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Assessing seedling quality of *Chrysophylum albidum* Linn using quantitative morphological traits

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Abstract
Seedling quality assessment of four location-based genotypes of Chrysophylum albidum was considered in this research work to assess the total quality of Chrysophylum albidum and specifically show the outstanding location-based genotype in term of seedling quality. Chrysophylum albidum genotypes were collected from four different locations in three local government areas of Oyo State in Nigeria; (i) Igbo Oloyin, {A-IO}, (ii) Koru koru, {A-KK} both in Akinyele Local Government, (iii) Akanran, {O-AK} in Ona-ara Local Government and (iv) Aba Olode, {I-AO} in Ido Local Government. The research work was set up in a screen house at the Federal College of Forestry, Ibadan, Nigeria in Randomized Complete Block Design. Seven quantitative agro-morphological characters considered were germination count, plant height, number of leaf, leaf length, leaf width, leaf area, and stem diameter at seedling stage accounted for seedling quality. Silvicultural practices were fully observed to nurture the seedlings during the research work. Results showed that for seedling height, all genotypes were significantly indifferent indicating uniform seedling quality with I-AO genotype having the highest value 6.16±0.69 while genotype A-KK had the lowest value of 5.09±0.37 and in stem diameter, A-KK had the highest value of 0.13±0.01while I-AO had the lowest value of 0.10±0.00 indicating the inverse correlation between the seedling height and stem diameter in I-AO and A-KK genotypes. Considering the germination trait, O-AK had the highest value of 5.00±0.01 with A-KK having the lowest value of 3.74±0.03. A-IO had the highest value in leaf area with 7.38±0.24 while I-AO had the lowest value of 6.26±0.47. It was then concluded that all genotypes considered had considerable seedling quality putting seedling height, stem diameter and leaf area into consideration. Also concluded for planting choice are O-AK genotype for greatest germination vigour, I-AO genotype for height trait consideration, A-KK genotype for stem diameter and A-IO genotype for leaf area consideration.

Keywords: seedling quality, morphology, traits, quantitative, viability

1. Introduction
Chrysophyllum albidum Linn is a common tree that is distributed in the tropical rain forest and coastal region of West Africa. It is commonly called African star apple. It is primarily a forest tree species and its natural occurrences have been reported in diverse eco-zones in Nigeria, Uganda, Niger Republic, Cameroon and Cote d'lvoire [1]. The plant often grows to a height of 36.5 m. The African star apple fruit is a large berry containing 4-5 flattened seeds or sometimes fewer due to seed abortion [2]. The plant recently has become a crop of commercial value in Nigeria. The fleshy pulp of the fruits is eaten especially as snack and relished by both young and old [3]. The fleshy and juicy fruits, which are popularly eaten, are the potential source of a soft drink [4, 5]. The fruits are also suitable for the production of fruit jams and jellies [6]. It is reported as an excellent source of vitamins, irons, flavors to diets and raw materials to some manufacturing industries [7, 1]. Ecologically, the tree has an efficient nutrient cycling and the high rate of mineralization of the leaves improves the quality of the top soil [8].

In spite of deforestation, which has resulted in substantial loss of these indigenous fruit trees, the remaining few ones which are being conserved are now undergoing domestication problem [7]. However, the joy of good fruit harvest by individual farmer or forest dweller is shorter-lived. This is because substantive percentages of the harvested fruits are lost due to post-harvest and marketing problems [9].

The demand for bigger, better, faster-growing seedlings have been ever-growing. As a result, forest seedling production is a continually evolving technology in reforestation.

Evaluating seedling quality is crucial for understanding seedling development in the nursery, as well as subsequent field growth and survival. Stock quality, however, often is assessed inconsistently and on only a limited basis. The phenotype of a plant is a term used to describe observable characteristics, such as height, biomass, and leaf shape [10]. [11] In his work reported "seedling quality evaluation can be used to establish benchmarks at specific points, such as time of lift or delivery, There are two categories of seedling quality assessment: morphological and physiological [10]. however reported, seedlings are relatively pampered in the nursery, they can have a rather perilous journey from their safe growing environment to their planting-out destination. During lifting, grading, storing, handling, and planting, opportunities for seedlings to be subject to moisture stress, temperature stress, or physical stress are numerous. These stresses are cumulative and can lead to poor field performance. When this occurs, there can sometimes be a dispute between the nursery and the landowner over what caused the poor growth, survival, or both after planting-out. Seedling quality data can assist in determining whether seedling performance issues are due to something that occurred in the nursery, improper planting practices, or environmental conditions after planting-out.

