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# EARLY GROWTH OF *Pterocarpus Santalinoides* L'Hérit. Ex DC SEEDLINGS AS INFLUENCED BY DIFFERENT GROWTH MEDIA

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**Abstract:** This study investigated the impact of growth media on the early growth of *Pterocarpus santalinoides*. The experiment was set up in a completely randomized design involving three replicates. Ten (10) seedlings per sowing media including topsoil, sharp sand, topsoil and sharp sand, topsoil and sawdust, and topsoil and poultry droppings were selected and transplanted into a polybag. Growth parameters (seedling height, collar diameter and leaf number) were determined and subjected to analysis of variance. Seedlings of *P. santalinoides* displayed significant differences ($p \leq 0.05$) in height at month 1, in collar diameter at month 2 to 4 and 6 and in leaf number at month 3 and non-significant differences ($p > 0.05$) in height at month 2 to 12. In collar diameter at months 1, 5 and 7 to 12 and in leaf number at months 1and 2 and 4 to 12.Average seedling height from month 1 to 12 was highest in topsoil and lowest in mixture of topsoil and sharp-sand. Average collar diameter from month 1 to 12 was highest in topsoil and lowest in mixture of topsoil and poultry dung. Average leaf production from month 1 to 12 was highest in topsoil and lowest in mixture of topsoil and sawdust and mixture of topsoil and poultry dung. Survival rate was 90% in seedlings grown in topsoil and sharp-sand mixture and 100% in topsoil, topsoil and sawdust mixture, and topsoil and poultry dung mixture. Topsoil was observed to be the most suitable growth media for raising seedlings of *P. santalinoides* and is therefore recommended for growth of the species.

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**Keywords:** *Pterocarpus santalinoides*, sowing media, early growth, seedling height, survival rate

## Introduction

*Pterocarpus santalinoides* is a shade-loving tree species usually found in forests in the riverine areas in tropical South America and Africa. It grows at altitudes 200-500m with a yearly mean temperature of 26°C and rainfall of 1600mm and prefers well drained soils (Orwa et al., 2009). It occurs throughout the tropics (Ogan, 2004; Keay et al., 2011). The species can overcome dryness for over 5 months as long as the roots can get to the water in the ground and can also tolerate waterlogging that occurs seasonally (PROTA, 2016).

The leaves are also used to treat skin diseases such as candidiasis, eczema and acne (Adesina, 1982; Adetunji, 2007). Similarly, Okwu and Ekeke (2003), noted that the plants are used in treating different illnesses including; diarrhoea, asthma, cough, malaria, diabetes, elephantiasis, rheumatism, dysentery, and cold. Adesina (1982) and Igoli (2005), also noted that the root concoction is used in treating patients' suffering from asthma. In Nigeria, this species is used as food or medicine (Nwokorie et al., 2015).The fresh leaves act as soup-making vegetables, while the bark of the stem is used to make pepper soup (Eze et al., 2012).

Dolor (2011) stated that "seed germination is influenced by many factors such as the type of substrate used, environmental factors such as oxygen, water, temperature and for some plant species, light". Also, Sa'id et al. (2015) noted that "the quality of seedlings raised is significantly influenced by growth medium because, plant roots are limited by the size and content (moisture, nutrient and air) of the nursery container". Growth medium has been documented to be a vital agent in the nursery that determines growth of seedlings (Baiyeri and Mbah, 2006) and plays the role of a reservoir for moisture and nutrients (Dolor, 2011). It has been found to affect seedling emergence, growth and quality (Okunlola, 2016).

According to Osaigbovo et al. (2010), "good potting media management is essential to the production of quality fruit tree seedlings, since vigorous growth is needed to face the seasonal hazards encountered in the field". The physical and chemical properties of growth medium can also affect air and water supply required by the growing plant (Baiyeri,

2005; Dolor, 2011). "Nursery media mixtures play a key role in improving soil properties which increase the rate of seedling growth by creating suitable environment with proper aeration, sufficient water and nutrient supply and excellent root system which, in turn results in luxurious growth of plants" (Dawid et al., 2014). A suitable sowing medium will help to reserve water and nutrients, provide support or anchorage and allow oxygen to diffuse to the roots of the plants (Abad et al., 2002).

