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GENETIC ARCHITECTURE OF YIELD AND QUALITY CHARACTERS IN GROUNDNUT

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ABSTRACT

Analysis of generation means was carried out in six crosses involving two cultivated varieties and three-exotic rust resistant cultures of groundnut (Arachis hypogaea.L) for pod yield and quality characters viz. Shelling percentage, Hundred kernel weight and Sound mature kernel percentage. The data revealed considerable proportion of non-allelic interactions. All characters were found to be controlled by both additive and non-additive gene action, however, in the case of shelling percentage predominance of non-additive gene action was observed.

While taking up studies on the transfer of rust (Puccinia arachidis Speg) resistance from exotic to Indian cultivars in groundnut, undesirable thick pericarp resulting in poor shelling and shrivelled nature of kernels were observed in the progeny of the crosses. As such the available sources of resistant cultures lacking agronomic and quality characters and hence need to be improved before it would be acceptable for market (Subrahmanyam and Mc Donald. 1983). To evolve high yielding rust resistant varieties, it was felt necessary to understand the genetic architecture of the quality attributes viz. shelling per cent, hundred kernel weight, sound mature kernel per cent besides pod yield. It was with this view, that the present study was conducted.

MATERIALS AND METHODS

The study comprised of two recommended cultivars viz. JL 24 and Co2 (Sub sp. fastigiata Var. vulgaris) and three rust resistant exotic cultures viz. NcAc 17090 (sub sp. fastigiata Var. fastigiata) and PI 414331 and PI 414332 (sub sp. hypogaea Var hypogaea). The country of origin of former one is Peru and that of latter two are Honduras. Each cross was considered as a genetic group and comprised of various segregating and non-segregating generations viz. P1, P2, F1, F2, BC 1 and BC 2.

The above six generations of the six cross combinations were raised in Randomised Block Design with three replications. Each non segregating generations as well as back crosses were sown in five rows. Whereas F2's were sown each in ten rows of 4 m. The distance between rows and plants within

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TABLE 1 : Scaling tests of six crosses in groundnut.

Name of the cross	Scaling tests		
	A	B	C
	Shelling Percentage		
Co 2 x NcAc 17090	-8.66** ± 1.33	-7.33** ± 2.66	-2.66 ± 2.98
Co 2 x PI 414331	22.00** ± 2.58	8.66** ± 2.91	16.00** ± 5.96
Co 2 x PI 414332	-5.66** ± 2.02	-9.66** ± 8.42	32.00** ± 2.98
JL 24 x NcAc 17090	12.00** ± 1.63	26.66** ± 2.66	32.66** ± 4.94
JL 24 x PI 414331	-0.33 ± 2.18	2.33 ± 1.97	21.33** ± 4.32
JL 24 x PI 414332	-4.33** ± 1.33	2.33 ± 1.88	2.00 ± 3.39
	Hundred kernel weight (g)		
Co 2 x NcAc 17090	-6.66 ± 12.47	8.00 ± 8.40	12.66 ± 16.80
Co 2 x PI 414331	-11.33 ± 11.19	4.00 ± 8.53	12.66 ± 13.12
Co 2 x PI 414332	-19.33** ± 6.56	-7.33 ± 8.35	-4.00 ± 24.23
JL 24 x NcAc 17090	7.00 ± 6.55	4.00 ± 7.30	3.66 ± 21.91
JL 24 x PI 414331	-1.00 ± 1.29	-4.66 ± 3.88	26.33** ± 5.95
JL 24 x PI 414332	4.33 ± 3.57	3.33 ± 5.07	-14.33** ± 2.47
	Sound mature kernel percentage		
Co 2 x NcAc 17090	-5.33 ± 7.05	27.33** ± 10.87	20.66 ± 13.20
Co 2 x PI 414331	-4.00 ± 12.27	-5.33 ± 7.42	-5.33 ± 10.10
Co 2 x PI 414332	-14.66 ± 15.97	14.66 ± 10.81	15.33 ± 0.80
JL 24 x NcAc 17090	16.33 ± 11.86	40.00** ± 15.56	27.00 ± 35.31
JL 24 x PI 414331	-3.66 ± 7.88	21.33** ± 10.54	3.66 ± 19.72
JL 24 x PI 414332	8.33 ± 10.10	-14.66 ± 11.85	-30.33 ± 20.23
	Pod yield/plant		
Co 2 x NcAc 17090	-0.02 ± 0.04	-0.02 ± 0.03	-0.04 ± 0.05
Co 2 x PI 414331	-0.13** ± 0.03	-0.05 ± 0.03	-0.21** ± 0.07
Co 2 x PI 414332	0.11** ± 0.84	-0.02 ± 0.03	0.02 ± 0.07
JL 24 x NcAc 17090	0.02 ± 0.03	-0.18** ± 0.04	-0.22** ± 0.07
JL 24 x PI 414331	0.11** ± 0.03	0.12 ± 0.07	0.26** ± 0.08
JL 24 x PI 414332	0.05** ± 0.02	0.07 ± 0.04	0.02 ± 0.10

row were maintained at 30 and 15 cm respectively. The competitive plants in non-segregating generations (Parents), 20 plants in F1's and back cross F1's and 50 plants in F2 of the six crosses were sampled at random.

