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Effect of weather parameters on pest-disease of okra during summer season in middle Gujarat

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ABSTRACT

To assess the impact of weather on pest-disease of okra, a field experiment was conducted in summer season 2009 in split plot design with five dates of sowing (D_1-15th February, D_2-1st March, D_3-15th March, D_4-1st April and D_5-15th April) and two spraying levels (S_0-control, S_1-spraying) at Agronomy Farm of B.A. College of Agriculture, Anand Agricultural University, Anand. The results revealed that the infestation of pests and diseases was higher in delayed sowing as compared to early sowing resulting reduction in yield by 44.4%. Different weather parameters were found to have different effect on various pests and diseases. The correlation study revealed that the Tmax had significant influence on jassid population while relative humidity had significant influence on aphid population. The whitefly, percent fruit damage and YVMV disease were significantly influenced by most of the parameters. However, bright sunshine hours (BSS) and pan evaporation (EP) did not have significant influence on any of the pests and disease of okra. Linear simple regression models, multiple regression models and curvilinear regression models developed with various weather parameters. Among all models, the curvilinear regression model using GDD was found well fitted in order to explaining the maximum extent of variability (83** to 98**%) in the population and intensity of most of the pests and disease except whitefly which was well explained by linear regression developed with VPmean (R^2 0.88**).

Key words: Weather, okra, pest, disease

Okra (*Abelmoschus esculentus* L.) is one of the most popular vegetable grown in tropical and sub-tropical regions. It is widely grown for its tender fruits, which are good source of minerals, fibers and vitamins. The fresh fruits are important as human food on account of its taste, flavour and nutritional values. It is rich in vitamin A, B, C and also minerals viz, calcium, phosphorous and iron. It is also used in soups and stews (Saini, 1996). In Gujarat the crop is grown in an area of 35,190 hactares with the production of 2,73,699 tons and productivity of 7.78 t ha^{1}. Okra crop is attacked by several insect pests, of which eleven species of insects have been recorded in Gujarat (Patel *et al*., 1970). Amongst these, the major insect and non insect pests *viz*. shoot and fruit borer, jassid, whitefly, aphid and mite are infecting okra crop during different growth stages and seasons. The losses caused by insect pests in okra have been estimated by various workers. Ghosh *et al*., (1999) reported 30.8 percent losses in fruit yield caused by insect pests at Coochbehar, West Bengal. Okra crop is also attacked by a number of diseases such as fungal, viral as well as nemic diseases viz. damping off, leaf spot, leaf blight, powdery mildew, yellow vein mosaic disease (Diwaker *et al*., 1986). It has been established that upto 5 percent yield of okra is reduced annually in India due to diseases (Sinha *et al.,* 2001). The basic information about relative occurrence and population dynamics of insect-pests and diseases due to congenial weather is necessary before deciding the strategy for management of pests and diseases.

MATERIALS AND METHODS

Field experiment on okra crop (cv. prabhani kranti) was carried out during summer season 2009 at Agronomy Research Farm of B.A. College of Agriculture, AAU, Anand (Gujarat) designed in split plot design with five dates of sowing viz. 15th February (D_1), 1st March (D_2), 15th March (D_3), 1st April (D_4) and 15th April (D_5) as a main plot treatments and two levels of spraying (S_0 and S_1) as a sub plot treatments with four replications. The spray of insecticides and fungicides was done as per outbreak of pest-diseases. The experimental site was situated at 22 ^{0}35' N latitude and 72 ^{0}55' E longitude and altitude of 45.1m above mean sea level. The soil of the experimental site is of alluvial origin and classified as "Sandy loam" belongs to Entisols order with good drainage as well as fair moisture retentive capacity. All the agronomic practices were followed as per recommended package of practices. The daily weather parameters recorded in agro-meteorological observatory situated near the experimental site was used for the study. The yield of green fruit was recorded separately from spraying (S_1) and non spraying treatment (S_0). The data pertaining to pests were recorded from the top, middle and lower leaves of randomly selected five tagged plants from each replication at weekly interval starting at one week after emergence of plant. The fruit damage caused by shoot and fruit borer was worked out based on percentage at weekly interval. The observation of percent YVMV was

Table 1: Greenfruit yield of okra as influenced by dates of sowing (D) and spraying (S) treatemnts

