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Screening of Groundnut Varieties and Germplasm against Collar rot, Stem rot and Dry Root rot Diseases

P. Palaiah*, T. Narendrappa and S.B. Mallesh

(Plant Pathology), ICAR-Krishi Vigyan Kendra, Raddewadagi, Kalaburgi-585 310, India

**Corresponding author*

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A B S T R A C T

The groundnut germplasm and varieties were evaluated to identify the sources of resistance to collar rot (*Aspergillus niger*), stem rot (*Sclerotium rolfsii*) and dry root (*Rhizoctonia bataticola*) diseases. A total of 64 AICRP groundnut germplasm and 33 popular groundnut varieties were screened under sick plot condition at MARS, Raichur. Only 31 germplasm showed highly resistant to stem rot; 37 germplasm lines resistance against collar rot; and 11 germplasm showed resistant against dry root rot diseases. However, out of 33 groundnut varieties evaluated against these diseases, none of the varieties showed highly resistant and resistant against three diseases and only 18 varieties found moderately resistant against collar rot and 20 varieties against stem rot and 29 varieties for dry root rot diseases.

Introduction

Groundnut (*Arachis hypogaea* L.) is one of the leguminous oilseed crops growing under both rainfed and irrigated conditions. India is pioneer in both area and production of groundnut in the world.

It is cultivated in more than 90 countries in the world. Asia contributes 63.4 per cent area and produces 71.7 per cent of world groundnut production (Madhusudhana, 2013).

In India, major groundnut growing states include Andhra Pradesh, Telangana, Gujarat, Karnataka and Tamil Nadu, former three states contribute to more than half the crop area in the country (Kumari *et al.*, 2016). The groundnut crop subjected to significant yield losses annually mainly due to biotic and abiotic factors. Among the biotic factors, seed and soil borne diseases have been recognized as one of the major constraints limiting the groundnut production.

Among the seed and soil borne pathogens, *Aspergillus niger* Van Tieghem, *Sclerotium rolfsii* Sacc and *Rhizoctonia bataticola* Taub have been reported to cause severe seedling mortality resulting patchy crop and reduced yield ranging from 25–40 per cent (Ghewande *et al.*, 2002). These pathogens infect

groundnut plants at the all stages of growth and causes pre-emergence rotting in the seeds, soft rot in emerging seedlings, collar rot/ dry root rot and stem rot in matured plants (Jhonson and Subramanyan, 2010).

Chemical and cultural practices have been the predominant control measures used in the past to manage soil-borne pathogens (Krishnakanth *et al.,* 1999). Persistence of the pathogen in the soil and its wide host range often limits the effectiveness of the chemical and cultural control of the soil borne diseases. However, partial resistant varieties in comparison to susceptible one, has better resistance efficiency (Shew *et al.,* 1984).

Growing resistant varieties against collar rot, stem rot and dry root rot diseases is a cost-effective control and unfortunately high degree of resistance to these soil borne diseases is not available among cultivable varieties. Hence, the present study was conducted to screen the groundnut germplasm and varieties against collar rot, stem rot and dry root rot pathogens for the identification of resistant sources.

Materials and Methods

The experiment was conducted at groundnut field of AICRP, Main Agricultural Research Station, Raichur during *kharif*-2016 and 2017, where groundnut sick plot has been developed and maintained over years for the screening of germplasm. Sixty four different groundnut germplasm and thirty three groundnut varieties (Table 1) along with one row of susceptible check TMV-2 was used to screen for collar rot, stem rot and dry root rot disease. The seeds were sown in rows with spacing of 30 × 10 cm in five metre length plot with two replication and for screening groundnut varieties the crop was sown in 5 x 3mt size plots with three replications separately. All recommended package and practices for groundnut in the region were followed. Final disease observations in terms of the per cent disease incidence (PDI) for collar rot was recorded at 20-30 days after sowing (DAS), for stem rot and dry root rot incidence was recorded at 45 DAS and 90 DAS using the following formula:

$$PDI = \frac{\text{Number of infected plants}}{\text{Total number of plants}} \times 100$$

The varieties as well as germplasm screened were further grouped as according to disease rating scale Resistant, Moderately resistant, Susceptible, Highly susceptible as given below:

Results and Discussion

Host plant resistance is the one of the effective methods in managing the soil borne diseases. Identification of resistant sources is an important factor in breeding methodology in selecting the resistant donors for incorporation of resistance into cultivars. A total of sixty four germplasm along with thirty three groundnut varieties were screened under sick plot against major root rot diseases caused by pathogens *viz., Aspergillus niger* Van Tieghem, *Sclerotium rolfsii* Sacc. and *Rhizoctonia bataticola* Taub. and the results are presented in the Table 2 & 3.

