Original Article

VARIABILITY IN GROWTH, YIELD, PHYSIOLOGICAL TRAITS AND PHYSICOCHEMICAL PROPERTIES OF SOME IMPROVED SESAME (*Sesamum indicum* L.) GENOTYPES IN LAFIA

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ABSTRACT

Sesame (Sesamum indicum L.) is a vital oilseed crop prized for its high-quality vegetable oil and nutritional value. A field trial was conducted at the Experimental Plot of the Department of Plant Science and Biotechnology, Federal University of Lafia, Nigeria, to evaluate growth, yield, physiological, and physicochemical variability among seven improved sesame genotypes (NCRIBEN 06E, LFF 02, NE 01, IFF 01, NCRIBEN 04E, DM 01, and NCRIBEN 02M) arranged in a Randomized Complete Block Design with three replications. Results revealed significant (P < .05) variability among genotypes for plant height (35.33–68.27 cm), pod length (1.70–2.70 cm), days to 50% flowering (37.73–59.37 days), days to 50% podding (45.00–67.57 days), and 100-seed weight (0.1943–0.3487 g). Genotype NCRIBEN 02M produced the tallest plants and longest pods alongside NCRIBEN 04E, while NCRIBEN 06E exhibited early flowering, early podding, and superior seed weight. Chlorophyll content (31.30–49.10 SPAD units) and leaf area potential (131.97–191.67 cm²) also varied significantly, with NE 01 recording peak values. Physicochemical profiling of seed oil demonstrated significant variations in acid value (0.11–1.48 mg KOH/g), free fatty acid (0.09–117.40 mg KOH/g), saponification value (78.54–358.19 mg KOH/g), and iodine value (100.11–107.32 g I2/100g oil). Genotypes NCRIBEN 06E and LFF 02 were identified as superior candidates for yield optimization and early maturity, while DM 01 and NCRIBEN 06E exhibited outstanding lipid stability. This genetic diversity offers valuable potential for sesame breeding and commercial exploitation.

KEYWORDS: Sesame, Genetic Variability, Growth Traits, Seed Yield, Physiological Traits, Physicochemical Properties

INTRODUCTION

Sesame (*Sesamum indicum* L.) is an important oilseed crop belonging to the family Pedaliaceae, which includes many annual and perennial plants (Alhassan et al., 2025). Its seeds are utilized across a wide variety of food applications, including bakery products, confectionery, sauces, and traditional culinary preparations, with a substantial portion harvested globally for edible oil and protein meal production (Ibrahim et al., 2026). Sesame seed oil is regarded as a high-quality vegetable oil owing to its superior nutritional profile, agreeable taste, and remarkable antioxidative stability. This exceptional shelf life and stability against rancidity are attributed to potent natural antioxidants, specifically sesamin, sesamolin, and sesamol (Namiki, 2007). The oil is predominantly rich in oleic and linoleic acids, which together constitute nearly 80% of total fatty acid content. These unsaturated fatty acids substantially enhance the nutritional value of sesame oil, making it an essential component of healthy human diets (Akinloye, 2026). Furthermore, the abundant polyunsaturated fatty acids and bioactive phytochemicals in sesame oil have been demonstrated to lower blood cholesterol, support blood pressure regulation, and reduce the risk of cardiovascular diseases, atherosclerosis, and specific cancers (Dar & Arumugam, 2013). The genus Sesamum represents the most economically significant taxon within the Pedaliaceae family due to its pivotal role in human nutrition and industrial manufacturing (Nura, 2014). Although several wild and related species exist such as *Sesamum radiatum, Sesamum alatum, Sesamum angustifolium, Sesamum angolense*, and Ceratotheca sesamoides Sesamum indicum remains the primary cultivated species worldwide on account of its superior seed and oil productivity (Eze et al., 2022). Believed to have originated in Africa before spreading throughout Asia and global agricultural zones, sesame has established itself as a staple commercial crop (Teklu et al., 2022). In Nigeria, cultivation is extensively distributed across the northern and central ecological zones, including Benue, Jigawa, Nasarawa, Kaduna, Kano, Katsina, Niger, Plateau, Kebbi, Taraba, Kogi, Sokoto, Yobe, and the Federal Capital Territory, with Benue and Jigawa states leading national production outputs (Onwuzuruike et al., 2024). In these regions, sesame is cultivated both for international commercial export and domestic consumption, where seeds and leaves serve as core ingredients in local dishes (Oboulbiga et al., 2025). Evaluating genetic variability among local and improved accessions is therefore essential for identifying superior parents for breeding and commercial production.

