Characterization of Groundnut (*Arachis hypogaea* L.) varieties as per DUS Guidelines

A.R. Karthikeyan, S. Ezhilkumar and P. Karthikeyan

Department of Genetics and Plant Breeding,
Faculty of Agriculture, Annamalai University, Annamalainagar 608 002, T.N., India

ABSTRACT

Seventy-five varieties of groundnut (*Arachis hypogaea* L.) were studied to know various morphological characters (DUS) responsible for the identification of groundnut varieties. Seeds were collected from National Oilseed Research Station, Junagadh, Gujarat, India. The groundnut varieties were evaluated with three replications using the randomized block design (RBD) in farmers field Mittahalli village, Krishnagiri, Tamil Nadu, India during 2020-21, 2021-22. Observation were recorded on morphometric characters *viz.*, seed colour, seed shape, testa colour, 100 seed weight, plant growth habit, leaflet size, leaflet colour, stem pubescence, flower present on main axis, flower arrangement on side branches, pod constrictions, pod reticulation, and presence of beak. On other hand plant growth habit, kernal colour, kernal shape and testa colour are important characters for the identification of groundnut varieties.

Introduction

Groundnut (*Arachis hypogaea* L.) is a legume crop and it is derived from two Greek words *viz.*, *Arachis* means legume and *hypogaea* means below the ground referring to geocarpic nature of pod formation. It is the thirteenth most important food crop and fourth most important oilseed crop in the world. It is grown in an area of 295 lakhhectares with production and productivity of 487 lakh tonnes and 1647 kg/ha^{-1} respectively in 2019. In India, it is cultivated in an area of 6014.95 ha with production and productivity of 10244.08 tonnes and 1703 kg/ha^{-1} respectively in 2021. Last ten decades, more than 130 improved varieties of groundnut have been released for commercial cultivation in India. All the released varieties have not been characterized for various morphological character to enable the identification of the varieties.

The differences in morphology act as a initial basics to differentiate one variety from other variety. The Government of India has enacted Plant Varieties and Farmers' Rights Act, 2001 for providing protection to plant varieties based on distinctiveness, uniformity and stability test (DUS test), which gives the importance to the farmers, breeders and researchers and treat them as partners in their effort for sustainable food security. The variety should be distinctiveness (capability of the variety to show clear differences among the varieties) uniformity (homogeneity within the variety) and stability (characteristics remain unchanged after repeated propagation) under PPV and FR Act 2001. The identified variety should be distinctiveness to be established and very important for its varietal registration Individual morphological characters have limited application, but when individual morphological characters used in conjunction with each other showed

considerable importance in detecting the varietal purity of the crop. The characters used for DUS test are primarily morphological characters being scored in the field and laboratory or with specific markers in the field during various growth stages of the crop varietal characterization *viz.,* seed, seedling, vegetative stage, reproductive stage and maturation stage. The morphological descriptors in sequential manner is useful and convenient to distinguish the different varieties. Keeping this in view, the present study was carried out to differentiate 75 groundnut varieties based on morphological markers as per DUS characterization.

Materials and Method

The genetically pure seventy-five groundnut varieties developed in India were used as source material for conduct of the experiment. All the varieties were collected form National Oilseed Research Station, Junagadh, Gujarat, India (Table 1). The field experiment was conducted at farmers' field in Mittahalli village, Krishnagiri District, Tamil Nadu, India with latitude 12.42° and longitude 78.17°. All groundnut

varieties were evaluated for two kharif seasons during 2020-21 and 2021-22. The experiment was conducted in randomized block design (RBD) with three replications and a plot size of 3 rows and 6 meter length. The recommended agronomic practices were followed for raising the crop. Morphometric characters were observed with help of a descriptors provided by National Test Guidelines and UPOV for the conduct of DUS test and totally 13 characters were recorded *viz.,* seed colour, seed shape, testa colour and 100 seed weight, plant growth habit, leaflet size, leaflet color, stem pubescence, flower present on main axis, flower arrangement on side branches, pod constrictions, pod reticulation and presence of beak. For grouping of varieties based on similarity in the character, clusters were formed genotypes and they were grouped using the R (studio) statistical programme to generate dendrogram.

