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Metroglyph analysis of Groundnut germplasms for the assessment of morphological variations and preliminary classification

Bajrang Lal Jakhar, Sanjay Kumar Sanadya, Smrutishree Sahoo and MM Sharma

Abstract
Morphological variations among 30 advance lines of groundnut were estimated using metroglyph and Index Score method for ten quantitative characters. The analysis of variance revealed significant differences among the genotypes for all characters. High estimates of the genotypic coefficient of variation (GCV) were observed for Seed yield per plant followed by the Seed Index, biological yield per plant and Harvest Index. Seed yield per plant and Seed Index showed high GCV and plotted a graph on their mean values which represented as a glyph. Remaining eight characters were depicted by a ray, the ray for anyone trait having the same position on each glyph. Thirty germplasms of groundnut were grouped into eight clusters, out of these group IV has the highest number of genotypes. Highly diverse germplasms on the basis of their total index score were ICMS-25, ICMS-97, ICMS-26, ICMS-20, and ICMS-82. The scoring procedure would be utilized in the preliminary screening of a large number of germplasm for selection with a desirable combination.

Keywords: Metroglyph analysis, groundnut, wonder legume, preliminary screening

Introduction
Groundnut (*Arachis hypogaea* L.), designated as "Wonder Legume" otherwise known as peanut, is a very important oilseed and cash crop for the farmers in arid and semi-arid tropics of India. Being an annual legume, it ranks 13th among food crops in the world as well as the first ranking oilseed crop of India. This is a member of genus Arachis and family is in the division *Papiolionaceae* of the family *Fabaceae* (Krapovickas and Gregory, 1994) [9]. The center of origin is believed to be the southern Bolivia to northern Argentina region of South America. Among the 80 species of genus Arachis, most of the species are diploid (2n= 2x = 20), whereas only two are allotetraploids. Hybridization between two wild species, the "A-genome ancestor" *Arachis duranensis* (AA-genome, 2n= 2x = 20) and *Arachis ipaensis* (BB-genome, 2n= 2x = 20) as "B-genome ancestor" then subsequent chromosome doubling results into the amphidiploid cultivated allotetraploid groundnut (AABB, 2n= 4x = 40) (Gregory and Gregory I976) [5]. Groundnut crop is highly self-pollinated as flowers are cleistogamous in nature. Groundnut is a herbaceous annual having a well-developed root system and a taproot. Fertilization is completed before midday in general. The peg is a stalk-like structure that bears the fertilized ovules at its tip. Its growth is positively geotropic until it has penetrated the soil to some depth. The fruit of groundnut normally referred to as a pod normally contains 2-4 seeds. However, the extent of out-crossing has recorded up to 3.9 percent. Groundnut kernels are rich in protein, carbohydrate, fiber, unsaturated fat and minerals such as phosphorous (P), calcium (Ca), magnesium (Mg), vitamin E, B complex and vitamin K. (Settaluri *et al.* 2012) [15]. It contains 44-56 percent oil, 22-30 percent protein and 9.5-19 percent carbohydrate. Groundnut is grown in more than 100 countries covering 25 million hectares around the world with an annual production of 34 million tonnes of nuts-in-shell. In India groundnut occupied an area of 4.75 million hectares with the production of 6.67 million tonnes and productivity 1.4 tonnes (Anonymous, 2016a) [2]. Rajasthan occupies 4th position in both, area (0.50 million hectares) as well as in production (1.02 million tonnes), with productivity 2.02 tonnes (Anonymous, 2016b) [3]. Major Groundnut producing districts of Rajasthan are Bikaner, Jodhpur, Churu, Jaipur, Hanumangarh, Sikar, Dausa, Nagaur, and Tonk, etc. The haulms and groundnut cake are used as animal feed. As a cash crop, it is frequently traded locally, regionally and globally, contributing to the national economy as well as rural household economy.
The success of any crop improvement program depends on variations present in the population of concerned species. Genetic variability in the plant material gives a more extensive degree

for selection which is an essential necessity for crop improvement. Metroglyph and Index score method given by Anderson, (1957) [1] and stated that it is a semi graphic method for assessing the pattern of morphological variation in a large number of germplasm lines taken at a time. Pictorial representation by metroglyph analysis can be used as a measure of relative genetic distance among the germplasm entries (Datta *et al.*, 2013) [4].

