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Influence of Growth Media on Early Growth and Development of Yam Seed

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ABSTRACT

Suitability of growing media or substrates is essential for production of quality seedlings for transplant. It directly affects the development and later maintenance of the extensive functional system. In the present study, different growth media were used to germinate the seed of white yam *(Dioscorea rotundata)* under a controlled growth chamber to identify which among the tried media is best for yam seed. The growth media tested were Cocopeat, Peat pellet, Carbonized rice husk, Top soil, Cocopeat + Top soil and Carbonized rice husk + Top soil. Each treatment was measured into a nursery seedling basket, arranged in randomized complete block design, and replicated four times. Daily minimum and maximum Temperature and Relative humidity records were recorded throughout the experiment. At 60 and 90 days after seed sowing, growth response parameters were recorded and were subjected to analysis of variance and treatment means were separated using least significant difference at 5% probability level. Highest germination of 71.65 and 88.65% at 60 and 90 days after sowing respectively were recorded from yam seed planted in Cocopeat and the same trend was observed in respect of growth response parameters taken. Top soil had the least influence as growth medium, which was not significantly different from response from its mixtures with other growth media.

Introduction

Yam (*Dioscorea spp*) is an important tuber crop. Nigeria is the largest world producer of yam with annual production, estimated at 26.587 million metric tones (Ikeorgu and Ogbanna, 2009). The plant Genus comprises of over 600 species with only 10 species producing edible tuber. Six of these edible species are cultivated in Africa, West Indies, Asia, South and Central America (Amusa, 2000; Tamiru *et al*., 2008; Bousalem *et al*., 2010; Elsie, 2011; Petro *et al*., 2011; Ibitoye *et al*., 2013). The primary species cultivated are the white yam (*Dioscorea. rotundata)*, yellow yam (*Dioscorea cayenensis)* and water yam (*Dioscorea alata)*, *D. rotundata* and *D. cayenensis* may have been first domesticated in the forest-savannah ecotone of West Africa (Hamon *et al*., 1995; Tostain *et al*., 2003).

Suitable growing media or substrates is essential for production of quality crops. It directly affects the development and later maintenance of extensive functional rooting system. A good growing medium provides sufficient anchorage of support to plant, serves as reservoir for nutrient and water, allows oxygen diffusion to root, and permits gaseous exchange between root and atmosphere outside root substrate (Abad *et al*., 2002). Nursery potting media influence quality of seedling produced (Agbo and Omaliko, 2006). The quality of seedling obtained from a nursery influences re-establishment in the field and the eventually productivity (Baiyeri, 2006).

Nutritionally, yams are a major source of nourishment to many populations in the world (Ile *et al*., 2006). Pharmaceutically, some species of *Dioscorea*, particularly *Dioscorea zingiberensis*, produces high concentration of diosgenin, a chemical used for the commercial synthesis of sex hormones and corticosteroids (Chen *et al*., 2003; Yuan *et al*., 2005; Islam *et al*., 2008).

Generally in practice, yams tubers are used as planting material (Odjugo, 2008; Zannou, 2009). Absence of viable seeds, long period required for obtaining usable tubers and phytosanitary problems are some of the factors that limit the rapid conventional propagation and economic exploitation of *Dioscorea* species (Tschannen *et al*., 2005; Balogun *et al*., 2006; Fotso *et al*., 2013). Yam production has been on the decline despite the increasing demand for local consumption and for export. Asumugha *et al*., (2009) reported that there is a need for increased production of yam not only to satisfy domestic need but also export demand. The major constraint to increase production of yam in Africa is the scarcity of seed yam (Udealor and Ezulike, 2009), soil degradation, poor handling and storability, pest and disease and other environmental factors (Ibitoye and Attah, 2012) and large quantities of about 30% of the previous year's harvest are required (Okoli and Akoroda, 1995).

An annual rainfall of about 1000 mm spread over five to six month and deep, fertile, friable, and well-drained soils are ideal for yam cultivation. Whole seed tubers or tuber portions are usually planted into mounds or ridges before or at the beginning of rainy season. Planting materials used in yam seed cultivation include; yam sett, seed yam, mini setts, yam vines and the yam seed. The commonly used planting materials are yam setts and seed yam but the improved method is the use of mini setts technology, use of yam vines and yam seed.

Otoo *et al*., (2001) reported that moist sawdust which is commonly available has been used effectively as a medium for sprouting mini setts but it is not easily available especially in areas where sawmills are not located (Asare-Bediako *et al*., 2007; Dasbak *et al*., 2011). It has therefore been necessary to find substitutes for the sawdust. Yam cultivars differ in their duration to sprout and would respond differently under different sprouting media (Dasbak *et al*., 2011). Therefore, this present research focused on assessing the possibility of using yam seed as planting material and to assess the effect of different growth media compositions on early growth and development of yam seedling.

