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PATHOGENIC VARIABILITY AMONG THE ISOLATES OF *RHIZOCTONIA BATATICOLA* (TAUB.) BUTLER, INCITING DRY ROOT ROT OF CHICKPEA (*CICER ARIETINUM* L.)

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ABSTRACT

Rhizoctonia bataticola is a serious pathogen of many crops. In the present studies, 12 isolates of *Rhizoctonia bataticola* from different agro climatic regions of Marathwada region of Maharashtra were analyzed for pathogenic variability. On the basis of disease expression, isolate Rb-9 (Mukhed, Nanded district) showed highest total mortality (98.40%) and found highly virulent on cultivar JG-62. These pathogenic variations in various isolates of *R. bataticola* may be considered important in disease management systems and will be useful in breeding programmes of chickpea.

Key words : *Rhizoctonia bataticola*, Chickpea, Symptoms, Dry root rot, Pathogenicity, Hyphal tip.

Introduction

Chickpea (*Cicer arietinum* L.) is the only cultivated species in the genus *Cicer* and is a self-pollinated diploid (2n=2x=16) crop. It is a cool season legume crop grown worldwide as a food crop. The seed is the main edible part of the plant. It is also called garbanzo gram or Bengal gram. Chickpea is a *Rabi* crop preferably sown in September-November and harvested in February. Crop matures in around 90-120 days, depending on variety. Areas having low to moderate rainfall and mid-cold weather are best suitable for the crop, preferably moderate rainfall of 60-90 cm per annum. It has indeterminate growth habit, which means that the growth cycle extends as long as moisture is available.

India is a major chickpea producing country during 2021-22 and the crop was cultivated in an area of 98.96 lakh ha with an annual production of 107.37 lakh tonnes with the productivity of 1086 kg/ha whereas in Maharashtra occupies an area of 19.80 lakh ha with total production of 19.17 lakh tonnes, respectively with productivity of 968 kg/ha (FW (DA&FW), Govt of India; Annual Report, 2021-22), while in Marathwada region it was cultivated in an area of 22.31 lakh ha with production and productivity of 23.96 lakh tonnes and 1192 kg/ha, respectively (Anonymous, 2022). Fifty-five pathogens have been so far reported on chickpea right from early seedling stage up to maturity and several of them are of economic importance. Among the several soil-borne fungal diseases, dry root rot caused by *Rhizoctonia bataticola* (Taub.) Butler is the most severe disease of chickpea especially in the central and southern zones, where the crop is mostly grown in *Rabi* season under rainfed conditions.

Predominantly, disease appears around flowering and podding stage. The first symptom is yellowing and sudden drying of the plants. The tap root becomes dark brown quite brittle in dry soil and shows extensive rotting resulting in the loss of lateral roots. The lower portion of the tap root is often left in the soil when plant is uprooted. Dry root rot caused 10-25 per cent crop losses in major chickpea growing states of India (Lakhran and Ahir, 2018). Also in Marathwada region of Maharashtra state with an average 16.12 per cent incidence was found (Kadam

et al., 2018). Therefore, the objective of this research to undertaken the study of pathogenicity test and pathogenic variability of *R. bataticola* isolates causing dry root rot obtained from chickpea in Marathwada region of the Maharashtra State.

Materials and Methods

Pathogenic variability among *R. bataticola* isolates

Pathogenic variability of 12 isolates of *R. bataticola* was assessed by employing sick soil method, the details of which are as given below:

Sick soil method

Pathogenic variability of 12 test isolates of *R. bataticola* was attempted by employing sick soil method. For the purpose, autoclaved and cooled potting mixture of soil : sand : FYM (2:1:1) was filled into black coloured nursery polybags (20 × 30 cm), disinfected with 5 per cent copper sulphate solution. The test isolates multiplied on sand: maize medium was inoculated (@ 50 g / kg potting mixture) separately in these bags, mixed thoroughly in top 5-6 cm layer, watered lightly and maintained in screen house for two weeks, so as to proliferate the test pathogen and make the potting mixture sick with *R. bataticola*.

