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Screening of Groundnut (*Arachis hypogaea* L.) Genotypes for Identification of Sources of Resistance against Leaf Spot Disease

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ABSTRACT

Background: Groundnut (*Arachis hypogaea* L.) is the fourth most important oil seed crop in the world. The early and late spots are a foliage disease more common and more destructive of groundnut which cause severe yield losses up to 70% and reduces the quality of the pod and fodder. Recent efforts have targeted on developing resistant source against leaf spot disease which are helpful for discarding the hazardous toxic chemical compounds used for controlling the disease. The current study aimed 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.

Methods: Seventy three groundnut genotypes were screened against late leaf spot disease under artificial epiphytotic conditions in field at AICRP on Groundnut, MPKV, Rahuri during *kharif* 2015-16. The observations of disease intensity and rate of infection were recorded.

Result: Among the Seventy three groundnut genotypes, 10 genotypes showed resistant and 33 genotypes showed the moderately resistant reaction to leaf spot disease. The 25 entries showed the susceptible and 05 genotypes showed the highly susceptible reaction to the leaf spot disease. All the susceptible cultivars belong to *A. hypogaea* sub. sp. *fastigiata* var. *fastigiata* to as Spanish bunch. These 10 resistant genotypes of groundnut including two wild species *viz.,* RHRG 6083, KDG 128, GPBD 4, ICGV 94118, ICGV 4983, ICG 12672, ICGV 13160 (*A. batizocoi*), ICGV 13165 (*A. cardenasi*), ICG 11426 and ICGV8193 were selected for intensive artificial screening under glasshouse conditions and also confirmed resistance. 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.

Key words: *Arachis hypogaea* L., Breeding, Leaf spot disease, Resistant genotypes, Screening.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is the fourth most important oil seed crop in the world. The groundnut production in India was 7180.5 thousand tonnes in 2015-16. It decreased by -221.2 thousand tonnes as compared to the groundnut production of 7401.7 thousand tonnes in the year 2014-15 (Anonymous 2015). Thus, the annual decrease recorded in the year 2015-16 was 2.99%. Yield losses in groundnut cultivars are produced by diverse causes, one of the further important is due to diseases Gaikpa *et al*. (2015). The early and late spots are foliage diseases more common and more destructive of groundnut. 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). Leaf spot disease cause severe yield losses up to 70% and reduces the quality of the pod and fodder. LLS together with rust can cause more than 50 per cent yield losses pretorius (2005), pod yield losses due to early and late leaf spot pathogens may range from 10-60 per cent (Ghuge *et al.* 1981). Thakur *et al.* (2012) indicated that *Cercospora* leaf spot (CLS) is a main severe disease of peanut and could produce yield reduction up to 50% or more. According to Walls and Wynne (1985), CLS are a major restriction to higher productions of groundnut and loss in yield of up to 70% has been indicated worldwide, where fungicides are not applied for leaf spot managements. Synthetic fungicides are useful in sustaining the production of crops and protecting the plants from fungal pathogens, but the use of these synthetic fungicides are expensive and cause serious threat to human health. Recent efforts have targeted on developing resistant source against leaf spot disease. 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. The hazard of pollution of the environment with toxic chemical compounds can also be discarded, that otherwise would have to be used in the crop for diseases control. In India, the control of disease in groundnut cultivation is a serious problem. The high expense

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associated with 8 to 10 fungicide sprayings during the crop cycle, is economically not feasible but serve as a challenge to develop resistance/tolerant varieties against foliar diseases such as early leaf spot (*Cercospora arachidicola* and late leaf spot (*Cercosporidium personatum*). Fungicides can be applied to control leaf spot and reduce yield loss, but fungicide utilization at recurrent periods is expensive. In Florida, a 10% reduction in yield is due to leaf spot epidemics no matter the use of six to eight chemical applications per crop cycle by most of the farmer.

There is need to evolve new lines that could sustain in heavy disease pressure. With this view, the present investigations was 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

Seventy three groundnut genotypes including two wild species were screened against late leaf spot under field conditions at All India Coordinated Research Project on Summer Groundnut, MPKV, Rahuri, Dist. Ahmednagar, Maharashtra, during *kharif* 2015-16. Seeds of different genotypes were procured from Agriculture Research Station, Kasbe Digraj, Dist. Sangali, Maharashtra and All India Coordinated Research Project on Summer Groundnut, MPKV, Rahuri, Dist. Ahmednagar, Maharashtra.

