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Occurrence, Pathogenicity and Assessment of Groundnut Genotypes Resistance to *Aspergillus niger* Inciting Collar Rot Disease

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A B S T R A C T

A survey was conducted for collar rot disease incidence in southern Karnataka showed that Tumkur district recorded highest collar rot disease incidence of 14 percent followed by Chamarajanagar (8.50%) whereas Kolar recorded least disease incidence of 3.3 percent in *Kharif*. During summer 3.3 percent disease incidence was observed in Davangere district. Collar rot of groundnut pathogen was isolated by following standard tissue isolation method and the culture was identified through morphological and cultural characters. Pathogenicity was proved by blotter paper technique and sick pot method and the culture was compared with original culture. Among sixty four genotypes screened for collar rot, five genotypes *viz.*, ICG 1994, ICG 2734, ICG 4749, ICG 13856 and ICG 7190 showed moderately resistant reactions. K-6 recorded least percent disease incidence (1.0 %) with highest pod yield of 10.5 q/ha compared to control TMV 2 with more disease incidence (2.30 %) and less pod yield of (7.7 q/ha).

Introduction

Groundnut (*Arachis hypogaea* L.) is a very important legume crop of tropical and sub-tropical areas of the world and cultivation of this crop is mostly confined to the geographical belt between 40°N and 40°S latitude (Pattee and Young, 1982). In India, it is one of the most important oilseed crop and regarded as 'king of oilseeds'. Globally groundnut is grown in 25.46 million ha, with the production of 45.30 million tons and with productivity of 1780 kg/ha. China ranks first in world with production of 16.91 million tons from 4.6 million ha of cultivated area with the productivity of 3614 kg / ha. India is one of the leading country in the production of groundnut in the world followed by China with production of 9.47 million tons from 5.25 million ha of cultivated area with productivity of 1804 kg/ha (Anon, 2014). The cultivation of crop was affected by many biotic and abiotic stresses (Muthukumar *et al.*, 2014). Among biotic stresses, groundnut is

attacked by many fungal, bacterial and viral pathogens. The most economically important fungal diseases are tikka, rust, stem rot, collar rot and various other soil borne diseases have also been reported which causes severe damage to the crop (Desai and Bagwan, 2005). Collar rot caused by *Aspergillus niger* van Teighem is one of the most important disease of groundnut which is more extensive in the *kharif* than the *rabi* and summer seasons and causes more damage in sandy loam and medium black soil. Annual world yield loss caused by collar rot is more than 10 per cent (Pande and Rao, 2000) and is more prevalent in soils with low moisture content and high temperature, approximately 30ºC (Kishore *et al.,* 2007). *A. niger* causing collar rot disease on groundnut seedlings was first reported by Jochem (1926). However, Jain and Nema, (1952) first reported from India. This disease appears in two phases, *viz.,* pre-emergence and post-emergence phase. In the pre-emergence phase, the seed may rot in the soil or be covered with black masses of spore on germination; the emerging hypocotyls are rapidly killed by these spores. In the post-emergence phase, circular light brown lesions appear initially on the cotyledons and as these advances the hypocotyls tissue or stem lesions become water-soaked and show light brown discoloration. The seedlings then collapse and die due to the rotting of the succulent hypocotyls. The loss due to this disease was reported up to 40-50 percent (Chahal *et al.,* 1974).

Since, chemical, biological and cultural practices had been followed to manage the soil borne pathogens (Krishnakanth *et al.,* 1999, Prabhukarthikeyan *et al.,* 2014; 2017; 2018; 2019). Persistence of the pathogen in soil and its wide range of host might often limits the effectiveness of the chemical and cultural management of soil borne pathogens (Palaiah *et al.,* 2019). However, partial resistant varieties in comparison to susceptible one, has better resistance efficiency (Shew *et al.,* 1984). Therefore, systematic screening of various groundnut germplasm lines for identifying resistant sources will help in identification of elite lines with superior resistance to these diseases. Hence the present study was taken up to assess the prevalence and incidence of collar rot of groundnut in south Karnataka, India and to identify the resistance against collar rot and stem rot pathogens.

