

**Guidelines for the Conduct of Test for
Distinctiveness, Uniformity and Stability**

On

Yam Bean
(Pachyrhizus erosus (L.))



**Protection of Plant Varieties and Farmers
Rights Authority (PPV&FRA),
Govt. Of India, New Delhi**

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YAM BEAN (*Pachyrhizus erosus* (L.))

Introduction

Yam bean (*Pachyrhizus erosus* (L.) of the family Leguminosae, is under the sub family Fabaceae (Papilionaceae). It is also called 'Potato bean' in English and '*Mishrikand*' in Hindi. In Bihar, it is called '*Kesaru*'. It is called '*Sank alu*' or '*Sankesh alu*' in West Bengal, Assam and Odisha. The yam bean appears to have originated in Mexico and northern South America, in the head-water region of the river Amazon, and was cultivated there in pre-Columbian days. Its cultivation spread to Indonesia and further introduction took place from the Philippines and Indonesia *via* Ceylon and India along the west coast of the African continent. 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.

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.

YAM BEAN (*Pachyrhizus erosus* (L.))

I. Subject

These test guidelines shall apply to all varieties, hybrids and parental lines of Yam bean [*Pachyrhizus erosus* (L)].

II. Planting material required

1. The Protection of Plant Varieties and Farmers' Rights Authority (PPV&FRA) shall decide when, where and in what quantity and quality the seed/planting material are required for testing of a variety denomination for registration under the Protection of Plant Varieties and Farmers' Rights (PPV&FR) Act, 2001. Applicants submitting such material from a country other than India shall make sure that all customs and quarantine requirements stipulated under relevant national legislations and regulations are complied with. The material is to be supplied in the form of seeds a minimum of 100 seeds.
2. The minimum quantity of planting material (seeds), to be supplied by the applicant, should be 75 - 100g for three replications.
3. The seed/planting material supplied shall be healthy, not lacking in vigour or affected by any pest or disease and it should certify that it shall also possess the highest genetic stability in the propagated material and uniformity.
4. The seed should not have undergone any chemical or bio-physical treatment which would affect the expression of the characteristics of the variety, unless the Registrar of the Authority has requested for such treatment. If it has been treated, full details of the treatment must be provided.

III. Conduct of tests

1. The minimum duration of DUS tests shall normally be at least two independent, similar growing seasons with two consecutive plantings, the second being sowing with the seed material harvested from previous season/trial.
2. The test shall normally be conducted at least at two test locations. If any essential characteristics of the candidate variety are not expressed for visual observation at these locations, the variety shall be considered for further examination at another appropriate test site or under special test protocol on expressed request of the applicant.
3. The field tests shall be carried out under conditions (irrigated/rainfed) favouring normal growth and expression of all test characteristics. The size of plot shall be such that plants or parts of plants could be removed for measurement and observation without prejudicing the other observations on the standing plants until the end of the growing period.

4. Each test shall include about 150 plants in the plot planted at a planting space specified below across three replications. Separate plots for observation and for measurement can only be used, if they have been subjected to similar environmental conditions.

5. All the replications shall be sharing similar environmental conditions of the test location.

6. Test plot design

No. of rows	: 5
No. of plants per row	: 5
Spacing: 60 x 20 cm; Plants/ replication	: 25
Number of replications	: 3

7. Observations should not be recorded on the plants in border rows.

8. Additional test protocols for special tests shall be established by the PPV & FR Authority as and when needed.

IV. Methods and observations

1. The characteristics described in the Table of characteristics shall be used for the testing of varieties for their DUS (section VII).

2. For the assessment of Distinctiveness and Stability, observations shall be made on at least 30 plants or parts of 30 plants, which shall be equally divided among three replications (10 plants per replication) and any other observations made on all plants in the test, disregarding any off-type plants. Maximum off types allowed is one plant for every 100 plants.

3. For the assessment of Uniformity, a population standard of 1% and an acceptance probability of at least 95 % shall be applied.

4. For the assessment of all colour characteristics, the latest Royal Horticultural Society (RHS) colour chart shall be used.

5. Unless otherwise indicated, all observation on the plant, observations on leaf and the vine should be made before the end of the growing phase, during the full expression time at physiological maturity. Unless otherwise indicated, all observations on the shoot should be made on the main twig.

