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Effect of coriander plant extract on the parasitization behaviour of *Trichogramma chilonis* Ishii (Hymenoptera : Trichogrammatidae)

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ABSTRACT: In the present investigation the coriander plant volatiles for the tritrophic interactions on the egg parasitoid *Trichogramma chilonis* Ishii is evaluated. The GCMS profile study of the foliage extract of coriander in both hexane and dichloromethane showed presence of 2-Dodecenal-(E), (E)-Tetradec-2-enal, Octadecane, Nonacosane, Hexadecane, Pentadecane and Heneicosane, which are of biologically active fractions in insects. In laboratory study the maximum parasitization was recorded in hexane extract treated *Corcyra* card (31.04 eggs/card) compared to 28.16 eggs per card observed in untreated control. The data gathered on number of parasitized eggs hatched into adult indicated that in hexane extract treated *Corcyra* card had 91.19 per cent while parasitoid emergence was 29.30 eggs per card followed by 87.76 per cent in untreated control 24.90 eggs per card. The GCMS profile study of the foliage extract of coriander in both hexane and dichloromethane showed presence of 2-Dodecenal-(E), (E)-Tetradec-2-enal, Octadecane, Nonacosane, Hexadecane, Pentadecane and Heneicosane, which are of biologically active fractions in insects. The above findings reveal the possible role of such active chemicals in parasitoid compatibility of the intercrop. © 2020 Association for Advancement of Entomology

KEYWORDS: Coriander, *Trichogramma chilonis,* tritrophic interactions, *Corcyra*, GC-MS

INTRODUCTION

The augmentatory biocontrol agent *Trichogramma chilonis* Ishii egg parasitoid is widely used for the management of various lepidopteran pests including brinjal shoot and fruit borer *Leucinodes orbonalis* Guenee. There are reports that the periodical release of *T. chilonis*, the egg parasitoid effectively control *L. orbonalis* problem in brinjal cultivation with substan-tial increase in yield (Satpathy *et al.*, 2005). Sasikala *et al.* (1999) found that the egg parasitoid *T. japonicum* could efficiently reduce *L. orbonalis* damage in brinjal. Niranjana (2015) indicated the egg parasitoid *T. pretiosum* is efficient in brinjal ecosystem among different *Trichogramma* spp tested. However, information on the performance of *T. chilonis* in coriander intercropped brinjal crop is not available so the present study was carried out. This research has been carried out in Agricultural College and Research Institute, Killikulam in Thoothukudi district of Tamil Nadu.

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MATERIALS AND METHODS

Studies on coriander plant extract in influencing parasitization behaviour of T. chilonis:

The kairomone extract of coriander (Var. CO1) was obtained using different solvents *viz.*, Hexane, Dichloromethane, Acetone and distilled water. The coriander leaf sample (50 gm) was taken and macerated with the 50 ml of specific solvents using the pestle and mortar. The extract was filtered through glass funnel with filter paper (Whatman No. 42). A total volume of 100 ml of filtrate form each solvent was collected in a reagent bottle (250 ml). The solvent extracts were further concentrated to dryness using rotary evaporator (IKA RV10). The extract thus obtained using different solvent system was stored in air tight glass vials at -20^0 C for further use.

Studies on the volatile profile of coriander solvent extracts:

In an attempt to understand the volatile profile of the coriander leaf extracts of different solvents system, GC-MS technique (Bandoni *et al.,* 1998) was followed. Gas Chromatography–Mass Spectrometry (Shimadzu QP 2020) available in Centre of Innovation at Department of Biotechnology at Agricultural College and Research Institute, Madurai was used. The compounds were identified by comparing with the NIST spectral library.

