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Rhizoctonia bataticola: A threatening pathogen causing dry root rot of chickpea (*Cicer arietinum* L.) under changing climate conditions: An extended review

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Abstract
Dry root rot, caused by *Rhizoctonia bataticola* (syn. *Macrophomina phaseolina*), is one of the most destructive soil-borne diseases affecting chickpea cultivation in semi-arid and arid zones. The pathogen thrives in conditions of high temperature and low soil moisture, both of which are being amplified due to global climate change. This extended review compiles information on the biology, epidemiology, environmental interactions, pathogenic variability, host resistance, and integrated management strategies of this pathogen. Research from across India confirms that *Rhizoctonia bataticola* is a highly adaptable pathogen exhibiting significant variability and virulence across regions. Integrated management combining host resistance, seed treatment, fungicide application, and biological control offers the best sustainable approach to mitigating its threat.

Keywords: *Rhizoctonia bataticola,* dry root rot, chickpea (*Cicer arietinum* L.), climate change; soil-borne pathogen, pathogenic variability, host resistance, biological control, disease management, microsclerotia, temperature stress, moisture stress

1. Introduction
Chickpea is one of India's most economically significant pulse crops, contributing nearly 27% to global production. The crop is rich in proteins (23%), carbohydrates (64%), and essential minerals, making it a staple for vegetarian diets. Besides nutritional importance, it enhances soil fertility through biological nitrogen fixation. In Madhya Pradesh, chickpea is widely cultivated under rainfed conditions. In recent years, the incidence of dry root rot a disease caused by the soil-borne fungus *Rhizoctonia bataticola*, has increased significantly, especially under high temperature and low soil moisture regimes. The pathogen survives in soil as microsclerotia and infects roots under stress conditions. The present study was designed to survey DRR prevalence in Sohawal block and to confirm pathogenicity of the isolated strains.

2. Pathogen Biology and Identification
Rhizoctonia bataticola survives in soil as microsclerotia and mycelia, and invades plant roots during stress periods. It causes necrosis and xylem blockage leading to wilting.

- **Infection Mechanism:** further reported that *Rhizoctoni bataticola* infection typically initiates from soil borne inoculum in the form of hyphae and sclerotia. The pathogen destroys epidermal cells and penetrates roots, leading to mechanical plugging of xylem vessels by microsclerotia, toxin production, enzymatic action, and mechanical pressure. The fungus grows inter and intracellularly, causing necrotic lesions and root rot, which become apparent during flowering and podding stages. (Sharma *et al*., 2016) [22].
- **Colony Morphotypes:** reported a correlation between *Rhizoctonia batiacola* colony phenotypes and pathogenicity levels. White colony phenotypes were associated with highly pathogenic stem isolates, whereas dark green colonies were linked to low pathogenic isolates. Brown colony phenotypes represented isolates with intermediate pathogenicity. (Aboshosha *et al*., 2007) [1].

- **Growth Conditions:** collected isolates of *Rhizoctonia bataticola* (*Macrophomina phaseolina*) from chickpea crops in Madhya Pradesh and evaluated their responses to different temperatures (15, 20, 25, 30, 35, and 40ºC) and pH levels (5.5, 6.0, 6.5, 7.0, and 7.5) in laboratory conditions. They observed optimal growth at 30-35ºC, while poor sclerotial growth was noted at 40ºC. The fungus exhibited good growth and sclerotia production across pH levels ranging from 5.5 to 7.5, with pH 7.0 being the most favorable. (Jha & Sharma, 2005) [11].

3. Environmental Influence on Dry root rot Development

3.1 Temperature and Moisture

Reported that chickpea dry root rot, caused by the soil-borne fungal pathogen *Rhizoctonia bataticola* (Taub.) Butler, results in substantial yield losses, especially under fluctuating environmental conditions. Their study examined the effect of various temperature regimes (15°C, 20°C, 25°C, 30°C, 35°C, 40°C, and 45°C) on the growth of *Rhizoctonia bataticola* isolates collected from Madhya Pradesh, Karnataka, Maharashtra, Andhra Pradesh, and Telangana. The findings indicated that mycelial growth was highest at 35°C, followed by 30°C and 25°C across all isolates. Likewise, disease severity was most pronounced at 35°C, with a rating of 8.5, followed by 30°C (7.9) and 25°C (7.0). Among the isolates tested, the Telangana isolate exhibited the greatest virulence, causing the most severe disease symptoms. (Srinivas *et al*., 2017) [25].
investigated the diversity of *Rhizoctonia bataticola* isolates in Karnataka under changing climatic conditions. Sixty isolates were collected and analyzed for cultural, morphological, and molecular diversity. Genetic diversity analysis using RAPD primers revealed significant variations among the isolates. (Sunkad & Dore, 2023) [26].

