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Short Comminucation

Epidemiology and weather-based forecasting model for anthracnose of grape under the semi-arid tropical region of Maharashtra

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In India, nearly 120 thousand ha area is under grapes, mainly for table or raisin purpose, with annual production of about 2600 thousand Mt. Thompson Seedless and its clonal selection Tas-A-Ganesh are the most popular and widely cultivated table and raisin grape cultivars in India. In the warm, tropical and sub-tropical environment, anthracnose disease caused by *Colletotrichum gloeosporioides* (Sawant *et al.*, 2012). The disease mostly affects tender shoots and young fruits and reduces vine productivity and fruit quality. Timely application of fungicides is the only effective method to manage anthracnose. Disease incidence and severity is reported to depend on weather parameters (Jamadar and Sataraddi, 2010; Pampanagouda *et al*., 2005), hence, it is possible to develop a weather-based disease forecasting model, which would enable the growers to take decisions on time to do judicious use of fungicides. This will help in better disease management with reduced fungicide use.

Epidemiological studies on cv. Anab-e-Shahi in Hyderabad area in Andhra Pradesh had shown that three rainy days with cumulative rainfall of 50 mm per week with cloudy weather helped anthracnose disease development (Rao and Satyanarayana, 1989). However, the epidemiology of anthracnose on Thompson Seedless in the commercial grape belt falling in the semi-arid tropical region of Maharashtra was not known. The present investigation was, therefore, carried out to study the influence of weather parameters on development of anthracnose disease in this region and to develop a disease forecasting model.

Studies were carried out during 2012, 2013 and 2014 at ICAR-National Research Centre for Grapes, Pune, located at 18p 29' N, 073p 59' E at altitude of 552 m. A 9-year-old vineyard of Thompson Seedless, planted on extended 'Y' trellis at 10' x 6' spacing between rows and vines respectively, was selected for the study. This location had history of severe natural occurrence of anthracnose infections, the study relied on natural incidence of disease. Vines were maintained with regular viticultural operations. Fungicides which could affect anthracnose disease were not applied

Weather data and disease observations were recorded from June to September when the disease first appears and is active during the monsoon period. Data on temperature, relative humidity and total rainfall were recorded on an automatic weather station (μMetos) located in the vineyard. The daily weather data was used to compute weekly averages for maximum temperature (Tmax), minimum temperature (Tmin), morning relative humidity (RH1, 8am) and afternoon relative humidity (RH2, 2 pm). Cumulative rain fall (CRF) over the period of study was computed.

Twelve vines in the vineyard were marked for observing disease severity. Ten shoots on each vine were randomly tagged and observations were recorded at weekly intervals starting from the first appearance of the disease. At each observation, disease severity was recorded on the apical 10 leaves using 0-5 scale, where,

0= no infection;

1= 1-10%;

2= 11-25%;

3= 26-49%;

4= 50-75%; and

5= > 76% leaf infection.

The ratings were converted to percent disease index (PDI) using the formula (Wheeler *et al.* 1969) as given below

$$\text{Percent Disease Index (\%)} = \frac{\text{Sum of numerical ratings}}{\text{No of leaves observed x Maximum rating}} \text{ X } 100$$

For each assessment date, the PDI of 12 vines were averaged to get the weekly PDI value. The weather variables of one week preceding the assessment date and cumulative rainfall were used as independent variables to identify the

Table 1: Average temperature and relative humidity, CRF and PDI of anthracnose during the study period

Year	No. of observations	Temperature (ºC)		Relative humidity(%)		CRF (mm)	PDI
		Tmax	Tmin	RH1	RH2		
2012	18	30.1	22.4	84	66	176	54.18
2013	15	31.9	23.1	67	52	391	84.16
2014	15	31.7	22.3	76	57	376	90.46

Table 2: Correlation coefficients of weather parameters with PDI of anthracnose of grapes

Weather parameter	2012	2013	2014	Pooled
Tmax	-0.327	-0.589**	-0.351	-0.392**
Tmin	-0.694**	-0.593**	-0.796**	-0.645**
RH1	-0.125	0.530*	0.851**	0.348**
RH2	0.870**	0.518*	0.624*	0.345**
CRF (mm)	0.121	0.718**	0.937**	0.786**

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

favourable conditions influencing the dependent variable, anthracnose PDI of the current week through regression analysis (Kanzaria *et al*. 2013). Linear prediction model based on weather parameters as (Tmax, Tmin, RH1, RH2, and CRF) independent variables and PDI were analysed by multiple linear regression using data from each year separately and the 3 years pooled data. Statistical analysis was carried out on SAS system ver.9.3.

