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Original Article

Germplasm Collection and Seed Morphological Characterisation of Bambara Groundnut (*Vigna subterranea* (L.) Verdc.) Accessions from Three Local Government Areas of Niger State, Nigeria

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ABSTRACT

Bambara groundnut (*Vigna subterranea* (L.) Verdc.) is an underutilised African legume with considerable potential for climate-resilient agriculture and food security. However, inadequate documentation of local landraces limits their effective conservation and utilisation in breeding programmes. This study characterised 30 Bambara groundnut accessions collected from Kontagora, Bida, and Paiko Local Government Areas of Niger State, Nigeria, using seed morphological descriptors and farmer-recognised local names. Accessions were collected from farmers and evaluated for seed colour, seed shape, seed size, hilum pigmentation, and eye-pattern type. Descriptive statistics were used to summarise the distribution of accessions and trait variation. Kontagora contributed the highest number of accessions (40.0%), followed by Bida (33.3%) and Paiko (26.7%). Local naming systems, including "Gurjiya", "Etsu", and "Èpí", reflected farmer-based classification of morphotypes. Considerable seed morphological variation was observed, particularly in seed colour, which ranged from cream, beige to brown, dark brown, black, and reddish-brown. Most accessions were round and medium-sized, while hilum pigmentation and eye-pattern types, including ring, blotched, speckled, mottled, and striped forms, further differentiated the germplasm. The findings demonstrated that Bambara groundnut landraces in Niger State harbour useful morphological diversity in seed that can support germplasm conservation, farmer-preferred trait selection, and future crop improvement. However, integration of passport data, agronomic evaluation, nutritional profiling, and molecular characterisation is recommended to further clarify genetic relationships and enhance the breeding value of the collected accessions.

Keywords: *Vigna subterranea*; Bambara groundnut; landraces; seed morphology; germplasm conservation; phenotypic diversity; Niger State; crop improvement.

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INTRODUCTION

Bambara groundnut (*Vigna subterranea* (L.) Verdc.) is an indigenous African legume widely cultivated in sub-Saharan Africa, where it ranks among the most important grain legumes after groundnut (*Arachis hypogaea* L.) and cowpea (*Vigna unguiculata* L.) (1, 2). The crop is valued for its high protein content, drought tolerance, and ability to produce under marginal soil conditions (3). Despite these attributes, Bambara groundnut remains underutilised, with limited attention given to its improvement and conservation (4).

Germplasm collection and characterisation are essential for understanding genetic diversity and supporting crop improvement programmes. Germplasm resources provide the basis for selection and breeding and contribute to the conservation of plant diversity (5). In Bambara groundnut, seed morphological traits such as seed colour, seed shape, hilum pigmentation, and eye-pattern type are commonly used descriptors for identifying variation among accessions (6).

Nigeria is considered a centre of diversity for Bambara groundnut, with landraces widely distributed across different agro-ecological zones (7). However, documentation of local germplasm, including their phenotypic characteristics and local naming systems, remains limited. Farmers often identify landraces based on visible traits such as seed colour, size, and pattern, which are reflected in local names (8, 9). However, such naming systems may not always correspond directly to genetic differences, making proper characterisation necessary (6).

Therefore, this study aimed to collect Bambara groundnut accessions from Kontagora, Bida, and Paiko Local Government Areas of Niger State and to characterise them using seed morphological traits.

MATERIALS AND METHODS

Study Area

The study was conducted in three Local Government Areas of Niger State, Nigeria: Kontagora (latitude 10°24′N, longitude 5°28′E), Bida (latitude 9°05′N, longitude 6°01′E), and Paiko (latitude 9°26′N, longitude 6°38′E). These LGAs represent different agro-ecological zones: Kontagora falls within the northern Guinea savanna, while Bida and Paiko lie in the southern derived savanna. The areas are known for Bambara groundnut cultivation, which is often intercropped with sorghum, millet, and cowpea.

