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Influence of meteorological parameters and pheromone trap catches on field infestation of early Shoot Borer, *Chilo infuscatellus* (Sneller) in sugarcane

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Abstract
An experiment to know the influence of meteorological factors and relation of moth capture in pheromone traps on field infestation of early shoot borer, *Chilo infescatellus (Sneller)* in sugarcane was conducted at Zonal Agricultural Research Station, Powarkheda, Hoshangabad during 2009 to 2012. Early shoot borer activity was started and ceased during 6th to 10th and 25th to 27th standard meteorological week, respectively. Whereas the highest (25.20%) and lowest (17.20%) cumulative infestation were observed in 2012 and 2010, respectively. The elevated maximum temperature and low humidity (morning and evening) were possibly contributed for lowest field infestation of early shoot borer. The data of field infestation (%), moth captures at pheromone traps and meteorological factors (SMW wise) were also subjected to multiple regression analysis. Out of the six regression combinations, the meteorological parameters of 2 weeks prior (r2=0.8999) had the maximum impact on early shoot borer field population, followed by the parameters of one week prior (r2=0.8820) and the same week (r2= 0.8698). The maximum (41OC) and minimum (19OC) temperature, relative humidity of morning (67%) and evening (21%) with no rain coincide with pheromone trap catch (0.49 moths day-1 trap-1) were found to be involved in peak activity of early shoot borer after two weeks.

Keywords: *Chilo infuscatellus* (Sneller), infestation, meteorological factors, pheromone trap, sugarcane

Introduction
Sugarcane is an important cash crop of India, which occupies a large area especially around the sugar factories and plays a vital role in rural economy and caters employment. The insect pests are important, among the various factors responsible for low productivity of sugarcane. The early shoot borer, *Chilo infuscatellus (*Sneller) and leaf hopper, *Pyrilla perpusilla* Walker are the key insect pests of Sugarcane in peninsular India. The winter sugarcane sown or ratooned after 1st fortnight of February received higher infestation of early shoot borer, while late sown or ratooned sugarcane normally receives severe infestation which causes gaps and drastically reduces the economical returns. The early shoot borer is active from 2nd fortnight of March to November and passes the winter as full grown larvae in stubble. The borer tunnels in the sugarcane stalks feeding on plant tissue and disturbing the flow of nutrients. The damaged plants produced dead hearts during growing season till formation of canes. The yield loss could reach up to 42 per cent when the incidence is at 60 day-old crop [3]. In different stages, it damages about 58 per cent shoots, causing a reduction of 33 per cent of cane yield, 0.25 to 3 unit of sugar recovery and 27 per cent of jaggery [1, 6]. Keeping in view the economic importance of the pest and crop, present study was carried out to find the most fitted multiple regression equation so that prediction and effective management can be done.

Material and Methods
The present study was conducted at All India Coordinated Research Project on Sugarcane at Zonal Agricultural Research Station, Powarkheda, Hoshangabad, Madhya Pradesh during 2009 to 2012. The variety, Co 86032 was planted in one acre and all the recommended cultural practices were followed during entire period of crop growing. Neither insecticide nor parasitoid treatment was done at any stage of crop against the pest. Infestation of early shoot borer was recorded at third day of each Standard meteorological week (SMW). The dead hearts were counted at randomly selected five places on 100 tillers at each place.

After recording counts, the dead hearts were removed to avoid recounting of the same in future. Three pheromone traps were installed in the second fortnight of February till harvest of crop in one acre of sugarcane crop (separate lure block). The moth captures were recorded daily in the morning hours. SMW wise meteorological data on average temperature (minimum & maximum), average relative humidity (morning & evening), total rain fall and rainy days was recorded from locally stationed meteorological observatory for the period of study.