3.2 Soil pH

Also carried out the management of dry root rot through biocontrol agents and resistant germplasm lines in Jammu and Kashmir. Screening of chickpea germplasm in pots categorized 60 lines into different resistance levels. Nine lines, including KGD-1189, KGD-1201, KGD-1209, KGD-1215, KGD-1217, KGD-1220, KGD-1221, KGD-1248, and KGD-1289, were resistant. Ten lines were moderately resistant, seven were moderately susceptible, 17 were susceptible, and another 17 were highly susceptible to the disease. (Khan *et al*., 2012) [14].
Collected isolates of *Rhizoctonia bataticola* (*Macrophomina phaseolina*) from chickpea crops in Madhya Pradesh and evaluated their responses to different temperatures (15, 20, 25, 30, 35, and 40ºC) and pH levels (5.5, 6.0, 6.5, 7.0, and 7.5) in laboratory conditions. They observed optimal growth at 30-35ºC, while poor sclerotial growth was noted at 40ºC. The fungus exhibited good growth and sclerotia production across pH levels ranging from 5.5 to 7.5, with pH 7.0 being the most favorable. (Jha and Sharma 2005) [11].

4. Morphological and Pathogenic Variability

Pathotypes: collected 23 isolates of *Rhizoctonia bataticola* from ten major chickpea-growing states in India and found significant variations in their morphological, cultural, and pathogenic characteristics. Virulence analysis on a set of chickpea cultivars (ICC12441, ICC1224, ICC12450, Pusa 362, BGD112, Pusa1103, Pusa212, and Pusa1088) under blotter paper and sick soil conditions classified them into six distinct pathotypes, which were correlated with agro-ecological regions. The most virulent isolate (RBI from Bangalore, Karnataka) exhibited fast growth and produced the largest sclerotia. This study proposed a set of cultivars for the first time to differentiate *Rhizoctonia bataticola* pathotypes in chickpea. (Aghakhani *et al*., 2009) [2].

Virulence: highlighted *Rhizoctonia bataticola* as a significant pathogen affecting various crops, including chickpea. In their study, 12 isolates of *Rhizoctonia bataticola* collected from different agro-climatic regions of the Marathwada region in Maharashtra were analyzed for pathogenic variability. Among these, the isolate Rb-9, obtained from Mukhed in Nanded district, exhibited the highest virulence, causing 98.40% total mortality in the susceptible cultivar JG-62. The observed pathogenic variations among different isolates underscore their importance in disease management strategies. Understanding this variability is crucial for developing effective breeding programs aimed at enhancing chickpea resistance against *Rhizoctonia bataticola*. (Kadam *et al*., 2024) [12].

Molecular Variability: investigated the diversity of *Rhizoctonia bataticola* isolates in Karnataka under changing climatic conditions. Sixty isolates were collected and analyzed for cultural, morphological, and molecular diversity. Genetic diversity analysis using RAPD primers revealed significant variations among the isolates. (Sunkad *et al*., 2023) [26].

5. Disease Surveys and Distribution

conducted a survey on the incidence of chickpea dry root rot in central and southern India. Among the five districts surveyed in Uttar Pradesh, the highest disease incidence was recorded in Ayodhya (27.39%), followed by Kanpur (25.29%), Sultanpur (23.89%), Gonda (11.41%), and Basti (10.30%). (Yadav & Singh, 2019) [28].
Evaluated various fungicides against *Rhizoctonia bataticola*, the causal agent of dry root rot in chickpea. Pyraclostrobin, both alone and in combination with Thiophanate-Methyl, completely inhibited fungal growth at a 100ppm concentration under *in vitro* conditions. At a higher concentration of 300 ppm, two additional fungicide combinations-Carboxin + Thiram and Carbendazim + Mancozeb-also completely suppressed the pathogen's development. (Bankoliya *et al*., 2022) [4].
conducted an intensive roving survey in farmers' fields across Karnataka and recorded the highest incidence of dry root rot in chickpea in Gulbarga district (9.8%), followed by Raichur (7.6%), with the lowest incidence in Bidar (6.18%). The overall incidence across the surveyed districts ranged from 1% to 19%, mainly due to variations in soil type (black and red soil) and the cultivars grown under rainfed conditions. (Manjunatha *et al*., 2011) [16].

