

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

**On**

**Greater Yam  
(*Dioscorea alata* L.)**



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

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## Greater Yam (*Dioscorea alata* L.)

### Introduction

Yams belong to the family *Dioscoreaceae* under Monocotyledons that include more than 600 species. Yams bring food security to 300 million people in the low-income food-deficit countries of the tropics. Yams are herbaceous climbers characterized by winged vines that twine on supports in the right hand direction. *D. alata*, the greater yam is the most widely cultivated yam species in India. It is a polyploid species that includes accessions with  $2n = 40$ , 60 and 80 chromosomes. The greater yam germplasm maintained at CTCRI consists of 491 accessions comprising of land races, exotic accessions, mutants and hybrids. The leaves are large, ovate or cordate in shape. Tubers are large, varying in shape and are usually 1-3 per plant. Tuber flesh is white, cream, yellow or purplish. Many cultivars produce aerial tubers or bulbils in the leaf axils.

Greater Yam is propagated vegetatively and seed yam (whole tuber) is the ideal source of planting material. Recommended size for planting material is 200 - 250 g setts. One or two ploughing or digging of the land up to a depth of 15 - 20 cm followed by opening of pits of the size 45 x 45 x 45 cm and filling of  $\frac{3}{4}$ <sup>th</sup> size of these pits with a mixture of 1 kg dry farm yard manure and top soil is the usual agronomic practice followed. Seed yams or yam setts are then planted in it and the optimum spacing recommended for yams is 90 cm X 90 cm. Application of well rotten FYM @ 10 t/ha at the time of field preparation is essential. Chemical fertilizers may be applied in the form of NPK @ 100:50:100 t/ha in two split doses. Along with the fertilizer application, weeding and earthing up also should be essentially done. As soon as the yam vine emerges, it tends to climb on any available support. Staking can be done by allowing vines trail on poles or live trees. On maturity, vines dries up and tubers are harvested eight to ten months after planting.



**Fig 1:** Field view of greater yam and harvested Tubers

## **I. Subject**

These test guidelines shall apply to all varieties of Greater Yam (*Dioscorea alata* 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 plant 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.
2. The material is to be supplied in the form of tubers. The minimum quantity of planting material, to be supplied by the applicant, should be 10 healthy tubers 750-1100g each without sprouts and any damage to the epidermal portion. The tubers shall be packed in cotton cloth bag with proper labelling.
3. The 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 plant material 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 a replanting with the harvested plant material of the first season or with reference to the agro climatic conditions of candidate variety.
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 (a third location) or under special test protocol on a expressed request of the applicant.
3. The field tests shall be carried out under conditions 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 25 plants in the plot size (4.5 m x 4.5 m) and 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:**

Plot size	:	4.5 m X 4.5 m
Spacing	:	90 cm X 90 cm
No. of Replications	:	3
No. of plants/replication	:	25

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.

#### **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.
3. For the assessment of Uniformity of characteristics on the plot as a whole (visual assessment by a single observation on group of plants or parts of plants), a population standard of 1% and an acceptance probability of at least 95 % shall be applied. Number of offtypes shall not exceed one out of 75 plants.
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 preferably at about 90 days after planting or 60 days before harvest in early maturing cultivars.

6. Vine and leaf characters should be recorded as the average expression of the character observed in a group of 8 plants during maximum growing phase (90 - 180 days).
7. All observations on the tubers should be made at the time of harvest (270 - 300 days after planting).
8. 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:

<b>Growth stages</b>	<b>Codes</b>
Early Growth stage (1 month after planting)	A
Active vegetative growth stage (6 months after planting)	B
Senescence/Harvesting stage (9 months after planting)	C

## V. Grouping 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 greater yam varieties:
  - a) Petiole colour (characteristic 4)
  - b) Leaf shape (characteristic 7)
  - c) Tuber shape (characteristic 15)
  - d) Tuber cortex colour (characteristic 16)
  - e) Tuber flesh colour (characteristic 17)

