J. Biol. Control, 20(1): 13-18, 2006

Influence of strain variability and kairomonal substances on parasitization efficiency of *Trichogramma chilonis* Ishii (Hymenoptera: Trichogrammatidae)

N. BAKTHAVATSALAM and P. L. TANDON
Project Directorate of Biological Control (ICAR)
P. B. No 2491, H. A. Farm Post, Bellary Road, Hebbal
Bangalore 560 024, Karnataka, India
E mail: nbakthavatsalam@yahoo.com

ABSTRACT: ***Trichogramma chilonis*** **Ishii is an effective egg parasitoid for the management of several lepidopterous borer pests. With a view to improve its efficiency further, study was conducted on the influence of strain variability and kairomonal substances on its parasitization under multiple-choice assay using an 8-arm olfactometer. The results revealed that irrespective of treatment with kairomonal substances, highest mean parasitization of *Corcyra cephalonica* (Stainton) eggs (21.5%) was done by strain collected from the sugarcane borers (Strain 15). Least mean parasitization was observed in eggs exposed to Strain 22. Among the five kairomonal substances tested, hexacosane (0.1%) induced highest mean egg parasitization. The interaction between *T. chilonis* strains and kairomones indicated that the combination of Strain 15 and hexacosane (0.1%) was most effective and registered highest egg parasitization (36.6%), followed by the combination of Strain 15 and tricosane (0.1%). The scope of selecting and utilizing the behaviorally responsive strains in combination with their effective kairomones for field release is discussed.**

KEY WORDS: Kairomonal substances, parasitization efficiency, strain variability, *Trichogramma chilonis*

INTRODUCTION

Trichogramma chilonis Ishii (Hymenoptera: Trichogrammatidae) is an effective egg parasitoid against several lepidopterous borer pests. Its efficacy has been proved either alone or in combination with other biocontrol agent for the management of *Helicoverpa armigera* (Hübner) on cotton (Rahman *et al.*, 2003; Balakrishnan *et al.*, 2004; Panchbhai *et al.*, 2004) and borer pest of sugarcane (Singhal *et al.*, 2001). Inter and intra-specific differences have been reported among *Trichogramma* spp. for various biological characters - adaptation to plant structures, habitat or climatic conditions; host attraction and suitability, walking speed, parasitization rate, response to searching stimulants (kairomones), fecundity, longevity and intrinsic rate of increase (Pak *et al.*, 1988). Several strains of trichogrammatids showing variation in biological attributes, i.e., resistance to pesticides and tolerance to climatic conditions have been studied in India (Ram, 1976; Ram and Sharma, 1977; Anonymous, 1994, 2004; Kumar *et al.*, 1994; Ingle *et al.*, 2004). However, the

Table 1. Details of strains used in this study

Sl. no.	Strain	Location	Host plant	Host insect
1.	Strain 14	Ludhiana, Punjab	Cotton	*Helicoverpa armigera*
2.	Strain 19	Rajahmundry, Andhra Pradesh	Tobacco	*H. armigera*
3.	Strain 24	Bangalore, Karnataka	Tomato	*H. armigera*
4.	Strain 22	Pune, Maharastra	Cotton	*H. armigera*
5.	Strain 15	Ludhiana, Punjab	Sugarcane	*Chilo* spp.

variation between strains in their response to the kairomones of their hosts is rather little known.

The kairomonal substances identified from the host insects, which attract the natural enemies, chiefly constitute unsaturated hydrocarbons - tricosane, pentacosane and docosane (Jones *et al.*, 1973). Compounds like tricosane, pentacosane, nonacosane were found to act as attractants for *T. chilonis* (Renou *et al.*, 1992; Padmavathi and Paul, 1998). The present study has been conducted with an objective to assess the influence of strain variability (within *T. chilonis*) and host kairomonal substances identified from the scales of *H. armigera* on parasitization efficiency of *T. chilonis*.

MATERIALS AND METHODS

The experiment was conducted during 2004-2005 in the Entomophagous Insect Behaviour Laboratory, Project Directorate of Biological Control under ambient conditions (Temperature 27±2°C and relative humidity 70±10%). Five strains of *T. chilonis* collected from different host plants and locations were used for studying their response to the kairomones (Table 1). However, these strains were earlier studied for different biological attributes. These strains were maintained on the eggs of *Corcyra cephalonica* (Stainton).

Kairomonal compounds

The kairomonal compounds like pentacosane, tricosane, nonacosane, docosane and hexacosane (Sigma Aldrich chemicals) were prepared at a concentration of 0.1 per cent with the hexane (HPLC grade) as the solvent. The kairomones were prepared freshly and the solution was sprayed on the Whatmann No 1. paper bits (approximately 2.5 cm^2) using an atomizer. The paper bits were left for 15 minutes at room conditions to ward off the smell of hexane.

