Madras Agric. J., 100 (7-9): 734-736, September 2013
https://doi.org/10.29321/MAJ.10.001394

Enhanced Activity of *Trichogramma chilonis* and *Chrysoperla zastrowi sillemi* on Eggs of *Earias vittella* and *Helicoverpa armigera* through Kairomonic Activity of Acetone Extracts of Okra

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Three entries of okra, No. 55, Arka Anamika and AE 9, identified as highly susceptible, susceptible and resistant, respectively to *Earias vittella* and *Helicoverpa armigera* during earlier field screening were selected and the kairomone effect of acetone extracts of their plant parts (flowers, tender and mature fruits, tender and mature leaves) to enhance the activity of *Trichogramma chilonis* and *Chrysoperla zastrowi silemi* was studied under laboratory condition. Acetone extract of flowers of No. 55 (1% or 10,000 ppm) enhanced the parasitism/predation by *T. chilonis* and *C. zastrowi silemi* on eggs of *E. vittella,* recording 55.33 and 58.33%, respectively while it was 6.67 and 10.67% in control (acetone). Similarly, the flower extract of No. 55 enhanced the activity of *T. chilonis* and *C. zastrowi silemi* by 65.33 and 68.67% on eggs of *H. armigera,* as compared to 10.67 and 12.55% in control.

Key words: *Chrysoperla zastrowi silemi*, *Earias vittella*, *Helicoverpa armigera* kairomone, Okra, *Trichogramma chilonis*

Chemical ecology is concerned with the communication of signals through specific chemicals between organisms in an eco-system (Greenblatt and Lewis, 1983). It has become a dominant aspect in the understanding of insect-plant interactions. Plants are known to produce a wide variety of allelochemicals that influence plant- insect relationships. This include attractants, oviposition excitants and feeding stimulants (kairomones). In today's scenario, several volatiles are known to affect insect communities resulting in behavioural diversities, such as that involving pheromones and host plant volatiles (Ananthakrishnan, 1992). Kairomones have been used to increase the host searching efficiency, host recognition and selection, induced oviposition on non-host, used as mass priming agent and monitoring of parasitoids/predators populations. Field release of *Trichogramma chilonis* and *Chrysoperla zastrowi silemi* for the management of various lepidopteran pests in different crop eco- system is under recommendation (Balakrishnan *et al*., 2004 a, b). Information on kairomonal effect of acetone extracts of various parts of three entries of okra on parasitic/predatory behaviour of *C. zastrowi silemi* and *T. chilonis* on eggs of *E. vittella* and *H. armigera* was generated in the present study under laboratory condition.

Materials and Methods

Okra shoot and fruit borer (*Earias vittella*) and fruit borer (*Helicoverpa armigera*) were cultured on okra fruits and artificial diet, respectively under laboratory condition. Eggs were harvested and utilized for lab experiments. Chemical cues or kairomones present in various parts of three entries of okra (No. 55 (highly susceptible), Arka Anamica (susceptible), AE 9 (resistant) were tested. Plant parts of three entries of okra (flowers, tender and mature fruits, tender and mature leaves) were collected separately and shade dried for 12 hours. A quantity of 20 g of each plant sample was weighed and chopped into small pieces. These were transferred to 250 ml conical flask. A known volume of acetone (100 ml) was poured into the individual conical flasks containing chopped plant materials. The mouths of the flasks were covered with non-absorbent cotton and were incubated for 72 hrs. The plant materials were filtered through Whatman number 1 filter paper. The extracts were concentrated by gentle heating at 50$_0$C (Shankarganesh and Khan, 2006). A concentration of 1% (10,000 ppm) of the extracts of plant parts of three entries of okra were prepared after dilution with acetone and used throughout the experiment. Fresh 0-24 hrs old eggs of *E. vittella* and *H. armigera* sterilized under UV lamp were washed twice in acetone to remove any traces of scales or kairomones present on the surface. These eggs were pasted with pure white gum on white cardboard, measuring 7 x 2 cm at the rate of 300 eggs per piece (egg card). Acetone extracts (1%) of three entries of okra (flowers, young and fruits, young and old leaves) were applied on two pieces of egg cards at the rate of 0.5 ml with a glass atomizer and shade dried for half an hour. Control was maintained with