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Materials and Methods

The experiment was carried out at the Teaching and Research Farm of Ladoke Akintola University of Technology (LAUTECH), Ogbomoso, Nigeria. Ogbomoso lies on latitude 8° 10' N and longitude 4° 10' E. The experimental materials used were botanical yam seed (*Dioscoria rotundata*), Peat-pellet, Cocopeat, carbonized rice husk, Top-soil, Nursery baskets and Thermo-hygrometer. Apart from top soil that was collected from LAUTECH farm, other materials were obtained from International Institution of Tropical Agriculture (IITA) Ibadan, Nigeria. Growth chamber was constructed for the experiment to prevent rodent attack using chicken net all round. Palm frond were used to shade the growth chamber on top. Nursery baskets (50 x 30 x 30 cm^3) filled with growth media were arranged inside it.

There were six different growth media used for the experiment, they are Peat-pellet, Cocopeat, Carbonized rice husk, Top Soil, Cocopeal + top Soil and Carbonized rice husk + top soil. Peat pellet is a packed growing medium from decomposed peat materials; an expandable medium, that needs water to swell up and be ready for use. Cocopeat is a natural fibre made out of coconut husks; it is a by-product from the extraction of coconut fibre from husks, dried under sun and ready for use. The carbonized rice husk, is gotten from rice husks carbonized and made useful in the farming industry. Loamy soil was collected from LAUTECH Teaching and Research farm. Cocopeat and carbonized rice husk mixed with top soil were combined in ratio 1:1 volume to volume. The Peat pellet, Cocopeat and Carbonised rice husk were all industrially produced.

The six growing media treatments were replicated four times giving a total of 24 treatment units arranged in randomised complete block design. A nursery basket is a treatment unit where 125 seeds were planted. Watering was done regularly on daily basis and intensive care was given to the plants. Fungus infection was prevented on the growth media by spraying of mancozeb (a fungicide).

Data collection on weather parameters commenced a day after sowing, seed germination, and growth response parameters. Temperature and relative humidity of the nursery environment were taken at 7:30 a.m and 3:00 p.m. daily throughout of the period of the experiment. The following response parameters were taken at 60 and 90 days after sowing (DAS):

$$\text{Percentage seed germination} = \frac{\text{Number of seed that germinate}}{\text{Number of seed sown}} \times 100$$

$$\text{Percentage dead seed} = 100 - \text{Percentage seed germination}$$

$$\text{Percentage normal seedlings} = \frac{\text{Number of normal seedlings}}{\text{Total number of seedlings}} \times 100$$

$$\text{Percentage abnormal seedlings} = 100 - \%\ \text{Normal seedlings}$$

Seedling stem length (cm)
Seedling root length (cm)
The leaf area was computed by using Length * Breath * 0.68 (cm^2). This was used to multiply number of leaves on the seeding. The number of leaves by counting

The seedling dry matter yield was obtained by harvesting the seedling, kept in a labelled envelope each and then dried in the oven at 80 C to a constant weight. It was then weighed on digital scale to obtain the dry matter yield.

The seedling vigour was estimated with a rating scale score of 1-4 where 1 stands for the poorest seedlings and 4 stands for the most robust seedlings.

Results and Discussion

Temperature and relative humidity of the micro environment of the growth chamber is presented on Figure 1. The minimum and maximum temperature ranged between 22.5 and 30 °C respectively while the minimum and maximum relative humidity ranged between 65 and 81. The influence of growth media on germination and seedling development is presented in Tables 1 and 2 at 60 and 90 days after sowing respectively. At both 60 and 90 DAS, growth media influenced germination significantly. This observation is in agreement with the report of Agbo and Omaliko, (2006) on significance of potting media. However, it has no significant effect on seedling strength and vigour. Highest seed germination percentage (71.65 and 88.65 at 60 and 90 days after sowing respectively) was observed in yam seed planted in Cocopeat while the least (18.65 and 41.33 at 60 and 90 DAS respectively) was recorded from those planted in top soil. Bhardwaj (2014) had identified the superiority of Cocopeat as a growth medium in his work on Pawpaw, which agreed with the findings from this work. The results obtained from yam set planted in the Peat pellet growth medium were not significantly different from that of Cocopeat. In addition, the results from Top soil growth media were not different significantly from Top soil mixtures. This corroborates the report of Dasbak *et at*., 2011 on sprouting response of yam under different growth media. Growth media tried had significant influence on all the growth parameters measured at 60 and 90 DAS (Tables 3 and 4 respectively). Highest average number of leaves at 90 DAS (8.00) was recorded from yam seed planted in Cocopeat, the value was not different significantly compared with 6.25 and 7.25 recorded from those planted in Peat pellet and Carbonised rice husk respectively. With regards to all other growth response parameters at 60 DAS, the least values were obtained from yam seed planted in top soil while the highest from Cocopeat. The same trend was observed at 90 DAS for other growth response parameters. Across all the responses, mixing top soil with other growth media tried did not influence the response significantly compared with planting in top soil alone.

