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Character Association studies on Foliar Disease Resistance with Yield and Yield Attributing Traits in Groundnut (*Arachis hypogaea* L.)

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ABSTRACT: Groundnut (*Arachis hypogaea* L.) is an important oil seed crop being adversely affected by two foliar fungal diseases *viz.*, late leaf spot and rust. The objective of this study is to ascertain the association of these foliar diseases with yield and yield component traits. Phenotypic and genotypic correlations revealed significant negative association of both these diseases with major yield attributing traits like matured pods plant^{-1}, hundred kernel weight, sound matured kernel percentage and pod yield plant^{-1}, which results in high yield losses. Hence, it is concluded that loss of photosynthetic area due to foliar diseases made clear reduction in yield components, and development of disease tolerant varieties can mitigate the problem besides reducing cost of cultivation to farmers.

Keywords: Groundnut, Foliar fungal diseases, Late leaf spot, Rust, Correlation.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is an important oil seed crop in the world. It is an allotetraploid with chromosome complement of 2n = 4x = 40 (AABB). It belongs to the subfamily Papilionaceae of the family Leguminosae, possess highly self-pollinated nature due to its closed flower structure. It is popularly known as "King of Oil Seeds". It is also called as peanut, earthnut, monkey nut, manila nut, goober nut and panda nut. It is a rich source of oil (45–50%) which contains high amount of unsaturated fatty acids (80%) that is good for health. Due to the presence of tocopherol, groundnut oil has high stability even after 10 hours of heating, without losing its original properties. It also contains 25% of proteins especially globulin proteins like arachin and conarachin (87% of total proteins). Besides these two, it also contains 8–14% of carbohydrates and vitamins like vitamin A and B–complex, especially thiamine and niacin. It contains high amount of resveratrol (15.04 µg/g and 3.66 µg/g in Spanish and Virginia types, respectively) which is an anti-cancerous component (Janila *et al*., 2013).

Globally, it is cultivated in an area of 29.92 mha with annual production of 55.30 Mt and productivity of 1851 kg ha^{-1} (FAOSTAT, 2021). India is the second largest producer of groundnut after China, behind the United States and Nigeria (Tiwari *et al*., 2018). The third most significant source of oil in the world is groundnut (Patil *et al*., 2020) and 49% of the groundnuts produced worldwide are crushed to extract oil, while 41% are eaten as food (Janila *et al*., 2016). The productivity of groundnut varies from year to year and season to season. It is limited by the influence of both biotic (pests and diseases) and abiotic stress conditions. Among the biotic stresses, late leaf Spot (LLS) (caused by *Phaeoisariopsis personata* Ber. and M A Curtis) and rust (caused by *Puccinia arachidis* Speg.) are the two major foliar fungal diseases results in yield loss up to 50% and 10–52% respectively based on the severity of their incidence. In majority of the cases these two diseases occur combinedly and results in yield loss of around 50–70% (Subrahmanyam *et al*., 1995; Mau and Ndiwa 2018). Both these foliar diseases results in heavy defoliation under severe condition which ultimately affect the pod growth and development and seed filling, there by yield losses (Chaudhari *et al*., 2017). Hence there is a need to investigate the association of both these diseases with the yield and yield attributing traits for efficient selection and advancement of superior genotypes for yield and yield attributing traits along with disease resistance.

MATERIALS AND METHODS

Thirty five advanced breeding lines of groundnut that were derived from nine different crosses, two resistant checks *viz.*, K 1812 and TCGS 1862 and two susceptible checks *viz.*, TAG 24 and TMV 2, for both LLS and rust disease were selected and sown during *Kharif*, 2022 in a Randomized Block Design (RBD) with two replications in Regional Agricultural Research Station (RARS), Tirupati. In each replication, every genotype was sown in 2 rows of 3 m length with a spacing of 30 cm between rows and 10 cm between plants within the row. All necessary cultural operations along with proper plant protection measures were taken to control insect pests. Observations were recorded for thirty five advanced breeding lines separately on randomly chosen five competitive plants in each line in each replication for six characters *viz.*, matured pods plant^{-1}, 100 pod weight (g), 100 kernel weight (g), shelling percentage, sound mature kernel percentage. Days to 50% flowering, days to maturity, LLS and rust severity scores at 75 DAS and 90 DAS (Subrahmanyam *et al*., 1995) were recorded on plot basis. Phenotypic and genotypic correlation coefficients were calculated based on the method given by Johnson *et al.* (1955).

