

Genetic Variability and Yield Performance of Some Maize (*Zea mays* L.) Accessions in Nigeria

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ABSTRACT

Maize (*Zea mays* L.) is predominantly cultivated as a rainy-season crop in Nigeria. This study assessed the genetic variability among twenty-one maize germplasms collected from selected states in northern Nigeria. Agronomic evaluations were conducted using a randomized complete block design (RCBD) with three replications. Yield-related parameters—including cob length and girth, thousand-grain weight, grain yield, and straw yield—were recorded at harvest and subjected to statistical analysis. The results showed significant variation ($P < 0.05$) among the accessions for cob length, with NG-03 producing the longest cob (21.60 cm). NGR-03 recorded the highest number of seeds per cob (42.40). However, the number of rows per cob did not differ significantly ($P > 0.05$) among the accessions. For total seeds per cob, NG-03 had the highest mean value (613.03). The lowest seed weight was observed in accession NGR-OY-29 (62.00), while NG-03 also produced the longest seed length (1.10 cm). Accession BA-01 differed significantly from all others in husk hair length, and JG-01 recorded the longest husk length (34.01 cm) among the accessions. Overall, the observed variations in yield parameters reflect substantial genetic diversity. These traits are therefore valuable for the identification, description, and characterization of maize accessions, providing useful information for future breeding programmes.

Keywords: Yield, Accession, germplasm, Variation, Genetics.

INTRODUCTION

Maize (*Zea mays* L.) is a major staple and the most important cereal crop in Nigeria. Botanically, it belongs to the Poaceae family and is recognized for its remarkable genetic potential, earning it the designation “queen of cereals” (7). As a monoecious species, maize bears both male (tassel) and female (ear) flowers on the same plant, a feature that promotes cross-pollination. Optimal maize growth requires adequate warmth and moisture from planting through flowering. The plant is characterized by broad, flag-like leaves measuring 50–100 cm in length and 5–10 cm in width, supported by erect stems typically 2–3 meters tall with multiple nodes that produce flag leaves. Internodes may extend 20–30 cm. The female inflorescence, or ear, forms near the stem under the leaves and is enclosed by several leaf layers, remaining concealed until the pale-yellow silks emerge from the whorl at the ear tip.

As one of the most versatile food crops, maize is consumed in multiple forms. Fresh ears may be boiled in salted water and eaten on the cob, or roasted over hot charcoal or ashes until browned. The grains can also be milled into flour or dough and prepared with vegetable soups. Maize is highly adaptable and can be cultivated in various seasons, which contributes to its global importance as both human food and livestock feed (6). In Togo, maize is predominantly grown during the rainy season. Understanding genetic diversity in maize is essential for breeders, as it reveals the extent of existing variability within germplasm.

Such information is critical for classifying germplasm into suitable heterotic groups for hybrid development, since genetically diverse parents typically produce hybrids with superior vigor and yield. Therefore, the evaluation and characterization of genetic diversity in maize germplasm are fundamental steps in hybrid maize breeding. Findings from this study will provide valuable insights for genetic improvement and breeding efforts in this key cereal crop.

MATERIALS AND METHODS

Collection of Maize (*Zea mays* L.) Germplasm

A germplasm exploration mission was conducted in collaboration with Agricultural Development Project (ADP) extension officers across major maize-producing regions of Nigeria. The collection targeted the north-central and northwestern zones, covering seven states: Niger, Nasarawa, Kwara, Plateau, Kaduna, Jigawa, and Bauchi. Field visits were made to farming communities within these states, during which questionnaires were administered—sometimes with the help of interpreters—and available maize accessions under cultivation were collected.

The questionnaire captured information such as local names of the accessions, seed sources, farmers' varietal preferences, production constraints, and economic relevance. Collections were carried out between September and October 2023, coinciding with the harvest season to ensure a broad and representative gene pool.

Seeds were placed in thick sealed envelopes, each assigned an entry number alongside details of the location and local variety name(s). The samples were then stored for further evaluation and characterization.

Characterization of Maize Germplasm

The seeds collected from farmers were initially characterized based on seed colour and seed size. The resulting seed morphotypes were subsequently planted and evaluated following the maize descriptor list developed by (11).

