EVALUATION OF THE GERMINATION OF *Pterocarpus santalinoides* L'Hérit. ex DC IN DIFFERENT SOWING MEDIA.

***Fredrick C[1, 2]., Ekeke, B.A[2]., Chukunda, F.A[2]. and Abere, S.A[2].**
Department of Forestry and Wildlife Management, Faculty of Agriculture, University of Port Harcourt, Nigeria
Department of Forestry and Environment, Faculty of Agriculture, Rivers State University, Nigeria
*****Corresponding author Email: *charity.fredrick@uniport.edu.ng,*

ABSTRACT
This study investigated the impact of five sowing media including sharpsand, topsoil, mixture of topsoil and sharpsand, topsoil and sawdust and topsoil and poultry dung on germination of *Pterocarpus santalinoides*. The experiment was set up in a completely randomized design involving three replicates. A total number of 450 seeds were used and germination was recorded for thirty days. Data collected on germination were subjected to analysis of variance. There were significant differences ($p \leq 0.05$) among sowing media with regards to mean germination percentage, mean germination time and germination index, but non-significant difference ($p > 0.05$) in germination emergence, germination duration, peak value, mean daily germination and germination value. Seeds sown in sharpsand had highest germination percentage (63.33%), germination index (2.15), peak value (0.78), mean daily germination (3.38), germination value (3.24), earliest emergence (7.33 days) and lowest duration (6 days) and mean germination time (9.11 days), while lowest germination percentage (40%) was observed in mixture of topsoil and sharpsand and topsoil and poultry dung; germination index (0.91), mean germination time (15.12 days), mean daily germination (1.10 days), germination value (0.41)and latest emergence (12 days) were observed in mixture of topsoil and poultry dung; while highest duration (11.33days) and lowest peak value (0.41), were observed in mixture of topsoil and sharp sand. Seeds sown in sharpsand displayed better germination parameters when compared to other treatments used and is therefore recommended for use when raising seedlings of *P. santalinoides*.
Keywords: *Pterocarpus santalinoides*, sowing media, seed germination, germination duration, peak value

INTRODUCTION

Pterocarpus santalinoides is a tree growing upto 9-12 m tall, having a diameter at breast height (DBH) of 1m, with low straggling branches (Orwa *et al.*, 2009). The species occur throughout the tropics (Ogan, 2004; Keay *et al.*, 2011) and prefers well drained soils *(*Orwa *et al.*, 2009). *Pterocarpus santalinoides* can be propagated by seeds, stem cuttings and root cuttings (Anowi *et al.*, 2012). Different parts of the plants are used in treating various ailments including diarrhea dysentery, asthma, rheumatism, elephantiasis, cough, diabetes, cold, and malaria (Okwu, and Ekeke, 2003; Nwokorie *et al.*, 2015). The leaves can be used as folder, the wood, white or yellow, not hard but termite-resistant is a good timber, cuttings on the stem exudes a red gum or resin while the bark contains tannins and dyes used for dyeing (Orwa *et al.*, 2009).

Reduced propagation rates in seedlings can be due to insufficient awareness of what they require including suitable sowing medium that can be introduced at the nursery stage to boost their development (Keyagha, *et al.*, 2016). Growth medium is an important production system of most plant (Okunlola, 2016). It is an extremely important factor that determines seedling quality in the nursery (Keyagha, *et al.*, 2016) and acts as a reservoir for nutrient, oxygen and moisture (Baiyeri and Mbah, 2006; Dolor, 2011; Dawid*et al.*, 2014). Soil provides anchorage for the plant's roots; hold enough water to enhance growth of plant and air spaces for respiration (Ayoola and Adeyeye, 2010). It is a relevant input for a better production of seedling and is also responsible for uniform and healthy growth of seedling (Parasana *et al.*, 2012), and proper development of the rooting system (Bhardwaj, 2014) since rapid growth is necessary to address the seasonal risks faced in the field (Osaigbovo *et al.*, 2010). Dolor (2013) also noted that the attribute of seedling gotten from the nursery influences field establishment. Suitable growth media is made up of organic materials to achieve physical and chemical needs which are needed by plants for maximum growth and development (Osaigbovo *et al.*, 2010). Its physical properties are considered to have a powerful impact on water and air supply to young seedlings (Dolor, 2011). Germination and growth of seedlings of different species respond differently to different growth media (Dolor, 2011; Dolor, 2013). Different growth media of different origins have been used for plant propagation (Kontoh, 2016; Sa'id *et al.*, 2015; Parasana *et al.*, 2012; Okunomo *et al.*,2009; Agbogidi *et al.*, 2007; Okunomo *et al.*, 2006). Knowing the most suitable media for a species is important in producing quality seedlings.