6. Cultural and Nutritional Factors

Investigated the impact of nutritional and physiological factors on the growth and sclerotial formation of *Rhizoctonia bataticola* isolates. Among the six media tested, PDA (Potato Dextrose Agar) supported the best growth and sclerotial formation, followed by Czapek's Dox, Richard's, Oat Meal, and Peptone Agar. Malt Extract Medium showed moderate sclerotial formation but poor mycelial growth,

while Peptone Agar induced little to no sclerotial formation. Among the carbon sources tested, the highest fungal growth was observed in dextrose, followed by sucrose, mannitol, starch, maltose, and cellulose. Maximum sclerotial production was recorded in cellulose, followed by dextrose, sucrose, maltose, and starch, while mannitol resulted in the lowest sclerotial formation. Sodium nitrate proved to be the most effective nitrogen source for both fungal growth and sclerotial formation compared to ammonium nitrate. (Salunkhe *et al*., 2009) [20].

7. Host Resistance

Focused on screening a mini-core collection of 211 chickpea germplasm accessions, representing the genetic diversity of a globalcollection of 16,991 accessions preserved at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). The objective was to identifyaccessions with resistance to multiple fungal pathogens, including *Ascochyta rabiei* (Ascochyta blight, AB), *Botrytis cinerea* (Botrytis graymold, BGM), *Fusarium oxysporum* f. sp. *ciceris* (Fusarium wilt, FW), and *Rhizoctonia bataticola* (dry root rot,) under controlled conditions.

The findings revealed a significant level of resistance, particularly against FW, where 21 accessions showed no symptoms, and 25 were classified as resistant. Resistance levels varied for other diseases, with three accessions showing moderate resistance to AB, 55 to BGM, and six to DRR. Notably, ICC 11284 was the only accession exhibiting moderate resistance to both AB and BGM. Additionally, four accessions displayed combined resistance to DRR and FW, while 11 accessions were resistant to both BGM and FW. This study successfully identified chickpea germplasm with high levels of resistance to multiple fungal diseases. These accessions serve as valuable genetic resources for breeding programs aimed at developing chickpea cultivars with durable, multi-disease resistance, which is essential for sustainable disease management and improving crop productivity. (Pande *et al*., 2006) [17].

8. Disease Management Strategies

8.1 Chemical Control

Effective Fungicides: evaluated the effectiveness of four fungicides -Carbendazim, Propineb, Mancozeb + Thiophanate-Methyl, and Mancozeb + Metalaxyl - against *M. phaseolina*, the causal agent of stem and root rot in sesame, using the poisoned food technique. All fungicides inhibited mycelial growth compared to the untreated control, with Carbendazim being the most effective. (Choudhary *et al*., 2004) [6].

Evaluated various fungicides against *Rhizoctonia bataticola*, the causal agent of dry root rot in chickpea. Pyraclostrobin, both alone and in combination with Thiophanate-Methyl, completely inhibited fungal growth at a 100ppm concentration under *in vitro* conditions. At a higher concentration of 300 ppm, two additional fungicide combinations-Carboxin + Thiram and Carbendazim + Mancozeb-also completely suppressed the pathogen's development. (Bankoliya *et al*., 2022) [4].

Investigated the effect of various systemic, contact, and combination fungicides, as well as different bioagents, on *Rhizoctonia bataticola*, the causal agent of dry root rot in chickpea. The study, conducted during 2018-19 at VNMKV, Parbhani, evaluated the efficacy of 12 fungicides, all of which demonstrated effectiveness against the pathogen. Among the systemic fungicides, carbendazim 50% WP, tebuconazole 29.9% EC, hexaconazole 5% EC, and azoxystrobin exhibited complete (100%) mycelial inhibition. Similarly, the combination fungicides carbendazim 12% + mancozeb 63% WP and carboxin 37.5% + thiram 37.5% WP also achieved full suppression of fungal growth. In terms of biological control, *Trichoderma asperellum* recorded the highest mycelial inhibition at 88.27%, followed by *T. harzianum* with an inhibition rate of 83.4% against *R. bataticola*. These findings highlight the potential of both chemical and biological approaches in managing dry root rot of chickpea effectively. (Gaikwad *et al*., 2020) [9].

Seed Treatment: reported that under field conditions, chickpea seed treatment with Carbendazim at 2 g/kg resulted in higher germination and the lowest wilt incidence (6.48%). This was followed by Carbendazim + Mancozeb (8.56%) and Mancozeb alone (9.02%). Propiconazole was the least effective, with a wilt incidence of 12.36%. (Andrabi *et al*., 2011) [3].