RESULTS AND DISCUSSION

To test the adequacy of the additive-dominance model, the following scales viz. A, B and C were estimated (Table 1) using the means and variances of the six generations available (Mather and Jinks., 1982). Since the scaling test indicated the inadequacy of additive-dominance model in some cases, the model was extended to additive, dominance and interaction (Six parameter model). The perfect fit solution given by Jinks and Jones (1958) was adopted to estimate the epistatic effects viz. additive x additive (i), additive x Dominance (j) and dominance x dominance (l) interactions and presented in Table 2.

For shelling percentage, dominance and epistatic effects of (i), (j) and (l) were responsible in the crosses involving Co 2 except in the cross Co 2 x PI 414332 where the additive effect was also significant. Whereas, additive, dominance and epistatic effects of (i), (j) and (l) were important for the crosses involving JL 24 except in the cross JL 24 x PI 414332 where, the effect of dominance was lacking.

Predominant control of additive gene effect for hundred kernel weight was observed. However, the effect of dominance and (i) and (l) type of interactions were also observed in the crosses involving JL 24 x PI 414331 and JL 24 x PI 414332 were also found to be important.

Preponderance of additive gene effects were observed in the inheritance of sound mature kernel percentage. Additive x dominance (j) type of interactions observed in the cross combinations involving NcAc 17090 were also should not be ignored.

For pod yield, the control of simple additive genes in three crosses and additive x dominance (j) type of interactions in another three crosses were observed. Mohinder Singh and Labana (1980) reported the genetic control of additive gene effects for pod yield in groundnut. However, Sandhu and Khehra (1976) observed the role of non additive gene effects for this character.

The significant additive genetic component observed in some crosses for the characters viz hundred kernel weight, sound mature kernel percentage and pod yield suggested, that simple pedigree or mass selection could also enhance the improvement but to a limited extent.

The shelling percentage was under the control of both additive and non additive gene action. Manoharan et al (1985) reported that the shelling percentage was controlled by additive gene action. However Mohinder Singh (1983) observed the predominant role of non additive gene action for this character. The improvement should be based on simultaneous exploitation of additive and non additive gene effects. The selection

TABLE 2 : THE COMPONENTS OF GENERATION MEANS FOR DIFFERENT CHARACTERS IN SIX CROSSES OF GROUNDNUT

Name of the cross	$\hat{m}$	$\hat{d}$	$\hat{h}$	$\hat{i}$	$\hat{j}$	$\hat{l}$
			Shelling Percentage			
Co 2 x NcAc 17090	74.00** ± 3.82	-0.66 ± 0.66	-33.33 ± 9.82	-13.33** ± 3.77	-1.33 ± 2.98	29.33** ± 6.11
Co 2 x PI 414331	46.00** ± 6.28	-0.66 ± 0.66	61.33** ± 14.66	14.66** ± 6.25	13.33** ± 3.52	-45.33** ± 8.84
Co 2 x PI 414332	111.00** ± 2.73	-3.66** ± 0.88	112.66** ± 7.68	-47.33** ± 2.58	3.99 ± 2.82	62.66** ± 5.33
JL 24 x NcAc 17090	61.66** ± 5.36	6.33** ± 0.88	43.00** ± 12.34	6.00 ± 5.29	-14.66** ± 3.12	-44.66** ± 7.15
JL 24 x PI 414331	87.00** ± 3.03	6.33** ± 0.88	-40.00** ± 7.03	-19.33** ± 2.90	-2.66 ± 2.10	17.33** ± 4.89
JL 24 x PI 414332	74.66** ± 2.54	3.33** ± 1.05	-10.33 ± 5.68	-4.00 ± 2.31	6.66** ± 2.10	6.00 ± 3.39
			Hundred kernel weight			
Co 2 x NcAc 17090	39.00* ± 17.30	4.66** ± 1.90	-15.00 ± 44.43	-11.33 ± 17.06	-14.66 ± 13.25	10.00 ± 29.18
Co 2 x PI 414331	47.00** ± 15.54	4.33** ± 1..08	-41.00 ± 41.53	-20.00 ± 15.26	- 15.33 ± 13.26	27.33 ± 27.05
Co 2 x PI 414332	51.33* ± 22.96	3.66** ± 1.53	-72.66 ± 48.83	-22.66 ± 22.82	-12.00 ± 8.37	49.33 ± 27.66
JL 24 x NcAc 17090	24.16** ± 7.61	7.50** ± 1.75	26.16 ± 36.11	7.33 ± 17.52	3.00 ± 3.69	-18.33 ± 22.10
JL 24 x PI 414331	62.83** ± 5.24	8.16** ± 1.87	-60.5** ± 11.87	-32.00** ± 4.89	3.66 ± 4.09	37.66** ± 6.79
JL 24 x PI 414332	1050** ± 5.86	6.50** ± 1.04	57.83** ± 17.61	22.00** + 5.77	1.00 ± 6.13	-29.66* ± 11.80

