INFLUENCE OF NURSERY MEDIA ON EMERGENCE AND EARLY GROWTH OF BAOBAB (*Adansonia digitata* L.) SEEDLINGS IN KABBA, KOGI STATE, NIGERIA

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ABSTRACT
Baobab is a multipurpose tree species with nutritional, medicinal and health benefits. Little is known about the suitable media that could support seedling emergence and early growth of the species. A study was conducted at the College of Agriculture, Kabba between March to September 2022 to examine the influence of nursery media on seedling emergence and early growth of baobab. The treatments involved topsoil (TS) (100%), TS+ Poultry manure (PM)+Rice husk (RH) (2:1:3), TS+PM+ Sawdust (SD) (2:1:3), TS+PM+ Oil palm bunch residue (OPBR) (2:1:3), TS+PM +OPBR+RH+SD (1:1:1:1:1). The experiment was laid out in a completely randomized design (CRD) with five replicates. Emergence parameters such as days to first seedling emergence, emergence percentage, emergence index and emergence rate index were taken. Growth traits measured were plant height (cm), number of leaves, stem girth (cm) and number of branches. The data collected were subjected to analysis of variance (ANOVA) using Genstat statistical software. The results indicated that nursery media positively influenced seedling emergence and growth parameters evaluated. Seeds planted in TS+PM+RH had the least number of days to first seedling emergence (22.8 days) and highest percent emergence (88%). The TS+PM+OPBR recorded the tallest plants (83.00, 114.00, 145.00 and 180.30 cm) at 3, 4, 5 and 6 months after planting (MAP), more leaves (43.00, 122.70, 159.00, 193.70 and 221.30) and widest stem girth (3.90, 5.53, 6.53, 7.70 and 8.77 cm) across the months. It also manifested a tendency to produce greater number of branches across the months. This was attributed to the use of well decomposed poultry manure and the inclusion of oil palm bunch residue which may have supplied more nitrogen that enhanced the growth of baobab seedlings.
Key words: Baobab, Nursery media, Emergence, Early growth

INTRODUCTION
Baobab (*Adansonia digitata* L.) is one of the most important underutilized plant species belonging to *Bombacaceae* family that occurs in drier parts of sub-Saharan Africa (Assogbadjo *et al.*, 2006; Kamatou *et al.*, 2011; De Smedt *et al.*, 2012; Gebauer *et al.*, 2016). Baobab is mainly found in countries like Nigeria, Tanzania, Kenya, Zimbabwe, Sudan, South Africa and Burkina Faso, (Sidibe *et al.*, 2002; Fischer *et al.*, 2020). The plant is considered important in savannah areas of Africa that are experiencing food and nutritional insecurity as well as socioeconomic marginalization (IFAD, 2011). Baobab is a large iconic deciduous tree attaining a height of 12−20 m or more (Bosch *et al.*, 2004) which can live for thousands of years (Palgreave, 2002). The plant produces large fruits that are valued for their citrus-like flavour (Gebauer *et al.*, 2002). The wood is whitish, spongy, soft and light which can be used in making fishing boats (Storrs, 1995).
The species is a multipurpose plant with the potential to contribute to family nutrition, food security, supporting sustainable landscape management and fostering rural development (Sidibe and William, 2002; Gebauer *et al.*, 2016; Jäckering *et al.*, 2019). Earlier studies by Osman (2004); Compaore *et al.* (2011); Olajide (2021) showed that baobab leaves, fruit pulp and seeds are good sources of minerals, vitamins and protein. Local communities in most of the countries in African utilize baobab leaves, seeds and pulp as food buffer during the dry season and as a valuable source of income (Buchmann *et al.*, 2010). Baobab pulp, seeds and leaves are incorporated into local dishes owing to the numerous health benefits (Assogbadjo *et al.*, 2012; Ciss´e *et al.*, 2013; Muthai *et al.*, 2017). Extracted oil from baobab seed is used in the cosmetics industry and is been sold internationally (Kumar, 2018). Baobab is gaining international prominence following the acceptance of the fruit pulp as a novel food ingredient and its application in cosmetic and pharmaceutical industries worldwide (Gruenwald and Galizia, 2005; Meinhold *et al.*, 2016). The plant parts can be used for medicinal purposes and the fibre utilized in making ropes, baskets, bags and handicrafts (Wickens and Lowe, 2008).
In spite of various uses of baobab, the baobab tree remains in the wild and has not been domesticated due to challenges with seed dormancy, prolonged juvenile stage, deforestation, climate change and increased population (De Smedt *et al.*, 2012; Sanchez *et al.*, 2011a; Jansen *et al.*, 2020). Its seed coat is hard resulting to erratic germination. Propagating baobab is not common and implementing conservation strategies are still on a snail run (Sanchez, 2011b; Gebauer and Luedeling, 2013; Gebauer *et al.*, 2016).

