Appraisal of association among abiotic factors and population of *Chilo infuscatellus* (Pyralidae: Lepidoptera)

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Abstract: *Chilo infuscatellus* is key pest of sugarcane crop in Pakistan. The study was carried out in southern areas to find the effect of relative humidity, temperature and rainfall on the population of *Chilo infuscatellus*. The impact of abiotic factors was find out by using simple correlation and regression equation. The results revealed that relative humidity and rainfall showed positive and highly significant relation with infestation and showed r-value 0.529 and 0.765 respectively. The minimum temperature showed positive and significant relation with infestation and showed r-value 0.406 while maximum temperature showed negative and non-significant correlation with infestation (-0.064). The coefficient of determination (R^2) = 70.4% was obtained by computing abiotic factors, temperature, relative humidity and rainfall mutually for multivariate regression models. In concluded, that findings of the present study could be helpful for the management of *Chilo infuscatellus*.
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Introduction:

Sugarcane is an important cash crop that plays a key role in the national economy of Pakistan. It shares in Agriculture and GDP of Pakistan 3.2 and 0.7% respectively. Sugarcane crop is mainly grown in three provinces of Pakistan, Sindh, Punjab and KPK and cultivated on an area of 1124 thousands hectares. It is 6.2% more than last year of 1058 thousands hectares. The sugarcane production was reported 62.5 million tons during 2012-13. In Pakistan, the yield of sugarcane crop is low than other countries in the world. There are many factors like seed quality, cultural practices, irrigation, fertilizers, diseases and the most important is the management of pest problems. The 12 species of insect pests of sugarcane are reported that damage the sugarcane plant (Ahmad *et al*., 2011; Chaudhry and Ansari, 1988). The insect pest caused serious damage in crop plants (Sabbir *et al.*, 2014). The species that damage the sugarcane crop are the sugarcane borers especially the sugarcane stem borer (Gul *et al.,* 2008). This pest is found almost, in all provinces of Pakistan (Hashmi, 1994; Cheng *et al.,* 1997). In sugarcane crop, 20% yield is reduced due to the attack of insect pests (Dhaliwal *et al.*, 2004). It was reported that 36.51% losses caused by sugarcane stem borer. The prescribed study was conducted to find the effects of environmental factors on population of *chilo infuscatellus* by computing correlation and multiple regression coefficients. Correlation analysis provides an opportunity to access the association among the characters and helps the researchers to determine their objectives (Ali *et al.,* 2013; Ali *et al.,* 2014abc).

Material and Method:

The experiment was conducted at Department of Entomology, University of Agriculture Faisalabad, Pakistan during 2009-10. Nine sugarcane varieties were sown in rows with 2.5 feet R × R and 1 foot P × P distance between the sets and plot 5 × 10 m^2 with five treatments in each block. The experiment was designed in a randomized complete block design and replicated three times. The data was collected on weekly basis from March to October. Observations were recorded on the percentage of each damage 15 shoots were selected randomly from each treatment in each replication. Damaged canes were separated, holes were counted and the whole damage percentage was calculated according to the following formula:

Infestation (%) = (No. of infested cane/ No of Total cane) × 100

The pre-treatment observations were recorded one day before each application of insecticide, while the post treatment observations were recorded 10, 20 and 30 days after each dressing of the insecticide. The data were analyzed by following analysis of variance (ANOVA) and means were compared by the Tukey HSD test (P≤5%) by using the software Statistix 8.1. The data of weather factors like temperature, humidity and rainfall were collected from the metrological observatory of university of Agriculture Faisalabad. The data obtained was subject to analyze to determine the effect of temperature, humidity and rainfall on the population dynamics of *chilo infuscatellus.* There

abiotic factors were responsible for the infestation like Temperature, Humidity and rainfall. The data on 15 days interval of both years were collected and correlated with infestation. The coefficient of determination was also determined through Multiple Regression Models.

Results:

It is evident from the results (Tables 1) that maximum and minimum temperature showed positive but non-significant with r-value 0.049 and 0440% while Relative humidity showed positive and significant correlation with infestation with r-value 0.637. The rainfall showed positive and highly significant correlation with infestation with r-value 0.770. The regression equation was fitted to be best. The contribution in fluctuating the pest infestation was 79.0 % when all the abiotic factors regressed together. During the next year (Table 2), maximum and minimum temperature and relative humidity showed positive but non-significant correlation with sugarcane stem borer infestation with r-value 0.410, 0.523 and 0.520% respectively and rainfall showed positive and highly significant effect on the infestation with r-0.781. The regression equation was again fitted to be best. The contribution of abiotic factors on the fluctuation of pest infestation during 2009 was calculated 97.9%. The results (Table 3) regarding correlation coefficient between weather factors and infestation of sugarcane stem borer during both years cumulatively revealed that maximum temperature showed negative and non-significant correlation with infestation -0.064% while minimum temperature showed positive and significant relation with infestation with r-value 0.406. The relative humidity and rainfall showed positive and highly significant correlation with infestation with r value 0.529 and 0.765%. The regression equation was again fitted to best. The cumulative effect of abiotic factors in fluctuating pest infestation was recorded 70.4%.