Materials and Methods

Survey of collar rot incidence on groundnut from south Karnataka

An intensive survey was conducted on the incidence of the disease in major groundnut growing areas of southern Karnataka *viz.,* Chamarajanagar, Chikkaballapur, Chitradurga, Davangere, Kolar and Tumkur districts. The roving survey was employed to assess the disease incidence. The information about cultivar grown, age of the plant, sole or mixed crop and previous crop were recorded during survey. The total number of plant present and number of plants showing disease symptoms due to the *Aspergillus niger* in each plot were counted and recorded. The percent disease incidence was calculated by using the following formula.

$$\text{Per cent disease incidence} = \frac{\text{Number of plants infected}}{\text{Total number of plants examined}} \times 100$$

Isolation of the *A. niger*

Groundnut plants showing typical collar rot symptoms were collected from different parts of southern parts Karnataka. The isolation of fungus was done following standard tissue isolation technique. Those parts of root and collar showing typical symptoms of disease were washed in running tap water and cut into

small bits. These bits were surface sterilized with 0.5 percent sodium hypochlorite solution for 30 seconds. The bits were washed thoroughly in sterile distilled water for 3-4 times to remove traces of sodium hypochlorite and then aseptically transferred to sterilized potato dextrose agar (PDA) plates and were incubated at 27 ± 1ºC for three days for growth of fungus. Later, the bit of fungal growth was transferred to PDA slants.

Mass multiplication

Sorghum seeds were used for the multiplication of *A. niger*. Two hundred and fifty grams of sorghum seeds in autoclavable Polypropylene covers and hundred grams of seeds in conical flask were saturated 20 percent of its weight and sterilized at 1.1 kg/cm2 pressure for 20 minutes. The bits of pure cultured mycelium were placed in the substrate filled Polypropylene covers and conical flask under aseptic condition and both were incubated at 27±1°C for 15 days. These seeds were shaken periodically to get uniform growth of fungus.

Pathogenicity test

Sick pot technique

Twenty days old culture of *A. niger grown* on sorghum seeds were mixed with sterilized soil separately at three percent w/w basis. Then apparently healthy surface sterilized groundnut seeds were sown in pots. Seeds sown in pots without inoculum served as control. Soil moisture was maintained approximately at field capacity by adding water at regular intervals. Observations were recorded regularly for the appearance and development of symptoms. The fungus were re-isolated from infected portion of the plant tissue and compared with that of original isolate.

Blotter paper technique

Blotting paper were cut into circles of 9 cm diameter and sterilized at 1.045 kg /cm^2 for 15 minutes. Three circles of blotting papers were placed at the bottom of sterilized Petri dishes aseptically and moistened by sterilized distilled water. Seeds were placed at an equal distance in each Petri dish. These dishes were incubated at 27 ± 1°C with 12 hours of light alternating with 12 hours of dark period. The seeds were examined after 7 days of incubation.

Screening for groundnut genotypes against collar rot disease

Soil inoculation technique

The *A. niger* grown on sorghum seeds medium were maintained at 27±1°C for 15 days was used for the soil inoculation. The mass multiplied culture which was maintained on sorghum seeds were mixed with sterilized soil. Prior to sowing, pots were sterilized with copper sulphate solution and filled with pathogen inoculated sick soil.

Screening under glasshouse condition

A total of sixty four genotypes were screened for their relative resistance against collar rot disease under sick pot condition in glasshouse. Four seeds of each genotype were sown in individual pots, CRD design was employed and replicated thrice. Observation regarding pre-emergent rot, post-emergent rot and collar rot was taken up to pod formation stage at 10 days interval. Finally disease incidence was calculated based on final observation

$$\text{Percent disease incidence} = \frac{\text{Number of plants infected}}{\text{Total number of plants examined}} \times 100$$

Screening under field condition

A total of seven cultivars were screened against collar rot in ARS, Rajavanthi, Pavagada. An observation on percent disease incidence was recorded at regular interval of time till pod formation stage. After estimating disease incidence the cultivars were categorized into different groups based on disease reaction *viz.*, immune, resistant, moderately resistant, moderately susceptible, susceptible, highly susceptible (disease rating 0, 1, 3, 5, 7 and 9 respectively) as per (Mayee and Datar, 1986).