Seedling growth stages are considered very important for raising a successful plantation because they are influenced by factors which are species specific (Missanjo et al., 2014). Studies on the factors that affect seedling growth of *P. santalinoides* are therefore required. A study involving early seedling growth of the species will help to encourage increased cultivation and domestication of the species and its integration into agroforestry system. Nursery media have been found to influence the performance of seedling produced in the nursery. It is therefore, necessary to find a suitable medium that will enhance growth of *P. santalinoides* in the nursery before they are transplanted out in the field to ensure good seedlings for plantation establishment.

Information from this study will provide the basic knowledge about the growth of the species that can be used for reforestation projects. Knowing the nursery requirements of *P. santalinoides* is important in producing quality seedlings that are capable of surviving harsh field conditions. The objective of this study was to evaluate the effect of growth media on the seedling growth of *P. santalinoides.*

## Materials and Methods

### Study location

The research was conducted at the Forest Nursery of the Department of Forestry and Wildlife Management, Faculty of Agriculture, University of Port Harcourt Rivers State, Nigeria, located at the Choba Campus of the University The university is situated within Latitude 04°52´30´´N and 04°55´0´´N and longitude 6°54´0´´E and 6°55´30´´E (Figure 3.1) on an area land of about 400 hectares in Choba community which is found 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

One hundred (100) seeds were nicked and directly sown in a germination tray measuring 21cmx15cmx8cm and filled with sharp sand. Watering was done as necessary. After one month of establishment, ten (10) seedlings per sowing media (topsoil, sharp sand, topsoil and sharp sand, topsoil and sawdust, and topsoil and poultry droppings) were selected and organized in a completely randomized design (CRD) for seedling growth performances. Each excavated seedling was transplanted into a polybag measuring 15.5cm x 20cm when flat (Plate 8). Watering was done once daily while weeding was carried out when required. No fertilizers or bacterial and/or mycorrhizal inoculation was used.

### Data collection

Initial shoot parameter measurements were done on all seedlings immediately after transplanting and monthly thereafter for twelve months. Data were collected on seedling height, stem collar diameter, leaf number and survival rate. Seedling height was measured from the substrate level to the tip of the youngest leaf using a meter rule; stem collar diameter was measured at the root collar using a digital caliper while leaf number was determined by directly counting the number of leaves. Seedling survival rate (SR) was determined using the formula below;

$$\text{Survival Rate (SR)} = \frac{Number\ of\ \ seedlings\ that\ survived}{Number\ of\ seedlings\ transplanted}$$

### Data analysis

Data collected on seedling growth 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 compare means and indicate levels of difference.

## Results

### Effects of growth media on seedling height of *P. santalinoides*

Seedlings of *P. santalinoides* displayed significant differences ($p \leq 0.05$) in height at months 1 and non-significant differences ($p > 0.05$) at months 2 to 12. Overall mean seedling height after 1 to 12 months varied from 22.78 cm at month 1 to 47.20 cm at month 12 (Table 1). Seedlings in topsoil exhibited highest height at 1 to 12 months (24.92, 27.07, 27.64, 30.50, 31.88, 33.28, 33.95, 35.69, 37.32 42.35 44.99

and 48.37cm respectively), while lowest height was observed in seedlings in mixture of topsoil and sharpsand at months 1 to 10 (20.07, 23.21, 24.29, 28.56, 29.43, 31.64, 32.43, 34.01, 36.10 and 38.04cm respectively) and in mixture of topsoil and sawdust at 11 to 12 (42.83 and 45.34 respectively). In summary, average height from month 1 to 12 was highest in topsoil and lowest in mixture of topsoil and sharpsand as shown in Table 1

**Effects of growth media on seedling collar diameter of *P. santalinoides***

Seedlings of *P. santalinoides* displayed significant differences ($p \leq 0.05$) in collar diameter at months 2 to 4 and 6 and non-significant differences ($p > 0.05$) at months 1, 5 and 7 to 12. Overall mean seedling collar diameter after 1 to 12 months varied from 1.87 mm at month 1 to 7.46 mm at month 12. Mean seedling collar diameter was highest in seedlings grown with topsoil at months 1 to 12 (2.014, 2.464, 2.673, 3.057, 3.243, 3.555, 4.742, 5.059, 5.971, 6.296, 6.794 and 7.698 mm respectively) while lowest collar diameter was observed in seedlings grown with a mixture of topsoil and sawdust at months 1, 2, 3, 4, 11 and 12 (1.790, 2.103, 2.163, 2.539, 6.419 and 7.060 mm respectively), topsoil and sharpsand at months 5 to 7 (2.682 2.877 and 4.088mm respectively) and topsoil and poultry dung at months 8 to 10 (4.327, 5.282 and 5.541 mm respectively). In summary, average collar diameter from month 1 to 12 was highest in topsoil and lowest in mixture of topsoil and poultry dung. This is shown in Table 2