6. Stem and leaf characters should be recorded as the average expression of the character observed in the main twig.

7. All observations on the tubers shall be made at the time of harvest.

8. Determining whether a difference between two varieties is clear depends on many factors, and should consider, in particular, the type of expression of the characteristic being examined, i.e. whether it is expressed in a qualitative, quantitative, or pseudo-qualitative manner. One means of ensuring that a difference in expression of characters, observed in a growing trial, is sufficiently consistent is to examine the characteristic in at least two independent growing cycles.

9. The optimum stage of plant growth for assessment of each characteristic is given in the sixth column of the Table of characteristics are described below:

Growth stages	Codes
Active vegetative growth stage (50 - 75 days after planting)	A
Flowering stage (70 - 100 days after planting)	B
Tuber harvesting stage (120 - 150 days after planting)	C
Seeds maturing stage (150 - 180 days after planting)	D

V. Grouping of characters

1. The candidate varieties for DUS testing shall be divided into groups to facilitate the assessment of Distinctiveness. The characteristics and their states which are known from experience not to vary or to vary only slightly within a variety are suitable for grouping purpose.
2. The following characteristics shall be used for grouping of yam bean varieties:
 - a) Flower colour, colour of standard and wing petal (Characteristic 6)
 - b) Pod length (Characteristic 10)
 - c) Tuber shape (Characteristic 12)
 - d) Seed shape (Characteristic 18)

VI. Characteristics and symbols

1. To assess Distinctiveness, Uniformity and Stability, the characteristics and their states as given in the Table of characteristics (Section VII) shall be used.
2. States of expression are given for each characteristic to define the characteristic and to harmonize descriptions. Notes (1 to 5) shall be used to describe the state of each character for the purpose of digital data processing and these notes shall be given against the states of each characteristic. In the case of qualitative and pseudo-qualitative characteristics, all relevant states of expression are presented in the characteristic. However, in the case of quantitative characteristics with 5 or more states, an abbreviated scale may be used to minimize the size of the Table of Characteristics.
3. **Legend**
 - (*) Characteristics that shall be observed during every growing season on all varieties and shall always be included in the description of the variety, except when the state of expression of any of these characters is rendered impossible by a preceding phenological characteristic or by the environmental conditions of the testing region. Under such exceptional situation, adequate explanation shall be provided.
 - (+) See explanations on the Table of characteristics in section VIII. It is to be noted that for certain characteristics the plant parts on which observations to be taken are given in the explanation or figure(s) for clarity and not for the colour variation.

4. Characteristics denoted with symbols QL and QN in first column of the Table of characteristics shall be indicated as:

QL: Qualitative characteristics

QN: Quantitative characteristics

5. Type of assessment of characteristics indicated in column seven of 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

VII. Table of characteristics

Sl. No.	Characteristics	States	Notes	Example varieties	Stages of observation	Type of assessment
1	2	3	4	5	6	7
1 (* (+)	Stem colour	Yellowish Green (Yellow Green group145-C) Light green (Yellow Green group145-A) Dark Green (Yellow Green group147-A)	1 3 5	DPH63 RM 1 RM2, 8x9	A	VS
2 (* (+)	Stem pubescence	Sparse (<10/cm ²) Dense (>10/cm ²)	1 3	RM 1 RM-2	A	VS
3 (* (+)	Leaflet shape (No. of teeth of terminal leaf)	Less (<5) Medium (5-7) More (>7)	1 3 5	RM 2, 8x9 RM1 EC 100546	A	MS
4 (* (+)	Leaf surface (Adaxial)	Smooth Rough	1 3	RM1 DPH 10, RM 2	A	VG
5 (* (+)	Flower density	Low (≤15) High (>15)	1 3	EC 100546, L19 8x9	B	VG
6 (* (+)	Colour of standard and wing petal	Light blue(Blue group 104-D) Violet blue (Violet blue group 96-C) White	1 3 5	RM 1 EC 100546, RM 2 -	B	VG
7 (* (+)	Sepal colour	Light brown (Grey Brown group 199-C) Brown (Grey Brown group199-A)	1 3	RM 1 RM2	B	VG
8 (* (+)	No. of Pods per 1-5 inflorescences/ primary branches	Low (≤10) High (>10)	1 3	DPH 20 8x9	B	VS
9 (* (+)	No. of Pods per Primary inflorescence	Low (≤6) High (>6)	1 3	DPH 20 8x9, RM 1	B	MS
10 (* (+)	Mature: Pod length (cm)	Short (≤6) Long (>6)	1 3	DPH 10, DPH 63 8x9	C	MS