The details on the instrumentation condition is as follow

Column type and Length	:	R_{xi} 5 MS Silica and 30m
Column diameter and Thickness	:	0.25mm and 0.25µm
Carrier gas	:	Helium
Flow rate	:	1 ml/ min
Injected port temperature	:	250^{0}C
Injection volume	:	0.5 µl
Split mode ratio	:	1:10
MS interface temperature	:	270^{0}C
MS ion sources temperature	:	200^{0}C
Oven temperature	:	70^{0}C with increase of 5^0 C per min to 120^{0}C ending with a 5 min isothermal at 280^0 C
Detector	:	MS
Total run time	:	40.00 min

Influence of coriander crop on parasitization behaviour of T. chilonis under laboratory condition (Free choice test):

Influence of coriander extract as kairomone on parasitization behaviour of *T. chilonis* was studied at a concentration of 0.1 per cent in respect of different solvent system. For this purpose the 0.1g of kairomone extract was dissolved in equal quantity of alcohol and the volume was made to 100 ml by using distilled water. The egg card of size 7cm × 2 cm having unparasitized *Corcyra* egg was taken and dipped into the kairomone extracts and shade dried. After shade drying the cards were labelled and hanged randomly from top of oviposition cage (45cm×35cm). For each treatment three cards were used. The cage had fine mesh (0.2 mm) fixed in all six side. The *T. chilonis* parasitized *Corcyra* card (0.5 cc) was placed inside the cage on a petriplate. The experimental setup was placed undisturbed in well ventilated dark place in the insect culture room maintained at 23-24^{0}C room temperature and 80 per cent RH. Four days of exposure period, the *Corcyra* cards were collected treatment wise and observed for the number of parasitized eggs which was easily differentiated by their black color. The cards were kept in laboratory undisturbed in a labelled zip lock cover for making further observations on extend of parasitization and parasitoid emergence pattern. Experiment was replicated thrice and repeated four times.

RESULTS AND DISCUSSION

Investigation on kairomone profile of coriander extracts (GC-MS study):

The performance of *T. chilonis* due to the influence of semiochemicals if any present in coriander was further investigated through biochemical analysis of volatile profile through GCMS study (Table 1). The GCMS profile of the foliage extract of coriander

Sample Information

Sample Described by customer as: Corander DCM

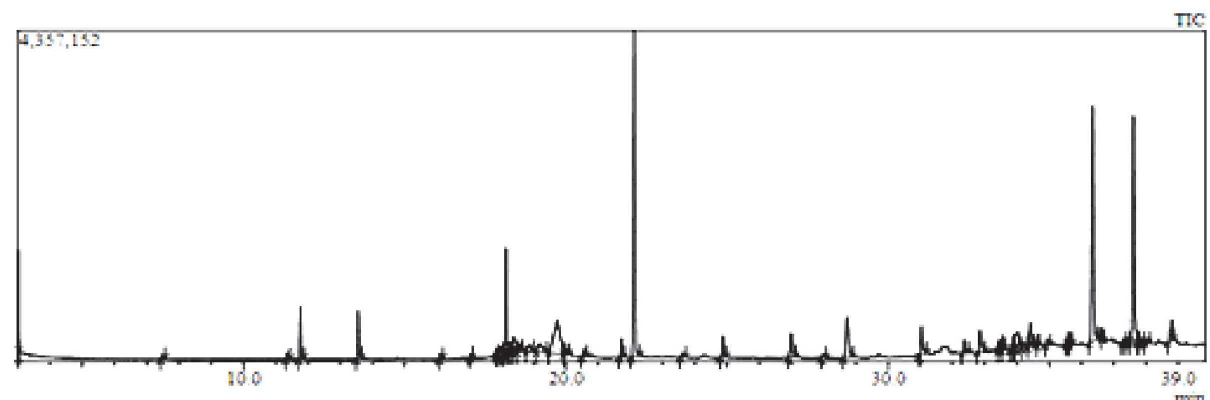

Fig. 1. GC-MS chromotogram of coriander extract (Dichloromethane extract)

