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RESEARCH ARTICLE

Genetic variability and association of late leaf spot resistance and productivity in groundnut (*Arachis hypogaea* L.)

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ABSTRACT

Large amount of variability was present for pod yield (PY) and resistance attributes like leaf are affected (LAA) and defoliation percentage (DF) in most of the segregating material of groundnut. The association analyses revealed the possibility of breaking undesirable linkages by shuffling genes through three way and back crossing designs. Higher proportion of desirable recombinants for most of the character combinations were observed in these cross categories. Single and double crosses were poor in giving superior recombinants. The non-significant correlation between yield and resistance indicated the possibility of incorporating disease resistance into the adapted cultivar without affecting the yield potential. But even in back and three way crosses frequencies of superior recombinants were considerably low revealing the existence of some amount of undesirable association between characters indicating the need for reshuffling of genes through selective inter-mating.

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INTRODUCTION

The low productivity in groundnut is attributed to several production constraints among which the widespread occurrences of foliar diseases are the major factor. Three major foliar diseases *viz.*, late leaf spot [*Phaeoisariopsis personata* (Berk. and Curt.) V. Arx] , early leaf spot (*Cercospora arachidicola* Hori) and rust (*Puccinia arachidicola* Speg.) are most destructive, causing yield losses upto 70 per cent (Subrahmanyam *et al.*, 1980). Over 50 per cent less in pod and fodder yield has been estimated due to late leaf spot disease in Karnataka (Reddy, 1984). The present study aims at determining the genetic variability and association of late leaf spot resistance and productivity parameters.

MATERIALS AND METHODS

To generate the experimental material, four groundnut genotypes were used. Two widely cultivated Spanish bunch varieties but susceptible to late leaf spot disease (TMV2 and JL 24) were used as ovule parents and two resistant germplasm lines (RMP 12 and PI 393516) were used as male parents (Table 1) [9]. The crossed material is generated using different mating designs like single, back, three-way and double crosses and the segregating material was advanced from S_1 to S_3 generation under different selection schemes.

Observations were recorded on yield/productivity parameters like pod yield per plant (PY), shelling percentage (SP) and hundred seed mass (HSM) and foliar disease resistance components *viz.,* defoliation percentage (DF), leaf area affected (LAA) and remaining green leaf area percentage (RG).

The statistical analysis for data on each character was carried out using individual plant observations. Phenotypic co-efficient of variation (PCV), broad sense heritability (H), genetic advance over mean (GAM), phenotypic correlation co-efficient(r) were computed by using appropriate equations. The number of crosses in each type being significant (positive /negative) or non-significant was also recorded (Fisher and Yates, 1967).

RESULTS AND DISCUSSION

The results of the present study as well as relevant discussions have been presented under following sub heads:

Variability in S_3 generation :

For evaluating various crosses and breeding methods it is essential to assess the variability in different characters and their potential for response to selection. Hence, each character was assessed for its heritable variation through the parameters, *viz.,* PCV, heritability, GAM.

The productivity parameters PY and disease resistance

Table 1: The parents used in the generations of experimental material and their identity

Parents	Designated code	Botanical group	Source/pedigree	Growth habit	Kernel colour	Days to maturity	Remarks/salientfeatures
Ovule/female							
TMV 2	A	Spanish bunch	Mass selection from Gudhiatham bunch	Erect	Tan	100-105	Recommended for cultivation in India
JL 24	B	Spanish bunch	Selection from EC94943	Erect	Tan	100-105	Recommended for cultivation in India
Male							
RMP 12 (ICG No. 6322)	C	Virginia bunch	Burkina Faso	Decumbent	Dark tan with light tan blotches	115-120	Proven source of resistance to late leafspot
PI393516 (ICG No. 7888)	D	Valencia bunch	Peru	Erect	White with red blotches	110-115	Proven source of resistance to late leafspot and rust

Table 2: Phenotypic coefficient of variation, heritability and genetic advance for late leafspot resistance and productivity parameters in groundnut

