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Evaluation of the use of pheromone traps in insect pest management on brinjal crop: An eco-friendly approach

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Abstract
Brinjal, (*Solanum melongena* L.) is an important vegetable and grown in almost 5 to 6 lac hectares in India. Insect pest predominates globally both quantitatively and qualitatively with respect to potential damage to agricultural crops. Chemical control method for increased crop yield was primarily used earlier. Indiscriminate application of broad-spectrum pesticides has led to many serious environmental and health problems like destruction of useful fauna and flora, secondary pest out-break etc. Due to excessive use of these compounds a wide spread contamination of biota including food commodities and human tissues were observed. Pesticides contribute to a greater percentage, among all other factors causing environmental pollution as these have entered the food chain. Looking at the damage caused, our objective was to evaluate alternative methods like, mass trapping of insect pest with use of pheromone traps at farmer's field on an unprotected brinjal crop for the control of brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee. Pheromone trap was found effective in reducing shoot damage and fruit infestation with 53.03 percent protection and 51.34 percent protection over control respectively. Thus, use of pheromone traps in Integrated Pest Management (IPM) strategy, can prove to be effective measure and is an eco-friendly approach towards sustainable development.

Keywords: Brinjal shoot and fruit borer, pheromone trap, pesticides, integrated pest management

Introduction

The brinjal fruit and shoot borer, *Leucinodes orbonalis* Guenee (Lepidoptera: Pyraustidae) is the major pest of brinjal, *Solanum melongena*, vegetable in the world (Purohit and Khatri, 1973; Kuppuswamy and Balasubramanian, 1980; Allam *et al*., 1982) [9, 7, 3]. As we know, pest control of moths is a very difficult task because this pest's larvae start feeding from inside the fruit or stem, remain inside the fruit or shoot throughout its larval stage, and come out only after the last instar stage. In this stage, larvae block their bore holes with their fecal matter, which protects them from natural enemies as well as topically applied insecticides. Eggplant is a cheap vegetable and available throughout the year, but production is affected seriously in the Indian sub-continent because of the high cost and low effectiveness of pesticides. In our country, 13-14 percent of total pesticides is used only in vegetable crop. Fruits are harvested at short intervals and consumed fresh in many areas, so the surveys of market samples show high level of pesticide residues on the fruits (Arora and Gopal 2002, Agnihotri 1999; Awasthi and Ahuja 1997) [2, 1, 4]. Due to the problem of insecticide residue on fruits and less-effectiveness of insecticide, alternative control strategies are required. Understanding of biology and ecology of the insect is needed for a pest control strategy to be effective. So, in this process adult population monitoring system can be an effective tool for pest management program.

In order to reduce the pesticide load in the environment, certain behavioral chemical can be utilize, such as use of sex pheromone against moths and butterflies and other smaller pest. We cannot use the light trap against *L. orbonalis*, because adult this moth is not attracted towards light traps. Zhu *et al*. (1987) [11] from China, identified (E)-11-hexadecenyl acetate (E11-16: Ac) as the major component in this insect's female sex pheromone and suggested that this compound could be important to attract male moths, although in favor of this fact, no data were presented. This discovery shifted in the management strategies towards the pheromone pest control, because it was promising to provide a solution in combating insect pests of crops as well also playing an important role in bio-safety concern.

Material and Method

Research site

To study the effectiveness of pheromone trap in the management of *L. orbonalis*, Field trials were undertaken at farmer's field located at village Samod, district Jaipur, Rajasthan. The coordinates of the field are 26°55′N 75°49′E /26.92°N 75.82°E. The village has an average elevation of 431 metres (1417 ft) from the sea level. Jaipur climate is hot semi-arid climate and it received over 650 millimetres (26 in) of rainfall annually. Most of the rain occur in the monsoon between June to September months during the year.

