

Original Research Article

<https://doi.org/10.20546/ijcmas.2020.909.430>

## Collection and Characterization of Indigenous *Dioscorea bulbifera* Genotypes of Chhattisgarh

Kamal Narayan<sup>1\*</sup>, J. Singh<sup>2</sup>, Deo Shankar<sup>2</sup>, R. Gayen<sup>3</sup>, N. Mehta<sup>4</sup> and R. R. Saxena<sup>5</sup>

<sup>1</sup>Horticulture, <sup>2</sup>Department of floriculture and landscape Architecture), <sup>3</sup>Department of Vegetable science, <sup>4</sup>Department of Genetics and Plant Breeding), KVK, Pahanda (A), Durg, I.G.K.V. (C.G.), India

<sup>5</sup>Director of Research, IGKV, Raipur, India

\*Corresponding author

### ABSTRACT

#### Keywords

*Dioscorea bulbifera*,  
Cordate leaf shape

#### Article Info

Accepted:  
26 August 2020  
Available Online:  
10 September 2020

Thirty indigenous genotypes of *Dioscorea* (*Dioscorea bulbifera*) collected from twelve districts of Chhattisgarh viz., Bastar, Korba, Dhamtari, Rajnandgaon, Surguja, Kondagaon, Sukma, Balod, Narayanpur, Kanker, Dantewada and Bijapur. The collected genotypes show wide range of variability in morphological characteristics. More variability was recorded in genotypes collected from Sukma district of Chhattisgarh followed by Bijapur and Kanker district. Petiole colour varied from all green with purple at both ends and all purplish green with purple at both ends with the frequency of 26.67% and 73.33% respectively. Petiole length in correlation to leaf blade is characterized in to three categories i.e. short, medium and long with 13.33%, 13.33% and 73.33% respectively. Highest frequency (50%) was recorded as rough aerial tuber texture followed by wrinkled (40%) and lowest frequency (10%) as smooth. However, all the genotypes of *Dioscorea bulbifera* exhibits cordate leaf shape, opposite leaf position, entire leaf margin, acute apex shape and the distance between lobes is intermediate.

### Introduction

*Dioscorea* is a large genus of annual twining herbs, distributed throughout the moist tropics of the world and extending into warm temperate regions. About 50 species are found in India; a large number among them occur in the wild state and a few are cultivated for their edible tubers. The yams of several species are soft, fleshy and edible. In Chhattisgarh, aerial yam has been cultivated mainly and extensively in densely populated

and high rainfall areas. In South part of the state, a large pool of aerial yam germplasm is found in farmer's field and forest areas. However, the existence of different vernacular names for the same cultivar of the species, or vice versa has created problems to classify accessions while avoiding duplicates. Yams form a cheap source of carbohydrate food and are extensively used by hill tribes in the uncultivated tracts of Assam, Bihar, Bengal, Madhya Pradesh, Orissa, Deccan etc. (Anonymous, 2005). Aerial yam commonly

known as *Dioscorea bulbifera* in India; air potato in abroad and locally known as *Dang Kanda*, *Lathi Kanda* and *Laat Kanda* in Chhattisgarh. It is a rich source of carbohydrate, protein, carotene and other vitamins and has high calorific value. It is a Kharif season crop and is most suitable under rainfed condition. Aerial yam comes under the group of minor tuber crop but it has major importance due to ethnic and high market value as compare to other *Dioscorea* species and it is a staple food of tribal farmers of Chhattisgarh.

Proper characterization and evaluation of germplasm and dissemination of the information to the plant breeders and others is a priority area in any germplasm management programme. Characterization of germplasm consists traits that are highly heritable, expressed in different environments and can be easily seen by the eye. Characterization information along with passport data provides an indication of the range of diversity in the collections, and is of considerable help to the breeders to narrow the selection of potential breeding stocks. Until a collection has been properly evaluated and its attributes become known to breeders, it has little practical use (Thomas and Mathur, 1991).

