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Research Article

Phenotypic screening of introgressed lines (Ils) for resistance to late leaf spot and rust diseases in groundnut (*Arachis hypogaea* L.)

N. Ramya selvi[1], PL.Viswanathan[1*], S. Manonmani[1], L. Rajendran[2] and S. Sundravadana[3]
[1]Department of Oilseeds, Centre for Plant Breeding and Genetics, TNAU, Coimbatore -641 003, Tamil Nadu, India
[2]Department of Plant Pathology, Centre for Plant Protection Studies, TNAU, Coimbatore - 641 003, Tamil Nadu, India
[3]Coconut Research Station, TNAU, Aliyar Nagar, Coimbatore – 642 101, Tamil Nadu, India
[*]**E-Mail**: palavisu@gmail.com

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Abstract
Groundnut is highly prone to foliar diseases and causes significant yield losses. To prevent the yield losses in groundnut, breeding resistant variety is an ideal way of managing the foliar diseases over chemical control considering the additional cost and ecological safety. Hence, an attempt has been made to screen the resistant genotypes from seventy five ILs for late leaf spot and rust. Genotypes were sown at two locations namely Department of Oilseeds, Centre for Plant Breeding and Genetics, TNAU, Coimbatore and Coconut Research Station, TNAU, Aliyar Nagar during kharif season, 2018. Fifteen genotypes were showed resistant (1-3) reaction for both late leaf spot and rust with the score range of 1 – 2.9 in both the locations. Two genotypes *viz.,* COG 17007 and COG 17030 showed resistance to both LLS and rust when compared to all check varieties, while significant increase for the productivity traits over parents and check varieties. Multi-location field evaluation of these ILs for the productivity may be lead to release of improved variety.

Keywords
Groundnut, Field screening, Hotspot areas, Resistance

Introduction

Groundnut (*Arachis hypogaea* L.) *Arachis* (derived from the Greek "*arachos*" meaning a weed) *hypogaea* (meaning an underground chamber) chromosome no.2n=4x=40 with two genomes, A and B and also known as groundnut, is an important annual legume in the world mainly grown for its oil content, green manure, food and animal feed (Pande *et al*., 2003) and Upadhyaya *et al*., 2006). It also play a major role in improves soil health by fixing atmospheric nitrogen. It is believed to be the native of Brazil to Peru, Argentina and Ghana. It was introduced into India during the first half of the sixteenth century from one of the Pacific islands of China. The total groundnut production in the world during the year 2016 -17 was 37.1 million MT from 26.4 million hectares with an average productivity of 1400kg/ha according to **IOPEPC (2017),** of which India is a world leader in groundnut farming, with 5.22 million hectares of cultivated area with the production of 7.56 million tones according to **DAC and FW (2016 - 17).** Owing to its nutritional composition, it has Oil content (43-54%), digestible proteins (22-30%), vitamins (E, K and B group), minerals (P, Ca, Mg and K) and phytosterols. Apart from edible groundnut India also in a position to supply blanched groundnut, roasted groundnut, roasted and salted groundnut, dry roasted groundnut and variety of groundnut based products (APEDA). It plays a major role in bridging the vegetable oil deficit in the country.

Several biotic and abiotic constraints limit the quantity and quality of the groundnut. Majority of the commercially grown varieties belongs to Spanish bunch types (*Arachis hypogaea* ssp. *fastigiata*), and they are highly susceptible to foliar diseases namely, rust caused by *Puccinia arachidis* and late leaf spot (LLS) caused by *Cercosporodicola personata*. Late Leaf Spots are formed under lower surface characterized by dark brown to black spots. Rust is characterized by Orange red or brown pustules (Urediospores) on lower surface of the leaves. Later, it became cinnamon brown with maturity. Co-occurrence of LLS and rust can cause yield loss up to 70% in India (Subrahmanyam *et al*., 1985). Recognition of potential genotypes tolerant to foliar diseases and simultaneously higher production would benefit the farmers and breeders for sowing or breeding proper variety. Utilization of tolerant and resistant cultivar not only to prevent the yield losses caused by diseases and also reduce the production cost, environmental hazards related to fungicide spraying. By keeping view of these above facts, the present study was designed to evaluate the groundnut genotypes for identification of resistance lines to late leaf spot (LLS) and rust diseases.

