

## Original Research Article

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## Survey, Surveillance & Cultural Characteristics of Dry Root Rot of Chickpea caused by *Rhizoctonia bataticolain* Derapur Tahsil, Kanpur

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### ABSTRACT

#### Keywords

Dry root rot,  
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Dry root rot caused by *Rhizoctonia bataticola* (Taub.) Butler [Pycnidial stage: *Macrophomina phaseolina* (Tassi) Goid] is a soil borne fungal pathogen. Keeping in view the importance of the disease due to change in climatic conditions, studies were conducted on distribution of the disease, cultural, morphological, pathological and molecular diversity. The experiment was conducted at Department of Plant Pathology CSA, Kanpur. In the present studies, twelve isolates of *R. bataticola* were isolated from disease sample of dry root rot of chickpea collected from different farmer's fields from twelve villages in Derapur tahsil in Kanpur, Uttar Pradesh, India. The pathogen was isolated and purified in PDA media by using standard isolation procedure and its pathogenicity was proven in pot culture. Further, on the basis of cultural characteristics and morphological characteristics of the pathogen, the fungal pathogen was identified as *R. bataticola*. In cultural characteristics six characters like colony colour, colony diameter, pigmentation, margin type, growth pattern and aerial hyphae were recorded. Maximum radial growth i.e. 90 mm was given by isolate Rb-07 of Sabalpur village followed by Rb-02 and Rb-12. Least radial growth of 45 mm was given by Rb-03 isolate of Nandpur village. Pigmentation was also observed in four isolates. Aerial hyphae were produced by six isolates.

### Introduction

Uttar Pradesh is a northern State and located between 26.85°N 80.91°E. The State of Uttar Pradesh falls under three agro-climatic zones viz. (a) Agro Climatic Zone-IV: Middle Gangetic Plains region, (b) Agro Climatic Zone-V: Upper Gangetic Plains region and (c) Agro Climatic Zone-VIII: Central Plateau

and Hills region. The Agro-climatic zone- V is among the larger and very thickly populated agro-climatic zones. The zone is characterized by semi-arid and sub-humid conditions. The mean Annual rainfall varies between 700 and 1,000 mm. There are three sub-zones under this agro-climatic zone viz. (i) Central Plains, (ii) North-Western Plains and (iii) South-Western Plains. South-

Western Plains has high proportion of arable and irrigated cropped area. The climate is semi-arid and the soil type is alluvium calcareous clay. The region receives about 721 mm of rainfall. More than 74% of the net sown area is irrigated and over 69% land is cultivated. This is largely on account of cultivation of low value crops principally wheat, bajra and chickpea. The region covers the districts of Badaun, Aligarh, Mathura, Agra, Etah, Farrukhabad, Kannauj, Mainpuri, Firozabad, Etawah, Kanpur Dehat, Derapur and Kanpurnagar.

Uttar Pradesh state has a total area of 577 thousand ha, production of 475.4 thousand tones and yield 824 kg/ha under chickpea cultivation (Rajbhar *et al.*, 2018). Fifty different pathogens have so far been reported on chickpea (Nene *et al.*, 1989) including diseases caused by fungal, bacterial, nematodes mycoplasma and viral pathogen. Dry root rot of chickpea is caused by *Rhizoctonia bataticola* is a soil and seed-borne necrotrophic fungal pathogen (Sharma and Pande 2013). It is one of the important diseases which mostly occurs under drought conditions and prevail at flowering and podding stage of the crop. It infects more than 284 plant species including monocot and dicot plant hosts (Farr *et al.*, 1995). The disease is favoured by high soil temperature (>30°C) and low soil moisture condition. The first report of occurrence of dry root rot in chickpea along with wilt was made by Padwick (Padwick, 1948).

Significant reduction of 25-70 per cent in chickpea production due to this disease in India has been reported (Ahmed and Ahmed 1969), (Pande and Sharma 2010). Environmental conditions like temperature, soil moisture and pH play an important role in the viability and growth of *Rhizoctonia bataticola* (Khare *et al.*, 1970). This investigation was carried out to find out the

severity of dry root rot caused by *Rhizoctonia bataticola* in chickpea in Kanpur region of the Uttar Pradesh state. Survey and surveillance of dry root rot of chickpea was done on farmer's field. Collection, isolation, purification and pathogenicity of the *Rhizoctonia bataticola* were studied.

