

Research paper

Assessment of disease incidence of dry root rot of mungbean incited by *Macrophomina phaseolina* (Tassi.) Goid, in Telangana State

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Handling Editor:

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Received: 28 July 2023

Accepted: 15 August 2023

ABSTRACT

Dry root rot of mungbean incited by *Macrophomina phaseolina* (Tassi.) Goid is the prime importance in reducing crop yield. Dry root rot became a major obstacle to the growers of mungbean which can lead to significant loss in production by reducing plant populations at both seedling and adult stages. Due to the above reason a roving survey was conducted during Rabi 2022-23 in a major mungbean growing areas of Telangana State to record the occurrence and distribution of the disease. The highest disease incidence of 31.7% was recorded in Ichoda village of Adilabad district and least disease incidence of 5.3% was recorded in Pallipadu village of Khammam district of Telangana State. Maximum mean dry root rot incidence was observed in Mahabubabad district (18.9%) followed by Warangal district (18.1%). It was observed that the disease was more prevalent in sandy loam soils followed by black soils and minimum in clay soils, and the areas where the local and private varieties are being used by farmers.

Key words: Mungbean, Root rot, *Macrophomina phaseolina*, Soil borne disease

INTRODUCTION

Mungbean, *Vigna radiata* (L.) R. Wilczek var. radiate, is a significant source of protein in Asia. It is also an economically significant pulse crop (Nair *et al.*, 2012). India is one of the world's top producers of mungbean and it is grown in the states of Rajasthan, Maharashtra, Madhya Pradesh, Odisha, Andhra Pradesh, Tamil Nadu, Telangana and Uttar Pradesh (Mallaiah and Rao, 2016). In Telangana, 0.7 lakh ha of area covered by mungbean with production of 38.05 thousand tonnes with an average yield of 507 kg ha⁻¹ in 2020-2021 (INDIASTAT, 2021). There are a number of biotic and abiotic factors that have an impact on mungbean production. Diseases which caused by fungal, bacterial and viral are the primary biotic constraints of mungbean production (Batzer *et al.*, 2022).

Among all the fungal diseases dry root rot incited by *Macrophomina phaseolina* (Tassi.) Goid is of prime importance in reducing crop yield (Raguchander *et al.*, 1993). According to Tetali *et al.* (2015), *M. phaseolina* is believed to cause anthracnose in over 500 plant species. It affects all parts of plants *viz.*, roots, stems, branches, petioles, leaves, pods and seeds. In mungbean, it causes significant production losses by reducing plant population at both seedling and adult stages (Khan *et al.*, 2016).

Dry root rot causes 10-44% yield loss in mungbean production in India and 33-44% due to Rhizoctonia root rot (Nair *et al.*, 2019). Leaf yellowing was a common symptom of root rot, plants wilt and eventually die when advanced stages of the disease are reached (Shahid *et al.*, 2017). Plants infected by *Macrophomina* show root rot symptom when pulled out from the soil and examined the basal stem and main root. Sclerotial bodies may be visible on the affected tissues in the advanced stages (Gahlot *et al.*, 2022). The pathogen overwinters as a sclerotial body in soil or crop residues for up to 3 years (Su *et al.*, 2001). The sclerotial properties of this pathogen make it difficult for mungbean growers to manage the disease (Kumari *et al.*, 2012). In view of the importance of the crop and disease, the present work is planned to carry out survey for the disease incidence of *Macrophomina phaseolina* in major mungbean growing areas of Telangana State.

MATERIALS AND METHODS

A roving survey was conducted during Rabi season 2022-23 in major mungbean growing areas of Telangana State to record the occurrence and distribution of root rot of mungbean. The locations in each district were selected randomly. The number of fields visited per district ranged from 5 to 10 and

