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Variability and Correlation Studies in Groundnut After Hybridization

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To estimate some genetic parameters and correlations in F_2 population of a cross involving a spreading and a bunch variety was studied. Heritability estimates were high for fruiting and vegetative nodes per secondary branch, lateral spread and 100-kernel weight. Pod yield was positively and highly associated with number of pods and 100-kernel weight and significantly with fruiting nodes per secondary branch. At genetic level primary branches, secondary branches, fruiting nodes per secondary branch, number of pods and 100-kernel weight were mostly highly associated with each other. Pod yield had positive and highly significant partial correlation with number of pods and 100-kernel weight only and both had the maximum contribution to pod yield.

The knowledge of phenotypic and particularly genotypic correlations among the morphological characters affecting pod yield is necessary to make rapid and efficient advance in plant breeding programme. An increase in yield potential has always been of fundamental importance. The objectives of this study were to determine the phenotypic and genotypic correlations between 12 morphological characters and pod yield, the five important components *inter se* and to determine the relative importance to each of the five components to pod yield.

MATERIAL AND METHODS

F_2 progenies of a cross between M 145 x Tifton 1108 were grown in 6 m long 30 cm apart rows having plants spaced at 30 cm at the Punjab Agricultural University Research Farm during *kharif* 1976-77. Estimates of heritability were derived using the formula of Mahmud and Kramer (1951). Phenotypic and genotypic correlations were calculated as outlined by Kwon and Torrie (1964) and partial and multiple correlations were estimated according to the formula suggested by Croxton and Cowden (1963).

RESULTS AND DISCUSSION

The estimates of phenotypic and genotypic coefficients of variation, heritability and genetic advance expressed as per cent of mean are given in Table I. High phenotpyic coefficient of variation was recorded in respect of fruiting nodes per secondary branch, secondary branches and vegetative nodes per secondary branch whereas it was very low for leaflet breadth and leaflet length. High genotypic coefficient of variation was observed for fruiting and vegetative nodes per secondary branch but was the

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TABLE I. Estimates of some genetic parameters and simple correlations between yield and its components

Character	PCV	GCV	H	GA of mean	rp	rg
Primary branches	28.89	22.12	.58	34.77	.1524	.2343
Secondary branches	69.59	34.47	.25	35.18	.2044	—.2207
Lateral spread (cm)	31.78	28.55	.81	52.82	—.0298	—.1769
Length of a primary branch	26.37	16.55	.39	21.40	—.0377	—.8826
Fruiting nodes per primary branch	50.54	36.68	.53	54.82	.1091	—.8703
Vegetative nodes per primary branch	30.85	16.27	.28	17.68	.0080	—.5862
Fruiting nodes per secondary branch	89.65	81.55	.83	152.85	.2365*	+1.7514
Vegetative nodes per secondary branch	61.37	53.17	.75	94.90	.0509	+1.7491
Leaflet length (cm)	17.44	10.39	.36	12.76	—.0975	.0548
Leaflet breadth (cm)	16.04	6.85	.18	6.03	—.1024	.8458
Number of pods	46.03	30.97	.45	42.93	.7373**	.8629
100-kernel weight (gm)	26.96	21.12	.61	34.07	.3521**	+1.3161
Pod yield	46.80	14.91	.10	9.87		

*, ** Significant at 0.05% and 0.01% respectively

PCV = Phenotypic coefficient of variability; GCV = Genotypic coefficient of variability
H = Heritability; GA = Genetic Advance

lowest again for leaflet breadth and length. Heritability estimates were high for fruiting nodes per secondary branch, lateral spread and vegetative nodes per secondary branch and was lowest for pod yield *per se*. Genetic advance as high as 152.85 per cent of mean was found in fruiting nodes per secondary branch followed by vegetative nodes per secondary branch and was very low for leaflet breadth and pod yield.

The total correlations between pod yield and 12 characters at both phenotypic levels are presented in Table I. At phenotypic level pod yield had positive and highly significant correlation with number of pods and 100-kernel weight but was significant with fruiting nodes secondary per branch. At genotypic level the correlations greater than +1 were recorded with fruiting and vegetative nodes per secondary branch and 100-kernel weight. Their magnitude was also fairly high with length per primary branch, fruiting nodes per primary branch, number of pods and leaflet breadth.

