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# Effect of volatiles from leaves of rice cultivars on the foraging behaviour of *Trichogramma* spp. (Hymenoptera: Trichogrammatidae)

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## ABSTRACT

*Within the ecosystem of a crop field, orchard, or vineyard, various chemicals released from organisms may modify the physiology, morphology or behaviour of the other members of the ecosystem. Chemical cues play a major role in transmitting information, whether the chemicals come from various herbivores, from plants or from the interaction of the herbivores and the plants. Plant hydrocarbons act as synomones for Trichogramma spp. in a variety of crop ecosystems. Some Trichogramma species show a preference for particular host plant species, in response to an attractive synomone. We tested the possible synomonal role of leaf extracts from 29 rice varieties on the foraging behaviour and parasitism rate of Trichogramma japonicum Ashmead and Trichogramma chilonis Ishii. The results indicated that both T. Chilonis and T. japonicum showed increased parasitization when volatiles of cultivars of rice were present. While for some volatiles from cultivars like Jyoti, KCP-1, Vilirajamundi and KRH-3 the response of T. Japonicum was very high, in cases like Basmati 370, IET-8116, KRH-3, KMT-148, Kadamba, KRH-2, Jaya and VTT-5204 the response by T. chilonis was high. A response of 67.44 % was recorded to volatiles from the variety KCP-1, by T. Japonicum; whereas, a response of 82.52% was recorded to volatiles from the variety Basmati, by T. chilonis.*

***Key words:*** *rice leaf volatile, foraging behaviour, Trichogramma*

Increasingly, natural, eco-friendly parasitoids, predators and pathogens are used to kill crop pests. Several parasitoids and predators, such as trichogrammatids, braconids, chrysalides and coccinellids are natural enemies of diverse pest species that infest important crops. Utilizing mechanisms that evidently have evolved over the eons, plants attract (by means of chemical cues) carnivorous arthropods that then feed on herbivore species that would otherwise cause crop damage. Additionally, such chemical cues may come from the herbivore or from the interaction of the herbivore and the plant. Some volatile chemical compounds emitted from plant tissue most likely were originally noxious substances that simply repelled pests; but in time, such emitted chemicals, or modified forms of them, became detectable by parasitoids and predators in search of prey that frequented these plants.

Parasitoids are aided by a complex of non-nutritional, volatile compounds secreted by plants, which are commonly referred to as semiochemicals. In particular, synomones play a major role by enabling natural enemies to follow a chemical gradient to find the potential host or prey on the plant (Hilker and Meiners 2006). Such cues may stimulate foraging and host selection behaviour by entomophages, increasing their effectiveness for IPM (Ahmad *et. al.,* 2004). In plants, hydrocarbons act as synomones for *Trichogramma spp.* in different crop ecosystems (Yadav *et. al.*, 2002; Paul *et. al.*, 2008). The genus *Trichogramma* Westwood has been widely used in biological control programmes because of its polyphagous nature against many lepidopteran pests of economically important crops (Fatouros *et. al.*, 2008). Many *Trichogramma* species show a preference for various species of host plants, possibly based on synomones (Hilker and Meiners 2006; Tabone *et. al.*, 2010). We tested the possible synomonal effect of leaf extracts from 29 varieties of rice on the foraging behaviour and parasitism rate of *Trichogramma japonicum* Ashmead and *Trichogramma chilonis* Ishii.

The experiments were conducted under laboratory conditions of 27±2°C and RH 70±10%, during 2008-2010. Leaf samples of the cultivars of rice in the vegetative phase (Table 1) were collected 30 days after they were transplanted at the VC Farm, Mandya, (Karnataka). The samples were transported in a sealed polythene container to the laboratory. For each determination, 5 grams of leaf material was added to a conical flask, 50 ml of methanol was added and mixed in a rotary shaker at 80-90 rpm, at ambient temperature for 24 hours. Then, the extract was filtered through Whatman filter paper. Additional methanol was added to bring the volume to 100 ml, and then the extract was stored in a refrigerator (5°C). The cultures of the egg parasitoids, *T. chilonis* and *T. japonicum*, were maintained on eggs of *Corcyra cephalonica* (Stainton). Two-day old adult females were used in all the experiments. Fresh eggs of *C. cephalonica* used in the experiments were obtained from the insects maintained in the laboratory.

**Table 1.** Percent Parasitization of *Trichogramma japonicum* and *Trichogramma chilonis* when exposed to the hexane extract of rice.

