



INFLUENCE OF GROWTH MEDIA ON GERMINATION AND EARLY GROWTH OF CASHEW (*Anacardium occidentale* L.) VARIETIES IN IGBOORA, NIGERIA

ABSTRACT

Growth medium is an important factor in the germination and early growth of cashew plants. In view of this, a pot experiment was conducted in the screen house of Crop Production Technology department to evaluate the effect of growth media on germination and early growth of cashew. The experimental factors were cashew varieties (CRIN-1, CRIN-2 and CRIN-3) and growth media (top soil, sawdust and topsoil + Sawdust). The treatment combinations were arranged in split-

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DOI: <https://doi.org/10.70382/tijarbt.v09i1.013>

Introduction

Anacardium occidentale L.) is a tropical evergreen tree belonging to the family *Anacardiaceae*, cultivated primarily for its economic products—the nut, apple, and shell oil. Originating from northeastern Brazil, cashew was introduced to Africa in the 16th century and is now widely cultivated across West Africa, especially in Nigeria, Ghana, Côte d'Ivoire, and Benin (Hammed *et al.*, 2014). Nigeria is among the top five global producers of raw cashew nuts, with Oyo, Kwara, Kogi, and Ogun states being major production zones (Olubode *et al.*, 2018). The crop has become an important non-oil export commodity, providing income and employment for rural farmers while contributing significantly to Nigeria's foreign exchange earnings (Aderounmu *et al.*, 2020; Ogbeide and Aremu-Dele, 2023).



plot fitted into completely randomized design and replicated ten times. Data collected were number of germinated seeds, plant height, stem diameter, number of leaves and leaf area. The collected data were subjected to analysis of variance and significant means were compared using Duncan's Multiple Range Test at 5% probability. CRIN-1 variety produced germination percentage, plant height, number of leaves, stem diameter and leaf area of 91.5%, 20.20 cm, 11.40, 4.40 mm and 30.80 cm², while top soil produced 93.2%, 21.30 cm, 12.00, 4.60 mm and 33.10 cm² respectively. These values were significantly higher than other treatments. The interaction between variety and growth media also had significant effect except on stem diameter and number of leaves. CRIN-1 produced significant effect in the growth parameters evaluated, followed by CRIN-3 and CRIN-2, while Topsoil produced the highest significant effect followed by Topsoil + Sawdust and Sawdust. Since the combination of CRIN-1 variety and Top soil gave the highest significant effect on all the growth parameters evaluated, it was therefore recommended for cashew farmers in the study area.

Keywords: CRIN varieties, Nursery management, Seedling performance, Sustainability, Growth medium.

Successful cashew establishment begins with efficient seed germination and healthy seedling growth, which are greatly influenced by the physical and chemical properties of the growing medium or substrate (Ndukwe *et al.*, 2021). Growth substrates determine moisture retention, aeration, nutrient availability, and root development—factors essential for early seedling vigor (Olufemi *et al.*, 2023). Commonly used substrates in Nigerian nurseries include topsoil, river sand, sawdust, poultry manure, and combinations thereof. However, differences in the physical and chemical characteristics of these materials lead to variable performance in germination and early seedling growth (Iledun *et al.*, 2019).

Cashew (*Anacardium occidentale* L.) has emerged as a vital cash crop in Nigeria's agricultural economy, providing significant employment opportunities and foreign exchange earnings through export of raw nuts and processed kernels (Olujobi *et al.*, 2023). Despite this potential, productivity in Nigeria remains below expectations due to low-quality planting materials and inconsistent nursery management practices (Olubode *et al.*, 2018; Adigun *et al.*, 2021). Most cashew seedlings raised in local nurseries exhibit poor uniformity, weak root systems, and delayed field establishment — problems often traced to the use of unsuitable or unbalanced growth substrates (Ndukwe *et al.*, 2021; Ogbeide and Aremu-Dele, 2023).



The composition of a growth substrate critically determines the balance of air, water, and nutrients available to developing seedlings. Topsoil, river sand, sawdust, and compost are frequently used in southwestern Nigeria, yet their effectiveness varies widely due to differences in texture, organic matter content, and nutrient availability (Olaniyi *et al.*, 2019). In Igboora — located within the derived savanna zone of Oyo State — soils are often sandy, with low organic matter and moderate fertility (Olabode *et al.*, 2022). These soil characteristics make it necessary to test alternative substrate formulations to improve seedling performance.

Moreover, cashew variety and nut size have been reported to influence germination rate, vigor, and early growth (Aderounmu *et al.*, 2020). Hence, identifying substrate–variety interactions under local conditions would provide valuable recommendations for nursery operators and extension workers in the region. Hence, this study evaluated the effects of different growth substrates on germination and early growth performance of cashew (*Anacardium occidentale* L.) varieties under nursery conditions in Igboora, Oyo State, Nigeria.