Results and Discussion

Thirteen characters were observed in 75 varieties of groundnut to establish distinctiveness among the

Table 1. List of varieties used for the study of Distinctiveness, Uniformity and Stability Test

S.No	Genotypes	S.NO	Genotypes	S.NO	Genotypes
1	AK 12-24	26	ICGS 11	51	S 206
2	AK 159	27	ICGS 37	52	SB XI
3	ALR 2	28	ICGS 44	53	SG 84
4	BSR 1	29	ICGV 86590	54	SG 99
5	CO 1	30	J 11	55	SP. IMPROVED
6	CO 2	31	JAWAN	56	TAG 24
7	CO 3	32	JL 220 (PHULE VYAS)	57	TG 17
8	CSMG 2001-2	33	JL 286 (PHULE UNAP)	58	TG 22
9	DH 40	34	JYOTHI	59	TG 26
10	DH 4-3	35	K 134	60	TG 3
11	DH 8	36	KADIRI 4	61	TG 37A
12	DH 86	37	KADIRI 5	62	TG 38
13	DRG 12	38	KISAN	63	TG 51
14	GANGAPURI	39	KOPARGAON 3	64	TIRUPATI 2
15	GAUG 1	40	KRG 1	65	TIRUPATI 4
16	GG 2	41	LGN 1	66	TKG 19 A
17	GG 3	42	M III	67	TLG 45
18	GG 4	43	MH 1	68	TMV 11
19	GG 5	44	MH 4	69	TMV 12
20	GG 6	45	OG 52-1	70	TMV 2
21	GIRNAR 1	46	R 2001-2	71	TMV 9
22	GIRNAR 3	47	R 2001-3	72	TPG 41
23	GPBD 4	48	R 8808	73	VG 9521
24	ICG (FDRS)4	49	R 9251	74	VRI 2
25	ICGS 1	50	RG 141	75	VRI 4

varieties and these were presented below as per the national test guide lines for the conduct of DUS test in groundnut (Anonymous, 2009). All the varieties were characterized in such a manner that essential characters considered first to classify similar and dissimilar varieties based on the expression of the characters.

The seed morphological characters *viz.*, testa color, kernal color, kernal shape and 100 kernel weight were easy to measure and classified the groundnut varieties into few broad categories. Testa color was observed as uniform in 62 varieties and the rests were observed (KEDARI-1, TPG-41, TMV-11, JAVAN, TG-17, TMV-2, TG-22, CO-1, TMV-9,

Table 2. Frequency distribution of Groundnut varieties for various DUS characters

S.No	Characters	States	Scale	No of Gen	FD (%)
1	Plant: Growth habit	Erect	1	08	10.66
		Semi-spreading	2	66	88
		Spreading	3	01	1.33
2	Leaflet: Size (fully developed basal leaflet)	Small (<4.0 cm)	3	57	76
		Medium(<4.0 –6.0 cm)	5	18	24
		Large (>6.0 cm)	7	00	00
3	Leaflet: Colour	Light green	1	20	26.66
		Green	2	39	52
		Dark green	3	16	4
4	Stem: Pubescence	Absent	1	00	00
		Sparse	3	40	53.33
		Medium	5	35	46.66
5	Flower: Presenceon main axis	Absent	1	44	58.66
		Present	9	31	41.33
6	Flower: Arrangement onside branches	Sequential	1	41	54.66
		Alternate	2	22	29.33
		Irregular	3	12	16
7	Pod: Constriction	Absent	1	15	20
		Shallow	3	27	36
		Medium	5	26	34.66
		Deep	7	07	9.33
8	Pod: Reticulation	Absent	1	07	9.33
		Medium	3	21	28
		Prominent	5	47	62.66
9	Pod: Presence ofbeak	Absent	1	25	33.33
		Present	9	50	66.66
10	Testa: Colour	Uniform	1	62	82.66
		Variegated	9	13	17.33
11	Kernel: Colour of testa (varieties with monochrome testa only)	White (1 A 1)	1	00	00
		Off white (1 A 2)	2	04	5.33
		Tan (12 E 4)	3	29	38.66
		Rose (Grayish red 8 B3)	4	11	14.66
		Purple (14 F 4)	5	07	9.33
		Dark purple(14 F 7)	6	04	5.33
		Salmon (6 A 4)	7	11	14.66
		Red (10 B 7)	8	05	6.66
		Dark red (11 C 8)	9	04	5.33
12	Kernel: Shape	Spheroid	1	35	46.66
		Cylindrical	2	31	41.3
		Fusiform	3	09	312
13	Kernel: Weight of 100 kernels (about 9% moisture)	Low (<36 g)	3	61	81.33
		Medium (36-50 g)	5	13	17.33
		High (51-65 g)	7	01	1.33
		Very high (>65 g)	9	00	00

