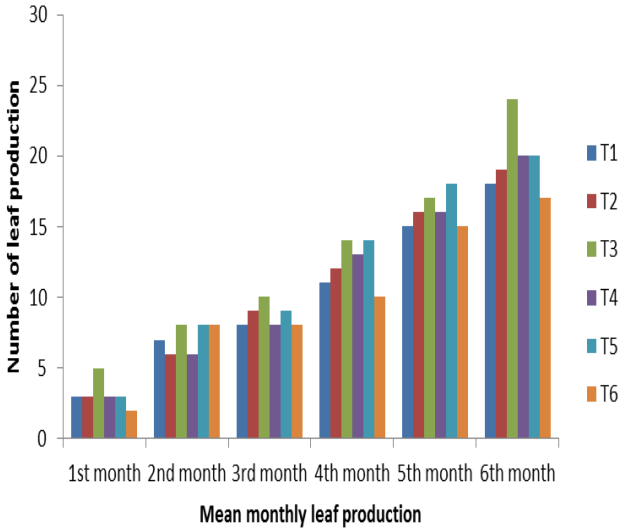

Figure 3: *Graphical display of mean monthly leaf production of T. tetraptera seedlings after different pre-germination application*

Table 2: Effects of pre-germination treatments of T. tetraptera seeds on seedlings height, collar diameter and number of leaves, six months after sowing

Pre-germination Treatment	Seedling height (cm)	Collar Diameter (cm)	Number of Leaves
Cold water (T_1)	40.35± 0.56^b	0.487± 0.006^b	18± 0.65^b
Hot water (T_2)	40.28± 0.56^b	0.487± 0.006^b	19± 0.65^b
Coconut water (T_3)	44.54± 0.56^a	0.488± 0.006^b	22± 0.65^a
Coconut milk (T_4)	40.26± 0.56^b	0.483± 0.006^b	20± 0.65^a
Hydrogen peroxide (T_5)	39.84± 0.56^b	0.487± 0.006^b	20± 0.65^a
Control, untreated (T_6)	40.35± 0.56^b	0.487± 0.006^b	18± 0.65^b

Conclusion

The seed dormancy in T. tetraptera is mainly due to the hard seed coat, which affects the seed germination. Results obtained in this experiment emphasized the necessity of treating T. tetraptera seeds before sowing, in order to enhance its growth. The pre-germination treatment of T. tetraptera seeds by using coconut water enhanced germination of the seeds, height and number of leaves of seedlings. Soaking the seeds in hot water did not have any significant effect on the seeds ability to germinate effectively. It is hoped that the results of this study will provide useful information for a large scale plantation development and encourage domestication.

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