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Genetic Relationship Of Yield Attributing Traits And Late Leaf Spot Tolerance With Pod Yield In BC_1F_2 Population Of (JL 24 X ICG 11337) X JL 24 Of Groundnut

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Abstract:
An experiment was conducted at the International Crops Research Institute for the Semi Arid Tropics, Patancheru at Hyderabad to study the genetic variability, correlation and path analysis in BC_1F_2 of (JL 24 X ICG 11337) X JL 24. High variability was observed for total number of pods per plant, mature seeds per plant, shelling per cent, hundred seed weight, LLS disease score at 75, 90 and 102 DAS and pod yield per plant. High PCV, GCV, heritability and genetic advance as per cent of the men was observed in mature pods per plant, mature seed per plant, immature seeds per plant, hundred seed weight, haulm weight per plant, LLS disease score at 75 DAS and pod yield plant. Whereas, moderate estimates of PCV and GCV with high heritability coupled with high genetic advance as per cent of mean for LLS disease score at 90 and 102 DAS. Low variability and genetic advance as per cent of mean was noticed for days to 50% flowering and days to maturity. In correlation coefficient study pod yield per plant was significantly and positively correlated with mature pods per plant, immature pods per plant, total pods per plant, mature seeds per plant, immature seeds per plant and haulm weight per plant, while it was negative non significant correlation with days to 50% flowering, days to maturity and shelling percent. Path analysis revealed that the maximum positive direct effect on pod yield per plant for mature seeds per plant, total pods per plant and hundred seed weight whereas, negative and maximum direct effect on yield was observed for mature pods per plant, immature pods per plant and shelling per cent.

Key words: *Correlation, path analysis, phenotypic variability.*

1.Introduction

Groundnut (Arachis hypogaea L.) is an important annual oilseed legume crop, valued as a rich source of protein, minerals and vitamins. It is the major oilseed crop in India and in Andhra Pradesh. India ranks second in groundnut production after China with an area of 4.93 million hectares and a production of 5.64 million tons during 2010 (FAOSTAT, 2012). But the average groundnut yield in the country is low (1.14 t/ha) compared to world average and that of China. The productivity is considered to be low because of number of constraints like abiotic (frequent droughts) and biotic stresses (attacks by pests and diseases). The low productivity of the crop is ascribed mainly due to two major foliar diseases namely late leaf spot (causal organism: Phaeoisariopsis personata [(Berk. and Curt.) Deighton]) and rust (causal organism: Puccinia arachidicola Speg.). These two diseases often occur together and causes up to 50-70% of yield losses in the crop (Subrahmanyam et al., 1985). Development of cultivars resistant/tolerant to late leaf spot could be effective in decreasing the production costs, improving production quality and reducing the detrimental effects of chemicals on our ecosystem. Improvement in any crop depends upon the extent of variability existing among different varieties/strains enables the breeder in determining the most potential genotypes for selection using genetic parameters like genotypic coefficient of variation, heritability and genetic advance (Mahendra Prasad et al., 1993). Assesment of interrelationship of number of component character is an important prerequisite in formulating effective breeding programme. As more variables are included in association studies, the indirect association becomes more complex . Hence, path coefficient analysis devised by Wright (1921) has been found useful in these situations It provides knowledge of paths through which a component character influences the expression of economic characters like yield (Abusaleha and Dutta, 1988). The present study was thus undertaken to determine the variability, correlation and direct and indirect effect through path coefficient analysis in groundnut.

