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PHENOTYPIC EVALUATION OF BACKCROSS POPULATION FOR YIELD AND FOLIAR DISEASES IN GROUNDNUT (*ARACHIS HYPOGAEA* L.)

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ABSTRACT

Groundnut is major rain fed oilseed crop and its production is mainly affected by biotic stresses (rust andlate leaf spot).Two backcross population were evaluated for yield and foliar diseases. ANOVA indicated significant differences for yield component traits and reaction to rust and LLS incidence. In both generations (BC_1F_3 and BC_2F_2) days to 50 per cent flowering and days to maturity exhibited low estimates of PCV and GCV values, whereas pod yield per plant and *Spodoptera litura* damage exhibited higher PCV and GCV estimates. High heritability coupled with high genetic advance as per cent of mean was observed for plant height, primary branches per plant, *Spodoptera litura* damage and pod yield per plant in both generations, indicates the additive gene control and scope for simple selection for improving these traits. Phenotypic correlations coefficients among characters indicated differences between BC_1F_3 and BC_2F_2generations. Lower incidence of LLS incidence at 90 days and *spodopteralitura* damage in BC_2F_2 generation as compared to BC_1F_3 generation as reveled by lower magnitudes of correlation coefficients and non-significant correlation.

INTRODUCTION

Groundnut is major rainfed oilseed crop, affected by several biotic and abiotic stresses, leading to wide fluctuations in annual production and productivity.Among the biotic stresses, rust and late leaf spot (LLS) are two economically important diseases of groundnut. Incidence of foliar diseases occur in most of the groundnut growing states in India but predominantly in south Indian states as conditions favour the development and spread of diseases. These diseases often occur together and cause yield losses up to 50-70% in the crop (Subrahmanyam *et al*.1985). Therefore, the use of groundnut resistant varieties to rust and leaf spot is considered to be an effective way to manage these diseases to reduce the additional cost of production as well as hazardous effect of fungicides on the soil and environment.

Several sources (wild arachis species and interspecific derivatives) of resistance to foliar diseases have been identified (Subrahmanyam *et al.* 1982; Walls *et al.* 1985; Anderson *et al.*1993 and Singh*et al.* 1997). These sources known to be associated undesirable traits like poor yield and late maturity(Mehan*et al*.1996 and Singh *et al*.1997). Both, simple and complex inheritance of resistance to foliar diseases is reported in literature.

There is a need to break these unfavourable linkages and release the genetic variability to recombine different desirable traits in genotypes. Hence backcross programme was attempted to recombine foliar disease resistance with agronomic traits.The success of plant breeding programmes relies heavily on the existence of genetic variability in plants for a particular trait (Arunkumar, 2013). The information of nature and magnitude of variability and associations among for disease resistance, yield and yield components will help the plant breeders to choose the appropriate breeding schemes to combine desirable features. The present study has aimed at evaluating the two backcross population for the genetic variability components and interrelationships among productive and foliar diseases.

MATERIALS AND METHODS

The material for present study consists of two backcross population derived from the cross between GPBD 4 and GM 4-3. GPBD 4 used as recurrent parent, possessing higher yield with foliar disease resistance, whereas GM 4-3 is a high oleate parent. Two backcross generations (BC_1F_3 and BC_2F_2) of cross (GPBD 4 × GM 4-3)-38 × GPBD 4 consists of 329 and 82 respectively were evaluated by following the augmented design with three checks at experimental plots of Department of Genetics and Plant Breeding, Main Agricultural Research Station, University of Agricultural Sciences, Dharwad. Backcross population were evaluated for days to 50 per cent flowering, plant height (cm), number of primary branches per plant, reaction to rust (90 DAS), late leaf spot (LLS) incidence at 90 days and *spodoptera litura* damage and pod yield per plant. The modified 9 point scale to rust and late leaf spot as given by Subba Rao *et al*. (1990) was used for screening backcross population. Backcross population were screened for *Spodoptera litura* under the natural epiphytotic condition as per the visual score as described by Ranga Rao and Wightman (1997). Genotypic and phenotypic coefficient of variation were worked out as per the method suggested by Burton and De Vane (1953), heritability and genetic advance were calculated according to Johnson (1955) and Robinson *et al*. (1949). The simple correlation coefficient was calculated as per Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