Field screening of genotypes and wild species against late leaf spot 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 (SB XI). The border was grown with susceptible genotype to maintain the effective inoculum load.

The leaf spot disease infected leaves were collected from the infected field. These infected leaves were soaked in water for half an hour. Then the leaf spot conidia were collected by rubbing the infected leaves in water and used for inoculation on test material. Artificial leaf spot disease, epiphytotic was created in screening experiment. Thirty days after sowing, plants were inoculated uniformly in the evening with leaf spot for three successive days during evening hours. The inoculum contained 20,000 conidia per ml water and mixed with Tween 80 (0.2 ml/1000 ml of water) as a mild surfactant and atomized on the plants using knapsack sprayer in field (Pandey *et al.* 2002). High humidity was maintained by irrigating the field in the night by surface irrigation. The severity of leaf spot was recorded on three compound leaves of the main stem chosen from bottom, middle and top position of five plants of each genotype with the interval of 10 days after inoculation (DAI) by using the scale 1-9 (Subramanyam *et al.* 1995) (Table 1).

The Infection rate ‘r’ was calculated by using the formula (Van der Plank, 1963):

$$r = \frac{2.3}{(t_2 - t_1)} \left[\log 10 \left(\frac{x_2 (1-x_1)}{x_1 (1-x_2)} \right) \right]$$

Where,

r = Infection rate in units per day.

t_1 = Time in days of first observation.

t_2 = Time in days of subsequent observation.

x_1 = Severity of late leaf spot on first observation.

x_2 = Severity of late leaf spot on subsequent observation.

On the basis of this screening and earlier report, ten resistant and two susceptible genotypes were chosen for intensive screening against leaf spot disease in glass house under controlled condition. Under glasshouse conditions, the plastic pots (size 22.5 cm × 22.5 cm) were filled by using sterilized mixture of soil, sand and compost (2:1:1). Five seeds were sown in each pot. After emergence, three healthy seedlings per pot were maintained.

The potted plants (30 days old) were sprayed with inoculum with a standard conidial suspension (20,000 conidia per ml) of *C. personata*. The conidial suspension was sprayed by using small garden hand sprayer during evening hours for three successive days. The potted plants were covered with polythene bags to create high humidity. Control plant pots were kept isolated from these inoculated pots.

RESULTS AND DISCUSSION

The data from Table 2 revealed that among the 73 genotypes screened against leaf spot disease of groundnut under natural field conditions, 45 genotypes were found free from leaf spot infection, whereas 7 genotypes *viz*., TAG 24, ICG 7766, ICG 5636, ICG 3136, ICG 6388, ICG 6381 and ICG 5320 showed PDI less than 1% while 21 genotypes found PDI between 1 to 10% upto 70 days after sowing of the crop. This indicates that during flowering stage of the crop (upto 70 days after sowing of the crop), most of the genotypes were found free from leaf spot disease or showing PDI less than 10% . The PDI was increased during pod filling stage on word and reached highest at maturity.

Out of 73 groundnut genotypes, 10 genotypes *viz*., RHRG 6083, KDG 128, GPBD 4, ICGV 94118, ICGV 4983, ICG 12672, ICGV 13160, ICGV 13165, ICG 11426 and ICGV 8193 showed resistant and 33 genotypes *viz*., RHRG 1007, KDG 123, KDG 171, ICG 8760, ICG 11337, ICG 4492, ICG 2857, KDG 160, ICG 12625,KDG 178, ICG 13787, RHRG 6021, RHRG 6097, KDG 209, ICG 6519, ICG 3992, ICG 6552, ICG 6466, ICG 7766, ICG 5001, KDG 187, ICG 6421, ICG 6223 ICG 6323, ICG 5663, ICG 5618, ICG 4581, ICG 5052, ICG 6388, ICG 6330, ICG 3899, ICG 6080 and ICG 4975 showed the moderately resistance to leaf spot disease. The 25 genotypes showed the susceptibility and 5 genotypes *viz*., SB XI, JL 24, TAG 24, ICR 48 and R 8808 showed the highly susceptible reaction to the leaf spot disease at maturity of crops (Table 3). The leaf spot progress data and low apparent infection rates which brought out the fact that the type of resistance was not necrogenous or hypersensitive but partial type resistance (Nevill 1981). The reason behind leaf spot resistance may be due to the components of resistance to *C. personatum* in resistant groundnut genotypes and the resistant genotypes had longer

Table 1: The 1-9-point scale for field evaluation of late leaf spot of groundnut.