The simple correlations between five component characters are given in Table II. Phenotypically positive and highly significant correlation was observed between primary branches with secondary branches, fruiting nodes per secondary branch and number of pods; secondary branches with fruiting nodes per secondary branch and number of pods; fruiting nodes per secondary branch with number of pods and number of pods with 100-kernel weight. At genotypic level an increase in magnitude was

TABLE II. Total correlation between components

Primary branches	Secondary branches	Fruiting nodes secondary branch	No. of pods	100-kernel weight
	.3682**	.3695**	.3460**	.1969
	.2140	.5487	.4847	.1853
		.5489*	.4410	.1863
		1.0939	-.1483	-.2286
			.4662**	.1991
			.8634	.2683
				.2453*
				.4663

* Significant (P=.05) ** Highly significant (P=.01)

In each cell upper values represent phenotypic and lower ones represent genotypic correlation coefficients.

observed between primary branches with fruiting nodes per secondary branch and number of pods; secondary branches with fruiting nodes per secondary branch although it exceeded 1; fruiting nodes per secondary branch with number of pods and 100-kernel weight and number of pods with 100-kernel weight.

The partial correlation coefficients between pod yield and five component characters keeping the effect of one or more variables constant are presented in Table III. Between pod yield and primary branches and also between pod yield and secondary branches, the true relationship decreased in magnitude and became negative in certain cases but was non-significant in all the combinations. Between pod yield and fruiting nodes per scondary branch although the simple correlation was significant, when the effect of other variables was eliminated individually or collectively there was a decrease in magnitude and change in sign but in all these cases the coefficients were non-significant. With number of pods the pod yield had highly significant partial correlation coefficients showing a slight increase when primary branches alone or with secondary branches were allowed for and a slight decrease in all other cases. The real association between pod yield and 100-kernel weight decreased in magnitude when the effect of other variables was allowed for singly or collectively so much so that there was a decrease in level of significance as well when number of pods alone or with secondary branehes and/or fruiting nodes per secondary branch; primary branches with number of pods alone or with fruiting nodes per secondary branch were allowed for.

The multiple correlation coefficients showing the combined effect of two or more independent characters towards pod yield is presented in Table IV. Primary branches with secondary branches alone or both with fruiting nodes per secondary branch had no significant effect on pod yield whereas the effect of fruiting nodes per secondary branch with primary branches or secondary branches was significant. In all other possible combinations the effect of two or more characters on pod yield was highly significant.

The total and relative contribution of the five independent variables to pod yield is given in Table V. Out of the five characters, number of pods contributed the maximum followed by 100-kernel weight, primary branches and

TABLE III. Partial correlation coefficients

r12.0	.1524	r13.0	.2044	r14.0	.2365*	r15.0	.7373**	r16.0	3521**
12.3	.0847	13.2	.1614	14.2	.1962	15.2	.7384**	16.2	3324**
12.4	.0720	13.4	.0919	14.3	.1519	15.3	.7367**	16.3	3265**
12.5	—.1620	13.5	—.1991	14.5	—.1794	15.4	.7294**	16.4	3203**
12.6	.0906	13.6	.1510	14.6	.1814	15.6	.7174**	16.5	2614*
12.34	.0539	13.24	.0785	14.23	.0786	15.23	.7388**	16.23	3190**
12.35	—.1173	13.25	—.1654	14.25	—.1455	15.24	.7328**	16.24	3142**
12.36	.0416	13.26	.1281	14.26	.1607	15.26	.7287**	16.25	2873**
12.45	—.1228	13.45	—.1369	14.35	—.1336	15.34	.7329**	16.34	3144**
12.46	.0305	13.46	.0655	14.36	.1208	15.36	.7281**	16.35	2862*
12.56	—.2028	13.56	—.2297	14.56	—.2136	15.46	.7218**	16.45	.2851*
12.345	—.1023	13.245	—.1189	14.235	—.0886	15.234	.7354**	16.234	.3108**
12.346	.0176	13.246	.0605	14.236	.1150	15.236	.7353**	16.235	.3023**
12.356	—.1544	13.256	—.1912	14.256	—.1735	15.246	.7301**	16.245	.3014*
12.456	—.1593	13.456	—.1587	14.356	—.1597	15.346	.7289**	16.345	.2955*
12.3456	—.1370	13.2456	—.1362	14.2356	—.1093	15.2346	.7349**	16.2345	.3084**

* Significant (P=.05) ** Highly significant (P=.01)

1 = Pod yield 2 = Primary branches 3=Secondary branches 4=Fruiting nodes per secondary branch 5=Number of pods 6=100-kernel weight

