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VARIABILITY AND CORRELATION STUDIES IN GROUNDNUT*

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Groundnut cultivation is gaining importance in Kerala during recent years. Eventhough India has the largest area under groundnut, the average production per hectare is low. This necessitates improvement of the present cultivars used. Study of genetic variability in the crop forms the prime requirement to achieve this aim. The present study is an attempt to understand the genetic variability present in bunch type varieties of groundnut.

Materials and Methods

Twentysix bunch varieties of groundnut selected from the germplasm maintained at the All India Co-ordinated Research Project on Oil seeds, Trivandrum, were used in this study. These varieties included both indigenous and exotic types showing wide diversity in phenotypic characters They were tested in randomised block design with three replications at the Instructional Farm of the College of Agriculture, Vellayani after a preliminary evaluation of their adaptability, during 1979-80. The plot size was 2.25 m x 1.2 m with 60 plants spaced at 15 cm x 30 cm. The management of the crop was done according to the Package of Practices Recommendations of Kerala Agricultural University (Anon., 1978).

Observations were recorded from 10 plants per plot on pod yield per plant height of main axis, number of primary branches, number of leaves, days to flowering, duration of flowering, number of flowers per plant, number of productive nodes, number of mature pods, dry weight of haulms, number of seeds per pod, 100 pod weight, 100 kernel weight, shelling percentage and oil content and the data statistically analysed.

Analysis of variance, genotypic, phenotopic and environmental variance and coefficients of variation were estimated according to the method described by Singh and Choudhary (1977). Heritability in the broad sense was estimated with reference to Hanson *et al.* (1956). Expected genetic advance under selection was estimated according to Johnson *et al.* (1955). Genotypic and phenotypic correlation coefficients were estimated according to Al-jibouri *et al.* (1958).

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Results and Discussion

All the fifteen characters studied in the 26 varieties showed wide diversity in phenotypic expression (Table 1) especially for characters like number of mature pods, 100 pod weight, number of primary branches, number of leaves and number of flowers per plant, where the maximum value recorded was more than double that of the lowest.

The analysis of variance for the 15 characters (Table 2) revealed highly significant differences in all the characters between varieties.

High genotypic and phenotypic coefficients of variation with low environmental coefficient of variation observed in 100 pod weight, number of primary branches, duration of flowering, 100 kernel weight and number of seeds per pod (Table 1) indicated that the observed phenotypic variance was mainly due to the genotype itself. Such characters are comparatively less influenced by environment, hence more reliability can be placed on their phenotypic performance. Height of main axis having high phenotypic and environmental coefficients of variation was highly influenced by the environmental effects and the phenotype was the result of the environmental effects to a greater extent. High genotypic, phenotypic and also environmental coefficients of variation (> 10%) for pod yield, number of leaves, number of mature pods,number of flowers, number of productive nodes, and dry weight of haulms prove that the observed phenotypic values are the expression of the genotypic variability modified by the environmental elements.

Burton (1952) suggested that genotypic coefficient of variation together with heritability estimates would give the best picture of the amount of advance to be expected by selection. Johnson *et al*. (1955) suggested that heritability along with genetic advance is more useful in predicting the resultant effect from selecting best individuals.

Number of mature pods, eventhough having high environmental coefficient of variation and only moderate heritability, has high genotypic coefficient of variation and genetic advance. This gives an expectation that substantial improvement by selection can be achieved though the character is to some extent subjected to environmental fluctuation. Sangha (1973) observed high genotypic coefficient of variation, heritability and genetic advance for number of pods per plant. Sivasubramanian *et al*. (1977) observed high values of genotypic coefficient of variation, heritability and genetic advance for height of main axis and number of pods per plant and suggested that certain amount of reliance can be placed on those characters for selection. Haulm weight showed high genotypic coefficient of variation and genetic advance but low heritability estimate. Basu and Asokaraj (1969) observed moderate heritability with high genetic advance for haulm weight.

Eventhough pod yield, the most important economic character, had high genotypic coefficient of variation, its heritability and genetic advance were low and environmental coefficient of variation high indicating that this character was highly influenced by the environment and was least dependable for advancement through selection when considered alone. Dixit *et al.* (1970) also observed low heritability and genetic advance for pod yield.

The results discussed above indicate that only 100 pod weight, 100 kernel weight, number of seeds per pod and number of primary branches have high genotypic coefficient of variation, heritabiiity and genetic advance. The environmental coefficient of variation was low for all these characters. This shows that these characters, due to substantial additive gene effect, can be most expected to express maximum response to selection.