Morphological quality is based on the physical attributes of the seedling, whereas physiological quality is based on the

seedling's internal functions. Of course, the two categories are not mutually exclusive. A seedling's morphological characteristics can be considered a physical manifestation of its physiological activities. Morphology is used far more often than physiology to evaluate seedling quality. Height and stem diameter are the two characteristics most commonly examined on forest seedling [10].

[12] reported that the ease with which most seedling morphological parameters can be measured makes them the most popular method for measuring seedling quality.

2. Materials and Methods

2.1 The Experimental Site

The experiment was carried out inside plant screen house of the Department of Forestry Technology, Federal College of Forestry, Jericho Ibadan, Oyo State. The College is situated in Ibadan South West Local Government of Oyo State. The area lies on Latitude 7^0 23'N and Longitude 3^0 51'E. The climate condition of the area is tropically dominated by rainfall pattern from 1200mm-1250mm. The average temperature is about 32^0 C, average relative humidity of 80%-85% and the ecology climate of the area experience rainfall with two distinct seasons; dry season usually from November-March and raining season usually from April-October [13].

2.1.1 Fruits Collection and Seed Extraction

Matured fruits of *Chrysophylum albidum* were collected from parent trees from four different villages surrounding Ibadan. The villages are (i) Igbo Oloyin, (ii) Koru koru both in Akinyele Local Government, (iii) Akanran in Ona-ara Local Government and (iv) Aba Olode in Ido Local Government, all in Oyo State. The seeds were extracted by squeezing the pods, and cleansed with water.

Table 1: Names and sources of the genotypes used for the study

S/n	Genotypes	Sources
1	I- AO	Aba Olode, Ido Local Government
2	O- AK	Akanran, OnaAra Local Government
3	A- IO	Igbo Oloyin, Akinyele Local Government
4	A- KK	Korukoru, Akinyele Local Government

***Source*:** Field survey, 2018.

Table 2: Materials used and their Uses

Serial	Materials	Uses
1	*Chrysophyllum albidum* seed	Seeds were raised for emancipation of variability.
2	Polythene pots	Polythene pots were filled with top soil to raise *Chrysophyllum albidum*.
3	Veneer caliper	Was used to measure the seedling girth on the main stem below the first two-leaves.
4	Top soil	A growth medium in which the seed were sowed.
5	Hand trowel	A tool used to fill the polythene pot with soil medium
6	Note book & Pencil	Was used to take & record readings of the research work.
7	Graduated ruler	Was used to measure the height of the plant, length and width of the leaves.
8	Sieve	Was used to sieve the top soil of foreign materials to give even soil medium.
9	Watering can	Was used to apply water to the seeds/seedlings.
10	Graduated stick	Was used to make 1cm sowing depth in order to have even depth of sowing seeds.

***Source*:** Field survey, 2018.

2.1.2 Methods

Three hundred seeds from four villages (making 75 seeds per village) were cleansed, scarified, tested for viability via water immersion and sown to the depth of 1cm in the polythene pots filled with sieved top soil. The soil was collected beside the college nursery to the depth of 8cm and sieved before filling into the poly-pots. The seeds were soaked in water at room temperature for 24 hours to enhance germination. The experiment was grouped with sampling units by the names of the villages. The experimental units were watered twice in a day (early in the morning and evening after sun set).

2.1.3 Experimental design

Three hundred (300) seeds were sown representing 75 seeds per village and planted in 12.5cm x 18.4cm x 14cm black polythene pots filled with sieved top soil. The experiment was laid-out in Randomized Complete Block Design (RCBD). Each sampling unit representing a village was replicated four times.

2.1.4 Data collection

One hundred and sixty (160) seedlings were randomly selected for data collection representing forty (40) seedlings per village. Parameters on which data was collected are shown below

Table 3: Parameters and Methods of Measurement

S/n	Parameters	Methods of Measurement
1.	Germination count:	The counting of emerged seedling after sowing of seeds The height of each seedling was taken from the soil
2.	Seedling height	surface to the tip of the seedling with the aid of graduated ruler.
3.	Seedling girth	Circumference of each seedling was taken from the base of the first leaves with the aid of vernier caliper.
4.	Leaf length	This was taken by graduated ruler from leaf petiole to leaf tip
5.	Leaf width	This was the measurement of the wider part of the leaf by graduated ruler.
6.	Leaf area	This was taken by Leaf Area = $\underline{x}$ y cm^2 (14).
7.	Number of leaf	This was done by counting of leaf emerged of each seedling.

