Catalogue Of Yam bean (*Pachyrhizus erosus* L.) Genetic Resources

भाकृअनुप
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FOREWARD

Dr. G. Byju
Director

From the Director

Yam bean (*Pachyrhizus erosus* L.) is an underutilized tropical legume valued for its edible tuberous roots, rich in carbohydrates and dietary fibre, and its potential role in sustainable agriculture due to its nitrogen-fixing ability is gaining prominence. Despite its nutritional and agronomic benefits, the crop remains largely underexploited in India and globally. Recognizing the need for systematic characterization and promotion of this crop, the present catalogue has been developed to document the phenotypic diversity of 146 yam bean genotypes conserved and evaluated at the ICAR-Central Tuber Crops Research Institute (ICAR-CTCRI). This characterization has been carried out in accordance with the Distinctness, Uniformity, and Stability (DUS) guidelines prescribed by the Protection of Plant Varieties and Farmers' Rights Authority (PPVFRA), Government of India. The catalogue includes detailed morphological descriptions, supported by photographic evidence, of key diagnostic traits such as leaf shape, flower and pod characteristics, and tuber morphology, among others. It aims to serve as a comprehensive reference for plant breeders, researchers, genetic resource managers, and policy makers involved in variety development, registration, and protection. Moreover, it is expected to facilitate the identification of promising genotypes for crop improvement programmes, encourage the conservation of genetic resources, and support the registration of novel and traditional varieties. By providing a standardized framework for evaluating and distinguishing yam bean genotypes, this catalogue contributes to bridging the gap between underutilized crops and mainstream agricultural development. The sincere efforts of Dr. Kalidas Pati, Senior Scientist, & other scientists, technical staff, and skilled support personnel involved in this work are deeply acknowledged, and I hope that this publication will stimulate greater interest and investment in the research and development of yam bean in India and abroad.

G. Byju
Director

ACKNOWLEDGEMENT

The authors gratefully acknowledge the constant support and guidance of Dr. G. Byju, Director, ICAR–Central Tuber Crops Research Institute (ICAR-CTCRI), for providing the necessary facilities and encouragement throughout the course of this work. We extend our sincere thanks to former Heads, Regional Centre, ICAR-CTCRI, Bhubaneswar and former Directors of ICAR-CTCRI Dr. S. K. Naskar and Dr. Archana Mukherjee, for their foundational efforts that have paved the way for this initiative. We also thank former Head, Regional Centre, ICAR-CTCRI, Bhubaneswar Dr. R.S. Misra for his support. We extend our thanks to Mr. B. K. Sahoo, retired Senior Technical Assistant, Mr. B. B. Das, Technical Officer, Dr. S.K. Jata, Technical Officer, and Mr. Keshav Paikaray, Senior Technical Assistant for their help and support. This work stands as a result of collaborative efforts and institutional support, and we express our heartfelt gratitude to all who have contributed directly or indirectly to its successful completion.

Authors

CONTENTS

ABSTRACT

This catalogue presents the comprehensive characterization of 146 genotypes of yam bean (*Pachyrhizus erosus* L.) based on the Distinctness, Uniformity, and Stability (DUS) guidelines prescribed by the Protection of Plant Varieties and Farmers' Rights Authority (PPVFRA), Government of India. The study was undertaken at Regional Centre, ICAR–Central Tuber Crops Research Institute (ICAR-CTCRI) with the objective of documenting the phenotypic variability among genotypes and identifying unique and stable traits for use in crop improvement and variety registration. Detailed morphological descriptors, supported by photographic documentation, are provided for each genotype, covering key traits such as leaf morphology, flower and pod characteristics, and tuber attributes. This catalogue serves as a valuable reference for breeders, researchers, and stakeholders involved in the conservation, utilization, and protection of yam bean genetic resources.

INTRODUCTION

Yam bean, scientifically known as (*Pachyrhizus erosus* L. Urban), is an underutilized leguminous tuberous roots vegetable crop. It has gained recent popularity due to its excellent nutritional value. In India, it goes by various names, such as Shankalu in Bengali, Kasaur, Sankalu and Misrikand in Hindi, Tani Uttan Kai in Tamil and Kandha in Telugu language. It is also known as potato bean and jicama. The word "*Pachyrhizus*" has originated from the two Greek words "*Pachys*" which means thick and "*rhiza*" meaning root. Yam bean is a starchy root crop with comparatively high sugar content and a good source of ascorbic acid. Tubers contain more than 82% water, 1.5% protein, 10% starch and 5-6% sugar.

Origin & Distribution

Yam bean is a hairy, twining herb native to Mexico and Central America and is cultivated in Mexico, Guatemala, El Salvador and to a limited extent in Honduras. It has been introduced to different tropical regions, with notable success in Southeast Asia, China, India, and Hawaii. Today the yam bean is known to be cultivated in large regions outside its original distribution area, e.g., in Southeast Asia, India and the Pacific. The tubers are found on sale in vegetable markets in the Philippines, Indonesia, Malaysia, Vietnam, Laos, Thailand, Cambodia, Burma and in Taiwan and China. . In India, yam bean is cultivated in Bihar, Jharkhand, Chhattisgarh, Uttar Pradesh and West Bengal. Cultivation of yam bean is expected to lead to sustainable agriculture because its tuber is nutritious and a highly productive.

Taxonomy & Classification

Yam bean belongs to the plant family *Fabaceae* (legume family), which includes numerous species of crops such as beans, peas, and lentils. The genus *Pachyrhizus* is placed within the subfamily *Faboideae* and tribe *Phaseoleae*, which are part of a larger family of leguminous plants. The taxonomic classification of yam bean is as follows:

- **Kingdom**: Plantae
- **Clade**: Angiosperms
- **Clade**: Eudicots
- **Order**: Fabales
- **Family**: *Fabaceae*
- **Subfamily**: *Faboideae*
- **Tribe**: *Phaseoleae*
- **Genus**: *Pachyrhizus*
- **Species:** *erosus*

Within this genus, the most widely cultivated species is *Pachyrhizus erosus*. The genus *Pachyrhizus* is often confused with other related leguminous species, such as *Phaseolus*, due to the similarities in their root structure and growth patterns. However, *Pachyrhizus* is distinct in its tuberous root system and specific growth habits.

Botany

Yam bean is a perennial herbaceous plant that exhibits a climbing or trailing growth habit. It belongs to the legume family, which is characterized by a podded fruit. The plant is known for its large, edible tuberous roots, which are the most economically valuable part of the plant. Flowers, either blue or white, and pods similar to peas, are produced on fully developed plants. The vine can reach a height of 4–5 metres (13–16 feet) given suitable support. The tubers weight vary from 100 to 1500 g.

Morphological Characteristics

1. **Root System**: The root system of *Pachyrhizus* consists of a large, tuberous root that grows underground. The roots are typically white or pale-colored, firm, and crisp in texture. These tubers can grow up to several kilograms in weight, depending on the species and growing conditions.
2. **Stem**: The plant has a slender, climbing, and sometimes trailing stem that can grow up to 5 meters in length. The stems are green and possess tendrils that allow the plant to climb or spread over surrounding vegetation.
3. **Leaves**: The leaves of yam bean are alternate and trifoliate (composed of three leaflets). The leaflets are typically heart-shaped, large, and may have a smooth to slightly hairy surface. They are often 10-20 cm long, with a deep green color.
4. **Flowers**: The plant produces flowers that are arranged in racemose inflorescences. These flowers are often white to pale purple in color, and they attract pollinators such as bees. The flowers are typically self-pollinating, although some cross-pollination may occur.
5. **Fruit**: The fruit of the yam bean is a leguminous pod, usually containing 2-8 seeds. The pods are smooth and cylindrical, measuring up to 15 cm in length. Upon maturity, the pods dehisce (split open), releasing the seed.