Mean temperature and RH parameters and cumulative rainfall (CRF) of the season and anthracnose PDI are presented in Table 1. Rainfall was recorded in all the years before the first appearance of the disease in late June or in the month of July on tender shoots. Lower CRF was observed in 2012 (176 mm) as compared to higher rain fall in 2013 (391 mm) and 2014 (376 mm). Disease severity was also low in 2012, as seen by maximum PDI of 54.48%, whereas in 2013 and 2014, PDI had increased to 84.16 % and 90.46% respectively. This corroborates earlier observations that anthracnose disease severity is mainly dependent on rainfall (Prasad and Nirvan, 1995; Rao & Satyanarayana, 1989).

The correlation between weather parameter and PDI, and their significance is presented in Table 2. The analysis showed that cumulative rainfall was significantly and positively correlated, while *T*min was significantly and negatively correlated with PDI, individually during all the three years. *T*max was also negatively correlated with the PDI of respective years. Negative correlation between *T*max and *T*min with PDI of anthracnose is also seen in other studies (Jamadar and Sataraddi, 2010; Pampanagouda *et al*., 2005; Singh *et al*., 2009). Unlike these observations, under north Indian conditions, anthracnose severity was reported to be positively correlated with *T*min (Thind *et. al*., 2001). RH1 and RH2 were positively correlated with PDI, except RH1 in 2012, where a negative correlation (non-significant) was seen. Similar positive correlation between relative humidity and anthracnose spore production was observed by Jamadar and Sataraddi (2010). Correlation analysis with the three years pooled data showed significant negative correlation of Tmin and Tmax with PDI, while RH1, RH2 and CRF showed significant positive correlation with PDI. Thus, it is clear that temperature, relative humidity, and rainfall, all play an important role in anthracnose disease progression.

The regression equation for the prediction of severity of anthracnose of grapes under the semiarid tropical region of Maharashtra was computed by linear regression analysis using the 3-year pooled data on PDI and weather parameters. The computed regression equation was:

$$PDI=32.00+3.30\ Tmax-7.17\ Tmin+0.77\ RH1-0.65\ RH2+0.20\ CRF\ldots \quad (R^2=0.761)$$

The coefficient of determination (R^2) was tested for significance at both 5% and 1% level of probability. The R^2 value indicated that 76.1% variation in grape anthracnose is explained by temperature, relative humidity and rainfall ($p<0.01$), but as seen by the regression equation, Tmax, RH1 and CRF had a positive influence on PDI, while Tmin and RH2 had a negative influence on the PDI.

This study has shown that the favorable weather conditions for development and progression of anthracnose disease was rainfall with minimum temperature between 22.33 to 23.12ºC, maximum temperature between 30.12 to 31.88ºC, RH1 more than 67% and RH2 more than 51%. The forecasting model was tested for prediction of disease by feeding recorded weather data for the years 2012-2014 as input parameters. The correlation coefficient (r) between the predicted disease severity and the observed PDI was 87.2 ($p < 0.01$). Thus the developed model can be used for prediction of the anthracnose disease in field under given environmental conditions.

REFERENCES

Jamadar, M.M and Sataraddi, A.R. (2010). Epidemiological aspects of grapevine anthracnose in northern dry zone of Karnataka. *J. Pl. Dis. Sci.,* 5(1):231-234.

Kanzaria, K.K., Dhruj, I.U., Sahu, D.D. (2013). Influence of weather parameters on powdery mildew disease of mustard under north Saurashtra agroclimatic zone. *J. Agrometeorol*., 15(1): 86-88.

Pampanagouda, B., Benagi, V.I. and Naraund, V.B. (2005). Role of weather factors in the disease development and spread of anthracnose of grape. *Agric. Sci. Digest.,* 25 (4):311-312.

Prasad, A. and Nirvan, R.S. (1965). Grape anthracnose and its control. *The Punjab Horti. J*., 15: 181 -190.

Rao, K.C. and Satyanarayana, A. (1989). Epidemiology of anthracnose of grape (Vitis vinifera) caused by *Elsinoë ampelina* around Hyderabad. *Indian J. Agric. Sci*., 59 (10): 655-657.

Sawant, I.S., Narkar, S.P., Shetty, D.S., Upadhyay, A. and Sawant, S.D. (2012). Emergence of *Colletotrichum gloeosporioides* sensu lato as the dominant pathogen of anthracnose disease of grapes in India as evidenced by cultural, morphological and molecular data. *Australas. Plant Pathol.,* 41: 493-504.

Singh, A., Verma, K.S. and Chander, M. (2009). Effect of weather parameters on *Colletotrichum gloeosporioides* causing anthracnose of guava. *Pl. Dis. Res.,* 24 (1): 38-40.

Thind, S.K., Arora, J.K., Kaur, N. and Monga, P. K. (2001). Periodicity and prediction model of grape anthracnose in Punjab: an agrometeorological approach. *Pl. Dis. Res.,* 16: 63-67.

Wheeler, B. E. J. (1969). An introduction to plant disease. John Wiley and sons Ltd, London. PP.301.

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