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STUDY ON GENETIC VARIABILITY FOR MORPHO- PHYSIOLOGICAL AND IMPORTANT YIELD ATTRIBUTING PARAMETERS IN GROUNDNUT (*ARACHIS HYPOGAEA L.*) GENOTYPES

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ABSTRACT

An investigation has been conducted on 32 genotypes along with four checks to elicit information on genetic variability for morpho- physiological characters during *Rabi*, 2024-25 at ZARS, Kalaburagi. The study revealed substantial variability among genotypes for growth and physiological traits, as reflected by moderate to high estimates of GCV and PCV. High heritability coupled with moderate to high genetic advance as percent of mean was observed for specific leaf area, specific leaf weight, and plant height, indicating the predominance of additive gene action and scope for improvement through selection. Moderate heritability with low genetic advance for traits like SPAD reading and Normalized Difference Vegetation Index suggests a greater role of non-additive gene effects and environmental influence. Among the physiological traits, specific leaf area and specific leaf weight at 60 and 90 DAS exhibited high heritability with appreciable genetic advance, emphasizing their utility as reliable selection criteria. Trait leaf area index showed low heritability, suggesting unstable genetic expression across environments. Overall, the results highlight the presence of exploitable genetic variability, particularly in specific leaf area, specific leaf weight, and plant height, which can be effectively utilized in breeding programs to enhance productivity and adaptability in groundnut.

Keyword **:** GCV, PCV, SPAD, Morpho-physio, leaf area index.

Introduction

Groundnut (*Arachis hypogaea* L.) is a self-pollinated, allotetraploid annual legume with a chromosome number of 2n = 4X = 40 and a genome size of about 2800 Mb/1C. Morphological characterization forms an essential part of groundnut breeding, as it helps uncover genetic variability and identify genotypes possessing desirable traits for enhanced yield and adaptability across diverse environments. Groundnut yield, being a complex and quantitatively inherited trait, is influenced by both internal physiological factors such as photosynthesis, assimilate partitioning, transpiration rate, leaf area and external environmental conditions. Despite its global significance, groundnut productivity remains comparatively low due to the effects of various abiotic and biotic stresses. By integrating morphological and physiological parameters, breeders can target key traits that influence productivity. Thus, morpho-physiological studies are fundamental to improving yield potential through physio- genetic and physio-agronomic approaches. Hence, the present study was carried out to identify the high performing and adaptable groundnut genotypes.

Materials and Methods

The material for the present study consists of 32 groundnut genotypes along with four checks *viz*., Dh-245, Sunoleic 95R, Kadiri-9 and TMV-2 in a Randomized Block Design with three replications during *Rabi* season 2024-25 at ZARS Kalaburagi. In each replication every genotype was sown by randomizing with a spacing of 30 cm between the rows and 10 cm between the plants within the rows. Standard agronomic practices as per recommendations in package of practices were followed. Observations were recorded on five randomly selected plants in each row at 60 and 90 DAS and variability analysis were studied on the following traits, plant height, leaf area, NDVI, SCMR, specific leaf area and specific leaf weight.

Result and Discussion

For 36 groundnut genotypes an analysis of variance was performed to assess potential difference among different genotypes. The variance arising from both known and unknown sources was estimated, and the results are presented in Table 1. The genotypes had showed a moderate to high variability across majority of morpho- physiological traits. The ANOVA for 14 characters indicated significant difference between genotypes for number of morpho- physiological traits like plant height at 60 and 90 DAS, Leaf area at 60 and 90 DAS, NDVI at 60 and 90 DAS, SCMR at 60 and 90 DAS, specific leaf area at 60 and 90 DAS, and specific leaf weight at both five percent and one percent levels of significance.

