Influence of Pre-Germination Treatments on Overcoming Seed Dormancy Seedling Growth of Indigenous Forest Tree Species (*Tamarindus indica* L) of Northwestern Nigeria

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ABSTRACT
This study was carried out at Kebbi State University of Science and Technology, Aliero, Kebbi State, to determine the effects of silvicultural treatments on the germination of indigenous forest tree species (Tamarindus indica l) of northwestern Nigeria. The study was carried out in the Forestry Laboratory of the Faculty of Agriculture. The effectiveness of nine (9) different presowing treatments was assessed, control inclusive. Treatment 1 (TRT1) seeds were soaked in tap water for 48 hours, Treatment 2 (TRT2) seeds were mechanically scarified opposite to micropyle, treatment 3, 4, and 5 (TRT3, TRT4, TRT5) seeds were immersed in H_2SO_4 *for 5, 10 and 15 minutes respectively, treatment 6, 7 and 8 (TRT6, TRT7 and TRT8) seeds were soaked in hot water (100°C) for 5, 10 and 15 minutes respectively and untreated seeds (CNTRL). A completely Randomized Design with three (3) replications was used. The data obtained were analyzed using one-way Analysis of Variance (ANOVA). Seeds of T. indica subjected to TRT3, TRT4, TRT5 and CNTRL recorded with highest FGP (100%) and was found to differ significantly* ($P<0.05$) *with other treatment and TRT7 and TR8 was recorded with the least FGP of 43.33 and 36.67% respectively. The result revealed that TRT4 significantly* ($P<0.05$) *enhanced the speed and germination rate of T. indica, Based on the result, pre-treatment of T. indica seeds with* H_2SO_4 *is recommended for effective germination.*

Keywords: *Presowing, Tamarindus Indica, Microphyle, Seedling, Germination*

INTRODUCTION

Forest ecosystem plays a vital role in human development and is believed that forest resources form the basis upon which different life forms depend (Danjuma, 2010). All living organisms solely depend upon vegetation directly or indirectly (Rabi'u et al, 2013), they need proper protection and management for continuous human development. One of the major problems people face in villages is a severe decline in tree density, due to human exploitation uncontrolled bush burning and rampant grazing by livestock and wildlife (Abdulrahman *et al.*, 2020). With the threats of global warming and increasing desertification, there is an urgent need to develop conservation strategies for dryland plants, thereby ensuring the preservation of their diversity (Geist and Lambin, 2012). Physical problems such as climate, soil, water balance, and topography harmed the plant biodiversity (Abraham, 2014). Biological problems such as diseases, pests, birds, rodent attacks, and uncontrolled browsing by livestock and wildlife also result in the decline and distribution of indigenous tree species (Maghembe *et al.*, 1998). Ambursa, *et al.*, (2018) related that human activities such as illegal cutting and massive clear-felling due to land use, infrastructural and political factors such as land tenure, rural development policies, and urban development lead to the decline of most of the indigenous tree species.

Previous studies have demonstrated that lack of seed sources is the major bottleneck, limiting the colonization of established plantations by indigenous tree species (Abraham, 2014). Many seeds have difficulty in germination such that their propagation is adversely affected by seed coat dormancy leading to poor growth potential (Ambursa *et al*., 2019). Danthu *et al.*, (2010), Most of these species have hard seed coats which is one of the several strategies for survival in specifically and temporally variable environments. In several species, seeds germinate rather slowly, and at times even fail to germinate (Azad *et al.*, 2011). This is because the seeds easily lose viability exhibited through the presence of oxygen and water in the embryo (Baskin and Baskin, 2004). If stored for a long time most seeds lose their viability (Nwoboshi, 1982) since they are not normally sown, until sometime after collection, so pre-germination treatment is important to prevent wasting time and money in sowing seeds with poor germination ability. This poor germination ability may be due to seed dormancy or insect attack, some such indigenous plant includes *Tamarindus indica* (Muhammad and Amusa, 2003). This study therefore intends to evaluate the response of different pre-germination treatment methods that could facilitate the germination of *T. indica.*

Tamarindus indica L

Tamarindus indica L (Tsamiya) is a leguminous tree in the family Leguminosaes. It most probably originated in tropical Africa (Coates-Palgrave, 1988). Tamarind is widespread throughout the tropics and subtropics and grows in more than 50 countries in Africa (Von Maydell, (1990). but has been cultivated for so long in India, that is sometimes reported to be indigenous there where it is known as ilmi in Hindus-Urdu (Abubakar *et al.*, 2008). It grows wild in African locales as diverse as Sudan, Cameroon, Nigeria, and Tanzania. It is widely distributed throughout the tropical belt, from Africa to South Asia, northern Australia, and throughout Oceania, Southeast Asia Taiwan, and China (Julia, 1987).