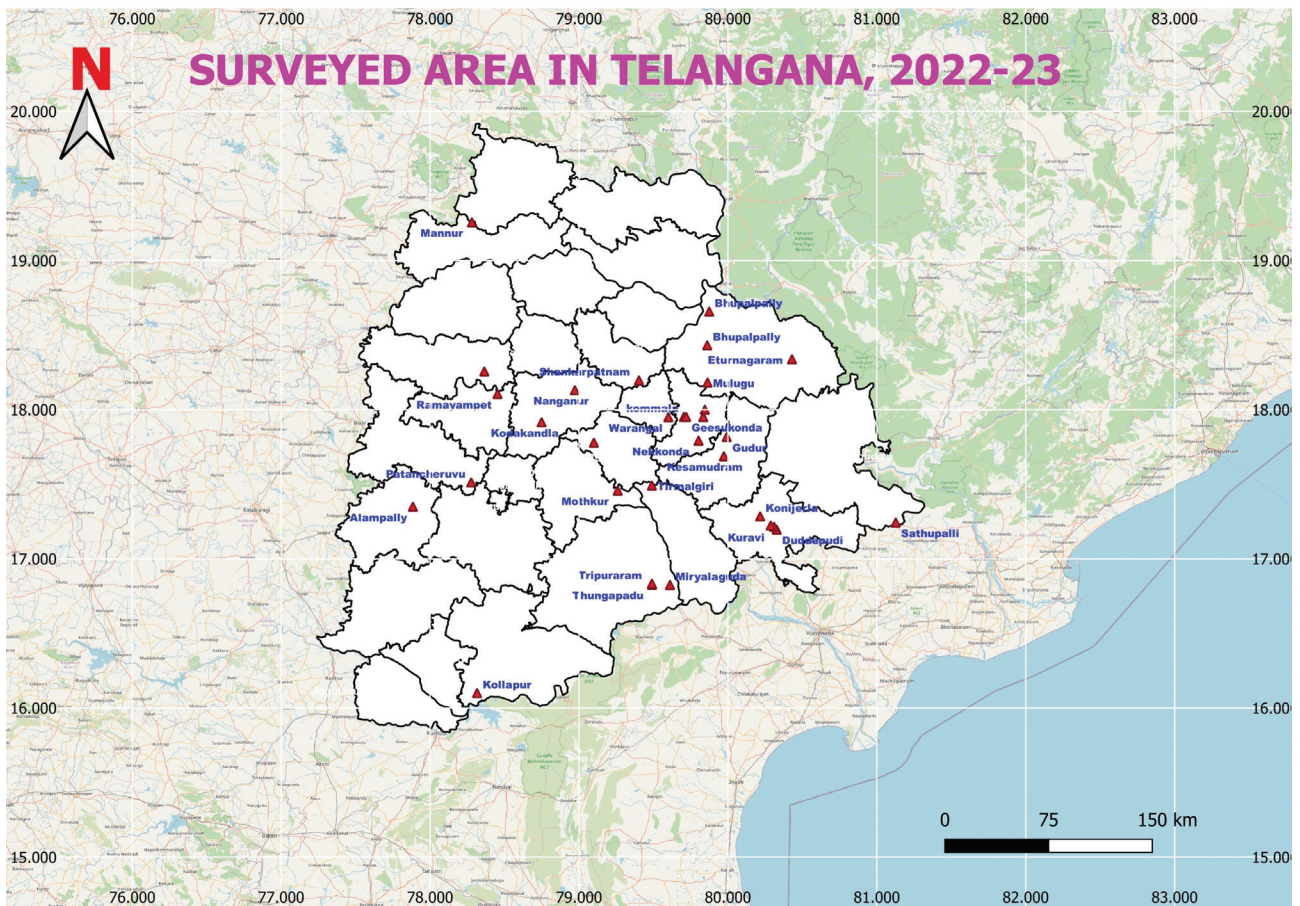


Fig 1. Map showing sample collection sites in different mungbean growing districts of Telangana during *summer- 2022-2*

a distance of 15-20 km was allowed between each field. A total of 50 fields covered in 18 districts in Telangana state and information on soil type, cultivars grown, disease incidence and agronomic practices followed by the farmers were recorded. At each location, in each field 5 spots of (m²) were chosen as representative of the whole field and counted the number of diseased and healthy plants in that area, based on this per cent disease incidence was calculated (Thori, 2012). Mungbean plants showing the typical dry root rot symptoms were collected from surveyed areas, packed in labeled paper bags and brought to the laboratory for isolation of the pathogen.

$$\text{Percent disease incidence} = \frac{\text{Number of plants infected}}{\text{Total number of plants}} \times 100$$

RESULTS AND DISCUSSION

Occurrence and distribution of root rot of mungbean

A roving survey was conducted during *Rabi* season 2022-23 in different major mungbean growing districts of Telangana state (Table 1). Totally 32 villages in 29 mandals of Telangana were covered to assess the status of root rot incidence of mungbean and collected diseased samples which showed root rot symptoms under field conditions. A total of 50 fields covered in 18 districts were surveyed and information pertaining to soil type, cultivars grown, disease incidence and agronomic practices followed by the farmers were recorded (Table 1).

