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Evaluation of indigenous *Dioscorea bulbifera* genotypes of Chhattisgarh for yield and yield attributing traits

Kamal Narayan, J Singh, Deo Shankar, R Gayen, N Mehta and RR Saxena

Abstract
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 stable food of tribal farmers of Chhattisgarh. Morphological characters show that the collected indigenous genotypes of *D. bulbifera* genotypes varied markedly. The genotypes are evaluated for growth, yield and quality attributes. The genotype IGDb-ARNL-17-17 recorded the highest plant height (9.43m), highest weight of individual aerial tuber (84.31 g), maximum aerial tuber diameter (6.06cm), maximum aerial tuber and underground tuber yield per plant, 1.019 kg and 0.140 kg respectively and highest aerial tuber yield (18.11 t/ha). The genotype IGDb-MHL-17-25 recorded the highest number of aerial tuber per plant (15.20). The genotype IGDb-MTPL-17-1 takes lowest (4.97) internode number to 1st branching. The maximum overall acceptability of aerial tuber was recorded (7.01) in genotypeIGDb-MTPL-17-1, whereas lowest was recorded (4.64) in genotypeIGDb-GDM-17-3.Underground tubers of all the collected genotypes of aerial yam were disliked by panel of judges.

Keywords: Evaluation, *Dioscorea bulbifera*, attributing traits

Introduction
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 stable food of tribal farmers of Chhattisgarh.
Dioscorea bulbifera is characterized by its aggressively high-climbing annual twining stems, large ovate leaves with prominent veins, and potato-like aerial tubers in the leaf axils (Morton 1974; Long and Lakela, 1976) [7, 4]. Production of large numbers of aerial tubers allows for rapid proliferation and colonization. The plants grow rapidly in full sun and they can overgrow and kill native flora (Schultz, 1993) [11]. According to Morisawa (1999) [6], vines grow as rapidly as 20 cm per day. There are eight economically most important species of yams that are cultivated as staples throughout the tropics (Coursey, 1967; Muluneh, 2006) [3, 9].Aerial yam (*Dioscorea bulbifera*) is one of the economically most important species of yam; it is distinguished from all other species by having particular bulbils on the base of leaves petioles to such an extent that tuberization is solely aerial (Martin, 1974; Tewodros, 2008) [5, 12].
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) [13].

Materials and Methods
The present investigation entitled "Evaluation of indigenous *Dioscorea bulbifera* genotypes of Chhattisgarh for yield and yield attributing traits" was conducted at IGKV, Shaheed Gundadhoor 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 *Diascorea* (*Diascorea bulbifera*) collected from twelve districts of Chhattisgarh *viz*., Bastar, Korba, Dhamtari, Rajnandgaon, Surguja, Kondagaon, Sukma, Balod, Narayanpur, Kanker, Dantewada and Bijapur. The experiment was laid out in Randomized Complete Block Design (RCBD) with 30 genotypes of *Diascorea* with 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 *Diascorea spp.* The analysis of variance was carried out for each character separately as per method of Panse and Sukhatme (1967) [10].

The cooked aerial and underground tubers were evaluated in three replications by a panel of 11 judges consisting of staff and students of SG College of agriculture and Research Station, Kumhrawand, Jagdalpur, Chhattisgarh for organoleptic test. Scoring was done for various characters based on 10 marks headonic scale rating (Amerine *et al*., 1965) [1]. The values given by each of the 11 judges were then averaged for statistical analysis. The scoring system for assessment of quality is described below:

Organoleptic Score	Scale (Rating)
9-10	Liked extremely (LE)
8-9	Liked very much (LVM)
7-8	Liked moderately (LM)
6-7	Liked slightly (LS)
5-6	Neither liked nor disliked (NLND)
4-5	Disliked slightly (DS)
3-4	Disliked moderately (DM)
2-3	Disliked very much (DVM)
1-2	Disliked extremely (LE)

Results and Discussion

Evaluation of *D. bulbifera* genotypes for growth and yield attributes

Leaf, plant and stem characters

The analysis of variance for each of the 14 characters of 30 genotypes was carried out on pooled basis. The results revealed that the differences due to genotypes were highly significant (Table- 1&2) for characters studied.

