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Cecile Brigitte MAKON

University of Yaounde I

Jude MANGA NDJAGA

University of Yaounde I

ALADJI ABATCHOUA MADI MADI IBRAHIM

University of Ngaoundéré

Luther Fort NKOULOU

Mbal Mayo Agricultural Research Centre

Cheriffa Nathalie Molo

University of Yaounde I

Benoit-Constant LIKENG-LI-NGUE

likengbeco@yahoo.fr

University of Yaounde I

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Variability, heritability and genetic advance of Agro-morphological and biochemical traits of African *Sesamum indicum* L. collection for genetic improvement

Cecile Brigitte MAKON^{1,4}, Jude MANGA NDJAGA^{1,4}, ALADJI ABATCHOUA MADI MADI Ibram², Luther Fort NKOULOU^{3,4}, Cheriffa Nathalie Molo¹, Benoit Constant LIKENG-LI-NGUE^{1,4*},

¹Department of Plant Biology, Faculty of Science, University of Yaounde I, P.O Box 812, Yaounde, Cameroon.

²Department of Sciences and Technics of Biological Agriculture, Faculty of Science, University of Ngaoundéré, P.O Box 454, Ngaoundéré, Cameroon.

³Institute of Agricultural Research for Development, Mbalmayo Agricultural Research Centre, P.O Box 2123, Yaounde, Cameroon.

⁴Research and Support Center for Agro-pastoral Producers in Cameroon (CRAPAC), Yaounde, Cameroon,

*Corresponding author : Benoit Constant LiKENG-LI-NGUE. E-mail : likengbeco@yahoo.fr/_orcid.org/0000-0003-3671-274X

Abstract

Sesame production in Cameroon is increasing steadily, especially in the country's northern regions. This study aimed to analyze the agronomic performance and oil quality of 28 sesame collections using an alpha-lattice design with two replicates and was carried out in Omog, central Cameroon. Agro-morphological traits [plant height (PH), number of branches per plant (NBP), number of capsules per plant (NCP), number of seeds per capsule (NSC), and 1000-grain weight (1000-GW)] and biochemical indicators of oil quality [(oil content, acid index (I_A), saponification index (I_S), ester index (I_E), iodine index (I_I), and peroxide index (I_P)] were used to estimate genetic variability. SH-ESS has the maximum PH (213.90 cm) but the lowest 1000-GW (1.55 g). SH-LAI had the greatest oil production and I_P ($p < 0.05$) at 883.07% and 13.93 meq O₂/g, respectively. Lastly, SH-GA4 had the lowest I_A (15.81 mg KOH/g), while SH-GIL had the lowest I_P (3.71 meq O₂/g). I_I and I_S values were high in the SH-LOU and SH-KA2 collections, with corresponding values of 295.11 g/100 g and 766.36 mg KOH/g ($p < 0.05$). Oil yield (SH-GOU, SH-BAI, and SH-LAI) and 1000-GW (SH-ARA, SH-BON, SH-BE1, and SH-DJO) showed a negative and insignificant correlation ($r = -0.291$). NBP and 1000-GW displayed high levels of genotypic and phenotypic coefficients of variation, as well as broad-sense heritability and genetic advance. This investigation is crucial for maximizing the use of genetic resources and producing better sesame genotypes, despite the significant genetic heterogeneity found in the 28 samples examined.

Keywords. *Sesamum indicum*; collections; oil quality; yield parameters; genetic diversity.

1. Introduction

The annual herbaceous plant sesame ($2n = 26$) is classified as part of the Pedaliaceae family. Its life cycle can range from 80 to 180 days, and it is native to tropical and subtropical areas. It is now extensively grown in arid and semi-arid regions of Africa, Asia, and South America due to rising demand (Weldemichael et al. 2021). Sesame is referred to as "the queen of oilseeds" because of its remarkable nutritional richness and health advantages (Ashri 2018). Its oil and seeds contain several qualities and a significant potential for nutrition. Sesame seeds are a great source of oil (44–57%), protein (18–25%), carbs (13.50%), and ash (5%) in addition to its nutritional and medicinal properties (Myint et al. 2020). Sesame's high oil, protein, and antioxidant content and anti-inflammatory qualities (Hsu and Parthasarathy 2017) have led to an increase in its intake worldwide.

The world production of sesame is 6,788,881.07 tons, with 3,662,735.25 tons coming from Africa and 70,000 tons from Cameroon (Anonymous 2023). Sudan (2,735,114.16 tons), India (1,590,878.08 tons), Myanmar (1,477,764.25 tons), China (888,700 tons), and Nigeria (840,000 tons) are the top exporters of sesame. The plant known as sesame is grown for its oilseeds. In addition to 10% palmitic acid and 5% stearic acid, sesame oil has about comparable amounts of oleic acid (35–54%) and linoleic acid (39–59%) (Wacal et al. 2019). Bioactive substances found in its oil, including tocopherols, phytosterols, and lignans (sesamin, sesamolin, sesamol, pinorelinol, and lariciresinol), are crucial in preventing oil oxidation and boosting its antioxidant activity (Kanu 2011). Furthermore, compared with soybean oil, corn oil, and most other common vegetable oils, sesame oil exhibits exceptionally high oxidative stability (Minioti and Georgiou 2010). Its production is quite modest, despite it being the first oilseed crop known to man and having higher-quality oil with health benefits. Since no international agricultural research institute has yet shown interest in it, it is usually ignored, or "orphaned," as a crop. Many other small crops have the same paradigm as sesame (Khuntia et al. 2024). However, genetic variability is of paramount importance because it provides insight into the nature and extent of variation within a cultivated species (Ola et al. 2023). To meet the increasing demand for improved genotypes and varieties, plant breeders today recognize the need to use genetic variability and diversity in breeding programmes. According to recent research by Sundari et al. (2022) and Angel et al. (2024), quantitative genetic indices including genetic gain, heritability, and phenotypic and genotypic coefficients of variation (PCV and GCV) are frequently employed to assess the genetic diversity of plant species. The development of traits depends solely on the degree of variability in the base material, and genetic diversity

remains a crucial prerequisite for crop improvement initiatives. It has been shown that non-heritable differences in a genotype can be caused by environmental factors like temperature, precipitation, and day length.

Therefore, research on variability significantly facilitates the classification of overall variance into heritable and non-heritable components (Patel et al. 2023). Leveraging knowledge of germplasm genetic variability enables the selection and improvement of high-yielding, high-quality cultivars. To identify the most promising accessions, the present study quantified the genetic diversity of agromorphological traits and oil quality indices in 28 sesame collections.

2. Materials and methods

2.1. Plant material and experimental design

The experiment was conducted out in Omog village located in Ngog-Mapubi subdivision, Nyong-et-Kellé division, in the Central Region, in the department of and the district of, which are located in the bimodal rainfall forest zone of Cameroon (3° 52' 15" north latitude and 10° 54' 33" east longitude), roughly 84.4 km west of Yaoundé. There are two dry seasons (november-february and june-july) and two rainy seasons (august-october and march-may). The trial's soil has a somewhat acidic pH and a sandy-clay texture.

The experimentation was carried out using an alpha-lattice (7×4) design with two replicates between April and August, 2024. There were 28 elementary plots in each replication, each of which represented a collection. Each plot was set up in a single row that was 1.5 m long and 0.75 m wide, with 10 cm between plants in each repeat and 0.5 m between rows. The crop was grown on 150.96 cm² of land using recommended methods. Table 1 displays the plant material, consisting of seeds from twenty-eight (28) African sesame accessions from Cameroon (15), Chad (11), Tanzania (1), and Kenya (1), all chosen for their physical traits.

Table 1. Characteristics of the sesame collections used in the study

N°	Codes	Collection	Origin	Integument (color)
01	SH-YAG	Yagoua	Cameroon	White
02	SH-BE2	Bertoua 2	Cameroon	White
03	SH-BE1	Bertoua 1	Cameroon	White
04	SH-KIT	Kitam	Cameroon	White
05	SH-ESS	Essé	Cameroon	White
06	SH-GA4	Garoua 4	Cameroon	White
07	SH-NO1	Nord 1	Cameroon	White
08	SH-BE3	Bertoua 3	Cameroon	White
09	SH-NO2	Nord 2	Cameroon	White
10	SH-KA1	Kaelé 1	Cameroon	White

11	SH-DJO	Djougui	Cameroon	White
12	SH-KOU	Kousseri	Cameroon	White
13	SH-KAE2	Kaelé 2	Cameroon	Yellow
14	SH-NO3	Nord 3	Cameroon	Brown
15	SH-MAN	Mangabi	Cameroon	Black
16	SH-TCH	Tchad	Chad	White
17	SH-TIM	Timilhe	Chad	White
18	SH-LAI	Laï	Chad	White
19	SH-BAI	Baïli	Chad	White
20	SH-LOU	Loumia	Chad	White
21	SH-GOU	Gounaïda	Chad	White
22	SH-BON	Bongor	Chad	White
23	SH-ARA	Aragana	Chad	White
24	SH-GIL	Gilar	Chad	White
25	SH-DE1	Dembé 1	Chad	Brown
26	SH-DEM	Dembe	Chad	Brown
27	SH-TAN	Tanzanie	Tanzania	White
28	SH-NAI	Nairobi	Kenya	White

2.2. Agronomic parameters measurement

Twenty eight plant (28) plants among the most competitive were randomly used to record yield statistics. Plant height (in centimeters), number of branches (in number), number of capsules (in number), number of seeds per capsule (in number), and weight of 1,000 seeds (in grams) were all noted.