2.Materials And Methods

This study was carried out at the ICRISAT, Patancheru, Hyderabad during Kharif 2010. The experimental material for the present study comprised of BC_1F_2 back cross population involving susceptible parent, JL 24 and LLS resistant ICRISAT genotype, ICG 11337 were used as parents. The genotype, ICG 11337 is interspecific derivatives bred at ICRISAT after incorporating genes that confer resistance to LLS from wild Arachis species, A. cardenasii (Singh et al., 1997). Cultivated A. hypogaea was used as female parent while A. cardenasii was the pollen parent in developing these interspecific derivatives. JL 24 is a popular short-duration groundnut variety in India, but is highly susceptible to LLS. JL 24 was selected from EC 94943, an introduction from Taiwan, at the Oilseeds Research Station, Jalgaon, Maharashtra and was released for cultivation in 1979. The F_1's were crossed to the susceptible parent, JL 24 to derive back cross generations and on the same F_1 plants, the F_2 seed was generated by allowing some flowers to self. Artificial disease epiphytotics was created by using "spreader row technique". TMV 2 susceptible to LLS, hence was planted at every 10^{th} row as well as five rows border around the field to maintain the effective innoculum load. Forty five days after sowing, plants were inoculated uniformly in the evening with the innoculum containing 20,000 conidia/ml water and mixed with Tween 80 (0.2 ml/ 1000 ml of water) as a mild surfactant and sprayed on the plants using knapsack sprayer. The weather conditions favoured good development of diseases. High humidity was maintained by irrigating the field in the evening for 30 minutes by sprinkler on rain-free days for 30 days from the day of inoculation. Additional innoculum was provided by placing pots containing diseased plants in the infector row for every 2 m. Rust disease was controlled by spraying calixin 1 ml /litre , while rest of the cultural operations and plant protection measures were followed as per recommended practices ensuring uniform and healthy crop stand. Following observations were recorded from on each individual plant, for parents randomly selected twenty plants of each parent viz., days to 50 % flowering, days to maturity, mature pods / plant, total pods / plant, mature seeds / plant, haulm weight / plant, 100- seed weight, shelling % , LLS disease score at 75 , 90 and 102 DAS and pod yield / plant. The population was planted without replication as it was segregating material. Each entry was planted in 3 meter length with 60 cm spacing between rows and 10 cm between plants within the rows. The recorded data were analyzed as suggested by Falconer (1989) for genotypic and phenotypic coefficients of variation, Hanson et al., (1956) for heritability and Johnson et al., (1955) for genetic advance, Al-Jibouri et al., (1958) for correlation coefficient and Dewey and Lu (1959) for path coefficient analysis.

3.Results And Discussion

In the present study significant differences were observed for all the characters. The estimates of the phenotypic coefficient of variation (Table 1) for all the character indicating a greater role of environment played in the manifestation of these characters. The high genetic variability in the form of phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) was observed for immature seeds per plant, immature pods per plant, pod yield per plant, mature pods per plant, mature seeds per plant, haulm weight per plant, total pods per plant, hundred seed weight and LLS disease score at 75 DAS. These results are similar to the findings of Shoba et al., (2008) for a hundred seed weight, haulm weight per plant, number of immature pods per plant. John et al., (2008) for number of mature pods per plant and number of immature pods per plant. LLS disease score at 70 DAS in RIL population by Sarvanamgala (2009). Moderate estimates of PCV and GCV was observed for LLS disease score at 90 and 102 DAS. These results are in accordance with the findings of John et al., (2008) for LLS disease score at 90 DAS. Low GCV and PCV were observed for days in 50% flowering, days to maturity and shelling percent. These results are in conformity with the findings of Dolme et al., (2010) for days to 50% flowering and days to maturity. Savaliya et al., (2009) for a shelling per cent.

Higher heritability value coupled with high genetic advance as per cent of mean for mature pods per plant, immature pods per plant, total pods per plant, mature seed per plant, immature seed per plant, haulm weight per plant, hundred seed weight per plant, LLS disease score at 75 DAS and pod yield per plant. These results are in agreement with Dolma et al., (2010) for mature seeds per plant, John et al., (2008) for immature pods per plant and Shoba et al., (2009) for a hundred seed weight. High heritability coupled high genetic gain for these characters due to a high additive genetic effect (Panse, 1957). High heritability coupled with low genetic gain was observed for days to maturity. Indicating that selection may be ineffective for this trait. Moderate heritability coupled with low genetic advances as per cent of mean for mature seeds per plant. It indicate that non additive gene effects playing an important role in the expression of this trait

The correlation study indicates the degree of interrelationship of plant characters for improvement of yield as well as late leaf spot disease tolerance in any breeding program. The genotype correlations (Table 2) were higher than the phenotypic correlations indicated the high degree of association between the two variables at genotypic level and the lower phenotypic values were resulted due to the interference of the environment between the two associated traits.

