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RESEARCH PAPER

Evaluation for *Sclerotium rolfsii* Sacc. resistance in F_4 and F_5 genotypes of groundnut (*Arachis hypogaea* L.)

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Abstract: Among biotic stresses, stem and pod rot caused by *Sclerotium rolfsii* Sacc. is a major constraint for production in most of the groundnut growing area. Persistence of the pathogen in soil and its wide host range often limit the effectiveness of chemical and cultural control of stem and pod rot signifying the role evaluation of genetic resistance. It is evident that stem rot disease has significant effect on the yield. Hence, the simultaneous evaluation of the genotype for the disease as well as yield potential would be more useful. One hundred and ten promising lines for *Sclerotium rolfsii* resistance in F_3 generation were evaluated in *S. rolfsii* sick plot by creating artificial inoculation condition using Augmented Design in rabi, 2016 and summer, 2017. Stringent selection through artificial inoculation was carried out based on percent disease incidence. Most of the genotypes were susceptible to the selected isolate and the resistant reaction was observed only in few genotypes. Three lines *viz.,* TMV-2 × AGL 168-3, Dh-86 × AGL 289-6 and TMV-2 × AGL 289-11 in F_4 and two lines *viz.,* TMV-2 × AGL 168-3 and Dh-86 × AGL 635-7) in F_5 generations exhibited disease incidence less than 10 %. Present study indicated that response of F_4 and F_5 lines to stem rot disease was variable over the seasons. Resistance of these genotypes to *S. rolfsii* varied with the growth stages of the plant.

Key words: Disease incidence, Generation, Groundnut, Resistance

Introduction

Groundnut or peanut (*Arachis hypogaea* L.) is one of the major economic oilseed crops of the world cultivated in an area of 24.48 million hectares with a total production of 42.74 million tons (Anon., 2014). The total production of groundnut in India is 7.41 million tonnes from an area of 5.22 million ha with a productivity of 1418 kg per ha (Anon, 2017). Karnataka is one among the major groundnut producing states with an annual production of 0.39 million tonnes from 0.57 million hectare and the productivity is 729 kg per hectare (Anon, 2016). Stem rot caused by Sclerotium rolfsii Sacc. is one of the major constraint to groundnut productivity which accounts for economic yield loss to the extent of 10 to 25 per cent and may go up to 80 per cent in severely infected fields (Rakholia and Jadeja, 2010; Pujer *et al.,* 2013), despite of crop management practices. The occurrence of the disease is more visible at 30 to 45 days after germination and at the time of harvest under rainfed situations due to low and erratic distribution of rainfall.

S. rolfsii preferentially attacks stem, but it can infect any part of the plant including root, leaf, flower and fruit. Drying or shriveling of the foliage and ultimately death of the plants occur after wilting. Characteristic sclerotia, first appear white and later brown to black, on stem surface of the plant adjacent to soil or on soil surface are produced (Bera *et al.,* 2014). Crop breeders are mainly concerned with identification of factors limiting productivity and formulation of appropriate breeding strategies to develop suitable genotypes. Screening for resistance in the field is complicated by the non-uniform spatial distribution of the pathogen which makes difficult to obtain consistent and reliable data (Shew *et al.,* 1984). While, development and maintenance of artificial sick plot with optimum inoculum load under field condition for screening of large number of genotypes is very difficult because of sensitivity of the pathogen to temperature, humidity, soil type, cropping system and host preference, thus limiting the success of breeding groundnut cultivar, resistant to stem rot through conventional breeding. In the present study, attempts have been made to screen F_4 and F_5 groundnut lines for tolerance to stem and pod disease caused by *S. rolfsii* under artificially inoculated conditions in field as well as in green house environment.

Material and methods

The experimental material comprised of pre-selected for *Sclerotium rolfsii* resistance, F_4 and F_5 lines derived from the cross between three local varieties *viz.,* TMV-2, Dh-86 and GPBD-4 and six stem rot resistant lines *viz.,* AGL 168, AGL 108, AGL 289, AGL 635, AGL 2255 and AGL 2389. Pedigree of checks is given in Table 1. The populations consisted of 110 promising lines for *Sclerotium rolfsii* resistance from F_3 generation and were evaluated in *S. rolfsii* sick plot with artificial inoculation condition in both F_4 and F_5 generation. The experiment was laid out at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad in a sick plot with Augmented Design. Genotypes were sown in five blocks without replication and each block consisted of twenty two entries with four susceptible (TMV-2, GPBD-4, GPBD-5 and Dh-86) and two resistant (AGL 289 and AGL 635) checks randomly repeated during *rabi,*

2016 and summer, 2017. Each entry was planted in row length of 3 meter with 30 cm spacing between rows and 10 cm between plants. Five seeds of each one hundred and ten promising lines were separately sown in 20 cm diameter earthen pots.