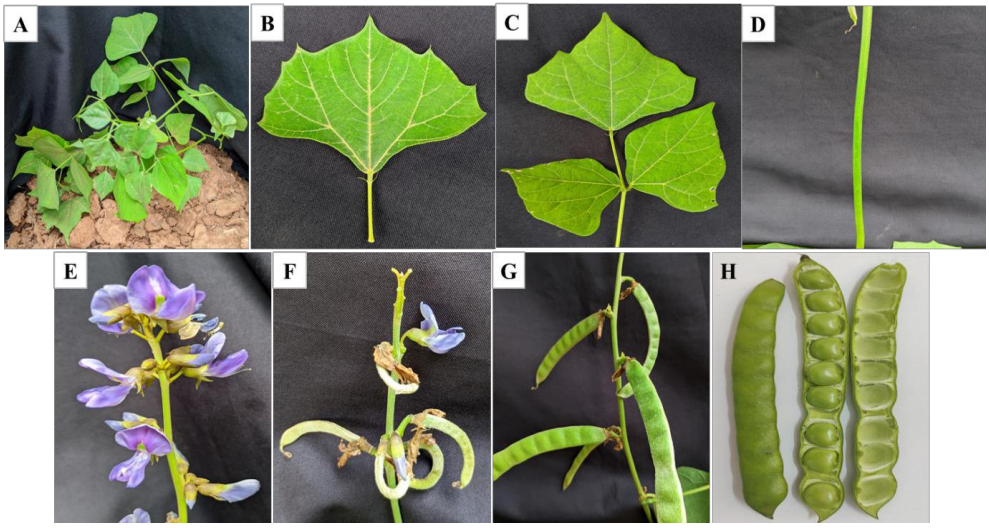


Fig.1. Morphology of Yam bean: A. Yam bean plant B. Adaxial surface C. Trifoliate leaf D. Stem E. Flowers F. Inflorescence G. Fruits H. Pod

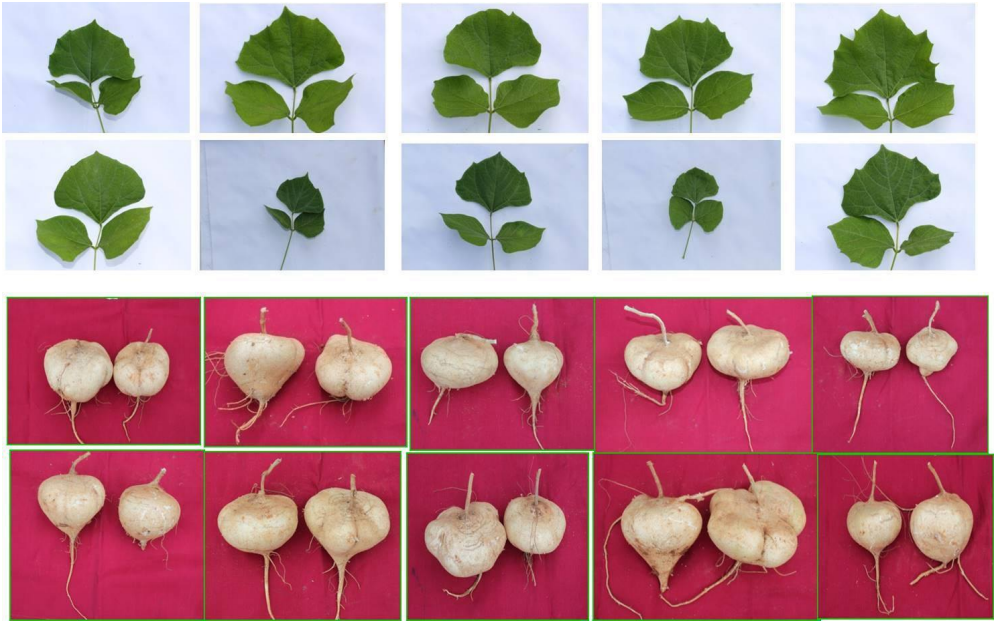


Fig.2. Leaf and Tuber diversity of yam bean

Growth Conditions

Yam bean requires a tropical or subtropical climate to thrive. It grows best in regions with average temperatures between 25-30°C and well-distributed rainfall. While it is adaptable to various soil types, it performs optimally in well-drained loamy soils with a pH range of 6.0-7.0.

Systematics and Cytogenetics

Systematics

The genus *Pachyrhizus* is part of the larger legume family, *Fabaceae*, and is closely related to other genera of legumes that produce tuberous roots, such as *Phaseolus* and *Vigna*. However, it differs from these genera by its distinct growth form (climbing or trailing), large tuberous roots, and morphological characteristics. Phylogenetic studies using molecular markers such as DNA sequencing have provided insights into the evolutionary relationships within the genus. It has been determined that *Pachyrhizus* shares a common ancestor with other leguminous plants in the tribe *Phaseoleae*, but its unique tuberous root system places it in a separate lineage.

Cytogenetics

The cytogenetics of *Pachyrhizus* species reveals significant variation in chromosome numbers across different species. The most common diploid species, *Pachyrhizus erosus*, has a chromosome number of 2n = 22, which is consistent across most populations. The genetic diversity of yam bean had been studied through Draft Genome Assembly. Cytogenetic studies on *Pachyrhizus* are still limited but essential for understanding its genetic diversity, potential for hybridization, and breeding for improved traits such as disease resistance, drought tolerance, and tuber yield.

Domestic, Industrial and Environmental Uses

The tubers are used in a number of different ways: (i) Fresh tubers (ii) as a vegetable - fresh tuber slices are used in various salad dishes; (iii) cooked tubers are used to prepare a soup, on their own or with other vegetables; (iv) tuber slices may be stir-fried, or (v) sliced or diced tubers may be preserved in vinegar with onion and chilly and used as a snack. Dried hay are used as animal feed. It should be noted that as the cultivated yam bean is reproductively pruned, the rotenone content of the hay does not reach anti-nutritional levels. The highly

efficient natural way in which the plant absorbs nitrogen makes it an attractive alternative for cultivation on poorer soil. The rotenone can be extracted in economic quantities from the mature seeds, the remaining seed oil is fit for consumption and can be marketed as an alternative to groundnut or cotton seed oil. The rotenone can be sold as a high-value naturally derived chemical or, using simpler extraction methods, be employed locally as a plant protective agent. Once both rotenone and oil have been removed, the remaining seed cake has protein content comparable to that of soybean cakes. In spite of the numerous reports on the insecticidal and piscicidal (fish killing) effect of the rotenone and rotenoids isolated from the seeds, yam bean has yet to be grown on a commercial scale for the production of rotenone.