Pod yield per plant recorded positive and significant correlation with mature seed per plant (0.81), total pods per plant (0.77), haulm weight per plant (0.34), immature seed per plant (0.32), and immature pods per plant (0.22). Such association was highly desirable as the improvement of these yield components results in an overall increase in pod yield. Similar results have been reported by Rajkumar (1991) for total pods per plant, Khanpara et al. (2010) for mature pods per plant and Patil et al. (2006) for sound mature kernel per cent.

This reveals the importance of these components increasing the pod yield. The highest degree of association between pods per plant and pod yield was the most reliable component of yield and could be very well utilized as an indicator of yield. The earlier studies also indicate the importance yield component (Parameswarappa et al., 2008 and Vaithiyalingan et al., 2010). Days to 50 per cent flowering, days to maturity, shilling per cent and hundred seed weight recorded non-significant and positive association with pod yield indicating that these traits could also be considered as yield attributing components. Days to 50 per cent flowering and days to maturity recorded negative significant correlation with LLS scores at different stages. These results indicate that LLS resistant genotypes or the lines were late flowering and hence late maturing. This association of LLS with late maturing has limited use of resistance in breeding programs for self pollinated crops.

The path coefficient analysis on phenotype correlation in respect of pod yield per plant is given in Table 3. The direct effect was high and positive for mature seeds per plant, (0.90) hundred seed weight (0.49) and total pods per plant (0.48). These results are in agreement with the findings of Mathews et al., (2001) for total number of pods per plant and mature seeds per plant. Four hundred seed weights by Korat et al., (2010). Hence, improvement of mature seeds per plant, hundred seed weight and total pods per plant results in improvement in the pod yield per plant. Whereas the negative and direct effect on yield was observed in mature pods per plant (-0.32), immature pods per plant (-0.18) and shelling percent (-0.05).

The indirect effect of mature pods per plant via total pods per plant (0.44) and mature seeds per plants (0.75) through were positive. These results are in conformity with Venkataravana et al., (2000). Haulm yield per plant exhibited the positive indirect effect on pod yield per plant through total pods per plant (0.12) and mature seeds per plant (0.19). Similar kind of associations were reported for hundred seed weight and mature seeds per plant by Mathews et al. 2001. Hence simultaneous selection based on both these characters will be effective for improving of pod yield per plant.

DS-75 noticed the negative indirect effect via matures pods per plant (-0.02) and hundred seed weight (-0.06). The results indicate that, when disease incidence is there at the early stages it reduces yield and its contributing characters. This may be due to the formation of lesions on leaves it reduces the transportation of photosynthates for development of pods and seeds. It results in more number of immature pods and seeds per plant. DS-90 exhibited the negative indirect effect through mature pods per plant (-0.02) and hundred seed weight (-0.06) and haulm weight per plant (-0.01). The results indicate that, when disease incidence was more it results in a reduction of pod yield per plant and its yield contributing characters such as mature pods per plant and hundred seed weight. It alternatively enhances the production of immature pods per plant. Hence, LLS score at 90 DAS will be effective for selecting disease resistant genotypes at early generation. DS-102 exhibited the negative indirect effect through hundred seed weight (-0.02) and haulm weight per plant (-0.02).

The LLS scores at three stages (DS_75, DS_90 and DS_102) recorded low positive or negative direct effect and negative indirect effect via mature pods per plant, immature pods per plant, hundred seed weight and haulm weight per plant. The results indicate that, when LLS disease incidence was more it reduces the yield. The results indicate that, when disease incidence is there at the early stages it reduces yield and its contributing characters. This may be due to the formation of lesions on leaves it reduces the transportation of photosynthates for development of pods and seeds. It results in more number of immature pods and seeds per plant. The positive direct effect was nullified by negative indirect effect via yield contributing characters. Selecting the plants for high yield contributing characters and less disease score can be rewarding in groundnut breeding programs.

