Development of Grey Mildew Disease in Cotton as Influenced by Weather Parameters and its Management

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Abstract

The effect of weather factors on the development of grey mildew in susceptible *Bt* Cotton hybrid Jadoo BG II was investigated during *kharif* 2013-2014 in vertisols at Regional Agricultural Research Station, Lam, Guntur under rainfed conditions. Weekly data on disease score at different phenological stages of the crop was recorded on randomly labelled plants and per cent disease intensity (PDI) was correlated with weather parameters. Grey mildew appeared during 44th meteorological week at flowering stage and reached its peak (43%) during the 52nd meteorological week at boll maturity stage. Significant negative correlation was observed for maximum temperature and minimum temperature with per cent disease intensity. Multiple linear regression of PDI indicated that for every one per cent increase in evening relative humidity there was corresponding increase of 0.64 in per cent disease index of grey mildew spot and suggests preventive and / or protective measures are to be taken up with recommended fungicides like 0.3% wettable sulphur or 0.1% carbendazim.

Keywords: Cotton, grey mildew, phenological stages, weather parameters

1. Introduction

Cotton is an important commercial crop in India with a production of 351 lakh bales of 170 kg lint in 2016–2017 from an area of 105 lakh ha with a productivity of 568 kg ha^{-1}, which is far behind the leading countries. Andhra Pradesh stood 6th in area (4.49 lakh ha) but 8th in production (13.10 lakh bales) and 2nd in productivity (719 kg ha^{-1}) during 2016–2017 (AICCIP 2017). 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%. Grey mildew caused by *Ramularia areola* is an economically important disease in Andhra Pradesh causing losses to the tune of 38.38% (Bhattiprolu, 2012) and 29.20% in India (Monga et al., 2013). Understanding the influence of weather factors on host stage and disease development is prerequisite to strategically manage the disease. Hence an experiment was conducted to assess the progress of grey mildew in relation to environmental factors along with phenological stage of the crop.

2. Material and Methods

The effect of weather factors on the development of grey mildew in susceptible *Bt* Cotton hybrid Jadoo BG II was investigated during *kharif,* 2013–2014 in vertisols at Regional Agricultural Research Station, Lam, Guntur under rainfed conditions. The crop was raised on 8th August 2013 in a bulk plot with an area of 150 m^2. Twenty five plants, in the middle rows, at random, were tagged and grey mildew disease was scored on 0 to 4 scale (Sheo Raj, 1988) at weekly intervals on labelled plants up to the end of the February and expressed as Percent Disease Intensity (PDI) using Wheeler's formula:

$$PDI = \frac{\text{Sum of numerical ratings} \times 100}{\text{Total no. of leaves scored} \times \text{Maximum disease grade}}$$

Meteorological data (maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, rain fall, sunshine hours) was recorded daily from sowing onwards and weekly means were calculated while rainfall during the standard meteorological week was totalled. Correlation between progress of grey mildew severity and weather factors was calculated and multiple regression equation was derived using Excel programme.

3. Results and Discussion

Grey mildew of cotton appeared during 44th meteorological week (29th Oct–4th Nov 2013), with mean maximum temperature (T) 31.3 °C, mean minimum temperature (T) 24.1 °C, mean morning relative humidity 94% (RH I), mean evening relative humidity 62% (RH II), sunshine hours (SSH) were 6.4h day^{-1}, rainfall (RF) was 1 mm $week^{-1}$ and wind speed was 3.3

km h^{-1} at flowering stage (Table 1).

Grey mildew increased progressively and reached its peak 43% during the 52nd meteorological week (24th–30th Dec, 2013) at the boll maturity stage, with mean maximum temperature

Table 1: Appearance and progress of grey mildew in *Bt* cotton hybrid Jadoo BG II during *kharif*, 2013−14

SMW	Month and date	Temperature °C		Relative humidity (%)		RF (mm)	Sun shine hours	Wind speed km h^{-1}	Intensity of grey mildew (%)
		Max	Min	I	II				
44	29 Oct-Nov.4	31.3	24.1	94	62	1.0	6.4	3.3	4.0
45	5-11	31.0	20.7	93	58	0.0	7.3	2.6	10.0
46	12-18	30.5	19.4	90	51	0.0	6.4	2.3	20.0
47	19-25	29.5	21.5	90	72	29.0	3.5	3.5	28.75
48	26 Nov-Dec.2	29.3	21.2	98	70	11.4	4.5	2.7	31.5
49	3-9	29.4	18.3	92	48	0.0	5.6	2.5	35.0
50	10-16	30.4	16.4	86	51	0.0	5.6	2.7	37.5
51	17-23	29.3	15.2	94	51	0.0	8.1	1.7	40.0
52	24-30Dec'13	28.9	16.4	93	49	0.0	6.4	2.5	43.0
1	1-7Jan'14	29.9	16.3	97	55	0.0	6.4	2.4	39.0
2	8-14	30.3	17.4	99	58	0.0	6.2	2.6	34.25
3	15-21	30.2	18.2	97	56	0.0	7.2	3.6	30.0
4	22-28	29.4	17.9	97	53	0.0	5.0	3.0	25.5
5	29Ja-4Fe	30.1	17.5	99	50	0.0	8.1	4.8	19.58
6	5-11Feb	32.6	17.3	99	50	0.0	4.8	2.8	9.4

