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Epidemiological studies on powdery mildew (*Oidium erysiphoides f.sp. ziziphi)* of *ber* in scarce rainfall zone of A.P

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Abstract

Ber, the king of arid fruits is an ancient fruit crop grown in arid and semi arid regions of India. The powdery mildew caused by *Oidium erysiphoides f. sp. ziziphi* Yen and Wang, is an important limiting factor in the successful cultivation of *ber*. To know the effect of different abiotic environmental factors on the development of disease, a field experiment was conducted from 1998 to 2015 on her cultivar Gola. Based on the epidemiological studies on ber powdery mildew, it is concluded that the disease initiation took place during 35th or 36th standard meteorological weeks and was siguificantly and negatively correlated with minimum temperature (< 23.60 °C) and raiufalt (< 24.76 mm) and positively correlated with relative humidity (> 76.32%) and sunshine hours (> 5.39).

Key words: *Ber*, epidemiology, powdery mildew, pathogen

Introduction

Ziziphus mauritiana Lamk., also known as Chinese date , a poor man's fruit crop belonging to the family Rhamnaceae grown in semi-arid and arid regions of India. It is quite nutritious and rich in vitamin C, used in Ayurveda for treating bleeding disorders, excessive thirst, fever, burning sensation etc. Its seeds possess anti cancer properties. In India, it is a minor fruit but of late the ber became an important cash crop in some areas and its acreage and production are increased. The crop is also affected by different biotic and abiotic stresses including pathogens causing many serious diseases. Among the diseases, powdery mildew, caused by *Oidium erysiphoides var. ziziphi* Yen and Wang, is a prime limiting factor in the successful cultivation of ber, causing great losses in quantity and quality of fruits. It is a regular feature on the crop from season to season and the loss in fruit yield roughly accounts for 50- 60 per cent. Even though many fungicides and resistant sources are available, meteorological factors play a major role in the development, spread and severity of powdery mildew disease (Chavan *et al.*, 1995; Balamuralikrishnan and Jeyarajan, 1997; Jahagirdar *et al.*, 2001 and Venkatesh and Jamadar, 2001) on ber. However, there are very few studies to confirm the relationship of weather in the development and severity of powdery mildew. Therefore, the present study was conducted during 1998-2015 on the above aspects with an aim to develop the forecasting models to reduce the cost of fungicide application in the effective management of this disease.

Materials and Methods

The experiment was initiated at Horticultural Research Station, Anantapuramu on five year old ber trees (variety Gola). The experiment was laid out in Randomized Block Design with three replications consisting of two trees per replication and observations were recorded on occurrence and severity of disease at weekly interval from initial appearance. The data of meteorological parameters *viz.*, temperature, rainfall, relative humidity and sunshine hours were collected from Agrometeorological Observatory, Agricultural Research Station, Ananthapuramu. The intensity of powdery mildew of ber was recorded by having five ratings

Grade	% infection
0	No infection
1	1-10% fruit/leaf area covered
2	11-25% fruit/leaf area covered
3	26-50% fruit/leaf area covered
4	51-75% fruit/leaf area covered
5	76-100% fruit/leaf area covered

Nearly twenty fruits per plant were randomly selected and fitted into different categories of ratings and the disease intensity was calculated using the formula defined by Mc Kinney (1923).

In this way, 19 years of data were recorded and the relationship of the disease incidence and spread was worked out with meteorological elements. The coefficient

of correlation of disease build up with all the meteorological elements was calculated by considering the disease as dependent variable and the meteorological elements as independent variables. Thus, the meteorological elements having high and significant correlation with the disease were identified. The procedure of the multiple regression analysis was then followed for evaluating the various combinations of independent variables for forecasting of this disease.

Results and discussion

The experimental results based on ninteen years pooled data revealed that disease initiated during 35th or 36th standard meteorological weeks with favourable T (min) < 23.60°C, Rainfall <24.76 mm, Relative humidity >76.32% and Sunshine hours > 5.39 and increased from September to December each year with its peak in the month of October. This clearly indicated that weather parameters played a crucial role in development of the powdery mildew.

The data were pooled for all the nineteen years and was subjected for regression analysis, to select the best weather elements for forecasting the disease incidence in ber. The coefficients of correlation obtained between various meteorological parameters and powdery mildew disease build up showed considerably high relationship. The data in Table 1 showed that the weather parameters exhibited significant negative correlation with minimum temperauure (- 0.57), rainfall (-0.71) while, positive with relative humidity (0.66) and sunshine hours (0.53). Similar results of suitable weather factors for development of powdery mildew was reported by Pareek and Nath (1996) and Thind *et al.* (2004) when the maximum temperature is between 24-35°C, minimum temperature between 4-22°C, morning RH 64-91% and evening RH 24-57%. The disease occurs with increased virulence during high rainfall years (Sharma, 2003). Similar temperature range of 20-25°C and relative humidity of 80-100 per cent were found to be most favourable for maximum conidial germination of powdery mildew in various crops as reported by many workers (Shahri *et al.* 2006, Jocob *et al.* 2008, Sankar and Sreeramula, 2008a and and Rakhonde *et al.* 2011).

Pandey *et al.* (2004) also investigated the effect of weather variables on outbreak and spread of powdery mildew in ber and found high humidity (85-90 per cent), moderate temperature (maximum temperature 33-34°C and minimum temperature, 23-25°C), low sunshine hours (4-7 h/day) and low wind speed (3-5 km/h) were favourable for disease initiation.

The experimental findings are also in accordance with the results of Jat and Goyal (2009) who recorded disease initiation during 39-46 standard meteorological weeks with peak PDI at an average maximum and minimum temperature of 24.7 and 4.9°C, average morning and evening relative humidity of 82.6 and 35.7 per cent respectively.

Fig 1: Ber fruits infected with powdery mildew disease

Based on the regression coefficients obtained for PDI of 19 years pooled data, linear equations were derived to predict the disease depending upon weather conditions prevailing during crop season.

Regression coefficients for PDI were obtained for independent variables viz., maximum temperature (°C), minimum temperature (°C), relative humidity (%), rainfall (mm) and sunshine hours as the dependent variable for disease incidence.

The multiple linear regression equation was fitted to the data and the equation arrived for the weather parameters was:

$Y = -440.61 + (9.83) X_1 + (0.31) X_2 + (1.56) X_3 + (0.42) X_4 + (-1.65) X_5 + (6.40) X_6$

$R^2 = 72\%$

Where, X_1 = maximum temperature (^{0}C), X_2 = minimum temperature (^{0}C), X_3 = relative humidity - I(%), X_4 = relative humidity -II(%), X_5 = rainfall (mm) and X_6 = sunshine hours

It was observed that when there was increase in one unit of maximum temperature, relative humidity and sunshine hours, the per cent disease index was increased by 9.99, 1.77 and 6.15 units respectively, whereas increase in one unit of minimum temperature the per cent disease index decreased by 1.5 units. The weather factors influenced the disease incidence to the extent of 72.0 per cent.

Table 1. Correlation coefficient of PDI (Per cent Disease Index) with weather parameters from (19 Years pooled)

S. No.	Weather Parameters	Per cent Disease Index (PDI)
1.	Maximum Temperature	-0.43
2.	Minimum Temperature	-0.57*
3.	RH1	+0.66**
4.	RH2	-0.32
5.	Rainfall	-0.71***
6.	Sunshine hours	+0.53*
*indicates significant at 5% ** indicates significant at 1% *** indicates significant at 0.05%		

Fig 2: Graph depicting the influence of significant weather parameters on PDI of ber powdery mildew in different standard meteorological weeks

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