***Source*:** Field survey, 2018.

2.1.5 Derivations

From growth parameters taken, two important growth determinants were derived. They are:

- $\text{Germination percentage} = \frac{\text{Number of seed germinated}}{\text{Number of seeds planted}} \text{ X } 100$
- Leaf Area = x/y cm^2 [14]

Where: x represent weight of graph paper covered with the leaf, (leaf-shape paper).
y represent weight of cm^2 graph paper

2.1.6 Data Analysis

Data collected were analyzed using [15].
Analysis of Variance was computed to highlight the site and genotypes effects on the seedling quality of *Chrysophylum albidum* genotypes.
Mean values of the seedling quality assessment was performed to test the significant relationship among the location-based *Chrysophylum albidum* genotypes under the scope of seedling quality assessment as revealed by morphological traits considered.

Table 4: Anova of Morpohologically Assessed Seedling Quality of *Chrysophylum albidum*

Source of Variation	DF	Plant Height	Stem Diameter	Leaf Production	Leaf Length	Leaf Width	Leaf Area	Germination
Block	3	2.04ns	3.45*	3.48*	1.48ns	1.19ns	3.18*	2.97*
Genotype	3	10.17*	10.76*	3.03*	4.63*	2.75*	5.89*	7.81*
Error	41	60.27	0.019	5.61	5.35	4.91	46.63	56.78

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*Significant (P≤0.05); ns-no significant (P>0.05)

From table 4, the analysis of variance of Chrysophylum albidum seedling quality assessment shows that plant height, stem diameter, leaf production, leaf length, leaf width, leaf area and germination were highly significant (P < 0.05) among the four genotypes while the block effect shows no significant difference in plant height, leaf production and leaf width. This indicates that all location-based genotypes show distinct variation in term of morphological traits. This agrees with the report of [16]; the characterization of a plant is the recording of variability of the characteristics which are highly heritable, easily visible to the eye and expressed in all environments. Also, in support of [17] observation that *Chrysophyllum albidum* have high yield for all the growth and yield characters such as stem diameter, number of leaves, plant height, number of branches, number of fruits, fruit weight, plant fresh weight and dry matter.

Table 5: Mean performance of Seedling Quality Assessed based on Morphological Attributes from four Genotypes of *Chrysophyllum albidum*

Genotype	Plant Height	Stem Diameter	Leaf Production	Leaf Length	Leaf Width	Leaf Area	Germination Percentage
I-AO	6.16±0.69a	0.10±0.00b	2.41±0.10b	3.55±0.15a	2.27±0.05a	6.36±0.31b	4.47±0.00ab
O-AK	5.24±0.25a	0.12±0.00ab	2.84±0.13a	3.72±0.07a	2.53±0.18a	6.26±0.47b	5.00±0.01a
A-IO	5.19±0.33a	0.12±0.00ab	2.49±0.08b	3.85±0.08a	2.43±0.04a	7.38±0.24a	4.17±0.00ab
A-Kk	5.09±0.37a	0.13±0.01a	2.71±0.13ab	3.69±0.14a	2.46±0.07a	7.09±0.35ab	3.74±0.03b

Mean ±SE with different alphabet in columns are significantly different from each other (P≤0.05)

Table 5 above details the mean performance of four genotypes of *Chrysophyllum albidum* evaluated for seven morphological characters. All genotypes are significantly different with respect to collar diameter, leaf production, leaf area and germination except plant height, leaf length and leaf width that are not significantly different from one another. This indicates that there is non-uniformity in their mode of energy assimilation for photosynthetic capability as observed at seedling stage. There is no significant difference among I-AO, O- AK, A- IO and A- KK in plant height, leaf length and leaf width. This shows that there is uniform quality among the seedlings of *Chrysophylum albidum* under study which partly conforms to the report of [10] that the height and stem diameter are easy and quick to measure and can be a good estimate of seedling quality and subsequent field performance. The study highlights the relationship between the morphological characters of *C. albidum*, and the characterization of a plant is the recording of variability of the characteristics which are highly heritable, easily visible to the eye and expressed in all environments [16].

4. Conclusion

From the result, it was concluded that morphological traits considered for assessing the seedling quality of location – based genotypes of Chrysophylum albidum showed the interrelationship significance among the genotypes.
From the point of germination count, O-AK had the highest value; in height, I-AO is the highest; stem diameter, A-KK has the highest value and considering the leaf area, A-IO has the highest value.
It is then concluded that other morphological traits both quantitative and qualitative should be studied to assess further the seedling quality of the species.

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