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Research Article

Influence of rice cultivars on the parasitization efficiency of *Trichogramma chilonis* Ishii and *Trichogramma japonicum* Ashmead

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ABSTRACT: Trichogrammatids are efficient egg parasitoids in rice agroecosystem and two species of *Trichogramma* viz., *Trichogramma chilonis* Ishii and *T. japonicum* Ashmead were reported from several species of rice stem borers and other lepiodpterous pests. Physicochemical variations between the cultivars of crops often interfere with the efficiency of the *Trichogramma* spp. The response of *T. chilonis* and *T. japonicum* to the variations in the volatile profile of rice cultivars was investigated. The results indicated that the parasitization efficiency of both *T. chilonis* and *T. japonicum* was influenced by the volatiles of rice cultivars. While in some cultivars, such as Kadamba, MTU-1010, KMT 148, KCP-1, the response of *T. chilonis* was very high, in some of the cultivars like CTH-1, MTU 1010, VTT-5204, the response by *T. japonicum* was high. The highest overall response of 83.89 % was recorded in the variety Kadamba by *T. chilonis*. Volatile profile of the cultivars indicated the presence of 9,12,15 octadecatrienoic acid and 9-octadecenal might have played positive role in the attraction of *T. chilonis* to specific cultivars while hexadecane, heptadecane, petadecane and hexadeconic acid might be responsible for the attraction of *T. japonicum*

KEY WORDS: *Trichogramma chilonis, Trichogramma japonicum, rice cultivars, volatile*

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INTRODUCTION

The *Trichogramma* of egg parasitoids play a significant role in the management of lepidopteran pests. *Trichogramma chilonis* Ishii and *Trichogramma japonicum* Ashmead are effective egg parasitoids used in the management of *Chilo* spp. and *Scirpophaga incertulas* Walker, respectively, on sugarcane and rice (Jalali *et al*., 2003).

Physicochemical characters of plants such as trichomes and leaf volatiles often influence the efficiency of the parasitism by trichogrammatids (Tandon, 2001). Inter species and intraspecies variation often play an important role in the trichogrammatid searching behaviour on plants (Khan and Tiwari, 2001; Shankarganesh and Khan, 2006a; 2006b; Balakrishnan *et al.,* 2006; Singh *et al.,* 2001; Virk *et al.,* 2004; Dandale *et al.,* 2002; Hakeem *et al*., 2006b; Basit *et al.,* 2001; Tandon and Bakthavatsalam, 2001; 2002; 2004; 2005). While the trichomes and their exudates negatively influenced the searching behaviour of *T. chilonis* on the chickpea (Romeis *et al.,* 1999), chemicals such as heneicosane in the vegetative phase and heneicosane and tricosane in the flowering phase in chickpea attracted trichogrammatids (Srivastava *et al.,* 2004).

In our studies, the parasitization response of *T. chilonis* and *T. japonicum* to the variations in the volatile profile of rice cultivars was investigated.

MATERIALS AND METHODS

The experiments were conducted under laboratory conditions of 27±2°C and RH 70±10%, during 2008-2010.

Plant extracts

Leaf samples of cultivars of rice in the vegetative phase (Table 1) were collected 30 days after they were transplanted from the VC farm, Mandya, (Karnataka) and the samples were brought in sealed polythene containers to the laboratory. For each determination, 5 grams of leaf material was kept in 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. The extract was filtered through Whatman filter paper and additional

Table 1: Percentage parasitization of *Trichogramma chilonis* and *Trichogramma japonicum* as influenced by the methanol extract of rice

