

Research Article

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# Effect of Different Growing Soil Media on Seed Germination and Growth of Tamarind as Influenced by Seed Dormancy Breaking Approaches



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## Abstract

The study investigated effect of different growing soil media on seed germination and growth of Tamarind as influenced by seed dormancy breaking approaches was conducted at Nursery Unit of Department of Forestry and Wildlife Management, Federal University Dutsin-Ma. The experiment was laid out in Completely Randomized Design with two factors, factorial arrangement having four replications. Data were recorded for days of seed emergence, germination percentage, number of leaves (NL), leaf area (LA), wet and dry matter weight. Seeds mechanically scarified (MS), sowed in top soil ( $S_1$ ) ( $S_1MS$ ) and seeds treated with 60% concentrated tetraoxosulphate (VI) acid ( $H_2SO_4$ ) for 10 minutes ( $A_{10}$ ) and sowed in  $S_1$  ( $S_1A_{10}$ ), MS sowed in river sand ( $S_2$ ) ( $S_2MS$ ), seeds treated with  $A_{10}$  and sowed in  $S_2$  ( $S_2A_{10}$ ), MS sowed in top soil plus river sand plus manure ( $S_3$ ) ( $S_3MS$ ) and seeds treated with  $A_{10}$  and sowed in  $S_3$  ( $S_3A_{10}$ ) germinated first 5 days after sowing (DAS), while control 9 DAS. Maximum germination percentage was recorded for seeds treated with  $A_{10}$  (100%) and MS (97.5%). No significant effect was virtually observed on growing soil media, except in  $S_3$  with significant value (1.4cm<sup>2</sup>) on LA. MS was significant on NL at 2, 6, 10 and 12 weeks after sowing (WAS), LA at 12 WAS, wet weight of shoot (WWS) at 2-12 WAS and dry weight of shoot (DWS) at 2-12 WAS respectively. In conclusion, mechanically scarified seeds at the micropyle and seeds treated with acid for at least ten minutes break dormancy of *T. indica* seeds better and recommended for use.

**Keywords:** Breaking seed dormancy; Seed germination and growth; Tamarind

## Introduction

*Tamarindus indica* is a leguminous tree in the family Fabaceae native to tropical Africa. The genus is a monotypic taxon, having only a single species [1]. It is cultivated widely in India, Bahamas, West Indies, and USA among others [2]. It is vital to note that natural regeneration of any plant species of a forest is essential for conservation and maintenance of biodiversity, which help in developing plant population of an area in time and space [3]. Deforestation, desertification and erosion are the most challenging and obvious factors responsible for biodiversity loss as well as soil degradation in the savanna regions. These limiting factors can be addressed and ultimately minimized through afforestation and re-afforestation or regeneration programmes. Nevertheless, to realize these regeneration programmes, seed collection and seed germination pre-treatment procedures must be taken into consideration, although optimum germination of seeds is often very difficult due to the issue of dormancy. Therefore, as a result of the fore going, it is necessary to identify the most appropriate pre-germination techniques suitable for raising *T. indica* seedlings under different potting media in the nursery [4].