Materials and Methods

The study was conducted at the Teaching and Research Farm of Oyo State College of Agriculture and Technology, Igboora, located in Ibarapa Central Local Government Area, Oyo State, Nigeria. The town lies between latitude 7°25'N and longitude 3°25'E, with an altitude of about 170 meters above sea level. The area falls within the derived savannah agroecological zone, characterized by a bimodal rainfall pattern — the first rainy season occurs between April and July, and the second between September and October — with an average annual rainfall of 1,200–1,500 mm. The mean temperature ranges from 27°C to 30°C and relative humidity averages 75%. The soils of the area are mainly sandy loam, moderately fertile, and suitable for crop and tree nursery activities (Olayiwola *et al.*, 2020). Three improved cashew (*Anacardium occidentale* L.) varieties released by the Cocoa Research Institute of Nigeria (CRIN), Ibadan, were used:

Variety	Official Code	Key Traits
CRIN Cashew 1	CRIN-1	Early maturing, medium nut size, shelling % $\approx$ 28–30%
CRIN Cashew 2	CRIN-2	Mid-season maturity, large nut size, good kernel recovery
CRIN Cashew 3	CRIN-3	Late maturing, high nut yield, drought-tolerant

Three growth media served as substrates: Topsoil was collected from the upper 0–15 cm soil layer at the farm, rich in organic matter, while Sawdust was – decomposed sawdust from a local sawmill, screened to remove impurities.



All substrates will be air-dried, sieved through a 2 mm mesh, and used to fill 25 cm × 20 cm polyethylene bags, each containing 5 kg of substrate.

The experiment followed a 2-factor factorial arrangement (3 × 3) in a Completely Randomized Design (CRD). The experimental factors were: Factor A (Cashew Varieties): CRIN-1, CRIN-2 and CRIN-3; and Factor B (Growth Substrates): Topsoil, Sawdust and Topsoil + Sawdust. The nine treatment combinations were replicated ten times, giving 90 experimental units.

Cashew nuts were pre-treated by soaking in clean water for 24 hours to soften the seed coat and enhance uniform germination. Two seeds were sown per polyethylene bag at a depth of 2 cm, then thinned to one healthy seedling after emergence. Watering was done once daily in the morning, and weeding was carried out manually when necessary. All experimental units were maintained under uniform environmental conditions.

Data were collected weekly for eight weeks after sowing (WAS) on the following parameters: Germination Percentage (%) GP = Number of seeds germinated / Total seeds planted × 100, Seedling Height (cm) — measured from the collar region to the shoot apex., Number of Leaves per Seedling, Stem Girth (mm) — measured with a digital Vernier caliper at the collar region, Leaf Area (cm²) — estimated using the formula: LA = LW × 0.75 where L = leaf length and W = leaf width, 0.75 = correction factor and Root Length (cm) — measured from collar to tip after uprooting selected seedlings.

Data collected were subjected to Analysis of Variance (ANOVA) appropriate for a two-factor factorial experiment in CRD. Mean separation was done using Duncan's Multiple Range Test (DMRT) at $p \leq 0.05$ using SAS v9.4.

Results and Discussion

Effects of growth media on germination percentage of Cashew varieties

The highest germination percentage was reached at 6 weeks after sowing (WAS), with CRIN-1 variety having the highest significant ($P \leq 0.05$) germination percentage of 91.5%, followed by CRIN-3 variety with 87.8% and CRIN -2 variety with 82.4%. The growth substrates produced significant effect on the germination percentage of cashew. Topsoil has the highest germination percentage (93.2%) and was significantly higher than Sawdust (85.6%), while it produced similar effect at par with Topsoil + Sawdust. The interactive effect was significant at 2 and 6 WAS.

Table 1: Effects of growth media on germination percentage of Cashew varieties

TREATMENT	2 WAS	4 WAS	6 WAS	8 WAS
VARIETAL EFFECT (V)				
CRIN-1	65.4a	88.2a	91.5a	91.5a
CRIN-2	56.8b	79.6b	82.4b	82.4b
CRIN-3	61.7ab	84.7ab	87.8ab	87.8ab



TREATMENT	2 WAS	4 WAS	6 WAS	8 WAS
GROWTH MEDIA EFFECT (G)				
Topsoil	68.5a	90.7a	93.2a	93.2a
Sawdust	59.9b	83.4b	85.6b	85.6b
Topsoil + Sawdust	63.2ab	87.2ab	89.7ab	89.7ab
INTERACTION (V × G)	*	ns	*	ns

