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Soilless Nursery Media for African Oil Bean (*Pentaclethra macrophylla* Benth) Seedling Production

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Authors' contributions

This work was carried out in collaboration between all authors. Author NCO designed the study, wrote the first draft and performed the statistical analysis with author AEE. All authors read and approved the final manuscript.

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ABSTRACT

African oil bean (*Pentaclethra macrophylla*) is an important multi-purpose tree crop. However, bottleneck in seedling production to fully domesticate this crop has not been resolved. This study was carried out to compare the effect of three different soilless media on the production of *Pentaclethra macrophylla* seedlings. The experiment was laid out in a completely randomized design (crd) with 10 replications using potting bags (25 x 23 cm) filled with the treatments namely sawdust + poultry manure (sd+pm) 3:1 volume by volume (v/v), rice hull + poultry manure (rh +pm) 3:1 v/v, and groundnut husk + poultry manure (gh + pm) 3:1 v/v. Top soil served as the control. Germination and plant growth parameters were studied; days to emergence, germination count (%), plant height and number of leaves at 30, 40, 50, 60 and 70 days after planting (dap).

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Germination count (%) was recorded highest on sd + pm while gh + pm had the least. This study suggests the use of sd + pm for seedling production.

Keywords: soilless media; oil bean.

1. INTRODUCTION

Growing of crops on soil is the conventional practice in crop production, and a traditional potting media is a container filled with top soil. The search for other media for cropping came as a result of increasing knowledge in plant nutrition as well as other serious difficulties observed in the use of soil in crop production. Soil poses numerous limitations for plant growth due to the presence of diseasing causing organisms (flora and fauna) in it, poor drainage and aeration resulting from soil compaction, and degradation due to soil erosion and leaching. Scholars have also reported that the cost of soil sterilization in the use of soil as a nursery media is expensive, likewise discouraged the digging up of agricultural soils for other nursery practices for its numerous negative effects in the ecosystem [1,2]. Generally, field soils are unsatisfactory for the production of plants in containers [3].

The development of standardized plant growing medium is an area of research that is fast gaining attention among workers, in an attempt to providing alternative growing media other than soil that will be suitable for container culture. Recently, plants can be cultivated in various containers filled with several possible growing materials which can be solid (like saw dust, rice hull, groundnut husk) called “Soilless culture” because no soil is present and plant roots get their nutrients from these artificial media [4]. Again through circulated nutrient solution called hydroponics or medium called aeroponics whereby plants get their nutrients through spraying or misting methods.

Soilless media provide a valid alternative to traditional cultivation technique, having the advantage of full control of the inputs whereby the techniques enhances the growth of crops faster than ordinarily may be grown on soil. Soilless media produce clean materials at harvest as it does not support disease carrying organisms unlike soil. In addition, being an anthropogenic substrate, it is often formulated to resist the growth of weed seeds; hence crops are grown in a healthy environment. Other advantages of this media include good drainage, high water retention ability, slow decomposition and good nutrient control, and lighter weight [5,6].

Invariably where good soil to grow crops is not available or where it is too expensive to maintain favourable soil condition to grow crops and there is high value for the growth of crops out of season, then growing crops without soil is the alternative. Although scholars have made several efforts in using other media in raising seedlings of *Pentaclethra macrophylla* [7,5], there is paucity of information on the use of soilless media to mass produce the seedlings of this crop, even as a means of forcing this crop for its greater production. Therefore this study was set up to compare the efficacy of some solid soilless media to mass produce the seedlings of *Pentaclethra macrophylla* for its sustainable cropping.

2. MATERIALS AND METHODS

This experiment was carried out at the Teaching and Research Screen House of School of Agriculture and Agricultural Technology, Federal University of Technology, Owerri, Imo State, located at latitude of 5^0 25’N and longitude of 7^0 0’E, and altitude of 55 m above sea level with an annual rainfall of 2000 mm and a relative humidity of 89-93%. The study area is located in the tropical humid rain forest agricultural zone of Nigeria, characterized by heavy rainfall between March to October while November to February is relatively dry.