Date of sowing	Greenfruit yield (kg ha^{-1})
Main plot	
D_1 (15th February)	9524
D_2 (1st March)	7177
D_3 (15th March)	4690
D_4 (1st April)	2750
D_5 (15th April	1925
S.Em.±	519
C.D at 5%	1599
C.V.%	14
Sub plot	
S_0	3723
S_1	6704
S.Em.±	727
C.D at 5%	2192
C.V.%	12

also recorded at weekly interval, the infected plants were counted out of total plants. The growing degree days (GDD) was also calculated from the date of commencement of each pest and disease. The weekly population of insect-pests and disease intensity was correlated with corresponding weekly weather parameters and GDD. On the bases of significant relationship, the regression analysis was performed to develop the forewarning models for predicting the pests and disease incidence. For correlation and regression study, SPSS version 10 software was used.

RESULTS AND DISSCUTION

Green fruit yield

The okra sown on 15th February (D_1) had produced significantly higher yield (9524 kg ha^{-1}) over the later sown crop viz. 1st March (D_2), 15th March (D_3), 1st April (D_4) and 15th April (D_5). The one day delay in sowing was found to cause reduction in yield by approximately 125 kg ha^{-1}. The higher yield of okra in early sown crops (D_1) was due to favourable weather conditions experienced by the crop for growth and yield as well as crop escaping the incidence of pests and diseases. Spraying treatment (S_1) caused 80% increase in yield over the controlled treatment (S_0). Further the results revealed that the pests and diseases of okra could cause reduction in yield to the extent of 44.4% (Table 1).

Jassid

The jassid first appeared in 3rd week after sowing (WAS) in all the sowing dates. Its population increased gradually and maximum population reached during 5 to 7 WAS under different dates of sowing. As the temperature increased the population of pest was found to increases. The correlation study revealed (Table 1) that the jassid population had significant positive correlation (r=0.577*) only with maximum temperature (Tmax). The positive correlations were obtained with Tmin, Tmean, BSS, EP and VP_1 though non significant (Table 2). Patel *et al*. (1997) also obtained significant positive relationship between jassid population and maximum temperature as well as bright sunshine hours. Since the biological activities are not always linear, hence amongst all models attempted (linear, multiple and curvilinear). The curvilinear model 2nd order polynomial model developed with GDD was found to explaine maximum variability (89.1%) in the jassid population. The polynomial model for jassid was found best for the forewarning of jassid population (Fig.1). The results was almost similar to the results obtained by Singh *et al.* (2009) observed that the 2nd order polynomial model for prediction of lucerne weevil fitted with GDD was highly significant.

Aphid

The aphid population was found to appeared late (7th WAS) in early sown crops. In later sown crop (D_4 and D_5) it appeared at 3rd WAS. The highest population of aphid was found to increase with delay in sowing. The rate of increment in aphid was lower in early sown crop and higher in later sown crop. The pest population was positively correlated with almost all the weather parameters except EP, which was negatively correlated. However, the significant positive correlations were obtained only with RH_1 (r=0.713*) and RHmean (r=0.678*). (Table 1). Narangalkar (2003) had also found positive correlation with afternoon relative humidity and mean relative humidity. Among all the linear and non linear models developed with different weather parameters, the exponential model developed with RH_1 was found the best with R^2=0.833**. This revealed that the population of aphid increased exponentially with increase in morning relative humidity. Thus, curvilinear regression model (exponential model) with RH_1 for aphid can be used to predicting the aphid population (Fig.2).

Whitefly

The activity of whitefly started late (6th WAS) in early sown crop (D_1) and early (3rd week in late sown crops (D_4 and D_5). The correlation study indicated that the whitefly population had highly significant positive correlation with Tmin, Tmean, RH_2, RHmean, WS, VP_1, VP_2, VPmean and GDD (Table 1). The highest significant positive correlation (r=0.938**) was associated with VPmean followed by with GDD (r=0.898**). Patel (1988) also reported that the whitefly population had significant and negative correlation with the minimum temperature, mean relative humidity and evening

Table 2: Correlation coefficient between different pest/disease and weather parameters