Bioassay

The experiment was conducted in an 8-arm olfactometer made of transparent, non-adsorbent and non-volatile acrylic sheet, consisting of a central arena of 7cm radius with 8 arms of each having 6 cm length and 3.5 cm inner diameter, fixed at equal interval. In each arm of the olfactometer, the paper bits treated with one of the kairomonal compounds were kept. A small bit of card, containing 50 fresh eggs of UV irradiated *C. cephalonica* was kept in each arm by the side of the kairomones paper bit and the arms were closed with a muslin cloth. One hundred adults from a particular strain were released in the arena of the olfactometer with all the five sides containing the kairomone compounds. One arm was maintained as control without any kairomone compounds with only the *Corcyra* egg bit. Two arms were kept closed with cello tapes to avoid the adults entering the room. A mild wind flow of 0.5m /second was maintained with the help of a mini fan fitted with an electronic regulator. The eggs were removed after 60 minutes and kept in the individual vials. After 4-6 days the eggs were observed for parasitization. The set-up was frequently rotated to nullify the effect of phototropism. The experiment was replicated 5 times for each strain.

The per cent eggs parasitized was computed from the raw data and then transformed to arcsine

values. Finally, the data were analyzed using two ways ANOVA with strains as one factor and kairomonal compounds as another.

RESULTS AND DISCUSSION

The criteria for strain selection in *Trichogramma* spp. are reported as adaptability to field temperature conditions, searching efficiency, host species and host age selection, host recognition, host suitability, and response to kairomones (Pak *et al.*, 1988). In the present study- " influence of strain variability and kairomonal substances on the parasitization efficiency of *T. chilonis*", it was observed that irrespective of treatment of different kairomonal substances, Strain-15 recorded highest mean parasitisation (21.5%) of *Corcyra cephalonica* eggs. The strain was significantly superior (p=0.05) to all other strains tested. Lowest mean egg parasitization was recorded by Strain 22 (10.9%). Among the five-kairomonal substances tested, hexacosane (0.1%) elicited significant highest mean parasitisation (19.04%), followed by tricosane (0.1%). However, the interaction between strains and kairomonal substances revealed that the combination of Strain 15 and hexacosane (0.1%) registered highest egg parasitization (36.6%), followed by the combination of Strain 15 and tricosane (0.1%) (Table 2). In earlier study, Paul *et al.* (2002) reported very high parasitoid attraction index and parasitism for *Trichogramma brasiliense* (Ashmead) and *Trichogramma exiguum* Pinto, Platner and Oatman as influenced by pentacosane and hexacosane. The behaviour of the entomophage to the kairomone compounds is attributed to the tuning of the entomophage to the kairomones from the host insect/ host plant from where it was collected. All the 5 strains collected were from different host plants though the host insect was same except for the sugarcane strain, which was collected from *Chilo* spp. The preference of strains to the particular compounds indicated that these kairomonal compounds might be present in more suitable proportion in sugarcane stem borers as compared to *H. armigera*. Aldrich and Zhang (2002)

Table 2. Parasitism by different strains of *T. chilonis* on the *C. cephalonica* eggs treated with different kairomonal compounds

Compound	Per cent parasitization					
	Strain 14	Strain 15	Strain 19	Strain 24	Strain 22	Mean
Tricosane	18.0 (24.96)	28.0 (31.61)	18.6 (25.50)	13.3 (21.37)	11.3 (19.61)	17.84 (24.62)
Pentacosane	20.6 (31.61)	20.6 (26.87)	18.6 (25.50)	10.6 (18.99)	11.3 (19.61)	16.62 (23.70)
Nonacosane	10.0 (18.06)	12.0 (19.53)	22.6 (25.86)	15.3 (22.98)	11.3 (19.61)	14.24 (21.21)
Hexacosane	10.0 (20.09)	36.6 (37.26)	18.6 (25.50)	18.0 (25.04)	12.0 (21.94)	19.04 (25.97)
Docosane	13.3 (20.95)	16.6 (26.60)	10.6 (18.99)	18.6 (25.50)	11.3 (19.34)	14.08 (22.22)
Control	7.3 (15.68)	15.3 (23.02)	18.06 (25.40)	16.6 (23.94)	8.0 (16.21)	13.16 (20.85)
Mean	13.4 (21.20)	21.5 (27.43)	17.9 (24.46)	15.4 (22.97)	10.9 (19.40)	
CD (P≥0.05)						
For strains	0.96					
For compound	1.05					
For strain and compound	6.66					

Figures in parentheses are arcsine-transformed values.

established that kairomone strains of *Euclytia flava* (Townsend) co-exist in nature, which showed differential response to the pheromone compounds of the host insect, *Podisus* sp. that is used as kairomone by the parasitoids. Similar observations were made on *Telenomus podisi* (Ashmead) strains (Borges *et al.*, 2003). The selection of strains for particular host and host plants is indirectly dependant on these volatile molecules, which constitute the kairomones. These studies also suggest that apart from biological attributes, this preference to kairomonal substances also form important criteria for the selection and improvement of strains. Feasibility of using hexaconsane as the kairomonal substance for the enhanced performance of this strain under field on *H. armigera* need to be explored.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. R. J. Rabindra, Project Director, Project Directorate of Biological Control for providing necessary facilities. The technical assistance rendered by Ms K. V. Usha (T-4), and Mr. Bharati Dasan, Technical officer (T-6) is gratefully acknowledged.