Surface sterilized (0.1 % $HgCl_2$) healthy seeds of chickpea cv. JG-62 were sown (10 seeds / bag) in these bags, watered lightly and maintained in the screen house. Three bags per test isolate were sown and maintained. Black coloured nursery polybags filled with autoclaved potting mixture without any inoculum and sown with surface sterilized healthy seeds of chickpea cv. JG-62 served as untreated control.

Observations on pre-emergence seed rot (PRESR) and post emergence seedling mortality (POESM) were recorded, respectively at 7-8 days and 15 and 30 days after sowing and total mortality was computed. Per cent PRESR, POESM and total mortality were calculated by applying following formulae:

$$\textbf{PRESR (\%)} = \frac{\text{No. of Seeds un-germinated}}{\text{Total no. of Seeds sown}} \times 100$$

$$\textbf{POESM (\%)} = \frac{\text{No. of Seedlings died}}{\text{Total no. of Seedlings}} \times 100$$

Total mortality (%) = PRESR + POESM

Results and Discussion

Variability among isolates of *R. bataticola*

Pathogenic variability

Pathogenic variability of 12 isolates of *R. bataticola* was determined by using sick soil method and the results obtained of this study are being elucidated under following sub-heads.

Sick soil method

The results (Table 1 and Plate 1) indicated that the entire 12 test isolates of *R. bataticola* as pathogenic and caused pre-emergence seed rot and post-emergence seedling mortality in chickpea (JG-62).

Days to initiation of dry root rot symptoms in chickpea was ranged from 07 DAS (Rb-9) to 16 DAS (Rb-8). Early symptoms were observed in isolate Rb-9 *i.e.* within 7 days, followed by isolate Rb-1 and 2 (8 DAS), Rb-11 (9 DAS) and in Rb-4 and Rb-10 within 10 DAS. However, remaining isolates was in the range of 11 DAS to 16 DAS.

Average pre-emergence seed rot (PRESR) was observed with the test isolates was ranged from 11.50 per cent (Rb-1) to 17.98 per cent (Rb-9), as against 0.00 per cent in untreated control. However, it was observed maximum with isolate Rb-9 (17.98%), followed by Rb-7 (16.95%), Rb-8 (16.37%) and Rb-10 (16.00%). Rest of the test isolates caused PRESR in the range of 11.50 to 15.45 per cent.

Similarly, in case of post-emergence seedling mortality (POESM) which was recorded at 15 and 30 DAS was recorded from 22.11(Rb-8) to 35.25 (Rb-9) per cent and 35.78 (Rb-8) to 52.75 (Rb-9) per cent, respectively. At 15 DAS, Rb-9 induced highest POESM (35.25%), followed by Rb-2 (28.80%) Rb-6 (27.78%), Rb-1 (27.50%) and Rb-4 (27.18%). Whereas in remaining isolates, POESM was observed in the range of 22.11 to 26.68 per cent. At 30 DAS, the isolate Rb-9 produced highest POESM (52.75 %), followed by Rb-2 (48.77 %), Rb-1 (46.20 %) and Rb-11 (45.73%). The rest of the isolates exhibited POESM in the range of 35.78 to 45.65 per cent.

Total mortality (PRESR + POESM) produced by the test isolates was ranged from 74.26 (Rb-8) to 98.40 (Rb-9) per cent. However, it was maximum per cent (98.40%) in the isolate Rb-9, followed by Rb-1 (91.75%), Rb-2 (91.17%) and Rb-11 (90.19%). In rest of the isolates induced total mortality in the range of 74.26 to 87.08 per cent. Thus, all of the 12 test isolates of *R. bataticola* were found to be highly pathogenic to chickpea Cv. JG-62.

Thus, based on present assessment on pathogenic variability study by adopting sick soil, indicated sick soil method as most efficient method. The isolate Rb-9 was found to be as highly virulent to chickpea as compared

Plate 1 : Pathogenicity and Pathogenic variability among the isolates of *R. bataticola* (Sick soil method).

establishing the disease caused by *R. bataticola* and proved the pathogenicity (Gade *et al*., 2018; Jayasimha *et al*., 2021; Basbagcia and Dolar, 2022).