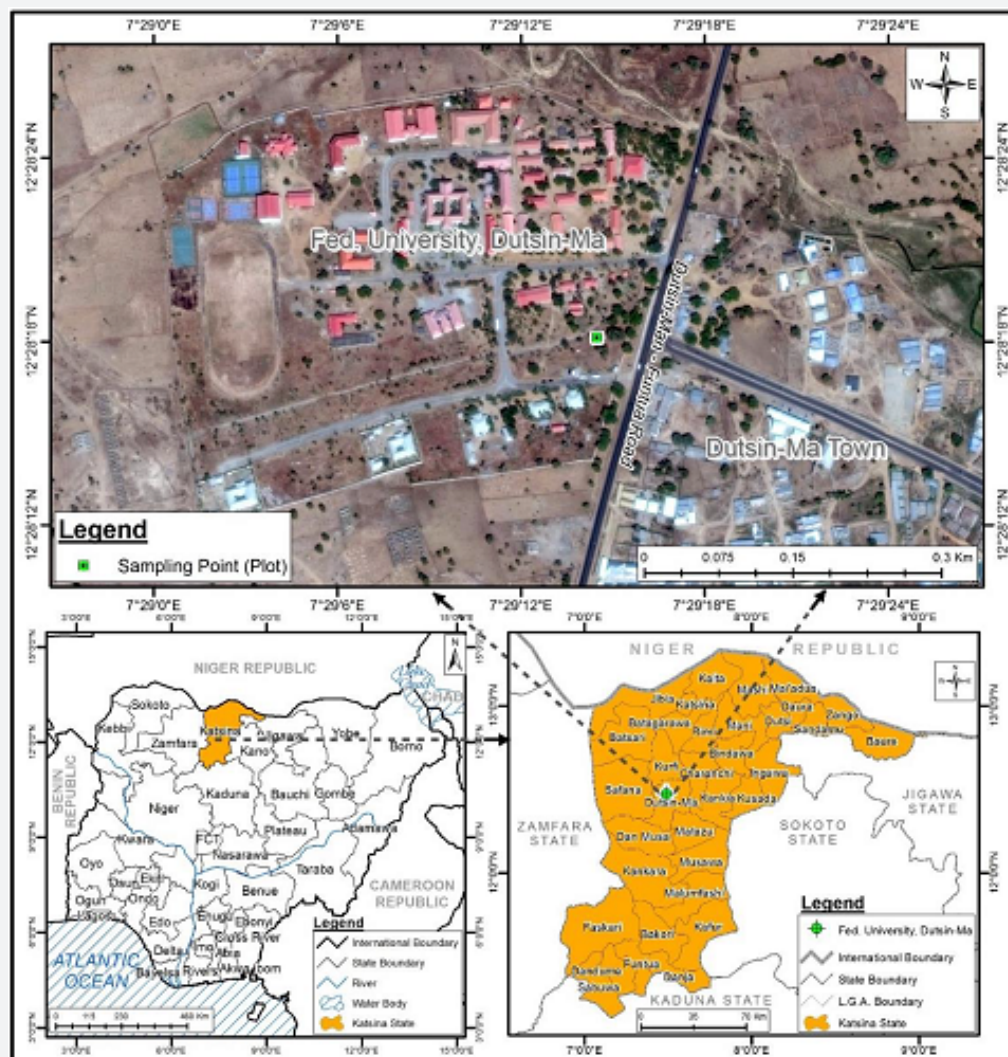
Seed germination is observed to be affected by many factors such as substrate type used, and environmental factors like oxygen, temperature and light [5]. Germination simply refers to a series of changes whereby an embryo grows into a seedling [6]. It involves absorption of water by the seed and splitting of seed testa giving rise to plumule (which grows upward and develops into stem and branches) and radicle (that grows downward and develops into root system). Germination through sexual reproduction dominates and supersedes other means in most savanna species [7]. Suitable growing media is expedient for production of quality seedlings. This affects the development and later maintenance of the extensive functional rooting system. A suitable growing medium provides sufficient anchorage to the plant, serves as reservoir of nutrients and water, permit oxygen diffusion to the roots and gaseous exchange between the roots and atmosphere outside the root substrate [8]. Good and suitable nursery potting media influence good and quality seedling production [9]. The quality of seedling obtained from a nursery affects re-establishment in the field, a garden or an orchard [10,11]. The study therefore aimed at investigating the

effect of different growing soil media on seed germination and growth of tamarind as influenced by seed dormancy breaking approaches.

**Materials and Methods**

The experiment was carried out in the nursery unit of the Department of Forestry and Wildlife Management, Federal

University Dutsin-Ma, Katsina State, Nigeria. The area lies between latitude 12°28'18.3" N and longitude 07°29'15.4" E (Figure 1) with an annual rainfall of 700mm, which is spread from May to September. The mean annual temperatures range from 29-31°C, the high temperature normally occurs in April/May and the lowest in December through February. The vegetation of the area is the Sudan savanna [12].



