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Evaluation of chickpea Germplasm against Dry Root Rot disease caused by *Rhizoctonia bataticola (Taub.)* Butler

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ABSTRACT

Chickpea dry root rot is caused by *Rhizoctonia bataticola* is the most destructive disease and causes severe losses in the yield. The present investigation was undertaken to screen different advanced breeding lines for their resistance to dry root rot disease under field conditions during *rabi,* 2018-19 and 2019-20 at RARS, Nandyal. A total of fifty one (51) Desi and kabuli chickpea advanced breeding lines were evaluated against dry root rot disease in which four (04) were found resistant, six (06) were moderately resistant, four (04) were moderately susceptible, 24 were susceptible and 13 were found to be highly susceptible to dry root rot disease.

Key words : *Chickpea, Dry root rot, Destructive, Advanced breeding lines, Rhizoctonia bataticola*

Introduction

Chickpea (*Cicer arietinum* L.) is a first grain legume originated from south west Asia. It accounts for 20 per cent of the world pulses production. Chickpea seeds is a good source of protein (18-23%) with having balanced amount of carbohydrates, starch, fat, crude fiber, soluble sugar and minerals such as calcium, phosphorous, iron, vitamin C, B complex. The genus belongs to the family Leguminaceae and sub family Papilionoidae. In recent years, the country has witnessed remarkable increase in area, production and productivity of chickpea. India contributes to a major share of the world's chickpea area (70 %) and production (67 %) and continues to be the largest chickpea producing nation (Dixit *et al*., 2019). In India, area under chickpea was 10.22 M/ha with production 9.88 MT and productivity 967 kg/ha.

Ecological, environmental and physiological factors and intensity of biotic stresses are known to aggravate the occurrence and also severity of the diseases. Dry root rot which affects crop at reproductive stage is a serious and widely distributed disease of chickpea causing 20-30 per cent crop losses in major chickpea growing states of India (Nene *et al*., 2012). Environmental factors like temperature, soil

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moisture and pH plays an important and key role in determining the viability and growth of the pathogen *Rhizoctonia.*

R. bataticola is a polyphagous soil borne pathogen infecting over 500 plant species worldwide causing huge losses. Though, the fungus is seed and soil borne (Dhingra and Sinclair, 1994), however, soil borne inoculum is more important in causing infection and disease development. Management of dry root rot through chemicals is not effective as *R. bataticola* has a broad host range and survives in soil for prolonged periods in the form of sclerotia. The scleratia will survive up to ten months even within the absence of the host plants and beneath prevailing dry soil conditions. Use of host plant resistance is that the most economical approach for management of dry root in chickpea. The present investigation was undertaken to find out the resistance source against dry root rot disease.

Materials and Methods

A total of fifty one (51) Desi and kabuli chickpea advanced breeding lines supplied by Chickpea Breeder, RARS, Nandyal were screened under field conditions for their resistance to dry root rot disease during *rabi*, 2018-19 and *rabi*, 2019-20 at Agricultural Farm, Nandyal. The experiment was laid out in Randomized Block Design replicated twice by following all recommended agronomic practices of ANGRAU. Inorder to create disease presuure, inoculum of the fungus, *R. bataticola which* was multiplied on sorghum grains for artificial inoculation was added to the soil at the time of flowering. The seeds of the test line were sown in infested soil. Each advanced line was sown in two rows of three meter row length each. Inorder to ensure the uniform spread of the pathogen, for every five test genotypes one line of L-550 susceptible check and Resistant check (WR-315) were sown in the first and last row of the experiment. Twenty five days after sowing of the seed, after carrying out of thinning in replicated rows, the total number of plants germinated in each row were counted. Number of infected plants at 60, 80 DAS & harvest and Percent Disease Incidence (%) at 60 & 80 DAS will be calculated.

Per cent Disease Incidence = Number of plants infected/total number of plants x 100

The advanced breeding lines were placed in various categories of resistance and susceptibility on the basis of percentage of plants infected with the dry root rot rated as under :

Based on disease incidence, the breeding lines were categorized into different groups as given in Table 2.

Results and Discussion

In the current study conducted during *rabi,* 2018-19 and 2019-20 at RARS, Nandyal, a total of fifty one (51) Desi and kabuli chickpea advanced breeding lines supplied by Chickpea Breeder RARS, Nandyal were screened under field conditions for their resistance against dry root rot disease.