Fig 1: Location of experiment site

The components included a) installation of pheromone traps @ 10 per hectare in the brinjal field. It started from initiation of flower on the eggplant and continue till final harvest of the vegetables. Pheromone lure should be changing after every 15 days intervals. b) the farmers were allowed to grow local brinjal variety with adopting all the local agronomic practices except plant protection.

Position of pheromone trap: Lure was baited in a funnel trap and trap position was near the highest point of the plant using supporting post approximately one meter high. Irrigation was done after establishment of seedlings at weekly intervals. Weed control was done by hand weeding once in every 30 days after planting.

Fig 2: Different pheromone traps placed in the brinjal field

Area of experiment plot-	1/2 hectare divided into five small quadrates
Control plot-	At a distance of 12.5 km apart from the treated plot
Plant variety-	Krishna gold
Life span of plant-	140-150 days
Plant grown	August month
Fruiting-	October month
Trap type	Funnel type
Lure brand name	Brinjal hit

Fig 3: Male *L. orbonalis* insect on brinjal plant

The data of adult male moths was recorded once in every week for three months. The data on infested shoot were recorded by direct count of healthy plants and infested plant and infested fruits percentage was calculated by using the formula given below.

$$\text{Percentage of damaged fruit} = \frac{\text{number of bored fruits counted}}{\text{total number of fruits harvested}} \text{ X } 100$$

For each plot

Percent protection over control was worked out by slight modification of Abbott's formula (Abbott, 1925), which is as follows.

$$\text{Percent protection over control} = \frac{\text{\% of bored fruits in control plot} - \text{\% of bored fruits in treated plot}}{\text{\% of bored fruits in control plot}} \text{ X } 100$$

Result and discussion

The results of the investigation with pheromone trap against shoot and fruit borer, *Leucinodes orbonalis*, are presented in table 1 and 2. Analysis of the data on pest infestation revealed that the borer was active in all months of the year. Lowest borer infestation was observed during the Jan.-Feb. months in rabi season and then gradually increased in the number. Correlation between moth capture data in pheromone traps with important weather parameters for the rabi crop of brinjal (Table 1) revealed that wind velocity had negative correlation while the relative humidity and temperature exhibit positive correlation. To determine the overall impact of selected weather parameter on moth captured, the data were subject to multiple regression analysis and following regression equation was worked out:

$Y= 40.514- 0.285X_1- 0.030X_2- 0.984X_3+ 1.176X_4- 0.239X_5- 1.282X_6$

(0.843) (0.181) (0.923) (0.670) (0.439) (0.758)

Figures in parentheses are S.E. of partial regression coefficient of respective variables; R^2 =0.313, where X1 and X2 refer to fruit and shoot infestation, X3 and X4 to maximum and minimum temperature, and X5 and X6 indicate relative humidity and wind velocity, respectively.

The weather variables together accounted for 31.30 percent (R2= 0.313) of the total variation in trap catches. Regression equation to predict percent shoot infestation based on trap catches was worked out as:

$Y= 8.916+ 0.336X_1- 0.074X_2$

Where, X_1, X_2 and Y were percent shoot and fruit infestation and trap catch, respectively.

The study revealed a significant positive correlation between relative humidity and shoot infestation (r=0.603) and also with fruit infestation (r=0.4736). In shoot and fruit infestation, percent protection over control was 53.03% and 51.34%, respectively and both are found significant. The study revealed a significant positive correlation between pheromone trap catches of *L. orbonalis* and damage to plant parts in the brinjal field. Earlier studies have pointed out similar relationship between moth catches in trap and percent of field infestation. For example, Deva Prasad *et al*. (1994) reported that pheromone catches of *Helicoverpa armigera* (Hubner) had positive relationship with damage to reproductive parts of the plant and larval population. Ferracini *et al*. (2020) [6] had also shown that pheromone-based sampling can be highly efficient for detecting and monitoring tortrix moth populations in chestnut groves, although it is also suggested by the author that additional research is required to provide a proper assessment of population impact on the plant health. In another study significant positive correlation was observed between pheromone trap catches of *P. gossypiella* and cotton boll damage percent (Buchelos *et al*. 1999) [5]. In similar case, pheromone trap catches of *S. litura* moth revealed a positive relationship in number of egg cluster and counting of larvae in the field (Sreenivasulu *et al*. 2003) [10].

