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Rajanna B
AICRP on Groundnut, Main Agricultural Research Station, University of Agricultural Sciences, Raichur, Karnataka, India

Divya K
Department of Genetics and Plant Breeding, College of Agriculture, University of Agricultural Sciences, Raichur, Karnataka, India

Lokesh GY
Department of Genetics and Plant Breeding, College of Agriculture, University of Agricultural Sciences, Raichur, Karnataka, India

Shivakumar K
AICRP on Linseed, Main Agricultural Research Station, University of Agricultural Sciences, Raichur, Karnataka, India

Sreedevi S Chavan
Department of Plant Pathology, College of Agriculture, University of Agricultural Sciences, Raichur, Karnataka, India

Corresponding Author:
Rajanna B
AICRP on Groundnut, Main Agricultural Research Station, University of Agricultural Sciences, Raichur, Karnataka, India

Screening of groundnut germplasm for resistance to late leaf spot disease

Rajanna B, Divya K, Lokesh GY, Shivakumar K and Sreedevi S Chavan

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Abstract
A set of 105 peanut germplasm were evaluated against late leaf spot during *kharif* 2021 at Main Agricultural Research Station, University of Agricultural Sciences, Raichur. The experiment was laid out in Augmented random block design. Data on LLS disease severity was collected using modified 1 to 9 point scale at 65, 85 and 105 days after sowing (DAS). Study revealed that, none of the genotype showed resistant reaction, 12 genotypes were moderate resistant, 40 genotypes were susceptible and 53 genotypes were found to be highly susceptible to LLS.

Keywords: Resistance, late leaf spot, peanut

Introduction
Groundnut (*Arachis hypogaea* L.) is self-pollinated, allotetraploid annual legume with chromosome number 2n = 4X = 40 and genome size of 2800 Mb/1C derived from natural hybridization between two diploid wild species *A. duranensis* (A genome) and *A. ipaensis* (B genome) followed by polyploidization. Groundnut is the sixth most important oilseed crop in the world and grown for oil (45-53%) and digestable protein (25-30%) across the globe.

In groundnut, several biotic and abiotic factors including diseases and pests, erratic rainfall, drought, poor soil conditions, market instability and lack of locally adapted high-yielding varieties may be reasons for this low level of productivity in India (Narh *et al.*, 2014) [13]. Groundnut yield is restricted because of foliar fungal diseases in most areas of the globe. Late leaf spot [*Phaeoisariopsis personata* (Berk. and Curt.) Deighton] and rust (*Puccinia arachidis*) are the most damaging, widely spread and economically significant foliar diseases of the groundnut, inflicting serious damage to the crop (Mc Donald *et al.*, 1985) [11]. They can collectively lower yield by 50-70 *per cent* (Subrahmanyam *et al.*, 1984) [18] depending on the stage of plant.

Late leaf spot are characterized by dark brown to black spots and usually do not have yellow halo. Most of the late leaf spot spores are formed on the lower surface giving it a rough and tufted appearance, whereas upper leaf surface is generally smooth. Leaf spot can cause yield losses up to 50 percent worldwide. In India, losses in yield due to leaf spot have been estimated to be in the range of 15-59 percent. (Tshilenge *et al*., 2012) [20].

However, efforts have been undertaken to control leaf spot diseases using a combination of cultural and chemical measures, but with limited success (Page *et al.*, 2002) [14]. The cultural practices such as crop rotation, removal, burning and burying of crop residues after harvest, removal of volunteer groundnut plants, deep turning of crop debris are seldom applied for a variety of reasons by small-scale farmers, such as insufficient land size, lack of information especially in carrying out crop rotation and labor intensiveness.

Use of host plant resistance is most efficient and cost-effective viable management option for resource limited farming systems in developing countries. Furthermore, the quantitative inheritance of LLS disease resistance has been described in several research (Khedikar *et al.*, 2010; Dwivedi *et al.*, 2002; Motagi *et al.*, 2001) [10, 7, 12] suggesting that the inheritance of LLS resistance is rather complicated making direct selection for LLS disease resistance problematic.

Materials and Methods

Screening of groundnut germplasm against late leaf spot (LLS) under field condition

Total 100 germplasm lines along with five checks were screened for LLS during *Kharif* 2021. Visual screening with modified 1-9 point scale as given by Subrahmanyam *et al.* (1995) [19] was used for screening of genotypes for late leaf spot disease. The visual scores (1-9) and extent of leaf area destroyed (0-100%) are linearly related to each other. The field disease scores were mainly based on the extent of leaf area damage. Late leaf spot disease reaction was categorized based on severity. Eight plants from each line were randomly selected and response of germplasm on disease severity of LLS was scored at 65, 85 and 105 DAS. Susceptible checks were sown after every twenty rows of test germplasm lines.