Cultivation

The yam bean is grown principally from seed. It can be also grown from sprouted roots saved from the previous crop. Traditionally yam bean is sown June-July with the onset of rain in North-Eastern India and is usually harvested in December-January. The time of sowing of seed varies from June to September accordingly to the purpose of the crop. If it is for seed purpose, sowing of seeds can be done in June-July. Late sowing discouraged the vegetative growth of the crop with less branching and flowering. Yam bean normally, flowers at 75 days after sowing. Removal of flowers results in better tuber yield and better quality. In case there is scarcity of rains, irrigation is required. For September sown crop, it is advisable to give supplementary irrigation so that the crop will not face moisture stress during tuberization.

Yam bean is harvested after 130-140 days of sowing. The tubers are usually dug manually. If harvesting is delayed, chances of cracking of tubers are more. Harvested tubers can be stored for 2-3 days without any deterioration. They can be stored successfully for at least 2 months at appropriate temperatures and can also be ‘field stored’, i.e., having the crop in the soil without removing top portion.

DESCRIPTORS

Characterization is known as description of qualities or peculiarities. It helps in identification of desirable traits present in various accessions. The following descriptors were used for the characterization of 146 germplasm genotypes of yam bean maintained at Regional Centre, ICAR--Central Tuber Crops Research Institute, Bhubaneswar, Odisha based on various qualitative and quantitative traits. Qualitative traits are most important in the classification of accessions as they are, generally, not influenced by the environment. A total of 17 characters has been used based on DUS guidelines for characterizing the 146 genotypes.

Type of assessment of characteristics indicated in Table of characteristics is as follows:

MG: Measurement by a single observation of a group of plants or parts of plants

MS: Measurement of a number of individual plants or parts of plants

VG: Visual assessment by a single observation of a group of plants or parts of plants

VS: Visual assessment by observations of individual plants or parts of plants

Sl. No.	Descriptors	States	Notes	Stages of observation	Type of assessment
1	Stem colour	Yellowish Green Light green Dark Green	1 3 5	A	VS
2	Stem pubescence	Sparse (<10/cm^2) Dense (>10/cm^2)	1 3	A	VS
3	Leaflet shape (No. of teeth of terminal leaf)	Less (<5) Medium (5- 7) More (>7)	1 3 5	A	MS
4	Leaf surface (Adaxial)	Smooth Rough	1 3	A	VG
5	Flower density	Low (≤15) High (>15)	1 3	B	VG

6	Colour of standard and wing petal	Light blue Violet blue White	1 3 5	B	VG
7	Sepal colour	Light brown Brown	1 3	B	VG
8	No. of Pods per 1-5 inflorescences/ primary branches	Low (≤10) High (>10)	1 3	B	VS
9	No. of Pods per Primary inflorescence	Low (≤6) High (>6)	1 3	B	MS
10	Mature: Pod length (cm)	Short (≤6) Long (>6)	1 3	C	MS
11	No. of seeds per pod	Low (≤6) High (>6)	1 3	B	MS
12	Tuber shape	Fusiform Round Irregular	1 3 5	B	VG
13	Neck length (cm)	Short (≤5) Long (>5)	1 3	B	MS
14	Tuber rings (Nos)	Few (≤1) Many (>1)	1 3	B	MS
15	Tuber surface	Smooth Rough	1 3	B	VS
16	Seed colour	Light brown Brown	1 3	D	VS
17	Seed shape	Square Circular	1 3	D	VG

1. **Stem colour**: The predominant colour of the stem of the primary branch is generally recorded during active vegetative growth at 50 days after planting. Among the 146 genotypes, 17 lines have yellowish green stem, 28 have light green and 101 have dark green stems.

Fig.3. Stem colour morphology

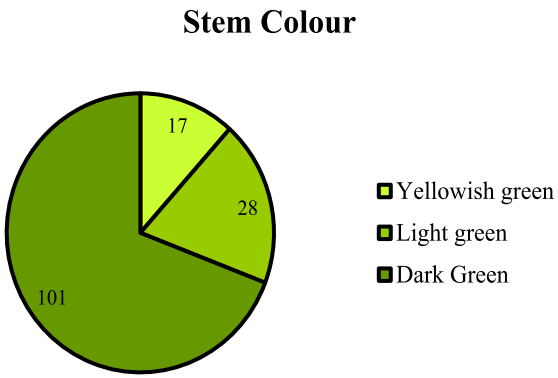


Fig.4. Genotype frequencies for stem colour

2. **Stem pubescence:** The pubescence of the stem of the primary branch is recorded during active vegetative growth at 50 days after planting. From the 146 genotypes, 135 genotypes have sparse pubescence while 11 have dense pubescence.

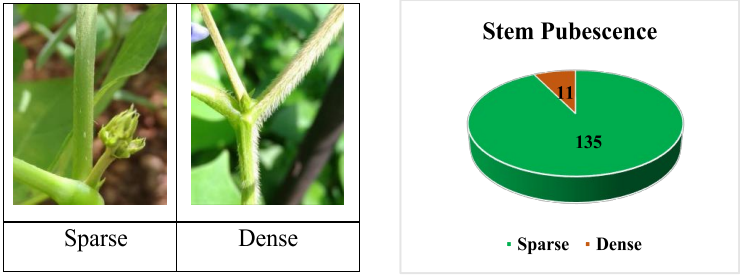


Fig.5. Morphology & genotype frequencies for stem colour

3. **Leaflet shape (No. of teeth)**: The number of teeth of the terminal leaflet of the compound leaf shall is recorded. The no. of teeth ranged from 3 to 10. Thirty nine genotypes have less than 5 teeth, 90 genotypes have 5 to 7 teeth and 17 genotypes have more than 7 teeth. DPH-5 and DL-33 have 10 teeth making the highest no. of teeth followed by YBBL-16, YBBL-11, YB-14-56, and three more with 9 teeth.

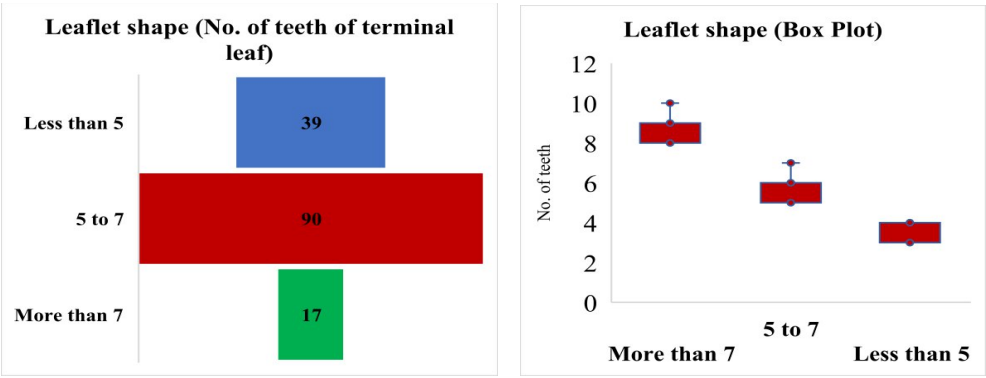


Fig.6. Genotype frequency and box plot for leaflet shape

4. **Leaf surface:** The texture of the leaf surface is recorded on adaxial surface of the fifth fully opened leaf of the primary branch. 39 yam bean genotypes have smooth surface and 107 genotypes have rough surface.

