



Weather Based Forewarning Model for Powdery Mildew Disease of Mustard

Sevak Das ^{a*} and K. K. Chauhan ^a

^a Department of Agricultural Meteorology, C. P. College of Agriculture, S. D. Agricultural University, Sardarkrushinagar, 385506, India.

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJAAR/2024/v24i3492

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/113429>

Original Research Article

Received: 26/12/2023
Accepted: 28/02/2024
Published: 01/03/2024

ABSTRACT

Powdery mildew disease is the most important disease of mustard (*Brassica Juncea*) which is highly sensitive to weather condition particularly temperature and humidity. To ascertain the relationship between weather variables and powdery mildew disease of mustard crop at Sardarkrushinagar, weekly powdery mildew data of 12 years (2010-11 to 2021-22) was collected from Centre for Oilseed Research, S.D. Agricultural University, Sardarkrushinagar. The data were pooled over the year and correlated with corresponding weather parameters recorded in Agromet Observatory, S.D. Agricultural University, Sardarkrushinagar. The forewarning regression equation was developed with the help of weather variables to predict the disease incidence. The results revealed that the maximum and minimum temperature ranged 26.2 to 38.1°C and 8.7 to 18.5°C respectively found congenial for disease incidence. The weather variables like maximum temperature (Tmax) and minimum temperature (Tmin) correlated significantly positive with powdery mildew disease. While morning relative humidity (RH I) and evening relative humidity (RH II) correlated significantly negative with disease severity. The impact of rainfall (RF), sunshine hour (SSH) and wind speed (WS) found positive but non-significant on powdery mildew disease. The weather variables those have significant relationship with powdery mildew disease, were used to develop multiple regression model. The regression equation $Y = 62.837 + 8.072 \cdot T_{max} -$

*Corresponding author: Email: dasagmet86@gmail.com;

3.919*RH1 developed with maximum temperature and morning relative humidity caused up to 96 % variability in the powdery mildew disease. Hence the combined effect of Tmax and RH1 was more pronounced and most influencing weather parameters on powdery mildew disease. Therefore, model could be used for predicting the powdery mildew disease well in advance.

Keywords: Weather; powdery mildew and forewarning equation.

1. INTRODUCTION

Mustard (*Brassica Juncea*) is one of the most important oilseed crop belonging to the family Brassicaceae and grown under wide range of agro-climatic conditions in India. Indian mustard is an important source of edible oil particularly in northern India with the lowest amount of saturated fats. Mustard leaves are rich source of vitamins, minerals, fiber and antioxidants. Mustard seed and oil are used as a condiment in the preparation of pickles and for flavoring various dishes. The crop is also utilized for the manufacturing of various industrial products like soaps, hairs oils, paints, varnishes, textiles, lubricants, auxiliaries etc. Indian mustard holds nearly 38 to 57% erucic acid, 4.7 to 13% linolenic acid, 27% oleic acid and 10-12% linoleic acid with a higher amount of vegetable oil ranging between 38 to 49% [1].

Mustard crop is affected by various biotic and abiotic factors of the environment. One of the main reasons behind low productivity of the rapeseed-mustard in the country is powdery mildew disease. Powdery mildew of mustard has been reported from several parts of the world and is considered as one of the constraints in Indian mustard production. The weather conditions particularly temperature and relative humidity are the most congenial parameters for outbreak of powdery mildew, which has been a limiting factor for successful cultivation of mustard. Dange *et al.*, [2] reported 17 per cent yield loss due to this disease in mustard in Gujarat state. Weather parameters such as temperature and relative humidity play an important role in disease development [3,4,5]. However, scanty information is available on the epidemiological aspects in relation to weather of this disease under north Gujarat agro-climatic conditions where the crop is cultivated during rabi season mainly in Banaskantha district as major crop. The crop is mainly affected by powdery mildew disease causing considerable losses in terms of both quality and quantity of the grain. Hence, the present investigation was carried out at Sardarkrushinagar to determine the influence of meteorological parameters on disease development.

