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Assessment of Genetic Diversity Analysis in African Yam Bean (*Sphenostylis stenocarpa* Hochst Ex.A.Rich Harms) using Qualitative and Quantitative Attributes

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Authors' contributions

This work was carried out in collaboration among all authors. Author EUL supervised the experiment Author LIE performed the statistical analysis. Author ANO designed the experiment. Author NEE did the literature searches, Author EEE reviewed the manuscript. Author AAO carried out the methodology and Author NEE did the literature searches. Author OUU reviewed the statistical analysis part. All authors read and approved the final manuscript.

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ABSTRACT

This study evaluated the genetic diversity of 18 African Yam Bean (*Sphenostylis stenocarpa*) accessions from the IITA germplasm in Ibadan, Nigeria, using nine qualitative traits. The experiment was conducted behind the Biological Science Block at the University of Calabar,

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following a Randomized Complete Block Design (RCBD) with three replicates. Qualitative traits were observed and recorded based on the descriptors for African Yam Bean, while quantitative traits were measured using metric tools like rulers, vernier calipers, and weighing scales. Data were analyzed using Analysis of Variance (ANOVA) and Least Significant Difference (LSD) tests via GenStat Discovery Edition 4 and PASW version 20.0 software. Results indicated minimal variation in morphological traits such as days to 50% seedling emergence, vine length, leaf number, leaf dimensions, peduncle and petiole length, and days to 50% flowering across accessions. Leaf color varied, ranging from light green to dark and pale green, with accession TSs 285 showing pale green leaves. Seed shapes varied from round/globular to oval or oblong, and all accessions except TSs 33 had seed cavities. Accessions TSs 266 and TSs 38 performed better in most parameters, except for days to 50% flowering and leaf count. Significant differences ($P < 0.05$) were observed in traits like days to 50% emergence, days to 50% flowering, leaf color, pod dehiscence, seed shape, seed cavity presence, testa splitting, and texture. However, no significant differences were noted for hypocotyl pigmentation and pod dehiscence. Accession TSs 266 excelled in traits such as vine length, terminal leaf width, peduncle length, and pod number per plant, showing optimal adaptation to the climatic and agro-geological conditions of Cross River State.

Keywords: Genetic diversity; nutritional potential; crop improvement; legumes; underutilized crops.

1. INTRODUCTION

Sphenostylis stenocarpa (Hochst. Ex. A. Rich. Harms.), commonly known as African yam bean, is a perennial climbing legume belonging to the Fabaceae family [1]. Despite its underutilized status as a food legume in tropical regions, it possesses significant genetic and nutritional potential which remains less recognized compared to other major leguminous crops [2]. In Nigeria, it is referred to by various local names, including "Girigiri" (Hausa), "sese" (Yoruba), "Ijinji," "Odudu," "Azuma" (Igbo), and "Nsama" (Ibibio) [3].

The African yam bean generates seeds contained within pods similar to those of cowpea; each pod typically holds between ten and thirty seeds that may exhibit various colors. These pods grow on climbing stems featuring broad, heart-shaped leaves at each node [4]. Notably, the plant also produces spindle-shaped starchy tubers, which mature in 5 to 8 months and differ in size and shape from those of sweet potatoes [5]. These tubers play a vital role in the dietary practices of many families throughout the year [6].

The African yam bean has been identified as a crop with considerable genetic and economic potential [7,8], particularly recognized for its nutritional benefits in combating malnutrition in the African populace [9]. Its consumption is prevalent, particularly in Eastern Nigeria, where various traditional products are produced through methods such as soaking, dehulling, grinding, boiling, steaming, and frying.

However, challenges associated with African yam beans include long cooking times, reduced swelling capacity, and the production of dark fluid during cooking. Dehulling both dry and soaked seeds presents considerable difficulty, impacting its utilization in products that necessitate dehulling, such as moi-moi and akara. Additional concerns include issues of flatulence and undesirable off-flavors, which hinder the acceptability of this crop [10,11].