## **Materials and Methods**

### **Survey and Surveillance**

A survey of chickpea fields was conducted in the twelve villages in Derapur Tehsil viz., Paraukh, Malatipur, Nandpur, Devki Purwa, Kapasi, Nunariya, Sabalpur, Khajurra, Mawai Mukta, Nanthu, Salempur and Akaaruin Kanpur Dehat during the month of February and March to record the incidence of dry root rot of chickpea. On an average, 03 farmer's fields of chickpea in each village were visited. Chickpea plants showing typical dry root rot symptoms were uprooted collected in separate paper bags and specifications like village name, latitude, longitude and crop stage were recorded and brought to the laboratory for further investigations (Table 1).

### **Isolation and purification**

Chickpea roots showing dry root rot symptoms were washed under running tap water and blot dried. Infected roots were cut into pieces of 4-5mm size and were surface sterilized by 1 per cent sodium hypochlorite (NaOCl) solution. After thorough washing in sterile distilled water, the pieces were then transferred by using forceps on to sterilized PDA media and incubated at  $28 \pm 2$  °C in BOD incubator (Anurag & Ved, 2019). The fungal colonies emanating from bits were examined on 4 days of incubation growing mycelium was marked on the underside and viewed through a light microscope.

### **Pathogenicity test**

Pathogenicity of the organism was confirmed by sick pot technique in earthen pots under greenhouse condition by using susceptible cultivar of chickpea variety BG-212 (Prameela Devi and Singh, 1998).

Inoculum was prepared from the 10 days old culture of *Rhizoctonia bataticola* grown on 100gm of sand maize meal media. Sand maize meal media was prepared by using sand and maize meal in 2:1 ratio, for the preparation of this media maize grains were broken into 3 to 4 pieces by using grinder just like porridge, this was soaked in sterile distilled water for 12 hours. After 12 hours excess water from maize was removed and sterile sand was added and properly mixed. Put 100gm sand maize meal media in 250 ml flask and autoclave all the 100 conical flask having media at 15 lbs. for 20 minutes. After cooling, the flasks were then inoculated with five mm disc of seven days old culture of *Rhizoctonia bataticola* and incubated at  $28 \pm 2^{\circ}\text{C}$ . After 15 days of incubation, the inoculum was taken out from the flask and a fungus-soil mixture by hand mixing the pathogen @ 50 g/kg autoclaved soil was prepared. Fill pots with the inoculated soil. Approximately 2 kg of sterile soil and 500gm of sterile FYM will be required to fill each pot (Mamta Sharma *et al.*, 2015). Water the pots and wait for 4 days before proceeding to the next step. 15 chickpea seeds of variety BG-212 were sown on each pot with two replication of each isolate with two control pots.

All these pots were then watered lightly and kept in a glass-house for further recording of observations on per cent seed germination, seedling mortality, etc. The observations on dry root rot incidence were recorded after 15 days of germination to flowering stage. Re-isolation of the pathogen was made from roots

of artificially inoculated and diseased plants showing the typical symptoms of dry root rot. The fungus growth obtained was transferred on potato dextrose agar slants for comparison with the original culture of *Rhizoctonia bataticola*. The symptoms of dry root rot were observed and recorded right from the initiation of the disease till the complete death of plants both in pot culture as well as under field condition. The culture of the pathogen obtained was identified on the basis of morphological and cultural characteristics. (Mayek *et al.*, 2002).

### **Cultural characteristics**

In cultural characteristics six characters like colony colour, colony diameter, pigmentation, margin type, growth pattern and aerial hyphae were recorded. Colony characters and sclerotia production ability of the isolates of *Rhizoctonia bataticola* were studied by growing it on potato dextrose agar media (PDA). The PDA media was prepared by following standard laboratory procedure given by Twite (1969), ansterilized by autoclaving at 15 lbs. for 20 minutes. After sterilization media was poured into sterile plastic petri plates and allowed to cool down and solidify. Then, the plates were inoculated with 2-5 mm disc of seven days old culture of *Rhizoctonia bataticola* and incubated at  $28 \pm 2^{\circ}\text{C}$  in BOD incubator.