Tamarind is an evergreen or semi-evergreen bushy tree that has a dense foliage crown. It is a slow-growing tree; the annual growth rate of seedlings is about 60cm and the juvenile stage takes between four and five years, but trees can reach up to 24m, height of bole 1-2m and have a trunk diameter of 1.5-2m (Jambulingam & Fernandes, 1986). Leaves are bright green in colour, alternate, and compound with 10-18 pairs of leaflets. Leaflets are 1.2-3 x 0.3-1.1 cm in size, petiolate, and rounded at the apex. Flowers are bisexual, 2.5cm wide, five-petalled, borne in small racemes, and yellow with orange or red streaks. Buds are pink with 4 sepals and 5 petals. The fruits are curved or straight pods with rounded ends, 12 to 15 cm in length, covered with a hard brown exterior shell. Fruit pulp is brown or reddish-brown when mature and the fruit pod contains between 1 and 12 flat and glossy brown seeds. The seed is 1.6cm long, very hard, shiny, smooth, and reddish or purplish brown with irregular shape and is joined to each other with tough fibres (Jambulingam & Fernandes, 1986).

Tamarind is valued mostly for its fruit, especially the pulp, which is used for a wide variety of domestic and industrial purposes. The acidic pulp is used as a favourite ingredient in culinary preparations, such as curries, chutneys, sauces, ice cream, and sherbet in the country where the tree grows naturally (Lotschert & Beese, 1994). Almost all parts of the tree find some use or the other in food, chemical, pharmaceutical, and textile industries, and as fodder, timber, and fuel (George & Rao, 1997).

MATERIALS AND METHODS

Study Area

The study was carried out at Kebbi State University of Science and Technology, Aliero. The study site lies on latitude 12°18′ 22″N and Longitude 4°29′ 35″E which covers an area of about 350km^2 (Olajuyigbe et al., 2012). Aliero is inhabited by an artisanal community with a special interest in onion and pepper farming. The area is dominated by two distinctive seasons: the wet season and the dry season with a mean annual rainfall of about 800mm and temperatures of about 26°C. Although, the temperature can go down to about 21°C during the harmattan and up to 40°C between April and June (Mukhtar, 2016). Suleiman, *et al.*, (2016) highlighted that the area possessed two important cultivated lands namely: dryland (arid – prolonged dryness) and fadama (floodplains – significant alluvial clay particles). The vegetation of the area is characterized by a few annual grasses, shrubs, and scattered trees (Suleiman, 2016) which are threatened by the inhabitants as a result of over-exploitation without replacement (Bello and Gada 2015).

Experimental Materials

Experimental Materials Two hundred and seventy (270) viable seeds of *T. indica* were obtained. The average weight of the seeds was measured and recorded. The germination assessment consisted of twenty-seven (27) observation plots (Petri dishes) and each contained ten (10) viable seeds.

Experimental Procedures.

Seed collection and viability test

The seed of *T. indica* was obtained from the forestry and fisheries lab. of KSUST Aliero. Before the germination experiment, a seed viability test was carried out using floatation methods, seeds were soaked into a beaker containing water and observed for ten (10) minutes to identify the viable seeds. The floatation method is the fastest way of testing seed viability, which is based on the observation that empty or nonviable seeds float while viable seeds sink or settle down to the bottom of the container (Bello and Gada, 2015).