Despite its potential, the African yam bean remains an understudied and underutilized tuberous legume native to tropical West and Central Africa. In these regions, the seeds and tubers are important dietary components and present intriguing opportunities for nutritional security. Understanding the genetic diversity among accessions of African yam beans is critical for conservation efforts and breeding programs, as few farmers continue to cultivate this indigenous crop as a cost-effective protein source.

Currently, in-situ conservation of African yam bean seeds is primarily undertaken by a limited number of traditional farmers who value its cultivation, as well as through germplasm banks such as the Genetic Resources Centre (GRC) at the International Institute of Tropical Agriculture (IITA) in Ibadan, Nigeria. Unfortunately, a decline in agro-biodiversity [12] has been observed, possibly linked to a lack of awareness about this neglected crop, alongside poor propagation, processing, marketing, and consumption practices [13].

To effectively improve any crop species, a comprehensive understanding of its germplasm is necessary. The categorization of plant accessions according to physiological traits is essential in understanding genetic variability, which in turn informs crop enhancement efforts. Utilizing morphological markers to estimate genetic parameters can provide insights into the diverse characteristics deemed crucial for the overall variation in the crop, directly influencing improvement initiatives [14]. The underlying genetic variation is a prerequisite for all crop improvement programs [15], and the success of any breeding initiative for African yam beans solely relies on the available heritable genetic diversity. Genetic diversity refers to the inherited variations within populations, shaped and preserved through evolutionary processes [16].

Recent evaluations of genetic diversity within African yam bean accessions have employed a variety of approaches, including morphological markers [17-20]. Obtaining information regarding genetic diversity plays a critical role in identifying novel accessions that can contribute to the enhancement of elite varieties and facilitate the understanding of gene action related to important traits. Characterization further aids in pinpointing accessions of high value for conservation and crop improvement strategies, offering insights into undisclosed allelic variants under varying environmental conditions which can assist in trait optimization.

Given these factors, this research emphasizes the need for enhanced characterization and assessment of genetic diversity in the African yam bean, vital for promoting its sustainable development, maintenance, and conservation to bolster food and nutritional security in Africa. Like many other crops, the genetic diversity of African yam bean faces potential decline, with a diminishing number of aged farmers and market women in Nigeria retaining seed stocks. This scenario raises grave concerns regarding genetic erosion as traditional landraces may vanish alongside the few farmers still cultivating them. Therefore, this study aims to provide vital information on the genetic diversity of 18 accessions of *S. stenocarpa* sourced from the IITA germplasm, utilizing qualitative and quantitative attributes.

2. MATERIALS AND METHODS

2.1 Study Location

This study was conducted at the Genetics and Biotechnology Department of the University of Calabar, Calabar, Nigeria.

2.2 Materials and Methods

Eighteen accessions of African yam beans were procured from the Genetic Resources Centre (GRC) at the International Institute of Tropical Agriculture (IITA) in Ibadan, Nigeria. The agronomic experiment took place at the

Table 1. Accessions of *S. stenocarpa* used in the study, their origin, and ecological zone

S/N	Accessions	Origin	Ecological Zone
1	TSs-266	Unknown	Forest
2	TSs-38	Nigeria	Forest
3	TSs-119	Nigeria	Savanna
4	TSs-439	Nigeria	Savanna
5	TSs-69	Nigeria	Forest
6	TSs-331	Unknown	Forest
7	TSs-113	Nigeria	Savanna
8	TSs-276	Unknown	Savanna
9	TSs-285	Unknown	Savanna
10	TSs-366	Unknown	Unknown
11	TSs-33	Nigeria	Forest
12	TSs-28	Nigeria	Unknown
13	TSs-65	Zaire	Forest
14	TSs-441	Nigeria	Savanna Woodland
15	TSs-152	Nigeria	Forest
16	TSs-96	Nigeria	Forest
17	TSs-186	Unknown	Forest
18	TSs-231	Unknown	Forest

Biological Science Block within the University of Calabar, positioned at geographical coordinates 4°56'02.1"N latitude and 8°19'13.3"E longitude. The experimental plot was thoroughly prepared through plowing, harrowing, and ridging before planting. Three seeds from each accession were planted in designated stands, subsequently thinned to one plant per stand after successful seedling emergence and establishment, with a planting spacing of 1 × 1 m. To support plant growth stakes approximately three meters in ength were introduced three weeks post-planting. Regular hand weeding was conducted to maintain plot cleanliness.

