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Monitoring the Population Dynamics of Brinjal Shoot and Fruit Borer (*Leucinodes orbonalis* Guen.) Through Pheromone Traps in Relation to Different Ecological Parameters

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ABSTRACT

Adult populations of brinjal shoot and fruit borer (BSFB), *Leucinodes orbonalis* Guenee were monitored through pheromone traps for two consecutive winter seasons of 2009-10 and 2010-11 in Keonjhar district of Odisha. It was observed that the pest made its first appearance during 41st Standard Week 2nd week of October and was active up to 11th Standard Week 2nd week of March in both the years of study. The first peak population level was noticed during 50th Standard Week and 48th SW, respectively in 2009-10 and 2010-11. However, the second peak was observed during 7th Standard Week in both the years of experiment. The correlation studies on abiotic factors and pheromone trap catch revealed that maximum temperature exhibited a significant positive correlation, whereas, relative humidity (both morning and afternoon) and rainfall were negatively correlated with the adult population level of BSFB. However, the extent of variation in adult trap catch due to the multiple interactions of abiotic factors was estimated to be 48.0 % during 2009-10 and 64.8 % during 2010-11 and among the abiotic factors, temperature and relative humidity played maximum role in adult population fluctuation.

Key words : Abiotic factors, Brinjal, *Leucinodes orbonalis*, Pheromone trap.

Brinjal shoot and fruit borer (*Leucinodes orbonalis* Guen.) is the most destructive pest of brinjal causing extensive damage to the growing shoots, flower buds and fruits and the losses due to this borer have been reported to the tune of 20-80 % in various parts of India (Raju *et al*., 2007). However, during the years of heavy infestation the yield loss may reach as high as 85-90 % (Patnaik, 2000 and Misra, 2008) inflicting substantial economic loss to the brinjal growers. Farmers are mostly applying toxic 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 infestation of *L. orbonalis*. However, it has resulted in many adverse effects like insecticide resistance, pest resurgence, residues, soil and water pollution and wide spread killing of natural enemies, pollinators and other beneficial organisms. In order to reduce the pesticide load in brinjal eco-system and to reduce the incidence of Brinjal Shoot and Fruit Borer (BSFB), adoption of some innovative pest management techniques is the need of the hour. Sex pheromone based pest management technique is gaining importance in the recent years for studying the seasonal incidence of BSFB and determination of the peak stages of population build up in order to schedule the appropriate time of plant protection measures (Tiwari *et al.,* 2009). The incidence and activity of *L. orbonalis* is also greatly influenced by different ecological parameters. 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. During the present investigation, an attempt has been made to study the seasonal variation in the population build up of *L. orbonalis* and to work out the relationship between the pattern of trap catch and prevailing ecological parameters so that the findings can be utilized in formulating timely pest management programme.

MATERIAL AND METHODS

The experiment was conducted in the instructional farm of Krishi Vigyan Kendra, Keonjhar during winter seasons of the year 2009-10 and 2010-11 to study the population dynamics of BSFB through pheromone trap. The brinjal variety Blue Star was grown with the recommended agronomic package of practices without any crop protection measures. The pheromone traps baited with corresponding lures (lucin lures) were installed in the unprotected brinjal plots (10 m X 5 m) and in each plot five numbers of pheromone traps (funnel trap) 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 trapped male moths were removed after recording the number of males per trap per week. The lures were replaced at every three weeks interval and traps were maintained throughout the cropping season. The data on meteorological parameters like maximum temperature, minimum temperature, relative humidity (morning and evening) and rainfall were collected from the meteorological observatory, Regional Research and Technology Transfer Station (RRTTS), Keonjhar for both the years of study. The relationship between the ecological parameters and the population dynamics of BSFB as evidenced from the trap catch was worked out by using simple correlation and regression analysis.