Disease score	Description	Severity (%)[1]
1	No disease	0
2	Lesions present largely on lower leaves; no defoliation	1-5
3	Lesions present largely on lower leaves, very few on middle leaves; defoliation of some leaflets evident on lower leaves	6-10
4	Lesions on lower and middle leaves but severe on lower leaves; defoliation of some leaflets evident on lower leaves	11-20
5	Lesions present on all lower and middle leaves; over 50% defoliation of lower leaves	21-30
6	Severe lesions on lower and middle leaves; lesions present but less severe on top leaves extensive defoliation of lower leaves; defoliation of some leaflets evident on middle leaves	31-40
7	Lesions on all leaves but less severe on top leaves; defoliation of all lower and some middle leaves	41-60
8	Defoliation of all lower and middle leaves; severe lesions on top leaves; some defoliation of top leaves evident	61-80
9	Almost all leaves defoliated, leaving bear sterns; some leaflets may remain, but show severe leaf spots	81-100

[1]Percentage leaf area damaged by the disease.

Table 2: Screening of groundnut genotypes for leaf spot disease in *kharif* 2015.

Sr. no.	Genotypes	PDI of leaf spot at							Grade	Category
		1	2	3	4	5	6	7		
		69 DAS	76 DAS	83 DAS	90 DAS	97 DAS	104 DAS	111 DAS		
1	SB XI	6.00	30.6	44.22	58.00	73.60	85.00	93.49	9	HS
2	JL 24	6.33	14.90	28.18	53.11	66.44	80.63	90.11	9	HS
3	RHRG 6083	0.00	0.40	6.3	7.5	11.11	16.33	19.9	3	R
4	RHRG 1007	0.00	3.11	7.11	12.00	20.00	32.33	50.44	5	MR
5	TAG 24	0.60	26.20	39.9	48.11	59.00	73.11	89.33	9	HS
6	JL 501	0.00	4.30	15.60	28.22	42.99	56.11	67.66	7	S
7	KDG 123	0.00	0.00	6.00	16.44	21.22	29.11	39.88	4	MR
8	KDG 171	0.00	0.00	3.11	11.11	22.66	31.31	40.88	4	MR
9	ICG 8760	0.00	1.11	3.11	12.11	25.33	32.50	40.00	4	MR
10	ICG 11337	0.00	0.00	5.00	15.44	20.00	27.17	37.31	4	MR
	SB XI	7.33	31.22	44.00	58.60	73.33	85.50	93.88	9	HS
11	ICG 4492	0.00	0.00	7.00	14.66	22.32	30.00	37.70	4	MR
12	ICG 5963	0.00	6.6	16.66	21.21	44.88	54.44	67.66	7	S
13	ICG 5610	0.00	5.00	16.33	22.00	45.00	52.22	67.11	7	S
14	ICG 2857	0.00	0.00	6.33	11.11	20.66	33.00	36.36	4	MR
15	ICG 6390	0.00	1.70	7.55	16.40	27.11	31.11	56.66	6	S
16	ICG 2186	0.00	5.30	19.11	29.29	35.66	55.88	69.11	7	S
17	KDG 128	0.00	0.00	1.20	4.00	16.66	20.36	22.60	3	R
18	GPBD 4	0.00	0.00	1.00	5.20	15.33	19.00	22.00	3	R
19	KDG 160	0.00	3.10	4.00	19.11	20.32	25.77	49.39	5	MR
20	ICGV 94118	0.00	0.00	0.00	1.32	2.22	7.33	12.12	2	R
	SB XI	7.33	31.22	44.00	58.60	73.33	85.50	93.88	9	HS
21	ICG 12625	0.00	0.00	2.11	11.11	22.66	39.77	48.88	5	MR
22	KDG 178	1.00	0.98	4.10	6.00	12.11	19.11	38.77	4	MR
23	RHRG 6110	0.00	2.22	9.33	20.50	29.29	59.55	68.55	7	S
24	ICG 13787	0.00	1.32	3.12	6.33	20.22	29.29	39.33	4	MR
25	RHRG 6021	0.00	2.60	7.55	21.11	31.11	36.00	46.18	4	MR
26	RHRG 6097	0.00	2.50	8.00	22.50	29.29	35.00	47.00	4	MR
27	KDG 209	0.00	0.00	0.30	1.22	12.12	22.50	37.33	4	MR
28	ICG 6519	0.00	5.30	10.66	20.18	27.11	42.32	56.22	5	MR
29	ICG 6357	0.00	4.90	16.99	30.15	44.99	52.00	69.59	7	S

Table 2: Continue...