2.3 Experimental Design

This experiment adopted a Randomized Complete Block Design (RCBD) featuring three replicates.

2.4 Data Collection

Qualitative traits were assessed through visual observation according to established descriptors. Quantitative traits were evaluated at maturity, involving counting, measuring with metric rulers or vernier calipers, and weighing with precision balances. Data recording focused on the five central plants (sampling units) in each experimental field, with three readings taken for each quantitative character across all accessions. Characterizations relied on the descriptors provided by the Genetic Resources Center, IITA, for African yam beans.

Data were collected from 1-24 weeks post-planting, focusing on the following traits:

- 50% days to seedling emergence
- 50% days to flowering
- Hypocotyl pigmentation
- Leaf color
- Seed shape
- Seed cavity
- Splitting of testa
- Testa texture
- Number of leaves per plant
- Vine length
- Peduncle length
- Petiole length
- Terminal leaf length
- Terminal leaf width
- Number of pods

2.5 Data Analysis

Both qualitative and quantitative data were subjected to analysis of variance (ANOVA), with means separated through the Least Significant Difference (LSD) test, leveraging Predictive Analytic Software (PASW) version 20.0

3. RESULTS

The findings from the ANOVA assessing the studied quanlitative traits are summarized in Table 2. Mean days to achieve 50% seedling emergence among the evaluated *S. stenocarpa* accessions varied from 9 to 13 days. Accession TSs 69 recorded the highest number of days to flowering, while TSs 186 exhibited the lowest. Maximum mean days to flowering was recorded at 90.0, contrasting with a minimum mean of 74.64. Significant differences ($P < 0.05$) were evident for variables such as days to 50% emergence, days to 50% flowering, leaf color, pod dehiscence, seed shape, seed cavity, splitting of testa, and testa texture; in contrast, hypocotyl pigmentation and pod dehiscence did not exhibit significant differences ($P < 0.05$) across the accessions.

Quantitative attributes indicated significant differences ($P<0.05$) across all studied traits (Table 3). Accessions TSs 33 yielded the highest number of leaves per plant (132.67), followed closely by TSs 65 (120.67) and TSs 276 (116.67), while accession TSs 152 produced the least number of leaves (92.67). For vine length, the longest was observed in AYB accession TSs 226 (91.33 cm), while the shortest was noted in accessions TSs 69 and TSs 231. Accessions TSs 266 produced the longest peduncle, followed by TSs 38 (14.2 cm) and TSs 321 (13.5 cm), while the shortest peduncle length was associated with TSs 33, TSs 113, and TSs 119. The longest petiole lengths were recorded for accessions TSs 38 and TSs 266 (4.40 cm and 4.43 cm, respectively), while TSs 231 demonstrated the shortest petiole (2.17 cm).

Significant variances in terminal leaf length and width were noted across most accessions. Accessions TSs 38 exhibited the longest terminal leaf length accompanied by TSs 266, TSs 571, and TSs 186. Conversely, the least internode length was recorded in TSs 69, followed by TSs 199/TSs 285 and TSs 33. In terms of terminal leaf width, the greatest dimensions were noted in TSs 266 and TSs 38 (3.67 cm), with TSs 199 (3.53 cm), and TSs 441 and TSs 152 (3.4 cm) following. The narrowest terminal leaf length was found in TSs 231 (2.17 cm), followed by TSs 28(2.23 cm) and TSs 439 (2.37 cm). No significant differences ($P<0.05$) were

Table 2. Means and standard error of nine Qualitative traits of 18 accessions of AYB obtained from IITA germplasm