Resistant/moderate resistant checks: K-1812, Dh 256, R-8808, K-9

Susceptible check: TMV-2

Results and Discussion

Diseases are the most important biotic stress that reduces the productivity of the crop plants. In groundnut late leaf spot is the most important disease that cause economic yield loss. This study was conducted to screen 105 germplasm under field condition for late leafspot disease during *Kharif* 2021-22. Germplasm were evaluated for late leaf spot by using modified 9-point scale which was given by Subrahmanyam *et al*., 1995 [19]. Scoring of disease was done based on severity. Grouping of germplasm lines based on their reaction against late leaf spot in groundnut under field condition is presented in Table 2 and fig 1.

Earlier researchers (Hossain *et al*., 2007; Subrahmanayam *et al*., 1982; Coffelt and Porter, 1986; Chaudhary, 1988; Waliyar *et al*., 1988; Dinakaran *et al*., 1992; Ghewande *et al*., 1992; Anderson *et al*., 1993; Waliyar *et al*., 1993; Bhat *et al*., 1995; Dubey *et al*., 1995; Rao *et al*., 1995) [9, 17, 4, 3, 21, 5, 22, 2, 6, 15] also attempted to screen groundnut genotypes for late leaf spot.

Among the 105 germplasm lines screened, none of the genotype showed resistant reaction (rating 0-3), twelve genotypes showed moderate resistance reaction (rating 4-5), forty genotypes showed susceptible reaction (rating 6-7) and fifty three genotypes were found to be highly susceptible (rating 8-9). Saleh and Trustinah (1996) [16] earlier reported that none of the genotypes were resistant to the late leaf spot disease.

The further conformance should be done with the artificial screening for the disease to identify the stable genotypes for disease reaction.

Table 1: Disease scoring of late leaf spot of groundnut at 65, 85 and 105 DAS

Sl. No.	Germplasm	LLS scoring @ 65 DAS	LLS scoring @ 85 DAS	LLS scoring @ 105 DAS
1	K 1812	2	3	6
2	Dh 256	2	3	6
3	R-8808	3	5	6
4	K-9	3	5	7
5	TMV 2	5	7	9
6	NRCG-CS-642	3	3	4
7	NRCG-CS-644	3	5	6
8	NRCG-CS-640	2	5	7
9	NRCG-CS-641	2	3	4
10	NRCG-CS-636	2	5	7
11	NRCG-CS-648	4	7	9
12	NRCG-CS-645	3	6	7
13	NRCG-CS-649	2	4	5
14	NRCG-CS-646	1	5	6
15	ISK-I-2021-1	1	3	6
16	NRCG-CS-635	2	4	6
17	NRCG-CS-647	3	5	7
18	NRCG-CS-643	2	5	8
19	NRCG-CS-638	2	4	6
20	TG-91	3	6	8
21	ISK-I-2021-7	1	3	6
22	TG-93	4	5	7
23	TG-94	4	5	8
24	TG-86	3	5	7
25	TG-87	2	6	9
26	TG-75	4	5	8
27	TG-88	2	6	9
28	TG-89	3	5	8
29	NRCG-HFS (SB) – 07	3	5	8
30	NRCG-HFS (SB) – 46	2	5	7
31	NRCG-HFS (SB) –77	3	5	8
32	NRCG-HFS (SB) –58	3	5	7
33	NRCG-HFS (SB) –47	3	4	6
34	NRCG-HFS (SB) –61	3	6	8
35	NRCG-HFS (SB) –21	4	7	9
36	NRCG-HFS (SB) –54	2	5	7
37	NRCG-HFS (SB) –18	3	6	9
38	NRCG-HFS (SB) –66	2	5	8

