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Correlation Studies in Back Cross Derived Population for Foliar Disease Resistance in Groundnut (*Arachis hypogaea* L.)

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A B S T R A C T

K e y w o r d s Groundnut, foliar diseases, correlation, kernel yield, back cross. **Article Info** *Accepted:* 04 April 2017 *Available Online:* 11 May 2017	The present experiment was conducted to study correlation for yield and yield contributing characters in BC_1F_1 generation derived from three crosses of groundnut *viz.,* CO 7 × GPBD 4, TMV 2 × GPBD 4 and TMV (Gn) 13 × GPBD 4. Correlation analysis indicated that kernel yield per plant was significant and positively associated with number of pods per plant, hundred pod weight, hundred kernel weight, shell weight, shelling out-turn and pod yield per plant for all the three crosses. Hence, all these characters may be considered as selection indices for kernel yield improvement in groundnut. Among LLS and rust disease score, LLS alone had significantly negative and positive association with shelling out-turn and sound mature kernel per cent, respectively. However, both disease score has no association with kernel yield and other yield components. Hence, development of high kernel yielding plants with resistance to both foliar diseases is possible.

Introduction

Groundnut (*Arachis hypogaea* L.) is one of the main oilseed and food legume crop in India. It is a self pollinated crop with chromosome number, $2n = 4x = 40$. It is being grown in 5.25 M ha with a production of 9.47 M.T and productivity of 1804 kg ha^{-1} (FAO STAT, 2014). India ranks second in groundnut production after China. But the average groundnut yield in the country is low compared to world average and that of China (3.4 t/ha). The productivity is considered to be low because of several biotic and abiotic

constraints which limit the quantity and quality of the groundnut yield. Among the biotic stresses, the two major foliar diseases *viz.,* rust (*Puccinia arachidis* Speg.) and late leaf spot *Cercosporidium personata* [(Berk. and Curt.) Deighton] are widely distributed diseases. These diseases often occur together and cause yield loss up to 50-70% in the crop (Subrahmanyam *et al.,* 1985). Therefore, the use of groundnut varieties resistant to rust and late leaf spot are considered important and an effective way to manage these diseases.

Development of cultivars resistant/tolerant to rust and late leaf spot could be effective in decreasing the production costs, improving production quality and reducing the detrimental effects of chemicals on our ecosystem. So the emphasis is to develop varieties having superior productivity traits coupled with rust and LLS disease resistance. In any plant breeding programs, understanding the relationships between yield and other characters is of paramount importance for making the best use of these relationships in selection. The efficiency of selection mainly depends on the direction and magnitude of association between yield and its components. Correlation analysis provides an opportunity to study the magnitude and direction of association of yield with its components and also among various components. Correlation between two characters may be due to linkage and / or pleiotropy. If caused by linkage, an undesirable correlation can be disrupted through hybridization followed by selection in segregating generations. With this view, the present study was conducted to evaluate back cross derived populations of three groundnut crosses for foliar disease resistance to determine the association between rust and LLS, yield and yield component characters.

Material and Methods

The present investigation was carried out during January to April 2016 at Department of Oilseeds, Tamil Nadu agricultural University. The experimental material consisted of three BC_1F_1 back across populations derived from CO 7 x GPBD 4, TMV 2 x GPBD 4 and TMV (Gn) 13 x GPBD 4 and four parents involved *viz.,* CO 7, TMV 2 and TMV (Gn) 13 (recurrent parents) and GPBD 4 (resistant donor). Recurrent parents were susceptible to rust and late leaf spot diseases but having high pod yield. The donor parent is resistance to rust and LLS diseases. To incorporate resistance to these