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30	ICG 3294	1.00	5.20	17.12	22.39	45.00	66.56	71.61	7	S
	SB XI	7.33	31.22	44.00	58.60	73.33	85.50	93.88	9	HS
31	ICG 3992	1.22	4.11	8.00	20.12	35.35	40.44	51.86	5	MR
32	ICGV 4983	0.00	0.00	0.00	0.22	5.32	15.12	20.36	3	R
33	ICG 6552	0.00	6.11	9.12	23.00	30.33	39.39	52.00	5	MR
34	ICGV 350	5.30	11.00	16.80	31.31	40.44	55.00	72.70	7	S
35	ICR48	7.12	20.32	27.27	36.88	45.90	60.60	88.85	9	HS
36	ICG 6466	0.00	3.11	9.99	22.32	30.30	41.12	55.00	5	MR
37	ICG 7766	0.90	2.12	10.00	21.23	29.29	38.11	52.52	5	MR
38	ICG 5001	0.00	1.00	8.88	19.11	29.29	36.36	48.15	4	MR
39	R 8808	2.33	5.66	15.00	22.2	35.56	52.60	81.32	9	HS
40	KDG 187	0.00	3.0	16.00	28.18	31.11	46.46	52.85	5	MR
	SB XI	7.33	31.22	44.00	58.60	73.33	85.50	93.88	9	HS
41	ICG 6421	0.00	0.00	6.00	14.66	24.24	34.22	49.48	4	MR
42	ICG 5636	0.40	6.22	15.55	25.33	41.33	56.44	70.39	7	S
43	ICG 6223	0.00	3.00	12.88	23.23	31.67	39.11	52.85	5	MR
44	ICG 6323	0.00	0.00	0.60	12.66	25.25	29.00	41.74	4	MR
45	ICG 5663	0.00	5.30	10.66	27.11	32.00	42.22	48.48	4	MR
46	ICG 12672	0.00	0.00	0.00	0.6	8.50	18.18	23.23	3	R
47	ICG 5618	0.00	6.30	11.66	27.11	31.00	42.22	54.22	5	MR
48	ICGV 13160	0.00	0.00	0.00	0.60	11.11	15.00	19.12	2	R
49	ICG 5387	1.20	5.33	16.16	35.35	47.00	56.56	77.00	7	S
50	ICG 3136	0.07	3.11	5.77	18.00	43.11	53.12	67.60	7	S
	SB XI	7.33	31.22	44.00	58.60	73.33	85.50	93.88	9	HS
51	ICG 5240	0.00	4.90	16.99	44.99	58.22	65.11	70.39	7	S
52	ICGV 13165	0.00	0.00	0.01	1.20	10.2	17.11	22.20	3	R
53	ICG 4581	0.00	0.00	4.50	17.12	34.20	47.50	39.15	4	MR
54	ICG 6550	1.20	4.44	12.88	34.55	55.20	60.11	70.39	7	S
55	ICG 5310	1.50	6.22	18.00	28.0	62.55	68.33	75.18	7	S
56	ICG 6238	2.30	6.33	15.66	31.31	56.00	61.61	75.07	7	S
57	ICG 3585	0.00	3.60	12.00	25.30	35.66	50.33	70.39	7	S
58	ICG 5052	0.00	0.00	5.00	11.11	17.33	34.20	42.55	4	MR
59	ICG 6388	0.80	4.40	46.16	22.70	35.00	43.11	51.52	5	MR
60	ICG 6497	1.33	5.60	16.99	30.00	44.99	58.22	70.30	7	S
	SB XI	7.33	31.22	44.00	58.60	73.33	85.50	93.88	9	HS
61	ICG 3515	4.00	8.33	15.11	31.66	56.66	61.61	75.07	7	S
62	ICG 6487	2.30	4.60	12.00	25.30	35.60	50.22	70.38	7	S
63	ICG 2252	3.33	12.00	16.88	34.66	55.55	67.11	74.09	7	S
64	ICG 6381	0.99	6.33	17.17	32.40	41.11	51.10	63.00	6	S
65	ICG 11426	0.00	0.00	0.00	0.19	4.44	9.39	15.32	3	R
66	ICG 6330	1.22	6.33	11.11	27.22	35.35	42.22	52.00	5	MR
67	ICGV 8193	0.00	0.00	0.90	10.00	16.20	20.00	25.96	3	R
68	ICG 2320	5.00	11.60	18.00	25.30	38.33	50.50	66.00	6	S
69	ICG 6221	1.33	4.44	11.22	23.23	33.39	57.77	70.39	7	S
70	ICG 5320	0.32	5.80	14.40	22.70	33.11	43.11	59.26	6	S
	SB XI	7.33	31.22	44.00	58.60	73.33	85.50	93.88	9	HS
71	ICG 3899	0.00	1.20	5.30	14.66	28.00	30.32	43.20	4	MR
72	ICG 6080	1.20	4.33	10.66	27.11	36.36	42.22	51.85	5	MR
73	ICG 4975	1.33	8.30	13.80	16.16	22.33	34.38	38.19	4	MR
	SEm±	0.19	0.28	0.38	0.54	0.65	0.53	1.67	-	-
	CD at 5%	0.54	0.77	1.05	1.53	1.80	1.49	4.68	-	-

