

# ASSESSMENT OF GENETIC DIVERSITY ANALYSIS IN AFRICAN YAM BEAN (*Sphenostylis stenocardia* Hochst Ex.A.Rich Harms) USING QUALITATIVE AND QUANTITATIVE ATTRIBUTES

## Abstract

A collection of 18 African Yam bean (*Sphenostylis stenocarpa*) accessions of IITA germplasm, Ibadan, Nigeria was assessed for genetic diversity based on nine qualitative data. This research was carried out behind the Biological Science Block, University of Calabar. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three (3) replicates. Qualitative traits were observed measured and recorded according to the descriptors for AYB while quantitative traits were counted, measured using metric rulers or vernier caliper, and weighed using a weighing balance. Data obtained were subjected to Analysis of Variance (ANOVA) and Least Significant Difference (LSD) using Genstat Discovery Edition 4 and PASW version 20.0 software. The results revealed minimal variations in morphological traits like days 50% seedling emergence, vine length, number of leaves, leaf length and width, peduncle, petiole length, and days to 50 % flowering in different accessions investigated. The leaf colour varied, ranging from light green, and dark green to pale green colour, accessions TSs 285 had a pale green colour. Also, seed shape varied as seeds were either round/globular, oval or oblong. Seed cavity was present in all accessions except for TSs 33. TSs 266 and TSs 38 accessions performed better in all parameters studied except for days to 50% flowering and number of leaves. There were significant ( $P < 0.05$ ) differences for days to 50% emergence, days to 50% flowering, leaf color, pod dehiscence, seed shape, seed cavity, and splitting of testa and testa texture whereas hypocotyl pigmentation and pod dehiscence showed no significant differences ( $P < 0.05$ ) for the studied accessions. Accessions from TSs 266 had better performances in vine length, terminal leaf width, peduncle length, and number of pods per plant. TSs 266 accession had adequately adapted to the climatic and agro-geological conditions of Cross River State.

**Keywords:** Genetic diversity, Nutritional potential, Crop improvement, Legumes, Underutilized crops

## INTRODUCTION

*Sphenostylis stenocarpa* (Hochst. Ex. A. Rich. Harms.), commonly known as African yam bean, is a perennial climbing legume belonging to the Fabaceae family [10]. 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 [14]. In Nigeria, it is referred to by various local names, including "Girigiri" (Hausa), "sese" (Yoruba), "Ijinji," "Odudu," "Azuma" (Igbo), and "Nsama" (Ibibio) [7].

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 [9]. 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 [16]. These tubers play a vital role in the dietary practices of many families throughout the year [4].

The African yam bean has been identified as a crop with considerable genetic and economic potential [5, 2], particularly recognized for its nutritional benefits in combating malnutrition in the African populace [1]. 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 bean 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.

Despite its potential, 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 bean 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 [13] has been observed, possibly linked to a lack of awareness about this neglected crop, alongside poor propagation, processing, marketing, and consumption practices [11].

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 [12]. The underlying genetic variation is a prerequisite for all crop improvement programs [18], and the success of any breeding initiative for African yam bean solely relies on the available heritable genetic diversity. Genetic diversity refers to the inherited variations within populations, shaped and preserved through evolutionary processes [15].

Recent evaluations of genetic diversity within African yam bean accessions have employed a variety of approaches, including morphological markers [6, 17, 3, 8]. 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 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.

## **MATERIALS AND METHODS**

### **Study Location**

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

### **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 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 length were introduced three weeks post-planting. Regular hand weeding was conducted to maintain plot cleanliness.

### **Experimental Design**

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

### **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 bean.

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

### **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

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

<b>S/N</b>	<b>Accessions</b>	<b>Origin</b>	<b>Ecological Zone</b>
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

## RESULTS

The findings from the ANOVA assessing the studied quantitative 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 uncovered between accessions TSs 38 and TSs 266 regarding terminal leaf length and width.

