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Genetic variability, mean performance studies in groundnut (*Arachis hypogaea* L.) under controlled environmental condition

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Abstract
Thirty-three groundnut genotypes were evaluated for various quantitative characters such as days to 50% flowering, days to maturity, fresh pod yield per plant, dry pod yield per plant, hundred seed weight, shelling percentage (%). Analysis of variance revealed significant differences among the genotypes for all the traits under controlled environment facility at 0.01 and 0.05 probability levels. The observations were recorded for six characters from three plants per genotype per replication in controlled environment facilities and mean were calculated. PCV was higher than the corresponding GCV for all the traits but the differences were small, indicating relatively less influence of the environment on these traits. High PCV and GCV values were recorded for fresh pod yield per plant, dry pod yield per plant and hundred seed weight. Days to 50% flowering, days to maturity, fresh pod yield per plant, dry pod yield per plant and hundred seed weight exhibited high heritability estimates. High genetic advance was recorded for fresh pod yield per plant, dry pod yield per plant, shelling percentage and hundred seed weight. Selection will be effective with character having high heritability and high genetic advance.

Keywords: Variability, heritability, genetic advance and mean performance

Introduction
Groundnut (*Arachis hypogaea* L.) is a self-pollinating crop with allotetraploid genome (2n=4x=40). It is an annual legume crop grown, mainly for its high-quality edible oil (44-56%) and easily digestible protein (22-30%) in its seeds. It is considered an important crop by virtue of its contribution towards satisfying the protein needs of many households who cannot afford animal protein. Groundnut oil contains high amount of oleic and linoleic acid (Engin *et al*., 2017) [3]. Besides oil and protein, it contains carbohydrates (10-25%), vitamins (E, K and B complex), minerals (Ca, P, Mg, Zn and Fe) and fiber. Groundnut shell is used as fuel, animal feed, cattle litter, filler material in feed and fertilizer industry, haulm (above ground vegetative parts) used as animal fodder and roots being a legume crop adds nitrogen (100-152 kg/ha) and organic matter to soil which helps to improve the soil fertility (Ayele, 2010) [1].
Groundnut is cultivated worldwide in tropical, subtropical and warm areas located between 40 °N and 40 °S. It ranks fifth position at global level as an oilseed crop occupying an area about 27.9 m ha having production 47 m t and productivity of 1676 kg/ha. In India, it spreads over an area of 5.02 m ha with a production of 8.11 m t and productivity of 1616 kg ha^{-1} (FAO STAT, 2021-22). In Telangana state it occupies 0.13 m ha with a production of 0.3 m t and productivity of 2364 kg/ha (India stat, 2021-22).
Improvement in yield is prime goal of any breeding programme. Yield is affected by environmental condition in considerable extent. Genetic variability is prerequisite to start any breeding programme. Selection can be effective only when there is considerable genetic variability is present.

Materials and Methods
The experimental material consists of thirty-three groundnut genotypes derived from different origins. The genotypes were obtained from Groundnut Breeding Unit, ICRISAT, Hyderabad. Selected groundnut genotypes were evaluated in completely randomized design with three replications at controlled environment facility, ICRISAT, Hyderabad. Observations on six component characters viz. days to 50% flowering, days to maturity, fresh pod yield per plant, dry pod yield per plant, hundred seed weight and shelling percentage were recorded on three

randomly selected plants from each genotype and mean values used for the statistical analysis. The analysis of variance for different characters was carried out using completely randomized design in SAS version 9.2 (SAS Institute Inc. 2013). The genotypic and phenotypic variance was calculated per the formulae (Burton and Devane, 1953) [2]. The broad sense heritability (h^2bs) was estimated for all characters as the ratio of genotypic variance to the total variance as suggested Lush (1949) [9] and Hanson *et al.* (1956) [5] Genetic variability parameters were worked out as proposed by (Johnson *et al*. 1955) [7]

Results and Discussion

Analysis of variance

Analysis of variance revealed significant differences among the genotypes for all the traits under study at 0.01 and 0.05 probability levels. The details are presented in table 4.3.6. Mean performance of genotypes and least significant difference (LSD) in terms of yield and its component characters are presented in table 1.