## **Materials and Methods**

The present investigation entitled “Collection, and characterization of indigenous *Dioscorea bulbifera* genotypes of Chhattisgarh” was conducted at IGKV, Shaheed Gundayoor College of Agriculture & Research Station (SG CARS), Kumhrawand, Jagdalpur, Bastar, Chhattisgarh during Kharif seasons of 2017-18 and 2018-19.

The soil situation of the experimental site is silty loam texture with pH of 6.5. Nitrogen and potassium content of the soil is low, while phosphorus level is medium to low. Bastar-

plateau comes under moist, sub-humid agro-climatic region of Chhattisgarh.

The Bastar division of Chhattisgarh received high rainfall coupled with comparatively lower temperatures and higher humidity. The average annual rainfall of this region is 1380 mm, most of which (85%) is received from third week of June to mid September and remaining distributed during February, March, May and October.

Thirty indigenous genotypes of *Dioscorea* (*Dioscorea bulbifera*) collected from twelve districts of Chhattisgarh viz., Bastar, Korba, Dhamtari, Rajnandgaon, Surguja, Kondagaon, Sukma, Balod, Narayanpur, Kanker, Dantewada and Bijapur (Table 1).

The experiment consists of 30 genotypes of *Dioscorea* planted in three replications. The genotypes were grown randomly in each replication/block in a total of 90 plots of 3m x 3m each containing 16 plants per plot with a spacing of 75 cm row to row and 75 cm plant to plant. Observations were recorded from five randomly selected sample plants in each treatment/replication and observed mean value used for statistical analysis. Characterization of genotypes was also done as per IPGRI (1997) descriptor of *Dioscorea* spp.

## **Results and Discussion**

The results of characterization and grouping of genotypes for different morphological characters based on characterization data as per IPGRI descriptor are presented in Table 2 to 4. The collected genotypes show wide range of variability in morphological characteristics. More variability was recorded in genotypes collected from Sukma district of Chhattisgarh followed by Bijapur and Kanker district.

**Table.1** Collection details of indigenous genotypes of *Dioscorea bulbifera*

S. No.	Collection No. and Name	Place of Collection	Status of plant (Cultivated/Wild)	Collected Material
1.	IGDb-MTPL-17-1	Village-Metupalli (Bijapur)	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
2.	IGDb-BJP-17-2	Bijapur	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
3.	IGDb-GDM-17-3	Geedam (Dantewada)	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
4.	IGDb-KDNR-17-4	Kodenar (Bastar)	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
5.	IGDb-KSKL-17-5	Keshakl-1(Kondagaon)	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
6.	IGDb-GRBD-17-6	Gariyaband	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
7.	IGDb-UMDH-17-7	Umradah (Kanker)	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
8.	IGDb-KRB-17-8	Korba	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
9.	IGDb-RJNG-17-9	Rajnandgaon	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
10.	IGDb-NGR-17-10	Nagari (Dhamtari)	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
11.	IGDb-KNR-17-11	Kanker	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
12.	IGDb-MLGD-17-12	Mulaguga (Sukma)	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
13.	IGDb-GOLGD-17-13	Gollaguda (Sukma)	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
14.	IGDb-KNDR-17-14	Kondre (Sukma)	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
15.	IGDb-KDRS-17-15	Kudukras (Sukma)	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
16.	IGDb-NRNP-17-16	Narayanpur	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
17.	IGDb-ARNL-17-17	Arjunali (Bijapur)	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
18.	IGDb-MOTT-17-18	Mottha (Sukma)	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
19.	IGDb-ATPL-17-19	Aatpal (Sukma)	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
20.	IGDb-KNGD-17-20	Konanguda (Bijapur)	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
21.	IGDb-NDPL-17-21	Nedpalli (Sukma)	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
22.	IGDb-MTR-17-22	Mater (Sukma)	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
23.	IGDb-KTGD-17-23	Kottaguda (Sukma)	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
24.	IGDb-PSML-17-24	Puspmalli (Sukma)	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
25.	IGDb-MHL-17-25	Mohala (Rajnandgaon)	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
26.	IGDb-BRMG-17-26	Bhairamgarh (Bijapur)	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
27.	IGDb-DMTR-17-27	Dhamtari	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
28.	IGDb-BLD-17-28	Darbari Nawagaon (Balod)	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
29.	IGDb-MDKMT-17-29	Mendrakhurd (Ambikapur)	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber
30.	IGDb-MDKDR-17-30	Mendrakhurd (Ambikapur)	Cultivated (Collected from <i>Badi</i> )	Aerial Tuber