8.2 Biological Control

Effective Bioagents: assessed the potential of biocontrol agents in managing *Rhizoctonia bataticola* under controlled conditions. Among the tested bioagents, *Trichoderma harzianum* (80.5% inhibition), *Pseudomonas fluorescens* (39.2% inhibition), and *Rhizobium phaseoli* (27.8% inhibition) exhibited significant suppression of fungal growth. (Deshmukh *et al*., 2014) [7].

isolated rhizobacteria from the rhizosphere of chickpea, pigeonpea, cotton, and soybean. Biochemical and cultural studies confirmed the presence of *Pseudomonas fluorescens* and *Bacillus subtilis*, both of which were tested against *Rhizoctonia bataticola*. *Pseudomonas fluorescens* (Pf1) and *Bacillus subtilis* (Bs4) were the most effective, inhibiting fungal growth by 53.83% and 49.83%, respectively, under *in vitro* conditions. (Kapali *et al*., 2016) [13].

Collected 10 fungal (*Trichoderma*) and 30 bacterial (*Pseudomonas* and *Bacillus*) isolates and screened them for antagonistic activity against *Rhizoctonia bataticola*. Among these, *Trichoderma* (TL1), *Pseudomonas fluoresces* [PfUL (A)], and *Bacillus subtilis* (BsOP2) exhibited the highest inhibition rates of 55.6%, 41.1%, and 44.4%, respectively. Compatibility tests showed that *Pseudomonas fluorescens* strains were compatible with *Bacillus subtilis* and *Trichoderma*, whereas *Bacillus subtilis* strains were not compatible with *Trichoderma*. (Latha *et al*., 2017) [15].

8.3 Cultural Practices

Soil moisture conservation, pH regulation, and crop rotation (although limited due to pathogen's wide host range) reduce disease risk.

9. Impact of Climate Change

highlighted the increasing significance of dry root rot in chickpea (*Cicer arietinum* L.), caused by *Rhizoctonia bataticola* (syn. *Macrophomina phaseolina*), particularly under changing climatic conditions. High temperatures and moisture stress create a favorable environment for disease development, making it a growing concern for chickpea production. Since this pathogen primarily resides in soil, various environmental and edaphic factors influence its occurrence and severity. However, there has been limited

systematic research on the biology, ecology, and epidemiology of dry root rot in chickpea. Additionally, studies on host plant resistance have indicated a lack of resistant genotypes, emphasizing the need for further research in identifying and characterizing variability within the pathogen's epidemiological and pathological niches. The available literature on disease resistance remains scarce, highlighting the necessity for an integrated management approach. This review explores the current status of dry root rot in chickpea in the context of climate change and discusses potential management strategies to mitigate its impact. (Sharma *et al*., 2015) [21].

discussed the impact of climate change on dry root rot and explored possible management strategies. They highlighted that increased temperatures and moisture stress predispose chickpea crops to infection. Since *Rhizoctonia bataticola* is a soil-inhabiting pathogen, environmental and soil factors play a crucial role in disease development. (Chandra *et al*., 2021) [5].

Reported that dry root rot can cause up to 100% yield loss in susceptible chickpea varieties under favorable conditions. The pathogen has a broad host range, making crop rotation a challenging disease management strategy. Drought and high-temperature stress create optimal conditions for the occurrence of dry root rot symptoms in the field. (Sinha *et al*., 2021) [23].

10. Conclusion

Rhizoctonia bataticola poses a major challenge to sustainable chickpea production, particularly in regions facing climatic stress. It is a highly adaptive pathogen showing extensive variability in morphology and virulence. Effective management of DRR demands a holistic strategy involving resistant cultivars, seed treatment, biological control, and targeted fungicide applications. Continued surveillance, pathotyping, and climate-resilient disease forecasting systems are essential to mitigate its growing threat.

