Journal of Agrometeorology 15 (1) : 86-88 (June 2013)

Short communication

Influence of weather parameters on powdery mildew disease of mustard under North Saurashtra agroclimatic zone

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Mustard is one of the most important oilseed crop grown under a wide range of agroclimatic conditions in India. The crop is damaged by various biotic and abiotic stresses. The weather conditions during December and January are the most congenial for outbreak of powdery mildew, which has been a limiting factor for successful cultivation of mustard. Dange *et al*., (2002) reported 17 per cent yield loss due to this disease in mustard in Gujarat. Weather parameters such as temperature and relative humidity play an important role in disease development (Gadre *et al*., 2002; Desai *et al.,* 2004 and Kohire *et al*., 2008). However, scanty information is available on the epidemiological aspects of this disease under north Saurashtra agroclimatic conditions where the crop is cultivated during *rabi* season with limited irrigation. The crop is mainly affected by powdery mildew causing considerable losses in terms of both quality and quantity. Hence, the present investigation was carried out to determine the influence of meteorological parameters on the development of disease.

Field experiments were conducted during four consecutive *rabi* seasons from 2007-08 to 2010-11 at Dry Farming Research Station, J.A.U., Jam-Khambhalia of north Saurashtra agroclimatic zone of Gujarat state. The mustard cultivar 'GM-2' was sown on 16th October during 2007-08 to 2009-10 and 18th October during 2010-11, adopting recommended package of practices in plot size 12.0 m x 9.0 m. The crop was protected against mustard sawfly (*Athelia lugens proxima* Klug) and mustard aphid (*Lipaphis erysimi* Kalt) by spraying endosulfan @ 0.07 and imidacloprid @ 0.005 per cent, respectively, during the years of experiment. Standard package of practices were followed to raise the crop.

The disease observations were recorded at four days interval from 20-tagged plants from initiation of the disease till the maturity of the crop and the severity was calculated on 0-12 point scale (Solanki, 1995). For each observation date, PDI was calculated by averaging 20-tagged plants to give a single value using the formula given by Wheeler (1969).

$$\text{PDI} = \frac{\Sigma \text{ Total rating}}{\text{Total plants observed x Maximum disease rating}} \text{ X } 100$$

Data on weather parameters such as maximum and minimum temperatures, morning and afternoon relative humidity (RH_1 and RH_2) were recorded from nearby agrometeorological observatory. Correlation and multiple regression analyses was carried out to determine the relationships between weather parameters and disease progress.

Weather factors and disease development

The PDI was recorded from the date of initiation of the disease to the crop harvest at an interval of four days. Correlation coefficient values based on the data of four consecutive years were calculated.

Mean weather parameters of the season and the disease intensity are presented in Table 1. The average maximum and minimum temperature during the four seasons varied from 27.2 to 28.9 °C and 10.9 to 12.6°C, respectively. Relative humidity during morning and afternoon ranged from 69 to 83 per cent and 27 to 42 per cent, respectively. The disease intensity ranged from as high as 91.7 per cent in 2008-09 to as low as 85.90 per cent during 2010-11. Maximum temperature (r=0.531, 0.758 and 0.470) was significantly positively correlated with the PDI during 2008-09, 2010-11 and on average basis, respectively. Minimum temperature showed positive correlation with PDI in all the years except 2008-09. The relationship between PDI and morning RH was positive (r=0.615) and significant during 2008-09 but negative (r=-0.553) and significant during 2009-10 which may be

Table 1: Average weather data and per cent disease intensity of powdery mildew from 2008-09 to 2010-11.