Statistical analysis

The data were statistically analyzed using the IRRISTAT version 92 developed by the International Rice Research Institute Biometrics unit, the Philippines (Gomez and Gomez, 1984).

Results and Discussion

Survey for collar rot of groundnut disease incidence in southern district of Karnataka

Survey was under taken in both *Kharif* and summer season, whereas disease was more during *Kharif* compared to summer. During *Kharif* 2016 the collar rot incidence was varied from 3.3 to 14 percent. However, in summer disease incidence was 3.3 percent (Table 1 and Table 2). Among the districts, highest mean incidence of 14 percent was recorded in Tumkur with a range of (12.50 %-17.00%) in Venkatapura and Rajavanthi villages of Pavagada taluk, followed by Chamarajanagar (8.50%), Chitradurga (6.40%) with a range of (3.5%-12.0%) in Vadanahalli and Siddeshwaradurga villages of Hiriyur and Challekere taluk, Chikkaballapur (6.15%) with a range of (2.0%-14.0%) in Gudibande (taluk) and Mindgall village of Chintamani taluk and Kolar (3.30%) with a range of (0.0%-7.0%) in Agara and Adugodi villages of Mulbagl taluk. During summer 3.3 percent disease incidence was recorded in Davangere with a range of (0.0%-5.0%) in Lokikere and Linganahalli villages of Davangere and Jagalur taluk. This wide variation in disease incidence was due to the change in the environment conditions, pathogen inoculum in soil, variation in date of sowing, cultural practices followed and cultivars used.

Isolation and identification of collar rot pathogen

Collar rot infected samples were collected from farmer's field in Tumkur and the pathogen was isolated by following standard tissue isolation method. The pure culture obtained was sub-cultured on Petri plate and slants containing potato dextrose agar stored in refrigerator for use in further studies. *A. niger* sub-cultured isolate was identified morphologically on the culture plates showing initially white to yellowish felt-like mat of mycelia, quickly turning black as conidia develop the pigment aspergillin during maturation. Further studies were conducted by examining the type of conidiophore branching, conidia texture, colour and vesicle shape, checking for the presence of biserrate form in *A. niger* through compound microscope. Observations under microscope showed that mycelia were septate, hyaline and conidiophores (Stipes) were long with spherical vesicles at the apex.

They were showing biserrate form, metulae was about to cover the entire surface from which the phialides extended. Conidia were globose, brown to black in colour and had rough surface (Figure 1). Based on the above cultural characters, morphological characters, and the growth of the fungus on media, the pathogen was identified as *Aspergillus niger.*

Table.1 Survey for collar rot disease incidence of groundnut in different districts of southern Karnataka in *Kharif* 2016-2017

Sl.No.	District	Taluk	Villages	Per cent disease incidence	District mean
1	**Chamarajanagara**	**Chamarajanagara**	Hardnahalli	8.5	**8.5%**
2	**Chitradurga**	**Challakere**	Belegere	7.0	**6.4%**
			Heggere	5.0	
			Kadegude	8.0	
			Katamdevarakote	6.0	
			Parasuramapura	10	
			Siddeswaranadurga	12	
			Mean	**8.0%**	
		Hiryur	Kasturirangappenahalli	6.0	
			Rayabommanahalli	5.0	
			Vadanahalli	3.5	
			Mean	**4.8%**	
3	**Chikkaballapur**	**Chintamani**	Munganahalli	8.5	**6.15%**
			Siddepalli	8.0	
			Gudisalahalli	4.5	
			Mindgall	14.0	
			Mittahalli	6.0	
			Mean	**8.2%**	
		Bagepalli	Nadampalli	9.0	
			Chelur	4.0	
			Pathapalya	8.0	
			Mean	**7%**	
		Gudibande	Gudibande	2.0	
			Molanhalli	4.5	
			Mean	**3.25%**	
4	**Kolar**	**Mulbagal**	Audgodi	7.0	**3.3%**
			Ramarayanakote	5.0	
			Tayalur	1.5	
			Agara	0.0	
			Mean	**3.3%**	
5	**Tumkur**	**Pavagada**	Rajavanthi	17.0	**14%**
			Macharajanahalli	14.5	
			Dommathamari	13.0	
			Neralekunte	13.0	
			Venkatapura	12.5	
			Mean	**14%**	