Correlation studies were made (Table 3) to get an idea about the nature of relationship of yield with other characters. This will also help to identify characters on which more emphasis and preference are to be given during selection programme. The result showed that at genotypic level, pod yield had a positive correlation with number of primary branches, duration of flowering, number of productive nodes, number of mature pods, 100 pod weight, 100 kernel weight shelling percentage and oil content whereas height of main axis, number of leaves, days to flowering, number of flowers, dry weight of haulm and seeds per pod showed negative correlation. Only the correlation of height of main axis, number of mature pods and oil content were significant.

All the characters excert height of main axis and number of seeds per pod showed a positive phenotypic correlation with pod yield. This shows that the expression of the characters is the result of genotypic factors modified by environmental effects to some extent. Raman and Sreerangaswamy (1970) found a high positive correlation for yield with number of primary branches and shelling percentage. Khengure and Sandhu (1972) observed high correlation of pod yield with number of primary branches, number of mature pods and shelling percentage. The results of the present study are in agreement with these findings. Shettar (1974) found a positive correlation for pod yield with height of main axis, number of mature pods and 100 seed weight. But in the present study a significant negative, correlation was observed between pod yield and height of main axis. Shettar (1974) also observed a negative correlation with shelling percentage which is not in agreement with the results obtained in the present study. Kushwaha and Tawar (1973) found that yield was positively correlated with plant height, number of mature pods, number of branches and straw weight. But in the present study, pod yield was found to be negatively correlated with height of main axis and dry weight of haulm. Dholaria *et al.* (1972) found that pod yield was significantly and positively correlated with number of pods, number of branches, shelling percentage and 100 kernel weight. Mahapatra (1966) observed a positive correlation between yield and shoot weight which disagreed with the present finding.

Table 1

Mean, range, variance, coefficients of variation, heritability and genetic advance of 15 characters in 26 varieties of groundnut

	Characters	Mean	Range	Genotypic variance	Phenotypic variance	Environmental variance	Genotypic coefficient of variation
		(1)	(2)	(3)	(4)	(5)	(6)
1	Pod yield (g/plant)	19.09	15.03— 24.71	3.74	12.17	8.42	10.13
2	Height of main axis (cm)	61.76	51.83- 79.26	33.38	76.40	43.01	935
3	No. of primary branches	7.23	4.50 — 9.23	1.13	1.40	0.27	14.73
4	No. of leaves	32.28	11.06— 50.36	65.73	160.80	95.07	25.11
5	Days to flowering	25.32	21.66— 28.33	2.81	3.31	0.50	6.62
6	Duration of flowering (days)	26.81	20.60- 31.00	7.35	11.16	3,80	10.11
7	No. of flowers per plant	98.68	61.43— 124.23	250.62	361.87	111.24	16.04
8	No. of productive nods	30.69	25.20— 38.43	16.89	32.64	15,74	1339
9	No. of mature pods	21.26	12.90— 31.23	21.85	31.59	9.74	21.98
10	Dry weight of haulm (g/plant)	19.58	15.28- 27.03	5.80	13.91	8.11	12.23
11	No. of seeds per pod	1.94	1.79— 3.01	0.055	0.056	0.0015	12.07
12	100 pod weight (g)	103.92	81.26—161.03	532.14	566.85	34.70	22.19
13	100 kernel weight (g)	47.15	38.90— 62.86	45.73	50 39	4.66	14.34
14	Shelling percentage	79.23	74.93- 82.00	3.61	5.05	1,.43	2.40
15	Oil content (%)	48.19	43.61 — 52.60	3.56	6.83	3..27	3.91

Table 1 continued

	Characters	Phenotypic coefficient of variation	Environmental coefficient of variation	Heritability in the broad sense	Genetic advance at 5% intensity of selection
		(7)	(8)	(9)	(10)
1	Pod yield (g/plant)	18.27	15.20	30.74	11.57
2	Height of main axis (cm)	14.15	10.61	43.70	12,73
3	No. of primary branches	16.40	7.20	80.71	27.27
4	No. of leaves	39.27	30.20	40.87	33.07
5	Days to flowering	7.19	2.79	84.87	12.57
6	Duration of flowering (days)	12.46	7.27	65.91	16.92
7	No. of flowers per plant	19.27	10.68	69.25	27.50
8	No. of productive nodes	18.61	12.92	51.75	19.84
9	No. of mature pods	26.43	14.68	69.15	37.65
10	Dry weight of haulm (g/plant)	18.99	14.53	41.44	16.25
11	No. of seeds per pod	12.23	1.96	97.42	24.56
12	100 pod weight (g)	22.90	5.66	93.87	44.30
13	100 kernel weight (g)	15.05	4.57	90.74	28.14
14	Shelling percentage	2.83	1.51	71.58	4.18
15	Oil content (%)	5.42	3.75	52.10	5.82