**Figure 1:** Federal University Dutsin-Ma showing study area.  
**Source:** Map Gallery, Geography Department, ABU, Zaria.

The major materials used for the experiment were as follow; Tamarindus indica seeds, soil media like top soil, river sand and cow dung; also, water, 60% concentrated tetraoxosulphate (VI) acid (H<sub>2</sub>SO<sub>4</sub>), polythene bags size of 30cm x 30.6cm dimension, sand paper (emery cloth) among others. The experimental was laid out as 3 x 5 factorial in a Completely Randomized Design (CRD) as indicated in Table 1.

**Data collection**

Record of data of the experiment was taken at interval of two (2) weeks to access different parameters which include:

**Days of emergence**

The number of days for sprouting from each pot was observed and recorded.

**Germination percentage (%)**

The percentages of germination were derived by dividing the total number of seeds germinated by the total number of seeds sown and then multiply by 100, the formula is estimated below:

$$Germination\ percentage = \frac{Number\ of\ seeds\ germinated}{Total\ number\ of\ seeds\ sown} \times 100$$

**Table 1:** Dormant seeds of Tamarind (*Tamarindus indica*) were Subjected to the following pre-germination treatments in different soil media.

Treatments	Description of the Treatments
S <sub>1</sub>	Top soil
S <sub>2</sub>	River sand
S <sub>3</sub>	Top soil plus river sand plus manure (1:1:1)
MS	Mechanically scarified seeds at the micropyle
(S <sub>24h</sub> )	Seeds soaked in water at room temperature for 24 hours
A <sub>5</sub>	Seeds soaked in 60% concentrated H <sub>2</sub> SO <sub>4</sub> for five (5) minutes
A <sub>10</sub>	Seeds soaked in 60% concentrated H <sub>2</sub> SO <sub>4</sub> for ten (10) minutes
C	Seeds not treated (Control)

**Number of leaves**

The total number of leaves from three (3) seedlings in each pot were counted and recorded.

**Leaf area (cm<sup>2</sup>)**

Using graph sheet, the leaf area was recorded at an interval of 2 week.

**Wet and dry matter weight of shoot (g)**

One seedling from each pot were carefully uprooted washed and sectioned into shoot, while sensitive weighing scale was used to measure the initial (wet) weight of the shoot. After the

fresh weight has been taken, seedling components, shoot were placed in the oven and dried at 75°C for three hours. The dried weights of each component were taken as their dried biomass and were measured by sensitive weighing scale.

**Data analysis**

Data were analyzed using Analysis of Variance (ANOVA) with the statistical Analysis System (SAS, 2003) statistical package 2003 version at 5% level of significance to determine differences in the treatment effect. The Fisher’s Least Significant Difference (F- LSD; P ≤ 0.05) was used to separate the means of differences among the treatments.

