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Monitoring of brinjal shoot and fruit borer (*Leucinodes orbonalis* Guenee) through pheromone traps and the impact of abiotic factors on trap catch

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ABSTRACT

Activity of brinjal shoot and fruit borer (BSFB), Leucinodes orbonalis Guenee was studied from the pheromone trap catches during summer 2010 and 2011 in Keonjhar district of Odisha. The pest was first appeared during 3rd standard meteorological week (SMW) in both the years of investigation and then registered an upward trend with two distinct peaks during the month of March-April and May. The correlation studies between abiotic factors and pheromone trapped male population of BSFB revealed a significant positive correlation with temperature (maximum, minimum and average) and negative correlation with relative humidity (both morning and afternoon). Rainfall did not influence the trap catch significantly. The extent of variation in trapped adult population male population due to the multiple interactions of abiotic factors was 82.4 % during 2010 and 56.3 % during 2011; among the abiotic factors, temperatures and relative humidity had key role in adult population fluctuation.

Key words: Abiotic factors, brinjal, *Leucinodes orbonalis*, pheromone trap

Among the different insect pests infesting brinjal (*Solanum melongena* L.), shoot and fruit borer (BSFB) *Leucinodes orbonalis* Guenee is the most serious pest causing extensive damage both in vegetative and reproductive stages of the crop (Banerjee *et al.,* 2009; Panja *et al.* 2013). The crop losses due to this pyralid borer had been reported to the tune of 20-80 % in various parts of India (Raju *et al*., 2007). In Odisha, it has been reported to cause 30-50 % yield loss (Mishra and Mishra, 1997). However, in the years of heavy infestation the yield loss may reach as high as 85-90 % (Patnaik, 2000 and Misra, 2008). Farmers are mostly applying many insecticides and their cocktail of mixtures in an indiscriminate manner with an average of 15-18 rounds of spray during crop growth period to minimize the BSFB infestation. However, it has resulted many adverse effects on the brinjal eco-system, surrounding environment, human health and also on the economics of brinjal production. Under these circumstances, exploitation of female sex pheromone based pest management technique has special importance for studying their seasonal incidence and determination of the peak population build up. Pheromone traps are now effectively used for the early detection of the BSFB and to monitor its seasonal activity in order to schedule the appropriate time of plant protection measures (Tiwari *et al*., 2009). The various weather parameters are also known to influence the seasonal activity of *L. orbonalis*. Thus, a comprehensive knowledge on the relationship between various weather parameters and seasonal incidence of BSFB in a particular locality is highly important for development of effective management strategies. The present study was undertaken to know the seasonal variation in the population build up of brinjal shoot and fruit borer and the influence of weather parameters on the trap catch.

MATERIALS AND METHODS

Field experiment to study the population dynamics of BSFB through pheromone trap was carried out in the instructional farm of Krishi Vigyan Kendra, Keonjhar (21° 30' N Latitude and 85° 30' E Longitude) during summer seasons of the year 2010 and 2011. The brinjal variety Blue Star (an open pollinated variety of SREEMA Seeds, Odisha) was grown in the observation plots with the standard agronomic package of practices without any crop protection measures. The pheromone traps were installed in the unprotected brinjal plots measuring 50 m^2. Five pheromone traps (funnel type) per plot were installed at 5 m spacing ensuring the lure position just above the crop canopy. The traps were inspected once in a week and the trap catches of male adults were expressed as number of males per trap per week. The lucin lures chemically constituting (E)-11-hexadecenyl acetate (Zhu *et al*., 1987) manufactured by Pest Control India Limited were replaced at every three weeks interval and traps were maintained throughout the cropping season. The meteorological parameters like maximum temperature, minimum temperature, relative humidity (morning and afternoon) and rainfall collected from the meteorological observatory, Regional Research and Technology Transfer Station (RRTTS), Keonjhar

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for both the years of study were subjected to correlation and regression analysis for determining the relationship between the adult male population abundance and weather parameters.

