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Effect of weather parameters on the development of Alternaria leaf spot and grey mildew in cotton

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ABSTRACT

The effect of weather factors on the development of alternaria leaf spot and grey mildew in *Bt* Cotton hybrid Jaadoo BG II was investigated at Regional Agricultural Research Station, Lam, Guntur during *kharif* 2013-2017. Maximum, minimum temperatures, evening relative humidity, rain fall, number of rainy days and wind speed were negatively correlated and significantly influenced the progress of alternaria leaf spot while number of sunshine hours showed positive significant influence. In case of grey mildew, minimum temperature, evening relative humidity, rain fall, number of rainy days, evaporation and wind speed were negatively correlated and significantly influenced the progress of disease. Multiple regression analysis of pooled data (2013-2016) showed that maximum, minimum temperatures, number of rainy days and wind speed significantly influenced the development of alternaria leaf spot (R^2=0.984) where as minimum temperature and evaporation significantly influenced the development of grey mildew (R^2=0.976). Validation of these regression equations during 2017-18 indicated the usefulness of these models for prediction of alternaia leaf spot and grey mildew in cotton under given environmental conditions.

Key words: Alternaria leaf spot, cotton, grey mildew, weather parameters

Cotton is an important commercial crop in India with a production of 377 lakh bales of 170 kg lint in 2017-2018 from an area of 122.35 lakh ha with a productivity of 524 kg ha^{-1}, which is far behind the leading countries. Andhra Pradesh stood 7th in area (5.44 lakh ha) but 5th in production (22.0 lakh bales) and 3rdin productivity (688 kg ha^{-1}) during 2017-2018 (Anonymous, 2018).Cotton crop is affected by fungal, bacterial and viral diseases.In India, foliar diseases have been estimated to cause yield losses up to 20 to 30 per cent. *Alternaria* spp including *A.macrospora* Zimm. and *A. alternata* (Fr.) Keissler cause leaf spot/blight. On leaves dark brown, circular or irregular spots develop concentric ridges with a target board appearance. Mature spots have dry grey centres which may crack and even drop. Occasionally cankers develop on stems leading to cracking and breaking of stem. Circular lesions develop on bolls. The disease under congenial conditions causes severe defoliation and reduction in boll formation. Losses due to Alternaria leaf spot/blight were to the tune of 38.2 per cent in cotton (Bhattiprolu and Prasada Rao, 2009).Grey mildew generally appears on older leaves as the plants reach maturity, in the form of irregularly angular, pale translucent spots with definite and irregular margin formed by the veins (called areolae). The lesions are light to yellowish green on the upper surface. Whitish frosty growth, the conidial stage of the causal fungus, appears chiefly on the under surface of the leaves. The affected leaves drop. Grey mildew, once a serious problem for diploid cottons especially in central India has now become a major problem in *Bt* cotton hybrids in central and south zones causing losses to the tune of 38.3 per cent (Bhattiprolu, 2012) and 29.2 per cent (Monga *et al.*, 2013). Understanding the influence of weather factors on host stage and disease development is prerequisite to strategically manage these diseases. In view of the importance of alternaria leaf spot and grey mildew in cotton, an experiment was conducted to assess the progress of these diseases in relation to environmental factors along with phenological stage of the crop.

MATERIAL AND METHODS

Field studies were carried out under All India Coordinated Cotton Improvement Project to investigate the appearance and progress of alternaria leaf spot and grey mildewin *Bt* Cotton hybrid Jaadoo BG II during *kharif* 2013-2017, at Regional Agricultural Research Station, Lam, Guntur.The crop was raised in a bulk plot of 150 m^2. Alternaria leaf spot and grey mildew were scored on 0 to 4scale where 0 = No disease; 1 = <5% leaf area infected; 2 = 6-20% leaf

Table 1: Correlation of alternarial leaf spot and grey mildew with weather factors in cotton (Pooled data of 2013-2016)

S. No.	Variable	Correlation coefficient (r)	
		Alternaria leaf spot	Grey mildew
1	Maximum temperature (^{0}C)	-0.543**	0.156NS
2	Minimum temperature (^{0}C)	-0.832**	-0.970**
3	Morning relative humidity (%)	-0.303NS	0.261NS
4	Evening relative humidity (%)	-0.796**	-0.711**
5	Rain fall(mm/wk)	-0.878**	-0.896**
6	Rainy days	-0.871**	-0.913**
7	Sunshine hours (hrs day^{-1})	0.605**	0.534NS
8	Wind speed (km h^{-1})	-0.562**	-0.651*
9	Evaporation	0.114NS	-0.884*

