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

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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 *Cercyra 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 intraspecific 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

<table>
<thead>
<tr>
<th>Sl. no.</th>
<th>Strain no.</th>
<th>Location</th>
<th>Host plant</th>
<th>Host insect</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Strain 14</td>
<td>Ludhiana, Punjab</td>
<td>Cotton</td>
<td><em>Helicoverpa armigera</em></td>
</tr>
<tr>
<td>2.</td>
<td>Strain 19</td>
<td>Rajahmundry, Andhra Pradesh</td>
<td>Tobacco</td>
<td><em>H. armigera</em></td>
</tr>
<tr>
<td>3.</td>
<td>Strain 24</td>
<td>Bangalore, Karnataka</td>
<td>Tomato</td>
<td><em>H. armigera</em></td>
</tr>
<tr>
<td>4.</td>
<td>Strain 22</td>
<td>Pune, Maharastra</td>
<td>Cotton</td>
<td><em>H. armigera</em></td>
</tr>
<tr>
<td>5.</td>
<td>Strain 15</td>
<td>Ludhiana, Punjab</td>
<td>Sugarcane</td>
<td><em>Chilo spp.</em></td>
</tr>
</tbody>
</table>

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 *Coreyra 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 cm²) 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 *Coreyra* 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
Influence of strain variability and kairomonal substances on parasitization efficiency of T. chilonis

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 Coreya 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 brasilense (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

<table>
<thead>
<tr>
<th>Compound</th>
<th>Strain 14</th>
<th>Strain 15</th>
<th>Strain 19</th>
<th>Strain 24</th>
<th>Strain 22</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tricosane</td>
<td>18.0(24.96)</td>
<td>28.0(31.61)</td>
<td>18.6(25.50)</td>
<td>13.3(21.37)</td>
<td>11.3(19.61)</td>
<td>17.84(24.62)</td>
</tr>
<tr>
<td>Pentacosane</td>
<td>20.6(31.61)</td>
<td>20.6(26.87)</td>
<td>18.6(25.50)</td>
<td>10.6(18.99)</td>
<td>11.3(19.61)</td>
<td>16.62(23.70)</td>
</tr>
<tr>
<td>Nonacosane</td>
<td>10.0(18.06)</td>
<td>12.0(19.53)</td>
<td>22.6(25.86)</td>
<td>15.3(22.98)</td>
<td>11.3(19.61)</td>
<td>14.24(21.21)</td>
</tr>
<tr>
<td>Hexacosane</td>
<td>10.0(20.09)</td>
<td>36.6(37.26)</td>
<td>18.6(25.50)</td>
<td>18.0(25.04)</td>
<td>12.0(21.94)</td>
<td>19.04(25.97)</td>
</tr>
<tr>
<td>Docosane</td>
<td>13.3(20.95)</td>
<td>16.6(26.60)</td>
<td>10.6(18.99)</td>
<td>18.6(25.50)</td>
<td>11.3(19.34)</td>
<td>14.08(22.22)</td>
</tr>
<tr>
<td>Control</td>
<td>7.3(15.68)</td>
<td>15.3(23.02)</td>
<td>18.06(25.40)</td>
<td>16.6(23.94)</td>
<td>8.0(16.21)</td>
<td>13.16(20.85)</td>
</tr>
<tr>
<td>Mean</td>
<td>13.4(21.20)</td>
<td>21.5(27.43)</td>
<td>17.9(24.46)</td>
<td>15.4(22.97)</td>
<td>10.9(19.40)</td>
<td></td>
</tr>
</tbody>
</table>

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 dependent 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 hexacontane 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.

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