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Identification of Resistance Sources of Groundnut (*Arachis hypogaea L.*) Genotypes for Major Foliar Diseases

Research Article

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Abstract

Groundnut (*Arachis hypogaea* L.) is the fourth most important oil seed crop in the world. The late spots and rusts are foliage diseases more common and more destructive of groundnut which cause severe yield losses up to 70% and reduces the quality of the pod and fodder. The present investigation aimed to identify the sources of resistance to leaf spots & rusts from the newly identified genotypes as well as from wild species and to study the way in which these were responding to the natural disease epiphytotic conditions. Twenty four groundnut genotypes were screened against leaf spots and rust diseases under natural epiphytotic conditions in field at, CRS,Aliyarnagar through AICRP experiments during Rabi 2024-2025 . Screening was carried out using infector row technique and the observations of disease intensity and rate of infection were recorded using 0-9 scale. Twenty four groundnut genotypes were screened for Early Leaf Spot, Late Leaf Spot, Rust & Alternaria leaf spot diseases of groundnut. Among the AVT-I entries screened for major diseases of groundnut, four entries viz., AIS-2024-7,AIS-2024-8, AIS-2024-9 and AIS-2024-11 showed resistance to leaf spots and rust diseases. AIS-2024-3, AIS-2024-4 & AIS-1-2024-3 are resistant to ELS, AIS-2024-7 found to be resistant to LLS, AIS-2024-1, AIS-1-2024-3, AIS-1-2024-7 are found to be resistant to Rust. Except 6 entries all the entries were resistant to Alternaria leaf spot disease. The susceptible check Co2 recorded maximum leaf spot disease grade of 7. The resistant lines will be useful to develop introgression lines using marker-assisted backcrossing approach to improve foliar fungal disease resistance in popular groundnut varieties.

Keywords: *Arachis Hypogaea* L; Breeding; Leaf Spot Disease; Resistant Genotypes; Screening

Introduction

Groundnut (*Arachis hypogaea* L.) is a grain legume and oilseed, presently cultivated in more than 100 countries throughout tropical, subtropical and warm temperate regions of the world with an annual production and productivity of 42.32 m tons and 1654 kg/ha nuts-in-shell, respectively [FAOSTAT,2014] [1]. Groundnut (*Arachis hypogaea* L.) called as King of oilseed crop, is grown in semi arid tropics of India. India ranks second in the world in groundnut scenario with an annual production of 5.9 million tons. Today, groundnut has a share of approximately 25% in the total Indian oilseed production. The major states in the production of groundnut are Gujarat (2.5 million tons), Maharashtra, Orissa and Madhya Pradesh. Diseases of groundnut reduce the yield and quality and increase the cost of production wherever the crop is grown.

Among diseases, stem rot, collar rot, aflaroot, leaf spots (early and late), rust and bud necrosis affects the groundnut crop both in *kharif* and *rabi*-summer. Among the foliar fungal diseases, economically important are early leaf spot, late leaf spot and rust. Early leaf spot is caused by *Cercospora arachidicola* Hori (Perfect stage-*Mycosphaerella arachidis* Deigton) and late leaf spot is caused by *Phaeoisariopsis*

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personata Berke & Curt (Perfect stage-*Mycosphaerella berkeleyi* Jenkins) both commonly called '*tikka* disease'. Among the groundnut diseases, late leaf spot caused by *Phaeoisariopsis personata* and rust caused by *Puccinia arachidis* are the most serious fungal diseases and account for more than 50% yield loss (Subramanian *et al.,* 1995) [2]. The late leaf spot usually appears at 55 to 60 days after sowing and causes more than 50% loss in pod and haulm yield (Jyosthana *et al.,* 2004). Besides these, in the past three years, *Alternaria* leaf blight had been occurring severely in summer groundnut (Kumar *et al*., 2012) [3]. The combined infection of rust and leaf spots cause losses to the tune of 90%.

Recent disease management researches are focusing on developing resistant source against foliar diseases. The cultivation of resistant and tolerant groundnut varieties does not only eliminate the crop losses caused by disease, but it also contributes to reduce costs related to fungicide sprayings and other control methods. There is need to develop new lines that could sustain in heavy disease pressure. With this view, the present investigations were done to identify the sources of resistance to leaf spot from the newly identified genotypes as well as from wild species and to study the way in which these were responding to the to the disease development.

