Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.7706

ISSN: 2582 – 2845

Ind. J. Pure App. Biosci. (2019) *7*(6), 136-139

Indian Journal of Pure & Applied Biosciences

Research Article

Effect of Meteorological Factors on Disease Severity of Yellow Rust in NW India

Madho Singh*, Ram Niwas, M. L. Khichar and Premdeep

Department of Agricultural Meteorology, CCS HAU, Hisar-125004, Haryana, India

*Corresponding Author E-mail: madhosingh.meena164@gmail.com

Received: 19.08.2019 | Revised: 25.09.2019 | Accepted: 3.10.2019

ABSTRACT

The survey was conducted during Rabi seasons of 2015-16 and 2016-17 at different locations of NW India, at HAU, Hisar. Yellow rust severity was recorded at 15 days intervals. Disease severity was higher (70%) during Rabi 2015-16 as compared to 2016-17 (60%) during both years (Pooled data). The maximum temperature, minimum temperature and Vapour pressure deficit were positively correlated whereas morning and evening relative humidity were negatively correlated with average disease severity and rainfall had non significant correlation with disease severity. The variability in disease severity can be explained from 83 to 99 percent by minimum temperature and maximum relative humidity.

Keywords: *Yellow rust disease, Stripe rust, Wheat, Puccinia striiformis, Regression model*

INTRODUCTION

With the current global situation requiring higher wheat production from declining land areas, more productive farming systems will potentially increase pressure from diseases such as stripe rust or yellow rust. Wheat crop in certain parts of Punjab, Haryana, J & K and parts of Uttarakhand and bordering crop fields in Uttar Pradesh are affected by stripe rust or yellow rust of wheat caused by a fungal pathogen, *Puccinia striiformis* probably occurred long before wheat was grown for food, whereas, Gadd from Europe first described it in 1777 (Eriksson & Henning 1896). The stripe rust pathogen is favored by long mild winter, wet and cool spring season. This disease appears if cold temperature with intermittent rains prevails during the months of February and March. Wind is the main means of spread or dispersal of stripe rust. Huerta-Espino et al. (2011) reported that *Puccinia triticina* has a wide virulence range and is broadly adapted to diverse climatic conditions, leading to regular and significant yield losses over large geographical areas. Severity of stripe rust is affected by different meteorological parameters and microclimate of crop. Microclimate modification can be useful in management of stripe rust as disease is highly influenced by microclimate of the crop.

Cite this article: Singh, M., Ram Niwas, Khichar, M.L., & Premdeep. (2019). Effect of Meteorological Factors on Disease Severity of Yellow Rust in NW India, *Ind. J. Pure App. Biosci. 7*(6), 136-139. doi: http://dx.doi.org/10.18782/2320-7051.7706

MATERIALS AND METHODS

Daily meteorological observations on temperature (^oC), relative humidity (%), vapour pressure deficit and rainfall (mm) were recorded at the Agro meteorological Observatory and regional research station located nearby at selected stations. The relative humidity data for Yamuna Nagar and Ambala was not available. We have taken average of 15 days for each weather parameters expect rainfall (sum of 15 days).

Stripe rust severity was recorded visually as the percentage of leaf area infected according to the modified Cobb's or Peterson's scale (Peterson et al., 1948). The disease was recorded on 10 randomly selected plants and per cent plants affected by the disease were recorded at 15 days intervals. Severity index was calculated by using the following formulae:

$$\text{Severity index (\%)} = \frac{\text{Area of plant tissue infected} \times 10}{\text{Total area of plant}} \times 100$$

Correlation coefficients and multiple regression analysis were carried out between stripe rust disease severity and different meteorological parameters like temperature, relative humidity, VPD and rainfall.

RESULT AND DISCUSSION

Disease severity

Disease severity index was calculated on the basis of per cent disease severity observations. Disease severity index was higher (70%) during *rabi* 2015-16 as compared to 2016-17 (60%). Difference in disease severity during both years was not high as weather conditions during both the years did not very much. Temperature and relative humidity were the key factors for stripe rust development. Maximum temperature range was recorded from 17 to 26.2^oC. However, the maximum disease development was noticed in temperature range from 18 to 24^oC.When the maximum temperature reached above 28^oC, disease advancement became stagnant. Milus & Seyran, (2004) reported that stripe rust caused by the new isolates tends to develop faster than the old isolates at relatively high temperatures. Temperatures above 28ºC were detrimental to infection caused by rust pathogen (Marchetti et al., 1976).