Sample Information

Sample Described by customer as: Consider plant Hexane

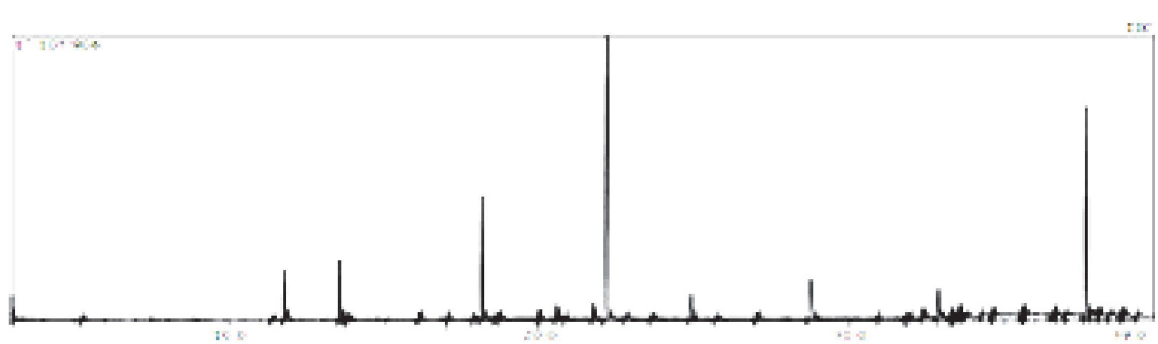

Fig. 2. GC-MS chromotogram of coriander extract (Hexane extract)

Table 1.The major volatile compounds identified from coriander plant extract using GC-MS

1. Hexane extract

S.No	RT	% Area	Chemical Compound
1.	11.791	4.92	Decanal
2.	13.733	3.39	2-Decen-1-ol, (E)-
3.	18.167	12.17	2-Dodecenal, (E)-
4.	22.179	27.88	(E)-Tetradec-2-enal
5.	28.763	4.01	(E)-Hexadec-2-enal
6.	37.633	20.62	n-Tetracosanol-1

2. Dichloromethane extract

S.No	RT	% Area	Chemical Compound
1.	11.769	2.74	Decanal
2.	13.554	2.39	2-Decenal, (Z)-
3.	18.147	4.57	2-Dodecenal, (E)-
4.	19.736	7.51	1-Heptacosanol
5.	22.117	18.66	(E)-Tetradec-2-enal
6.	27.001	2.00	Neophytadiene
7.	28.723	4.15	(E)-Hexadec-2-enal
8.	31.034	2.07	n-Hexadecanoic acid
9.	34.010	2.16	Octatriacontyltrifluoroacetate
10.	36.354	15.63	1-Triacontanol
11.	37.607	11.92	n-Tetracosanol-1
12.	38.804	1.59	Nonacosane

was studied in two different solvent systems namely hexane (non-polar) and dichloromethane (intermediately polar). The major compound recovered in the non-polar solvent system includes (E)-Tetradec-2-enal (27.88 %), n-Tetracosanol-1(20.62 %) and 2-Dodecenal, (E) (12.17 %). The other compounds found in significant proportion are decanal (4.92 %), 2-decenal, (Z) (3.39 %), and (E)-hexadec-2-enal (4.01 %) (Fig. 1).

The intermediate polar compound dichloromethane, the major volatile compounds detected includes (E)-Tetradec-2-enal (18.66 %), 1-Triacontanol (15.63 %), n-Tetracosanol-1 (11.92 %) and 2-Dodecenal, (E) (4.57 %) (Fig. 2). The other compounds found are decanal (2.74 %), 2-decenal, (Z) (2.39 %), and (E)-hexadec-2-enal (4.15 %). Among various compound detected 2-Dodecenal-(E),(E)-Tetradec-2-enal, Octadecane, Nonacosane, Hexadecane, Pentadecane and Heneicosane are of known biologically active fractions on insects. The major compound (E)-Tetradec-2-enal was found to an extend of 28.86 per cent in hexane and 18.66 per cent in dichloromethane. The other compound 2-Dodecenal-(E) was found upto 3.39 per cent in hexane and 2.39 per cent in dichloromethane. In hexane fraction the other bioactive compound identified includes Hexadecane (1.43 %), Pentadecane (0.76 %) and Octadecane (0.16 %). Nonacosane (1.59 %) and Heneicosane (0.38 %) are the two bioactive compounds recovered in dichloromethane fraction.