Present results obtained on pathogenic variability among the isolates of *R. bataticola* causing dry root rot of chickpea are in consensus with those findings of several other workers *viz*., Monga *et al*. (2004) reported that pathogenic variability among the 15 test isolates of *R. bataticola* caused seedling mortality of cotton in the range of 31.3-91.6 per cent. However, it was significantly highest (range 65.6-91.6%) with the isolates RJ-9, PB-2, HR-25, RJ-6, RJ-16 and HR-18; moderate (42.7%) with the isolates HR-15 and RJ-23 and minimum (19.8-31.3%) in the isolates RJ-19, RJ-22, RJ-24, RJ-28 and HR-17. Aghakhani and Dubey (2009a) reported all 23 isolates of *R. bataticola*, as highly pathogenic to chickpea, which caused dry root rot incidence in the range of 31.7 to 100 per cent. Similarly, Sharma *et al*. (2012a, b) also studied pathogenic variability among 94 isolates of *R. bataticola*

Table 1 : Pathogenic variability amongst the isolates of *R. bataticola* (Sick soil method).

S. no.	Isolates	Av. PRESR* (%)	Av. POESM* (%)		Total Mortality (%)	Days to initiation of symptoms
			15 DAS	30 DAS		
1.	**Rb_1**	11.50	27.50	46.20	91.75	08
2.	**Rb_2**	13.60	28.80	48.77	91.17	08
3.	**Rb_3**	15.35	24.94	41.38	81.67	12
4.	**Rb_4**	15.45	27.18	44.45	87.08	10
5.	**Rb_5**	14.75	22.75	45.65	83.15	11
6.	**Rb_6**	13.33	27.78	43.55	84.66	11
7.	**Rb_7**	16.95	24.18	36.67	78.83	14
8.	**Rb_8**	16.37	22.11	35.78	74.26	16
9.	**Rb_9**	17.98	35.25	52.75	98.40	07
10.	**Rb_{10}**	16.00	25.35	44.40	85.75	10
11.	**Rb_{11}**	14.78	26.68	45.73	90.19	09
12.	**Rb_{12}**	12.45	24.08	40.95	77.48	15
13.	**control**	0.00	0.00	0.00	0.00	-
SE(m) ±	-	-	**0.63**	**0.77**	-	-
C.D. (P=0.01)	-	-	**1.85**	**2.26**	-	-

*Based on total no. of seed sown PRESR- Pre-emergence seed rot, POESM- Post-emergence seedling mortality.

with remaining isolates (Plate 1). Therefore, the isolate Rb-9 (Mukhed, Nanded district) was selected and used for further *in vitro* (plate and pot culture) studies.

Similarly, several earlier workers have found soil inoculation (sick soil) method as most suitable in causing dry root rot of chickpea and reported all test isolates as highly pathogenic to chickpea. Gade *et al*. (2018) as well studied pathogenic variability among 40 isolates of *R. bataticola*, causing soybean dry root rot and reported that two isolates *viz*., Rb-3 and Rb-17 as

highly pathogenic with 71- 100 per cent mortality. Basbagcia and Dolar (2022) also studied pathogenic variability among 19 isolates of *R. bataticola*, causing chickpea dry root rot on cultivar ILC 482. They reported that among the 19 isolates disease severity varied from 42.80 to 100%. Whereas only one isolate (IS30) was moderately virulent, all remained isolates exhibited highly virulent.

Conclusion

All 12 isolates of *R. bataticola* exhibited a wide range of pathogenic variability, employed by sick soil method which was found to be most efficient. Based on results of sick soil method, the isolate Rb-9 (Mukhed, Nanded district) was found as highly virulent and or pathogenic to chickpea, which was selected and used for further *in vitro* studies.

There was more diversity in *R. bataticola* isolates with respect to pathogenicity. The determination of variability among *R. bataticola* isolates is fundamental to guide the development of appropriate strategies for disease management according to different agro ecological zones. The present studies provide information on the pathogenic variability of *R. bataticola* in major chickpea growing Marathwada regions of Maharashtra. These results will be useful in developing integrated strategies for the management of chickpea dry root rot and breeding programs for pulses and other crops.

Author contribution

S. S. Kadam recorded and analysed observations. S. S. Kadam and S. N. Banne, wrote the manuscript. D. G. Hingole, conceived and designed the research and guided during period of research work.

Conflict of interest

There is no conflict of interest regarding the manuscript among the authors.

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