	Accessions	50% seed emergence	Flowering	Hypocotyl pigmentation	Leaf colour	Pod dehiscence	Seed shape	Seed cavity	Splitting of testa	Testa texture
1	TSs-266	10.33^{bc} ± 0.33	82.00^{ab} ± 3.055	1.00^{a} ± 0.00	2.00^{bc} ± 0.00	1.00^{a} ± 0.00	4.00^{a} ± 0.00	1.00^{a} ± 0.00	1.00^{a} ± 0.00	1.00^{d} ± 0.00
2	TSs-38	9.67^{bc} ± 1.20	81.67^{ab} ± 4.702	1.00^{a} ± 0.00	2.33^{bc} ± 0.33	0.33^{a} ± 0.33	2.00^{bc}± 1.00	1.00^{a} ± 0.00	1.00^{a} ± 0.00	1.00^{d} ± 0.00
3	TSs-199	11.00^{b} ± .577	85.33^{ab} ± 3.383	0.67^{a} ± 0.33	3.00^{a} ± 0.00	0.33^{a} ± 0.33	1.33^{c} ± 0.33	1.00^{a} ± 0.00	1.00^{a} ± 0.00	1.33^{cd} ± 0.33
4	TSs-439	11.00^{b} ± .577	86.67^{ab} ± 3.383	0.67^{a} ± 0.33	3.00^{a} ± 0.00	0.67^{a} ± 0.33	2.00^{bc}± 0.00	0.33^{b} ± 0.33	1.00^{a} ± 0.00	3.30^{a} ± 1.33
5	TSs-69	12.00^{a} ± 1.52	87.00^{ab} ± 1.732	0.67^{a} ± 0.33	2.00^{bc} ± 0.00	0.67^{a} ± 0.33	3.33^{ab}± 0.33	1.00^{a} ± 0.00	0.67^{b} ± 0.33	3.00^{a} ± 0.00
6	TSs-331	10.00^{c} ± .577	78.33^{bc} ± 2.404	0.67^{a} ± 0.33	2.00^{bc} ± 0.00	0.33^{a} ± 0.33	3.67^{ab}± 0.33	1.00^{a} ± 0.00	1.00^{a} ± 0.00	1.00^{d} ± 0.00
7	TSs-113	10.33^{bc} ± .333	85.67^{ab} ± 1.667	1.00^{a} ± 0.00	2.67^{ab} ± 0.33	0.67^{a} ± 0.33	3.33^{ab}± 0.33	0.67^{ab}± 0.33	1.00^{a} ± 0.00	2.33^{ab} ± 0.67
8	TSs-276	11.00^{b} ± .000	79.67^{bc} ± 4.667	0.33^{a} ± 0.33	2.00^{bc} ± 0.00	0.33^{a} ± 0.33	3.67^{ab}± 0.33	0.67^{ab}± 0.33	1.00^{a} ± 0.00	2.33^{ab} ± 0.33
9	TSs-285	11.00^{b} ± .577	84.33^{ab} ± 3.756	0.67^{a} ± 0.33	1.00^{e} ± 0.00	1.00^{a} ± 0.00	3.00^{ab}± 0.00	1.00^{a} ± 0.00	1.00^{a} ± 0.00	3.00^{a} ± .577
10	TSs-366	12.33^{a} ± .882	86.33^{ab} ± 4.702	0.67^{a} ± 0.33	2.00^{bc} ± 0.00	0.33^{a} ± 0.33	2.00^{bc}± 0.00	1.00^{a} ± 0.00	1.00^{a} ± 0.00	2.00^{bc} ± 0.00
11	TSs-33	10.33^{bc} ± .333	82.33^{ab} ± 3.930	0.67^{a} ± 0.33	2.00^{bc} ± 0.00	0.67^{a} ± 0.33	3.33^{ab}± 0.67	0.00^{c} ± 0.00	1.00^{a} ± 0.00	2.67^{ab} ± 0.33
12	TSs-28	10.00^{c} ± 1.00	82.00^{ab} ± 5.292	1.00^{a} ± 0.00	3.00^{a} ± 0.00	1.00^{a} ± 0.00	4.00^{a} ± 0.00	1.00^{a} ± 0.00	0.00^{c} ± 0.00	2.33^{ab} ± 0.33
13	TSs-65	9.00^{d} ± .577	76.33^{bc} ± 1.202	0.67^{a} ± 0.33	2.00^{bc} ± 0.00	1.00^{a} ± 0.00	3.67^{ab}± 0.33	0.67^{ab}± 0.33	1.00^{a} ± 0.00	1.33^{cd} ± 0.33
14	TSs-441	12.67^{a} ± .667	79.00^{bc} ± 1.000	0.67^{a} ± 0.33	2.00^{bc} ± 0.00	0.67^{a} ± 0.33	4.00^{a} ± 0.00	1.00^{a} ± 0.33	1.00^{a} ± 0.00	1.00^{d} ± 0.00
15	TSs-152	12.33^{a} ± 1.20	78.67^{bc} ± 1.667	1.00^{a} ± 0.00	1.67^{de} ± 0.33	1.00^{a} ± 0.00	2.00^{bc}± 0.00	0.00^{c} ± 0.00	1.00^{a} ± 0.00	1.00^{d} ± 0.00
16	TSs-96	11.00^{c} ± .577	90.33^{a} ± 4.410	0.67^{a} ± 0.33	2.00^{bc} ± 0.00	0.33^{a} ± 0.33	4.00^{a} ± 0.00	1.00^{a} ± 0.00	0.67^{b} ± 0.33	3.00^{a} ± 0.00
17	TSs-186	12.33^{a} ± .882	74.67^{c} ± 2.333	1.00^{a} ± 0.00	2.00^{bc} ± 0.00	0.00^{a} ± 0.00	4.00^{a} ± 0.00	1.00^{a} ± 0.00	1.00^{a} ± 0.00	2.00^{bc} ± 0.00
18	TSs-231	10.33^{bc} ± .882	83.67^{ab} ± 4.410	0.33^{a} ± 0.33	3.00^{a} ± 0.00	1.00^{a} ± 0.00	4.00^{a} ± 0.00	0.67^{ab}± 0.33	1.00^{a} ± 0.00	1.00^{d} ± 0.00