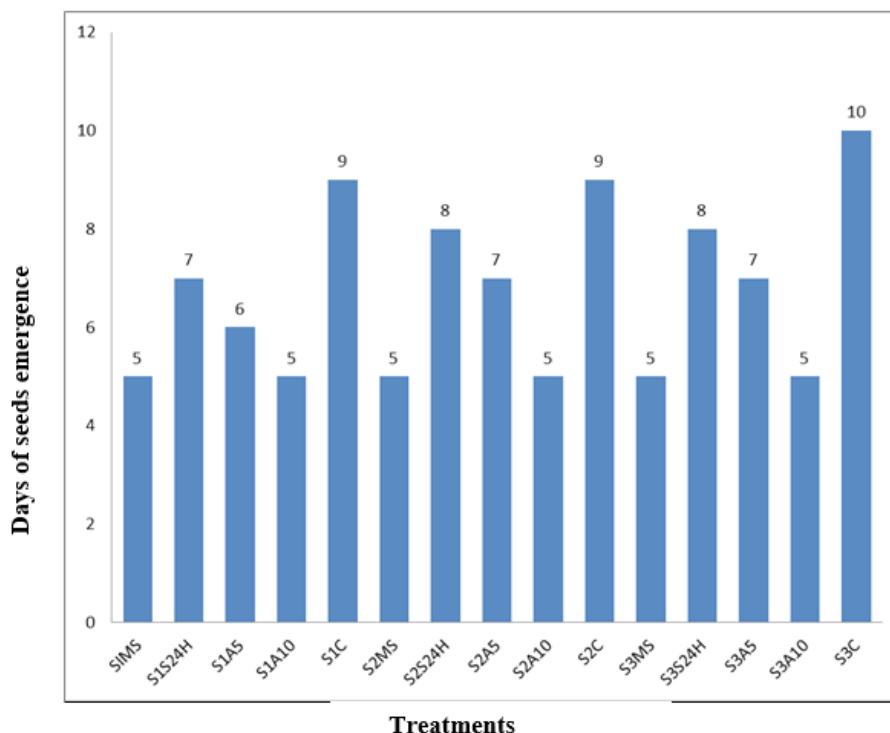
**Results**

**Days of seeds emergence**

Seeds mechanically scarified (MS) and seeds treated with tetraoxosulphate (VI) acid (H<sub>2</sub>SO<sub>4</sub>) for 5 minutes had the lowest days of seeds emergence at (5) DAS and seeds not treated (C) had the highest days of seeds emergence in top soil plus river sand plus manure in 1: 1: 1 (S<sub>3</sub>) (Figure 2).

**Germination percentage (%)**

Seeds treated with 60% concentrated tetraoxosulphate (VI) acid (H<sub>2</sub>SO<sub>4</sub>) for 10 minutes (A<sub>10</sub>) sowed in river sand (S<sub>2</sub>) had the highest germination percentage (100%) (S<sub>2</sub>A<sub>10</sub>) followed by seeds mechanically scarified (MS) in top soil (S<sub>1</sub>) had (97.5%) (S<sub>1</sub>MS) and the lowest is the seeds not treated (C) with germination percentage of (65% in top soil (S<sub>1</sub>) (S<sub>1</sub>C) (Figure 3).



