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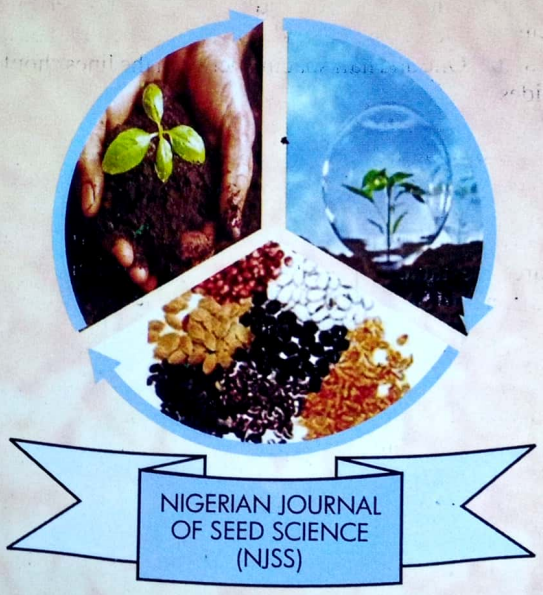

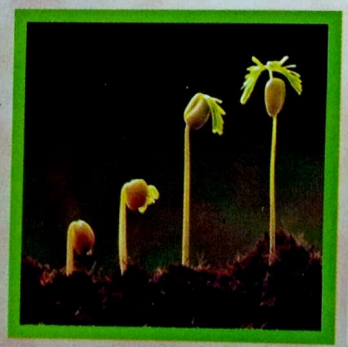

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Each manuscript should be arranged in the following order: Title, Author(s), Affiliations, Abstract, Text (separated into introduction, methodology, results (including tables and figures), discussion and conclusion), Acknowledgments and References.

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Content

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Effects of Sowing Depth and Growing Medium on Emergence and Growth of Golden Palm (*Chrysalidocarpus* Lutescens) Seedlings

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Abstract

Golden Palm *(Chrysalidocarpus lutescens)* is an important slow growing but bushy ornamental palm widely used for air purification, indoor and outdoor beautification. Experiment to determine the effects of different sowing depths (2, 4, 6 and 8 cm) and growing media (topsoil, rice husk and sawdust) on emergence and growth of *Chrysalidocarpus lutescens* seedlings was conducted at the Horticultural Nursery of the Federal University of Agriculture, Abeokuta, Ogun State, Nigeria in 2012 and validated in 2014. Treatments were arranged in Completely Randomized Design and replicated four times. Data collected on seedling emergence, plant height, number of leaves, number of roots, root length, shoot fresh weight, root fresh weight, shoot dry weight and root dry weight were subjected to analysis of variance (ANOVA). Treatment means were then separated at 5% probability level. The study revealed that sowing depth significantly influenced seed germination and seedling emergence (%). Highest percentage of seedling emergence in few days was observed in seeds sown at 2 cm depth than other depths. Effect of different growing media on days to seedling emergence, root and shoot growth was significant ($p \leq 0.05$). Topsoil medium supported seedling emergence and growth than rice husk or sawdust. It can be concluded that Horticulturist and Nurserymen could improve seedling emergence and growth of *Chrysalidocarpus lutescens* by sowing at 2 cm depth in topsoil medium.

Keywords: Ornamental palm, seed germination, planting depth, seedling establishment, environmental beautification

Introduction

Golden palm (Chrysalidocarpus lutescens) belongs to the family Arecaceae and is one of the most popular and beautiful garden palms, producing multiple stems. It is a small to medium sized palm, native to Madagascar, but now widely cultivated in many countries of the world especially in the tropical and sub-tropical regions for indoor and outdoor beautification, environmental gratification and climatic purposes (Doria *et al.*, 2012; Murphy *et al.*, 2016).