Materials and Methods

Plant material

The present investigation was carried out during Kharif-2017 at Research Farm, ARS, SKRAU, Bikaner. The experimental material consisted of 30 advance lines procured from DGR, Junagarh, Gujarat, India in RBD with three replications. Each genotype was grown with a spacing of 30 cm between rows and 10 cm between plants within the row. Uniform agronomic practices were followed during the crop season to raise a good crop as recommended package and practices for the Agro-climatic zone IC of Rajasthan. The experimental germplasms were sown on June 28, 2017 and harvested on November 10, 2017.

Observations

The observations were recorded from each replication for ten characters *viz*. Days to 50% flowering, days to maturity, number of branches per plant, number of pods per plant, number of seeds per pod, shelling percent, 100-kernel weight (Seed Index), biological yield per plant, seed yield per plant and harvest index (%). Days to 50% flowering and days to maturity recorded on the plot basis in each replication.

Statistical analysis

Analysis of Variance (ANOVA) was done by subjecting the data to the statistical method based on Randomized Block Design (RBD) described by Panse and Sukhatme (1978) [10]. Estimation of genetic variability parameters *viz*., range, phenotypic coefficient of variation, genotypic coefficient of variation, heritability (h^2), genetic advance and genetic advance as % of mean were calculated separately for each character.

For metroglyph analysis, the first two characters having high variability on the basis of genotypic coefficient of variation are selected. The mean values of X character for each genotype are plotted on the graph against the mean values of Y character. A small circle by which the position of genotypes is represented on the graph is called glyph. Then the genotypes are divided into three groups and these groups are given an index score of 1, 2 and 3 respectively. Thus the whole graph is divided into 9 parts. Genotypes in each part of the graph are representing one variability group. Variation for each character is depicted by the length of ray which depends on the index score value of a genotype. Each character occupies a definite ray position. The variation is analyzed for various traits within the group and between the groups. Thus the maximum and minimum score that an individual genotype can get is 3n and n respectively where n is the total number of characters studied (Singh and Narayanan, 2000) [16].

Result and Discussion

Analysis of Variance

The analysis of variance showed significant differences among the lines indicating sufficient variability exist among the advance lines used for the present study (Table 1).

GCV and PCV

High estimates of PCV and GCV were observed for characters seed yield per plant (44.04 & 42.37), Harvest Index (30.90 & 28.16), number of pods per plant (30.04 & 26.98) and biological yield per plant (28.62 & 28.28) (Table 2). Such high genetic variation was also reported by earlier workers Ramana *et al.* (2015) [12] for Harvest Index and seed yield per plant, John *et al.* (2007) [7] for biological yield per plant, Rao *et al.* (2014) [13] for number of pods per plant and Seed Index, Wadikar *et al.* (2018) [17] for Seed Index.

Metroglyph analysis

The germplasms were plotted taking seed yield per plant on X-axis and Seed Index on Y-axis as these two characters exhibited high GCV. The range of each character was divided into three equal classes (low, medium and high respectively) and each character was represented by different length of the ray depending on their index score. Low; medium and high scores were represented with 1, 2 and 3 respectively according to their range mean of mean values (Table 3). The 30 advance lines of groundnut were graphically represented as metroglyph (Figure 1) following Anderson (1957) [1]. Group I containing the line ICMS-37 was placed farthest from the group VIII with ICMS-20. ICMS-37 and ICMS-20 had contrasting mean values for both the axes. Distributions of germplasms of groundnut have been given in Table 5. Thirty germplasms of groundnut were grouped into eight clusters among Groups I and VI, containing only one advance line each, groups II and VIII contain two advance lines each, groups III and V, containing three advance lines each, group VII, with six advance lines, and IV, comprising of twelve advance lines were placed closely on the scattered plot (Table 5). The advance lines of group IV had medium values for both axes. The total index score values recorded for 30 germplasms ranged from 15 to 26 (Table 4). The germplasm ICMS-82 showed the highest score (26), while ICMS- 13 and ICMS-37 showed the lowest score (15). The germplasms which had the index score from 21 to 26 constituted the upper superior class and the germplasms which were between the index score of 15 to 20 constituted the lower (inferior), class. Several workers had suggested metroglyph analysis for preliminary classification of genotypes in different crop plants (Punitha *et al.*, 2010; Jha *et al.*, 2011; Kang *et al.*, 2013; Sanadya *et al.* 2018) [11, 6, 8, 14].