Germplasm Collection

A total of 30 Bambara groundnut accessions were collected from farmers across Kontagora, Bida, and Paiko Local Government Areas of Niger State. Purposive sampling was used to capture visible variation in seed traits among local landraces, particularly differences in seed colour, seed size, and seed coat pattern. Some farmers provided more than one accession where the seed types were visibly different. To reduce duplication, farmers were asked to identify the local names of the landraces and describe their distinguishing seed features. Seed samples that appeared identical and were obtained from nearby farmers were excluded unless clear differences in seed morphology were observed. Each accession was assigned a unique identification code based on the collection location: NG-KTG for Kontagora, NG-PAK for Paiko, and NG-BDA for Bida.

The local name of each accession was recorded directly from the farmers. The collected seeds were manually cleaned to remove debris, air-dried, and stored in labelled paper envelopes under ambient laboratory conditions prior to characterisation.

Seed Morphological Characterisation

Seed morphological characterisation was conducted on mature dry seeds using standard Bambara groundnut descriptors (10). The traits evaluated included seed colour, seed shape, seed size, hilum eye pattern (presence or absence), and pigmentation around the hilum, and type of eye pattern.

Data Analysis

The distribution of accessions across LGAs was expressed as percentages. Phenotypic trait frequencies were calculated for the entire collection and for each LGA separately to explore geographic variation. No inferential statistics were applied, as the objective was descriptive characterisation.

RESULTS

Germplasm Collection and Distribution of Accessions

A total of 30 Bambara groundnut (*Vigna subterranea*) accessions were collected across three Local Government Areas (LGAs) in Niger state. The accessions were sourced from major Bambara groundnut-producing communities in Kontagora, Bida, and Paiko, representing the primary production belts in the study region.

Distribution of Accessions

Kontagora contributed the highest number of accessions (12, 40%), followed by Bida (10, 33.3%) and Paiko (8, 26.7%) (Fig 1).

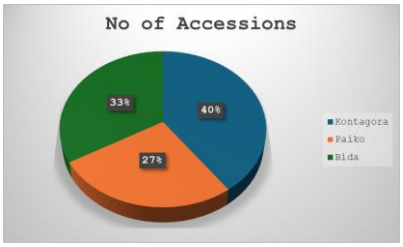

Figure 1: Percentage Number of Accessions Collected from the Local Governments.

Local Naming Systems

The accessions exhibited variation in local naming across the study areas. In Kontagora, the accessions were generally referred to as “Gurjiya”, with modifiers such as “Gurjiya fari”, “Gurjiya bak’i”, and “Gurjiya mai tabo”. In Paiko, names such as “Etsu”, “Etsu gyo”, and “Etsu tsombwi” were recorded, while in Bida, names included “Èpí”, “Èpí èzè”, and “Èpí tsùn-tsùn”

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Table 1: Accession numbers, local names, and local government areas of Bambara groundnut germplasm collected from selected locations in Niger State, Nigeria.

Accession Number	Local name	Local Government
NG-KTG-001	Gurjiya mai tabo	Kontagora
NG-KTG-002	Gurjiya bak’i	Kontagora
NG-KTG-003	Gurjiya	Kontagora
NG-KTG-004	Gurjiya fari	Kontagora
NG-KTG-005	Gurjiya	Kontagora
NG-KTG-006	Gurjiya	Kontagora
NG-KTG-007	Gurjiya mai tabo	Kontagora
NG-KTG-008	Gurjiya fari	Kontagora

NG-KTG-009	Gurjiya	Kontagora
NG-KTG-010	Gurjiya fari	Kontagora
NG-KTG-011	Gurjiya	Kontagora
NG-KTG-012	Gurjiya mai tabo	Kontagora
NG-PAK-013	Etsu gyo	Paiko
NG-PAK-014	Etsu tsombwi	Paiko
NG-PAK-015	Etsu	Paiko
NG-PAK-016	Etsu	Paiko
NG-PAK-017	Etsu tsombwi	Paiko
NG-PAK-018	Etsu gyo	Paiko
NG-PAK-019	Etsu tsombwi	Paiko
NG-PAK-020	Etsu	Paiko
NG-BDA-021	Èpí èzè	Bida
NG-BDA-022	Èpí	Bida
NG-BDA-023	Èpí	Bida
NG-BDA-024	Èpí tsùn-tsùn	Bida
NG-BDA-025	Èpí èzè	Bida
NG-BDA-026	Èpí èzè	Bida
NG-BDA-027	Èpí tsùn-tsùn	Bida
NG-BDA-028	Èpí tsùn-tsùn	Bida
NG-BDA-029	Èpí èzè	Bida
NG-BDA-030	Èpí tsùn-tsùn	Bida

Seed Morphological Variation

The seed morphological evaluation revealed variation among the accessions in seed colour, seed shape, seed size, and hilum characteristics. Seed colour ranged from cream and beige to brown, dark brown, black, and reddish-brown, indicating considerable diversity within the collection.

