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SK Mohanty
Krishi Vigyan Kendra, Puri, Orissa University of Agriculture and Technology, Bhubaneswar, Orissa, India

A Mohanty
Krishi Vigyan Kendra, Puri, Orissa University of Agriculture and Technology, Bhubaneswar, Orissa, India

S Srichandan
Krishi Vigyan Kendra, Bolangir, Orissa University of Agriculture and Technology, Bhubaneswar, Orissa, India

Correspondence
SK Mohanty
Krishi Vigyan Kendra, Puri, Orissa University of Agriculture and Technology, Bhubaneswar, Orissa, India

Monitoring of okra shoot and fruit borer (*Earias vittella*) fabricius through pheromone traps and the impact of abiotic factors on trap catch

SK Mohanty, A Mohanty and S Srichandan

Abstract
Seasonal incidence of Okra Shoot and Fruit borer, *Earias vittella* Fabricius was studied from the pheromone trap catches during Summer 2013 and 2014 in Balasore district of Odisha. The adult moth was first appeared during 10th and 11th Standard Meteorological Week (SMW) in two years of study respectively. The correlation study between abiotic factors and pheromone catch of the adult male population revealed a significant positive correlation with temperature (maximum, minimum, average) and a negative correlation with relative humidity (morning, afternoon and average) and rainfall. The extent of fluctuation in trapped adult male population due to multiple interactions of abiotic factors was 85.4% during 2013 and 89.9% during 2014. Among the independent environmental variables temperatures played the dominant role followed by relative humidity in adult population variation.

Keywords: Fruit and shoot borer, pheromone trap, adult moth, abiotic factors

Introduction

Okra. *Abelmoschus esculentus* (L.) Moench is an important vegetable crop cultivated throughout the tropical and warm temperate regions of the world. About nine lepidopterous insect species found to feed on different parts of okra plant at different stages (Kumar *et al.*, 2007) [5]. Among them the fruit borer complex created havoc by causing both quantitative and qualitative loss to the crop. The extent of yield losses due to the infestation of okra shoot and fruit *viz, Earias vittella* (Fab.) and *Earias insulana* Boisd borer were found to 50.58% (Brar *et al.*, 1994) [3]. Farmers rely on excessive use of chemical pesticides to increased production cost and aggravated the ill effect pesticides. In this context exploitation of sex pheromone based management technique for studying their seasonal incidence and determination of the peak period of activity has been reported to be useful by several works
(Patil *et al*, 1992) [8]. Pheromone trap was as an effective method for monitoring and *E. vittella* and *H.armigera* in okra (Askari *et al*, 2008). The various environmental variable are also known to influence the seasonal activity of *E. vittella*. Trap catches in relation to field infestation and weather factors are crucially important for the development of effective IPM module in a particular locality. The present investigation was carried out to know the seasonal fluctuation in the population build up of okra shoot and fruit borer and the impact of weather parameters on the trap catch.

Materials and Methods

The present experiment was carried out to study the population dynamics of okra shoot and fruit borer through pheromone trap in the instructional form of Krishi Vigyan Kendra Baliapal, Balasore (21^{0}.64’N latitude and 87$^{0.}$29’E longitude) during the summer seasons of the year 2013 and 2014. The okra F_1-hybrid (Shakiti) of Nun hums Pvt. Ltd Company was grown on the observation plots with the standard agronomic package and practices without any crop protection. The pheromone traps were installed in the 300M^2 okra plots without any plant protection measures. Pheromone traps were set at a spacing of 10M ensuring the lure position above the crop canopy. The traps were examined only in a week and the trap catches of male adults were expressed as the number of males trap per week. The earias lures chemically constituting six component mixture of hexadecanol, (Z)-II hexadecenal, (E,E)-10,12-hexadecadienal, octadecanal, (Z)-II-Octadecanal and (E,E)-10,12 hexadecadien-I-ol in 1:2:10:2:4:1 ratio (Cork *et al.*, 1986) [4] manufactured by pest control of India Limited were replaced at three weeks interval and traps were maintained throughout the cropping period. The weather parameters like temperature(maximum, minimum, average), relative humidity (morning, afternoon and average) and rainfall collected from the meteorological observatory, Regional Research and Technology Transfer Station (RRTTS), Ranital Bhadrak for two years of study were subjected to correlation and regression analysis for establishing the relationship between the adult male population abundance and climatic parameters