Germination Assessment:

Seeds were subjected to four pre-treatment methods with the untreated seeds as control. The pre-treatment methods are;

(i) Seeds were soaked in 98% sulphuric acid concentration for 5, 10, and 15 min
(ii) Seeds were mechanically scarified with the sandpaper opposite to micropile;
(iii) Seeds were soaked in cold water at room temperature for 48 hours
(iv) Seeds were soaked in boiled water at 100°C for 5, 10 and 15 minutes
(v) Control (untreated seeds)

Each treatment combination had 10 seeds, making a total of 270 seeds for the experiment. The pre-treated seeds were sown in a germination dish (GD) moistened with a paper towel and covered with its lid. The germination dish was arranged in a Completely Randomized Design (CRD) with 10 seeds per GD. Each treatment combination was replicated three (3) times.

Pre-germination treatment		**Number of seeds treated and sown**
Coldwater soaked for 48 hours	**(TRT1)**	30
Mechanical Scarification	**(TRT2)**	30
Conc. H2SO4 for 5 mins	**(TRT3)**	30
Conc. H2SO4 for 10 mins	**(TRT4)**	30
Conc. H2SO4 for 15 mins	**(TRT5)**	30
Hot water (100°C) for 5 mins	**(TRT6)**	30
Hot water (100°C) for 10 mins	**(TRT7)**	30
Hot water (100°C) for 15 mins	**(TRT8)**	30
Untreated seeds	**(CONTROL)**	30

Table 1: Treatment combination with several treated seed

Data Collection.
Germination parameters were determined daily (Ajayi and Fakorede, 2000) for thirty days. The seed was considered germinated when the tip of the radical grew out of the seed coat. Several seeds that emerged were recorded daily from the day of the first germination to the end of the germination period (4th week after sowing). Data collected on the germination of seeds were used to calculate the following:

1. Final germination percentage (FGP).
2. Mean germination time (MGT)
3. Coefficient of the velocity of germination (CVG.
4. Germination rate index (GRI)
5. Germination index (GI).
6. Time spread of germination (TSG)
7. Germination Energy (GE) = FGP/LDG

The methodology of calculations of parameters 1, 2, 4, 6 & 7 followed Kader (2005), and 5 followed Ranal et al. (2009).

Data analysis
The data collected were subjected to a one-way analysis of variance (ANOVA) and the means were separated at $P \leq 0.05$ using Duncan's Multiple Range Test (DMRT). All statistical analyses were done using the SPSS statistical package 20.0 version.

RESULT
Effect of seed pre-treatment on mean germination parameters of *Tamarindus indica*

In *T. indica* (Table 4.1.3) Highest FGP (100%) was attained by the seeds treated with Conc. H_2SO_4 (TRT3, TRT4 & TRT5) and control, but there is a significant difference ($P<0.05$) in CVG, GI, GRI, GE, and MGT between Acid treatments and control, the lowest MGT (3.2) was recorded from TRT3 and TRT5 while highest MGT (17.88) was obtained from TRT1. The highest GI was obtained from TRT4 (986.67) followed by TRT3 (980) and the lowest GI (320) was recorded from TRT8. The highest CVG (31.37) was recorded from TRT5 followed by TRT3 (31.27) and the lowest was from TRT8 (6.14). The highest GRI (31.37) was recorded from TRT5 followed by TRT3 (31.27) and the lowest GRI was obtained from TRT8. The highest GE (48.33) was recorded from TRT 4 and the lowest GE (1.62) was obtained from TRT8. The highest TSG was obtained from TRT8 (15) followed by TRT1 (13) and the lowest TSG was obtained from TRT2 (0.33). DMRT values showed no significant difference ($P<0.05$) between TRT3, TRT4, and TRT5 all the germination indices are statistically significant at a 5% level of probability. TRT4 significantly ($P<0.05$) recorded with the highest FGP reduced MGT with a low value of 3.27 days and highest GRI (30.79), highest GE (48.33), lower FDG (3) with maximum GI value (973.33) among treatment recorded with 100% FGP

DISCUSSION

Effect of seed pre-treatment on mean germination parameters of *Tamarindus indica*