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acetone alone. One such egg card was considered as one replication and each extract was replicated four times. Each egg card was inserted in a glass vial of 15 x 2.5 cm was introduced with 40 freshly emerged *T. chilonis* adults. The per cent parasitization on *E. vittella* and *H. armigera* eggs by *T. chilonis* was recorded on 3, 5 and 7th day after release. In another laboratory experiment, egg cards were prepared in a similar way and each egg card containing 300 eggs of *E. vittella* and *H. armigera* were enclosed in a glass vial of 15 x 2.5 cm along with five numbers of fresh second instar of *C. zastrowi silemi* . Each extract was replicated four times and acetone alone was used in control. The per cent predation on eggs of *E. vittella* and *H. armigera* by *C. zastrowi silemi* was recorded 24 hrs after release.

Results and Discussion

The efficacy of acetone extracts of various parts of three entries of okra (No. 55 (highly susceptible), Arka Anamica (susceptible), AE 9 (resistant)) at 1% or 10,000 ppm on the parasitization of eggs of *E. vittella* by *T. chilonis* revealed that flower extract was effective in eliciting the highest activity of *T. chilonis*, recording 18.33% on third day after introduction of the parasitoid which was significantly different from extracts of tender fruits of No. 55 (15.33%), tender (12.67%) and mature (10.67%) leaves of No. 55 and mature fruits of No. 55 (11.67%) when compared to control (2.67%) (Table 1). On fifth and seventh day after introduction of parasitoid, flower extract of No. 55 enhanced the activity of parasitoid, recording 47.67 and 53.33% while it was 4.67 and 6.67% in control, respectively. Acetone extract of No. 55 (1%) elicited kairomonal effect on the predation by *C. zastrowi silemi* on the eggs of *E. vittella* which was 58.33%, followed by extracts of flowers of Arka Anamica (49.33%), tender fruits of No. 55 (47.67%) and tender fruits of No. 55 (45.67%) while it was 10.67% in control (Table 1).

Level of parasitization of *T. chilonis* was enhanced when eggs of *H. armigera*, treated with acetone extract of flowers of No. 55 (1%) was exposed which recorded 65.33%, seven days after introduction of parasitoids while it was 10.67% in control (Table 1). Similarly, the predation by *C. zastrowi silemi* on eggs of *H. armigera* was enhanced to 68.67% due to the application of flower extract, 24 h after introduction, as compared to 12.55% in control.

Parasitoids and predators of herbivores use chemical cues released by host plants to find the host habitat initially and then the herbivore on host plant. This response of the parasitoid towards plant produced chemicals could be due to the presence of certain hydrocarbons, fatty acids or proteins present in that plant (Ananthakrishnan, 1992). Among the

Table 1. Parasitism/predation by *T. chilonis* and *C. zastrowi silemi* on eggs of *E. vittella* and *H. armigera*, as influenced by acetone extracts of plant parts of okra

