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REACTION OF CHICKPEA VARIETIES/GENOTYPES AGAINST DRY ROOT ROT DISEASE INCITED BY *Rhizoctonia bataticola*

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ABSTRACT

In this study seventy-two entries of chickpea were screened under natural field condition against dry root rot disease and found that the none of variety or germplasm was recorded free from disease and categorized as resistant. Evaluation of genotypes for percent disease incidence (PDI) across 2023-24 and 2024-25 revealed significant variation in disease resistance. Among 72 genotypes/varieties screened, 10 were found moderately resistant, 14 entries were exhibited moderately susceptible reaction entries were exhibited susceptible reactions while 10 entries were recorded highly susceptible to dry root rot disease.

***Key words*:** Dry root rot, Varieties/Genotypes, Screening, *Rhizoctonia bataticola*, Chickpea, Disease incidence

Introduction

Chickpea (*Cicer arietinum* L.) is an important pulse crop that belongs to the *Leguminaceae* family and is grown in tropical, subtropical and temperate regions of the world and occupies the third position among important grain legumes after common bean and pea (Anwar *et al.*, 2009). Chickpea, the most important pulse crop widely grown in India, accounts for nearly 75 per cent of the total pulse production in the world (Keote *et al.*, 2019). It is produced as a *Rabi* season crop, under irrigated and rainfed conditions having a very important position in the arid and semi-arid farming system.

Chickpea is an important grain legume providing an enormous source of minerals, fibers and proteins both for humans and animals. Chickpea seeds contains phosphorus (340 mg/100 g), calcium (190 mg/100 g), magnesium (140 mg/100 g), iron (7 mg/100 g) and zinc (3 mg/100 g) and on an average 23% protein, 64% total carbohydrates (47% starch, 6% soluble sugar), 5% fat, 6% crude fiber and 3% ash. Its protein is rich in lysine and has low sulphur-containing amino acids; therefore, it is a protein-rich supplement and resource of cheap protein compared to animal protein to all cereal-based diets, mainly for vegetarians. Its lipid ratio is high in unsaturated fatty acids, so it is extensively appreciated as healthy food. On the other hand, chickpea plays an important role in improving soil fertility by fixing atmospheric nitrogen. It meets 80 per cent of nitrogen necessity from symbiotic nitrogen fixation, can fix up to 140 Kg N/ha from the air, and adds a large amount of residual nitrogen for subsequent crops. It also adds plenty of organic matter, which improves soil health and fertility. Because of its deep taproot system can resist drought conditions by extracting water from deeper layers in the soil profile (Kashiwagi *et al.*, 2005; Krishnamurthy *et al.*, 2003).

The average production of chickpea is low in spite of high yielding varieties and new agronomic practices. The reasons for low yield are numerous, but the main cause is the prevalence of diseases. The chickpea crop is attacked by 172 pathogens (67 fungi, 3 bacteria, 22

viruses, 80 nematodes and mycoplasma) all over the world (Nene and Sheila, 1996). Chickpea suffers from a large number of fungal diseases namely Fusarium wilt (*F. oxysporum* f. sp. *ciceri*), Dry root rot (*Rhizoctonia bataticola*), Ascochyta blight (*Ascochyta rabiei)*, Powdery mildew (*Leveillula taurica*), Alternaria blight (*Alternaria alternata*), Colletotrichum blight (*Colletotrichum dematium*), Stemphylium blight (*Stemphylium sarciniforme*), Wet root rot (*Rhizoctonia solani*), Sclerotinia stem rot (*Sclerotinia sclerotiorum*) and Foot rot (*Operculella padwickii*) (Singh and Sharma, 2005; Dubey *et al.*, 2007).Chickpea diseases may cause yield losses up to 100% depending on time of infection. Reports indicate that dry root rot (DRR) is emerging as a potential threat to chickpea production (Pande *et al.*, 2010; Sharma *et al.*, 2010 and Ghosh *et al.*, 2013).