## 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 9) 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 9 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 VII. 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.	Characteristic	States	Notes	Example varieties	Stage of observation	Type of Assessment
1	2	3	4	5	6	7
1 (* (+)	Young stem colour	Green (Yellow-Green group 144)	1	Da 240	A	VS
		Purple (Red Purple group 59)	3	Sree Neelima		
2 (* (+)	Young fully open leaf colour	Yellowish (Yellow Green group N144)	1	Da 22	A	VS
		Dark green (Green group 137)	3	Da 240		
		Light Brown (Grey Brown group N199)	5	Da 81		
		Purple (Red Purple group 59)	7	Sree Neelima		
3 (* (+)	Colour of wings	Green (Yellow Green group 144)VG	1	Da 21	B	VG
		Green with purple margin (Yellow Green group 144)	3	Da 340		
4 (* (+)	Petiole colour	Green (Yellow Green group 144)	3	Da 240	B	VG
		Green with pigmentation	5	Da 340		
5 (* (+)	Petiole length (cm)	Short ( $\leq 5$ cm)	3	Da 73	B	MS
		Medium (5-10cm)	5	Da 215		
		Long ( $\geq 10$ m)	7	Da 222		
6. (* (+)	Mature leaf colour	Pale green (Yellow Green group 144)	1	Sree Nidhi	B	VG
		Dark green (Green group 137)	3	Sree Swathy		
7 (* (+)	Leaf shape	Cordate narrow	1	Sree Nidhi, Da 13	B	VG
		Cordate broad	3	Da 340, Sree Swathy		
		Sagittate narrow	5	Da 240		
		Sagittate broad	7	Da 287		
8 (* (+)	Leaf margin pigmentation	Absent	1	Sree Nidhi	B	VS
		Present	9	Sree Neelima		
9 (* (+)	Leaf lobes in a Leaf	Non overlapping	1	Da 516	B	VS
		Overlapping	9	Da 515		



10 (* (+)	Flowering	Absent	1	Da 240	C	VG
		Present	9	Sree Karthika		
11 (* (+)	Sex	Female	1	Sree Roopa	C	VG
		Male	3	Sree Karthika		
12 (* (+)	Aerial tubers	Absent	1	Da 303	C	VG
		Present	9	Sree Neelima		
13 (* (+)	Aerial tuber: cortex colour	Yellow (Greyed Orange group 164-C)	1	Sree Swathy	C	VS
		Purple (Purple group N78-B)	3	Sree Neelima		
14 (* (+)	Aerial tuber flesh colour	Cream (White group NN155A)	1	Sree Swathy	C	VS
		Yellow (Greyed Yellow group 162C)	3	Dah106		
		Light purple (Purple Violet group N82D)	5	Da 492		
		Purple (Purple group N78A)	7	Da 340		
15 (* (+)	Tuber shape	Linear	1	Da 17-6, Da 8	C	VS
		Oval	3	Sree Shilpa, Da 84		
		Digitate	5	Sree Roopa		
		Cylindrical	7	Sree Nidhi, Sree Karthika		
		Irregular	9	Da 340		
16 (* (+)	Tuber cortex colour	Cream (Yellow White group 158)	1	Da 278	C	VS
		Yellow (Yellow Orange group 17)	3	Sree Swathy Da 243		
		Light purple (Red purple group 62)	5	Sree Nidhi		
		Dark purple (Purple group N79)	7	Sree Neelima		
17 (* (+)	Tuber flesh colour	White (White group 155)	1	Sree Nidhi	C	VS
		Yellowish white/offwhite (Yellow White 158)	3	Sree Karthika		
		Yellow (Yellow orange group 17-19)	4	Da 509		
		Light purple (Red purple 65)	5	Sree Neelima		
		Purple (Purple Violet N80)	7	Da 340		
		Mixed	9	Da504		

18 (* (+)	Hairs/roots on tuber	Sparse (<4/sq. inch)	3	TCR115	C	VS
		Dense (>4/ sq. inch)	5	DaH9-2		
19 (* (+)	Tuber: appearance of cross section	Amorphous	1	Da385	C	VS
		Granular	3	Sree Keerthy Da526		
20 (* (+)	Tuber oxidation /browning	Absent	1	Da 508	C	VS
		Present	9	Sree Nidhi		

## VIII. Explanation for the Table of characteristics

**Characteristic 1. Young stem colour:** Determined by recording the predominant colour of the young emerging vine.



Green  
(1)



Purple  
(3)

**Characteristic 2. Young fully open leaf colour:** Determined by recording the predominant colour of the young leaves on emerging vines at one month after planting