Collar rot (*Aspergillus niger* Van Tieghem)

Out of sixty four germplasm screened against collar rot caused by *Aspergillus niger*, thirty seven germplasm have showed >10 per cent disease incidence and were categorized as resistant; twenty-one germplasm were grouped under moderately resistant which showed collar rot incidence ranging from 10 to 20 percent (Table 2). However, remaining six germplasm *viz.*, ISK-I-4, ISK-I-5, ASK-1, LSVT-I-7, LSVT-I-1 and DTWUE-6 were

found moderately susceptible and none of the germplasm showed susceptibility. When 33 groundnut varieties screened for collar rot disease, none of the varieties showed highly resistant and resistant reaction. The eighteen groundnut varieties *viz.,* KRG-1, R-2001-3, Kadiri-9, KGD-128, ICGV-00350, GPBD-4, GPBD-5, Dh-101, Dh-216, G2-52, TG-37A, Ch-2, TDG-51, S-230, DSG-1, ICGV-00351, Chintamani-2 and J-11 were moderately resistant (Table 3) and eleven varieties *viz*.. R-2001-2, Dh-86, K. Haritandra, Kadari-6, Dharani, TAG-24, TDG-39, TPG-41, TG-17, TAG-26, TG-37A were moderately susceptible. The rest of four varieties like TMV-2, TG-75, TG-51 and TAG-47 were highly susceptible against collar rot.

Stem rot (*Sclerotium rolfsii* Sacc)

The present investigation revealed that thirty one germplasms (Table 2) showed highly resistant with stem rot incidence upto <10 per cent and twenty seven germplasm showed resistant with the disease incidence ranging from 10-19 percent and six germplasm showed moderately resistant against stem rot disease ranging from 20-29 per cent.

Out of thirty-three groundnut varieties, 20 varieties *viz.*, KRG-1, R-2001-2, R-2001-3, Kadiri-9, KGD-128, ICGV-00350, GPBD-4, GPBD-5, Dh-101, Dh-216, G2-52, Dharani, Ch-2, TAG-24, TG-51, TDG-51, DSG-1, ICGV-00351, TG-37A and J-11 showed moderately resistance with disease incidence of 20-29 per cent and seven varieties *viz*., TG-75, K. Haritandra, Kadari-6,TG-37A, TDG-39, TPG-41 and Chintamani-2 were found moderately susceptible and only six germplasms showed susceptibility with > 30 per cent (Table 3). However, none of the varieties showed resistant and highly resistant against stem rot caused by *Sclerotium rolfsii.*

Table.1 Germplasm and varieties used for screening collar rot, stem rot and dry root rot disease

Germplasm	Total no.
ISK-I-1, ISK-I-2, ISK-I-3, ISK-I-4, ISK-I-5, ISK-I-6, ISK-I-7, ISK-I-8, ISK-I-9, ISK-I-10, ISK-I-13, ISK-I-14, ISK-I-15, ISK-I-27, ISK-I-28, ISK-I-30, ISK-I-31, ISK-I-35, ISK-I-37, ISK-I-38, ISK-I-39, ISK-I-40, IVK-I-1, IVK-I-2, IVK-I-3, IVK-I-4, IVK-I-5, IVK-I-6, IVK-I-7, IVK-I-8, IVK-I-10, IVK-I-13, IVK-I-17, IVK-I-18, IVK-I-19, IVK-I-20, IVK-I-21, IVK-I-24, IVK-I-25, IVK-I-26, ASK-1, ASK-2, ASK-3, ASK-4, ASK-5, LSVT-I-1, LSVT-I-2, LSVT-I-3, LSVT-I-4, LSVT-I-5, LSVT-I-6, LSVT-I-7, LSVT-I-11, LSVT-I-12, LSVT-I-14, DTWUE-1, DTWUE-2, DTWUE-3, DTWUE-4, DTWUE-5, DTWUE-6, DTWUE-7, DTWUE-8 and DTWUE-9	64
Varieties	33
KRG-1, R-2001-2, R-2001-3, Kadiri-9, KGD-128, TG-75, ICGV-00350, GPBD-4, GPBD-5, Dh-86, Dh-101, Dh-216, G2-52, K. Haritandra, Kadari-6, Dharani, TG-37A, Ch-2, TAG-24, TG-51,TDG-39, TDG-51, TPG-41, TG-17, S-230, DSG-1, TAG-26, ICGV-00351, CHINTAMANI -2, TG-37A, TAG-47, TDG-51	