Macrophomina phaseolina (Tassi) Goid (formerly referred to as *Rhizoctonia bataticola*) is a soil borne necrotrophic fungal pathogen (asexual form) that causes dry root rot (DRR) disease in chickpea. Similarly, *M. phaseolina* strains cause foliage blight in cowpea (*Vigna unguiculata*) root rot in mungbean (*Vigna radiata*), and charcoal rot in corn (*Zea mays*) and soybean (*Glycine max*) (Gupta *et al.*, 2012 ; Gupta and Sharma, 2015). Microsclerotia and hyphae are the forms of inoculum that survive in the soil. The mycelia infect the roots of the plant, followed by penetration through the epidermal cells ultimately causing necrosis (Singh and Mehrotra, 1982). This disease mostly appears at flowering and pod formation stages as scattered dried plants. The dropping of petioles and leaflets is confined to top of the plant. The taproot is blackened, with signs of rotting and loss of lateral roots. The roots become brittle, and conspicuous, minute, dark microsclerotia can be observed on the inside of the bark of split roots (Sinha *et al.*, 2019 and Khaliq *et al.*, 2020). Under field conditions, disease symptoms appear during the crop's reproductive phase as straw colored leaves and petioles and, finally, dried foliage.

Dry root rot is a major disease that causing significant loss in chickpea. Earlier, it was reported to cause yield loss of about 10-25 per cent (Pal, 1998). But after that it became severe in most chickpea growing areas and caused more than 50 per cent yield loss (Massoud and Kumar, 2001).

Although chemical control and agronomic practices can reduce the disease burden, they are not economically or environmentally sustainable in the long term, especially for resource poor farmers. One of the most effective and environmentally sound strategies to manage dry root rot disease is the development of resistant cultivars. Varietal resistance offers a cost-effective, durable, and farmer-friendly approach to disease management.

Table : Disease scale for categorization of genotypes Patidar *et al.*, (2019).

Rating scale	Disease incidence (%)	Category
1	0-10	Resistant (R)
3	10.01-20	Moderately resistant (MR)
5	20.01-30	Moderately susceptible (MS)
7	31.01-50	Susceptible (S)
9	>50	Highly susceptible (HS)

Therefore, the identification and screening of resistant chickpea varieties is a crucial step in any integrated disease management program. Varietal screening involves the evaluation of different genotypes under natural or artificial inoculation.

Materials and Methods

Experimental site and materials

Total seventy-two chickpea genotypes (Table 1) were screened under natural conditions for their reactions (Table 2) against dry root rot (*Rhizoctonia bataticola*) with three replications during *rabi*, 2023-24 and 2024-25 at Agronomy farm, S.K.N College of Agriculture, Jobner, Jaipur. Susceptible check (GNG 1581) was planted on every 7th row alternately (30 cm × 10 cm row to row and plant to plant distance, respectively).

Per cent disease incidence (PDI) and disease control in various experiments were calculated as follows:

$$\text{Disease incidence (\%)} = \frac{\text{Number of diseased plants}}{\text{Total number of plants observed}} \times 100$$

Results and Discussion

Host plant resistance is an ultimate tool to keep away the diseases. A simple and low-cost method to know the source of resistance in genotypes is screening under natural field conditions at Agronomy Farm of SKNCOA Jobner. The evaluation of different genotypes for percent

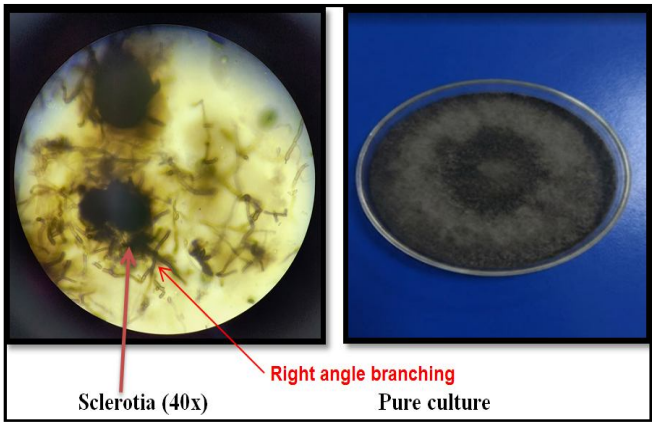


Fig. 1: Morphological characteristics of *Rhizoctonia bataticola*.