The recorded data were subjected to assess the field infestation (per cent) and moth captures (day-1trap-1). Six multiple regression of various combinations i.e., field infestation (%), moth captures (day-1trap-1) of current week and the independent factors (meteorological parameters) of same week, 1, 2, 3, 4, 5 weeks prior were computed to have the best fitted

multiple regression equation. The data analysis and calculation of regression equations were done by using analysis it version of Microsoft excel.

Results and Discussion

The results obtained are presented in the table 1. It revealed that early shoot borer infestation was observed at their active periods 10th to 25th, 9th to 27th, 10th to 28th and 6th to 25th standard meteorological weeks consecutively from 2009 to 2012. Average field infestation (1.04, 0.91,

1.07 and 1.26% per week) and moth captures (0.18, 0.18, 0.22 and 0.31day-1 trap-1) were

recorded, respectively in 2009, 2010, 2011 and 2012. Highest cumulative (25.20%) and average infestation (1.26%) was recorded in 2012. During 2010, minimum cumulative %) and average field infestation (0.91%) was recorded. During this year, average maximum and minimum temperature (40OC and 21.32OC), average relative humidity in morning and evening (66.84% and 19.26%) was observed. This high temperature and low humid situation seems to be create unfavorable situation and responsible for lowest average weekly infestation of early shoot borer during 2010. Similar findings were also recorded that the adult emergence from over wintering larvae in February [8].

The multiple regression study revealed that all the multiple regression equations obtained from various combinations showed significant impact of independent factors on early shoot borer field infestation. Out of six (table 2) multiple regression equation, the parameters 2 weeks prior (r2=0.8999) was found to be best fitted followed by the parameters 1 week prior (r2=0.8820) and same week (r2= 0.8698).

Early shoot borer field infestation and the parameters 2 weeks prior:

R2 = 0.8097

y = -1.85 +3.359*X1 +0.066*X2 -0.02*X3 +0.00004*X4 -0.0004*X5 -0.014*X6 +0.171*X7

Where

Y- Early shoot borer field infestation (%), X1 - Moth capture per day per trap, X2- Mean Max Temp OC., X3-Mean Min Temp OC, X4-Mean RH % (morning), X5- Mean RH% (evening), X6-Total Rain fall (mm), X7- Total Rainy Days

The coefficients (table 2) obtained in various equations also revealed that the moth captures at pheromone traps had significant and positive impact on field infestation. The coefficients obtained for this factor were statistically significant at 1 per cent in all the combinations, except 5th week prior combination in which the coefficient is significant only at 5 per cent. Among the meteorological parameters, the maximum temperature had positive and significant impact on field infestation of early shoot borer. The coefficients obtained for this factor for 2, 3, 4 and 5 week prior were significant at 1 per cent, while the coefficients for same and one week prior was also significant but at 5 per cent. The minimum temperature had negative impact on the field infestation. The coefficients obtained for this factor were significant at 1 per cent of 4, 5 and same week; at 5 per cent of 1 week prior and had non- significant relation of 2 and 3 week prior. The relative humidity of morning and evening, total rain fall and number of rainy days had non-significant impact on early shoot borer field infestation.

This results are in agreement with the finding of [2, 10, 4] that infestation levels were positively and significantly correlated with maximum, minimum and mean temperature, while rainfall had no effect on the infestation level. It also reported that the maximum temperature and minimum temperature had significant and positive; while relative humidity exerted a week negative correlation on light trap catches of *C. infuscatellus* [7]. The multiple regression equation of parameters 2 weeks prior (r2=0.8999) was the best fitted and recorded 70.4% cumulative effect of a-biotic factors in fluctuating *C. infuscatellus* infestation and also said that the regression equation was fitted best [9]. Significant and positive correlation of maximum temperature, while highly significant and negative correlation of minimum relative humidity with *C. infuscatellus* incidence [5].

