Environment and Ecology 42 (2B) : 846—850, April—June 2024
Article DOI: https://doi.org/10.60151/envec/NHEM2312
ISSN 0970-0420

Exploring the Role of Environmental Factors on the Emergence of Leaf Blight of Mungbean in Maharashtra State, India

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Received 28 September 2023, Accepted 7 April 2024, Published on 3 June 2024

ABSTRACT

Leaf blight disease (LBD) of mungbean caused by *Macrophomina phaseolina* is one of the major yields reducing factor in mungbean (*Vigna radiata* (L.) Wilczek). Temperature and relative humidity play a significant role in development of this disease. In the present studies which was carried out at Agricultural Research Station, Badnapur during *kharif* 2017. The factors were found to have a temperature showing non-significant and humidity showing significant role in disease development on leaf blight under field conditions. Maximum temperature (31.4^{0}C), minimum temperature (25.61^{0}C) and relative humidity (84.04%) favored high disease development. Positive and non-significant correlation was observed between disease and temperature while significant, positive correlation was noticed between disease development and relative humidity. This is the first-time study on the impact of weather parameter on leaf blight of mungbean in Maharashtra State.

Keywords *Vigna radiata, Macrophomina* blight, Epidemiology, Minimum temperature, Disease severity.

INTRODUCTION

Mungbean (*Vigna radiata* L.) also called green gram, is an ancient and well known *kharif* pulse crop of India. Also, it is one of the most important pulse crops cultivated in countries like Burma, Shri Lanka, South and North America, China, Africa and India. India alone accounts for about 2/3rd of total global production of mungbean. More than 80% of mungbean production comes from10 states viz., Rajasthan, Madhya Pradesh, Maharashtra, Bihar, Karnataka, Tamil Nadu, Gujarat, Andhra Pradesh, Odisha and Telangana (Anonymous 2016). Maharashtra rank third in production of mungbean after Rajasthan and Madhya Pradesh. Although mung beans are typically planted in the *kharif* season, numerous early cultivars are now on the market that may be grown in the summer and springtime. Numerous maladies that are brought on by nematodes, bacteria, viruses, fungus and other abiotic stressors cause mungbean (Khaire and Hake 2018).

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Fungal infections that reduce mungbean yield are a major concern for the nation's farmers as well as for food security in general (Batzer *et al*. 2022). Among the numerous fungi that are common in mungbean cultivation and cause significant production losses are powdery mildew (Dhande *et al.* 2023), rust (Khaire and Hake 2018) and anthracnose (Misal *et al.* 2019), *Macrophomina* blight (MB) and root rot (Khaire *et al.* 2020) and viral maladies like leaf curl and crinkle (Bansode *et al*. 2023). The most serious diseases in Maharashtra that have been observed to cause significant economic loss is LBD (Khaire *et al.* 2020). At any stage of crop development, *M. phaseolina* can harm every part of the plant, including the leaves, roots, pods, stem. In mungbean, the pathogen causes leaf blight, seedling blight, stem canker, damping-off, seedling blight, and seed decay (Khaire *et al.* 2023). The emergence of LBD on mungbean, which is brought on by *M. phaseolina*, is significantly influenced by environmental conditions. The progression of the disease and spread of the pathogen are strongly influenced by temperature (maximum and minimum) and relative humidity (RH). Due to limited research work on LBD of mungbean in Maharashtra, it is decided to conduct investigations to determine the epidemiology for these economically important and destructive fungal foliar disease in mungbean growing area. In order to understand their impact on the appearance of diseases in the mungbean crop, the current experiment was carried out.

MATERIALS AND METHODS

The impact of the environment on the emergence of disease

At the experimental farm, ARS, Badnapur, investigated the impact of climatic parameters such temperature (highest and lowest) and RH (morning in per cent) on the growth and development of LBD mungbean. During the *kharif* season of 2017, this study was conducted. All additional agricultural and pest management precautions were taken as advised in the accompanying set of precautions. Five randomly selected plants from one cultivar, JL-781, were chosen for this investigation and were labelled. Every observation plant had three trifoliate leaves (lower, middle, and upper) that were chosen from the primary branch for documenting measurements.