Description of the Study Area

The research was conducted in the Experimental Garden located in Ilorin, Kwara State, Nigeria. Ilorin lies within the North-Central geopolitical zone and is geographically positioned at longitude 4.544°E and latitude 8.53°N. The city covers an estimated area of 50.2 square kilometres and had a population of approximately 1,064,000 according to the 2006 National Population Census. The climate is tropical, with mean annual temperatures ranging between 20–38°C, relative humidity averaging 25%, and annual rainfall of about 101.45 mm. The region experiences two distinct seasons: a rainy season from May to October and a dry season from November to April. The vegetation is characteristic of the Guinea savannah, dominated by grassland interspersed with scattered trees.

Experimental Design, Sowing of Seeds and Thinning of Seedlings

The maize accessions were planted using a completely randomized design with three replications. Each accession was grown in a single-row plot with both inter-row and intra-row spacing of 3 feet, as described by (12). Five seeds were sown per hole and later thinned to two plants per stand. A total of 39 plants were established per row, and data were collected from 23 plants per row. Manual weeding was performed at one-month intervals.

Collection and Analysis of Soil Samples

Soil samples were collected from the experimental field and analysed for pH (in H₂O and CaCl₂), exchangeable Ca, Mg, K, Na, and effective cation exchange capacity (ECEC). All analyses followed the standard procedures of the Association of Official Analytical Chemists (13).

Seed Germination Test

For each accession, 100 seeds were placed in sterilized Petri dishes and allowed to germinate under laboratory conditions. Germination counts were recorded seven days after sowing. The number of seeds that germinated was expressed as a percentage, following the method described by (9). Germination percentage was calculated using the formula:

$$\text{Germination (\%)} = (\text{Number of germinated seeds} / \text{Total seeds planted}) \times 100$$

Measurement of Yield Parameters

Yield evaluation for the different maize accessions involved assessing the number of fruits per plant (NF), the number of seeds per pod (NSP), and the weight of fruit (WF). For NSP and WF, ten fruits from each accession were randomly selected, and the recorded values were used for statistical analysis. NF was determined by counting the total number of fruits produced per plant at the end of the life cycle.

NSP was assessed by opening the fruits and counting viable seeds, identified based on firmness and size. WF was obtained by weighing the pods using a weighing balance, and the mean values of each yield parameter were calculated per fruit or plant.

RESULTS

Length of Cob

Analysis of variance (ANOVA) for cob length revealed significant differences among the accessions ($P < 0.05$). Accession NG-03 produced the longest cob (21.60 cm), which differed significantly from all other accessions. In contrast, accession JG-04 had the shortest cob length (15.40 cm).

Number of Seeds per Cob

The analysis of variance (ANOVA) showed significant differences ($P < 0.05$) among the accessions with respect to the number of seeds per cob. Accession NGR-03 produced the highest number of seeds per cob (42.40), a value that differed significantly from all other accessions. In contrast, accession NA-01 recorded the lowest number of seeds per cob (16.00), which was also significantly different ($P < 0.05$) from the remaining accessions. Accessions NG-02, JG-04, BA-02, KW-03, JG-01, JS-02, BA-03, KW-01, NA-03, NG-01, JG-02, JS-02, BA-01, JG-03, and KD-04 exhibited no significant differences among themselves.

Number of Rows per Cob

A similar pattern was observed for the number of rows per cob. The ANOVA indicated no statistically significant differences ($P > 0.05$) among the accessions, although minor variations were present in their mean values.

Total Seed Number per Cob

With regard to total seed count per cob, accession NG-03 recorded the highest mean (613.03), followed by KD-03 with a mean of 468.80. However, no significant differences ($P > 0.05$) were detected among all the accessions.

Weight of Seeds

Seed weight per plant varied across the accessions. NG-03 had the highest seed weight (0.68), followed by JG-01 (0.58); this value was statistically similar to NGR-NG-02 but significantly different from all other accessions. The lowest seed weight was recorded for accession NGR-OY-29 (62.00), while the remaining accessions showed significant differences among themselves.