The characteristic disease symptoms observed in seedling stage in the surveyed areas are the roots became brown and rot resulting in death of the whole plant. In advanced stage, the whole plant became brown coloured and small dot-like black minute sclerotial structures were seen on stem,

Table 1. Data collected during sample collection from mungbean growing fields of Telangana state during 2022-2023

| District | Mandal | Village | Latitude | Longitude | Soil type | Previous crop grown | Variety | Stage of the crop | % disease incidence | |
|----------------------|---------------|----------------|-------------|-------------|-------------|---------------------|----------|-------------------|---------------------|-------|
| Warangal | Warangal | Paidipally | 17.949709° | 79.599442° | Sandy soil | Green gram | WGG-2 | 30 | 18.1 (25.1*) | |
| Warangal | Kommala | Kommala | 17.95197° | 79.7038916° | Black soils | Cotton | Local | 60 | 18.1 (25.2) | |
| Warangal | Geesukonda | Gangadevipally | 17.951205° | 79.71899° | Clay loam | Cotton | Local | 50 | 16.7 (24.1) | |
| Warangal | Duggondi | Marrepalle | 17.999695° | 79.8444366° | Clay soil | Green gram | WGG-42 | 20 | 9.1 (17.5) | |
| Warangal | Nekkonda | Pattipaka | 17.79195° | 79.8022° | Sandy loam | Rice | Unknown | 30 | 28.4 (32.2) | |
| Warangal | Duggondi | Thimmapet | 17.950945° | 79.8337783° | Red chalka | Cotton | MGG-295 | 20 | 12.5 (20.7) | |
| Khammam | Duddepudi | Pallipadu | 17.195624° | 80.327403° | Red chalka | Paddy | MGG295 | 15 | 5.3 (13.3) | |
| Khammam | Kuravi | Gudrathimadugu | 17.214364 ° | 80.309546° | Clay loam | Cotton | Local | 20 | 14.5 (22.3) | |
| Khammam | Konijerla | Konijerla | 17.222643° | 80.286727° | Clay loam | Cotton | MGG-295 | 25 | 6.3 (14.5) | |
| Khammam | Konijerla | Vepakuntla | 17.284351° | 80.216044° | Black soil | Cotton | MGG-295 | 25 | 12.7 (20.8) | |
| Nalgonda | Miryalaguda | Kampasagar | 16.824329° | 79.610532° | Sandy loam | Paddy | TM-96-2 | 30 | 29.6 (32.9) | |
| Nalgonda | Thungapadu | Thungapahad | 16.8259440° | 79.4898450° | Clay loam | Chilli | Local | 50 | 13.6 (21.6) | |
| Nalgonda | Tripuraram | Donka thanda | 16.8329310° | 79.4890820° | Red chalka | Cotton | MGG-385 | 15 | 9.3 (17.7) | |
| Jangaon | Kodakandla | Authapur | 17.91565° | 78.74805° | Sandy loam | Paddy | T9 | 45 | 13.0 (21.1) | |
| Jangaon | Jangaon | Peddapahad | 17.7787° | 79.0991° | Black soil | Paddy | Local | 30 | 9.4 (17.8) | |
| Mahabubabad | Gudur | Marrimitta | 17.8166680° | 79.9915795° | Clay laom | Paddy | WGG-42 | 40 | 16.4 (23.9) | |
| Mahabubabad | Kesamudram | Penugonda | 17.6874450° | 79.9722980° | Sandy loam | Paddy | MGG-207 | 60 | 18.9 (25.7) | |
| Bhupalpally | Bhupalpally | Gummallapalle | 18.657764° | 79.874015° | Clay loam | Paddy | T9 | 30 | 13.1 (20.9) | |
| Bhupalpally | Bhupalpally | Bhupalpally | 18.431436° | 79.860483° | Sandy loam | Fallow | Local | 45 | 16.6 (24.0) | |
| Bhadradri Kothagudem | Sathupalli | Ashwaraopet | 17.2433318° | 81.1267435° | Red chalka | Paddy | MGG-295 | 20 | 14.7 (22.5) | |
| Bhadradri Kothagudem | Eturnagaram | Eturnagaram | 18.3378° | 80.4299° | Red chalka | Chilli | Unknown | 30 | 5.7 (13.7) | |
| Vikarabad | Alampally | Girgatpally | 17.3492980° | 77.8836510° | Sandy loam | Fallow | WGG-37 | 40 | 16.4 (23.8) | |
| Karimnagar | Shankarpatnam | Yeradpalle | 18.196142° | 79.402035° | Black soil | Cotton | Local | 30 | 23.7 (29.0) | |
| Bhongir | Mothkur | Mushipatla | 17.456900° | 79.259200° | Sandy loam | Cotton | MGG-351 | 50 | 12.7 (20.8) | |
| Mulugu | Mulugu | Abbapuram | 18.1816° | 79.8626° | Black soil | Cow pea | T9 | 45 | 21.5 (27.6) | |
| Rangareddy | Patancheruvu | Patancheruvu | 17.512414° | 78.2753706° | Sandy loam | Black gram | MGG-295 | 25 | 14.2 (22.1) | |
| Suryapet | Tirmalgiri | Regula kutta | 17.4907880° | 79.4887010° | Clay loam | Paddy | MGG-348 | 30 | 10.5 (18.8) | |
| Siddipet | Nanganur | Kothurpalle | 18.1304760° | 78.9715660° | Black soil | Cotton | MGG-295 | 20 | 8.4 (16.9) | |
| Adilabad | Mannur | Ichoda | 19.255988° | 78.28012° | Sandy loam | Cotton | PS7 | 30 | 31.7 (34.2) | |
| Medak | Ramayampet | Akannapet | 18.1051730° | 78.4518200° | Black soil | Maize | IPM-2-14 | 60 | 21.6 (27.9) | |
| Mahaboobnagar | Kollapur | Laxmipalle | 16.0995270° | 78.3146660° | Black soil | Cotton | T9 | 15 | 25.2 (30.1) | |
| Kamareddy | Biknur | Pondurthi | 18.2563960° | 78.3633320° | Red chalka | Coriander | IPM-214 | 50 | 9.8 (18.2) | |
| | | | | | | | | | CD (p=0.05) | 2.181 |
| | | | | | | | | | SE(d) | 1.088 |
| | | | | | | | | | CV | 5.866 |