Name of the cross	$\hat{m}$	$\hat{d}$	$\hat{h}$	$\hat{i}$	$\hat{j}$	$\hat{l}$
			Sound matured kernel percentage			
Co 2 x NcAc 17090	$66.33^{**} \pm 8.05$	$10.33^{**} \pm 3.88$	36.33 ± 233.99	1.33 ± 7.05	$-32.66^{**} \pm 10.15$	$-23.33 + 18.61$
Co 2 x PI 414331	$82.00^{**} \pm 14.60$	$10.00^{**} \pm 3.11$	-13.333 ± 41.22	-4.00 ± 14.36	1.33 ± 13.96	13.33 ± 27.12
Co 2 x PI 414332	$90.33^{**} \pm 22.16$	$3.00^{**} \pm 0.82$	-31.00 ± 59.65	-15.33 ± 22.14	-29.33 ± 17.75	15.33 ± 39.29
JL 24 x NcAc 17090	$39.83^{*} \pm 16.74$	$11.83^{**} \pm 3.85$	108.50 ± 57.76	29.33 ± 26.46	$-23.66^{**} \pm 2.23$	$-85.66^{*} \pm 38.21$
JL 24 x PI 414331	$65.50^{**} \pm 16.00$	$15.00^{**} \pm 3.06$	40.83 ± 37.21	14.00 ± 15.71	$-25.00^{*} \pm 9.61$	-31.66 ± 24.70
JL 24 x PI 414332	$52.50^{**} \pm 18.04$	$4.50^{**} \pm 0.65$	51.83 ± 45.00	24.00 ± 18.03	23.00 ± 11.62	-17.61 ± 30.69
			Pod yield			
Co 2 x NcAc 17090	$0.29^{**} \pm 0.01$	$-0.06^{**} \pm 0.01$	-0.18 ± 0.15	0.01 ± 0.05	0.02 ± 0.05	8.33 ± 0.10
Co 2 x PI 414331	$0.20^{**} \pm 0.05$	$8.33^{**} \pm 0.01$	-0.09 ± 0.13	0.04 ± 0.05	$-0.08^{*} \pm 0.03$	0.14 ± 0.09
Co 2 x PI 414332	$0.20^{**} \pm 0.06$	$-0.06^{**} \pm 0.01$	0.27 ± 0.15	0.11 ± 0.06	0.13 ± 0.05	-0.20 ± 0.10
JL 24 x NcAc 17090	$0.22^{**} \pm 0.08$	$-0.08^{**} \pm 8.12$	-0.08 ± 0.19	0.06 ± 0.07	$0.20^{**} \pm 0.05$	0.10 ± 0.12
JL 24 x PI 414331	$0.25^{**} \pm 0.09$	$-0.01^{*} \pm 4.71$	0.21 ± 0.24	-0.03 ± 0.09	-0.02 ± 0.06	-0.20 ± 0.15
JL 24 x PI 414332	$0.18^{*} \pm 0.10$	$-0.08^{**} \pm 0.01$	0.35 ± 0.21	0.11 ± 0.09	-0.02 ± 0.04	-0.23 ± 0.12

programme aiming to improve this character in a population should accumulate the favourable additive genes and simultaneously maintain heterozygosity in the population for manifestation of the dominance and epistatic gene effects. The reciprocal recurrent selection proposed by Comstock, Robinson and Harvey (1949) appears to be the best available method to meet the requirement. Jensen's (1970) diallel selective mating system involving recurrent selection procedures would also serve the purpose for incorporating genes from various sources. However, the above mentioned breeding programme require extensive crossing work which is cumbersome in groundnut, being a self pollinating crop.

Since the early generation intermating, besides accumulating the favourable genes and maintaining the heterozygosity in the population is likely to throw out desirable recombinants. The multiple crosses viz. three way crosses, double crosses and intermating of F2 segregant may yield better results than the conventional single crosses to evolve varieties with acceptable level of shelling per cent and quality traits while incorporating rust resistance.

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