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GENETIC ARCHITECTURE AND ORDER EFFECT IN TRIPLE CROSSES OF GROUDNUT (*Arachis hypogaea* L.)

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ABSTRACT

Sixty, three-way hybrids involving six parents were tested. The data on 20-pod mass were analysed as per a triallel analysis model. The character showed predominantly epistatic genetic variance. The magnitude of additive x dominance type of epistasis was maximum followed by dominance x dominance and additive gene effects respectively. The dominance and additive x additive type of interactions were negative and considered equal to zero. The cross combination (ALR 2 x JL 24) x Girnar 1 recorded the highest three-line specific effects, whereas, the other combinations of the same three parents, (Girnar 1 x JL 24) x ALR 2 and (Girnar 1 x ALR 2) x JL 24 exhibited negative estimates.

KEY WORDS : Groudnut, Epistasis, Additive gene effects, Order effects

Groundnut (*Arachis hypogaea* L.) is an important oilseed crop grown under varying climatic conditions. In the semi arid tropics, it is mostly grown under rainfed conditions in marginal and sub-marginal lands. Hence, developing varieties with stability in performance is one of the criteria in the crop improvement programme. To achieve this, there is a need to broaden the initial genetic base by adopting multiple crosses, so that the genes can be incorporated from different sources. In the process of widening the initial genetic base, three-way crosses are the next logical step to single crosses (Arunachalam *et al.* 1985). The knowledge on the combining ability of the parent is essential for the choice of parents in three-way crosses. Further the understanding of the nature of gene action will help to formulate suitable breeding strategy. Such information is meagre in groundnut.

The present attempt therefore, was made to further analyse the gene action of pod mass through the triallel analysis developed by Rawling and Cockerham (1962), Hinkelmann (1965) and Ponnuswamy *et al.*, (1974), which provides information not only on additive, dominance and epistasis type of gene action, but also about the order effects of the parents in three-way crosses.

MATERIALS AND METHODS

All possible sixty, three-way crosses involving six divergent groundnut strains, *viz.*, (1) ICGS 44, (2) Girnar 1, (3) ALR 2, (4) JL 24, (5) GG 2 and (6) Co 2 were raised in a randomized block design with three replications at Regional Research Station, Vridhachalam during Kharif'94. Data on 20-pod weight were recorded on 15 randomly selected plants. Mean data were subjected to triallel analysis according to Ponnuswami *et al.* (1974). The following formula was used :

Y_{ijkl} = $m + b_l + G_{(ijk)} + e_{ijkl}$, where

Y_{ijkl} = The phenotypic value in the l_{th}

Table 1. Mean squares for pod mass in groundnut

Source of variation	df	M.S.
General line effect of first kind (hi)	5	6.88**
General line effect of second kind (gi)	5	46.12**
2-Line specific effect of first kind (dij)	9	5.38*
2-Line specific effect of second kind (sij)	19	10.63*
3-Line specific effect (T_{ijk})	21	16.82**
Crosses	59	14.73**
Error	118	3.70

** P < 0.01

Table 2. Estimates of general-line and two-line specific effects for pod mass

Lines	General-line effects		Two-line specific effects S_{ij} (upper half) and S_{ji} (lower half) (Figures in the bracker corresponds to dij)					
	First kind (hi)	Second kind (gi)	1	2	3	4	5	6
1	0.21	-0.32	-	-0.88*	0.47	1.66**	-0.06	-1.18**
				(-0.27)	(0.37)	(-0.71)	(0.92)*	(-0.31)
2	0.14	0.39	0.39	-	-0.06	-0.27	0.47	-0.53
					(-0.35)	(0.47)	(0.93)*	(-0.77)
3	1.71**	-1.37**	-0.46	0.03	-	0.28	-0.06	0.21
						(0.16)	(-0.88)	(0.70)
4	1.27**	1.12**	-0.74	1.51**	-1.41**	-	-1.21**	1.86**
							(-0.65)	(0.72)
5	-0.55**	-0.16	1.59**	-0.29	-0.38	-0.55	-	-0.35
								(-0.33)
6	0.63*	0.34	-0.77	-0.37	1.38**	-1.11**	0.87*	-

SE (hi) = 0.26 ; SE(gi) = 0.33 ; SE(sij) = 0.41 ; SE (dij) = 0.47

**, * Sigificant at 1 and 5 per cent level respectively.

Note : 1. ICGS 44, 2. Girnar 1, 3. ALR 2, 4. JL 24, 5. GG2 and 6. Co 2.

replication by ijth cross (grand parents) mated to k_{th} parent ;

m = General mean ;

b_l = Effect of l_{th} replication

$G_{(ij)k}$ = The cumulative effect of the triallel cross (ij)k, where i and j are grand parents and k is the parent ;