2.3. Phytochemical characterization of oil

2.3.1. Extraction of oils

Sesame oil was extracted from 5 g of crushed seeds using n-hexane as the extraction solvent in a rotary evaporator. After extracting the solvent at 80°C and low pressure, the excess solvent was removed from the oil using liquid nitrogen. The oil was collected and placed in 10 mL vials for further biochemical analysis after concentration using a pipette. The yield was computed using the following formula after the extracted oil was weighed:

$$R(\%) = \frac{M}{MO} \times 100$$

Where: **R (in %)** = yield expressed as a percentage; **M** = mass in grams of the resulting dry extract; **MO** = mass of oil.

Titrimetry method was used to conduct the physicochemical studies of the oil. Acid index, iodine index, peroxide index, saponification index, and ester index were the parameters we assessed.

2.4. Estimation of genetic parameters related to productivity and oil indices

2.4.1. Phenotypic and genotypic coefficients of variation

The following formulas were presented by Johnson et al. (1955) to determine genotypic and phenotypic coefficients of variation:

$$PCV = \frac{\sqrt{\sigma^2 p}}{\bar{x}} \times 100$$

$$GCV = \frac{\sqrt{\sigma^2 g}}{\bar{x}} \times 100$$

Where: $\sigma^2 p$ = phenotypic variance, $\sigma^2 g$ = genotypic variance, and $\bar{x}$ = average value of character. However, PCV and GCV estimates collapse into three categories: low (> 10%), moderate (10-20%), and high (> 20%).

2.4.2. Broad-sense heritability (H^2)

Allard's (1960) formula was used to assess heritability in the wide sense (H^2):

$$H^2 = \frac{\sigma^2 g}{\sigma^2 p} = \frac{\sigma^2 p - \sigma^2 E}{\sigma^2 p}$$

Where: $\sigma^2 I$ = Inter-varietal or phenotypic variance; $\sigma^2 i$ = Intra-varietal or environmental variance. However, heritability values in the broad sense are high (> 60%), medium (30-60%) and low (< 30%) (Dabholkar1992).

2.4.3. Genetic advances

The genetic advances (GA) were estimated using the method suggested by Allard (1960), and the selection gain was assessed based on the phenotypic standard deviation and the value of heritability in the broad sense:

$$GA = K \times H^2 \times \sqrt{(\sigma^2 p)} \text{ and } GAM (\%) = \frac{GA}{\bar{x}} \times 100$$

Where: GA = genetic advances from selection; K = standardized selection differential or selection differential whose value depends on the intensity of selection ($K = 1.75$ for a selection intensity of 10%); $\sigma^2 p$ = phenotypic variance in the initial population; H^2 = heritability in the broad sense; GAM = genetic advance percentage of mean. Therefore, genetic gain values are high (> 20%), average (10-20%), and low (< 10%) Johnson et al. (1955).

2.5. Statistical analysis

R version 4.1.2 (R Development Core Team 2022) was used to analyse the data, based on five yield criteria and phytochemical components of the oil's quality. Principal component

analysis (PCA) and dendrogram were carried out using SPAD 5.5 (Monoposte, Decisia, Pantin, France).

3. Results

3.1. Yield descriptors

The average plant height varied greatly among all collections, ranging from 110.00 cm (SH-NAI) to 213.90 cm (SH-ESS) at the 5% threshold (Table 2). The SH-KIT (8.1 ± 3.44) and SH-BE2 (6.9 ± 3.14) collections had the largest average number of branches per plant (Table 2), while SH-TCH (0.3 ± 0.67), SH-NAI (1.0 ± 1.05), and SH-NO2 (1.11 ± 1.52) had the lowest NBP (Table 2). High values were found for the NCP trait in the SH-KIT (144 ± 49.17) and SH-BE3 (147.70 ± 16.22) collections, the NSC trait in the SH-GIL (81.40 ± 6.13) and SH-GOU (87.90 ± 9.51) collections, and the 1000-GW trait in the SH-NO1 (2.75 g) and SH-ARA (2.85 g) collections (Table 2). By contrast, the SH-ESS et SH-MAN collections exhibited the lowest 1000-GW values. The recorded values were 1.55 and 1.60 g, respectively (Table 2).

Table 2. Average yield performance of 28 sesame collections

Collections	Agromorphological parameters				
	PH (cm)	NBP (No.)	NSC (No.)	NGC (No.)	1000-GW(g)
SH-ARA	160.50 ± 13.92^{bcd}	3.20 ± 0.39^c	90.60 ± 68.10^{cd}	81.00 ± 7.27^c	2.85 ± 0.05^d
SH-BAI	143.00 ± 24.35^b	4.20 ± 1.14^{cd}	114.70 ± 87.78^{cd}	77.70 ± 8.31^b	2.25 ± 0.47^{abc}
SH-BE1	142.90 ± 21.45^b	2.40 ± 0.83^{bc}	48.80 ± 23.21^{ab}	75.80 ± 3.22^b	2.60 ± 0.10^c
SH-BE2	192.80 ± 22.14^{cde}	6.90 ± 1.14^{ef}	109.40 ± 46.85^{cd}	72.70 ± 6.75^a	1.85 ± 0.05^a
SH-BE3	181.80 ± 14.13^{cd}	6.70 ± 1.23^{def}	147.70 ± 16.22^e	72.40 ± 4.83^a	2.10 ± 0.42^{ab}
SH-BON	136.20 ± 35.07^{ab}	3.10 ± 1.07^c	59.50 ± 19.70^b	71.30 ± 17.61^a	2.70 ± 0.10^{cd}
SH-DE1	165.20 ± 23.87^{bcd}	3.90 ± 1.96^{cd}	107.40 ± 72.81^{cd}	84.10 ± 6.99^{cd}	2.30 ± 0.31^{abc}
SH-DEM	188.00 ± 40.39^{cd}	2.20 ± 1.68^{bc}	77.70 ± 46.18^c	77.30 ± 6.42^b	2.55 ± 0.05^{bc}
SH-DJO	158.40 ± 19.99^{bc}	3.70 ± 0.31^c	114.70 ± 18.52^{cd}	72.50 ± 6.32^a	2.60 ± 0.07^c
SH-ESS	213.90 ± 15.40^{def}	5.80 ± 1.61^{de}	139.60 ± 25.99^e	73.10 ± 4.06^a	1.55 ± 0.26^a
SH-GA4	170.30 ± 21.58^c	4.20 ± 2.55^{cd}	82.50 ± 27.86^c	77.90 ± 4.50^b	1.75 ± 0.05^a
SH-GIL	144.50 ± 18.42^b	4.10 ± 1.92^{cd}	99.40 ± 17.00^{cd}	81.40 ± 6.13^c	2.55 ± 0.36^{bc}
SH-GOU	123.60 ± 18.91^{ab}	3.20 ± 0.82^c	63.10 ± 25.65^{bc}	87.90 ± 9.51^d	1.80 ± 0.11^a
SH-KA1	164.40 ± 7.32^{bcd}	2.10 ± 0.44^{bc}	47.10 ± 19.65^{ab}	72.80 ± 2.89^a	2.40 ± 0.21^b
SH-KA2	150.45 ± 20.02^{bc}	5.00 ± 1.70^{cde}	55.00 ± 21.19^b	72.80 ± 3.22^a	1.85 ± 0.36^a
SH-KIT	187.30 ± 11.96^{cd}	8.10 ± 2.44^f	144.00 ± 49.17^e	72.40 ± 4.27^a	1.85 ± 0.26^a
SH-KOU	145.45 ± 34.01^b	3.30 ± 1.16^c	70.10 ± 26.22^c	75.90 ± 9.37^b	2.00 ± 0.21^{ab}
SH-LAI	141.50 ± 22.25^b	3.70 ± 1.94^c	101.80 ± 39.30^{cd}	72.70 ± 7.04^a	2.30 ± 0.10^{abc}
SH-LOU	134.30 ± 13.40^{ab}	2.70 ± 1.63^{bc}	57.20 ± 19.45^b	77.50 ± 6.00^b	2.50 ± 0.21^{bc}
SH-MAN	161.80 ± 12.95^{bcd}	6.50 ± 1.80^{def}	94.70 ± 31.90^{cd}	77.10 ± 3.92^b	1.60 ± 0.42^a
SH-NAI	110.00 ± 36.90^a	1.00 ± 0.05^{ab}	41.50 ± 29.81^a	72.50 ± 8.12^a	2.40 ± 0.10^b
SH-NO1	162.70 ± 15.06^{bcd}	1.60 ± 0.17^b	83.70 ± 23.41^c	75.80 ± 6.98^b	2.75 ± 0.05^{cd}
SH-NO2	144.90 ± 25.38^b	1.11 ± 0.52^{ab}	55.20 ± 12.91^b	73.80 ± 5.37^a	2.30 ± 0.15^{abc}
SH-NO3	154.60 ± 21.91^{bc}	1.70 ± 0.63^b	39.40 ± 12.89^a	73.40 ± 8.60^a	2.60 ± 0.31^c