diseases, resistant donor *viz.,* GPBD 4 was used in crossing programme and backcrossed with respective recurrent parents. Three back crossed derived populations and four parents were sown in unreplicated plots during January 2016 at Department of Oilseeds, Tamil Nadu Agricultural University, Coimbatore. The back crossed derived populations were grown in 4 rows of 5 m length and parents in 2 rows of 5 m length, adapting a spacing of 30 cm between the rows and 10 cm between the plants within a row. All the recommended agronomic practices were followed to raise healthy crop. Data on nine characters *viz.,* number of pods per plant, hundred pod weight (g), hundred kernel weight (g), shelling out-turn (%), sound mature kernel per cent, rust and LLS disease score, pod yield per plant (g) and kernel yield (g) were recorded. Data were collected on all the plants in each cross and each parent for yield and yield components and correlation analysis was done. Phenotypic correlation coefficients were estimated as per the method given by Johnson *et al.,* (1955). The correlation coefficients were calculated for individual crosses.

Results and Discussion

Yield is a complex trait which is the end product of interplay of many yield Components. The efficiency of selection mainly depends on the direction and magnitude of association between yield and its components. Knowledge on the strength and type of association is an important pre-requisite for the formulation of breeding procedure. Hence, correlation studies provide an opportunity to study the magnitude and direction of association of yield with its components and also among various components. Correlation coefficient analysis among yield and yield attributes in CO 7 × GPBD 4, TMV 2 × GPBD 4 and TMV (Gn) 13 × GPBD 4 of groundnut are presented in Table 1. The correlation coefficient between

kernel yield per plant and foliar disease scores *viz.,* rust and late leaf spot are furnished in Fig. 1 and Fig. 2, respectively.

Correlation between kernel yield per plant and other yield attributes

Among the nine characters studied, kernel yield per plant had significant and positive association with number of pods per plant, hundred pod weight, hundred kernel weight, shelling out-turn, sound mature kernel per cent and pod yield per plant in all the three crosses. Hence, these characters may be considered as selection indices for improvement of kernel yield. These results are in accordance with the findings of Borkar and Dharankuttikar *et al.,* (2014), Kumar *et al.,* (2014) and Prabhu *et al.,* (2014) for number of pods per plant, Mothilal (2003), Narasimhulu *et al.,* (2012) and Priyadharshini (2012) for hundred pod weight, Shoba *et al.,* (2012) for hundred kernel weight, Raut *et al.,* (2010) and John *et al.,* (2014) for shelling out-turn, Nandini and Savithramma (2012) for sound mature kernel per cent, Prabhu *et al.,* (2014), Gupta *et al.,* (2015), Darvhankar *et al.,* (2015), and Shreya *et al.,* (2015) for pod yield per plant.

Correlation between pod yield per plant and other yield attributes

Pod yield per plant recorded significant and positive association with number of pods per plant, hundred pod weight, hundred kernel weight, shelling out-turn in all the three crosses.

Hence, these characters may be useful as selection criteria for pod yield improvement. This was in accordance with the results of Prabhu *et al.,* (2014) and Mothilal (2003) for hundred pod weight, Priyadharshini (2012) for hundred kernel weight, Padmaja *et al.,* (2013) for shelling out-turn.

Correlation between number of pods per plant and other yield attributes

Number of pods per plant had positive and significant correlation with hundred pod weight, hundred kernel weight and shelling out-turn. Similar findings were reported by Anitha (2013).

Correlation between hundred pod weight and other yield attributes

In all the three crosses, the traits hundred kernel weight and shelling out-turn showed positive and significant association for this character. In addition to these characters, sound mature kernel per cent showed positive and significant correlation with hundred pod weight in the cross CO 7 × GPBD 4. This was in agreement with findings of Narasimhulu *et al.,* (2012), Pavithradevi (2013) and Anitha (2013).

Correlation between hundred kernels and other yield attributes

Shelling out-turn showed positive and significant association with hundred kernel weight an all the three crosses, In addition to this character, sound mature kernel per cent registered positive and significant correlation with hundred kernel weight in the cross CO 7 × GPBD 4. The present result was in accordance with Anitha (2013), pavithradevi (2013).