**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 <sup>bc</sup> ± 82.00 <sup>ab</sup>	± 1.00 <sup>a</sup> ± 0.00	2.00 <sup>bc</sup>	± 1.00 <sup>a</sup> ± 0.00	4.00 <sup>a</sup>	± 1.00 <sup>a</sup>	± 1.00 <sup>a</sup>	± 1.00 <sup>d</sup>	±	
2 TSs-38	0.33	3.055	1.00 <sup>a</sup> ± 0.00	0.00	0.33 <sup>a</sup> ± 0.33	0.00	0.00	0.00	0.00	
3 TSs-199	9.67 <sup>bc</sup> ± 1.20	81.67 <sup>ab</sup>	± 0.67 <sup>a</sup> ± 0.33	2.33 <sup>bc</sup>	± 0.33 <sup>a</sup> ± 0.33	2.00 <sup>bc</sup> ±	1.00 <sup>a</sup>	± 1.00 <sup>a</sup>	± 1.00 <sup>d</sup>	±
4 TSs-439	11.00 <sup>b</sup> ± .577	4.702	0.67 <sup>a</sup> ± 0.33	0.33	0.67 <sup>a</sup> ± 0.33	1.00	0.00	0.00	0.00	
5 TSs-69	11.00 <sup>b</sup> ± .577	85.33 <sup>ab</sup>	± 0.67 <sup>a</sup> ± 0.33	3.00 <sup>a</sup> ± 0.00	0.67 <sup>a</sup> ± 0.33	1.33 <sup>c</sup>	± 1.00 <sup>a</sup>	± 1.00 <sup>a</sup>	± 1.33 <sup>cd</sup>	±
6 TSs-331	12.00 <sup>a</sup> ± 1.52	3.383	0.67 <sup>a</sup> ± 0.33	3.00 <sup>a</sup> ± 0.00	0.33 <sup>a</sup> ± 0.33	0.33	0.00	0.00	0.33	
7 TSs-113	10.00 <sup>c</sup> ± .577	86.67 <sup>ab</sup>	± 1.00 <sup>a</sup> ± 0.00	2.00 <sup>bc</sup>	± 0.67 <sup>a</sup> ± 0.33	2.00 <sup>bc</sup> ±	0.33 <sup>b</sup>	± 1.00 <sup>a</sup>	± 3.30 <sup>a</sup>	±
8 TSs-276	10.33 <sup>bc</sup>	3.383	0.33 <sup>a</sup> ± 0.33	0.00	0.33 <sup>a</sup> ± 0.33	0.00	0.33	0.00	1.33	
9 TSs-285	± .333	87.00 <sup>ab</sup>	± 0.67 <sup>a</sup> ± 0.33	2.00 <sup>bc</sup>	± 1.00 <sup>a</sup> ± 0.00	3.33 <sup>ab</sup> ±	1.00 <sup>a</sup>	± 0.67 <sup>b</sup>	± 3.00 <sup>a</sup>	±
10 TSs-366	11.00 <sup>b</sup> ± .000	1.732	0.67 <sup>a</sup> ± 0.33	0.00	0.33 <sup>a</sup> ± 0.33	0.33	0.00	0.33	0.00	
11 TSs-33	11.00 <sup>b</sup> ± .577	78.33 <sup>bc</sup>	± 0.67 <sup>a</sup> ± 0.33	2.67 <sup>ab</sup>	± 0.67 <sup>a</sup> ± 0.33	3.67 <sup>ab</sup> ±	1.00 <sup>a</sup>	± 1.00 <sup>a</sup>	± 1.00 <sup>d</sup>	±
12 TSs-28	12.33 <sup>a</sup> ± .882	2.404	1.00 <sup>a</sup> ± 0.00	0.33	1.00 <sup>a</sup> ± 0.00	0.33	0.00	0.00	0.00	
13 TSs-65	10.33 <sup>bc</sup>	85.67 <sup>ab</sup>	± 0.67 <sup>a</sup> ± 0.33	2.00 <sup>bc</sup>	± 1.00 <sup>a</sup> ± 0.00	3.33 <sup>ab</sup> ±	0.67 <sup>ab</sup> ±	1.00 <sup>a</sup>	± 2.33 <sup>ab</sup>	±
14 TSs-441	± .333	1.667	0.67 <sup>a</sup> ± 0.33	0.00	0.67 <sup>a</sup> ± 0.33	0.33	0.33	0.00	0.67	
15 TSs-152	10.00 <sup>c</sup> ± 1.00	79.67 <sup>bc</sup>	± 1.00 <sup>a</sup> ± 0.00	1.00 <sup>e</sup> ± 0.00	1.00 <sup>a</sup> ± 0.00	3.67 <sup>ab</sup> ±	0.67 <sup>ab</sup> ±	1.00 <sup>a</sup>	± 2.33 <sup>ab</sup>	±
16 TSs-96	9.00 <sup>d</sup> ± .577	4.667	0.67 <sup>a</sup> ± 0.33	2.00 <sup>bc</sup>	± 0.33 <sup>a</sup> ± 0.33	0.33	0.33	0.00	0.33	
17 TSs-186	12.67 <sup>a</sup> ± .667	84.33 <sup>ab</sup>	± 1.00 <sup>a</sup> ± 0.00	0.00	0.00 <sup>a</sup> ± 0.00	3.00 <sup>ab</sup> ±	1.00 <sup>a</sup>	± 1.00 <sup>a</sup>	± 3.00 <sup>a</sup>	
18 TSs-231	12.33 <sup>a</sup> ± 1.20	3.756	0.33 <sup>a</sup> ± 0.33	2.00 <sup>bc</sup>	± 1.00 <sup>a</sup> ± 0.00	0.00	0.00	0.00	± .577	
	11.00 <sup>c</sup> ± .577	86.33 <sup>ab</sup>	±	0.00		2.00 <sup>bc</sup> ±	1.00 <sup>a</sup>	± 1.00 <sup>a</sup>	± 2.00 <sup>bc</sup>	±
	12.33 <sup>a</sup> ± .882	4.702		3.00 <sup>a</sup> ± 0.00		0.00	0.00	0.00	0.00	
	10.33 <sup>bc</sup>	82.33 <sup>ab</sup>	±	2.00 <sup>bc</sup>	±	3.33 <sup>ab</sup> ±	0.00 <sup>c</sup>	± 1.00 <sup>a</sup>	± 2.67 <sup>ab</sup>	±
	± .882	3.930		0.00		0.67	0.00	0.00	0.33	
		82.00 <sup>ab</sup>	±	2.00 <sup>bc</sup>	±	4.00 <sup>a</sup>	± 1.00 <sup>a</sup>	± 0.00 <sup>c</sup>	± 2.33 <sup>ab</sup>	±
		5.292		0.00		0.00	0.00	0.00	0.33	
		76.33 <sup>bc</sup>	±	1.67 <sup>de</sup>	±	3.67 <sup>ab</sup> ±	0.67 <sup>ab</sup> ±	1.00 <sup>a</sup>	± 1.33 <sup>cd</sup>	±
		1.202		0.33		0.33	0.33	0.00	0.33	