39	NRCG-HFS (SB) –78	3	5	8
40	NRCG-HFS (SB) –9	2	5	7
41	NRCG-HFS (SB) –82	3	6	9
42	NRCG-HFS (SB) –51	2	4	7
43	NRCG-HFS (SB) –38	2	4	7
44	NRCG-HFS (SB) –25	1	4	7
45	NRCG-HFS (SB) –81	3	6	9
46	NRCG-HFS (SB) –45	4	6	9
47	NRCG-HFS (SB) –80	4	6	8
48	NRCG-HFS (SB) –06	3	5	8
49	NRCG-HFS (SB) –17	1	5	8
50	NRCG-HFS (SB) –72	2	5	7
51	NRCG-HFS (SB) –107	2	4	7
52	NRCG-HFS (SB) –124	1	4	6
53	NRCG-HFS (VB) –43	2	6	8
54	NRCG-HFS (VB) –70	2	5	8
55	NRCG-HFS (VB) –103	2	4	7
56	NRCG-HFS (VB) –59	2	5	7
57	NRCG-HFS (VB) –44	2	5	8
58	NRCG-HFS (VB) –111	2	4	7
59	NRCG-HFS (VB) –15	4	7	9
60	NRCG-HFS (VB) –19	4	6	8
61	NRCG-HFS (VB) –01	4	5	7
62	NRCG-HFS (VB) –26	4	5	7
63	NRCG-HFS (VB) –29	2	4	7
64	NRCG-HFS (VB) –88	2	4	6
65	NRCG-HFS (VB) –128	1	4	6
66	NRCG-HFS (VB) –57	3	4	6
67	NRCG-HFS (VB) –62	2	4	5
68	NRCG-HFS (VB) –34	2	3	5
69	NRCG-HFS (VB) –86	3	4	5
70	NRCG-HFS (VB) –27	2	4	7
71	NRCG-HFS (VB) –90	2	4	6
72	NRCG-HFS (VB) –11	3	5	8
73	NRCG-HFS (VB) –40	2	5	8
74	NRCG-HFS (VB) –85	2	5	8
75	NRCG-HFS (VB) –64	3	5	8
76	NRCG-HFS (VB) –55	3	4	7
77	NRCG-HFS (VB) –50	3	5	6
78	NRCG-HFS (VB) –28	4	6	9
79	NRCG-HFS (VB) –05	4	7	9
80	NRCG-HFS (VB) –30	5	7	8
81	NRCG-HFS (VB) –53	4	5	6
82	NRCG-HFS (VB) –101	2	4	5
83	NRCG-HFS (VB) –37	3	5	6
84	NRCG-HFS (VB) –75	4	7	9
85	NRCG-HFS (VB) –76	4	6	8
86	NRCG-HFS (VB) –04	4	6	8
87	NRCG-HFS (VB) –03	4	5	7
88	NRCG-HFS (VB) –118	2	4	5
89	NRCG-HFS (VB) –42	2	3	5
90	NRCG-HFS (VB) –108	3	4	7
91	NRCG-HFS (VB) –08	2	5	7
92	NRCG-HFS (VB) –79	4	6	8
93	NRCG-HFS (VB) –117	2	4	7
94	NRCG-HFS (VB) –02	3	5	7
95	NRCG-HFS (VB) –350	3	5	6
96	NRCG-HFS (VB) –60	3	4	5
97	NRCG-HFS (VB) –48	3	4	5
98	NRCG-HFS (VB) –63	3	5	7
99	NRCG-HFS (VB) –109	1	5	7
100	NRCG-HFS (VB) –14	4	5	8
101	NRCG-HFS (VB) –39	3	5	7
102	NRCG-HFS (VB) –67	2	5	7
103	ISK-I-2021-3	2	4	6
104	NRCG-HFS (VB) –52	3	4	5
105	NRCG-HFS (VB) –36	2	5	8

Table 2: Grouping of germplasm lines based on the reaction against late leaf spot of groundnut