**Effects of growth media on seedling leaf number of *P. santalinoides***

Seedlings of *P. santalinoides* displayed significant differences ($p \leq 0.05$) in leaf number at months 3 and non-significant differences ($p > 0.05$) at months 1and 2 and 4 to 12. Overall mean seedling leaf number after 1 to 12 months varied from 5.5 at month 1 to 45.4 at month 12. Mean seedling leaf number was highest in seedlings grown with topsoil at month 1 to 9 (6.0, 8.9, 13.7, 18.4, 23.4, 28.7, 35.4, 38.2 and 40.0 respectively) and in mixture of topsoil and sharpsand at months 10 to 12 (45.3, 45.9 and 47.9 respectively),while lowest leaf number was observed in mixture of topsoil and poultry dung at month 1, 2, 3, 4, and 10 (4.6, 7.2, 11.3, 16.3 and 39.6 respectively), in mixture of topsoil and sawdust at months 5, 6, 11 and 12 (21.6, 27.5, 41.0 and 43.0 respectively) and in mixture of topsoil and sharpsand and topsoil and poultry dung at months 7 to 9 (34.4, 35.9 and 37.9 respectively). In summary, average leaf production from month 1 to 12 was highest in topsoil and lowest in mixture of topsoil and sawdust and mixture of topsoil and poultry dung. This information is shown in Table 3

The survival rate of *P. santalinoides* seedlings under the different sowing media revealed that survival rate varied from 90% in seedlings grown in a mixture topsoil and sharpsand to 100% in mixture of topsoil and sawdust, topsoil only and mixture of topsoil and poultry dung (Figure 1).

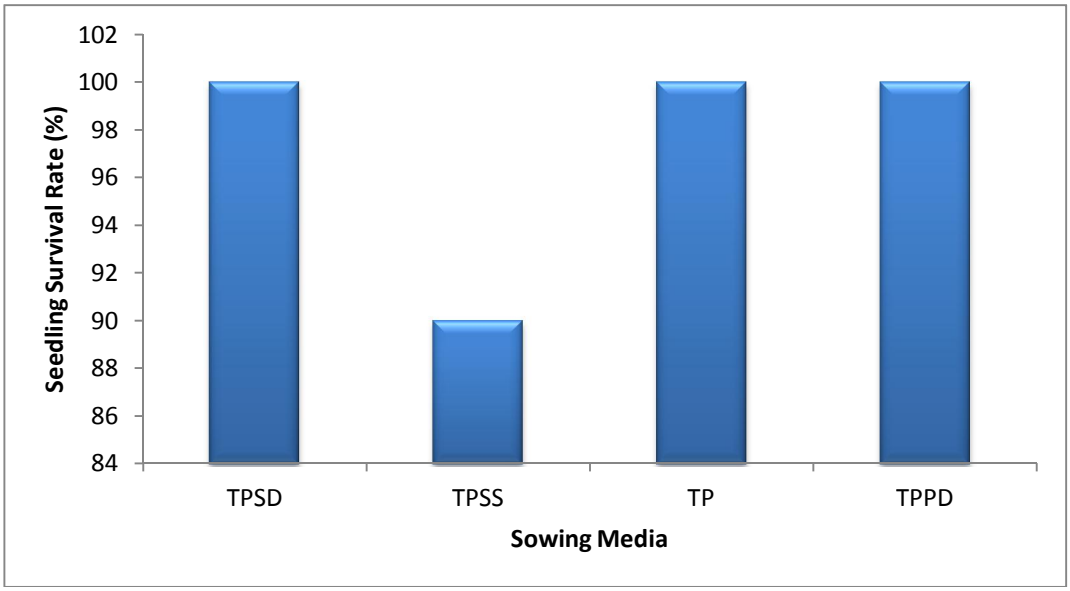


**Figure 1. Effects of growth media on seedling survival rate of *P. santalinoides*. Where TP/SD = topsoil and sawdust, TP/SS = topsoil and sharpsand, TP = topsoil, TP/PD = topsoil and poultry droppings and SS = sharp sand.**

