# Evaluation of Biological Attributes on *Trichogramma chilonis* and *Trichogramma japonicum* on different Factitious Hosts under Laboratory Conditions

Anoosha V[1*]; Chalapathi Rao NBV[2]; Govardhan Rao V[3]; Neeraja B[4]; Kireeti A[5]; Mujahid Khan[6]

[1-5]Dr. YSRHU-Horticultural Research Station, Ambajipeta
[6]Sri Karan Narendra Agriculture University, Jobner, Rajasthan
*Corresponding Author

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***Abstract—*** *The laboratory experiment was conducted during 2024 to study the different biological parameters of Trichogramma chilonis and Trichogramma japonicum on the factitious hosts Corcyra cephalonica and Cadra cautella. The present study revealed that 94.44 to 96.67 percent egg parasitization was recorded on C. cephalonica, which was found to be statistically at par with C. cautella eggs (93.33 to 96.67%). In the case of T.chilonis, percent parasitization ranged from 90.00 to 93.33% on both C. cephalonica and C. cautella eggs.*

*A shorter development period of T. chilonis was observed (7.67 days) when reared on the eggs of C. cautella, which was found at par with the eggs of C. cephalonica (8.00 days). In the case of T. japonicum, the development period ranged from 8.33 to 8.67 days when reared on both factitious hosts. Adult longevity was higher when T. chilonis and T. japonicum were reared on C. cautella eggs compared to C. cephalonica eggs.*

*Fecundity was not affected by the number of eggs or host species, as results were statistically at par. In the case of T. chilonis and T. japonicum, maximum female parasitoid recovery was noticed from the parasitized eggs of C. cautella, which was at par with C. cephalonica. The number of host eggs showed significant differences in percent adult emergence of both parasitoids. The highest percent adult emergence of T. chilonis and T. japonicum was reported when one gravid female parasitoid was exposed to 10 eggs/card, and the results were significantly different from the other two treatments (20 eggs/card and 30 eggs/card).*

***Keywords— C. cephalonica, C. cautella, T. chilonis, T. japonicum.***

## I. INTRODUCTION

Trichogrammatids are polyphagous egg parasitoid wasps distributed globally and play a crucial role in biological pest control, especially against lepidopteran pests, by parasitizing the eggs of other insects, thereby supporting ecological balance and sustainable agricultural practices (Jalai et al., 2016; Mahankuda and Sawai, 2020). They are widely used in biological control strategies, especially in inundative releases. Over 200 insect species are parasitized by various strains of trichogrammatids (Tanwar et al., 2006).

Various methods involving the use of chemicals and breeding strategies have helped enhance the efficacy of these parasitoids as bioagents in the eco-friendly management of many crops. *Trichogramma* wasps are commonly reared on factitious hosts such as *Ephestia kuehniella*, *Sitotroga cerealella*, and *Corcyra cephalonica* to facilitate mass production for biological control applications. These artificial hosts enable controlled rearing conditions, ensuring a consistent supply of parasitoids (Knutson, 2000).

However, it is important to note that prolonged rearing on factitious hosts can lead to host preference shifts, potentially affecting the parasitoid's efficiency on target pests under field conditions. Therefore, monitoring and managing host use in laboratory settings is crucial for maintaining the effectiveness of *Trichogramma* wasps in biological control programmes.

The present study was carried out to evaluate the efficiency of *T. chilonis* and *T. japonicum* on different factitious hosts (*Corcyra cephalonica* and *Cadra cautella*) in the laboratory by assessing their biological attributes, i.e., percent parasitism, adult longevity, development period, fecundity, percent adult emergence, and sex ratio.

## II. MATERIALS AND METHODS

The experiment was conducted in a Factorial Completely Randomized Design (FCRD) with twelve treatments, three factors, and three replications at the Biocontrol Laboratory, Department of Entomology, Dr. YSRHU-HRS, Ambajipeta, during 2024, to study the biological attributes of egg parasitoids *T. chilonis* and *T. japonicum* on the factitious hosts *C. cephalonica* and *C. cautella* eggs. Both parasitoids and factitious host egg cultures were reared at the Biocontrol Laboratory of Dr. YSRHU-HRS, Ambajipeta.

Twelve treatments were separated into different groups, i.e., 10 eggs/card, 20 eggs/card, and 30 eggs/card, respectively, for three replications. Similarly, other groups were made as per the requirement of the treatments. The desired-sized empty cards were smeared with gum, and host eggs were stuck on each card. These cards were then kept in glass tubes (15 × 2.5 cm). The host eggs were exposed to one gravid female parasitoid. The following observations were recorded.