Weather parameters	Pest/disease				
	Jassid	Aphid	Whitefly	Percent fruit damage	Percent YVMV
Tmax	0.577 *	0.148	-0.257	0.163	-0.052
Tmin	0.035	0.284	0.865 **	0.924 **	0.882 **
Tmean	0.266	0.403	0.773 **	0.758 **	0.879 **
RH_1	-0.032	0.713 *	0.609 *	0.667 *	0.851 **
RH_2	-0.37	0.487	0.845 **	0.867 **	0.892 **
RHmean	-0.186	0.678 *	0.781 **	0.808 **	0.944 **
BSS	0.222	0.358	0.274	0.264	0.347
WS	-0.276	0.064	0.787 **	0.893 **	0.777 **
EP	0.465	-0.354	-0.174	0.099	-0.290
VP_1	0.002	0.625	0.799 **	0.895 **	0.945 **
VP_2	-0.262	0.572	0.882 **	0.913 **	0.920 **
VPmean	-0.336	0.338	0.938 **	0.925 **	0.875 **
GDD	-0.089	0.306	0.898 **	0.896 **	0.957 **

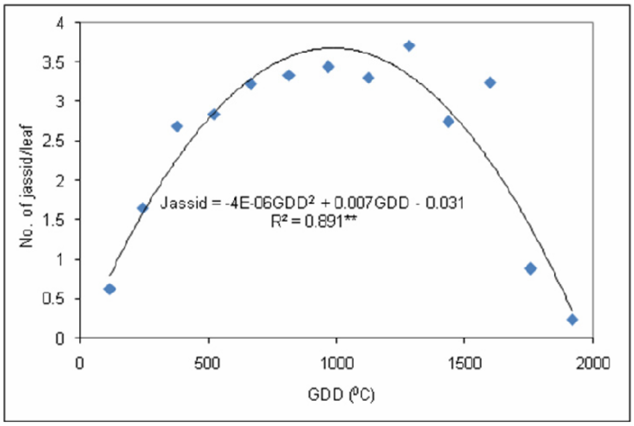

Fig 1: Curvilinear relationship between jassid and GDD

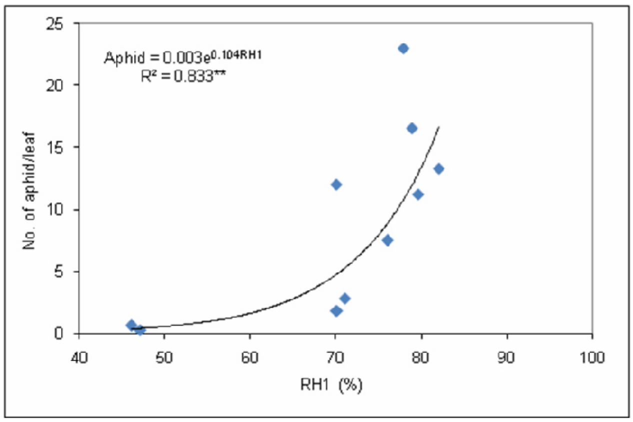

Fig 2: Curvilinear relationship between aphid and RH_1

relative humidity in *kharif* season. Unlike aphid and aphid, the whitefly was linearly significantly correlated with most of the weather parameters. Hence, the linear model developed with VPmean was found to the maximum explaine variability (88.1%) in whitefly population during crop growth period (Fig.3). Hence, this simple model can be used to forewarning the whitefly population.

Percent fruit damage caused by shoot and fruit borer

The fruit damage was observed during 3 to 4 WAS in all the sowing dates. The maximum percent fruit damage was between 14.8 to 31.4% in different dates of sowing. The correlation analysis revealed (Table 1) that all the weather parameters had positive correlations with percent fruit damage. The highly significant positive correlations were found with Tmin, Tmean, RH^2 RHmean, WS, VP_1, VP_2 and GDD. The highest positive significant correlation was obtained with VPmean (r=0.925**) followed by Tmin (r=0.924**). Kumar and Urs (1988) also reported that the infestation of fruit borer (*Earias vittella*) was more severe in warmer months sowing as compared to rainy or cooler months sowing at Bangalore. Although the linear developed could explaine high level variability in percent fruit damage, however the curvilinear regression model (4th order polynomial model) fitted with GDD (Fig.4) was found to best as it explained as much as 98.7% variability in the percent damage caused due to fruit borer. Thus the model can be used for forewarning the damage incidence in okra by shoot and fruit borer.