Table.2 Categorization of groundnut germplasm against collar rot, stem rot and dry root rot disease incidence under field conditions

Phenotypic reaction	Disease incidence (%)*		No. of entries	Groundnut germplasam
Highly resistant	Stem rot	<10	31	ISK-I-6, ISK-I-10, ISK-I-14, ISK-I-35, ISK-I-37, IVK-1-4, IVK-1-5, IVK-I-7,IVK-I-8,IVK-I-10,IVK-I-13,IVK-I-17,IVK-I-21,IVK-I-24,IVK-I-25,IVK-I-26,ASK-1,ASK-2,ASK-3,ASK-4,ASK-5,LSVT-I-1,LSVT-I-2,LSVT-I-4,LSVT-I-5,LSVT-I-6,LSVT-I-7,LSVT-I-12, DTWUE-3,DTWUE-5, DTWUE-8
Resistant	Collar rot		37	ISK-I-2, ISK-I-6, ISK-I-10, ISK-I-13, ISK-I-15, ISK-I-30, ISK-I-31, ISK-I-35, ISK-I-38, ISK-I-39, ISK-I-40, IVK-I-1, IVK-I-2, IVK-I-4, IVK-I-5, IVK-I-8, IVK-I-10, IVK-I-13, IVK-I-18, IVK-I-19 IVK-I-20, IVK-I-21, IVK-I-24, IVK-I-25, IVK-I-26, ASK-2, ASK-3, ASK-4, LSVT-I-1, LSVT-I-2 LSVT-I-4, LSVT-I-14, DTWUE-1, DTWUE-2, DTWUE-3, DTWUE-4, DTWUE-5
	Dry root rot		11	ISK-I-9,ISK-I-10,ISK-I-13, ISK-I-14,ISK-I-15,ISK-I-27,ISK-I-35,ISK-I-37,ISK-I-38,ISK-I-39, IVK-I-5
	Stem rot	10 -19	27	ISK-I-1, ISK-I-2, ISK-I-3, ISK-I-4, ISK-I-5, ISK-I-7, ISK-I-8, ISK-I-9,ISK-1-13,ISK-1-27,ISK-1-31, ISK-I-38,ISK-I-39 ISK-I-40, IVK-I-1, IVK-I-2, IVK-1-3,IVK-1-6,IVK-I-20,LSVT-1-3,LSVT-I-11, LSVT-I-14, DTWUE-1, DTWUE-2, DTWUE-6, DTWUE-7, DTWUE-9
Moderately resistant	Collar rot	10-20	21	ISK-I-1,ISK-I-3,ISK-I-7,ISK-I-8,ISK-I-9,ISK-I-14,ISK-I-27,ISK-I-28,ISK-I-37,IVK-I-3,IVK-I-6 IVK-I-7,IVK-I-17,ASK-5,LSVT-I-3,LSVT-I-5,LSVT-I-6,LSVT-I-11,DTWUE-7,DTWUE-8 DTWUE-9
	Stem rot	20-29	6	ISK-1-15, ISK-1-28, ISK-1-30, IVK-1-18, IVK-1-19, DTWUE-8
	Dry root rot	11.1-30	26	ISK-I-1,ISK-I-2,ISK-I-4,ISK-I-5,ISK-I-6,ISK-I-40,IVK-I-1,IVK-I-4,IVK-I-10,IVK-I-13,IVK-I-17 IVK-I-21,IVK-I-24,IVK-I-25,IVK-I-26,ASK-1,ASK-2,ASK-3,LSVT-I-2,DTWUE-1,DTWUE-3 DTWUE-4,DTWUE-5,DTWUE-6,DTWUE-7,DTWUE-9
Moderately susceptible	Collar rot	20-40	6	ISK-I-4, ISK-I-5, ASK-1, LSVT-I-7, LSVT-I-12, DTWUE-6
Susceptible	Collar rot	40-60	0	-
	Stem rot	>30	0	-
	Dry root rot	30.1-50	25	ISK-I-3, ISK-I-7, ISK-I-8, ISK-I-30,ISK-I-31,IVK-I-2,IVK-I-3,IVK-I-6,IVK-I-7,IVK-I-8,IVK-I-19 IVK-I-20, ASK-4,ASK-5,LSVT-I-1,LSVT-I-3,LSVT-I-4,LSVT-I-5,LSVT-I-6,LSVT-I-7,LSVT-I-11,LSVT-I-12, LSVT-I-14,DTWUE-2, DTWUE-8
Highly susceptible	Collar rot	>60	0	-
	Dry root rot	>50	2	ISK-I-28, IVK-I-18

