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Occurrence and distribution of chickpea dry root rot in central part of India

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Abstract
During the 2014-2015 Rabi season, a survey was done to determine the distribution and incidence of chickpea dry root rot by soil type and irrigation situation. Most farmer's fields are dominated by local varieties. Dry root rot disease was observed in all of the locations, with an incidence ranging from 2.54 to 20.89 percent regardless of cultivar types and locations. The findings revealed that dry root rot has recently become widespread in all of India's central chickpea-growing regions. In comparison to irrigated conditions (4.49 percent), the incidence of dry root rot was higher in rainfed conditions (10.48 percent). According to the survey, alluvial soil was the best for DRR development.

Keywords: Survey, chickpea, dry root rot (DRR), soil type and irrigation condition

Introduction
After dry beans (*Phaseolus vulgaris* L.) and dry peas (*Pisum sativum* L.), chickpea (*Cicer arietinum* L.) is the third most significant pulse crop in the Leguminoceae family. Chickpeas have their origins in the Eastern Mediterranean (Aykoid and Doughty, 1964) [4]. India is the world's greatest producer of chickpeas, accounting for 66.78 percent of total area and 66.13 percent of total production (Anon. 2018a) [2]. Chickpeas are produced on 10.56 million hectares in India, with a production of 12.30 million tonnes and a productivity of 1063 kg per hectare. Madhya Pradesh produced 4.60 million tonnes of chickpeas, with a yield of 1280 kg/ha and an area of roughly 3.59 million ha. Madhya Pradesh accounts for roughly 40.92 percent of the country's overall production (Anon., 2018b) [3]. It is an essential grain legume grown for protein-rich seeds for human consumption and for its nitrogen-fixing capacity, which helps to maintain soil fertility. Chickpea seeds contain 20% protein, 64% carbohydrates, 47% starch, 5% fat, 6% crude fibre, 6% soluble sugar, and 3% ash, as well as minerals like calcium (202 mg), phosphorus (312 mg), iron (10.2 mg), vitamin C (3.0 mg), calorie value (360 cal), small amounts of B complex, fibre (3.9g), and moisture (9.8g) (Dhawan *et al.*, 1991) [6]. Chickpea dry root rot is a dangerous and widespread disease caused by *Rhizoctonia bataticola.* A soilborne necrotrophic fungus is the causal agent (Aghakhani and Dubey, 2009) [1]. The stages of pod setting and late flowering are usually when the plant is most susceptible to dry root rot. Plants that have been infected look to be entirely dried (Pande and Sharma, 2010) [12]. The disease on rotten roots is characterised by the destruction of lateral roots and widespread rotting. Brittle and minute sclerotial bodies can be seen mostly on the tape root's exterior surface and in the pith cavity (Rashid *et al.*, 2014; Vijay *et al.*, 2006) [14, 18]. The survey's goals were to: 1) determine the occurrence and distribution of chickpea dry root rot; 2) determine the incidence of dry root rot and 3) determine the effect of irrigation conditions and soil types on the development of dry root rot.

Materials and Methods
During the Rabi seasons of 2014-15, an intense roving survey was done in the farmer's fields of Madhya Pradesh's districts of Gwalior, Malwa, and Nimar to determine the occurrence of root rot in chickpea. A minimum of five fields were selected in each location and each field, observation was recorded from four random places. During the flowering stage, 40 fields in 15 districts were surveyed and data on soil type, cultivars cultivated, disease incidence, and irrigation conditions were recorded. In each field, four $1m^2$ quadrants were chosen at random. Infected and total plants were counted in each quadrant. Percent disease incidence was estimated using the number of infected and total plants.

Chickpea plants with characteristic indications of dry root rot were gathered from assessed regions, wrapped in marked paper bags, and sent to the laboratory for pathogen isolation.

$$\text{Per cent disease incidence} = \frac{\text{Diseased plants}}{\text{Total number of plants}} \text{x} 100$$

