

Genetic Divergence Study in Groundnut Genotypes (*Arachis hypogaea* L.)

Abstract: Employing the Mahalanobis D^2 statistic, a divergence study was performed on 36 groundnut genotypes and 13 clusters were identified. Indicating that the genotypes of these groups may be more divergent from one another, the maximum inter-cluster distance (D) was found between cluster II and cluster XIII (315.56), followed by cluster III and cluster IX (289.56), cluster III and cluster XII (289.21), and cluster XII and cluster XIII (297.11). The genotypes in the mentioned clusters showed a significant difference in the means for traits that contribute significantly to yield, indicating that the genotypes in these clusters make ideal parents in a hybridization programme to produce transgressive segregants and improve groundnut.

Key words: Clusters, genetic divergence, groundnut

Introduction: Groundnut (*Arachis hypogaea* L.) is the member of *Papilionaceae* subfamily of the *Fabaceae* family which included chief edible oil seed crops in the world. South America is where the domesticated peanut (*Arachis hypogaea* L.) first appeared. It is a significant source of food, fuel and oil. According to Jambunathan et al. (1985), groundnut seeds (kernels) contain 35.6–54.2% oil, 16.2–36.0% protein (Dwivedi et al. 1990) and 10–20% carbohydrates (Salunkheet al. 1992). 100 g of the kernels provide 564 kcal of energy (Jambunathan, 1991). Additionally, the seeds are a good source of vitamins E, niacin, folacin, riboflavin, and thiamin as well as minerals including calcium, phosphorus, and iron. The success of a plant breeding programme is greatly influenced by the selection of suitable parents. It is anticipated that using divergent parents will produce hybrids with potential recombinants. Genetic improvement mostly depends upon the amount of genetic variability present in the population. When a plant breeder is concerned with a complicated trait like pod yield, the combined merit of many desired traits becomes more significant than any one character. In order to increase the pod and kernel yield, parents must be chosen based on the proportion of characters with quantitative divergence, which can be determined using the D^2 -statistic developed by Mahalanobis (1936). The present study was conducted to determine the nature and magnitude of genetic divergence among the 36 bunch type groundnut genotypes, which will help to plan hybridization programmes to develop groundnut varieties with improved traits. Murty and Arunachalam (1966) stressed the use of Mahalanobis's D^2 statistic for estimating genetic divergence because it allows precise comparison among all the population in given any groups before executing actual crosses.

Materials and Methods: At the Research Farm of the Department of Genetics and Plant Breeding, RVSKVV, College of Agriculture, Gwalior (M.P.), during the Kharif season 2018–19, an experiment involving 36 groundnut genotypes for 14 traits was carried out using a randomized block design (RBD) with three replications. Each genotype was sown in one row of 5 m length with a spacing of 30 cm x 10 cm for each replication. The 14 numerical characters include Days to Maturity, Number of Pods per Plant, Days to 50% Flowering, Number of Primary Branches per Plant, Plant Height (cm), Number of Secondary Branches per Plant, and Days to 50% Fruiting. Five randomly chosen plants from each genotype in each replication were measured for their pod yield per plant (gm), 100 pod weight (gm), kernel yield per plant (gm), shelling percentage (%), pod yield per hectare (kg), sound mature kernel (%) and kernel yield per hectare (kg). Using Mahalanobis D^2 (1936), expanded by Rao (1952), the genetic diversity between genotypes was calculated. According to Tocher's technique, the genotypes were categorized into clusters based on their D^2 values (Rao, 1952).

The intra- and inter-cluster distances were calculated utilising Singh and Chaudhary's approach from 1985. The method of Singh was used to calculate the each character's contribution to divergence.

