Pre-Sowing Treatments Pathways for Enhancing Milletia thonningii (Schum. and Thonn.) Seeds Germination in Kaduna Northern Guinea Savanna Ecology Zone of Nigeria

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Abstract

Pre-sowing treatment applications have greatly enhanced the germination of seeds of tree species used in afforestation programmes all over the world. Pre-Sowing Treatments Pathways for Enhancing Milletia thonningii (Schum. and Thonn.) Seeds Germination in Kaduna Northern Guinea Savanna Ecology Zone of Nigeria was studied at the Savannah Forestry Research Station Nursery. The treatments consisted of Boiled water (100ºC) for 5 minutes, 10 minutes and 15 minutes; diluted sulphuric acid (H_2S0_4) soaking time for 10minutes, 15 minutes and 20 minutes; Seed scarification (sand papering and cracking) and control. Ten (10) seeds from each of the treatments were sown in germination boxes containing sterilized riverbank sand and replicated three (3) times. The experimental design adopted was a Completely Randomized Design (CRD). Data from germination were analyzed using descriptive statistics and Analysis of Variance (ANOVA) at 95% (P> 0.05) level of probability. Results revealed that the seed of Milletia thonningii (Schum. and Thonn.) seeds scarified showed a significant germination percentage (89.52±6.23) than any other methods, followed by soaking in sulphuric acid (H_2S0_4) for 15 minutes (69.62±6.23) then, soaking in hot water for 15 minutes which gave (36.86±11.76). However, the seeds in the control were significant (P>0.05) lower in germination percentage (2.12±6.23) than any other methods applied. Therefore, it is concluded that for effective, sustainable and fast multiplication of germination of Milletia thonningii (Schum. and Thonn.) seeds in the tree nursery for afforestation programmes scarification methods should be adopted.

Keywords: Germination, Multiplication, Sustainable, Afforestation, Nursery, Seed Priming

Introduction

Milletia thonningii is a savanna and secondary forest species belonging to the family *Fabaceae* and sub family *Papilionoideae* often found on riverbanks. *M. thonningii* occurs as clumps or thickets on plains usually associated with termitaria belonging to the genus macrotermes (Adewusi, 1997). It is a deciduous tree that can attain a height of up to 20 m and a short bole of diameter up to 1 m with a dense crown. Bark smooth, grayish and thin, when slashed shows creamy yellow. Flowering occurs between November and March. The fruiting season is between March and November. However, fruits are ready for collection around the end of November. It grows well in an area with Mean annual rainfall of 600-1 000 mm. Leaves pinnate (simple compound) with a slender, glabrous common stalk, 10-15 cm long and 3-4 pairs of opposite leaflets with terminal leaflet 6-10 cm long and 2.5-5.5 cm broad, elliptic or obovate, shortly acuminate with blunt tip or slightly notched, cuneate at base. (Keay,1989). The lower leaflets are progressively more rounded at the base, glabrous above, minutely hairy or glabrous beneath except for the characteristic brush of stiff white hair at each side of the mid rib at the base with about 6 pairs of thin, up-curving lateral nerves running out very close to the margin. The lower leaflets are ovate or ovate-elliptic about 4-7 cm long and 2-4 cm wide (Keay,1989). Flowers are blue, mauve or purple, 1.5 cm long, becoming paler as they expand, arranged singly or in pairs along a glabrous central stalk, 12-22 cm long pendulous among newly forming leaves. The racemes sometimes are grouped in terminal panicles. Individual flowers have slender, slightly hairy stalk 6-12 mm long with a pair of very small but conspicuous linear bracteoles halfway up. Fruit is a dehiscent pod, 12-15 cm long and 18-25 mm broad, with more or less parallel margins or slightly broader towards the apex, sharply beaked, cuneate at the base, glabrous, smooth, flat and woody, usually containing 3-6 discoid black seeds about 10 mm across. (Keay,1989; Skerman,1997)