Table 1: Reaction of chickpea genotypes to dry root rot disease under field conditions.

S. No.	Genotypes /varieties	Disease incidence*		Pooled	DR
		2023-24	2024-25		
1	CSJ 1223	29.66(32.97)	32.50(34.73)	31.08(33.86)	S
2	GP 118	31.33(34.02)	34.00(35.60)	32.67(34.82)	S
3	GP 124	36.16(36.90)	32.33(34.50)	34.25(35.77)	S
4	GP 137	62.66(52.45)	54.86(47.78)	58.76(50.07)	HS
5	GP 161	37.66(37.74)	39.52(38.91)	38.59(38.34)	S
6	GP 167	21.25(27.39)	19.26(25.92)	20.25(26.72)	MS
7	GP 174	44.66(41.82)	39.67(38.96)	42.16(40.41)	S
8	GP 241	41.66(40.17)	43.10(41.00)	42.38(40.59)	S
9	GP 180	46.00(42.68)	38.00(38.03)	42.00(40.37)	S
10	GP 217	58.66(49.98)	51.00(45.55)	54.83(47.76)	HS
11	GP 203	20.13(26.63)	25.00(29.97)	22.56(28.33)	MS
12	GP 213	27.14(31.33)	20.48(26.59)	23.81(29.06)	MS
13	GP 221	18.66(25.55)	23.83(29.11)	21.25(27.43)	MS
14	GP 238	54.33(47.47)	48.00(43.83)	51.16(45.65)	HS
15	GP 240	47.66(43.64)	44.00(41.53)	45.83(42.58)	S
16	GP 248	45.33(42.29)	49.00(44.40)	47.16(43.35)	S
17	GP 264	56.33(48.62)	51.80(46.01)	54.06(47.32)	HS
18	GP 274	56.33(48.62)	53.45(46.96)	54.89(47.79)	HS
19	GP 39	14.67(22.49)	21.33(26.99)	18.00(24.89)	MR
20	GP 37	59.00(50.18)	55.00(47.85)	57.00(49.01)	HS
21	GP 38	24.66(29.57)	28.83(32.45)	26.75(31.07)	MS
22	GP 43	43.67(41.33)	45.00(42.10)	44.33(41.72)	S
23	GP 5	19.00(25.79)	25.00(29.97)	22.00(27.94)	MS
24	GP 52	25.66(30.40)	28.50(32.23)	27.08(31.32)	MS
25	GP 55	47.66(43.64)	44.00(41.53)	45.83(42.58)	S
26	GP 57	58.66(50.00)	54.00(47.28)	56.33(48.63)	HS
27	GP 59	26.33(30.82)	21.51(27.60)	23.92(29.24)	MS
28	GP 6	30.50(33.45)	36.00(36.84)	33.25(35.17)	S
29	GP 65	17.51(24.72)	16.43(23.76)	16.97(24.28)	MR
30	GP 70	17.33(24.56)	18.00(25.08)	17.67(24.83)	MR
31	GP 79	50.44(45.24)	57.00(49.01)	53.72(47.13)	HS
32	GP 81	17.55(24.60)	22.22(27.71)	19.89(26.44)	MR
33	GP 86	62.48(52.23)	53.00(46.70)	57.74(49.44)	HS
34	GP 9	48.00(43.83)	45.00(42.10)	46.50(42.97)	S
35	RSG884N/S	47.00(43.25)	41.00(39.79)	44.00(41.53)	S
36	RSG 896	28.00(31.92)	24.92(29.90)	26.46(30.92)	MS
37	RSG963LC	48.00(43.83)	50.15(45.06)	49.07(44.45)	S
