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Research Note

Parasitic efficiency of different egg parasitoids against invasive fall armyworm, *Spodoptera frugiperda* (J. E. Smith)

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ABSTRACT: A study was conducted to examine the parasitic efficiency of different egg parasitoids viz., *Trichogramma chilonis* Ishii, *Trichogramma pretiosum* Riley (Hymenoptera: Trichogrammatidae) and *Telenomus remus* Nixon (Hymenoptera: Scelionadae) of *Spodoptera frugiperda* J.E. Smith (Lepidoptera: Noctuidae) and *Corcyra cephalonica* Stainton (Lepidoptera: Pyralidae), respectively under the laboratory condition at 28 ± 3°C. The investigation showed that *T. chilonis* displayed a parasitic efficiency ranging from 85 to 87 per cent, *T. pretiosum* from 80 to 89 per cent, and *T. remus* from 7 to 90 per cent. Both host species were accepted for parasitization, but *C. cephalonica* was identified as more suitable for the development of *T. chilonis* and *T. pretiosum*, while *S. frugiperda* was deemed the most suitable host for rearing *T. remus*. These findings contribute valuable insights into the host preferences and parasitic efficiencies of these parasitoids, essential information for potential applications in biological control strategies against agricultural pests.

Keywords: *Corcyra cephalonica*, egg parasitoids, parasitism, *S. frugiperda*

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The fall armyworm, *Spodoptera frugiperda* (J.E. Smith, 1797) (Lepidoptera, Noctuidae), is the most damaging maize pest in various countries, originated in America's tropical and subtropical regions, and annually migrates greater distances (Agboyi *et al*., 2020). The larvae of this pest feed on the maize crop extensively (Bueno *et al*., 2010). An investigation was undertaken to study the effectiveness of alternative methods for controlling this invasive pest, as well as the significant annual expenditure on chemical insecticides. The persistent use of various insecticides poses long-term sustainability challenges, contributing to the development of insecticide resistance, heightened production costs, and resulting in adverse effects on biodiversity, the environment, and the health of growers and consumers. The research aims to eco-friendly strategies to address these challenges, aiming for a more sustainable and balanced approach to pest management that minimizes adverse effects associated with conventional chemical control (Kenis *et al*., 2019). Biopesticides and biocontrol agents are emerging as alternative strategies to traditional chemical pesticides. These biological options are advantageous due to their host-specific nature, which reduces the risk of pest resurgence. Moreover, they are considered eco-friendly because of their higher selectivity and biodegradable properties. The use of biopesticides not only addresses environmental concerns associated with chemical pesticides but also aligns with sustainable pest management practices by promoting a more targeted and environmentally conscious approach to crop protection (Kumari *et al*., 2016).

Biological control, an integral component of Integrated Pest Management (IPM), employs natural enemies to regulate pests (Kenis *et al*., 2019). Egg parasitoids stand out as promising biological control agents for effectively managing this pest by targeting its eggs. Egg parasitoids are organisms that deposit their eggs on or inside a host organism's egg. The resulting larvae feed on the host egg tissues, eventually maturing and pupating. The damaging stage of this pest is the larval stage and egg parasitoids kill this pest in the egg stage and prevent them from causing damage to the host plant. The review of global literature revealed that egg parasitoids viz., *Trichogramma chilonis* Ishii, *Trichogramma pretiosum* Riley and *Telenomus remus* Nixon are associated with this pest. So, a study has been taken up to evaluate the parasitic efficiency of these egg parasitoids on *S. frugiperda* and *C. cephalonica*.

The eggs of various hosts, including *S. frugiperda* and *C. cephalonica*, were collected from host insect cultures that were raised in laboratories. A glass tube with a diameter of 2.5 cm and a length of 15 cm served as the experimental unit. Within the experimental tube, one pre-mated (2-day-old) female of each parasitoid species -*T. chilonis*, *T. pretiosum*, and *T. remus* was placed. Additionally, adult food in the form of an 80 per cent honey solution soaked in a cotton swab was supplied. Twenty recently laid, UV-irradiated eggs of the corresponding hosts were glued on a white paper card strip of 4 x 2 cm, and the glass tube was filled with the eggs (parasitoid : host ratio of 1:50) to determine the parasitism rate. After that, cotton plugs were used to seal the tube. The experiment, following a Completely Randomized Design with five replications, continued until parasitoid mortality. Based on the number of eggs that became blackout of all the eggs exposed to the parasitoids, the percentage of parasitism was calculated.