Materials used for this experiment were viable seeds of African oil bean collected from seed bank of the Department of Crop Science and Technology. Groundnut husk was sourced from groundnut cottage industry while saw dust was from saw mill. Rice hull were collected from rice mill industry from Abakilki, top soil was gotten from the forest and poultry manure from poultry farm of Animal Science Department. Other materials used were nursery bags (25 x 23 cm), hand towel, weighing scale and meter rule.

Viable seeds used for the study were selected by flotation method. The seeds were soaked in a suitable container filled with enough water. The water was stirred with a stick and allowed to

settle for about 30 minutes. The seeds that sank were regarded viable and the ones that floated as non-viable which were discarded. Samples used for the experiment were collected from the viable seeds.

The treatments combinations were Saw dust+ Poultry manure (SD + PM) 3:1 volume by volume (v/v), Rice hull + Poultry manure (RH + PM) 3:1 v/v and Groundnut husk + Poultry manure (GH + PM) 3:1 v/v. The nursery bags (25 x 23 cm) were filled up to $^3/_4$ level with the treatment. Two seeds were sown into each potting bag at the depth of 2 cm which was later thinned down to one, and the units were watered once a week with a 500 cm^3 watering can. Data were collected on percentage germination, days to emergence, plant height and number of leaves at 30, 40, 50, 60 and 70 days after emergence. The data collected were subjected to analysis of variance (ANOVA) and means separated using fishers least significance difference at 5% level of probability.

3. RESULTS

3.1 Days to Emergence and Percentage Germination

The ANOVA on days to emergence (DTE) as displayed in Table 1 showed marked significant differences ($P<0.05$). The least number of DTE of 27 was observed for top soil (control), followed by 38 days for SD + PM medium, while RH + PM medium had the highest number of DTE of 42. The result on percentage germination showed that 85% of the oil bean seeds planted in SD+ PM medium emerged (same as top soil), while only 35% germination (the least) was observed for seeds planted in GH + PM medium.

3.2 Plant Height

The result on mean plant height showed that significant differences ($P<0.05$) were observed at only 30 and 40 days after planting (DAP). However, SD + PM medium consistently recorded the highest mean value on plant height of 6.93 cm, 24.31 cm, 30.84 cm, 37.87 cm and 41.95 cm at 30, 40, 50, 60 and 70 DAP in that order. On the other hand, the least mean plant height of 1.0 cm, 9.94 cm, 17.49 cm, 23.31 cm and 32.21 cm at 30, 40, 50, 60 and 70 DAP were observed for GH + PM medium (Table 2).

3.3 Number of leaves at 30, 40, 50, 60 and 70 DAP

The analysis of variance on mean number of leaves as displayed on Table 3 showed no significant differences ($P<0.05$). The mean number of leaves recorded for all the media at 30, 40, 50, 60 and 70 DAP were statistical indifferent.

4. DISCUSSION

The variation in the performance of oil bean seeds planted on different soilless media used in this study reflected the physical and chemical properties of the various media. The attributes of each soilless medium has generally displayed a far reaching effect on seedling performance (Tables 1 – 3). A suitable medium for planting viable seeds in raising nursery for African Oil bean seedling must be sufficiently aerated and also should have a high water holding capacity to be able to retain nutrients. An overview on the results (Tables 1-3) of this study showed that SD + PM medium recorded the best performance in all the parameters evaluated. This medium enhanced the emergence and growth of oil bean seedling more than other media used in the study. On the other hand, GH + PM medium consistently recorded the least performance in all parameters investigated (days to emergence, germination count, plant height, number of leaves), which may be due to this medium's poor physical condition. Some scholars [8,9] observed that the relative balance of air and water within a medium pore space is critical to plant growth.