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, no. of leaves/plant at 30 days after emergence (DAE) varied 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.

Stem length varied from 126.17 cm to 208.57 cm, highest internode numbers (22.90) were recorded in genotypes IGDb-MHL-17-25 and lowest internode number (11.39) was recorded in IGDb-BJP-17-2. The genotype IGDb-MTPL-17-1 takes lowest (4.97) internode number to 1st branching. The genotype IGDb-MHL-17-25 recorded the more number of branches (7.82) above ground and highest plant height (9.43 m) at maturity was recorded in genotype IGDb-ARNL-17-17.

Tuber character

Collected *Dioscorea bulbifera* genotypes exhibit significant difference for number of aerial tuber/plant, weight of individual aerial tuber, aerial tuber diameter, weight of aerial tuber per plant, aerial tuber yield (t/ha), weight of underground tuber per plant and dry matter content of aerial tuber.

Number of aerial tuber per plant ranged from 3.62 to 15.20, recorded in genotype IGDb-DMTR-17-27 and IGDb-MHL-17-25, respectively with the mean of 8.63**.** Highest weight of individual aerial tuber (84.31 g) was recorded in genotype IGDb-ARNL-17-17 and lowest (28.66 g) in genotype IGDb-GOLGD-17-13**.** Mean performance for both years was 57.32g**.** Aerial tuber diameter ranged from 3.80 cm to 6.06 cm, recorded in genotype IGDb-GOLGD-17-13 and IGDb-ARNL-17-17 respectively with the mean of 4.92 cm.

Weight of aerial tuber per plant shows significant differences and ranged from 0.179 kg to 1.019 kg with the mean of 0.497 kg/plant. Highest weight of aerial tuber per plant was recorded in genotypeIGDb-ARNL-17-17 followed by genotype IGDb-MHL-17-25 (0.886 kg/plant) and lowest was recorded in genotype IGDb-DMTR-17-27.

Aerial tuber yield ranged from 3.18 t/ha to 18.11 t/ha with mean performance of 8.84 t/ha. Highest aerial tuber yield was recorded in genotype IGDb-ARNL-17-17 and differed significantly from all other genotypes. Highest underground tuber per plant was recorded in genotype IGDb-ARNL-17-17 (0.140 kg/plant) followed by IGDb-ATPL-17-19 (0.112 kg/plant) and lowest was recorded in genotype IGDb-MDKMT-17-29 (0.024 kg/plant). Mean performance for both years was 0.069 kg/plant.

Mulualem and Mohammed (2012) reported that 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. Furthermore, similar result was reported by Asfaw (2006) in Taro and Woyessa (2006) [14] in *Plectranthus edulis.*

Evaluation of *D. bulbifera* genotypes for quality attributes

Dry Matter Content: Dry matter content of aerial tuber ranged from 24.05% to 32.74% recorded in genotype IGDb-KDNR-17-14 and IGDb-ARNL-17-17, respectively with mean of 26.91% from both the year.

Organoleptic evaluation

The organoleptic score of *D. bulbifera* was recorded after cooking of aerial and underground tuber for overall acceptability by panel of judges. Keeping these various attributes of aerial and underground tuber; the results are presented in table -3.

The maximum overall acceptability of aerial tuber was recorded (7.01) in genotypeIGDb-MTPL-17-1, whereas lowest was recorded (4.64) in genotypeIGDb-GDM-17-3.

Underground tubers of all the collected genotypes of aerial yam were disliked by panel of judges. The maximum overall acceptability of underground tuber was recorded (4.47) in genotype IGDb-MTPL-17-1, whereas lowest was recorded (2.95) in genotype IGDb-RJNG-17-9.

