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Assessment of Variability, Heritability and Genetic Advance in Groundnut (*Arachis hypogaea* L.)

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ABSTRACT

The present research, entitled "Assessment of Variability, Heritability, and Genetic Advance in Groundnut (*Arachis hypogaea* L.)," was conducted on 15 genotypes with 16 characteristics. The analysis of variance revealed that genotypic variation was extremely significant for all of the traits under consideration. Additionally, the phenotypic coefficient of variance was larger than the genotypic coefficient of variation in magnitude. Quantitative features include the number of pods and kernels per plant, days to bloom initiation, days to 50% flowering, and days to maturity, test weight, shelling percent, and kernel yield per plant showed high heritability indicating that the variation was caused by additive gene action. The correlation estimates provide a better understanding of yield components and studies on genotypic and phenotypic correlation coefficients of different traits help the plant breeder during selection.

Keywords Groundnut, Genetic variability, Genotypes, Heritability, Genetic advance.

INTRODUCTION

The groundnut (*Arachis hypogaea* L.) belongs to the Papilionaceae subfamily of the Fabaceae family (Sharma *et al.* 2017, Kulheri *et al.* 2022, Suchitra 2022). Due to the presence of edible oil, it is considered a king of oilseed crops (Menge *et al.* 2018 and Meena 2021). The world's tropical, subtropical, and warm temperate climates are where groundnuts are currently cultivated, with Brazil in South America serving as their principal place of origin (Radhamani and Singh 2008 and Semba *et al.* 2021). Being a cleistogamous flower in the crop species, it is highly self-pollinated (Janila *et al.* 2013) and geotropic orientation about light after fertilization promotes pod development in the soil. Its cultivation was achievable at 40°N and 40°S latitudes due to a wide range of adaptations in various agro-climatic conditions and soils (Gantait *et al.* 2019, Halder *et al.* 2020). The species of groundnut are allotetraploid (2n=4x= 40) diploid (2n=20) and aneuploidy (2n=18), grain legume (Radhakrishnan *et al.* 2022).

Groundnut is farmed on 295 million hectares worldwide, producing 487 million tonnes and yielding 1647 kilograms per hectare. With 101 lakh tonnes produced and productivity of 1816 kg/ha in 2020-

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21, India leads the globe in groundnut crop acreage and production (agricoop.nic.in). A sizable portion of high-quality edible oil (50%) as well as quickly assimilated protein (25%) and carbohydrates (20%) can be found in groundnut seeds. It also contains minerals such as phosphorus, calcium, and zinc and vitamins such as A, C, E, K, thiamine and niacin. Meat, eggs, and other veggies are all lower in protein than groundnuts Gummadala *et al.* (2022). For growing children, pregnant women, and nursing mothers, freshly roasted peanuts with jaggery and goat milk are extremely beneficial. It strengthens the body's defenses against hepatitis and TB.

The level of genetic variability in genotypes determines the efficacy of a crop improvement program, so it is the primary step to investigate the genetic diversity that exists in the crop species. The combination of genetic progress and heritability estimates elucidates the form of character that can be improved by selection (Alake 2018 and Aswini *et al.* 2023). As a result, the current study looked at diversity, heritability and genetic advancement in different groundnut populations.

MATERIALS AND METHODS

The present experimental research entitled "Assessment of Variability, Heritability and Genetic Advance in Groundnut (*Arachis hypogaea* L.)" was conducted during the *kharif* season of 2021. It was held in the Department's Crop Research Center (CRC), located at a latitude of 26°14 N and a longitude of 78°14 E, at an elevation of 206 meters above mean sea level. The experimental material comprised 15 different genotypes of groundnut i.e., Kadiri-6, Kadiri Amaravati, Kadiri -8, Gujarat gold, Kadiri lepakshi (K1812), TCGS 1694, Kadiri-4, Kadiri chitravathi, Kadiri bold 7, Gujarat k6, Kadiri Haritha Andhra, Kadiri-9, Nitya Haritha (TCGS1157), Dharani (TCGS 1043) and Dheeraj (TCGS 1073). All the genotypes were collected from the Agriculture Research Station, Kadiri, Andhra Pradesh. Three replications of the experiment were conducted using a Randomized Complete Block Design (RBD). The sowing was done by dibbling seeds with a spacing of 45 cm × 10 cm. All genotypes were sown in a plot size of 3.5 m × 4.0 m each. The recommended packages of practices were adopted for optimum crop growth. The data were recorded on 16 morphological characters namely days to flowering, days to 50% flowering, days to maturity, no. of branches per plant, plant height, no. of pods per plant, no. of kernels per plant, no. of kernels per pod, test weight (g), sound mature kernels, shelling percent (%), biological yield per plant (g), harvest index (%), oil content (%), pod yield per plant (g), and kernel yield per plant (%).

