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Aerobiology on air borne conidia of *Alternaria triticina* over the crop canopy of wheat under field condition

S. S. MAITY AND SRIKANTA DAS
Department of Plant Pathology, Faculty of Agriculture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur 741252, Nadia, West Bengal

Movement of aerial spores of *Alternaria triticina* were trapped from sampled air over crop canopy (wheat during growing season of 1996-97 and 1997-98. Spore deposition was counted and stepwise multiple linear regression computer programme was used to identify the important meteorological variables from maximum temperature, minimum temperature, maximum relative humidity, minimum relative humidity, rainfall, wind velocity, dew deposition and sunshine hours to predict the movement of air borne conidia of *Alternaria triticina* over the wheat crop during the cropping season. It was observed that spore deposition was positively correlated with maximum temperature, minimum temperature, and wind velocity. Air borne spore of *Alternaria triticina* was maximum with increase in temperature above 30ºc and minimum 20ºc, wind velocity above 5.0 km/hr The prediction equation of movement of air borne conidia of *Alternaria triticina* was $y = (-)\ 105.83 + 4.870x_1 - 88.96x_6 + 5.32x_7$ ($R^2 = 0.9533$) and viable conidia was $y = 200.642 - 1.591x_2 - 10.3178x_3 + 0.286x_6 + 2.372x_9$.

Kew words : Aerobiology, wheat, *Alternaria triticina,* meteorological factors, conidia, multiple regression analysis, prediction equation

INTRODUCTION

The leaf blight disease of wheat caused by *Alternaria* was first reported from Kalimpong hills of West Bengal by Kaiser and Islam (1994). Now this disease has gaining importance causing yield loss with association of *Helminthosporium sativum* which has been found to cause root rot, black point and leaf blotch diseases of wheat. The air borne disease caused by *Alternaria triticina* causing leaf blight are mainly foliar disease. Quantification of dispersal gradients have been more fruitfully developed for wheat rust (Klochko and Lebedev 1990). The role of aerobiology in plant pathology was that the air borne organisms involved in the disease development require identification, enumeration, assessment predictability of behavior, when and how these organisms reach their host, infect, survive and cause epidemic (Hirst, 1991). The aerobiology of leaf blight disease has not received due attention, through, it causes heavy damage to wheat crop recently. Because of the paucity of aerobiological information of leaf blight caused by *Alternaria triticina,* this experiment was carried out to correlate by significance of spore with meterological perameters which are an important source of primary inoculum.

MATERIALS AND METHODS

The field experiment was conducted at the University District Seed farm, Kalyani for consecutive two year 1996-97. The wheat cultivar "UP-262' was sown on 3rd week on November with normal agronomic practices. Randamized block design was followed using three replications, with 5 × 10 m plot size. For spore trapping a rotary sampler on ball bearing (which is movable with air currents) was used (Das, 1992). The trap was designed to hold a single slide. The trap rotated with the function of wind direction and velocity. Ten traps were placed in the centre and another none at different places in a square plots (0.36 m) with their trapping surface at the same level just above the crop canopy. The slides in the spore trap which was coated with cellophane strips were changed regularly at 7 am and 5 pm daily and exposed to 24 hrs. In the laboratory the conidia were counted and 10 such observations per slide were recorded and computed into a number of spore/mm^2. The different meteorological factors like maximum and minimum temperature, wind velocity, dew deposition and sunshine hrs were also monitored from the meteorological observatory near the experimental field. The data were then analysed to MRA (Multiple Regression Analysis) and correlative matrix were done to find out the relationshop and a comparison was done with the predicted and observed value of conidia to obtain the viable prediction equation.

RESULTS AND DISCUSSION

Movement and deposition of conidia of *Alterneria triticina* depended uon the different meteorological factors such as temperature, relative humidity, total rainfall, dew deposition, wind velocity and sunshine hrs. Effects of individual factors on spore count over crop canopy were assessed. Two years pooled mean data showed that the conidia were found in the air in high numbers during March, when the temperature attained maximum 30-35°C and minimum 20-23°C, relative humidity maximum 92-95 %, minimum 40-65 % and wind velocity 3-5 km/hr. All the data were then subjected to multiple regession analysis (7 days average spores and meteorological data) find out the statistical correlation between conidia lodging and meteorological parameters.