It filters xylene and toluene from the air and very effective humidifier due to its transpiration of 1 litre of water per 24 hrs at 1.8 m height (Wolverton, 2010). Because of its dense and clustering growth habit, golden palm primarily is used as a screen plant in tropical and sub-tropical landscapes, but can be used as a specimen palm to show off its golden canes (Broschat and Donselman, 1986: Broschat, 1994). The yellow-golden flowers are very attractive to bees while some birds such as the *Pitangus sulphuratus*, *Coereba flaveola* and *Thraupis sayaca* eat

its fruit. *Chrysalidocarpus lutescens* develops like a tree. It exhibits a smooth silver-green trunk which is topped with arching feather shaped fronds. It grows in clusters forming thick clumps of many stems to create a butterfly look. It develops long leaves; typical of palm trees, with a pretty erect stem in the lower part, bringing an arched crown (Whitmore, 1977). The common names of Chrysalidocarpus lutescens are yellow palm, golden cane palm, areca palm, golden fruited palm, yellow butterfly palm, golden feather palm.

The primary method through which palms are propagated is by seed which could be slow and erratic with low germination percentage (Broschat and Donselman, 1987).

Seedling emergence and establishment in nursery production is commonly affected by several factors. Sowing depth, seeding position, seed size and growing media influence on seedling emergence and growth of some plants have been investigated and reported (Arnulfo and Mexal, 2002; Olosunde, 2015). Broschat and Donselman (1987) investigated the effects of fruit maturity, storage, presoaking and cleaning on germination of some palms. Sowing depth is the distance from the surface of the soil to the point at which a seed is planted in the soil. Planting of seeds of crops at too deep or shallow depth can result in poor and/or delayed emergence and sometimes failure of seedling to emerge (Olosunde, 2015).

Growing medium is the material on which plant can grow and it must support the growth of the plant. There are hundreds of different kinds of growth media that a plant can grow on. The best growing medium for a particular purpose depends on many variables such as type of system that is in use, the kind of crop that will be grown, availability, cost, inherent quality, the local environment and others (Olosunde, *et al.*, 2015). Several growing media such as are listed below; oasis cubes, coconut fiber, rice husk, perlite, vermiculite, expanded clay pellets, sawdust, sand, sphagnum moss, soil less mix, air, fiberglass insulation and others have been reported (Blanchard and Runkle, 2008).

Nursery growers or managers in Nigeria can improve seedling emergence and growth by using the correct sowing depth and selecting a growing medium with good drainage to ensure optimum seedling emergence and establishment. The study of ornamental palms have been neglected and this work was initiated to determine best sowing depth and growing medium for rapid and optimum seed germination and seedling growth of *Chrysalidocarpus lutescens* under open nursery conditions.

Materials and Methods

The experiment was conducted at the Horticultural Nursery of the Federal University of Agriculture, Abeokuta (7°15'N, long 3°25'E), Ogun state, South West, Nigeria between January and May, 2012 and validated between April and August, 2014. The experiment was laid out in a 3 x 4 factorial arrangement in a Completely Randomized Design (CRD) with four replicates. Treatments consisted of three growing media (Rice husk, sawdust and top soil) and four different

sowing depths (2, 4, 6 and 8 cm).

Shovel was used to collect topsoil (20 cm depth) from the Crop Research field at the Federal University of Agriculture, Abeokuta while sawdust and rice husk were sourced from the milling factories in Abeokuta. In each trial, a total of 1,500 fresh ripen fruits of *Chrysalidocarpus lutescens* were harvested from matured trees in Ikeja, Lagos State, Nigeria. Forty eight of seven (7) litres capacity pots were filled with different media to 3 litre mark from where a meter rule was used to determine 2, 4, 6 and 8 cm height. Then, 25 seeds with average weight of 1.75 g were planted on their sides in each pot and then covered with varying media thickness/ layers (2, 4, 6 and 8 cm).