Table 3: Reaction of groundnut genotypes to leaf spot disease.

Sr. no	Scale	Reaction	No. of genotypes	Name of genotypes
1.	>3	Resistant	10	RHRG 6083, KDG 128, GPBD 4, ICGV 94118, ICGV 4983, ICG 12672, ICGV13160, ICGV 13165, ICG 11426 and ICGV 8193
2	4-5	Moderately Resistant	33	RHRG 1007, KDG 123, KDG 171, ICG 8760, ICG 11337, ICG 4492, ICG 2857, KDG 160, ICG 12625, KDG 178, ICG 13787, RHRG 6021, RHRG 6097, KDG 209, ICG 6519, ICG 3992, ICG 6552, ICG 6466, ICG 7766, ICG 5001, KDG 187, ICG 6421, ICG 6223 ICG 6323, ICG 5663, ICG 5618, ICG 4581, ICG 5052, ICG 6388, ICG 6330, ICG 3899, ICG 6080 and ICG 4975
3	6-7	Susceptible	25	JL 501, ICG 5963, ICG 5610, ICG 6390, ICG 2186, RHRG 6110, ICG 6357, ICG 3294, ICGV 350,ICG 5636, ICG 5387, ICG 5240, ICG 6550, ICG 6238, ICG 3585, ICG 6497, ICG 3515, ICG 6487, ICG 2252, ICG 6381, ICG 2320, ICG 6221, ICG 5320, ICG 3136 and ICG 5310
4	8-9	Highly susceptible	05	SB XI, JL 24, TAG 24, ICR 48 and R 8808

Table 4: Severity and infection rate of late leaf spot in some genotypes of groundnut in artificial inoculation under pot condition.

Sr. no.	Genotypes	LLS severity % days after planting					Infection rate (r)
		40	50	60	70	80	units/day
1	RHRG 6083	10.33 (18.63)	16.88 (24.20)	25.44 (30.20)	29.89 (32.94)	31.33 (34.01)	0.025
2	KDG 128	10.33 (18.38)	14.66 (22.50)	25.67 (30.43)	22.22 (28.11)	33.33 (35.24)	0.027
3	GPBD 4	10.33 (18.74)	14.66 (22.43)	23.33 (28.82)	30.11 (33.02)	33.33 (35.01)	0.027
4	ICGV 94118	10.33 (18.56)	14.66 (22.41)	24.44 (29.61)	29.89 (33.01)	31.33 (34.03)	0.025
5	ICGV 4983	10.33 (18.59)	23.33 (28.82)	27.67 (31.72)	30.11 (33.28)	33.33 (35.25)	0.027
6	ICG 12672	10.33 (18.33)	15.56 (23.22)	17.78 (24.86)	22.22 (27.86)	31.11 (33.89)	0.025
7	ICG 13160	10.33 (18.12)	11.11 (19.42)	14.56 (22.33)	18.78 (25.36)	23.44 (28.92)	0.019
8	ICG 13165	10.33 (18.48)	12.33 (20.50)	16.66 (23.95)	20.00 (26.26)	27.57 (31.60)	0.021
9	ICG 11426	10.33 (18.71)	13.33 (21.40)	23.33 (28.82)	24.22 (29.39)	33.11 (35.10)	0.027
10	ICGV 8193	10.33 (18.65)	17.00 (24.33)	24.11 (29.35)	31.11 (33.66)	33.33 (35.25)	0.027
11	JL 24	10.33 (18.74)	29.99 (33.20)	51.11 (45.64)	73.00 (59.57)	86.67 (69.02)	0.052
12	SB XI	13.33 (21.41)	30.11 (33.26)	60.00 (50.79)	75.56 (60.74)	88.89 (70.84)	0.048
	SEm±	1.94	1.18	1.41	1.94	1.83	-
	CD at 5%	NS	3.46	4.13	5.70	5.37	-

•Figures in parentheses indicates arc sin transformed values.

latent periods, reduced sporulation and less defoliation. This type of resistance was similar to that of found in the slow-rusting reaction known in groundnut and cereal rusts (Hasabnis, 1998 and Dwivedi, 2002). Because of the reduced infection rate in the resistant cultivars used in the present investigation, it can be considered as partial resistance which has been so reported earlier by Kolte, (1985), Mendez-Natera *et al*. (2016) and Khute *et al*. (2018).