Table 1. Conventional disease grading (0–9).

Rating scale	Description
0	No symptoms on the leaf
1	Small, irregular brown spots covering 1% or less of the leaf area
3	Small, irregular, brown spots with concentric rings covering 1-10% of the leaf area
5	Lesions enlarging, irregular, brown with concentric rings covering 11-25% of the leaf area
7	Lesions coalescing to form irregular brown patches with concentric rings. Covering 26-50% of the leaf area. Lesion also on stem and petioles
9	Lesions coalescing to form irregular, dark brown patches with concentric rings covering 51% or more of the leaf area. Lesions on stem and petioles

The proportion of blight disease intensity (DI) was calculated using a 0–9 grade (Table 1) disease assessment system (Mayee and Datar 1986). At weekly intervals, thirteen observations on the progression of the disease were made. Immediately as the initial sign of LBD appeared in the field up to maturity, assessments were made. Weather-related variables were associated to the prevalence of LBD. For the present study, weather information from ARS, Badnapur, was employed. To find out the relationship between per cent disease intensity (PDI) and various climatic factors viz., temperature, RH, wind velocity (WV) and rainfall. The correlation analysis was workout using statistical methods.

$$\text{PDI (\%)} = \frac{\text{Summation of all numerical rating observed}}{\text{No. of leaves observed x maximum rating}} \times 100$$

RESULTS AND DISCUSSION

Experiment was conducted to study different weather parameters favorable for LBD intensity and their

Table 2. Correlation between climatic factors and LBD intensity in *Kharif* 2017.

Sl. No.	Climatic factors	Correlation coefficient (r)
1	Temperature (min ^{0}C)	- 0.302
2	Temperature (max ^{0}C)	- 0.215
3	Relative humidity (%) evening	0.384*
4	Relative humidity (%) morning	0.502**
5	Rainfall (mm)	0.952**
6	Wind velocity (km/hr)	- 0.119

*Significant at 0.05 %- 0.324, **Significant at 0.01 %-0.487.
Intercept = 25.17, F-value = 47.10, R^2 = 0.930, SEY = 2.17.

Table 3. Weekly meteorological data and per cent LBD intensity observation at ARS, Badnapur during *kharif* 2017.

MW	Temperature (^{0}C)		RH (%)		Cumulative rainfall (mm)	WV (km/hr)	LBD intensity (%)
	Min	Maxi	Evening	Morning			
25	22.02	28.50	66.92	80.50	121	15.44	00.00
26	21.27	31.40	63.31	80.42	157	14.85	00.00
27	25.61	29.14	62.21	78.90	298.5	13.57	00.00
28	25.45	29.65	64.67	84.94	298.5	13.28	00.00
29	24.07	27.35	62.28	80.70	472	13.58	23.48
30	23.80	28.91	66.91	81.08	508.5	14.20	33.96
31	25.01	28.68	61.06	83.53	528	17.00	40.66
32	26.06	29.92	61.76	82.22	528	12.14	47.78
33	26.09	30.27	60.92	80.23	528	12.10	52.73
34	24.66	29.36	61.45	84.91	678	18.85	53.33
35	24.57	29.90	61.19	81.22	678	12.00	65.67
36	23.48	30.86	62.60	82.69	708	12.57	66.09
37	24.05	29.68	64.38	84.04	727	15.00	66.46

relation with temperature, RH, WV and rainfall. The result is presented here under Tables 2- 3 and Fig. 1.

Temperature

The range of temperature minimum and maximum showed that the no significant correlation with the LBD intensity. In the meteorological week from 25 Jun to 22 July, disease intensity was 0.00 at maximum temperature range from 28.50 ^{0}C to 31.4 ^{0}C and minimum temperature range from 21.27 ^{0}C to 25.61 ^{0}C. The result of temperature and intensity resulted that, there was minimum impact of temperature on LBD intensity.