During *rabi,* 2018-19, five entries *viz.,* AVT_1 (RF)-2; IVT (LS)-12, 14; IVT (K+ELSK)-15 ; IVT (RF)-24 showed resistant reaction, nine entries (IVT (D)-21; AVT (D)-8, 14; AVT_1 (LS)-1,4 ; IVT (LS)-8 ; IVT (RF)-

Table 1. List of Chickpea Advanced Breeding lines

S.No	Name of the entry	No. of Entries	List of Entries
1	IVT (D)	08	IVT (D)-2, 3, 10, 17, 21, 28, 30, 35
2	AVT_1(D)	05	AVT_1(D)- 6, 8, 11, 14, 15
3	AVT_1 (LS)	04	AVT_1 (LS) -1,4,6,8
4	AVT_2 (D)	01	AVT_2 (D) - 1
5	AVT_1 (RF)	03	AVT_1 (RF) – 1, 2, 3
6	IVT (LS)	08	IVT (LS) – 4, 6, 8, 11, 12, 13, 14, 16
7	IVT (MH)	02	IVT (MH) – 7, 9
8	IVT (K+ELSK)	04	IVT (K+ELSK) – 14, 15, 17, 19
9	IVT (RF)	08	IVT (RF) – 1, 2, 3, 6, 8, 9, 24, 27
10	AVT_{2+1} (MH)	02	AVT_{2+1} (MH) – 1, 2
11	AVT_{2+1} (DTIL)	03	AVT_{2+1} (DTIL) – 2, 3, 5
12	AVT_1 (K+ELSK)	02	AVT_1 (K+ELSK) – 1, 3
13	AVT_{2+1} (WRIL)	01	AVT_{2+1} (WRIL) - 1
	Total	**51**	

Table 2. Table showing disease Reaction for Dry Root Rot

S. No	Dry Root Rot incidence (%)	Symptoms of Dry Root Rot	Disease Reaction
1	0-10	No infection	Resistant (R)
2	11-20	Very few small lesions black discolouration on roots	Moderately Resistant (MR)
3	21-30	Lesions on roots clear and small, but less, new roots free from infection	Moderately Susceptible(MS)
4	31-50	Lesions on roots more, many new roots free from infection	Susceptible (S)
5	51-100	Roots infected and completely discoloured	Highly Susceptible (HS)

Table 3. Reaction of Chickpea breeding lines against Dry Root Rot (DRR) during *rabi,* 2018-19

Reaction	No. of Entries	List of Entries
Resistant (R)	05	AVT_1(RF)-2; IVT (LS)-12,14; IVT (K+ELSK)-15; IVT (RF)-24
Moderately Resistant (MR)	09	IVT (D)-21; AVT (D)-8, 14; AVT_1 (LS)-1,4; IVT (LS)-8;IVT (RF)-27; AVT_{2+1} (DTIL)-3,5
Moderately Susceptible (MS)	04	IVT (D)-28, 30 ; IVT (RF) - 3,6
Susceptible (S)	18	IVT (D) - 2,3,10,17,35; AVT1 (D)-6, 11, 15; AVT_2 (D)-1, IVT (LS)-16; IVT (K+ ELSK)-14,17 ; IVT (RF)- 8, 9 ; AVT_{2+1} (MH)- 1, 2
Highly Susceptible (HS)	15	AVT (LS)-6, 8 ; AVT_1 (RF)-1,3 ; IVT (LS) - 4,6, 11, 13;IVT(MH)-7, 9; IVT (K+ELSK)-19; IVT (RF)-1, 2 ; AVT_{2+1} (DTIL)-2 ; AVT_1 (K+ELSK)-1
Total	51	

Table 4. Reaction of Chickpea breeding lines against Dry Root Rot (DRR) during rabi, 2019-20