MATERIALS AND METHODS

Study Area

The study was conducted at the experimental farm of the Department of Plant Science and Biotechnology, Federal University of Lafia, Nasarawa State, Nigeria. Lafia is situated in North-Central Nigeria within a coordinate envelope of approximately 8°29′–8°32′ N and 8°30′–8°33′ E (Abdullahi, 2021). The region features an undulating landscape drained by the Gwayaka and Mada river systems and seasonal tributaries (Ogah et al., 2025). Lafia experiences a tropical savanna climate (Köppen classification Aw) with distinct wet

(April to October) and dry (November to March) seasons (Wakili et al., 2025). The area receives an average annual rainfall of approximately 1,645 mm, with a mean temperature of 26.7°C (Abimbola et al., 2023; Iliyasu et al., 2019). The soil is predominantly acidic sandy loam to loamy sand, characterized by low total nitrogen, organic matter, and cation exchange capacity.

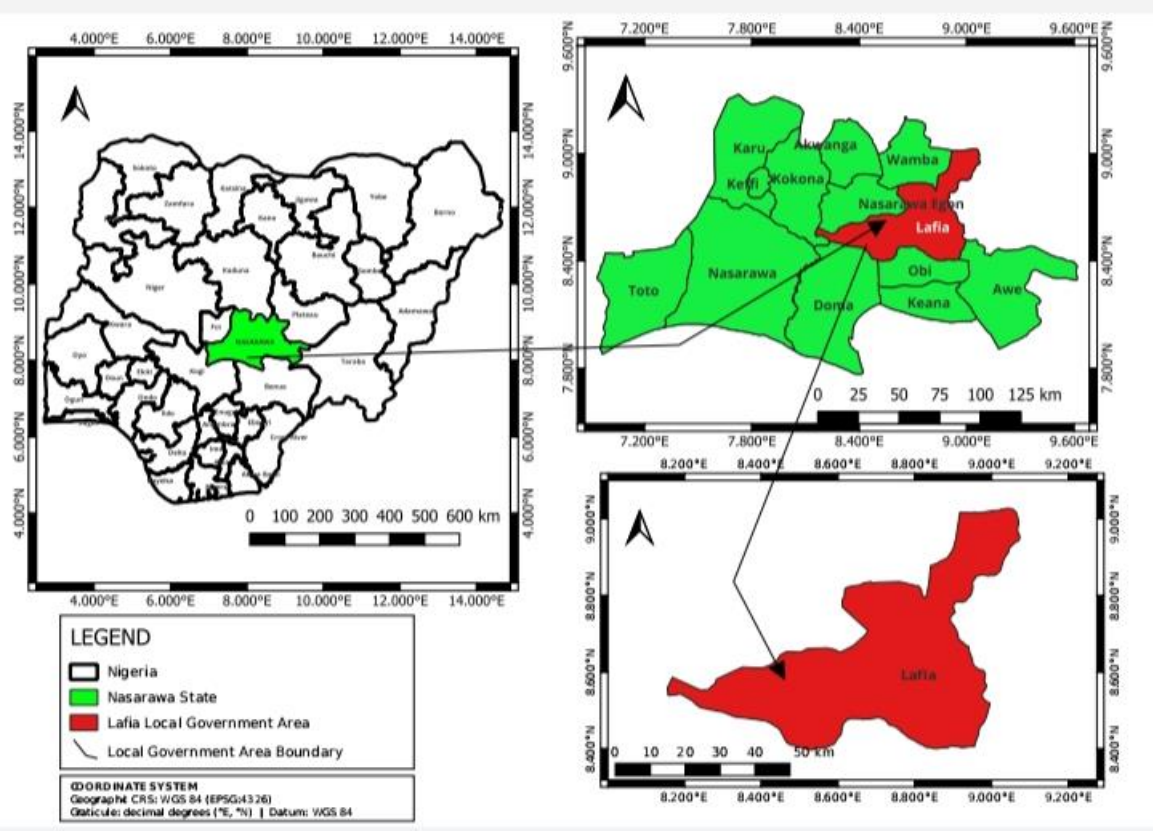


Figure 1: Map of Lafia as Generated using GIS

Planting Material and Experimental Design

Seven sesame genotypes were evaluated in this study: three improved genotypes obtained from the National Cereal Research Institute (NCRI), Badeggi, Niger State (NCRIBEN 06E [V1], NCRIBEN 04E [V5], and NCRIBEN 02M [V7]), two local landraces from farmers in Lafia (LFF 02 [V2] and IFF 01 [V4]), one variety from Doma (DM 01 [V6]), and one variety from Nasarawa Eggon (NE 01 [V3]). The trial was laid out in a Randomized Complete Block Design (RCBD) with three replications. Each plot measured 1 m × 1 m with three plant rows spaced at 30 cm between rows and 15 cm within rows.

Cultural Practices

Field preparation involved manual clearing, raking, and seedbed preparation using hoes. Seeds were sown directly at a depth of 3 cm. Manual weeding was executed at 2, 4, and 6 weeks after sowing (WAS). Agronomic practices were maintained uniformly across all experimental plots following established procedures described by Ibrahim et al. (2026) and Kana et al. (2026).

Data Collection