Table 1: Mean performance of Aerial Yam (*Dioscorea bulbifera*) genotypes: Pooled analysis (2017-18 & 2018-19)

Genotypes	Characters													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
IGDb-MTPL-17-1	8.72	183.50	22.16	8.36	21.04	4.97	7.04	14.09	57.29	0.809	4.92	14.38	0.111	28.84
IGDb-BJP-17-2	8.97	132.10	12.43	6.20	11.39	4.98	4.22	6.57	43.87	0.287	4.48	5.11	0.039	26.13
IGDb-GDM-17-3	8.55	179.71	15.22	8.00	14.33	6.99	6.43	12.19	53.96	0.660	4.77	11.72	0.093	27.78
IGDb-KDNR-17-4	10.15	133.78	14.40	5.09	13.25	8.13	4.24	4.60	56.24	0.258	4.88	4.59	0.037	25.41
IGDb-KSKL-17-5	12.49	146.32	15.33	6.12	14.43	6.78	4.68	6.37	72.53	0.463	5.65	8.22	0.065	27.28
IGDb-GRBD-17-6	13.63	126.17	13.52	5.45	12.48	9.01	4.69	4.43	68.16	0.303	4.64	5.39	0.042	31.66
IGDb-UMDH-17-7	8.79	184.38	16.22	6.42	15.29	5.49	6.86	12.12	35.79	0.433	3.93	7.69	0.056	25.23
IGDb-KRB-17-8	8.87	164.26	14.69	8.22	13.75	6.72	5.80	9.14	73.29	0.668	5.61	11.88	0.088	28.70
IGDb-RJNG-17-9	12.84	153.00	14.45	6.64	13.50	6.69	4.79	6.54	71.13	0.466	5.69	8.28	0.062	28.40
IGDb-NGR-17-10	14.09	167.68	15.77	5.67	14.53	8.58	4.75	7.86	43.42	0.342	4.35	6.07	0.048	26.60
IGDb-KNR-17-11	10.14	173.43	15.14	7.32	14.14	5.68	5.96	9.40	59.68	0.557	5.11	9.91	0.077	27.65
IGDb-MLGD-17-12	13.37	156.98	13.96	7.82	13.01	6.04	4.38	7.63	75.48	0.574	5.74	10.21	0.082	29.25
IGDb-GOLGD-17-13	12.28	171.83	14.87	5.13	13.85	6.13	5.22	9.36	28.66	0.271	3.80	4.82	0.038	24.36
IGDb-KNDR-17-14	8.72	168.84	13.86	7.77	12.86	8.20	4.69	8.84	59.83	0.530	5.21	9.42	0.075	24.05
IGDb-KDRS-17-15	11.70	159.62	14.27	6.99	13.26	8.62	6.37	7.54	66.18	0.499	5.29	8.88	0.067	24.48
IGDb-NRNP-17-16	10.67	194.41	17.83	6.44	16.76	6.79	4.88	10.92	43.85	0.475	4.49	8.45	0.065	27.62
IGDb-ARNL-17-17	12.26	202.28	21.60	9.43	20.53	6.73	7.81	12.08	84.31	1.019	6.06	18.11	0.140	32.74
IGDb-MOTT-17-18	9.74	176.35	13.77	5.74	12.71	8.03	4.97	7.24	57.32	0.418	4.92	7.43	0.061	27.19
IGDb-ATPL-17-19	13.86	186.29	19.92	8.37	19.02	7.61	6.67	10.94	76.60	0.840	5.89	14.93	0.112	25.90
IGDb-KNGD-17-20	12.76	161.88	16.00	5.78	14.82	7.26	4.45	7.55	60.15	0.454	5.10	8.07	0.059	24.93
IGDb-NDPL-17-21	8.82	197.49	21.26	8.99	20.48	8.15	7.25	11.92	58.33	0.695	4.89	12.35	0.097	28.70
IGDb-MTR-17-22	11.28	191.51	19.71	7.34	16.88	8.23	6.59	11.62	46.67	0.546	4.63	9.71	0.074	27.51
IGDb-KTGD-17-23	13.45	186.71	21.63	7.61	20.75	6.68	7.16	12.47	57.43	0.716	5.00	12.72	0.101	28.26
IGDb-PSML-17-24	14.01	142.20	16.84	4.31	15.74	6.73	3.69	5.26	47.51	0.247	4.48	4.39	0.036	24.11
IGDb-MHL-17-25	8.51	208.57	23.94	8.99	22.90	6.45	7.82	15.20	59.02	0.896	4.87	15.93	0.136	25.87
IGDb-BRMG-17-26	13.63	175.11	17.83	7.39	16.88	5.63	6.76	10.62	67.11	0.709	5.38	12.60	0.097	24.60
IGDb-DMTR-17-27	13.15	130.41	15.46	4.12	14.44	6.97	3.61	3.62	49.26	0.179	4.65	3.18	0.026	24.51
IGDb-BLD-17-28	11.58	134.51	13.40	5.12	12.36	7.92	3.67	4.96	37.19	0.185	3.89	3.29	0.027	26.82
IGDb-MDKMT-17-29	10.72	137.12	14.69	5.30	13.65	7.25	3.60	3.87	48.84	0.188	4.53	3.35	0.024	26.75
IGDb-MDKDR-17-30	13.79	130.92	12.49	4.53	11.57	7.59	3.50	3.96	60.40	0.238	4.82	4.23	0.031	25.88
General Mean	11.38	165.24	16.42	6.69	15.35	7.03	5.42	8.63	57.32	0.497	4.92	8.84	0.069	26.91
Sem	0.09	3.81	1.09	0.33	1.10	0.45	0.35	0.60	1.44	0.03	0.13	0.64	0.003	0.90
Sed	0.13	5.40	1.54	0.47	1.55	0.64	0.49	0.85	2.04	0.05	0.19	0.90	0.004	1.27
CD at 5%	0.27	10.81	3.09	0.95	3.12	1.28	0.98	1.70	4.08	0.10	0.39	1.81	0.009	2.55
CV (%)	1.48	4.00	11.51	8.70	12.44	11.17	11.08	12.08	4.36	12.56	4.87	12.56	7.79	5.81