Table 1. Correlation among abiotic factors and infestation during year 2008

Character	Infestation (%)	Max. Temp. (°C)	Min. Temp. (°C)	Relative Humidity (%)
Temp. Maximum	0.049			
Temp. Minimum	0.44	0.498		
Relative Humidity (%)	0.637*	-0.394	0.065	
Rainfall (mm)	0.770**	-0.023	0.222	0.446

* = Significant (P<0.05), ** = Highly significant (P<0.01)

Regression Equation

$Y = - 24.0 + 0.176 X_1 + 0.567 X_2 + 0.295 X_3 + 0.227 X_4$

Where, Y = Infestation (%), X_1 = Maximum temperature (°C), X_2 = Minimum temperature (°C), X_3 = Relative humidity (%), X_4 = Rainfall (mm), Coefficient of determination (R^2) = 79.0%

Table 2. Correlation among abiotic factors and infestation during year 2009

Character	Infestation (%)	Max. Temp. (°C)	Min. Temp. (°C)	Relative Humidity (%)
Temp. Maximum	0.41			
Temp. Minimum	0.523	-0.046		
Relative Humidity (%)	0.52	-0.178	0.036	
Rainfall (mm)	0.781**	0.035	0.466	0.287

* = Significant (P<0.05), ** = Highly significant (P<0.01)

Regression Equation

$Y = - 13.5 + 2.89 X_1 + 0.489 X_2 + 0.209 X_3 + 0.258 X_4$

Where, Y = Infestation (%), X_1 = Maximum temperature (°C), X_2 = Minimum temperature (°C), X_3 = Relative humidity (%), X_4 = Rainfall (mm), Coefficient of determination (R^2) = 97.9%

Table 3. Correlation among abiotic factors and infestation during year 2008 and year 2009

Character	Infestation (%)	Max. Temp. (°C)	Min. Temp. (°C)	Relative Humidity (%)
Temp. Maximum	-0.064			
Temp. Minimum	0.406*	0.522**		
Relative Humidity (%)	0.529**	-0.345	0.063	
Rainfall (mm)	0.765**	-0.0.79	0.301	0.347

* = Significant (P<0.05), ** = Highly significant (P<0.01)

Regression Equation

Y= - 6.0 - 0.059 X1+ 0.448 X2 + 0.170 X3 + 0.280 X4

Where, Y = Infestation (%), X_1 = Maximum temperature (°C), X_2 = Minimum temperature (°C), X_3 = Relative humidity (%), X_4 = Rainfall (mm), Coefficient of determination (R^2) = 70.4%

Discussion

The impact of weather factors like Relative humidity, Temperature and Rainfall on the infestation and population was tested during 2008-09. Simple correlation and multiple regression models was worked out for determination the effect of weather factors on the population fluctuation of both of the years separately as well as collectively. The results revealed that rainfall showed positive and highly significant correlation with infestation during both years 2008-09, as well as on cumulative basis. Similarly relative humidity showed positive and significant correlation with infestation during both years 2008-09, as well as on cumulative basis. There was positive and non-significant correlation between maximum and minimum temperature during both years 2008-09 but negative and non-significant on cumulative basis. The present findings are conformity those of Rustamani *et al.,* (1997) who reported non-significant and positive effect of temperature on stem borer population. In multiple regression analysis temperature and relative humidity showed positive and non-significant impact on the stem borer population. These findings are conformity with those of Mahmood (1989). The present findings are contradicted with those of Anonymous (1995-96) which showed non-significant and negative impact of relative humidity and rainfall with borer infestation. The present findings are also comparable with those of Shah *et al.,* (1981) who reported that rainfall and relative humidity showed positive and temperature showed negative impact on the borer infestation. The present findings are non comparable with those of Nagaraja and Chanty (1957) who reported positive impact of the temperature with borer infestation.

Conclusion

It is concluded from the above discussion that maximum temperature did not affect *chilo infuscatellus* population while the minimum temperature showed positive response. The affect of rainfall and humidity showed positive and highly significant.

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