Comparison of pheromone traps against brinjal shoot and fruit borer, *Leucinodes orbonalis* (Lepidoptera: Crambidae)

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ABSTRACT

The brinjal shoot and fruit borer, Leucinodes orbonalis is a destructive pest of brinjal and its control is difficult as the larvae inhabited inside the shoots or fruits of brinjal. Two different studies were conducted in farmer's field at Coimbatore, Tamil Nadu, India during Rabi 2013/14 (September, 2013 – January, 2014) and 2014/15 (September, 2014 – January, 2015) to evaluate the efficacy of 1) types of traps viz., sleeve and Wota-T traps, and erection heights viz., 30, 60, 90 cm above the crop canopy and at crop canopy level, and 2) concentration of lure viz., one, two and three mg (Lucin-lure®), and frequency of replacement of lure viz., 21, 45 and 60 days. The results showed that the Wota-T traps baited with 3 mg lure concentration, replaced at every 21 days caught more number of male moths of L. orbonalis. Trap catch was significantly higher in pheromone traps placed in the same level of canopy.

Keywords: *Leucinodes orbonalis, lure, pheromone traps, replacement frequency, traps erection height*

Introduction

The brinjal shoot and fruit borer, *Leucinodes orbonalis* (Guenée) (Lepidoptera: Crambidae) is the most noxious and destructive pest of brinjal and widely distributed in South Asian countries (Talekar, 2002). The yield loss up to 60-80% (Krishnaiah and Vijay, 1975; Kaur *et al*., 2010) was recorded in brinjal cultivation by the infestation of *L. orbonalis*. The management of this pest is difficult as its larvae inhabit inside the plant's shoots or fruits by forming tunnels (Alam *et al*., 2003) and the pesticide do not reach the pest directly. The control of *L. orbonalis* is fairly possible when the spraying of pesticides was occurred before the neonate larvae bore inside shoots or fruits; once in the shoots or fruits, larvae are inaccessible to the killing action of surface applied chemicals. Since neonate larvae can enter fruits or shoots within only a few hours of hatching from eggs, pesticides have to be applied frequently in order to have sufficient toxic residues on the plant surface adequate enough to kill the crawling larvae (Alam *et al*., 2003). Besides, the frequent application of insecticides is not advisable when the crops are in fruiting stage.

Though, farmers rely exclusively on the application of pesticides to control *L. orbonalis*, produce blemish-free brinjal fruits and get maximum yield (Srinivasan, 2008). Excessive use of chemical pesticides in brinjal cultivation enhances the accumulation of residues in brinjal fruits, thereby threatens the human health and environment (Srinivasan, 2008). Thus the present trend of pest management moves towards the development of eco-friendly management practices through Integrated

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Pest Management (IPM). The integration of pheromone trap as an effective component of IPM program (Gunawardena and Attygalle, 1989; Cork *et al*., 2001; Chatterjee, 2009; Mazumder and Khalequzzaman, 2010) in monitoring pest population for early decision making, and also mass trapping of pests using lures baited with a killing agent. Based on the moth catches in pheromone trap it is easy to recognize the prevailing life stages of brinjal shoot and fruit borer at the brinjal cultivation on a particular time and which will direct to select the proper management practices against brinjal shoot and fruit borer. Therefore, the study on comparison of pheromone traps of brinjal shoot and fruit borer will help to select proper pheromone trap with suitable erection height and lure replacement interval which findings reduce the indiscriminate use of insecticides in brinjal cultivation against brinjal shoot and fruit borer, *L. orbonalis*.

Materials and Methods

Trap type and erection height in relation to crop canopy

A field experiment was conducted in a farmer's field at Coimbatore, Tamil Nadu, India for assessing the types of traps *viz*., sleeve and Wota-T traps (Fig. 1) and erection heights *viz*., 30, 60, 90 cm above the crop canopy and at crop canopy level during *Rabi*, 2013/14 (September, 2013 – January, 2014) with an air temperature 27±5 °C and Relative Humidity 70±5%.