11 (* (+)	No. of seeds per pod	Low (≤ 6)	1	DPH 10	B	MS
		High (> 6)	3	8x9, RM 1		
12 (* (+)	Tuber shape	Fusiform	1	RM-2	B	VG
		Round	3	RM -1, 8x9		
		Irregular	5	DPH 10, LNo. 3		
13 (* (+)	Neck length (cm)	Short (≤ 5)	1	8x9, RM 2	B	MS
		Long (> 5)	3	DPH 10, DPH 63		
14 (* (+)	Tuber rings (Nos)	Few (≤ 1)	1	8x9, RM 1, RM 2	B	MS
		Many (> 1)	3	DPH-10		
15 (* (+)	Tuber surface	Smooth	1	RM 1	B	VS
		Rough	3	8x9, RM2		
16 (* (+)	Seed colour	Light brown (Greyed Orange group 166-D)	1	DPH 6	D	VS
		Brown (Greyed Orange group 166-B)	3	RM 1, RM 2		
17 (* (+)	Seed shape	Square	1	DPH 20	D	VG
		Circular	3	8x9		

VIII. Explanation for the Table of characteristics

Characteristic 1. Stem colour: The predominant colour of the stem of the primary branch to be recorded during active vegetative growth at 50 days after planting.



Yellowish green
(1)



Light green
(3)



Dark Green
(5)

Characteristic 2. Stem pubescence: The pubescence of the stem of the primary branch to be recorded during active vegetative growth at 50 days after planting.

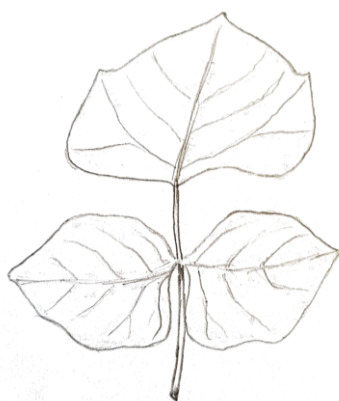


Sparse
(1)

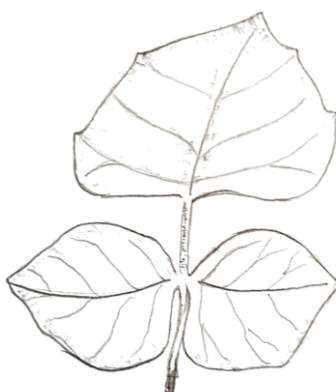


Dense
(3)

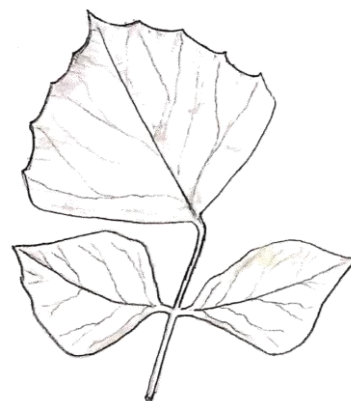
Characteristic 3. Leaflet shape (No. of teeth): The number of teeth of the terminal leaflet of the compound leaf shall be recorded.



**Less
(1)**

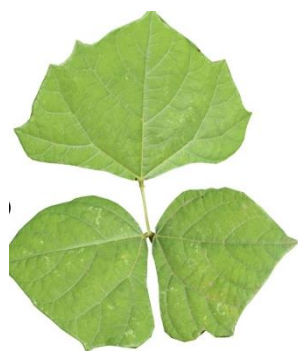


**Medium
(3)**

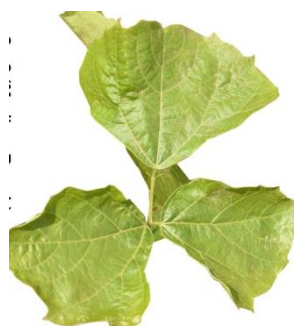


**More
(5)**

Characteristic 4. Leaf surface: The texture of the leaf surface to be recorded on adaxial surface of the fifth fully opened leaf of the primary branch.



