



RESEARCH ARTICLE

ASSESSMENT OF AGRO-MORPHOLOGICAL VARIABILITY AND HERITABILITY ESTIMATES IN SELECTED SESAME (*SESAMUM INDICUM* L.) VARIETIES UNDER THE FOREST-SAVANNA TRANSITION ZONE OF EDO STATE

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ABSTRACT

A field experiment was conducted at the Teaching and Research Farm, Ambrose Alli University, Emaudo Annex, Ekpoma, Edo State, to assess agro-morphological variability and estimate heritability among selected sesame (*Sesamum indicum* L.) varieties. The experiment was laid out in a Randomized Complete Block Design (RCBD) with four replicates. Data collected on growth and yield traits were analyzed using analysis of variance (ANOVA) and genetic models, while means were separated using the Least Significant Difference (LSD) test at 5% probability level. Significant differences were observed among the varieties for all vegetative and yield traits. NCRIBEN 01M recorded the highest plant height across 2, 4, 6, and 8 weeks after planting (WAP), whereas E8 produced the highest number of leaves, leaf area, stem girth, and number of branches. High heritability and genetic gain values were obtained for key traits such as plant height (95.24% and 12.32), number of leaves per plant (98.25% and 16.35), and leaf area (95.01% and 12.76), indicating predominance of additive gene effects. Similarly, high heritability estimates were observed for stem girth, number of branches, days to 50% flowering and maturity, number of seeds per pod, 1000-seed weight, pod weight, and seed yield. Conversely, low heritability values for plant height at later growth stages suggest non-additive gene effects. The high heritability and genetic gain recorded for most traits imply that these characters can be effectively improved through selection. Based on superior yield and heritable performance, E8 and NCRIBEN 01M are recommended for cultivation in the forest-savanna transition zone of Edo State.

KEYWORDS

Genetic variability; heritability; genetic gain; sesame (*Sesamum indicum*); yield components; correlation; additive gene effect; randomized complete block design (RCBD); agronomic traits; variety evaluation

1. INTRODUCTION

Genetic variability Genetic variability is the foundation of crop improvement, as it provides the raw material for selection and breeding. In sesame (*Sesamum indicum* L.), variability among genotypes is expressed through differences in morphological and agronomic traits such as plant height, number of branches, number of capsules per plant, capsule length, seed weight, and overall seed yield. Understanding the extent of this variability enables plant breeders to identify superior genotypes with desirable traits that can be exploited for yield enhancement, adaptability, and stress tolerance (Khan et al., 2020; Zhang et al., 2019). For an oilseed crop like sesame, where productivity in sub-Saharan Africa is still far below its potential, studies on genetic variability are crucial for bridging the yield gap.

In recent years, research has highlighted wide genetic diversity in sesame across Africa and Asia, yet most breeding programs still rely on uncharacterized landraces. Molecular studies have confirmed significant variability within and between populations, supporting the need for comprehensive phenotypic evaluations (Dossa et al., 2017). In Nigeria, sesame is widely grown across northern and central states, but systematic evaluation of varieties in southern ecological zones remains limited. Given that genotype × environment interaction strongly influences trait

expression, assessing variability and trait associations in the forest-savanna transition zone is critical for identifying locally adapted and high-yielding varieties.

Studying the genetic variability and heritability of agro-morphological traits in sesame varieties cultivated in Edo State will provide essential baseline information for breeding programs targeting southern Nigeria. Such investigations help identify genotypes with desirable and stable traits that can be exploited for yield improvement and adaptability under local environmental conditions. Furthermore, understanding the magnitude of heritable variation among sesame varieties contributes to the conservation and effective utilization of genetic resources for future crop improvement. Ultimately, the identification of highly heritable and agronomically superior traits will support the development of improved sesame varieties capable of thriving across diverse agro-ecological zones, thereby enhancing productivity, farmer income, and the competitiveness of Nigerian sesame in global markets (Anyanwu et al., 2021; FAO, 2023).

Objective of the study

The overall objective of this study is to assess the extent of agro-morphological variability and estimate heritability among selected sesame (*sesamum indicum* L.) varieties (NCRIBEN 05E, E8, YANDEV 55, NCRIBEN 01M, and NCRIBEN 02M) grown in the forest-savanna transition zone of Edo State for their potential use in crop improvement

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programs.

The specific objectives are;

- Assess morphological and yield variability among sesame varieties.
- Estimate heritability, genetic advance, and genetic gain for key traits.
- Identify heritable traits for breeding improvement.
- Recommend high-performing varieties for the forest-savanna transition zone.

