

Effects of sowing media and pre-sowing treatments on germination of *Monodora myristica* (Gaertn.) Dunal (African nutmeg)

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ABSTRACT

Monodora myristica is an important multipurpose indigenous tree species which has economic value as food, medicine and artefacts. The sale of *M. myristica* seeds as an inexpensive local nutmeg substitute is now less common outside its region of production. This is as a result of excessive pressure on the wild populations, which leads to its decline. There is inadequate information on appropriate germination techniques on this species which has made its cultivation difficult. Effects of sowing media and pre-sowing treatments on the germination of *Monodora myristica* were investigated. Two sowing media (SM): top soil (S₁) and river sand (S₂); two pre-sowing treatments (PTs): mechanical scarification (Ms) and soaking in water at room temperature for 24 hours (S_{24h}); and control: direct sowing (Ds) were used. Data on rate of germination, number of days to completion of germination, number of days to seedling emergence and cumulative germination percentage were recorded. Data were analyzed using analysis of variance while means were separated using Least Significant Difference (LSD). PT had significant effect ($p < 0.05$) on number of days to completion of germination, but SM and interaction between SM and PT were not significantly related at ($p > 0.05$). PT and their interaction had no significant effect on germination rate at ($p > 0.05$). Pre-sowing treatments were significant on number of days to completion of germination. The treatments have various positive effects on germination behaviour of *Monodora myristica* and can be applied to achieve faster germination and seedling emergence.

Keywords: Sowing media, pre-sowing treatments, germination, seedlings emergence, *Monodora myristica*

INTRODUCTION

The African nutmeg "*Monodora myristica*" is a tropical perennial plant of the family Annonaceae or custard apple family of flowering plants (Celtnet, 2011). It is a deciduous forest tree with huge, lush, rounded crown giving heavy shade; the back is grey with vertical ridges distinctly rounded; it has a clear trunk and branches horizontally (Peter-Onoh *et al.*, 2014).

The seeds of African nutmeg are the most economically important part of the tree. In the past, its seeds were widely sold as an inexpensive local nutmeg substitute in the regions that it can be found. This is now less common outside its region of production (Celtnet, 2011). The seeds are widely used in West Africa as a substitute for an aromatic spice nutmeg in soups, stews and cakes. In traditional medicine, the seeds are used as a stimulant and for treatment of stomach ache and headaches

(Katende *et al.*, 1995). They are also used as rosary beads and are considered by some to have magical properties. The timber is easy to work and used for carpentry, turnery, walking sticks and also cultivated as an ornamental (Okpala, 2015).

Most indigenous species grow naturally in the wild and are popular for their multiple uses (Mathowa *et al.*, 2014). Little is known about growth media suitable for propagating seedlings of indigenous trees in arid and semi-arid areas (Mathowa *et al.*, 2014). Good production of permanent tree crop seedlings in the nursery phase is highly influenced by the nursery soil used. The time between sowing of seed and the completion of effective germination is critical to the nurseryman for the success of many Silvicultural operations, while early germination ensures maximum seedling development before the occurrence of unfavourable meteorological conditions (Forrest, 1964). Farmers' attempts to propagate them have not succeeded due to insufficient information on their agronomic requirements (Mathowa *et al.*, 2014).

Seed germination through pre-sowing treatments has led to great improvements in rapid and uniform field emergences which are two essential prerequisites to increase yield, quality, and ultimately profits in crops (El-Dengawy, 2005).

M. myristica seeds take minimum of two months for germination (Mathew, 1992). In the case of *M. myristica* it is very essential to determine the suitable pre-sowing treatment method that can greatly enhance the cumulative germination percentage, rate of germination and reduce days to seedling emergence from several weeks to only few days, also to improve the number of days to completion of germination to a shorter periods in the nursery with the aim of producing a uniform crop. It is therefore necessary to

find out the most appropriate nursery medium to enhance *M. myristica* seeds emergence in the nursery to meet the ever increasing demand for this multi-purpose trees in recent years. This study therefore, investigated the effects of growing media and pre-sowing treatments on germination of *Monodora myristica* in the nursery.

MATERIALS AND METHODS

This research was carried out in the screen house of the Nursery unit, Department of Forest Resources Management, University of Ibadan, Nigeria. The experimental site is located approximately on Latitude 07°26'N and Longitude 3°54'E, having an altitude of 277 m above sea level. Ibadan climate is West Africa tropical monsoon which is characterized by wet and dry seasons. The temperature in the screen house ranged from 19°C at night to 35°C during the day using Hygro-Thermometer (Olajuyigbe and Adegeye, 2014). The annual rainfall of the area is between 1258 mm - 1437 mm with mean daily temperature ranging from 22°C - 31°C and the soil of the area is ferric luvisols (Sarrah and Ayrault, 2001 in Onefeli and Adesoye, 2014).