Results and Discussion: Based on D^2 value, the 36 groundnut genotypes were divided into 13 clusters (Table 2). Cluster I included the most genotypes (19), followed by Cluster IV (6), and the remaining clusters each contained a single genotype. According to Zaman et al. (2010), the inter-cluster distance (Table 3) was greater than the intra-cluster distance, indicating that the genotypes of the distant group have more diversity. The inter-cluster distance analysis revealed that clusters II and XIII had the highest divergence (315.56), followed by cluster III and IX (289.56), cluster III and XII (289.21), and cluster XII and cluster XIII (297.11). Because these clusters had relatively high divergence in comparison to others, the genotypes in these clusters can be used to choose the parents for hybridization. Cluster III and Cluster V were next in line with a minimum inter-cluster distance of 27.81, followed by Cluster II and Cluster VI with a minimum inter-cluster distance of 47.89. While other clusters were mono-genotypic with no intra-cluster divergence, in cluster 4 (66.88) and cluster I (45.14) had the highest intra-cluster distances. Character's role in contributing to divergence (Table 1) were observed maximum in 100 pod weight(21.59%) followed by number of primary branches per plant(21.27%), number of secondary branches per plant(20.48%), pod yield per plant(18.10%), sound mature kernel(13.65%), plant height(1.90%), number of pods per plant(1.59%) whereas, magnitude of genetic divergence was less than one per cent for 100 kernel weight(0.79%), days to 50% flowering(0.16%), pod yield per hectare(0.16%), and kernel yield per hectare(0.32%). Days to maturity, plant production of kernels per day, and shelling percentage do not influence divergence. [These findings are in conformity with those reported earlier in groundnut by Vivekananda et al. \(2015\); Niveditha et al. \(2017\); Chavadhari et al. \(2018\) and Saritha K et al. \(2018\).](#) According to a suggestion, the character contributing the most to divergence should be prioritized for future hybridization projects. The emphasis should be placed on genotypes belonging to clusters II, III, IX, XII, and XIII for choosing parents used for further crop development programmes, considering the cluster distances and cluster means in the current analysis.

Conclusion: JGN-3 of cluster XIII, ICGV-13564 of cluster XII, ICGV-13558 of cluster IX, Girnar-3 of cluster III, and ICGV-13208 of cluster II were found to be diverse and superior for kernel yield and the majority of the attributing features based on genetic diversity study. These genotypes might be used in upcoming breeding programmes for advancement.

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Reference:

- Chavadhari R.M., Kachhadia V.H., Vachhani J. H., Virani M.B. (2017). Genetic variability studies in groundnut (*Arachis hypogaea* L.). *Electronic Journal of Plant Breeding*, **8**(4):1288-1292.
- Dwivedi S.L., Jambunathan R., Nigam S.N., Raghunath K., Ravi Shankar K. and Nagabhushanam G.V.S. (1990). Relationship of seed mass to oil and protein contents in peanut. *Peanut Science*, **17**(2): 48-52.

- Jambunathan R., Raju S.M. and Barde S.P. (1985). Analysis of oil content of groundnut by nuclear magnetic resonance spectrometry. *Journal of the Science of Food and Agriculture*, **36**(2): 162-166.
- Murty, B. R. and Arunachalam, V. (1966). The nature of divergence in relation to breeding systems in crop plants. *Journal of Genetics and Plant Breeding*, **25**: 188-198.
- Mahalanobis, P.C. (1936). On the generalized distance in statistics. *Proceedings on Natural Institute of Sciences, India*, **2**(1): 49-55.
- Niveditha P.D., Sudharani M. and Rajesh A.P. (2017). Genetic diversity for kernel yield and qualitative traits in peanut stem necrosis tolerant groundnut genotypes of Andhra Pradesh. *Electronic Journal of Plant Breeding*, **8**(1): 390-394.
- Rao, C.R. (1952). *Advanced Statistical Methods in Biometrical Research*, John Wiley and Sons, New York, pp 390.
- Salunkhe D.K., Chavan K., Adsule R.N. and Kadam S.S. (1992). Peanut, In: *World oilseeds. Chemistry, Technology, and Utilization*. Van Nostrand Reinhold Publ. Co., New York, pp 140-216.
- Saritha K., Vasanthi R.P., Priya M.S. and Latha P. (2018). Genetic divergence analysis in groundnut (*Arachis hypogaea* L.). *Electronic Journal of Plant Breeding*, **9**(4):1361.
- Singh, D. (1981). The relative importance of characters affecting divergence. *Indian Journal Genetics*, **41**: 237-245.
- Singh, R.K. and Chaudhary, B.D. (1985). *Biometrical methods in quantitative genetic analysis*. Kalyani Publishers, New Delhi, India.
- Vivekananda Y., Khoyumthem P. and Singh N. Brajendra (2015). Genetic Divergence Analysis in Groundnut (*Arachis hypogaea* L.). *Electronic Journal of Plant Breeding*, **6** (1): 315-317.
- Zaman, M.A., Tuhina-Khatum, Bhuiyan, M.M.H., Moniruzzamn, M. and Yousuf, M.N. (2010). Genetic divergence in groundnut (*Arachis hypogaea* L.). *Bangladesh Journal of Plant Breeding and Genetics*, **23**(1):45-4