**Table.2** Morphological characterization of indigenous genotypes of Aerial Yam (*Dioscorea bulbifera*) as per IPGRI descriptor

S. N.	A. Leaf characters							
	Collection No. and Name	Leaf shape	Leaf position	Distance between lobes	Petiole colour	Petiole length in correlation to leaf blade	Leaf apex shape	Leaf margin
1	IGDb-MTPL-17-1	Cordate	Opposite	Intermediate	All green with purple at both ends	Long	Acute	Entire
2	IGDb-BJP-17-2	Cordate	Opposite	Intermediate	All purplish green with purple at both ends	Medium	Acute	Entire
3	IGDb-GDM-17-3	Cordate	Opposite	Intermediate	All green with purple at both ends	Long	Acute	Entire
4	IGDb-KDNR-17-4	Cordate	Opposite	Intermediate	All green with purple at both ends	Short	Acute	Entire
5	IGDb-KSKL-17-5	Cordate	Opposite	Intermediate	All green with purple at both ends	Short	Acute	Entire
6	IGDb-GRBD-17-6	Cordate	Opposite	Intermediate	All green with purple at both ends	Short	Acute	Entire
7	IGDb-UMDH-17-7	Cordate	Opposite	Intermediate	All purplish green with purple at both ends	Short	Acute	Entire
8	IGDb-KRB-17-8	Cordate	Opposite	Intermediate	All purplish green with purple at both ends	Long	Acute	Entire
9	IGDb-RJNG-17-9	Cordate	Opposite	Intermediate	All green with purple at both ends	Long	Acute	Entire
10	IGDb-NGR-17-10	Cordate	Opposite	Intermediate	All green with purple at both ends	Long	Acute	Entire
11	IGDb-KNR-17-11	Cordate	Opposite	Intermediate	All green with purple at both ends	Long	Acute	Entire
12	IGDb-MLGD-17-12	Cordate	Opposite	Intermediate	All green with purple at both ends	Long	Acute	Entire
13	IGDb-GOLGD-17-13	Cordate	Opposite	Intermediate	All purplish green with purple at both ends	Medium	Acute	Entire
14	IGDb-KNDR-17-14	Cordate	Opposite	Intermediate	All purplish green with purple at both ends	Long	Acute	Entire
15	IGDb-KDRS-17-15	Cordate	Opposite	Intermediate	All green with purple at both ends	Long	Acute	Entire
16	IGDb-NRNP-17-16	Cordate	Opposite	Intermediate	All green with purple at both ends	Long	Acute	Entire
17	IGDb-ARNL-17-17	Cordate	Opposite	Intermediate	All green with purple at both ends	Long	Acute	Entire
18	IGDb-MOTT-17-18	Cordate	Opposite	Intermediate	All green with purple at both ends	Long	Acute	Entire
19	IGDb-ATPL-17-19	Cordate	Opposite	Intermediate	All green with purple at both ends	Long	Acute	Entire
2	IGDb-KNGD-17-20	Cordate	Opposite	Intermediate	All green with purple at both ends	Long	Acute	Entire
21	IGDb-NDPL-17-21	Cordate	Opposite	Intermediate	All green with purple at both ends	Long	Acute	Entire
22	IGDb-MTR-17-22	Cordate	Opposite	Intermediate	All purplish green with purple at both ends	Long	Acute	Entire
23	IGDb-KTGD-17-23	Cordate	Opposite	Intermediate	All purplish green with purple at both ends	Long	Acute	Entire
24	IGDb-PSML-17-24	Cordate	Opposite	Intermediate	All purplish green with purple at both ends	Long	Acute	Entire
25	IGDb-MHL-17-25	Cordate	Opposite	Intermediate	All green with purple at both ends	Long	Acute	Entire
26	IGDb-BRMG-17-26	Cordate	Opposite	Intermediate	All green with purple at both ends	Long	Acute	Entire
27	IGDb-DMTR-17-27	Cordate	Opposite	Intermediate	All green with purple at both ends	Medium	Acute	Entire
28	IGDb-BLD-17-28	Cordate	Opposite	Intermediate	All green with purple at both ends	Long	Acute	Entire
29	IGDb-MDKMT-17-29	Cordate	Opposite	Intermediate	All green with purple at both ends	Medium	Acute	Entire
30	<b>IGDb-MDKDR-17-30</b>	<b>Cordate</b>	<b>Opposite</b>	<b>Intermediate</b>	<b>All green with purple at both ends</b>	<b>Long</b>	<b>Acute</b>	<b>Entire</b>