Reaction	No. of Entries	List of Entries
Resistant (R)	04	AVT_1 (RF) - 2; IVT (K+ELSK) - 15; IVT (RF) - 27; AVT_{2+1} (DTIL)-5
Moderately Resistant (MR)	06	AVT_1 (D)-8, 14 ; AVT_1 (LS)-4; IVT (LS)-16; IVT (RF)-24; AVT_{2+1} (DTIL) -3
Moderately Susceptible (MS)	09	IVT (D)-2, 17; AVT_1(D)-15, AVT_1 (LS)-1, 8; IVT (LS)-12, 13 ; IVT (K+ELSK)- 14, 17
Susceptible (S)	20	IVT (D)-3, 21; AVT_1 (D)-6, 11 ; AVT_1 (LS) -6 ; AVT_2 (D)-1; AVT_1 (RF) - 1; IVT (LS) - 4, 6, 8, 11, 14, IVT (K+ ELSK)- 19; IVT (RF)-3, 6, 8; AVT_{2+1} (MH) - 1, 2 ; AVT_1 (K +ELSK)-3
Highly Susceptible (HS)	12	IVT (D)-10, 28, 30, 35; AVT_1 (RF)-3; IVT (MH)-7 ; IVT (RF) -1, 2, 9; AVT_{2+1} (DTIL) – 2 ; AVT_1 (K+ELSK)-1, AVT_{2+1} (WRIL)-1
Total	51	

Table 5. Reaction of Chickpea breeding lines against Dry Root Rot (DRR) [Average of *rabi,* 2018-19 and 2019-20]

Reaction	No. of Entries	List of Entries
Resistant (R)	04	AVT_1 (RF)-2, AVT_{2+1} (DTIL)-5, IVT (K+ELSK)-15, IVT (RF)-3
Moderately Resistant (MR)	06	AVT_1(D)-8, 14; AVT_1 (LS) -4 ; IVT (LS)-12; IVT (RF)-27; AVT_{2+1}(DTIL)-3
Moderately Susceptible (MS)	04	AVT1(LS)-1, IVT (LS)-8, 16, 14
Susceptible (S)	24	IVT (D)-2,3,17,21,28,30,35; AVT_1 (D)- 6, 11, 15; AVT_1(LS)-8; AVT_2(D)-1; IVT (LS)-4,6,13; IVT (K+ELSK)-14, 17; IVT (RF)-3,6,8; AVT_{2+1}(MH)-1, 2; AVT_1 (K+ELSK)-3, AVT_{2+1} (WRIL)-1
Highly Susceptible (HS)	13	IVT (D)-10, AVT_1 (LS)-6, AVT_1 (RF)- 1, 3, IVT (LS)-11 , IVT (MH)-7, 9; IVT (K+ELSK)-19, IVT (RF)-1,2,9; AVT_{2+1}(DTIL)-2, AVT_1(K+ELSK)-2
Total	51	

27 and AVT_{2+1} (DTIL)-3,5 found moderately resistant reaction, four entries *viz.*, IVT (D)-28, 30 and IVT (RF) - 3,6 showed moderately susceptible, eighteen showed susceptible (IVT (D) - 2,3,10,17,35; AVT1 (D) - 6, 11, 15; AVT_2 (D)-1, IVT (LS)-16; IVT (K+ ELSK)-14, 17; IVT (RF)- 8, 9 and AVT_{2+1} (MH)- 1, 2) and fifteen entries (AVT (LS)-6, 8; AVT_1 (RF)-1,3; IVT (LS) - 4,6, 11, 13; IVT(MH)-7, 9; IVT (K+ELSK)-19; IVT (RF)-1, 2; AVT_{2+1} (DTIL)-2 and AVT_1 (K+ELSK)-1 have been found to show highly susceptible reaction (Table 3). While during *rabi,* 2019-20, four entries *viz.*, AVT_1 (RF) – 2 ; IVT (K+ELSK) -

Field view of the experimental trial conducted at Sick plot of RARS, Nandyal

R check

S check

Table 6. Screening of chickpea entries against Dry Root Rot [from Average data of *rabi*, 2018-19 and 2019-20]

% Mortality	Score Reaction	Entries												
		IVT (D)	AVT_1 (D)	AVT_1 (LS)	AVT_2 (D)	AVT_1 (RF)	IVT (LS)	IVT (MH)	IVT (K+ELSK)	IVT (RF)	AVT_{2+1} (MH)	AVT_{2+1} (DTIL)	AVT_1 (K+ELSK)	AVT_{2+1} (WRIL)
0-10	Resistant	—	—	—	—	01	—	—	01	01	—	01	—	—
11-20	Moderately Resistant	—	02	01	—	—	01	—	—	01	—	01	—	—
21-30	Moderately Susceptible	—	—	01	—	—	03	—	—	—	—	—	—	—
31-50	Susceptible	07	03	01	01	—	03	—	02	03	02	—	01	01
51-100	Highly Susceptible	01	—	01	—	02	01	02	01	03	—	01	01	—
	Total entries (51)	08	05	04	01	03	08	02	04	08	02	03	02	01