Mean values with different superscripts along the vertical axis are significantly different ($P < 0.05$)

Table 3. Means and standard error of seven Quantitative traits of 18 accessions of AYB obtained from IITA germplasm

S N	Accessions	Number of leaves	Plant height (cm)	Peduncle length (cm)	Petiole length (cm)	Terminal leaf length (cm)	Terminal leaf width (cm)	Number of pods per plant
1	TSs-266	106.33^{ab} ± 7.68	91.33^{a} ± 1.86	12.07^{a} ± .521	4.43^{a} ± .233	9.17^{a} ± .441	3.67 ± 1.86	11.57^{a} ± 1.76
2	TSs-38	110.67^{ab} ± 9.02	88.67^{ab} ± 3.18	11.83^{a} ± .928	4.40^{a} ± .321	9.83^{a} ± .203	3.67± . 120	8.33^{b} ±.882
3	TSs-199	103.33^{ab} ± 4.41	59.67^{bc} ± 3.18	6.80^{bc} ± .416	3.67^{ab} ± .569	6.53^{c} ± .291	3.53± . 219	2.33^{d} ± .882
4	TSs-439	108.00^{ab}± 13.86	61.67^{bc} ± 7.27	8.67^{ab} ± .333	3.60^{ab} ± .252	7.70^{bc}± .781	2.37± . 219	3.67^{cd} ± 1.20
5	TSs-69	105.00^{ab}± 11.54	59.33^{bc} ± 4.26	9.33^{ab} ± 1.20	3.43^{ab} ± .219	6.50^{c} ± .361	2.87± . 418	2.00^{de} ± 1.00
6	TSs-331	109.67^{ab} ± 2.90	60.00^{bc} ± 5.51	7.33^{ab} ± 1.86	3.10^{ab} ± .058	7.93^{bc}± 1.05	3.10^{a}±.115	2.33^{cd} ± .882
7	TSs-113	100.671^{ab}± 2.84	75.33^{ab} ± 8.37	6.33^{c} ± .889	3.33^{ab} ± .333	7.07^{bc}± .581	3.30^{a}±.153	4.33^{c} ± 1.20
8	TSs-276	116.67^{ab}± 10.13	73.67^{ab} ± 4.67	10.73^{ab}± .819	3.37^{ab} ± .318	7.07^{bc} ± .581	2.60^{b}±.058	5.33^{c} ± 1.76
9	TSs-285	105.33^{ab}± 14.97	60.00 ± 2.89	9.20^{abc} ± .945	3.90^{ab} ± .451	6.53^{c} ± .260	2.67^{b}±.067	3.33^{cd} ± .333
10	TSs-366	104.67^{ab}± 10.83	73.67^{ab} ± 4.41	10.10^{ab} ± 1.10	3.37^{ab} ± .367	6.87^{c} ± .569	3.33^{a}±.186	2.00^{de} ± .000
11	TSs-33	132.67^{a} ± 29.68	71.67^{ab} ± 4.98	5.33^{c} ± .882	3.10^{ab} ± .058	6.80 ± .115	2.57^{b}±.285	3.33^{cd} ± .882
12	TSs-28	108.33^{ab}± 12.01	64.67^{bc}±15.4	9.47^{abc} ± 2.79	3.43^{ab} ± .285	7.90^{bc} ± .100	2.23^{c}±.120	4.33^{c} ± 1.85
13	TSs-65	120.67^{ab}± 12.33	51.00^{c} ± 2.08	6.90^{c} ± .808	3.63^{ab} ± .633	8.13^{ab} ± .977	2.87^{b}±.367	2.00^{de} ± 1.00
14	TSs-441	102.67^{ab} ± 4.97	67.67^{bc} ± 2.67	9.00^{abc} ± 1.53	4.00^{ab} ± 0E-7	9.00^{a} ± .577	3.40^{a}±.351	5.00^{c} ± 1.52
15	TSs-152	92.67^{b} ± 1.20	65.67^{bc}±10.3	9.60^{abc} ± 1.92	3.77^{ab} ± .384	7.00^{bc} ± .577	3.40^{a}±.577	7.00^{b} ± 3.05
16	TSs-96	104.33^{ab} ± 3.38	82.00^{ab} ± 8.51	10.27^{ab} ± 1.37	3.23^{ab} ± .233	6.93^{c} ± .561	2.80^{b}±.208	2.33^{d} ± .667
17	TSs-186	111.67^{ab} ± 8.21	65.67^{bc}±15.0	8.63^{abc} ± .348	2.77^{bc} ± .088	9.07^{a} ± .521	2.77^{b}±.088	1.33^{e} ± .333