The inoculums were collected from the field of Main Agricultural Research Station, Dharwad. The standard procedure to obtain pure culture was followed as suggested by Bagwan, (2011) and Bekriwala *et al.* (2016). Sand corn meal medium was prepared in the proportion of 95:5 in order to get maximum sclerotial production (Abeygunwardhana and Wood, 1975). The pure culture of isolate of *S. rolfsii* was inoculated separately in flasks under aseptic condition and incubated at 27 $\pm$ 1^{0}C for 30 days. These flasks were shaken often to get uniform growth of isolate. Inoculum containing mycelium and sclerotia along with corn meal and sand was applied to the soil surface, around the base of the plants 125 g per 2.5 m row, at 30 days after sowing or at flower initiation. Chopped wheat stubble (3-4 cm pieces) was scattered along the rows to enhance the fungal growth. The inoculation was repeated after two weeks. During summer season, the field was irrigated at five days interval until pod formation to promote stem rot development. The interval was increased at 15 days to promote pod infection.

The incidence of stem rot caused by *S. rolfsii* was recorded on visual basis in F_4 and F_5 generation by adopting ICRISAT scale for pod and stem rot incidence. 0- immune, 0.1-10 highly resistant, 10-20 Resistant, 20-50 moderately susceptible and > 50 highly susceptible (Ashok *et al.,* 2004).

The per cent disease incidence in terms of mortality of plants was calculated by using the formula (Number of infected plants/ Total number of plants) x 100".

Result and discussion

In this study, a total of 110 groundnut lines from F_4 and F_5 population along with five susceptible (AGL 168, AGL 108, AGL 289, AGL 635, AGL 2255 and AGL 2389) and two resistant (AGL 289 and AGL 635) check cultivar were screened for resistance to stem rot disease both in *kharif,* 2016 (F_4) and *rabi,* 2017 (F_5). The disease incidence of checks and lines of both the generations at various stages of crop growth *viz.,* 30, 45, 60, 90 days after sowing, before harvest and at harvest were recorded.

All other lines except seven were found to be resistant at 30 DAS during *rabi.* 30 lines showed disease incidence range between 3.33 to 11.76 % at 40 DAS. 58 lines recorded disease incidence ranging from 3.13 to 13.04 % at 60 DAS. A range of 3.13 to 21.05 % was observed in 72 lines. From the results it was evident that before harvest 105 lines recorded 3.45 to 36.84 % disease incidence. At harvest, 103 lines showed disease incidence in a range of 4.35 to 57.89 %. Total disease incidence in different genotypes was computed and it was ranging from 6.30 to 62.50 %. Compared to number of lines having resistance reaction before harvest stage, more resistant lines were recorded at harvest.

All other lines except three were observed resistant at 30 DAS during summer. Disease incidence (2.63 to 16.67 %) was observed in 22 lines at 45 DAS, while at 60 DAS, 60 lines showed disease incidence of 2.78 to 16.67 %. At 90 DAS, 78 lines showed disease incidence ranging from 2.78 to 33.33%. It was observed that before harvest totally 93 lines recorded disease incidence in the range of 3.13 to 58.33 %. At harvest, 105 lines showed disease incidence with a range of 6.25 to 69.57 %. Total disease incidence ranged between 6.25 to 82.61 %. Unlike in F_4 generation, F_5 had more resistant lines before harvest compared to number of resistant lines at harvest.