**Table.3** Morphological characterization of indigenous genotypes of Aerial Yam (*Dioscorea bulbifera*) as per IPGRI descriptor

S. No.	B. Vine, plant and aerial Tuber characters						
	Collection No. and Name	Aerial tuber Texture	Aerial tuber skin colour	Aerial tuber Shape	No. of underground tuber	Twining direction	Present/ absent of spine
1.	IGDb-MTPL-17-1	Wrinkled	Dark Brown	Round	1	Clockwise	Absent
2.	IGDb-BJP-17-2	Rough	Dark Brown	Round	1	Clockwise	Absent
3.	IGDb-GDM-17-3	Wrinkled	Dark Brown	Round	1	Clockwise	Absent
4.	IGDb-KDNR-17-4	Smooth	Light Brown	Round	1	Clockwise	Absent
5.	IGDb-KSKL-17-5	Smooth	Dark Brown	Round	1	Clockwise	Absent
6.	IGDb-GRBD-17-6	Smooth	Light Brown	Round	1	Clockwise	Absent
7.	IGDb-UMDH-17-7	Wrinkled	Light Brown	Round	1	Clockwise	Absent
8.	IGDb-KRB-17-8	Rough	Dark Brown	Round	1	Clockwise	Absent
9.	IGDb-RJNG-17-9	Rough	Dark Brown	Round	1	Clockwise	Absent
10.	IGDb-NGR-17-10	Wrinkled	Light Brown	Round	1	Clockwise	Absent
11.	IGDb-KNR-17-11	Rough	Dark Brown	Round	1	Clockwise	Absent
12.	IGDb-MLGD-17-12	Rough	Dark Brown	Round	1	Clockwise	Absent
13.	IGDb-GOLGD-17-13	Wrinkled	Dark Brown	Round	1	Clockwise	Absent
14.	IGDb-KNDR-17-14	Rough	Dark Brown	Round	1	Clockwise	Absent
15.	IGDb-KDRS-17-15	Rough	Dark Brown	Round	1	Clockwise	Absent
16.	IGDb-NRNP-17-16	Wrinkled	Light Brown	Round	1	Clockwise	Absent
17.	IGDb-ARNL-17-17	Rough	Dark Brown	Round	1	Clockwise	Absent
18.	IGDb-MOTT-17-18	Wrinkled	Light Brown	Round	1	Clockwise	Absent
19.	IGDb-ATPL-17-19	Rough	Dark Brown	Round	1	Clockwise	Absent
20.	IGDb-KNGD-17-20	Rough	Dark Brown	Round	1	Clockwise	Absent
21.	IGDb-NDPL-17-21	Rough	Dark Brown	Round	1	Clockwise	Absent
22.	IGDb-MTR-17-22	Wrinkled	Light Brown	Round	1	Clockwise	Absent
23.	IGDb-KTGD-17-23	Wrinkled	Light Brown	Round	1	Clockwise	Absent
24.	IGDb-PSML-17-24	Wrinkled	Light Brown	Round	1	Clockwise	Absent
25.	IGDb-MHL-17-25	Rough	Dark Brown	Round	1	Clockwise	Absent
26.	IGDb-BRMG-17-26	Rough	Dark Brown	Round	1	Clockwise	Absent
27.	IGDb-DMTR-17-27	Wrinkled	Light Brown	Round	1	Clockwise	Absent
28.	IGDb-BLD-17-28	Rough	Dark Brown	Round	1	Clockwise	Absent
29.	IGDb-MDKMT-17-29	Wrinkled	Light Brown	Round	1	Clockwise	Absent
30.	<b>IGDb-MDKDR-17-30</b>	<b>Rough</b>	<b>Dark Brown</b>	<b>Round</b>	<b>1</b>	<b>Clockwise</b>	<b>Absent</b>