Seedling emergence was determined as described by Fakorede and Agbana, (1983) from first day of emergence to 79 days after sowing:

Seedling emergence percentage:

$$\frac{\text{Number of seedlings emerged}}{\text{Number of seeds planted}} \times \frac{100}{1}$$

Plant samples were carefully removed from each growth medium by carefully placing under rinsing water to wash off the medium particles from the roots. Then, number of roots/plant and length of longest root were recorded. Fresh root and shoot samples of seedlings were oven dried at 70 °C to constant weight before weighing with the aid of the sensitive weighing scale to obtain the dry weight. The data collected were subjected to analysis of variance (ANOVA) and Least Significant Difference (LSD) test was used to separate the treatment means at 5% probability level.

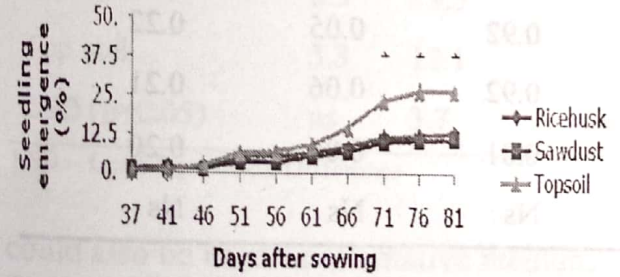
Results

Chemical analysis of the different growing media revealed that sawdust contained 0.20% N, 0.05 mg/kg P, 22.5 K and 2.59% C, rice husk had 0.17% N, P was 0.12 mg/kg, 6.93% K and 1.90% C while topsoil had 0.09% N, 1.41 mg/kg P, 0.26% K and 0.77% C. (Table 1).

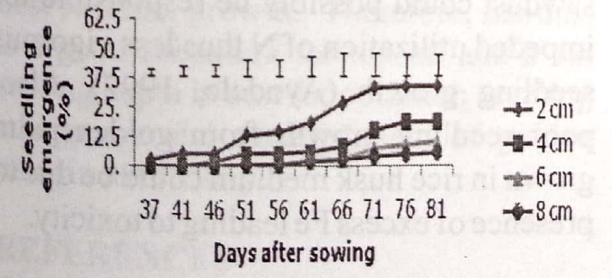
Table 1: Physical and chemical properties of the growing media

Growing media	N %	P mg/kg	K %	Cu mg/kg	Mn mg/kg	Zn mg/kg	Fe mg/kg	C %	pH
Sawdust	0.2	0.05	22.5	17.3	2.25	15.0	8.75	2.59	6.0
Rice husk	0.17	0.12	6.93	21.5	28.75	28.25	201.25	1.90	6.2
Topsoil	0.09	1.41	0.26	4.05	5.10	3.7	18.38	0.77	6.9

Effect of sowing depth on seedling emergence of *Chrysalidocarpus lutescens* was significant ($P < 0.05$) across sampling period (Figure 1a). The percent seedling emergence was highest at 2 cm depth, followed by those sown at 4, 6 and then 8 cm sowing depths. However, there was no significant difference between seeds sown at 6 and 8 cm depths. Higher percent of seeds raised in topsoil emerged faster than those planted in rice husk or sawdust (Figure 1b). Highest number of emerged seedlings was observed from seeds sown in topsoil (4% to 34%) followed by those in rice husk (4% to 24%) and the sawdust (4% to 22%) at 37 and 81 days after sowing. Percent seedling emergence in rice husk or sawdust was not significantly ($p< 0.05$) different.



(a)



(b

Figure 1: Effect of growing medium (a) and sowing depth (b) on seedling emergence of Chrysalidocarpus lutescens (Mean of two trials) Error Bars = LSD (Least Significant Difference)

Sowing depth significantly ($P\leq 0.05$) affected number and length of root per plant, fresh and dry root and shoot weight (Table 2). Seedlings from seeds sown at the depth of 2 and 4 cm produced more and longer roots than when seeds were sown at 6 and 8 cm. Similarly, highest fresh and dry root and shoot weight values were recorded for seedlings sown at 2 and 4 cm while those sown at 8 cm depth had least values)

Effect of growing media on number of roots per plant, fresh and dry root weight of golden palm was not significant ($P\leq 0.05$) as presented in Table 3. However, seedlings from seeds sown in sawdust had longest root (18.3 cm), followed by those planted in topsoil (15.6 cm) than those grew on rice husk (9.5 cm). Similarly, seedling grown on topsoil (1.0 g and 0.28 g) and sawdust (1.1 and 0.19 g) had significantly higher fresh and dry shoot weight, respectively, than those planted in rice husk (0.7 g and 0.18 g).