### **Results and Discussion**

#### **Pathogenicity**

Pathogenicity of the fungus was carried out in pot culture by using chickpea variety BG-212 which exhibited symptoms of dry root rot after 25 days of inoculation. The initial symptoms include yellowing, drooping of the petioles and leaflets only on the tips (Gupta *et al.*, 2012). Leaves and stems of the affected plants are straw colored; in some

cases, lower leaves turn brown, tap root turns black, shows signs of rotting, and is devoid of lateral and finer roots. A grayish mycelium can sometimes be seen on the tap root. The dead roots are quite brittle and show shredding of bark and lateral root. Minute sclerotia can be seen on the exposed wood of the root and inner side of the bark or

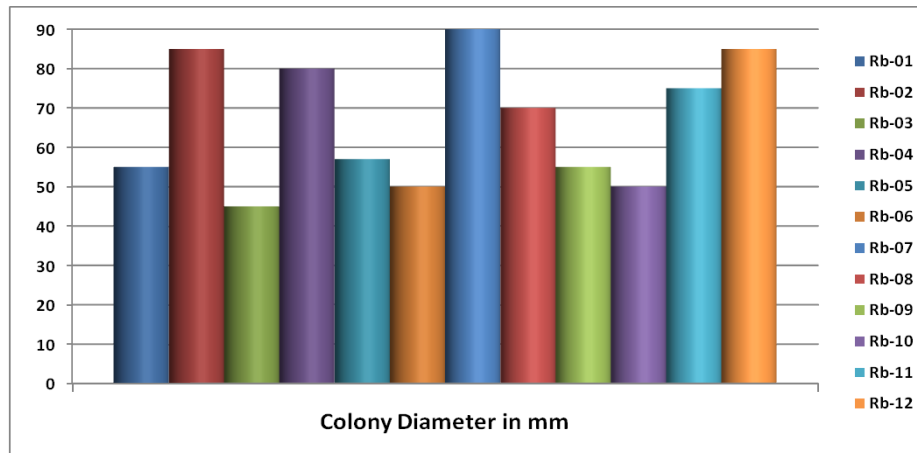
whenever split open at the collar region vertically (Jayalakshmi *et al.*, 2008). Symptoms of dry root rot produced by the artificially inoculated and diseased plants were identical and confirmed with those symptoms observed on naturally infected chickpea plants in the field.

**Table.1** Survey dry root rot infected fields of chickpea in Derapur Tahsil

| S.No | Place   | Village Name | Lattitude  | Longitude  | Crop Stage |
|------|---------|--------------|------------|------------|------------|
| 01   | Derapur | Paraukh      | 26°27'18"N | 79°44'06"E | Flowering  |
| 02   | Derapur | Malatipur    | 26°37'12"N | 79°42'03"E | Flowering  |
| 03   | Derapur | Nandpur      | 26°22'02"N | 79°47'47"E | Flowering  |
| 04   | Derapur | DevkiPurwa   | 26°32'45"N | 79°53'03"E | Flowering  |
| 05   | Derapur | Kapasi       | 26°29'18"N | 79°45'17"E | Podding    |
| 06   | Derapur | Nunariya     | 26°33'29"N | 79°48'12"E | Podding    |
| 07   | Derapur | Sabalpur     | 27°10'38"N | 79°25'06"E | Flowering  |
| 08   | Derapur | Khajurra     | 26°27'29"N | 79°48'22"E | Podding    |
| 09   | Derapur | MawaiMukta   | 26°21'22"N | 79°48'21"E | Podding    |
| 10   | Derapur | Nanthu       | 26°22'43"N | 79°46'50"E | Flowering  |
| 11   | Derapur | Salempur     | 26°24'40"N | 79°46'58"E | Podding    |
| 12   | Derapur | Akaaru       | 26°30'55"N | 79°47'10"E | Flowering  |