In the present study, stringent selection through artificial inoculation was carried out. Three lines derived from crosses (TMV-2 × AGL 168-3, Dh-86 × AGL 289-6 and TMV-2 × AGL 289-11) showed highly resistant reaction against stem rot with a range of 6.30 to 8.70 % disease incidence in F_4 generation. While in F_5, two lines (TMV-2 × AGL 168-3 and Dh-86 × AGL 635-7) showed highly resistant reaction against stem rot with 6.25 to 7.14 % of disease incidence. TMV-2 × AGL 168-3 genotype recorded disease incidence less than 10 % in both the generations indicating its consistency in resistance reaction against the disease. Remaining genotypes exhibited difference

Table 1. Checks used for experiment and their identity

Sl. No.	Parents Lines	Pedigree	Maturity (days)	Salient features
1	GPBD-4	KRG-1 × ICGV-86855	105-110	Slight reticulation, slight beak, moderate constriction, high O/L ratio, resistant to foliar diseases
2	TMV-2	Mass selection from Gudhiatham bunch	105-110	Widely adapted, small, uniform pods susceptible to LLS
3	Dh-86	Dh-40 × Dh-8	90	High shelling turnover (70%), highly susceptible to rust and LLS
4	GPBD-5 TestersA			
5	GL-289A GL-635	ICGV 91114 × ISATGR 1212	110-115	Bold types with less beak, less reticulation, less constriction uniform pods with bold kernels, resistant to stem rot disease

Table 2. Promising top ten stem rot resistant lines for yield and different yield contributing traits in F_5 generation of groundnut

Line description	Total PDI (%)	NMP	PYPP (g)	KYPP (g)	SH %	SMK %	TW (g)	Oil %
Dh-86 × AGL 2255-7	6.25	28.00	32.80	24.54	74.81	83.12	45.90	48.09
TMV-2 × AGL 168-3	7.14	27.20	25.71	19.50	75.83	86.11	40.22	49.14
Dh-86 × AGL 635-2	11.76	26.80	29.27	20.00	68.33	89.92	44.29	46.58
TMV-2 × AGL 289-3	12.50	25.40	27.33	20.98	76.77	84.67	39.50	48.50
TMV-2 × AGL 635-2	14.29	23.80	26.67	21.07	79.00	84.55	41.09	45.26
GPBD-4 × AGL 289-11	15.79	23.20	29.81	21.37	71.69	82.38	38.85	48.14
TMV-2 × AGL 2255-6	16.67	20.00	30.10	21.60	71.77	85.83	43.32	48.50
Dh-86 × AGL 289-6	17.24	24.40	26.17	17.00	64.95	80.29	41.44	48.08
GPBD-4 × AGL 635-10	18.75	19.20	23.85	17.35	72.73	80.75	37.36	48.13
Dh-86 × AGL 168-4	20.00	19.40	21.00	15.24	72.59	81.18	41.76	46.03
TMV-2	71.13	21.21	27.27	21.14	72.37	87.18	41.59	46.43
Dh -86	71.56	19.44	20.35	16.10	70.62	83.81	36.22	45.03
GPBD-4	67.89	20.24	24.94	19.25	74.65	88.95	37.53	47.15
GPBD-5	66.69	19.90	22.40	17.87	73.02	85.12	35.47	46.76
AGL-289								
AGL-635	8.81	27.22	22.93	17.29	75.43	81.83	41.05	47.75
	6.45	26.28	22.47	17.50	78.28	88.04	38.64	47.16
C.D. (BiVi - BjVj)		2.75	3.99	3.33	3.10	8.18	6.47	4.22

1.Total PDI – Total per cent disease incidence
2.NMP- Number of Mature pods
3.PYPP (g) - Pod yield per plant
4.KYPP (g) – Kernel yield per plant
C.D. (BiVi - BjVj) – CD between varieties
5. SH % - Shelling per cent
6. SMK % - Sound Mature Kernel per cent
7. TW (g) – Test weight
8. Oil % - Oil content

in disease reaction in F_4 and F_5 generations. Regarding the evaluation of disease resistance in groundnut, most of the genotypes were susceptible to the selected isolate and the resistant reaction was observed only in few genotypes. Similar results were evidenced by Farooq *et al.,* 2011 and Eslami *et al.,* 2015. In F_5 generation, Dh-86 × AGL 2255-7 and TMV-2 × AGL 168-3 showed disease incidence of less than 10 %. Genotype, Dh-86 × AGL 2255-7 recorded higher value for number of mature pods, pod yield per plant, kernel yield per plant and test weight. Among all top ten lines, TMV-2 × AGL 635-2 had higher value for shelling per cent, Dh-86 × AGL 635-2 for sound mature kernel per cent and TMV-2 × AGL 168-3 for oil content (Table 2). Results of the present study were similar to Bera *et al.* (2014) which indicated the response of F_4 and F_5 lines to stem rot disease was variable over the seasons. Resistance of these genotypes to S. rolfsii varied with the growth stages of the plant. Screening for resistance to S. rolfsii must be specific to growth stages for identification of genotypes.

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