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# Effect of nursery media on emergence and growth of tamarind (*Tamarindus indica* L.) seedlings

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**Key words**
Emergence, dry matter, growth media; seedling growth, tamarind seedlings.

## 1 SUMMARY

**Four growth media were evaluated for their effect on emergence and growth of tamarind seedlings in the nursery. The nursery media comprised of two rice hull based media (RHB) and two saw dust based media (SDB) formulated on volume basis in the following ratios: 1:2:3 (rice hull: poultry manure: river sand), 2:3:1 (rice hull: poultry manure: river sand), 1:4:3 (Saw dust: poultry manure: river sand) and 1:2:3 (Saw dust: poultry manure: river sand). The soilless nursery media were laid out in completely randomized design (CRD), replicated five times. Analysis of variance revealed significant effect of growth media on emergence and seedling growth of tamarind. The saw dust based media exhibited superior performance in most seedling growth characters evaluated, including dry matter attributes. This has been ascribed to the use of well weathered saw dust and inclusion of higher proportions of poultry manure in the saw dust based media which may have supplied more nitrogen to compensate for N depletion by microbial decomposition activities characteristic of saw dust.**

## 2 INTRODUCTION

The tamarind, *Tamarindus indica*, belongs to the family Leguminosae and is native to tropical Africa (Morton, 1987). Tamarind pulp, made up of sugars, organic acids and vitamins, is the most important tamarind product (NAS, 1979). The fruit tree is highly valued as an ornamental plant (Morton, 1987). In addition, young leaves, flowers and immature pods are edible (NAS, 1979).

In Nigeria, drink made from tamarind is particularly popular among Muslims during the period of fasting (Onuora and Usman, 2004), probably due to its laxative properties. Local inhabitants in the savanna regions of the country where the species occurs normally use it to improve the taste of liquid food preparations such as pap. In this way it acts to supplement or substitute for sugar. The medicinal properties of tamarind are also well appreciated. A recent study by Onuora and Usman (2004) established that wine processed from tamarind pod compares favourably to standard grape wine which is exotic and more costly.

The benefits derived from tamarind justify increased scientific attention to its selection, breeding and cultural practices (NAS, 1979). This will accelerate the process of domesticating cultivation particularly in Nigeria where the species is still considered wild.

According to Morton (1987) modern trends in tamarind plantation establishment are moving away from planting at stake to raising seedlings in the nursery which are later transplanted to the field. However, tamarind seedling emergence could be slow and erratic, spreading over a period of two months even with pretreatment. Its growth rate could equally be

slow (FAO, 2005). However, the use of a suitable nursery medium could address both problems (Baiyeri, 2003). Generally, growth medium has been adjudged to be the most critical factor determining seedling quality in the nursery (Baiyeri and Mbah, 2006).
Baiyeri and Mbah (2006) found that seedlings of *Treculia africana* do better when raised in saw dust based media than the soil based medium. Similarly, rice hull based media were found to be superior in raising *Musa* plantlets compared to those based on saw dust (Baiyeri, 2005). According to Albery (1975), saw dust is the most commonly used media substrate. It is also readily available. As such it was decided to vary the composition of the saw dust based media used by Baiyeri (2005) in the present work by adjusting the poultry manure component. Since a more standard growth media for this species has not been described, it was decided in this study to assess tamarind seedling emergence and growth response to rice hull and saw dust based media with the aim of identifying the best media for the raising of tamarind seedlings in the nursery.

## 3 MATERIALS AND METHODS

**3.1 Study site**: The experiment was conducted at the Teaching and Research Farm of the University of Agriculture, Makurdi (7.41°N, 8.37°E, 97m above sea level), Nigeria, between September, 2007 and February, 2008.

**3.2 Media preparation**: Four media were formulated on volume basis from rice hull or sawdust, poultry manure and river sand. Two of the media were rice hull based (RHB), and the other two were saw dust based (SDB). Composition of the media was formulated as follows:

1. Media 1:2:3 (RHB) – Rice hull: Poultry manure: River sand
2. Media 2:3:1 (RHB) – Rice hull: Poultry manure: River sand
3. Media 1:4:3 (SDB) – Saw dust: Poultry manure: River sand
4. Media 1:2:3 (SDB) – Saw dust: Poultry manure: River sand

The composted media were left for three weeks before seeds were planted. Physico-chemical properties of the media were also determined prior to seed sowing.