Correlation between shelling out-turn and other yield attributes

LLS score showed negative and significant association with this character in the cross CO 7 × GPBD 4 and TMV (Gn) 13 × GPBD 4 whereas rust score recorded negative and significant association with shelling out-turn in the cross TMV 2 × GPBD 4. Similar results have been reported by John *et al.,* (2014), Padmaja *et al.,* (2013) and Prabhu *et al.,* (2014).
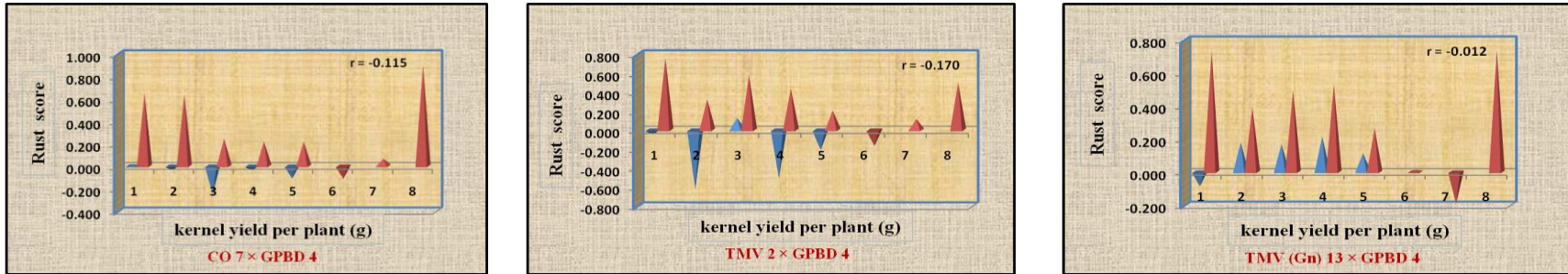
Table.1 Correlation coefficient between yield and yield attributes in groundnut

| Character	Cross	Number of pods per plant	100- pod weight (g)	100- kernel weight (g)	Shelling out-turn (%)	Sound Mature Kernel (%)	Rust Score	LLS Score	Pod yield per plant (g)	Kernel yield per plant (g)
Number of pods per plant	C1	1.000	0.201*	0.214*	0.279**	-0.088	0.015	-0.028	0.795**	0.648**
	C2	1.000	0.208*	0.239*	0.337**	0.359*	-0.048	-0.022	0.508**	0.761**
	C3	1.000	0.248*	0.230*	0.289*	0.09	-0.088	-0.172	0.825**	0.733**
100- pod weight (g)	C1		1.000	0.208*	0.231*	0.212*	-0.035	-0.156	0.576**	0.638**
	C2		1.000	0.168	0.486**	0.132	-0.626**	0.141	0.601**	0.322**
	C3		1.000	0.646**	0.624**	0.184	0.178	-0.031	0.337*	0.392**
100- kernel weight (g)	C1			1.000	0.404**	0.245*	-0.253**	-0.021	0.217*	0.243*
	C2			1.000	0.202*	0.109	0.126	-0.138	0.204*	0.573**
	C3			1.000	0.539**	0.145	0.168	-0.144	0.459**	0.494**
Shelling out-turn (%)	C1				1.000	0.054	-0.038	-0.224*	0.235*	0.220*
	C2				1.000	-0.109	-0.512**	0.163	0.336**	0.436**
	C3				1.000	-0.038	0.213	-0.247*	0.263*	0.531**
Sound Mature Kernel (%)	C1					1.000	-0.111	0.034	0.052	0.218*
	C2					1.000	-0.212*	0.170	0.172	0.205*
	C3					1.000	0.114	0.040	0.182	0.263*
RUST Score	C1						1.000	-0.269*	-0.094	-0.115
	C2						1.000	-0.357**	-0.224*	-0.170
	C3						1.000	0.106	-0.009	0.012
LLS Score	C1							1.000	-0.057	0.065
	C2							1.000	0.108	0.115
	C3							1.000	-0.099	-0.194
Pod yield per plant (g)	C1								1.000	0.900**
	C2								1.000	0.499**
	C3								1.000	0.739**
Kernel yield per plant (g)	C1									1.000
	C2									1.000
	C3									1.000