Length of Seeds per Cob

Seed length also differed significantly among the accessions. NG-03 produced the longest seeds per cob (1.10), a value significantly higher than that of all other accessions. The shortest seed length (0.20) was observed in KW-01. Significant differences were recorded among the remaining accessions.

Length of Hair

ANOVA results revealed significant differences in husk hair length among the accessions. Accession NG-03 had the highest mean hair length (24.00). Accessions NG-02, JG-04, JS-01, NA-02, JG-01, BA-03, KW-01, NA-03, NG-01, and BA-01 showed no significant differences among themselves, though they differed significantly from the other accessions.

Length of Husk

Accession JG-04 recorded the shortest husk length (24.40), whereas accession JG-01 produced the longest husk length (34.01). The husk length of JG-01 was significantly different from all other accessions.

Table 1: Yield Parameters of Twenty-Three (23) Maize Landraces Studied

Parameters	Length of Cob	No of Seed Per Cob	No of Row Per Cob	Total Seed No Per Cob	Weight of Seeds	Length of Seeds	Length of Hair	Length of Husk
NA-01	16.00±1.05ab	20.80±1.85a	13.00±0.45a	269.00±22.03ab	0.34±0.04bcdef	0.46±0.04ab	12.80±1.02a	25.40±1.50ab
NG-02	19.40±1.91abcd	27.80±2.94ab	13.20±0.86a	372.60±61.21ab	0.52±0.08fgh	0.34±0.04ab	15.40±1.60ab	29.00±1.52abcde
JG-04	15.40±1.57a	24.20±4.02ab	13.40±0.87a	314.80±45.46ab	0.30±0.08abcd	0.31±0.06ab	16.60±3.08ab	24.40±0.81a
JS-01	19.20±1.11abcd	34.40±3.59bc	13.60±1.47a	457.20±47.18b	0.44±0.02cdefgh	0.40±0.00ab	17.40±1.78ab	30.00±1.92abcde
BA-02	16.40±1.44ab	27.00±2.07ab	13.40±0.60a	364.20±38.68ab	0.50±0.05efgh	0.30±0.03ab	13.20±2.60a	27.20±1.50abcd
KW-03	16.40±1.44ab	27.00±2.07ab	13.40±0.60a	364.20±38.68ab	0.50±0.05efgh	0.30±0.03ab	13.20±2.60a	27.20±1.50abcd
KD-01	17.80±0.80abcd	34.20±3.71bc	12.40±0.40a	397.60±43.02ab	0.48±0.04defgh	0.29±0.01ab	12.80±1.74a	28.80±2.99abcd
NA-02	18.40±0.98abcd	34.20±3.12bc	13.20±0.49a	446.80±31.53b	0.50±0.03efgh	0.34±0.04ab	15.20±1.74ab	30.60±1.78bcde
NG-03	21.60±1.40d	42.40±3.09c	14.40±0.98a	613.60±72.21c	0.68±0.09i	1.10±0.73c	24.00±4.56b	30.40±1.25bcde
JG-01	21.20±0.92cd	28.20±4.57ab	13.40±1.03a	381.60±77.93ab	0.58±0.06hi	0.52±0.04ab	19.80±2.40ab	34.00±1.05e
JS-02	17.33±1.76abc	26.33±3.28ab	14.33±0.88a	380.00±62.86ab	0.23±0.03ab	0.47±0.07ab	14.00±2.31a	28.00±0.58abcd
BA-03	17.70±0.58abc	28.00±3.36ab	12.80±0.49a	363.60±54.69ab	0.26±0.02abc	0.44±0.07ab	16.60±2.34ab	26.40±1.43abcd
KW-01	16.90±0.84ab	27.20±2.85ab	14.00±1.10a	370.40±20.99ab	0.14±0.02a	0.20±0.00a	20.60±4.18ab	31.90±1.83cde
KD-02	18.00±1.30abcd	32.20±3.95b	14.40±1.17a	453.60±45.88b	0.38±0.02bcdefg	0.40±0.00ab	14.20±2.65a	27.80±1.11abcd
NA-03	16.50±1.02ab	28.80±1.98ab	14.00±0.63a	402.80±31.39ab	0.38±0.04bcdefg	0.48±0.06ab	16.90±1.63ab	29.00±0.00abcde
NG-01	17.10±0.87ab	30.00±2.17ab	12.00±0.71a	357.00±25.43ab	0.32±0.04bcde	0.48±0.04ab	19.00±4.15ab	28.10±2.88abcd
JG-02	16.20±1.32ab	25.00±1.82ab	12.20±0.80a	305.00±28.22ab	0.32±0.06bcde	0.50±0.03ab	14.10±3.02a	26.00±0.77abc
JS-03	17.80±0.92abcd	28.40±2.25ab	14.40±1.47a	408.00±53.01ab	0.38±0.06bcdefg	0.46±0.02ab	14.20±1.98a	31.68±1.71cde
BA-01	17.80±1.66abcd	27.00±4.34ab	11.40±0.98a	303.60±48.92ab	0.38±0.04bcdefg	0.80±0.00bc	18.70±4.00ab	31.10±2.35bcde
KD-02	20.00±0.84bcd	32.20±3.18b	12.40±0.40a	400.40±43.49ab	0.34±0.04bcdef	0.56±0.04ab	12.60±0.93a	26.40±2.46abcd
KD-03	18.60±0.58abcd	32.00±2.65b	14.40±1.17a	468.80±68.51b	0.36±0.10bcdef	0.56±0.04ab	15.40±2.73ab	32.20±1.89de
JG-03	16.00±0.45ab	29.00±2.37ab	13.00±0.63a	372.60±21.77ab	0.30±0.03abcd	0.40±0.00ab	14.30±2.66a	26.60±1.38abcd
KD-04	16.68±0.29ab	24.40±4.27ab	13.40±0.40a	323.80±50.57ab	0.56±0.04ghi	0.54±0.05ab	19.50±2.43ab	28.10±0.81abcd