Table.2 Survey for collar rot disease incidence of groundnut in district of southern Karnataka during summer 2016-2017

Sl.No.	District	Taluk	Villages	Per cent disease incidence	District mean
1	**Davangere**	**Davangere**	Belavanur	3.5	**3.3%**
			Lokikere	0.0	
			Hadadi	2.0	
			Naganoor	1.0	
			Mean	**1.6%**	
		Jagalur	Linganahalli	5.0	

Table.3 Screening for genotypes against collar rot disease in glass house condition

Sl.No.	Genotypes	Germination (%)	Pre-emergent collar rot (%)	Post-emergent collar rot (%)	Collar rot (%)	Total Disease incidence (%)	Disease reaction
1	ICG 188	58.33	41.67	0.00	25	100.00	HS
2	ICG 1173	33.33	66.67	0.00	0.00	66.67	HS
3	ICG 1323	83.33	16.67	0.00	16.67	33.34	S
4	ICG 1326	75.00	25.00	0.00	0.00	25.00	S
5	ICG 1435	66.67	33.33	0.00	0.00	33.33	S
6	ICG 1859	100.00	0.00	16.67	8.33	25.00	S
7	ICG 1994	91.67	8.33	0.00	0.00	8.33	MR
8	ICG 2734	91.67	8.33	0.00	0.00	8.33	MR
9	ICG 2738	33.33	66.67	33.33	0.00	100.00	HS
10	ICG 3120	58.33	41.67	0.00	0.00	41.67	S
11	ICG 3263	75.00	25.00	8.33	8.33	41.67	S
12	ICG 3336	58.33	41.67	0.00	0.00	41.67	S
13	ICG 3700	58.33	41.67	0.00	0.00	41.67	S
14	ICG 4343	33.33	66.67	0.00	0.00	66.67	HS
15	ICG 4389	8.33	91.67	0.00	0.00	91.67	HS
16	ICG 4412	33.33	66.67	16.67	8.33	91.67	HS
17	ICG 4527	41.67	58.33	8.33	0.00	66.66	HS
18	ICG 4589	83.33	16.67	0.00	0.00	16.67	MS
19	ICG 4601	41.67	58.33	0.00	0.00	58.33	HS
20	ICG 4749	100.00	0.00	0.00	8.33	8.33	MR
21	ICG 4750	58.33	41.67	0.00	0.00	41.67	S
22	ICG 4888	25.00	75.00	0.00	0.00	75.00	HS
23	ICG 4998	41.67	58.33	25	0.00	83.33	HS
24	ICG 6407	8.33	91.67	0.00	0.00	91.67	HS
25	ICG 7000	58.33	41.67	0.00	0.00	41.67	S
26	ICG 7181	91.67	8.33	0.00	8.33	16.66	MS
27	ICG 7190	91.67	8.33	0.00	0.00	8.33	MR
28	ICG 7243	66.67	33.33	0.00	0.00	33.33	S
29	ICG 7412	83.33	16.67	0.00	0.00	16.67	MS
30	ICG 7633	91.67	8.33	8.33	25	41.66	S
31	ICG 8666	66.67	33.33	58.33	0.00	91.66	HS
32	ICG 9610	58.33	41.67	0.00	0.00	41.67	S
33	ICG 9841	0.00	100.00	0.00	0.00	100.00	HS