Materials and Methods

Experimental Site

Table 1: Screening AVT I & II entries for resistance/tolerance to major foliar diseases of groundnut.

S.No	Entries	Disease severity (1-9 scale)											
		ELS			LLS			Rust			Alternaria leaf blight		
		Grade	PDI	Category	Grade	PDI	Category	Grade	PDI	Category	Grade	PDI	Category
1	AIS 2024-1	3.3	26.67	MS	3	26.67	MR	1	8.90	R	0	0	R
2	AIS 2024-3	1.3	8.90	R	3	26.67	MS	2	16.78	MR	2.3	17.78	MR
3	AIS 2024-4	1	8.90	R	3	26.67	MR	4	35.56	MS	0	0	R
4	AIS 2024-5	3	26.67	MS	3.5	26.84	MR	3	26.67	MS	0	0	R
5	AIS 2024-6	2.3	17.80	MR	2.5	14.82	MR	2	16.78	MR	0	0	R
6	AIS 2024- 7	2	17.78	MR	2	6.00	R	2.7	26.67	MS	0	0	R
7	AIS 2024 -8	1.5	15.78	MR	3.5	26.74	MR	3.3	26.67	MS	0	0	R
8	AIS 2024 -9	1.5	15.78	MR	2.5	14.82	MR	1.7	16.70	MR	2.7	26.67	MS
9	AIS 2024-10	2.3	17. 80	MR	3.3	29.63	MS	3.3	26.75	MS	0	0	R
10	AIS 2024-11	2.3	17.80	MR	2	17.78	MR	2.7	26.67	MS	2.7	26.67	MS
11	AIS 2024 -12	2.7	26.67	MS	2.5	14.82	MR	2	16.78	MR	0	0	R
12	AIS-1-2024-1	1.7	17.58	MR	3.5	26.74	MR	2	16.78	MR	0	0	R
13	AIS-1-2024-2	1.5	17.45	MR	3	26.67	MS	3	26.67	MR	0	0	R
14	AIS-1-2024-3	1.3	8.90	R	2.7	23.70	MR	1.3	8.90	R	3	26.67	MS
15	AIS-1-2024-4	2	17.78	MR	4.3	38.42	MS	2	16.78	MS	3	26.67	MS
16	AIS-1-2024-5	2.5	26.47	MS	3.7	32.59	MS	1.7	16.70	MR	0	0	R
17	AIS-1-2024-6	2	17.78	MR	4.7	41.48	MS	2.3	17.78	MR	0	0	R
18	AIS-1-2024-7	3.3	26.73	MS	2.5	14.71	MR	1.3	8.90	R	2.3	17.78	MR
19	AIS-1-2024-8	2	17.78	MR	2.7	23.70	MR	3	26.67	MS	0	0	R
20	AIS-1-2024-9	3.3	26.73	MS	5.3	47.30	MS	2.7	26.67	MS	0	0	R
21	AIS-1-2024-10	2.5	26.47	MS	3.3	29.53	MS	3.3	26.67	MS	0	0	R
22	AIS-1-2024-11	2	17.78	MR	4.3	38.52	MS	2.7	26.67	MS	0	0	R
23	Sus.check Co2	4	35.56	MS	4.7	41.48	MS	3.7	35.56	MS	4.3	38.52	MS
24	Res.check ALR3	3	26.67	MS	3.3	29.63	MS	3.7	26.67	MS	4.7	41.48	MS
	C.V.		57.681			17.088			28.824			87.486	
	SE(d)		10.260			3.636			6.311			7.259	

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The research was conducted during October to December 2025 at Coconut Research Station, Aliyarnagar, Tamil Nadu, India. The site lies near Western Ghats (100 N latitude and 770 E longitude) and at an Altitude of 260 m above Mean Sea Level in Coimbatore district of Tamil Nadu.

