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Weather Variables in Relation to Development and Progress of Foliar Blight of Wheat

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Abstract

Blight disease development on wheat varieties such as Sonalika, HW 2010, HD 2285, HW 2012 and K 65, sown in the fourth week of November revealed that foliar blight incidence was maximum in 5—11 March during 2008 - 2009 and 2009 - 2010 crop season. It was found that climatic conditions prevailing from 12 February to 11 March, were more favorable for blight development with average minimum and maximum atmospheric temperature around 12 C and 25.90 C, respectively and relative humidity more than 80%. During this period the crop received maximum amount of monsoon and rains which directly promoted the disease intensity. Development, progress and correlation of foliar blight with environmental conditions were studied on different wheat cultivars during both the crop seasons. The results revealed that cumulative increase was significant among the years, cultivars and observation intervals. The maximum increase in foliar blight was recorded on Sonalika and HD 2285, however the progression was least on wheat cultivar K 65. Higher R^2 values showed that variation can be explained upto 88.8—92.67% with combined effect of temperature and relative humidity. Multiple regression equation was developed for forecasting of the disease.
Key words : Foliar blight, Weather parameters, *Triticum aestivum, Wheat.*

Wheat (*Triticum aestivum* L.) is one of the main *rabi* crops, widely cultivated throughout the country. Foliar blight in wheat are mainly caused by species of *Alternaria triticina* Prasada and Prabhu and *Bipolaris sorokiniana* Sacc. Shoem. (Teleomorph : *Cochliobolus sativus* (Ito and Kuribayashi) Drechs. Ex. Dastur (1). This disease caused by both of these pathogens is generally taken as a group because in most of these cases it is rather difficult to distingguish one from the other under field conditions. The plant is susceptible in all the stages of growth from tillering to the time of grain formation. The present study was therefore aimed to find out the relationship between disease progress and weather variables for better management of the disease.

Methods

Five cultivars of wheat such as Sonalika, HW 2010, HD 2285, HW 2012 and K 65 were grown at the Krishi Vigyan Kendra, Post Graduate College, Ghazipur (Uttar Pradesh). The seeds of each cultivars were sown in the fourth week of November with three replications in randomized block design in plot measuring 5×3 m^2 during 2008-09 and 2009-10 crop seasons. All the agronomical and cultural practices were followed to have a good crop. Trials were conducted under natural epiphytotic conditions. The temporal development of the disease was recorded on 10 randomly selected plants from each of the five cultivars at seven days intervals starting from 7 January till the leaves become senescent, using 0—9 rating scale (2) . The weather data viz., weekly mean temperature, relative humidity and rainfall throughout the crop period was recorded at the meteorological observatory of the College located about 200 meters from the experimental plot. The percent disease intensity (PDI) was calculated by employing the fallowing formula :

$$\text{PDI} = \frac{\text{Sum of total numerical ratings}}{\text{Total number of leaves examined} \times \text{highest ratings}} \times 100$$

The data was analyzed using a randomized three factorial design. Analysis of variance was done as

Table 1. Foliar blight disease intensity on different cultivars of wheat during 2008-09 and 2009-10 cropping seasons.

Year	Standard week	Percent disease intensity on Sonalika	HW 2010	HD2285	HW 2012	K 65
2008-09	1	4.44	3.08	3.95	3.46	3.20
	2	5.56	3.58	5.43	4.07	4.19
	3	7.40	4.69	7.90	6.17	6.04
	4	10.37	6.41	10.00	8.64	9.50
	5	21.48	11.72	15.43	13.45	13.33
	6	32.96	16.29	22.47	21.23	17.90
	7	38.15	26.54	34.07	29.62	24.94
	8	46.67	34.56	45.60	36.79	32.35
	9	59.26	40.12	47.90	40.24	37.03
	10	68.52	49.13	58.64	48.39	45.06
2009-10	1	5.19	3.70	4.56	4.19	3.70
	2	6.29	5.30	6.79	5.55	4.93
	3	8.52	6.41	9.38	8.52	7.16
	4	16.67	9.13	11.23	10.37	10.62
	5	25.19	13.58	16.54	14.19	14.81
	6	35.93	18.52	23.82	22.96	20.37
	7	40.74	31.35	35.56	31.97	26.70
	8	55.93	37.78	43.58	39.25	35.67
	9	67.40	42.09	48.15	41.36	41.73
	10	75.93	54.32	61.23	56.54	49.38
CD at 5% Year (Y)	0.42	Interaction CD at 5% YI	0.95			
Variety (V)	0.67	YV	1.34			
Interval (I)	0.95	IV	2.12			
		YIV	NS			

per the formula given by Gomez and Gomez (3) with pooled data of two years. The disease progress curves were developed using linear equations. Simple regression using in dependent variables for each year was

Table 2. Weather parameters in relation to progress of foliar blight of wheat during the 2008-09 and 2009-10 cropping seasons.