1. Leaf length (cm)
2. Stem length (cm) 20 DAE
3. No. of leaves /plant (30DAE)
4. Plant height (m)
5. Internode no. (30 DAE)
6. No. of internode to 1st branching
7. Number of branches above ground
8. Numbers of aerial tuber per plant
9. Weight of aerial tuber (gm)
10. Weight of aerial tuber/plant (kg)
11. Aerial tuber Diameter (cm)
12. Aerial tuber Yield (t/ha)
13. weight of underground tuber per plant (kg)
14. Dry matter content of aerial tuber (%)

Table 2: Analysis of Variance for yield and yield attributing traits of Aerial Yam (*Dioscorea bulbifera*): Pooled analysis (2017-18 & 2018-19)

	Mean Sum of Squires		
	Replication	Genotype	Error
Observations df	**2**	**29**	**58**
1. Leaf length (cm)	0.0202	12.130*	0.0285
2. Stem length (cm) 20 Days after emergence (DAE)	15.586	1746.729*	43.749
3. No. of leaves /plant (30 Days after emergence)	6.350	29.939*	3.576
4. Plant height (m)	0.036	6.603*	0.339
5. Internode no. (30 Days after emergence)	6.906	29.249*	3.647
6. No. of internode to 1st branching	0.208	3.522*	0.6177
7. Number of branches above ground	0.506	5.565*	0.360
8. Numbers of aerial tuber per plant	0.282	31.870*	1.087
9. Weight of aerial tuber (gm)	8.994	521.094*	6.241
10.Weight of aerial tuber/plant (kg)	0.00209	0.1550*	0.00390
11. Aerial tuber Diameter (cm)	0.1151	0.9950*	0.0574
12. Aerial tuber Yield (t/ha)	0.6626	48.992*	1.233
13. weight of underground tuber per plant (kg)	0.000018	0.00303*	0.000028
14. Dry matter content of aerial tuber (%)	1.478	13.550*	2.446

*Significant at 5% levels.