Most accessions exhibited a round seed shape, while a smaller proportion were oval. Seed size was predominantly medium, with a few small-sized accessions observed. Variation was also recorded in hilum pigmentation and eye-pattern type, including ring, speckled, blotched, mottled, and striped patterns. The observed variation in seed colour, pattern, and hilum characteristics among the accessions is illustrated in Figure 2.

Figure 2: Representative seed morphological variation among selected Bambara groundnut (*Vigna subterranea* (L.) Verdc.) accessions collected from Niger State, Nigeria, showing differences in seed colour, pattern, size, and hilum characteristics.

The distribution of seed coat colour among the collected accessions is presented in Figure 3. The figure shows that cream-coloured seeds were the most predominant, accounting for 27% of the total accessions. This was followed by light brown seeds (20%), while beige and tan each constituted 13%. Other seed colours,

including dark brown, light tan, and brown, were less frequent (7% each), whereas black and reddish-brown were the least represented (3%).

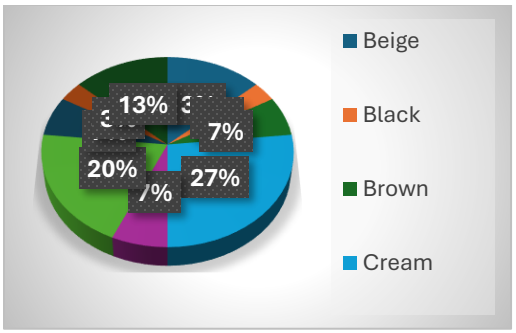

Figure 3: Percentage distribution of seed colour among Bambara groundnut accessions collected from Kontagora, Paiko, and Bida LGAs.

Table 2: Qualitative phenotypic characteristics of Bambara groundnut accessions

S/N	Accession	Seed colour	Seed shape	Seed size	Eye pattern around hilum	Pigmentation around eye	Kind of eye patt
1	KTG-001	Brown	Round	Medium	Present	Dark brown	Spotted
2	KTG-002	Black	Round	Medium	Present	Black	Spotted
3	KTG-003	Light tan	Round	Medium	Absent	None	None
4	KTG-004	Cream	Oval	Medium	Present	Prominent	Ring
5	KTG-005	Beige	Round	Small	Present	Distinct	Speckled
6	KTG-006	Tan	Oval	Medium	Absent	None	None
7	KTG-007	Light brown	Round	Medium	Present	Visible	Blotched
8	KTG-008	Cream	Oval	Medium	Present	Prominent	Ring
9	KTG-009	Beige	Round	Small	Absent	None	None
10	KTG-010	Cream	Round	Medium	Absent	None	None
11	KTG-011	Tan	Oval	Medium	Present	Distinct	Speckled
12	KTG-012	Light brown	Round	Medium	Present	Visible	Blotched
13	PAK-013	Cream	Round	Medium	Present	Prominent	Ring
14	PAK-014	Light brown	Oval	Medium	Present	Distinct	Speckled
15	PAK-015	Beige	Round	Small	Absent	None	None
16	PAK-016	Tan	Oval	Medium	Absent	None	None
17	PAK-017	Dark brown	Round	Medium	Present	Visible	Blotched
18	PAK-018	Cream	Round	Medium	Absent	None	None
19	PAK-019	Brown	Round	Medium	Present	Prominent	Mottled
20	PAK-020	Light tan	Oval	Medium	Present	Visible	Ring
21	BDA-021	Light brown	Round	Medium	Absent	None	None
22	BDA-022	Tan	Oval	Medium	Present	Prominent	Ring
23	BDA-023	Beige	Round	Small	Absent	None	None
24	BDA-024	Cream	Round	Medium	Present	Prominent	Ring
25	BDA-025	Dark brown	Round	Medium	Present	Visible	Blotched
26	BDA-026	Light brown	Round	Medium	Absent	None	None
27	BDA-027	Cream	Round	Medium	Present	Prominent	Mottled
28	BDA-028	Cream	Round	Medium	Present	Distinct	Striped
29	BDA-029	Light brown	Round	Medium	Absent	None	None
30	BDA-030	Reddish-brown	Round	Medium	Present	Visible	Speckled