RESULTS AND DISCUSSION

The seasonal variation in the male moth catch of BSFB in the pheromone trap during the study period are presented in Figure 1 which revealed that the pest first made its appearance during 41st SW (2nd week of October) i.e. 12 days after transplanting and was active up to 11th SW (2nd week of March) in both the years of study i.e. 2009-10 and 2010-11. In 2009-10 the first peak was noticed during 50th SW (2nd week of December) *i.e.* 70 DAT with average 5.4 male adults/trap/week while the second peak was observed at 7th SW (2nd week of February) with 6.0 male adults/trap/week. However, in 2010-11 the initial peak was visualized during 48th SW (last week of November) *i.e.* 59 DAT with 5.0 male adults/trap/week and the subsequent peak was observed at 7th SW (2nd week of February) with 6.2 male adults/trap/week. The present findings are in harmony with Varma *et al*. (2009) who observed that maximum population of *L. orbonalis* during rabi season prevailed during 2nd to 4th week of December.

Various weather parameters that prevailed one week ahead of the pest appearance when correlated with the pheromone trap catch, revealed that during winter seasons of both the years of experiment, maximum temperature showed a significant positive relationship with the pheromone trap catch (r = 0.430 and 0.511, respectively). While minimum temperature resumed negative relationship with adult trap catch, the average temperature retained positive relationship but the influence of both the abiotic factors was not much pronounced. Relative humidity (both morning and afternoon) had significant negative correlation with the pheromone trap catch during both the years of investigation (r = -0.458 to -0.692) and so was the case with rain fall, where during 2010-11, significant negative relationship was witnessed. The present findings are supported by 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 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.

In the present experiment an attempt was 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 (®) 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 among all the weather parameters, maximum temperature was found to exert maximum influence with 57.69 % contribution on the fluctuation of adult trap catch followed by 35.12 % by the average temperature and other parameters could not have any noticeable

Table 1. Correlation between the abiotic factors and pheromone trap catch of *Leucinodes orbonalis* during *summer* season.

Year	Correlation Value (r) with different abiotic factors					
	Max. Temp. (° C)	Min. Temp. (° C)	Avg. Temp. (° C)	Rainfall (mm)	RH % (Morning)	RH % (After noon)
2009-10	0.430 *	-0.086	0.173	-0.357	-0.494 *	-0.458 *
2010-11	0.511*	-0.296	0.071	-0.429 *	-0.616 *	-0.692*

* Correlation is significant at the 0.05 level

Table 2. Regression coefficients between the abiotic factors and pheromone trap catch of *Leucinodes orbonalis* during *summer* 2010.

Abiotic factors	Partial regression coefficient (b)	Standard Error [SEb (±)]	Standard partial regression coefficient (β)	Student "t" value	% contribution (#)
Max. Temp .(° C) (X_1)	0.762	0.281	1.947	2.708	57.69
Min. Temp. (° C) (X_2)	-	-	-	-	-
Avg. Temp. (° C) (X_3)	-0.615	0.250	-1.519	-2.458	35.12
Rainfall (mm) (X_4)	-0.097	0.129	-0.305	-0.754	1.42
RH % (Morning) (X_5)	-0.028	0.108	-0.142	-0.255	0.31
RH % (After noon)(X_6)	0.115	0.130	0.599	0.887	5.46

The prediction equation of adult catch: $Y= -9.673+0.762 X_1-0.615 X_3-0.097 X_4-0.028 X_5+0.115 X_6$
Coefficient of determination (R^2) = 0.480
Contribution of individual abiotic parameters to the variation in pheromone trap catch.

Table 3. Regression coefficients between the abiotic factors and pheromone trap catch of *Leucinodes orbonalis* during *kharif* 2010.

