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BIOLOGICAL PARAMATERS OF TRICHOGRAMMA CHILONIS FEED ON CORCYRA CEPHALONICA EGGS

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Article Info

Abstract

The genus Trichogramma includes an important egg parasitoid wasp Trichogramma chilonis which is a promising biocontrol agent for many agricultural pests globally. In the present study, biological parameters of T. chilonis were assessed reared on the eggs of Corcyra Cephalonica eggs under laboratory conditions (temperature 25 ± 1˚C: relative humidity 60±5 %, and lethal dose of 14:10). Percent parasitism, percent emergence, developmental time, sex ratio, and body size of emerged wasps from C. Cephalonica eggs were recorded. Result showed that T. chilonis successfully parasitized C. Cephalonica eggs up to 67.83% whereas the adult emergence was 58.66%. The developmental duration of T. chilonis was 7 days. The result also showed the emerged progeny population was female-biased (58.22%) as compared to male (41,78%). Based on the morphometric analysis, the average head width, body length, and hind tibia length of newly emerged T. chilonis females were 214.2µm, 472.1µm, and 138.5µm respectively. Whereas, the average head width, body length, and hind tibia length of male wasps were 204.7µm, 447.3µm, and 127.4µm. It is concluded that C. Cephalonica can be used as a potential host for the rearing of promising bio-control agent T. chilonis under laboratory conditions.

Keywords:

Trichogramma chilonis; Corcyra Cephalonica; Rearing; Biological Parameters.

1. Introduction

Egg parasitoids, including over 200 Trichogramma species, have already been tested against a wide range of lepidoptera of economic importance, mainly through inundative (augmentative) releases (Iqbal et al., 2021). The genus Trichogramma is comprised of approximately 650 parasitoid species. Literature suggests that nearly 200 species of the aforementioned genes are known parasitoid of the eggs of virus lepidopteran pests. Around 70 species of the genes Trichogramma have been mass-produced on a commercial scale and released in the field to control lepidopteran pest of different crops (Desneux et al., 2010). Species that are frequently reported and collected from crops in different agro-ecological systems are T. atop virilia, T. Chilonis, T. Deion, T. Thalense, T. Brevicapillum, T. Exiguum, T. Fuentesi, T. Minutum, T. Nubilale, T. Platneri, T. Pretiosu. Trichogramma species are best suitable biocontrol agents due to their convenient mass production, ability to attack multiple crop pests, and control the pests at their juvenile stages to prevent crops damage (Smith et al 1996; Sarwar et al 2013; Kuske et al. 2023).

Among the more than 230 species documented worldwide, egg parasitoids of the genus *Trichogramma* Westwood (Hymenoptera: Trichogramma tidae) are extensively used against agricultural pests in both annual and perennial crops (Oliveira et al., 2020). In northeastern China, the area of maize relying on Trichogramma releases for control of corn borers jumped from 600,000 to 5,500,000 ha during 2005–2015, accounting for 35% of the area under corn cultivation in this most important corn production region in China (Huang et al., 2020). It has been reported that the consistent release of Trichogramma parasitoids in a particular geographic location for many years leads to great economic and biological advantages (Wang et al., 2014).

Trichogramma tidea is a family of tiny wasps that are being used as biological control agents as well as parasitoid modeling (polilov et al., 2012). Trichogramma spp. are the most promising parasitoids in biological control programs because they parasitize lepidopteron eggs and kill them before they may harm the host plant (Ajudia et al 2018). In India, Rice moth, C. cephalonica, a stored grain pest is being utilized in various biocontrol research, developmental and extension units for mass production of number of natural enemies (Kumari et al., 2020). In addition, previous reports indicated up to 86% parasitism of T. chilonis toward Spodoptera frugiperda eggs (Zhang et al., 2023). Trichogramma species include. In a single day, a single female can parasitize up to ten host eggs (Ahlawat et al., 2023). The mass rearing and quality production of T. chilonis depends on several factors, i.e., temperature, relative humidity, photoperiod and host egg quality (Parveen et al., 2012). Experiments are conducted to assess the biology of T. chilonis cultured on C. cephalonica eggs under laboratory condition, having in mind the parasitoid's agricultural economic important.

2. MATERIALS AND METHODS

The current study was conducted in 2023 at the bio-control laboratories (JAMRA FARM TAKHTBAI MARDAN), to examine the biological parameters of T. chilonis Ishii. was reared on C. cephalonica host eggs under specific laboratory conditions (temperature 26±1 ˚C and 60-70 percent relative humidity with 16:8 light and dark cycle) (Lalitha et al., 2023).