1.a) Wota-T

1.b) Sleeve trap

Fig.1 Types of traps

The sex pheromone of *L. orbonalis*, a mixture of (E)-11-hexadecenyl acetate and (E)-11-hexadecen-1-ol) showed promising effect (Zhu *et al*., 1987; Attygale *et al*., 1988; Cork *et al*., 2001) against the moths of *L. orbonalis*. The commercialized sex pheromone of *L. orbonalsi* with similar properties were purchased at Pest Control of India, New Delhi, India and used for the study.

The Wota-T traps which consisted a hood to hold pheromone lure and a tray where soapy water was kept whereas the sleeve trap had a hood to place pheromone lure and sleeve made by polyethylene to collect caught moths. Both traps were purchased at Pest Control of India, New Delhi, India.

The traps were installed 30 days after transplanting of brinjal at different heights *viz*., 30, 60, 90 cm above the crop canopy and at crop canopy level with an inter trap distance of 20 m. The traps were fixed on bamboo poles and two mg of lure (Lucin-lure®) were used. The lures were fixed on the lower side of the hood. The experiment was laid out in Randomized Block Design with 8 treatments, and each treatment was replicated thrice.

Pheromone lures concentration and interval of lure replacement

Field experiment was carried out in a farmer's field at Coimbatore, Tamil Nadu, India during *Rabi*, 2014/15 (September, 2014 – January, 2015) to find out the effect of concentration *viz*., One, two and three mg lures (Lucin-lure®) and frequency of replacement of lure *viz*., 21, 45 and 60 days. The experiment was laid out in RBD with 9 treatments and each treatment replicated thrice.

The frequency of replacement of lure (Lucin-lure®) has been mentioned in the label of its commercial product as 2 months (60 days). In general, it was assumed from the previous studies that

the lure can be effective for about 21 days and it is climate dependent. Therefore, the study has been designed to check the suitability of recommended frequency of replacement of lure to the study area.

Data analysis

Observations on moth catches were recorded at weekly intervals, and monthly averages were calculated to evaluate the efficacy of each treatment using two-way ANOVA.

Results and Discussion

Trap type and erection height

Mean number of moths captured in two types of traps at different heights is presented in Table 1 & Fig. 2. The numbers of moths captured in Wota-T traps were significantly greater than the sleeve traps. The moth catches ranged from 3.08 to 9.33 in sleeve trap, while it was 7.08 to 23.50 in Wota-T traps at different heights (Fig. 3).

Among the heights tested, height at crop canopy level proved to be the most optimum in Wota-T traps (23.50 moth catches/trap) as well as sleeve traps (9.33 moth catches/trap). The lowest moth catches were observed in 90 cm above the canopy level (7.08 and 3.08 moth catches/trap in Wota-T traps and sleeve traps, respectively).

Cork *et al*., (2003) stated that open delta trap caught significantly greater numbers of *L. orbonalis* males than other traps tested by them at the canopy level (delta, open delta, water with plastic bottle and sleeve trap). However, the authors revealed that open traps with water were more efficient in trapping adult male moths as water prevents the moths from escaping. Apart from these, Nandihalli *et al*., (1991); and Raj *et al*., (2000) suggested that sleeve and funnel traps were superior in catching *Helicoverpa armigera*. Similarly, Mohan Naik *et al*., (1993) noticed that sleeve and ICRISAT funnel traps were found better than sticky traps in catching *Helicoverpa armigera*.

Although there were few references (Andagopal *et al*., 2010) to prove the efficacy of Wota-T trap, Cork *et al*., (2003) mentioned that the open trap with water performed better in capturing the *L. orbonalis* moths. The Wota-T trap was an open typed trap and contained water hence the findings of present study could be evidenced by the study of Cork *et al*., (2003) and Andagopal *et al*., 2010.

Pheromone lures concentration and changing interval

The data (Table 2 & Fig. 4) on lure concentration and changing frequency showed that three mg septum replaced every 21 days was the most effective (39.87 moths/trap) followed by two mg septum replaced every 21 days (29.19 moths/trap) and three mg septum replaced every 45 days (27.34 moths/trap). The least trap catches were recorded in one mg septum replaced every 60 days (14.07 moths/trap).

