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INTEGRATED CONTROL OF BRINJAL SHOOT AND FRUIT BORER *LEUCINODES ORBONALIS* GUENÉE

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ABSTRACT

Shoot and fruit borer, *Leucinodes orbonalis* is one of the key pests of brinjal. A field experiment was carried out to evaluate the effect of behavioural, biological and botanical control methods against this at Coimbatore. Pheromone trapping at 60 traps/ ha, *Trichogramma pretiosum* release at 1.25 lakh/ ha at weekly interval with a total of 11 releases and spraying of sweet flag EC formulation@ 4 ml/ l at 15 days interval with a total of six sprays were evaluated singly and in combination. Observations at weekly intervals on shoot and fruit damage revealed that the combination of pheromone trapping, *T. pretiosum* releases and sweet flag EC spraying was effective with 42.87% and 91.04% reduction in fruit and shoot infestation over control, respectively. However, with fruit damage it was on par with sole *T. pretiosum* release (38.91% reduction over control), pheromone trapping + *T. pretiosum* release (37.24% reduction) and sweet flag EC formulation spray + *T. pretiosum* release (39.21%).

Key words: Brinjal, *Leucinodes orbonalis*, pheromone, *Trichogramma pretiosum,* sweet flag EC, sole and combination, fruit and shoot damage

Brinjal *Solanum melongena* L. originated in India (Patil and Mane, 2013) and is now grown extensively (Hanur et al., 2014; Manasa et al., 2016) and India is the second largest producer of brinjal after China, in South Asia (Talekar, 2005; Javed et al., 2017; Mathur et al., 2012). It is a host for more than 150 pests, among them nine are major pests (Niranjana and Sridhar, 2014). The shoot and fruit borer, *Leucinodes orbonalis* Guenée (Crambidae: Lepidoptera) is one of the key pests, which adversely affects the plant growth as well as marketable fruit yield both in terms of quantity and quality (Srinivasan, 2008; Tiwari et al., 2011; Pareet and Basavangoud, 2012; Tripathi, 2016; Yadav and Sharma, 2005; Gautam et al., 2008; Kavitha et al., 2008; Maravi et al., 2013).

For an ecofriendly IPM, maintenance of natural enemies like predators and parasitoids is necessary. Trichogrammatids are one of the most important groups of bioagents (Naik et al., 2015). After identification of (*E*) 11- hexadecenyl aas the major component of female sex pheromone (Zhu et al., 1987; Attygalle et al., 1988; Cork et al., 2003), male suppression using sex pheromone is an important component of IPM (Cork et al., 2001). The integrated approach with trichogrammatids and pheromone could reduce pesticide load in brinjal, and hence the present study to evaluate the same.

MATERIALS AND METHODS

The field experiment was carried out to evaluate the effect of behavioural, biological and botanical control methods, on local cultivar of brinjal at Madathur and Chinnathadagam. The experiments were conducted in Randomized Block Design (RBD) with spacing 50x50 cm, with plot size of 1.0 ha. The modules with pheromone trapping and control were carried out in Madathur to reduce the effect of pheromone on other treatments and rest of treatments and control were carried out in Chinnathadagam. Each treatment plots were spaced 10 m apart and replicated thrice, with all agronomic practices followed regularly without recommended plant protection operations. The treatment details are shown in Table 1.

The pheromone dispensers were obtained from Sun Agro Biotech Research Centre, Chennai. The dispensers used were pheromone impregnated rubber septa and the trap used were modified delta trap with pair of wholes on the lateral sides of trap. *T. pretiosum* were reared and mass produced in biocontrol laboratory Department