Both backcross (BC_1F_3 and BC_2F_2) generations exhibited significant variation for productive and foliar disease traits under study indicating the presence of adequate variability created through backcross programme. The analysis of variance revealed significant differences among in BC_1F_3 generation of cross (GPBD 4 × GM 4-3)-38 × GPBD 4 for all the characters (Table 1).The estimates of range, phenotypic coefficient of variance (PCV) and GCV(Genotypic coefficient of variance), Genetic advance as per cent of mean (GAM) are indicated in the Table 3. Days to 50 per cent flowering ranged from 30 to 35 days with an average of 30 days. Backcross population matured in minimum duration of 93 days and maximum of 109 days with average of 97 days. Lowest value of plant height recorded was 8.25cm and highest was 34 cm with mean value of 21.34 cm. Primary branches per plant ranged from 2 to 10 with an average of 5. Lowest rust incidence in BC_1F_3 population was 3 and maximum score was 8 with average of 3, whereas LLS incidence was lowest score of 2 to highest score 9 with an average score of 3. *Spodoptera litura* damage was ranged from 18 to 90 per cent with average damage of 61 per cent in BC_1F_3 generation. Pod yield per plant ranged from 6.5 g to 49 g with average weight of 29 g per plant in BC_1F_3 generation.

The analysis of variance revealed significant differences among in BC_2F_2 generation of cross (GPBD 4 × GM 4-3)-38 × GPBD 4 for all the characters (Table 2). The estimates of range, PCV and GCV, GAM indicated in the Table 3. Days to 50 per cent flowering ranged from 29 to 36 days with an average of 31 days. Backcross population matured in minimum of 92 days and maximum of 109 days with average of 97 days. Plant height ranged from 10 cm to 34 cm with mean value of 22.15 cm. Primary branches per plant was ranged from 3 to 7 with an average of 5. Rust incidence in BC_2F_2 population ranged from 3 to 8 score with average of 3, whereas LLS incidence ranged from 3 to 9 with an average score of 3. *Spodoptera litura* damage ranged from 30 to 88 per cent with average damage of 57 per cent. Pod yield per plant ranged from 2.5 g to 54 g with average weight of 22.19 g per plant in BC_2F_2 generation.

PCV and GCV estimates

The phenotypic coefficient of variation (PCV) had higher estimates than corresponding GCV for all traits and there was a narrow difference between PCV and GCV values for all traits except rust and LLS incidence at 90 days in both generations (Table 3). The narrow differences between PCV and GCV values indicated that variability was mainly due to genotypic differences and little influence of environment in the expression

Table 1: Analysis of variance for pod yield and its components in groundnut genotypes (*Arachis hypogaea* L.) in BC_1F_3 generation of (GPBD4 × GM 4-3)-38 × GPBD 4 cross

Source of variation	df	Days to 50 per cent flowering	Days to maturity	Plant height (Cm)	Primary branches per plant	Rust incidence at 90 DAS	LLS incidence at 90 DAS	*Spodoptera* damage (%)	Pod yield per plant (g)
Block (eliminating Check + Genotypes)	9	0.81	0.308	0.134	226	0.133	0.37	0.09	0.283
Entries (ignoring Blocks)	332	3.723**	7.736**	23.43**	1.672**	.870**	1.41**	199.54**	72.446**
Checks	2	12.7**	248.03**	279.1**	2.8**	36.3**	81.7**	1300.2**	21.033**
Genotypes	329	3.68**	2.009**	18.28**	1.658**	0.534	.659*	172.79**	68.517**
Checks vs. Genotypes	1	0.057	1411.2**	1200.5**	4.089**	40.6**	90.002**	6797.4**	1467.9**
Error	18	0.293	0.257	0.322	0.281	0.3	0.293	0.566	0.403

Table 2: Analysis of variance for pod yield and its components in groundnut genotypes (*Arachis hypogaea* L.) in BC_2F_2 generation of (GPBD 4 × GM 4-3)-38 × GPBD 4 cross

Source of variation	df	Days to 50 per cent flowering	Days to maturity	Plant height (Cm)	Primary branches per plant	Rust incidence at 90 DAS	LLS incidence at 90 DAS	*Spodoptera* damage (%)	Pod yield per plant (g)
Block (eliminating Check + Genotypes)	11	0.172	0.333	0.72	0.202	0.121	0.242	0.081	0.323
Entries (ignoring Blocks)	85	2.5**	31.12**	37.89**	.955**	2.654**	4.512**	326.77**	146.58**
Checks	2	13.44**	304.0**	336.11**	3.44**	42.33**	100**	1573.44**	24.11**
Genotypes	82	2.139**	3.722**	14.13**	.906**	1.434**	1.434**	236.98**	150.1**
Checks vs. Genotypes	1	10.54**	1760.01**	1413.75**	0.002	24.604**	69.004**	5286.02**	43.481**
Error	22	0.293	0.242	0.293	0.293	0.273	0.242	0.535	0.354