Two hundred and eighty eight (288) seeds of *M. Myristica* were extracted from a fruit obtained from Okiti-pupa, Ondo State, Nigeria. After washing away the whitish aromatic pulp with cold water, the seeds were tested for viability by floating test (Daneshvar *et al.*, 2017). Two hundred and sixteen (216) viable seeds were used for this study. Seventy two (72) seeds were selected and were divided into two groups of 36 each; and each group was sowed directly on river sand and top soil in germination baskets respectively. Another 72 seeds were selected and scarified by cracking the coat, the scarified seeds were then grouped into two; 36 batches each and were sown on the two sowing media top soil and river sand. The remaining 72 seeds were pre-treated by soaking in water at room temperature for 24-hours. These

were also divided into 36 seeds each; the first was sowed on river sand while, the second was sowed on top soil respectively. The sowing was done by keeping the seeds in vertical position about 3cm deep in the media. The germination baskets were irrigated immediately after sowing and subsequently daily till the final emergence was observed.

EXPERIMENTAL DESIGN

The experimental design adopted was Completely Randomized Design (CRD). The experiment was subjected to the following four treatments and control:

Treatment 1 (S_1) = topsoil, Treatment 2 (S_2) = river sand, Treatment 3 (M_s) = Mechanical scarification, Treatment 4 (S_{24h}) = Soaking in water at room temperature for 24 hours and Control (D_s) = Direct sowing. The four treatments includes: Two sowing media (SM): topsoil (S_1) and river sand (S_2) and two pre-sowing treatments (PTs): Mechanical scarification (M_s) and Soaking in water at room temperature for 24 hours (S_{24h}) and control: Direct sowing (D_s). The experiment was laid out in a 2 x 3 factorial with the following treatment combinations as shown below in Table 1.

Table 1: Experimental Layout

	D_s	M_s	S_{24h}
S_1	$D_s S_1$	$M_s S_1$	$S_{24h} S_1$
S_2	$D_s S_2$	$M_s S_2$	$S_{24h} S_2$

METHOD OF DATA COLLECTION

Daily observations were made on the germination baskets to record number of seeds germinated per day, time taken for initial and final emergence (days) were also recorded. Recordings were discontinued and considered to have been completed when no additional germination took place in two weeks. Germination behaviours like germination percentage, rate of germination and cumulative germination were recorded using the method suggested by Saupe (2009), who put forward that germination rate could be determined by calculating the germination percentage at different time intervals after sprouting and cumulative germination percentage could be estimated when data collection has being discontinued.

DATA ANALYSIS

The data generated were analyzed using analysis of variance (ANOVA) as described in (Adesoye, 2004).

$$Y_{ij} = \mu + B_i + T_j + e_{ij}$$

Where,

μ = Overall mean

B_i = effect of the block

T_j = effect of jth treatment

e_{ij} = random error term

Fisher LSD test was used for post hoc analysis.

$$LSD_{A,B} = t_{0.05/2, DFW} \sqrt{MSW(1/n_A + 1/n_B)}$$

Where:

t = critical value from the t-distribution table

MSw = mean square within, obtained from the results of ANOVA test

n = number of scores used to calculate the means (Andale, 2016).

And graphical analysis was also used for some whole figures.

Percentage germination of seed was calculated as shown below:

$$\text{Germination \%} = \frac{N}{Y} \times 100$$

Where N = number of seeds germinated y = number of seeds sown (Gummert and Rickman, 2004).

RESULTS

Rate of germination

There were no significant differences ($p > 0.05$) in the effect of sowing media, pre-sowing treatments and interaction between sowing media and pre-sowing treatments on germination rate of *Monodora myristica* seeds (Table 2.)

Table 2: Analysis of variance for effect of sowing media and pre-sowing treatments on rate of germination of *Monodora myristica*.

Source of Variation	Degree of Freedom	Sum of Square	Mean Square	F	P-Value
SM	1	24.08	24.08	0.198	0.66 ns
PT	2	350.64	175.32	1.445	0.25 ns
PT*SM	2	209.17	104.59	0.861	0.43 ns
Error	48	5825.59	121.37		
Total	53	6409.48			

ns = not significant at 5% probability level.