Characters	PCV	H	GAM
PY	54.15	77.62	87.53
SP	9.24	55.74	12.08
HSM	23.91	80.46	37.68
LAA	63.80	68.66	111.98
DF	57.23	75.47	76.50
RG	13.80	71.06	22.17

PCV : Phenotypic co-efficient of variation, H : Broad sense heritability, GAM : Genetic advance over mean (%)

Table 3: Total number of crosses showing significant (positive/negative) and non significant associations among resistance and yield traits

Character combinations	SC (12)			BC (12)			TWC (12)			DC (93)		
	+ve	-ve	NS	+ve	-ve	NS	+ve	-ve	NS	+ve	-ve	NS
Yield-yield traits												
PY-SP	2	0	10	3	0	9	4	0	8	1	0	2
PY-HSM	7	0	5	9	0	3	7	0	5	2	0	1
PY-SP-HSM	5	0	7	5	0	7	5	0	7	1	0	2
Yield-resistance traits												
PY-LAA	1	0	11	0	1	11	1	0	11	1	0	2
PY-DF	1	0	11	0	0	12	1	2	9	0	0	3
PY-RG	1	0	11	0	0	12	0	1	11	0	0	3
PY-LAA	0	1	11	0	1	11	1	1	10	0	0	3
SP-DF	1	0	11	0	0	12	3	1	8	0	0	3
SP-RG	1	0	11	0	0	12	1	1	10	0	0	3
HSM-LAA	1	0	11	0	0	12	0	0	12	0	0	3
HSM-DF	0	0	12	0	0	12	0	2	10	0	0	3
HSM-RG	0	1	11	0	0	12	1	0	11	0	0	3
Resistance-resistance traits												
LAA-DF	0	2	10	2	3	7	0	2	10	0	0	3
LAA-RG	1	0	11	2	4	6	0	1	11	0	0	3
DF-RG	0	12	0	0	12	0	0	12	0	0	3	0

Note: Figures in parenthesis indicate total number of crosses, NS: Non-significant attributes like LAA and DF exhibited high amount of variability in terms of PCV. Variability recorded for SP and RG was comparatively less (Table 2). All characters have recorded high heritability values, but only PY, LAA and DF have exhibited higher genetic advance over mean indicating their suitability for selection in terms of response.

Groundnut being a self fertilized allotetraploid, it has some inherent problems in combining desirable genes from different botanical groups especially through single crosses. Multiple crosses particularly back crosses to the adapted parent may be useful in incorporating exotic germplasm into adapted population Kenworthy and Brim (1979), Puranik *et al.* (1973) and Reddy (1984).

Character association :

In order to study the association among characters, phenotypic correlation co-efficients (r) between the pairs of selected characters were compared. The phenotypic correlation co-efficients among different yield parameters (PY, SP and HSM) were either positive or non-significant. The positive association is desirable since the yield would be supported by SP and HSM. This suggests the possibility of simultaneous improvement for several yield parameters or independent improvement of individual character. There was no major shift in association between different types of crosses except in three way crosses where in two non-significant correlations for PY-SP were shifted to positive association (Table 3).

The association between the components of yield and disease resistance was predominantly non-significant except in a few three-way crosses. The positive correlation co-efficients were observed for pod yields with disease resistance parameters LAA and DF Gowda *et at.* (1996). A few undesirable positive associations between yields and resistance components observed in single crosses were missing in back crosses (Table 3). Three-way crosses deserved special mention in having some desirable negative associations between PY and DF, SP with LAA and DF, HSM and DF.

The non-significant correlation between yields and resistance indicated the possibility of incorporating disease resistance into adapted cultivar without affecting the yield potential. Invariable negative correlation between DF and RG revealed predominance of DF in determining the magnitude of RG. Plants with low defoliation percentage can be selected for leaf spot resistance Anderson *et al.* (1991). Several non-significant association of resistance components in single crosses were shifted to either positive or negative correlations in back crosses, indicating the shift in the interrelationships due to mating systems. The present investigation revealed the possibility of breaking undesirable linkages between pod yield and other characters including disease resistance by reshuffling of genes through multiple crosses such as back and three-way crosses.

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