*, ** Significant at 5 % and 1 % level of probability, respectively; C1 - CO 7 × GPBD 4; C2 - TMV 2 × GPBD 4; C3 - TMV (Gn) 13 × GPBD 4

Fig.1 Correlation coefficient between kernel yield per plant and rust score in groundnut

Fig.2 Correlation coefficient between kernel yield per plant and late leaf spot score in groundnut
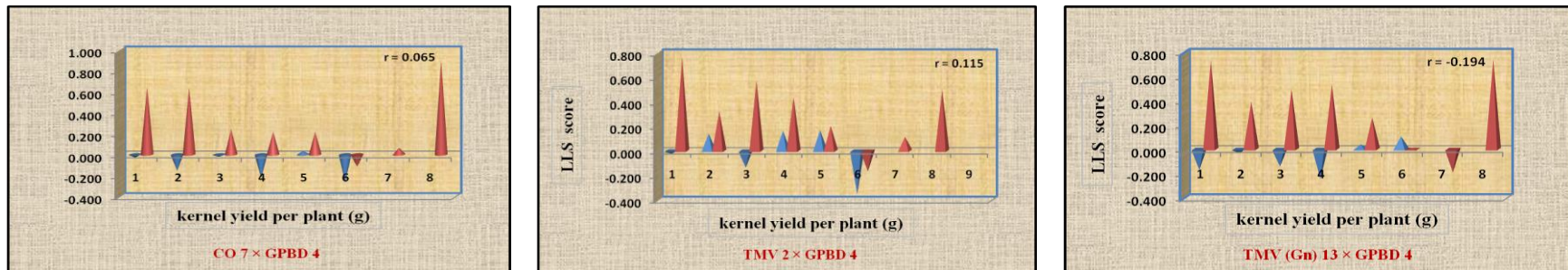
Correlation between sound mature kernel, disease scores and other yield attributes

Among the rust and LLS disease score, LLS alone had significantly negative and positive association with sound mature kernel per cent in this back cross populations. However, both the disease score has no association with other yield components. These results are in conformity with findings of Padmaja *et al.,* (2013), Prabu *et al.,* (2014) and Sarvamangala (2009).

In conclusion, the present results on correlation coefficients revealed that number of pods per plant, hundred pod weight, hundred kernel weight, shell weight, shelling out-turn and sound mature kernel per cent were the most important attributes and may contribute considerably towards higher yield *i.e.,* kernel yield per plant in all the three crosses. Among the LLS and rust disease score, LLS score alone had significantly negative and positive association with shelling out-turn and sound mature kernel per cent. The rust score had significant and negative correlation with shelling-out turn in one cross only. However, both LLS and rust disease scores has no correlation with kernel yield and other yield components in all the three crosses. Hence, development of high kernel yielding genotypes with resistance to both foliar diseases is possible.

Acknowledgments

References

Anitha, B.K. 2013. Identification of quantitative trait loci for oil yield and marker assisted backcross for high oleic acid in groundnut (*Arachis hypogaea* (L). *Ph.D. Ag.) Thesis* submitted to the Tamil Nadu Agricultural University, Coimbatore.

Borkar, V.H. and Dharanguttikar, V. M. 2014. Evaluation of groundnut (*Arachis hypogaea* L.) genotypes for physiological traits. *Int. J. Scientific and Res. Publications*. 4(1): 1-8.

Darvhankar, M.S., Kamdar, J.H., Kasundra, S.V., Jasani, M.D., Das, P., Maurya, A.K., Ajay, B.C. and Bera, S.K. 2015. Genetic variability and trait association in groundnut (*Arachis hypogaea* L). National seminar on strategic interventions to enhance oilseeds production in India, *ICAR- Directorate of Rapeseed Mustard Research, Bharatpur.*

Gupta, R.P., Vachhani, J.H., Kachhadia, V.H., Vaddoria, M.A. and Brad, H.R. 2015. Correlation and Path analysis in Virginia groundnut (*Arachis hypogaea* L. *Electronic J. Plant Breeding,* 6(1): 248-252.

