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Pheromone trapping protocols for brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee (Lepidoptera: Pyralidae): evaluation of trap design, quantity and dispenser

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ABSTRACT

Studies were conducted at the Indian Institute of Horticultural Research, Bangalore, and Central Horticultural Experiment Station, Bhubaneshwar, India, to evaluate trap design, quantity of pheromone loading and dispensers for attracting brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee (Lepidoptera: Pyralidae) using indigenously synthesized pheromone lure [synthesized by Indian Institute of Chemical Technology (IICT), Hyderabad], during 2003 and 2004. A water trap consisting of plastic container (20 cm dia. and 7.5 cm depth) with a facility to place the pheromone septum was designed. Pheromone load of 4 mg in both water trap and Pest Control India (PCI®) delta trap was observed to catch higher number of male moths compared to dispensers with lesser loading. When trap designs were compared, water trap with pheromone lure was observed to attract higher number of males than Pest Control India (PCI®) delta trap. Among the different pheromone dispensers tested, rubber septum was superior to plastic vial or plastic septum. Rubber septum supplied by Bio Pest Management® captured significantly higher number of moths compared to rubber and plastic septum supplied by different firms. A comparison of IICT synthesized lures along with some commercially available lures indicated that Bio Pest Management® lure dispensed in rubber outperformed PCI® and IICT lures.

Key words: Brinjal shoot and fruit borer, *Leucinodes orbonalis*, pheromone traps and lures

INTRODUCTION

Brinjal (*Solanum melongena* L.) is an economically important vegetable in Bangladesh, China, India, Pakistan, the Philippines, Sri Lanka and Thailand. Among insect pests, brinjal shoot and fruit borer (BSFB), *Leucinodes orbonalis* Guenee (Lepidoptera: Pyralidae) is the most destructive pest. It is considered nearly monophagous although potato has been recorded as an alternate host (Nandihalli *et al*, 1996). At present, farmers rely exclusively on chemical insecticides to control this pest. Several workers have reported that insecticides such as dimethoate, phosphamidon, cypermethrin and monocrotophos (Ahmad, 1977; Kuppuswamy and Balasubramanian, 1980; Jagan Mohan *et al*, 1980) are effective in reducing of BSFB. Among these, synthetic pyrethroids have been widely used. It is observed that BSFB defies all the chemical control measures. According to Cork *et al* (2001), farmers spray 50 to 70 times during the six-month growing season of brinjal. In Bangladesh, insecticides were recently observed to be applied daily during summer, which resulted in outbreak of secondary pests such as red spider mite, *Tetranychus cucurbitae* Rahman and Sapra (Acari: Tetranychidae), and serious health consequences for both producers and consumers (Kabir *et al*, 1996).

With the increasing importance accorded to sustainable agriculture, Integrated Pest Management (IPM) is becoming more widely adopted, leading to decrease in use of chemicals (Jones, 1998). After identification of the major component of BSFB female sex pheromone (Zhu *et al*, 1987; Attygale *et al*, 1998), Male Annihilation Technique (MAT) using sex pheromones is considered to be one of the most important components of IPM in BSFB (Cork *et al*, 2001). The present study was to evaluate the field efficacy of indigenously synthesized BSFB pheromone along with trap design, pheromone dispensers and to compare these with some commercially available lures. This could help to develop mass trapping and IPM of BSFB.

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MATERIAL AND METHODS

Synthesis of individual pheromone components of brinjal fruit and shoot borer was done at Organic Division-I of the Indian Institute of Chemical Technology (IICT), Hyderabad. The pheromone components I [(E)-11-hexedecenyl acetate] and II [(E)-11-hexadecen-1-ol] used in this study had > 99.5% isomeric and > 97% product purity. Rubber septa and plastic septa dispensers used for the study were purchased from commercial suppliers and were subjected to solvent pretreatment prior to preparation of pheromone lures. *Leucinodes orbonalis* sex pheromone lures were prepared by impregnating pre-activated pheromone dispensers with 100:1 blend of (E)-11-hexadecenyl acetate (100) and (E)-11-hexadecen-1-ol (1). Loadings of the pheromone blend onto the dispensers was adjusted to 0.5 mg – 4.0 mg as per requirement and design of the field experiment. The lures thus prepared were stored in at -20°C until deployment in the field.