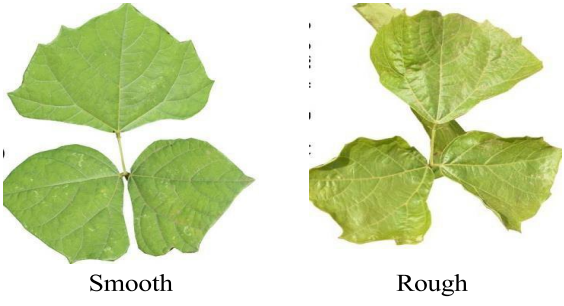
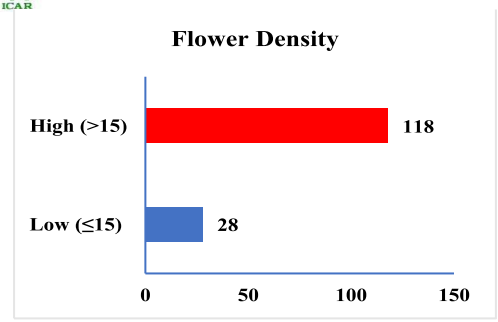


Fig.7. Leaf surface morphology

5. **Flower density** of the inflorescence is recorded as Low (≤15) and High (>15). Twenty eight genotypes of yam bean have low flower density whereas rest 118 have high flower density. EC100566, L No 3 and YB-13-87 have the highest number of flowers (26).



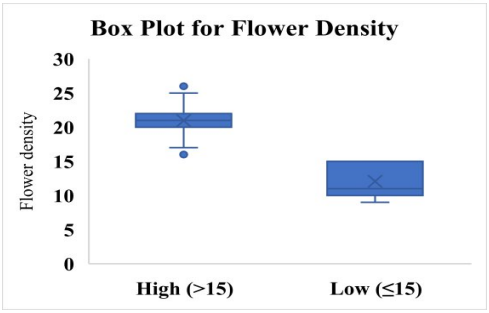
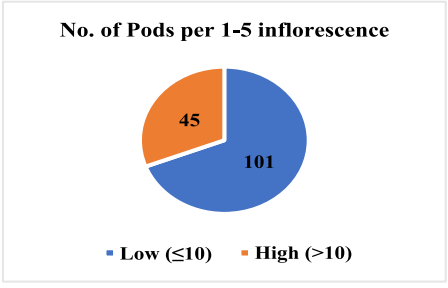


Fig.8. Genotype frequency and box plot for flower density.

6. **Colour of standard and wing petal (Flower colour):** Out of the 146 genotypes, 22 genotypes have light blue colour flower and 122 have violet blue colour flower. Only two genotypes WF-24 and YBWF-1 bear white flower.

Fig.9. Flower colour and wing petal morphology

7. **Sepal colour:** Among the 146 genotypes accessed, 118 genotypes have light brown colour sepal and rest 28 have brown colour sepal.
8. **No. of Pods per 1-5 inflorescences/ primary branches:** The pod number is recored as high for more than 10 pods and low for less than or equal to 10 pods. The no. of pods ranged from 4 to 18. 101 genotypes have less number or equal to 10 pods while, 45 genotypes have more than 10 pods. L-19 and L-3 have recorded the highest number of pods followed by EC100548 and YB-4-86 (16 pods). EC100546 has the lowest no. of pods (4 pods).



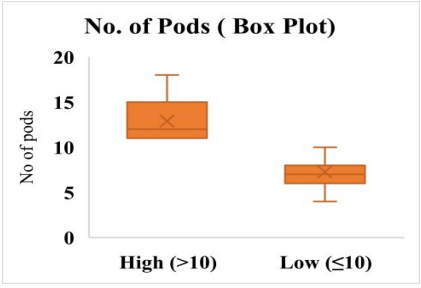


Fig.10. Genotype frequency and box plot for no. of pods per 1-5 inflorescence

9. **Pods per primary inflorescence:** The pod numbers per primary inflorescence is recored as high for more than 6 pods and low for less than or equal to 6 pods. The no. of pods ranged from 4 to 18. 101 genotypes have less number or equal to 10 pods while, 45 genotypes have more than 10 pods. L-19 and L-3 have recorded the highest number of pods followed by EC100548 and YB-4-86 (16 pods). EC100546 has the lowest no. of pods (4 pods).

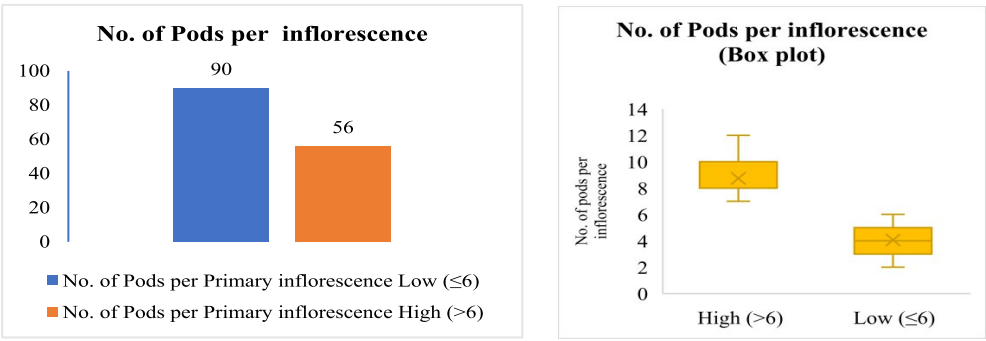


Fig.11. Genotype frequency and box plot for no. of pods per primary inflorescence

10. **Mature Pod length (cm):** The mature pod length is characterised as short for length less than or equal to 6 cm and long for length more than 6 cm. A total of 79 genotypes have short length of mature pods and 67 genotypes have pod length more than 6. The pod length of 146 genotype ranged from 4 cm to 15.5 cm. DL-7 has the logest pod of 15.5 cm followed by DL-25 (15.1 cm) and YB-5-43, YB-552 and DL-10 (15 cm). YB566 and DL-3 have shortest pod length (4 cm).

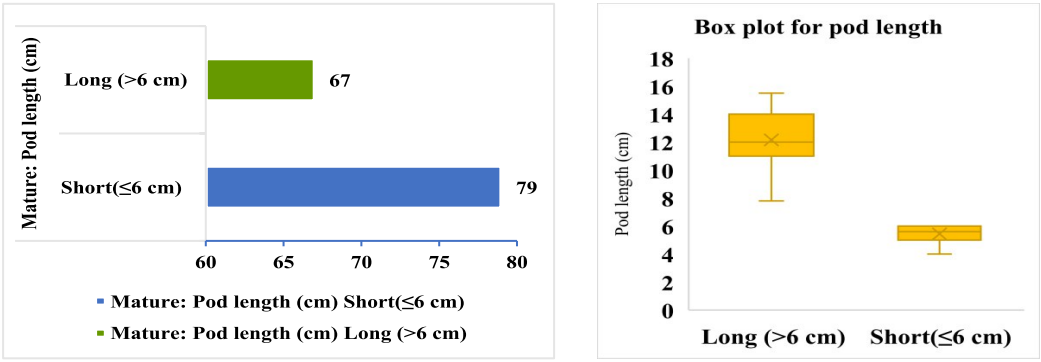


Fig.12. Genotype frequency and box plot for mature pod length

11. **Number of seeds per pod:** Pods with seeds less than or equal to 6 seeds is characterised as low and pods with more than 6 seeds as high. A total of 79 genotypes have short length of mature pods hence with less than 6 seeds and 67 genotypes have pod length more than 6 with more than 6 seeds. Number of seeds ranged from 4 to 9 seeds per pod. 19 genotypes have pods with 9 seeds and 16 genotypes have only 4 seeds per pod.