**3.3 Seed preparation and planting:** Seeds of tamarind were obtained by soaking fruits collected from Makurdi, Nigeria, in water for 2 hours after removing the outer shell. Afterwards, seeds were extracted out of the pulp by rubbing vigorously between the palms. In each of the 7-litre plastic containers filled with nursery media, five (5) of the air dried seeds were planted. The media were laid out in a completely randomized design (CRD) replicated five times with each replicate containing 2 plastic containers with a total of ten seeds. Seedlings germinating were thinned to 3 per pot at the end of the seedling emergence count, at 8 weeks after planting (WAP). The seedlings were maintained in the nursery by watering at appropriate intervals.

**3.4 Data recording and analysis:** Seedling emergence was monitored at 3-day intervals for a period of 8 weeks. Parameters estimated from the emergence counts were emergence percentage (E%), emergence index (EI) and emergence rate index (ERI). These were calculated based on formulae adopted by Fakorede and Ojo (1981) as follows:

$$E\% = \frac{No\ of\ Seedlings\ emerged}{Total\ number\ of\ seeds\ planted}\ X100$$

$$EI = \frac{\sum\ (Number\ emerged)(DAP)}{Total\ seedlings\ emerged}$$

$$ERI = \frac{EI}{E\%\,(in\ decimal)}$$

Where DAP = Days after planting.

At 20 weeks after planting, seedling growth characters were measured. Oven dry weights of the various plant parts were also taken from which dry matter content and distribution were estimated.

Data collected were subjected to analysis of variance (ANOVA). Where significant F-test was found, means were separated using F-LSD. The statistical software for the analysis was GENSTAT Discovery edition 3, Release 7.2DE (GENSTAT, 2007).

## 4 RESULTS

Results of physico- chemical analysis of the growth media is presented in Table 1. The result showed variation in both the physical and chemical properties of the media as a consequence of the different types and proportions of the constituents used.

**Table 1:** Physico-chemical properties of nursery media evaluated for tamarind seedling emergence and growth at Makurdi, Nigeria, between 2007 and 2008.

| **Properties** | **Nursery media** | | | |
|---|---|---|---|---|
| **Physical** | 1:2:3 (RHB) † | 2:3:1 (RHB) | 1:4:3( SDB) | 1:2:3 (SDB) |
| Total sand (%) | 89 | 87 | 91 | 89 |
| Silt (%) | 5 | 7 | 3 | 5 |
| Clay (%) | 6 | 6 | 6 | 6 |
| Water holding capacity(%) | 15.4 | 5.2 | 9.4 | 25.5 |
| Porosity (%) | 66 | 83 | 64 | 61 |
| Bulk density(Db) (g/cm$^3$) | 0.88 | 0.45 | 0.93 | 1.02 |
| **Chemical** | | | | |
| Organic carbon (%) | 4.87 | 6.81 | 3.99 | 3.41 |
| Organic matter (%) | 8.39 | 11.75 | 6.88 | 5.82 |
| Total nitrogen (%) | 0.27 | 0.55 | 0.27 | 0.28 |
| Phosphorus (ppm) | 67.7 | 64.7 | 75.6 | 49.8 |
| Sodium (meq/100g) | 0.29 | 0.39 | 0.29 | 0.19 |
| Potassium(meq/100g) | 0.48 | 0.81 | 0.48 | 0.38 |
| Calcium (meq/100g) | 2.8 | 3.2 | 3.2 | 3.6 |
| Magnesium (meq/100g) | 2.4 | 6.4 | 3.8 | 4.6 |
| C E C (%) | 6.8 | 17.6 | 9.2 | 7.2 |
| pH ($H_2O$) | 6.9 | 6.7 | 6.9 | 6.8 |
| pH ($CaCl_2$) | 6.4 | 6.3 | 6.4 | 6.3 |

† RHB – Rice hull based; SDB – Saw dust based

Table 2 is a summary of the response of seedling emergence and growth to nursery media. Growth media significantly influenced seedling emergence percentage and emergence rate index with media 1:2:3 (RHB) having poor values of both parameters. Emergence index however did not vary significantly across treatments. Seedling growth exhibited remarkable response to growth media in respect of height, girth, number of leaflets and length of compound leaves in favour of the saw dust based media.