Table 1: Analysis of variance for yield and its component traits for controlled environment experiment of thirty-three groundnut genotypes studied during *kharif* (2019).

SV	df	DF	DM	FPD	DPP	HSW	SP
TRT	32	16.81**	61.95**	11.16**	4.72**	323.1**	255.4**
Error	66	0.42	1.72	0.66	0.22	1.06	1.18
Total	98	17.23	63.68	11.83	5.78	324.2	256.6

** indicate significance at 0.01 and 0.05 probability levels, DF- Days to 50% flowering, DM- Days to maturity, FPD- Fresh pod yield per plant (g), DPP- Dry pod yield per plant (g), HSW- Hundred seed weight (g), SP- Shelling percentage (%) and SV- Source of variation.

Mean performance of genotypes

Mean performance of given thirty-three genotypes were explained as per table 2.

a. Days to 50% flowering

Days to 50 per cent flowering ranged from 30 to 39 days with a general mean of 34. The genotypes ICG 4749 and ICG 3700 took only 30 days to reach 50 per cent flowering stage, while the genotype ICGV 15090 took 39 days.

b. Days to maturity

Days to maturity ranged from 99 days to 125 days with a general mean of 117. The genotype ICGV 91283 reported maturity at 99 days while genotype ICGV 10094 reported maturity at 125 days.

c. Fresh pod yield per plant (g)

Fresh pod yield per plant ranged from 2.26 to 11.26 grams with a general mean of 5.08 grams. The genotype ICG 1326 reported highest fresh pod yield with 11.26 grams while ICGV 91279 reported lowest fresh pod yield with 2.26 grams.

d. Dry pod yield per plant (g)

Dry pod yield per plant (g) ranged from 1.19 to 7 grams with a general mean of 2.8. The genotype ICG 1326 reported highest dry pod yield (7 grams) while the genotype ICGV 181065 reported lowest (1.19 grams) dry pod yield.

e. Hundred seed weight (g)

Hundred seed weights ranged from 18.56 to 60.88 grams with a general mean of 34.36. The genotypes ICGV 181490 and ICGV 181065 reported highest hundred seeds weights (60.88 grams), (59.30 grams) grams respectively, while the genotype ICG 1859 reported lowest hundred seeds weight (18.56 grams).

f. Shelling percentage (%)

Shelling percentage (%) ranged from 33.55 to 67.16 percent with a general mean of 51.720. The genotype J 11 reported highest shelling percentage (67.16), while the genotype ICGV 03043 reported lowest shelling percentage (33.55).

Table 2: Mean performance for thirty-three groundnut genotypes of controlled environment experiment studied during *kharif* (2019).

Sr. No	Genotypes	DF	DM	FPD	DPP	HSW	SP
1	ICGV 03043	31.66	117.33	6.43	4.26	49.43	33.55
2	ICG 1122	31.66	116.33	6.03	4.13	30.28	58.27
3	ICG 1323	32.66	114.66	6.80	3.43	28.92	52.11
4	ICG 3700	30.66	113	5.6	3.53	31.33	54.56
5	ICG 1326	32.66	114.66	11.26	7	26.19	48.54
6	ICGV 02206	34.66	117.33	3.2	2.46	27.8	38.12
7	ICG 10020	36.66	117.66	4.83	3.2	28.49	54.11
8	ICGV 02207	32.66	116.66	3.31	1.86	31.78	39.30
9	ICGV 91278	31.66	114.66	3.56	1.82	30.77	54.76
10	ICG 4749	30.66	115.66	3.96	2.02	29.37	56.82
11	ICG 1994	32.66	114	4.28	2.3	28.15	61.86
12	ICG 3336	34	114.3	3.36	1.40	34.44	54.98
13	ICGV 181065	37.33	118	3.33	1.19	59.30	36.07
14	ICG 1859	35.33	115	5.76	3.38	21.81	59.72
15	ICG 9407	32.66	112.66	6.6	5.33	44.82	57.08
16	ICG 10094	34.66	125.66	3.63	2.63	32.80	61.98
17	ICGV 07222	37	124.33	6.06	4.5	42.2	39.37
18	ICGV 03042	36.66	119	6.7	2.73	38.62	52.84
19	ICGV 181490	33	122.66	5.2	3.73	60.88	54.66
20	ICGV 91284	34.66	117.66	8.16	2.42	23.43	64.89
21	ICG 1173	32.33	117.66	4.46	2.32	27.6	42.02