SH-TAN	190.20 ± 26.05 ^{cde}	3.60 ± 0.17 ^c	61.20 ± 28.04 ^{bc}	81.00 ± 2.45 ^c	2.55 ± 0.15 ^{bc}
SH-TCH	141.70 ± 22.79 ^b	0.30 ± 0.07 ^a	37.60 ± 14.99 ^a	70.80 ± 6.51 ^a	2.45 ± 0.05 ^b
SH-TIM	155.60 ± 20.92 ^{bc}	2.60 ± 0.71 ^{bc}	80.90 ± 31.03 ^c	80.70 ± 5.01 ^c	2.45 ± 0.36 ^b
SH-YAG	139.80 ± 13.54 ^{ab}	1.70 ± 0.82 ^b	34.90 ± 17.96 ^a	70.80 ± 5.88 ^a	2.10 ± 0.31 ^{ab}

*Values with the same letter in the same column are not significantly different at the $P < 0.05$ threshold.

PH : average plant height ; NBP : average number of branches per plant ; NCP : average number of capsules per plant ; NSC : average number of seeds per capsule ; 1000-GW : average weight of 1000 seeds. No. : Number

3.2. Average oil yield

The oil content of sesame varied across accessions (Fig. 1). The four accessions with the greatest average oil yields were SH-LAI (883.07%), SH-GOU (852.07%), SH-BAI (833.03%), and SH-MAN (712.95%) (Fig. 1). In contrast, the accessions SH-ARA (289.32%), SH-BE1 (305.72%), SH-GA4 (324.57%), and SH-BON (335.73%) had low sesame oil yields (Fig. 1).

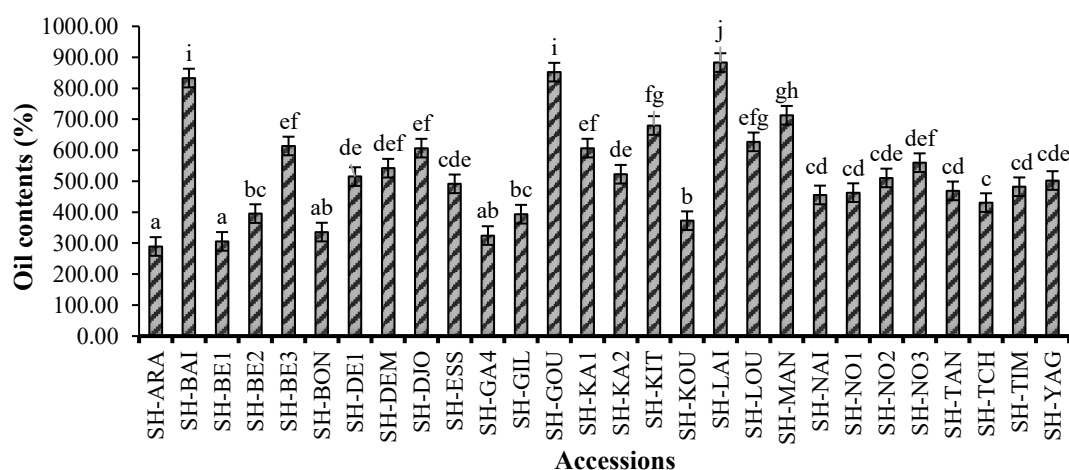


Fig. 1. Oil yield of the 28 sesame collections. Values with same letters are not significantly different at $p < 0.05$ (Tukey test).

3.3. Impurity rate (%)

Fig. 2 shows that the impurity rate varied from 2.37% (SH-GA4) to 5.56% (SH-ARA). The highest impurity levels were found in the varieties SH-ARA (5.56%), SH-BON (5.25%), SH-LOU (5.19%), and SH-DE1 (5.12%); the lowest values were found in the collections SH-GA4 (2.38%), SH-ESS (2.56%), SH-NO3 (2.56%), and SH-TCH (2.63%) (Fig. 2).

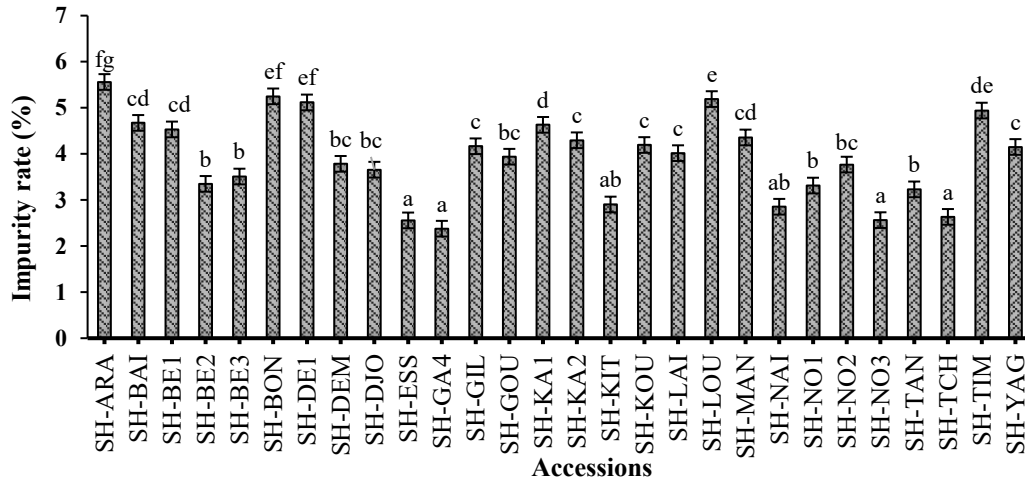


Fig. 2. Average impurity rate in sesame collections. Values with same letters are not significantly different at $p < 0.05$ (Tukey test).

3.4. Physicochemical analyses of sesame oil from collections

3.4.1. Acid index (I_A)

The acid index indicates that oils are in good condition and have not degraded by measuring their free fatty acid concentration. The I_A values varied from 15.81 to 34.91 mg of KOH/g of oil. At 15.81 mg of KOH/g of oil, accession SH-GA4 had the lowest I_A value (Table 3).

3.4.2. Saponification index (I_s)

According to the Codex standard (2009), sesame oil has a saponification index of 187–195 mg KOH/g of oil. The accession SH-KA2 had the highest I_s , measuring 766.37 mg KOH/g of oil (Table 3). A high concentration of high molecular weight triglycerides may be indicated by this high I_s value. Additionally, we observed that the SH-BE1 and SH-MAN types had the lowest values 584.28 and 587.14 mg KOH/g of oil, respectively (Table 3).

3.4.3. Ester index (I_E)

The difference between the acid index and the saponification index is known as the ester index. Table 3 depicts that the ester index values for the sesame collections ranged from 559.24 ± 131.14 mg KOH/g of oil (SH-BE1) to 737.08 ± 97.80 mg KOH/g of oil (SH-NAI). However, the SH-GIL, SH-KAI, SH-KA2, SH-NAI and SH-TCH collections all have ester index values of 700 mg KOH/g of oil (Table 3).

3.4.4. Iodine index (I_I)

Iodine index values varied from 104.95 to 108.39 g/100 g of oil and from 7.9 to 27.9 g/100 g of oil (Table 3). As shown in Table 3, the three sesame types with the highest I_I values

were SH-LOU (295.12 g/100 g of oil), SH-KA1 (256.78 g/100 g of oil), and SH-MAN (255.19 g/100 g of oil).