79.00 <sup>bc</sup>	±	2.00 <sup>bc</sup>	±	4.00 <sup>a</sup>	± 1.00 <sup>a</sup>	± 1.00 <sup>a</sup>	± 1.00 <sup>d</sup>	±
1.000		0.00		0.00	0.33	0.00	0.00	
78.67 <sup>bc</sup>	±	2.00 <sup>bc</sup>	±	2.00 <sup>bc</sup>	± 0.00 <sup>c</sup>	± 1.00 <sup>a</sup>	± 1.00 <sup>d</sup>	±
1.667		0.00		0.00	0.00	0.00	0.00	
90.33 <sup>a</sup>	± 4.410	3.00 <sup>a</sup>	±	4.00 <sup>a</sup>	± 1.00 <sup>a</sup>	± 0.67 <sup>b</sup>	± 3.00 <sup>a</sup>	±
74.67 <sup>c</sup>	± 2.333	0.00		0.00	0.00	0.33	0.00	
83.67 <sup>ab</sup>	±			4.00 <sup>a</sup>	± 1.00 <sup>a</sup>	± 1.00 <sup>a</sup>	± 2.00 <sup>bc</sup>	±
4.410				0.00	0.00	0.00	0.00	
				4.00 <sup>a</sup>	± 0.67 <sup>ab</sup>	1.00 <sup>a</sup>	± 1.00 <sup>d</sup>	±
				0.00	0.33	0.00	0.00	

Mean values with different superscript along the vertical axis are significantly different ( $e \alpha 0.05$ )

