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Studies on the Incidence of Dry Root Rot in Peanut Growing Areas of Krishnagiri, Dharmapuri and Karur Districts of Tamil Nadu and *in vitro* Assessment of Saltation Characters of *Macrophomina phaseolina* Syn (*Rhizoctonia bataticola*)

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ABSTRACT

Groundnut (*Arachis hypogaea*) is a self-pollinated oilseed crop commonly called as Manila nut, Monkey nut, Peanut, Earthnut. They are packed with proteins, essential amino acids, fatty acids and various other micro and macro nutrients. But the production and the quality of the oil from the groundnut is hampered by the dry root rot incited by *Macrophomina phaseolina* (Syn. *Rhizoctonia bataticola*) which causes havoc to the farmers in major groundnut growing areas of Tamil Nadu. Confronting this issue, the current research was undertaken with an objective to examine the prevalence and the incidence of dry root rot in groundnut across major peanut-growing regions of Karur, Krishnagiri and Dharmapuri districts in Tamil Nadu, India during 2023-24, along with evaluating the cultural characteristics among isolates of *Macrophomina phaseolina.* Roving survey was conducted across multiple locations in the Karur, Krishnagiri, and Dharmapuri districts revealed the widespread presence of charcoal rot in groundnut crops, with varying incidence levels across different soil types and cultivation practices. The highest incidence was reported in Nedungal (MP4), Krishnagiri district, at 30.16%. Disease prevalence was higher in improved cultivars such as VRI-2 and CO types, particularly in sandy loam and loamy sand soils with rainfed conditions. *Macrophomina phaseolina* isolates showed substantial cultural heterogeneity among the investigated locations. Some colonies developed sclerotia, while others did not, and colony colours ranged from deep black to greyish black, with different degrees of pigmentation observed at 7 days after inoculation (DAI).

Keywords Groundnut (*Arachis hypogaea*), Dry root rot, *Macrophomina phaseolina,* Charcoal rot, Cultural variability.

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INTRODUCTION

Groundnut (*Arachis hypogaea* L.) a notable oilseed crop from the Fabaceae family earned a sobriquet as the “King of Oilseeds”. The legume cum oilseed crop is also called as Peanut, Earthnut, and Monkey Nut (Biswas and Bhattacharjee 2019). Peanut being rich in oil content, straddle the categories of cereal legumes and oil crops. In India, they emerged as

the leading oilseed crop by cultivated area, second only to soybean in overall production (Meghana *et al.* 2023). Peanut was cultivated for about an area of 7.74 million hectares with the total production of 7.61 million tonnes and with a productivity of 991.8 kg ha^{-1} (McCarty *et al.* 2016). The groundnut quality and the yield attributes are constantly hampered by the plant pathogens and the dry root rot disease incited by *Macrophomina phaseolina* (Pycnial stage) *Rhizoctonia bataticola* (Sclerotia stage). The fungus causes several disease symptoms, including charcoal rot, root rot, seedling blight, foliar blight, dry rot, pod rot, and seed rot causes substantial production losses in crops (Kumar *et al.* 2020). The symptoms including leaf yellowing, root decay, and finally the plant dead the health of infected plants frequently deteriorates significantly as a result of a reduction in soluble carbohydrates and proteins, which are crucial for plant growth and photosynthesis. Hydrogen peroxide ($H2O_2$) and malondialdehyde (MDA), which are markers of oxidative stress in the plant, are also elevated by the disease. Together, these elements cause the plant tissue to degrade and collapse, which ultimately results in the plant's death (Abbas *et al.* 2024). *Macrophomina phaseolina* is severe and growing catastrophe to groundnut production in India, aggravated by rising temperatures and unpredictable rainfall (Pamala *et al.* 2023). The occurrence of dry root rot disease may be related to the predominance of dry circumstances in rainfed environments, which provides the conducive environmental conditions to pathogen multiplication and development (Muthukumar *et al.* 2014). Warming temperatures and increased frequency of moisture stress are making the disease more severe in humid tropical regions. Rising temperatures have had a significant impact on the growing incidence of dry root rot in different regions during the past few years (Savary *et al.* 2011). The ideal temperature range for the fungi to infect, colonize, and develop was between 25 and 35°C (Srinivas *et al.* 2017). The pathogen grows well at a pH level of 6.5, with substantial development noticed around this range (Ranjan *et al.* 2024). *M. phaseolina* produces black, melanized microsclerotia with 50-200 cells that can live in soil for up to 15 years (Gupta *et al.* 2012) Additionally these microsclerotia persist in soil and sprout at warm temperatures range between (28-35°C) (Zveibil *et al.* 2012).