Character	**Mean**	**Range**	**PCV**	**GCV**	**Heritability (h^2) (%)**	**GA**	**GAM (%)**
DFF	32	29-35	4.32	3.16	53.40	1.54	4.76
DM	104	103-117	3.55	3.50	97.00	7.39	7.09
MPD	14	3-44	47.34	39.81	70.73	9.86	68.97
IPD	3	0-16	100.50	83.88	69.66	4.45	144.21
TPD	17	4-55	44.48	38.14	73.53	11.70	67.37
MSD	20	4-50	47.98	40.88	72.61	14.63	71.76
ISD	4	0-33	115.93	85.65	54.58	5.39	130.34
HSW(g)	29.73	12.40-54.40	26.36	22.91	75.51	12.19	41.00
SH (%)	65.01	57-70	4.47	1.82	16.57	0.99	1.53
HUW (g))	18.42	4.70-42.60	44.69	37.70	71.17	12.07	65.51
DS_ 75	3	1-5	21.88	20.42	87.10	1.32	39.25
DS_90	6	4-8	13.04	11.74	81.06	1.38	21.78
DS_102	8	4-9	11.99	11.69	94.96	1.95	23.46
PYD (g)	8.89	2.10-26.30	45.84	40.39	77.64	6.51	73.32

Table 1: Mean, Range And Genetic Parameters In BC_1F_2 Population Of A Groundnut Cross (JL 24 × ICG 11337) × JL 24

DFF **-** Days to 50 per cent flowering
DM **-** Days to maturity
DS_75 **-** LLS disease score at 75 days after sowing
MPD **-** Mature pods per plant
IPD **-** Immature pods per plant
TPD **-** Total pods per plant
DS_90 **-** LLS disease score at 90 days after sowing
MSD **-** Mature seeds per plant
ISD **-** Immature seeds per plant
HSW **-** Hundred seed weight

DS_102 - LLS disease score at 102 days after sowing
SH - Shelling per cent
HUW - Haulm weight per plant
PYD - Pod yield per plant
PCV - Phenotypic coefficient of variation (%)
GCV - Genotypic coefficient of variation (%)
GA – Genetic advance
GAM – Genetic advance as percent of mean

Trait	DFF	DM	MPD	IPD	TPD	MSD	ISD	HSW	SH	HUW	DS_75	DS_90	DS_102	PYD
DFF	1.00	0.45**	-0.09	0.01	-0.08	-0.07	-0.09	0.02	-0.10	-0.14	0.22**	-0.12	-0.06	-0.04
DM		1.00	-0.05	0.05	-0.03	-0.08	0.01	0.18*	0.00	-0.09	-0.14	-0.32**	-0.16*	-0.01
MPD			1.00	0.10	0.92**	0.83**	0.38**	-0.23**	-0.03	0.25**	0.04	0.06	0.12	0.77**
IPD				1.00	0.48**	0.06	0.40**	0.24**	-0.26**	0.09	0.12	-0.01	0.14	0.22**
TPD					1.00	0.76**	0.50**	-0.11	-0.13	0.26**	0.07	0.04	0.16*	0.77**
MSD						1.00	0.13	-0.40**	0.02	0.21*	0.17*	0.17*	0.12	0.81**
ISD							1.00	0.20**	-0.14	0.07	0.01	0.10	0.25**	0.32**
HSW								1.00	-0.13	0.15	-0.12	-0.12	-0.04	0.12
SH									1.00	-0.01	-0.01	-0.21**	-0.23**	-0.11
HUW										1.00	-0.02	-0.25**	-0.37**	0.34**
DS_75											1.00	0.36**	0.38**	0.15
DS_90												1.00	0.61**	0.13
DS_102													1.00	0.12
PYD														1.00

Table 2: Phenotypic Correlation Coefficients Of Different Characters In Bc_1f_2 Population Of A Groundnut Cross (Jl 24 × Icg 11337) × Jl 24