Year	Standard week	Weather parameters Max. temp.	Min. temp	Mean	Max. RH%	Min. RH%	Mean	Rainfall
2008-09	1	23.27	7.17	15.22	93.28	40.14	66.71	0.00
	2	22.80	5.97	14.38	89.00	38.14	63.57	0.00
	3	20.68	7.92	14.30	94.28	46.00	70.14	2.80
	4	21.01	5.48	13.24	95.14	42.14	68.64	0.00
	5	22.97	7.22	15.09	86.42	39.00	62.71	0.00
	6	23.67	7.45	15.56	76.00	43.00	59.50	0.00
	7	25.80	7.60	16.70	76.14	38.71	57.42	0.00
	8	25.70	8.11	16.90	72.57	38.71	55.64	0.00
	9	28.92	10.97	19.94	75.42	37.71	56.56	0.00
	10	30.98	11.74	21.36	89.85	33.43	61.64	0.00
2009-10	1	16.70	7.00	11.85	90.70	78.70	84.70	0.00
	2	17.10	8.10	12.60	89.80	65.62	77.50	0.00
	3	20.50	5.40	12.95	86.00	49.50	67.75	0.00
	4	21.10	5.80	13.45	90.10	53.40	71.75	0.00
	5	23.00	9.20	16.10	83.00	54.10	68.55	1.20
	6	23.70	7.90	15.80	86.00	41.80	63.90	0.00
	7	27.40	12.00	19.70	85.70	47.20	66.45	0.00
	8	24.00	10.70	17.35	83.20	52.80	68.00	25.20
	9	23.80	10.10	16.95	85.50	47.80	66.65	0.00
	10	25.90	12.00	18.95	81.40	44.00	62.70	6.00

Table 3. Correlation coefficient of cumulative increase of foliar blight on different cultivars of wheat in relation to environmental factors during 2008-09 and 2009-10 crop season (combined). Critical value ± 0.632 and 0.765.

Environmental factors	Sonalika	HW 2010	HD 2285	HW 2012	K 65
Maximum temperature	0.9561**	0.9553**	0.9604**	0.9625**	0.9529**
Minimum temperature	0.9253**	0.9457**	0.9402**	0.9333**	0.9277**
Average temperature	0.9588**	0.9664**	0.9674**	0.9659**	0.9578**
Maximum RH	–0.7296**	– 0.6861*	– 0.7005*	– 0.7131*	– 0.6984*
Minimum RH	– 0.7984**	0.7616**	– 0.7835**	– 0.7912**	– 0.7871**
Average RH	– 0.8446**	– 0.8006**	– 0.8208**	– 0.8318**	– 0.8216
Rainfall	0.3809	0.4196	0.4168	0.4288	0.4154

examined. Multiple and stepwise regressions were developed following the method of Gomez and Gomez (3). For each year data were analyzed separately and regression equations similar to one mentioned below were developed by combining data of both the years.

$$Y = a + b_1 x_1 + b_2 x_2 .... b_5 x_5$$

Where, Y =predicted foliar blight, A = Intercept/constant, b_1 to b_5 = partial regression coefficients, x_1 to x_5 = independent weather variables.
Significance of coefficient of multiple determination (R^2) and partial regression coefficients (b) values was fallowed at 5% level of probability.

Results and Discussion

The development and progress of a disease under natural conditions is influenced by prevailing environmental of factors, the type of host cultivars and availability of pathogen inoculums. Percent disease intensity and temporal development of disease showed that all the varieties were susceptible to foliar blight pathogens except cv K 65 (Table 1). The progress of the disease was faster on Sonalika and HD 2285 than in HW 2010 and HW 2012 cultivars. The disease intensity was higher in 2009-10 than in the 2008-09 crop season. This may be due to higher relative humidity (RH) and favourable temperature during the cropping seasons of 2009-10 (Table 2). The progress of the disease was found to be highly significant among the years, cultivars and observation intervals. The interactions among all these variables were also highly significant except year × interval × varieties. When the cumulative increase was compared with the prevailing environmental factors, it was found that the disease progressed fairly well with maximum temperature ranging between 22.97 and 30—98 C, and minimum temperature between 7.22 and 12.0 C ; Maximum RH between 76.14 and 86.42% and the rainfall directly promoted the disease intensity. Neema and Joshi (4) also reported that the combined effect of high temperature, high RH and long periods of leaf wetness due to rainfall and daily dew periods of more than 12 hours favour high disease incidence. The temperature range 17—26 C has provided optimum conditions for growth, infection, lesion development and sporulation of *Bipolaris sorokiniana.*

The disease progress curve for different varieties showed linear relationship between disease intensity and crop growth stage (r^2 = 0.89 to 0.93).

To develop a quantitative relationship between disease progress and weather variables, multiple and step wise regression analysis was performed. Correlation coefficients were found significant for maxi-

Table 4. Regression equations based on pooled data of two years.

Equation	Independent variation	Cultivars				
		Sonalika	HW 2010	HD 2285	HW 2012	K 65
Regression	Max Temp.	7.29	3.8576	6.1958	5.334	4.8155
Coefficient	Max. RH	–0.332	– 0.586	– 0.0123	– 0.0868	– 0.0303
Intercept		–110.93	– 20.50	– 118.828	– 95.309	– 89.9055
Residual SE		454.78	202.297	271.962	196.225	199.4299
R^2		0.9164	0.888	0.9223	0.9267	0.9081

mum temperature, minimum temperature and average temperature (Table 3). There was a positive correlation between temperature and disease progress while negative and significant correlation coefficient was associated with minimum relative humidity, maximum relative humidity and average relative humidity that the relative humidity does appear to play a role in disease development and progress. The prediction equation developed using stepwise regression analysis (Table 4) showed that variation can be explained between 88.8 – 92.67% for different cultivars with the help of maximum temperature and relative humidity. The R^2 values showed that there might be some other unknown factors involved in the development of disease and this requires further studies for explaining the remaining variability.

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