(a) Genotypic and phenotypic coefficient of variance

The outcomes of ANOVA were used for the calculation of phenotypic and genotypic coefficients of variation (GCV and PCV), heritability and to predict genetic advance as percent of mean (GAM) for traits studied. The research investigations on coefficient of variation relies on a percent mean to express variance and the results obtained on phenotypic coefficient of variance (PCV), genotypic coefficient of variance (GCV), heritability and genetic advance as a percent mean are expressed trait wise in Table 2. The statistical values provide insights into the available variability, gene action and potential for improvement of these traits through selective breeding or other genetic interventions. The outcomes of PCV and GCV are depicted in fig. 1, further heritability and GAM in fig. 2. The PCV values were higher than GCV for all traits, indicating environmental influence (Table 2). The estimation of genotypic and phenotypic coefficient of variation indicates the amount of genetic and non-genetic present for different desirable characters.

The highest genotypic coefficient of variation (GCV) observed for specific leaf weight at 90 DAS followed by plant height at 60 DAS and specific leaf area at 60 DAS. The highest phenotypic coefficient of variation (PCV) observed for plant height at 60 DAS followed by specific leaf area at 90 DAS and leaf area index at 60 DAS. Higher GCV and PCV for plant height, specific leaf area and specific leaf weight. These results suggest that several of the evaluated traits exhibit significant genetic variability indicating the potential for improvement through selective breeding. Traits like plant height, specific leaf area and specific leaf weight are particularly promising for effective selection. The similar result was observed by Padmashree *et al*. (2023), Kumar *et al*. (2023) for plant height; Kumar *et al*. (2019) and Kalariya *et al*. (2017) for specific leaf area; Savita *et al*. (2019) for specific leaf weight; Namo *et al.* (2020) for leaf area index.

The small difference observed between PCV and GCV indicates that environmental influence was minimal, allowing the genotype to be largely expressed in the phenotype for most traits. Thus, selection based on phenotypic performance would be highly effective. In the present study, moderate values of GCV were observed for plant height at 60 DAS, specific leaf area at 60 and 90 DAS, specific leaf weight at 60 and 90 DAS. Moderate PCV values were observed for plant height at 60, 90 DAS, leaf area index 60 and 90 DAS, specific leaf area at 60, 90 DAS and leaf area index at 60, 90 DAS. In accordance with the result of John *et al.* (2011). Lower GCV and PCV was observed for leaf area at 60 and 90 DAS, NDVI at 60 and 90 DAS, SCMR at 60 and 90 DAS. Similar result was also reported by Vijayabharathi and Savithramma (2023) for leaf area; Chapu *et al*. (2022) for NDVI; Abdurrasheed *et al*. (2024) for SCMR readings.

(b) Heritability and genetic advance

High heritability was observed for plant height at 60 and 90 DAS, leaf area at 90 DAS, specific leaf area at 60 and 90 DAS and specific leaf weight at 90 DAS. Moderate heritability was observed for leaf area at 60 DAS, NDVI at 60 and 90 DAS, SCMR readings at 60 and 90 DAS and leaf area index at 60 DAS. Low heritability was observed for leaf area index at 90 DAS. Similar result obtained by Narendra *et al.* (2017).

Higher genetic advance as percent of mean was observed for plant height at 60 DAS, specific leaf area at 60 DAS and specific leaf weight at 90 DAS. These results in accordance with John *et al*. (2019) for plant height; Nagaveni and Hasan khan (2019) for specific leaf area; Savita *et al*. (2019) for specific leaf weight. Moderate GAM was observed for plant height at 90

DAS, leaf area at 60 and 90 DAS, NDVI at 90 DAS, leaf area index at 60 DAS specific leaf area at 90 and specific leaf weight at 60 DAS. Kumar et al. (2023) for plant height; Vijayabharathi and Savithramma (2023) for leaf area; Chapu *et al.* (2022) for NDVI; Namo *et al.* (2020) for leaf area index; John *et al.* (2014) for specific leaf area; Kumari *et al.* (2020) for specific leaf weight. Low GAM was observed for NDVI at 60 DAS, SCMR at 60 and 90 DAS and leaf area index at 90 DAS. Abdurrasheed *et al.* (2024) for SCMR readings; John *et al.* (2014) for leaf area index.