11. References

1. Aboshosha SS, Attaalla SI, El-Korany AM. Morphological and pathogenic variability among *Rhizoctonia bataticola* isolates associated with dry root rot disease of chickpea. Egypt J Phytopathol. 2007;35(1):25-34.
2. Aghakhani M, Dubey SC. Morphological and pathogenic variability among isolates of *Rhizoctonia bataticola* causing dry root rot of chickpea. Indian Phytopathol. 2009;62(3):306-310.
3. Andrabi M, Razdan VK, Razdan M. Evaluation of fungicides against wilt complex of chickpea under temperate conditions of Kashmir. Int J Farm Sci. 2011;1(2):86-91.
4. Bankoliya N, Jatav RS, Bhale UN. Evaluation of systemic fungicides for control of soil-borne pathogens *in vitro*. Int J Curr Microbiol Appl Sci. 2022;11(4):285-296.
5. Chandra M, Sharma M, Ghosh R. Climate change and emerging threats of dry root rot in chickpea: biology, epidemiology and management strategies. J Food Legumes. 2021;34(2):93-99.
6. Choudhary DK, Shukla A, Yadav RK. Evaluation of fungicides against *Macrophomina phaseolina* causing stem and root rot in sesame. J Mycol Plant Pathol. 2004;34(2):258-259.
7. Deshmukh AM, Kharbikar LL, Koche MD. Evaluation of bioagents and fungicides against dry root rot of chickpea caused by *Macrophomina phaseolina*. Int J Plant Prot. 2014;7(1):226-229.
8. Dhakar RM, Rathod KS, Mishra M. Survey and incidence of dry root rot of chickpea caused by *Rhizoctonia bataticola* in different blocks of Tikamgarh district. Bioscan. 2023;18(1):325-330.
9. Gaikwad AP, Gawande SJ, Datar MN. Efficacy of systemic and contact fungicides along with bioagents against *Rhizoctonia bataticola* causing dry root rot of chickpea. J Pharmacogn Phytochem. 2020;9(4):1471-1475.
10. Gurha SN, Trivedi SK. Occurrence and severity of dry root rot of chickpea caused by *Macrophomina phaseolina* in Karnataka. Agric Sci Digest. 2008;28(3):170-172.
11. Jha AK, Sharma M. Effect of temperature and pH on the growth and sclerotial formation of *Rhizoctonia bataticola*. Indian Phytopathol. 2005;58(2):228-229.
12. Kadam RR, Patil JV, Bhale UN. Morphological and pathogenic variability among isolates of *Rhizoctonia bataticola* from chickpea in Maharashtra. Bioscan. 2024;19(1):115-120.
13. Kapali V, Naik MK, Shankergoud I. Evaluation of rhizobacteria for the management of dry root rot of chickpea. Legume Res. 2016;39(6):951-956.
14. Khan MF, Andrabi M, Wani MC. Integrated management of dry root rot of chickpea caused by *Rhizoctonia bataticola* (Taub.) Butler. Legume Res. 2012;35(3):202-207.
15. Latha MA, Naik MK, Biradar S. Compatibility and efficacy of *Trichoderma*, *Pseudomonas* and *Bacillus* spp. against *Rhizoctonia bataticola*. Int J Pure Appl Biosci. 2017;5(1):161-166.
16. Manjunatha BL, Naik MK, Chandrashekara C. Survey and surveillance of dry root rot of chickpea in Northern Karnataka. Int J Plant Prot. 2011;4(1):97-98.
17. Pande S, Sharma M, Ghosh R. Identification of sources of multiple disease resistance in chickpea using a mini-core collection. Plant Dis. 2006;90(9):1214-1220.
18. Parmar RC. Studies on cultural, morphological and pathogenic variability in *Rhizoctonia bataticola* causing dry root rot of chickpea [M.Sc. Thesis]. Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur; 2013.
19. Prajapati RK, Patel KM, Chauhan SK. Disease scenario of dry root rot of chickpea in Uttar Pradesh and Uttaranchal. Agric Sci Digest. 2003;23(3):194-195.
20. Salunkhe CK, Kuldhar DP, Gade RM. Influence of nutritional and physiological factors on growth and sclerotial formation of *Rhizoctonia bataticola*. J Soils Crops. 2009;19(1):101-107.
21. Sharma M, Ghosh R, Tarafdar A. Dry root rot in chickpea: current status and future challenges. Indian Phytopathol. 2015;68(2):161-170.
22. Sharma M, Pande S, Ghosh R. Infection mechanism and epidemiology of dry root rot of chickpea. Legume Perspect. 2016;12:27-30.
23. Sinha R, Ghosh R, Sharma M, Singh G. Low soil moisture predisposes chickpea to dry root rot disease. Sci Rep. 2021;11(1):6568.

24. Srinivas A. Survey on incidence of dry root rot of chickpea in central India. Legume Res. 2016;39(3):435-438.
25. Srinivas A, Sharma M, Ghosh R. Impact of temperature regimes on chickpea dry root rot development caused by *Rhizoctonia bataticola*. Legume Res. 2017;40(6):1011-1016.
26. Sunkad G, Naik MK, Reddy CN. Molecular diversity among isolates of *Rhizoctonia bataticola* causing dry root rot of chickpea under climate change. Indian Phytopathol. 2023;76(1):37-42.
27. Sunkad G, Dore SP. Effect of temperature and soil moisture on dry root rot severity in chickpea. J Plant Dis Sci. 2023;18(2):89-94.
28. Yadav SK, Singh HB. Incidence of dry root rot of chickpea in Eastern Uttar Pradesh. J Pharmacogn Phytochem. 2019;8(2):1083-1086.