Table 3: Organoleptic score of steam boiled aerial tuber of *Dioscorea bulbifera* on hedonic scale

S.No.	Treatment	Cooking quality	Appearance of tuber after cooking	Flavour of cooked tuber	Texture of cooked tuber	Sweetness of cooked tuber	Over all acceptability	Hedonic scale rating
1	IGDb-MTPL-17-1	7.01	8.94	6.01	7.96	5.12	7.01	LM
2	IGDb-BJP-17-2	6.50	5.51	4.84	4.26	4.16	5.05	NLND
3	IGDb-GDM-17-3	6.24	6.01	4.73	3.11	3.11	4.64	DS
4	IGDb-KDNR-17-4	6.31	5.12	4.68	3.76	3.76	4.73	DS
5	IGDb-KSKL-17-5	5.69	4.32	5.16	5.74	3.92	4.97	DS
6	IGDb-GRBD-17-6	5.16	4.68	5.76	6.02	5.12	5.35	NLND
7	IGDb-UMDH-17-7	6.01	5.89	4.98	6.71	5.62	5.84	NLND
8	IGDb-KRB-17-8	5.12	5.01	6.17	7.13	4.78	5.64	NLND
9	IGDb-RJNG-17-9	5.66	6.01	6.02	4.76	4.65	5.42	NLND
10	IGDb-NGR-17-10	5.06	5.76	5.13	5.35	3.98	5.06	NLND
11	IGDb-KNR-17-11	6.18	5.99	5.99	6.31	4.09	5.71	NLND
12	IGDb-MLGD-17-12	6.2	5.86	6.12	5.52	5.1	5.76	NLND
13	IGDb-GOLGD-17-13	6.09	6.17	6.02	4.83	4.3	5.48	NLND
14	IGDb-KNDR-17-14	6.58	6.90	5.35	6.12	4.45	5.88	NLND
15	IGDb-KDRS-17-15	7.02	6.84	5.76	5.14	5.62	6.08	LS
16	IGDb-NRNP-17-16	6.67	7.01	5.16	3.39	5.55	5.56	NLND
17	IGDb-ARNL-17-17	7.22	7.64	6.02	4.48	6.02	6.28	LS
18	IGDb-MOTT-17-18	7.02	7.11	6.13	6.36	5.12	6.35	LS
19	IGDb-ATPL-17-19	4.81	4.02	5.84	6.12	5.41	5.24	NLND
20	IGDb-KNGD-17-20	5.26	4.66	5.16	5.38	4.88	5.07	NLND
21	IGDb-NDPL-17-21	5.33	4.89	5.64	7.18	3.78	5.36	NLND
22	IGDb-MTR-17-22	6.08	5.67	5.55	4.36	4.32	5.20	NLND
23	IGDb-KTGD-17-23	5.34	6.18	5.72	5.38	5.22	5.57	NLND
24	IGDb-PSML-17-24	6.04	6.24	5.16	6.12	4.98	5.71	NLND
25	IGDb-MHL-17-25	7.19	7.09	5.79	7.02	6.32	6.68	LS
26	IGDb-BRMG-17-26	5.18	6.16	7.88	7.44	5.02	6.34	LS
27	IGDb-DMTR-17-27	5.55	4.89	6.79	5.65	5.67	5.71	NLND
28	IGDb-BLD-17-28	7.18	4.06	8.12	5.32	5.35	6.01	LS
29	IGDb-MDKMT-17-29	6.66	4.12	7.79	4.89	5.01	5.69	NLND
30	IGDb-MDKDR-17-30	7.82	4.10	5.3	5.55	5.44	5.64	NLND

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