Data were recorded on growth, yield, physiological, and physicochemical parameters. Growth and yield traits measured included plant height (cm), number of leaves per plant, number of pods per plant, pod length (cm), days to 50% flowering, days to 50% podding, and 100-seed weight (g). Physiological traits included leaf chlorophyll content (measured in SPAD units using a portable chlorophyll meter), leaf area potential (cm^2), and relative water content (RWC, %). Physicochemical characteristics of the extracted oil were evaluated for seed oil color, pH, temperature (°C), acid value (mg KOH/g oil), free fatty acid (% FFA as oleic acid), saponification value (mg KOH/g oil), and iodine value (g I2/100g oil).

Physicochemical Analysis of Extracted Oil

Sesame seed oil was extracted using n-hexane solvent extraction as outlined by Mbaebie (2010). Physical properties (color, pH, temperature) were determined immediately following extraction. Chemical properties including acid value and percent free fatty acids (% FFA) were determined by AOAC titrimetric methods. Saponification value was evaluated via alcoholic KOH reflux titration, and iodine value was determined using Wijs method as described by Oboulbiga et al. (2025).

Data Analysis

Data collected were subjected to Analysis of Variance (ANOVA) using IBM SPSS Statistics (Version 20.0) under the General Linear Model (GLM). Significant differences among treatment means were separated using the Least Significant Difference (LSD) test at a 5% probability level ($P < .05$).

RESULTS

Growth-Related Traits of Sesame Genotypes

Mean performance and analysis of variance for growth traits are presented in Table 1. Highly significant variability was observed among genotypes for plant height ($F(6, 14) = 6.389$, $P = .002$) and pod length ($F(6, 14) = 14.780$, $P < .001$). However, differences in number of leaves ($F(6, 14) = 0.205$, $P = .969$) and number of pods per plant ($F(6, 14) = 0.794$, $P = .590$) were statistically non-significant. Plant height ranged from 35.33 cm in NE 01 (V3) to 68.27 cm in NCRIBEN 02M (V7). Pod length varied between 1.70 cm in NE 01 (V3) and 2.70 cm in both NCRIBEN 04E (V5) and NCRIBEN 02M (V7).