**TABLE 3: Means and standard error of seven Quantitative traits of 18 accessions of AYB obtained from IITA germplasm**

Accessions	Number of leaves (NL)	Plant height (PH) (cm)	Peduncle length (cm)	Petiole length (cm)	Terminal leaf length	Terminal leaf width	Number of pods per plant (NPPP)
TSs-266	106.33 <sup>ab</sup> ± 7.68	91.33 <sup>a</sup> ± 1.86	12.07 <sup>a</sup> ± .521	4.43 <sup>a</sup> ± .233	9.17 <sup>a</sup> ± .441	3.67 ± 1.86	11.57 <sup>a</sup> ± 1.76
TSs-38	110.67 <sup>ab</sup> ± 9.02	88.67 <sup>ab</sup> ± 3.18	11.83 <sup>a</sup> ± .928	4.40 <sup>a</sup> ± .321	9.83 <sup>a</sup> ± .203	3.67 ± .120	8.33 <sup>b</sup> ± .882
TSs-199	103.33 <sup>ab</sup> ± 4.41	59.67 <sup>bc</sup> ± 3.18	6.80 <sup>bc</sup> ± .416	3.67 <sup>ab</sup> ± .569	6.53 <sup>c</sup> ± .291	3.53 ± .219	2.33 <sup>d</sup> ± .882
TSs-439	108.00 <sup>ab</sup> ± 13.86	61.67 <sup>bc</sup> ± 7.27	8.67 <sup>ab</sup> ± .333	3.60 <sup>ab</sup> ± .252	7.70 <sup>bc</sup> ± .781	2.37 ± .219	3.67 <sup>cd</sup> ± 1.20
TSs-69	105.00 <sup>ab</sup> ± 11.54	59.33 <sup>bc</sup> ± 4.26	9.33 <sup>ab</sup> ± 1.20	3.43 <sup>ab</sup> ± .219	6.50 <sup>c</sup> ± .361	2.87 ± .418	2.00 <sup>de</sup> ± 1.00
TSs-331	109.67 <sup>ab</sup> ± 2.90	60.00 <sup>bc</sup> ± 5.51	7.33 <sup>ab</sup> ± 1.86	3.10 <sup>ab</sup> ± .058	7.93 <sup>bc</sup> ± 1.05	3.10 <sup>a</sup> ± .115	2.33 <sup>cd</sup> ± .882
TSs-113	100.67 <sup>ab</sup> ± 2.84	75.33 <sup>ab</sup> ± 8.37	6.33 <sup>c</sup> ± .889	3.33 <sup>ab</sup> ± .333	7.07 <sup>bc</sup> ± .581	3.30 <sup>a</sup> ± .153	4.33 <sup>c</sup> ± 1.20
TSs-276	116.67 <sup>ab</sup> ± 10.13	73.67 <sup>ab</sup> ± 4.67	10.73 <sup>ab</sup> ± .819	3.37 <sup>ab</sup> ± .318	7.07 <sup>bc</sup> ± .581	2.60 <sup>b</sup> ± .058	5.33 <sup>c</sup> ± 1.76
TSs-285	105.33 <sup>ab</sup> ± 14.97	60.00 ± 2.89	9.20 <sup>abc</sup> ± .945	3.90 <sup>ab</sup> ± .451	6.53 <sup>c</sup> ± .260	2.67 <sup>b</sup> ± .067	3.33 <sup>cd</sup> ± .333
TSs-366	104.67 <sup>ab</sup> ± 10.83	73.67 <sup>ab</sup> ± 4.41	10.10 <sup>ab</sup> ± 1.10	3.37 <sup>ab</sup> ± .367	6.87 <sup>c</sup> ± .569	3.33 <sup>a</sup> ± .186	2.00 <sup>de</sup> ± .000
TSs-33	132.67 <sup>a</sup> ± 29.68	71.67 <sup>ab</sup> ± 4.98	5.33 <sup>c</sup> ± .882	3.10 <sup>ab</sup> ± .058	6.80 ± .115	2.57 <sup>b</sup> ± .285	3.33 <sup>cd</sup> ± .882
TSs-28	108.33 <sup>ab</sup> ± 12.01	64.67 <sup>bc</sup> ± 15.4	9.47 <sup>abc</sup> ± 2.79	3.43 <sup>ab</sup> ± .285	7.90 <sup>bc</sup> ± .100	2.23 <sup>c</sup> ± .120	4.33 <sup>c</sup> ± 1.85
TSs-65	120.67 <sup>ab</sup> ± 12.33	51.00 <sup>c</sup> ± 2.08	6.90 <sup>c</sup> ± .808	3.63 <sup>ab</sup> ± .633	8.13 <sup>ab</sup> ± .977	2.87 <sup>b</sup> ± .367	2.00 <sup>de</sup> ± 1.00
TSs-441	102.67 <sup>ab</sup> ± 4.97	67.67 <sup>bc</sup> ± 2.67	9.00 <sup>abc</sup> ± 1.53	4.00 <sup>ab</sup> ± 0E-7	9.00 <sup>a</sup> ± .577	3.40 <sup>a</sup> ± .351	5.00 <sup>c</sup> ± 1.52
TSs-152	92.67 <sup>b</sup> ± 1.20	65.67 <sup>bc</sup> ± 10.3	9.60 <sup>abc</sup> ± 1.92	3.77 <sup>ab</sup> ± .384	7.00 <sup>bc</sup> ± .577	3.40 <sup>a</sup> ± .577	7.00 <sup>b</sup> ± 3.05
TSs-96	104.33 <sup>ab</sup> ± 3.38	82.00 <sup>ab</sup> ± 8.51	10.27 <sup>ab</sup> ± 1.37	3.23 <sup>ab</sup> ± .233	6.93 <sup>c</sup> ± .561	2.80 <sup>b</sup> ± .208	2.33 <sup>d</sup> ± .667
TSs-186	111.67 <sup>ab</sup> ± 8.21	65.67 <sup>bc</sup> ± 15.0	8.63 <sup>abc</sup> ± .348	2.77 <sup>bc</sup> ± .088	9.07 <sup>a</sup> ± .521	2.77 <sup>b</sup> ± .088	1.33 <sup>e</sup> ± .333
TSs-231	101.33 <sup>ab</sup> ± 3.38	59.33 <sup>bc</sup> ± 15.3	10.63 <sup>ab</sup> ± 2.62	2.17 <sup>c</sup> ± .167	7.10 <sup>bc</sup> ± .666	2.17 <sup>c</sup> ± .167	2.33 <sup>d</sup> ± .882