34	ICG 10020	58.33	41.67	0.00	0.00	41.67	S
35	ICG 10094	91.67	8.33	0.00	8.33	16.66	MS
36	ICG 10479	41.67	58.33	0.00	0.00	58.33	HS
37	ICG 10933	66.67	33.33	25	0.00	58.33	HS
38	ICG 11426	0.00	100.00	0.00	0.00	100.00	HS
39	ICG 12370	66.67	33.33	58.33	8.33	99.99	HS
40	ICG 13856	91.67	8.33	0.00	0.00	8.33	MR
41	ICG 14985	33.33	66.67	0.00	0.00	66.67	HS
42	ICG 87264	33.33	66.67	0.00	0.00	66.67	HS
43	ICG 95419	33.33	66.67	0.00	8.33	75.00	HS
44	ICGV 87165	0.00	100.00	0.00	0.00	100.00	HS
45	ICGV 91114	50.00	50.00	0.00	0.00	50.00	S
46	ICGV 903021	41.67	58.33	33.33	0.00	91.66	HS
47	GKVK 2	66.67	33.33	8.33	16.67	58.33	HS
48	GKVK 4	50.00	50.00	0.00	8.33	58.33	HS
49	GKVK 5	50.00	50.00	0.00	0.00	50.00	S
50	GKVK 8a	83.33	16.67	66.67	0.00	83.34	HS
51	GKVK 8b	66.67	33.33	33.33	16.67	83.33	HS
52	GKVK 12	75.00	25.00	25	0.00	50.00	S
53	GKVK 17	66.67	33.33	0.00	0.00	33.33	S
54	KCG 6	41.67	58.33	25	0.00	83.33	HS
55	KCG 9	41.67	58.33	0.00	0.00	58.33	HS
56	AVK-2015-9	41.67	58.33	8.33	0.00	66.66	HS
57	TMV-2	66.67	33.33	58.33	8.33	99.99	HS
58	AVK-2015-12	33.33	66.67	0.00	25	91.67	HS
59	ISK-1-2014-15	25.00	75.00	0.00	0.00	75.00	HS
60	ISK-1-2015-5	8.33	91.67	0.00	8.33	100.00	HS
61	ISK-1-2015-8	33.33	66.67	8.33	0.00	75.00	HS
62	ISK-1-2015-9	16.67	83.33	0.00	0.00	83.33	HS
63	ISK-1-2015-10	50.00	50.00	16.67	16.67	83.34	HS
64	ISK-1-2015-11	25.00	75.00	16.67	0.00	91.67	HS
65	TMV 2 (Control)	100.00	0.00	0.00	0.00	0.00	-

Table.4 Disease reaction of groundnut genotypes for collar rot disease under glasshouse condition

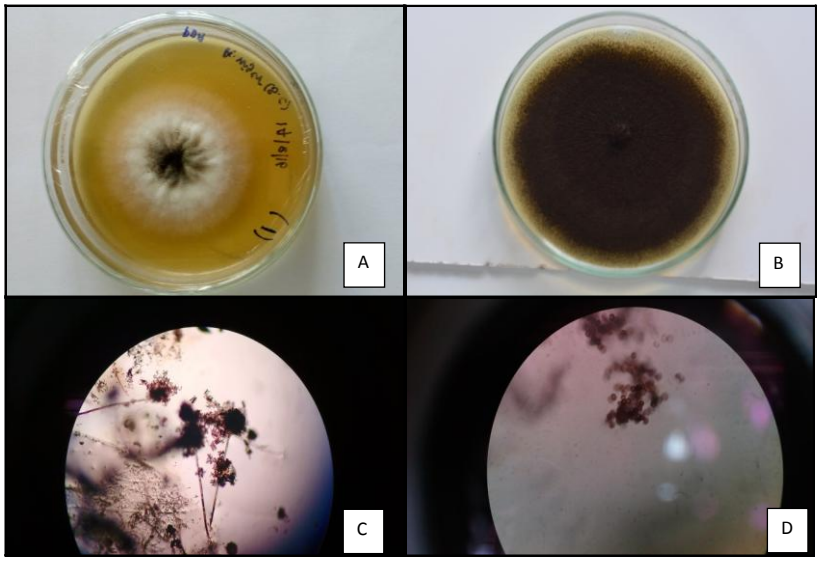
Scale	Reaction	Genotypes	No. of genotype
0	Immune	Nil	-
1	Highly resistant	Nil	-
3	Moderately resistant	ICG 1994,ICG 2734, ICG 4749, ICG 13856, ICG 7190	5
5	Moderately susceptible	ICG 4589, ICG 7181, ICG 7412, ICG 10094	4
7	Susceptible	GKVK-5, GKVK-12, GKVK-17, ICG 1323, ICG 1326, ICG 1435, ICG 1859, ICG 3120, ICG 3263, ICG 3336, ICG 3700, ICG 4750, ICG 7000, ICG 7243, ICG 7633, ICG 9610, ICG 10020, ICGV 91114	18
9	Highly susceptible	AVK-2015-9, AVK-2015-12, ISK-2014-15, ISK-1-2015-5, ISK-1-2015-8, ISK-1-2015-9, ISK-1-2015-10, ISK-1-2015-11, ICG 87264, ICG 95419, ICG 1173, ICG 2738, ICG 188, ICG 4343, ICG 4389, ICG 4412, ICG 4527, ICG 4601, ICG 4888, ICG 4998, ICG 6407, ICG 8666, ICG 9841, ICG 10479, ICG 10933, ICG 11426, ICG 12370, ICG 14985, ICGV 87165, ICGV 903021, GKVK-2, GKVK-4, GKVK-8a, GKVK-8b, KCG 6, KCG 9, TMV-2	37
Total No. of genotypes			64