Rice variety	Percent parasitization	
	T. chilonis	*T. japonicum*
BASMATI 370	50.14 (44.97)	26.33 (30.82)
CTH-3	33.23 (35.04)	47.62 (43.62)
CTH-1	34.70 (35.80)	55.69 (48.51)
KMT-105	28.12 (31.79)	31.72 (33.99)
KMT-148	56.00 (48.53)	37.59 (37.64)
KCP-1	52.99 (46.71)	38.13 (38.03)
MANGLA	42.94 (40.49)	29.24 (32.58)
RASI	33.26 (35.30)	21.87 (27.69)
MTU-1010	58.27 (49.80)	55.55 (48.24)
JYOTI	36.13 (36.66)	22.58 (27.93)
KMP-149	38.05 (37.96)	18.24 (24.99)
JR-20	18.23 (23.29)	23.63 (28.96)
IR-64	44.56 (41.69)	30.25 (33.23)
IR-30864	32.75 (34.68)	42.32 (40.56)
KRH-2	36.02 (36.39)	41.41 (40.05)
KRH-3	36.29 (36.88)	17.46 (24.41)
TANU	0.64 (3.63)	32.59 (34.75)
MTU-1001	27.55 (31.52)	30.85 (33.56)
IET-8116	30.1 (33.11)	17.45 (24.37)
VILIRAJAMUNDI	34.45 (38.96)	47.43 (43.50)
MANDYA VIJAYA	39.91 (39.16)	28.88 (32.46)
RP-BIO-326	32.87 (34.90)	32.32 (34.53)
VTT-5204	36.19 (36.84)	50.36 (45.18)
KADAMBA	83.89 (66.57)	32.59 (34.72)
JAYA	26.37 (54.40)	34.59 (35.98)
BR2-655	43.27 (33.66)	29.79 (33.01)
TN1	41.675 (40.16)	38.62 (37.16)
PTB-33	41.98 (40.27)	25.39 (30.14)
TRIGUNA	31.23 (33.92)	29.45 (32.76)
CONTROL	24.14 (29.42)	24.15 (29.42)
CD at 5%	8.96	6.45
CV %	20.78	16.1

methanol was added to bring the volume to 100 ml and the extract was stored in a refrigerator (5°C).

Insect cultures

The cultures of the egg parasitoids, *T. chilonis* and *T. japonicum* were maintained on the eggs of *Corcyra cephalonica* (Stainton), at the Entomophagous Insect Behaviour Laboratory. Two-day old adult females were used in all the experiments. Fresh eggs of *C. cephalonica* used in the experiments were obtained from the Mass Production Laboratory of this Institute.

Wind tunnel bioassay

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.). 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 rice varieties 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 flow of filtered (passed through the activated charcoal) air at 25 cm per second was maintained from the trap chamber to the test chamber. After 60 minutes, the egg cards were collected and kept in a small vial for observation. The parasitization, which is directly related to the number of adults visiting the egg cards, was counted once the eggs turned black after 5 days of experiment. Six replications were maintained for each treatment. The per cent of eggs parasitized was computed from these observations. The percentage values were transformed into arcsine values and then the data were subjected to analysis of variance (ANOVA).

Volatile analysis

Volatile analysis of the rice samples was conducted in an Agilent GC-MS. The inlet temperature was kept at 250°C, with a constant flow of helium of 99.999% purity @ 1ml/min. A phenyl siloxane column (30 m x 0.25 um) (HPMS–5 Column) was used as the stationary phase. The oven program was set at an initial temperature of 40°C min^{-1} with a 2 minute hold and a ramp of 6°C min^{-1} until 180°C, held for 2 min, with a column flow of 1 ml/min, and the mass spectral detector was maintained at a temperature of 280°C. The mass spectra created using the MS was compared with those in the Wiley Mass Spectral Library.

RESULTS AND DISCUSSION

Both *T. chilonis* and *T. japonicum* showed parasitization response to cultivars of rice. However, there were variations between the cultivars. While, in some cultivars like Kadamba, MTU-1010, KMT 148, KCP-1, the response by *T. chilonis* was very high, in cultivars like CTH-1, MTU 1010, VTT-5204 the response by

T. japonicum was high. Strikingly, the highest response of 83.89% was recorded in the variety Kadamba by *T. chilonis*. This result revealed that *T. chilonis* can also be effectively used in the selected cultivars of rice (Table 2), which confirms earlier studies (Wakil, 2011; Chakraborty, 2011).

The volatile profile for the different varieties of rice cultivars indicated that KMT-148, MTU-1010 and KCP-1 showed the presence of 9,12,15 octadecatrienoic acid and KCP-1 showed the presence of 9-octadecenal, which should have acted as attractants for *T. chilonis*. For *T. japonicum*, the commonality of chemicals in the preferred cultivars, like CTH-1, MTU-1010 and VIT 5204, include hexadecanes heptadecane, petandeance and hexadeconic acid. The presence of pentadecane, ocatdecane and nonadecane was noticed in cultivar 5204. Additionally, 9,12,15 octadecatrienoic acid was present in MTU-1010.