Okra variety/plant part	% parasitization by *T. chilonis* on eggs of *E. vittella*			% predation by *C. zastrowi silemi* on eggs of *E. vittella* (after 24 h)	% parasitization by *T. chilonis* on eggs of *H. armigera*			% predation by *C. zastrowi silemi* on eggs of *H. armigera* (after 24 h)
	3rd day	5th day	7th day		3rd day	5th day	7th day	
Flowers								
No. 55 (HS)	18.33_{a}	47.67_{a}	55.33_{a}	58.33_{a}	22.63_{a}	57.00_{a}	65.33_{a}	68.67_{a}
Arka Anamica (S)	11.67_{d}	37.33_{c}	46.33_{c}	49.33_{b}	15.67_{d}	47.33_{d}	56.67_{c}	59.33_{b}
AE 9 (R)	9.67_{g}	12.67_{k}	16.67_{j}	27.67_{h}	12.67_{g}	20.33_{k}	25.33_{k}	37.67_{i}
Tender fruits								
No. 55 (HS)	15.33_{b}	43.33_{b}	48.67_{b}	47.67_{c}	18.67_{b}	51.33_{b}	58.00_{b}	55.33_{c}
Arka Anamica (S)	10.33_{f}	31.67_{e}	40.67_{d}	45.67_{d}	15.33_{e}	43.67_{e}	45.67_{f}	41.67_{f}
AE 9 (R)	8.33_{h}	10.67_{l}	13.67_{k}	29.67_{g}	10.33_{h}	18.33_{l}	21.67_{l}	32.67_{j}
Mature fruits								
No. 55 (HS)	11.67_{d}	32.33_{d}	35.67_{f}	41.33_{e}	17.67_{c}	48.33_{c}	51.67_{d}	45.33_{d}
Arka Anamica (S)	5.33_{j}	25.67_{j}	28.33_{i}	41.33_{e}	13.33_{f}	40.67_{f}	42.67_{g}	42.67_{e}
AE 9 (R)	5.33_{j}	8.67_{m}	10.33_{n}	25.67_{i}	10.33_{h}	15.67_{m}	18.63_{m}	28.33_{k}
Tender leaves								
No. 55 (HS)	12.67_{c}	31.33_{f}	37.67_{e}	38.33_{f}	15.67_{d}	38.67_{g}	47.67_{e}	40.33_{g}
Arka Anamica (S)	9.67_{g}	30.67_{g}	35.33_{g}	23.67_{j}	12.67_{g}	35.67_{h}	42.33_{h}	25.67_{l}
AE 9 (R)	5.67_{i}	7.67_{n}	11.33_{l}	18.67_{l}	10.33_{h}	13.33_{n}	15.67_{n}	18.67_{n}
Mature leaves								
No. 55 (HS)	10.67_{c}	29.67_{h}	35.67_{f}	27.67_{h}	9.67_{i}	30.67_{i}	40.67_{i}	38.67_{h}
Arka Anamica (S)	8.33_{h}	28.67_{i}	32.67_{h}	20.33_{k}	10.33_{h}	29.67_{j}	38.67_{j}	23.33_{m}
AE 9 (R)	4.33_{k}	6.67_{o}	10.67_{m}	15.67_{m}	8.33_{j}	12.67_{o}	15.67_{n}	16.33_{o}
Control (acetone)	2.67_{l}	4.67_{p}	6.67_{o}	10.67_{n}	5.67_{k}	9.33_{p}	10.67_{o}	12.55_{p}
SEd	0.0051	0.0757	0.0030	0.0016	0.0022	0.0027	0.0017	0.0016
CD (P=0.05)	0.0105	0.1546	0.0061	0.0033	0.0045	0.0055	0.0036	0.0032

HS – Highly susceptible; S – Susceptible; R – Resistant

*Mean of four replications; Figures in table are original values and subject to arcsine transformation during statistical analysis