Materials and Methods

Seventy five introgression lines (ICGV 17001 to ICGV 17075) along with five checks *viz.,* CO 7, VRI 8, TMV (Gn) 13, TMV 14 and ICGV07222 were used in this study. Screening for LLS and rust diseases was carried out at two locations *viz.*, Department of Oilseeds, Coimbatore located in the Latitude and Longitude of 11°02'S and 76°92'W respectively and Coconut Research Station, Aliyar Nagar (Hotspot area) located in the Latitude and Longitude of 10°48'S and 76°97'W respectively which is the most favourable condition for LLS and rust disease development. Aliyar Nagar is considered as endemic for LLS and rust disease where disease occurs throughout the year and is maximum at *kharif* season (Vindhiyavarman *et al.* 1993). All the seventy five ILs were planted in a field using Randomized Complete Block Design (RCBD) with two replications during *kharif* 2018. Each genotype was planted in 4 rows of 4m length with adopting a spacing of 30 x 10cm. Checks were planted along with advanced breeding materials. Evaluation of level resistance to both LLS and rust were done on each entries at 90 days after sowing (DAS) by using Modified 9-Point scale proposed by Subrahmanyam *et al*., (1995). It was based on score as follows: 1 - highly resistant, 1 - 3 = resistant, 4 - 5 = moderately resistant, 6 - 7 = susceptible, 8 - 9 = highly susceptible given by ICRISAT (1995).

Results and Discussion

The mean value of foliar fungal diseases (LLS and rust) scores, pod yield per plant, kernel yield per plant, oil content for seventy five genotypes with five checks over two locations are shown in the Table 1.

Among 75 ILs, fifteen genotypes COG 17001, COG 17004, COG 17007, COG 17008, COG 17009, COG 17018, COG 17030, COG 17031, COG 17032, COG 17033, COG 17034, COG 17035, COG 17036, COG 17037 and COG 17063 were showed immune reaction to late leaf spot with the score range of 1.6 to 2.9 in Coimbatore and 1.4 to 2.9 in Aliyar Nagar. Similar results have been reported earlier by Ishu kumar khute *et al*., (2018); Gaikpa *et al*., (2015).Visual field disease score for rust were taken in which fifty five genotypes including above fifteen genotypes (immune to LLS) were showed resistance reaction for rust with the score range of 1.1 to 2.9 in Coimbatore and 1 to 2.9 in Aliyar Nagar. The level resistance was confirmed by Chaudhari *et al.* (2017); Chaudhari and Sunil, (2017); Paratwagh and Bhat, (2015).

Pod yield per plant, kernel yield per plant and oil content were also recorded for all the genotypes. The genotypes COG 17001, COG 17002, COG 17007, COG 17008, COG 17012, COG 17013, COG 17024, COG 17025, COG 17041, COG 17058, COG 17059 and COG 17068 had high mean range (40 – 66g) for pod yield per plant. Genotypes COG 17006, COG 17011, COG 17021, COG 17038, COG 17044, COG 17046, COG 17057, COG 17060, COG 17061, COG 17062 and COG 17071 had moderate mean range (35 – 40g) and remaining genotypes had low mean range (22 – 34g). This result was supported by Gaikpa *et al*. (2015); Narasimhulu *et al*. (2012). With respect to kernel yield per plant, the genotypes COG 17001, COG 17002, COG 17008, COG 17024, COG 17058, COG 17059 and COG 17068 had high mean range (30 – 60g). Genotypes COG 17006, COG 17007, COG 17012, COG 17013, COG 17021, COG 17025, COG 17038, COG 17048, COG 17055, COG 17057, COG 17061, COG 17062, COG 17066 and COG 17071 had moderate mean range (25 – 30g). Remaining genotypes had low mean range for kernel yield per plant with the range of 16 – 25g. This finding was confirmed by Narasimhulu *et al*. (2012). With regard to oil content, nine genotypes *viz.*, COG 17004, COG 17005, COG 17007, COG 17008, COG 17016, COG 17048, COG 17052, COG 17053 and COG 17068 had high mean oil content of 51 – 52%. The remaining genotypes had moderate mean oil content of 44 – 50% were recorded. Rathod and Toprope, (2018) asserted same findings in groundnut.