*Figures in parenthesis are arc sine transformed values

branches and seeds. The affected plants showed wilting, drying, drooping of leaves and ultimately death of the plants at pre-mature stage. The dark cortical lesions were formed near the collar region on stem in the beginning showing brown discoloration. The infected plants could be easily pulled out of the ground due to the secondary roots were decayed

leaving the tap root only which showed sign of plant die. The root bark shredded off easily and black minute sclerotial bodies were observed on such roots. When the plants were uprooted, the lower portion of tap root remained inside the soil devoid of most of lateral roots (Plate 1).



Plate 1. Mungbean crop with symptoms of dry root rot in fields (A, B and C are the dry root rot infected plants showing drying and death of the whole plant; D and E are the symptoms of infected plants with dried and discoloured roots with brown vascular discoloration; F- Black minute sclerotial bodies on stem portions of the infected plants)

It is evident from the (Table 1) that the dry root rot incidence ranged from 5.3% - 31.7% per cent. The highest disease incidence of 31.7 per cent was recorded in Ichoda village of Adilabad district where the crop was grown in sandy loam soils followed by Kampasagar village of Nalgonda district with 29.6%, and 28.4% in Pattipaka village of Nekkonda mandal of Warangal district where mungbean was grown in sandy loam soils, Laxmipalle village of Mahaboobnagar with 25.2% disease incidence and least disease incidence of 5.3% in Pallipadu village of Khammam district. The mean maximum dry root rot incidence was recorded in Mahabubabad district (18.9%) followed by Warangal (18.1%).