**Table.4** Frequency distribution of quantitative traits of *Dioscorea bulbifera*

S.N.	Quantitative characters	Index and description adopted	Frequency (%)
1.	Leaf shape	Cordate	100
2.	Leaf position	Opposite	100
3.	Distance between lobes	Intermediate	100
4.	Petiole colour	All purplish green with purple at both ends	73.33
		All green with purple at both ends	26.67
5.	Petiole length in correlation to leaf blade	Short (<2cm)	13.33
		Medium (=2cm)	13.33
		Long (>2cm)	73.33
6.	Leaf apex shape	Acute	100
7.	Leaf margin	Entire	100
8.	Aerial tuber Texture	Smooth	10
		Wrinkled	40
		Rough	50
9.	Aerial tuber skin colour	Light brown	36.67
		Dark brown	63.33
10.	Aerial tuber Shape	Round	100
11.	Present/ absent of spine	Absent	100
12.	Twinning direction	Present	100

### Leaf and petiole character

All the collected genotypes of *Dioscorea bulbifera* exhibits cordate leaf shape, opposite leaf position, entire leaf margin, acute apex shape and distance between lobes is intermediate. No. of leaves/plant ranged from 12.43 to 23.94. Highest number of leaves was recorded in genotype IGDb-MHL-17-25 and lowest in IGDb-BJP-17-2. Highest leaf length (14.09 cm) was observed in genotypes IGDb-NGR-17-10 and lowest leaf length (8.51 cm) was recorded in IGDb-MHL-17-25.

Genotypes were categorized into two groups on the basis of petiole colour. Petiole colour varied from all green with purple at both ends and all purplish green with purple at both ends with the frequency of 26.67% and 73.33% respectively. Genotypes were categorized in to three groups *i.e.* short, medium and large petiole length in correlation to leaf blade. The highest frequency was observed in long petiole length in correlation to leaf blade (73.3%) followed by short (13.3%) and medium (13.33%).

### Stem and plant character

All the collected genotypes exhibit clockwise

twinning habit and spineless stem. No spine was recorded in collected genotypes; however stem length, internode number to 1<sup>st</sup> branching differs significantly.

### Tuber character

Genotypes are categorized into three groups on the basis of aerial tuber texture *i.e.* smooth, wrinkled and rough. Highest frequency (50%) was recorded as rough aerial tuber texture followed by wrinkled (40%) and lowest frequency (10%) was recorded as smooth aerial tuber texture. All the collected *Dioscorea bulbifera* genotypes exhibit round shape aerial tuber having single underground tuber. The collected genotypes shows dark brown and light brown aerial tuber skin colour with the frequency of 63.33% and 36.67% respectively.