**Table.2** Cultural characteristics of different isolates of *Rb* from different locations of Derapur Tahsil

| S.No | Place   | Village    | Isolate No. | Colony Colour | Colony Diameter | Pigmentation | Margin Type | Growth Pattern | Aerial Hyphae |
|------|---------|------------|-------------|---------------|-----------------|--------------|-------------|----------------|---------------|
| 01   | Derapur | Paraukh    | Rb-01       | Black         | 55 mm           | No           | Regular     | Flat           | Present       |
| 02   | Derapur | Malatipur  | Rb-02       | Black         | 85 mm           | No           | Regular     | Flat           | No            |
| 03   | Derapur | Nandpur    | Rb-03       | Gray          | 45 mm           | Yes          | Irregular   | Fluffy         | No            |
| 04   | Derapur | DevkiPurwa | Rb-04       | Black         | 80 mm           | No           | Regular     | Flat           | Present       |
| 05   | Derapur | Kapasi     | Rb-05       | Black         | 57 mm           | No           | Irregular   | Flat           | No            |
| 06   | Derapur | Nunariya   | Rb-06       | Gray          | 50 mm           | Yes          | Regular     | Fluffy         | Present       |
| 07   | Derapur | Sabalpur   | Rb-07       | Black         | 90 mm           | No           | Regular     | Flat           | No            |
| 08   | Derapur | Khajurra   | Rb-08       | Gray          | 70 mm           | No           | Regular     | Flat           | No            |
| 09   | Derapur | MawaiMukta | Rb-09       | Black         | 55 mm           | No           | Irregular   | Fluffy         | Present       |
| 10   | Derapur | Nanthu     | Rb-10       | Black         | 50 mm           | Yes          | Regular     | Flat           | Present       |
| 11   | Derapur | Salempur   | Rb-11       | Gray          | 75 mm           | No           | Regular     | Flat           | Present       |
| 12   | Derapur | Akaaru     | Rb-12       | Black         | 85 mm           | Yes          | Irregular   | Fluffy         | No            |

**Fig.1** Radial growth in mm of different isolates of *Rb* from different locations of DerapurTahsil

### Identification of fungal pathogen

The pathogenic culture isolated from the diseased plants was identified on the basis of the morphological characters like presence of sclerotia and right angled hyphae and was confirmed by using, “Leica DM 2000 Compound Microscope” from Dept. of plant Pathology, C.S.A University of Agriculture & Technology, Kanpur-208002.

### Cultural Characteristics

The results with respect to the colony characteristics of *Rhizoctonia bataticola* on various culture media are presented in Table 2. From that result, it was revealed that there was a significant difference in cultural characteristics among different isolates from different villages of Derapur tehsil. Eight isolates among twelve were producing black colour colony and remaining four were showing gray colour. In radial growth there were three types of isolates i.e. fast growing, medium and slow growing (Figure 1). In fast growing isolates, colony diameter must be more than 80 mm, three isolates viz., Rb-02, Rb-07 and Rb-12 showed diameter of 85mm, 90mm and 85mm respectively, belongs to this category followed by medium growing (between 60 to 80 mm) three isolates like Rb-

04, Rb-08 and Rb-11 showed medium colony diameter. In third category the colony diameter must be less than 60 mm; six isolates like Rb-01, Rb-03, Rb-05, Rb-06, Rb-09 and Rb-10 were showing slow colony growth. Pigmentation was also observed in four isolates like Rb-03, Rb-06, Rb-10 and Rb-12. *Rhizoctonia bataticola* showed two types of margins i.e. regular and irregular. Regular margin was showed by eight isolates like Rb-01, Rb-02, Rb-04, Rb-06, Rb-07, Rb-08, Rb-10 and Rb-11 and four isolates were showing irregular margin. There were two type of growth pattern i.e. flat and fluffy, in case of Rb. Four isolates Rb-03, Rb-06, Rb-09 and Rb-12 were showing fluffy pattern while remaining eight isolates were showing flat pattern. Aerial hyphae were also produced by six isolates like Rb-01, Rb-04, Rb-06, Rb-09, Rb-10 and Rb-11.

The symptoms produced were exactly identical to those described earlier by Sharma *et al.*, (2015), Narsimhan (1929) and Mehrotra and Aneja (1990). Pure culture of *Rhizoctonia bataticola* was again when re-inoculated on chickpea cultivar BG-212 in pot culture and the symptoms shows that affected plants are straw colored and the tap root turns black, shows signs of rotting, and is devoid of lateral and finer roots. The dead roots are quite

brittle and show shredding of bark and lateral root and minute black sclerotia can be also be seen on the tap root. Such seedling becomes straw coloured, dry and collapsed within few days. The symptoms of dry root rot of chickpea observed were similar to those recorded earlier by Sharma *et al.*, (2015), and Mehrotra and Aneja (1990). The cultural studies results obtained are in agreement with the findings of (Dhingra and Sinclair (1973a, 1973b); Arca *et al.*, (1989) and Shekhar *et al.*, (2006a). who also reported about the colony colour, colony diameter, pigmentation, margin type, growth pattern and aerial hyphae produced by *Rhizoctonia bataticola* in Potato dextrose agar media.

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### Compliance with Ethical Standards

The authors declare that they have no conflict of interest.

This article does not contain any studies with human participants or animals performed by any of the authors.

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