From seventy five genotypes, COG 17008 had high mean range for pod yield per plant (41.8g), kernel yield per plant (30.4g) and oil content (52.1%) and low mean range for late leaf spot (2.5 and 2.6) and rust (1.3 and 1). The genotypes COG 17058 and COG 17059 had high pod yield per plant (44.9g), kernel yield per plant (32.7g) with moderate oil content (46.9%) moderate mean range for late leaf spot (3.8 and 3.8) and low mean range for rust (1.3 and 1). Genotype COG 17007 was recorded with high pod yield per plant (42.4g), high oil content (51.2%), moderate kernel yield per plant (28.2g), low disease score for late leaf spot (1.6 and 1.4) and low disease score (1.3 and 1.4) for rust. the selected genotypes are comparable with checks for disease resistance. From this, COG 17007 and COG 17030 were superior to the all five checks.

Results of correlation analysis among the traits under studied are presented in Table.2. Agronomic yield contributing traits *viz.*, pod yield per plant and kernel yield per plant showed non significant negative correlation with foliar diseases (Table 2). This result was supported by Rathod and Toprope, (2018); Gaikpa *et al*. (2015); Paratwagh and Bhat, (2015); Shoba *et al*. (2012). From this result, we would confer non resistant genotypes are prone to

foliar diseases and cause yield losses but not quality of the produce. According to these criterions, selected genotypes are considered to be suitable for multi location trial or else it will be used as parents in hybridization programme for developing high yielding foliar disease resistance varieties.

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Table1. Mean values of characters over two locations (Coimbatore and Aliyar Nagar)

S. No.	Genotypes	PYP (g)	KYP (g)	OC (%)	Disease score (Coimbatore)		Disease score (Aliyar Nagar)	
					LLS	RUST	LLS	RUST
1	COG17001	66.4	49.8	45.6	2.8	1.8	1.6	1.0
2	COG17002	46.7	30.2	50.0	3.4	1.1	3.8	1.0
3	COG17003	32.4	22.1	48.4	3.4	1.5	4.4	1.9
4	COG17004	26.6	17.5	51.5	2.3	1.5	1.6	1.0
5	COG17005	33.8	24.1	52.0	3.6	2.3	3.1	1.0
6	COG17006	38.8	25.3	49.0	3.4	1.5	3.6	1.6
7	COG17007	42.4	28.2	51.2	1.6	1.3	1.4	1.4
8	COG17008	41.8	30.4	52.1	2.5	1.3	2.6	1.0
9	COG17009	28.1	20.0	48.6	2.6	1.8	3.1	1.0
10	COG17010	31.8	18.7	50.1	4.0	2.5	3.3	1.6
11	COG17011	39.4	23.3	50.9	3.8	3.3	4.5	3.5
12	COG17012	44.7	26.5	49.1	3.9	1.4	3.2	1.3
13	COG17013	54.9	27.9	45.8	4.0	2.6	4.6	3.4
14	COG17014	27.6	19.4	48.2	4.1	2.3	5.8	3.2
15	COG17015	25.0	17.0	47.1	3.1	1.4	4.1	1.3
16	COG17016	26.8	18.9	51.1	2.9	2.0	3.6	2.7
17	COG17017	28.0	20.4	48.8	3.5	2.8	3.9	2.9
18	COG17018	24.1	18.1	50.2	2.9	2.9	2.9	2.4
19	COG17019	30.9	20.1	49.3	4.5	2.4	5.5	1.4
20	COG17020	25.9	18.7	50.6	4.4	3.5	5.4	3.5
21	COG17021	38.7	24.5	45.8	3.6	1.9	2.8	1.3
22	COG17022	32.3	23.0	47.7	4.1	1.6	5.6	1.5
23	COG17023	22.7	16.6	47.4	3.9	3.1	4.8	4.4
24	COG17024	47.5	34.1	47.7	4.4	1.6	3.8	1.2
25	COG17025	40.5	28.2	47.8	3.6	1.4	1.8	1.0
26	COG17026	33.6	19.6	50.3	5.0	4.4	5.1	5.0
27	COG17027	27.0	17.8	47.0	2.8	1.3	4.7	1.0
28	COG17028	24.5	19.4	44.6	3.9	1.4	5.4	1.0
29	COG17029	26.9	16.2	47.0	3.1	1.4	3.3	1.0
30	COG17030	30.7	21.1	46.6	2.3	1.1	1.8	1.0
31	COG17031	30.5	22.8	50.0	2.5	2.5	2.6	3.3
32	COG17032	30.6	16.8	47.2	3.0	1.3	3.1	1.1
33	COG17033	27.8	18.6	47.7	4.0	2.3	3.4	1.0
34	COG17034	31.4	23.6	48.7	3.5	2.6	4.3	1.9
35	COG17035	28.3	13.8	47.6	3.4	1.6	3.5	1.0
36	COG17036	28.9	19.7	46.1	2.6	1.4	2.8	1.0
37	COG17037	32.4	23.0	47.4	3.8	1.5	3.7	1.1
38	COG17038	35.8	24.8	45.8	5.1	3.6	4.9	3.0
39	COG17039	27.3	18.7	49.2	4.1	1.9	4.6	1.0
40	COG17040	29.8	22.4	49.4	4.4	3.4	5.1	4.2
41	COG17041	42.8	23.9	49.2	4.4	3.3	4.7	2.0
42	COG17042	41.8	23.9	47.0	5.4	3.0	5.9	2.3
43	COG17043	26.3	17.6	50.7	5.5	4.0	6.3	3.8
44	COG17044	36.8	21.9	49.8	5.9	3.1	6.0	2.3
45	COG17045	29.0	16.4	50.9	5.4	3.6	5.6	4.0
46	COG17046	37.6	21.4	49.9	5.4	4.0	5.8	3.8
47	COG17047	28.2	24.0	50.7	5.4	3.9	5.9	3.5
48	COG17048	39.4	25.7	51.8	5.5	3.8	6.4	3.8
49	COG17049	33.2	19.3	50.6	5.0	2.5	4.9	3.2
50	COG17050	23.2	15.7	48.3	4.3	3.4	4.6	4.0
51	COG17051	32.6	22.7	49.3	4.4	2.6	5.7	3.3
52	COG17052	23.3	16.3	51.7	3.6	2.4	3.6	1.3
53	COG17053	30.5	23.4	52.2	3.9	3.4	4.4	2.8
54	COG17054	34.7	20.9	49.5	3.8	2.5	4.1	4.1
55	COG17055	32.6	25.6	50.1	3.3	1.1	4.3	1.0
56	COG17056	34.5	24.3	47.7	3.9	1.1	4.8	1.0
57	COG17057	38.0	25.4	46.8	3.8	1.1	3.6	1.0
58	COG17058	44.9	32.7	46.9	3.8	1.3	3.8	1.0
59	COG17059	45.6	33.2	48.3	4.0	1.1	4.3	1.0
60	COG17060	35.5	22.4	49.0	3.8	1.1	3.5	1.0