3.4.5. Peroxide index (I_P)

The peroxide index value varies significantly, from 3.71 to 13.93 meq O₂/kg of oil (Table 3). SH-LAI collection had the highest value (13.93 meq O₂/kg of oil), followed by SH-ESS (10.36 meq O₂/kg of oil). Additionally, our findings revealed low peroxide index values for the SH-DEM (4.01 meq O₂/kg of oil) and SH-GIL (3.71 meq O₂/kg of oil) accessions (Table 3).

Table 3. Average of various oil index for 28 sesame collections.

Collections	Oil quality index				
	I _A (mg KOH/ g)	I _S (mg KOH/ g)	I _E (mg KOH/ g)	I _I (g I ₂ /100 g)	I _P (meq O ₂ / g)
SH-ARA	33.84 ± 7.23 ^{cd}	630.19 ± 21.11 ^{ab}	596.34 ± 24.43 ^a	203.03 ± 25.86 ^{abc}	8.32 ± 2.46 ^{cd}
SH-BAI	30.86 ± 4.60 ^{cd}	649.33 ± 40.18 ^{ab}	618.46 ± 27.03 ^{ab}	239.79 ± 48.89 ^c	8.80 ± 3.24 ^{cd}
SH-BE1	25.04 ± 5.74 ^{bc}	584.28 ± 30.18 ^a	559.24 ± 31.14 ^a	219.69 ± 17.16 ^{bc}	4.99 ± 2.04 ^{ab}
SH-BE2	20.66 ± 2.04 ^b	649.10 ± 44.47 ^{ab}	628.44 ± 46.07 ^{ab}	224.40 ± 28.64 ^{bc}	6.26 ± 0.47 ^b
SH-BE3	21.67 ± 8.23 ^b	615.94 ± 59.61 ^a	594.27 ± 56.87 ^a	232.10 ± 17.75 ^c	5.05 ± 1.34 ^{ab}
SH-BON	34.56 ± 4.70 ^{cde}	665.39 ± 56.99 ^b	630.82 ± 59.56 ^{ab}	200.92 ± 76.28 ^{abc}	6.95 ± 2.30 ^{bc}
SH-DE1	30.03 ± 2.80 ^{cd}	652.19 ± 80.43 ^b	622.15 ± 89.15 ^{ab}	156.16 ± 94.15 ^a	5.63 ± 1.12 ^b
SH-DEM	25.57 ± 3.58 ^{bc}	675.07 ± 77.05 ^b	649.50 ± 73.94 ^{ab}	206.16 ± 34.97 ^{abc}	4.01 ± 1.56 ^a
SH-DJO	22.33 ± 5.58 ^b	613.44 ± 25.49 ^a	591.10 ± 28.39 ^a	211.37 ± 50.7 ^{abc}	4.51 ± 0.68 ^{ab}
SH-ESS	18.24 ± 7.23 ^{ab}	716.61 ± 93.39 ^{bc}	698.36 ± 91.87 ^{abc}	235.67 ± 27.55 ^c	10.36 ± 2.35 ^{de}
SH-GA4	15.81 ± 5.31 ^a	684.46 ± 27.34 ^b	668.65 ± 27.45 ^{abc}	198.25 ± 11.62 ^{ab}	5.33 ± 2.30 ^b
SH-GIL	28.37 ± 3.75 ^c	758.33 ± 87.84 ^c	729.96 ± 98.04 ^{bc}	147.37 ± 35.53 ^a	3.71 ± 1.30 ^a
SH-GOU	25.84 ± 4.71 ^{bc}	654.39 ± 72.95 ^{ab}	628.55 ± 69.42 ^{ab}	158.43 ± 42.59 ^a	6.18 ± 1.23 ^b
SH-KA1	34.54 ± 1.59 ^{cde}	745.07 ± 12.89 ^c	710.53 ± 18.25 ^{bc}	256.78 ± 48.63 ^{cde}	9.02 ± 3.16 ^{cde}
SH-KA2	32.54 ± 2.68 ^{cd}	766.37 ± 18.36 ^c	733.82 ± 39.32 ^{bc}	179.51 ± 42.21 ^{ab}	5.74 ± 1.81 ^b
SH-KIT	18.24 ± 3.59 ^{ab}	634.92 ± 55.77 ^{ab}	616.67 ± 57.29 ^{ab}	242.69 ± 11.15 ^{cd}	8.15 ± 1.88 ^c
SH-KOU	27.89 ± 3.20 ^c	690.62 ± 90.07 ^b	662.73 ± 98.37 ^{abc}	200.79 ± 13.31 ^{abc}	5.90 ± 0.84 ^b
SH-LAI	27.07 ± 8.23 ^c	681.88 ± 85.80 ^b	654.81 ± 85.98 ^{ab}	243.60 ± 62.12 ^{cd}	13.93 ± 10.68 ^f
SH-LOU	34.35 ± 6.28 ^{cde}	663.24 ± 44.09 ^{ab}	628.89 ± 44.61 ^{ab}	295.12 ± 26.48 ^{ef}	7.96 ± 2.53 ^c
SH-MAN	24.38 ± 3.77 ^{bc}	587.14 ± 61.30 ^a	562.75 ± 73.22 ^a	255.19 ± 19.62 ^{cde}	4.24 ± 0.96 ^a
SH-NAI	21.83 ± 6.84 ^b	758.92 ± 50.14 ^c	737.08 ± 97.80 ^{bc}	236.57 ± 22.13 ^c	4.90 ± 1.42 ^{ab}
SH-NO1	23.55 ± 5.87 ^b	721.70 ± 50.06 ^{bc}	698.14 ± 47.53 ^{abc}	155.89 ± 44.55 ^a	5.23 ± 0.81 ^b
SH-NO2	27.08 ± 8.69 ^c	710.05 ± 70.87 ^{bc}	682.97 ± 64.00 ^{abc}	219.82 ± 64.42 ^{bc}	6.78 ± 0.04 ^{bc}
SH-NO3	18.41 ± 2.74 ^{ab}	708.92 ± 31.95 ^{bc}	690.51 ± 25.69 ^{abc}	246.83 ± 28.79 ^{cd}	6.83 ± 1.13 ^{bc}
SH-TAN	23.14 ± 9.69 ^b	705.19 ± 61.65 ^{bc}	682.05 ± 54.33 ^{abc}	241.25 ± 75.63 ^{cd}	6.09 ± 0.98 ^b
SH-TCH	19.18 ± 2.45 ^{ab}	726.94 ± 48.54 ^{bc}	707.76 ± 46.46 ^{bc}	232.65 ± 48.70 ^c	7.79 ± 0.51 ^c
SH-TIM	34.91 ± 2.29 ^{cde}	694.31 ± 45.98 ^{bc}	659.39 ± 34.06 ^{ab}	234.94 ± 94.89 ^c	5.61 ± 0.44 ^b
SH-YAG	27.60 ± 6.92 ^c	718.19 ± 126.01 ^{bc}	690.58 ± 38.84 ^{abc}	233.92 ± 52.59 ^c	6.41 ± 0.62 ^{bc}

I_A : Index of acid ; I_S : Index of saponification ; I_E : Index of ester ; I_I : Index of iodine ; I_P : Index of peroxide. n= 4.

*Values with the same letter in the same column are not significantly different at the P < 0.05 threshold.

3.5. Interdependence between agro-morphological parameters and oil indices

3.5.1. Correlation between the different parameters studied

Principal component analysis (PCA) revealed a 50% dependence between accessions based on agro-morphological parameters (PH, NBP, NCP, NSC, and 1000-GW) and oil quality indices (oil content, I_A , I_E , I_S , I_I , and I_P) examined (PC1 = 30.97% and PC2 = 17.83% with a total variability of 48.80%) (Fig. 3A).

The dendrogram revealed four groups. Group 1 consists of thirteen collections (SH-NO2, SH-YAG, SH-NO3, SH-TAN, SH-TIM, SH-NAI, SH-TCH, SH-KA2, SH-ESS, SH-GIL, SH-NO1, SH-DE1, and SH-DEM) and exhibits high values for I_E , I_S , I_A and 1000-GW (Fig. 3B). Group 2 consists of six collections (SH-ARA, SH-BE1, SH-BON, SH-KOU, SH-GA4, and SH-BE2) with low oil content values (Fig. 3B). The NSC, NCP, NBP, I_I and I_P characters are moderate for the collections in group 3, but higher for those in group 4 (SH-BAI, SH-LAI, SH-KIT, SH-KAI, and SH-LOU) (Fig. 3B).