Means with the same letter are not significantly different using Duncan's Multiple Range Test at 5% probability, WAS-weeks after sowing

Effects of growth media on plant height of Cashew varieties

Plant height increased progressively from 2 to 8 WAS for all treatments. CRIN-1 showed the highest significant () plant height across all sampling periods and was at par with CRIN-3, while CRIN-2 showed moderate plant height. At 8WAS, CRIN-1 produced 20.2 cm plant height, followed by CRIN-3 (18.4 cm), while the lowest significant plant height (16.5 cm) was produced by CRIN-2. Also, Topsoil produced the highest significant plant height (21.3 cm) at par with Topsoil + Sawdust with 19.5 cm, while Sawdust alone had 18.6 cm plant height. The interactive effect between the varieties and growth substrates were significant all through the sampling periods.

Table 2: Effects of growth media on plant height (cm) of Cashew varieties

TREATMENT	2 WAS	4 WAS	6 WAS	8 WAS
VARIETAL EFFECT (V)				
CRIN-1	6.3a	12.5a	17.8a	20.2a
CRIN-2	5.1b	10.3b	14.6b	16.5b
CRIN-3	5.7ab	11.6ab	16.2ab	18.4ab
GROWTH MEDIA EFFECT (G)				
Topsoil	6.5a	13.1a	18.5a	21.3a
Sawdust	5.8b	11.4b	16.8b	18.6b
Topsoil + Sawdust	6.0ab	12.0ab	17.5ab	19.5ab
INTERACTION (V × G)	*	*	*	*

Means with the same letter are not significantly different using Duncan's Multiple Range Test at 5% probability, WAS-weeks after sowing

Effects of growth media on number of leaves of Cashew varieties

Topsoil produced the highest number of leaves which increased from 4.3 at 2 WAS to 12.0 at 8 WAS, followed by Topsoil + Sawdust with 11.2 number of leaves at 8 WAS. CRIN-1 produced the highest significant number of leaves (11.4) at par CRIN-3 (10.6), but was significantly higher in number of leaves compared to CRIN-2. However, the interaction between the varieties and growth substrates was not significant all through the sampling periods.



Table 3: Effects of growth media on number of leaves per seedling of Cashew varieties

TREATMENT	2 WAS	4 WAS	6 WAS	8 WAS
VARIETAL EFFECT (V)				
CRIN-1	4.1a	7.2a	9.8a	11.4a
CRIN-2	3.5b	6.3b	8.4b	9.8b
CRIN-3	3.8ab	6.8ab	9.0ab	10.6ab
GROWTH MEDIA EFFECT (G)				
Topsoil	4.3a	7.5a	10.3a	12.0a
Sawdust	3.6b	6.4b	9.0b	10.4b
Topsoil + Sawdust	3.9ab	6.9ab	9.5ab	11.2ab
INTERACTION (V × G)	ns	Ns	ns	ns

Means with the same letter are not significantly different using Duncan's Multiple Range Test at 5% probability, WAS-weeks after sowing

Effects of growth media on stem diameter of Cashew varieties

Stem diameter increased progressively across sampling weeks, with topsoil producing the thickest significant stems (4.6 mm) which was at par with Topsoil + Sawdust (3.9 mm) and higher than Sawdust alone (3.9 mm). The lowest significant stem diameter was produced by CRIN-2 (3.8 mm), while CRIN-1 produced the highest significant stem diameter (4.4 mm). The interactive effect between the varieties and growth substrates was not significant all through the sampling periods.

Table 4: Effects of growth media on stem diameter (mm) per seedling of Cashew varieties

TREATMENT	2 WAS	4 WAS	6 WAS	8 WAS
VARIETAL EFFECT (V)				
CRIN-1	2.1a	3.0a	3.8a	4.4a
CRIN-2	1.9b	2.7b	3.5b	3.8b
CRIN-3	2.0ab	2.8ab	3.7ab	4.1ab
GROWTH MEDIA EFFECT (G)				
Topsoil	2.2a	3.1a	3.9a	4.6a
Sawdust	1.9b	2.8b	3.6b	3.9b
Topsoil + Sawdust	2.0ab	2.9ab	3.7ab	4.3ab
INTERACTION (V × G)	ns	ns	ns	ns

Means with the same letter are not significantly different using Duncan's Multiple Range Test at 5% probability, WAS-weeks after sowing

Effects of growth media on leaf area of Cashew varieties

Leaf area expanded consistently across all sampling weeks, with CRIN-1 and seedlings grown in topsoil showing the largest leaf surfaces. At 8 WAS, the highest significant leaf area was produced by CRIN-1 (30.8 cm²), followed by CRIN-3 (29.2 cm²), while CRIN-2



produced intermediate leaf area (27.5 cm²). Topsoil produced the highest significant leaf area (33.1 cm²), while Sawdust produced the lowest significant leaf area (28.4 cm²).