REFERENCES

Aldrich, J. R. and Zhang, A. 2002. Kairomone strains of *Euclytia flava* (Townsend), a parasitoid of stink bugs. *Journal of Chemical Ecology*, **28**: 1565-1582.

Anonymous, 1994. *Chrysopids and Trichogrammatids: Strain Selection and Utilization*. Technical Bulletin No. 9, Project Directorate of Biological Control, Bangalore. 45pp.

Anonymous, 2004. *PDBC-Annual Report 2003-04*. Project Directorate of Biological Control. Bangalore 560 024.

Balakrishnan, N., Baskaran, R. K. M. and Mahadevan, N. R. 2004. Efficacy of *Trichogramma chilonis* Ishii in combination with bio-pesticides against *Helicoverpa armigera* (Hübner) in rainfed cotton ecosystem. *Journal of Biological Control*, **18**(2): 121-127.

Borges, M., Colazza, S., Ramirez-Lucas, P., Chauhan, K. R., Moraes, M. C. B. and Aldrich, J. R. 2003. Kairomonal effect of walking traces from *Euschistus heros* (Heteroptera: Pentatomidae) on two strains of *Telenomus podisi* (Hymenoptera: Scelionidae). *Physiological Entomology*, **28**(4): 349-355.

Ingle, M. B., Ghorpade, S. A., Salagre, A. R. and Bade, B. A. 2004. Improvement in the egg parasitoid (*Trichogramma chilonis* Ishii) to insecticide tolerance. *Journal of Maharastra Agriculutral University*, **29**(3): 303-304.

Jones, R. L., Lewis, W. , Berozoa, M., Bierl, B. A. and Sparks, A. N. 1973. Host seeking stimulants (kairomones) for the egg parasite, *Trichogramma evanescens*. *Environmental Entomology*, **2**(4): 593-596.

Kumar, M. G., Sundarababu, P. C. and Edward, Y. S. J. T. 1994. Contact toxicity of insecticides to ecotypes of egg parasitoid, *Trichogramma chilonis* Ishii. *Madras Agricultural Journal*, **81**(8): 437-439.

Padmavathi, C. and Paul, A. V. N. 1998. Saturated hydrocarbons as kairomonal source for the parasitoid *Trichogramma chilonis* Ishii. (Hymenoptera: Trichogrammatidae). *Journal of Applied Entomology*, **122**(1): 29-32.

Pak, G. A., Noldus, L. P. J. J., Albeek, F. A. N. van. and Lenteren, J. C. van. 1988. The use of *Trichogramma* egg parasites in the inundative biological control of lepidopterous pests of cabbage in the Netherlands. *Ecological Bulletins*, **39**: 111-113.

Panchbhai, P. R., Sharnagat, B. K., Nemade, P. W., Bagade, I. B. and Nanddaar, N. R. 2004. Efficacy of independent and combined releases of *Trichogramma chilonis* and *Chrysoperla carnea* against cotton bollworms. *Journal of Soils and Crops*, **14**(2): 371-375.

Paul, A. V. N., Singh, S. and Singh, A. K. 2002. Kairomonal effect of some saturated hydrocarbons on the egg parasitoids, *Trichogramma brasiliensis* (Ashmead) and *Trichogramma exiguum* Pinto, Platner and Oatman (Hymenoptera: Trichogrammatidae). *Journal of Applied Entomology*, **126**(7-8): 409-416.

Rahman, S. J., Rao, A. G. and Reddy, P. S. 2003. Potential and economics of Biointensive insect pest management (BIPM) module in cotton for sustainable production. pp. 279-283. In: P. L. Tandan, C. R.

Ballal, S. K. Jalali and R. J. Rabindra. (Eds.), *Biological Control of Lepidopteran Pests*. Society for Biocontrol Advancement, Bangalore.

Ram, A. 1976. Studies for improving fecundity and sex ratio of *Trichogramma fasciatum* (Perkins) (Hymenoptera: Trichogrammatidae). *Entomologists Newsletter*, **6**(2): 12.

Ram, A. and Sharma, A. K. 1977. Selective breeding for improving fecundity and sex ratio of *Trichogramma fasciatum* (Perkins) (Trichogrammatidae, Hymenoptera) an egg parasite of lepidopterous hosts. ENTOMON, **2**(2): 133-137.

Renou, M., Nagnan, P., Berthier, A. and Durier, C. 1992. Identification of compounds from the eggs of *Ostrinia nubilalis* and *Mamestra brassicae*. *Entomlogia Experimentalis et Applicata*, **63**(3): 291-303.

Singhal, R. C., Gupta, M. R. and Narayan, D. 2001. Eco-friendly approach for minimizing populations of sugarcane stalk borer (*Chilo auricilius*) in the Tarai belt of Uttar Pradesh, India. In: D. M. Hogart (Ed.), *Proceedings of XXIV Congress of International Society of Sugarcane Technologists*, **2**: 374-377.