**Smooth
(1)**



**Rough
(3)**

Characteristic 5. Flower density of the inflorescence to be recorded as Low (1) and High (3)



**Low
(1)**



**High
(3)**



**Low
(1)**



**High
(3)**

Characteristic 6. Flower colour, colour of standard and wing petal



Light Blue

(1)



Violet Blue

(3)

Characteristic 8. Pods per branch: The number of mature pods per branch to be counted and recorded as low (1) and high (3)



Low
(1)



High
(3)



Low
(1)



High
(3)

Characteristic 9. Pods per inflorescence: Low (1), High (3)



**Low
(1)**



**High
(3)**



**Low
(1)**



**High
(3)**

Characteristic 10. Pod length (cm): Short (1), Long (3)



**Short
(1)**



**Long
(3)**

Characteristic 11. Number of seeds per pod: Low (1), High (3)



**Low
(1)**



**High
(3)**



**Low
(1)**



**High
(3)**

Characteristic 12. Tuber shape



Fusiform
(1)



Round
(3)

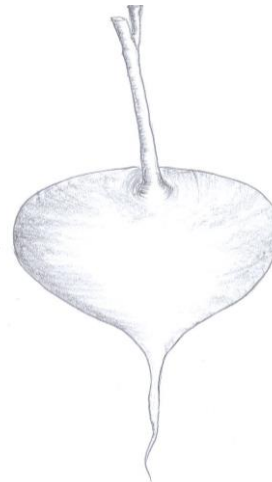


Irregular
(5)

Characteristic 13. Neck length (cm): The neck length of the mature tuber (tuber stalk) shall be recorded in cm and classified as short (1) and long (3)



Short
(1)



Long
(3)

Characteristic 14. Tuber rings (Nos): Few (1), Many (3)



Few
(1)



Many
(3)

Characteristic 15. Tuber surface: Smooth (1), Rough (3)



Smooth
(1)



Rough
(3)

Characteristic 16. Seed colour:



Light brown
(1)



Brown
(3)

Characteristic 17. Seed shape:



Square
(1)



Circular
(3)

IX. Working group details

The test guidelines developed by the task force (03/2018) constituted by the PPV & FR Authority for Yam Bean (*Pachyrhizus erosus* (L.) with consultation by Nodal officer, ICAR-CTCRI(HQ), Thiruvananthapuram & Co-Nodal officer ICAR-CTCRI, Regional Centre, Bhubaneswar. Technical inputs also provided by the PPV & FR Authority.

1. **Dr. S.K. Naskar (Plant Breeding),** Chairman
Former Director, ICAR-CTCRI
4, Deshbandhu Road, Jadavpur, Kolkata 700032
2. **Dr. (Mrs.) Archana Mukherjee** Member
Director, ICAR-CTCRI
Sreekariyam, Thiruvananthapuram 695017, Kerala
3. **Dr. K Joseph John** Member
Pr. Scientist & Officer In-Charge
ICAR-NBPGR Regional Station - Thrissur
Vellanikkara, KAU P.O. Thrissur - 680656, Kerala
4. **Dr. Kalidas Pati,** Member
Senior Scientist, ICAR-CTCRI Regional Centre
Dumuduma, Bhubaneswar
5. **Dr. Ashish Narayan** Member
Tuber Breeder
RAU, Eastern Regional Centre, Dholi
Muzaffarpur - 843121, Bihar
6. **Dr. M. N. Sheela** Member
Head of Division, Crop improvement
ICAR-CTCRI, Sreekariyam, Thiruvananthapuram
695017, Kerala
7. **Dr. Ravi Prakash** Member Secretary
Registrar(Farmers' Rights), PPV & FRA, New Delhi

X. DUS testing Centre:

Nodal DUS test centre	Co Nodal DUS rest cene
ICAR - Central Tuber Crops Research Institute, Sreekaryam,Thiruvananthapuram-695017, Kerala	Rajendra Agricultural University, Dholi