**Figure 2:** Days of seeds emergence of tamarind as affected by different soil media and pre-germination treatments.

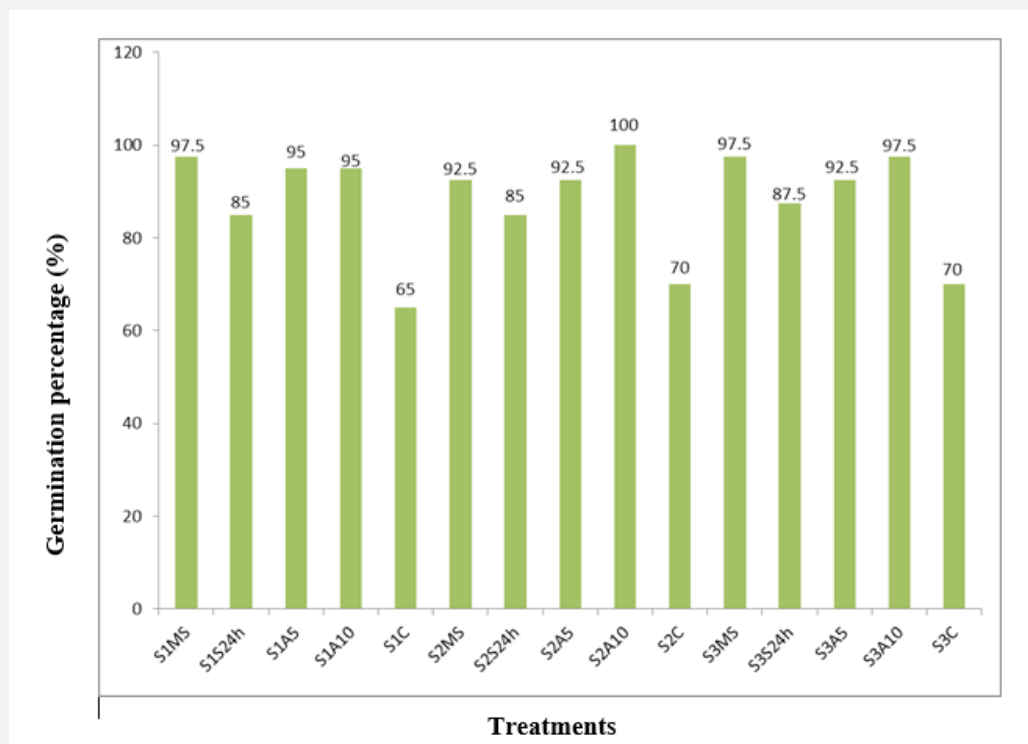


Figure 3: Germination percentage of tamarind as affected by different soil media and pre-germination treatments.

### Number of leaves

There was no significant effect on number of leaves across all the period of the experiment by the various soil media. But Seeds mechanically scarified at the micropyle had significantly

higher values (38.83, 104.50, 147.50, and 171.33) on number of leaves at 2, 6, 10-12 WAS respectively, while seeds soaked in water at room temperature for 24 hours ( $S_{24h}$ ) had significantly lower values (34.33, 96.42, 137.83 and 160.83) at 2, 6, 10-12 WAS across the weeks among others (Table 2).

Table 2: Number of leaves of tamarind as affected by different soil media and pre-germination treatments at interval of 2 WAS

Treatment	Number of Leaves					
	2 WAS	4 WAS	6 WAS	8 WAS	10 WAS	12 WAS
Soil media						
$S_1$	35.4	66.7	100.4	122.4	143.4	166.5
$S_2$	36.1	69.5	98.4	199.7	142.6	165.2
$S_3$	35	65.9	99.6	119.2	143.4	167.1
SE±	1.72	2.601	3.268	3.251	3.251	3.763
Pre-germination treatments						
MS	38.83 <sup>a</sup>	69.83	104.50 <sup>a</sup>	122.92	147.50 <sup>a</sup>	171.33 <sup>a</sup>
$S_{24h}$	34.33 <sup>b</sup>	63.7	96.42 <sup>b</sup>	116.7	137.83 <sup>b</sup>	160.83 <sup>b</sup>
$A_5$	36.20 <sup>ab</sup>	64.83	99.70 <sup>ab</sup>	121.8	144.20 <sup>ab</sup>	166.50 <sup>ab</sup>
$A_{10}$	34.70 <sup>ab</sup>	68.2	98.70 <sup>ab</sup>	120.83	142.70 <sup>ab</sup>	166.00 <sup>ab</sup>
C	33.50 <sup>b</sup>	69.83	98.00 <sup>ab</sup>	119.83	143.50 <sup>ab</sup>	167.20 <sup>ab</sup>
SE±	2.159	3.33	4.051	4.06	4.4	4.685

Means followed by the same letters within the same column and treatment are not significantly different at 5% level of probability using Least Significant Difference (LSD).  $S_1$ =Top soil;  $S_2$ =River sand;  $S_3$ =Top soil + River sand + Manure; MS: Mechanical scarification,  $S_{24h}$ : Seeds soaked in water for 24 hours,  $A_5$ : Seeds soaked in Tetraoxosulphate (VI) acid for 5 minutes,  $A_{10}$ : Seeds soaked in Tetraoxosulphate (VI) acid for 10 minutes, C: Seeds not pre-treated; SE±: Standard Error.

### Leaf area (cm<sup>2</sup>)

Seeds sowed in soil media had significantly higher effect on leaf area in top soil plus river sand plus manure ( $S_3$ ) at 12 WAS

with the value (1.49) and top soil ( $S_1$ ) had significantly lower effect on leaf area with (1.37) at 12 WAS. However, seeds mechanically scarified (MS) and seeds soaked in tetraoxosulphate (VI) acid for

5 minutes ( $A_5$ ) had significant higher values (1.51 and 0.87) at 6 and 12 WAS and seeds mechanically scarified (MS), seeds soaked in tetraoxosulphate (VI) acid for 5 minutes ( $A_5$ ) had significantly lower values (0.80 and 1.34) at 6 and 12 WAS among others (Table 3).