2.1 Rearing of C. cephalonica (rice meal moth):

The eggs of C. cephalonica (rice meal moth) were obtained from an already established cultured reared an artificial diet. The artificial diet contain corn flour, wheat bran, sugar, yeast, and water (200 gm, 57 gm, 20 gm, 8.55 gm, and 42 ml) as shown in figure 5 (soumya et al., 2023). The eggs were kept at constant temperature (at 28˚C with 70% relative humidity) in the growth chamber for hatching. After hatching of eggs, larvae were transferred to larvae rearing cages having an artificial diet as shown in figure 4. A supplementary artificial diet was provided once weeks till the adult's emergence. Upon the emergence, the adult were collected in small plastic vials and were shifted to ovi-positions jars. The oviposition jars were made from transparent materials having a net both sides (top and bottom) and were kept on large size petri-dish for egg collection. The adults were allowed for mating and oviposition inside the jars. Every morning the eggs were collecting from the petri dishes and were subjected to further experiments.

2.2.Rearing of T. chilonis

For rearing the methodology of (soumya et al., 2023) was followed. Fresh eggs of C. cephalonica were obtained to maintain the T. chilonis culture. The C. cephalonica eggs that were collected were placed in a little vial with mesh over the top opening. The C. cephalonica eggs were sprinkled on the cards (4×3) cm uniformly and were left till the gums were dry. Then these cards were kept in rearing jars containing T. chilonis for multiplication as shown in figure 4.

2.3.Study of the biology of T. chilonis reared on C. cephalonica

To test the biological parameters of T. chilonis reared on host eggs of C. cephalonica, a total of 720 eggs of C. cephalonica were counted under the microscope. Small striped-shaped cards were prepared and 120 eggs of C. cephalonica were glued to each card. Newly emerged two pairs (male and females) of T. chilonis collected from the established cultured and were transferred to each glass tube that hosted a C. cephalonica eggs card (120 eggs per card). The T. chilonis parasitoid was allowed to parasitize host eggs for 24 hours. After 24 hours, parasitized egg cards were shifted to in an incubator chamber having environmental conditions of 26±1 ˚C temperature, 60-70% relative, and 16:8 light and dark cycle. The test was replicated six times. All the egg cards of C. cephalonica were examined on daily basis and the following parameters were recorded.

2.4.Morphometric analysis of emerged wasps

After emergence within 8hr, T. chilonis parasitoid were transferred to a glass tube (3.5 cm diameter, 10 cm long) and refrigerated at -4 ˚C for 10 minutes for storing till further processing. For morphometric analysis, ten fresh T. chilonis male and female samples were examined. Three end point for each wasp were taken into account for morphometric analysis under a microscope. The following parameters were examined.

- Wasp body length (from the front edge to the tip of the ovipositor)
- Wasp head width (from the outer edge of the left compound eye to the outer edge of the right compound eye)
- Wasp hind tibia length

2.5.Parasitism and bio-parameters of the *T. chilonis*

The percentage of parasitized eggs, the percentage of adults emerging, the developmental stage, the sex ratio, and the measurement of the body size of the emerging parasitoid wasps were all accurately recorded in the data.

3. RESULT AND DISCUSSION

The biological parameters of T. chilonis i.e. percent parasitism, percent emergence, developmental time wasps, and the proportion of sixes produced in a laboratory condition using C. cephalonica host eggs were recorded as shown in Table 1. The result showed that C. cephalonica was suitable laboratory-rearing host of T. chilonis parasitoid. When two mated females of T. chilonis were provided with 120 C. cephalonica eggs in a glass tube for 24hr, the percentage of parasitism recorded was 67.83% and the percent emergence of adults was 58.66%. the developmental period of T. chilonis was 7 days. After the emergence of wasps, the percentage of male and female wasps was recorded in the progeny population. The percentage of female wasp was 58.22% and of the male wasps was 41.78%. These results suggested that C. cephalonica moth is a factitious host for mass rearing of T. chilonis parasitoids under laboratory conditions.

Table 1: Recorded biological parameters of T. chilonis reared on C. cephalonica host.

Parasitoid wasp	**Biological parameters of T. chilonis**					**Eggs of C. cephalonica host (n)**
T. chilonis	Parasitism (%)	Emergence (%)	Developmental period (days)	Sex ratio Male (%)	Sex ratio Female (%)	
	67.83	58.66	7	41.78	58.22	120

Assessment of the body size of C. cephalonica reared T. chilonis was carried out by measuring the width of the head width, length of the body, and hind tibia. Both the male and female T. chilonis wasps were included in the morphometric analysis. The average head width, body length, and hind tibia length of T. chilonis female were 214.2 µm, 204.7 µm, and 472.1 µm, 500 µm, respectively. Similarly, the average head width, body length, and hind tibia length T. chilonis male counterparts were 100 µm, 138.5 µm, as shown in figure 1. respectively. Our finding showed that C. cephalonica eggs reproduce large-size T. chilonis parasitoid