2. MATERIALS AND METHODS

2.1 Experiment Location

The field work was carried out in the Teaching and Research Farm, Faculty of Agriculture, Ambrose Alli University, Emaudo Annex, Ekpoma. Ekpoma is located in a forest – savanna transition zone of Edo State between Latitude 6°45' North and Longitude 6°08' East with a mean air temperature of 29°C, relative humidity of 70%, sunshine of about 5-7 hours/day and mean annual rainfall of about 1200-1500 mm (Ighalo and Remison, 2010).

2.2 Materials used

Five varieties (NCRIBEN 05E, E8, YANDEV 55, NCRIBEN 01M and NCRIBEN 02M) of sesame from National Cereals Research Institute, Badeggi, Niger state, were used.

2.3 Experimental design

The experiment was a Randomized Complete Block Design (RCBD) with four replicates, The experimental site was cleared using cutlass and the debris packed away. The plots were demarcated into 20 plots, measuring 2m by 2m each and an alley of 1m between plots. Total land space used was 11m by 14m. The five varieties were sown on flat ground. Each contained 24 plant stands/plot with a spacing of 45cm by 30cm given a total of 480 plant stands in the entire experimental field.

2.4 Data Collection.

Data collected were:

2.4.1 Vegetative characters

Number of leaves per plant, plant height, leaf length, leaf breadth, stem girth, number of branches per plant, number of capsules per plant, weight of capsule per plant, number seed per capsule, 1000 seed weight, capsule length and seed yield per hectare

- Number of leaves per plant: Number of leaves per plant from five randomly selected plants were visually counted and the average value recorded.
- Plant height (cm): height in centimeters from the ground level to the tip of the plant.
- Leaf length: Leaf length from five randomly selected plants per plot was taken with the aid of a measuring tape (calibrated in centimeter).
- Leaf breadth: Leaf breadth from five randomly selected plants per plot was also taken with the aid of a measuring tape (calibrated in centimeter).
- Stem girth: A measuring tape was used to take the plant distance around the stem from five randomly selected plants perpendicular to the stem axis and the average value recorded.
- Number of branches per plant: Number of branches from five randomly selected plants per plot were visually counted and the average value recorded.

2.4.2 Yield and yield component

These parameters were:

- Number of capsules per plants: The number of capsules/plant from three plants/plot were visually counted and the average value recorded.
- Weight of capsule per plant: Sensitive measuring scale was used to take the weight of capsule of five plants/plot and the average value was recorded.
- Days to 50% flowering: The number of days from the date of sowing to the day 50% of the population flowered for each of the twenty plots was recorded and the average of each plot was also recorded.

- Days to 50% maturity: Number of days from the date of transplanting to the date of 50% of the population flowered for each of the twenty plots flowered and the average of each plot were recorded.
- Capsule length: The length of capsule from five plants/plot was taken with the aid of a measuring tape (calibrated in centimeter).
- 1000 seed weight: weight in grams of 1000 seeds.
- Seed yield per hectare: seed yield was obtained from each experimental plot and was converted to get seed yield per hectare.

2.5 Data analysis

Plant growth and yield data collected were analysed using analysis of variance (ANOVA) at 5% level of probability and the means separated using the Least Significant Difference (LSD), when F – ratio prove significant.

2.6 Genetic Analysis

The genetic analysis was based on the agronomic and yield related to genotypic and phenotypic expressions. The mean square at treatment levels were taken as the phenotypic variation and the mean square at error levels were subtracted from their corresponding phenotypic variance to give the genotypic variance parameters and calculated as described by Allard (1999) as follows:

- Heritability (Ho): Heritability in the broad sense was calculated using the Formula:

$$Ho = \frac{\delta_g^2}{\delta_{ph}^2} \times 100$$

Where; δ_g^2 = genotypic variance, δ_{ph}^2 = phenotypic variance

- b. Genotypic Advance: This was calculated using the formula:

$$GA = \frac{\delta_g^2}{\delta_{ph}^2} \times k$$

where; δ_g^2 = genotypic variance

δ_{ph}^2 = square root of phenotypic variance

K = 2.06 (10% selective index)

Genetic Gain (GG): This was calculated in terms of Genetic Advance (GA) expressed as a percentage of the population mean as follows:

$$GG = \frac{GA}{\bar{x}} \times 100 \text{ Where } \bar{x} = \text{Population mean, GA} = \text{Genetic Advance}$$