Conclusion

On the basis of present data, it is concluded that the pheromone trap is able to increase the fruit yield significantly over untreated check and can be used in reducing the infestation of *L. orbonalis* in the field conditions. It is also useful for detection and monitoring of moth population in field.

Table 1: Pheromone trap catches, extent of shoot and fruit infestation by *Leucinodes orbonalis* in brinjal during the study period (*rabi* season).

Time of observation	Moths catch/trap/week	Shoot infestation (%)	Fruit infestation (%)	Temperature (°c)		R.H. (%)	Wind Velocity km/h
				Max.	Min.		
1st week	15.6	10.2	29.8	30	18	41	6
2nd week	13.8	8.4	17.2	27	19	46	6
3nd week	10.2	8.2	7.6	26	19	55	6
4th week	10.2	4	7.6	22	15	55	4
5th week	13	4	7.8	23	11	54	3
6th week	11	7.2	8.6	22	11	52	5
7th week	10.8	6	12.6	23	9	49	3
8th week	10.8	5.8	19	23	8	46	4
9th week	10.4	5	9.2	20	12	51	11
10th week	13.8	3	8.6	17	5	52	5
11th week	11.2	7.2	10	22	8	51	5
12th week	11	7	14	22	8	44	5
13th week	11.8	7.2	23.6	22	10	43	8
14th week	12.4	9.4	23.6	25	12	45	5
15th week	8.6	9.8	26.8	26	13	43	6
16th week	14	8.2	21	23	14	45	8
17th week	12	8.2	24.8	24	14	47	9
18th week	12.4	8	28	25	15	44	10
19th week	14	10	29.4	28	16	44	6
20th week	15.8	10.4	31.6	34	19	38	6

Table 2: Performance of pheromone trap in the management of *Leucinodes orbonalis* and their effect on fruit yield.

Modules	Shoot damage			Fruit damage			Fruit yield		
	% Shoot damage	% Protection over control	t' value	% Fruit damage	% Protection over control	t' value	Yield (T/ha)	% Gain over control	t' value
a) Installation of trap	7.36	53.03	10.24*	18.29	51.34	3.18*	1.73	59.3	6.02*
b) Control	15.67	–		37.59	–		1.086	–	

