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

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Abstract

The present investigation entitled "Genetic Variability, Heritabity and Genetic Advancein groundnut (*Arachis hypogaea* L.)" was conducted during *kharif,* 2020. In the experiment thirty diverse genotypes including four checks namely UG-5 (Pratap Raj Mungphali), TG37A, GG-7, JL-501 of groundnut, were grown at the instructional farm, CTAE, MPUAT, Udaipur. This experiment was conducted in RBD with three replications. Analysis of variance revealed that genotypes were highly significant for all the thirteen characters, indicated the presence of ample genetic variability available in the experimental material under study that can be further exploited for groundnut improvement. On the basis of this study the genotype UG-197, UG-229, UG-232, UG-229, UG-234, UG-228, UG-234, UG-192, UG-234, UG-192 and UG-236 were found to have considerably high mean values for traits like dry pod yield per plant, plant height, sound mature kernels, number of branches per plant, 100-kernel weight, kernel weight per plant, shelling percentage, biological yield per plant, harvest index, duration between flowering to pegging, oil content while genotypes UG-199 and UG-198 have considerably low mean values for traits like days to 50 per cent flowering and days to maturity respectively. So above genotypes can be further used in breeding programme. An ideal plant of groundnut is one which should have higher value of harvest index, duration between flowering to pegging, kernel weight per plant, number of branches per plant and plant height.

Key words : *Genetic variability, heritability, genetic advance, genotypes, groundnut.*

Introduction

Groundnut (*Arachis hypogaea* L.), is an important crop among oilseeds, self-pollinated and chromosome number (2n=4x=40) grown in tropical and subtropical regions of the world. Groundnut (*Arachis hypogaea* L.) is believed to be the native crop of Brazil. It was introduced in India during the first half of the sixteenth century from one of the Pacific Islands of China, where it was introduced earlier from either Central America or South America. Groundnut has other synonyms such as peanut, earthnut, monkey nut, goober, panda and manila nut. Research efforts of Dr. George Washington Carver during early 1900 made it an important commercial crop in the southern USA. Now, groundnut is one of the principal economic crops of the world; ranking 6th in edible oil production among oilseed crops, 3rd most important source of vegetable protein and 13th among food crops. It also occupies first rank among oilseed crops of India.

Groundnut is widely grown under wet conditions in semi-arid regions including Africa, Americas and Asia and it grows best in light, sandy loam soils. To develop well, groundnut need warm weather throughout the growing season. It can be grown with as little as 350 mm of water but for best yields need at least 500 mm rainfall. Groundnut is the also known as "The king of oilseeds". Groundnut contains on the average 12-15% carbohydrates, 25-30% protein and 45-50% oil. The nuts may be chewed uncooked, but are usually eaten boiled or roasted. The nuts can also be boiled, fried, ground into groundnut butter, or crushed for oil. Groundnut is also a rich and dietary source of minerals such as K, Na, Ca, Mn, Fe and Zn and biologically active compounds like riboflavin, thiamine, arginine, resveratrol, phytosterols and flavonoids that are ingested right away as fresh, baked or cooked kernels otherwise, oil isolated from the kernel is consumed as cooking oil. The haulms (vegetative portions of plant) of groundnut deliver superior quality hay as animal feed since these are enrich with protein and ensure enhanced deliciousness as well as assimilation rate in comparison to other forage.

Groundnut is one of the most important cash crops of our country. India is the second largest producer of groundnut after China. Groundnut is the largest oilseed in India in terms of production. Groundnut butter is extensively used in the preparation of soup and as bread spread. In India the area of groundnut cultivation during 2018-19 is 48.537 lakh ha, production was 69.696 lakh tonnes with productivity 1436 kgha^{-1} (1). In India, its cultivation is mostly confined to the southern states *viz*., Gujarat, Karnataka, Andhra Pradesh, Tamil Nadu and Maharashtra. The other important states growing groundnut area are Madhya Pradesh, Rajasthan, Uttar Pradesh and Punjab. In Rajasthan the area of groundnut

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Table-1 : Mean square for RBD in individual environment.

