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Research Article

Effect of Meteorological Parameters on Alternaria Blight Incidence in Mustard Crop

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ABSTRACT

Alternaria blight is an important mustard disease which causes significant economic losses. A field experiment was conducted to study the effect of meteorological parameters on incidence of Alternaria blight in mustard grown under different sowing environments. Mustard was cultivated with three dates of sowing (10th October, 5th November and 1st December) and two mustard cultivars (RLC-3 and PBR-357) replicated thrice under split plot design during *rabi* 2017-18. Alternaria blight incidence was observed at weekly intervals randomly from ten plants per plot under different treatments. The 1st December sown crop showed higher disease incidence (62% & 72%) as compared to 5th November sown crop (59 % & 63%) and 10th October sown crop (45% & 56%) in mustard cultivar RLC-3 and PBR-357 respectively. It was observed that the maximum, minimum temperature and sunshine hours showed a significant positive correlation with disease incidence. While morning relative humidity had a significant negative correlation with disease incidence. The R^2 values were observed in the range of 0.89 to 0.93 indicating that most of the meteorological parameters contributed significantly in Alternaria blight incidence.

Key words: Alternaria blight, Correlation, Disease incidence, Meteorological parameters, Mustard

Introduction

Indian mustard (*Brassica juncea*) is the second most important oil seed crop in India after soybean. It accounts for nearly 20–22 per cent of the total oilseeds produced in country. Mustard is vulnerable to weather variability so any change in weather can effect crop growth and production. From 1997 onwards a reduction in mustard yield was observed due to erratic rainfall pattern, which created water stress (drought and excess rainfall) and temperature increase (Kumar, 2005).

Different biotic stresses like insect-pest, diseases and weeds etc. effect crop growth and production. Diseases and insect pests are important limiting factors, which restrict the fast expansion of cultivation and reduce the productivity of these crops. The severe attack of many diseases on mustard crop not only deteriorates the quality of the seeds but also reduces the oil content. Number of diseases attack mustard crop and about 30 diseases are recognized to effect crops in India (Saharan, 1992). Among these, Alternaria blight is considered as one of the important disease as it is economically important. Most of the commercially grown varieties are susceptible or moderately susceptible to this disease.

Occurrence of any disease is influenced by congenial weather conditions. Different meteorological parameters affect the occurrence, development and spread of mustard diseases.

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Biswas (2013) observed that the Alternaria leaf blight disease caused by *Alternaria brassicae* is a major destructive fungal disease of mustard (*Brassica juncea* (L) Czern and Coss) in India. A range of maximum temperature 23-29ºC was found to be suitable for disease development. While, it was found to be decreased with the higher range of minimum temperature. Maximum relative humidity in range of 80-90 per cent and minimum relative humidity in range of 52 to 58 per cent were the most suitable ranges for lesion development. An average sunshine of 7-8 hours per day favoured the disease development. The incidence of Alternaria blight in rapeseed-mustard fields is influenced by air temperature, relative humidity, soil conditions at the time of sowing, splashing rain, wind velocity, leaf wetness, and inoculum density available in the soil (Meena *et al.,* 2011).

Alternaria blight is one of the important disease caused by *Alternaria brassicae* causing 30-70 per cent yield loss of *Brassica* crops (Mishra *et al.,* 2010). Mamgain *et al.* (2014) studied that *Alternaria brassicae* induced leaf blight has been found to have a drastic effect on members belonging to plant families such as Cucurbitaceae, Brassicaceae and Solanaceae which have nutritional as well as economic importance. Among oilseeds, rapeseed and mustard group comprise a major proportion of edible oilseeds. Losses up to more than 50 percent due to Alternaria blight have been reported by many workers *viz*. Chahal (1986), Saharan (1992), Chattopadhyay (2008) and Meena *et al.* (2010). Thus, one of the major challenges of research on crucifers is to develop knowledge about the epidemiological factors responsible for the development of Alternaria blight and ways to minimize the losses caused by this disease. Pragya *et al*. (2017) revealed that in mustard crop, micrometeorology plays crucial role by checking the population of pests and diseases without causing any environmental degradation. Keeping these aspects in view, this study was planned to know the effect of different meteorological parameters on Alternaria blight incidence in mustard grown under different dates of sowing.

Material and Methods

The experiment was carried out during *rabi* season of 2017-18 at the Research Farm, Department of Climate Change and Agricultural Meteorology, Punjab Agricultural University, Ludhiana (30°54′N latitude and 75°48′E longitude and at an altitude of 247 meter above mean sea level). The experiment on mustard crop was conducted with three dates of sowing (10th October, 5th November and 1st December) and two mustard cultivars (RLC-3 and PBR-357) replicated thrice under split plot design with dates of sowing in main plot and cultivars in sub plot.