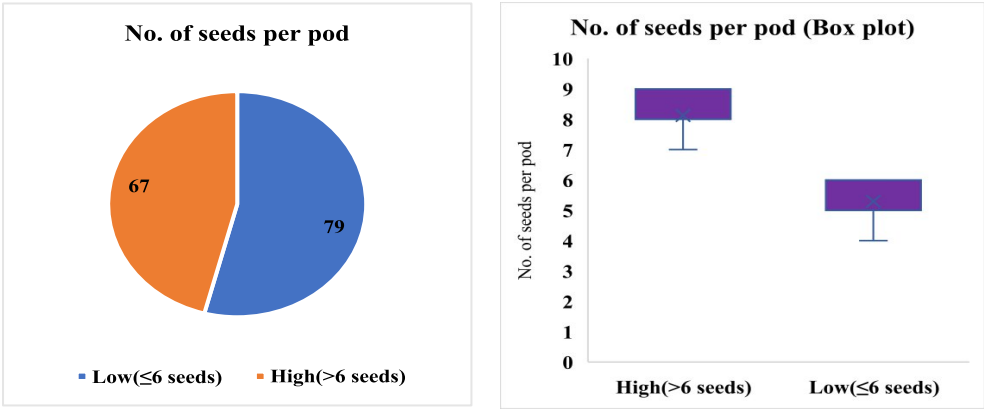


Fig.13. Genotype frequency and box plot for no. of seeds per pod

12. **Tuber shape:** All the 146 genotypes have been categorized under 3 tuber shapes as given in Figure. A total of 28 genotypes produces fusiform shaped tubers, 39 genotypes bear round shaped tubers and 79 genotypes have irregular shape tubers.

Fusiform **Round** **Irregular**

Fig.14. Tuber shape morphology

13. Neck length (cm): The neck length of the mature tuber (tuber stalk) is recorded in cm and classified as short (≤5 cm) and long (>5 cm). among the 146 genotypes of yam bean, 67 have neck length ranging from 1.3 cm to 3.5 cm and rest 79 genotypes have neck length ranging from 5.2 cm to 7.2 cm. YBBL-18 has the longest neck length (7.2 cm) followed by YB-562 and DPH-9 (7 cm). Shortest neck length of 1.3 cm was recorded for 4mB3-65, YB-561 and DL-33.

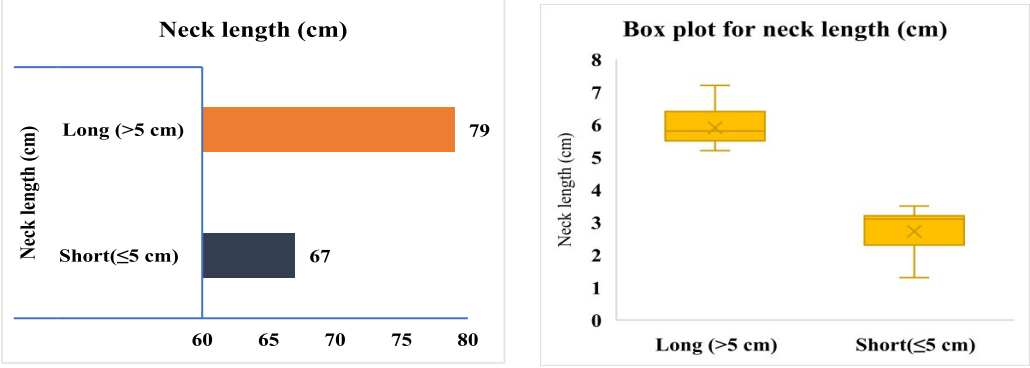


Fig.15. Genotype frequency and box plot for neck length

14. Tuber rings (Nos): Less than or equal to one ring on the tuber is marked as few and more than rings is marked as many. Out of 146 genotypes, 56 genotypes have only 1 or no rings on tubers and rest 90 have more than 1 ring with as many as 6 rings. 14 genotypes have 6 rings followed by 19 genotypes with 5 rings on tuber.

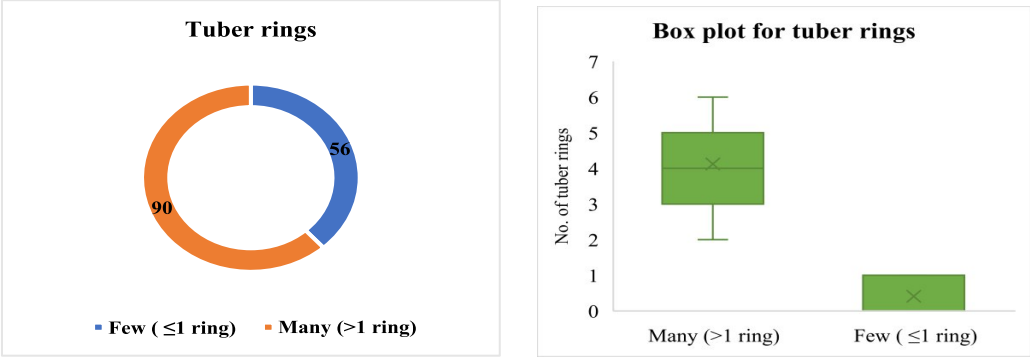


Fig.16. Genotype frequency and box plot for no. of tuber rings

15. **Tuber surface:** The tuber shape is characterised as smooth and rough. Among the 146 accessed yam bean genotypes, 50 genotypes have smooth surface whereas 96 genotypes have rough surface.

Smooth Rough

Fig.17. Tuber surface morphology

16. **Seed colour:** Yam bean generally produces seeds of two colours i.e., light brown and brown. Here 124 genotypes produce light brown colour seeds and 22 genotypes bear brown colour seeds.

17. **Seed shape:** Similar to that of seed colour, yam bean also produce two shapes of seed. Seventeen genotypes produce square seeds and rest 129 genotypes produce circular seeds.