Results and Discussion

The seasonal fluctuation of male moth catch of *E. vittella* in the pheromone trap revealed that the first appearance of moth was noticed during 10th standard week (SW) (2nd week of March) i.e. 14 days after showing (DAS) and thereafter the pest population gradually increased and attained its peak during 20th standard week (last week of May) i.e. 78 DAS with average of 8.60 male adults/ trap/week in summer, 2013. (Fig-1)

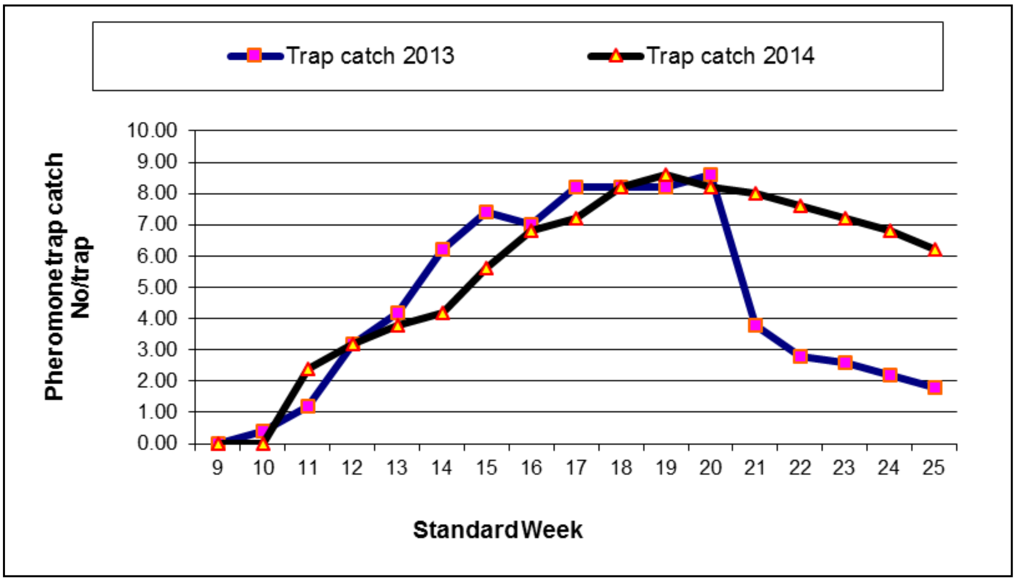

Fig 1: Seasonal trend of pheromone trap catch (summer 2013-14)

Thereafter, the adult trap catch showed a declining trend with low level of population during the final harvesting stage. While in 2014, the pest first appeared during 11th SW (last week of March) i.e. 16 DAS and attained its peak during 19th SW (3rd week of May) i.e. 72 DAS with average of 8.60 adult / trap / week. Then onwards it decreased towards the end of the crop season. From the results of both the years it was revealed that during the summer season maximum pest population was recorded during 1st fortnight of April to the 2nd fortnight of May. The results are in conformity with the findings of Bajad *et al*. (2014) [2] who revealed that the activity of the shoot and fruit borer commenced on five week old crop and continued till the removal of the crop. Meena *et al*. (2015) [6] reported that the infestation of okra shoot and fruit borer commenced from four weeks after sowing. It implies that egg laying may be started during 2nd and 3rd week of sowing.

The multiple correlation analysis revealed a strong positive correlation between the adult moth catch and temperature (maximum, minimum, and average) were observed (r = 0.516 to 0.903). While relative humidity (morning, afternoon and average) was negatively correlated with the adult population of *E. vittella* in both the years of trial. It was statistically significant during the afternoon of 2013 and average RH only (r = - 0.728 and – 0.662, respectively).The rainfall had a negative effect with non- significant correlation values. The present findings are supported by the results of Mohapatra (2006) [7] who reported that pheromone trap catch of *E vittella* positively correlated with temperature, negatively influenced by morning and evening RH and rainfall in cotton at Umerkote (Odisha). Thus the findings of the present investigation clearly indicated that high temperature and low humidity played an important role in building up of moth population.