MATERIALS AND METHODS

An extensive roving survey was conducted in the major peanut growing areas of Karur, Dharmapuri and Krishnagiri district of Tamil Nadu to examine the presence and severity of Charcoal rot of Peanut during the year 2022-2023. This survey was conducted on two peanut growing seasons viz., *kharif* (June -September) and *rabi* (October- January). The plants showing bark shedding and the plants with no secondary root formation infested with black coloured pycnidia masses (typical charcoal rot symptoms) Were carefully collected from the field and placed in the air tight polythene Ziplock bags and the necessary details about them are labelled properly. The disease incidence in the *invivo* conditions was calculated using the disease incidence formula given by Vidhyasekaran 2004.

$$\text{PDI} = \frac{\text{No of diseased infected plants}}{\text{Total no of plants observed}} \times 100$$

In the laboratory using the sterile scalpels the infected plant portions along with the healthy plant portions were cut and surface sterilized with the surface sterilization agent Mercury chloride @ 0.1% and they were repeatedly washed to ward off the traces of sterilizing agents. Then they are carefully placed and incubated in autoclaved sterile distilled water agar amended with Streptomycin sulphate @ 0.1 for 3 days as the water agar contains minimal nutrients it greatly reduced the chance of fungal pathogenic contamination and streptomycin sulphate arrest the growth of bacterial contamination in the Petri plates. Then using a 4 mm sterile corn borer the mycelium grown from the infected plant parts after 3 days were carefully augured and the mycelial disc was then placed in the autoclaved sterile half strength Potato dextrose agar medium which supports the stable growth phase for this fast-growing plant pathogen and the saltation (Cultural and Morphological characters) of the pathogen *Macrophomina phaseolina* Syn (*Rhizoctonia bataticola*) were assessed.

RESULTS AND DISCUSSION

In (Table 1) shows the incidence of Charcoal rot or dry root rot as surveyed in major peanut-growing areas of

Table 1. Survey on the incidence of Charcoal rot in major peanut growing areas in Krishnagiri, Karur and Dharmapuri on *kharif* season (June-September) 2022-2023.

Sl. No.	Isolate code	Locality	District	Soil Type	Variety	Irrigated/ rainfed	Charcoal Rot incidence (%)	Severity rating
1	Mp1	Ayyampalayam	Karur	Sandy loam	CO 3	Irrigated	28.48	Moderate
2	Mp2	Puliyur	Karur	Sandy loam	Local	Irrigated	32.26	Severe
3	Mp3	Puthukoottai	Karur	Sandy loam	CO 2	Irrigated	22.02	Mild
4	Mp4	Marudepalli	Krishnagiri	Sandy loam	VRI-2	Rainfed	36.68	Severe
5	Mp5	Nedungal	Dharmapuri	Sandy loam	JL-24	Rainfed	33.78	Severe
6	Mp6	Palacode	Dharmapuri	Loamy sand	VRI-2	Rainfed	23.87	Moderate
7	Mp7	Shoolagiri	Krishnagiri	Loamy sand	VRI-2	Rainfed	31.68	Severe
8	Mp8	Kadagathur	Krishnagiri	Clay loam	TMV-7	Irrigated	21.12	Mild
9	Mp9	Sellampatti	Karur	Clay loam	Local	Rainfed	33.46	Severe
10	Mp10	Devarahalli	Krishnagiri	Black soil	Local	Irrigated	28.92	Moderate

Krishnagiri, Karur and Dharmapuri during the *Kharif* season (June-September) of the year 2022-2023. Disease severity varies very much between the localities and soil type. The least incidence was noticed to be 21.12% in Kadagathur locality of Krishnagiri, while maximum incidence was noted to be 36.68% in Marudepalli, Krishnagiri with rainfed conditions and sandy loam soil. Six isolates exhibited a heavy incidence rating, thus signifying the susceptibility of local peanut varieties to the pathogen. Similarly, (Amrate *et al.* 2024) conducted a survey on the incidence and the distribution of charcoal rot on soybean across 16 districts in Madhya Pradesh found that the disease incidence ranged from 16.25% on Malwa plateau and highest disease incidence of 44.5% in Kymore plateau and Satpura hills. This study underscores and reflected our investigations. Contrary to this, the Rabi season survey in Table 2 registered a 10-12% lower scale of disease incidences; the highest recorded incidence that showed 32.75% in Marudepalli, Krishnagiri, and the minimum at 18.85% recorded in Kadagathur, Krishnagiri. This might be due to that Tamil Nadu receives most of its rainfall during the Northeast Monsoon season (October-December). The epiphytology situation during the month October- January might not be conducive for the disease development as it is dry root rot disease. So that of the disease incidences that during the *Rabi* season fell under the moderate rating category whereby seven isolates scored moderate ratings.