DFF - Days to 50 per cent flowering
DM - Days to maturity
MPD- Mature pods per plant
DS_75 – LLS disease score at 75 days after sowing
IPD -Immature pods per plant
TPD -Total pods per plant
MSD - Mature seeds per plant
DS_90 - LLS disease score at 90 days after sowing
ISD - Immature seeds per plant
HSW - Hundred seed weight (g)
SH - Shelling per cent (%)
DS_102 - LLS disease score at 102 days after sowing
HUW - Haulm weight per plant (g)
PYD - Pod yield per plant (g)
** Significant at P≤ 0.01,
* Significant at P≤ 0.05

Trait	DFF	DM	MPD	IPD	TPD	MSD	ISD	HSW	SH	HUW	DS_75	DS_90	DS_102	Phenotypic Correlation With Pod Yield
DFF	**0.02**	-0.01	0.03	0.00	-0.04	-0.07	0.00	0.01	0.00	-0.01	0.01	0.00	0.00	**-0.04**
DM	0.01	**-0.02**	0.02	-0.01	-0.01	-0.07	0.00	0.09	0.00	0.00	-0.01	-0.01	0.00	**-0.01**
MPD	0.00	0.00	**-0.32**	-0.02	0.44	0.75	0.02	-0.11	0.00	0.01	0.00	0.00	0.00	**0.77****
IPD	0.00	0.00	-0.03	**-0.18**	0.23	0.05	0.02	0.12	0.01	0.00	0.01	0.00	0.00	**0.22****
TPD	0.00	0.00	-0.30	-0.09	**0.48**	0.68	0.02	-0.05	0.01	0.01	0.00	0.00	0.00	**0.77****
MSD	0.00	0.00	-0.27	-0.01	0.36	**0.90**	0.01	-0.20	0.00	0.01	0.01	0.00	0.00	**0.81****
ISD	0.00	0.00	-0.12	-0.07	0.24	0.12	**0.05**	0.10	0.01	0.00	0.00	0.00	0.00	**0.32****
HSW	0.00	0.00	0.07	-0.04	-0.05	-0.37	0.01	**0.49**	0.01	0.01	-0.01	0.00	0.00	**0.12**
SH	0.00	0.00	0.01	0.05	-0.06	0.02	-0.01	-0.06	**-0.05**	0.00	0.00	0.00	0.00	**-0.11**
HUW	0.00	0.00	-0.08	-0.02	0.12	0.19	0.00	0.07	0.00	**0.04**	0.00	-0.01	0.01	**0.34****
DS_ 75	0.00	0.00	-0.01	-0.02	0.04	0.15	0.00	-0.06	0.00	0.00	**0.05**	0.01	-0.01	**0.15**
DS _90	0.00	0.01	-0.02	0.00	0.02	0.15	0.00	-0.06	0.01	-0.01	0.02	**0.02**	-0.01	**0.13**
DS_102	0.00	0.00	-0.04	-0.02	0.08	0.11	0.01	-0.02	0.01	-0.02	0.02	0.01	**-0.02**	**0.12**

Table 3: Path Coefficient Analysis Of Component Characters Towards Pod Yield Per Plant In BC_1F_2 Population Of A Groundnut Cross (JL 24 × ICG 11337) × JL 24
Diagonal Values (Bold Letters) Indicate Direct Effects And All Other Values Are Indirect Effects
Residual Effect =0.30

DFF - Days to 50 per cent flowering
DM - Days to maturity
MPD- Mature pods per plant
DS_75 - LLS disease score at 75 days after sowing
IPD -Immature pods per plant
TPD -Total pods per plant
MSD - Mature seeds per plant
DS_90 - LLS disease score at 90 days after sowing
ISD - Immature seeds per plant
HSW - Hundred seed weight (g)
SH - Shelling per cent (%)
DS_102 - LLS disease score at 102 days after sowing
HUW - Haulm weight per plant (g)
PYD - Pod yield per plant (g)

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