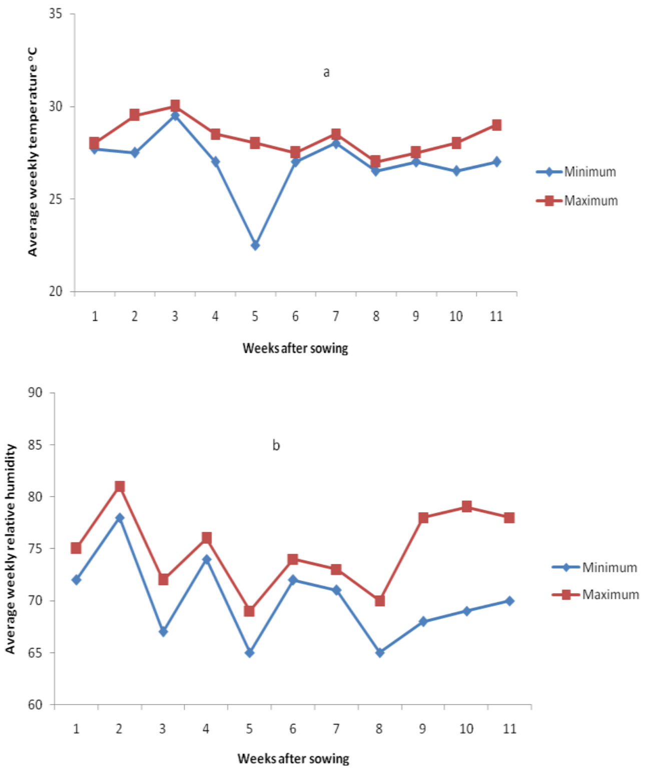

Fig 1. Average weekly Temperature (a) and Relative humidity (b) of growth chamber environment

Table 1. Effects of growth media on germination and seedling development of Yam Seed at 60 days after sowing

Growth Media	Percentage seed germination	Percentage dead seed	Percentage normal seedlings	Percentage abnormal seedlings	Average seedling vigour
Cocopeat	71.65a	28.35c	85.47a	14.53a	3.25a
Peat pellet	68.00a	32.00c	92.83a	7.17a	3.50a
Carbonized rice husk	48.33ab	51.68bc	92.35a	7.65a	3.00a
Carbonized rice husk + Top Soil	29.00bc	71.00ab	92.00a	8.00a	3.50a
Cocopeat + Top Soil	26.00bc	74.00ab	92.65a	7.35a	3.00a
Top Soil	18.65c	81.35a	88.40a	11.60a	3.25a

Means with the same letter along the column are not statistically different

Table 2. Effects of growth media on germination and seedling development of Yam Seed at 90 days after sowing

Growth Media	Percentage seed germination	Percentage dead seed	Percentage normal seedlings	Percentage abnormal seedlings	Average seedling vigour
Cocopeat	88.65a	11.35c	20.08a	79.93a	3.50a
Peat pellet	85.68ab	14.33c	17.48a	82.50a	3.75a
Carbonized rice husk	71.00b	29.00b	16.88b	83.13a	3.00a
Carbonized rice husk + Top Soil	50.00c	50.00a	15.53a	84.48a	3.50a
Cocopeat + Top Soil	51.68c	48.35a	16.55a	83.45a	3.00a
Top Soil	41.33c	58.68a	18.50a	81.50a	3.25a

Means with the same letter along the column are not statistically different

Table 3. Effects of growth media on growth parameters of yam seedling at 60 days after sowing

Growth media	Average number of Leaves	Average leave area (cm^2)	Average s tem length (cm)	Root length (cm)	Dry matter yield (mg)
Cocopeat	1.75a	6.16a	5.78a	2.78a	0.09a
Peat pellet	1.23a	5.79a	4.83ab	1.63ab	0.07ab
Carbonized rice husk	1.50a	3.79a	4.58bc	2.93a	0.05ab
Carbonized rice husk + Top Soil	1.00a	3.88b	4.18bc	1.13b	0.38ab
Cocopeat + Top Soil	1.40a	3.15b	4.88ab	2.25ab	0.53ab
Top Soil	1.00a	2.13b	3.70c	0.89b	0.03b

Means with the same letter along the column are not statistically different

Table 4. Effects of growth media on growth parameters of yam seedling at 90 days after sowing

Growth media	Number of Leaves	Leave area (cm^2)	Stem length (cm)	Root length (cm)	Dry matter yield (mg)	Number of Leaves
Cocopeat	8.00a	10.35a	8.30a	4.95a	0.10a	6.56ab
Peat pellet	6.25ab	7.09ab	7.08a	3.05ab	0.05b	6.75ab
Carbonized rice husk	7.25a	6.93ab	7.18a	4.03ab	0.05b	8.10a
Carbonized rice husk + Top Soil	3.75bc	4.61bc	5.78ab	1.83b	0.03b	4.65bc
Cocopeat + Top Soil	6.25ab	2.86c	6.23a	2.78ab	0.05b	4.50bc
Top Soil	3.25c	7.32ab	3.48b	1.45b	0.02b	3.50c

Means with the same letter along the column are not statistically different

Conclusion

The result revealed that Top soil alone or in combination with other growth media used in this work may possibly not be suitable for optimum performance of yam seedling. Generally, Cocopeat supported optimum performance of yam seed cultivation when compared with other growth media. Cocopeat could therefore be recommended for yam seed cultivation under the condition of this experiment.

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