In order to mitigate the human influence on the biological structure of the forest, there is therefore need for regeneration of the plant species. Although *P. santalinoides* appears to be an important species, it has received limited research attention in Nigeria. There is inadequate knowledge about the silviculture of the species which creates the need for germination and seedling growth studies on the species to provide essential information on the silviculture of the

species. If establishment of the species in pure/mixed plantation is not encouraged, the probability of obtaining the species for use on a sustained basis will be very low which will subsequently endanger the species continuity.

Seed germination is one of the most important processes in the natural life cycle of plants (Al-Ansari and Ksiksi, 2016). Studies on the factors that affect germination of *P. santalinoides* species are therefore required. A study involving germination of the species will help to encourage increased cultivation of the species. Nursery media have been found to influence the emergence of seedling and it is therefore necessary to find a suitable medium that will enhance germination of *P. santalinoides* in the nursery to ensure good seedlings for plantation establishment. The objective of this study was to evaluate the effect of sowing media on the germination of *P. santalinoides.*

MATERIALS AND METHODS

Study location

The study was carried out at the Department of Forestry and Wildlife Management Nursery, University of Port Harcourt, Rivers State, Nigeria. The University of Port Harcourt is located at Latitude 4.90794 and 4.90809 N and Longitude 6.92413 and 6.92432 E on a land area of about 400 hectares in Obio/Akpor Local Government Area of Rivers State (Chima *et al.*, 2017).

Seed collection

Mature fruits of *P. santalinoides* for this study were collected from healthy mother trees in Eziama Ntigha Autonomous Community in Isi-alangwa North Local Government Area, Abia State. Viability test was carried out to know the seeds that are viable before sowing; this was carried out by using floatation method where seeds were soaked for three hours. The seeds that sank were regarded as viable and used for the study, while the seeds that floated were discarded.

Experimental design

The experiment was laid out in a completely randomized design consisting of 450 randomly selected seeds for the five (5) different sowing media (topsoil, sharpsand, topsoil and sharpsand, topsoil and sawdust, and topsoil and poultry droppings) i.e. 30 seeds *3 replicates * 5 sowing media = 450 experimental units. Seeds were sown in germination trays measuring 17cm x 13cm x 35cm. No fertilizers or bacterial and/or mycorrhizal inoculation were applied. Germination was said to have occurred when the plumule emerged from the soil surface. Watering and weeding was carried out regularly and when required throughout the period of the experiment. Germination process was monitored every day from the date of sowing for 30 days

Data collection

Germination parameters

Observation on germination was made and recorded daily; this was terminated after thirty days. A seed was considered to have germinated when the cotyledons is evident above the soil surface (*Fandohan et. al.,* 2010). Data collected on germination was used to calculate germination percentage (GP), germination emergence (GE) germination duration (GD), mean germination time (MGT), germination index (GI), peak value (PV), mean daily germination (MDG) and germination value (GV) for each treatment using the equation below

$$\text{Germination percentage (GP)} = \frac{Total\ germinated\ seeds}{Total\ seeds\ sown} * \frac{100}{1} \quad (1)$$

Germination emergence (GE) =Time to germinate after sowing (2)

Germination duration (GD) = Day to germinate after sowing to end of germination (3)

$$\text{Mean Germination Time (MGT)} = \frac{\sum(t_i\ X\ n_i)}{\sum n_i} \quad (4)$$

Where t_i is the number of days starting from the date of sowing and n_i is the number of seeds germinated at each day (Bewley and Black 1994).

$$\text{Germination Index (GI)} = \left(\frac{G1}{1}\right) + \left(\frac{G2}{2}\right) + \ldots\ldots + \left(\frac{Gx}{x}\right) \quad (5)$$

Where G is the number of seeds germinated in day 1, 2…, and x represents the corresponding day of germination (Botsheleng *et al.*, 2014).

$$\text{Peak Value (PV)} = \frac{Highest\ germinated\ seeds}{number\ of\ days}$$ (Czabator, 1962) (6)

$$\text{Mean Germination Time (MDG)} = \frac{Total\ number\ of\ germinated\ seeds}{Total\ number\ of\ days}$$ (Czabator, 1962) (7)

Germination Value (GV) = PV * MDG (Czabator, 1962) (8)

Data analysis

Data collected on germination were analysed using SPSS statistical software (SPSS version 18, SPSS Inc.). One-way analysis of variance was used to determine variation and F value was significant at $p \leq 0.05$. Duncan Multiple Range Test was used to indicate compare means and indicate levels of difference.