RESULTS AND DISCUSSION

The foliar fungal disease *viz.*, LLS and rust have adverse negative effects on major yield and yield attributing traits. There is a negative and significant association was observed between pod yield plant^{-1}, matured pods plant^{-1}, sound matured kernel percentage and days to maturity with LLS score at both 75 and 90 DAS. Similarly, significant negative association was observed between pod yield plant^{-1} and hundred kernel weight with rust scores at 75 DAS and matured pods plant^{-1} and days to maturity with rust score at 75 DAS (Table 1), which results in yield losses. Similar results were reported by Nadaf *et al.* (2017); Taprope *et al.* (2018) for pod yield plant^{-1}, Chaudhari *et al.* (2017) for days to maturity and sound matured kernel percentage and Mahesh *et al*. (2018) for matured pods plant^{-1}. Hence, selection and advancement of lines having lower disease severity scores for both the disease will be rewarding for the development of elite lines with higher yielding ability.

LLS score at 90 DAS showed low positive and significant association with rust score at 90 DAS (Table 1), indicating that resistance to both the diseases can be incorporated by single breeding effort. These results were in agreement with the scientific findings of Narasimhulu *et al*. (2012); Chaudhari *et al*. (2017) for LLS with rust scores.

Table 1: Phenotypic (r_p) and genotypic (r_g) correlation analysis for foliar disease reaction yield, yield attributing traits and in groundnut.

Characters		DM	MPP	HPW	HKW	SP	SMK	LLS Score (75 DAS)	Rust Score (75 DAS)	LLS Score (90 DAS)	Rust Score (90 DAS)	Correlation with PYP
DFF	r_p	0.041	0.038	-0.132	0.102	-0.035	-0.025	-0.086	-0.089	-0.058	-0.084	0.064
	r_g	0.068	0.031	-0.119	0.318**	0.017	-0.045	-0.158	-0.092	-0.127	-0.183	0.042
DM	r_p		0.129	-0.057	0.007	-0.256*	0.198	-0.735**	-0.156	-0.733**	-0.305**	0.212
	r_g		0.154	-0.084	0.008	-0.308**	0.298**	-0.759**	-0.153	-0.753**	-0.315**	0.268*
MPP	r_p			-0.163	-0.089	-0.238*	-0.047	-0.278*	-0.146	-0.305**	-0.133	0.756**
	r_g			-0.280*	-0.137	-0.308**	-0.234*	-0.343**	-0.241*	-0.361**	-0.168	0.879**
HPW	r_p				0.620**	0.219	0.282*	0.076	-0.211	0.008	-0.195	0.059
	r_g				0.818**	0.467**	0.574**	0.001	-0.133	-0.014	-0.181	0.037
HKW	r_p					0.331**	0.329**	-0.115	-0.284*	-0.15	-0.274*	0.064
	r_g					0.373**	0.421**	-0.116	-0.483	-0.154	-0.379**	0.130
SP	r_p						0.191	0.117	0.077	0.149	0.019	-0.095
	r_g						0.171	0.308	0.302	0.338	0.152	-0.117
SMK	r_p							-0.235*	-0.044	-0.237*	0.058	0.005
	r_g							-0.229*	0.184	-0.264*	0.255*	-0.196
LLS Score (75 DAS)	r_p								0.217	0.951**	0.283*	-0.276**
	r_g								0.230*	0.965**	0.289*	-0.344**
Rust Score (75 DAS)	r_p									0.369**	0.832**	-0.162
	r_g									0.375**	0.873**	-0.230*
LLS Score (90 DAS)	r_p										0.432**	-0.313**
	r_g										0.435**	-0.386**
Rust Score (90 DAS)	r_p											-0.241*
	r_g											-0.302**

**= Significance at 1 % level; *= Significance at 5 % level
DFF: Days to 50 % flowering; DM: Days to maturity; MPP: Matured pods plant^{-1}; HPW: 100 pod weight (g); HKW: 100 kernel weight (g); SP: Shelling percentage; SMK: Sound matured kernel percentage; LLS : Late leaf spot (1 to 9 scale); PYP: Pod yield plant^{-1} (g)

Pod yield plant^{-1} showed positive and significant association with number of matured pods plant^{-1}and days to maturity at both phenotypic and genotypic levels and days to maturity genotypic level (Table 1). Thus, as per earlier establishment by Rao *et al.* (2014); Surbhi *et al.* (2016); Rathod and Toprope (2018); Hampannavar *et al.* (2018); Kumar *et al.* (2019); Mohapatra and Khan (2020); Mitra *et al*. (2021) by increasing the number of matured pods plant^{-1}, simultaneously the pod yield plant^{-1} will be increased and according to Sudhishna *et al*. (2021) long duration varieties yields more than the short duration varieties. This indicated that further advancement of generations for pod yield plant^{-1} can be done more efficiently and effectively by selecting the lines with more number of matured pods plant^{-1} and maturity duration as the genotypic association is higher than the phenotypic association.