The two year polled data were analysed by multiple regression analysis and correlation matrix showed that a positive correlatiion existed between conidia lodging over crop canopy and maximum temperature (ryx_1 = 0.920), minimum temperature (ryx_2 = 0.911) and wind velocity (ryx_9 = 0.903) but

Table 1 : Correlation matrix of conidia lodging with meteorological factors.

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
Y	0.920**	0.911**	−0.599**	−0.335	−0.165	0.036	0.082	−0.392*	−0.803**	0.194
Maximum temperature (X_1)	—	0.958**	−0.557**	−0.396*	−0.273	0.118	−0.008	−0.253	0.761**	0.244
Minimum temperature (X_2)	—	—	−0.771**	−0.442*	−0.071	−0.097	−0.163	−0.195	0.760**	0.112
Difference in temperature (X_3)	—	—	—	0.402*	−0.401*	0.545**	−0.490**	0.005	−0.513**	0.220
Maximum relative humidity (X_4)	—	—	—	—	0.146	0.234	−0.061	−0.033	−0.464**	0.023
Minimum relative humidity (X_5)	—	—	—	—	—	−0.928**	0.601**	0.138	−0.170	−0.404*
Difference in relative humidity (X_6)	—	—	—	—	—	—	−0.613**	−0.148	−0.008	0.406*
Number of rainy days (X_7)	—	—	—	—	—	—	—	0.153	0.164	−0.191
Dew deposition (X_8)	-	—	—	—	—	—	—	—	−0.088	0.189
Wind Velocity (X_9)	—	—	—	—	—	—	—	—	—	0.385*
Sunshine hours (X_{10})	—	—	—	—	—	—	—	—	—	—

*Significant at P = 0.05, **Significant at P = 0.01, y = Conidia lodging.

Table 2 : Correlation matrix of conidia lodging with meteorological parameters.

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
Y	0.276	0.430*	−0.633**	−0.118	−0.309	−0.348	0.321	0.245	0.350*	−0.125
Maximum temperature (X_1)	—	0.958**	−0.557**	−0.396*	−0.273	0.118	−0.008	−0.253	0.761**	0.244
Minimum temperature (X_2)	—	—	−0.771**	−0.442*	−0.071	−0.097	−0.163	−0.195	0.760**	0.112
Difference in temperature (X_3)	—	—	—	0.402*	−0.401*	0.545**	−0.490**	0.005	−0.513**	0.220
Maximum relative humidity (X_4)	—	—	—	—	0.146	0.234	−0.061	−0.033	−0.464**	0.023
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Dew deposition (X_8)	-	—	—	—	—	—	—	—	−0.088	0.189
Wind Velocity (X_9)	—	—	—	—	—	—	—	—	—	0.385*
Sunshine hours (X_{10})	—	—	—	—	—	—	—	—	—	—

*Significant at P = 0.05, **Significant at P = 0.01, y = Conidia lodging.

other seasonal factors like dew deposition (ryx_8 = –0.392) and difference in temperature (ryx_3 = –0.599) were negatively correlated. Other meteorological parameters like maximum and minimum relative humidity, number of rainy days and sunshine hours had no correlation in conidia trapping over crop canopy. Maximum temperature, however, interacted positively with minimum temperature and wind velocity but negatively with difference in temperature and maximum relative humidity. The difference in temperature was positively correlated with maximum humidity where as negatively correlated with minimum relative humidity, number of rainy days and wind velocity. On the other hand the negative correlation of dew deposition did not interacted statistically with wind velocity and sunshine hours, where as positively correlated wind velocity interacted positively with sunshine hours. Minimum relative humidity was positively correlated with numbers of rainy days and negatively correlated with difference in relative humidity and sunshine hours. These observations were stringly supported by very high co-efficient determination $R^2 = 0.9207$ (Table 1).