Data collected regarding soil type indicated that the disease incidence was high in sandy loam soils (12.7%-31.7%) in the districts of Warangal, Nalgonda, Jangaon, Mahabubabad, Bhupalpally, Vikarabad, Bhongir, Rangareddy and Adilabad followed by black soils (8.4% - 28.4%) in the districts of Mahaboobnagar, Medak, Suryapet, Mulugu and Karimnagar, and least in clay soils (6.3%-16.7%) in the districts of Khammam and Suryapet. Samples were collected when the crop was at 15-60 days stage and the maximum disease incidence was observed during 30 days stage *i.e.*, flowering stage. Disease incidence was also higher in areas where farmers used local and private varieties. Since *Macrophomina phaseolina* is a soil borne pathogen, its activity depends on available free oxygen in soil.

A competition between plants and microorganisms arises during seed germination. Sandy soils with higher number of macropores have the capacity to hold adequate air though they are poor in water holding capacity compared to clay soils. This might be the probable reason for high percentage of dry root rot incidence in sandy loams when compared to clay loams. In a similar study, Mallaiah and Krishna Rao (2016) reported prevalence of dry root rot in eight key greengram growing mandals in Chittoor district of Andhra Pradesh. Dry root rot was found in high (11.1%) and low (4.2%) frequencies in sandy loam and clay soils, respectively, among the three soil types studied. Similarly, variations due to soil type and geographical locations were reported by Mohanpriya *et al.* (2017) in cowpea and Tyagi *et al.* (1988) chickpea.

Principal component analysis

The data collected during the survey was scored based on common variables and characters. Further, Principal Component Analysis of recorded survey data was done using OPSTAT software and the results are shown in the Table 2

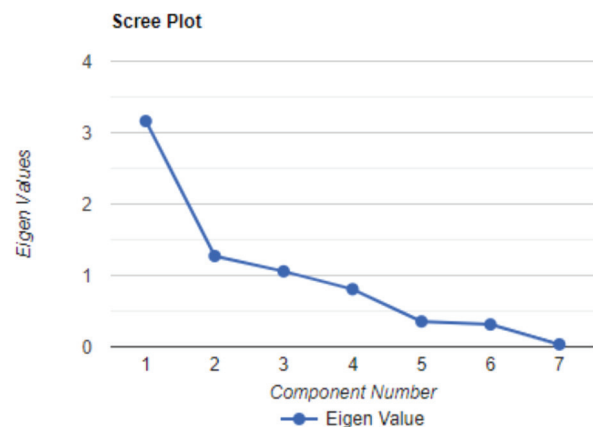


Fig. 2. Scree plot for survey data of major mungbean growing regions of Telangana state by using Principal Component Analysis

Table 2. Principal Component Analysis of *Macrophomina phaseolina* population of different survey variables

| Component | Eigen value | Proportion | Cumulative (%) |
|----------------------------|-------------|------------|----------------|
| Area | 3.162 | 0.452 | 0.452 |
| Mandal | 1.272 | 0.182 | 0.633 |
| Soil type | 1.057 | 0.151 | 0.784 |
| Previous crop grown | 0.807 | 0.115 | 0.900 |
| Variety | 0.355 | 0.051 | 0.950 |
| Stage of the crop | 0.313 | 0.045 | 0.995 |
| Per cent disease incidence | 0.034 | 0.005 | 1.000 |

According to Principal Component Analysis, Eigen value ≥ 1 i.e., per cent disease incidence, area and village components were considered for existence of variability among 32 different isolates of *Macrophomina phaseolina*. The results from the principal component analysis of recorded survey data were shown in the form of Eigen values, which shows that the highest Eigen value was recorded at per cent disease incidence level indicates greater variability with regard to geographical location (Table 2).

CONCLUSION

A roving survey was conducted among different major mungbean growing areas to assess the dry root rot incidence in Telangana State. Among twenty-nine madals and eighteen districts surveyed, the *Macrophomina phaseolina* disease incidence varied from district to district and within the district ranging from 5.3% to 31.7%. The highest disease incidence of 31.7% was recorded in Ichoda village in Mannur mandal of Adilabad district and least disease incidence of 5.3% was recorded in the fields of Pallipadu village of Khammam district. The disease was more prevalent in sandy loam soils and least in clay soils. The disease also varied with the crop stage and was observed highest during flowering stage.

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