Table 2: Morphometric analysis of T. chilonis wasps

Body Morphometric parameter	**T. chilonis developed in C. cephalonica eggs**	
	Male Morphometry (µm)	Female Morphometry (µm)
Head width	204.7 (µm)	214.2 (µm)
Body length	472.1 (µm)	500 (µm)
Hind tibia length	100 (µm)	138.5 (µm)

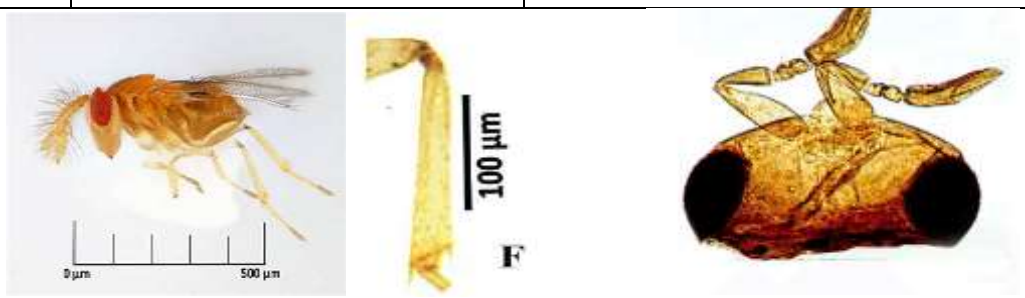

Figure1: morphometric analysis of Trichogramma chilonis

An appropriate selection of suitable Trichogramma species as a bio-control agent in IPM depends on multiple parameters i.e. evaluation of its parasitic potential, a developmental period in the host eggs, emergence rate in female-biased on progeny (Zhang et al., 2014; Song et al., 2015; Hou et al., 2018). Trichogramma parasitoids regard progeny emergence rates and parasitic potential to be reliable measures of host suitability (Zhang et al., 2018; Li et al., 2019). Our research revealed a significant level of parasitism and the emergence of T. chilonis from host eggs, demonstrative that C. cephalonica could serve as a good host for the mass rearing of T. chilonis in laboratory environment the advantages for large-scale production of T. chilonis for agricultural uses are the short developmental period in the female-biased progeny of T. chilonis in C. cephalonica host eggs. Hence parasitoid was reared in suitable host eggs

which are used as bio-control agents should have the potential to parasitize host multiple eggs and produce female-biased progeny (Hoffmann et al., 2001).

An in-depth analysis of how a specific host species effects of parasitoids key life traits during development, which are connected to parasitoid growth, body size, reproduction, and survival, is necessary for the development of cost-effective methods for the large-scale production and rearing of promising bio-control agents. (Morais et al., 2019; Watt et al., 2015; Wang et al., 2020). Our investigation revealed that T. chilonis wasp of a large size was developed from C. cephalonica host eggs. Larger body can provide parasitoid wasp a fitness advantages, which in turn increases parasitoid longevity and parasitic potential. (Wang and Keller, 2020). Large-bodied parasitoid wasps have characteristics that benefit their parasitic potential, such as lifetime fertility, increased dispersal potential, high longevity, and good host finding abilities. (Tang et al., 2017). The primary goal of numerous biological control programs is the development of lo-cot methods for the mass production of bio-control agent to monitor agricultural pests. (Watt et al. 2015). Our investigation showed that C. cephalonica is an excellent candidate host for the large-scale production of T. chilonis wasps. The selection and availability of suitable host species play a major role in the mass rearing of Trichogramma species.

Figure 2: Preparation of the diet for C. cephalonica and routine checking for small larval rearing

Figure 3: Display of Corcyra cephalonica eggs

Figure 4: Preparation of Trichocerids of the Trichogramma eggs

Figure 5: The artificial diet containing corn flour, wheat flour, wheat bran, and rice husk

Figure 6: Trichogramma eggs sprinkled on cards

4. Conclusion and recomendation

The present study investigated the biological parameter of T. chilonis such as percent parasitism, percent emergence, development duration, and sex ratio of factitious host C. cephalonica eggs. Trichogramma chilonis has successfully parasitized the host eggs, completed its incubation period in a short time interval and the progeny were mostly female-biased. Further the morphometric analysis of T. chilonis was also evaluated and found to be exerting positive selection pressure on T. chilonis progeny is indicated by the marked increase in the body morphometric parameters that in turn favor parasitoid longevity and parasitic potential. These finding demonstrated that C. cephalonica could be used as a potential host for the rearing of promising bio-control agent T. chilonis under laboratory conditions. It is further recommended that the

local farmers should be trained for rearing the Trichogramma and the government should facilitate the agriculture extension department for providing them with sufficient resources for conducting research on rearing the biological control agents and carrying out farmer field school (FFS).

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