Field Experiment and Design

The land was ploughed and harrowed using a tractor and divided into plots of 4 m x 5 m with 1 m interval between plots. The treatment was arranged in a randomized complete block design and replicated three (3) times. Sowing was done manually on 9th July 2025. One seed was planted per hole at a depth of approximately 4 cm. A plot consisted of six rows with spacing of 0.3 m between rows and 0.1 m between plants in a row. Weed control was done using hoe to remove weeds and hand pulling of weeds where necessary.

Disease Scoring

Field screening of genotypes and wild species against leaf spots & rust disease was carried out to identify the source of resistance by following "Infector row technique". Ten test genotypes of groundnut were sandwiched among the susceptible genotype (CO2). The border was grown with susceptible genotype to maintain the effective inoculum load. High humidity was maintained by irrigating the field in the night by surface irrigation. The leaf spots & rust disease infected leaves were collected from the infected field. The severity of diseases was recorded on three compound leaves of the main stem chosen from bottom, middle and top position of five plants of each genotype by using the scale 1-10 (Florida Scale). Disease scoring data for leaf spots & rust was analyzed and categorized in different groups of groundnut genotypes (Table 1) and (Table 2) based on the resistance reactions.

Data Collection and Analysis

Data was collected on leaf spot disease severity. Data on leaf spots and rust severity were taken at 30, 60 and 90 days after planting using the scale of (1-10) based on visual observations where 1 = no disease, 2 = very few lesions on leaves in lower canopy, 3 = few lesions on leaves in lower and upper canopy, 4 = some lesions on leaves in lower and upper canopy with ≤10% defoliation, 5 = lesions noticeable in upper canopy and ≤ 25% defoliation, 6 = lesion numerous with ≤50% defoliation, 7 = lesions very numerous with ≤75% defoliation, 8 = numerous lesions on few remaining leaves with ≤90 defoliation, 9 = remaining leaves covered with lesions with ≤95% defoliation, and 10 = plants defoliated or dead (Singh *et al*.,2011). Ten plants were sampled per plot. Data collected were subjected to analysis of variance and the mean difference separated using the least significant difference test at LSD of p≤ 0.05 using Genstat statistical package (4th edition).

Results and Discussion

The data from (Table 2) revealed that among the 24 genotypes screened against leaf spots & rust diseases of groundnut under natural field conditions, four entries *viz*., AIS-2024-7, AIS-2024-8, AIS-2024-9 and AIS-2024-11 showed resistance to both leaf spots and rust diseases. AIS-2024-3, AIS-2024-4 and AIS-1-2024-3 are resistant to

Table 2: Reaction of groundnut genotypes to leaf spots and rust disease.

Sl.No	Resistance	ELS	LLS	ALS	Rust
1	Resistance (0%)	AIS-2024-3,AIS-2024-4,AIS-1-2024-3	AIS 2024- 7	AIS 2024-1, AIS 2024-4, AIS 2024-5, AIS 2024-6, AIS 2024-7, AIS 2024-8, AIS 2024-10, AIS 2024-12, AIS-1-2024-1, AIS-1-2024-2, AIS-1-2024-3, AIS-1-2024-5, AIS-1-2024-6, AIS-1-2024-8, AIS-1-2024-9, AIS-1-2024-10, AIS-1-2024-11	AIS-2024-1,AIS-1-2024-3,AIS-1-2024-7
2	Moderately Resistance (21-50%)	AIS-2024-6, AIS-2024-7, AIS-2024-8 AIS-2024-9, AIS-2024-10, AIS-2024-11, AIS-1-2024-1 AIS-1-2024-2, AIS-1-2024-4, AIS-1-2024-6, AIS-1-2024-8, AIS-1-2024-11	AIS 2024-1, AIS 2024-4, AIS 2024-5, AIS 2024-6, AIS 2024 -8, AIS 2024 -9, AIS 2024-11, AIS 2024 -12, AIS 2024 -12, AIS-1-2024-1, AIS-1-2024-3, AIS-1-2024-7, AIS-1-2024-8,	AIS-2024-3,AIS-1-2024-7	AIS-2024-3, AIS-2024-6,AIS-2024-9, AIS-2024-12,AIS-1-2024-1 AIS-1-2024-2,AIS-1-2024-5,AIS-1-2024-6
3	Moderately Susceptible (50-70)%	AIS-2024-1,AIS-2024-5,AIS-2024-12,AIS-1-2024-7,AIS-1-2024-9,AIS-1-2024-9,AIS-1-2024-10	AIS 2024-3, AIS 2024-10, AIS-1-2024-2, AIS-1-2024-4, AIS-1-2024-5, AIS-1-2024-6, AIS-1-2024-9, AIS-1-2024-10, AIS-1-2024-11,	AIS-2024-9, AIS-2024-11, AIS-1-2024-3,AIS-1-2024-4	AIS-2024-4, AIS-2024-5,AIS-2024-7,AIS-2024-8,AIS-2024-10 AIS-2024-11,AIS-1-2024-4,AIS-1-2024-8 AIS-1-2024-9,AIS-1-2024-10,AIS-1-2024-11
4	Susceptible (70-100%)	-	-	-	-