Pod yield plant^{-1} has a non-significant association with sound matured kernel percentage, which might be due to the significant negative association of sound matured kernel percentage with LLS score at 90 DAS (Table 1) as it affects the pod growth and development which ultimately results in improper seed filling. These findings were in accordance with the scientific reports of Hampannavar *et al.* (2018) for the association of pod yield plant^{-1} with sound matured kernel percentage.

It was observed that days to maturity has a low positive and significant association at genotypic level with sound matured kernel percentage, which indicates that the association between these two traits is due to the genetic background and not influenced by the environment. Selection and advancement of lines with medium or long duration will help us to increase the sound matured kernel percentage. Hampannavar *et al*. (2018); Sudhishna *et al*. (2021); Sharma *et al*. (2023) reported similar findings from their study.

As expected hundred pod weight has a positive and significant association at both phenotypic and genotypic levels with hundred kernel weight and sound matured kernel percentage. These results were agreed with the finding of Zaman *et al*. (2011); Sharma *et al*. (2023). Similarly, hundred kernel weight showed a positive and significant association with shelling percentage and sound matured kernel percentage both at phenotypic and genotypic levels. These observations were in accordance with Zaman *et al*. (2011); Patidar and Nadaf (2017) for shelling percentage and Hampannavar *et al*. (2018) for sound matured kernel percentage. Selection and advancement based on these traits will be rewarding in improving the yielding ability of the selected lines.

Development of new lines or varieties with resistance to major pests and diseases is utmost important to achieve targeted yields in disease endemic areas. Hence, the advanced breeding lines which were selected based on these character association studies can be further advanced for yield testing in multi-locational trials to identify superior lines among them and for their further release and notification.

CONCLUSIONS

Both the foliar fungal diseases *viz*., LLS and rust have adverse effects on yield and yield attributing traits like number of pod yield plant^{-1}, matured pods plant^{-1}, hundred kernel weight and sound matured kernel percentage (%). Hence advanced breeding lines with low disease severity scores for LLS and rust along with more number of matured pods plant^{-1}, maximum hundred pod and kernel weights, maximum shelling and sound matured kernel percentage should be given importance while selection and further advancement as it maximizes the yielding ability of the selected lines.

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Conflict of Interest. None.

REFERENCES

Chaudhari, S., Khare, D., Sundravadana, S., Variath, M. T., Manohar, S. S. and Janila, P. (2017). Genetic analysis of foliar disease resistance, yield and nutritional quality traits in groundnut. *Electronic Journal of Plant Breeding*, *8*(2), 485-493.

FAOSTAT (2020-2021). Food and Agriculture Organization of the United Nations. World Agricultural Production, Rome, Italy. http: // faostat.fao.org/.

Hampannavar, M. R., Khan, H., Temburne, B. V., Janila, P. and Amaregouda, A. (2018). Genetic variability, correlation and path analysis studies for yield and yield attributes in groundnut (*Arachis hypogaea* L.). *Journal of Pharmacognosy and Phytochemistry*, *7*(1), 870-874.

Janila, P., Nigam, S. N., Pandey, M. K., Nagesh, P. and Varshney, R. K. (2013). Groundnut improvement: use of genetic and genomic tools. *Frontiers in Plant Science*, *4,* 23.

Janila, P., Variath, M.T., Pandey, M. K., Desmae, H., Motagi, B. N., Okori, P., Manohar, S. S., Rathnakumar, A. L., Radhakrishnan, T., Liao, B. and Varshney, R. K. (2016). Genomic tools in groundnut breeding program: status and perspectives. *Frontiers in Plant Science*, *7,* 289.

Johnson, H. W., Robinson, H. F. and Comstock, R. E. (1955). Estimates of genetic and environmental variability in soybeans. *Agronomy journal*, *47,* 314-318.

Kumar, N., Ajay, B. C., Rathanakumar, A.L., Radhakrishnan, T., Mahatma, M. K., Kona, P. and Chikani, B. M. (2019). Assessment of genetic variability for yield and quality traits in groundnut genotypes. *Electronic Journal of Plant Breeding*, *0*(1), 196-206.