Discussion

The sowing depth and media used for germination affected emergence percentage and seedling growth of golden palm. Low maximum germination percentage observed in this study supported the report of Tomlinson, (1990), that palms could have less than 20% total germination even at more than 100 days after sowing. Differences in the effect of media on time of germination and seedling emergence may be traced to the variation in characteristics like water holding capacities, sticking properties of soil, water and air infiltration rate (Baiyeri and Mbah

Table 2: Effect of sowing depth on rooting characteristics and dry matter accumulation of *Chrysalidocarpus lutescens* seedlings.

Sowing depth (cm)	Number of root	Root length(cm)	Fresh root weight(g)	Fresh shoot weight(g)	Dry root weight(g)	Dry shoot weight (g)
First trial (2012)						
2	1.6	16.9	0.4	1.1	0.09	0.29
4	1.5	16.3	0.3	1.1	0.09	0.27
6	1.1	12.5	0.2	0.9	0.05	0.17
8	1.1	12.1	0.2	0.8	0.06	0.14
LSD (p=0.05)	0.4	2.9	0.03	0.2	0.02	0.04
LSD (p=0.05)						
Second trial (2014)						
2	3.1	12.1	0.14	0.81	0.07	0.39
4	3.4	10.46	0.16	0.92	0.05	0.22
6	3.1	10.86	0.14	0.92	0.06	0.21
8	3.1	9.8	0.13	0.81	0.06	0.20
LSD (p=0.05)	ns	1.63	ns	Ns	Ns	Ns

LSD – Least Significant Difference

(2006). The deeper the sowing depth of seeds, the fewer numbers of emerged seedlings and the greater the number of days to emergence. This observation corroborates the findings of Minore (1985) and Olosunde (2015) on fir and *Polyalthia longifolia,* respectively.

Superior seedling emergence and growth observed in topsoil medium could be attributed to P content which probably promoted early crop establishment. Higher organic carbon content in rice husk and sawdust could possibly be responsible for impeded utilization of N thus less vigorous seedling growth (Ayodele, 1997). Also, poor seedling growth from golden palm grown in rice husk medium could be due to presence of excess Fe leading to toxicity.

Conclusion

In conclusion, topsoil is the best medium for seed propagation and seedling establishment of golden palm under tropical environment. However, sawdust

Table 3: Effect of growth medium on rooting characteristics and dry matter accumulation of *Chrysalidocarpus lutescens* seedlings.

Growth media	Number of root	Root length(cm)	Fresh root weight(g)	Fresh shoot weight(g)	Dry root weight(g)	Dry shoot weight (g)
First trial (2012)						
Rice husk	1.4	9.5	0.3	0.7	0.07	0.18
Sawdust	1.3	18.5	0.4	1.1	0.07	0.19
Top soil	1.4	15.6	0.3	1.0	0.08	0.28
LSD (p=0.05)	ns	2.5	Ns	0.2	Ns	0.04
Second trial (2014)						
Rice husk	3.1	15.2	0.16	1.02	0.05	0.21
Sawdust	3.3	19.5	0.14	0.8	0.05	0.19
Top soil	3.3	12.1	0.12	0.8	0.08	0.20
LSD (p=0.05)	ns	3.7	ns	0.24	Ns	Ns

LSD – Least Significant Difference

could also be used as alternative medium. Sowing seeds of golden palm at 2 cm depth resulted in faster seedling emergence and best seedling growth. Therefore, sawdust is a good substitute for topsoil and 2 cm sowing depth is best for optimum seedling emergence and establishment of golden palm in the nursery.

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