**Table 2:** Media effect on emergence and growth of tamarind seedlings at Makurdi, Nigeria, between 2007 and 2008.

| Media | E%† | EI | ERI | Height (cm) | Seedling Girth(cm) | No of compound leaves | Length of compound leaves(cm) | No of leaflets | No of branches | Length of longest root(cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1:2:3(RHB) | 93.3 | 17.8 | 19.1 | 20.6 | 0.34 | 30.6 | 3.8 | 451.0 | 2.6 | 30.9 |
| 2:3:1(RHB) | 66.7 | 16.7 | 25.7 | 27.2 | 0.38 | 36,6 | 4.0 | 596.0 | 2.4 | 25.7 |
| 1:4:3(SDB) | 80.0 | 16.4 | 21.7 | 35.2 | 0.52 | 42.6 | 5.3 | 759.0 | 3.0 | 36.5 |
| 1:2:3(SDB) | 86.7 | 16.5 | 19.7 | 30.1 | 0.52 | 36.0 | 5.1 | 623.0 | 2.8 | 34.0 |
| LSD(0.05) | 16.3 | NS | 4.2 | 5.2 | 0.12 | NS | 0.8 | 146.0 | NS | NS |

† E% - Emergence percentage; EI – Emergence index; ERI – Emergence rate index

NS – No significant difference; RHB – Rice hull based; SDB – Saw dust based.

An assessment of dry matter attributes of tamarind revealed significant influence of growth media on dry weight of shoot and whole seedling (Table 3). The nursery media however did not influence the dry matter distribution significantly. It was however observed that dry matter distribution pattern was skewed in favour of the above ground portion of the plant.

Correlation analysis among all the measured characters revealed a reasonable number of significant relationships (Table 4). Thus, emergence percentage had significant negative statistical linkage with emergence index which in turn was negatively but significantly correlated with seedling height. Plant height had a positive significant relationship with total dry weight of seedling. It also correlated positively and significantly with all above ground seedling attributes except number of branches. Number of branches had positive significant statistical linkage with seedling diameter and length of compound leaves. Relationship of similar nature was observed between number of compound leaves and number of leaflets. Interestingly, length of longest root was significantly and positively correlated only with length of the compound leaves.

## 5 DISCUSSION

The values for emergence percentage obtained in this study (66.7 – 93.3%) seem impressive when compared with the range of 33.2 – 73.2% reported in a trial involving seven provenances (Ugese and Dennis, 2006). Differences in the seed sources most likely influenced the results, hence the wide disparity in values of the two trials. It was interesting however, that in the earlier study, seeds from Makurdi still recorded the highest emergence of 73.2%.

**Table 3:** Dry matter attributes of tamarind seedlings grown on four different nursery media at Makurdi, Nigeria, between 2007 and 2008.

| Media | Dry wt of root (g) | Dry wt of shoot (g) | Total dry wt (g) | Shoot/root ratio | %DMR† | %DMS |
|---|---|---|---|---|---|---|
| 1:2:3(RHB) | 3.2 | 4.0 | 7.2 | 1.2 | 45.3 | 54.7 |
| 2:3:1(RHB) | 4.3 | 5.6 | 9.9 | 1.3 | 43.6 | 56.4 |
| 1:4:3(SDB) | 3.9 | 6.1 | 10.0 | 1.6 | 38.9 | 61.0 |
| 1:2:3(SDB) | 4.4 | 5.7 | 10.1 | 1.2 | 43.6 | 56.4 |
| LSD(0.05) | NS | 1.3 | 1.9 | NS | NS | NS |

† %DMR – Percent dry matter distribution to the shoot; %DMS – Percent dry matter distribution to the shoot. RHB – Rice hull based; SDB – Saw dust based
NS – No significant difference

It is interesting that even in seedling characters that did not show significant response such as root length and number of branches, the two saw dust based media still manifested a tendency to do better. The superior performance of the saw dust based media as reported herein contrasts sharply with results obtained by Baiyeri (2005) in the weaning of banana/plantain plantlets where the rice hull based media were better than the saw dust based ones. In another study, rice hull media were also found to be superior to the soil based media (Baiyeri and Mbah, 2006). Even though saw dust is recognized as the commonest wooden material used in potting mix (Albery, 1975), it normally suffers from depletion of available nitrogen in the process of decomposition by microorganisms (Woolton *et al.*, 1981). This fate is not suffered by rice hull which decays more slowly and easily incorporates into media where it impacts positively on the physical properties of drainage and aeration (Baiyeri, 2005).