RESULTS AND DISCUSSION

The seasonal variation of male moth catch of BSFB in the pheromone trap revealed that male moth was first trapped during 3rd SMW i.e. between 9 - 11 days after transplanting of summer brinjal crop in both the years (Fig. 1). The trap catches showed an increasing trend as the crop grows; the pest attained the first peak at 14th SMW (1st week of April) with a population of 9.6 male moths trap^{-1} week^{-1} during 2010 while in 2011, the first peak was observed at 13th SMW (end of March) with 9.2 male moths trap^{-1} week^{-1}. Thereafter the trap catch showed a gradual reduction and again attained the second peak at 19th SMW (2nd week May) with 9.2 and 9.0 male moths trap^{-1} week^{-1} in both the years of study, respectively. The rate of reduction of trapping of male moths of BSFB was apparently more in 2011 than in 2010. It is clearly observed from two seasons' data that during summer BSFB was found prevalent from 9th to 21st SMW. The pheromone trap catches of male moths of shoot and fruit borer in summer brinjal crop showed two distinct peaks; once at 15th SMW with 9.5 male moths trap^{-1} week^{-1} and another at 19th SMW with 10.7 male moths trap^{-1} week^{-1} in Bhubaneswar (Samal, 2008). The findings of present authors lie in close conformity with the above findings.

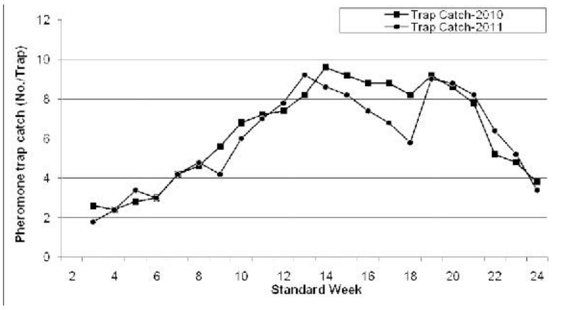

Fig 1: Seasonal variation in pheromone trap catch of BSFB during summer season

The multiple correlation analysis indicated a strong positive correlation between the male moth trap catch of BSFB and temperature (maximum, minimum and average) during both the years of experiment (r = 0.65 to 0.89). Relative humidity (both morning and afternoon) was negatively correlated with the variation on male moth population level in both the years of experiment, however, it was statistically significant during 2010 (r = -0.82 and -0.66 for morning and afternoon, respectively) only. Rainfall did not influence the male moth catch significantly during both the years of study. The present findings are at par with the results of Tiwari *et al*. (2009) who observed that the correlation of moth catches in the pheromone trap was found to be positive and significant with maximum and average temperature during 2005-06 and with maximum, minimum and average temperature in the subsequent year of study and rest of the weather parameters like relative humidity and rainfall did not show any significant correlation with the adult moth catch. Shukla and Khatri (2010) also observed that both maximum and minimum temperature had positive correlation and relative humidity had negative correlation with the adult moth population of *L. orbonalis*. Thus, the findings of the present investigation clearly indicated that both temperature and relative humidity played an important role in building up of moth population.

Table 1: Correlation between the abiotic factors and pheromone trap catch of *L. orbonalis* of *summer* grown brinjal

Year	Correlation value* (r) with different abiotic factors					
	Temperature (ºC)			Rainfall (mm)	Relative humidity (%)	
	Maximum	Minimum	Average		Morning	After noon
2010	0.89 *	0.75 *	0.84 *	-0.04	-0.82 *	-0.66 *
2011	0.71 *	0.65 *	0.69 *	0.22	- 0.24	-0.23