Data collected were subjected to statistical analysis by using R studio (software). The components of genetic parameters including analysis of variance, heritability, genetic advance, and correlation coefficient were analyzed.

RESULTS AND DISCUSSION

In Table 1, the analysis of variance revealed that all the genotypes showed significant variation for all 16 quantitative characters under study (Fig. 1). The

Table 1. Analysis of variance for kernel yield and its components in groundnut.

Sl. No.	Characters	Mean sum of squares		
		Replication	Genotypes	Error
	Degree of freedom	2	14	28
1	Days to flower initiation	6.29	20.40**	2.81
2	Days to 50% flowering	2.49	29.26**	2.87
3	Days to maturity (cm)	29.76	89.04**	11.11
4	No. of branches per plant	1.62	3.37*	1.34
5	Plant height	4.08	29.79**	7.35
6	No. of pods per plant	6.16	23.59**	3.06
7	No. of kernels per plant	6.69	94.60**	2.62
8	No. of kernels per pod	0.03	0.13**	0.03
9	Test weight (g)	5.49	39.23**	2.04
10	Sound mature kernels	26.76	51.14**	12.87
11	Shelling percent	10.05	161.86**	6.77
12	Biological yield per plant (g)	0.82	6.62**	2.16
13	Harvest index (%)	2.44	80.29**	28.43
14	Oil content (%)	9.85	8.38*	3.92
15	Pod yield per plant (g)	0.91	7.92**	1.79
16	Kernel yield per plant (g)	2.30	18.71**	1.37

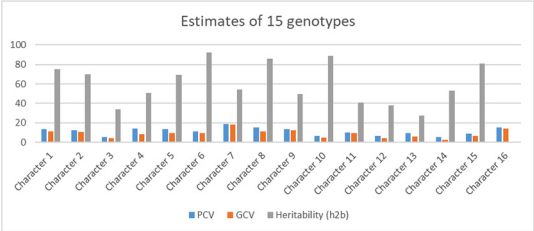

Fig. 1. Phenotypic coefficient of variance (PCV), genetic coefficient of variance (GCV), and heritability (h^2b) estimates of 15 genotypes of groundnut.

mean sum of squares of the traits suggested that the selected genotypes were genetically diverse from each other and a considerable amount of variability exists among them. Similar findings were also revealed by Narasimhulu *et al*. (2012) and Zaman *et al.* (2011).

A significant difference was observed among the genotypes for all the characters which indicates the prevalence of genetic diversity. Table 2 shows the mean, range, genotypic and phenotypic variation, coefficients, heritability and genetic advance of all the traits.

The coefficient of variation for phenotypes was significantly greater in magnitude than the coefficient of variation for genotypes for all the traits under each analysis. PCV and GCV are classified into low (below 10%), medium (10-20%) and high (above 20%). This study shows the moderate value of PCV and GCV for days to flower initiation, days to 50% flowering, no. of kernels per plant, no. of kernels per pod, test weight, and kernel yield per plant. Moderate PCV and low GCV were recorded for no. of branches per plant, plant height, and no. of pods per plant. Low values of PCV and GCV were recorded for days to maturity, sound mature kernels, shelling percent, biological yield per plant, harvest index, oil content, and pod yield per plant. Similar findings were made by Nath and Golakia *et al.* (2005), Kumar *et al.* (2019), and Chavadhari *et al.* (2017).

Heritability is a metric for the degree to which phenotypic variation is caused by a gene's function. Genetic diversity, which is passed down from parent to offspring, has embraced heritability, to make effective improvements in the character for which

Table 2. Genetic parameters of variation for kernel yield and its components in groundnut.