Result and Discussion

Disease and regions

All of the sites had dry root rot, with incidences ranging from 2.54 to 20.89 percent (Table 1). Lukwasa had the highest dry root rot incidence (20.89%), followed by Shivpuri, Kolarash, Ruthiyai, Mau, Raghogarh, Panchor (17.67, 15.88, 15.75, 15.34, 14.34 and 12.07%, respectively) and Khargone had the lowest (2.54%), followed by Rajpur, Barwani, Deshgaon, Dewas and Kukshi (3.20, 3.45, 3.52, 3.96 and 4.14%, respectively). Table-2 shows that Indore district had the highest disease incidence (15.34%), followed by Shivpuri, Sehore, Guna, Gwalior, Rajgarh and Jhabua (14.47 12.07 11.02 9.11 8.51 and 8.08%, respectively), while Dewas had the lowest disease incidence (3.96 percent), followed by Khargone, Barwani, Dhar, Khandwa, Alirajpur, Sajapur, and Burhanpur (5.00, 5.47, 6.82, 7.31, 7.57, 7.76 and 7.80%, respectively). Gurha and Trivedi (2008) [7] found up to 60 per cent incidence of dry root rot in Gulberga and Raichur in a previous survey. According to a survey conducted by Trivedi and Gurha (2006) [17] in several blocks of Bhundelkhand region (U.P.) and reported that the infection of *R. bataticola* on chickpea ranged from 5 to 22 per cent. Manjunatha *et al.* (2011) [9] conducted an intensive roving survey in farmers' fields in Raichur, Gulbarga, and Bidar districts of Karnataka. Gulbarga district had the highest prevalence of dry root rot in chickpea (9.8%), Raichur had the second highest (7.6%), and Bidar had the lowest (6.18%). Khan *et al.* (2012) [8] conducted a survey to determine the occurrence and incidence of chickpea dry root rot. Shangus in Jammu and Kashmir had the highest disease incidence of up to 40%, while Naina in Jammu and Kashmir had the lowest DRR incidence of up to 4.11 per cent.

Disease and irrigation condition

In the present investigation irrigation condition of all the places were recorded. Data on disease incidence in irrigated fields and unirrigated field was presented in table-3. Table 14 shows that the percent disease incidence in irrigated places ranged from 2.54 per cent (Khargone) to 7.67 per cent (Biaora), while it ranged from 5.17 per cent (Sendwa) to 20.89 per cent (Lukwasa) in locations where no irrigation facilities was available. In comparison to unirrigated fields (10.48%), irrigated fields had a lower disease incidence (4.59%). According to Sharma and Pande (2013), dry root rot incidence and severity were higher in plants subjected to moisture stress (40 percent and 60 percent SMC) than in non-stressed plants (80 percent and 100 percent SMC). Bajpal *et al.* (1999) [5] found similar results, stating that hot and dry weather in vertisols favoured disease development more than alfisols. This finding is consistent with Pande *et al.* (2004) and Manjunath *et al.* (2011) [9], who found that chickpea plants were subjected to moisture stress during the rabi season, which resulted in increased development of sclerotia of Rhizoctonia *sp.* on chickpea plant roots. According to Mina and Dubey (2010) [10], soil moisture was found to be adversely linked with chickpea wilt incidence. According to Pande *et al.* (2010) [11], the chickpea crop in central and southern India was likely prone to dry root rot development due to variable moisture stress and higher temperatures.

Disease and soil type

The dry root rot incidence per cent ranged from 4.58 per cent (Guna) to 20.89 per cent (Lukwasa) in locations where the chickpea crop was grown in alluvial soil, from 3.20 per cent (Rajpur) to 12.07 per cent (Panchor) in locations where the chickpea crop was grown in medium black soil, and from 2.54 per cent (Khargone) to 15.34 per cent (Mau) in locations where the chickpea crop was grown in deep black soil. Deep black soil (6.75 percent) had a lower disease incidence than medium black soil (7.47%) and alluvial soil (12.24%). According to a survey conducted by Manjunath *et al* (2011) [9], dry root rot of chickpeas differed from place to place, owing to variable soil characteristics (black/red soil conditions). Taya *et al.* (1988) [16] share similar finding. As comparing the different soil types, sandy soil sustained the most disease (78.33 per cent) when compared to clay soil (51.56 per cent) (Rajkrishan *et al.*, 1999) [13].