River sand had a greater effect on germination rate (8.75%) compared to top soil (7.20%). Seeds of *Monodora myristica* sown directly (Ds), recorded the highest mean rate of germination (9.88%); while those mechanically scarified recorded the least of 4.48% mean rate of germination.

The interaction between soaking in water at room temperature for 24hours and top soil gave the optimum mean rate of germination of 10.80%, closely followed by that of direct sowing (Ds) on river sand

and direct sowing on top soil at 10.19% and 9.57% respectively.

Number of days to completion of germination

Table 3 shows that, pre-sowing treatments had significant effect ($p < 0.05$) on number of days to completion of germination of *M. myristica* seeds at 1% probability level, while sowing media and interaction between pre-sowing treatments and sowing media did not show any significant effect ($p > 0.05$).

Table 3: Analysis of variance for effect of sowing media and pre-sowing treatments on number of days to completion of germination of *Monodora myristica*.

Source of Variation	Degree of Freedom	Sum of Square	Mean Square	F	P-Value
SM	1	18.8	18.8	0.185	0.67 ns
PT	2	895.6	447.8	4.407	0.02 **
PT*SM	2	635.4	317.7	3.127	0.05 ns
Error	66	6705.9	101.6		
Total	72	8227.3			

** = Highly significant at 1% probability level

ns = Not significant at 5% probability level.

Table 4 reveals that the highest number of days to completion of germination 58.71days was recorded on top soil compared to 55.11days in river sand. The seeds of *M. myristica* soaked in water at room temperature for 24hours took the longest number of days (59.71days) to complete germination, while, the seeds subjected to mechanical scarification completed germination in the shortest period (49.69days).

The interaction between river sand and Soaking in water at room temperature for 24hours recorded the longest number of days to completion of germination (62.20days); this is closely followed by direct sowing on top soil (60.43days) and the shortest was recorded by mechanical scarification and top soil (45.00days).

Table 4: Effect of sowing media, pre-sowing treatments and interaction between sowing media and pre-sowing treatments on number of days to completion of germination of *Monodora myristica* Seeds.

Sowing media	S1	S2				
Mean	58.17a	55.11a				
Pre-sowing treatments	Ds	Ms	S _{24h}			
Mean	57.23a	49.69b	59.71a			
Sowing Media	S1			S2		
Pre-sowing Treatments	Ds	Ms	S _{24h}	Ds	Ms	S _{24h}
Mean	60.43b	45.00a	57.45ab	53.29a	51.10a	62.20b

LSD_{0.05}: Means within rows followed by the same alphabets are not significantly different.

Cumulative Germination Percentage

Cumulative germination percentage of *M. myristica* seeds was improved by sowing media and pre-sowing treatments as shown in Figure 1. Seeds soaked in water at room temperature for 24 hours (S_{24h}) before sowing on top soil (S₁) had the highest

germination value of 97.22%. Next was 91.66% for seeds sown directly (Ds) in river sand, while the least germination of 11.11% was recorded in seeds subjected to mechanical scarification and sown on topsoil.

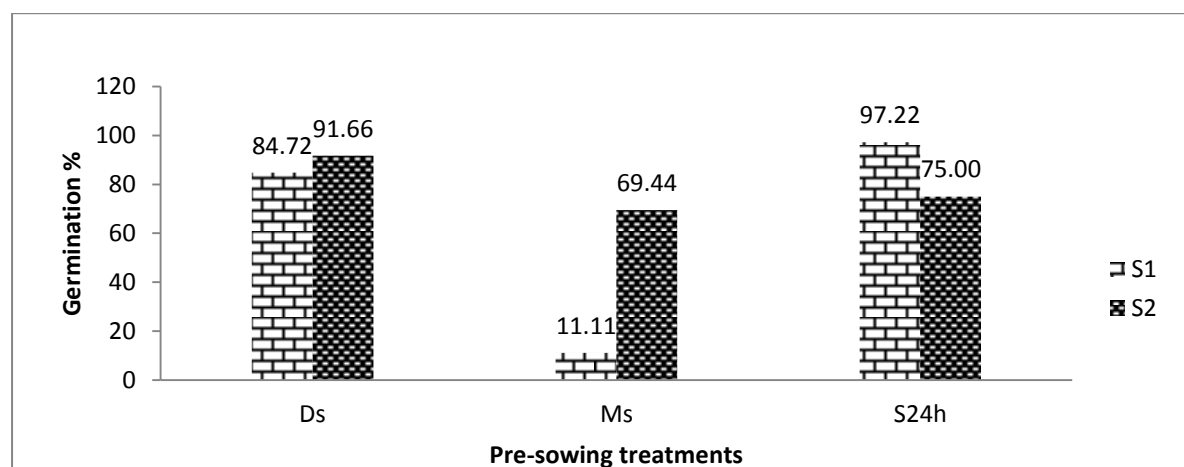


Figure 1: Effect of sowing media and pre-sowing treatments on cumulative germination of *Monodora myristica*.