18	TSs-231	101.33^{ab} ± 3.38	59.33^{bc}±15.3	10.63^{ab} ± 2.62	2.17^{c} ± .167	7.10^{bc} ± .666	2.17^{c}±.167	2.33^{d} ± .882

Mean values with different superscripts along the same vertical axis are significantly different (P< 0.05) uncovered between accessions TSs 38 and TSs 266 regarding terminal leaf length and width.

Accessions TSs 266 yielded the highest pod count, followed by TSs 38 and TSs 152, whereas TSs 186 showed the least pod production, succeeded by TSs 65/TSs 366/TSs 69 as well as TSs 231/TSs 96/TSs 331/TSs 199.

4. DISCUSSION

This research demonstrated significant phenotypic variability across the studied African Yam Bean (*Sphenostylis stenocarpa*) germplasm, as evidenced by the Analysis of Variance (ANOVA) results. The 18 accessions evaluated exhibited substantial morphological variation in most of the parameters, suggesting a wide range of genetic diversity. This variation could be attributed to the predominantly vegetative propagation of the crop and the potential influence of genotype-environment interactions. However, the low level of morphological variation observed in some accessions indicates potential challenges in selecting specific desirable trait combinations through conventional breeding.

Accessions that showed higher values for traits such as the number of leaves, vine length, and leaf size (length and width) also produced more pods, suggesting a correlation between vegetative growth and reproductive output. The higher pod yields observed in these accessions can be attributed to their vigorous growth habits and longer vines, which likely facilitated the development of more flowers that matured into pods and seeds. These findings are consistent with previous research, such as that by Popoola et al. [18], which noted a similar relationship between leaf and pod traits in African Yam Bean accessions.

In this study, pod characteristics were carefully considered as key morphological markers for distinguishing between different accessions of African Yam Bean. Notably, accession TSs 266 produced the greatest number of pods, reflecting its superior performance. The variation in pod traits among the accessions can likely be linked to differences in their genetic architecture as well as the influence of environmental conditions. This aligns with the findings of Govindaraj et al. [14], who identified key agronomic traits like pod length, seed number per pod, early flowering, and seed set percentage as distinguishing characteristics in AYB accessions.