Yellowish  
(1)



Dark green  
(3)

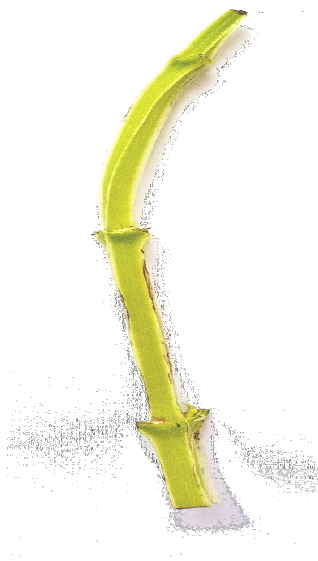


Light Brown  
(5)



Purple  
(7)

**Characteristic 3. Colour of wings:** The colour of wings of main stem recorded at 6 month after planting when the plant is fully developed.



Green  
(1)



Green with purple margin  
(3)

**Characteristic 4. Petiole colour:** The predominant color of petioles of the mature leaves recorded at 6 month after planting.



Green  
(3)



Green with pigmentation  
(5)

**Characteristic 6. Mature leaf colour:** The predominant colour of the mature leaf on main stem recorded at 6 month after planting.



Pale green  
(1)



Dark green  
(3)

**Characteristic 7. Leaf shape:** The predominant shape of the mature leaf on main stem recorded at 6 month after planting.



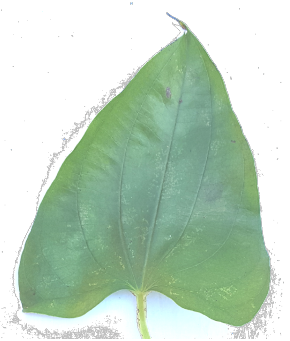
Cordate narrow  
(1)



Cordate broad  
(3)

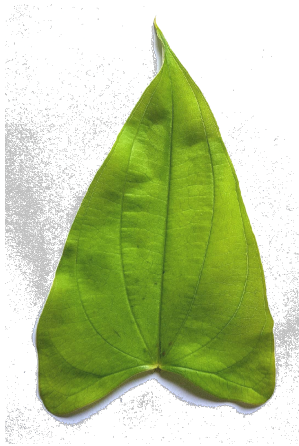


Sagittate narrow  
(5)



Sagittate broad  
(7)

**Characteristic 8. Leaf margin pigmentation:** The predominant color of leaf margin of the mature leaves on main stem recorded at 6 month after planting.

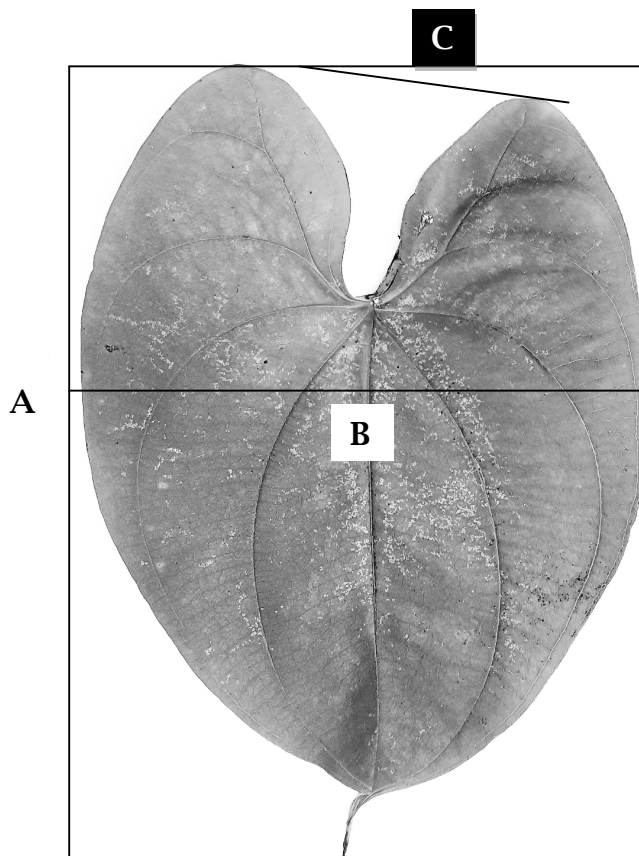


Absent  
(1)



Present  
(9)

**Characteristics 9. Leaf lobes in a leaf:** Recorded as given in Fig.1 and classified as non overlapping (1) and overlapping (9).