15; IVT (RF) – 27 and AVT $_{2+1}$ (DTIL)-5 found resistant, six entries viz., AVT_1 (D)-8, 14; AVT_1 (LS)-4; IVT (LS)-16; IVT (RF)-24 and AVT_{2+1} (DTIL) -3 showed moderately resistant reaction, nine entries (IVT (D)-2, 17; AVT_1(D)-15, AVT_1 (LS)-1, 8; IVT (LS)-12, 13 ; IVT (K+ELSK)- 14, 17) are moderately susceptible, twenty entries viz., IVT (D)-3, 21; AVT_1 (D)-6, 11; AVT_1 (LS) -6; AVT_2 (D)-1; AVT_1 (RF) - 1; IVT (LS) - 4, 6, 8, 11, 14, IVT (K+ ELSK)- 19; IVT (RF)-3, 6, 8; AVT $_{2+1}$ (MH) - 1, 2 and AVT_1 (K +ELSK)-3 are susceptible and highly susceptible reaction recorded in twelve entries (IVT (D)-10, 28, 30, 35; AVT_1 (RF)-3 ; IVT (MH)-7 ; IVT (RF) -1, 2, 9; AVT_{2+1} (DTIL) – 2 ; AVT_1 (K+ELSK)-1 and AVT_{2+1} (WRIL)-1 (Table 4). However, cent per cent mortality was observed in the susceprible check (L-550) indicating the high and uniform sickness in the soil.

Average of two years data, i.e. *rabi*, 2018-19 and 2019-20 was taken for all the 51 entries. According to the disease incidence and disease reaction the entries were classified into five groups. A total of fifty one entries of desi and kabuli were evaluated under field conditions against dry root rot disease. As per Table 5, Out of 51 entries screened, four entries (AVT_1 (RF)-2, AVT_{2+1} (DTIL)-5, IVT (K+ELSK)-15 and IVT (RF)-3 were found resistant. Six entries viz., AVT_1(D)-8, 14; AVT_1 (LS)-4 ; IVT (LS)-12; IVT (RF)-27 and AVT_{2+1} (DTIL)-3 found moderately resistant. Four entries (AVT_1 (LS)-1 and IVT (LS)-8, 16, 14) showed highly susceptible reaction to dry root rot disease. Twenty four entries viz., IVT (D)-2,3,17, 21, 28, 30, 35; AVT_1 (D)- 6, 11, 15; AVT_1 (LS)-8; AVT_2(D)-1; IVT (LS)-4, 6,13; IVT (K+ELSK)-14, 17; IVT (RF)-3,6,8; AVT_{2+1} (MH)- 1, 2; AVT_1 (K+ELSK)-3 and AVT_{2+1} (WRIL)-1 were found susceptible and thirteen entries (IVT (D)-10, AVT_1 (LS)-6, AVT_1 (RF)- 1, 3, IVT (LS)-11, IVT (MH)-7, 9; IVT (K+ELSK)-19, IVT (RF)-1,2,9; AVT_{2+1} (DTIL)-2 and AVT_1(K+ELSK)-2 have been found highly susceptible to dry root rot disease.

Khan *et al.* (2012) screened sixty Germplasm lines of chickpea for their resistance to dry root rot disease under pot culture conditions showed that nine lines were found resistant. Waghe *et al.*, 2018 screened 127 entries both under *in vitro* and field conditions and found that six lines viz., JG-2000-07, JSC 37, MPJG 89-11551, MPJG 89-9023, CSJ 592 and Rajas were found resistant. Field experiment conducted with 75 germplasm lines during *rabi*, 2016-17 by Hanuman and Bindu Madhavi, 2018 revealed that 17 entries have found moderately resistant and 52 entries were susceptible whereas six entries were recorded as highly susceptible to dry root rot disease.

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