Table.5 Screening for cultivars against collar rot disease in field condition

Sl.No.	Cultivars	Collar rot*(%)	Disease reaction	Pod yield (q/ ha)*
1	GKVK-5	1.70 (1.48)	MR	8.2 (2.95) [b]
2	K-9	1.70 (1.48)	MR	8.2 (2.95) [b]
3	KCG-6	1.70 (1.48)	MR	9.7 (3.19) [a]
4	TMV-2	2.30 (1.67)	MR	7.7 (2.86) [b]
5	GKVK-13	2.70 (1.79)	MR	8 (2.95) [b]
6	K-6	1.0 (1.22)	MR	10.5 (3.32) [a]
7	ICGV91114	1.30 (1.34)	MR	10.0 (3.24) [a]
8	GPBD-4	3.30 (1.95)	MR	7.6 (2.85) [b]
	F Test	NS		**
	S.Em ±	0.78		0.48
	CD at (0.05 %)	1.69		1.04

Figures in parentheses are arc sin angular transformed values

Fig.1 Cultural and morphological characters of *A. niger*



A. Initial white mycelial growth of *A. niger* on PDA
B. Colony turns into black colour upon sporulation
C. Microscopic view with complete structure of *A. niger*
D. Conidia brown in colour with rough surface

Pathogenicity

The Pathogenicity was conducted by sick pot method and blotter paper technique. Pathogenicity test was conducted by following artificial inoculation of soil with *A. niger* on susceptible groundnut cultivar TMV 2. The culture prepared by using sorghum seeds were inoculated to sick soil. The collar rot symptoms were observed at different stages of crop. Symptoms *viz.*, pre-emergent seed rot, post-emergent seedling rot, collar rot at crown region of plant and finally death of the plant were recorded. Symptoms where the *A. niger* inoculated artificially were similar to that of the plants identified in the field condition. Re-isolation of the pathogen from artificially inoculated plant were compared with original culture of *A. niger* it was found to be similar with regards to all morphological characters on PDA.

Pathogenicity test was also performed in laboratory by blotter paper technique. Five infected seeds were placed at equidistance in Petri dishes for incubation. Re-isolation of the pathogen from infected seeds obtained were compared with original culture of *A. niger,* was found to be similar with respect to morphological characters on PDA.

Screening for groundnut genotypes against collar rot disease

Sorghum seeds were used for the multiplication of *A. niger* were mixed to sterilized soil and filled into sterilized pots. After two days each pot was sown with four seeds at equidistance. Different groundnut genotypes were screened for collar rot disease in sick pot maintained at glass house, Department of Plant Pathology, GKVK, Bengaluru during 2016-17 and field screening was done in ARS, Rajavanthi, Pavagada. The observations were recorded from date of sowing to maturity stage. The genotypes were categorized into disease reactions based on the disease incidence.