The present study is in accordance with Hilker *et al.* (2002) who found that the volatile semiochemicals, non-volatile cues also mediate host searching behaviour of *Trichogramma* spp. Plants on which adult moths have been present may provide such cues for host location. In the work of Bruce (2001), Tandon and Bakthavatsalam (2005) and Nathan (2007) they indicated that the host plant volatile components are known to influence the performance of biocontrol agent. Benzaldehyde, (S)-(±)-limonene, (R,S)-(±)-linalool, (E) myroxide, (Z)-b-Ocimene, phenyl acetaldehyde, and (R)- (±)-piperitone are components identified in *Tagetes erecta* that attract both *Helicoverpa armigera* and its parasitoids. They also reported the trap crop *T. erecta* is *Trichogramma*-friendly. Seni and Dilawari (2011) observed synomonal response of *H. armigera* females to flower extracts of African marigold, cotton, okra and pumpkin to varying degree which was due to the presence of favourable hydrocarbons.

Table2. Influence of coriander extracts on parasitization behaviour of *T. chilonis* (Free choice test)

Treatments	Number of parasitized eggs/ card (Mean of 20 observation)				Mean
	Exp 1	Exp 2	Exp 3	Exp 4	
Hexane extract of coriander	37.55(6.15)	29.00(5.37)	34.65(5.93)	26.75(5.22)	31.04
Dichloro methane extract of coriander	21.50(4.64)	18.21(4.25)	20.46(4.58)	14.55(3.85)	18.68
Acetone extract of coriander	23.71(4.91)	22.06(4.70)	23.35(4.88)	20.66(4.59)	22.45
Distilled water extract of coriander	18.70(3.43)	23.23(4.82)	21.54(4.69)	19.46(4.42)	20.73
Control	34.72(5.93)	27.52(5.22)	25.60(5.11)	24.79(5.02)	28.16
SEm	0.248	0.221	0.021	0.223	
CD (0.01)	1.032	0.922	0.088	0.926	

Figures in parentheses are square root transformed values.

Table 3. Influence of coriander extracts on *T. chilonis*parasitoid recovery pattern of (Free choice test)

Treatments	Number of parasitized eggs/ card (Mean of 20 observation)				Mean
	Exp 1	Exp 2	Exp 3	Exp 4	
Hexane extract of coriander	37.09(6.12)	25.17(5.05)	30.74(5.58)	24.20(4.95)	29.30
Dichloro methane extract of coriander	20.05(4.49)	18.21(4.30)	12.84(3.59)	14.55(3.85)	16.42
Acetone extract of coriander	15.81(4.00)	16.60(4.11)	15.46(3.96)	17.48(4.23)	16.34
Distilled water extract of coriander	18.70(3.43)	14.71(3.86)	21.54(4.69)	9.36(3.13)	16.07
Control	33.24(5.81)	23.20(4.84)	24.43(4.99)	18.73(4.32)	24.90
SEm	0.245	0.272	0.242	0.282	
CD (0.01)	1.057	1.134	1.009	1.173	

Figures in parentheses are square root transformed values.