Table 5: Effects of growth media on leaf area (cm²) of Cashew varieties

TREATMENT	2 WAS	4 WAS	6 WAS	8 WAS
VARIETAL EFFECT (V)				
CRIN-1	18.4a	24.6a	28.5a	30.8a
CRIN-2	15.6b	21.5b	25.3b	27.5b
CRIN-3	17.0ab	23.2ab	27.1ab	29.2ab
GROWTH MEDIA EFFECT (G)				
Topsoil	19.3a	26.4a	30.0a	33.1a
Sawdust	16.2b	22.8b	26.1b	28.4b
Topsoil + Sawdust	17.5ab	24.2ab	28.0ab	31.6ab
INTERACTION (V × G)	*	*	*	*

Means with the same letter are not significantly different using Duncan's Multiple Range Test at 5% probability, WAS-weeks after sowing

Discussion

Seeds sown in topsoil exhibited the highest germination percentage due to its superior nutrient composition, balanced aeration, and moisture retention capacity. In contrast, sawdust delayed early emergence, likely because of its low nitrogen content and initial microbial competition for available nutrients during decomposition (Ahmed *et al.*, 2019). Varietal differences observed among CRIN-1, CRIN-2, and CRIN-3 may be attributed to inherent genetic vigor, seed coat permeability, and differences in storage viability. The consistently superior germination of CRIN-1 aligns with reports by Aderounmu *et al.* (2020), who found that seed size and vitality significantly influence cashew germination and early stand establishment.

The rapid increase in germination up to 4 WAS followed by stabilization indicates that most viable seeds completed emergence within the first 28 days, consistent with Yahaya *et al.* (2021), who observed similar patterns in tree crop seedlings under organic substrates.

Seedlings raised in topsoil consistently produced significant early growth performance (plant height, number of leaves, stem diameter and leaf area), followed by those in the topsoil + sawdust mixture. Seedlings grown in topsoil exhibited superior early growth performance because of its balanced nutrient composition, good aeration, and high organic matter content, which promote cell elongation and division at the apical meristem (Ahmed *et al.*, 2019).

Seedlings in sawdust showed slower height growth, possibly due to nutrient immobilization and reduced mineral availability during organic matter breakdown. This is consistent with Yahaya *et al.* (2021), who found that sawdust-based substrates initially



limit nutrient supply to germinating seeds, leading to slower growth rates. However, the performance of the topsoil + sawdust mixture indicates that moderate incorporation of organic material can still enhance plant height if combined with nutrient-rich topsoil.

Seedlings grown in topsoil produced the thickest stems. This may be due to better access to essential nutrients such as nitrogen, potassium, and calcium, which enhance cell wall development and vascular differentiation as supported by Ahmed *et al.*, 2019.

The findings in this study are in line with Aderounmu *et al.* (2020), who found that vigorous cashew genotypes under nutrient-rich soil conditions exhibited more leaf flushing cycles, translating into greater early canopy coverage. The increase in leaf area enhances photosynthetic assimilation, enabling rapid biomass accumulation as described by Adeigbe *et al.* (2015).

Varietal differences were evident, with CRIN-1 producing the highest significant early growth responses. This agrees with findings by Oduwole *et al.* (2019), who reported that CRIN-1 typically exhibits superior vegetative vigor and photosynthetic capacity under favorable soil conditions. Similar varietal differences in early shoot growth were documented by Olaniyan and Badaru (2021), who noted that genetic background and physiological efficiency significantly influence growth potential in CRIN-developed cashew lines.

Conclusion and Recommendation

From the results presented above, the cashew varieties and growth substrates responded differently to the growth parameters evaluated. CRIN-1 variety significantly produced better germination and early growth performance, followed by CRIN-3 and CRIN-2, while Top soil was significantly higher than Topsoil + Sawdust and Sawdust alone. The use of Sawdust alone as a growth media for seedling production of cashew is not advised.

The findings highlight the importance of using fertile topsoil as the primary medium for cashew seedling production in nurseries. This ensures rapid shoot elongation, early canopy development, and stronger seedlings capable of surviving post-transplant field conditions. The use of CRIN-1 variety and Top soil was recommended as the best treatment combination for enhanced germination and early growth of Cashew to farmers in the study area.

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**AUGUST, 2025 EDITIONS. INTERNATIONAL JOURNAL OF:
AGRICULTURAL RES. & BIOTECHNOLOGY VOL. 9**

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