Disease incidence (%): Incidence of disease was observed at weekly intervals randomly from ten plants per plot under different treatments and per cent disease incidence was calculated on the basis of following formulae:

$$\text{Disease incidence (DI, \%)} = \frac{\text{No. of diseased plants}}{\text{Total No. of plants examined}} \times 100$$

Different meteorological parameters viz. maximum and minimum temperature (°C), morning and evening relative humidity (%), rainfall (mm) and sunshine hours (hrs) were obtained from the agrometeorological observatory, Department of Climate Change and Agricultural Meteorology, Punjab Agricultural University, Ludhiana. Data analysis was conducted by using statistical analysis software R (version 3.5.2). Correlation coefficients and regression models were developed to study effect of different meteorological parameters on DI. While doing analysis, disease incidence was considered as dependent variable with different meteorological parameters as independent variables. In regression analysis multicolinearity is an important factor so to reduce that effect, adjusted R^2 value was used instead of R^2.

Results and Discussion

Alternaria blight incidence

The disease incidence under different dates of sowing i.e. 10th October, 5th November and 1st December in both mustard cultivars viz. RLC-3

and PBR-357 was observed visually (Fig. 1). The results revealed that there was a significant effect of date of sowing on disease incidence. With change in sowing time, disease incidence showed variability. The 1st December sown crop showed higher disease incidence (62% & 72%) as compared to 5th November (59% & 63%) and 10th October sown crop (45% & 56%) in mustard cultivars RLC-3 and PBR-357 respectively (Fig. 1). Among cultivars, PBR-357 showed higher disease incidence as compared to RLC-3. Resistance or tolerance of any variety or a cultivar to disease is an important varietal character. Variability in per cent disease incidence among different dates of sowing was due to prevailing weather conditions which a crop received during particular date of sowing. Alternaria blight development and spread is influenced by prevailing weather conditions. From results it can be concluded that the late sown mustard crop provide favourable conditions for Alternaria blight development as compared to early and