28.9 °C, mean minimum temperature 16.4 °C, RH I 93%, RH II 49%, SSH 6.4 h day^{-1}, nil rain fall and wind speed was 2.5 km h^{-1} (Figure 1). Grey mildew disease was initiated in August, increased in September and reached peak level in the month of October at Dharwad (Venkatesh et al., 2015).

Significant negative correlation was observed for maximum temperature and minimum temperature with PDI. RH I, RH II, Sunshine hours and wind speed showed negative and non-significant correlation while positive and non-significant correlation was obtained with rain fall during the period of study (Table 2).

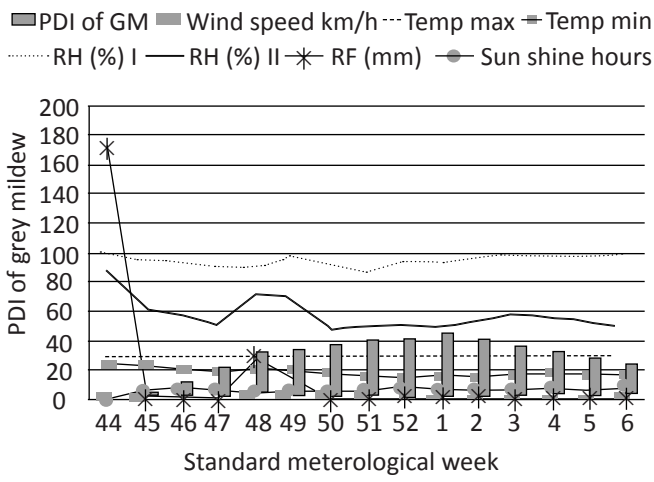

Figure 1: Progress of grey mildew in cotton hybrid Jadoo BG II

The data on per cent disease index was subjected to step up multiple linear regression analysis (Table 3) and the following equation was obtained:

Table 2: Correlation between grey mildew and weather factors during *kharif*, 2013–2014

Variable	Correlation co-efficient (r)
Maximum temperature (°C)	-0.77**
Minimum temperature (°C)	-0.64*
Morning relative humidity (%)	-0.16 NS
Evening relative humidity (%)	-0.14 NS
Rainfall (mm day^{-1})	0.05 NS
Sunshine hours (hours day^{-1})	-0.01 NS
Wind Speed (km h^{-1})	-0.37 NS

**Significant at (p=0.01); *Significant at (p=0.05); NS: Non significant

Y=321.8204-6.67 max T-4 .06 min T-0.57 RH I+0.64 RH II (R^2=89.63%)

The coefficient of determination (R^2) was 0.8963, which

Table 3: Multiple linear regression analysis of per cent disease index of grey mildew and weather factors during *kharif*, 2013–2014

Variable	Regression co-efficient (b)	Standard error (E)	t-value
Maximum temperature	-6.67**	1.47	-4.53
Minimum temperature	-4.06**	0.83	-4.89
Morning relative humidity	-0.57NS	0.33	-1.72
Evening relative humidity	0.64*	0.26	2.41

Intercept (a): 349.70; F cal value: 21.63; T tab value: 2.16; Intercept Per cent of variation attributable to the Regression (R^2): 89.63%; **Significant at (p=0.01); *Significant at (p=0.05); NS: Non-significant