RESULT

Germination commenced on day 7 in sharpsand and topsoil and sawdust mixture with sharpsand maintaining highest germination throughout the

germination period. Higher germination varied between mixture of topsoil and sawdust; and topsoil only from day 8 to 10 with topsoil and sawdust mixture maintaining a higher germination from day 11 to 30. Although a higher germination was observed in topsoil and poultry dung mixture at day 8 and 9, sharpsand had higher germination from day 10 to 26 with both treatments indicating equal germination from day 27 to 30 (Figure 1).

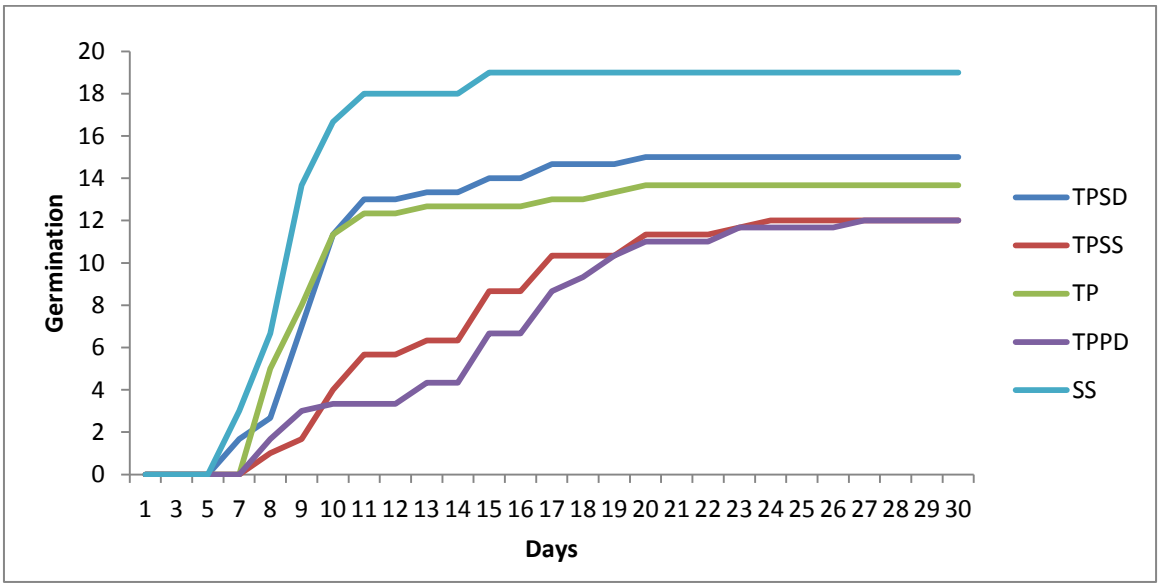

Figure 1. A times series plot showing germination trend of *P. santalinoides* from 1 to 30 days after sowing in different sowing media.Where TP/SD = topsoil and sawdust, TP/SS = topsoil and sharpsand, TP = topsoil, TP/PD = topsoil and poultry droppings and SS = sharpsand.

There were significant differences ($p \leq 0.05$) among sowing media with regards to mean germination percentage, mean germination time and germination index, but non-significant difference ($p > 0.05$) in germination emergence, germination duration, peak value, mean daily germination and germination value.

Mean germination percentage varied from 40 to 63.33%. Seeds sown in sharpsand exhibited highest germination percentage (63.33%), followed by seeds sown in a mixture of topsoil and sawdust (50%) while seeds sown in a mixture of topsoil and sharpsand and topsoil and poultry dung had lowest germination percentage (40%) (Figure 2).