Trap design

The water trap consisted of a plastic container (basin type) of 20 cm dia. and 7.5 cm depth (Fig. 1). The container was filled with water and the pheromone lure was hung 2.5 cm above the water surface using insulated metallic wire. The lure was protected from direct sunlight using a circular plastic plate. The trap was placed 30 cm above the crop canopy using bricks. The trap height with respect to canopy height was adjusted at weekly intervals. Water level in the container was maintained at a constant and lures were replaced with fresh ones every month. A small quantity of soap solution was added to the water to avoid escape of trapped moths. This trap was compared with Delta sticky trap (30 cm x 10 cm; Fig. 2) supplied by PCI (Pest Control India, Bangalore). Observation on the number of male moths trapped was made on a daily basis.

Fig. 1. Water trap designed at IIHR

Pheromone quantity

The experiment was conducted from January - June 2003 using *Arka Neelkant,* a bacterial wilt resistant brinjal variety, at the Indian Institute of Horticultural Research (IIHR), Bangalore. The pheromone dispenser used in this study was a plastic vial. Different pheromone loadings *viz.,* 0, 0.5, 1.0, 2.0 and 4.0 mg were evaluated for their efficacy in attracting male BSFB moths using water and delta traps. The experiment was laid out in a randomized block design and replicated three times. A distance of 10 m between each treatment and a distance of 15 m between each replication was maintained. Pheromone lures were replenished once in four weeks. PCI delta traps and water traps were placed as and when required.

Table 1: Trap catches of *Leucinodes orbonalis* in water and delta traps with various pheromone loads at IIHR, Bangalore

Treatments	Total number of moths trapped	Mean±SD catch / trap*
Water trap with 0.5 mg pheromone load	59	20±1.01(4.35)^b
Water trap with 1.0 mg pheromone load	59	20±0.61(4.31)^b
Water trap with 2.0 mg pheromone load	61	20±0.90(4.27)^b
Water trap with 4.0 mg pheromone load	110	37±1.52(5.99)^a
PCI delta trap® with 0.5 mg pheromone load	44	15±0.86(3.80)^b
PCI delta trap® with 1.0 mg pheromone load	39	13±0.27(3.66)^b
PCI delta trap® with 2.0 mg pheromone load	53	18±0.49(4.17)^b
PCI delta trap® with 4.0 mg pheromone load	61	20±1.05(4.41)^b
Water trap with 0.0 mg pheromone load	11	4±0.42(1.89)^c
PCI delta trap with 0.0 mg pheromone load	9	3±0.01(1.69)^c
CD (p=0.05)		1.56
CV (%)		23.65

Figures in parentheses are $\sqrt{x+0.1}$ transformed values ; * = Mean of three replications
Superscripts of the same sign in a column indicate non-significant difference

Fig. 2 PCI® delta trap

Fig. 3 PCI® water trap

Pheromone dispenser

The experiment was conducted from January to April 2004 using brinjal variety *Arka Neelkant,* at IIHR, Bangalore and at Central Horticultural Experiment Station (CHES), Bhubaneswar. Two dispensers, rubber septa and plastic vials supplied by local commercial firms were evaluated (Table 2). Aldrich rubber septa imported from the United Kingdom was also used in the study. All dispensers were impregnated with 4.0 mg IICT synthesized pheromone these dispensers were placed in PCI® traps (Fig. 3). Seven treatments were imposed following randomized complete block design and replicated four times at IIHR and three times at CHES. Fresh lures were replaced once in four weeks.

Comparative evaluation of commercially available IICT-synthesized pheromone lures

A study was conducted from September to December 2004 to assess the trapping potential of indigenously synthesized IICT and commercially available lures. The experiment was conducted in randomized block design with four replications. Each replication consisted of 98 plants (var. *Arka Neelkant*) in 5 x 5 m^2 area with one trap per replication. PCI® water traps (Fig. 3) were used for all the lures. Lures were changed every 4 weeks. The commercial lures evaluated were Bio pest management® rubber septa, Bio pest management® plastic septa and PCI® rubber septa. These three lures of commercial firms were compared with the IICT synthesized lure impregnated in different dispensers.

RESULTS AND DISCUSSION

Pheromone quantity and trap design

Results indicated that the total trap catch was highest in water trap with 4 mg pheromone loading (37.00±1.52 moths/trap) during the trapping period of 6 months. This was followed by a pheromone load of 4 mg in delta sticky trap, which recorded 20.00±1.05 moths per trap. The trap catches in these treatments were significantly higher compared to both water trap and delta trap with 0, 0.5, 1.0 and 2.0 mg pheromone loading (Table 1). Pheromone loadings of 0.5 and 1.0 mg caught significantly less number of moths (Table 1). When water traps and PCI delta traps® were compared irrespective of loading, water

Table 2. Catches of *Leucinodes orbonalis* in water trap with different types of pheromone dispensers (loaded with 4 mg of IICT synthesized pheromone) at IIHR, Bangalore, and CHES, Bhubaneswar