On the basis of these screening and earlier reports, ten resistant and two susceptible genotypes were chosen for intensive screening against leaf spot disease under pot condition. The data obtained on leaf spot disease severity and rate of infection are given in the Table 4.

The results from field screening and pot culture revealed that resistant cultivated genotypes such as RHRG 6083, KDG 128, GPBD 4, ICGV 94118, ICGV 4983, ICG 12672, ICG 11426 and ICGV 8193 had shown very slow leaf spot disease progress as against high rate of disease progress in the susceptible, JL 24 and SB XI cultivars. From the results it is also evident that absolute resistance or immunity in cultivated genotypes is not available but high degree of resistance was available in many groundnut lines. The level of leaf spot disease resistance was similar to that found in slow rusting type reaction of the cereal crops. While, two wild species *i.e.* ICGV 13160 (*Arachis batizocoi)*, ICGV 13165(*A. cardenasi*) showed high resistance.

Ten resistant and two susceptible genotypes were subjected to glass house inoculations under controlled conditions and sequence of events leading to late leaf spot appearance on the leaves of the same age was examined.

The time sequence of morphological symptom development on the resistant and susceptible genotypes was studied. It was observed that minute chlorotic spots became visible after nine to ten days on the susceptible leaves (Table 5). However, till 14-19 days, the spots were not seen on the leaves of the resistant genotypes. The chlorotic lesion turns brown within 48 hours in SB XI but took more than three to four days in resistant genotypes. The clear dark brown lesion

Table 5: Time sequence of morphological symptoms development in LLS resistant and susceptible groundnut genotypes under glasshouse conditions.

Visible symptoms	Time (days) after inoculation										
	RHRG 6083	KDG 128	GPBD 4	ICGV 94118*	ICG 4983	ICG 12672*	ICG 13160*	ICG 13165*	ICG 11426*	ICG 18193*	JL-24	SB-XI
Minute chlorotic spots	16	17	15	17	19	19	19	20	18	19	10	11
Brown lesion	18	19	18	20	23	22	25	25	22	23	13	13
Mature black lesion	22	22	23	25	27	26	28	29	28	28	17	16
Roughness of lesion on lower surface	29	29	31	34	**	**	**	**	**	**	21	21

*- Mature lesion was light brown for longer time with sight yellow halo around the lesion.

**- Intense roughness not observed.

with black dense colour on the under surface, a characteristics of late leaf spot, appeared 15 to 16 days after inoculation on susceptible genotypes while it took nearly 21 to 28 days on the resistant genotypes. The roughness of lesions due to heavy sporulation was evident on 20 days after inoculation in both JL 24 and SB XI but was less evident on resistant genotypes except RHRG 6083, KDG 128, GPBD 4 and ICGV 94118 till 28, 28, 30 and 33 days, respectively. Slightly yellow halo was visible around small mature lesions on the resistant genotypes but it was absent in JL 24 and SB XI. Screening of germplasm and other advanced breeding lines were done at several places for these diseases, systematic screening especially of the germplasm was rather less. 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). It was observed that out of the 13,000 germplasms screened, 54 lines were found resistant to late leaf spot. Gopal *et al.* (1984) evaluated six genotypes and four susceptible controls (Girnar 1, JL 24, TMV 2 and KRG 1) for LLS and rust resistance. R 8972 was most resistant to LLS and rust, with scores of 3.0 and 2.5, respectively in 1-9 scale. R 8972 served as donor parent in hybridization embarked upon with JL 24, TMV 2 and KRG 1 to evolve disease resistant, high yielding cultivars. Similar type of work was also reported by Subramanyam *et al.* (1980); Earnshaw *et al.* (1992), Huq *et al.* (1996), Jiang *et al.* (1998), Pensuk *et al.* (2003), Hossain *et al.* (2007) Dey *et al.* (2016), in black gram (Priyanka *et al*. 2018).

CONCLUSION

With these studies 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.

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