Values are Mean±Standard Error of mean. Value follow by the same superscript along the column are not significantly different at $p < 0.05$

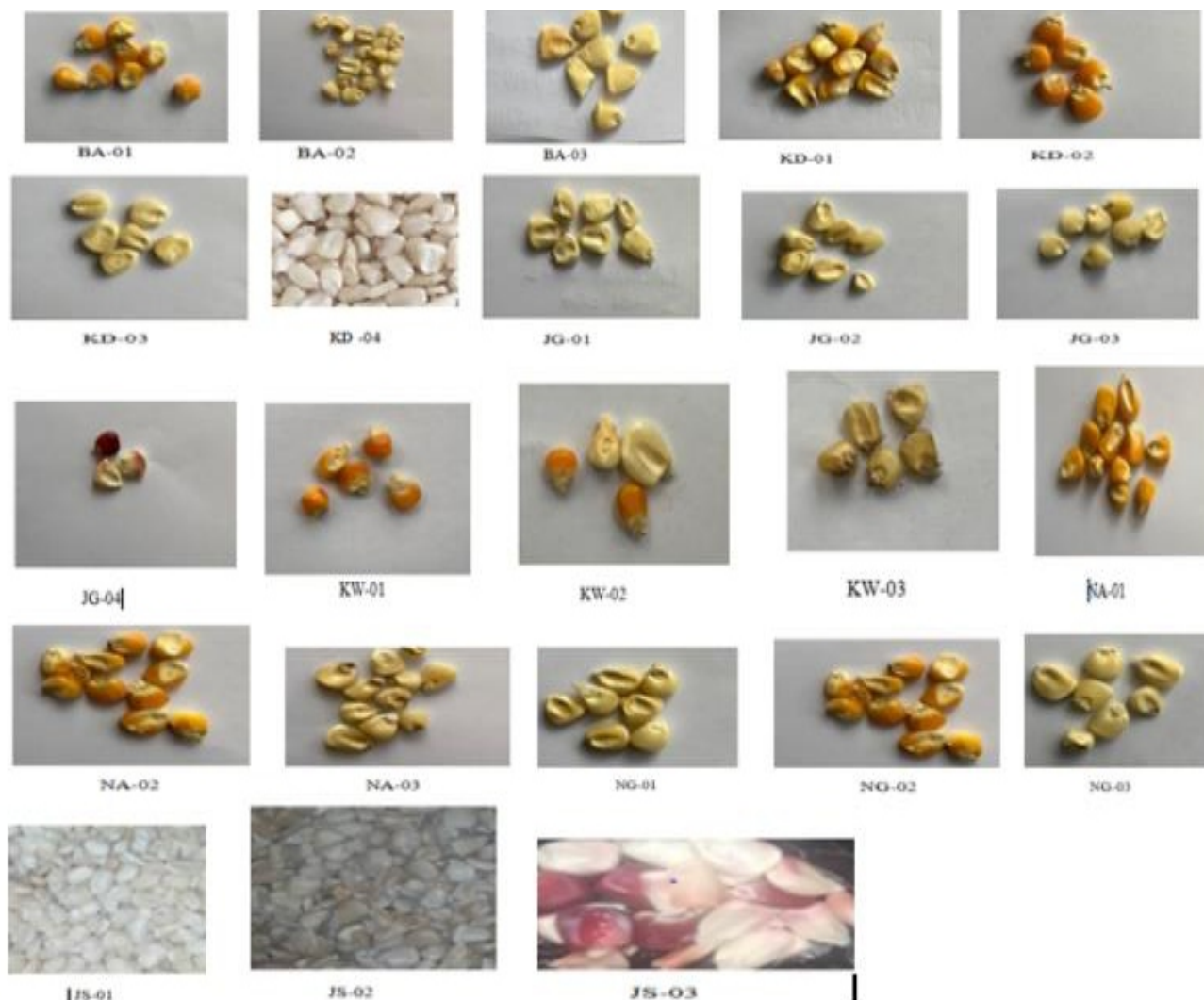


Plate I: Variations in seed color of the different Maize accessions

DISCUSSION

Variations in cob length among the maize (*Zea mays* L.) accessions may be attributed to environmental influences. This observation aligns with the findings of (7), who reported that cob length is determined by a combination of genetic factors, environmental conditions, and agronomic practices such as nitrogen fertilization and water availability. Similarly, (1) noted that agro-morphological traits—such as increased cob length—can contribute to higher yield potential, improved ear structure, and better grain arrangement.

The number of rows per cob is also a key agronomic trait in maize, with significant implications for grain yield, ear shape, and seed distribution (8). As highlighted by (2), row number is shaped by genetic makeup, environmental factors, and management practices. An increase in row number can enhance grain yield, ear filling, and yield stability (1). However, an excessively high number of rows may negatively affect seed size, grain quality, and overall yield (3). The differences in cob length observed in this study may therefore be due to varietal characteristics, consistent with the observations of (9) in their evaluation of maize accessions in Brazil.