showed that weather factors caused variation in per cent disease index to the extent of 89.63%. It was also observed from the step up regression equation that among weather factors studied the partial regression coefficient (b) for evening relative humidity was significant and positively correlated (0.64) whereas maximum temperature (-6.67) and minimum temperature (-4.06) had significant and negative correlation with per cent disease index. Therefore, it was evident that for every one per cent increase in evening relative humidity there was corresponding increase of 0.64 in percent disease index of grey mildew, whereas one per cent increase in maximum temperature and minimum temperature led to corresponding decrease in per cent disease index of grey mildew of 6.67% and 4.06%, respectively. Similar observations were made by previous workers. Heavy rainfall (833.2 mm) during June to September, minimum and maximum temperature in the ranges of 19.7 °C-23.7 °C and 29.4 °C-30.9 °C, respectively and relative humidity (RH) between 78%-85% in the morning hours and 45.5%-62% in the evening hours, contributed for grey mildew development in Maharashtra (Shivankar, 1989) while minimum and maximum temperature in the ranges of 24-25 °C and 28-31 °C respectively, relative humidity (RH) between 90-91% and cultivation of highly susceptible *G. arboreum* cultivar AKH 4 were responsible for grey mildew epidemics (Mukewar et al., 1994). Temperature regime of 20 °C–30 °C with prolonged high humidity (>80%) and frequent rains though required for infection and development of grey mildew by *Ramularia areola*, cool weather coupled with prolonged dewy periods in the absence of rains has been found conducive for the development of grey mildew (Johnson et al., 2013). Grey mildew incidence could be predicted at lead week two in the initiation phase for varieties Laxmi (R^2=0.74) and DCH-32 (R^2=0.92). R^2 reduced with decrease in lead time (Venkatesh et al., 2015). During the present investigation lead weeks showed R^2=0.93 for maximum and minimum temperatures in the popular *Bt* hybrid Jadoo BG II. The best fit prediction models are presented in Figure 2.

4. Conclusion

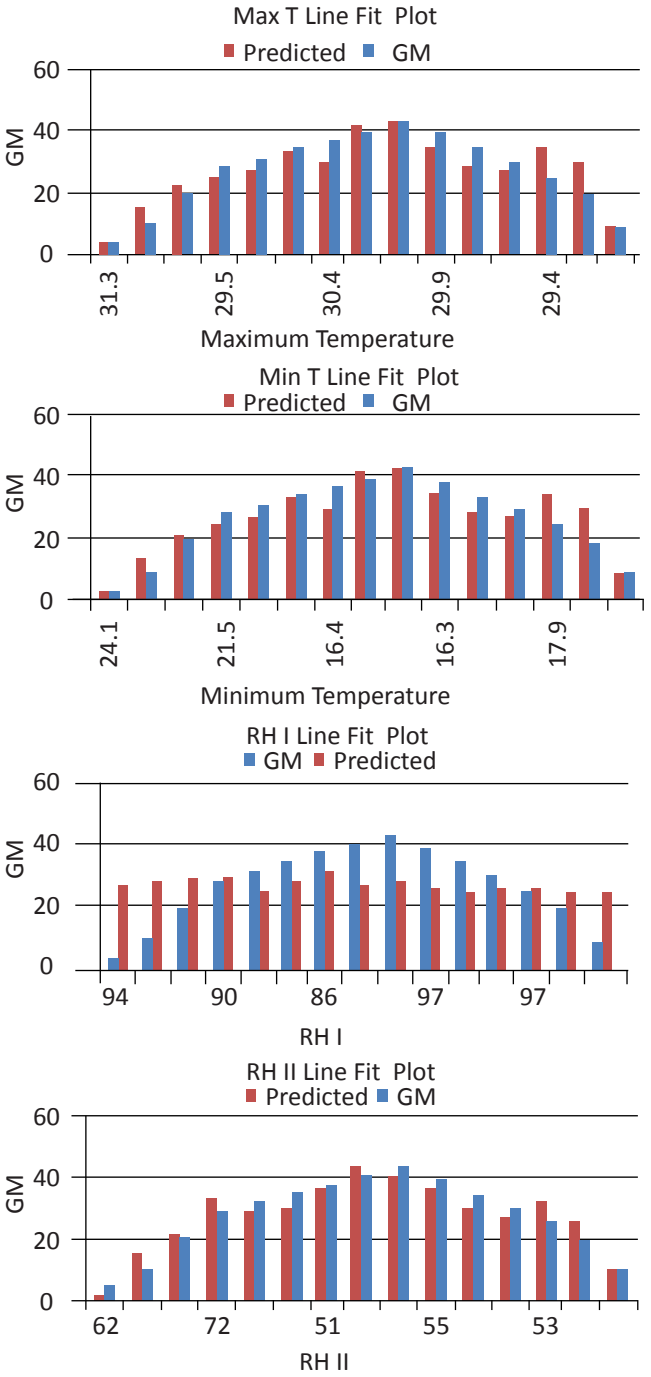

Figure 2: Best fit prediction equations for grey mildew in *Bt* hybrid Jadoo BG II at Guntur

Present studies are useful to plan the management strategies against this important disease and suggest preventive and / or protective measures with recommended fungicides like 0.3% wettable sulphur or 0.1% carbendazim (Bhattiprolu, 2012) against grey mildew under the above mentioned weather conditions.

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