22	ICGV 15083	35.33	120.66	8.63	3.26	47.72	37.87
23	55 - 437	36.33	120.66	4.9	2.93	18.56	50.82
24	ICG 27	35	116	3.26	1.28	34.89	51.89
25	ICGV 91283	38	99.66	2.89	1.6	29.61	65.95
26	ICGV 181075	32.33	117.66	5.96	2.53	47.24	43.83
27	ICGV 91279	31.66	117.33	2.26	1.23	36.24	56.01
28	ICG 3267	37	116	2.4	1.4	34.11	63.62
29	ICGV 03331	35.66	122	3.86	2.66	47.18	46.25
30	ICGV 15090	39.66	124.66	5.13	2.43	22.94	42.81
31	J 11	31.66	119.66	4.43	3.08	28.86	67.16
32	TMV 2	31.33	117.66	5.6	3	22.13	51.54
33	JL 24	32.66	117	5.96	3.75	35.98	53.23
	Mean±S.E	34±0.24	117±0.46	5.08±0.34	2.87±0.13	34.36±1.03	51.71±0.92
	Range lowest	30.66	99.66	2.26	1.19	18.56	33.55
	Range highest	39.66	125.66	11.26	7	60.88	67.16
	CV%	1.91	1.12	16.04	16.67	3.003	2.10
	CD at 5%	1.06	2.14	1.33	0.78	1.682	1.77

DF- Days to 50% flowering, DM- Days to maturity, FPD- Fresh pod yield per plant (g), DPP- Dry pod yield per plant (g), HSW- Hundred seed weight (g), SP- Shelling percentage (%

Variability parameters

Phenotypic and genotypic Variation

Estimated variance component, phenotypic coefficient of variability (PCV) and genotypic coefficient of variability (GCV) of the characters studied are presented in table 3. The PCV varied from 3.97 to 40.17% and GCV from 3.82 to 42.58%. PCV was higher than the corresponding GCV for all the traits but the differences were small, indicating relatively less influence of the environment on these traits. High PCV and GCV values were recorded for fresh pod yield per plant, dry pod yield per plant and hundred seed weight. Low PCV and GCV values were observed for days to flowering and days to maturity. GCV values and PCV values were almost same for shelling percentage. High PCV and GCV indicate that selection may be effective based on these characters and their phenotypic expression would be good indication of the genotypic potential. Vinithashri *et al*., (2019) [11] recorded high GCV, PCV values for no. of pods per plant, 100 pod weight, 100 kernel weight, shelling percent and number of mature kernels. Mitra *et al*., (2021) [10] reported that number of pods/plant, secondary branches, kernel width and pod yield displayed a higher level of coefficient of variation both at phenotypic and genotypic level.

Table 3: Variability parameters for thirty-three groundnut genotypes of controlled environment experiment studied during *kharif* (2019).

Sr. No	Traits	GM	Range	CV (%)		h^2	GA (at 5%)
				PCV	GCV		
1.	DF	34.02	30.66-39.66	7.12	6.87	93.0	13.65
2.	DM	117.2	99.66-125.66	3.97	3.82	92.9	7.60
3.	FPD	5.08	2.26-11.26	40.17	36.72	83	69.16
4.	DPP	2.87	1.19-7	45.65	42.58	87	81.83
5.	HSW	34.36	18.56-60.88	30.27	30.16	99.2	61.9
6.	SP	51.72	33.55-67.16	17.89	17.81	99.1	36.53

DF- Days to 50% flowering, DM- Days to maturity, FPD- Fresh pod yield per plant (g), DPP- Dry pod yield per plant (g), HSW- Hundred seed weight (g), SP- Shelling percentage (%), GM- General mean, CV- Coefficient of variation, h^2- Heritability (broad sense), GV- Genetic advance as percent of mean.