**Table 3:** Leaf area ( $cm^2$ ) of tamarind as affected by different soil media and pre-germination treatments at interval of 2 WAS.

Leaf Area ( $cm^2$ )						
Treatment	2 WAS	4 WAS	6 WAS	8 WAS	10 WAS	12 WAS
Soil media						
$S_1$	0.5	0.62	0.84	0.92	1.13	1.37 <sup>b</sup>
$S_2$	0.56	0.64	0.83	0.95	1.1	1.41 <sup>ab</sup>
$S_3$	0.49	0.63	0.85	0.95	1.14	1.49 <sup>a</sup>
SE±	0.02	0.02	0.015	0.018	0.029	0.043
Pre-germination treatments						
MS	0.46	0.62	0.85 <sup>a</sup>	0.94	1.17	1.51 <sup>a</sup>
$S_{24h}$	0.49	0.6	0.80 <sup>b</sup>	0.92	1.1	1.34 <sup>b</sup>
$A_5$	0.46	0.65	0.87 <sup>a</sup>	0.93	1.13	1.43 <sup>ab</sup>
$A_{10}$	0.49	0.66	0.83 <sup>ab</sup>	0.94	1.1	1.44 <sup>ab</sup>
C	0.5	0.64	0.85 <sup>a</sup>	0.95	1.11	1.38 <sup>b</sup>
SE±	0.026	0.026	0.018	0.023	0.036	0.056

Means followed by the same letters within the same column and treatment are not significantly different at 5% level of probability using Least Significant Difference (LSD).  $S_1$ =Top soil;  $S_2$ =River sand;  $S_3$ =Top soil + River sand + Manure; MS: Mechanical scarification,  $S_{24h}$ : Seeds soaked in water for 24 hours,  $A_5$ : Seeds soaked in Tetraoxosulphate (VI) acid for 5 minutes,  $A_{10}$ : Seeds soaked in Tetraoxosulphate (VI) acid for 10 minutes, C: Seeds not pre-treated; SE±: Standard Error.

### Wet weight of shoot (g)

**Table 4:** Wet weight of shoot of tamarind as affected by different soil media and pre-germination treatments at interval of 2 WAS.

Wet Weight of Shoot						
Treatment	2 WAS	4 WAS	6 WAS	8 WAS	10 WAS	12 WAS
Soil media						
$S_1$	0.8	0.9	1.3	2.3	2.6	3.1
$S_2$	0.8	0.9	1.3	2.43	2.6	3.1
$S_3$	0.8	0.9	1.3	2.45	2.6	3.1
SE±	0.047	0.051	0.053	0.096	0.1	0.11
Pre-germination treatments						
MS	0.88 <sup>a</sup>	0.98 <sup>a</sup>	1.40 <sup>a</sup>	2.56 <sup>a</sup>	2.83 <sup>a</sup>	3.35 <sup>a</sup>
$S_{24h}$	0.78 <sup>abc</sup>	0.84 <sup>b</sup>	1.26 <sup>b</sup>	2.33 <sup>b</sup>	2.46 <sup>c</sup>	2.90 <sup>c</sup>
$A_5$	0.72 <sup>c</sup>	0.88 <sup>ab</sup>	1.26 <sup>b</sup>	2.39 <sup>b</sup>	2.69 <sup>ab</sup>	3.13 <sup>b</sup>
$A_{10}$	0.82 <sup>ab</sup>	0.95 <sup>a</sup>	1.28 <sup>ab</sup>	2.38 <sup>b</sup>	2.54 <sup>bc</sup>	3.03 <sup>bc</sup>
C	0.78 <sup>bc</sup>	0.89 <sup>ab</sup>	1.25 <sup>b</sup>	2.30 <sup>b</sup>	2.55 <sup>bc</sup>	3.08 <sup>bc</sup>
SE±	0.059	0.064	0.067	0.12	0.12	0.066