On seed emergence, analysis of variance showed that there were significant differences ($P<0.05$) on days to emergence (Table 1). Apart from the control, Saw dust + poultry manure medium among the other soilless media recorded the least mean number of days to emergence of approximately 38. Again, this medium recorded the highest germination count of 85% (same as the control). Apparently, the high porosity and aeration quality of this medium satisfied the necessary conditions for the germination of oil bean seeds more than the other media used in the study. The volume of poultry manure to saw dust in this medium was in the ratio 3:1, which enhanced aeration, nutrient distribution and retention, resulting to a favourable condition that enhanced the observed early seed emergence of *Pentaclethra macrophylla*. Robert [10] had observed that a high level of aeration is essential for seed germination. In many seed based experiments, seeds of many plant species will not germinate well at an Oxygen level considerably lower than that present in the atmosphere [11]. On the other hand, the highest number of days to emergence

Table 1. Result on days to emergence and percentage germination count of *Pentaclethra macrophylla* seedlings

Treatment	Days to emergence	Percentage germination count
RH +PM	42.	60
SD +PM	38.	85
GH + PM	39.	35
Top soil	27	85
$LSD_{0.05}$	10	

GH= Groundnut Husk; PM=Poultry Manure; RH=Rice Hull; SD=Saw Dust

Table 2. Effect of media on seedlings height at 30, 40, 50, 60 and 70 DAP

Treatment	Value for mean days on plant height				
	30	40	50	60	70
RH + PM	4.58	21.92	28.37	31.18	39.52
SD + PM	6.93	24.31	30.84	37.87	41.95
GH + PM	1.0	9.94	17.49	23.31	32.21
Top soil	9.07	27.93	39.53	39.26	40.30
$LSD_{0.05}$	1.80	8.82	NS	NS	NS

DAP=Days after Planting; GH= Groundnut Husk; NS=Not Significant; PM=Poultry Manure; RH=Rice Hull SD=Saw Dust

Table 3. Effect of media on number of leaves at 30, 40, 50, 60 and 70 DAP

Treatment	Mean number of leaves			
	40 DAP	50DAP	60DAP	70DAP
RH+PM	12.40	16.33	16.40	16.40
SD+PM	13.50	18.50	19.63	19.63
GH+PM	-	9.00	15.29	15.29
Top soil	12.17	16.33	18.00	18.00
$LSD_{(0.05)}$	Ns	Ns	Ns	Ns

DAP= Days after Planting; GH= Groundnut Husk; NS= Not Significant; PM= Poultry Manure; RH=Rice Hull; SD=Saw Dust

of approximately 42 days was observed for RH + PM medium, while GH + PM medium had the least germination count of 35%. These results have some implication on the coarse nature of these media; with the presence of large particles the porosity of these media are bound to be low. The physical nature of these media showed that they have high tendency to get water logged more than the other media. In fact while they appear dry at the surface, the lower part of the potting media was super saturated with water. Water logged medium usually have leaching and aeration problems which are contrary to conditions necessary for seed germination. This explains the observed delayed seed emergence in RH + PM medium and low percentage germination in GH + PM medium. This indicates that poor physical condition of a medium is a very common inhibitor of seedling development [12, 5].

Plant height result as displayed in Table 2 showed marked significant differences at 40 and 50 DAP. Clearly, seedlings from SD + PM medium were taller than that of other media. The seedlings from this medium had tremendous increase in growth which may be due to physical nature of this medium that aided fast nutrient mineralization. Presumably, the readily available nutrients in SD + PM medium may have enhanced root development. In addition to the earlier discussed physiochemical properties, this medium gave a good anchorage to the crops which may have also facilitated growth. Furthermore, poultry manure used in formulating this medium is rich in nitrogen, which is critical in the growth of crop. Being a soilless media, *P. macrophylla* is not able to fix atmospheric nitrogen via root symbiotic relationship with bacterial in the soil. Hence poultry manure found in this medium provided the nitrogen that enhanced the growth of this crop. Again, GM + PM medium still recorded the least mean on plant height. The critical growth of a plant is determinant on the size of the particles of the potting medium [9].

The result on number of leaves at 30, 40, 50, 60 and 70 DAP was not similar to that from other parameters investigated, as no significant difference (P>0.05) was observed (see Table 3). Statistically, the mean values on number of leaves observed for all the media used in this study were the same. The type of the compound leaves of this crop may have some implication on the result observed.

5. CONCLUSION

Farmers should be educated and encouraged to use soilless media for crop production, it is an unconventional method that utilizes organic waste for crop production. In this study, SD + PM medium, enhanced seedling production of *Pentaclethra macrophylla* as observed in days to emergence, percentage germination and plant height.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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