The comparatively better performance of the saw dust based media in the present study could be due to the higher proportion of poultry manure incorporated. This was a deliberate attempt to forestall or compensate for any drastic reduction in

nitrogen levels due to decomposition in the course of the experiment. Moreover, the saw dust used was highly decomposed. Expectedly, the saw dust based media had comparable levels of nitrogen with the others (Table 1). It is most likely that they did not suffer from nitrogen deficiency with time, hence the results obtained. A careful scrutiny of media composition in the case under contrast (Baiyeri, 2005) revealed that in all the media, poultry manure was less than either saw dust or rice hull.
Dry matter distribution pattern of tamarind seedlings in which 38.9 – 45.3% of photo-assimilates went to the roots seem contrary to reports by Baiyeri (2003) in cashew and African breadfruit. In both species, dry matter allocation to the root was less than 20%. In a study with shea tree (*Vitellaria paradoxa*) seedlings, Ugese *et al.* (2008) recorded dry matter allocation to the root of more than 70%. It is probable that savanna species as typified by tamarind and the shea tree in this case focus more on root development early enough as a survival strategy in the harsh savanna environment.
The negative correlation between emergence index and seedling height suggest a positive influence of earliness of seedling emergence on subsequent seedling growth. In other words, the shorter the number of days to seedling emergence, the greater the seedling growth, specified by height in this case. This result, including the significant relationship among seedling characters, conforms to that obtained with shea butter tree seedlings although the positive effect of earliness of emergence on seedling growth appeared to be more pronounced in the latter (Ugese *et. al*., 2005). The positive correlation between length of compound leaves and that of longest root could be an indication that the extensiveness of the root system of the seedlings could be assessed by how long the compound leaves are. However, further studies are needed for more authoritative deduction on the matter.
In conclusion, this study has found that saw dust based media 1:4:3 and 1:2:3 (Saw dust: Poultry manure: River sand) exhibited superior performance in terms of tamarind seedling growth and should be used especially in environments with an abundance of saw dust and poultry manure.

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**Table 4:** Linear correlation coefficients among seedling emergence and growth characters of tamarind seedlings grown on four different nursery media at Makurdi, Nigeria, between 2007 and 2008.

| | E%† | EI | ERI | HT | NCL | LCL | NLF | SDIAM | NBR | LLR | DWR | DWS | TDW | S/R | %DMR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **%DMS** | -.120 | -.021 | .082 | .307 | .174 | .378 | .164 | .253 | -.103 | -.110 | -.341 | .687** | .325 | .885** | -1.00** |
| **%DMR** | .120 | .020 | -.085 | -.309 | -.178 | -.378 | -.167 | -.252 | .099 | .110 | .344 | -.684** | -.321 | -.885** | - |
| **S/R** | -.052 | -.045 | .091 | .428 | .152 | .305 | .187 | .272 | .005 | -.030 | -.193 | .657** | .374 | - | |
| **TDW** | -.326 | -.234 | .141 | .634** | .329 | .403 | .339 | .714** | .431 | -.014 | .770** | .906** | - | | |
| **DWS** | -.311 | -.191 | .141 | .612* | .327 | .491* | .348 | .651** | .255 | -.061 | .427 | - | | | |
| **DWR** | -.222 | -.211 | .089 | .432 | .210 | .121 | .199 | .543* | .534* | .063 | - | | | | |
| **LLR** | .372 | -.187 | -.496 | .333 | .329 | .554* | .330 | .320 | .180 | - | | | | | |
| **NBR** | .111 | -.092 | -.102 | .328 | .395 | .075 | .133 | .508* | - | | | | | | |
| **SDIAM** | -.029 | -.297 | -.300 | .646** | .295 | .517* | .402 | - | | | | | | | |
| **NLF** | -.094 | -.387 | .121 | .577** | .677** | .616** | - | | | | | | | | |
| **LCL** | .147 | -.251 | -.273 | .687** | .383 | - | | | | | | | | | |
| **NCL** | -.044 | -.184 | .260 | .525* | - | | | | | | | | | | |
| **HT** | -.172 | -.452* | -.046 | - | | | | | | | | | | | |
| **ERI** | -.631** | .236 | - | | | | | | | | | | | | |
| **EI** | 0.293 | - | | | | | | | | | | | | | |

† E% - Emergence percentage; EI – Emergence index; ERI – Emergence rate index,; Ht – Height; NCL – Number of compound leaves; LCL – Length of compound leaves; NLF – Number of leaflets; SDIAM – Seedling diameter; NBR – Number of branches; LLR – Length of longest root; DWR – Dry wt of root; DWS – Dry wt of shoot; TDW – Total dry wt; S/R – Shoot/Root ratio; %DMR – Percent dry matter distribution to the root; %DMS – Percent dry matter distribution to the shoot; *, ** - Correlation is significant at the 0.5 and 1% levels of probability respectively