61	COG17061	35.6	26.8	48.9	3.0	1.1	3.8	1.0
62	COG17062	38.9	27.7	48.2	3.6	1.1	4.6	1.0
63	COG17063	33.5	21.7	47.1	2.8	1.1	2.5	1.0
64	COG17064	34.7	23.8	50.4	4.4	1.1	4.9	1.0
65	COG17065	32.0	21.9	47.3	3.5	1.3	3.6	1.1
66	COG17066	33.3	27.0	50.3	3.3	1.3	2.8	1.0
67	COG17067	30.7	22.3	49.3	5.6	1.4	5.8	1.1
68	COG17068	44.2	34.0	51.8	4.5	2.1	4.1	1.8
69	COG17069	30.1	22.0	49.3	4.9	1.4	5.4	1.4
70	COG17070	30.9	21.1	50.8	5.1	2.3	6.3	3.3
71	COG17071	37.5	28.1	50.8	4.9	2.3	5.5	2.9
72	COG17072	33.9	23.6	45.8	5.4	2.4	5.9	3.5
73	COG17073	28.4	20.4	48.1	5.4	3.1	6.3	4.1
74	COG17074	32.5	20.8	47.2	5.6	2.0	6.0	3.1
75	COG17075	30.2	20.3	46.5	6.1	2.6	6.0	2.4
76	CO 7 (Check 1)	29.6	22.3	51.4	4.6	2.9	6.2	5.1
77	ICGV 07222 (Check 2)	27.3	19.2	48.0	2.5	1.5	2.9	1.9
78	VRI 8 (Check 3)	38.2	28.7	49.1	4.4	2.9	4.1	3.7
79	TMV 13 (Check 4)	30.2	23.8	51.7	5.3	4.1	5.0	4.4
80	TMV 14 (Check 5)	26.0	17.1	51.5	4.9	2.9	5.0	1.9
	Mean	**33.6**	**22.9**	**48.9**	**4.0**	**2.2**	**4.3**	**2.2**