They are drought-resistant, frequently grow well in arid soil, and may form incredibly deep root systems. *M. thonningii* leaves are used as fodder for both cattle and sheep, the flowers are excellent in apiary for apiculture, the flowers provide nectar in the dry season for bees, and this potential can be utilized for honey production (Dalziel,1948; Linington & Ellis 1996). The wood and the woody dry pods which drop after releasing the seeds are a source of fuelwood, *M. thonningii* provide excellent timber with the sap wood yellowish-white with a darker greenish brown heartwood, heavy with fine grained, very hard, flexible and polishes well, It is used to make handles for implements such as axes, knives, tools, and the flexible young branches are used in construction of huts yam stakes, fencing poles and making traps (Adewusi,1997). The Leaf juice is poisonous and is used to poison water snails and the tree species provide excellent Medicinal properties, root and bark decoctions are used for worm's expulsion and as laxative, while the boiled pulverized roots and the bark are used for blood purification, Leaf extract is used for diarrhea or dysentery and a decoction of the bark is purgative (Dalziel,1948; Linington & Ellis 1996). Production of heavy litter by *M. thonningii* coupled with a network of lateral roots makes it good for soil conservation and erosion control especially on sloping ground , It is an agroforestry species because of its ability in nodulation, nitrogen fixing and soil improver, leaves are shed in large quantity during the dry season and serve as mulch, *M. thonningii* is also a very good ornamental tree species used in aboreculture owing to its flowers that appear in the dry season as well as the dark green foliage, it is often cultivated as an avenue tree or as a living fence. (Skerman,1997)

Many seeds have difficulty in germination such that their propagation is adversely affected by seed coat dormancy leading to poor growth potential Danthu *et al*., (1992). In several species, seeds germinate rather

slowly, and at times even fail to germinate (Dogon daji, 2002). This is because the seeds easily loose viability exhibited through the evolution of oxygen and water to the embryo (Nwoboshi, 1982). One of the major problems associated with afforestation programmes in the tropics is the fact that most tropical forest tree seeds exhibit one form of dormancy or another Ajiboye and Agboola (2008). The conditions necessary to allow seeds to break dormancy and germinate can be highly variable among species, within a species, or among seed sources of the same species Luna *et al.,* (2009). Hard seed coat, type and sizes have been identified by Agboola, (1996) as some attributes which affect germination and growth of indigenous species and sometimes, This poor germination ability may be due to seeds dormancy or insect attack, some of such indigenous plant includes *Milletia thonningii* among others However, if stored for a long time most seed lose their viability, since they are not normally sown, until sometimes after collection, so pre-germination treatment is important to prevent wasting time and money in sowing seeds with poor germination ability. The pre-treatment of this species seeds is necessary to enhance accessibility of water and oxygen into the seeds and to obtain optimum germination and improved performance for plantation establishment especially in arid and semi-arid regions where desert encroachment due to excessive deforestation led to dwindling agricultural field by the resultant poor soil status (Abubakar, 2002). Consequently, communities are no longer able to meet the upsurge in demand for forest products, food, fodder, fuelwood and other minor forest products. Therefore, there is an urgent need to explore the methods of seed pre-germinating, raising and tending of various species so that most of them are protected from extinction due to the threat of surging anthropogenic activities. Meanwhile the neglect of this species leads to loss of information on more efficient methods of pretreating both indigenous and exotic seeds to induce quick germination of tree species for plantation establishment. The objective of the study was to enhance seed germination of *Milletia thonningii* (Schum. & Thonn.) using priming techniques in Northern Guinea Savannah Ecological Zone of Nigeria.

Materials and Methods

Study Area

The study was conducted in Savanna Forestry Research Station nursery situated in Institute for Agricultural Research (I.A.R) farm Samaru in Kurumi Bomu village. Located at Latitude 12°13'and 11°11'N / Longitude 8°39' and 7°38' E and 686m above sea level (Figure 1). It is located in Sabon – gari Local Government Area of Kaduna State. The vegetation in the local Government Area is the Northern Guinea Savannah woodland type, characterized by short scattered drought resistant trees with undergrowth of grass that serves as fuel for bushfires in the long dry season with mean annual rainfall of 1000mm – 1500mm, temperature of 25.6°C (78.1°F), precipitation of 1,117.6mm and humidity of 69% respectively (Sodimu *et al.*, 2021).

