Evaluation of growth media, seed-sizes and microclimate on sproutability of *Tetracarpidium conophorum* (African walnut)

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ABSTRACT

African walnuts (*Tetracarpidium conophorum*) are fruits of a woody perennial climber plant with decorative, nutritive, medicinal, agricultural and industrial values. Seed quality, germination medium and environmental condition are some of the key factors of seed germination. This study evaluated the interactions of sowing media, seed sizes and microclimate on emergence of *Tetracarpidium conophorum*. Seeds of three size categories (Large (<1.5 cm), Medium (1.6-1.90 cm) and Small (>2.0 cm)) were sown into two media (sterilized river sand and treated sawdust). The growth media were placed under three microclimates (open nursery, humid propagator and black polythene cover) and observed for germination. The experiment was laid out in a 3 × 2 × 3 factorial in completely randomized design. The results show that large sized seeds sown in sterilized river sand in the open nursery had 100% germination while the medium sized seeds sown in saw-dust under humid propagator produced the least germination percentage (44.4%). Overall assessment of the experiment therefore showed that large seeds sown in sterilized river sand in open nursery as best for seedling emergence of *T. conophorum*.

Keywords: *Tetracarpidium conophorum,* microclimate, humid propagator, seed quality

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INTRODUCTION

The tropical African walnut, known as *Tetracarpidium conophorum* or *Plukenetia conophora* (Oyekale *et al*. 2015), belongs to the family Euphorbiaceae (Edem *et al*., 2009; Ayeni and Nuhu, 2018). African walnuts are fruits of a woody perennial climber plant, found mostly in the dense rain-forest of Africa (Ojobor *et al*, 2015) and is popularly known as African walnut, black walnut and Nigerian walnut (Ekwe and Ihemeje 2013; Nwaichi *et al*., 2017). In Nigeria, the walnut is referred to as *asala*, u*wusa*/ *awusa* in Yoruba, *ekporo* in the Efik dialect, *ukpa*in in Igbo (Ayodele, 2003), *gawudibairi* in Hausa, and *okhue* or *okwe* among the Bini tribe of Edo State (Kanu *et al*., 2015).

African walnuts are edible seeds that are widely cultivated for their delicacy (Ayeni and Nuhu, 2018) and like many plants in Africa and other parts of the world, has been proven to have decorative, nutritive, medicinal, agricultural and industrial values over the years (Ihemeje *et al*, 2010). The fruits come in a hard kernel casing which releases a whitish round nut when cracked open. The shell color is often black but can be any shade of grey (Ayoola *et al*, 2011).The entire plant including leaves and roots have nutritional and medicinal properties, for which it is cultivated. For instance, the bark is used by local people as a mild laxative (Janick and Paul, 2008), while the seed kernel, when eaten raw, is known to have a bitter taste like the kola nut and is considered to be a tonic and aphrodisiac (Aiyeloja and Bello, 2006).

The fruits, which are basically a type of nut, are the most commonly used part of the plant; they are edible and used for various purposes, including masticatory, thrush, anti-helminth, syphilis and also as an antidote against snake bites (Obianime and Uche 2010). The nut oil contains 48% – 50% dry weight of oil, golden yellow with a taste and odour similar to linseed oil (Negi *et al*., 2011) and, according to Isong *et al.,* (2013), the oil is a non-drying oil suitable for paint and soap making as well as other industrial purposes and also has potential as a source of biofuel when compared with commercial graded diesel.

Despite the numerous nutritional, ethno-medicinal and phyto-chemical uses, *Tetracarpidium conophorum* has not attracted enough valuable research compared to other forest products due to its recognition as a non-timber product. African walnut is still mostly found in the wild as a climber in the forest region of Africa and usually cultivated by subsistence farmers (Oyekale *et al.*, 2015; Chijoke *et al.,* 2015) reported that planting materials are not available in the open market because of non-existence or a few available nurseries of the plant. In essence, information available concerning the silvicultural requirements in terms of soil, seed quality, appropriate germination media, micro- climate among other factors for mass propagation of the species in the nursery is inadequate at best. These aspects of this important NTFP have not been thoroughly researched yet seed quality is thought commonly to be an important focus of selection on the life histories of plants because of the likelihood of dispersal and germination (Armstrong and Westoby, 1993) and survival (Bonfil, 1998) can all depend on seed. Hence, there is a growing concern as to what can be done to

develop standard silvicultural technique for regeneration of *T. conophorum* and provide adequate information on germination of the species. This study therefore seeks to evaluate some aspects of germination conditions best for mass propagation of *T. conophorum* plant.