Table 1: Analysis of Variance for different characters of groundnut

Source of variation	DF	DM	NOB	NOP	NOS	S%	SI	BY	SY	HI
Replication	10.90**	5.68*	0.24	10.86	0.03	19.49	237.86**	187.51*	21.90	4.77
Genotype	4.85**	6.94**	4.261*	156.64*	0.122**	262.27*	991.14*	2030.75*	191.84*	94.128*
Error	2.71	3.59	0.93	11.60	0.08	21.60	10.44	16.29	5.00	5.99

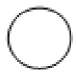
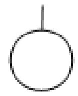
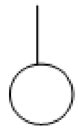
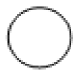
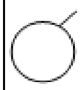
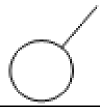
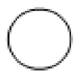
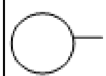
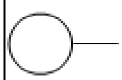
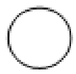
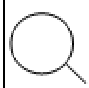
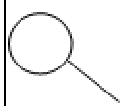
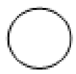
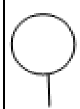
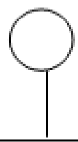
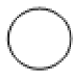
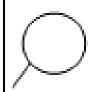
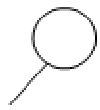
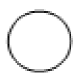
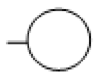
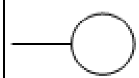
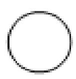
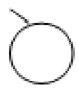
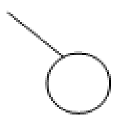
*,** significant at 5% and 1% respectively

Table 2: Estimation of genetic parameters variation for different characters in groundnut

Parameters	DF	DM	NOB	NOP	NOS	S%	SI	BY	SY	HI
Mean	33.1	132.24	7.11	25.77	1.59	56.35	60.66	91.62	18.63	19.25
Range	29-36	128-138	4-11.34	9.40-53	1-2.3	11.38-68.4	28.66-100.4	38.80-150	3.86-45.09	5.97-32.33
PCV (%)	5.59	1.64	20.08	30.04	19.34	17.91	30.28	28.62	44.04	30.90
GCV (%)	2.55	0.8	14.81	26.98	7.46	15.89	29.81	28.28	42.37	28.16
H	44.12	48.33	78.17	92.59	34.43	91.76	98.95	99.2	97.39	93.64
GA	1.16	1.51	1.92	13.78	0.14	17.67	37.05	53.17	16.04	10.8
GA as % mean	3.49	1.15	26.98	53.48	9.02	31.36	61.08	58.03	86.13	56.14

DF = Days to 50% flowering, DM = Days to maturity, NOB = Number of branches per plant, NOP = Number of pods per plant, NOS = Number of seed per plant, S% = Shelling %, SI = Seed Index, BY = Biological Yield per plant, SY = Seed yield per plant and HI = Harvest Index

Table 3: Index score and signs used for eight characters for metroglyph analysis of Groundnut germplasms

S. No.	Character	Range	Score1		Score2		Score3	
			Value less than	Sign	Value from - to	Sign	Value more than	Sign
1	Days to 50% flowering	29-36	31		32-34		35	
2	Days to maturity	128-138	131		132-135		136	
3	No. of branches per plant	4-11.34	6.4		6.5-8.8		8.9	
4	No. of pods per plant	9.40-53	23.5		23.6-37.5		37.6	
5	No. of seed per pod	1-2.3	1.4		1.5-1.8		1.9	
6	Shelling %	11.38-68.4	30		31-50		51	
7	Biological yield per plant (g)	38.80-150	75		76-113		114	
8	Harvest Index	5.97-32.33	14.5		14.6-23.40		23.41	

Pictorial representation of germplasms (Figure 1) as brought about by the scattered plot of metroglyph analysis can be used as a measure of relative genetic distance among the germplasms. The metroglyph analysis was found to be useful for preliminary classification of germplasm and its divergence study. Coupled with an index score, metroglyph could be of great use in preliminary screening and classification of genotypes when a large number of germplasm are available. Highly diverse germplasms on the basis of their total index score were ICMS-25, ICMS-97, ICMS-26, ICMS-20 and ICMS-82, and less diverse germplasms were ICMS-13, ICMS-37, ICMS-91, ICMS-89 and ICMS-6. It can be also inferred that the scoring procedure would be utilized in the preliminary screening of a large number of genotypes for selection of germplasm with a desirable combination of various characters influencing the seed yield per plant with Seed Index in groundnut.