2. MATERIALS AND METHODS

2.1 Data Collection

Weekly powdery mildew disease data spanning twelve years from 2010-2011 to 2021-2022, were collected from the Centre for Oilseed Research, S.D. Agricultural University, Sardarkrushinagar. The data encompassed from 3rd to 13th standard meteorological weeks (SMW). The data on disease intensity were pooled over the year and used for analysis and results interpretation. Simultaneously, corresponding weekly weather parameters were obtained from the nearby agrometeorological observatory located at Agronomy Instructional Farm, S.D. Agricultural University, Sardarkrushinagar. These parameters included maximum temperature (Tmax), minimum temperature (Tmin), morning relative humidity (RH I), afternoon relative humidity (RH II), rainfall (RF), sunshine hours (SSH), and wind speed (WS). These variables were selected based on their known or hypothesized associations with powdery mildew disease dynamics.

2.2 Data Analysis

The pooled disease intensity data over the twelve-year period were subjected to comprehensive statistical analysis to evaluate patterns and correlations. Initially, correlation studies were conducted to explore relationships between weekly disease intensity and the various weekly weather parameters. Based on significant correlation coefficients between disease intensity and weather variables, regression study was also performed to develop forecasting model for the disease. Stepwise regression method was utilized in the creation of forecasting model due to the complex nature of disease development; wherein various meteorological variables are anticipated to interact and impact powdery mildew disease. The process of stepwise regression makes it possible to find significant indicators among a group of possible variables. This was obtained using the SPSS statistical software package version 20, leveraging its capabilities for correlation and regression analysis. Since the

diseases are not influenced by a single weather parameter but by interaction of more than one variables, hence multiple regression equations were developed for powdery mildew disease of mustard. The multiple regression equation used in this study is represented as follows:

$$Y = a_1X_1 + a_2X_2 + a_3X_3 + C$$

Where,

Y = disease intensity (%)

X1, X2 and X3 = weather variables

a1, a2 and a3 = partial regression coefficients

C = constant (intercept)

3. RESULTS AND DISCUSSION

3.1 Weather Factors and Disease Development

The average maximum and minimum temperature during the period of disease incidence varied from 26.2 to 38.1 °C and 8.7 to 18.5 °C respectively. Similarly, relative humidity during morning and afternoon varied from 67 to 73 per cent and 27 to 35 per cent respectively. The disease intensity during the period ranged from 0.2 to 98.0 per cent on pooled basis. The incidence of disease increased with advancement of maximum and minimum temperature. Correlation study revealed that, the maximum and minimum temperature showed significant positive correlation with disease incidence. The relationship between disease intensity and morning and afternoon relative humidity was found significant negative. Verma *et al.* [6] also reported that maximum and minimum temperature had positive impact while, evening and morning relative humidity had negative impact on powdery mildew disease of

mustard. The correlation of rainfall, sunshine hours and wind speed with PDI was found to be non significant. Highest correlation coefficient ($r = 0.973^{**}$) obtained with maximum temperature followed by minimum temperature ($r = 0.964^{**}$) (Table 1). Thus, it is clearly indicated that the temperature and relative humidity play an important role in powdery mildew disease development in mustard crop. The similar results were reported by Saharan and Kaushik [7]; Dang *et al.*, [8] and Gadre *et al.*, [3]. They reported that temperature had significant positive relationship with the powdery mildew disease of mustard. The present findings also in close conformity with the results reported by Desai *et al.*, [4]; Kohire *et al.*, [5]. Similar results also reported by Kanzaria *et al.*, [9]. They reported that maximum and minimum temperature showed significantly positive correlation with PDI while morning and afternoon relative humidity had significantly negative correlation with disease incidence.