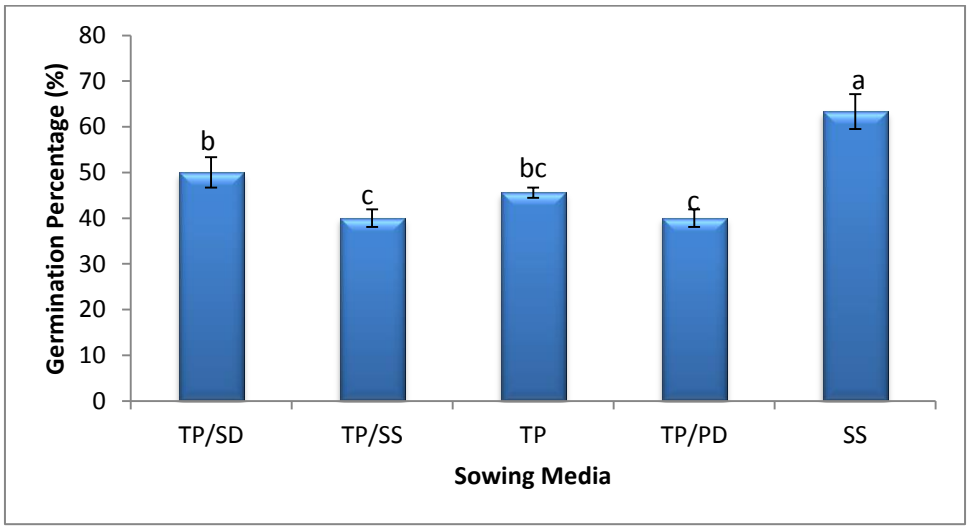

Figure 2. Effect of sowing media on germination percentage (GP) of *P. santalinoides* seeds. Means with the same alphabet on the same column are not significantly different ($p > 0.05$). Where TP/SD = topsoil and sawdust, TP/SS = topsoil and sharpsand, TP = topsoil, TP/PD = topsoil and poultry droppings and SS = sharpsand.

The number of days which seeds of *P. santalinoides* took to emerge after sowing varied from 7.33 to 12 days. Emergence was earliest in seeds sown in sharpsand (7.33 days) when compared to seeds sown in topsoil (8.33 days), mixture of topsoil and sawdust (8.67 days), mixture of topsoil and sharpsand (11 days) and topsoil and poultry dung (12 days). Mean germination duration ranged from 6 to 11.33 days. Seeds sown in sharpsand exhibited lowest germination duration (6 days) followed by seeds sown in a mixture of topsoil and sawdust (7.33 days) while seeds sown in a mixture of topsoil and poultry dung and topsoil and sharpsand had highest germination duration (11.33 days) (Figure 3).

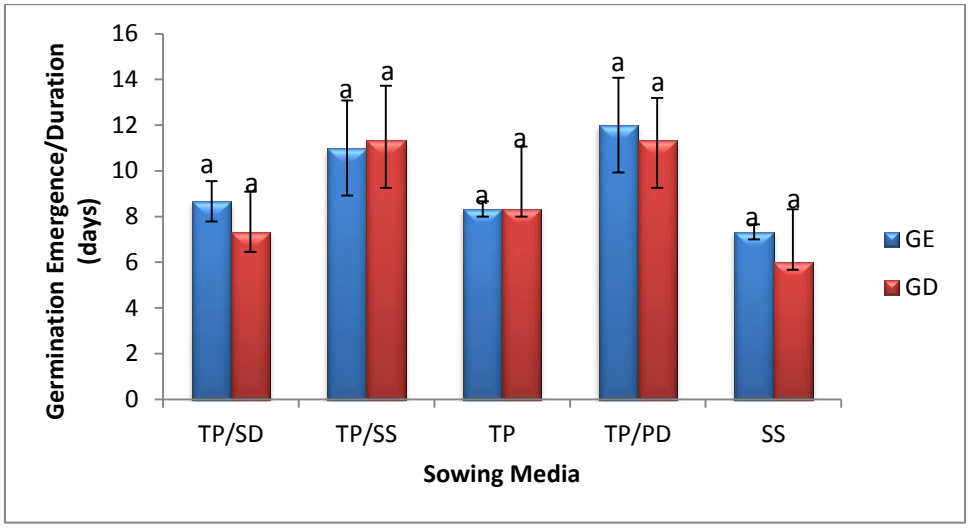

Figure 3. Effect of sowing media on germination emergence (GP) and duration (GD) of *P. santalinoides* seeds.Means with the same alphabet on the same column are not significantly different ($p > 0.05$). Where TP/SD = topsoil and sawdust, TP/SS = topsoil and sharpsand, TP = topsoil, TP/PD = topsoil and poultry droppings and SS = sharpsand.

Mean germination time ranged from 9.11 to 15.12 days. Highest mean germination time was observed in a mixture of topsoil and poultry dung (15.12 days) while seeds sown in sharpsand exhibited lowest mean germination time (9.11 days). Mean germination index ranged from 0.91 to 2.15. Highest germination index was observed in seeds sown in sharpsand (2.15 days), followed by mixture of topsoil and sawdust (1.55) and lowest in mixture of topsoil and poultry dung (0.91). Mean peak value varied between 0.38 and 0.78 with seeds sown in sharpsand exhibiting highest peak value (0.78), followed by seeds sown in topsoil (0.77), seeds sown in a mixture of topsoil and poultry dung (0.74), mixture of topsoil and poultry dung (0.40) and mixture of topsoil and sharpsand (0.38) (Table 1).