3. RESULTS AND DISCUSSION

Table 1: Plant height (cm) of sesame at 2, 4, 6 and 8 WAP

Variety	WAP			
	2	4	6	8
YANDEV 55	10.44c	28.50b	71.45b	105.60b
E 8	17.18b	47.90a	76.9ab	131.30a
NCRIBEN 05E	14.95b	33.58b	84.35ab	127.00a
NCRIBEN 01M	21.92a	49.45a	87.00a	127.70a
NCRIBEN 02M	15.08b	32.43b	71.25b	119.50ab
LSD(P<0.05)	2.80	6.51	13.18	20.09

Values with same alphabet in the same column are insignificantly different using LSD (P<0.05). LSD: Least significant Difference

Table 2: Number of leaves/plant of sesame at 2, 4, 6 and 8 WAP

Variety	WAP			
	2	4	6	8
YANDEV 55	8.20b	25.15b	75.55b	129.80b
E 8	18.70a	43.55a	126.05a	185.00a
NCRIBEN 05E	9.00b	28.70b	79.80b	135.40b

Table 2 (cont) : Number of leaves/plant of sesame at 2, 4, 6 and 8 WAP				
	WAP			
NCRIBEN 01M	17.15a	44.95a	120.70a	179.20a
NCRIBEN 02M	8.06b	26.40b	85.20b	139.80b
LSD(P<0.05)	2.14	6.21	18.12	19.37

Values with same alphabet in the same column are insignificantly different using LSD (P<0.05). LSD: Least significant Difference

Table 3 : Leaf area/plant (cm²) of sesame at 2, 4, 6 and 8 WAP				
Variety	WAP			
	2	4	6	8
YANDEV 55	118.78b	1748.59c	6783.08b	11430.15b
E 8	190.27b	2492.44ab	10040.28a	20467.16a
NCRIBEN 05E	134.79b	1910.59bc	5616.98b	13012.25b
NCRIBEN 01M	362.32a	3002.74a	10425.68a	18077.09a
NCRIBEN 02M	132.22b	1744.88c	5888.03b	10557.54b
LSD(P<0.05)	5.71	19.03	26.30	24.64

Values with same alphabet in the same column are insignificantly different using LSD (P<0.05). LSD: Least significant Difference

Table 4: Stem girth(cm) of sesame at 2, 4, 6 and 8 WAP				
Variety	WAP			
	2	4	6	8
YANDEV 55	0.30b	1.06b	1.50bc	1.84bc

E 8	0.57a	1.54a	1.84a	2.58a
NCRIBEN 05E	0.33b	0.98b	1.38c	1.74c
NCRIBEN 01M	0.37b	0.84b	1.65ab	2.156b
NCRIBEN 02M	0.34b	1.05b	1.39c	1.84bc
LSD(P<0.05)	0.12	0.40	0.23	0.36

Values with same letter(s) in the same columns are not significantly different at 5% level of probability; LSD: Least significant difference

Table 5: Number of branches/plant of sesame at 4, 6 and 8 WAP			
Variety	WAP		
	4	6	8
YANDEV 55	4.55b	6.38bc	9.65b
E 8	5.15b	11.40a	16.90ab
NCRIBEN 05E	5.30b	5.75c	11.15b
NCRIBEN 01M	5.83b	10.25ab	17.00ab
NCRIBEN 02M	8.75a	13.65a	20.50a
LSD(P<0.05)	2.16	4.13	8.46

Values with same letter(s) in the same columns are not significantly different at 5% level of probability; LSD: Least significant difference

Table 6 : Days to 50% flowering and maturity, and yield and yield components of sesame								
Variety	Days to 50% Flowering	Days 50% Maturity	Number of pods/plant	Number of seeds/pod	Pod length (cm)	Weight of 1000 Seeds (g)	Pod weight (kg/ha)	Seed weight (kg/ha)
YANDEV 55	51.00bc	74.00ab	85.55ab	69.00c	3.42b	6.75b	611.20b	474.40bc
E 8	48.00c	68.50c	116.17a	126.50a	5.89a	13.75a	963.80a	708.80a
NCRIBEN 05E	57.75a	78.50a	77.55b	81.75c	3.51b	5.00b	711.20b	458.80bc
NCRIBEN 01M	58.50a	75.25ab	92.35ab	73.00c	5.15ab	8.00b	758.80b	333.80c
NCRIBEN 02M	53.00b	70.75bc	105.30ab	110.25b	5.41ab	11.75a	698.80b	552.50ab
LSD(P<0.05)	4.13	5.2	30.1	15.86	2.14	3.07	204.70	180.60