Mahesh, R. H., Hasan, K., Temburne, B. V., Janila, P. and Amaregouda, A. (2018). Genetic variability, correlation and path analysis studies for yield and yield attributes in groundnut (*Arachis hypogaea* L.). *Journal of Pharmacognosy and Phytochemistry*, *7*(1), 870-874.

Mau, Y. S. and Ndiwa, A. S. S. (2018). Field evaluation of late leaf spot and leaf rust resistance and the associated yield losses in Indonesian groundnut genotypes. *Asian Journal of Plant Sciences*, *17*(3), 134-141.

Mitra, M., Gantait, S. and Kundu, R. (2021). Genetic variability, character association and genetic divergence in groundnut (*Arachis hypogaea* L.) accessions. *Legume Research-An International Journal*, *44*(2), 164-169.

Mohapatra, N. and Khan, H. (2020). Character association and path analysis in F3 segregating generations for yield and its component traits in groundnut (*Arachis hypogaea* L.). *Journal of Pharmacognosy and Phytochemistry*, *9*(4), 794-799.

Nadaf, H. L. 2017. Genetic improvement for yield through induced mutagenesis in groundnut (*Arachis hypogaea* L.). *Legume Research-An International Journal*, *40*(1), 32-35.

Narasimhulu, R., Kenchanagoudar, P. V. and Gowda, M. V. C. (2012). Study of genetic variability and correlations in selected groundnut genotypes. *International Journal of Applied Biology and Pharmaceutical Technology*, *3*(1), 355-358.

Patidar, O. P. and Nadaf, H. L. (2017). An assessment of genetic variability and traits association among high oleic advanced breeding lines for yield and quality traits in groundnut (*Arachis hypogaea* L.). *Electronic Journal of Plant Breeding*, *8*(1), 201-205.

Patil, R., Viswanatha, K. P., Upadhyaya, H. D., Lokesha, R., Khan, H. and Gururaj, S. (2020). Genetic diversity, association and principle component analyses for agronomical and quality traits in genomic selection training population of groundnut (*Arachis hypogaea* L.). *Indian Journal of Genetics and Plant Breeding*, *80*(03), 282-290.

Rao, V. T., Venkanna, V., Bhadru, D. and Bharathi, D. (2014). Studies on variability, character association and path analysis on groundnut (*Arachis hypogaea* L.). *International Journal of Pure Applied Bios*ciences, *2*(2), 194-197.

Rathod, S. S. and Toprope, V. N. (2018). Studies on Variability, Character association and Path analysis on groundnut (*Arachis hypogaea* L.). *International Journal of Pure and Applied Biosciences*, *6*(2), 1381-1388.

Sharma N. and Tiwari, S., Tripathi M. K., Neha Gupta, Sangeeta Singh and Sikarwar R. S. (2023). Selection of groundnut germplasm lines based on yield, nutritional, antinutritional and antioxidant parameters. *Scientist*, *2*(1), 96-105.

Subrahmanyam, P., McDonald, D., Waliyar, F., Reddy, L. J., Nigam, S. N., Gibbons, R. W., Rao, V. R., Singh, A. K., Pande, S., Reddy, P. M. and Rao, P. S. (1995). Screening methods and sources of resistance to rust and late leaf spot of groundnut. *Information Bulletin* no. 47.

Sudhishna, E., Naik, K. S. S., Srinivas, T. and Ramesh, D. (2021). Studies on Character Association and Path Analysis in Groundnut. *The Andhra Agricultural Journal*, *68*(2), 182-188.

Surbhi, J., Singh, P. B. and Sharma, P. P. (2016). Correlation and path analysis in groundnut (*Arachis hypogaea* L.). *International Journal of Current Research*, *8*(8), 35811-35813.

Tiwari, S., Kumar, N., Pramanik, A., Joshi, E., Sasode, D. S., Sikarwar, R. S., Tomar, R. S., Tripathi, M. K., Kandalkar, V. S. and Singh, A. K. (2018). Breeding for foliar disease resistance in groundnut using conventional and molecular approaches. *Proceedings of Plant Science and Molecular Biology*, *15*, 56-62.

Zaman, M. A., Tuhina-Khatun, M., Ullah, M. Z., Moniruzzamn, M. and Alam, K. H. (2011). Genetic variability and path analysis of groundnut (*Arachis hypogaea* L.). *The Agriculturists*, *9*(1-2), 29-36.

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