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Genetic Variability, Heritability and Genetic Advance of Yield and Related Traits of Groundnut (*Arachis hypogaea* L.)

U.K. Nath and M.S. Alam
Department of Genetics and Plant Breeding,
Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

Abstract: Fifteen exotic groundnut genotypes collected from ICRISAT along with a local check (Dhaka-1) were used to study their performance, genetic variability, heritability and genetic advance of yield and yield contributing characters. Significant variations were observed for all the characters in all the genotypes used in the experiment. Higher phenotypic coefficients of variations were observed for plant height, primary branches per plant, pods per plant, harvest index and pod yield plant^{-1}. Characters like plant height, pods per plant, 100-pods weight, shelling percentage, harvest index and pod yield per plant showed high heritability. Considerable high genetic advances in percentage of mean were found for plant height, pods per plant, harvest index and pod yield per plant.

Key words: Variability, coefficient of variation, heritability, genetic advance, genetic advance in percentage of mean, groundnut

Introduction

The cultivated groundnut *Arachis hypogaea* L. is one of the most important oil and protein producing legume crop of the semi-arid tropics. Groundnut kernel contains 45-50 % high quality oil, more than 25 % highly assimable protein and vitamins B and E. It is one of the most important source of quality edible oil in the world. Bangladesh is seriously deficit in edible oil production. The per capita consumption of edible oil is one of the lowest in the world (3 kg/head/year), is one fifth of recommended requirement for a balanced diet (Elias, 1998). Bangladesh have to import edible oil more than 50% of its requirement every year (Anonymous, 2001). The soil and climate of Bangladesh are quite suitable for the production of groundnut. It is cultivated mostly in sandy soil and riverbeds. In spite of its importance as an oil crop and of multifarious uses in every day life, its cultivation as well as productivity has been declining gradually. This may be mainly due to (I) intensive cultivation of HYVs of rice and (ii) unavailability of high yielding varieties of groundnut (Rahman *et al.*, 1992). Therefore, development of high yielding varieties of groundnut is essential to compete economically with HYVs of rice as well as to gear up the production trend of this crop.

The basic key to bring about the genetic upgrading to a crop is to utilize the available or created genetic variability. If the variability in the population is largely due to genetic cause with least environmental effect, the probability of isolating superior genotype is a prerequisite for obtaining higher yield, which is the ultimate expression of various yield-contributing characters. Therefore, direct selection for yield could be misleading (Islam and Rasul, 1998). This is difficult to judge what proportion of the observed variability is heritable and what proportion is non-heritable i.e., environmental. The process of breeding in such population is primarily conditioned by the magnitude and nature of interactions of genotypic and environmental variations in plant characters. It becomes necessary to partition the observed variability into its heritable and non-heritable components and to have an understanding of parameters such as genetic coefficient of variation, heritability genetic advance. The present study was undertaken to achieve the following objectives:

* To estimate variability for yield and yield contributing traits in set groundnut genotypes
* To estimate heritability and genetic advance of yield and yield components and
* To find out and establish suitable selection criteria for higher pod yield through study of variability.

Materials and Methods

The experiment was conducted at the experimental farm of the Department of Genetics and Plant Breeding, Bangladesh Agricultural University, Mymensingh during November 2000 to May 2001. Soil of the experimental plot was silty loam in texture and it was medium high land belonging to Old Brahmaputra flood plain with soil pH 6.81. The climate was sub-tropical in average. It was dry with moderately low temperature during the vegetative and early flowering stage and with heavy rain during late flowering and maturing stage of the crop. Fifteen groundnut genotypes collected from ICRISAT along with an indigenous variety Dhaka-1 were used to study the different genetic components. The experimental plots were prepared properly with fertilizers like urea (two splits 25 + 25 kg ha^{-1}), triple super phosphate (T.S.P 120 kg ha^{-1}); muriate of potash (MP 100 kg ha^{-1}) and gypsum (two splits 60 + 60 kg ha^{-1}).

The experiment was laid out in a 4 × 4 Balanced Lattice design with 5 replications. The unit plot size was 1.2 × 5.0 m^2. The distance between rows and plants was 30 and 15 cm respectively for proper development and growth of plants. On the other hand plot-to-plot and replication-to-replication distance were 0.5 and 1.0 m respectively. Seeds of the genetic materials were sown on 24th November 2000. The seeds were sown in furrows at a depth of 4 cm approximately. After complete emergence thinning was done to maintain 15 cm distance from plant to plant. Plant protection measures were taken against attack of insects and diseases like caterpillar, aphids, leaf spot of groundnut. No irrigation was applied during the total period of the experiment. The mean data of 10 sample plants for different traits were analyze for variance following the Balanced Lattice design and DMRT suggested by Gomez and Gomez (1984).