Sateeshkumar *et al*., (2009) stated that a dose of 2 mg per dispenser is considered sufficient for the purpose of monitoring the pest incidence of *L. orbonalis* and also cost effectiveness. The trap catches were highest in those traps with lures changed every 21 days, while changes made every 45th and 60th day were also promising but only up to 21 days and thereafter declined gradually indicating that irrespective of the changing frequency, the test lures were found to be effective up to 21 days. These results are in conformity with those of Lalitha Kumari and Reddy (1992); Patil and Mamadapur (1996); Loganathan *et al*., changed in three weeks. (1999) who

reported that lures must be changed in three weeks.

Table 1. Effect of pheromone trap types and erection height on *L. orbonalis* moth catches

Types of pheromone traps	Erection height	Overall mean moth catch/trap*
Sleeve trap	30 cm above canopy level	7.58^{cd} (2.84)
	60 cm above canopy level	5.92^{e} (2.53)
	90 cm above canopy level	3.08^{f} (1.89)
	canopy level	9.33^{c} (3.14)
Wota-T trap	30 cm above canopy level	22.08^{a} (4.75)
	60 cm above canopy level	12.42^{b} (3.59)
	90 cm above canopy level	7.08^{de} (2.75)
	canopy level	23.50^{a} (4.90)
SEd	Types of pheromone traps	0.08
	Erection height	0.11
	Interaction	0.15
CD (0.05)	Types of pheromone traps	0.16
	Erection height	0.23
	Interaction	0.32

*Values are mean of three replications.
Values in parentheses are based on square root (√(X+0.5)) transformation.
In column, means with similar alphabets do not vary significantly at P=0.05 by DMRT.

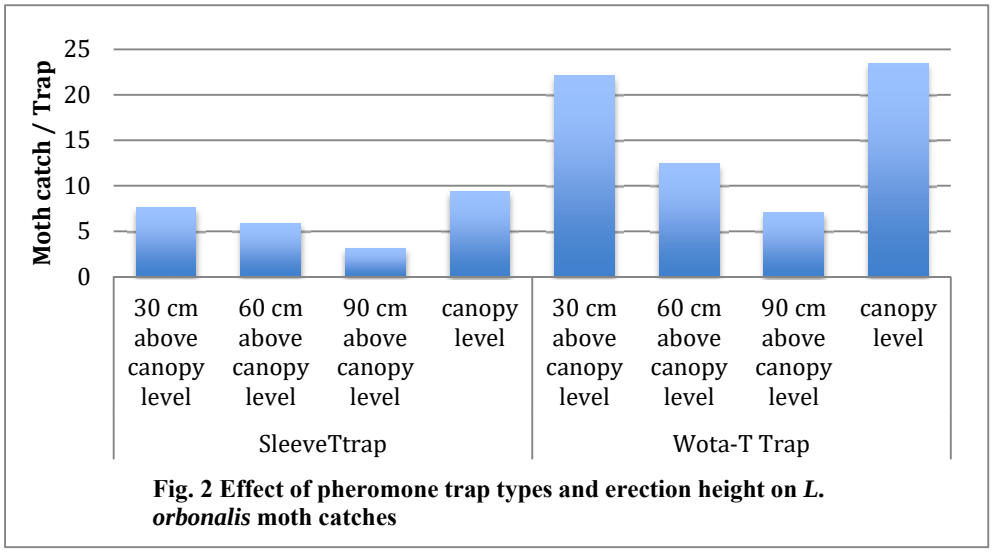

Fig. 2 Effect of pheromone trap types and erection height on *L. orbonalis* moth catches

Fig. 3. Moth catches in Wota-T trap

Table 2. Effect of concentration and replacement interval of pheromone lure on moth catches of *L. orbonalis*