*Dioscorea bulbifera* globally known as aerial yam or air potato is distinguished from the other *Dioscorea* species by having special aerial bulbils which appear at the base of the leaf petioles (Croxtton *et al.*, 2011; Silva *et al.*, 2016). The range and mean performance showed the presence of considerable amount of variability among the accessions. For instance,

bulbils fresh yield varied from 4.39 to 14.57 tones/ha, tuber yield varied from 2.0 to 8.22 tones/ha, number of bulbils varied from 43.66 to 98.67/plot, bulbils length varied from 5.33 to 9.0 cm and tuber diameter varied from 5.64 to 9.15 cm (Mulualem and Mohammed, 2012).

Mulualem and WeldeMichae, G. (2013) characterized *Dioscorea* Species and observed that, the bulbils skin color of the accessions ranged from light brown (23.40%) to dark brown (40.43%), whereas bulbils were round (38.30%), oval (34.04%), elongate (21.28%) and irregular (6.38%) in shape. In this study, accessions showed three different bulbils surface textures: smooth (61.70%), wrinkled (14.90%) and rough (23.40%). Similarly, it is in agreement with the works of Muluneh *et al.*, (2006) who reported that there is a wide range of variability of tubers among in Ethiopia. Furthermore, similar result *Dioscorea* species was reported by Asfaw (2006) in Taro and Woyessa (2006) in *Plectranthus edulis*.

## References

- Anonymous. 2005. Annual Report of the National Bureau of Plant Genetic Resources 2005 - 2006, NBPGR, Pusa Campus, New Delhi, India, 148 pp.
- Asfaw K. 2006. Characterization and divergence analysis of some Ethiopian taro (*Colocasia esculenta* (L.) accessions. M.Sc thesis, Alemaya University, Alemaya.
- Croxton M.D., Andreu M.A., Williams D.A., Overholt W.A., Smith J.A. 2011. Geographic Origins and Genetic Diversity of Air-Potato (*Dioscorea bulbifera*) in Florida. *Invasive Plant Science and Management*, 4: 22-30.
- Muluneh, T. 2006. Assessing diversity in yam (from Ethiopia based on morphology, AFLP *Dioscorea* spp.) marker and tuber quality and farmers' management of landraces. Ph.D. thesis, George –August University. Germany
- Mulualem, T. and Mohammed, H. 2012. Genetic variability and association among yield and yield related traits in Aerial Yam (*Dioscorea bulbifera* (L.) Accessions at South western Ethiopia. *Journal of Natural Sciences Research*, 2:9.
- Mulualem T. and WeldeMichae G. 2013. Agronomical Evaluation of Aerial Yam/*Dioscorea bulbifera*/ Accessions collected from South and Southwest Ethiopia. *Greener Journal of Agricultural Sciences* 3 (9), pp. 693-704.
- Silva D.M., Siqueira M.V.B.M., Carrasco N.F., Mantello C.C., Nascimento W.F., Veasey E.A. 2016. Genetic diversity among air yam (*Dioscorea bulbifera*) varieties based on single sequence repeat markers. *Genetics and molecular research*, 2016, 15, gmr.15027929.
- Thomas, T. A and P. N. Mathur. 1991. Germplasm Evaluation and Utilization. In: Plant Genetic Resources Conservation and Management. R. S. Paroda and R. K. Arora (eds.).Published by the International Board for Plant Genetic Resources, Regional Office for South and Southeast Asia, NBPGR, Pusa Campus, New Delhi 110012, India. pp. 149-181.
- Woyessa, G. 2006. Morphological characterization and divergence analysis of (Vatke) *Plectranthus edulis*. Agnew collection in Ethiopia. M.Sc. thesis, Presented to School of Graduate Studies, Hawassa University, Awassa.

### How to cite this article:

Kamal Narayan, J. Singh, Deo Shankar, R. Gayen, N. Mehta and Saxena, R. R. 2020. Collection and Characterization of Indigenous *Dioscorea bulbifera* Genotypes of Chhattisgarh. *Int.J.Curr.Microbiol.App.Sci.* 9(09): 3463-3469. doi: <https://doi.org/10.20546/ijcmas.2020.909.430>