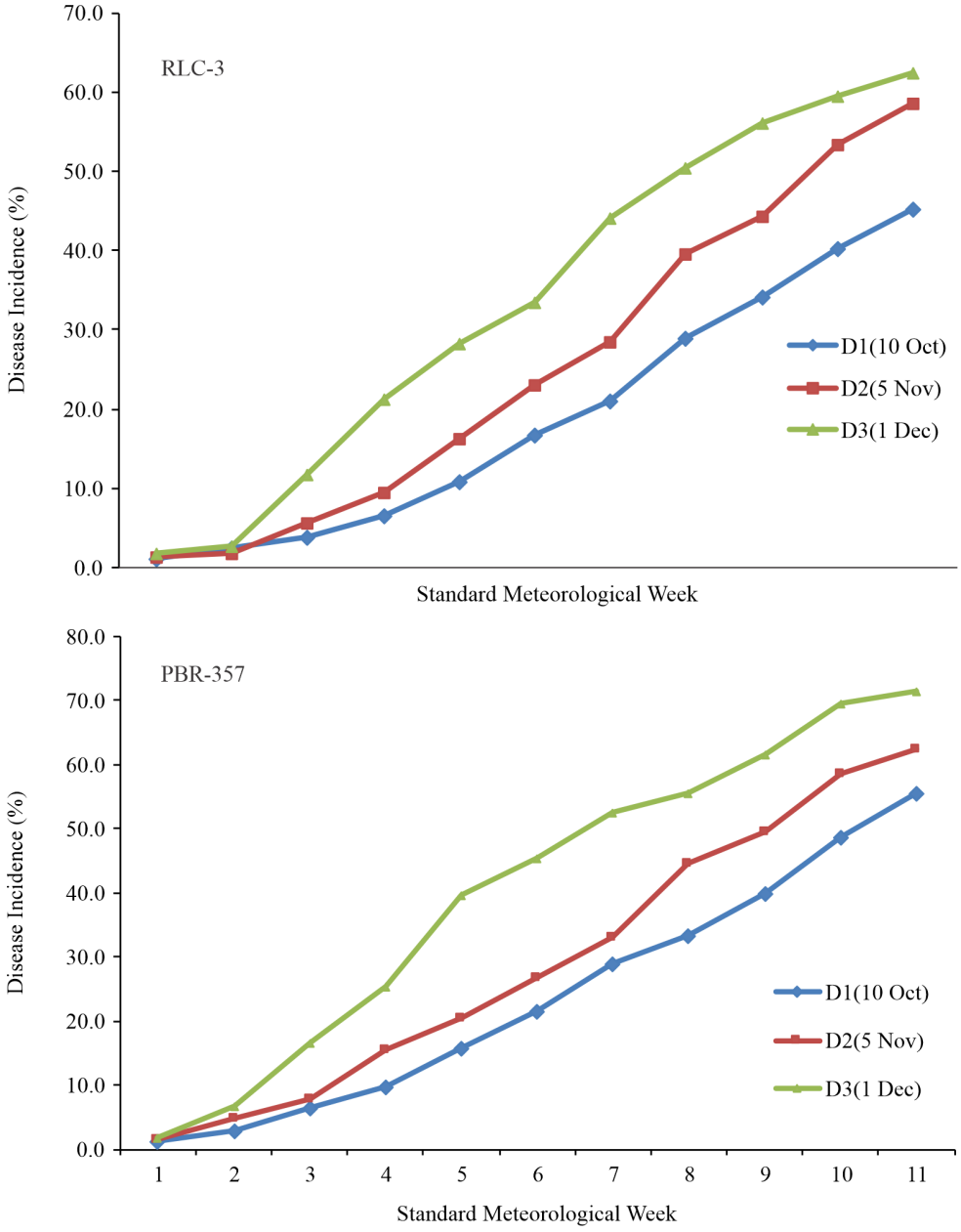

Fig. 1. Effect of date of sowing on Alternaria blight incidence in mustard cultivars

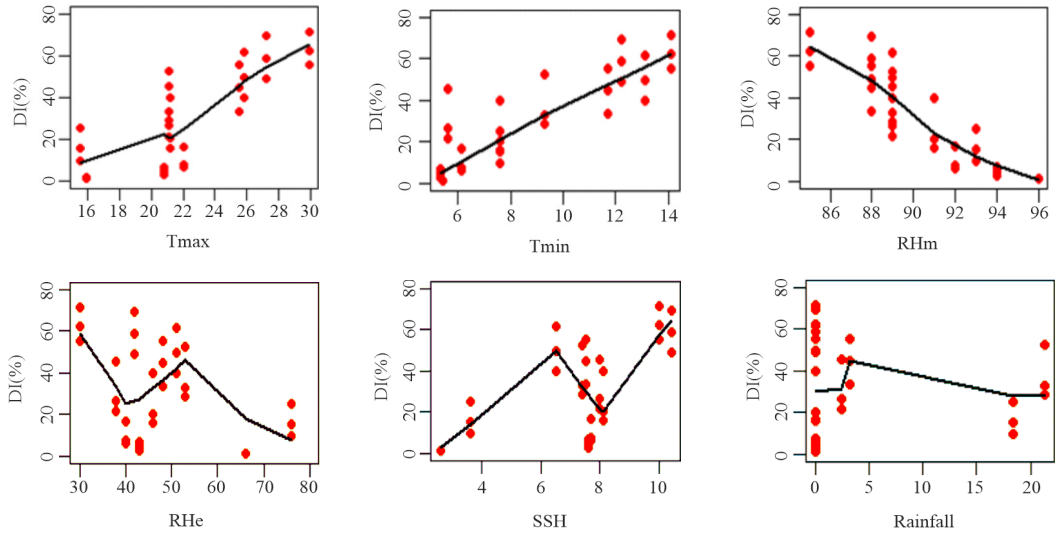

Fig.2. Different meteorological parameters and progression of Alternaria blight incidence

timely sown crop. These results are in accordance with those given by Dange *et al.* (2003) they reported that the effect of date of sowing on the disease incidence in mustard and found that early sown crop i.e. in the month of October, resulted in less disease incidence as compared to late sowing crop. Talukdar *et al.* (2017) also reported that per cent disease incidence was found to be lowest in the early sown crop (7th November) and gradually increased with successive delay in sowing dates (14th November to 5th December). Similarly, Das *et al*. (2018) concluded that delayed sown (beyond October) mustard crop is infested more by aphid due to increase in temperature (which may be favourable for aphid multiplication) during the reproductive stage of the crop.