Means followed by the same letters within the same column and treatment are not significantly different at 5% level of probability using Least Significant Difference (LSD).  $S_1$ =Top soil;  $S_2$ =River sand;  $S_3$ =Top soil + River sand + Manure; MS: Mechanical scarification,  $S_{24h}$ : Seeds soaked in water for 24 hours,  $A_5$ : Seeds soaked in Tetraoxosulphate (VI) acid for 5 minutes,  $A_{10}$ : Seeds soaked in Tetraoxosulphate (VI) acid for 10 minutes, C: Seeds not pre-treated; SE±: Standard Error.

Seed sowed in soil media had no significant effect on wet weight of shoot across all the period of the experiment. But seeds mechanically scarified (MS) had significantly higher values (0.88, 0.98, 1.40, 2.56, 2.83, 3.25) on wet weight of shoot across 2-12 WAS, while Seeds soaked in cold water for 24 hours ( $S_{24h}$ ) at 4 WAS, seeds not treated (control), at 6 and 8 WAS, seeds soaked in tetraoxosulphate (VI) acid for 5 minutes ( $A_5$ ), at 12 WAS with significantly lower values (0.84, 1.25, 2.30, and 3.13) (Table 4).

### Dry weight of shoot (g)

There was no effect on dry weight of shoot by different soil media across all the period of the experiment. However, seeds mechanically scarified (MS) had significantly higher values (0.39, 0.43, 0.58, 0.97, 1.14, and 1.32) respectively on dry weight of shoot at 2-12 WAS respectively, while seeds soaked in tetraoxosulphate (VI) acid for 5 minutes ( $A_5$ ) at (2 and 12) WAS,

seeds soaked in water for 24 hours ( $S_{24h}$ ) at 4 WAS, seeds not treated (C) at 6-8 WAS had significantly lower values (0.30, 0.37, 0.52, 0.88 and 1.24) respectively on dry weight of shoot among others (Table 5).

**Table 5:** Dry weight of shoot of tamarind as affected by different soil media and pre-germination treatments at interval of 2 WAS.

Dry weight of shoot						
Treatment	2 WAS	4 WAS	6 WAS	8 WAS	10 WAS	12 WAS
Soil media						
$S_1$	0.4	0.4	0.6	0.9	1.1	1.22
$S_2$	0.34	0.4	0.53	0.92	1.1	1.23
$S_3$	0.4	0.4	0.53	0.92	1.1	1.3
SE±	0.022	0.02	0.021	0.036	0.036	0.041
Pre-germination treatments						
MS	0.39 <sup>a</sup>	0.43 <sup>a</sup>	0.58 <sup>a</sup>	0.97 <sup>a</sup>	1.14 <sup>a</sup>	1.32 <sup>a</sup>
$S_{24h}$	0.35 <sup>ab</sup>	0.37 <sup>b</sup>	0.54 <sup>ab</sup>	0.89 <sup>b</sup>	1.00 <sup>c</sup>	1.20 <sup>c</sup>
$A_5$	0.30 <sup>b</sup>	0.38 <sup>b</sup>	0.52 <sup>b</sup>	0.92 <sup>b</sup>	1.10 <sup>ab</sup>	1.24 <sup>b</sup>
$A_{10}$	0.36 <sup>a</sup>	0.42 <sup>ab</sup>	0.53 <sup>b</sup>	0.90 <sup>b</sup>	1.00 <sup>bc</sup>	1.20 <sup>bc</sup>
C	0.34 <sup>ab</sup>	0.38 <sup>b</sup>	0.52 <sup>b</sup>	0.88 <sup>b</sup>	1.10 <sup>abc</sup>	1.22 <sup>bc</sup>
SE±	0.028	0.025	0.026	0.043	0.044	0.049

Means followed by the same letters within the same column and treatment are not significantly different at 5% level of probability using Least Significant Difference (LSD).  $S_1$ =Top soil;  $S_2$ =River sand;  $S_3$ =Top soil + River sand + Manure; MS: Mechanical scarification,  $S_{24h}$ : Seeds soaked in water for 24 hours,  $A_5$ : Seeds soaked in Tetraoxosulphate (VI) acid for 5 minutes,  $A_{10}$ : Seeds soaked in Tetraoxosulphate (VI) acid for 10 minutes, C: Seeds not pre-treated; SE±: Standard Error.