Conclusion

The overall findings revealed the presence of considerable variability among the genotypes studied. This existing variation can be effectively utilized through suitable breeding strategies to develop improved varieties. The high GCV and PCV values observed for most traits indicated ample genetic variability among the genotypes, which is essential for effective selection. Furthermore, high estimates of heritability and genetic advance for several traits suggest the predominance of additive gene action, indicating that direct selection for these traits would be effective in improving yield.

Table 1 : Analysis of variance for morpho-physiological traits in groundnut

Source	Df	Mean sum of squares							
		PH60	PH90	LA60	LA90	NDVI60	NDVI90	SCMR60	SCMR90
Replication	2	4.62	0.97	0.28	0.09	0.00369	0.000081	6.24	4.43
Genotype	35	12.41**	18.48**	1.78**	1.55**	0.0101**	0.0077**	13.47**	7.07**
Error	70	1.57	3.19	0.38	0.26	0.0032	0.0016	4.30	2.24
Total	107								

Contd …..

Source	Df						
		LAI60	LAI90	SLA60	SLA90	SLW60	SLW90
Replication	2	0.28	0.09	202.87	28.41	0.16	0.05
Genotype	35	1.78**	1.55**	2034.89**	869.07**	1.57**	1.18**
Error	70	0.38	0.26	112.32	63.53	0.11	0.06
Total	107						

Significant at 5% level=* and significant at 1% level=**

Where, PH60=Plant height @60DAS, PH90 =Plant height @90DAS (cm), LA60= Leaf area @60DAS, LA90= Leaf area @90DAS(dm^2), NDVI60= Normalized Difference Vegetation Index (Green seeker) @60DAS, NDVI90 = Normalized Difference Vegetation Index (Green seeker) @90DAS, SCMR60= SPAD Chlorophyll Meter Reading @60DAS, SCMR90= SPAD Chlorophyll Meter Reading @90DAS, ,LAI60= Leaf area index @60DAS, LAI90= Leaf area index @90DAS, SLA60=Specific leaf area @60DAS, SLA90=Specific leaf area @90DAS(cm^2/gm), SLW60= Specific leaf weight @60DAS, SLW90= Specific leaf weight @90DAS(mg/cm^2).

Table 2 : Estimation of mean and genetic variability for morpho-physiological traits in groundnut genotypes

Sl. No.	Trait	Mean	Range		GCV (%)	PCV (%)	h^2 (%)	GA (%)	GAM (%)
			Minimum	Maximum					
1.	Plant height (cm) @60DAS	15.41	10.65	21.22	12.33	14.77	69.73	3.27	21.21
2.	Plant height (cm) @90DAS	24.41	19.58	30.98	9.25	11.79	61.53	3.65	14.95
3.	Leaf area (dm^2) @60DAS	10.09	8.45	11.54	6.78	9.10	55.45	1.05	10.40
4.	Leaf area (dm^2) @90DAS	8.32	6.31	9.99	7.89	10.0	62.19	1.07	12.81
5.	Normalized Difference Vegetation Index @60DAS	0.81	0.62	0.90	5.99	9.18	42.97	0.07	7.81
6.	Normalized Difference Vegetation Index @90DAS	0.65	0.47	0.74	6.92	9.34	54.92	0.07	10.56
7.	SPAD Chlorophyll meter reading @60DAS	41.10	36.30	45.70	4.25	6.60	41.57	2.32	5.65
8.	SPAD Chlorophyll meter reading @90DAS	39.82	35.86	43.33	3.19	4.93	41.88	1.69	4.25
9.	Leaf area index @60DAS	2.80	2.11	3.64	8.47	13.44	39.70	0.31	10.99
10.	Leaf area index @90DAS	3.32	2.94	3.95	5.95	11.39	27.35	0.21	6.41
11.	Specific leaf area (cm^2/g) @60DAS	211.25	168.42	269.04	11.98	12.99	85.09	48.10	22.77
12.	Specific leaf area (cm^2/g) @90DAS	154.99	121.21	195.27	10.57	11.76	80.87	30.36	19.59
13.	Specific leaf weight (mg/cm^2) @60DAS	6.57	5.23	8.25	10.60	11.74	81.62	1.30	19.74
14.	Specific leaf weight (mg/cm^2) @90DAS	4.84	3.72	6.12	12.62	13.64	85.60	1.17	24.05