Number of days to seedling emergence

Sowing media and pre-sowing treatments highly influenced the number of days to seedling emergence as shown in figure 2.

The least number of days to seedlings emergence of 32days was recorded for

seeds sown directly (Ds) on river sand (S_2), closely followed by 36days in seeds scarified mechanically (Ms) before sowing on river sand (S_2), while the longest days to germination emergence was 46days in seeds sown directly on topsoil.

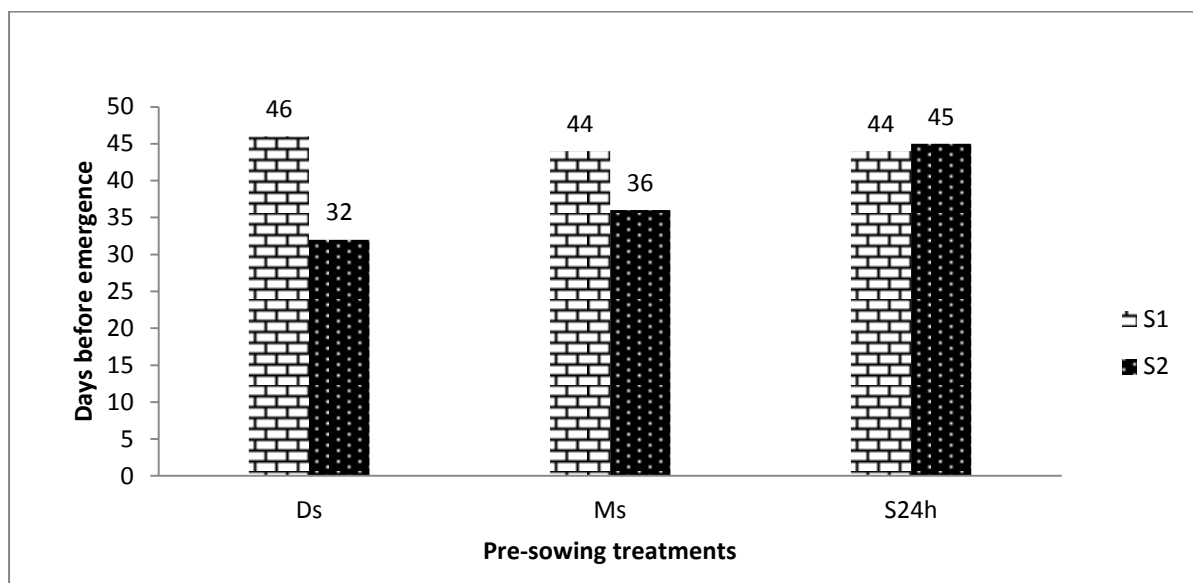


Figure 2: Effect of sowing media and pre-sowing treatments on no of days to seedlings emergence of *Monodora myristica*.

DISCUSSION

Seeds of *M. myristica* sown in river sand had the highest rate of germination and shortest number of days to seedling emergence. According to Fry (2017), river sand is characterized with light properties and has particles that do not stick together. This probably explains why seeds of *M. myristica* recorded highest rate of germination and shorter number of days to seedling emergence since it will be easier for emerging seedlings to push through the sand. This is contrary to Yerima *et al.* (2015), who reported that seeds of *Helianthus annuus* had the same highest germination rate on soil, sawdust+soil and sand+soil compared to low germination rate in sole river sand and sawdust substrates. It however agrees with findings of Pahla *et al.* (2014) in their work on “Effects of soil type and different pre-sowing treatments on seedling emergence and vigour of *Acacia sieberiana*” that the

seeds of *A. sieberiana* took shortest time to emerge on sandy soil as compared to clay. The difference observed in the case of *H. Annuus* may be attributed to the amount of energy in the seed cotyledon, which may have effect on the vigour of the emerging seedling. Thus, a sowing medium, which possessed light particles that are not sticky, should be considered when the aim for raising *M. myristica* is for faster rate of germination and slower number of days to seedlings emergence.