Results and Discussion

Analysis of variance showed highly significant variations among the genotypes for the traits days to flowering, plant height, number of primary branches plant^{-1}, pods per plant, kernels pod^{-1}, 100-pods weight, shelling percentage, harvest index and pod yield plant^{-1} (Table 1). The mean value exhibited that genotypes ICGV93260 required the highest days for flowering (57.80 days) and the lowest days was required by Dhaka-1 (53.2 days) (Table 2). For the character plant height ICGV86635 produced the tallest plant (94.23 cm) and ICGV93255 was dwarf (46.11cm) among the genotypes. Considering the character number of primary branches per plant, genotype ICGV92126 bore the maximum primary branches (10.6) and ICGV86635 had the minimum number of primary branches per plant (5.30). In the

Corresponding Author: Mr. Ujjal Kumar Nath, Lecturer, Department of Genetics and Plant Breeding, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

Table 1: Analysis of variance for nine morphophysiological traits of groundnut genotypes

	Mean square with level of significance			
	Sources of variation			
Traits	Replications (4 df)	Treatment adjusted (15 df)	Blocks within replications (15 df)	Error-effective/intra block (45 df)
Days to flowering	0.394	6.050**	0.177	0.377
Plant height (cm)	12.785	778.030**	8.766	5.250
Number of primary branches/plant	0.209	10.120**	0.270	0.328
Pods/plant	1.330	351.030**	4.950	4.460
Kernels/pod	0.018	0.084**	0.007	0.009
100-pod weight (g)	2.188	474.690**	1.520	2.030
Shelling %	7.970	272.210**	6.160	5.080
Harvest index	2.830	256.690**	1.230	1.690
Pod yield/plant (g)	1.403	321.440**	0.620	0.930

** Significant at 1% level of probability

Table 2: Performance of nine different characters with mean and range studied in 16 groundnut genotypes

	Traits								
Genotypes	Days to flowering	Plant height (cm)	No. of primary branches/plant	Pods/ plant	Kernel/ pod	100-pods weight (g)	Shelling %	Harvest index	Pod yield plant (g)
ICGV92109	56.60B-E	50.16F-H	8.80BC	26.17EF	1.15EF	82.60G	48.98BC	29.00DE	27.20C
ICGV92113	56.40C-E	48.17GH	6.98FG	25.02E-G	1.31C-E	96.80C	38.74EF	26.40FG	24.60D
ICGV92116	56.80A-D	55.29DE	7.57D-G	15.61 I	1.23C-F	90.60D	47.83CD	27.40D-F	24.70D
ICGV92118	56.60B-E	76.31B	7.92C-F	23.36FG	1.31C-E	84.80FG	39.47E	21.20I	21.10EF
ICGV92120	56.60B-E	50.92E-G	5.32H	27.59DE	1.31C-E	84.40FG	39.97E	39.00AB	21.80E
ICGV92121	56.60B-E	51.12E-G	9.12B	27.61DE	1.34CD	80.00H	44.60D	27.00EF	16.90 I
ICGV92126	55.20F	63.08C	10.60A	46.65A	1.22C-F	100.00B	39.67E	24.40GH	44.20A
ICGV93232	56.60B-E	65.68BC	8.58B-D	22.09GH	1.10F	90.40D	46.08CD	23.40HI	19.20GH
ICGV93233	55.60D-F	68.96B	7.54D-G	18.87HI	1.38BC	86.40EF	52.03B	26.20FG	12.30J
ICGV93255	56.00D-F	46.11H	7.46E-G	31.27CD	1.39BC	111.40A	32.37G	37.00B	34.60B
ICGV93260	57.80A	52.98EF	8.42B-E	29.03C-E	1.39BC	80.00H	44.53D	29.40CD	17.80HI
ICGV93261	55.40EF	55.24DE	6.66G	32.24C	1.58A	88.80DE	38.82EF	40.60A	24.20D
ICGV93269	57.60AB	53.61D-F	7.54D-G	28.55C-E	1.16D-F	95.60C	31.65G	31.40C	25.20D
ICGV93277	56.00D-F	51.95E-G	5.60H	26.89EF	1.40BC	83.80G	33.59G	38.40AB	20.00FG
ICGV86635	57.40A-C	94.23A	5.30H	10.49J	1.52AB	89.00D	57.82A	14.40J	12.10J
Dhaka-1	53.20G	57.64D	7.21FG	37.22B	1.28C-E	68.40I	35.20FG	23.40HI	17.90HI
Mean	56.27	58.84	7.53	26.79	1.31	88.31	41.95	28.66	22.73
Range	53.2-57.8	46.11-94.23	5.3-10.6	10.49-46.65	1.10-1.58	68.40-111.40	31.65-57.82	14.40-40.60	12.10-44.20