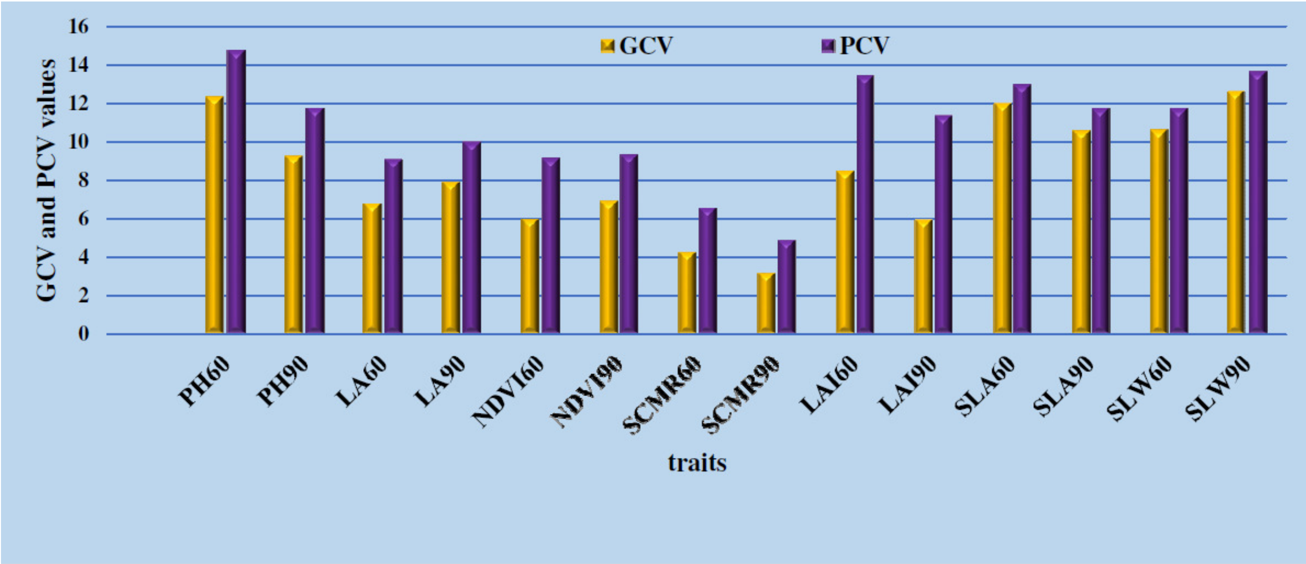

Fig. 1 : Phenotypic and genotypic coefficient of variability for morpho-physiological traits in groundnut genotypes

Where, PH60=Plant height @60DAS, PH90 =Plant height @90DAS (cm), LA60= Leaf area @60DAS, LA90= Leaf area @90DAS(dm^2), NDVI60= Normalized Difference Vegetation Index (Green seeker) @60DAS, NDVI90 = Normalized Difference Vegetation Index (Green seeker) @90DAS, SCMR60= SPAD Chlorophyll meter reading @60DAS, SCMR90= SPAD Chlorophyll meter reading @90DAS, LAI60= Leaf area index @60DAS, LAI90= Leaf area index @90DAS, SLA60=Specific leaf area @60DAS, SLA90 =Specific leaf area @90DAS(cm^2/gm), SLW60= Specific leaf weight @60DAS, SLW90= Specific leaf weight @90DAS(mg/cm^2).