The number of seeds per cob is a crucial determinant of total grain yield in maize (8). This trait, like others, is influenced by genetics, environmental conditions, and management practices (2). Higher seed numbers per cob often result in increased grain yield, improved ear filling, and greater yield stability (1). Excessively high seed numbers, however, can lead to smaller seed size, reduced grain quality, and yield decline (3). Seed weight, another important yield component, is influenced by a complex interaction of physiological and genetic factors. Understanding these interactions can guide breeders in developing genotypes suited to varying environments by balancing yield potential with stress tolerance. Optimal seed weight depends on growing conditions such as climate, soil characteristics, and planting density (2).

Seed length in maize is also a multifactorial trait. Increased seed length is generally associated with higher grain yield, improved seed quality, and enhanced yield stability (1). However, extremely long seeds may reduce total seed number and consequently lower grain yield (3).

Husk length is a quantitative trait that varies significantly across maize genotypes (8). Previous studies have shown that husk length affects several critical aspects of maize development, including ear protection, moisture retention, pest and disease resistance, and grain quality (4). The variation in husk length observed in the present study is comparable to the findings of (5), who also reported considerable diversity in this trait.

Overall, the present research identified several accessions exhibiting diverse and desirable yield-related traits. These accessions represent valuable genetic resources and may serve as promising parental lines for future biotechnology applications and maize improvement programmes.

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