Table 1: Mean Performance of Growth-Related Traits of the Sesame Genotypes

Genotype	Plant height (cm)	Number of leaves	Number of pods	Pod length (cm)
NCRIBEN 06E (V1)	58.67a ± 2.37	12.67 ± 4.88	9.57 ± 3.50	2.40a ± 0.10
LFF 02 (V2)	50.33ab ± 6.25	11.67 ± 0.85	11.00 ± 5.36	2.63a ± 0.15
NE 01 (V3)	35.33b ± 4.90	13.10 ± 0.85	11.13 ± 3.19	1.70b ± 0.10
IFF 01 (V4)	57.43a ± 3.04	12.43 ± 2.01	16.00 ± 5.20	2.47a ± 0.06
NCRIBEN 04E (V5)	63.83a ± 9.09	12.43 ± 2.50	16.33 ± 9.39	2.70a ± 0.10
DM 01 (V6)	57.73a ± 12.78	13.77 ± 3.22	17.90 ± 9.68	2.60a ± 0.17
NCRIBEN 02M (V7)	68.27a ± 7.09	13.20 ± 0.85	20.23 ± 13.09	2.70a ± 0.30

Note. Values are mean ± SD (n = 3). Means in the same column sharing the same superscript letter are not significantly different at P < .05.

Yield-Related Traits of Sesame Genotypes

Yield-related traits exhibited highly significant (P < .001) variation across all measured parameters (Table 2). Days to 50% flowering (F(6, 14) = 30.669, P < .001) ranged from 37.73 days in NCRIBEN 06E (V1) to 59.37 days in NE 01 (V3). Days to 50% podding (F(6, 14) = 99.849, P < .001) showed a similar pattern, ranging from 45.00 days in LFF 02 (V2) to 67.57 days in NE 01 (V3). Furthermore, 100-seed weight (F(6, 14) = 37.271, P < .001) varied markedly, with NCRIBEN 06E (V1) recording the highest weight (0.3487 g) and DM 01 (V6) recording the lowest (0.1943 g).

Table 2: Mean Performance of the Sesame Genotypes for Yield-Related Traits

Genotype	Days to 50% flowering	Days to 50% podding	100-seed weight (g)
NCRIBEN 06E (V1)	37.73c ± 0.71	45.03c ± 1.35	0.3487a ± 0.0042
LFF 02 (V2)	41.20c ± 4.67	45.00c ± 0.70	0.3243a ± 0.0065
NE 01 (V3)	59.37a ± 0.91	67.57a ± 1.20	0.3040a ± 0.0020
IFF 01 (V4)	52.83b ± 1.34	64.37ab ± 2.27	0.2087b ± 0.0261
NCRIBEN 04E (V5)	50.53b ± 1.56	61.37b ± 1.46	0.2080b ± 0.0329
DM 01 (V6)	51.10b ± 2.23	63.93ab ± 2.12	0.1943b ± 0.0200
NCRIBEN 02M (V7)	47.77b ± 1.97	60.20b ± 1.64	0.2050b ± 0.0161

Note. Values are mean ± SD (n = 3). Means in the same column sharing the same superscript letter are not significantly different at P < .05.

Physiological Traits of Sesame Genotypes

Physiological attributes demonstrated significant genetic divergence among the accessions (Table 3). Chlorophyll content (F(6, 14) = 12.988, P < .001) ranged from 31.30 SPAD units in NCRIBEN 02M (V7) to 49.10 SPAD units in NE 01 (V3). Leaf area potential (F(6, 13) = 15.512, P < .001) showed a corresponding trend, peaking at 191.67 cm^2 in NE 01 (V3) compared to 131.97 cm^2 in DM 01 (V6). Relative water content (RWC) maintained standard stability across genotypes under rainfed conditions, ranging from 81.20% in LFF 02 (V2) to 84.80% in IFF 01 (V4).

Table 3: Mean Performance of the Sesame Genotypes for Physiological Traits

Genotype	Chlorophyll content (SPAD)	Leaf area potential (cm^2)	Relative Water Content (%)
NCRIBEN 06E (V1)	46.83a ± 1.33	185.47a ± 9.30	83.70 ± 0.00
LFF 02 (V2)	46.40a ± 0.20	186.20a ± 3.54	81.20 ± 0.00
NE 01 (V3)	49.10a ± 0.87	191.67a ± 11.02	82.10 ± 0.00
IFF 01 (V4)	39.13ab ± 8.18	134.77b ± 8.39	84.80 ± 0.00
NCRIBEN 04E (V5)	31.73b ± 3.33	146.33b ± 14.25	84.70 ± 0.00
DM 01 (V6)	31.93b ± 3.75	131.97b ± 7.16	81.50 ± 0.00
NCRIBEN 02M (V7)	31.30b ± 2.70	143.80b ± 17.11	83.00 ± 0.00

Note. Values are mean ± SD (n = 3). RWC = relative water content. SD = 0.00 for RWC within replicates.