Disease severity and meteorological parameters

Several environmental variables affect the production, dispersal and survival of uredinospores (Eversmeyer & Kramer, 1995). The correlation coefficients were worked out between disease severity and meteorological parameters. for *rabi* Pooled data (2015-16 and 2016-17) (Table 1). Total rainfall did not show significant relationship with disease severity. The maximum temperature, minimum temperature and vapour pressure deficit were positively correlated with the disease severity at all the stations. Similar results were reported by Murray et al. (2005). Papastamati et al. (2007) also reported that the most important weather variable for the progress of stripe rust is temperature, followed by dew period and light quantity. The disease severity showed a negative correlation with morning and evening relative humidity. Similar results were reported by Lemaire et al. (2002).

The high rainfall may have played significant role in disease spread as indicated in different studies. Pielaat et al. (1998) proposed a model to represent the special spread of spores by rain splash from a point source at any time during a rain event over a homogenous surface. The model was applicable for characterizing splash dispersal under range of conditions. Similarly, Srinivasan (1983) also developed regression models for the prediction of stripe rust in sub-mountain and central plain regions of Punjab and he also reported that relative humidity and precipitation frequency were the major factors influencing the outbreak of this disease.

The multiple regression analysis was conducted to find the cumulative effect of different meteorological parameters on disease severity by taking disease severity as dependent variable and different meteorological parameters as independent variables. The multiple regression analysis between disease severity and meteorological parameters for different row spacing is shown in table 4. Similar regression models for predicting the stripe rust in central plain regions of Punjab were developed by Dutta et al. (2008). Rader et al. (2007) developed two models to predict the occurrence of leaf rust (caused by *Puccinia recondita* or *P. triticina*) using air temperature, relative humidity and precipitation.

Table 1: Correlation study between weather parameters and disease severity during both year 2015-16 & 2016-17 (Pooled)

Station Name	Tmax	Tmin	RHm	RHe	Rainfall	VPD
Jammu	0.73**	0.91**	-0.71*	-0.78**	-0.31	0.82**
Gurdaspur	0.89**	0.89**	-0.82**	-0.82**	-0.35	0.70*
Dhaula Kuan	0.92**	0.95**	-0.86**	-0.82**	-0.22	0.48
Yamuna Nagar	0.62*	0.91**	-	-	-0.29	-
Ambala	0.74*	0.87	-	-	-0.31	-
Karnal	0.86**	0.95**	-0.90**	-0.94**	0.00	0.93**
Hisar	0.89**	0.93**	-0.83**	-0.77*	-0.47	0.90**
Pooled	0.60*	0.64*	-0.55*	-0.38	-0.17	0.36

Multiple Regression Model

The multiple regression analysis between stripe rust incidence and weather parameters presented in Table 2.

Variability in yellow rust disease severity can be explained up to 87 percent by maximum temperature and relative humidity maximum at Jammu, 94 percent at Gurdaspur by maximum temperature and relative humidity maximum, 94 percent at Yamuna Nagar by maximum temperature and relative humidity maximum, 83 percent at Dhaula Kuan by maximum temperature, 89 percent at Ambala by minimum temperature, and 99 percent at Karnal by maximum temperature and relative humidity maximum, and 92 percent at Hisar by maximum temperature and relative humidity maximum. Ashourloo et al. (2014) found the similar result.