Year	No. of observations	Temperature (°C) Maximum	Temperature (°C) Minimum	Relative humidity (%) Morning	Relative humidity (%) Afternoon	Per cent disease intensity
2007-08	15	27.2	10.9	76	27	88.8
2008-09	14	28.2	12.6	77	42	91.7
2009-10	13	27.6	12.4	69	30	87.1
2010-11	15	28.9	12.5	83	40	85.9

Table 2: Correlation coefficients between PDI and weather parameters

Sr. No.	Meteorological factors	Correlation coefficient ' r ' 2007-08	2008-09	2009-10	2010-11	Average
1	T_{max}	0.363	0.531*	0.545	0.758**	0.470**
2	T_{min}	0.393	-0.234	0.084	0.479	0.178
3	RH_1	-0.294	0.615*	-0.553*	0.461	-0.005
4	RH_2	-0.706**	-0.712**	-0.428	0.121	-0.284**

Table 3: Multiple regression equations for prediction of powdery mildew disease in mustard

Sr. No.	Meteorological factors	Regression coefficient ' b ' 2007-08	2008-09	2009-10	2010-11	Average
1	T_{max}	-.3030	1.3011	10.9165*	22.9234**	5.5663**
2	T_{min}	7.1330	2.6481	-2.4366	5.9336	3.8247
3	RH_1	-.5567	1.4709	-2.0121	0.2071	0.2426
4	RH_2	-2.1298*	-1.8462	1.0931	-2.6668**	-1.2826**
	Intercept (á)	68.80	-58.3	-123.5	-604.2	-133.1
	R^2	0.599	0.592	0.681	0.807	0.362

*Significant at 5%; ** Significant at 1%

due to high morning RH (77%) during 2008-09 and low morning RH (69%) during 2009-10. Afternoon RH was highly significant and negatively correlated with PDI (r=-0.70, -0.712 and -0.284), respectively during the years 2007-08, 2008-09 and in pooled analysis. Thus, it is clear that both temperature and relative humidity play a major role in powdery mildew disease development as reported earlier by Saharan and Kaushik (1981); Dang *et al.*, (1998) and Gadre *et al.* (2002). They reported that temperature had significant positive relationship with the powdery mildew disease of mustard. Present findings are also in close conformity with the results obtained by Desai *et al.* (2004) and Kohire *et al.* (2008). They reported importance of temperature and relative humidity in disease development by *E. cruciferarum* in mustard.

Prediction of powdery mildew disease

To formulate simple and effective model for powdery mildew prediction, weather factors were considered. Powdery mildew symptoms were observed in second fortnight of December with the per cent disease intensity from initiation of disease to crop harvest as 1.25 to 88.8; 2.50 to 91.7; 2.09 to 87.1 and 1.67 to 85.9 respectively, during the year 2007-08, 2008-09, 2009-10 and 2010-11. The prediction equation was developed during all the four years and pooled (Table 3). The R^2 values revealed that the weather parameters that were regressed on disease intensity could explain the variation to the extent of 59 to 81 per cent in different years. It may be concluded that maximum temperature (28.9ºC) coupled with afternoon RH (40%) favoured powdery mildew intensity under natural conditions during the year 2010-11.

The regression equation for the prediction of per cent disease intensity was

$$Y = -604.2570 + 22.9234X_1 + 5.9336X_2 + 0.2071X_3 - 2.6668X_4 \ldots\ldots\ldots\ldots\ldots \quad (R^2 = 0.8076)$$

Variation accounted by this regression equation is 81 per cent.

Regression model developed for predicting PDI showed that different weather variables influenced differently and responsible for the increase or decrease of PDI to a given extent. This may be due to different weather conditions in different years. The favourable environmental conditions identified for development and progress of powdery mildew disease was maximum temperature between 27.2 to 28.9ºC and afternoon RH from 27 to 42%. These observations are in agreement with the findings of Dang *et al*., (1998) at Hissar and Solanki *et al*, (1999) at Anand, Gujarat with regards to powdery mildew of mustard.

CONCLUSIONS

Powdery mildew initiated at the crop age of 66-74 days, which gradually increased till harvest. Out of four variables, the most contributing variables identified for the disease development under North Saurashtra agroclimatic conditions were maximum temperature and afternoon relative humidity.

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Received : September 2012 ; Accepted : April 2013