MATERIALS AND METHODS

The experiment was conducted at the Federal College of Forestry, Jericho Hills (latitude 7^0 26'N and longitude $3^0$51'E) Ibadan in South West Local Government Area of Oyo State. The area has annual rainfall range of 1300mm – 1500mm with a bimodal pattern, average humidity of about 65% and average temperature is about 26^0C (FRIN, 2017). Seed samples in a seed lot were separated into three size classes (Large (<1.5cm), Medium (1.6-1.90cm) and Small (>2.0cm)) using visual observation. The diameter and weight of the samples from each size class were categorized using vernier caliper and electronic weighing balance respectively.

Polythene pots (12.0cm × 8.0cm x 6.0cm) were separately filled with sterilized river sand and treated sawdust and seeds from each size classes sown into them at 2cm depth. The sown seeds were then subjected to three environmental conditions: humid propagator, open nursery and under a structure covered with black polythene. The experiment was a 3 x2 x 3 factorial laid in completely randomized design. A total of ten (10) seeds were used per treatment, replicated three (3) times. The samples were watered once daily and monitored for germination. Sprouts were observed on the sown seeds as evidence of germination, counted as they were noticed and recorded. The data collected were subjected to descriptive statistics like percentages, means, graphs and inferential statistic (Analysis of variance)

RESULTS

Percentage Germination of *Tetracarpidium conophorum* of different sizes and weights under two germination Environments

Table 1 shows percentage germination of *Tetracarpidium conophorum* seeds sown on different sowing media and different environmental condition. Microclimatic regimes, sowing media and seed size are the major factors determining the success of plantation establishment especially at early stage, and the most convenient basis for determining the success of such plantation. Large sized seed had 100% germination in both sterilized river sand and treated sawdust in the open nursery. The results revealed that the average germination ranged between 66.67 and 100%. Germination on river sand irrespective of size and micro climate ranged between 55.56 and 100% while on treated sawdust was from 44.4 to 100%. All seed sizes sown in river sand under black polythene cover had 100% germination each. Small and large seed sizes under humid

propagator also had 100% germination each. Also, large and medium sized seeds sown in treated sawdust in the open nursery gave 100% germination each. This was also for large seeds sown in river sand under black polythene cover while small seed sample sown in treated sawdust was next with 88.89%. The least was however recorded in treated sawdust with medium seed size under humid propagator (44.4%). The overall highest mean germination was recorded for large seeds sown in the two media but under humid propagator with 100% each while its medium size had the least (66.5%).

Table 1: Germination percentage of *Tetracarpidium conophorum*

Microclimate	**Seed Size**	**River sand (%)**	**Treated Sawdust (%)**	**Average (%)**
Open Nursery	Large	88.89	100	94.45
	Medium	55.56	100	77.78
	Small	66.67	66.67	66.67
Humid Propagator	Large	100	100	100
	Medium	88.89	44.4	66.65
	Small	100	66.67	83.34
Black Polythene	Large	100	88.89	94.45
	Medium	100	77.78	88.89
	Small	100	88.89	94.45

Table 2: F. Cal. of Analysis of Variance conducted on Percentage Germination of *Tetracarpidium conophorum*

Sources of variation	**% Germination**
Microclimate (MC)	39.45*
Seed Size (SS)	118.25*
Sowing Media (SM)	59.84*
MC * SS	59.31*
MC * SM	213.04*
SS * SM	29.71*
MC * SS * SM	34.01*