Table 4. Per cent parasitoid emergence of *T. chilonis* influenced by coriander extracts

Treatments	Number of parasitized eggs/ card (Mean of 20 observation)				Mean
	Exp 1	Exp 2	Exp 3	Exp 4	
Hexane extract of coriander	98.77(0.46)	86.79(3.83)	88.72(3.91)	90.47(2.55)	91.19(1.74)
Dichloro methane extract of coriander	93.26(1.45)	100.00 (0.00)	62.76(7.62)	100.00 (0.00)	89.00(2.26)
Acetone extract of coriander	66.68(7.90)	75.25(5.46)	66.21(7.89)	84.61(3.18)	73.19(6.11)
Distilled water extract of coriander	100.00(0.00)	63.32(8.52)	100.00 (0.00)	82.58 (10.10)	86.48(4.66)
Control	95.74(1.48)	84.30(4.32)	95.43(1.17)	75.55(6.06)	87.76(3.26)

Studies on coriander extracts on parasitization behaviour of *T. chilonis* under laboratory studies:

Studies on extend of parasitization-

With an aim to understand the role of kairomone presence of the intercrop (coriander), the parasitization performance of *T. chilonis* was studied using the laboratory host *Corcyra* egg card treated with kairomones of different solvent system. In the observation I, maximum level of parasitization was noticed in hexane (37.55 eggs/ card) treated *Corcyra* cards and minimum level of parasitization was observed in distilled water (18.70 eggs/ cars) treated *Corcyra* card compared to 34.72 eggs per card in control. In the second observation, the parasitization observed was 18.21 eggs per card in dichloromethane treated *Corcyra* eggs and 29.00 eggs per card in hexane treated *Corcyra* egg card compared to 27.52 eggs per card in control. During observation III, the highest level of parasitization was observed in hexane (34.65 eggs/ card) treated *Corcyra* cards and a low level of parasitization of 20.46 eggs per card was recorded in dichloromethane treated *Corcyra* cards compared to 25.60 eggs per card seen in control. In observation IV, the peak level of parasitization was recorded in hexane (26.75 eggs/ card) extract treated card compared to 24.79 eggs per card in control and a low level of parasitization was recorded in dichloromethane treated *Corcyra* card (14.55) (Table 2).

Based on overall mean, the treatments were in the order of hexane (31.04 eggs/ card) > untreated control (28.16 eggs/ card) > acetone (22.45 eggs/ card) > distilled water (20.73 eggs/ card) > dichloromethane (18.68 eggs/ card).

Studies on parasitoid recovery pattern-

Further observations on the number of parasitoids emerging from the parasitized eggs were made under laboratory condition. For this purpose, the parasitized cards of previous experiment were kept undisturbed in a labelled in zip lock cover and observation on number of parasitoid emerged from each parasitized cards were recorded (Table 3). In overall mean, a maximum parasitoid recovery was recorded in hexane extract treated *Corcyra* card (29.30 eggs) followed by untreated control (24.90 eggs), dichloromethane (16.42 eggs), acetone (16.34 eggs) and distilled water (16.07 eggs).

Studies on parasitoid emergence-

Based on overall mean data, compared to 87.76 per cent parasitoid emergence was seen in control, maximum per cent parasitoid emergence was observed in hexane treated card (91.19 %) followed by dichloromethane treated card (89.00 %), aqueous extract treated card (86.48 %) and 73.19 per cent parasitoid emergence in acetone treated *Corcyra* cards (Table 4).

The result of the present observation is in accordance with the finding of Tandon and

Bakthavatsalam (2005) to reported the volatile compounds obtained from hexane *Tagetes erecta* flower extract to show increased parasitization potential in *T. chilonis.* Yadav *et al.* (2001) reported the presence of pentacosane in potato (*Solanum tuberosum*) and soybean (*Glycine max*) and classified pentacosane as favourable saturated hydrocarbon for *T. exiguum, T. chilonis* was observed to be associated mainly with tricosane, heneicosane, pentacosane and hexacosane during the vegetative period and heneicosane and hexacosane during the flowering period. The coriander extract contains 2-Dodecenal-(E), (E)-Tetradec-2-enal, Octadecane, Nonacosane, Hexadecane, Pentadecane and Heneicosane which are of biologically active fractions on insects.. The findings reveals possible role of such active chemicals in parasitoid compatibility of the intercrop coriander.

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