Table 2

Analysis of variance for 15 characters in 26 varieties of groundnut

Source of variation	Degrees of freedom	Mean Square: Pod yield/ plant	Height of main axis	No. of primary branches	No. of leaves	Days to flowering	Duration of flowering	No. of flowers/ plant	No. of productive nodes
Block	2	16.11	876.67	1.33	3.08	3.12	12.12	1048.18	48.42
Treatments	25	19.65**	143.17**	3.68**	292.27**	8.94**	25.88**	863.11**	66.43**
Error	50	8 42	43.01	0.27	95.07	0.50	3.80	111.24	15.74

Table 2 continued

Source of variation	Degrees of freedom	Mean Square: No. of mature pods	Dry weight of haulm	No. of seeds/pod	100 pod weight	100kernel weight	Shelling %	Oil content
Block	2	2443	61.13	0.0086	7.44	0.7585	3 28	6.35
Treatments	25	75.30**	25.53**	0.1666**	161.14**	141.87**	12.29**	3.27**
Error	50	9.74	8.11	0.0014	34.70	4.66	1.43	3.27

** Significant at 1% level

Table 3

Genotypic and phenotypic correlation coefficients among fifteen characters in groundnut

Characters	Pod Yield	Height of main axis	Number of primary branches	No. of leaves	Days to 50% flowering	Duration of flowering	No. of flowers per plant	No. of productive nodes
Pod yield	—	—0.5891**	0.1981	— 0.1981	-0.0034	0.0398	-0.2368	0.0239
Height of main axis	—0.2812	—	—0.6658**	0.2305	—0.5016**	-0.2632	-0.3525	—0.1299
Number of primary branches	0.1077	-0.3549*	—	—0.1088	0.6083**	0.1829	0.4329**	—0.0109
Number of leaves	0.2954*	__0.0544	-0.0285	—	—0.2039	—0.3261*	- 0.5279**	0.1157
Days to flowering	0.0087	- 0.3655**	0.4733**	—0.1207	—	0.5999**	0.4029**	0.1992
Duration of flowering	0.0907	-0.2264	0.1291	—0.1354	0.4283**	—	0.6996**	0.6148**
Number of flowers per plant	0.0211	-0.2349	0.3921**	-0.2959*	0.2703	0.6523**	—	0.5249**
Number of productive nodes	0.3419*	-0.1134	0.0628	0.2698	0.0883	0.5503**	0.5417**	—
Number of mature pods	0.7188**	—0.3906**	0.4641**	0.0162	0.2694*	0.3453	0.3967**	0.4422**
Dry weight of haulms	0.3591*	0.2047	-0.0242	0.7619**	0.0411	0.2356	—0.0646	0.5207**
Number of seeds per pod	—0.0510	0.5170**	—0.5737**	0.1494	—0.5601**	—0.3752**	—0.4465**	—0.1484
100 pod weight	0 0519	0.3131*	—0.6557**	0.2298	—0.3986**	—0.3150*	—0.5324**	—0.1744
100 Kernel weight	0.0966	0.0626	—0.3963**	0.2611	—0.1048	-0.2163	—0.3978**	—0.1547
Shelling percentage	0.1261	—0.3991**	0.5228**	—0.2047	0.2771	0.1935	0.3768**	0.1046
Oil content	0.2956*	—0.2993*	0.1105	0.1970	—0 0058	0.0583	0.0486	0.0643