T_1	Release of *T. pretiosum*@ 1.25 lakh/ ha at weekly interval (12 releases)
T_2	Pheromone trap@ 60 numbers/ ha and lures replaced at 15 days interval (six replacements)
T_3	Spraying of botanical insecticide (Sweet flag EC) at 4 ml/ l in 15 days interval (six sprays)
T_4	Release of *T. pretiosum*@ 1.25 lakh/ ha at weekly interval (12 releases) + Pheromone trap@ 60 numbers/ ha and lures replaced at 15 days interval (six replacements)
T_5	Release of *T. pretiosum*@ 1.25 lakh/ ha at weekly interval (12 releases) + Spraying of botanical insecticide (Sweet flag EC) at 4 ml/ l in 15 days interval (six sprays)
T_6	Pheromone trap@ 60 numbers/ ha and lure replaced at 15 days interval (six replacements) + Spraying of botanical insecticide (Sweet flag EC) at 4 ml/ l in 15 days interval (six sprays)
T_7	Pheromone trap@ 60 numbers/ ha and lures replaced at 15 days interval (six replacements) + Release of *T. pretiosum*@ 1.25 lakh/ ha at weekly interval (12 releases) + Spraying of botanical insecticide (Sweet flag EC) at 4 ml/ l in 15 days interval (six sprays)
T_8	Untreated control

of Agricultural Entomology, Tamil Nadu Agricultural Entomology, Coimbatore at 25±2°C and 65±5% RH. The sweet flag EC is a formulation of biopesticide made from *Acorus calamus* in Department of Agricultural Entomology, Tamil Nadu Agricultural Entomology, Coimbatore. The damage levels of shoots were recorded at weekly interval and fruits at each harvest from five plants and assessed for % damage and reduction over untreated control.

RESULTS AND DISCUSSION

The results of the field trial revealed that the shoot damage occurred only during the initial vegetative period, ranged between 0.00 to 6.27% in control plots (Table 1). Reduction of shoot damage over control was maximum (91.04%) with combination of pheromone trapping, *T. pretiosum* release and sweet flag EC formulation spray (T_7) followed by 74.99% with pheromone trapping and *T. pretiosum* release (T_4). Least reduction in damage was observed with sweet flag EC formulation spray, which was 28.66%. The shoot infestation declined just after fruiting initiated. The fruit damage both in terms of numbers as well as weights at each harvest and was pooled and % reduction over control was calculated, and it was observed to be 4.02 to 58.85% (Table 2). The maximum reduction of damage

Table 1. Effect of integrated control on *L. orbonalis*

Treatments	Shoot damage (%)						Reduction over control (%)
	44 DAT	51 DAT	58 DAT	65 DAT	72 DAT	Mean	
Field at Chinnathadagam							
T1	0.48 (2.66)^{b}	0.32 (2.24)^{a}	0.28 (2.11)^{a}	0.24 (2.00)^{a}	0.00 (0.55)^{a}	0.26 (1.91)	53.76
T3	1.59 (7.23)^{a}	1.33 (4.21)^{a}	0.00 (0.55)^{a}	0.00 (0.55)^{a}	0.31 (2.20)^{a}	0.65 (2.95)	28.66
T5	0.00 (0.55)^{a}	0.00 (0.55)^{a}	0.83 (3.40)^{a}	0.39 (2.43)^{a}	0.00 (0.55)^{a}	0.24 (1.50)	63.81
T8	1.09 (5.09)^{bc}	0.77 (4.30)^{a}	1.48 (5.66)^{a}	0.32 (2.23)^{a}	0.83 (3.40)^{a}	0.90 (4.14)	0.00
Field at Madathur							
T2	0.00 (0.55)^{a}	0.79 (3.33)^{a}	0.51 (2.73)^{a}	0.71 (3.16)^{a}	1.37 (5.48)^{a}	0.68 (3.05)	69.78
T4	0.00 (0.55)^{a}	0.68 (3.10)^{a}	0.00 (0.55)^{a}	0.54 (3.61)^{a}	1.03 (4.80)^{a}	0.45 (2.53)	74.99
T6	0.00 (0.55)^{a}	0.00 (0.55)^{a}	1.07 (5.04)^{a}	0.87 (4.43)^{a}	0.86 (5.26)^{a}	0.56 (3.17)	68.63
T7	0.00 (0.55)^{a}	0.00 (0.55)^{a}	0.34 (2.31)^{a}	0.00 (0.56)^{a}	0.00 (0.55)^{a}	0.07 (0.90)	91.04
T8	0.00 (0.55)^{b}	5.59 (13.06)^{b}	6.27 (14.47)^{b}	5.77 (13.75)^{a}	2.44 (8.65)^{a}	4.01 (10.10)	0.00
SEd	1.3929	2.8168	2.7903	2.3426	2.5499		
CD	2.9529	5.9715	5.9154	4.9662	5.4055		