Rating	Reaction	Genotype
0-3	Resistant	No Genotypes were resistant
4-5	Moderate resistance	NRCG-CS-642, NRCG-HFS (VB) –62, NRCG-CS-641, NRCG-CS-649, NRCG-HFS (VB) –34, NRCG-HFS (VB) –86, NRCG-HFS (VB) –101, NRCG-HFS (VB) –118, NRCG-HFS (VB) –42, NRCG-HFS (VB) –60, NRCG-HFS (VB) –48, NRCG-HFS (VB) –52
6-7	Susceptible	K-1812, Dh256, R 8808, K-9, NRCG-CS-644, NRCG-CS-640, NRCG-CS-636, NRCG-CS-645, NRCG-CS-646, ISK-I-2021-1, NRCG-CS-635, NRCG-CS-647, NRCG-CS-638, ISK-I-2021-7, TG-93, TG-86, NRCG-HFS (SB) – 46, NRCG-HFS (SB) –58, NRCG-HFS (SB) –47, NRCG-HFS (SB) –54, NRCG-HFS (SB) –9, NRCG-HFS (SB) –51, NRCG-HFS (SB) –38, NRCG-HFS (SB) –25, NRCG-HFS (SB) –72, NRCG-HFS (SB) –107, NRCG-HFS (SB) –124, NRCG-HFS (VB) –103, NRCG-HFS (VB) –59, NRCG-HFS (VB) –111, NRCG-HFS (VB) –01, NRCG-HFS (VB) –26, NRCG-HFS (VB) –29, NRCG-HFS (VB) –88, NRCG-HFS (VB) –128, NRCG-HFS (VB) –57, NRCG-HFS (VB) –27, NRCG-HFS (VB) –90, NRCG-HFS (VB) –55, NRCG-HFS (VB) –50, NRCG-HFS (VB) –53, NRCG-HFS (VB) –37, NRCG-HFS (VB) –03, NRCG-HFS (VB) –108, NRCG-HFS (VB) –08, NRCG-HFS (VB) –117, NRCG-HFS (VB) –02, NRCG-HFS (VB) –350, NRCG-HFS (VB) –63, NRCG-HFS (VB) –109, NRCG-HFS (VB) –39, NRCG-HFS (VB) –67, ISK-I-2021-3
8-9	Highly susceptible	TMV-2, NRCG-CS-648, NRCG-CS-643, TG-91, TG-94, TG-87, TG-75, TG-88, TG-89, NRCG-HFS (SB) – 07, NRCG-HFS (SB) –77, NRCG-HFS (SB) –61, NRCG-HFS (SB) –21, NRCG-HFS (SB) –18, NRCG-HFS (SB) –66, NRCG-HFS (SB) –78, NRCG-HFS (SB) –82, NRCG-HFS (SB) –81, NRCG-HFS (SB) –45, NRCG-HFS (SB) –80, NRCG-HFS (SB) –06, NRCG-HFS (SB) –17, NRCG-HFS (VB) –43, NRCG-HFS (VB) –70, NRCG-HFS (VB) –44, NRCG-HFS (VB) –15, NRCG-HFS (VB) –19, NRCG-HFS (VB) –11, NRCG-HFS (VB) –40, NRCG-HFS (VB) –85, NRCG-HFS (VB) –64, NRCG-HFS (VB) –28, NRCG-HFS (VB) –05, NRCG-HFS (VB) –30, NRCG-HFS (VB) –75, NRCG-HFS (VB) –76, NRCG-HFS (VB) –04, NRCG-HFS (VB) –79, NRCG-HFS (VB) –14, NRCG-HFS (VB) –36

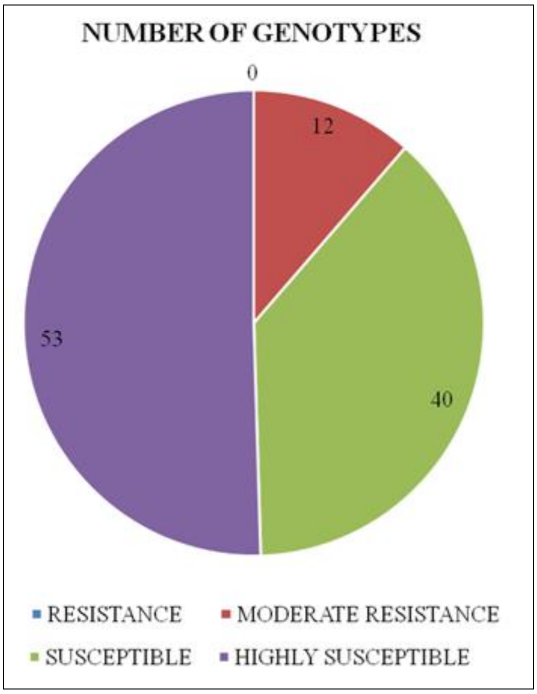

Fig 1: Number of genotypes with different reaction towards late leaf spot in groundnut

Conclusion

This study evaluated 105 groundnut germplasm lines for resistance to late leaf spot disease. None of the genotypes showed complete resistance. Twelve genotypes exhibited moderate resistance, while 40 were susceptible and 53 were highly susceptible. These findings highlight the need for continued screening and breeding efforts to identify and develop groundnut varieties with improved resistance to late leaf spot, ensuring better yield and disease management in groundnut cultivation. Future research should focus on artificial screening techniques to confirm disease resistance and enhance the development of stable, high-yielding varieties.

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