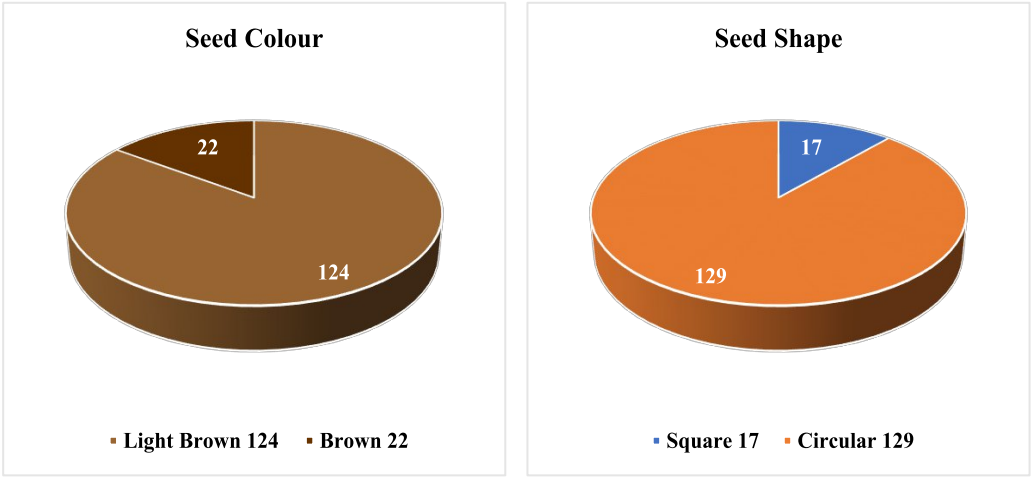


Fig.18. Genotype frequency for seed colour and seed shape

Tabulation of characters for 146 yam bean genotypes

Yam bean Genotypes	Stem colour	Stem pubescence	Leaflet shape (No. of teeth of terminal leaf)	Leaf surface (Adaxial)	Flower density
YBBL-6	1	1	5	3	21
EC100547	5	1	4	1	23
YBBL-19	5	1	8	3	15
YBBL-4	5	1	5	3	24
ECIW562	5	1	6	3	23
YBBL-17	3	1	5	3	18
L-19	5	1	5	3	20
IC 2514	5	1	4	1	11
YBBL-8	3	1	5	1	22
EC100566	5	3	3	3	26
EC100563	1	1	7	3	24
YBBL-3	5	1	4	1	17
YBBL-16	5	1	9	3	15
YBBL-18	5	1	6	3	22
YBBL-20	5	1	5	3	21
YBBL-15	3	1	5	3	25
YBBL-12	1	1	5	3	16
EC100549	5	1	4	1	19
EC100541	5	1	8	3	12
YBBL-7	5	1	6	3	21
EC100565	5	1	5	3	23
Rajendra Local	3	1	5	3	25
EC100548	5	1	5	3	17
EC100551	5	1	3	1	11
EC100567	3	1	6	1	22
EC100550	5	3	4	3	23
EC100543	1	1	5	3	21
EC100542	5	1	4	1	24
YBBL-11	5	1	9	3	15
EC100544	5	1	7	3	20
EC100568	5	1	6	3	22
YBBL-5	3	1	5	3	24
YBBL-1	1	1	7	3	21
EC100560	5	1	3	1	23
IC25112	5	1	8	3	10
EC100562	5	1	5	3	17
YBBL-2	5	1	5	3	21

YBBL-13	3	1	6	3	24
EC100554	5	1	7	3	21
YBBL-14	5	1	4	1	9
EC100546	3	1	5	1	23
YBBL-9	5	3	4	3	22
YBBL21	1	1	6	3	22
L No 3	5	1	3	1	26
YBBL-10	5	1	8	3	10
YB-22-52	5	1	5	3	21
YB-12-88	5	1	7	3	25
WF-24	3	1	6	3	21
YB-25-1	5	1	6	3	24
4mB2-82	5	1	4	1	10
YB-21-91	3	1	6	1	23
4mB3-65	5	3	4	3	21
YB-4-86	1	1	5	3	25
YB-5-43	5	1	3	1	20
YB-19-55	5	1	8	3	15
YB-17-10	5	1	5	3	22
YB-23-28	5	1	5	3	24
4m-19	3	1	6	3	20
YB-16-2	5	1	5	3	23
YB-18-21	5	1	4	1	11
YB-20-69	3	1	6	1	17
YB-6-78	5	3	4	3	21
YB-15-5	1	1	5	3	24
YB-7-67	5	1	3	1	24
YB-14-56	5	1	9	3	10
YB-8-70	5	1	5	3	23
WD-9	5	1	6	3	22
YB-11-63	3	1	6	3	21
YB-13-87	1	1	5	3	26
YB-10-1	5	1	5	1	21
DPH-5	5	1	10	3	10
DPH-7	5	1	5	3	20
DPH-21	5	1	5	3	21
DPH-22	3	1	5	3	23
PH-6	5	1	5	3	21
PH-7	5	1	5	1	15
PH-9	3	1	6	1	19
PH-10	5	3	4	3	20
PH-11	1	1	5	3	17
PH-14	5	1	3	1	20

PH-21	5	1	8	3	12
PH-22	5	1	5	3	18
YBWF-1	5	1	5	3	20
NEPALI	3	1	5	3	22
DW-1	1	1	6	3	22
RM-1	5	1	4	1	21
IC25113	5	1	8	3	10
L-1	5	1	6	3	21
IC2517	5	1	5	3	19
L-19	3	1	5	3	22
L-3	5	1	5	3	17
R-LOCAL	5	1	4	1	9
YB-540	3	1	5	1	20
YB-541	5	3	3	3	18
YB-543	1	1	5	3	20
YB-544	5	1	3	1	22
YB-545	5	1	8	3	10
YB-546	5	1	5	3	24
YB-547	5	1	5	3	21
YB-548	3	1	6	3	19
YB-550	5	1	5	3	20
YB-551	5	1	3	1	15
YB-552	3	1	7	1	17
YB-554	5	3	4	3	20
YB-558	1	1	5	3	22
YB-560	5	1	4	1	21
YB-561	5	1	8	3	11
YB-562	5	1	6	3	17
YB-563	5	1	6	3	20
YB-564	3	1	6	3	24
YB-565	5	1	7	3	21
YB-566	5	1	4	1	10
YB-567	3	1	5	1	21
YB-568	5	3	4	3	19
YB-569	1	1	6	3	20
DL-1	5	1	4	1	17
DL-2	5	1	9	3	15
DL-3	5	1	5	3	20
DL-4	5	1	7	3	18
DL-5	3	1	6	3	20
DL-6	1	1	5	3	22
DL-7	5	1	3	1	22
DL-10	5	1	9	3	10

DL-13	5	1	5	3	21
DL-14	5	1	5	3	18
DL-16	3	1	7	3	20
DL-17	5	1	5	3	20
DL-18	5	1	4	1	10
DL-19	3	1	5	1	22
DL-20	5	3	4	3	22
DL-21	1	1	5	3	17
DL-22	5	1	4	1	20
DL-25	5	1	9	3	15
DL-26	5	1	5	3	22
DL-27	5	1	6	3	22
DL-28	3	1	6	3	21
DL-29	1	1	5	3	16
DL-30	5	1	4	1	16
DL-33	5	1	10	3	15
BC4B-1	5	1	5	3	18
BC4B-2	5	1	6	3	18
DPH-9	3	1	5	3	15
DPH-58	5	1	7	3	18
DPH-70	5	1	4	1	14
DPH-88	3	1	6	1	20
RM-2	5	3	4	3	22