Table 4: A total index score of groundnut germplasms for ten characters

Germplasms	DF	DM	NOB	NOP	NOS	S%	SI	BY	SY	HI	Total
ICMS-3	2	2	3	1	2	2	3	3	1	2	21
ICMS-4	1	2	3	1	2	3	3	3	2	2	22
ICMS-6	1	2	2	2	2	3	2	1	1	2	18
ICMS-10	1	2	2	2	2	3	2	2	2	2	20
ICMS-12	2	2	2	1	2	3	3	2	2	2	21
ICMS-13	2	2	2	2	1	1	2	1	1	1	15
ICMS-16	2	1	1	2	1	3	3	2	2	3	20
ICMS-17	2	2	2	1	2	3	3	1	1	2	19
ICMS -20	2	2	2	2	2	3	3	3	3	3	25
ICMS-25	3	2	2	2	1	3	2	2	2	3	22
ICMS-26	3	1	2	2	2	3	3	3	2	2	23
ICMS-28	2	2	2	1	2	3	2	1	1	2	18
ICMS-32	3	2	2	1	2	2	1	3	1	1	18
ICMS-33	2	1	2	2	3	3	2	1	1	2	19
ICMS-36	2	3	1	2	2	3	1	1	1	2	18
ICMS-37	2	1	1	1	3	3	1	1	1	1	15
ICMS-43	1	1	1	2	2	3	2	1	2	3	18
ICMS-50	2	2	2	1	2	3	1	1	1	3	18
ICMS-58	2	2	2	2	2	3	2	2	1	2	20
ICMS-59	2	2	2	3	2	3	2	3	1	1	21
ICMS-71	2	2	1	2	3	3	1	2	2	2	20
ICMS-79	3	1	2	2	3	3	2	2	1	1	20
ICMS-82	2	2	2	3	3	3	2	3	3	3	26
ICMS-83	3	2	1	1	1	3	2	2	1	2	18
ICMS-88	2	2	1	1	1	3	1	2	2	3	18
ICMS-89	2	2	1	1	1	3	2	1	1	3	17
ICMS-90	2	3	2	1	2	3	3	1	1	2	20
ICMS-91	2	2	2	1	1	3	1	2	1	1	16
ICMS-97	2	2	2	2	3	3	2	2	2	2	22
ICMS-100	2	1	2	2	2	3	3	2	2	2	21
Total	61	55	54	49	59	86	62	56	45	62	589

DF = Days to 50% flowering, DM = Days to maturity, NOB = Number of branches per plant, NOP = Number of pods per plant, NOS = Number of seed per plant, S% = Shelling %, SI = Seed Index, BY = Biological Yield per plant, SY = Seed yield per plant and HI = Harvest Index

Table 5: Distribution of groundnut germplasms into different clusters

Cluster	Number of germplasm	Composition of cluster	Distribution
I	1	ICMS-37	Low seed yield per plant and low seed index
II	2	ICMS-36 and ICMS-50	Moderate seed yield and low seed index
III	3	ICMS-13, ICMS-32, and ICMS-91	Low seed yield and moderate seed index
IV	12	ICMS-6, ICMS-10, ICMS-28, ICMS-33, ICMS-43, ICMS-58, ICMS-59, ICMS-71, ICMS-79, ICMS-83, ICMS-88, and ICMS-89	Moderate seed yield and moderate seed index
V	3	ICMS-25, ICMS-82, and ICMS-97	High seed yield and moderate seed index
VI	1	ICMS-90	Low seed yield and High seed index
VII	6	ICMS-3, ICMS-4, ICMS-12, ICMS-17, ICMS-26 and ICMS-100	Moderate seed yield and High seed index
VIII	2	ICMS-16 and ICMS-20	High seed yield and high seed index