Farmers' Preference Ranking

Informal farmer interviews indicated that seed colour, seed size, cooking quality, and market acceptability were important criteria used in selecting Bambara groundnut landraces. Cream and light-brown seeds were generally preferred because farmers associated them with better market demand, faster cooking, and acceptable taste. Medium-sized seeds were also preferred over small seeds due to their higher perceived market value. Dark-coloured and very small-seeded accessions were less preferred by most farmers, although some were retained for household use, animal feed, or specific cultural purposes. Female farmers placed greater emphasis on cooking time and taste, while male farmers more frequently mentioned market price, seed colour, and seed size as important selection criteria.

Table 3: Farmers' preference ranking of Bambara groundnut accessions.

Criterion	Most preferred trait	Reason for preference	Least preferred trait	Reason for low preference
Seed colour	Cream/light brown	Better market acceptability and consumer appeal	Black/dark brown	Lower market preference
Seed size	Medium	Better grain appearance and market value	Small	Poorer market appeal
Eye pattern	Ring/prominent eye	Associated by farmer	Striped/no eye	Less preferred
		s with good cooking quality	pattern	appearance
Cooking quality	Faster-cooking types	Saves fuel and time	Slow-cooking types	Requires longer cooking time
Taste	Sweet/soft-textured types	Preferred for household consumption	Hard/less palatable types	Less acceptable for food use

DISCUSSION

The results of this study revealed considerable variation in seed morphology among Bambara groundnut accessions collected from Niger State. The observed diversity in seed colour, seed shape, and hilum characteristics is consistent with previous findings, which reported significant variation in seed traits among African Bambara groundnut landraces (6).

The wide range of seed colours observed suggests genetic diversity within the collected germplasm. Similar observations have been reported in previous studies, where Bambara groundnut landraces exhibited diverse seed coat colours influenced by farmer selection and environmental adaptation (6). The predominance of cream and light-brown seeds in this study may reflect local farmers' preferences or adaptations to the agro-ecological conditions of the study area. In addition, the local naming patterns observed suggest that farmers classify Bambara groundnut landraces based on visible seed traits

such as colour, size, and surface characteristics (8).

Farmers' preference assessment showed that cream-coloured and light-brown, medium-sized seeds were generally preferred because of their perceived higher market value, faster cooking time, and greater consumer acceptability (9, 11). Dark-coloured and small-seeded accessions were less preferred, although farmers still maintained some of them for household use, seed conservation, or cultural purposes (12)

The dominance of round seed shape and medium seed size observed in this study suggests some level of uniformity within the collection. However, the presence of oval and small-seeded accessions indicates that additional variation exists, which may be useful for breeding purposes. Similar variability in Bambara groundnut has been reported by (13), who highlighted the importance of phenotypic diversity for crop improvement.

Variation in hilum pigmentation and eye-pattern type further supports the usefulness of seed morphological traits in distinguishing Bambara groundnut accessions. However, morphological traits alone may not fully capture genetic differences, and therefore, molecular characterisation is recommended to complement these findings (6).

CONCLUSION

This study collected and characterised 30 Bambara groundnut accessions from three LGAs in Niger State. The results showed variation in seed morphological traits, particularly seed colour and hilum characteristics. Farmer preference assessment further revealed that cream-coloured and light-brown, medium-sized seeds were most preferred, primarily due to their higher market value, faster cooking time, and greater consumer acceptability. These preferred morphotypes should be prioritised for conservation and participatory breeding programs. The findings highlight useful diversity within the germplasm, which can support conservation and breeding efforts of Bambara groundnut in Nigeria. Future studies should include agronomic evaluation and molecular characterisation to further understand the genetic relationships among these accessions.

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