* Categorization of germplasm based on year pooled data

Table.3 Categorization of groundnut varieties against collar rot, stem rot and dry root rot disease incidence under field conditions

Phenotypic reaction	Disease incidence (%)*		No. of entries	Groundnut varieties
Highly resistant	Stem rot	<10	0	-
Resistant	Collar rot		0	-
	Dry root rot		0	-
	Stem rot	10 -19	0	-
Moderately resistant	Collar rot	10-20	18	KRG-1, R-2001-3,Kadiri-9,KGD-128,ICGV-00350,GPBD-4,GPBD-5,Dh-101,Dh-216,G2-52,TG-37A, Ch-2,TDG-51,S-230,DSG-1,ICGV-00351,Chintamani -2, J-11
	Stem rot	20-29	20	KRG-1,R-2001-2,R-2001-3,Kadiri-9,KGD-128,ICGV-00350,GPBD-4,GPBD-5,Dh-101,Dh-216, G2-52, Dharani, Ch-2,TAG-24,TG-51,TDG-51,DSG-1,ICGV-00351,TG-37A, J-11
	Dry root rot	11.1-30	29	KRG-1,R-2001-2,R-2001-3,Kadiri-9,KGD-128,TG-75,ICGV-00350,GPBD-4,GPBD-5,Dh-86,Dh-101,Dh-216,G2-52,K. Haritandra,Dharani,TG-37A,Ch-2,TG-51, TDG-39,TDG-51,TPG-41,TG-17,S-230,DSG-1,ICGV-00351,Chintamani -2,TG-37A,TAG-47, J-11
Moderately susceptible	Collar rot	20-40	11	R-2001-2, Dh-86,K. Haritandra,Kadari-6,Dharani,TAG-24,TDG-39,TPG-41,TG-17,TAG-26, TG-37A
	Stem rot		7	TG-75, K. Haritandra,Kadari-6,TG-37A,TDG-39,TPG-41,Chintamani -2
Susceptible	Collar rot	40-60	4	TMV-2, TG-75, TG-51, TAG-47
	Stem rot	> 30	6	TMV-2, Dh-86, TG-17, S-230, TAG-26, TAG-47
	Dry root rot	30.1-50	4	TMV-2, Kadari-6,TAG-24, TAG-26
Highly susceptible	Collar rot	> 60	Nil	-
	Dry root rot	> 50	Nil	-

* Categorization of germplasm based on year pooled data

Disease rating scale for dry root rot disease (Wheeler *et al.*, 1969)

Percent infection	Disease
< 10% infection	Resistant
11.1-30% infection	Moderately Resistant
30.1-50% infection	Susceptible
>50% infection	Highly susceptible

Disease rating scale for stem rot disease (Bera, 2016)

Percent infection	Disease
<10% infection	Highly resistant
10 -19% infection	Resistant
20-29% infection	Moderately Resistant
>30% infection	Susceptible

Disease rating scale for collar rot (Rohtas, 2014)

Percent infection	Disease
<10% infection	Resistant
10 -20% infection	Moderately Resistant
21-40% infection	Moderately susceptible
40-60% infection	Susceptible
>60% infection	Highly susceptible

Dry root rot (*Rhizoctonia bataticola* Taub.)