| Rice Variety | Percent Parasitization | |
|---|---|---|
| | *T. japonicum* | *T. Chilonis* |
| Basmati 370 | 37.99 (40.72)[j, k, l] | 82.52 (48.83)[a] |
| CTH-3 | 53.44 (37.90)[c, d, e, f] | 50.68 (40.83)[f, g, h, i] |
| CTH-1 | 30.95 (42.75)[l, m] | 60.23 (52.49)[d, e, f] |
| KMT-105 | 29.74 (42.40)[j, k, l] | 46.05 (58.62)[g, h, i, j] |
| KMT-148 | 51.55 (38.61)[c, d, e, f] | 72.75 (40.84)[b, c] |
| KCP-1 | 67.44 (44.47)[a, b] | 53.83 (53.21)[e, f, g, h, i] |
| Mangla | 26.50 (42.98)[l, m] | 60.61 (41.78)[d, e, f] |
| Rasi | 50.88 (43.11)[c, d, e, f, g] | 31.97 (51.13)[l] |
| MTU-1010 | 38.67 (41.59)[f, g, h, i, j] | 44.78 (56.54)[h, i, j, k] |
| Jyoti | 63.99 (38.33)[a] | 35.24 (38.61)[j, k, l] |
| KMP-149 | 37.95 (40.19)[g, h, i, j, k, l] | 35.79 (51.40)[j, k, l] |
| JR-20 | 21.85 (43.12)[m] | 42.06 (38.25)[i, j, k, l] |
| IR-64 | 44.81 (42.69)[c, d, e, f] | 57.07 (46.50)[d, e, f, g, h] |
| IR-30864 | 42.49 (40.07)[e, f, g, h, i, j] | 32.93 (52.01)[k, l] |
| KRH-2 | 39.91 (36.96)[h, i, j, k, l] | 67.21 (40.66)[c, d] |
| KRH-3 | 60.01 (39.65)[c, d, e] | 79.85 (50.05)[a, b] |
| TANU | 47.68 (39.81)[d, e, f, g, h, i] | 59.26 (40.73)[d, e, f] |
| MTU-1001 | 46.79 (46.14)[c, d, e, f, g, h] | 56.88 (50.92)[d, e, f, g, h] |
| IET-8116 | 30.57 (40.95)[k, l, m] | 80.50 (50.55)[a, b] |
| Vilirajamundi | 61.08 (37.80)[b, c] | 57.24 (36.92)[d, e, f, g] |
| Mandya vijaya | 52.96 (43.69)[c, d, e, f] | 46.12 (52.57)[g, h, i, j] |
| RP-BIO-326 | 36.83(39.90)[g, h, i, j, k, l] | 63.19 (39.15)[c, d, e] |
| VTT-5204 | 58.58 (42.78)[b, c, d] | 60.02 (51.10)[d, e, f] |
| Kadamba | 33.60 (41.46)[j, k, l] | 71.88 (52.07)[b, c] |
| Jaya | 36.23 (37.67)[i, j, k, l] | 60.38 (39.75)[d, e, f] |
| BR2-655 | 38.70 (43.04)[f, g, h, i, j, k] | 45.67 (57.48)[g, h, i, j] |
| TN1 | 63.37 (36.08)[a, b] | 50.62 (39.89)[f, g, h, i] |
| PTB-33 | 35.49 (41.16)[h, i, j, k, l] | 31.04 (50.41)[l] |
| Triguna | 41.45 (45.23)[f, g, h, i, j, k] | 42.59 (48.41)[i, k, l] |
| Control | 17.22 (39.05)[n] | 17.30 (40.91)[m] |
| CD (P<0.05) | 6.39 | 7.16 |

Value within parantheses are angular transformed values
values with similar superscripts under the same column does not differ significantly

The bioassays were conducted in a plastic wind tunnel made of transparent, non-adsorbent, non-odorant acrylic sheet (4mm thick), with a trap chamber (25 cm dia.) and a test chamber (25 cm dia.) connected through a tunnel (15 cm dia.), as shown in Figure 1a & 1b. The length of the wind tunnel was 100 cm. A rubber septa impregnated with 0.2 ml samples of the methanol extracts of the respective varieties of rice was positioned at a distance of 50 cm from the test chamber, along with a small piece of card board containing 50 UV radiated fresh eggs of *C. cephalonica.*

One hundred adults of *T. chilonis* or *T. japonicum* were released into the test chamber and a wind flow of filtered air (passed through activated charcoal) at 25 cm per second was maintained from the trap chamber into the test chamber. After 60 minutes, the egg cards were collected and kept in a small vial for observation. The rate of parasitization, which is directly related to the number of adults visiting the egg cards, was calculated once the eggs turned black after 5 days. Six replications were performed for each treatment. The per cent of eggs parasitized was computed from these data. The percentages were transformed into arcsine values; and then, the data were subjected to an analysis of variance (ANOVA).

Both *T. japonicum* and *T. chilonis* showed parasitization of *Corcyra* eggs on different cultivars of rice. However, there were important variations between the cultivars. In some cultivars like Jyoti, KCP-1, TN1, Vilirajamundi and KRH-3 the response by *T. japonicum* was very high, in other cultivars like Basmati 370, IET-8116, KRH-3, KMT-148, Kadamba, KRH-2, Jaya and VTT-5204 the response by *T. chilonis* was high. Strikingly, the highest response of 67.44% was recorded in the variety KCP-1 by *T. japonicum* and 82.52% was recorded in the variety Basmati. This result revealed that *T. japonicum* can also be effectively used in the selected cultivars of rice (Table 1), which confirms earlier studies (Wakil *et. al.*, 2011; Chakraborty *et. al.*, 2011).

The possible synomonal effects of leaf extracts of 29 varieties of rice on *T. japonicum and T. chilonis* were tested. Extracts from the vegetative phase of KCP-1 showed the maximum percentage parasitism response for *T. japonicum*, whereas, Basmati showed a maximum percentage parasitism response for *T. chilonis*. The marked foraging response of the Trichogrammatids towards particular varieties of rice might be due to the presence of certain favourable hydrocarbons and other chemicals. From a pest management view point, the present findings may be utilized to enhance the effectiveness of the deployment of egg parasitoids against many potentially damaging lepidopterous pests.

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