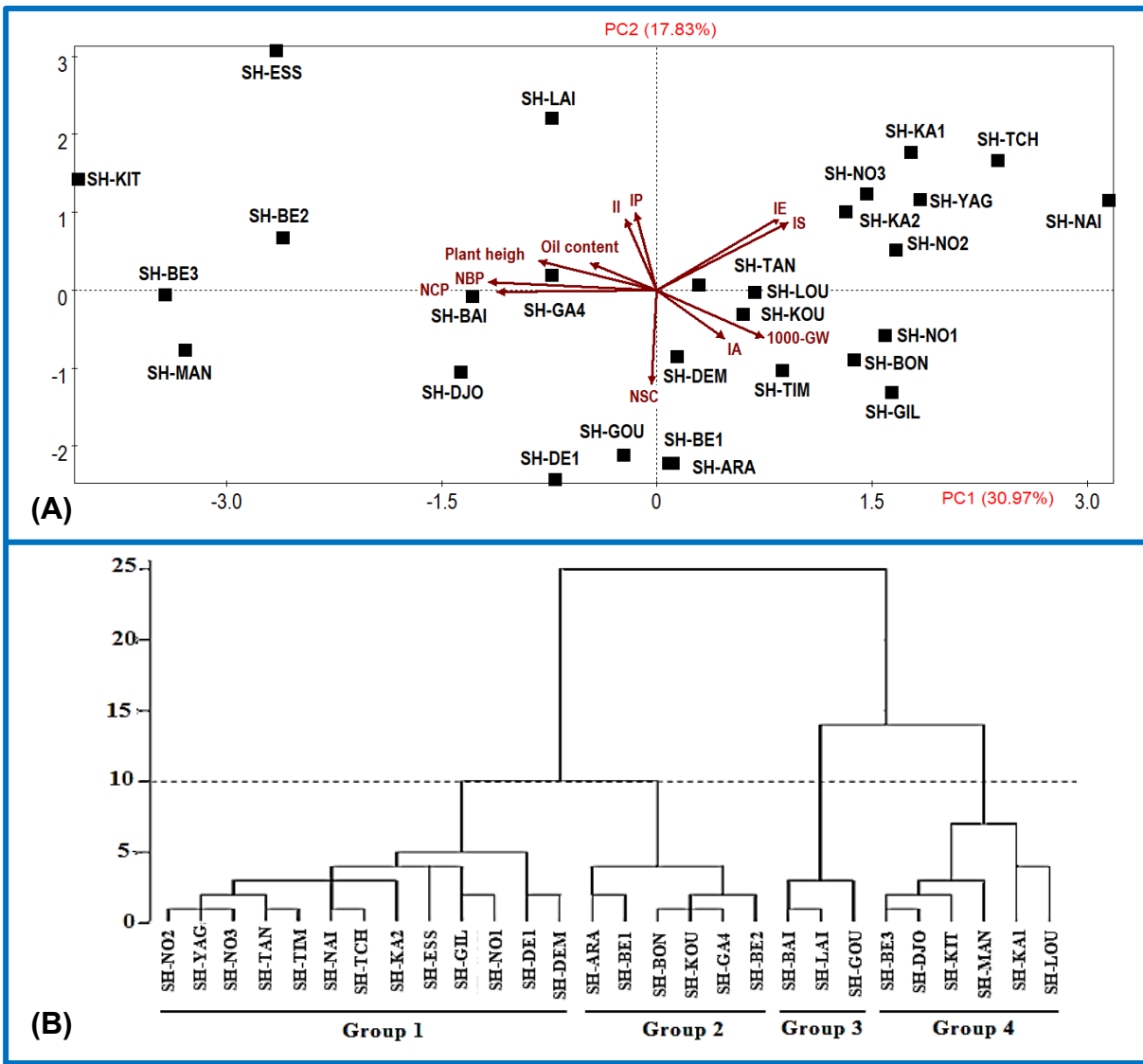


Fig. 3. Principal component analysis (A) and dendrogram (B) based on the agro-morphological parameters and quality of oils characteristics of various sesame accessions.

The number of branches per plant and the number of capsules per plant were found to have a strong and highly significant genetic association, with $r = 0.795$ ($p < 0.01$) (Fig. 4). However, our findings revealed an inverse relationship between the weight of 1000 grains and the number of branches per plant, with a highly significant negative genetic correlation coefficient of $r = -0.627$ ($p < 0.01$) (Fig. 4). The saponification index and the ester index, however, showed a positive and highly significant relationship ($r = 0.994$, $p < 0.01$) (Fig. 4).

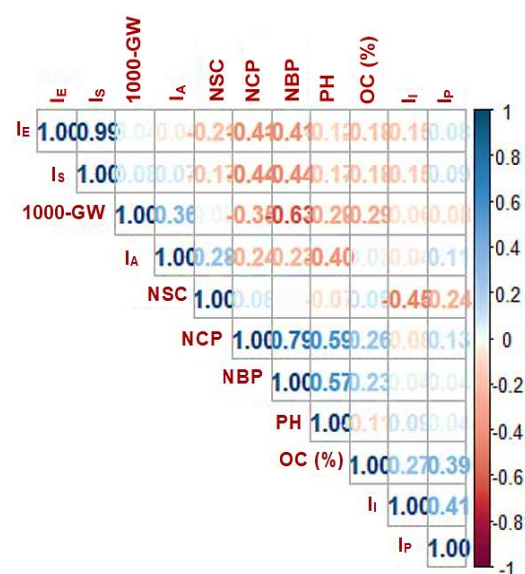


Fig. 4. Correlation coefficient of all characters studied. Pearson's correlation coefficient is represented by the color of the values. The correlations are shown by a p -value of 0.05 (significant) and by a p -value of 0.01 (high significant). A positive correlation coefficient is represented by the various values of blues, and a negative correlation coefficient is represented by the various reds of red. The strength of the R^2 correlation coefficient determines the color's intensity. The scale on the right shows how various colors are interpreted.

3.5.2. Estimates of the variability of different traits

For every attribute examined, PCV was generally higher than GCV. Regarding our findings, GCV values ranged from 4.53% (IS) to 113.02% (NBP), whereas PCV ranged from 14.04% to 130.85% for the saponification index and the number of branches per plant, respectively (Table 4). According to our findings, agro-morphological parameters had very high broad-sense heritability values: 91% for 1000-GW, 82% for plant height, and 74% for number of grains per plant (Table 4). Another important consideration in choosing various features is genetic gain. NBP had the greatest level of advance in genetics (201.10%), followed by NCP (106.66%) and 1000-GW (69.23%). On the other hand, IE, IS, and IA showed the least level of genetic advance, with corresponding values of 2.99%, 3.01%, and 4.63% (Table 4). Based on

our findings, NBP and 1000-GW have especially high heritability and large genetic advance (Table 4). However, the broad range of heritability (H^2) values for the variables under study is 5% to 91% (Table 4).

Table 4. Estimates of variability, broad-sense heritability and genetic advance for growth, yield and enzymatic activities in sesame.

Character	Mean	Range		Coefficient of variation		Broad-sense heritability (H^2)	Genetic advance (GA)
		Min.	Max.	GCV(%)	PCV(%)		
Plant height (cm)	157.35	71.50	240.00	31.24	34.33	82	58.56
NBP	3.52	0.00	16.00	113.02	130.85	74	201.10
NCP	80.69	5.00	400.00	74.07	105.95	48	106.66
NSC	75.89	35.00	114.00	10.47	14.74	50	15.32
1000-GW (g)	2.26	1.20	2.90	35.11	36.68	91	69.23
I _A	25.98	2.80	56.89	9.80	42.77	5	4.63
I _S	680.79	411.40	965.77	4.53	14.04	10	3.01
I _P	6.59	2.18	28.29	38.13	53.73	50	55.74
I _I	218.17	55.98	338.97	16.49	27.30	36	20.53
I _E	654.80	381.48	945.88	4.61	14.61	9	2.99
Oil content (%)	527.72	217.10	1182.03	11.82	40.97	8	7.03

Min. : minimum ; **Max.** : maximum ; **GCV** : genotypic coefficient variance ; **PCV** : phenotypic coefficient variance ; **NBP** : average number of branches per plant ; **NCP** : average number of capsules per plant ; **NSC** : average number of seeds per capsule **I_A** : Index of acid ; **I_S** : Index of saponification ; **I_E** : Index of ester ; **I_I** : Index of iodine ; **I_P** : Index of peroxide.