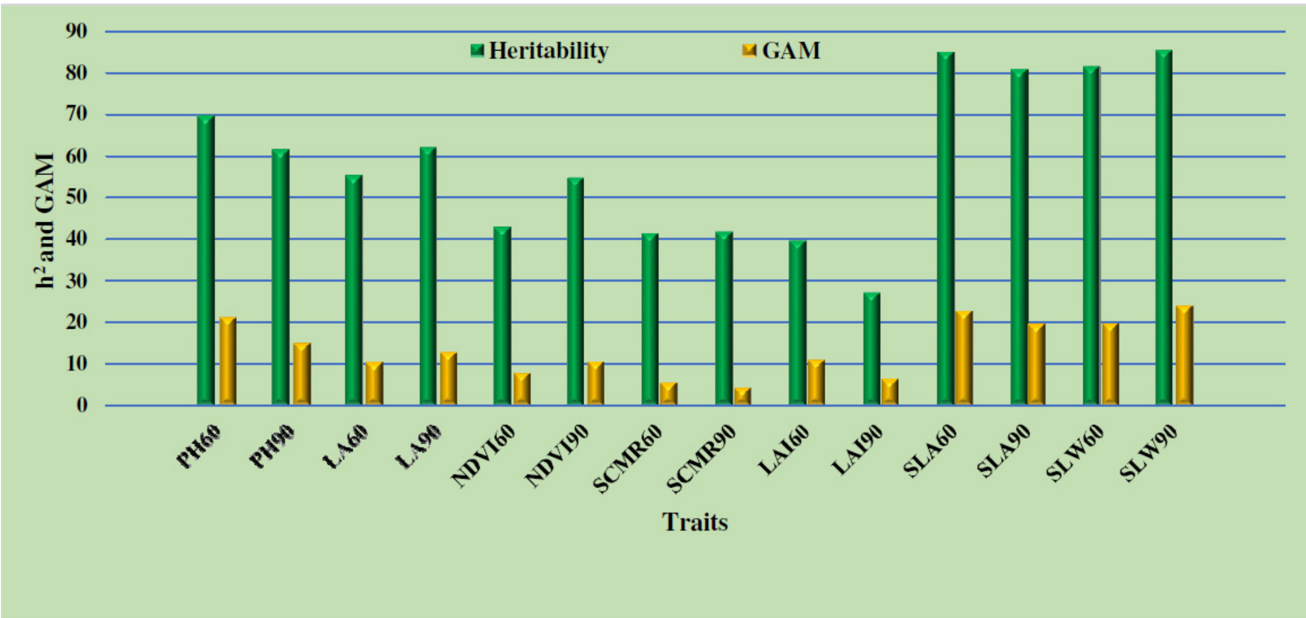

Fig. 2 : Heritability and genetic advance as per cent of mean for morpho-physiological traits in groundnut genotypes

Where, PH60=Plant height @60DAS, PH90 =Plant height @90DAS (cm), LA60= Leaf area @60DAS, LA90= Leaf area @90DAS(dm^2), NDVI60= Normalized Difference Vegetation Index (Green seeker) @60DAS, NDVI90 = Normalized Difference Vegetation Index (Green seeker) @90DAS, SCMR60= SPAD Chlorophyll meter reading @60DAS, SCMR90= SPAD Chlorophyll meter reading @90DAS, LAI60= Leaf area index @60DAS, LAI90= Leaf area index @90DAS, SLA60=Specific leaf area @60DAS, SLA90 =Specific leaf area @90DAS(cm^2/gm), SLW60= Specific leaf weight @60DAS, SLW90= Specific leaf weight @90DAS(mg/cm^2).

Disclaimer (Artificial Intelligence)

Author(s) hereby declares that NO generative AI technologies such as Language Models (ChatGPT. COPILOT, *etc.*) and text-to-image generators have been used during the writing or editing of this manuscript.

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