Table 1: Survey of chickpea dry root rot in Madhya Pradesh

S. No	District	Name of the village visited	Rainfed/ Irrigated	Soil type	Dry root rot incidence (%)	
					Range	Average
1	Gwalior	Ghatigaon	Rainfed	Alluvial Soil	8-15%	10.57
2	Gwalior	Mohana	Rainfed	Alluvial Soil	6-9%	7.65
3	Shivpuri	Lukwasa	Rainfed	Alluvial Soil	15-40%	20.89
4	Shivpuri	Goda	Rainfed	Alluvial Soil	2-11%	7.53
5	Shivpuri	Shivpuri	Rainfed	Alluvial Soil	9-21%	17.67
6	Shivpuri	Kolarash	Rainfed	Alluvial Soil	12-19%	15.29
7	Shivpuri	Badarwas	Rainfed	Alluvial Soil	4-17%	10.95
8	Guna	Binaganj	Rainfed	Alluvial Soil	5-11%	9.27
9	Guna	Guna	Irrigated	Alluvial Soil	2-7%	4.58
10	Guna	Raghogarh	Rainfed	Alluvial Soil	8-17%	14.34
11	Guna	Rudhiyai	Rainfed	Alluvial Soil	13-17%	15.88
12	Rajgarh	Biaora	Irrigated	Medium black soil	5-13%	7.67
13	Rajgarh	Sarangpur	Rainfed	Medium black soil	6-11%	9.34
14	Sajapur	Sajapur	Rainfed	Medium black soil	4-13%	8.94
15	Sajapur	Makshi	Rainfed	Medium black soil	4-10%	6.57
16	Sehore	Panchor	Rainfed	Medium black soil	10-13%	12.07
17	Dewas	Dewas	Irrigated	Medium black soil	3-5%	3.96
18	Indore	Mau	Rainfed	Deep black soil	12-18%	15.34

19	Khargone	Barwaha	Irrigated	Deep black soil	4-7%	5.10
20	Khargone	Bhikangaon	Rainfed	Deep black soil	4-9%	6.68
21	Khargone	Khargone	Irrigated	Deep black soil	1-4%	2.54
22	Khargone	Segaon	Rainfed	Deep black soil	3-7%	5.69
23	Khandwa	Deshgaon	Irrigated	Deep black soil	2-5%	3.52
24	Khandwa	Khandwa	Rainfed	Deep black soil	11-13%	11.09
25	Burhanpur	Asirgarh	Irrigated	Medium black soil	5-8%	6.45
26	Burhanpur	Bhurhanpur	Rainfed	Medium black soil	7-11%	9.15
27	Barwani	Jhulwania	Rainfed	Medium black soil	8-11%	10.05
28	Barwani	Sendwa	Rainfed	Medium black soil	4-7%	5.17
29	Barwani	Rajpur	Irrigated	Medium black soil	2-5%	3.20
30	Barwani	Barwani	Irrigated	Deep black soil	1-7%	3.45
31	Dhar	Kukshi	Irrigated	Deep black soil	3-5%	4.14
32	Dhar	Bagh	Rainfed	Deep black soil	4-11%	7.84
33	Dhar	Sardarpur	Rainfed	Medium black soil	5-8%	7.05
34	Dhar	Dhar	Rainfed	Medium black soil	5-9%	7.25
35	Dhar	Ghatabillor	Rainfed	Medium black soil	2-13%	9.38
36	Dhar	Betma	Irrigated	Medium black soil	3-8%	5.26
37	Jhabua	Bhabra	Irrigated	Deep black soil	4-7%	5.29
38	Jhabua	Jhabua	Rainfed	Medium black soil	10-12%	10.86
39	Alirajpur	Mangode	Irrigated	Medium black soil	3-7%	4.69
40	Alirajpur	Alirajpur	Rainfed	Deep black soil	6-14%	10.45

Table 2: Survey of dry root rot of chickpea in districts of Madhya Pradesh

S. No.	District	Per cent disease incidence
1	Gwalior	9.11
2	Shivpuri	14.47
3	Guna	11.02
4	Rajgarh	8.51
5	Sajapur	7.76
6	Sehore	12.07
7	Dewas	3.96
8	Indore	15.34
9	Khargone	5.00
10	Khandwa	7.31
11	Burhanpur	7.80
12	Barwani	5.47
13	Dhar	6.82
14	Jhabua	8.08
15	Alirajpur	7.57

Table 3: Occurrence of dry root rot in different soil types and irrigation condition

Irrigation conditions	Dry root rot incidence (%)	
	Range	Average
Rainfed	5.17-20.89	10.48
Irrigated	2.54-7.67	4.59
Soil types	**Dry root rot incidence (%)**	
	Range	**Average**
Alluvial	4.58-20.89	12.24
Medium black	3.20-12.07	7.47
Deep black	2.54-15.34	6.75

Conclusion

The highest incidence of dry root rot was found in Lukwasa during the survey, while the lowest incidence was found in Khargone. Irrigated fields had a lower incidence of dry root rot than non-irrigated fields. Deep black soil had a lower disease incidence than medium black soil and alluvial soil.

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