AK-12-24, AK 159, TIRUPATI-2 and DRG 12). Based on kernel colour the varieties were grouped as, tan colour in 4 varieties (KISAN, CO-1, GG-6 and GG-3), rose color in 11 varieties, purple color in 7 varieties (CO-3, GIRNAR-1, LGN-1, TAG-24, GG-2, KADIRI-4 and TLG-45), dark purple color in 4 varieties (VG 9521, K134, TG 37A and DRG12), red color in 5 varieties (VIR-4, TPG 41, R 2001-3, GANGAPURI AND R 8868), dark red color in 4 varieties (DH40, KOPURGAN-3, OG521 and MH4) and 11 varieties were grouped as salmon color (Table 2). Maximum weight (51-65g) per 100 seeds were recorded in (TLG 45), low seed weight (>36g) were observed in 61 varieties, medium 100 seed weight (36-50g) were observed in 13 varieties and none of the varieties recorded very high 100 seed weight (>65g). Based on the seed shape, the studied 75 varieties were grouped as spheroid in 35 varieties, cylindrical in 31 varieties and 9 varieties as fusiform (VIR 3, KGV-86, CSMG-2001-2, KSG-11, TKG 19A, GIRNAR-3, TGL-7, LGN-7, LGN-1 and SG-99) were recorded. These results were in conformity with the findings of Calderin *et al*. (2002) in *Vigna radiata* and *Vigna unguiculate* (2006) in sunflower and Patra *et al*. (2010) in rice revealed the use of seed characters for the identification of varieties.

For the plant growth habit, among the 75 varieties studied, 8 varieties were observed as erect (JYOTHI, K-134, TMV-12, TMV-2, TMV-9, VG9521, VRI-2 AND VRI-4), 66 varieties were of semi-

spreading type and one genotype was spreading growth habit (CSMG-2001-2). The small leaflet size less (⁰4) cm was observed in 57 varieties and medium size (4-6 cm) was observed in 18 varieties and none of the varieties were observed in large leaf let size (>6 cm). The leaf let color of 25 varieties were light green color and 39 varieties were green color and 16 varieties were observed as dark green leaflet color. Similar research findings were reported in crops like *Viciafaba* (Bond and Crofton, 2001), pearl millet (Arunkumar *et al*., 2004), Jute (Kumar *et al*., 2006), Lucerne (Dumbre *et al*., 2007), maize (Yadav and Singh, 2010) and switch grass (Cortese *et al*., 2010) for varietal identification.

The stem pubescence was present in all the varieties with spares stem pubescence was observed in 40 varieties and medium stem pubescence was observed in 35 varieties.