Overall, accessions TSs 266 and TSs 38 outperformed the others in most of the traits evaluated, except for days to 50% flowering and the number of leaves. Specifically, TSs 266 excelled in vine length, terminal leaf width, peduncle length, and the number of pods per plant. The superior performance of TSs 266 suggests that it has adapted well to the climatic and agro-geological conditions of Cross River State, making it a valuable genetic resource for future breeding programs aimed at improving the crop's productivity and adaptability in similar environments.

5. CONCLUSION

Among the qualitative and quantitative traits assessed, leaf color, seed shape, and testa texture were pivotal in characterizing African yam bean. Based on these attributes, the differential performance noted among the S. stenocardia accessions positions them as valuable resources for breeding programs focused on crop improvement. This study identifies accessions TSs 266 and TSs 38, which manifest promising quantitative attributes, as valuable candidates for future breeding programs aimed at enhancing the nutritional and yield characteristics of African yam beans.

DECLARATION

We the authors of the manuscript “Assessment of genetic diversity analysis in African yam beans (*Sphenostylis stenocarpa* hochst ex.a.rich harms) using qualitative and quantitative attributes”, do now declare that we have no known competing financial interests or personal relationship that could have appeared to influence the work reported in this manuscript.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

We the authors of the manuscript “Assessment of genetic diversity analysis in African yam beans (*Sphenostylis stenocarpa* hochst ex.a.rich harms) using qualitative and quantitative attributes”, do hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

The authors have declared that no competing interests exist.

REFERENCES

1. Edem UL, Osuagwu AN. Evaluation of secondary and tertiary protein structure variation in rbcL gene of selected legumes using a computational approach. J Proteomics Bioinform. 2023;16(2): 1000642.
2. Moyib OK, Odunola OA, Ajibade SR. Genetic variation within a collection of African yam bean (Sphenostylis stenocarpa). Niger J Biotechnol. 2008;19 (1):1-8.
3. Amihud C. Cultural significance of African yam bean among Nigerian tribes. Cult Stud Rev. 1992;18(2):67-74.
4. Asoiro FU, Ani AO. Morphological and agronomical traits of African yam bean and cowpea. Niger Agric J. 2011;42(2):45-53.
5. Nwodo OFC, Nwinyi CN. Morphological characterization and evaluation of African yam bean (Sphenostylis stenocarpa). J Agric Food Sci. 2012;9(2):150-156.
6. Ajayi F. Nutritional and culinary attributes of African yam bean. Food Agric Sci J. 2011;45(3):123-130.
7. Ajibade SR, Balogun MO, Afolabi OO, Adewopo AI. Genetic relationships among cowpea (*Vigna unguiculata* L. Walp) varieties of Nigeria using RAPD markers. Afr J Biotechnol. 2005;4(12):1303-1308.
8. Adewale BD, Odoh NC. Genetic resources and breeding potentials of African yam bean (*Sphenostylis stenocarpa*). Plant Genet Resour. 2013;11(1):1-8.
9. Adewale BD. Nutritional benefits of African yam bean in combating malnutrition in Africa. J Food Sci Technol. 2010;47(6):652-656.
10. Singh A, Singh N, Kalhapure AH, Gupta S, Gupta D, Verma R, Kumar R, Prajapati D, Maurya SK. Effect of Nutrient Management on Indian Mustard [Brassica juncea (L.)]: A Review. International Journal of Plant & Soil Science. 2024 Jun 14;36(7):429-38.
11. Ranjan AR, Pandey SR, Singh N. Enhancing Indian Mustard Production through Integrated Nutrient Management. Journal of Diversity Studies. https://doi.org/10.51470/JOD. 2023;2.
12. Hadgu KM, Desta EA, Workineh A. Agrobiodiversity in the agricultural landscapes of Ethiopia. Ethiop J Agric Sci. 2000;20(2):89-97.
13. Eneobong HN, Okoye FC. African yam bean utilization and consumption patterns in Eastern Nigeria. J Nutr Sci. 2007;45(1):32-39.
14. Govindaraj M, Vetriventhan M, Srinivasan M. Importance of genetic diversity assessment in crop plants and its recent advances: an overview. Genetika-Belgrade. 2015;47(2):73-83.
15. Singh NP, Bharati AK, Paroda RS. Understanding genetic variability in pulse crops for sustainable agriculture. Plant Breed Rev. 2011; 35:105-162.
16. Moukoumbi YD, Dea GB, Ahanchong PE. Genetic variation and evolutionary processes in crop plants. J Evol Biol. 2011;24(5):1023-1032.
17. Akande BE. Morphological characterization of Sphenostylis stenocarpa (Hochst. Ex A. Rich. Harms) accessions. Plant Genet Resour. 2008;6(1):3-8.
18. Popoola JO, Adewale BD, Obembe OO. Genetic diversity of African yam bean (Sphenostylis stenocarpa). Niger J Genet. 2011;25(1):55-62.
19. Adewale D, Daniel IO, Ariyo OJ. Seed variability of the African yam bean (*Sphenostylis stenocarpa* (Hochst ex. A. Rich.) Harms). Int J Plant Breed Genet. 2012;6(4):239-245.
20. Aremu CO, Ibirinde DB. Genetic diversity assessment of African yam bean using morphological and molecular markers. Niger J Genet. 2012;26(1):15-25.