38	RSG 973	15.50(23.11)	19.67(25.93)	17.58(24.71)	MR
39	RSG991CH	34.00(35.64)	37.00(37.44)	35.50(36.54)	S
40	RSGD 1083	13.00(21.11)	15.00(22.77)	14.00(21.95)	MR
41	RSGD 1112	26.79(31.08)	21.00(27.24)	23.89(29.20)	MS
42	RSGD 1123	31.00(33.81)	36.22(36.96)	33.61(35.40)	S
43	RSGD 1141	18.00(25.089)	16.00(23.56)	17.00(24.33)	MR
44	RSGD 1147	23.00(28.63)	28.00(31.92)	25.50(30.30)	MS
45	RSGD 1148	32.18(34.53)	34.00(35.64)	33.09(35.09)	S
46	RSGD 1156	45.00(42.10)	51.18(45.67)	48.09(43.88)	S
47	RSGD 1164	29.70(32.82)	31.00(33.81)	30.35(33.35)	S
48	RSGD 1181	23.00(28.63)	27.00(31.28)	25.00(29.97)	MS
49	RSGD 1186	29.00(32.56)	33.96(35.52)	31.48(34.06)	S
50	RSGD 1195	48.00(43.83)	52.00(46.13)	50.00(44.98)	S
51	RSGD 1197	32.48(34.72)	35.00(36.24)	33.74(35.49)	S
52	RSGD 1198	35.00(36.24)	38.00(38.03)	36.50(37.14)	S
53	RSGD 1199	23.00(28.63)	22.00(27.94)	22.50(28.29)	MS
54	RSGD 1201	24.18(29.36)	21.18(27.28)	22.68(28.41)	MS
55	RSGD 1204	45.00(42.10)	22.00(27.94)	33.50(35.33)	S
56	RSGD 1210	43.00(40.95)	46.00(42.68)	44.50(41.80)	S
57	RSGD 1225	34.00(35.64)	31.00(33.81)	32.50(34.73)	S
58	RSGD 1231	48.00(43.83)	43.00(40.95)	45.50(42.39)	S
59	RSGD 1232	35.00(36.24)	38.59(38.38)	36.79(37.32)	S
60	RSGD 1246	19.00(25.81)	18.55(25.07)	18.77(25.53)	MR
61	RSGD 1250	36.18(36.96)	40.00(39.20)	38.92(38.94)	S
62	RSGD 1253	17.00(24.33)	19.00(25.81)	18.00(25.08)	MR
63	RSGD 1255	38.00(38.03)	39.00(38.62)	38.50(38.32)	S
64	RSGD 1260	33.67(35.38)	36.63(37.22)	35.14(36.33)	S
65	RSGD 1261	18.00(25.08)	17.00(24.33)	17.50(24.71)	MR
66	RSGD 1262	30.00(33.19)	32.00(34.42)	31.00(33.80)	S
67	RSGD 1263	42.11(40.43)	46.00(42.68)	44.05(41.56)	S
68	RSGD 1273	47.00(43.25)	52.51(46.42)	49.75(44.84)	S
69	RSGD 1276	45.00(42.10)	48.00(43.83)	46.50(42.97)	S
70	GP 2	47.67(43.63)	43.44(41.18)	45.55(42.42)	S
71	RSGD 924	41.00(39.79)	38.67(38.42)	39.83(39.11)	S
72	GNG 1581	56.00(48.43)	57.00(49.01)	56.50(48.72)	HS
	SEm±	**1.35**	**1.48**	**1.00**	**-**
	CD $_{(p=0.05)}$	**3.79**	**4.14**	**2.82**	**-**
	CV (%)	**6.45**	**7.06**	**5.79**	**-**