This study revealed that acid pretreatment (TRT3, TRT4, and TRT5) could break up *T. indica* seed coat dormancy and enhance germination over the other scarification methods. The acid scarifications resulted in the highest FGP with the lowest FDG (4DAS) when compared with the control whose germination started at 13 DAS and ended at 19 DAS, it was also observed that the higher the duration of seed immersion in H_2SO_4 the higher the speed of germination. The result was supported by Mohammad & Amusa's (2011) findings, who reported that seeds of *T. indica* germinate within 3 days after 60mins immersion in conc. H_2SO_4. The study also tallies with the work of Abubakar and Muhammad (2013) in which 100% FGP was recorded in *T. indica* pretreated with conc. H_2SO_4. The result may also agree with the results obtained by Bello and Gada (2015) who reported that the most effective method of pretreating *T. indica* was scarification with conc. H_2SO_4 where the FGP can reach up to 98%. In other findings by Amusa (2018), was found that Conc. H2SO4 is highly effective in breaking seed coat dormancy in *T. indica*, it encourages germination and reduces the imbibition period.

Mechanical scarification (TRT2) gave a significant ($P<0.05$) of 93.33% FGP, meanwhile, TRT2 and Control are statistically the same in MGT, and GI but differed in CVG, GRI and GE. Mechanical scarification has been shown to enhance germination in seeds of many species (Missanjo *et al*., 2014).

Hot water pre-treatment resulted in a low germination percentage as related to the cold water treatment probably due to the high temperature to which the seeds were exposed. This argument is supported by the conclusions of Singh *et al*., (2019) who indicated that hot water may tend to be destructive to enzymatic activities at higher temperatures when used as pre-treatment. Moreover, this finding did not agree with Girase *et al.*, (2002) who found that three varieties of *Acacia nilotica and A. farnesiana* responded well with hot water (100^oC) treatment immersed for 10 and 15 mins as a means of breaking seed coat dormancy. There was a significant difference in FGP between control and hot water treatment (TRT 6, TRT7, and TRT8), control has 100% FGP, while TRT7 and TRT8 have FGP of 43.33 and 36.67 respectively, this is in support with Macdonald and Conrad, (2015) who observed poor germination from species treated with hot water due to charring and burning of seeds as a result of prolonged exposure.

Conclusion

The studies were carried out to determine the best method of breaking seed dormancy that is effective, and affordable, for optimum and uniform germination. Based on the result, pre-treatment of *T. indica* seeds with sulphuric acid is recommended for effective germination.

Table 2: The effects of seed pre-treatment on mean germination parameters of *Tamarindus indica*

TREATMENT	FGP (%)	MGT (day)	GI (%/day)	CVG	GRI (%/day)	GE (%/day)	FDG (day)	LDG (day)	TSG (day)
TRT1	80[c]	17.88[ab]	566.67[c]	6.33[c]	5.14[cd]	3.62[b]	9.66	22.66	13
TRT2	93.33[b]	5.93[a]	716.67[b]	16.95[b]	16.17[b]	10.08[ab]	3.67	9	5.33
TRT3	100[a]	3.2[a]	980[a]	31.27[a]	31.27[a]	25.00[ab]	3	4	1
TRT4	100[a]	3.27[a]	973.33[a]	30.77[a]	30.79[a]	48.33[a]	3	3.33	0.33
TRT5	100[a]	3.2[a]	986.67[a]	31.37[a]	31.37[a]	47.22[a]	3	3.67	0.67
TRT6	90[c]	14.17[ab]	696.67[a]	7.21[c]	6.46[c]	5.75[b]	8	20	12
TRT7	43.33[d]	12.18[b]	370[d]	8.21[c]	3.56[d]	2.60[b]	6.67	16.67	10
TRT8	36.67[d]	16.30[ab]	320[d]	6.17[c]	2.24[d]	1.62[b]	7.67	22.67	15
CONTROL	100[a]	15.67[ab]	763.33[b]	6.4[c]	6.4[c]	5.19[b]	13	19.33	6.33

*means followed by the same letter (superscript) are statistically the same at a 5% level of probability. Key: Final Germination Percentage (FGP), Germination rate index (GRI), Coefficient of Velocity of Germination (CVG), Germination energy (GE), and Germination Index should have higher values and lowest values in Germination Mean Time (GMT), First Germination Day (FGD), Last day of Germination (LDG) and Time Spread of Germination (TSG).

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