** Significant at 1% level; *Significant at 5% level; NS-Non Significant

area infected; 3 = 20-40% leaf area infected and 4 = >40% leaf area are infected(Sheo Raj, 1988), at weekly intervals on randomly labeled plants up to the end of the January and expressed as Percent Disease Index (PDI) using Wheeler's formula (1969);

$$PDI = \frac{\text{Sum of numerical ratings}}{\text{Total number of leaves scored x maximum rating}} \times 100$$

Meteorological data viz. maximum temperature (T_{max}), minimum temperature (T_{min}), morning relative humidity (RH I), evening relative humidity (RH II), rainfall, rainy days, sunshine hours, evaporation and wind speed were recorded daily from sowing onwards and weekly means were calculated while rainfall during the standard meteorological week was totaled. Correlation between progress of disease severity and weather factors was calculated to understand the quantitative relationship. Multiple regression equations with independent weather variables were derived using Excel programme to identify the critical parameters for development of both diseases.The regression equations developed for the pooled data (2013-2016) were validated in 2017-18 for predicting the intensity of alternaria leaf spot and grey mildew in cotton.

RESULTS AND DISCUSSION

Alternaria leaf spot appeared during 36th to 38thstandard meteorological week (SMW) at vegetative stage and maximum PDI reached during 42nd to 49th SMW at boll formation and development.Grey mildew appeared during 43rd to 47th SMW(flowering to boll development stage) and maximum PDI reached during 51st to 4thSMW at boll development to boll bursting stage.Correlation analysis of pooled data (2013-2016) revealed that all the weather parameters except sunshine hours had negative and significant influence on the progress of alternaria leaf spot while number of sunshine hours showed positive significant influence (Table 1).In case of grey mildew, minimum temperature, evening relative humidity, rainfall, number of rainy days,evaporation and wind speed had negative and significant influence on the progress of the disease (Table 1). Gowdar *et al*. (2007) recorded negative correlation with weather parameters.

Multiple regression analysis showed that maximum (T_{max}), minimum (T_{min}) temperatures, number of rainy days (Rd) and wind speed (w) significantly influenced the development of alternaria leaf spot.

$$PDI = 37.322 - 1.451\ T_{max} + 0.749\ T_{min} - 4.133\ Rd + 3.271\ W \quad (R^2=0.984)$$

Where, PDI = Percent Disease Index, T_{max} = Maximum temperature, T_{min} = Minimum temperature, Rd = Number of rainy days and W = Wind speed

Moving averages of dependent as well as independent variables prompted the highest coefficient of determination (Bhattiprolu and Monga, 2018). Minimum temperature and afternoon relative humidity werefound critical to forecast the alternaria blight disease in cotton genotypes (Venkatesh *et al.*,2013).Significant negative correlation of PDI with maximum, minimum temperatures and positive correlation with morning RH and sun shine hours was recorded in cotton variety, Narasimha (Venkatesh *et al.*,2016).