	IIHR, Bangalore		CHES, Bhubaneshwar	
Treatment	Total moths	Mean±SD /trap	Total moths	Mean±SD /trap
Aldrich® rubber septa *	29	7.25±1.60(2.38)^{bc}	66	22.00±1.80(4.67)^{a}
Abhishek® rubber septa*	56	14.00±1.10(3.70)^{ab}	94	31.33±1.46(5.56)^{a}
Basarass® rubber septa*	22	5.50 ±1.19(2.32)^{bc}	35	11.67±1.59(3.29)^{ab}
Bio-pest management® rubber septa	69	17.25±1.35(4.01)^{a}	107	35.67±1.69(5.90)^{a}
Bio-pest management® plastic septa	24	6.00±1.34(2.31)^{bc}	54	18.00±1.12(4.24)^{a}
Blank	0	0.00±0.33(0.32)^{d}	1	0.33±0.12(0.56)^{c}
CD (p=0.05)		1.452		2.15
CV (%)		5.91		30.62

Figures in parentheses are $\sqrt{x+0.1}$ transformed values

Table 3. Comparative efficiency of IICT lure dispensed in different septa with commercial lures in attracting *L. orbonalis*

Treatments	Pheromone source	Total no. of moths	Mean±SD per trap per night
Abhishek® rubber septa	IICT	160	0.70±0.60(1.06)[b]
Abhishek® plastic vial	IICT	211	0.90±0.30(1.25)[ab]
Asthagiri® herbal plastic septa	IICT	241	0.90±0.40(1.19)[b]
Bio pest management® plastic septa	Commercial	501	2.10±1.40(1.56)[a]
Bio pest management® rubber septa	Commercial	653	2.60±1.70(1.69)[a]
PCI® rubber septa	Commercial	317	1.20±0.70(1.30)[ab]
Blank / Empty	Empty	7	0.10±0.02(0.72)[c]
CD			0.33
CV (%)			17.99

Figures in parentheses are $\sqrt{X+0.1}$ transformed values
Superscripts of the same sign in a column indicate non-significant difference

traps were observed to be more effective than delta traps. Significant variation in trap catches between water and delta sticky traps indicated that water traps were more efficient than delta traps. Water trap is also cheaper and long lasting.

Dispensers

Pheromone lures dispensed in rubber septa were superior to polyethylene or plastic septa in trapping BSFB moths. In the trials conducted at IIHR, Bangalore and CHES, Bhubaneswar, the Bio pest management® rubber septa trapped maximum BSFB moths. But at CHES, Bhubaneswar, other dispensers performed on par with Bio-pest management® septa even though the latter caught highest number of moths (107 males) with mean of 35.67 per trap. The significant variability in the trap catches across septa indicates that in addition to pheromone loading, use of appropriate dispenser is most important for success in mass trapping. Dispensing septa dictate rate of release of pheromone and that varies with the technology. Hence, variation in response of male moths to pheromone traps is attributed to the nature of the dispenser used. The mean number of moths trapped in Bangalore (17.25 males/ trap) was less compared to that in Bhubaneswar (35.67 males / trap), which indicated that pest density and weather parameters influence trap catches in different regions (Krishna Kumar *et al*, 2004). Another possibility could be behavioural polymorphism in the populations of *L. orbonalis* or geographic variation in female sex pheromone which has been reported in many Lepidopteran pests including rice leaf folder, *Cnephalocrocis medinalis* Guenee (Kawazu *et al*, 2000) and *Helicoverpa armigera* (Kumar and Shivakumara, 2002). However, this needs to be confirmed in *L. orbonalis*.

Efficiency of indigenously synthesized IICT lures

The performance of commercial lures may vary with the quality and quantity of sex pheromone. Bio Pest Management BSFB pheromone lures in rubber and plastic septa trapped higher number of moths (2.60±1.70 males/ trap/night) (Table 3). Catches in plastic septa and rubber septa of Bio pest management were not statistically different. Number of moths trapped by IICT lures irrespective of type of dispensers was statistically not significant. The IICT lure loaded in three different dispensers were on par with catches of PCI rubber septa. However, the pheromone loading synthesized by IICT was 4 mg/vial and the load in commercial company is unknown. Hence, depending on the cost : benefit ratio, pheromone loading to increase the efficacy of lures needs investigation.

The findings in the present study suggest that trap design, quantity of lure and nature of dispensers affect the response of *L. orbonalis* to synthetic sex pheromone. Water trap with pheromone load of 4mg dispensed in rubber septum is recommended for mass trapping of BSFB.

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