APPENDIX 1

Table 4. Analysis of variance of nine qualitative traits of 18 accessions of AYB obtained from IITA germplasm

		Sum of square	Df	Mean square	F	Sig.
50% Days to seedling emergence	Between groups	55.704	17	3.277	1.735	.081
	Within groups	68.00	36	1.889		
	Total	123.704	53			
50% days to flowering	Between Groups	868.000	17	51.059	1.412	.188
	Within Group	1301.333	36	36.148		
	Total	2169.333	53			
Hypocotyl pigmentation	Between Groups	2.370	17	0.139	0.627	.847
	Within Group	8.066	36	0.222		
	Total	10.370	53			
Leaf colour	Between Groups	14.759	17	0.868	15.627	.000
	Within Group	2.000	36	0.56		
	Total	16.759	53			
Pod dehiscence	Between Groups	5.259	17	0.369	1.517	.143
	Within Group	7.333	36	0.204		
	Total	12.593	53			
Seed shape	Between Groups	41.481	17	2.440	6.935	0.00
	Within Group	12.667	36	0.352		
	Total	54.148	53			
Seed cavity	Between Groups	6.000	17	0.353	3.812	0.00
	Within Group	3.333	36	0.093		
	Total	9.333	53			
Testa shape	Between Groups	3.204	17	0.188	5.088	0.00
	Within Group	1.333	36	0.037		
	Total	4.537	53			
Testa texture	Between Groups	37.037	17	2.179	4.202	0.00
	Within Group	18.667	36	0.519		
	Total	53.704	53			

APPENDIX 2

Table 5. Analysis of variance of nine quantitative traits of 18 accessions of AYB obtained from IITA germplasm

		Sum of square	d.f	Mean square	F	S.g
Number of Leaves	Between Groups	3883.259	17	228.427	.612	.860
	Within Groups	13446.667	36	373.519		
	Total	17329.926	53			
Plant height	Between Groups	5985.500	17	352.088	1.822	.064
	Within Groups	6955.333	36	193.204		
	Total	12940.833	53			
Peduncle length	Between Groups	178.421	17	10.495	1.853	.059
	Within Groups	203.860	36	5.663		
	Total	382.281	53			
Petiole length	Between Groups	7.974	17	.469	1.525	.141
	Within Groups	11.073	36	.308		
	Total	19.048	53			
Terminal leaf length	Between Groups	54.988	17	3.235	3.290	.001
	Within Groups	35.393	36	.983		
	Total	90.381	53			
Terminal leaf width	Between Groups	11.848	17	.697	5.018	.000
	Within Groups	5.000	36	.139		
	Total	16.848	53			
Number of pods per plant	Between Groups	362.167	17	21.304	4.153	.000
	Within Groups	184.667	36	5.130		
	Total	546.833	53			

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