*- Significant at 5%

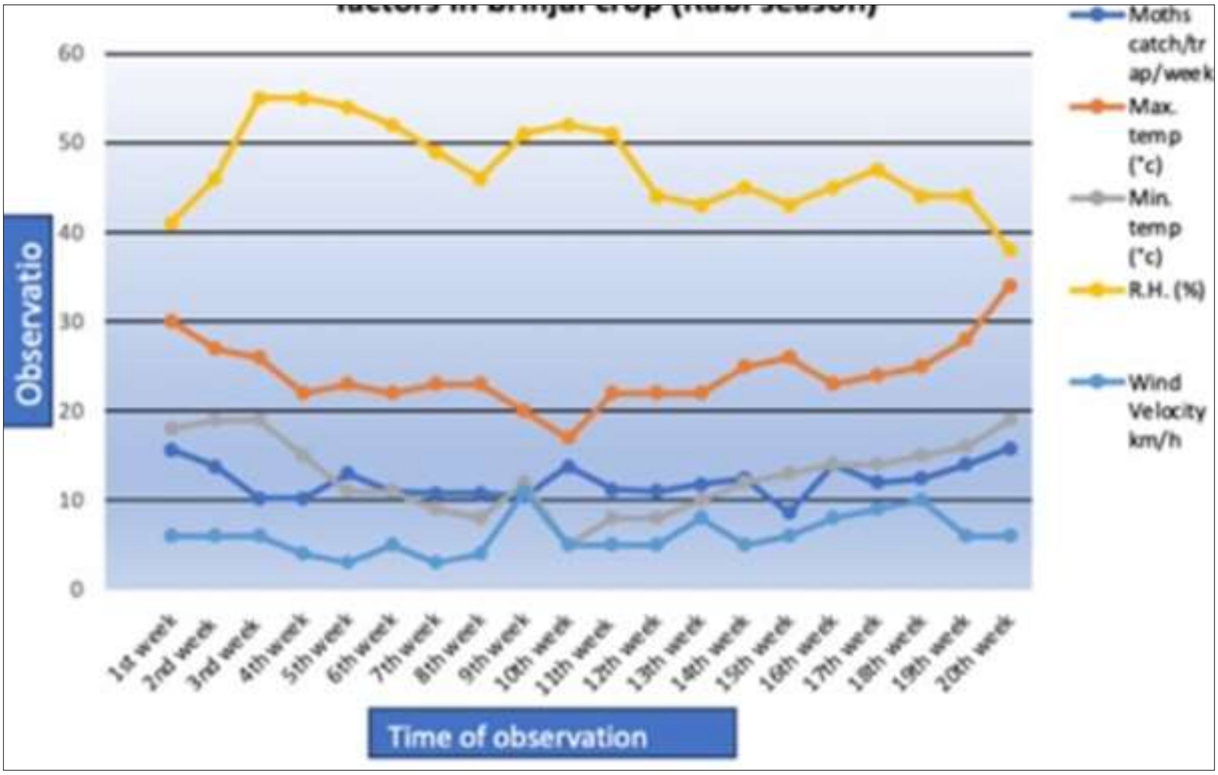

Fig 4: Moth Trap Data in relation to important weather factors in brinjal crop (Ravi season)