### 2.1 Treatment Details:

#### 2.1.1 Number of eggs parasitized:

Under laboratory conditions, 10, 20, and 30 eggs of *C. cephalonica* and *C. cautella* were exposed for parasitization by *T. chilonis* and *T. japonicum*. Parasitized eggs were recorded by counting the blackened eggs (Singh et al., 1998). The data recorded were converted into percentages, and percent egg parasitization was calculated.

**Total Treatments:** 12

**Replications/Treatment:** 3

**Total Glass Tubes (15 × 2.5 cm):** 36 glass tubes

T1: One female of *T. chilonis* / 10 eggs of *C. cephalonica*
T2: One female of *T. japonicum* / 10 eggs of *C. cephalonica*
T3: One female of *T. chilonis* / 10 eggs of *C. cautella*
T4: One female of *T. japonicum* / 10 eggs of *C. cautella*
T5: One female of *T. chilonis* / 20 eggs of *C. cephalonica*
T6: One female of *T. japonicum* / 20 eggs of *C. cephalonica*
T7: One female of *T. chilonis* / 20 eggs of *C. cautella*
T8: One female of *T. japonicum* / 20 eggs of *C. cautella*
T9: One female of *T. chilonis* / 30 eggs of *C. cephalonica*
T10: One female of *T. japonicum* / 30 eggs of *C. cephalonica*
T11: One female of *T. chilonis* / 30 eggs of *C. cautella*
T12: One female of *T. japonicum* / 30 eggs of *C. cautella*

#### 2.1.2 Development period of *T. chilonis* and *T. japonicum* on different host eggs:

The duration between exposure of *C. cephalonica* and *C. cautella* host eggs to parasitoid females and adult emergence of *T. chilonis* / *T. japonicum* was recorded under laboratory conditions.

#### 2.1.3 Adult longevity (in days):

Five newly emerged adult parasitoids per treatment were kept in small glass vials (7.5 × 1.21 cm) with a streak of honey on the inner wall and a strip of eggs. Adult longevity was determined from the day of emergence until death.

#### 2.1.4 Fecundity:

The number of host eggs parasitized by the gravid female was counted, and fecundity was determined as per the method described by Miura and Kobayashi (1995). The number of eggs parasitized by a single female per day was used to express fecundity.

### 2.1.5 Sex ratio:

Emerged adults were categorized into male and female under a microscope based on morphological characters:

- **Female:** Antennae clubbed with few short hairs on flagellum.
- **Male:** Antennal hairs tapering and moderately long.

### 2.2 Percent adult emergence:

Out of total parasitized host eggs, the number of parasitoids emerged was counted based on emergence holes, and percent adult emergence was determined:

$$\text{Percent adult emergence} = \frac{\text{Number of black eggs with emergence hole}}{\text{Number of parasitized host eggs}} \times 100 \quad (1)$$

### 2.3 Statistical Analysis:

Data were analyzed using a three-factorial Completely Randomized Design (CRD) in OPSTAT software.

## III. RESULTS AND DISCUSSION

### 3.1 Percent egg parasitization:

The data presented in Table 1 show that for *T. chilonis*, percent parasitization ranged from 94.44 to 96.67% on *C. cephalonica*, which was found at par with *C. cautella* (93.33 to 96.67%). For *T. japonicum*, percent parasitization ranged from 90.00 to 93.33% on both hosts.

Maximum parasitization occurred when parasitoids were exposed to 10 eggs/card, followed by 20 and 30 eggs/card. These findings agree with Kumari et al. (2020), who reported the highest percent parasitism of *T. chilonis* (89.33%) in *C. cephalonica* and 88.33% in *H. armigera*.

**TABLE 1**

**PERCENT PARASITIZATION BY *T. CHILONIS* AND *T. JAPONICUM* ON DIFFERENT HOST EGGS**

| Parasitoid | 10 eggs | | 20 eggs | | 30 eggs | |
|---|---|---|---|---|---|---|
| | *C.cephalonica* | *C.cautella* | *C.cephalonica* | *C.cautella* | *C.cephalonica* | *C.cautella* |
| ***T.chilonis*** | 96.67 | 96.67 | 95 | 93.33 | 94.44 | 93.33 |
| | -83.86 | -83.86 | -79.55 | -77.71 | -79.35 | -75.36 |
| ***T.japonicum*** | 93.33 | 90 | 91.67 | 93.33 | 90 | 92.22 |
| | -77.71 | -75 | -73.79 | -75.24 | -71.73 | -76.72 |

| | Factor 'A' | Factor 'B' | Factor ' C' | Interaction |
|---|---|---|---|---|
| | (No. of eggs) | (Host) | (Parasitoid) | (AxBxC) |
| **'F' test** | NS | NS | NS | NS |
| **SE(m)±** | 2.695 | 2.2 | 2.2 | 5.39 |
| **CD (p=0.05)** | -- | -- | -- | -- |