Utilizing suitable nursery medium could solve the aforementioned problems. The successful production of quality seedlings in the nursery relies on selection of suitable media (James and Michael, 2009). Media plays critical role in seed germination and serves as a determining factor to a successful tree planting programme (Manenoi *et al.,* 2009). Growth media is a place where seeds are sown and source of nutrients for seedling growth and development (Khadijah *et al.,* 2020). A good nursery media should be able to provide anchorage, adequate nutrients, aeration and retain water moderately (Abad *et al.,* 2002). Adding organic matter to potting media is crucial as it supplies essential nutrients needed by seedlings (Khan *et al.,* 2006). The biological, physical and chemical properties of a nursery media is determined by organic matter content (Grace *et al.,* 2006) and it is vital in sustenance of the ecosystem's productivity (Kirchmann *et al.,* 2004). Baiyeri and Mbah (2006) posited that *Treculia africana* seedlings performed better when raised in saw dust based media compared with the soil based medium. In another study, Baiyeri, (2005) stated that rice hull based media exhibited superiority in raising Musa plantlets than those in sawdust based media. Since standard nursery media for baobab has not been determined in the study area. Identifying the appropriate media for seedling emergence and early growth for the species could ensure food security, improve the diet of the people, accelerate the cultivation of the crop and prevent it from going into extinction. This study assessed baobab seedling emergence and early growth responses to different nursery media with the aim of determining the best media for the raising of baobab seedlings in the nursery.

MATERIALS AND METHODS

Experimental site: The study was carried out at the College of Agriculture, Kabba (7.8231˚N, 6.0732˚E and 400 m above sea level, Kogi State, Nigeria between March to September, 2022. The area is located in the Southern Guinea Savanna Zone and is characterized by monomodal rainfall that spans between April to November with peak in June. The dry season extends from December to March. The mean annual rainfall is 1570 mm per annum with an annual temperature ranging from 18-32˚C and the mean relative humidity is 60%. The dry season commences in December and runs through to March (Weatherbase, 2019).

Experimental materials: Dry fruits of baobab were sourced from the wild at Kabba, Kabba/Bunu Local Government Area of Kogi State. Poultry manure utilized was collected from the livestock section of College of Agriculture, Kabba. The oil palm bunch residue was obtained from the Horticulture Section, College of Agriculture, Kabba. Also, the rice hull used was gotten from a rice mill in Kabba and the sawdust was collected from a saw mill in Kabba. The soil and other media components used were analyzed for physical and chemical properties at the Soil Science Departmental Laboratory, Faculty of Agriculture, University of Nigeria, Nsukka.

Experimental design and procedure: The nursery media involving the following were formulated on volume basis: topsoil (TS) (100%), TS+ Poultry manure (PM)+Rice husk (RH) (2:1:3), TS+PM+ Sawdust (SD) (2:1:3), TS+PM+ Oil palm bunch residue (OPBR) (2:1:3), TS+PM +OPBR+RH+SD (1:1:1:1:1). The different nursery media were thoroughly mixed and filled into a perforated polyethylene bag with diameter of 38.5 cm and length of 48 cm. The media were moistened and left for four weeks before planting. The seeds were extracted, soaked in warm water overnight and ten seeds were planted per pot. The experiment was laid out in a completely randomized design (CRD) with five replications. At eight weeks after emergence count, the seedlings were thinned to three per pot. Weeds were handpicked and watering was done at appropriate intervals.