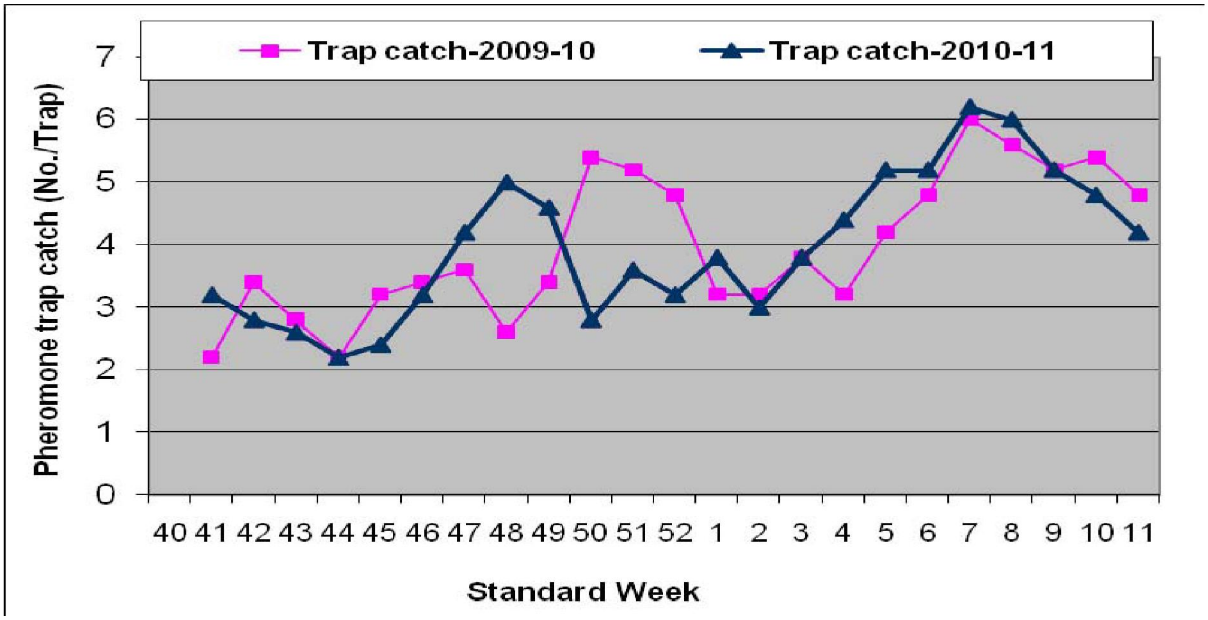
Abiotic factors	Partial regression coefficient (b)	Standard Error [SEb (±)]	Standard partial regression coefficient (β)	Student "t" value	% contribution (#)
Max. Temp .(° C) (X_1)	0.533	0.254	1.247	2.104	48.93
Min. Temp. (° C) (X_2)	-	-	-	-	-
Avg. Temp. (° C) (X_3)	-0.386	0.253	-0.869	-1.526	23.76
Rainfall (mm) (X_4)	-0.014	0.100	-0.027	-0.137	0.02
RH % (Morning) (X_5)	0.109	0.073	0.650	1.503	13.29
RH % (After noon)(X_6)	-0.115	0.079	-0.667	-1.450	14.00

The prediction equation of adult catch: $Y= -3.313+0.533 X_1-0.386 X_3-0.014 X_4 + 0.109 X_5- 0.115 X_6$

Coefficient of determination(R^2) = 0.648

Contribution of individual abiotic parameters to the variation in pheromone trap catch.

Fig-1. Seasonal trend in pheromone trap catch of BSFB during summer season.



effect. However, contribution of all the abiotic factors in the variation of pheromone trap catch was found to be the extent of 48.0 % ($R^2 = 0.480$). The corresponding R^2 value for rabi 2010-11 was estimated to be 0.648 indicating the combined effect of all abiotic factors on adult population abundance was 64.8 %. Among all the independent environmental parameters maximum temperature continues to play the dominant role in influencing the pattern of pheromone trap catch (48.93 %). The second most important factor was observed to be average temperature that exerted 23.76 % influence on the population fluctuation and relative humidity (morning) and relative humidity (afternoon) contributed up to 13.29 and 14.0 %, respectively

Conclusion

Hence, from the present study it can be concluded that during winter season BSFB had two distinct peak population levels, one during November-December and other at second week of February. Among the weather parameters maximum temperature had positive influence and relative humidity and rainfall exhibited negative effect on the variation of pheromone trap catch. However, temperature and relative humidity had maximum percentage contribution to the pheromone trap catch.

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