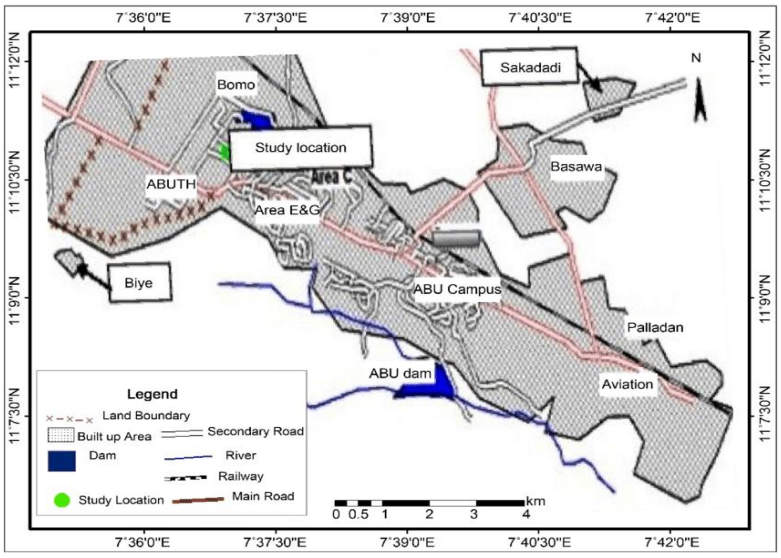

Figure 1: Showing the Study location of the SFRS, Nursery

Treatments and Experimental Design

Treatments consisted of Boiled water (100ºC) for 5 minutes, 10 minutes and 15 minutes; diluted sulphuric acid (H_2S0_4) soaking time for 5 minutes, 10 minutes and 15 minutes. Seed scarification and control. Ten (10) seeds each were soaked in Three (3) Treatments arranged in Completely Randomized Design (CRD). Ten (10) seeds from each of the treatments were sown in germination box containing sterilized riverbank sand and replicated three (3) Times.

Procedure for Experimentation

Experiment 1 (Hot Water Treatment)

Water was boiled for 100ºC, and seeds were added to the boiled water and allowed it to soak for three different times 5, 10, and 15 minutes. Then the seeds were removed and allowed to cool.

Experiment 2 (Acid treatment)

The seeds were soaked in diluted sulphuric acid (H_2S0_4) for three different periods (5, 10, and 15minutes). After the soaking the seeds were removed, washed and rinsed in running tap water to remove any remaining acid.

Experiment 3 (Scarification treatment)

Mechanical scarification was done by carefully filling the seeds with sandpaper until the seeds begins to crack. Caution must be taken while carrying out this scarification process not to damage the embryo of the seeds.

Experiment 4 (Control)

Milletia thonningii (Schum. and Thonn.) seeds sown without any pre-germination treatment served as control.

Data Collection

Seed Germination was monitored for forty days (40 days) and data were collected on Days of emergence (Number of days taken for first emergence), rate of germination (Number of seeds germinated) and germination percentage. Percentage seed Germination (PG) and Germination Rate (GR) were estimated with the following equations:

$$GP = \frac{SG}{TS} \times 100 \quad \text{.....equation (1)}$$

Where:

GP = Germination percentage
SG = Seed germinated
TS = Total number of seeds germinated

$$GR = \frac{GP}{T} \quad \text{.....equation (2)}$$

Where:

GR = Germination rate
GP = Germination percentage
T = Time taken

Data Analysis

Data from germination were analyzed using descriptive statistics and Analysis of Variance (ANOVA) with SPSS statistical package and means were compared using Least Significant Difference (LSD) test at ($P>0.05$) level.