Data collection and analysis: Days to first emergence: It was determined by counting the number of days from planting to when the tender shoot protruded out of the media and the average recorded
Emergence percentage (E%), emergence index (EI) and emergence rate index (ERI) were calculated based on the following formulae adopted by Fakorede and Ojo (1981):

$$E\% = \frac{No\ of\ Seedlings\ emerged}{Total\ number\ of\ seeds\ planted} X\ 100$$

$$EI = \frac{\sum (Number\ emerged)\ (DAP)}{Total\ seedlings\ emerged}$$

$$ERI = \frac{EI}{E\%\ (in\ decimal)}$$

Similarly, plant height (cm) (it was measured using a meter ruler from the soil level to the terminal bud), number of leaves (the number of leaves were counted and the average recorded), number of branches (the number of branches were counted and the average taken) and stem girth (cm) (this was measured at about 2.5 cm above the soil level using a Vernier caliper).

Statistical analysis: The data collated were subjected to analysis of variance (ANOVA) following the procedure outlined for CRD using Genstat software (2013). Significantly different means was separated using least significant difference test (LSD) at 5% level of probability.

RESULTS

Physical and chemical properties of the nursery media

Physical and chemical properties of the nursery media used for the experiment is shown in Table 1. The results showed variations in both the physical and chemical properties of the media owing to different components and proportions in each. The soil is characterized to be sandy clay loam. Properties of the

soil and other media indicated that the soil is acidic with pH value of 5.10. The pH recorded for TS+PM+OPBR, TS+PM+OPBR+SD+RH, TS+PM+RH and TS+PM+SD with respective values of 7.9, 7.5, 7.8 and 7.7 showed alkaline levels. The nitrogen content (0.09%) of the soil was very low while those of TS+PM+OPBR, TS+PM+OPBR+SD+RH, TS+PM+RH and TS+PM+SD were a little bit high as a result of poultry manure addition. The distinct variability in the physical and chemical properties of the nursery media could influence seedling emergence and seedling performance of baobab.

Table 1: Physical and chemical properties of the nursery media utilized for emergence and early seedling growth of baobab

Physical	TS (100%)	TS+PM+OPBR (2:1:3)	TS+PM+OPBR+SD +RH (2:1:1:1:1)	TS+PM+RH (2:1:3)	TS+PM+SD (2:1:3)
Coarse sand (g/kg)	360	420	430	450	440
Silt (g/kg)	90	80	80	80	60
Clay (g/kg)	240	130	130	130	130
Textural class	SCL	SCL	SCL	SCL	SCL
Chemical					
pH(H_2O)	5.10	7.9	7.5	7.8	7.7
pH in KCl	4.20	7.0	6.8	6.7	7.0
Organic carbon (g/kg)	15.40	28.30	29.20	19.00	25.30
Organic matter (g/kg)	26.80	35.20	45.10	31.20	39.10
Total nitrogen (g/kg)	0.90	1.90	1.70	1.60	1.70
Phosphorus (mg/kg)	7.92	29.10	16.42	28.87	27.02
Sodium (Na^+) Cmol/kg	0.08	0.09	0.10	0.10	0.12
Calcium (Ca^{2+}) Cmol/kg	0.87	4.53	4.11	3.48	4.33
Potassium (K^+) Cmol/kg	0.27	0.19	0.15	0.16	0.19
Magnesium (mg^{2+}) Cmol/kg	1.29	1.87	1.46	1.50	1.36
CEC (Cmol/kg)	16.60	11.21	17.31	15.73	13.51
Base Sat. (g/kg)	530.00	856.40	865.00	821.40	812.20

Sandy clay loam (SCL)

Emergence parameters

The data presented in Table 2 indicated that there was a significant ($P < 0.05$) effect of nursery media on seedling emergence and percent seedling emergence. however, emergence index and emergence rate index did not vary statistically. Earliness to first seedling emergence (22.8 days) and highest percent emergence (88%) was obtained in media TS+PM+RH. The value obtained in
TS+PM+RH with respect to first seedling emergence was statistically similar to the value recorded in TS+PM+OPBR. Sole topsoil exhibited delay in seedling emergence with 26.4 days. Seeds planted in TS+PM+OPBR+SD+RH had the least percent emergence (40%).