Leaf length

(A)

Leaf breadth

(B)

Distance between leaf lobes

(C)

**Characteristic 11. Sex:** recorded on flowering plants

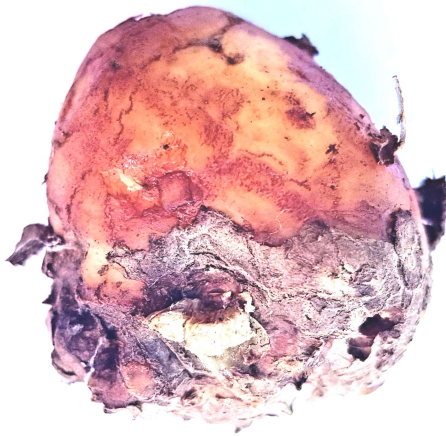


Female  
(1)



Male  
(3)

**Characteristic 13: Aerial tuber cortex colour:** Predominant colour of the aerial tuber cortex recorded at 9 month after planting



Yellow  
(1)



Purple  
(3)

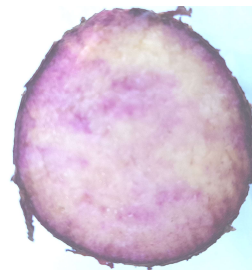
**Characteristic 14: Aerial tuber flesh colour:** Predominant aerial tuber flesh colour recorded at 9 month after planting



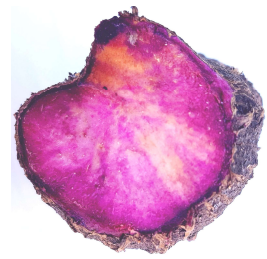
Cream  
(1)



Yellow  
(3)



Light purple  
(5)



Purple  
(7)

**Characteristic 15. Tuber Shape**



Linear  
(1)



Oval  
(3)



Digitate  
(5)



Cylindrical  
(7)

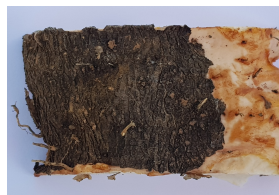


Irregular  
(9)

**Characteristic 16. Tuber cortex colour:** The predominant colour of the cortex recorded on fully matured tubers at nine months after planting



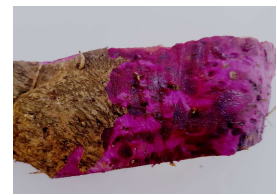
Cream  
(1)



Yellowish  
(3)



Light purple  
(5)



Dark Purple  
(7)

**Characteristic 17. Tuber flesh colour:** The predominant flesh colour of the cross section of the fully matured tubers at middle portion recorded at nine months after planting



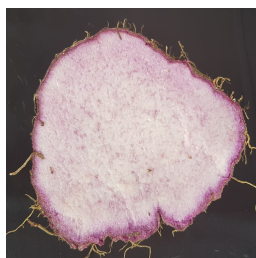
White  
(1)



Yellowish white/offwhite  
(3)



Yellow  
(4)



Light purple  
(5)



Purple  
(7)



Mixed  
(9)



**Characteristic 18. Hairiness of tuber:** Recorded on matured tubers at nine months after planting.



Sparse  
(3)



Dense  
(5)

**Characteristic 19. Tuber appearance of cross section:** Graininess of the cross section of the fully matured tubers recorded at nine months after planting.



Amorphous  
(1)



Granular  
(3)

**Characteristic 20. Tuber oxidation /browning:** The tuber may be cut into small pieces and colour may be observed after 15 minutes to record browning due to the presence of phenolics.



Absent  
(1)



Present  
(9)

## IX. Working group details

The test guidelines developed by the task force (03/2018) constituted by the PPV & FR Authority for Greater yam (*Dioscorea alata 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.

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## X. DUS testing Centre:

<b>Nodal DUS test centre</b>	<b>Co Nodal DUS rest cene</b>
ICAR - Central Tuber Crops Research Institute, Sreekaryam,Thiruvananthapuram-695017, Kerala	ICAR-CTCRI Regional Centre Dumduma, Bhubaneswar