Table 1: Standard Meteorological Week wise early shoot borer field infestation, pheromone trap catches and meteorological parameters during 2009 to 2012 at Z.A.R.S., Powarkheda

Year (Standard Meteorological Weeks	Particulars	ESB infestation (%)	Moth (Day-1 trap-1)	Max Temp (OC)	Min Temp (OC)	Morning RH (%)	Evening RH (%)	Rain fall (mm)	Rainy Days
2009 (10 to 25)	Max	2.40	0.57	45.00	27.00	98.00	41.00	97.80	5.00
	Min	0.00	0.00	35.00	13.00	74.00	17.00	0.00	0.00
	Av	1.04	0.18	40.88	20.59	84.65	25.35	9.04	0.71
	Total	17.60	3.01	-	-	-	-	153.70	12.00
2010 (9 to 27)	Max	2.20	0.48	46.00	29.00	100.00	45.00	138.60	6.00
	Min	0.00	0.00	31.90	11.80	28.00	7.00	0.00	0.00
	Av	0.91	0.18	40.43	21.32	66.84	19.26	9.67	0.53
	Total	17.20	3.45	-	-	-	-	183.80	10.00
2011 (10 to 28)	Max	2.40	0.52	45.00	27.00	100.00	64.00	95.90	7.00
	Min	0.20	0.00	31.00	11.00	44.00	13.00	0.00	0.00
	Av	1.07	0.22	39.74	21.26	78.79	31.84	14.66	1.05
	Total	20.40	4.25	-	-	-	-	278.50	20.00

2012 (6 to 25)	Max	3.40	0.79	45.00	29.50	90.00	45.00	45.60	2.00
	Min	0.00	0.00	27.00	6.00	48.00	12.00	0.00	0.00
	Av	1.26	0.31	38.06	18.11	74.50	27.05	4.48	0.35
	Total	25.20	6.19	-	-	-	-	89.60	7.00

Table 2: Regression Statistics: Early shoot borer field infestation (%) v/s moth captures at pheromone trap and meteorological parameters for the year 2009 to 2012 at Z.A.R.S., Powarkheda

Regression	R2	F calculated	Regression Equation
Same week	0.7566	29.7520	y = -0.796 +3.21*X1 +0.068*X2 -0.052*X3 -0.008*X4 +0.006*X5 +0.003*X6 -0.052*X7
With 1 week before	0.7780	33.5391	y = -1.422 +3.455*X1 +0.063*X2 -0.044*X3 +0.001*X4 +0*X5 -0.002*X6 +0.077*X7
With 2 weeks before	0.8097	40.7364	y = -1.85 +3.359*X1 +0.066*X2 -0.02*X3 +0.00004*X4 -0.0004*X5 -0.014*X6 +0.171*X7
With 3 weeks before	0.7253	25.2733	y = -1.971 +3.036*X1 +0.093*X2 -0.05*X3 -0.001*X4 -0.007*X5+0.002*X6 -0.038*X7
With 4 weeks before	0.6387	16.9195	y = -3.257 +2.152*X1 +0.178*X2-0.129*X3 -0.01*X4 +0.008*X5 -0.035*X6 +0.142*X7
With 5 weeks before	0.4462	7.7104	y = -3.231 +1.212*X1 +0.188*X2 -0.159*X3 -0.006*X4 +0.009*X5 -0.005*X6 +0.024*X7

Note: Y- Early shoot borer field infestation (%), X1 - Moth capture per day per trap, X2-Mean Max Temp OC., X3-Mean Min Temp OC, X4-Mean RH % (morning), X5-Mean RH% (evening), X6-Total Rain fall (mm), X7- Total Rainy Day

Conclusion

The study concluded that the meteorological parameter of two week prier i.e. maximum (41OC) and minimum (19OC) temperature, relative humidity of morning (67%) and evening (21%) with no rain coincide with pheromone trap catch (0.49 moths day-1 trap-1) were found to be involved in peak activity of early shoot borer. Also the parameters of 2 weeks prior (r2=0.8999) was found to be best fitted for the prediction of field infestation of early shoot borer in sugarcane. Whereas the high temperature and low humid conditions were unfavorable and responsible for lowest average weekly infestation of early shoot borer.

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