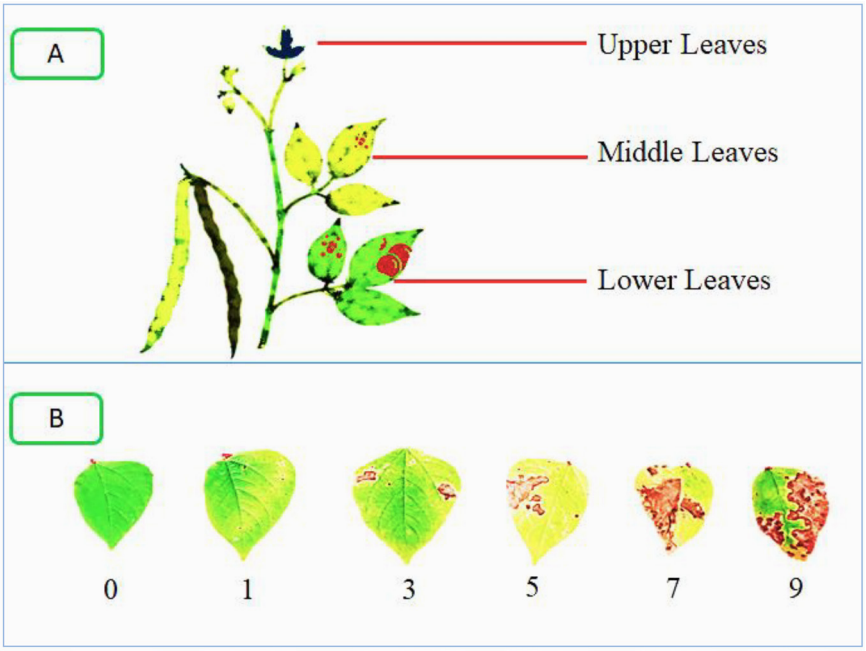

Fig. 1. Selection of LBD affected leaves for PDI observations . A) Trifoliate leaves upper, middle and bottom, B) Applying 0-9 grade disease rating scale to count PDI given by Mayee and Datar (1986) [The original diagram prepared for this manuscript by Dr. Pravin Khaire].

Relative humidity

The range of RH minimum and maximum showed that has a significant and positive correlation to disease intensity. Highest positive correlation with LBD intensity indicate that the LBD intensity increases with increase in RH. The maximum DI (66.46%) was observed at RH 84.04% in the 37th meteorological week in (17 to 23 September) and minimum LBD intensity (23.48%) was observed at RH 80.70% in the 29th meteorological week in 23 to 29 July.

Rainfall

As concerned to rainfall it has significant and positive correlation to LBD intensity. As the results indicate that, the LBD intensity increases with respect to increase in rainfall. In the 37th meteorological week, the maximum disease intensity 66.46% was observed when cumulative rainfall was 727 mm. The LBD intensity i.e., 0.00% and 23.48% was observed when the cumulative rainfall was 298.5 and 472 mm respectively.

Wind velocity

The wind velocity was found no- significant and negatively correlated to the LBD intensity. There is no much role of wind velocity in the intensity of LBD. The results showed that the temperature has no positive correlation to LBD intensity whereas, relative humidity (0.502) and cumulative rainfall (0.952) have shown highly significant and positively correlation with DI and WV showed no significant and negatively correlated to the LBD intensity. The contrast results obtained by Tandel *et al.* (2014) reported that the temperature has positive correlation to LBD intensity whereas, relative humidity (0.792), rainfall (0.549) have shown negatively significant correlation with LBD severity in mungbean. There are no similar reports on the mungbean were reported earlier on the weather aspect.

ACKNOWLEDGMENT

The authors would like to thank Head, Department of Plant Pathology, College of Agriculture and ARS, Badnapur for providing for necessary research facilities to conduct the trail.

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