Table 3: Estimates of genetic parameters for pod yield and its component traits in BC1F3 and BC2F2 generations of groundnut

Parameters	Generation	Days to 50 per cent flowering	Days to maturity	Plant height (Cm)	Primary branches per plant	Rust incidence at 90DAS	LLS incidence at 90 DAS	*Spodoptera* damage (%)	Pod yield per plant (g)
Minimum	BC_1F_3	30	93	8.25	2.25	3	2	18.33	6.5
	BC_2F_2	29	92	10	3.5	3	3	30	2.5
Maximum	BC_1F_3	35	109	34	10.5	8	9	90.28	49
	BC_2F_2	36	109	34	7.25	8	9	88.89	54
Mean	BC_1F_3	30.74	97.30	21.34	5.45	3.29	3.34	61.55	29.76
	BC_2F_2	31.18	97.98	22.15	5.11	3.64	3.84	57.25	22.19
ó² g	BC_1F_3	3.18	1.65	16.88	1.29	0.22	0.34	161.89	64.03
	BC_2F_2	1.42	2.67	10.63	0.47	0.89	0.92	181.72	115.32
ó² p	BC_1F_3	3.48	1.90	17.20	1.58	0.52	0.64	162.46	64.43
	BC_2F_2	1.71	2.92	10.93	0.76	1.16	1.16	182.25	115.67
GCV (%)	BC_1F_3	5.80	1.33	19.76	20.73	14.73	18.40	20.24	26.35
	BC_2F_2	3.80	1.71	16.39	13.45	28.24	28.60	21.89	49.27
PCV (%)	BC_1F_3	6.06	1.43	19.95	22.88	22.64	25.02	20.28	26.43
	BC_2F_2	4.17	1.79	16.61	17.13	32.26	32.17	21.92	49.35
h² (BS)	BC_1F_3	0.92	0.87	0.98	0.82	0.42	0.54	0.923	0.956
	BC_2F_2	0.83	0.92	0.97	0.62	0.77	0.79	99.056	99.42
GA	BC_1F_3	3.52	2.46	8.38	2.12	0.63	0.89	0.99	0.994
	BC_2F_2	2.23	3.23	6.63	1.11	1.70	1.75	27.73	22.09
GAM (%)	BC_1F_3	11.44	2.54	40.33	38.71	19.74	27.88	41.63	54.10
	BC_2F_2	7.12	3.38	33.30	21.76	50.90	52.39	45.02	99.9

ó² g - Phenotypic variance, ó² p- Genotypic variance, GCV (%) – Genotypic coefficient of variance, h² (BS)- Heritability in broad sense GCV (%) – phenotypic coefficient of variance, GA- Genetic advance GAM- Genetic advance as per cent of mean

of these traits. In both generations (BC_1F_3 and BC_2F_2) days to 50 per cent flowering and days to maturity exhibited low estimates of PCV and GCV values, whereas pod yield per plant and *Spodoptera litura* damage exhibited higher PCV and GCV estimates. Plant height showed moderate PCV and GCV estimates in both (BC_1F_3 and BC_2F_2) generations. Primary branches per plant showed moderate PCV and GCV estimates in BC_2F_2 generation and high estimates of PCV and GCV values in BC_1F_3 generation. The results are in conformity with the earlier findings of Venkateshmurthy *et al.* (2005), Korat *et al.* (2009),Zaman *et al.*(2011), Rao *et al.*(2012),Vishnuvardhan *et al.*(2012) and Sunday and Omalayo (2013) for days to 50 per cent flowering, days to maturity, pod yield per plant, plant height and primary branches per plant. Rust and LLS incidence at 90 days showed moderate to high estimates of PCV and GCV values. Similar kind of moderate to high PCV and GCV estimates for rust and LLS incidence at 90 days was also observed by Jakkeral *et al.* (2014), Padmaja *et al.* (2013) and Azaruddin (2010).

Heritability and genetic advance estimates

High heritability coupled with high genetic advance as per cent of mean was observed for plant height, primary branches per plant, *Spodoptera litura*d amage and pod yield per plant in both generations (Table 3).High heritability coupled with high genetic advance as per cent of mean for plant height, primary branches per plant was also noticed by Korat *et al.* (2009),Zaman *et al.* (2011), John *et al.* (2011), sudha *et al.* (2012),Rao *et al.*(2012),Vishnuvardhan *et al.*(2012),Sunday and Omalayo (2013) and Patil *et al.* (2014). High heritability coupled with high genetic advance as per cent of mean for these traits indicates the additive gene control and scope for simple selection for improving these traits.