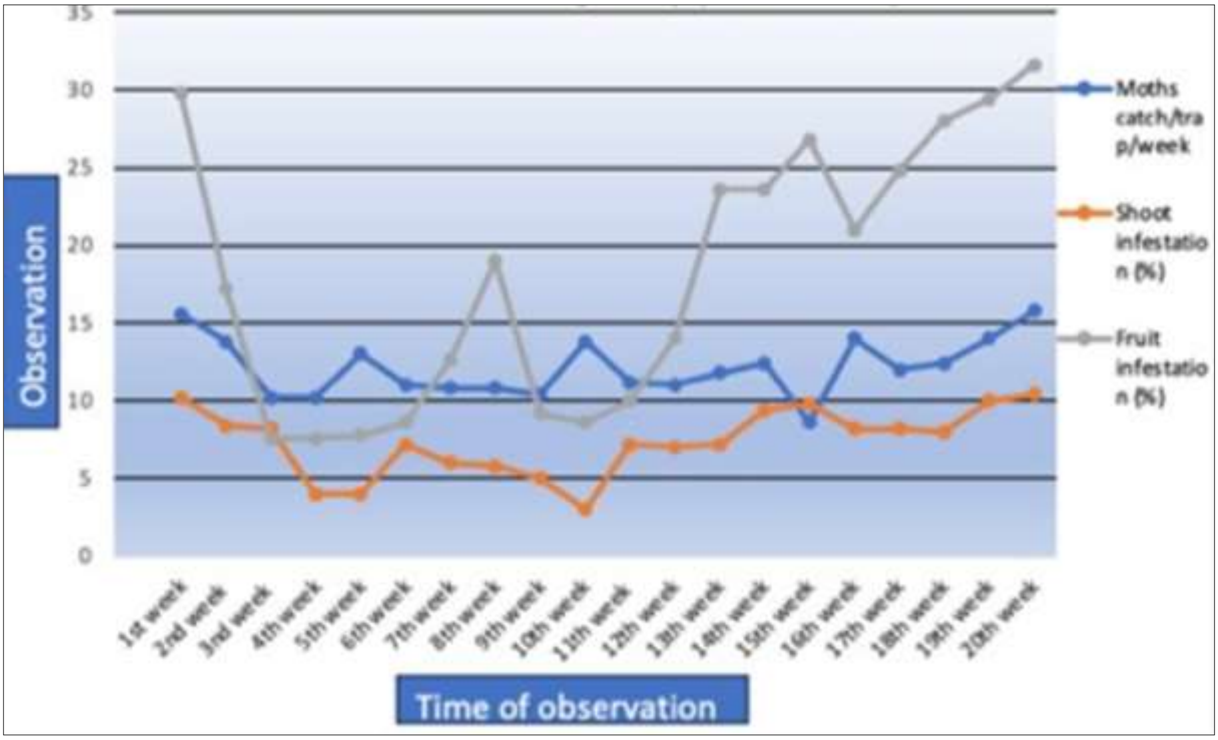

Fig 5: Moth trap data in relation to shoot and fruit infestation in brinjal crop (Rabi season)

References

1. Agnihotri NP. Supervised trials of pesticides on crops. AICRP on Pesticide Residues, Division of Agricultural Chemicals, I.A.R.I., In N.P. Agnohotri (Ed.) Pesticide, Safety Evaluation and Monitoring, New Delhi, 1999, 71.
2. Arora S, Gopal M. Status of pesticide residues in brinjal (*Solanum melongena* L.): Indian Scenario. Annals of Agricultural Research,2002:23(3):352–354.
3. Allam MA, Kameswara RP, Krishnamurthy Rao BH. Chemical control of brinjal shoot and fruit borer, *Leucinodes orbonalis* Guen. with newer insecticides. Entomon,1982:7:133-135.
4. Awasthi MD, Ahuja AK. Occurrence of pesticide residues in market and farmgate samples of vegetables in and around Bangalore city. Journal of Food Science and Technology, Mysore,1997:34:146.
5. Buchelos CT, Athanassiou CG, Papapostolou CC, Georgiou A. Correlation between the number adult male *Pectinophora gossypiella* (Saund.) (Lepidoptera: Gelechiidae) catches on pheromone traps and the rate of infestation in fruiting bodies of cotton plants by young larvae in three regions of central Greece. Journal of Applied Entomology,1999:123:433-436.
6. Ferracini C, Pogolotti C, Lentini G, Saitta V, Busato E, Rama F *et al*. Performance of Pheromone-Baited Traps to Monitor the Seasonal Abundance of Tortrix Moths in Chestnut Groves. Insects,2020:11(11):807.
7. Kuppuswamy S, Balasubramanian M. Efficacy of synthetic pyrethroids against brinjal fruit borer, *Leucinodes orbonalis* Guen. S. Indian Hort.,1980:28(3)91-93.
8. Prasad VD, Rambabu L, Reddy GPV. An action threshold for *Helicoverpa armigera* Hb. Based on pheromone trap catches in cotton. Indian Journal of Plant Protection,1993:22(1):17-18.
9. Purohit ML, Khatri AK. Note on the chemical control of *L. orbonalis* (Guen) (Lepidoptera: Pyraustidae) on brinjal. Indian J. Agric. Sci.,1973:43:214-215.
10. Sreenivasulu B, Naidu VG, Prasad PR. Monitoring of *Spodoptera litura* Fab., through sex pheromones in groundnut. Journal of Applied Zoological Researches,2003:14(2):148-50.
11. Zhu P, Kong F, Yu S, Yu Y, Jin S, Hu X *et al*. Identification of the sex pheromone of eggplant borer, *Leucinodes orbonalis* Guen`ee (Lepidoptera: Pyralidae). Z. Naturforschung,1987:42:1347-1348.