Physicochemical Properties of Seed Oil

Chemical evaluation of seed oil revealed highly significant (P < .001) variation across all parameters (Table 4). Acid values ranged from 0.11 ± 0.00 mg KOH/g in DM 01 (V6) to 1.48 ± 0.02 mg KOH/g in NCRIBEN 02M (V7). Free fatty acid content ranged from 0.09 ± 0.00 mg KOH/g in NCRIBEN 06E (V1) to 117.40 ± 1.15 mg KOH/g in NCRIBEN 02M (V7). Saponification values showed extreme variation, peaking at 358.19 ± 1.65 mg KOH/g in IFF 01 (V4) compared to 78.54 ± 0.73 mg KOH/g in DM 01 (V6). Iodine values ranged between 100.11 ± 0.24 g I2/100g in NCRIBEN 02M (V7) and 107.32 ± 0.30 g I2/100g in LFF 02 (V2).

Table 4: Physicochemical Properties of Oil Extracted from Sesame Genotypes

Parameter	NCRIBEN 06E (V1)	LFF 02 (V2)	NE 01 (V3)	IFF 01 (V4)	NCRIBEN 04E (V5)	DM 01 (V6)	NCRIBEN 02M (V7)	F-value
Acid Value (mg KOH/g)	1.04±0.02b	0.88±0.01c	—	0.56±0.01d	0.28±0.01e	0.11±0.00f	1.48±0.02a	4489.76*
Free Fatty Acid (mg KOH/g)	0.09±0.00e	44.56±0.62c	—	105.75±1.37b	41.74±0.60d	44.60±0.44c	117.40±1.15a	8503.76*
Saponification Value (mg KOH/g)	174.80±1.39c	161.80±1.28d	—	358.19±1.65a	105.18±0.95e	78.54±0.73f	319.77±1.56b	23094.29*
Iodine Value (g I2/100g)	103.07±0.11c	107.32±0.30a	—	103.38±0.20c	103.77±0.19b	101.96±0.16d	100.11±0.24e	390.59*

*Note. Values are mean ± SD. Means within a row bearing different superscript letters differ significantly at P < .05 (LSD post-hoc). *P < .001.*

Physical Properties of Extracted Seed Oil

Physical attributes of extracted seed oil are summarized in Table 5. Oil color exhibited wide chromatic diversity, ranging from reddish-brown in NCRIBEN 06E (V1) to light brown/amber in LFF 02 (V2), light orange-brown with sediment in IFF 01 (V4), deep orange-brown in NCRIBEN 04E (V5), light orange-brown in DM 01 (V6), and yellowish-orange in NCRIBEN 02M (V7). Oil pH varied from 5.2 in DM 01 (V6) to an alkaline 11.3 in NCRIBEN 06E (V1), while

extraction temperature remained uniform at 30–31°C.

Table 5: Physical Properties of Oil Extracted from Sesame Genotypes

Genotype	Colour	pH	Temperature (°C)
NCRIBEN 06E (V1)	Reddish brown (orange-brown)	11.3	31
LFF 02 (V2)	Light brown / amber	6.7	30
IFF 01 (V4)	Light orange-brown with brown sediment	6.5	30
NCRIBEN 04E (V5)	Orange-brown (deep amber)	5.3	30
DM 01 (V6)	Light orange-brown	5.2	30
NCRIBEN 02M (V7)	Yellowish orange (light amber)	6.5	30



Plate 1: Seedbed Preparation



Plate 2: Recording days to 50% flowering

DISCUSSION

The significant variation observed in plant height among sesame genotypes (Table 1) reflects strong genetic control governing vegetative growth, though modulated by environmental factors such as soil nutrient availability and moisture (Alhassan et al., 2025; Ogah et al., 2025). Genotype NCRIBEN 02M (V7) achieved the highest plant height (68.27 cm), while NE 01 (V3) was the shortest (35.33 cm). Plant height is an essential structural trait in sesame breeding; taller plants often support greater canopy depth, whereas shorter architecture provides lodging resistance under severe wind and heavy rainfall. Non-significant variations in leaf number suggest that foliar initiation rates are relatively stable across these genotypes under uniform agro-ecological management, corroborating early findings by Mbaebie (2010). Pod length, being a highly heritable morphological trait, showed stable expression, with NCRIBEN 04E and NCRIBEN 02M producing significantly longer pods (2.70 cm), which aligns with heritability observations reported by Esquinas-Alcázar (2005).