Results and Discussion

Effect of Hot Water Treatment on *Milletia Thonningii* (Schum and Thonn)

The percentage germination of seeds soaked in 100ºC hot water (Table 1) for 15 minutes was significantly higher and gave percentage germination of (36.86±11.76) than those of all other hot water treatment of 5 minutes and 10 minutes. The seed treated with hot water at 100ºC for 10minutes gave germination percentage of (26.53±5.63) and for 5minutes gave (21.32±5.62). The result from this work is in agreement with the finding of Duguma *et. al.,* (1998) who noted that hot water is the most effective way of improving seed coat permeability in seeds of *Leucaena leucocephala*. But contrary to the work of Gill *et al.,* (2006) who stated that seeds of *Calliandra prototricensis* failed to germinate in hot water. Also, in contrast because hot water negatively impacted seed viability, likely due to excessive damage to the embryo, as observed in *Sapindus mukorossi*, *Dalbergia sissoo* and *Avena fatua*, where seed sources exhibited significant variation in germination and growth attributes (Gera *et al.,* 2016; Abutaba, 2015; Rocha *et al.* 2022). Hot water treatments negatively impacted seed germination and seedling growth due to prolonged exposure to high temperatures which likely caused thermal damage to embryonic tissues. However, Owonubi *et al.,* (2005) reported that soaking of *Azadirachta indica* seeds for one and two hours resulted in increasing rate of seeds germination supporting the work of Ibrahim & Otegbeye (2004) on the seeds of *Adansonia digitata.*

Table 1: Germination of Milletia Thonningii (Schum. and Thonn.) in Hot Water

Treatment (Minutes)	Mean Number of Days for First Emergence	Mean Number of Seeds Germinated	Germination Percentage
5	7.00±0.00[a]	0.2132	21.32±5.62[c]
10	12.62±0.55[a]	0.2653	26.53±5.63[c]
15	14.00± 0.00[a]	0.3686	36.86 ±11.76[c]
SE ±	0.00		0.00

Mean with the same letters along the same column are not significantly different from each other (P>0.05)

Effect of Sulphuric Acid Treatment on *Milletia Thonningii* (Schum. And Thonn.) Germination

The percentage germination of seeds treated with 15 minutes, soaking of H_2S0_4 was significantly higher (P> 0.05) for (69.62±6.23) than those for 5 minutes, that had (63.21±10.23) and for 10 minutes which gave (66.13±11.23) (Table 2) Fifteen (15) minutes soaking in H_2SO_4 gave the highest germination percentage of 69%, though there were no significant differences between the other 2 level (5, 10) which gave 63% and 66% respectively. This result is in accordance with the work of Aduradola *et al.,* (1998) on *Enterolobium cyclocarpum*, *Pilostigma reticulatum* and Adio *et al.,* (2006) on *Adansonia digitata* who noted that treatment with acid significantly promoted germination of the seeds. This finding is also similar to prior reports of Dachung and verinumbe (2006) that acid treatment of seeds removes the waxy layer of the seed coat by chemical decomposition of the seed coat components that, faster the rate of germination. While Danthu *et al.,* (1992) also observed that treatment with sulphuric acid for six (6) to twelve (12) hours led to germination of more than 90% of seeds within twenty (20) days of sowing. Agbogidi *et al.,* (2007) noted that soaking of *Dacyodes edulis* seed in sulphuric acid H_2SO_4 reduces the germination period considerably and concluded that it was the best method, though, dangerous. Therefore, when using safety precaution is very important.