Eleven germplasm showed resistance reaction against dry root rot disease with incidence of < 10 per cent. Twenty-six germplasm were showed moderately resistant reaction and their disease incidence range of 11-30 per cent and 25 germplasm were found susceptible (Table 2) and ISK-1-28 and IVK-I-18 were highly susceptible to *Rhizoctonia bataticola* with disease incidence of > 50 per cent.

Out of 33 varieties screened against *Rhizoctonia bataticola* under field condition revealed that, none of varieties were found resistant or highly resistant to dry root rot disease (Table 3) where as rest of the twenty nine varieties *viz.*, KRG-1, R-2001-2, R-2001-3, Kadiri-9, KGD-128, TG-75, ICGV-00350, GPBD-4, GPBD-5, Dh-86, Dh-101, Dh-216, G2-52, K. Haritandra, Dharani,TG-37A, Ch-2, TG-51,TDG-39, TDG-51, TPG-41, TG-17, S-230, DSG-1, ICGV-00351, Chintamani -2, TG-37A,TAG-47 and J-11 were moderately resistant with 11 to 30 per cent disease incidence; and other varieties., TMV-2, Kadari-6, TAG-24 and TAG-26 were found susceptible to *Rhizoctonia bataticola*.

Germplasm screening is an important aspect for identifying resistant lines against plant diseases. Elite lines showing strong resistance to specific diseases will further be used in breeding programmes. Groundnut Collar rot, Stem rot and dry root rot diseases are causing significant yield losses at global level but satisfactory levels of resistance are not available in cultivable varieties and the present study on identifying elite germplasm

lines for effective management of above soil borne diseases is on-going programme with AICRP centres. Previous reports indicated that the resistance of Spanish bunch types *viz.*, C -421 and C- 1780 to the collar rot pathogen under field conditions (Gorbet and Shokes., 2002).

Similarly Moradia (2012) also reported in groundnut against dry root rot, 28 varieties showed resistant and 6 varieties were moderately resistant and rest 37 varieties were found susceptible. While conducting screening trial Rakholiya and Jadeja (2010) were screened 26 groundnut varieties for *S. rolfsii*, out of which fourteen groundnut cultivars *viz.*, J-11, GG-2, GG-4, GG-5, GG-6, GG-7, JL-24, TAG-24, TG-26, GG-20, GG-13, GG-11, BAU-13 and ICGV-86564 showed resistant against *S. rolfsii*. However, the spreading type *viz.*, GG-11 and GG-13 were moderately resistant, while eight varieties *viz.*, J-11, GG-4, GG-6, JL-24, TG-26, TAG-24, BAU-13 and ICGV-86564 were found susceptible, four varieties *viz.*, GG-2, GG-5, GG-7 and GG-20 were highly susceptible to *S. rolfsii*.

Neha Rani (2014) conducted screening of 20 entries of groundnut and the cultivar, DH-86 showed maximum root rot per cent incidence during *kharif* followed by CHICO cultivar and ICGV-07214. The variety ICGV-00338 showed maximum root rot incidence during *spring* followed by ICGV-02005. The minimum root rot disease incidence was recorded in the variety ICGV-07210 and similarly three breeding lines, ICGV-86699, ICGV-91114 and ICGV- 89280 lines (Divya rani *et al.*, 2018).

Germplasm screening has been a continuous process against these diseases, integrating the host-plant resistance with other sustainable options under IDM is an ideal strategy over long run in managing soil-borne diseases. Attempt was made on screening 64 germplasm lines along with existing 33 groundnut varieties under sick plot conditions and groundnut varieties *viz.*, KRG-1, R-2001-3, Kadiri-9, KGD-128, ICGV-00350, GPBD-4, GPBD-5, Dh-101, Dh-216, G2-52, TG-37A, Ch-2, TDG-51, S-230, DSG-1, ICGV-00351, Chintamani -2 and J-11 were found as moderately resistant and which could be utilized as one of the component of integrated disease management programme.

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