Table 2: Effect of nursery media on seedling emergence, percent seedling emergence, emergence index and emergence rate

Media	DFE	%E	EI	ERI
TS (100%)	26.4	56	30.37	57.5
TS+PM+OPBR (2:1:3)	23.6	56	28.69	48
TS+PM+OPBR+SD+RH (2:1:1:1:1)	25.6	40	25.57	64.2
TS+PM+RH (2:1:3)	22.8	88	31.65	36.5
TS+PM+SD (2:1:3)	26	56	30.99	57
LSD (0.05)	1.17	15.64	NS	NS

TS- Sole topsoil, PM- Poultry manure, OPBR- Oil palm bunch residue, SD- Sawdust and RH- Rice hull. NS-non-significant.

Growth traits

As shown in Table 3, plant height varied with the nursery media at 3, 4, 5 and 6 months after planting (MAP) except at 2 MAP. Media TS + PM + OPBR had the tallest plants (83.00, 114.00, 145.00 and 180.30 cm) at 3, 4, 5 and 6 MAP, respectively. This was closely followed by TS+PM+OPBR+SD+RH. However, plants that grew in TS + PM + SD gave the least plant height of 38.70, 66.30, 90.00 and 117.30 cm.

Table 3: Effect of nursery media on plant height (cm) of baobab (*Adansonia digitata*) at 2, 3, 4, 5 and 6 months after planting

	Plant height in months after planting				
Media	2	3	4	5	6
TS (100%)	34.30	60.00	90.70	124.30	158.70
TS+PM+OPBR (2:1:3)	51.30	83.00	114.00	145.00	180.30
TS+PM+OPBR+SD+RH (2:1:1:1:1)	49.30	76.00	102.30	132.30	163.00
TS+PM+RH (2:1:3)	25.00	38.70	66.30	90.00	117.30
TS+PM+SD (2:1:3)	38.70	66.70	93.70	125.00	156.70
LSD (0.05)	NS	23.86	25.27	16.49	11.41

TS- Sole topsoil, PM-Poultry manure, OPBR- Oil palm bunch residue, SD- Sawdust and RH- Rice hull.

Table 4 showed significant (P< 0.05) influence of nursery media on number of leaves of baobab across the months. Noteworthy is that, TS+PM+OPBR produced more leaves at 2, 3, 4, 5 and 6 MAP with respective values of 43.00, 122.70, 159.00, 193.70 and 221.30. This was keenly followed by TS+PM+OPBR+SD+RH while plants grown in TS+PM+RH (2:1:3) had the least (12.30, 28.70, 60.70, 93.30 and 125.00.

Table 4: Effect of nursery media on number of leaves of baobab (*Adansonia digitata*) at 2, 3, 4, 5 and 6 months after planting

	Number of leaves in months after planting				
Media	2	3	4	5	6
TS (100%)	24.70	37.00	67.70	96.30	129.70
TS+PM+OPBR (2:1:3)	43.00	122.70	159.00	193.70	221.30
TS+PM+OPBR+SD+RH (2:1:1:1:1)	41.00	82.00	111.00	144.30	179.30
TS+PM+RH (2:1:3)	12.30	28.70	60.70	93.30	125.00
TS+PM+SD (2:1:3)	23.70	52.30	90.70	120.30	141.30
LSD (0.05)	19.46	30.14	33.03	29.93	40.67

TS- Sole topsoil, PM- Poultry manure, OPBR- Oil palm bunch residue, SD- Sawdust and RH- Rice hull.

Significant ($p < 0.05$) difference was observed among the nursery media on stem girth of baobab (Table 5) at 2, 3, 4, 5 and 6 MAP. The results on comparison between nursery media with respect to stem girth across the months was in the following order TS+PM+OPBR >TS+PM+OPBR+SD+RH >TS+PM+SD >TS 100% >TS+PM+RH.