The multiple regression equation for alterinaria leaf

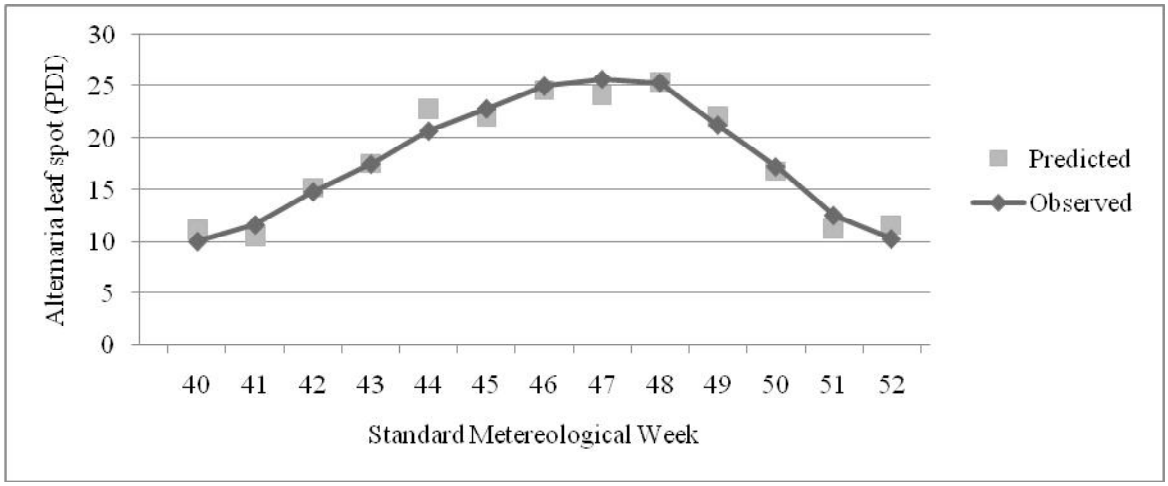

Fig.1: Validation of Prediction model for Alternaria leaf spot of cotton (2017)

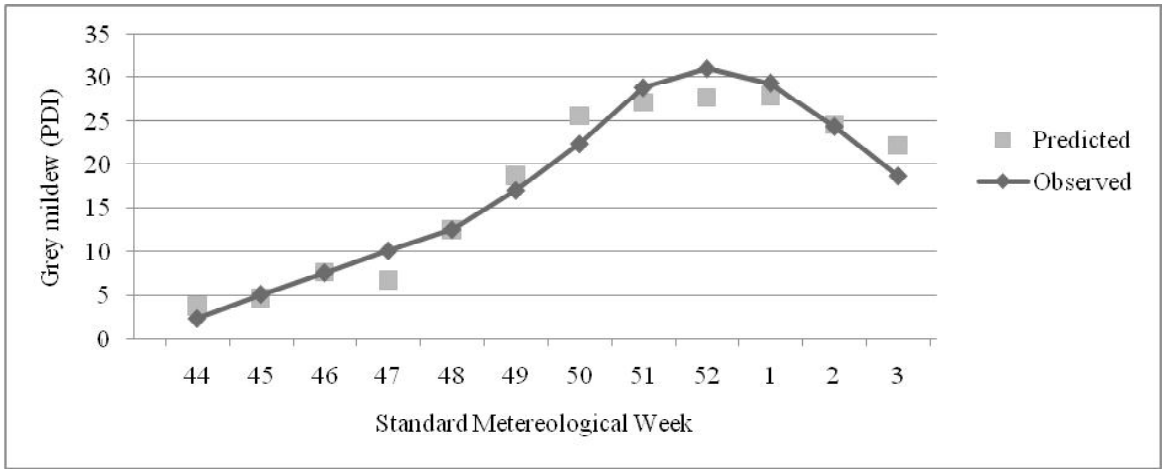

Fig.2: Validation of Prediction model for grey mildew of cotton (2017)

spot was validated during 2017-18 (Fig 1). The predicted PDI were very close to the observed PDI. Hence, the equation can be used to predict the PDI of alterinaria leaf spot.

In case of grey mildew,multiple regression analysis of pooled data (2013-2016) showed that minimum temperature (T_{min}) and evaporation (E) significantly influenced the development of disease.

$$PDI = 177.028 - 10.583\ T_{min} + 10.078\ E \qquad (R^2=0.976)$$

Temperature regime of 20^0C–30^0C with prolonged high humidity (>80%) and frequent rains though required for infection and development of grey mildew, cool weather coupled with prolonged dewy periods in the absence of rains were also found conducive for the development of grey mildew (Johnson *et al*., 2013).

The multiple regression equation for grey mildew was validated during 2017-18 (Fig 2).The predicted PDI were very close to the observed values, Thus, the developed regression models can be used for prediction of alternaria leaf spot and grey mildew in cotton under given environmental conditions.

CONCLUSION

It is concluded that maximum,minimum temperatures, number of rainy days and wind speed are the critical parameters contributing to the development of Alternaria leaf spot where as maximum,minimum temperatures, and evaporation are the critical parameters in case of grey mildew in cotton and farmers are advised to take up preventive and / or protective measures with recommended fungicides like 0.3% copper oxy chloride or 0.3% mancozeb or 0.1% propiconazole against Alternaria leaf spot and 0.3% wettable sulphuror 0.1% carbendazim under favourable weather conditions as given under weekly advisories from the University.

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