3.2 Forecasting Model for Powdery Mildew Disease

To forecast of disease, multiple linear regression equation was developed with those weather variables which had highest significant correlation coefficient with disease intensity. Stepwise regression procedure were followed for disease prediction in an advance. The equation $PDI = 62.837 + 8.072 T_{max} - 3.919 RH I$ with coefficient of determination (R^2) value 0.96 and error of estimate 7.43 developed with maximum temperature and morning relative humidity could explained 96 per cent variability in powdery mildew disease (Table 2). Thus, maximum temperature and morning relative humidity found most influencing weather parameters (predictors) for disease forecasting. Such model could be used successfully for disease forecasting well in advance. It could be used in timely spraying in the crop for controlling the disease to avoid the yield loss.

Table 1. Correlation coefficient between weather variables and powdery mildew disease

Sr. No.	Weather variables	Correlation coefficient (r)
1.	Tmax	0.973**
2.	Tmin	0.964**
3.	RH I	-0.754**
4.	RH II	-0.899**
5.	RF	0.494
6.	SSH	0.048
7.	WS	0.408

Table 2. Regression equation for prediction of powdery mildew disease

Sr. No.	Regression equation	R ²	Error of estimate
1.	PDI = 62.837 + 8.072Tmax - 3.919 RH I	0.96	7.43

4. CONCLUSION

The incidence of powdery mildew disease of mustard under north Gujarat agro-climatic condition increased rapidly with an increase in temperature and decrease in relative humidity. Warm and dry weather condition favour the incidence of powdery mildew disease of mustard in the region. The maximum temperature and morning relative humidity found most influencing weather variables for disease development.

ACKNOWLEDGEMENT

Authors are greatly thankful to Centre for Oilseed Research, S.D. Agricultural University, Sardarkrushinagar to provide powdery mildew disease data of mustard crop for successful completion of present investigation.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

- Kumar D, Maurya N, Bharati YK, Kumar A, Kumar K, Srivastava K. Alternaria blight of oilseed brassicas: a comprehensive review. Afr J Microbiol Res. 2014;8(30): 2816-2829.
- Dange SRS, Patel RL, Patel SI, Patel KK. Assessment of losses in yield due to powdery mildew disease in mustard under North Gujarat conditions. J. Mycol. Pl. Pathol. 2002;32(2):249-250.
- Gadre UA, Joshi MS, Mandokhot AM. Effect of weather factors on the incidence of alternaria leaf blight, white rust and powdery mildew of mustard. Annals Pl. Prot. Sci. 2002;10(2):337-339.
- Desai AG, Chattopadhyay C, Agrawal R, Kumar A, Meena RL, Meena PD, Sharma KC, Rao MS, Prasad YG, Ramakrishna YS. *Brassica juncea* powdery mildew epidemiology and weather based forecasting models for India - a case study. Zeitschrift – fur – Pflanzenkrankheiten – und –Pflanzenschutz. 2004;111(5):429-438.
- Kohire OD, Kohire VOP, Ahmed R, Chavan SS, Khilare VC. Epidemiology of powdery mildew of mustard in Marathwada. J. Pl. Dis. Sci. 2008;3(2):235-236.
- Verma PK, Negi HS, Kaur G, Kumar R. Progression of Powdery Mildew of Indian Mustard (*Brassica juncea* L.) in Relation to Weather Parameters. International Journal of Environment and Climate Change. 2023;13(10):2197-2203.
- Saharan GS, Kaushik JC. Occurance and epidemiology of powdery mildew of *Brassica*. Indian Phytopath. 1981;34(1): 54-57.
- Dang JK, Sangwan MS, Kaushik CD. Studies on epidemiology and chemical control of powdery mildew of mustard. Bhartiya KrishiAnusandhan Patrika. 1998;13(1/2): 43-47.
- Kanzaria KK, Dhruj IU, Sahu DD. Influence of weather parameters on powdery mildew disease of mustard under North Saurashtraagroclimatic zone. J. of Agrometeorology. 2013;15(1): 86-88.

© Copyright (2024): Author(s). The licensee is the journal publisher. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
<https://www.sdiarticle5.com/review-history/113429>