Table 2. Volatile profile of rice cultivars using GCMS

Rice variety	Volatiles identified
BASMATI 370	Heptadecane, 13-tetradecanal, 2,4–dioctylphenol, hexadecanoic acid, 9,12,15-octadecatrienoic acid
CTH-3	Heptadecane, 13-tetradecanal
CTH-1	Hexadecane, eicosane, heptadecane, 2 propanone, hexadecanoic acid
KMT-105	2-Propanone, hexadecanoic acid
KMT-148	2-Propanone, hexadecanoic acid, 9,12, 15-octadecatrienoic acid, ethyl linoleolate
KCP-1	Pentadecane, octadecane, 9-octadecenal, 13-tetradecenal, tetradecanoic
MANGLA	1-Octene, heptadecane, 13-tetradecenal, 14-methyl-8-hexadecyn-1-ol, hexadecanoic acid, 9,12, 15-octadecatrienoic acid
RASI	Heptadecane, 9-octadecenal, 13-tetradecenal, tetradecanoic, hexadecanoic acid, 9,12, 15-octadecatrienoic acid
MTU-1010	1-Hexadecanol, hexadecane, heptadecane, pentadecane, 13-tetradecanal, nonadecane, hexadecanoic acid, 9,12,15-octadecatrienoic acid.
JYOTI	13-Tetradecenal, 1, 12-tridecadiene, 9-hexadecenoic acid, 9,12,15-octadecatrienoic acid.
KMP-149	2-Propanone, hexadecanoic acid, 9,12, 15-octadecatrienoic acid, ethyl linoleolate
JR-20	Heptadecane, octadecane, 13-tetradecanal ,hexadecanoic acid, 9,12,15-octadecatrienoic acid
IR-64	Pentacosane, octadecane, 9-octadecenal, 13-tetradecenal, tetradecanoic
IR-30864	2-Propanone, heptadecane, 13-tetradecenal, hexadecanoate, hexadecanoic acid, 9,12, 15-octadecatrienoic acid.
KRH-2	Hexadecane, octadecane, Geranyl linalool isomer, Styrene, 5-Hydroxymethylfurfural, 2, 6-dimethoxyphenol
KRH-3	Heneicosane, octacosane, pentacosane, heptadecane, hexadecanoic acid
TANU	Hexadecane, eicosane, heptadecane, pentadecane, octadecane, nonadecane
MTU-1001	Heptadecane, Phytol, methyl linoleate, Neophytadiene, Methyl octadecanoate
IET-8116	Hexacosane, Tricosane, Farnesol, Isocaryophyllene, (E,E)-Farnesyl acetone, Triacontane, Pentacosane, Nonacosane, Octacosane
VILIRAJAMUNDI	Hexadecanoic acid, 9.12,15- octadecatrienoic acid
MANDYA VIJAYA	Hexadecanoic acid, 9,12,15-octadecatrienoic acid
RP-BIO-326	Nonadecane, hexadecanoic acid, 9.12,15- octadecatrienoic acid
VTT-5204	Pentadecane, octadecane, nonadecane
KADAMBA	Hexadecane, eicosane, heptadecane, 9,12, 15-octadecatrienoic acid.
JAYA	Thunbergol, Neophytadiene, Octacosane, Geranyl linalool isomer, Cyclohexane, Styrene, 5-Hydroxymethylfurfural, 2, 6-dimethoxyphenol, Heptadecane, Octadecane, Eicosane, trans-Phytol
BR2-655	Hexadecane, heptadecane, nonadecane, Pentacosane, Octacosane
TN1	5-(Hydroxymethyl)furfural, 4-vinyl-2-methoxy-phenol, 1,4-dihydro-1-naphthalenone, (E)-isoeugenol, isopropylpseudocumene, cyclohexane, thunbergol, farnesyl acetate, heptacosane, eicosane, hexacosane, tricosane, farnesol, methyl palmitate, isocaryophyllene, (E,E)-farnesyl acetone, triacontane, pentacosane, nonacosane, octacosane
PTB-33	Heptacosane, eicosane, hexacosane, tricosane, hexadecanoic acid
Triguna	Phytol, methyl linoleate, neophytadiene, nethyl palmitate, hexadecanoic acid, methyl octadecanoate

Madhu *et al.* (2000) indicated that nonadecane in sorghum elicited higher parasitisation by *T. japonicum*. Rani *et al.* (2007) inferred that pentadecane, hexadecane and nonadecane deterred oviposition. Pentadecane, octocosane and heptadecane were considered to be favourable hydrocarbons for *T. exiguum* and not for *T. brasiliensis* (Paul *et al.*, 2002). Generally, trichogrammatid preferred compounds having higher number of carbon atoms. However, to establish the preference of cultivars by different species, individual compounds and combinations of compounds need to be tested.

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