Values with same letter(s) in the same columns are not significantly

different at 5% level of probability; LSD: Least significant difference

Table 7: Genetic analysis of vegetative and yield characters of some varieties of sesame						
Character	Weeks after planting	PCV	GCV	H _o (%)	GA	GG
Plant height	2	69.375	66.072	95.24	1.96	12.32
	4	369.34	351.49	95.17	1.96	5.11
	6	210.82	137.59	65.26	1.34	1.71
	8	420.6	250.5	59.56	1.23	1.01
Number of leaves	2	110.109	108.181	98.25	2.02	16.53
	4	374.96	358.73	95.67	1.97	5.84
	6	2299.7	2161.4	93.99	1.94	1.99
	8	2729.2	2571.1	94.21	1.94	1.26
Leaves area	2	275.31	261.58	95.01	1.96	12.76
	4	1073.5	920.9	85.78	1.77	2.74
	6	2271	1979.5	87.16	1.8	2.26
	8	3181.9	2926.5	91.97	1.89	1.98

Table 7 (cont): Genetic analysis of vegetative and yield characters of some varieties of sesame

Stem girth	2	0.046705	0.4036	86.41	1.78	468.42
	4	0.28208	0.21408	75.89	1.56	142.73
	6	0.14995	0.12704	84.72	1.75	112.9
	8	0.47187	0.41741	88.46	1.82	89.7
Number of branches	4	10.872	8.907	81.93	1.69	28.55
	6	45.222	38.026	84.09	1.73	18.25
	8	81.3	51.17	62.94	1.3	8.67
Days to 50% flowering		79.700	72.5	90.97	1.87	23.49
Days to 50% maturity		60.83	49.44	81.28	1.67	22.28
Number of pod		954.6	572.8	60	1.24	21.3
Number of seed		2518.3	2412.3	95.8	1.97	22.14
Pod length		5.17	3.24	62.68	1.29	27.62
1000 seeds		52.175	48.2	92.38	1.9	21
Pod weight		69138	51490	74.47	1.53	20.2
Seed yield		76172	62437	81.97	1.69	20.33

PCV: Phenotypic coefficient of variation; GCV: Genotypic coefficient of variation; Ho: Heritability; GA: Genetic advance; GG: Genetic gain

The plant height obtained from NCRIBEN 01M at 2WAP was significantly different from E8, NCRIBEN 05M, NCRIBEN 02M and YANDEV 55. At 4WAP, there was no significant difference between the plant height of NCRIBEN 01M and E8 but both varieties differed significantly from the other varieties. The height of E8 was not significantly different from other varieties except for those of YANDEV 55 at 6 and 8WAP (Table 1). It was observed that height of plant affected the yield of sesame significantly. The significant difference in the height of sesame among varieties may be due to variation in their genetic make-up as well as environmental factors.

The varieties of sesame varied significantly for number of leaves/plant from 2,4,6 and 8WAP. However, E8 and NCRIBEN 01M differed significantly from other varieties. There was no significance different between NCRIBEN 02M, NCRIBEN 05M and YANDEV 55 (Table 2). Number of leaves play significant role in the photosynthesis of crops. It was observed that E8 and NCRIBEN 02M had more number of leaves per plant. This is in agreement with the work reported that increase in number of leaves per plant may or may not result to increase in yield/plant (Weeraratna and Weerasinghe, 2009).

NCRIBEN 01M differed significantly from other varieties for total leaf area/plant. E8 and NCRIBEN 02M were not significantly different from each other but the two varieties respectively differed significantly from the other varieties at 2WAP. E8 and NCRIBEN02M differed from NCRIBEN 01M at 4WAP. The leaf area at 6 and 8WAP, showed that E8 and NCRIBEN 02M were significantly different from NCRIBEN 01M, NCRIBEN 05M and YANDEV 55 (Table 3). Leaf area is an important component for determining plant growth and development. This is because leaves determine the photosynthetic activity in the plant.

E8 differed significantly for stem girth from all other varieties except for NCRIBEN 01M at 6WAP. There were significant differences for number of branches/plant at 2, 4, 6 and 8WAP among the varieties of sesame (Table 4). It was observed that number of branches/plant varied significantly for all the varieties of sesame. NCRIBEN 02M differed significantly from other varieties at 4WAP (Table 5). At 6 and 8WAP, it was observed that there was no significance different between NCRIBEN 02M, NCRIBEN 01M and E8. This study the difference in number of branches/plant is as a result of variation in their genetic make-up (Beheshti and Fard, 2010; Toan et al., 2010).

There were significant differences for all the varieties for the number of days to 50% flowering. Days to 50% maturity differed significantly. It was observed that early flowered varieties also matured earlier. It revealed that early ripened varieties with shorter period of growth yielded more seeds. This result agreed with that early maturing varieties exhibit shorter growth period and contributed immensely to seed yields (Toan et al., 2010).