## Discussion

The result of the study showed that there was no significant difference ( $P \leq 0.05$ ) among the soil media on number of leaves, wet and dry matter weight except on leaf area with soil medium (top soil plus river sand plus manure in 1: 1: 1) ( $S_3$ ). This shows that soil media employed had no significant effect on germination of Tamarind seeds as long as adequate pre-germination treatments were carried out on them. Seeds mechanically scarified was significant on number of leaves at 2, 6, 10 and 12 WAP, leaf area at 12 WAP, wet weight of shoot at 2-12 WAP and dry weight of shoot also at 2-12 WAP respectively. Germination of *Tamarindus indica* seeds started 5 days after sowing (DAS). The seeds treated with 60%  $H_2SO_4$  for 10 minutes ( $A_{10}$ ) and the seeds mechanically scarified (MS) emerged 5 DAS. Seeds mechanically scarified and sowed in top soil ( $S_1MS$ ), seeds treated with 60% concentrated tetraoxosulphate (VI) acid ( $H_2SO_4$ ) for 10 minutes and sowed in top soil ( $S_1A_{10}$ ), seeds mechanically scarified and sowed in river sand ( $S_2MS$ ), seeds treated with 60% concentrated  $H_2SO_4$  for 10 minutes and sowed in river sand ( $S_2A_{10}$ ), seeds mechanically scarified and sowed in top soil plus river sand plus manure ( $S_3MS$ ) and seeds treated with 60% concentrated  $H_2SO_4$  for 10 minutes and sowed in top soil plus river sand plus manure ( $S_3A_{10}$ ) germinated first, 5 DAS, while the seeds that were not treated at all (control) (C) showed the longest days of germination, 9 DAS. These findings agree with Olatunji [13] who reported that seeds soaked in acid for a short time enhances seed germination and its germination percentage. However, seeds that stayed longer period in acid may likely have its embryo destroyed and thereby be prevented from germination as confirmed by Ariana [14]. Meanwhile, the best pre-sowing treatment observed to produce the highest germination percentage were with the seeds treated

with 60% concentrated  $H_2SO_4$  for 10 minutes ( $A_{10}$ ) and seeds mechanically scarified (MS) which gave the highest germination percentages of 100% and 97.5% respectively. This agrees with Adelani & Oyebamiji [15,16] who reported that seeds used to have high germination percentage when pre-treated with acid at 60% concentrated  $H_2SO_4$  for short time duration. Seeds of *T. indica* treated with 60% tetraoxosulphate (VI) acid ( $H_2SO_4$ ) for 10 minutes ( $A_{10}$ ) in soil media of top soil plus river sand plus manure ( $S_3$ ) had the highest germination percentage ( $S_3A_{10}$ ) (100%) in all treatments and soil media, follow by the seeds mechanically scarified (MS) in soil media of top soil plus river sand plus manure ( $S_3$ ) (97.5%) and seeds not treated at all (control) (C) gave the least percentage in top soil ( $S_1$ ) (65%) of germination respectively.

## Conclusion and Recommendation

This study conclude that seeds emerged 5 DAS, and maximum germination percentage was recorded for seeds treated with  $A_{10}$  (100%) and MS (97.5%). There was no significant effect virtually observed on growing soil media, except in top soil plus river sand plus manure ( $S_3$ ) which is a better germination growing soil media. Seeds mechanically scarified and seeds soaked in concentrated 60%  $H_2SO_4$  for 10 minutes were the best pre-germination treatments for breaking Tamarind seeds, while mechanical scarification method also improved the seedling growth in terms of number of leaves, leaf area, wet and dry matter weight of shoot and they are recommended as good approach for breaking dormancy of tropical seeds.

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