$G_{(ij)k} = g_{ij} + g_k + F_{(ij)k}$;

g_{ij} = Average effect of F1 hybrid ;

$g_{ij} = h_i + h_j + d_{ij}$;

h_i = The general line effect of i_{th} parent as grand parent (the first kind general line effect) ;

d_{ij} = Two line (i x j) specific effect of first kind (grand parent) ;

$F_{(ij)k}$ = Non-additive effect of F_1 hybrid (i x j) with both parents ;

$F_{(ij)k} = S_{ik} + S_{ij} + T_{ijk}$;

S_{ik} = Two-line specific effect where i is half-parent and k is the parent. Hence specific effect of second kind ;

T_{ijk} = Three line specific effect ;

e_{ijkl} = Error effect

RESULTS AND DISCUSSION

The analysis of variance for three-way crosses (triallel cross analysis) showed that the general line, two line (both first and second kind) and three-line specific effects were significant (Table 1). General line effect of first and second kind (h_i and g_i) indicated that JL 24 was the only parent which showed good general combining ability of both

Table 3. Estimates of three-line specific effects (tijk) for pod mass

Grand Parental lines		Parental lines					
		1	2	3	4	5	6
1	2	-	-	-1.19	2.63**	-2.16**	0.72
1	3	-	-0.22	-	-2.10**	1.21	1.11
1	4	-	-1.84**	1.62*	-	0.89	-0.67
1	5	-	-0.14	0.39	0.91	-	-1.16
1	6	-	2.21**	-0.82	-1.44*	0.05	-
2	3	1.39*	-	-	-0.27	-1.25	0.13
2	4	-2.31	-	-0.01	-	1.60*	0.72
2	5	1.61*	-	1.82**	-1.86**	-	-1.58**
2	6	-0.69	-	-0.61	-0.50	1.81**	-
3	4	-0.69	3.01**	-	-	-0.29	-2.02**
3	5	-1.09	-0.36	-	0.69	-	0.77
3	6	0.40	-2.42**	-	1.68*	0.33	-
4	5	1.10	-0.43	-2.64**	-	-	1.97**
4	6	1.91**	-0.74	1.03	-	-2.19**	-
5	6	-1.61	0.94	0.41	0.25	-	-

SE (tijk) = 0.65

**, * Significant at 1 and 5 per cent level respectively.

Note : 1. ICGS 44, 2. Girnar 1, 3. ALR 2, 4. JL 24, 5. GG 2 and 6. Co 2.

Table 4. Magnitude of components of genetic variance for pod mass in groundnut

Components	Estimates
Additive	805.09
Dominance	-1377.05
Additive x additive	-1322.05
Additive x dominance	6225.16
Dominance x dominance	1523.28

kinds, whereas Co 2 exhibited significant and positive estimate only for general line effect of first kind only (Table 2).

The estimates of two-line specific effect of first kind (d_{ij}) were positive and significant for the crosses Girnar 1 x GG 2 and ICGS 44 x GG 2 suggesting their superiority as good grand parents for three-way crosses. Similarly, two-line specific effect of second kind (S_{ij}) was the highest in crosses JL 24 x Co 2 and ICGS 44 x JL 24 and the reciprocal effects (S_{ji}) were positive and significant for GG 2 x ICGS 44, JL 24 x Girnar 1, Co 2 x ALR 2 and Co 2 x GG 2.

These results indicate that all the crosses with high two-line specific effects of second kind had invariably reciprocal differences and considered as they are associated with the order effects in the three-way hybrids as also shown by .

The estimates of three-line specific effects (t_{ijk}) (Table 3) were found to be highly positive and significant in 12 crosses. Considering the best performing triplet (ALR 2 x JL 24) x Girnar 1, only JL 24 is a good combiner. The same parents in the triplet (Girnar 1 x JL 24) x ALR 2 and (Girnar 1 x ALR 2) x JL 24 exhibited negative effects demonstrating the over riding influence of c... of crossing. The superiority of three-line specific effects in triplets for the character may be due to (i) either involvement of at least one parent showing better general combining ability (general line effect), with the restriction that it should be placed in a specific position in the triplet, or (ii) either cross showing better two-line specific effects and / or (iii) rarely due to purely interaction effects among three poor general combiners making the triplet.

The estimates of components of genetic variation (Table 4) revealed that dominance and additive x additive interaction were negative and considered equal to zero, indicating the importance of additive x dominance and dominance x dominance epistatic variance, besides additive genetic variance. The preponderance of additive gene action in governing pod mass was reported by Manoharan (1992) in groundnut. Thus predominance of epistatic component of genetic variance for pod mass has to be considered while formulating breeding procedure for the improvement of pod mass in groundnut.

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