DR: Disease reaction; * Average of three replications
** Figures in parentheses are angular transformed values

Continue ...1

disease incidence (PDI) revealed significant variation across the two years, 2023-24 and 2024-25.

Resistant/tolerant cultivars are the most viable, environmentally safe, economically sound and less expensive technique for disease management. Therefore, identification of the source of resistance is a basic requirement in breeding programme for development of disease resistance. Hence, the present investigation was undertaken to find out the source of resistance against



Fig. 2: Typical disease symptoms of dry root rot of chickpea.

Table 2: Categorization of chickpea genotypes/varieties based on their reaction against dry root rot disease (As per Patidar *et al*., 2019).

Disease reaction	Disease incidence (%)	Genotypes/ varieties	Total entries
Resistant	0-10	-	0
Moderately resistance	10.1-20	GP 39, GP 65,GP 70, GP 81, RSG 973,RSGD 1083,RSGD 1141, RSGD 1246	10
Moderately susceptible	20.1-30	GP 167, GP 203, GP 213, GP 221, GP 38, GP 5, GP 52, GP 59, RSG 896, RSGD 1112, RSGD 1147, RSGD 1181, RSGD 1199, RSGD 1201	14
Susceptible	30.1-50	CSJ 1223, GP 118, GP 124, GP 161, GP 174, GP 241, GP 180, GP 240, GP 248, GP 43, GP 55, GP 6, GP 9, RSG 884 N/S, RSG 963 LC, RSG 991 CH, RSGD 1123, RSGD 1148, RSGD 1156, RSGD 1164, RSGD 1186, RSGD 1195, RSGD 1197, RSGD 1198, RSGD 1204, RSGD 1210, RSGD 1225, RSGD 1231, RSGD 1232, RSGD 1250, RSGD 1255, RSGD 1260, RSGD 1262, RSGD 1263, RSGD 1273, RSGD 1276, GP 2, RSGD 924	38
Highly susceptible	> 50	GP 137, GP 217, GP 238, GP 264, GP 274, GP 37, GP 57, GP 79, GP 86 and GNG 1581	10

dry root rot pathogen.

Among screened 72 genotypes/varieties, 10 were found moderately resistant (GP 39, GP 65,GP 70, GP 81, RSG 973, RSGD 1083, RSGD 1141, RSGD 1246), 14 entries were exhibited moderately susceptible reaction (GP 167, GP 203, GP 213, GP 221, GP 38, GP 5, GP 52, GP 59, RSG 896, RSGD 1112, RSGD 1147, RSGD 1181, RSGD 1199, RSGD 1201), 38 entries were exhibited susceptible reactions (CSJ 1223, GP 118, GP 124, GP 161, GP 174, GP 241, GP 180, GP 240, GP 248, GP 43, GP 55, GP 6, GP 9, RSG 884 N/S, RSG 963 LC, RSG 991 CH, RSGD 1123, RSGD 1148, RSGD 1156, RSGD 1164, RSGD 1186, RSGD 1195, RSGD 1197, RSGD 1198, RSGD 1204, RSGD 1210, RSGD 1225, RSGD 1231, RSGD 1232, RSGD 1250, RSGD 1255, RSGD 1260, RSGD 1262, RSGD 1263, RSGD 1273, RSGD 1276, GP 2, RSGD 924) while 10 entries were recorded highly susceptible to dry root rot disease (GP 137, GP 217, GP 238, GP 264, GP 274, GP 37, GP 57, GP 79, GP 86 and GNG 1581).



Fig. 3: Screening of Genotypes/ varieties.

Conclusion

The comprehensive screening of seventy two chickpea genotypes under natural field conditions over two years (*Rabi* 2023-24 and *Rabi* 2024-25) has revealed a clear spectrum of resistance levels to dry root rot disease. Although none of the entries exhibited complete resistant, 10 genotypes demonstrated notable moderately resistance with low percent disease incidence (PDI), making them promising candidates for future breeding programs. The identification of moderately susceptible genotypes further enhances our understanding of the genetic diversity in disease response. The statistically strong findings of this study highlight the firmness and potential for directed breeding strategies aimed at refining disease resistance in chickpea, ultimately contributing to more robust crop production systems.

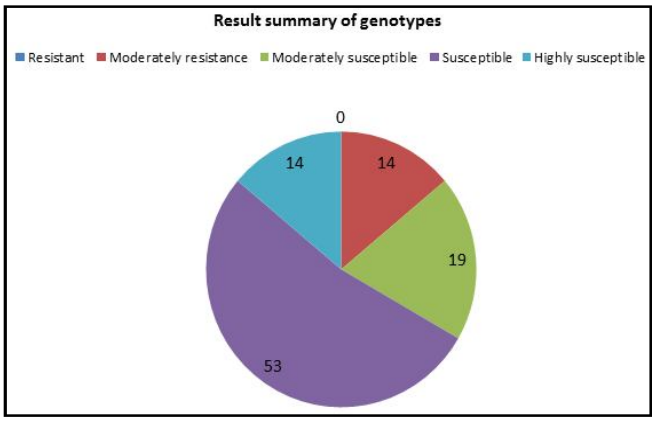


Fig. 4: Frequency of genotypes under various categories of disease reaction.

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