Table 1: percent contribution of characters towards divergence in 36 groundnut genotypes

S.N.	Characters	Times Ranked 1 st	% contribution of traits towards divergence
1	100 pod weight (gm)	136	21.59 %
2	Number of primary branches per plant	134	21.27 %
3	Number of secondary	129	20.48 %
4	Pod yield per plant	114	18.1 %
5	Sound mature kernel (%)	86	13.65 %
6	Plant height (cm)	12	1.9 %
7	Number f pods per plant	10	1.59 %
8	100 kernel weight (gm)	5	0.79 %
9	Kernel yield per ha(kg)	2	0.32 %
10	Days to 50% flowering	1	0.16 %
11	Pod yield per ha (kg)	1	0.16 %
12	Days to maturity	0	0.00 %
13	Kernel yield per plant (gm)	0	0.00 %
14	Shelling percentage	0	0.00 %

Table 2: Distribution of groundnut genotypes in different clusters

Cluster	Number of genotypes	Genotypes
I	19	ICGV -13562, ICGV-13554, ICGV-13560, ICGV-13575, ICGV-13557, ICGV-13214, ICGV-9895, ICGV-13219, ICGV-13226, ICGV-13227, ICGV-13220, ICGV-13233, ICGV-13235, ICGV-13240, ICGV-8010, ICGV-13246, ICGV-8110, ICGV-13545, Girnar 2
II	1	ICGV-13208
III	1	Girnar 3
IV	6	ICGV-13567, ICGV-13565, ICGV-13237, ICGV-13229, PBS-12200, PBS-12201
V	1	ICGV-13243
VI	1	ICGV-13555
VII	1	ICGV-13574
VIII	1	Mallika
IX	1	ICGV-8705
X	1	ICGV-13558
XI	1	ICG-X-1400-65-F ₂
XII	1	ICGV-13564
XIII	1	JGN-3

Table 4: Cluster means value for 14 traits in groundnut genotypes

Cluster	Plant height(cm)	Days to 50% flowering	Days to maturity	No. of primary branches per plant	No. of secondary branches per plant	No. of pods per plant	Pod yield per plant	100 pod weight (gm)	Kernel yield per plant	100 kernel weight (gm)	Shelling %	Sound mature kernel (%)	Pod yield per ha.(kg)	Kernel yield per ha.(kg)
I	26.69	36.12	111.11	3.49	3.77	21.95	9.59	112.26	6.36	34.16	64.11	85.14	3192.26	2114.30
II	26.43	36.00	111.00	4.10	4.50	25.00	14.73	145.00	9.73	36.00	62.72	85.00	4906.33	3241.33
III	20.40	39.00	114.00	3.00	3.20	24.67	7.77	82.00	5.37	32.00	70.07	80.00	2586.00	1787.33
IV	28.17	33.11	108.11	3.59	3.67	22.61	13.12	142.33	8.69	45.33	66.18	90.72	4407.17	2895.22
V	22.47	36.67	111.67	3.03	2.53	20.00	8.03	106.00	5.30	38.00	69.58	86.00	2675.00	1765.00
VI	25.80	34.67	109.67	3.33	4.00	30.33	15.13	125.00	9.93	31.00	61.74	83.00	5039.00	3308.00
VII	27.20	34.33	109.33	4.60	4.40	34.00	14.93	102.00	9.97	36.00	66.33	91.00	4972.67	3309.00
VIII	27.83	34.33	110.33	4.50	4.77	36.67	12.13	87.00	8.20	33.00	69.03	84.00	4040.67	2730.33
IX	28.07	36.00	111.00	4.03	3.50	35.00	20.03	144.0	13.50	45.00	67.48	92.00	6671.00	4495.67
X	25.50	36.00	111.00	5.00	3.40	27.67	10.20	92.00	6.87	35.00	63.54	86.00	3396.67	2286.67
XI	32.90	36.00	111.00	4.27	2.40	30.00	9.77	82.00	6.33	36.00	65.68	89.00	3252.33	2109.00
XII	32.20	35.00	110.00	5.40	3.20	37.00	17.73	118.00	11.67	40.00	65.53	90.00	5905.00	3885.00
XIII	34.10	31.00	106.00	3.07	2.93	37.00	7.97	80.00	5.37	27.00	69.40	89.00	2653.00	1781.00