Heritability and Genetic Advance

In the present study, broad sense heritability was computed for the characters under study and is presented in table 3. It ranged from 83% for shelling percentage to 99.2% for hundred seed weight. Days to 50% flowering, days to maturity, fresh pod yield per plant, dry pod yield per plant and hundred seed weight exhibited high heritability estimates.

The genetic advance as the percentage of the mean (GAM) at 5% selection intensity is presented in table 3. Estimates of genetic advance as percent of mean at 5% selection intensity ranged from 7.6 for days to maturity to 81.83 for dry pod yield per plant). High genetic advance was recorded for fresh pod yield per plant, dry pod yield per plant, shelling percentage and hundred seed weight. Kumar *et al*., (2019) reported that Days to 50% flowering, number of pods/plant, 100 pod weight, 100 sound mature kernel and sound mature kernel had high heritability coupled with high genetic advance as per cent of mean and medium to high genotypic coefficient of variation. Mitra *et al*., (2021) [10] founded that genetic advance with higher heritability indicated preponderance of additive variance for pod length, pod yield and number of pods/plant.

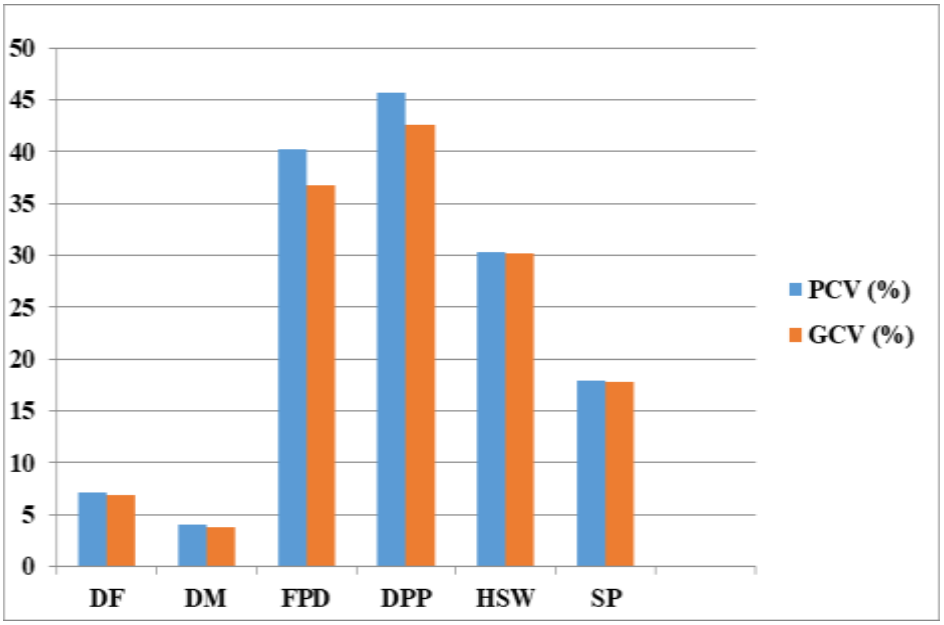

Fig 1: Graphical representation of PCV and GCV of thirty-three groundnut genotypes studied under controlled environment condition during *kharif* (2019).

Conclusion

Genetic variability is prime importance in breeding program because selection is possible only when there is considerable variability present in population. High heritability along with high genetic advance indicate additive gene action. Selection is effective when there is additive gene action in the genotypes. These selected genotypes can be used in further breeding programmes to breed new cultivars suitable various agro climatic conditions.

Conflict of interest: None

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