**significant difference (P≤0.05)*

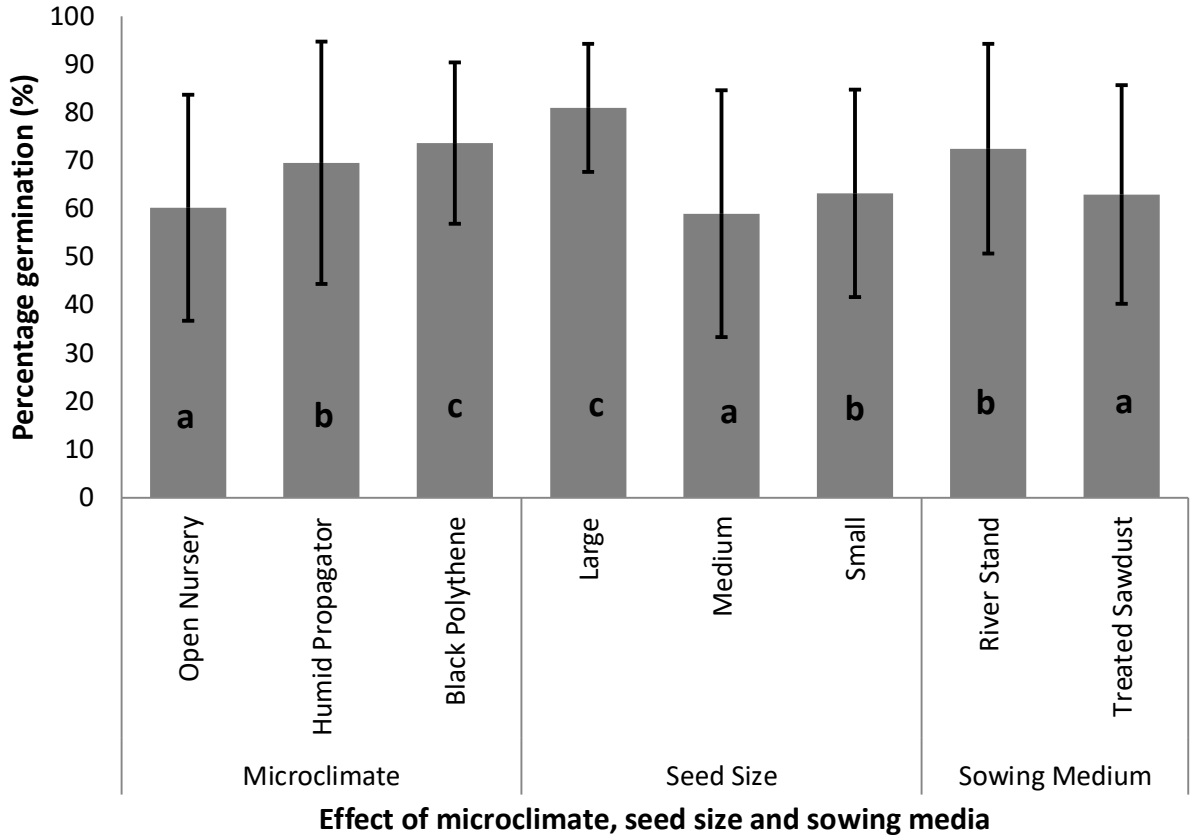

Figure 1: Effect of microclimate, seed size and sowing media on percentage germination of *Tetracarpidium conophorum*. *Mean Values with error bar, numbers carrying the different alphabets in the bar are significant (P≤0.05)*

Table 3a: Effect of interaction on percentage germination of *Tetracarpidium conophorum*

Microclimate	**Sowing Medium**	**Mean±SD**
Open Nursery	River Stand	46.53±13.10a
	Treated Sawdust	73.91±24.09b
Humid Propagator	River Stand	81.84±13.22b
	Treated Sawdust	55.90±28.84a
Black Polythene	River Stand	89.96±0.00b
	Treated Sawdust	59.17±7.75a
Seed Size	**Sowing Medium**	
Large	River Stand	80.94±13.68a
	Treated Sawdust	81.02±13.76a
Medium	River Stand	62.21±24.46b
	Treated Sawdust	55.80±27.80a
Small	River Stand	74.29±23.51b
	Treated Sawdust	52.16±12.69a

Mean Value±SD, number carrying the different alphabet in column are significant (P≤0.05)

Table 3b: Effect of interaction on percentage germination of *Tetracarpidium conophorum*