Yellow vein mosaic virus (YVMV) disease

The result revealed that the incidence of YVMV disease was late in early sown crop while in later sown crop

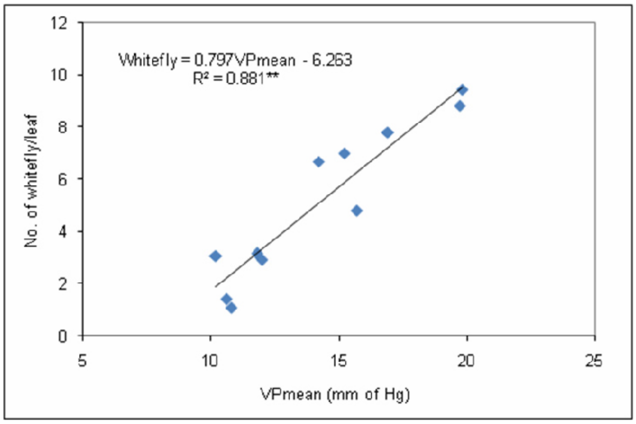

Fig 3: Linear relationship between whitefly and VPmean

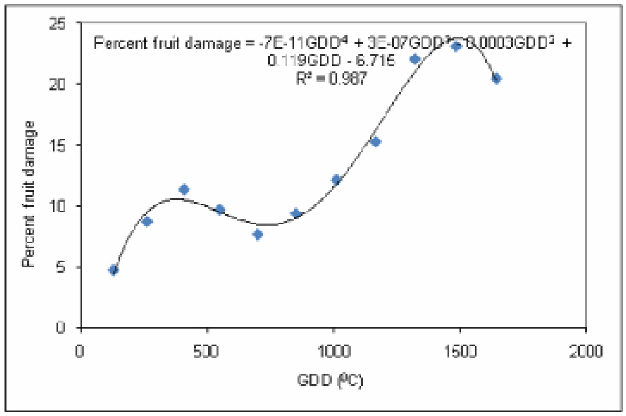

Fig 4: Curvilinear relationship between fruit damage and

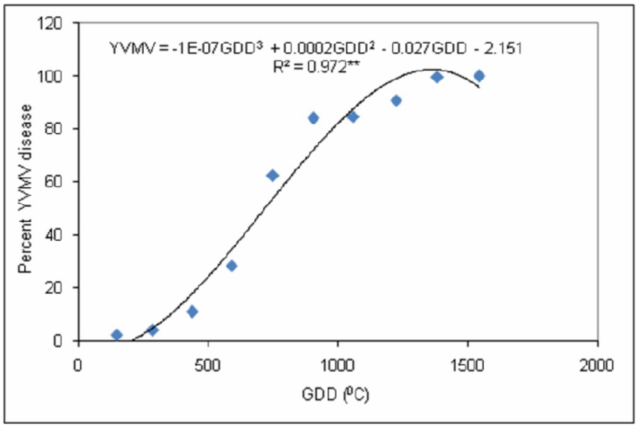

Fig 5: Curvilinear relationship between YVMV and GDD

the incidence of disease was early. The incidence increased very rapidly and all the plants got infection in all the sowing dates. The correlation study revealed (Table 1) that the disease was highly significantly and positively correlated with Tmin, Tmean, RH_1, RH_2, RHmean, WS, VP_1, VP_2 VPmean and GDD. The non significant correlations were obtained with Tmax, and EP. The highest positive significant correlation was found with GDD (r=0.957**) followed by VP_1 (r=0.945**). Ali *et al*. (2005) also reported that the minimum temperature and relative humidity had significant correlation with YVMV disease. The linear, multiple and curvilinear regression models developed with weather parameters explained equally good amount of variability in YVMV disease infestation however, the curvilinear regression model developed with GDD explained maximum (97.2%) variability in the disease intensity. This model can be used to predict the disease incidence with better accuracy (Fig 5).

CONCLUSION

Weather parameters were found to have significant influence not only on growth and yield of okra but also initiation and development of pests and disease of okra. The incidence of different pests and disease was found vary with different sowing sowing dates. The incidence of pests and diseases could caused reduction in fruit yield of okra by 44.4%, while with spraying field loss could be avoided up to 80 percent. Jassid population was mostly influenced by maximum temperature while aphid population was determined by relative humidity. Most of the weather parameters had significant positive correlations with whitefly, percent fruit damage and YVMV disease. The bright sunshine hours (BSS) and pan evaporation (EP) did not have significant influence on any of the pests and disease of okra under the study. Among the various models attempted (linear, multiple and curvilinear), the curvilinear regression models developed with different weather parameters were found better in explaining the variability in pests population and diseases intensity. GDD was found to explain higher variability in jassid, fruit borer and YVMV disease which can be used for forewarning of the pest & disease. Morning relative humidity can be used for forecasting the aphid population while mean vapour pressure can be used for whitefly forewarning.

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