Successful infection and disease development needs survival of conidia present in the air. So the conidia which were trapped also tested their viability and a multiple correlation was done with metorological factors and per cent of viable number of conidia present in air. It was observed that viable number of conidia deposited on slide was positively correlated

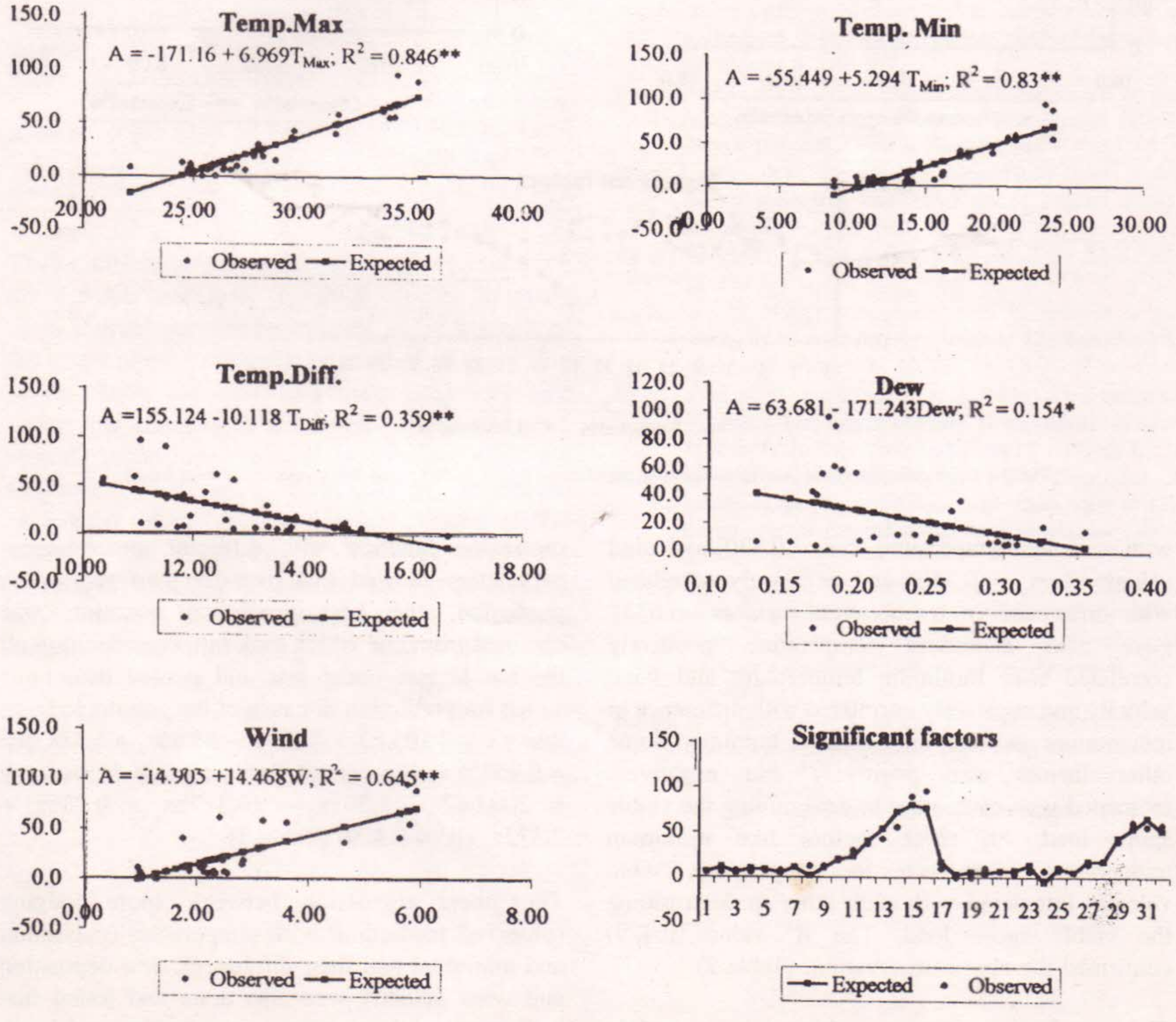

Fig. 1 : Dependence of *Alternaria spore* count on significant (T_{max}, T_{min}, T_{diff} Dew deposition and Wind velocity) abiotic factors.