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Yam bean Genotypes	Colour of standard and wing petal	Sepal colour	No. of Pods per 1-5 inflorescences/ primary branches	No. of Pods per Primary inflorescence	Mature: Pod length (cm)
YBBL-6	3	3	11	7	6
EC100547	3	1	15	8	11
YBBL-19	3	1	6	3	11
YBBL-4	3	1	5	4	6
ECIW562	3	1	5	4	5.8
YBBL-17	3	1	8	3	6
L-19	3	1	18	9	13.5
IC 2514	1	1	8	2	5.5
YBBL-8	1	1	9	11	11
EC100566	3	3	7	5	14
EC100563	3	3	13	9	4.5
YBBL-3	3	1	12	11	11
YBBL-16	3	1	6	2	12.5
YBBL-18	3	1	8	3	4.5
YBBL-20	3	1	6	4	5
YBBL-15	3	1	8	2	5
YBBL-12	3	3	11	10	6
EC100549	3	1	11	11	13
EC100541	3	1	7	3	14.5
YBBL-7	3	1	6	4	6
EC100565	3	1	6	4	6
Rajendra Local	3	1	7	5	6
EC100548	3	1	16	8	11
EC100551	1	1	9	5	6
EC100567	1	1	8	8	12
EC100550	3	3	8	3	11
EC100543	3	3	15	10	6
EC100542	3	1	11	9	10.5
YBBL-11	3	1	8	5	11
EC100544	3	1	7	5	6
EC100568	3	1	5	3	5.5
YBBL-5	3	1	6	6	5.8
YBBL-1	3	3	11	8	5
EC100560	3	1	11	9	14
IC25112	3	1	6	3	11
EC100562	3	1	5	4	5.5
YBBL-2	3	1	7	6	5
YBBL-13	3	1	6	2	6
EC100554	3	1	13	8	12.5

YBBL-14	1	1	8	2	6
EC100546	1	1	4	8	13
YBBL-9	3	3	7	3	14.5
YBBL21	3	3	11	10	6
L No 3	3	1	11	12	14
YBBL-10	3	1	5	3	11
YB-22-52	3	1	8	6	5
YB-12-88	3	1	6	5	6
WF-24	5	1	8	2	5.7
YB-25-1	3	1	12	9	12.5
4mB2-82	1	1	7	3	6
YB-21-91	1	1	6	9	11
4mB3-65	3	3	8	2	14
YB-4-86	3	3	16	10	6
YB-5-43	3	1	12	9	15
YB-19-55	3	1	10	3	11
YB-17-10	3	1	6	4	5
YB-23-28	3	1	10	4	6
4m-19	3	1	8	5	6
YB-16-2	3	1	12	8	12.5
YB-18-21	1	1	8	6	5.8
YB-20-69	1	1	10	7	11
YB-6-78	3	3	8	6	10.8
YB-15-5	3	3	15	8	6
YB-7-67	3	1	13	12	11.5
YB-14-56	3	1	7	5	11
YB-8-70	3	1	6	6	5.5
WD-9	3	1	8	6	4.5
YB-11-63	3	1	5	2	4.5
YB-13-87	3	3	11	10	5
YB-10-1	3	1	12	11	10.5
DPH-5	3	1	6	3	13.5
DPH-7	3	1	7	4	5
DPH-21	3	1	5	6	6
DPH-22	3	1	8	3	4.5
PH-6	3	1	13	7	11
PH-7	1	1	7	2	4.6
PH-9	1	1	6	7	12.5
PH-10	3	3	10	5	10.5
PH-11	3	3	15	11	5
PH-14	3	1	14	9	7.8
PH-21	3	1	10	5	14
PH-22	3	1	8	4	5.2

YBWF-1	5	1	7	4	5.4
NEPALI	3	1	8	3	5.5
DW-1	3	3	11	9	5.6
RM-1	3	1	15	8	12
IC25113	3	1	6	4	13
L-1	3	1	5	4	4.6
IC2517	3	1	8	3	4.8
L-19	3	1	7	4	5.1
L-3	3	1	18	10	12
R-LOCAL	1	1	6	3	6
YB-540	1	1	6	11	8.5
YB-541	3	3	10	4	8.8
YB-543	3	3	11	8	6
YB-544	3	1	12	7	14
YB-545	3	1	9	3	12.5
YB-546	3	1	8	6	5.8
YB-547	3	1	8	3	5.6
YB-548	3	1	8	2	5.4
YB-550	3	1	12	7	7.8
YB-551	1	1	7	5	5.7
YB-552	1	1	7	8	15
YB-554	3	3	6	5	14
YB-558	3	3	15	11	4.6
YB-560	3	1	11	10	12
YB-561	3	1	6	4	13
YB-562	3	1	8	6	4.8
YB-563	3	1	9	6	5.2
YB-564	3	1	8	3	5.5
YB-565	3	1	13	10	12
YB-566	1	1	10	2	4
YB-567	1	1	8	8	11
YB-568	3	3	7	5	13.5
YB-569	3	3	12	8	4.5
DL-1	3	1	11	7	14
DL-2	3	1	6	5	11
DL-3	3	1	6	6	4
DL-4	3	1	8	5	5
DL-5	3	1	8	2	5
DL-6	3	3	11	8	5.6
DL-7	3	1	15	8	15.5
DL-10	3	1	10	5	15
DL-13	3	1	7	3	6
DL-14	3	1	8	3	5.8

DL-16	3	1	7	6	6
DL-17	3	1	11	7	11
DL-18	1	1	7	5	4.5
DL-19	1	1	8	7	12
DL-20	3	3	8	4	13
DL-21	3	3	12	7	6
DL-22	3	1	15	7	14
DL-25	3	1	8	4	15.1
DL-26	3	1	10	6	5
DL-27	3	1	7	6	5.5
DL-28	3	1	8	3	5.5
DL-29	3	3	13	8	5.8
DL-30	3	1	12	7	9.4
DL-33	3	1	8	2	14
BC4B-1	3	1	5	5	5.8
BC4B-2	3	1	5	5	5.7
DPH-9	3	1	7	4	6
DPH-58	3	1	15	8	12.5
DPH-70	1	1	7	6	6
DPH-88	1	1	8	7	7.8
RM-2	3	3	10	6	14

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Yam bean Genotypes	No. of seeds per pod	Tuber shape	Neck length (cm)	Tuber rings (Nos)	Tuber surface	Seed colour	Seed shape
YBBL-6	6	5	5.5	3	3	1	3
EC100547	8	3	3.2	1	3	1	3
YBBL-19	8	5	2.5	1	3	1	3
YBBL-4	6	5	5.4	4	3	1	3
ECIW562	6	1	6.4	3	1	1	1
YBBL-17	6	5	5.4	5	3	1	3
L-19	8	3	5.6	6	1	1	3
IC 2514	6	5	2.2	3	1	1	3
YBBL-8	8	3	2.4	1	1	3	3
EC100566	9	1	2.3	1	3	3	3
EC100563	6	5	6.7	4	3	1	3
YBBL-3	9	3	3.2	0	3	1	3
YBBL-16	9	5	2.4	1	3	1	3
YBBL-18	5	5	7.2	3	3	1	3
YBBL-20	5	1	5.6	4	1	1	1
YBBL-15	6	5	5.4	4	3	1	3
YBBL-12	6	5	5.5	4	3	1	3
EC100549	9	3	3.5	0	3	1	3
EC100541	8	5	3.3	0	3	1	3
YBBL-7	6	5	5.2	4	3	1	3
EC100565	6	1	5.2	4	1	1	1
Rajendra Local	6	5	5.7	5	3	1	3
EC100548	8	3	5.8	6	1	1	3
EC100551	6	5	3.1	4	1	1	3
EC100567	8	3	2.2	1	1	3	3
EC100550	7	1	2.3	0	3	3	3
EC100543	6	5	6.4	4	3	1	3
EC100542	8	3	3.4	0	3	1	3
YBBL-11	8	5	2.4	1	3	1	3
EC100544	6	5	6.5	5	3	1	3
EC100568	5	1	5.4	5	1	1	1
YBBL-5	5	5	5.2	5	3	1	3
YBBL-1	5	5	6.7	5	3	1	3
EC100560	8	3	2.5	0	3	1	3
IC25112	8	5	3.1	1	3	1	3
EC100562	6	5	6	6	3	1	3
YBBL-2	6	1	5.5	4	1	1	1
YBBL-13	6	5	5.8	6	3	1	3