In a column means followed by same letter(s) are not significantly different by DMRT (P= 0.05) acetone extracts of various parts of three entries of okra tested for kairomonal activity, flower extract of No. 55 was more effective to enhance the parasitization and predation rate of *T. chilonis* and *C. zastrowi silemi*, respectively on the eggs of *E. vittella* and *H. armigera*. Leaf extracts obtained from flowering period of chickpea varieties were reported to increase the parasitoid activity index of *T. chilonis* (Madhulika Srivastava *et al*., 2004) rather than collected from vegetative period of chickpea. High synomonal activity of the extracts of various parts of host plants collected from flowering to *T. chilonis* period might be due to the presence of more number of hydrocarbons like octacosane, tricosane, docosane, pentacosane, heneicosane and hexacosane which were categorized as favourable for *Trichogramma* spp. as suggested in earlier studies (Paul *et al*., 2002). In the present study, acetone extracts of old fruits and old leaves of okra were poor in eliciting synomonal activity for *T. chilonis* which is unreasonable that old parts might not be having hydrocarbon compounds or might be due to unfavourable allelochemics, as reported by Padmavathi and Paul (1998). High parasitism was recorded in the susceptible cultivars such as Suvin, while it was reduced in resistant cultivars presumable because of undesirable chemical factors, as evident from the chemical profiles of various cultivars of cotton (Annadurai *et al*., 1992).

Enhanced predatory activity of *C. zastrowi silemi* on eggs of *E. vittella* and *H. armigera* treated with acetone extract of flowers of No. 55 coincided with studies of Annadurai *et al*. (1992) who observed higher predation by *C. scelestes* in cotton varieties containing synomonal factors such as eicosane, pentacosane and docosane in squares and flowers. Ananthakrishnan (1991) also indicated the presence of important synomonal sources such as pentacosane, docosane, tricosane and nonacosane especially from young bolls, squares and flowers in cotton varieties.

Acknowledgement

Author is thankful to Department of Bio-Technology,Govt. of India, New Delhi for financial assistance.

References

Ananthakrishnan, T.N. 1991. Chemical ecology in biological control. *Curr. Sci*., **3:** 259-263

Ananthakrishnan, T.N. 1992. Chemodynamics of insect-plant interactions. *Palaeobotanist*, **41:** 144-148

Annadurai, A.S., Murugesan, S. and Senrayan, R. 1992. Tritrophic interactions in *Heliothis armigera* Hubner (Noctuidae:Lepidoptera) and its natural enemy systems: A chemical ecological approach, pp. 83-101. In: Emerging Trends in Biological Control of Phytophagous Insects Ananthakrishnan, T.N. (ed.). Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 255p.

Balakrishnan, N., Murali Baskaran, R.K. and Mahadevan, N.R. 2004 a. Field efficacy of *Chrysoperla carnea* (Stephens) in combination with biopesticides against *Helicoverpa armigera* (Hubner) on cotton under rainfed condition. *J. Biol. Contl.*, **18:** 147-153

Balakrishnan, N., Murali Baskaran, R.K. and Mahadevan, N.R. 2004 b. Evaluation of management modules of bollworms on cotton under rainfed condition. *Ann. Pl. Protect. Sci*., **13:** 373-378

Greenblatt, J.A. and Lewis, W.J. 1983. Chemical environment for manipulation for pest insect control. *Environ. Mgmt*., **7:** 35-41

Madhulika Srivastava, Paul, A.V.N., Singh, A.K. and Prem Dureja. 2004. Synomonal effect of chickpea varieties and egg parasitoid, *Trichogramma chilonis* Ishii (Tri chogrammatidae:Hymenoptera). *Indian. J. Ent*., **66** : 332-338

Padmavathi, C. and Paul, A.V.N. 1998. Saturated hydrocarbons as kairomonal source for the egg parasitoid, *Trichogramma chilonis. Indian. J. Ent*., **59:** 85-92

Paul, A.V.N., Singh, S. and Singh, A.K. 2002. Kairomonal effect of some saturated hydrocarbons and the egg parasitoids, *Trichogramma brasiliensis* (Ashmead) and *Trichogramma exiguum* Pinto, Planter and Oatman (Hymenoptera:Trichogrammatidae). *J. Appl. Ent*., **126:** 409-416

Shankarganesh, K. and Khan, M.A. 2006. Effect of some weed extracts on parasitization behavior of *Trichogramma* spp. (Hymenoptera : Trichogrammatidae). *J. Ent. Res*., **30:** 151-153

Received: March 15, 2013; Accepted: April 15, 2013