Characters	Range		Mean	Coefficient of variation		Heritability (h^2b)	GA	GA% mean
	Min	Max		PCV	GCV			
Days to flower initiation	18.67	26.00	22.02	13.38	11.00	67.58	4.10	18.62
Days to 50% flowering	24.00	35.00	27.98	12.21	10.60	75.40	5.31	18.96
Days to maturity (cm)	107.67	126.00	116.71	5.22	4.37	70.04	8.79	7.53
No. of branches per plant	7.67	11.67	9.96	14.26	8.28	33.70	0.99	9.90
Plant height	23.27	33.27	28.62	13.46	9.56	50.42	4.00	13.98
No. of pods per plant	22.67	32.67	27.76	11.34	9.43	69.10	4.48	16.14
No. of kernels per plant	24.67	45.33	30.56	18.88	18.12	92.14	10.95	35.83
No. of kernels per pod	1.25	1.98	1.65	15.31	11.28	54.31	0.28	17.12
Test weight (g)	23.63	36.28	28.62	13.28	12.30	85.84	6.72	23.48
Sound mature kernels	70.00	82.33	77.16	6.56	4.63	49.77	5.19	6.73
Shelling percent	64.35	88.47	77.49	9.87	9.28	88.43	13.93	17.97
Biological yield per plant (g)	27.25	33.05	30.33	6.30	4.02	40.82	1.61	5.30
Harvest index (%)	60.69	82.07	72.58	9.32	5.73	37.82	5.27	7.26
Oil content (%)	43.33	48.00	45.25	5.14	2.69	27.49	1.32	2.91
Pod yield per plant (g)	18.86	24.30	21.97	8.91	6.51	53.32	2.15	9.79
Kernel yield per plant (g)	13.38	21.49	17.42	15.35	13.80	80.78	4.45	25.55

selection is used. The heritability for wide sense was calculated for all of the traits under investigation and is shown in Table 2, with a range of 27.49 to 92.14%.

High heritability (above 60%) was observed for days to flower initiation (67.58), days to 50% flowering (75.40), and days to maturity (70.04), no. of pods per plant (69.10), no. of kernels per plant (92.14), test weight (85.84), shelling percent (88.43), and kernel yield per plant (80.78). Moderate heritability (30-60%) was observed for traits like no. of branches per plant (33.70), plant height (50.42), no. of kernels per pod (54.31), sound mature kernels (49.77), biological yield per plant (40.82), harvest index (37.82), and pod yield per plant (53.32). Low heritability (below 30%) was observed for oil content (27.49). Genetic advance as a percentage of the mean is presented in Table 2 and observed the range from 2.91% to 35.83%. The highest genetic advance as a percentage of the mean (above 20%) (at 5% selection intensity) was recorded for no. of kernels per plant (35.83), test weight (23.48), and kernel yield per plant (25.55). Moderate genetic advance as a percentage of the mean (10-20%) was recorded for days to flower initiation (18.62), days to 50% flowering (18.96), and plant height (13.98), no. of pods per plant (16.14), no. of kernels per pod (17.12) and shelling percent (17.97). Low genetic advance as a percentage of the mean (below 10%) was recorded for days to maturity (7.53), no. of branches per plant (9.90), sound mature kernels (6.73), biological yield per plant (5.30), harvest index (7.26), oil content (2.91), and pod yield per plant (9.79). In the current set of groundnut genotypes, substantial heritability together with high genetic progress as a percent of the mean was reported for kernel yield, showing the prevalence of additive gene impact and the potential for successful selection for the enhancement of these traits. Similar findings were reported by Aparna *et al.* (2018), Bhargavi *et al.* (2017) and Mahesh *et al.* 2017. Additionally, Yusuf *et al.* (2017) and Shrotri *et al.* (2021) reported on the large magnitude of heritability in groundnut.

CONCLUSION

The present study showed a considerable amount of variation in all the genotypes due to the mean sum of squares of the traits and significantly higher PCV than GCV for all the traits under study indicates environmental interaction with divergent genotypes. Heritability also reflects the genetic variability, which is passed down from parent to off spring, to make effective improvements in the character for which selection is used. High heritability was observed for days to flower initiation, days to 50% flowering, days to maturity, number of pods per plant, number of kernels per plant, test weight, shelling percent, and kernel yield per plant and the highest genetic advance as percentage of mean was recorded for number of kernels per plant, test weight, and kernel yield per plant. The high heritability together with high genetic advance as a percent of the mean shows the prevalence of additive gene impact and the potential for successful selection for the improvement of these traits.

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