Early phenological development is a primary breeding target for drought escape in semi-arid and savanna zones. Genotypes NCRIBEN 06E (V1) and LFF 02 (V2) demonstrated marked earliness, reaching 50% flowering in 37.73 and 41.20 days and 50% podding in 45.03 and 45.00 days, respectively (Table 2). Early flowering enables crops to complete reproductive development prior to the onset of terminal moisture stress (Teklu et al., 2022). Conversely, NE 01 (V3) exhibited late maturity (59.37 days to flowering), which, while increasing risk under short rainy seasons, allows for prolonged vegetative assimilation. Significant divergence in 100-seed weight further highlights differences in seed filling efficiency. NCRIBEN 06E produced the heaviest seeds (0.3487 g), a trait highly valued in commercial grain markets for superior extraction yield and market preference (Emmanuel, 2026).

Physiological assessment demonstrated that NE 01 (V3) accumulated the highest chlorophyll content (49.10 SPAD units) and leaf area potential (191.67 cm^2), indicating enhanced light interception and photosynthetic capacity (Table 3). Darker

green foliage with higher chlorophyll density directly promotes assimilate synthesis for biomass accumulation, supporting observations by Akinloye (2026). Larger leaf canopies also promote rapid soil shading, suppressing weed competition and conserving soil moisture (Aliyu et al., 2019). Relative water content remained highly stable across all accessions (81.20%–84.80%), indicating that adequate, well-distributed rainfall during the trial prevented tissue dehydration, consistent with findings by Agboola (2020) and Haruna and Abimiku (2012).

Physicochemical analysis of extracted seed oil revealed important industrial and dietary characteristics (Table 4 and Table 5). Acid values (0.11–1.48 mg KOH/g) and free fatty acid levels in top accessions like NCRIBEN 06E (0.09 mg KOH/g) reflect minimal lipid degradation and low hydrolytic rancidity, confirming that solvent extraction preserved triacylglycerol integrity (Fasuan et al., 2018; Olasunkanmi et al., 2017). Saponification values (78.54–358.19 mg KOH/g) and iodine values (100.11–107.32 g I2/100g) confirm high proportions of long-chain fatty acids and high degrees of unsaturation, agreeing with reports by Mary et al. (2026) and Quoc and Phuong (2026). Oil color variations from light amber to reddish-brown reflect natural pigment composition, where lighter oils (LFF 02, NCRIBEN 02M) are preferred for direct culinary use, while darker pigmented oils suit cosmetic and traditional pharmaceutical applications (Aremu et al., 2025; Jafari et al., 2025).

CONCLUSION

This study established significant genetic variability among the evaluated sesame genotypes in Lafia across growth, yield, physiological, and physicochemical parameters. Based on the major findings, genotype NCRIBEN 06E (V1) demonstrated superior overall agronomic potential, combining early flowering (37.73 days), early podding (45.03 days), maximum seed weight (0.3487 g/100 seeds), and exceptional oil purity (lowest FFA of 0.09 mg KOH/g). Genotype LFF 02 (V2) likewise proved outstanding for early maturity and high iodine value (107.32 g I2/100g oil). Additionally, NCRIBEN 02M (V7) recorded superior plant height (68.27 cm) and pod length (2.70 cm), while NE 01 (V3) exhibited peak physiological capacity with highest chlorophyll (49.10 SPAD) and leaf area (191.67 cm^2). These findings highlight NCRIBEN 06E and LFF 02 as prime candidates for direct commercial release and incorporation into regional breeding programs aiming at early maturity, high yield, and superior lipid quality.

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