Microclimate	Seed Size	Sowing Medium	Mean±SD
Open Nursery	Large	River Stand	62.88±3.95e
		Treated Sawdust	89.95±0.00f
	Medium	River Stand	33.75±1.91ab
		Treated Sawdust	89.95±0.00f
	Small	River Stand	42.95±1.15c
		Treated Sawdust	41.81±1.63c
Humid Propagator	Large	River Stand	89.95±0.00f
		Treated Sawdust	89.95±0.00f
	Medium	River Stand	62.92±4.35e
		Treated Sawdust	26.35±0.99a
	Small	River Stand	89.95±0.00f
		Treated Sawdust	51.39±15.67cd
Black Polythene	Large	River Stand	89.95±0.00f
		Treated Sawdust	63.14±6.14e
	Medium	River Stand	89.95±0.00f
		Treated Sawdust	51.08±2.42cd
	Small	River Stand	89.95±0.00f
		Treated Sawdust	63.28±7.04e

Mean Value±SD, number carrying the different alphabet in column are significant (P≤0.05)

Percentage Germination of *Tetrocarpidium conophorum*

Table 2 revealed significant differences (P≤0.05) in the germination of *T. conophorum* seeds subjected to microclimate, seed size and sowing media. The interactions of microclimate and sowing medium; seed size and sowing; and combined interactions of microclimate, seed size and sowing media were also significant. The mean percentage germination of *T. conophorum* ranged (Figure 1) from 60.22 - 69.56 % (microclimate), 59.00-80.98% (seed size) and sowing media (62.23 - 72.48%). Meanwhile, effect of microclimate, seed size and sowing media were significantly different from each other (Figure 1). The effect of interaction also differed significantly (Tables 3a & 3b).

DISCUSSION

In some tree species larger seeds are regarded to produce bigger seedlings with the potential to survive better and grow stronger. Larger sized seed could indicate better genetic potential for quality germination of seeds (Abideen *et al.*, 1993; Alptekin *et al.*, 2002). All factors considered were significant on sproutability of *Tetracarpidium conphorum*. However, large seed class performed significantly better than the medium and small seed size classes in terms of germination percentage (Table 2). This is in agreement with the findings of Navarro *et al.*, 2006 which may be due to the fact that

larger sized seeds have the potential to produce larger embryos and have a high respiration rate that results in greater field emergence than the small sized seeds. Seed sizing appears to be a tool to the nursery manager to produce larger seedlings (Singh, 1998). However, discarding small seeds should not be practiced unless there is good genetic evidence to justify the practice (Karrfalt, 2004).

Unfavorable growing environment is amongst the major factors that contribute to poor germination, growth and quality of tree seeds in tropical areas (Elisha *et al*., 2012). Natural temperature changes play a dominant role in controlling the temperature range over which germination may occur in seed populations of species that exhibit seasonal dormancy patterns (Robin, 2001). Temperature is the single most important factor in the regulation of the timing of germination, because of its role in dormancy control and/or release, or climate adaptation. (Hartmann *et al*., 1997) Modification of the crop microclimate through natural shading influences soil temperature and this will have an effect on germination and performance of forest tree seeds in the nursery for small- scale farmers who have inadequate resources to construct a controlled environment such as greenhouse and want to improve their living standards (Elisha *et al*., 2012).

The microclimate to which the seeds of *T. conophorum* were subjected had effect on the percentage germination because environmental effects like temperature, relative humidity, sowing medium among others affect germination of plants. The report by Colombo *et al*., 2015 and Gunaga *et al.,* 2011 confirmed that seed size is one of the considerable qualities which affect germination, survival, seedling growth and its establishment. Thus, there is the likelihood that the larger the seed, the faster the rate of germination while compared with medium and smaller sizes. According to Aderounmu *et al.,* (2019), sowing media had effect on germinability of *Afzelia africana* irrespective of seed size.

CONCLUSION

The experiment conducted on germination of *Tetracarpidium conophorum* showed that germination performance was significantly affected by seed size, sowing media and micro-climate. Maximum germination percentages was shown by large seeds irrespective of media or environment. From the result obtained, it could be concluded and recommended that large sized seeds of *T. conophorum* are best be propagated en-mass on sterilized river sand in the open nursery thus, reducing the cost of constructing propagator during the early stage of species.

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