Table 2: Germination of Milletia thonningii (Schum. and Thonn.) in Sulphuric Acid (H2S04)

Treatment (Minutes)	Mean Number of Days for First Emergence	Mean Number of Seeds Germinated	Germination Percentage
5	7.00±0.00[a]	0.6321	63.21 ±10.23[b]
10	12.36 ±1.15[a]	0.6613	66.13±11.23[b]
15	11.00± 0.00[ab]	0.6962	69.62±6.23[b]
SE ±	0.00		15.00

Mean with the same letters along the same column are not significant different from each other (P>0.05)

Effect of Mechanical Scarification Treatment on *Milletia Thonningii* (Schum. And Thonn.) Germination

The germination percentage of all the scarified seeds had germination percentage of (89.52±6.23) (Table 3). The results indicate that mechanical scarification was the most effective dormancy-breaking method, significantly improving germination percentage and seedling growth recorded the highest germination percentage (89.52%), confirming that physical abrasion effectively weakens the seed coat without damaging the embryo. The superiority of the scarification aligns with previous findings in other tree species, where physical scarification enhances water and gas permeability, thereby promoting uniform and rapid germination (Krishnakumar *et al.,* 2017; Bisht *et al.,* 2016). This is in agreement with the work of Vannila

et. al, (2025) Where the best results were obtained when the seeds of Blue Gold (*Indigo tinctorial* L.) are subjected to Mechanical scarification during their studies. Also, in agreement with earlier findings of Duguma *et al. (*1998) who observed that mechanical scarification is an efficient way of improving seed coat permeability of *Pterocarpus angolensis* and *Leucaenia leucocephala* seeds. Tomlinson & Nikiema (2000) also observed that seed dormancy resulting from an impermeable seed coat may be overcome by peeling off the coat. According to Agbogidi *et al.,* (2007), who noted that scarification gave the highest mean percentage germination than either immersion in hot water or sulphuric acid, but there was no significant difference between one scratches with sand paper (96.67%) and two scratches with sand paper (86.67%) on seeds for *Acacia sieberiana* but *Acacia seyel* recorded 83.33% and for one and two scratches. This result also agrees with earlier report by Owonubi *et al.* (2005) on seed germination of *Pterocarpus osun* when subjected to filling and clipping at their micropyle end. Similarly, Owonubi *et al.,* (2005) stated that seeds of *Pinus bruatia* germination improved when it was rubbed with sandpaper at the micropyle end. Duguma *et al., (*1998) affirmed that seed scarification is the most effective way of improving seed coat permeability in seed of *L*eucaena *leucocephala.*

Table 3: Germination of Milletia thonningii (Schum. and Thonn.) in Scarification

Treatment (Minutes)	**Mean Number of Days for First Emergence**	**Mean Number of Seeds Germinated**	**Germination Percentage**
	12.36 ± 1.15[a]	0.8952	89.52± 6.23[a]
SE ±	0.672		0.305

Mean with the same letters along the same column are not significant different from each other (P>0.05)

The lowest germination percentage was found for seeds in the untreated control which gave 2.12±6.23 (Table 4). This was not in agreement with results of work reported by El- Nour *et al.,* (1991) where they found that control untreated seeds of *Balanite aegyptiaca* had significantly higher germination than seeds boiled in hot water.

Table 4: Germination of Milletia thonningii (Schum. and Thonn.) in Control

Treatment (Minutes)	**Mean Number of Days for First Emergence**	**Mean Number of Seeds Germinated**	**Germination Percentage**
	6.18±11.12[b]	0.0212	2.12 ±6.23[d]
SE ±	6.17		0.305

Mean with the same letters along the same column are not significant different from each other (P>0.05)

Conclusion and Recommendation

Conclusion

The results of the *Milletia thonningii* (Schum. and Thonn.) seed pre-germination treatment showed that mechanically scarified methods improved seed germination. Therefore, Mechanical scarification can be concluded to be the best method of breaking dormancy in *Milletia thonningii* (Schum. and Thonn.) which resulted in an increased germination percentage of 89.52±6.23.

Recommendation

Based on the results above it is recommended that for easy multiplication of seedlings of *Milletia thonningii* (Schum. and Thonn.) for plantations establishment the nursery workers should adopt the use of mechanical scarification method as a pre-sowing treatment to promote and enhance better germination of the species.

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