The quantity of pods produced varied among the varieties. The analysis observed significant difference in number of pods due to varietal response (Basu et al., 2009). The number of seeds/pods differed significantly among the varieties. Also, the length of pod showed significant difference between E8 and other varieties.

E8 and NCRIBEN 02M were not significantly different from each other for 1000 seeds weight but differed significantly from other varieties. The significant variation observed between E8 and other varieties in pod length and weight of 1000 seeds may be attributed to variation in genetic constitution of the varieties. E8 varied significantly from others for pod

weight and seed yield. Seed yield are major factor for selection process. As a study reported significant differences on the seed yield among varieties (Basu et al., 2009; Beheshti and Fard, 2010; Toan et al., 2010).

High Heritability (95.24% and 95.17%) and Genetic Gain (12.32 and 5.11) were obtained for plant height at 2 and 4WAP. Also, High Heritability (98.25% and 95.67%) and Genetic Gain (16.35 and 5.84) were observed for number of leaves/plant at 2 and 4WAP. High values for Heritability (95.01%) and Genetic Gain (12.76) was observed for leaf area at 2WAP. While, high values for Heritability (86.41%, 75.89%, 84.72% and 88.46) and Genetic Gain (468.42, 143.73, 112.90 and 89.70) were recorded for stem girth was observed at 2, 4, 6 and 8 WAP. In the same vein, High Heritability (81.93%, 84.09 and 62.94%) and Genetic Gain (28.55, 18.25 and 8.67) were recorded for number of branches/plant at 4,6 and 8WAP. Also, The Heritability (90.97%) and Genetic Gain (23.49) values for days to 50% flowering were high. In the same vein, days to 50% maturity had high values for Ho (81.28%) and GG (22.28). Also, High values for Heritability (95.80%, 92.38%, 74.47% and 81.97%) and Genetic Gain (22.14, 21.00, 20.20 and 20.33) values of number of seeds/pod, 1000 seed weight, pod weight and seed yield were observed. High Heritability leads to high Genetic Gain. This research reported that high value for Heritability may be due to additive gene effect. Hence, this can be used as basis for selection Sadeghi, 2011. Researchers, reported that broad sense heritability are commonly used to detect genetic variance (Ramalho et al., 2012). The higher the broad sense heritability value, the lower the influence of the environment on the expression of the trait. That study reported that high heritability suggests high component of heritable portion of variation that can be exploited by breeders in the selection of superior genotypes (Dagnoko et al., 2013).

Low values for Heritability and Genetic Gain were observed from 6 to 8WAP for plant height. Low Heritability and Genetic Gain is as result of non-additive gene

4. CONCLUSION

The study revealed substantial agro-morphological variability among the evaluated sesame varieties, with high heritability and genetic gain recorded in several yield-related traits. These findings indicate the predominance of additive gene effects, suggesting that such traits can be effectively improved through selection. Among the tested varieties, E8 and NCRIBEN 01M consistently exhibited superior performance for plant height, number of leaves, leaf area, stem girth, pod length, 1000-seed weight, number of seeds per pod, number of pods per plant, and seed yield. The observed variability and heritability estimates provide valuable information for identifying promising parental materials and advancing sesame breeding programs in southern Nigeria.

Summary of Findings

- Significant differences were observed among the varieties for most vegetative and yield traits.
- Variety E8 exhibited the best overall performance for growth and yield parameters, followed closely by NCRIBEN 01M.
- High heritability and genetic gain were obtained for days to 50% flowering (90.97%; 23.49), days to 50% maturity (81.28%; 22.28), pod length (62.68%; 27.62), 1000-seed weight (92.38%; 21.00), number of seeds per pod (95.80%; 22.14), number of pods per plant (60.00%; 21.30), pod weight (74.47%; 20.20), and seed yield (81.97%; 20.33).
- Traits with high heritability and genetic gain are controlled mainly by

additive genes and can serve as reliable selection indices in breeding.

- Traits with low heritability and genetic gain are likely governed by non-additive genes and may respond poorly to direct selection.

RECOMMENDATIONS

Sesame performs well in the forest-savanna transition zone of Edo State and can be promoted as a viable cash crop for farmers in this region.

Based on high heritable and yield-related performance, E8 and NCRIBEN 01M are recommended for large-scale cultivation and as parental lines in future breeding programs.

Moderate rainfall conditions are optimal for sesame production, as excessive moisture delays flowering and reduces yield potential.

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