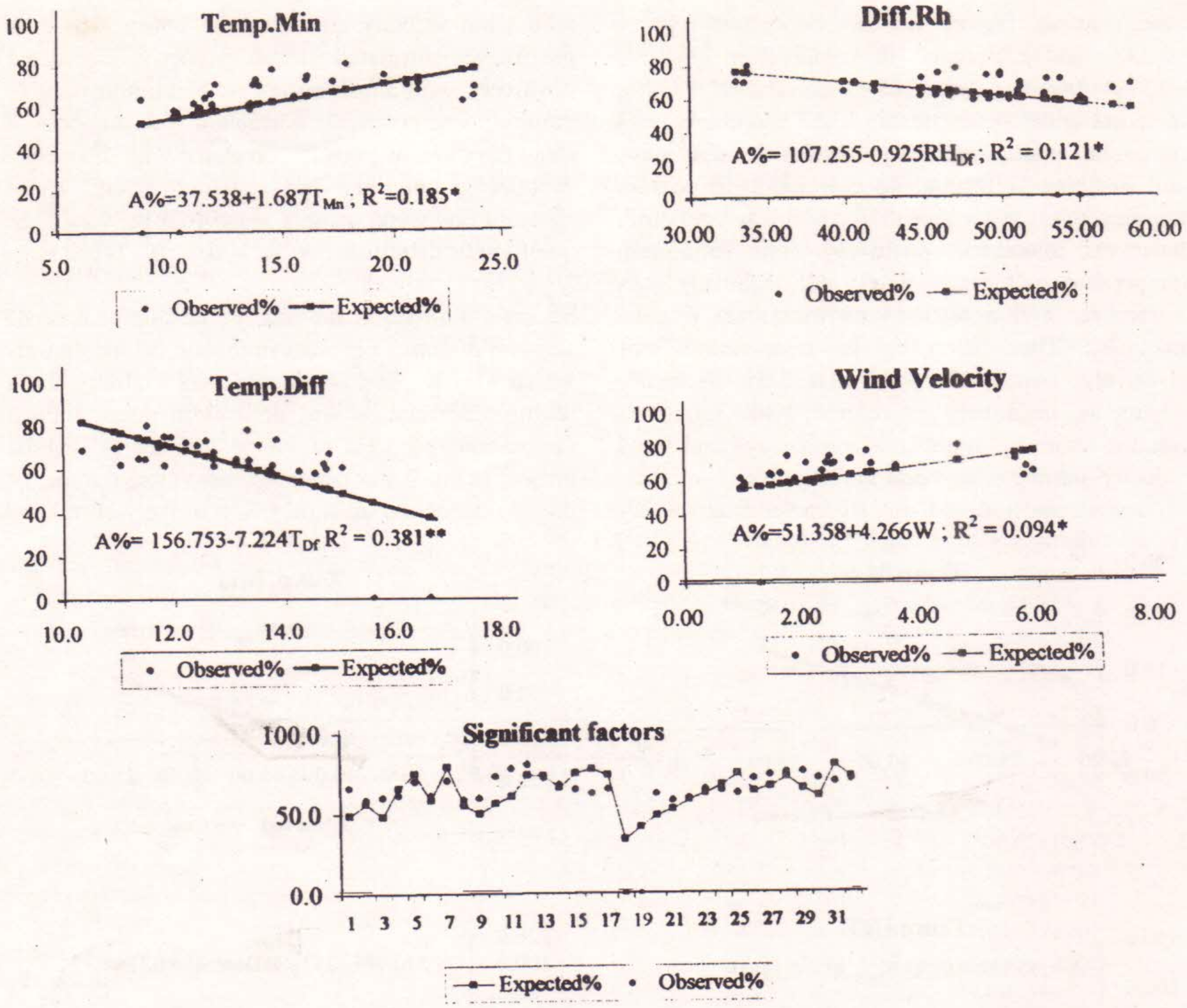

Fig. 2 : Dependence of viable *Alternaria* spore on significant (T_{max}, T_{min}, RH_{diff} and Wing velocity) abiotic factors.