Number of days to completion of germination and cumulative germination percentage were highly favoured by top soil. Top soil has high water-holding capacity, moderate aeration and stimulates warmth, which better facilitates germination than river sand (Lois, 2016). These factors are responsible for the higher cumulative germination rate recorded within a shorter period of time in top soil

owing to its physical and chemical properties. This study therefore supports the claim by Barwick (2004) that *M. Myristica* seed prefers a deep, fertile loam soil and a sheltered position in full sun or light shade for high germination percentage. In the study by Peter-Onoh *et al.* (2014), it was observed that *M. myristica* seed germinated faster in sawdust than top-soil and river sand. This agrees with this study though sawdust was not used. However, the fact that sawdust has higher water retention capacity and ability to generate warmth which promotes faster germination may be reason for the observation recorded by Peter-Onoh *et al.* (2014). This is an indication that water and warmth are very important for good germination of *M. myristica* seeds. Therefore, sowing media with higher water retention capacity and warmth generation ability should be given preference when selecting sowing media for *M. myristica*.

The seeds of *M. myristica* sown directly without any pre-sowing treatment recorded the highest rate of germination and shortest number of days to seedlings emergence. This agrees with Katende *et al.* (1995), who reported similar observation for *M. myristica* in Uganda. This work however contradicts Pahla *et al.* (2014), who observed that seeds of *Acacia sieberiana* that had been exposed to H_2SO_4 for 60 minutes before sowing, took shortest number of days (6 days) to emerge, whilst directly sown seeds recorded the longest time to emergence (18 days). Also, the result of this study differs from the findings of Azad *et al.* (2011) that, seeds of *Acacia auriculiformis* gave better germination rate of 83% in hot water followed by 78% in mechanical scarification and least 43% in control (direct sowing). The difference observed may be attributed to species difference.

Mechanical scarification (Ms) reduced number of days to completion of germination better compared to other pre-

sowing treatments. The shortest period of optimum germination obtained in the mechanical scarification (Ms) treatment of *M. Myristica* may be as a result of abrading the seed coat which exposed its cotyledon to water and warmth readily, as such facilitates germination of the seeds through the supply of adequate water and warmth to the embryo to initiate the germination process (Fateme and Mousa, 2016). Therefore, exposure of the cotyledon (through mechanical scarification) to the essential conditions for germination gives a faster seedling emergence and also reduces the number of days to completion of germination.

Soaking of seeds in water at room temperature for 24 hours (S_{24h}), enhanced cumulative germination percentage better when compared to other pre-sowing treatments. This shows that soaking the seeds in water at room temperature helps in softening the seed coats and leaching of potential inhibitors, also, it reduces the time that required for germination to start and complete and it increases the germination percentage (Hartman *et al.*, 2007). The enhancement of cumulative germination percentage, which was observed in the seeds soaked in water at room temperature, may be due to alteration of the physiology of embryos and activation of enzymes, so that developmental processes occur more rapidly after sowing (Kattimani *et al.*, 1999). This study therefore supports the findings of Haider *et al.* (2014) that seeds of *Acacia catechu* soaked in water at room temperature for 24 hours, showed highest cumulative germination and occurred between 05-15 days after sowing compared to seeds soaked for 48 hours in water at room temperature 05-15 days after sowing, seeds soaked in hot water for 30 seconds 05-13 days after sowing and direct sowing which recorded least cumulative germination percentage between 7-17 days after sowing. Therefore, soaking the seeds of *M. myristica* in water at room

temperature is desirable for a higher cumulative germination percentage.

CONCLUSION

It is evident from this study that the sowing media and pre-sowing treatments have different or various effects on the germination behaviour of *Monodora myristica*. For rate of germination, the effects of sowing media and pre-sowing treatments were not significantly different from each other. The seeds soaked in water at room temperature for 24 hours and sown in top soil performed better in terms of cumulative germination, while seeds that were subjected to mechanical scarification before sowing in top soil gave optimal germination in minimum number of days. Also seeds that were not pre-treated before sowing on river sand recorded fastest seedling emergence.

Therefore, if emphasis is on rate of germination, any of the pre-sowing treatments (mechanical scarification, soaking in water at room temperature for 24 hours or direct sowing) on any of the sowing media (top soil or river sand) can be used since the effects observed in the study were not significantly different from each other. For high cumulative germination, soaking of the seeds in water at room temperature for 24 hours before sowing on topsoil is recommended.

Seeds should undergo mechanical scarification before sowing on topsoil in order to experienced minimum number of days for its germination; while untreated seed and river sand are recommended for faster seedling emergence.

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