Screening for genotypes against collar rot disease in glasshouse condition

Sixty four genotypes were screened for collar rot of groundnut and results are presented in Table 3. Among sixty four genotypes screened along with control for collar rot, five genotypes *viz.,* ICG 1994, ICG 2734, ICG 4749, ICG 13856 and ICG 7190 showed moderately resistant reaction with 1-10 percent disease incidence, whereas four genotypes *viz.,* ICG 4589, ICG 7181, ICG 7412 and ICG 10094 showed moderately susceptible reactions with (11-20 %) disease incidence, eighteen genotypes *viz.,* GKVK- 5, GKVK-12, GKVK-17, ICG 1323, ICG 1326, ICG 1435, ICG 1859, ICG 3120, ICG 3263, ICG 3336, ICG 3700, ICG 4750, ICG 7000, ICG 7243, ICG 7633, ICG 9610, ICG 10020 and ICGV 91114 showed susceptible reaction with (21-50 %) disease incidence, remaining thirty seven genotypes *viz.,* AVK-2015-9, AVK-2015-12, ISK-2014-15, ISK- 1-2015-5, ISK-1-2015-8, ISK-1-2015-9, ISK-1-2015-10, ISK-1-2015-11, ICG 87264, ICG 95419, ICG 1173, ICG 2738, ICG 188, ICG 4343, ICG 4389, ICG 4412, ICG 4527, ICG 4601, ICG 4888, ICG 4998, ICG 6407, ICG 8666, ICG 9841, ICG 10479, ICG 10933, ICG 11426, ICG 12370, ICG 14985, ICGV 87165, ICGV 903021, TMV-2, GKVK-2, GKVK-4, GKVK-8a, GKVK-8b, KCG 6 and KCG 9 showed highly susceptible reaction with disease incidence of 51-100 percent, whereas control was free from disease (Table 4).

Screening for groundnut cultivars against collar rot disease in field condition

Eight cultivars were screened for collar rot and results are presented in Table 5. Among eight cultivars screened for collar rot of groundnut, all of them were showed moderately resistant reaction with (1-10 %) disease incidence. Cultivar K-6 recorded highest pod yield of 10.5 q/ha followed by ICGV 91114 (10.0 q/ha), KCG-6 (9.7 q/ha), GKVK -5 and K-9 (8.2 q/ha), GKVK-13 (8.0 q/ha), TMV-2 (7.7 q/ha) and GPBD-4 (7.6 q/ha). Three cultivars *viz.,* ICGV 91114, KCG-6 and GKVK-5 were showed susceptible to disease in pot studies, whereas, they showed moderately resistance reaction, due to the inoculum load in the natural field condition as well as the performance of the cultivar in the field condition.

Collar rot is caused by *Aspergillus niger* van Teighem is one of the most important disease of groundnut which is more extensive in the *kharif* than the *rabi* and summer season and is now becoming serious threat to groundnut production recently (Desai and Bagwan, 2005). As per literature reviewed and there is a need to generate the detailed investigations on certain aspects of collar rot of groundnut. Investigations were carried out in respect to survey for disease incidence, isolation, identification of the pathogen and pathogenicity, screening of groundnut genotypes and the results are discussed here.

Collar rot disease incidence was highest in Tumkur (14%) followed by Chamarajanagar (8.50%), Chitradurga (6.40%), Chikkaballapur (6.15%) and Kolar (3.30%) in *Kharif* season. The 3.3 percent disease incidence was recorded in Davangere during summer. The results were conformity with findings of Surekha Prabhu (1991) who recorded occurrence of disease in Kolar and Chikkaballapur districts of southern Karnataka on different cultivars of groundnut. Kadam *et al.,* (2011) also conducted field surveys of groundnut in the Marathwada region of Maharashtra and recorded maximum disease incidence (17.8%) in Renepur, Tahsil and minimum disease incidence (8.9%) in Nilanga. The same type of observation was recorded and which revealed that collar rot of groundnut varied from locality to locality due to different soil

conditions, cultivars used, cultivation practices and environmental conditions prevailing over these tracts. The higher incidence may be due to exposure of chickpea plants to moisture stress conditions and high temperature (Kishore *et al.,* 2007).