Mean value with different superscripts along the same vertical axis are significantly different (P < 0.05)

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.

## **DISCUSSION**

This research showed high variability across the studied germplasm, as significant differences were found for several phenotypic characters. Analysis of variance (ANOVA) results of quantitative morphological traits studied in 18 *S. stenocapa* showed significant morphological variation in all parameters evaluated. The variation in morphological traits among accessions may be attributed to the fact that the crop is mainly vegetatively propagated in nature and perhaps genotype-environment interactions. The result indicated a low level of morphological variation among the accessions, pointing to difficult possibilities of obtaining desirable trait combinations of specific accessions. The accessions with higher values for the number of leaves per plant, vine per plant, vine length, and leaf length and width per plant were observed to produce a greater number of pods per plant. The high pod yield observed for some of the accessions can be attributed to the long vine length and luxuriant growth habit of the accessions, which encourage the production of large number of flowers that mature into pods and seeds. This result is consistent with the findings of [17] who reported accession of AYB with higher values for the number of leaves and leaf length was observed to produce a greater number of pods per plant. In this study, we took into consideration several pods as morphological characters to distinguish AYB. The result revealed that accessions TSs 266 had the greatest number of pods. The differences in pod traits among accessions may be attributed to variations in the genetic architecture of different accessions and prevailing environmental conditions. [12] revealed that accessions with desirable agronomic traits such as pod length, high number of seeds/pods, lower days to flowering, and a higher seed set percentage were distinguishing characters in AYB accession.

Generally, TSs 266 and TSs 38 accessions performed better in all parameters studied except for days to 50% to flowering and number of leaves. Accessions from TSs 266 had better performances in vine length, terminal leaf width, peduncle length, and number of pods per plant. TSs 266 accession had adequately adapted to the climatic and agro-geological conditions of Cross River State.

## CONCLUSION

Among the qualitative and quantitative traits assessed, leaf color, seed shape, and testa texture were pivotal in characterizing African yam bean. The differential performance noted among the *S. stenocarpa* accessions based on these attributes positions them as valuable resources for breeding programs focused on crop improvement.

## RECOMMENDATIONS

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 bean.

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UNDER PEER REVIEW

**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	to	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	to	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			

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Testa texture	Between Groups	37.037	17	2.179	4.202	0.00
	Within Group	18.667	36	0.519		
	Total	53.704	53			

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UNDER PEER REVIEW

**TABLE 5: Analysis of variance of nine quantitative traits of 18 accessions of AYB obtained from IITA germplasm**

		<b>Sum of square</b>	<b>d.f</b>	<b>Mean square</b>	<b>F</b>	<b>S.g</b>
NL	Between Groups	3883.259	17	228.427	.612	.860
	Within Groups	13446.667	36	373.519		
	Total	17329.926	53			
PH	Between Groups	5985.500	17	352.088	1.822	.064
	Within Groups	6955.333	36	193.204		
	Total	12940.833	53			
PEDUNCLE	Between Groups	178.421	17	10.495	1.853	.059
	Within Groups	203.860	36	5.663		
	Total	382.281	53			
PETIOLE	Between Groups	7.974	17	.469	1.525	.141
	Within Groups	11.073	36	.308		
	Total	19.048	53			
TLL	Between Groups	54.988	17	3.235	3.290	.001
	Within Groups	35.393	36	.983		
	Total	90.381	53			
TLW	Between Groups	11.848	17	.697	5.018	.000
	Within Groups	5.000	36	.139		

	Total	16.848	53			
NPPP	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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