### 3.2 Development period:

Data in Table 2 show that the development period of *T. chilonis* was shorter (7.67 days) on *C. cautella* eggs and statistically at par with *C. cephalonica* (8.00 days). For *T. japonicum*, the development period ranged from 8.33 to 8.67 days on both hosts. These findings align with Dileep (2012), Funde et al. (2020), and Rathi and Ram (2000), who reported similar development durations on *C. cephalonica*.

**TABLE 2**

**DEVELOPMENT PERIOD OF *T. CHILONIS* AND *T. JAPONICUM* ON DIFFERENT HOST EGGS**

| Parasitoid | 10 eggs | | 20 eggs | | 30 eggs | |
|---|---|---|---|---|---|---|
| | *C.cephalonica* | *C.cautella* | *C.cephalonica* | *C.cautella* | *C.cephalonica* | *C.cautella* |
| ***T.chilonis*** | 8 | 7.67 | 8.33 | 8 | 8.33 | 8 |
| | -2.99 | -2.94 | -3.05 | -3 | -3.05 | -2.99 |
| ***T.japonicum*** | 8.67 | 8.67 | 8.33 | 8.67 | 8.67 | 8.33 |
| | -3.11 | -3.11 | -3.05 | -3.11 | -3.11 | -3.05 |

| | Factor 'A' | Factor 'B' | Factor ' C' | Interaction |
|---|---|---|---|---|
| | (No. of eggs) | (Host) | (Parasitoid) | (AxBxC) |
| **'F' test** | NS | NS | Sig | NS |
| **SE(m)±** | 0.031 | 0.025 | 0.025 | 0.061 |
| **CD (p=0.05)** | -- | -- | 0.073 | -- |

### 3.3 Adult longevity

As shown in Table 3, *T. chilonis* exhibited the highest adult longevity (8.67 days) when reared on *C. cautella*, significantly different from *C. cephalonica* (7.33 days). Similarly, *T. japonicum* adults lived longer (8.67 days) on *C. cautella* than on *C. cephalonica* (7.67 days). These findings support the observations of Shirazi (2006) and Funde et al. (2020).

**TABLE 3**

**ADULT LONGEVITY OF *T. CHILONIS* AND *T. JAPONICUM* ON THE DIFFERENT HOST EGGS**

| Parasitoid | 10 eggs | | 20 eggs | | 30 eggs | |
|---|---|---|---|---|---|---|
| | *C.cephalonica* | *C.cautella* | *C.cephalonica* | *C.cautella* | *C.cephalonica* | *C.cautella* |
| ***T.chilonis*** | 7.33 | 8 | 7.67 | 8.67 | 8 | 8.67 |
| | -2.89 | -2.99 | -2.94 | -3.11 | -2.99 | -3.11 |
| ***T.japonicum*** | 7.67 | 8.33 | 8.33 | 8.67 | 8.33 | 8.33 |
| | -2.94 | -3.05 | 93.05) | -3.11 | -3.05 | -3.05 |

| | Factor 'A' | Factor 'B' | Factor ' C' | Interaction |
|---|---|---|---|---|
| | (No. of eggs) | (Host) | (Parasitoid) | (AxBxC) |
| **'F' test** | NS | Sig | NS | NS |
| **SE(m)±** | 0.035 | 0.028 | 0.028 | 0.07 |
| **CD (p=0.05)** | -- | 0.083 | -- | -- |

### 3.4 Fecundity

Data in Table 4 reveal no significant differences among hosts regarding fecundity. *T. chilonis* parasitized 5.67–6.67 eggs per female, while *T. japonicum* parasitized 4.67–6.67 eggs. Fecundity was unaffected by host or egg number. Similar findings were reported by Funde et al. (2020) and Shirazi (2006).