**Table 1. Effects of growth media on seedling height of *P. santalinoides***

| Pretreatment | Seedling Height (cm) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | HT 1 | HT 2 | HT 3 | HT 4 | HT 5 | HT 6 | HT 7 | HT 8 | HT 9 | HT 10 | HT 11 | HT 12 | Mean |
| TP/SD | 23.20ab | 25.41a | 25.94a | 30.21a | 30.46a | 32.12a | 32.69a | 34.57a | 36.49a | 40.24a | 42.83a | 45.34a | 33.29a |
| TP/SS | 20.07b | 23.21a | 24.29a | 28.56a | 29.43a | 31.64a | 32.43a | 34.01a | 36.10a | 38.04a | 44.79a | 47.37a | 32.93a |
| TP | 24.92a | 27.07a | 27.64a | 30.50a | 31.88a | 33.28a | 33.95a | 35.69a | 37.32a | 42.35a | 44.99a | 48.37a | 34.65a |
| TP/PD | 22.92ab | 25.12a | 26.34a | 29.08a | 30.39a | 31.97a | 32.79a | 34.62a | 36.64a | 41.38a | 44.86a | 47.72a | 33.40a |
| Mean | 22.78 | 25.20 | 26.05 | 29.59 | 30.54 | 32.25 | 32.97 | 34.72 | 36.64 | 40.50 | 44.37 | 47.20 | 33.57 |
| *P* | 0.054 | 0.218 | 0.417 | 0.776 | 0.761 | 0.877 | 0.884 | 0.854 | 0.950 | 0.461 | 0.859 | 0.724 | 0.781 |

Values in the same column with the same subscript letter do not differ significantly ($p > 0.05$). HT1-12 = Height of seedlings at month 1 to 12. Where TP/SD = topsoil and sawdust, TP/SS = topsoil and sharpsand, TP = topsoil, TP/PD = topsoil and poultry droppings and SS = sharp sand.

**Table 2. Effects of growth media on seedling collar diameter of *P. santalinoides***

| Pretreatment | Seedling Collar Diameter (mm) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CD 1 | CD 2 | CD 3 | CD 4 | CD 5 | CD 6 | CD 7 | CD 8 | CD 9 | CD 10 | CD 11 | CD 12 | Mean |
| TP/SD | 1.79a | 2.10b | 2.16b | 2.54b | 2.78ab | 3.02ab | 4.16b | 4.53ab | 5.70a | 6.14a | 6.42a | 7.06a | 4.05a |
| TP/SS | 1.85a | 2.20ab | 2.40ab | 2.54b | 2.68b | 2.88b | 4.09b | 4.51ab | 5.69a | 6.16a | 6.74a | 7.67a | 4.10a |
| TP | 2.01a | 2.46a | 2.67a | 3.06a | 3.24a | 3.56a | 4.74a | 5.06a | 5.97a | 6.30a | 6.79a | 7.70a | 4.46a |
| TP/PD | 1.83a | 2.11b | 2.34b | 2.54b | 2.71b | 2.89b | 4.15b | 4.33b | 5.28a | 5.54a | 6.58a | 7.43a | 4.00a |
| Mean | 1.87 | 2.22 | 2.40 | 2.67 | 2.85 | 3.09 | 4.29 | 4.60 | 5.69 | 6.04 | 6.63 | 7.46 | 4.15 |
| *P* | 0.631 | 0.040 | 0.009 | 0.042 | 0.070 | 0.051 | 0.078 | 0.137 | 0.276 | 0.240 | 0.847 | 0.473 | 0.163 |

Values in the same column with the same subscript letter do not differ significantly ($p > 0.05$). CD1-12 = Collar diameter at I month to 12 months. Where TP/SD = topsoil and sawdust, TP/SS = topsoil and sharpsand, TP = topsoil, TP/PD = topsoil and poultry droppings and SS = sharp sand.

**Table 3. Effects of growth media on seedling leaf number of *P. santalinoides* (μ±SE).**

| Pretreatment | Seedling Leaf Number | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LN 1 | LN 2 | LN 3 | LN 4 | LN 5 | LN 6 | LN 7 | LN 8 | LN 9 | LN 10 | LN 11 | LN 12 | Mean |
| TP/SD | 5.8a | 7.3b | 11.8b | 17.3ab | 21.6b | 27.5a | 35.1a | 36.7a | 39.4a | 40.1a | 41.0a | 43.0a | 27.08a |
| TP/SS | 5.6a | 7.6ab | 12.4ab | 17.2ab | 22.2ab | 27.6a | 34.4a | 35.9a | 37.9a | 45.3a | 45.9a | 47.9a | 28.50a |
| TP | 6.0a | 8.9a | 13.7a | 18.4a | 23.4a | 28.7a | 35.4a | 38.2a | 40.0a | 42.3a | 44.0a | 46.0a | 28.70a |
| TP/PD | 4.6a | 7.2b | 11.3b | 16.3b | 22.4ab | 28.3a | 34.4a | 35.9a | 37.9a | 39.6a | 42.5a | 44.5a | 27.08a |
| Mean | 5.5 | 7.75 | 12.3 | 17.3 | 22.4 | 28.0 | 34.8 | 36.7 | 38.8 | 41.8 | 43.4 | 45.4 | 27.84 |
| *P* | 0.254 | 0.057 | 0.038 | 0.161 | 0.137 | 0.428 | 0.423 | 0.320 | 0.642 | 0.350 | 0.625 | 0.625 | 0.298 |