Table 3 continued

Characters	Number of mature pods	Dry weight of haulm	Number of seeds per pods	100 pod weight	100kernel weight	Shelling %	Oil content
Pod yield	0.6176**	—0.1889	— 0.1469	0.0935	0.0893	0.1366	0.6716**
Height of main axis	—0.9598**	0.2107	0.7424**	0.5811**	0.1304	—0 8141**	—0.5102**
Number of primary branches	0.5159**	—0.1649	—0.6461**	—0.7735**	—0.4667	0.6965**	0.0956
Number of leaves	-0.3546*	0.7863**	0 2054	0.3514*	0.3634**	—0.4147**	0.2239
Days of flowering	0.3396*	0.1597	—0.5927**	—0.4444**	-0.1329	0.3603*	—0.0171
Duration of flowering	0.4196*	0.2210	—0.4580**	—0.3663**	-0.2414	0.2771	0.0780
Number of flowers per plant	0.4367**	0.2462	—0.5309**	—0.6749**	—0.5484**	0.5726**	0.1113
Number of productive nodes	0.3534*	0.4914	-0.2079	—0.2823*	—0.2747	0.0487	0.0768
Number of mature pods	—	—0.1751	—0.5407**	—0.6519**	—0.5927**	—0.7037**	0.3511*
Dry weight of haulms	0.1714	—	0.0057	0.2134	0.2161	—0.4116**	0.1332
Number of seeds per pod	—0.4386**	0.0285	—	0.6899**	0.1656	-0.6034	—0.5240**
100 pod weight	—0.5389**	0.1205	0.6616**	—	0.8024**	—0.8513**	-0.0421
100 Kernel weight	—0.4385**	0.1632	0.1631	0.7918**	—	—0.6171**	—0.3956**
Shelling percentage	0.5254**	—0.1799	—0.5009**	—0.7046**	—0.4995*	—	0.1228
Oil content	0.2006	0.1271	—0.3766**	0.0038	0.2698	0.1119	—

Genotypic correlations are shown above the diagonal and phenotypic correlations are shown below the diagonal

* Significant at 5% level

** Significant at 1% level

The negative correlation of height of main axis, number of leaves and dry weight of haulm with pod yield may be due to the diversion of a major portion of photosynthates produced for the vegetative growth of the plant. Tall plants may have an increased internodal length affecting peg elongation and pod development. Patra (1973) observed that a high yielding form will have shorter internodes at the flowering stage and the lesser the growth during flowering the more was the pod yield. These three characters showed a negative correlation with number of mature pods also which had significant positive correlation with pod yield.

The negative correlation of days to flowering with yield of pods shows that an early flowering variety is expected to produce higher pod yield. Number of flowers was negatively correlated with pod yield. The later formed flowers generally do not produce any pods or even if any pods are formed, they may not be mature enough at the time of harvest, thus not contributing to the final yield. In the present study, it was observed that in majority of the varieties only less than *40%* of the flowers produced are contributing to the final yield. But the number of flowers was found to be significantly and positively correlated with number of mature pods.

Number of seeds per pod was significantly and negatively correlated with number of mature pods which had a significant positive correlation with pod yield. The varieties having a high number of seeds per pod may be producing only a fewer number of pods.

Summary

A variability and correlation study was conducted on 26 bunch varieties of groundnut. 100 pod weight, 100 kernel weight, number of seeds per pod and number of primary branches have high genotypic coefficients of variation, heritability and genetic advance and low environmental coefficients of variation. Except number of seeds per pod, the other characters showed a positive correlation with pod yield. These characters due to substantive additive gene effect, can be most expected to express maximum response to selection.

സംഗ്രഹം

ഇരുപത്തിയാറ് വ്യത്യസ്ത നിലക്കടലയിനങ്ങളിൽ വിളവും ജനിതക ഘടകങ്ങളും തമ്മിലുള്ള പരസ്പര ബന്ധവും വിചരണവും പഠനവിധേയമാക്കി 100 കായ്കളുടെ തൂക്കം, 100 വിത്തുകളുടെ തൂക്കം, ഒരു കായിൽ ഉള്ള വിത്തുകളുടെ എണ്ണം, പ്രഥമ ശിഖരങ്ങളുടെ എണ്ണം എന്നിവയ്ക്ക് ഉയർന്ന ജനിതക വിചരണ ഗുണാംശവും പാരമ്പര്യാർജിനീയതയും ജനിതകനേട്ടവും ഉള്ളതായും ഇവയിൽ ഒരു കായിൽ ഉള്ള വിത്തുകളുടെ എണ്ണം ഒഴിച്ചുള്ള ഘടകങ്ങൾ വിളവുമായി ധനാത്മക സഹസംബന്ധമുള്ളതായും കണ്ടു. ഇവ അഡിറ്റീവ് ഘടകങ്ങളാകയാൽ നിർധാരണം വഴി മെച്ചപ്പെടുത്താവുന്നതാണ്.

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