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ELS (PDI 9.0%), AIS-2024-7 found to be resistant to LLS (PDI 6.0%), AIS-2024-1, AIS-1-2024-3, AIS-1-2024-7 (PDI 9.0%) are found to be resistant to Rust. Except 6 entries all the entries were resistant to *Alternaria* leaf spot disease. AIS-2024-6, AIS-2024-7, AIS-2024-8, AIS-2024-9, AIS-2024-10, AIS-2024-11, AIS-1-2024-1, AIS-1-2024-2, AIS-1-2024-4, AIS-1-2024-6, AIS-1-2024-8, AIS-1-2024-11 genotypes were found to be moderately resistant to ELS. AIS 2024-1, AIS 2024-4, AIS 2024-5, AIS 2024-6, AIS 2024 -8, AIS 2024 -9, AIS 2024-11, AIS 2024 -12, AIS 2024 -12, AIS-1-2024-1, AIS-1-2024-3, AIS-1-2024-7, AIS-1-2024-8 were found to be moderately resistant to LLS. AIS-2024-3, AIS-2024-6, AIS-2024-9, AIS-2024-12, AIS-1-2024-1, AIS-1-2024-2, AIS-1-2024-5,AIS-1-2024-6 were moderately resistant to rust. Leaf spot diseases produced by *C. arachidicola* and *C. personatum* are present every year on groundnut in India and can decrease seed productions over 50%, if no fungicides are applied for control (Ambang *et al*., 2011) [4].

Being hot spot location for leaf spots and rust, natural infection pressure used in the genotypes in this present investigation, it can be considered as partial resistance which has been so reported earlier by Mendez-Natera *et al.* (2016) [5] and Khute *et al.* (2018) [6]. Since early eighties, ICRISAT has systematically evaluated the world collection of germplasm numbering about 13,000 accessions collected from 86 countries for their reaction to ELS, LLS and rust

(Subrahmanyam *et al.,*1995) [2]. It was observed that out of the 13,000 germplasms screened, 54 lines were found resistant to late leaf spot. Similar type of work was also reported by Pensuk *et al.* (2003) [7] Hossain *et al.* (2007) [8], Dey *et al.* (2016) [9]. Later, more accessions and advanced lines were identified (GCP 2011; Monyo & Varshney,2016; Reddy, Nigam, Rao, & Reddy, 2001, Varshney *et al.,* 2014) [10-13] and some of these lines combine rust and leaf spot resistance. Chaudhary *et al*., (2019) [14] used a set of 340 diverse peanut genotypes and screened for LLS and rust resistance and yield traits across three locations in India under natural and artificial disease epiphytotic conditions. The study revealed significant variation among the genotypes for LLS and rust resistance at different environments. Development of resistant cultivars is one of the best means of reducing crop yield losses from leaf spots and rust and also the best strategy to overcome additional cost of production (Prabhu *et al*., 2015) [15-19]. These selected resistant lines from this study may be used as a gene pool to obtain superior commercial types and to improve leaf spots and rust resistance in groundnut.

Conclusion

With these screening experiments it can be concluded that, some newly developed genotypes and wild *Arachis* species were having the high degree of resistance. These genotypes will be useful to improve foliar fungal disease resistance in popular groundnut varieties. These selected resistant lines may be used as a gene pool to obtain superior commercial types and to improve early and late leaf spot resistance in groundnut.

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