Late leaf spot (LLS) and rust incidence at 90 days showed high heritability coupled with high genetic advance as per cent of mean in BC_2F_2 generation. In BC_1F_3 generation rust incidence at 90 days showed moderate heritability and genetic advance as per cent of mean, whereas LLS incidence at 90 days showed moderate heritability coupled with high genetic advance as per cent of mean. Similar kind of moderate to high heritability and genetic advance as per cent of mean for rust and LLS was observed by Jakkeral *et al.* (2014), Padmaja *et al.*(2013) and Azaruddin (2010).In both generations, high heritability coupled with low genetic advance as per cent of mean was observed for days to 50 per cent flowering and days to maturity (Rao *et al.*(2012); Vishnuvardhan *et al.* (2012) and Sunday and Omalayo (2013) suggesting the non-additive gene control in the expression of these traits.

Correlation among yield components and foliar diseases

Association among yield and foliar diseases are indicated in Table 4. Days to 50 per cent flowering correlated significant positively with days to maturity in both (BC_1F_3 and BC_2F_2) generations. Similar kind of positive association was also noticed by channayya (2009). Days to 50 per cent flowering correlated negatively with plant height and rust and LLS incidence at 90 days in BC_2F_2 generation. Days to maturity correlated significant positively with days to 50 per cent flowering and plant height in both generations. Similar kind of positive correlation between days to maturity and plant height was also noticed by Alam et al. (1985b). It is also associated significant negatively with pod yield per plant in BC_1F_3 generation. Negative relation between days to maturity and pod yield per plant was also observed by Wu *et al.* (1993),Korat *et al.* (2009) and Sunday and Omalayo (2013).

In BC_2F_2 generation, Primary branches per plant associated negatively with rust and LLS incidence at 90 days, whereas in BC_1F_3 generations it correlated negatively with plant height. This is in accordance with Prabhu *et al.*(2015).*Spodoptera litura* damage correlated negatively with days to maturity in

Table 4: Estimates of phenotypic correlation coefficients for pod yield and its components in BC_1F_3 and BC_2F_2 generation of (GPBD 4 × GM 4-3)-38 × GPBD 4 cross

Character	Days to 50 per cent flowering		Days to maturity		Plant height (Cm)		Primary branches per plant		Rust incidence at 90 DAS		LLS at 90 DAS		*Spodoptera* incidence (%)		Pod yield per plant (g)	
	BC_1F_3	BC_2F_2	BC_1F_3	BC_2F_2	BC_1F_3	BC_2F_2	BC_1F_3	BC_2F_2	BC_1F_3	BC_2F_2	BC_1F_3	BC_2F_2	BC_1F_3	BC_2F_2	BC_1F_3	BC_2F_2
Days to 50 per cent flowering	1	1	0.337**	0.198*	-0.064	-0.328**	0.051	0.048	-0.111*	-.181*	-0.068	-.224*	-0.022	-0.17	0.034	0.019
Days to maturity			1	1	0.155**	0.328**	-0.049	0.09	0.091	0.009	0.106*	0.04	-.303**	-.554**	-.191**	0.105
Plant height (Cm)					1	1	-.195**	-0.053	.235**	0.505**	0.277**	0.615**	-0.088	-0.085	-0.046	0.034
Primary branches per plant							1	1	0.017	-0.182*	-0.037	-0.218*	-0.006	-0.061	-0.054	0.054
Rust incidence at 90 DAS									1	1	0.906**	0.934**	-0.063	0.058	-.436**	-0.209*
LLS at 90 DAS											1	1	-0.051	0.053	-.416**	-0.16
Spodoptera incidence (%)													1	1	0.105*	-0.118
Pod yield per plant (g)															1	1

both generations and pod yield per plant in BC_1F_3 generations. In both generations, LLS incidence at 90 days associated positively with rust incidence at 90 days. This is in accordance with Azaruddin (2010).Both rust and LLS incidence at 90 days are correlated positive significantly with plat height in both generations.

Phenotypic correlations coefficients among characters indicated differences between BC_1F_3 and BC_2F_2 generations. In BC_1F_3 generation, significant yield reduction observed due to biotic stresses *viz*., *Spodoptera litura* damage, rust incidence at 90 days and LLS incidence at 90 days whereas in BC_2F_2 generation only rust incidence at 90 days affected significantly the pod yield per plant indicating the lower incidence of LLS incidence at 90 days and *Spodoptera litura* damage in BC_2F_2 population as indicated in lower magnitudes of correlation coefficients and nonsignificant negative relation.

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