4. Discussion

To select varietal genotypes of this plant species that produce high-performing, productive genotypes, an agro-morphological assessment of sesame remains essential. According to these findings, the average plant height of all 28 sesame accessions was roughly 157.35 cm. These findings are in contrast to those of Hamissou et al. (2020), who found that sesame collections cultivated in Niger had an average plant height of 139.75 cm. Sundari et al. (2022) and Patel et al. (2023) reported similar findings, with lower values of 92.66 cm for collections cultivated in India. This genetic diversity may be related to environmental factors, including changes in sunlight and temperature. However, our results showed that the collections SH-KIT (8.1) and SH-BE2 (6.9) had an average of more branches per plant than any other collection. According to the findings of Hamissou et al. (2020), each plant has an average of 9.7 branches. According to our findings, the average number of branches per plant (3.52) is larger than that of Khuntia et al. (2024) (2.34) and lower than that of Hamissou et al. (2020) (9.7). Rahnema and Akhshandeh (2006) argue that changes in the environment and growing

conditions may be the cause of this difference. It should be mentioned that one of the most crucial selection factors in sesame breeding programs is the number of branches. This is because more branches enable each plant to produce more capsules, which raises the seed production (Baydar 2005).

In this regard, a program aimed at increasing seed yield could employ these collections as possible genotypes. Some authors have conducted similar research on *S. indicum* and found lower average values of approximately 31.53 (Patel et al. 2023) and 45.97 (Khuntia et al. 2024) for the number of capsules per plant trait, in contrast to our results of 80.69. On the other hand, Pavani et al. (2020) found an average of 113.9 for Indian sesame collections, which is greater than our data. Sundari et al. (2022), Patel et al. (2023), and Khuntia et al. (2024) found the same results, with 74.12, 50.15, and 61.05 for the average number of seeds per capsule trait and 2.90, 3.24, and 3.49 for the average weight of 1000 seeds trait. These results show values below 75.89 for the number of seeds per capsule trait and above 2.26 g for the average weight of 1000 seeds trait. It should be mentioned, though, that the seed yield of some accessions was lower than that of other accessions with a higher number of capsules. This could be related to the capsules' maturity and indicate indeterminate growth of sesame, leading to the production of immature capsules at harvest time. One of the most crucial characteristics for identifying the best variety of sesame is its ability to produce capsules (Baydar 2005).

The oil products of an oilseed change depending on its production area (Kitenge et al. 2022). With an overall average of 52.72%, this finding may be advantageous for some industrial or food usage. In earlier research on Indian sesame, Pavani et al. (2020) and Sundari et al. (2022) found average oil yields of 44.30% and 23.83%, respectively. However, our research revealed that the sesame yield value was between 25 to 50%, as recommended by Kiandji (2001). Kitenge et al. (2022) claimed that a low or high sesame oil output could be explained by the experimental setup and methodology. According to Kitenge et al. (2022), the oil yield of two sesame cultivars from the Democratic Republic of the Congo, Kalayibantu and Kasaï, was rather low, ranging from 19 to 19.7%. Depending on genetic factors associated with genotype, environmental circumstances, climate, stage of development, time of seed collection, and analytical method, the composition of sesame seeds may play a role. On the other hand, top-grade sesame seeds typically have an impurity level of less than 3%, which is still a critical quality standard. Our results showed that the impurity rate ranged from 2.37% (SH-GA4) to 5.56% (SH-ARA). These findings indicated a high level of free fatty acids in the oil because they are higher than the Codex Alimentarius (1999) standard of 1. The risk of oil hydrolysis is indicated by the free fatty acid level, according to Zahran and Tawfeuk (2019). This could be

explained by the fact that the new aqueous extraction conditions did not accelerate certain reactions, such as hydrolysis and hydration of esters and unsaturated molecules in sesame oil. Furthermore, the acidity index may promote the oxidative breakdown of oils via chemical and enzymatic hydrolysis, leading to the production of volatile compounds.

50-60% of the oil in sesame seeds originates from this oilseeds crop. Accordingly, the main characteristics of sesame oil quality indicators are high antioxidant content, high purity, and low impurity levels (Gharby et al. 2015). These indicators are used to gauge the physical and chemical properties of oils, such as the free fatty acid content, I_A , I_P , I_I , I_S and I_E . The literature indicates that because of its low I_A value, accession SH-GA4 would yield oil that could be used on an industrial basis (Barka 2016). In this way, sesame oil has high stability due to its low acidity index value. However, Kitenge et al. (2022) found that oil from two types of sesame extracted using a traditional mechanical process in the Democratic Republic of the Congo produced different results, with values of 1.4 and 1.5 mg KOH/g of oil. On the other hand, following hexane extraction, Barka's (2016) results revealed somewhat higher acid index values (2.2 mg KOH/g of oil).

The length of the fatty acid chain that esterifies glycerol and is present in the oil is correlated with the saponification index (I_S) (Adrian et al. 1998). These findings are opposed to those of Okandza et al. (2017) and Adeniyi (2019), who found 186 mg KOH/g oil for sesame seeds in the Democratic Republic of the Congo and 261.34 mg KOH/g oil in Nigeria, respectively. Given its high I_S , this suggests that this sesame oil would be less suited for consumption but might be used to produce soap. Nevertheless, there is an inverse relationship between the saponification index and the oil's molecular weight. Therefore, a fatty substance's saponification index increases as its molar mass decreases. The amount needed to saponify the esterified acids in one gram of fat is represented by ester value, which was found to be equal to saponification value. According to our findings, the ester value of the 28 samples under investigation varied between 559.24 à 737.08 mg KOH/g of oil. These findings are different from those of Adeniyi (2019), who stated that the I_E of sesame seed oil was 256.48 mg KOH/g of oil. These findings also conflict with those of Kitenge et al. (2022), who reported a smaller range of values for sesame cultivars from Niger, ranging from 15.1 mg KOH/g of oil (Kalayibantu) to 18.4 mg KOH/g of oil (Kasaï). An abundance of esters and low molecular weight fatty acids would be indicated by this high I_E value.

In addition to revealing an oil sample's tendency toward oxidation and lack of humidity, the iodine index (I_I) can be used to evaluate the degree of unsaturation in the sample. I_I values varied from 104.95 to 108.39 g/100 g of oil and from 7.9 to 27.9 g/100 g of oil, respectively,

according to recent research by Zahran et al. (2020) and Kitenge et al. (2022). This implies that some of our collections' sesame oil may be considered cooking oil. Additionally, it should be mentioned that the iodine value shouldn't be either too high (which would raise the oxidation level) or too low (which would change its physical properties) (Sher and Hussain 2009).

The peroxide index indicates the quantity of oxygen that is chemically bound to an oil or fat in the form of peroxides, particularly hydroperoxides. The SH-LAI collection recorded the highest value (13.93 meq O₂/kg of oil) in our study, which is an important result that will help us to understand the impact of different collections. These findings are in line with those of Kitenge et al. (2022), who found that a high rate of rancidity was linked to peroxide index values between 5.9 and 10.9 meq/kg of oil. In contrast, the work of Zahran et al. (2020) indicated lower values, ranging from 1.01 to 2.87 meq/kg of oil. This suggests that the potential of these oil samples going rancid and degrading at room temperature is decreased. When evaluating the early phases of oxidative damage, the peroxide value would be a very helpful and sensitive criterion. Additionally, our findings revealed low peroxide index values for the SH-DEM (4.01 meq O₂/kg of oil) and SH-GIL (3.71 meq O₂/kg of oil) accessions, which seem to be acceptable levels in accordance with the Codex Alimentarius (2009).

It is evident from an analysis of the major effects of the datasets for the numerous traits under study that many of these traits are linked because of reciprocal relationship, whether positive or negative (Kant et al. 2011). The findings show that for majority of traits direct effects were typically more important than indirect effects. In our study, the average number of branches per plant and the average number of capsules per plant were displayed to have a strong and highly significant genetic connection. These findings are consistent with those of Zangui and Amoukou's (2025) study on sesame collections in Niger, which demonstrated the genetic relationship between the two features. This could be explained by the fact that a plant with more branches would have more places where capsules could form, which would increase the number of capsules per plant. For plant height and grain yield, Mohammad et al. (2005) and Zangui and Amoukou (2025) observed a negative association between these two parameters. A plant with many branches must divide its resources among a larger number of seeds, which may result in an increase in the weight of each seed per capsule. This link can be explained by increasing competition for energy, water, and nutrients. Based to some studies, if the acid index stays constant, an increase in the saponification index which indicates the presence of fatty acids in sesame oil would result in a proportionate increase in the ester index (Kitenge et al. 2022). When identifying performance determinants, however, correlation analysis results can occasionally be deceptive because they simply provide details about the relationship rather than

the cause of it. Path analysis (Wright 1921), which divides the correlation coefficient into the direct and indirect effects of independent factors on the dependent component, can be used to uncover the cause of such relationships. This approach makes it easier to create an efficient selection strategy and clearly illustrates the relationships between features. Therefore, before starting a breeding program to increase yield through component qualities, it is crucial to determine the genetic basis of correlation.