TABLE IV. Multiple correlation coefficients

RI (23)	.2204	RI (234)	.2580	RI (2345)	.7559**
RI (24)	.2465*	RI (235)	.7535**	RI (2346)	.3959**
RI (25)	.7455**	RI (236)	.3814**	RI (2356)	.7793**
RI (26)	.3620**	RI (245)	.7517**	RI (2456)	.7776**
RI (34)	.2527*	RI (246)	.3917**	RI (3456)	.7774**
RI (35)	.7495**	RI (256)	.7696**		
RI (35)	.3793**	RI (345)	.7527**		
RI (45)	.7471**	RI (346)	.3956**		
RI (46)	.3908**	RI (356)	.7731**		
RI (56)	.7581**	RI (456)	.7707**	RI (23456)	.7824**

* Significant (P=.05) ** Highly significant (P=.01)

1 = Pod yield 2 = Primary branches 3 = Secondary branches 4 = Fruiting nodes per secondary branch 5 = Number of pods 6 = Kernel weight

TABLE V. Relative contribution of independent variables

Eliminated character	Total $R1^2$ .6122 (23456) relative	Partial correlation	
2	.0077	r 12.3456	—.1370
3	.0075	r 13.2456	—.1362
4	.0048	r 14.2356	—.1093
5	.4554	r 15.2346	.7349**
6	.0408	r 16.2345	.3084**

** Highly significant (P=.01)

1 = Pod yield 2 = Primary branches 3 = Secondary branches 4=Fruiting nodes per secondary branch 5 = Number of pods 6 = 100-kernel weight

secondary branches while that of the fruiting nodes per secondary branch was the lowest. The magnitude of the corresponding partial correlation coefficients was also in the same order.

Phenotypically considerable amount of variability had been exhibited by the characters, fruiting nodes per secondary branch, secondary branches and vegetative nodes per secondary branch. Genetic component in these traits was substantially high except for secondary branches which were largely influenced by environment. An opportunity for a considerable degree of improvement in six out of 13 characters was indicated by heritability estimates. Their values ranged from .53 to .83. By selecting top 5 per cent individuals about 43 per cent improvement can be made in number of pods, about 10 per cent in pod yield and 34 per cent in 100-kernel weight.

Positive correlation between pod yield with number of pods, 100-kernel weight and fruiting nodes per secondary branch indicate that their increase will lead to increased pod yield and all these characters can be improved simultaneously. Non-significant association between pod yield with other morphological characters suggest that selection for the former could be made without adversely affecting the other traits. Sangha (1973) had also reported non-significant correlation between pod yield and primary branches, secondary branches and length per primary branch. In general genotypic correlations were higher in magnitude than their corresponding phenotypic estimates which was due to making effect of environment on the genetic association between characters.

Phenotypically the three major components of pod yield, *viz:* number of pods, 100-kernel weight and fruiting nodes per secondary branch and also two other important traits, primary branches and secondary branches were also positively and highly associated with one another suggesting an increase in any one of them would lead to increase in the other traits. Khangura and Sandhu (1972) had also observed highly significant correlation between primary branches, secondary branches, length per secondary branch and number of pods.

The real association between pod yield and its morphological components as indicated by partial correlation coefficients revealed that pod yield had no association with primary branches, secondary branches and fruiting nodes per secondary branch. With number of pods the consistent magnitude of the partial correlation coefficients even after eliminating the effect of other traits individually or in all other possible combinations suggest that these traits had little effect in suppressing or stimulating the association between pod yield and number of pods. But the number of pods do contribute to the correlation between pod yield and 100-kernel weight since the magnitude of the partial correlation coefficients was very much lessened when the effect of number of pods was eliminated. The stimulating effect of number of pods was lowered when it was considered in combination with primary branches, secondary branches or fruiting nodes per secondary branch. The latter three characters too had a little stimulating effect in the expression of true correlation. These estimates are comparable to those previously reported by Sangha and Sandhu (1970, 1975) and Sangha (1973).

The combined effect of two or more independent variables to pod yield was highly significant in most of the cases. Number of pods with 100-kernel weight had more marked effect than the other three characters. These five independent traits accounted for 61 per cent variability in pod yield out of which number of pods followed by 100-kernel weight contributed the maximum. These estimates are camparable to those previouly reported by Sangha and Sandhu (1970, 1975) and Sangha (1973). Khangura and Sandhu (1972) observed that 70.66 per cent variability was accounted for by length per primary branch and number of pods whereas 3.55 per cent by primary branches and length per secondary branch.

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