**TABLE 4**

**FECUNDITY OF *T. CHILONIS* AND *T. JAPONICUM* ON DIFFERENT HOST EGGS**

| Parasitoid | Fecundity /Per day/female | | | | | |
|---|---|---|---|---|---|---|
| | 10 eggs | | 20 eggs | | 30 eggs | |
| | *C.cephalonica* | *C.cautella* | *C.cephalonica* | *C.cautella* | *C.cephalonica* | *C.cautella* |
| ***T.chilonis*** | 6.67 | 6.33 | 6.33 | 5.67 | 6.33 | 5.33 |
| | -2.77 | -2.69 | -2.7 | -2.57 | -2.7 | -2.49 |
| ***T.japonicum*** | 5.67 | 5.67 | 4.67 | 5.33 | 6.67 | 5.67 |
| | -2.57 | -2.57 | -2.37 | -2.51 | -2.77 | -2.56 |

| | Factor 'A' | Factor 'B' | Factor ' C' | Interaction |
|---|---|---|---|---|
| | (No. of eggs) | (Host) | (Parasitoid) | (AxBxC) |
| **'F' test** | NS | NS | NS | NS |
| **SE(m)±** | 0.075 | 0.061 | 0.061 | 0.15 |
| **CD (p=0.05)** | -- | -- | -- | -- |

### 3.5 Sex ratio

Data in Table 5 show that *T. chilonis* produced the highest female ratio from *C. cautella* (1:1.80), at par with *C. cephalonica* (1:1.78). *T. japonicum* showed a similar trend with *C. cautella* (1:1.73) and *C. cephalonica* (1:1.52). Comparable results were observed by Funde et al. (2020).

**TABLE 5**

**SEX RATIO OF *T. CHILONIS* AND *T. JAPONICUM* ON DIFFERENT HOST EGGS**

| Parasitoid | 10 eggs | | 20 eggs | | 30 eggs | |
|---|---|---|---|---|---|---|
| | *C.cephalonica* | *C.cautella* | *C.cephalonica* | *C.cautella* | *C.cephalonica* | *C.cautella* |
| ***T.chilonis*** | 01:01.8 | 01:01.8 | 01:01.7 | 01:01.8 | 01:01.3 | 01:01.4 |
| ***T.japonicum*** | 01:01.2 | 01:01.6 | 01:01.5 | 01:01.7 | 01:01.0 | 01:01.3 |

| | Factor 'A' | Factor 'B' | Factor ' C' | Interaction |
|---|---|---|---|---|
| | (No. of eggs) | (Host) | (Parasitoid) | (AxBxC) |
| **'F' test** | NS | NS | NS | NS |
| **SE(m)±** | 0.132 | 0.108 | 0.108 | 0.263 |
| **CD (p=0.05)** | -- | -- | -- | -- |

### 3.6 Percent adult emergence

Table 6 indicates that when 10 host eggs were offered, adult emergence of *T. chilonis* was 96.67% on both hosts. For *T. japonicum*, adult emergence was 96.30% on *C. cautella* and 89.63% on *C. cephalonica*. Significant differences were observed between treatments. When 20 and 30 eggs/female were provided, adult emergence ranged between 84.45–91.80% in both parasitoids. These findings align with Rathi and Ram (2000) and Funde et al. (2020).

**TABLE 6**

**PERCENT ADULT OF *T. CHILONIS* AND *T. JAPONICUM* ON DIFFERENT HOST EGGS**

| Parasitoid | 10 eggs | | 20 eggs | | 30 eggs | |
|---|---|---|---|---|---|---|
| | *C.cephalonica* | *C.cautella* | *C.cephalonica* | *C.cautella* | *C.cephalonica* | *C.cautella* |
| ***T.chilonis*** | 96.67 | 96.67 | 84.45 | 89.45 | 91.8 | 89.28 |
| | -83.86 | -83.85 | -67.2 | -71.05 | -73.41 | -70.88 |
| ***T.japonicum*** | 89.63 | 96.3 | 89.06 | 89.28 | 91.4 | 89.12 |
| | -74.65 | -83.51 | -70.69 | -70.89 | -73 | -70.74 |

| | Factor 'A' (No. of eggs) | Factor 'B' (Host) | Factor ' C' (Parasitoid) | Interaction (AxBxC) |
|---|---|---|---|---|
| **'F' test** | sig | NS | NS | NS |
| **SE(m)±** | 2.022 | 1.651 | 1.651 | 4.043 |
| **CD (p=0.05)** | 5.902 | -- | -- | -- |

## IV. CONCLUSION

From the results of the present study, it is concluded that maximum female parasitoid recovery and shorter development periods of *T. chilonis* and *T. japonicum* were observed from parasitized eggs of both *C. cautella* and *C. cephalonica*. The highest percent adult emergence for both species was recorded when one gravid female parasitoid was exposed to 10 eggs/card, significantly different from the 20- and 30-egg treatments.

These findings are of great importance for utilizing the almond moth (*C. cautella*) along with the commonly used factitious host *C. cephalonica* in the preparation of trichocards in biocontrol laboratories.

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