Table 2: multiple regression models for prediction of yellow rust disease incidence in wheat crop pooled data (2015-16 &2016-17)

Sr. No.	Station name	Regression equation	R^2
1	Jammu	Y=-236.87+14.97 Tmin+1.77 RHm	0.87
2	Gurdaspur	Y= 255.60+6.74 Tmin-3.23 RHm	0.94
3	Yamuna Nagar	Y= 425.97+11.98 Tmin-5.44 RHm	0.94
4	Dhaula Kuan	Y= -157.18+19.71 Tmin	0.83
5	Ambala	Y= -71.0+11.0 Tmin	0.89
6	Karnal	Y= -747.95+34.03 Tmin +5.28 RHm	0.99
7	Hisar	Y= 55.28+3.20 Tmin -0.72 RHm	0.92

*Y= Disease Severity, Tmin= Minimum temperature, RHm= Relative humidity morning

CONCLUSION

Maximum temperature, minimum temperature and vapour pressure deficit had positive significant correlation while RHm and RHe had negative significant correlation with disease severity of yellow rust. Minimum temperature and relative humidity maximum can be used as a predictor variable for forewarning incidence of yellow rust of wheat.

REFERENCES

Ashourloo, D., Mobasheri, M.R., & Huete, A. (2014). Developing two spectral disease indices for detection of wheat leaf rust (*Puccinia triticina*). *Remote Sensing*; *6*, 4723–4740.

Dutta, Indrani, Dhaliwal, L. K., Mann, S. K., & Chahal S. K. (2008). Effect of meteorological parameters on phenology, yield and yield contributing characteristics and yellow rust of wheat. *J. Agrometeorol*. *10*(1), 189-92.

Eriksson, J., & Henning, E. (1896). The cereal rusts as well as history and natural control measures. Stockholm PA (tr) pp-463 Norstedt and Soner, Stockholm.

Eversmeyer, M. G., & Kramer, C. L. (1995). Survival of Puccinia recondita and P. Graminis urediniospores exposed to temperatures from subfreezing to 35°C. *Phytopath. 85*, 161–164.

Huerta-Espino, J., Singh, R. P., Germán, S., McCallum B. D., Park, R. F., & Chen, W. Q. (2011). Global status of wheat leaf rust caused by *Puccinia triticina*. *Euphytica 179*, 143–60.

Lemaire, D., Huret, S., Calaym, F., & Maraite, H. (2002). Understanding *P. striiformis* west. pidemics on winte r wheat. Meded Rijksuniv Gent -Fak Landlbourwkd Toegep. *Biol Wet 67*, 251-56.

Kumar, V.P. (2014). Development of weather-based prediction models for leaf rust in wheat in the Indo-Gangetic plains of India. *Eur J Plant Pathol. 140*, 429-40.

Marchetti, M.A., Melching, J.S., & Bromfield, K.R. (1976). The effects of temperature and dew period on germination and infection by urediospores of *Phakopsora pachyrhizi*. *Phytopathol*. *66*, 461-63.

Milus, E.A., & Seyran, E. (2004). New races of *Puccinia striiformis* f. sp. *tritici* more aggressive than older races at 18 °C. *In* Proceedings of the 11th International Cereal Rusts and Powdery Mildews Conference. 22–27 August 2004, John Innes Centre, Norwich, UK. European and Mediterranean Cereal Rust Foundation, Wageningen, Netherlands. *Cereal Rusts and Powdery Mildews Bulletin*, Abstr. A2.50.

Murray, G., Wellings, C., & Simpfendorfer, S. (2005). *Stripe Rust: Understanding the disease in wheat*, New South Wales Department of Primary Industries. Pp 1-12.

Papastamati, K. Bosch, & Van den, F. (2007).The sensitivity of the epidemic growth rate to weather variables, with an application to yellow rust on wheat. *Phytopath 97*, 2, 202-10.

Peterson, R. E., Campbell, A. B., & Hannah, A. E. (1948). A diagrammatic scale for estimating rust intensity of leaves and stems of cereals. *Can J of Res*. *26*, 496–500.

Pielaat, A., Madden, L. V., & Gort, G.1998. Spores splashing under different environmental conditions: A Modeling Approach. *Phytopath.88*, 1131-39

Rader, T., Racca, P., Jorg, E., & Hau, B. (2007). PUCREC/PUCTRIa decision support system for the control of leaf rust of winter wheat and winter rye. EPPO Bulletin, *37*(2), 378–82.

Srinivasan, G. (1983). Role of meteorological factors in the Epidemiology of Karnal bunt and rust diseases of wheat. M.Sc Thesis, Punjab Agricultural University, Ludhiana.