EC100554	8	3	5.2	6	1	1	3
YBBL-14	6	5	3.2	6	1	1	3
EC100546	7	3	3.2	0	1	3	3
YBBL-9	8	1	3.3	1	3	3	3
YBBL21	6	5	5.2	6	3	1	3
L No 3	7	3	3.5	0	3	1	3
YBBL-10	8	5	3.2	0	3	1	3
YB-22-52	5	5	5.4	5	3	1	3
YB-12-88	5	1	6.1	4	1	1	1
WF-24	5	5	6.2	4	3	1	3
YB-25-1	8	3	6.1	4	1	1	3
4mB2-82	5	5	1.5	4	1	1	3
YB-21-91	8	3	2.4	0	1	3	3
4mB3-65	8	1	1.3	0	3	3	3
YB-4-86	5	5	5.6	4	3	1	3
YB-5-43	7	3	3.4	0	3	1	3
YB-19-55	8	5	2.3	1	3	1	3
YB-17-10	5	5	5.7	5	3	1	3
YB-23-28	4	1	5.5	6	1	1	1
4m-19	5	5	6.6	4	3	1	3
YB-16-2	7	3	6.1	4	1	1	3
YB-18-21	5	5	3.2	5	1	1	3
YB-20-69	7	3	2.4	1	1	3	3
YB-6-78	8	1	3.1	1	3	3	3
YB-15-5	5	5	5.8	5	3	1	3
YB-7-67	8	3	1.9	1	3	1	3
YB-14-56	8	5	2.2	0	3	1	3
YB-8-70	4	5	5.5	5	3	1	3
WD-9	6	1	6.2	3	1	1	1
YB-11-63	6	5	6.1	4	3	1	3
YB-13-87	4	5	6.3	3	3	1	3
YB-10-1	8	3	2.3	0	3	1	3
DPH-5	9	5	2.4	0	3	1	3
DPH-7	5	5	5.7	5	3	1	3
DPH-21	6	1	5.6	6	1	1	1
DPH-22	4	5	5.2	3	3	1	3
PH-6	9	3	5.2	4	1	1	3
PH-7	6	5	2.5	3	1	1	3
PH-9	8	3	3.1	0	1	3	3
PH-10	8	1	3.2	0	3	3	3
PH-11	6	5	5.7	4	3	1	3
PH-14	8	3	3.2	0	3	1	3
PH-21	8	5	3.3	1	3	1	3

PH-22	6	5	5.8	4	3	1	3
YBWF-1	4	1	6.4	5	1	1	1
NEPALI	5	5	6.5	6	3	1	3
DW-1	5	5	5.4	4	3	1	3
RM-1	9	3	3.4	1	3	1	3
IC25113	9	5	3.5	1	3	1	3
L-1	6	5	5.7	6	3	1	3
IC2517	6	1	6.7	6	1	1	1
L-19	6	5	5.6	6	3	1	3
L-3	8	3	5.2	6	1	1	3
R-LOCAL	4	5	3.4	5	1	1	3
YB-540	8	3	3.2	1	1	3	3
YB-541	8	1	3.2	0	3	3	3
YB-543	4	5	5.9	4	3	1	3
YB-544	9	3	3.1	0	3	1	3
YB-545	9	5	2.4	1	3	1	3
YB-546	4	5	6.1	5	3	1	3
YB-547	4	1	6.5	2	1	1	1
YB-548	4	5	6.4	3	3	1	3
YB-550	9	3	6.5	4	1	1	3
YB-551	5	5	2.4	2	1	1	3
YB-552	7	3	2.3	1	1	3	3
YB-554	7	1	1.9	0	3	3	3
YB-558	5	5	5.6	3	3	1	3
YB-560	8	3	1.5	1	3	1	3
YB-561	8	5	1.3	1	3	1	3
YB-562	6	5	7	5	3	1	3
YB-563	6	1	6.4	3	1	1	1
YB-564	6	5	5.5	2	3	1	3
YB-565	9	3	5.2	2	1	1	3
YB-566	6	5	2.2	4	1	1	3
YB-567	5	3	2.3	1	1	3	3
YB-568	5	1	3.4	0	3	3	3
YB-569	6	5	5.2	2	3	1	3
DL-1	7	3	2.4	0	3	1	3
DL-2	9	5	2.5	0	3	1	3
DL-3	5	5	5.7	3	3	1	3
DL-4	6	1	5.8	5	1	1	1
DL-5	5	5	6.4	3	3	1	3
DL-6	4	5	6.5	3	3	1	3
DL-7	7	3	3.1	0	3	1	3
DL-10	9	5	3.2	0	3	1	3
DL-13	6	5	5.4	3	3	1	3

DL-14	4	1	5.8	4	1	1	1
DL-16	6	5	6.7	5	3	1	3
DL-17	9	3	5.7	4	1	1	3
DL-18	6	5	3.2	3	1	1	3
DL-19	9	3	3.3	0	1	3	3
DL-20	8	1	3.5	1	3	3	3
DL-21	4	5	5.2	2	3	1	3
DL-22	8	3	3.2	0	3	1	3
DL-25	9	5	1.5	0	3	1	3
DL-26	5	5	5.9	3	3	1	3
DL-27	5	1	6.1	2	1	1	1
DL-28	5	5	6.5	3	3	1	3
DL-29	4	5	6.4	3	3	1	3
DL-30	9	3	2.4	0	3	1	3
DL-33	9	5	1.3	0	3	1	3
BC4B-1	6	5	6.5	4	3	1	3
BC4B-2	6	1	5.6	4	1	1	1
DPH-9	4	5	7	2	3	1	3
DPH-58	7	3	6.4	3	1	1	3
DPH-70	4	5	3.4	5	1	1	3
DPH-88	8	3	2.3	0	1	3	3
RM-2	6	1	3.3	0	3	3	3

CONCLUSION

The characterization of 146 yam bean (*Pachyrhizus erosus* L.) genotypes using DUS (Distinctness, Uniformity, and Stability) descriptors revealed significant phenotypic diversity across multiple morphological and agronomic traits. The study successfully identified distinct genotypes based on key DUS characters such as leaf morphology, flower color, tuber shape and size, pod characteristics, and growth habit. The observed variation underscores the rich genetic diversity present within the yam bean germplasm, which can be effectively utilized for variety development and genetic improvement.

The identification of stable and uniform genotypes with unique trait combinations provides a valuable foundation for breeders seeking to develop high-yielding, climate-resilient, and consumer-preferred yam bean varieties. Furthermore, the results support the registration and protection of novel genotypes under the PPV&FR Act, ensuring legal recognition and promoting the conservation of this underutilized legume crop. Continued characterization and evaluation across different agro-climatic zones are recommended to further validate the stability of key traits and to explore genotype-environment interactions for future breeding and commercialization efforts.

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