*Note: * significant at 5 % level*

In the present experiment an attempt has been made to study the combined effect of different abiotic factors on the population dynamics and damage level of *L. orbonalis* and for this purpose coefficient determination (R^2) was computed through multiple regression analysis. Besides, percentage contribution of different weather parameters to the pheromone trap catch was also calculated from the standardized partial regression coefficient values (β) to study their individual effect and to assess the crucial weather parameter that determines the population abundance of BSFB. It was revealed from table- 2 that during 2010, the combined contribution of weather parameters on the pheromone trap catch was estimated to be 82.4 % (R^2 = 0.824), whereas maximum temperature was found to be the most important factor significantly contributing 86.52 % in the fluctuation of pheromone trap catch followed by minimum temperature (13.12%). However, during the subsequent year the contribution of all the environmental parameters in together on the adult trap catch was found be to the tune of 56.3% (R^2 = 0.563) (table-3). In contrast to first season, relative humidity (after noon) had the highest effect with 36.46 % contribution followed by maximum temperature (29.25 %), average temperature (17.48 %) and rainfall (16.68 %). Hence, from the above findings it can be concluded that temperatures and relative humidity were the important factors and played maximum and significant role in adult population fluctuation of *L. orbonalis.*

Table 2: Regression coefficients between the abiotic factors and pheromone trap catch of *L. orbonalis* during *summer'10*

Abiotic factors	Partial regression coefficient (b)	Standard error [SEb (±)]	Standard partial regression coefficient (β)	Student "t" value	% contribution (#)
Max. Temp. (ºC) (X_1)	0.677	0.252	1.330	2.687	86.52
Min. Temp. (ºC) (X_2)	-0.261	0.180	-0.518	-1.447	13.12
Avg. Temp. (ºC) (X_3)	-	-	-	-	-
Rainfall (mm) (X_4)	-0.61	0.110	0.080	0.552	0.31
RH% (Morning) (X_5)	-0.072	0.164	-0.018	-0.044	0.02
RH% (After noon) (X_6)	-0.089	0.090	-0.025	-0.100	0.03

The prediction equation of adult catch: $Y= -11.135+0.677\ X_1- 0.261\ X_2+0.06\ X_4-0.007\ X_5-0.009\ X_6; R^2= 0.824$
Contribution of individual abiotic parameters to the variation in pheromone trap catch.
Note: *Per cent contribution of individual abiotic factor* = $(\beta_i)^2/[\Sigma(\beta_i)^2 \ldots\ldots\ldots(\beta_j)^2] \times 100$

Table 3: Regression coefficients between the abiotic factors and pheromone trap catch of *L. orbonalis* during *summer* '11

Abiotic factors	Partial regression coefficient (b)	Standard error [SEb (±)]	Standard partial regression coefficient (β)	Student "t" value	% contribution (#)
Max. Temp. (ºC) (X_1)	0.214	1.173	0.335	0.183	29.25
Min. Temp. (ºC) (X_2)	-	-	-	-	-
Avg. Temp. (ºC) (X_3)	0.153	1.102	0.259	0.139	17.48
Rainfall (mm) (X_4)	0.199	0.231	0.253	0.858	16.68
RH% (Morning) (X_5)	-0.09	0.238	-0.22	-0.038	0.13
RH% (After noon) (X_6)	-0.171	0.224	-0.374	-0.767	36.46

The prediction equation of adult catch: $Y= 5.397+0.214\ X_1+ 0.153\ X_3+0.199\ X_4-0.009\ X_5-0.171\ X_6; R^2= 0.563$
Contribution of individual abiotic parameters to the variation in pheromone trap catch.
Note: *Per cent contribution of individual abiotic factor* = $(\beta_i)^2/[\Sigma(\beta_i)^2 \ldots\ldots\ldots(\beta_j)^2] \times 100$

Hence, from the present study it can be concluded that during *summer* season the pest had two distinct peak population levels, one during end of March to first week of April and other at second week of May. However, higher field population level of *L. orbonalis* was observed from second week of March to end of May. Among the weather parameters temperature and relative humidity played an important role on the variation in moth population. While, temperature exerted a positive influence, relative humidity had negative role on the variation of pheromone trap catch.

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