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Impact of weather parameters on disease intensity of white rust of *Brassica juncea*

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ABSTRACT

India is one of the major producers of oilseed crops in the global oilseed market. Rapeseed-mustard is one of the seven edible oilseed crops grown in India, and it holds a unique place in the country's agricultural economy and social structure. Of all the biotic and abiotic stresses that threaten mustard crop, white rust caused by an obligate biotrophic fungus *Albugo candida* is one of the most devastating. The experiments were conducted at Guru Kashi University, Talwandi sabo (Punjab) under the field and laboratory conditions to study the management of white rust during Rabi season 2018-2019. In the present study, Correlation analysis of disease intensity with weather factors indicated that maximum temperature (17.9-22.1°C) and minimum temperature (2.2-9.4°C), maximum relative humidity (85.4–92.6%), and total rainfall (mm) has significant positive correlation with disease intensity, while minimum relative humidity (45.0-63.7%) has a significant negative correlation. Temperature (min.) and Rainfall were found to have maximum positive correlation and significantly with disease intensity than other weather parameters. Hence, it means temperature (Min.) and rainfall increases the disease intensity of white rust of mustard.

Key words : *Brassica juncea, Weather parameter, Oilseed*

Introduction

The oilseed crops especially brassica crops play a wide role in agricultural economy of the world and it is one of the major contributors to Yellow Revolution. Several biotic and abiotic stresses are liable for reducing the production and productivity of rapeseed-mustard. Biotic stresses are diseases and pests and abiotic stresses are environmental factors. One of the most destructive diseases of rapeseed-mustard is white rust/blister, which is caused by the obligate biotrophic fungus *Albugo candida*. In India, it has been reported to cause yield losses of up to 60% (Meena *et al.,* 2002), up to 85% (Godika *et al.,*

2001; Biswas *et al*., 2007), and most recently, 36.88% (Bal and Kumar, 2014). The white rust disease is characterized by both symptoms resulting from the local infection (leaf phase) and systemic infection (staghead phase) (Butler, 1918; Walker, 1957).

The pustules of white rust developed at a faster rate when the average temperature was between 10-18°C and average relative humidity wasmore than 65% (Lakra and Saharan, 1991). Maximum temperature of 26-29 °C, minimum temperature of 14-15 °C and average relative humidity more than 65% was found favorable for development of white rust (Sangeetha and Siddaramaiah, 2007). According to Lakra *et al*. (1989), sporangia of *A. candida* can survive for 4 to 5 days at 15 °C on detached-infected leaves of *B. juncea*. Melhus (1911) observed that sporangia did not germinate below 0°C or above 25 °C and suggested that 10 °C as the optimum cardinal temperature for sporangial germination. But, Napper (1933) did not observe sporangial germination above 20 °C and found that sporangial germination of *A. candida* takes places readily at 1-18 °C.

Maximum temperature of 26-29 °C, minimum temperature of 14-15 °C and average relative humidity more than 65% was found favorable for development of white rust (Sangeetha and Siddaramaiah, 2007). Favourable meteorological conditions might give bumper production as against in a year with some exceptional weather hazards or incidence of any yield reducing pathogen and pests. Keeping in view, the present investigation was undertaken to find out influence of weather parameters such as temperature (maximum and minimum), relative humidity (maximum and minimum) and rainfall (mm) under field conditions on development of white rust disease in mustard.

Field Site and experimental design

The Agriculture Research Farm of the Guru Kashi University in Talwandi Sabo, Bathinda (Punjab) served as the site of the field tests for the investigation on white rust of mustard. Four different varieties of Indian mustard (V1- PBR 97, V2-Varuna (T-59), V3- Giriraj, and V4- Parasmani 2) were planted during the Rabi season of 2018–2019 in a split plot design with three replications. Standard spacing and use of recommended doses of N, P, and K fertilizers were applied in a natural setting.