Understanding genetic variability is crucial for any crop improvement effort and is necessary for effective varietal selection. By analyzing the genetic combination of agromorphological characteristics and oil quality markers in 28 sesame collections, this insight can be attained. This variability can be divided into heritable and non-heritable components using genetic indices such as heritability, genetic advance, phenotypic and genotypic coefficients of variation (Azam et al. 2018; Likeng-Li-Ngue et al. 2025; Njock et al. 2025).

For every attribute examined, PCV was generally higher than GCV. This would suggest that attributes are less influenced by the environment and that population composition may possibly be responsible for the notable variations seen. Thus, phenotypic values may offer a useful basis for selection. The same findings were observed by Khuntia et al. (2024) and Tadesse et al. (2024) on *Sesamum indicum*, and by Njock et al. (2025) on *Abelmoschus esculentus*, which highlighted a stronger significance in PCV than in GCV, regardless of the feature evaluated. According to recent research on maize by Likeng-Li-Ngue et al. (2025), some features may be more impacted by the environment than by genetics. This implies that the GCV is the genetic component of the total variance and that the PCV of a trait is the expression of the genotype/environment interaction.

However, previous work has demonstrated that when a trait's GCV and heritability values are extremely high, a selection program would be more successful (Burton, 1952; Likeng-Li-Ngue et al. 2025; Njock et al. 2025). Burton (1952) divided heritability estimates into three categories: low (below 50%), medium (between 50% and 70%), and high (beyond 70%). According to our findings, agromorphological parameters had very high broad-sense heritability values: 91% for 1000-GW, 82% for plant height, and 74% for number of grains per plant. These percentages, which are 64.18%, 61.84%, and 85.96% for Patel et al. (2023) and 87.36%, 83.92%, and 88.33% for Khuntia et al. (2024), are comparable. The high broad-sense heritability should be assessed at more than 60% ($H^2 > 60\%$), according to Ramya et al. (2017) and Njock et al. (2025). While qualities with low heritability suggest that selection will be affected by environmental factors, the characters predict that selection will be more successful. Nonetheless, the peroxide index (50%), number of seeds per capsule (50%), number of capsules

per plant (48%), and iodine index (36%) exhibit moderate heritability values in our study. According to research by Yadav et al. (2015) on *Hordeum vulgare* L. and Bharat et al. (2020) on *Sesamum indicum* L. moderate heritability would suggest that environmental influences have lesser impact. Since heritability would be based on total genetic variance, which includes both fixable (additive) and non-fixable (dominant and epistemic) variance, this would support less effective selection. However, some studies shown that expected genetic advance and broad-sense heritability are essential for traits under selection.

Another important consideration in choosing various features is genetic gain. But Muluken et al. (2016) ; Patel et al. (2023) ; Khuntia et al. (2024); and Likeng-Li-Ngue et al. (2025) showed that combining high heritability with high genetic advance provided, more insight into genes interaction and changes than considering each parameter separately. These findings are similar to those of the researchers cited before. This may show how additive gene action affects their expression, implying that early-generation selection influences these features. On the other hand, both additive and non-additive gene action may be present if high heritability and low genetic advance are seen (Yadav et al. 2015; Likeng-Li-Ngue et al. 2025; Njock et al. 2025). The conclusions of Vijay et al. (2015) and Ramya et al. (2017), who revealed that the broad-sense heritability value associated with genetic advance was more reliable for character selection than heritability estimates alone, are supported by this.

5. Conclusion

The objective of this study was to examine the genetic variety of oil quality markers and yield parameters in seeds from 28 sesame collections. Significant diversity was observed among collections studied when the composition of the accession groups tested using various methods of selection was analyzed. High characteristics for PH, 1000-GW, and NSC were displayed by the SH-BAI, SH-TAN, SH-ARA, SH-ESS, SH-DEM, and SH-BE2 collections. High oil yields were found in more than half of the collections examined. High oil quality indicators were linked to this yield, and some of these indices appear to be pertinent to the SH-BAI, SH-GOU, SH-LAI, and SH-MAN collections. These traits seemed to be highly heritable and controlled by additive gene action based on the 1000-GW, NBP and I_p value. Therefore, the primary direct selection criteria to producing high-yielding, high-quality oil sesame collections were found to be PH, NBP, 1000-GW, oil yield, and oil quality indices. However, correlation analysis revealed a strong positive and significant correlation between certain traits that could serve as criteria for improving sesame seeds as part of a program to improve this crop.

References

- Adeniyi OO (2019) Extraction and characterization of underutilized seed oils sampled. *Int Ann Sci* 7:48–52. <https://doi.org/10.21467/ias.7.1.48-52>
- Adrian J, Dan Villier P, Potus J (1998) Introduction à l'analyse nutritionnelle des denrées alimentaires. Tec & doc-Lavoisier, Paris, p 254
- Allard RW (1960) Principles of plant breeding. John Wiley and Sons Inc, New York
- Angel DP, Ahamed ML, Satish Y, Patro TSSK, Prakash KK, Srivastava RK (2024) Genetic variability analysis for yield and important agronomic traits in association panel of pearl millet [*Pennisetum glaucum* (L.) R. Br.]. *Int J Adv Biochem Res* 8:843–848. <https://doi.org/10.33545/26174693.2024.v8.i9Sj.2230>
- Anonymous (2023) FAO statistical databases and data sets. <https://www.fao.org/faostat/fr/#data/QCL/visualiz>
- Ashri A (1998) Sesame breeding. *Plant Breed Rev* 16:179–228. <https://doi.org/10.1002/9780470650110.ch5>
- Azam MG, Hossain MA, Alam MS, Rahman KS, Hossain M (2018) Genetic variability, heritability and correlation path analysis in mungbean (*Vigna radiata* L. Wilczek). *Bangladesh J Agric Res* 43:407–416. <https://doi.org/10.3329/bjar.v43i3.38389>
- Barka A (2016) Evaluation des indices de nature physico-chimiques de quelques huiles alimentaires des fritures et impact sur la santé du consommateur. Dissertation, Université de Tlemcen, Algérie
- Baydar H (2005) Breeding for the improvement of the ideal plant type of sesame. *Plant Breed* 124:263–267. <https://doi.org/10.1111/j.1439-0523.2005.01080.x>
- Bharat P, Dileep T, Siddharth P, Manohar P, Yogendra S, Gita K (2020) Genetic variability heritability and genetic advance studies in sesame (*Sesamum indicum* L.). *J Pharmacog Phytochem* 9:1679–1681. <https://www.phytojournal.com>
- Burton GW (1952) Quantitative inheritance in grasses. In: Proceedings of the 6th International Grassland Congress, vol 1, Pennsylvania State College, 17–23 August 1952, pp 277–283
- Codex Alimentarius (1999) Codex standard for named vegetable oils, current official standards (amended 2003, 2005). FAO/WHO Food Standards. <https://www.codexalimentarius.net>
- Codex Alimentarius (2009) Standard for named vegetable oils. Codex Stan 210-1999, revision 2009. <https://www.codexalimentarius.org>
- Dabholkar AR (1992) Elements of bio metrical genetics. Concept Publishing Company, New Delhi, pp 57–116
- Gharby S, Harhar H, Guillaume D, Roudani A, Boulbaroud S, Ibrahimi M, Ahmad M, Sultana S, Ben Hadda T, Chafchaoui-Moussaoui I, Charrouf Z (2015) Chemical investigation of *Nigella sativa* L. seed oil produced in Morocco. *J Saudi Soc Agric Sci* 12:172–177
- Hamissou Z, Amoukou A I, Boureima S, Hamissou AM (2020) Caractérisation agromorphologique des accessions de sésame (*Sesamum indicum* L.) collectées au Niger. *Int J Innov Appl Stud* 29:902–914
- Hsu E, Parthasarathy S (2017) Anti-inflammatory and antioxidant effects of sesame oil on atherosclerosis: a descriptive literature review. *Cureus* 9:1438. <https://doi.org/10.7759/cureus.1438>
- Johnson HW, Robinson HF, Comstock RF (1955) Estimates of genetic and environmental variability in soybeans. *J Agric Sci* 47:314–318. <https://doi.org/10.2134/agronj1955.00021962004700070009x>
- Kandji A (2001) Etude de la composition chimique et de la qualité d'huiles végétales artisanales consommées au Sénégal. Dissertation, Université Cheikh Anta Diop de Dakar, Sénégal
- Kant S, Lamba RAS, Panwar IS, Arya RK (2011) Variability and inter-relationship among yield and quality parameters in bread wheat. *J Wheat Res* 3:50