Characters	Replica -tion	Geno- type	Error
	[2]	[29]	[58]
Days to 50% flowering	0.60	6.13**	0.55
Duration between flowering to pegging	2.40	7.33**	0.42
Plant height (cm)	0.76	72.26**	3.28
No. of branches per plant	0.07	2.33**	0.09
Days to maturity	1.14	37.46**	1.78
Day pod yield per plant (g)	0.25	6.62**	1.46
Kernel weight per plant (g)	0.08	1.35**	0.14
100-Kernel weight (g)	0.91	43.88**	1.24
Sound mature kernel (%)	8.72	38.15**	5.55
Shelling percentage (%)	5.55	21.01**	2.25
Biological yield per plant (g)	0.15	28.94**	4.66
Harvest index (%)	0.79	91.30**	14.86
Oil content (%)	0.23	7.26**	0.22

*,** Significant at 5% and 1% respectively.

cultivation during 2018-19 was 6.689 lakh ha, production was 16.381 lakh tonnes with productivity 2449 kgha^{-1} (1).

The progress of any breeding programme depends upon the extent of genetic variability present in the population. In a self-pollinated crop like groundnut, therefore, it is necessary for a plant breeder to quantify the variability in terms of phenotypic coefficient of variation (PCV), genotype coefficient of variation (GCV), heritability (h^2) and genetic advance (GA).

Materials and Methods

The present investigation was carried out to elicit the information on "Genetic Variability, Heritability and Genetic Advance in groundnut (*Arachis hypogaea* L.) Genotypes" during *Kharif* 2020 at the instructional farm CTAE, MPUAT, Udaipur. The 30 genotypes along with 4 checks of groundnut were evaluated for genetic variability, correlation and path analysis for 13 economically important traits during *Kharif 2020*.

CTAE, Maharana Pratap University of Agriculture and Technology, Udaipur is situated at an elevation of 579.5 meters above mean sea level, latitude of 24º35' North and longitude of 73°42' East.

The experimental material used in the present investigation was consisted of the 30 diverse genotypes along with 4 checks of groundnut genotypes representing diversity in adaptability and variability in characters and geographical origin. The experimental material was evaluated for genetic variability, correlation analysis and path analysis for 13 economically important traits during *Kharif 2020*.

The experimental materials consisting of thirty diverse genotypes of groundnut were sown in randomized block design in three replications. Each entry was planted in a plot size of 4.80 x 0.90 m^2 accommodating 5 rows of 5 m length, keeping row to row and plant to plant distance of 30 cm and 10 cm, respectively. All the recommended package of practices was followed to raise a good and healthy crop.

Five competitive plants for each entry were randomly selected for recording observations for all the quantitative characters in each replication except days to 50 per cent flowering, duration between flowering to pegging and days to maturity, where observations were recorded on plot basis.

Statistical analysis : To test the difference among the genotypes, the analysis of variance was worked out separately for each character as per method suggested by (2) and using standard statistical procedure given by (3). Genotypic coefficient of variation (GCV) and Phenotypic coefficient of variation (PCV) were calculated as per the standard formula suggested by (4).

$$\text{Genotypic variance } (\sigma^2_g) = \frac{MSg - MSe}{r}$$

$$\text{Phenotypic variance } (\sigma^2_p) = \sigma^2_g + \sigma^2_e$$

Heritability (h^2) was calculated in broad sense by using the following formula given by (5).

$$h^2 = \frac{\sigma^2_g}{\sigma^2_p} \quad 100$$

Genetic gain (GG) is the genetic advance expressed as per cent of mean. It was estimated by using the formula of (5,6).

$$GA = k \quad _p \quad h^2$$

Where,

K = Selection differential (value of k at 5% selection intensity = 2.06)

$_p$ = Phenotypic standard deviation

h^2 = Heritability in broad sense

$$\text{Genetic advance (as percentage of mean)} = \frac{GA}{\bar{X}} \quad 100$$

Where,

GA = Expected genetic advance under selection

$\bar{X}$ = General mean of a character

Results and Discussion

Analysis of variance revealed that mean sum of squares due to genotypes were highly significant for days to 50 per cent flowering,duration between flowering to pegging, plant height (cm), number of branches per plant, days to maturity, dry pod yield per plant (g), kernel weight per

Table-2 : Genetic variability parameters for yield and its contributing traits in chickpea.