Table 1: Correlation between the abiotic factors and pheromone trap catch of *E.vittella* of summer 2013 and 2014 grown okra

Correlation value* (r) with different abiotic factors							
Year	**Temperature (°C)**			**Rainfall (mm)**	**Relative humidity (%)**		
	Maximum	**Minimum**	**Average**		**Morning**	**Afternoon**	**Average**
2013	0.52*	0.66*	0.88*	- 0.48	- 0.24	- 0.73*	- 0.66*
2014	0.88*	0.77*	0.90*	- 0.24	- 0.29	- 0.12	- 0.23

In the present investigation attempt was made to study the combined effect of different abiotic factors on the population dynamics and damage level of *E.vittella* and for which coefficient determination (R^2) was calculated through multiple regression analysis. Besides, percentage contribution of different ecological variables to the pheromone trap catch also computed from the standardized partial regression values (β) to study their individual effect and to evaluate the vital climatic parameter that determines the population abundance of *E.vittella.* It was revealed from the table - 2 that during summer, 2013 the coefficient determination value (R^2) for pheromone trap catch was 0.854 which indicated that 85.4% variation in adult trap catch was caused due to abiotic factors. However, among the weather parameters maximum contribution to the variation of pheromone trap catch was observed for average temperature (64.39%) followed by minimum temperature (14.39%) while very negligible contribution was shared by other weather parameters. The corresponding R^2 value for summer 2014 (table-3) was estimated to be 0.899 indicating the combined effect of all abiotic factors on the adult population abundance to be 89.9%. Among all the independent environmental parameters, maximum temperature was found to be the most important factor significantly contributing 44.62% in the fluctuation of pheromone trap catch followed by minimum temperature (41.54%).

Table 2: Regression coefficients between the abiotic factors and pheromone trap catch of during summer 2013.

Abiotic factors	Partial regression coefficient (b)	Standard error [SEb (±)]	Standard partial regression coefficient (β)	Student "t' value	% contribution (#)
Max.temp(^{0}C) (X_1)	0.09	0.272	0.72	0.324	6.89
Min. Temp(^{0}C) (X_2)	0.19	-	0.16	-	14.39
Avg.Temp(^{0}C) (X_3)	0.85	0.287	0.38	3.342	64.39
RH%(Morning) (X_4)	0.08	0.042	0.57	0.734	6.06
RH%(After noon) (X_5)	-0.07	0.051	0.08	0.771	5.30
RH%(Average) (X_6)	-		-		-
Rainfal (mm) (X_7)	-0.04	0.013	0.06	1.967	3.03

The prediction equation of adult catch $Y=-30.86+0.09x_1+0.19x_2+0.85x_3+0.08x_4-0.07x_5-0.04x_7$
#Contribution of individual abiotic parameters to the variation in pheromone trap catch
Note: per cent contribution of individual abiotic factor = $(\beta_i)^2/[\sum(\beta_i)^2........(\beta_j)^2]\times100$

Table 3: Regression coefficients between the abiotic factors and pheromone trap catch of during summer 2014.

Abiotic factors	Partial regression coefficient (b)	Standard error [SEb (±)]	Standard partial regression coefficient (β)	Student "t' value	% contribution (#)
Max.temp(^{0}C) (X_1)	0.58	0.148	0.67	2.631	44.62
Min. Temp(^{0}C) (X_2)	0.54	0.168	0.49	2.101	41.54
Avg.Temp(^{0}C) (X_3)	-	-	-	-	-
RH%(Morning) (X_4)	-0.02	0.101	-0.07	0.893	1.54
RH%(After noon) (X_5)	0.11	0.031	0.25	-0.235	8.46
RH%(Average) (X_6)	-	-	-	-	-
Rainfal (mm) (X_7)	0.05	0.007	0.19	1.235	3.85

The prediction equation of adult catch $Y=-33.31+0.58x_1+0.54x_2-0.02x_4+0.11x_5+0.05x_7$
#Contribution of individual abiotic parameters to the variation in pheromone trap catch
Note: per cent contribution of individual abiotic factor = $(\beta_i)^2/[\sum(\beta_i)^2........(\beta_j)^2]\times100$

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