Replacement interval	Concentration	Overall mean moth catch/trap*
21 days	1 mg septum	20.97^{cd} (4.63)
	2 mg septum	29.19^{b} (5.45)
	3 mg septum	39.87^{a} (6.35)
45 days	1 mg septum	17.71^{e} (4.27)
	2 mg septum	21.21^{cd} (4.66)
	3 mg septum	27.34^{b} (5.28)
60 days	1 mg septum	14.07^{f} (3.82)
	2 mg septum	20.27^{d} (4.56)
	3 mg septum	22.68^{c} (4.81)
SEd	Replacement interval	0.07
	Concentration	0.07
	Interaction	0.11
CD (0.05)	Replacement interval	0.14
	Concentration	0.14
	Interaction	0.24

*Values are mean of three replications
Values in parentheses are based on square root (√(X+0.5)) transformation.
In each column, means with similar alphabets do not vary significantly at P=0.05 by DMRT.

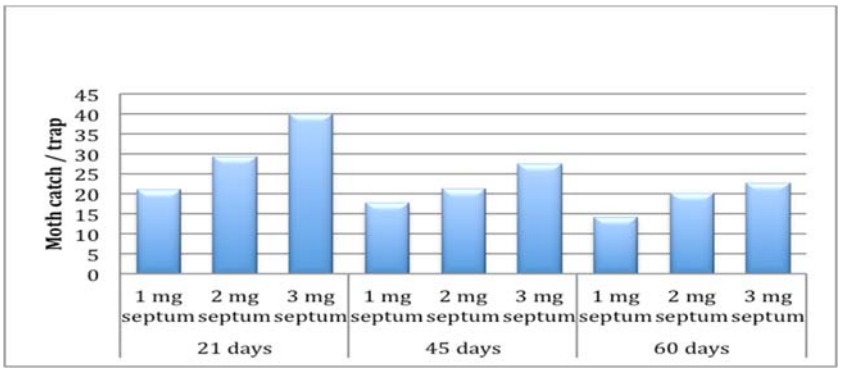

Fig. 4. Effect of concentration and replacement interval of pheromone lure on moth catches of *L. orbonalis*

Conclusion

It can be concluded from the study that the Wota-T trap was the most suitable trap to catch the more number of adult moths of *Leucinodes orbonalis* than the sleeve trap. Further the study revealed that to install the pheromone trap at the canopy level was most appropriate height.

In addition, the study stated the superiority of 3 mg concentration of lures of sex pheromone of *L. orbonalis* in catching the maximum adult moths of *L. orbonalis*. Among the tested replacement intervals of pheromone lure 21 days gave better results with more adult moth catches.

References

Alam, S. N., Rashid, M. A., Rouf, F. M. A., Jhala, R. C., Patel, J. R., Satpathy, S., Shivalingaswamy, T. M., Rai, S., Wahundeniya, I., Cork, A., Ammaranan, C. and Talekar, N. S. (2003). Development of an integrated pest management strategy for eggplant fruit and shoot borer in South Asia. Shanhua, Taiwan: AVRDC—the World Vegetable Center. Technical Bulletin No. 28. AVRDC Publication No. 03-548. 56 pp.

Andagopal, V.N., Prasad T.V., Jethwa Dha rmrajsinh, Gedia M.V., Koradia V.G., Patel H.V. (2010). Evaluation of pheromone traps against brinjal fruit and shoot borer, Leucinodes orbonalis Guenee. *Indian Journal of Entomology* 72(1): 7 – 10.

Attygale, A. B., J. Schwarz and N. E. Gunawardena. (1988). Sex pheromone of brinjal shoot and fruit borer *Leucinodes orbonalis* Guenee (Lepidoptera: Pyrallidae). *Zeitschrift für Naturforschung* **43**: 790-792.

Chatterjee, H. (2009). Pheromones for the management of brinjal fruit and shoot borer, *Leucinodes orbonalis* Guenee. *Karnataka Journal of Agriculture Science* 22: 594-596.

Cork, A., Alam, S. N., Rouf, F. M. A. and Talekar, N. S. (2003). Female sex pheromone of brinjal shoot and fruit borer *Leucinodes orbonalis*: Trap optimization and application in IPM trials. *Bulletin of Entomological Research* **93**: 107-113.