John, K., Vasanthi, R.P., Venkateswarlu, O., Muralikrishna, T. and Naidu, P.H. 2014. Genetic analysis and regression studies for yield and yield attributes in F2 segregating population of groundnut (*Arachis hypogaea* L). *Legume Res.,* 31(3): 210-213.

Johnson, H.W., Robinson, H.F. and Comstock, R.E. 1955. Genotypic and phenotypic correlations in soybean and other implications in selection. *Agronomy J.,* 47: 477-483.

Kumar, D.R., Sekhar, M.R., Reddy, K.R. and Ismail, S. 2014. Character association and path analysis in groundnut (*Arachis hypogaea* L). *Int. J. Appl. Biol. Pharm.*

Technol., 3(1): 385-389.

Mothilal, A. 2003. Genetics of vegetative and reproductive traits in groundnut (*Arachis hypogaea* L). *Ph.D. Ag.) Thesis* submitted to Tamil Nadu Agricultural University, Coimbatore.

Nandini, C. and Savithramma, D.L. 2012. Character association and path analysis in F8 recombinant inbred line population of the cross NRCG 12568 × NRCG 12326 in groundnut (*Arachis hypogea* L). *Asian J. Biol. Sci.,* 7(1) : 55-58.

Narasimhulu, R., Kenchanagoudar, P.V. and Gowda, M.V.C. 2012. Study of genetic variability and correlations in selected groundnut genotypes. *Int. J. Appl. Biol. Pharm. Technol.,* 3(1): 355-358.

Padmaja, D., Eswari, K.B., Rao, M.V.B. and Reddy, S.M. 2013. 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. *Int. J. Innovative Res. Develop.,* 2(9): 191-196.

Pavithradevi, S. 2013. Identification of Quantitative Trait Loci (QTLs) for yield and yield component traits under drought stress in Spanish bunch groundnut (*Arachis hypogaea* L). *Ph.D. Ag.) Thesis* submitted to Tamil Nadu Agricultural University, Coimbatore.

Prabhu, R., Manivannan, N., Mothilal, A. and Ibrahim, S.M. 2014. Magnitude and direction of association for yield and yield attributes in groundnut (*Arachis hypogaea* L). *Electronic J. Plant Breeding,* 5(4): 824-827.

Priyadharshini, M. 2012. Molecular marker analysis for yield and yield component characters under non stress and drought stress conditions in groundnut (*Arachis hypogaea* L), Unpublished Ph.D. Ag.) Thesis, submitted to Tamil Nadu Agricultural University, Coimbatore.

Raut, R.D., Dhaduk, L.K. and Vachhani, J.H. 2010. Character association and path coefficient analysis in F_2 generation (*Arachis hypogaea* L). *Int. J. Agri. Sci.,* 6(1): 234-237.

Sarvamangala, S.C. 2009. Construction of genetic linkage map and QTL analysis for foliar disease resistance, nutritional quality and productivity traits in groundnut (*Arachis hypogaea* L). *Ph. D. Thesis*, University of Agricultural Sciences, Dharwad.

Shoba, D., Manivannan, N., Vindhiyavarman, P. and Nigam, S.N. 2012. SSR markers associated for late leaf spot disease resistance by bulked segregant analysis in groundnut (*Arachis hypogaea* L). *Euphytica*, 188(2): 265-272.

Shreya, R. Vasanthi, P., Ainmisha and Srivastava, K. 2015. Correlation studies in early segregating generation in groundnut (*Arachis hypogaea* L). *The Bioscan,* 10(4): 1975-1979.

Subrahmanyam, P., Moss, J.P., McDonald, D., Rao, P.V.S. and Rao, V.R. 1985. Resistance to leaf spot caused by *Cercosporidium personatum* in wild *Arachis* species. *Plant Dis.,* 69: 951-954.