White rust intensity (Disease Severity)

No plant protection measures were taken in contrast to any diseases. Observe data once in 7 days for recorded the percent disease intensity (PDI). Selected five randomly plants in each plot and were tagged for taking observations for disease component and three leaves were selected on each plant in the side of bottom, middle and top. The formula given by Mayee and Datar (1986) (Table 1 and Eq. 1) was used to calculate theper cent disease intensity as follows:

Percent Disease Intensity =

$$\frac{\text{Sum of individual rating scale}}{\text{No.of disease Plants observed} \times \text{Maximum disease rating}} \times 100$$

Effect of weather parameters on White rust intensity

The different weather parameters viz. temperature (maximum and minimum), relative humidity (maximum and minimum) and rainfall (mm) affecting epidemic development under field conditions were considered. The maximum plant disease intensity (severity) was observed on Varuna followed by PBR-97 and Parasmaani-2. In the present study, Correlation analysis of disease intensity with weather factors (date of weekly meteorological data from 17th December – 04th March) indicated that maximum temperature (17.9-22.1°C) and minimum temperature (2.2-9.4°C), maximum relative humidity (85.4–92.6%), and total rainfall (mm) has significant positive correlation with disease intensity, while minimum relative humidity (45.0-63.7%) has a significant negative correlation. Temperature (min.) and

Table 1. White rust disease rating scale

Rating Scale	Disease severity Per cent	Disease reaction
0	0	Immune (I)
1	Less than 5%	Highly Resistant (HR)
3	5-10%	Resistant (R)
5	11-25%	Moderately Resistant (MR)
7	26-50%	Susceptible (S)
9	Greater than 50%	Highly Susceptible (HS)

Table 2. Correlation-coefficient between weather parameters and white rust intensity (Severity) on mustard varieties during *Rabi*, 2018-19

Variety	Date of Sowing	Correlation Coefficient (r) Weather factor				
		X1	X2	X3	X4	X5
PBR 97	D1	0.3351	0.1211	0.0159	-0.3912	0.5360
	D2	0.7184	0.6986	0.9882	-0.4678	0.5161
T-59	D1	0.5082	-0.178	0.0507	-0.4221	0.3648
	D2	0.3590	0.1138	0.5923	0.4328	0.4309
Giriraj	D1	0	0	0	0	0
	D2	0	0	0	0	0
Parasmani 2	D1	0.5404	0.2601	0.0270	-0.3805	0.5628
	D2	0.4327	0.2471	-0.7119	-0.4794	0.4703
Overall Mean		0.3617	0.1578	0.1203	-0.2135	0.3601

Value r at 5% = 0.631,X1= Temperature (Min.) °C, X2=Temperature (Max.) °C, X3= Relative humidity Max.) %, X4= Relative humidity (Min) %, X5= Total Rainfall (mm)

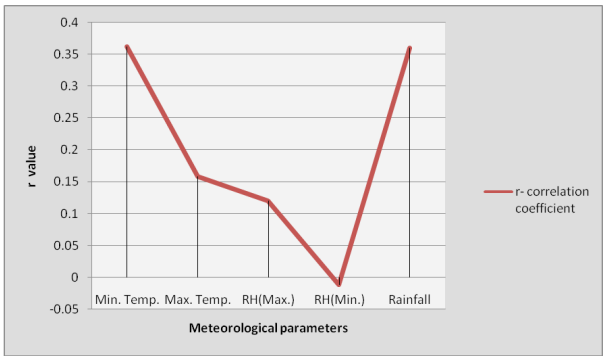

Fig. 1. Correlation-coefficient between weather parameters and white rust intensity on varieties of mustard during *Rabi*, 2018-19

Rainfall were found to have maximum positive correlation and significantly with disease intensity than other weather parameters. Hence, it means temperature (Min.) and rainfall increases the disease intensity of white rust of mustard. (Table 2 and Fig. 1). Similar results regarding correlation between weather parameters and disease intensity were in conformity with the findings of earlier reported by Bains and Jooty (1979) and Raj *et al.,* (2008). Similar findings were also reported by Bal and Kumar (2014), who showed that the role of weather conditions like humidity, temperature and rainfall on white Rust disease and measured loss in yield. The first visible symptoms of white rust appeared 42 days after sowing. The development of white rust was favored by a mean temperature ranging from 11.4 to 17.7°C and 13.5 to 19.3°C along with an average relative humidity of more than 70%. A highly significant positive correlation was observed between disease severity as well as maximum and minimum temperatures. The average loss in seed yield due to this disease was estimated to be 36.88%.

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Author Contributions

We declare that all authors were involved in the research work and preparation of manuscript. Amanpreet Singh Sran, Dr. Bahaderjeet Singh and Dr. Ram Singh are the main authors, contributed in the planning and performing the experiment, field sampling, laboratory work, data analysis and writing of manuscript. All authors read and approved the final version of manuscript.

Conflict of interest

The authors declare no conflict of interest in the study.

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