Meteorological parameters and disease development

Every insect, pest or disease has a favourable period during which it flourish well similarly, *Alternaria brassicae* development and progression is influenced by different meteorological parameters. At a specific time period, a particular meteorological parameter influences disease occurrence, development and spread. Analysis was conducted to observe the effect of different meteorological parameters on disease incidence (DI) as shown in Fig. 2. It was observed that maximum temperature and minimum temperature significantly influenced disease incidence. Maximum temperature in the range of 21-23°C was most favourable for disease development but maximum disease progressed up to temperature in the range of 26-30°C. Minimum temperature in the range of 6-14°C during January and February favoured development and progression of disease. Morning and evening relative humidity in the range of 87-88 per cent and 40-52 per cent was most favourable for disease development and progression after that with increase in morning and evening relative humidity disease showed decreasing trend. Sunshine hours in the range of 7-8 hours were most favourable for disease development and sunshine hours in range of 9-10 hours showed positive effect on disease progression. Rainfall is not favourable for development of disease. Disease showed maximum incidence during zero rainfall period. The results are in corroboration with the findings observed by Gupta *et al.* (2003) who revealed that meteorological parameters significantly influence mustard diseases. They observed that eighty five-day old plants showed highest disease severity because maximum temperature in the range of 20.4-31.6°C and minimum temperature in the range of 4.9-14.4°C had significant and maximum relative humidity 80-94 per cent and minimum relative humidity 33-56 per cent had significant effect on disease.

Table 1. Correlation coefficients between Alternaria blight incidence and different meteorological parameters (pooled data RLC-3 and PBR-357)

Parameters	Date of Sowing		
	10th October	30th November	5th December
Tmax (°C)	0.86**	0.85**	0.80**
Tmin (°C)	0.90**	0.89**	0.90**
RHm (%)	-0.88**	-0.89**	-0.93**
RHe (%)	-0.47*	-0.46*	-0.49*
RF (mm)	-0.13	-0.12	-0.01
SSH (Hours/day)	0.66*	0.65*	0.67*

*values significant at P≤0.05 and **values significant at P≤0.01

Correlation coefficients between disease incidence and meteorological parameters

Correlation coefficients between disease incidence and different meteorological parameters viz. maximum and minimum temperatures, morning and evening relative humidity, rainfall and sunshine hours were worked out and presented in Table 1. It was observed that the maximum, minimum temperature and sunshine hours showed a significant positive correlation with disease incidence. While morning and evening relative humidity showed a significant negative correlation with disease incidence. Rainfall didn't show any significant relationship with disease incidence. Similarly, Neog *et al.* (2015) reported significant negative correlation of Alternaria blight with maximum and minimum temperature in the north bank plains zone of Assam. Saharan and Saharan (2001) also reported that Alternaria blight of cluster bean is correlated significantly with minimum temperature.

Regression analysis between disease incidence and meteorological parameters

The regression analysis between different meteorological parameters like maximum and minimum temperature, morning and evening relative humidity, rainfall and sunshine hours and disease incidence was worked out. Best fit regression equations were selected for each treatment, (Table 2). From the R^2 values it can be concluded that most of meteorological parameters were the major determinants of disease incidence and the R^2 value explained the percent variability in disease incidence due to different meteorological parameters. The R^2 value was observed in the range of 0.89 to 0.93 indicating that most of the meteorological parameters contributed significantly in the development and progression disease. Razdan *et al.* (2012) found maximum temperature, morning relative humidity and rainfall influence the disease incidence which is in corroboration with the present findings. Weather parameters play a vital role in causing disease incidence. Similarly, Talukdar *et al.* (2017) carried out regression analysis and concluded that decrease of evening relative humidity and bright sunshine hours during the growing period aggravated the disease in late sown crops.

Conclusions

In present study, highly significant correlation coefficients (r) and coefficient of determinants (R^2) indicated that meteorological parameters play

Table 2. Stepwise regression analysis between Alternaria blight incidence and meteorological parameters

Date of sowing	Regression equations	Adjusted R^2 value
10th Oct	Y= 215.42+ 0.28Tmax + 2.12Tmin - 2.66RHm + 0.29RHe - 0.31 RF + 0.84 SSH	0.89**
5th Nov	Y= 340.4+ 0.35Tmax + 2.25Tmin - 4.21 RHm + 0.58RHe - 0.51 RF + 1.64 SSH	0.92**
1st Dec	Y= 708.5+2.74Tmax + 2.71 Tmin - 7.75RHm + 0.81RHe - 0.71 RF + 4.69 SSH	0.93**

**values significant at P≤0.01

Where, Tmax: Maximum temperature (°C); Tmin: Minimum temperature (°C); RHm: Morning relative humidity (%); RHe: Evening relative humidity (%); RF: Rainfall (mm); SSH: Sunshine hours (Hours/days)

significant role in Alternaria blight development and progression. The meteorological parameters can be used to develop weather based disease prediction model which can be very helpful for issuing disease forewarning so that necessary precautions can be taken in order to manage disease incidence. By altering date of sowing, crop can escape economic losses caused by Alternaria blight to some extent.

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