Table 5: Effect of nursery media on stem girth (cm) of baobab (*Adansonia digitata*) at 2, 3, 4, 5 and 6 months after planting

	Stem girth in months after planting				
Media	2	3	4	5	6
TS (100%)	2.80	3.70	4.60	5.30	6.20
TS+PM+OPBR (2:1:3)	3.90	5.53	6.53	7.70	8.77
TS+PM+OPBR+SD+RH (2:1:1:1:1)	3.07	4.10	5.10	5.87	6.77
TS+PM+RH (2:1:3)	2.23	2.90	3.53	4.30	5.50
TS+PM+SD (2:1:3)	3.03	4.07	4.87	5.77	6.77

LSD (0.05)	0.66	0.75	0.73	0.67	1.13

TS- Sole topsoil, PM- Poultry manure, OPBR- Oil palm bunch residue, SD- Sawdust and RH- Rice hull. NS-non-significant

Nursery media had no significant ($p > 0.05$) effect on number of branches of baobab at 2, 3, 4, 5 and 6 MAP (Table 7). However, plants grown in media TS+PM+OPBR was 74.11, 73.00, 67.80, 62.82 and 56.12% superior with respect to number of branches across the months compared with TS+PM+RH that gave the least. The control (TS 100%) performed better when compared with TS+PM+RH.

Table 7: Effect of nursery media on number of branches of baobab (*Adansonia digitata*) at 2, 3, 4, 5 and 6 months after planting

Media	Number of branches in months after planting				
	2	3	4	5	6
TS (100%)	2.67	10.00	16.70	23.70	31.30
TS+PM+OPBR (2:1:3)	9.00	25.00	41.30	57.30	67.70
TS+PM+OPBR+SD+RH (2:1:1:1:1)	8.00	22.00	30.00	37.70	43.70
TS+PM+RH (2:1:3)	2.33	6.70	13.30	21.30	29.70
TS+PM+SD (2:1:3)	2.33	12.00	23.00	34.30	45.30
LSD (0.05)	NS	NS	NS	NS	NS

TS- Sole topsoil, PM- Poultry manure, OPBR- Oil palm bunch residue, SD- Sawdust and RH- Rice hull. NS-non-significant

DISCUSSION

Seedling emergence

The values recorded for emergence percentage (40-88%) in this present work seem encouraging when compared with 33.2 – 73.2% as reported by Ugese and Dennis (2006) in *Tamarindus indica*. On the other hand, Ugese (2010) reported higher percent seedling emergence (66.7–93.3%) in *Tamarindus indica* in comparison with the values recorded in this work. Differences in the species, composition of the media and location of collection of seeds must have influenced the results that led to the variability. It was evident that media TS+PM+RH enhanced seedling emergence and gave the highest seedling emergence percentage than other media used in this study. The superior performance exhibited of seedlings in TS+PM+RH could be attributed to improved aeration, high water holding capacity and stimulation of warmth by the media. The finding agrees with the report of Ugese (2010) who stated that rice hull based media enhanced seedling emergence in *Tamarindus indica.* Similar result was reported by Peter-Onah *et al. (*2014); Baiyeri and Mbah (2006) in *Monodora myristica* and *Treculia africana*, respectively.

Early seedling growth

It is pertinent to note that media TS + PM + OPBR increased plant height, number of leaves and stem girth of baobab in most of the sampling months. It also had the tendency to produce more branches. The addition of poultry manure and oil palm bunch residue could have increased the organic matter and nitrogen contents in the media leading to the better seedling performance. Nursery media has pronounced effect on the seedling growth traits (Riaz *et al.*, 2008). The use of media containing essential nutrients in sufficient amount is crucial for seedlings to attain maximum growth (Ikram *et al.,* 2013). Riaz *et al.* (2008); Parasana *et al*. (2013) found that incorporating organic substrates such as leaf and farmyard manure enhances growth characteristics of *Zinnia elegans* and *Mangifera indica,* respectively. Substrates utilized in a media could positively influence the performance of a wide range of plants in the nursery (Peter-Onoh *et al.,* 2014) because of the availability of adequate nutrients in it (Grigatti *et al.,* 2007).

CONCLUSION

The result of this study showed that nursery media positively influenced some of the emergence and most of the growth parameters evaluated. Media TS+PM+RH enhanced seedling emergence. Media TS + PM + OPBR showed superiority with respect to baobab seedling growth and should be used especially in the study area where there is abundant poultry manure and oil palm bunch residue.

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