S. No.	Characters	Mean	Range		GCV (%)	PCV (%)	h^2 (bs) (%)	Genetic Advance	Genetic Gain
			Min.	Max.					
1.	Days to 50% flowering	33.60	31	36	4.06	4.62	77.05	2.46	7.34
2.	Duration between flowering to pegging	12.68	10.53	15.33	11.97	13.01	84.61	2.88	22.67
3.	Plant height (cm)	39.20	31.33	47.50	12.23	13.08	87.52	9.24	23.57
4.	Number of branches per plant	6.80	5.50	8.73	12.69	13.47	88.78	1.67	24.63
5.	Days to maturity	105.41	98	111	3.27	3.51	87.01	6.63	6.29
6.	Dry pod yield per plant (g)	12.95	10.60	16	10.12	13.78	54.01	1.98	15.33
7.	Kernel weight per plant (g)	5.37	4.10	6.47	11.82	13.78	73.56	1.12	20.88
8.	100-kernel weight (g)	40.12	31.60	46.90	9.40	9.80	92.00	7.45	18.57
9.	Sound mature kernels (%)	85.42	80.23	91.47	3.86	4.74	66.21	5.53	6.47
10.	Shelling percentage (%)	71.06	65	75.23	3.52	4.10	73.50	4.42	6.21
11.	Biological yield per plant (g)	31.97	26.70	37.50	8.90	11.17	63.45	4.67	14.60
12.	Harvest index (%)	40.69	31.01	54.10	12.41	15.61	63.16	8.26	20.31
13.	Oil content (%)	42.82	40.27	45.80	3.58	3.74	91.53	3.02	7.05

plant (g), 100-kernel weight (g), sound mature kernels (%), shelling percentage (%), biological yield per plant (g), harvest index (%), and oil content (%). Whereas mean sum of squares due to replication were found to be non-significant for all the characters, Table-1. The overall analysis of ANOVA indicated the presence of ample genetic variability available in the experimental material under study that can be further exploited for groundnut improvement.

The magnitude of GCV varied from 3.27 percent in Days to maturity to 12.69 percent in number of branches per plant. It was found that Genotypic coefficient of variation (GCV) was found moderate (10-20%) for number of branches per plant (12.69%) followed by harvest index (12.41%), plant height (12.23%), duration between flowering to pegging (11.97%), kernel weight per plant (11.82%) and dry pod yield per plant (10.12%). The GCV was low (<10%) for 100-kernel weight (9.40%), biological yield per plant (8.90%), days to 50% flowering (4.06%), sound mature kernel (3.86%), oil content (3.58%), shelling percentage (3.52%) and Days to maturity (3.27%). The present findings are in accordance with the finding of (6,7,8).

The phenotypic coefficient of variation (PCV) was higher in magnitude than that of genotypic coefficient of variation for all the characters under study. The moderate (10-20%) PCV was recorded for harvest index (15.61%) followed by dry pod yield per plant (13.78%), kernel weight per plant (13.78%), number of branches per plant (13.47%), plant height (13.08%), duration between flowering to pegging (13.01%) and biological yield per plant (11.17%). The characters *viz.,* 100-kernel weight (9.80%), sound mature kernel (4.74%), days to 50% flowering (4.62%), shelling percentage (4.10%), oil content (3.74%) anddays to maturity (3.51%) showed low (<10%) phenotypic coefficient of variation. The present findings are in accordance with the finding of (6,7,8).

Broad sense heritability was estimated for all the characters under study. High (>60%) heritability was observed for most of the traits and it was noted highest for 100-kernel weight (92.00%) followed by oil content (91.53%), number of branches per plant (88.78%), plant height (87.52%), days to maturity (87.01%), duration between flowering to pegging (84.61%), days to 50% flowering (77.05%), kernel weight per plant (73.56%), shelling percentage (73.50%), sound mature kernels (66.21%), biological yield per plant (63.45%) and harvest index (63.16%). However,dry pod yield per plant (54.01%) exhibited moderate (30-60%) estimate of heritability. Similar findings have also been reported by (6,9,10,11,12,13). The genetic advance was found low (<10%) for all the characters such as plant height (9.24%) followed by harvest index (8.26%), 100-kernel weight (7.45%), days to maturity (6.63%), sound mature kernels (5.53%), biological yield per plant (4.67%), shelling percentage (4.42%), oil content (3.02%), duration between flowering to pegging (2.88%), days to 50% flowering (2.46%), dry pod yield per plant (1.98%), number of branches per plant (1.67%) and kernel weight per plant (1.12%). Significantly for all the traits (14). Similar findings have also been reported by (8,15).

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