Table 2

Treatments	Fruit infestation at harvest (%)							Reduction over control (%)
	Picking I	Picking II	Picking III	Picking IV	Picking V	Picking VI	Mean	
				Field at Chinnathadagam				
T_1	7.11 (15.45)^{e}	11.39 (19.71)^{ab}	23.87 (29.20)^{a}	26.05 (30.69)^{ab}	27.02 (31.29)^{bc}	20.03 (26.58)^{abc}	19.25 (25.48)	38.91
T_3	7.35 (15.72)^{e}	17.81 (24.89)^{bc}	32.46 (34.72)^{ab}	35.10 (36.31)^{c}	36.74 (37.30)^{de}	27.64 (31.72)^{de}	26.18 (30.11)	16.64
T_5	4.02 (11.28)^{e}	6.51 (14.74)^{a}	24.90 (29.89)^{a}	24.49 (29.65)^{a}	34.06 (35.69)^{cd}	20.90 (27.21)^{bc}	19.15 (24.74)	39.21
T_8	14.46 (42.78)^{a}	24.42 (48.77)^{f}	41.38 (50.10)^{d}	38.56 (46.39)^{d}	37.86 (41.91)^{e}	32.76 (29.24)^{cd}	31.57 (43.20)	-
				Field at Madathur				
T_2	34.72 (35.99)^{b}	30.74 (33.42)^{de}	45.55 (42.45)^{c}	49.41 (44.67)^{d}	20.66 (26.77)^{ab}	17.48 (24.35)^{ab}	33.09 (34.61)	29.29
T_4	36.42 (37.08)^{b}	29.18 (32.52)^{de}	41.34 (39.95)^{bc}	34.77 (36.12)^{c}	19.19 (25.81)^{a}	16.01 (23.59)^{ab}	29.49 (32.51)	37.24
T_6	35.71 (36.70)^{b}	39.36 (38.85)^{e}	45.15 (42.22)^{c}	47.35 (43.48)^{d}	20.31 (26.77)^{ab}	18.67 (25.59)^{abc}	34.43 (35.60)	26.55
T_7	23.91 (29.27)^{c}	34.06 (35.62)^{de}	36.45 (37.12)^{bc}	33.04 (35.06)^{bc}	18.81 (25.64)^{a}	14.79 (22.47)^{a}	26.84 (30.86)	42.87
T_8	46.15 (22.17)^{d}	56.45 (29.57)^{cd}	58.85 (39.96)^{bc}	52.40 (38.30)^{c}	44.66 (37.97)^{de}	23.94 (34.90)^{e}	47.08 (33.81)	-
SEd	2.57	3.37	2.79	2.31	2.40	2.10		3.34
CD (0.05)	5.44	7.15	5.91	4.89	5.09	4.46		7.17

was observed with combination of pheromone trapping, *T. pretiosum* release and sweet flag EC formulation spray (T_7) which was 42.87% lesser than control. The least effective treatment was sweet flag EC formulation spray (T_3).

The present study revealed that the combination of pheromone trapping with *T. pretiosum* release and spraying sweet flag EC formulation was the best method with 91.04% reduction in shoot infestation and 42.87% and 48.59% reduction in fruit infestation in terms of number and weight over control, respectively. The results suggest that pheromones by themselves did not control the infestation but the integration with *T. pretiosum* releases and spraying of sweet flag EC imparted a better control. The pheromone trapping might have played a vital role in preventing the mating of adult moths, which leads to reduced egg load on crop.

Similar studies conducted in cotton by Ahmad et al. (2001) indicated that the integration of pheromone trapping with inundative releases of *T. chilonis* resulted in the suppression of pink and spotted bollworms to a sub economic level. The use of sex pheromone for trapping along with spray of azadex and mechanical control resulted in a 76.59% reduction in damage and the pheromone trapping alone gave a substantial protection over control (Hirak, 2009). Efficacy of *T. pretiosum* observed in this study is in accordance with Niranjana and Sridhar (2014) who reported that *T. pretiosum* was the effective egg parasitoid against *L. orbonalis*. Though the initial reduction in damage by shoot and fruit borer was not satisfactory upon trapping the insects continuously pheromone trapping showed a significant superiority over other treatments (Bhumita et al., 2013).

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