The causal organism of collar rot pathogen was isolated from diseased plants of groundnut by following standard tissue isolation method. The pure culture was obtained through hyphal tip culture, maintained on potato dextrose agar and stored in refrigerator for further studies.

These results are in conformity with earlier workers of Jackson (1962), Anderegg *et al.,* (1976), Mohamed *et al.,* (2012), Matloob and Juber (2014). *A. niger* culture plates showed initially white to yellowish felt-like mat of mycelia, quickly turned black as conidia produced aspergillin pigment during maturation. Conidiophore was without segmentation, vesicle was spherical, it was biserrate form and conidial characters like brown colour, rough texture were observed through compound microscope.

The results of the present investigations are inconformity with those observed by Okuda *et al.,* (2000) and Diba *et al.,* (2007). Visual observation on collar rot of groundnut plants was recorded at various stages of crop growth. Symptoms appeared from initial stage to maturation stage. Affected plants showed various types of symptoms *viz.,* pre-emergent seed rot, post-emergent seedling rot, collar rot at crown region of plant followed by death of the plant. Similar symptomatic observations were made by several workers Morwood (1945), Jain and Nema (1952), Gibson (1953), Chohan (1965), Gajera *et al.,* (2011), Rakholia *et al.,* (2012). Pathogenicity test was performed by sick pot culture technique, collar rot symptoms were observed from 7-50 days after sowing. Symptoms consisted of pre-emergent seed rot, post-emergent seedling rot, collar rot at crown region of plant. Symptoms due to collar rot in potted plants inoculated with *A. niger* were similar to that in the field. Re-isolation of the pathogen from infected portion was made and pathogenic cultures obtained were compared with original culture of *A. niger* and found to be similar with findings of Sen and Kapoor (1975), Kataria and Grover (1976), Radhakrishanan and Sen (1985) and Ramakrishna and Kolte (1989).

In laboratory pathogenicity was proved by blotter paper technique. After seven days of inoculation, the seeds were covered by black spores, emerged seedlings were rotted finally death of the seedlings were occurred. Re-isolation of the pathogen from infected portion was made and pathogenic cultures obtained was compared with original culture of *A. niger* and found to be similar with the findings of Guptha and Chohan (1970), Mercer and Kisyambe (1978), Shim *et al.,* (1996) and Cavallo *et al.,* (1994). The utilization of resistant varieties is a classical approach to prevent the catastrophic losses caused by collar rot it reduces the cost of production and increase yield. Keeping this in view, investigation on performance of groundnut genotypes against collar rot disease under sick pot condition and field conditions were under taken. Among sixty four genotypes screened for collar rot five genotypes *viz.,* ICG 1994, ICG 2734, ICG 4749, ICG 13856 and ICG 7190 showed moderately resistant reactions, whereas four genotypes viz., ICG 4589, ICG 7181, ICG 7412 and ICG 10094 showed moderately susceptible reactions, eighteen genotypes showed susceptible reaction and thirty seven genotypes showed highly susceptible reaction. None of the genotypes showed immune and resistant reaction under glasshouse condition. Among eight cultivars screened for collar rot of groundnut in field condition, all of them

were showed moderately resistant reaction disease incidence. Cultivar K-6 recorded least per cent disease incidence (1.0%) and highest pod yield of 10.5 q/ha, TMV-2 and GPBD-4 recorded more per cent disease (2.3% & 3.3%) with least pod yield of (7.7 q/ha) and (7.6 q/ha) respectively. Similarly Mehan *et al.*, (1987), Dasgupta and Raj (1997), Bhatia and Gangopadhyay (1996), Gaur and Singh (1993) and Sarawat *et al.*, (2004) reported resistant genotypes, moderately resistant genotypes, moderately susceptible genotypes, susceptible genotypes and highly susceptible genotypes for collar rot disease with varying level of yield.

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