with minimum temperature ($ryx_2 = 0.430$) and wind velocity ($ryx_9 = 0.350$) and negatively correlated with difference in temperature ($ryx_3 = -0.633$). Here also maximum temperature positively correlated with minimum temperature and wind velocity and negatively correlated with difference in temperature and maximum relative humidity. Some other factors also positively and negatively interacted with each other in determining the viable spore load. So these factors like minimum temperature, difference in temperature, wind velocity interacted with each other in determining the viable spore load. The R^2 value (0.429) confirmed the above observation. (Table 2).

The prediction equation from the multiple regression function with different meterological parameters showed that over the two years data prediction, the best prediction equation was obtained from one which took into consideration all the ten factors under test and pooled data most suited for prediction of cause of the conidia lodging was $y = (-)\ 105.83 + 4.470x_1 - 88.96x_6 + 5.32x_7$ ($R^2 = 0.9533$) and in case of viable conidia depostion $y = 200.642 - 1.591x_2 - 10.3178x_3 + 0.286x_6 + 2.372x_9$ ($R^2 = 0.429$) (Table 3).

The linear regression between spore lodging (observed prediction) with temperature (maximum and minimum and their diference), dew deposition and wind velocity wee also done and found that individually they were positively correlated.

However, when observed spore lodging and predicted or expected spore lodging were compared, it was found that the prediction equation provided the best model as they matched very well with actual data. This result also confirmed by high R^2 values (Fig1). The viable conidia which were lodged in the slides also showed the same pattern as earlier and their regression between observation and predicted or expected viable conidia with minimum temperatures, temperature difference in relative humidity and wind velocity and their individual relation also confirmed by high R^2 values (Fig. 2).

Table 3 : Daily mean correlation of observed and predicted no of conidia deposited on slides through prediction equation.

	Number of Conidia				Prediction equation of Spore lodging
Months	Observed		Predicted		$Y = -105.83 +$
	1996-97	1997-98	1996-97	1997-98	$4.870x_1 - 88.96x_6 +$
December	0.73	0.63	1.22	1.19	$5.32x7$ ($R^2 = 0.9533$)
January	1.19	0.77	0.52	1.05	Prediction equation of viable spore lodging.
February	3.46	1.63	3.46	1.64	$Y = 200.642 - 1.591x_2 - 10.3178x_3 + 0.286x_6$
March	9.41	6.96	9.22	6.62	$+ 2.372x_9$ ($R^2 = 0.429$)

Thus multicolinearity was apparent in determining the conidia load over the crop canopy. In many fungi diurnal periodicity appears to be a result of the effect of environmental conditions in triggening spore release mechanisms (Hirst, 1953). He also stated that changes in wind velocity, temperature, humidity, sunshine, rainfall or dew were clearly responsible for some modifications of diurnal periodicity of air spores. Ali and Ahmad (1992) reported that relative humidity was negatively correlated with prevalence of air borm conidia, wind velocity has an impotent role in conidia deposition as dislodging of spores from the conidiophores was increased with air turbulance and dissemination and deposition was higher (Hjelmroos, 1993). It was also observed that *Alternaria triticina* conidia deposition increased abruptly during the month of March, later stage of crop growth. This ws confirmed with the observation of Marchegay *et al.* (1990). Prabhu and Prasad (1966) reported that the susceptibility of wheat plants of *Alternaria triticina* increased with the age of the crop and this investigation also confirmed the presence of abundant conidia during this period. From this result it was observed that correlation and changes of conidia load with detailed weather records above the crop could provide much informations above the epidemiology and spread of the disease. This study also indicated the factors or interaction of factors controlling the observed fluctuatons in conidia load.

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