Table 3: Genotypic variance, phenotypic variance, genotypic coefficient of variation, phenotypic coefficient of variation, genetic advance and genetic advance in percentage of mean of yield and yield contributing characters/traits of 16 genotypes of groundnut

Genetic components	Days to flowering	Plant height (cm)	No. of primary branches/ plant	Pods/ plant	Kernels pod	100-pods weight (g)	Shelling (%)	Harvest index	Pod yeild/plant (g)
Genotypic variance	1.136	154.56	1.96	69.31	0.02	94.53	53.43	51.00	64.10
Phenotypic variance	1.51	159.81	2.29	73.77	0.029	96.56	58.51	52.69	65.03
Genotypic coefficient of variation (%)	1.89	21.12	18.59	31.07	10.79	11.00	17.42	24.91	32.22
Phenotypic coefficient of variation (%)	2.18	21.48	20.09	32.06	12.99	11.13	18.23	25.32	35.47
Heritability (%)	75.23	96.71	85.58	93.95	68.96	97.89	91.32	96.79	98.56
Genetic advance	1.90	25.18	2.67	16.62	0.24	19.82	14.39	14.47	16.37
Genetic advance in percentage of mean	3.38	42.79	35.46	62.03	18.32	22.44	34.30	50.49	72.02

character pods plant^{-1}, ICGV92126 had produced the highest number of pods plant^{-1} (46.65) and genotype ICGV86635 the lowest number (10.49) and genotype ICGV93261 had produced maximum kernels pod^{-1} (1.58) and that of ICGV93232 had produced minimum kernels pod^{-1} (1.1). Maximum value (111.4 g) for 100-seeds weight was found for the variety ICGV93255 due to larger pod size and Dhaka-1 produced the minimum (68.4 g) pod weight. Shelling percentage was higher (57.82%) for ICGV86635 and lower for ICGV93255. Harvest index ranged from 40.6 to 14.4 and the highest harvest index was exhibited by ICGV93261 and lowest by ICGV86635. Highest pod yield plant^{-1} (44.2 g) was produced by the variety ICGV92126 followed by ICGV93255 and the lowest yield was produced by the variety ICGV86635 (12.1 g). Singh and Singh (1999), Ganesan and Sudhakar (1995), Mishra and Yadav (1992), Uddin *et al*. (1995), Khurram *et al*. (1998) and Yadav *et al*. (1998) observed similar results with the present findings for most of the characters.

The phenotypic variance was slightly higher than genotypic variance for all the traits (Table 3). On the other hand, phenotypic coefficient of variations were slightly higher than genotypic coefficient variations for almost all the traits except pod yield plant^{-1} indicating lower environmental effect for these traits. Pod yield plant^{-1} showed considerable difference between phenotypic coefficient of variation (35.47%) and genotypic coefficient of variation (32.22%), reflecting considerable environmental effect on pod yield plant^{-1} (Table 3).

High heritability (>60%), high genetic advance (>10) and high genetic advance in percentage of mean (>20%) were showed by the traits plant height, pods per plant, 100-pods weight, shelling %, harvest index and pod yield plant^{-1}. The genotypes were found genetically different from each other which is an agreement with the observation of Hossain (1988), Manoharan (1990), Khurram *et al*. (1998), Naazar *et al*. (2000) Singh and Singh (1999) and Islam and Rasul (1998). The highly heritable characters with high genetic advance and high genetic advance in percentage of mean could be further improved through individual plant selection.

Days to flowering exhibited high heritability with low genetic advance and low genetic advance in percentage of mean indicated little scope for further improvement through individual plant selection. But number of primary branches plant^{-1} and kernels pod^{-1} showed high heritability with low genetic advance and moderate genetic advance in percentage of mean also indicated very limited scope for the improvement through individual plant selection.

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