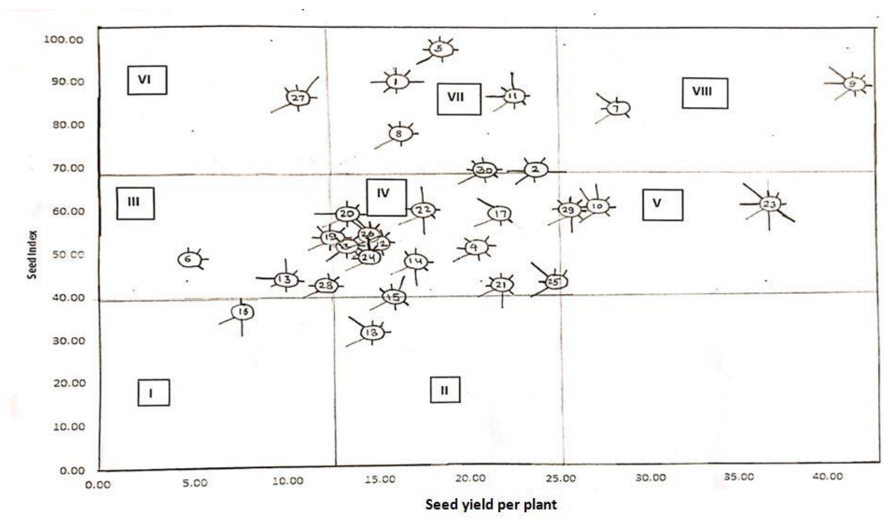


Fig 1: Scattered diagram of metroglyph analysis of groundnut germplasms

Authors' contribution

Conceptualization of research; designing of the experiments; execution of field experiments and data collection; analysis of data and interpretation; preparation of the manuscript.

Declaration

The authors declare no conflict of interest.

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References

1. Anderson R. A semigraphical method for the analysis of complex problems. Proc. Natl. Acad. Sci. USA. 1957; 43:923-927.
2. Anonymous. Agricultural Statistics – At a Glance, MoA & FW, GOI, 2016a.
3. Anonymous. Rajasthan Agricultural Statistics – At a Glance, Commissionerate of Agriculture, Government of Rajasthan, Jaipur, 2016b, 76.
4. Datta D, Mukherjee BK, Barua NS, Das SP. Metroglyph analysis of maize (*Zea mays* L.) Inbreds for preliminary classification and group constellation. African Journal of Agricultural Research. 2013; 8(45):5659-5663.
5. Gregory WC, Gregory MP. Groundnut. In: *Evolution of Crop Plants*, Simmonds NW(Ed.). Longman Group Ltd., London, 1976, 151-154.
6. Jha UC, Singh DP, Paul PJ, Roopa GL. Metroglyph analysis for morphological variation in chickpea (*Cicer arietinum* L.). Madras Agricultural Journal. 2011; 98:121-123.
7. John K, Vasanthi RP, Venkateswarlu O. Variability and correlation studies for pod yield and its attributes in F_2 generation of six Virginia x Spanish crosses of groundnut (*Arachis hypogaea* L.). Legume Research. 2007; 30(4):292-296.
8. Kang SA, Muhammad N, Farooq AK, Frasat S. Divergence analysis and association of some economical characters of sugarcane (*Saccharum officinarum* L.). Journal of Plant Breeding and Genetics. 2013; 1:1-6.
9. Krapovickas A, Gregory WC. *Taxonomía del género Arachis* (*Leguminosae*). Bonplandia. 1994; 8:1-186.
10. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers. ICAR pub. New Delhi, 1978, 361.
11. Punitha D, Ganesamurthy K, Rajarathinam S. Metroglyph analysis of morphological variations in sorghum germplasm collections. Electronic Journal of Plant Breeding. 2010; 1:536-541.
12. Ramana EV, Vasanthi RP, Reddy KH, Reddy BVB, Reddy BR. Studies on genetic variability for yield, yield components and resistance to kalahasti malady in groundnut (*Arachis hypogaea* L.). International Journal of Applied Biology and Pharmaceutical Technology. 2015; 6(1):72-74.
13. Rao VT, Venkanna V, Bhadru D, Bharathi D. Studies on variability, character association and path analysis on groundnut (*Arachis hypogaea* L.). International Journal Pure and Applied Biology. 2014; 2(2):194-197.
14. Sanadya SK, Shekhawat SS, Sahoo S, Kumar A, Kumari N. Metroglyph analysis in sewan grass (*Lasiurus sindicus* Henr.) accessions. Forage Research. 2018; 44(2):86-89.
15. Settaluri VS, Kandala CVK, Puppala N, Sundaram J. Peanuts and Their Nutritional Aspects-A review Food and Nutrition Sciences. 2012; 3:1644-1650.
16. Singh P, Narayanan SS. Biometrical Techniques in Plant Breeding. Revised edition. Kalyani Publishers, New Delhi, 2000, 264.
17. Wadikar PB, Dake AD, Chavan MV, Thorat GS. Studies on character association and variability studies of yield and its attributing character in groundnut (*Arachis hypogea* L.). International Journal Current Microbiology and Applied Science. 2018; 6:924-929.