Cork, A., S. N. Alam, A. Das, C. S. Das, G. C. Ghosh, S. Phythian, D. I. Farman, D. R. Hall, N. R. Masten, K. Vedham, F. M. A. Rouf and K. Srinivasan. (2001). Female sex pheromone of brinjal shoot and fruit borer *Leucinodes orbonalis* (Lepidoptera: Pyrallidae): Blend optimization. *Journal of Chemical Ecology* **27**: 1867-1877.

Gunawardena, N. E. and Attygalle, A. B. (1989). The sex pheromone of the brinjal pest, *Leucinodes orbonalis* Guenee

(Lepidoptera): Problems and Perspectives. *Journal of National Science Council of Sri Lanka* **17(2)**: 161 – 171.

Kaur, M., S. Dhatt, S. Ajmer, J. Sandhu and S. Gosal Satbir. (2010). Genetic transformation of Cry 1AC gene to counter fruit and shoot borer of brinjal (*Solanum melongena* L). *Crop Improvement* **37**(2): 200.

Krishnaiah, K. and O. P. Vijay. (1975). Evaluation of Brinjal varieties for resistance to shoot and fruit borer *Leucinodes orbonalis* Guen. *Indian Journal of Horticulture* **32**: 84-86.

Lalitha Kumari, V. L. and Reddy, D. D. R. (1992). Evaluation of pheromone trap designs for trapping *Spodoptera litura* and *Helicoverpa armigera* and their reproductive behavior. *Indian Journal of Plant Protection* **20**: 18-23.

Loganathan, M., Sasikumar, M. and Uthamaswamy, S. (1999). Assessment of duration of pheromone dispersion for monitoring *Helicoverpa armigera* (H.) on cotton. *Journal of Entomological Reseach* **23**(1): 61-64.

Mazumder, F and Khalequzzaman, M. (2010). Eggplant shoot and fruit borer *Leucinodes orbonalis* guénee male moth catch in sex pheromone trap with special reference of lure elevation and IPM. *Journal of bio-science* 18: 9-15.

Mohan Naik, Lingappa, B. and Patil, B. V. (1993). A note on the efficiency of different pheromone traps in monitoring *Helicoverpa armigera* (Hubner) males. *Karnataka Journal of Agricultural Sciences* **6**(1): 64-66.

Nandihalli, B. S., Huger, P. and Patil, B. V. (1991). Efficacy of three types of pheromone traps in trapping *Heliothis armigera* Hub. *Madras Agriculture Journal* **78**(1-4): 91-92.

Patil, B. V. and Mamadapur, B. B. (1996). Performance of some sex pheromone traps and lures of Helicoverpa armigera (H.). *Indian Journal of Plant Protection* **24** (1&2): 128-129.

Raj, H. S., M. P. Gupta and M. L. Verma. (2000). Comparative effectiveness of traps for trapping male moths of *Helicoverpa armigera*. *Annals of Plant Protection Sciences* **8**(2): 235-236.

Sateeshkumar, J. V., Koteswara Rao, S. R. and Rahman, S. J. (2009). Effect of certain factors on pheromone trap moth catches of brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee. *Indian Journal of Entomology* **71**(4): 317-319.

Srinivasan, R. (2008). Integrated Pest Management for eggplant fruit and shoot borer (*Leucinodes orbonalis*) in South and Southeast Asia: Past, Present and Future. *Journal of Biopesticides* **1**(2): 105-112.

Talekar, N. S. (2002). Controlling eggplant shoot and fruit borer: A simple, safe and economical approach. International Cooperators' Guide, Publication No. #02-534, Shanhua, Taiwan: Asian Vegetable Research and Development, Center.

Zhu, P., F. Kong, S. Yu, S. Jin, X. Hu and J. Xu. (1987). Identification of the sex pheromone of eggplant borer, *Leucinodes orbonalis* Guenee (Lepidoptera: Pyralidae). *Zeitschrift für Naturforschung* **42**: 1347-1348.