Values in the same column with the same subscript letter do not differ significantly ($p > 0.05$). LN1-12 = number of leaves at month 1 to 12. Where TP/SD = topsoil and sawdust, TP/SS = topsoil and sharpsand, TP = topsoil, TP/PD = topsoil and poultry droppings and SS = sharp sand.

**Discussion**

The type of growth media used for propagation could affect seedlings quality. The non-significant variations found in seedling height of *Pterocarpus santalinoides* subjected to various sowing media at month 2 to 12 indicated that young seedling of the species were not influenced by sowing media. This agrees with the result of Dolor (2011) and Adeniji et al. (2019) who observed non-significant differences in height of *Irvingia wombolu* and *Ceiba petandra* seedlings treated with different soil media. While significant differences were observed in some months within the first six month of sowing seeds, non-significant difference differences were observed at the later months. According to Dolor (2011), variation in young seedling may be attributed to nutrient content in seeds of the species as young seedlings have dependable cotyledons that are rich in stored food reserves still attached to them until the seedling become autotrophic. Significant differences observed in seedling collar diameter during the early stages of growth corresponds with the result of Okonomo et al. (2006), who reported significant differences in collar diameter of *Gambeya albida* at 2 to 12 week after sowing and Fredrick et al. (2017 and 2018) who observed significant differences in collar diameter of *C. albidum* and *F. albida* seedling respectively at early growth (1 to 5 months after sowing). Non-significant differences observed in collar diameter as seedlings grew older were an indication that growth of *P. santalinoides* seedlings could only be influenced by growth media at early stages of growth. This is in confirmation with the result of Keyagha et al. (2016), who observed non-significant differences in seedling collar diameter of *Irvingia wombulu*. The lack of major variations in the number of leaves, except for month 3,

supported the results of Sekepe et al. (2013) and Keyagha et al. (2016), who observed lack of influence of growth media in number of leaves of *Irvingia wombulu* and *Cassia abbreviate* seedlings respectively.

Highest "seedling height, collar diameter and leaf number" observed in topsoil implies that it is the most suitable media for the growth of the species and that topsoil does not need to be amended since it contains the necessary nutrients required for early plant growth. This finding concurs with that of Okunlola (2016), who observed that top soil supported taller seedlings and higher number of leaves of three tropical tree species. Similarly, Agbogidi et al. (2007) and Adeniji et al. (2019), reported highest "height, collar diameter and leaf number' in seedling of *Dacrodyes edulis* and *Ceiba pentandra* respectively, planted in topsoil when compared to seedlings in other growth media. According to Agbogidi et al. (2007), better growth performance observed in *D. edulis* seedlings in topsoil could be due to topsoil containing more of both micro and macro nutrients required by plants for their normal growth and developmental activities as seedlings after germination depend on available nutrients in the soil. A higher seedling height observed in mixture of topsoil and poultry dung concurs with that findings of Okunomo et al. (2006), who noted that poultry droppings is the richest and most concentrated manure of soil amendment on farm. Also, higher "collar diameter and leaf number" was observed in mixture of topsoil and sharp sand. According to Dolor (2011), sand warms up more rapidly leading to increase in soil temperature which directly influences the photosynthetic functions of plants, water absorption, cell wall permeability, respiration, enzyme activity, nutrients transpiration and protein coagulation.

**Conclusion**

Furthermore, results of this study have established that seedling growth parameters were significantly influenced in some months and were not in others. Topsoil was observed to be the most suitable growth media for raising seedlings of *Pterocarpus santalinoides* as seedlings grown in topsoil displayed better growth parameters (seedling height, collar diameter and leaf number). Topsoil is therefore recommended for growth so as to get the necessary nutrients required by plants during growth as this medium improved the development performance of the seedlings.

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