In supplementing to this study, the saltation characters of several isolates of *Macrophomina phaseolina* were also recorded and illustrated in Table 3 are significant information sources regarding the in-vitro growth characteristics of the pathogen. For instance, the highest mycelial growth was recorded as 84.00 mm in isolate Mp6 while the least growth was recorded in the isolate Mp3, with a growth of 78.50 mm. The colours of the colonies differed, with

Table 2. Survey on the incidence of Charcoal rot in major peanut growing areas in Krishnagiri, Karur and Dharmapuri on *rabi* season (October-January) 2022-2023.

Sl. No.	Isolate code	Locality	District	Soil Type	Variety	Irrigated/ Rainfed	Charcoal rot incidence (%)	Severity rating
1	Mp1	Ayyampalayam	Karur	Sandy loam	Kadiri	Irrigated	25.43	Moderate
2	Mp2	Puliyur	Karur	Sandy loam	TMV-2	Irrigated	28.80	Moderate
3	Mp3	Puthukoottai	Karur	Sandy loam	TMV-7	Irrigated	19.66	Mild
4	Mp4	Marudepalli	Krishnagiri	Sandy loam	VRI-2	Rainfed	32.75	Severe
5	Mp5	Nedungal	Dharmapuri	Sandy loam	JL-24	Rainfed	30.16	Severe
6	Mp6	Palacode	Dharmapuri	Loamy sand	VRI-2	Rainfed	21.31	Moderate
7	Mp7	Shoolagiri	Krishnagiri	Loamy sand	TAG-24	Rainfed	28.29	Moderate
8	Mp8	Kadagathur	Krishnagiri	Clay loam	TMV-7	Irrigated	18.85	Mild
9	Mp9	Sellampatti	Karur	Clay loam	Local variety	Rainfed	29.88	Moderate
10	Mp10	Devarahalli	Krishnagiri	Black soil	Local variety	Irrigated	25.82	Moderate

Table 3. Saltation characters of various isolates of *Macrophomina phaseolina* (*Rhizoctonia bataticola*) in *in vitro* conditions on 10 DAI.

Isolate code	Mycelial growth (mm)	Colony color	Appearance	Sclerotia	Sclerotia size (µm)	Sclerotia color and texture	Colony texture	Pigmentation
Mp1	75.45 (60.31)	Greyish black	Fluffy growth	Present	85.2	Brown, Hard, Irregular	Smooth	No
Mp2	79.20 (62.85)	Deep black	Profuse aerial growth	Present	88.7	Brown, Hard, Irregular	Velvety	Yes
Mp3	78.50 (61.99)	Black	Flat aerial growth	Absent	-	-	Rough	No
Mp4	82.65 (66.12)	Greyish black	Flat growth	Absent	-	-	Smooth	Yes
Mp5	76.10 (60.75)	Black	Fluffy growth	Present	82.1	Brown, Hard, Irregular	Velvety	No
Mp6	84.00 (67.45)	Greyish black	Fluffy aerial growth	Absent	-	-	Rough	Yes
Mp7	78.30 (61.75)	Greyish black	Fluffy Growth	Present	83.6	Dark brown, Hard, Irregular	Smooth	No
Mp8	85.20 (68.30)	Deep Black	Aerial growth	Absent	-	-	Velvety	Yes
Mp9	80.45 (64.01)	Black	Fluffy aerial growth	Present	86.8	Pale brown, Hard, Irregular	Rough	No
Mp10	83.15 (66.87)	Black	Flat Growth	Absent	-	-	Smooth	Yes

the variation from greyish black for Mp1 and Mp4 to deep black recorded in Mp2. Presence of sclerotia was noticed in many of the isolates, such as Mp1 and Mp2 that were 85.2 µm and 88.7 µm respectively while Mp5 produced 82.1 µm, therefore maximum size of sclerotia ranged from 88.7 µm and minimum size of 82.1 µm among the studied isolates. The texture as well as colour of the colonies was different; several of the isolates like Mp2, Mp6, Mp8 presented texture as velvety, whereas some other isolates like Mp3, Mp4, and Mp7 presented roughness in the colony texture. Similar studies were undertaken by (Basbagci and Dolar 2022). They examined 19 chickpea isolates of R. bataticola for their morphological, genetic, and virulence characteristics. The isolates showing high heterogeneity by exhibiting variability in colony colour texture and growth. Thus, this investigation corroborates with our research investigation.

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