Mean daily germination ranged from 1.10 to 3.83 days. Highest mean daily germination was observed in seeds sown in sharpsand (3.83 days), followed by seeds sown in a mixture of topsoil and sawdust (2.43), while seeds sown in a mixture of topsoil and poultry dung exhibited lowest mean germination time (1.10 days). Mean germination value varied from 0.41 to 3.24. Seeds sown in sharpsand exhibited highest germination value (3.24), followed by seeds sown in topsoil (1.94) and lowest in mixture of topsoil and poultry dung (0.41). Summary of this result is presented in Table 1.

Table 1. Effects of sowing media on mean germination parameters of *P. santalinoides* (μ±SE).

Pretreatment	Mean germination Time	Germination Index	Peak Value	Mean Daily Germination	Germination Value
TP/SD	10.071±0.96ab	1.55±0.23b	0.74±0.08ab	2.43±0.81a	1.73±0.46a
TP/SS	13.73±1.52bc	0.97±0.15c	0.38±0.02b	1.14±0.20a	0.44±0.10a
TP	9.87±0.74ab	1.46±0.12bc	0.77±0.17a	2.38±1.15a	1.94±1.08a
TP/PD	15.12±2.06c	0.91±0.21c	0.40±0.12ab	1.10±0.12a	0.41±0.08a
SS	9.11±0.11a	2.15±0.14a	0.78±0.13a	3.83±1.26a	3.24±1.55a
Mean	11.57±0.80	1.41±0.14	0.61±0.07	2.18±0.42	1.55±0.43
P value	0.026	0.003	0.059	0.212	0.199

Means with the same alphabet on the same column are not significantly different ($p > 0.05$). Where TP/SD = topsoil and sawdust, TP/SS = topsoil and sharpsand, TP = topsoil, TP/PD = topsoil and poultry droppings and SS = sharpsand.

DISCUSSION

The outcome of this study revealed that a better germination trend was observed in sharp sand throughout the period of germination making it the most suitable media for the germination of *Pterocarpus santalinoides*. Significant difference observed in germination percentage of *P. santhalinoides* seeds among sowing media agrees with the findings of Ikyaagba *et al.* 2018 and Fredrick *et al.* (2018) who noted that sowing media significantly affected germination percentage in seeds of *Afzelia africana* and *Annona muricata* respectively. The lack of significant effect of growth media on some germination parameters observed in this study concurs with that of Medagoda and Weerawardana (2007); Dolor (2011) and Alabi *et al.* (2019) who observed that media had no significant effect on the germination of *Macadamia*, *Irvingia wombulu*, and Tamarind seeds respectively. "According to Diaz-Zorita *et al*. (2005) and Cernac *et al*. (2006), germination is independent of soil nutrient status, but depends on the cotyledons still attached to the seedling which are rich in stored food reserves until the seedling becomes autotrophic". Isirimah *et al*. 2003 also reported that embryos depend on stored nutrient in the seeds for germination and metabolic activities.

Highest mean germination parameters (germination percentage, emergence, duration, mean germination time, germination index, peak value, mean daily germination and germination value) were observed in seeds sown in sharpsand. According to Dawid *et al.* (2014), highest germination observed in sharpsand may be due to the porosity of the soil which allowed for good medium aeration. Jawayria *et al.* (2018) noted that earliest seeds emergence observed on river sand in their work might be attributed to the fact that river sand are porous in nature which permits easy penetration of water leading to early emergence of plumule. This result concurs with that of Fredrick *et al.* (2017) who observed highest germination percentage in seeds of *Chrysophyllum albidum* sown in sharpsand. Similarly, Agbogidi *et al.* (2007) observed highest germination percentage in seeds of *Dacryodes edulis* sown in sharpsand and also attributed it to a greater porosity in sharpsand when compared to other media leading to much spaces for water and air which are the basic requirement for germination of seeds. On the contrary, Okunomo *et al.* (2009) reported highest mean germination percentage and rapid emergence observed in seeds of *Persea americana* in topsoil and attributed it to increased water retention ability of the soil.

CONCLUSION

Results of this study have established that while some germination parameters were significantly influenced by different sowing media, others were not affected. Seeds sown in sharpsand showed better germination parameters (germination percentage, emergence, duration, mean germination time, germination index, peak value, mean daily germination and germination value) when compared to other treatments used and is therefore recommended for use when raising seedlings of *P. santalinoides*.

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