- Kanu PJ (2011) Biochemical analysis of black and white sesame seeds from China. *Am J Biochem Mol Biol* 1:145–157. <https://doi.org/10.3923/ajbmb.2011.145.157>
- Khuntia JB, Dash AP, Kar KR, Biswajit L, Hansaraj P, Vabhishek S, Subhadra P, Mishra S, Pani B, Satapathy S (2024) Unveiling genetic variability and character associations in sesame. *Biochem Cell Arch* 24:1135–1142. <https://doi.org/10.51470/bca.2024.24.1.1135>
- Kitenge ND, Mabiala MDGC, Mbadu ZV, Mukala KCA, Nsimba MJC, Kelani NF (2022) Etude de quelques paramètres des huiles de deux variétés (Kalayibantu et Kasai) de sésame extrait par la méthode mécanique traditionnelle. *Rev Cong Sci Technol* 1:86–89. <https://doi.org/10.5757161/zenedo.022.v1.i2.11>
- Likeng-Li-Ngue BC, Zenabou N, Ngalle BH, Mindjembe PSC, Bell JM (2025) Genetic diversity of maize (*Zea mays* L.) landraces from Cameroon and Democratic Republic of Congo using phenological, biometrical and yield components. *Am J Plant Sci* 6:682–701. <https://doi.org/10.4236/ajps.2025.165049>
- Minioti KS, Georgiou CA (2010) Comparison of different tests used in mapping the Greek virgin olive oil production for the determination of its total antioxidant capacity. *Grasas Aceites* 61:45–51. <https://doi.org/10.3989/gya.010508>
- Mohammad T, Sajjad-Haidar, Qureshi MJ, Khan AJ, Roshan-Zamir (2005) Correlation and path analysis in candidate bread wheat (*Triticum aestivum*) lines evaluated in micro-plot test trial. *Pak J Sci Ind Res* 48:284–288. <https://www.biostaging.pjsir.org/index.php/biological-sciences/article/view/1395>
- Muluken D, Wassu M, Endale G (2016) Variability heritability and genetic advance in Ethiopian okra [*Abelmoschus esculentus* (L.) Monech] collections for tender fruit yield and other agro morphological traits. *J Appl Life Sci Int* 4:1–12. <https://doi.org/10.9734/jalsi/2016/19483>
- Myint D, Gilani SA, Kawase M, Watanabe KN (2020) Sustainable sesame (*Sesamum indicum* L.) production through improved technology: an overview of production, challenges, and opportunities in Myanmar. *Sustainability* 12:3515. <https://doi.org/10.3390/su12093515>
- Njock RS, Likeng-Li-Ngue BC, Mbo NLF, Manga NJ, Ngalle BH, Bell JM (2025) Genetic analysis of the effect of sodium azide (chemical mutagen) induction on three Cameroonian okra (*Abelmoschus esculentus* (L.) Moench) varieties' growth characteristics, yield, and enzymatic activities. *J Sci Agric* 9:146–157. <https://doi.org/10.25081/jsa.2025.v9.9499>
- Okandza Y, Ossoko JP, Yoca JE, Dzondo MG, Tsieri MM, Yesly A, Toubate B (2017) Etude de quelques propriétés physico-chimiques de l'huile de *Sesamum indicum* L. originaire de la République du Congo. *IOSR J Biotechnol Biochem* 3:11–16. <https://doi.org/10.9790/264X-03061116>
- Ola M, Patel M, Kumar A, Ram M, Pant N (2023) Genetic variability for seed yield and its component characters in taramira (*Eruca sativa* Mill.). *Pharma Innov J* 12:3102–3105. <https://www.thepharmajournal.com>
- Patel MK, Tiwari D, Sharma V, Prasad OM, Saroj N, Kumar S, Harisha R, Singh D (2023) Deciphering the genetic variability for seed yield components in sesame (*Sesamum indicum* L.). *Int J Environ Clim* 13:1118–1126. <https://doi.org/10.9734/ijecc/2023/v13i102761>
- Pavani K, Lal Ahamed M, Ramana JV, Sirisha ABM (2020) Studies on genetic variability parameters in sesame (*Sesamum indicum* L.). *Int J Chem Stud* 8:101–104. <https://doi.org/10.22271/chemi.2020v8.i4b.9673>
- Ramya AR, Ahamed L, Rakesh K, Srivastava (2017) Genetic diversity analysis among inbred

- lines of pearl millet [*Pennisetum glaucum* (L.) R. Br.] based on grain yield and yield component characters. *Int J Curr Microbiol Appl Sci* 6:2240–2250. <https://doi.org/10.20546/ijcmas.2017.606.266>
- Sher H, Hussain F (2009) Ethnobotanical evaluation of some plant resources in Northern part of Pakistan. *Afr J Biol* 8(17). <https://doi.org/10.4314/ajb.v8i17.62131>
- Sundari S, Vasline AY, Saravanan K (2022) Selection of traits for seed yield improvement through variability parameters in sesame (*Sesamum indicum* L.) genotypes. *J Appl Nat Sci* 14:829–834. <https://doi.org/10.31018/jans.v14i3.3507>
- Tadesse M, Geleta N, Nepir G (2024) Studies of genetic variability in sesame (*Sesamum indicum* L.) collections for morpho-agronomic traits at Werer, Ethiopia. *Agric For Fish* 13:22–30. <https://doi.org/10.11648/j.aff.20241302.12>
- Vijay KG, Vanaja M, Jyothi LN, Maheswari M (2015) Studies on variability, heritability and genetic advance for quantitative traits in black gram (*Vigna mungo* L.). *Agric Res J* 52:28. <https://doi.org/10.5958/2395-146X.2015.00056.3>
- Wacal C, Ogata N, Basalirwa D, Sasagawa D, Kato M, Handa T, Masunaga T, Yamamoto S, Nishihara E (2019) Fatty acid composition of sesame (*Sesamum indicum* L.) seeds in relation to yield and soil chemical properties on continuously monocropped upland fields converted from paddy fields. *Agronomy* 9:801. <https://doi.org/10.3390/agronomy9120801>
- Weldemichae MY, Baryatsion YT, Sbhatu DB, Gebresamuel AG, Juhan H, Kassa AB, Baraki SF, Gebremedhn HM, Gebrelibanos TS, Mebrahtu MM, Gebru MM, Meresa BK, Teklay M, Berhe BD, Gebru HA (2021) Effect of sodium azide on quantitative and qualitative stem traits in the M2 generation of Ethiopian sesame (*Sesamum indicum* L.) genotypes. *Sci World J*. <https://doi.org/10.1155/2021/6660711>
- Yadav SK, Singh AK, Pandey P, Singh S (2015) Genetic variability and direct selection criterion for seed yield in segregating generations of barley (*Hordeum vulgare* L.). *Am J Plant Sci* 6:1543–1549. <https://doi.org/10.4236/ajps.2015.69153>
- Zahran HA, Tawfeuk HZ (2019) Physicochemical properties of new peanut (*Arachis hypogaea* L.) varieties. *OCL* 26:19. <https://doi.org/10.1051/ocl/2019018>
- Zahran HA, Abd-Elsaber A, Tawfeuk HZ (2020) Genetic diversity, chemical composition and oil characteristics of six sesame genotypes. *OCL* 27:39. <https://doi.org/10.1051/ocl/2020034>
- Zangui H, Amoukou AI (2025) Evaluation des caractéristiques agromorphologiques de huit (8) génotypes de sésame (*Sesamum indicum* L.) du Niger. *J Anim Plant Sci* 64:12113–12129. <https://doi.org/10.35759/JAnmPlSci.v64-2.6>

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Credit authorships contribution statement

576 **Makon CB** : Writing original draft, methodology, writing – review and editing. **Manga NJ** :
577 Methodology, writing review, editing, investigation, formal analysis, and visualization. **Aladji**
578 **Abatchoua MMI** : Conceptualization, methodology, writing review and editing. **Nkoulou LF**
579 : Methodology, writing review, editing. **Cheriffa Nathalie Molo**: Writing review and editing,
580 investigation. **Likeng-Li-Ngue BC** : Conceptualization, writing review and editing,
581 Supervision.