Table 2. **Correlations between the agronomic traits and disease scores**

Traits	PYP(g)	KYP(g)	LLS 1	RUST 1	LLS 2	RUST 2
PYP(g)	1	0.885**	-0.028	-0.179	-0.212	-0.180
KYP(g)		1	-0.079	-0.228*	-0.229*	-0.210
LLS 1			1	0.601**	0.856**	0.539**
RUST 1			.	1	0.529**	0.839**
LLS 2					1	0.574**
RUST 2						1

** Correlation is significant at the 0.01 level.

*Correlation is significant at the 0.05 level.

Where PYP – Pod Yield per Plant, KYP – Kernel Yield per Plant, OC – Oil Content in percentage, LLS 1 – Late Leaf Spot score in Coimbatore, RUST 1 – Rust score in Coimbatore, LLS 2 - Late Leaf Spot score in Aliyar Nagar, RUST 2 – Rust score in Aliyar Nagar.

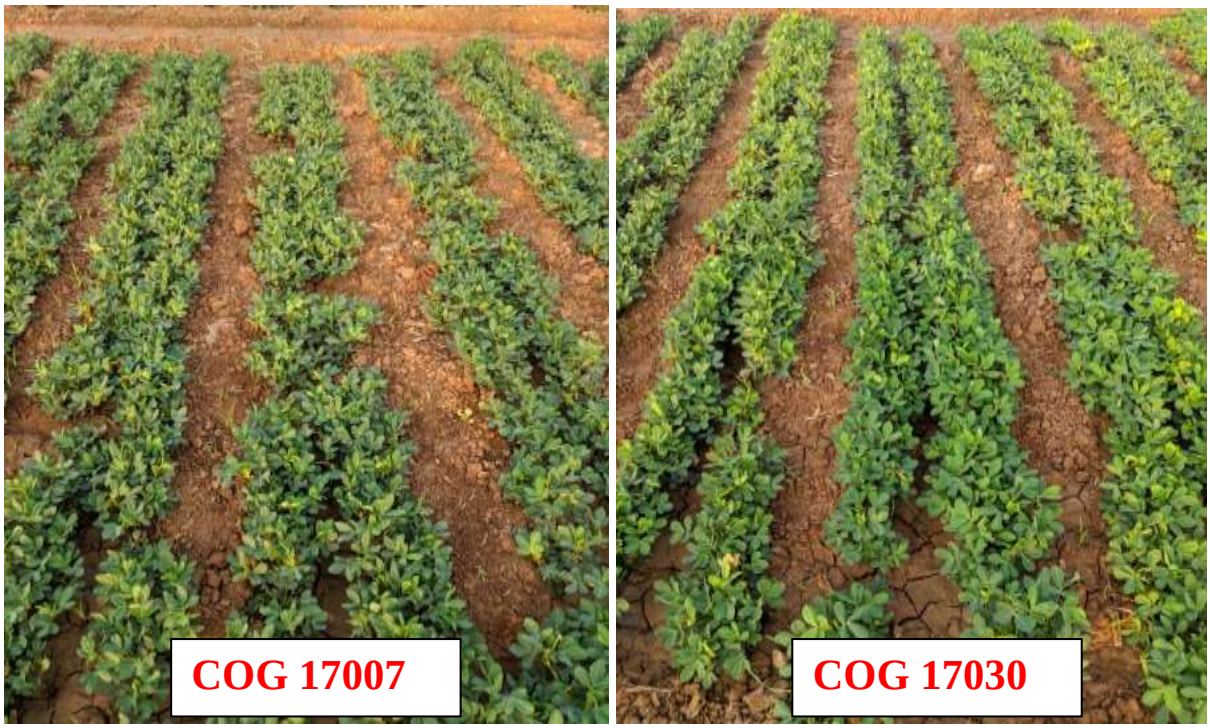

Fig.1. Field view of better resistance genotypes from 75 ILs

Fig. 2. Pod and Kernel features of better resistance genotypes from 75 genotypes

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