Based on the flower character the studied 75 varieties of groundnut were grouped into two categories as flower present on main axis was observed in 31 varieties and rest of the varieties were observed as absent on main axis. Same as like in flower arrangement on side branches were categorized into sequential, alternate and irregular. So out of 75 genotypes 41 varieties of flower were sequential, 22 varieties of flower were alternate and 12 varieties like CO-2, CSMG 2001-2, DRG-12, GAUG 1, GG2, GG6, KISAN, OG 52-1, R 2001-3 R8808, SBXI AND TKG 19A showed irregular arrangement of flower
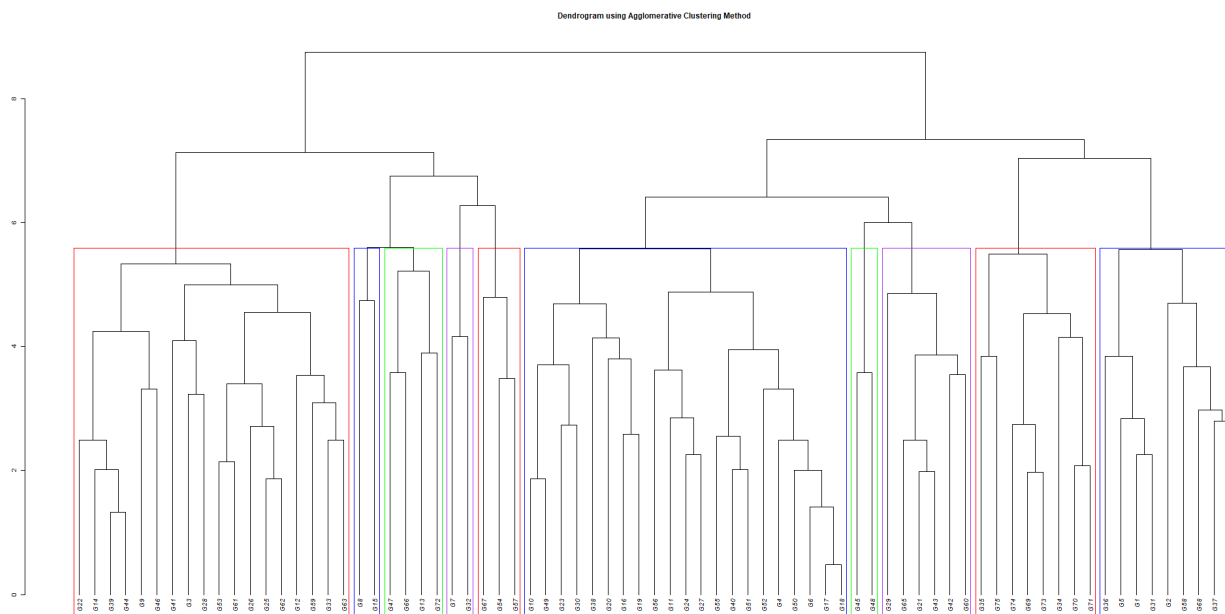

Fig. 1. Dendrogram of 75 varieties of groundnut based on 13 morphological traits

on side branches. Gupta *et al.* (2010) Distinctness in Indian soybean (*Glycine max*), (Palmer *et al.*, 2004; Takahashi *et al.*, 2008)

The pod constriction was as observed shallow in 27 varieties, medium in 26 varieties and deep constriction was observed in (7 varieties)(ICGV 86590, JL 220, MIII, TG 3 TIRUPATI 4 and VRI 2) and pod constriction was absent in 15 varieties. The pod reticulation was observedon 21 varieties, prominent pod reticulation was observed in 47 varieties and pod reticulation was absent in 7 varieties. The pod beak was present in 50 varieties and was absent in rest of the varieties.

Dendrogram results

A dendrogram (Fig. 1) based on R (studio) statistical analysis indicated that the 75 varieties were grouped into two main clusters (main cluster I and main cluster II). Main cluster I was further grouped into 5 sub clusters (sub clusters I, II, III, IV and V). Sub-cluster I was further divided into two sub groups (Ia-1 and Ia-2). Sub group Ia-1 consisted of 6 varieties and Ia-2 consisted of 12 varieties. Sub cluster II consisted of 2 varieties, sub cluster III consisted of 4 varieties, sub cluster IV consisted of 2 varieties and sub cluster V consisted of 3 varieties. The main cluster II was further grouped into 5 sub clusters (sub clusters I, II, III, IV and V). Sub cluster I grouped into two sub group IIa-1 and IIa-2, sub group IIa-1 consisted of 8 varieties and IIa-2 consisted of 13 varieties. Sub cluster II consisted of 2 varieties, sub cluster III consisted of 6 varieties, sub cluster IV consisted of 8 varieties and sub cluster V consisted of 9 varieties.

Conclusion

From the above studies, it is concluded that 75 groundnut varieties were found to be distinctive on the basis of 13 essential characters. From that the identification of varieties based on plant character gave better results inspite of many short comings. This study will be useful for breeder, researchers and farmers to identify groundnut varieties and the seek protection under Protection of Plant Varieties and Farmers Rights Act, 2001.

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