The data revealed (Table 1) that the average parasitism ranged from 85 to 87, 80 to 89 and 7 to 90 per cent, respectively in the laboratory condition at 28 ± 3°C temperature. The eggs of *C. cephalonica* exhibited the highest average parasitism for both *T. chilonis* and *T. pretiosum* (87 ± 0.55% and 89 ± 0.83%, respectively), while the eggs of *S. frugiperda* showed the least parasitization (85 ± 0.80% and 80 ± 0.71%, respectively). In contrast, *T. remus* demonstrated maximum parasitic efficiency on *S. frugiperda* eggs (90 ± 1%), and minimum on *C. cephalonica* eggs (7 ± 0.55%), as detailed in Table 1.

The results of the present investigation on the parasitization capacity of *T. chilonis* were in close conformity with the findings of Sisay *et al*. (2019) revealed that the parasitization percentage of *T. chilonis* was observed to be 20.9 per cent on eggs of *S. frugiperda* in Kenya during 2018. The parasitization percentage of *T. chilonis* was (83.75, 81.25, and 75.00 per cent, respectively) on *C. cephalonica* on 24, 48 and 72 hours old eggs respectively (Honnayya & Gawande, 2018).

The potential parasitism of *T. pretiosum* was 29.23 per cent on the eggs of *S. frugiperda* (Jaraleño-Teniente *et al*., 2020). Pinto and Fernandes (2020) illustrated that *T. pretiosum* parasitised 100 per cent eggs of *S. frugiperda*. The female of *T. pretiosum* parasitised 121.3 ± 5.0 eggs of *S. frugiperda*, during adulthood with an average of 23.5 ± 4.5 eggs per day. Laurentis *et al*. (2019) exhibited that the per cent parasitism of *T. pretiosum* on *C. cephalonica* eggs after 24 hours of exposure was 57.4 per cent and 84.6 per cent after 48 hours of exposure, respectively.

During the first 24 hours, 90.0 per cent of the *S. frugiperda* eggs were parasitized by *T. remus*. Females parasitized 574.0 eggs during adulthood with an average of 58.5 eggs per day (Pinto & Fernandes, 2020). Pomari-Fernandes *et al*. (2015) found that *T. remus* reared on *C. cephalonica* exhibited varying parasitism rates, ranging from 2.98 to 66.15 parasitized eggs per female across different generations (F0 to F9, F13, and F19). Additionally, when these *T. remus* individuals, reared on *C. cephalonica* eggs, were exposed to parasitism on *S. frugiperda* eggs for 24 h, the parasitized eggs per female ranged from 51.60 to 170.10. This suggests that the host species and exposure conditions significantly influence the parasitism behaviour of *T. remus*.

According to the current research, the parasitoids accepted both hosts' eggs for parasitization. In comparison to *S. frugiperda*, *C. cephalonica* is most suited for the development of *T. chilonis* and *T. pretiosum*. However, *S. frugiperda* is the best host for *T. remus* rearing.

Table 1. Parasitic efficiency of different egg parasitoids in parasitizing *S. frugiperda* and *C. cephalonica* eggs

Sr. No.	Parasitoids	List of hosts eggs	Total no of eggs on strip	No. of eggs parasitized			Per cent parasitism (Mean ± SD)
				4th day	5th day	Mean	
1.	*T. chilonis*	*C. cephalonica*	100	84	90	87	87 ± 0.55
2.	*T. chilonis*	*S. frugiperda*	100	82	88	85	85 ± 0.80
3.	*T. pretiosum*	*C. cephalonica*	100	87	91	89	89 ± 0.83
4.	*T. pretiosum*	*S. frugiperda*	100	77	83	80	80 ± 0.71
5.	*T. remus*	*C. cephalonica*	100	04	10	07	07 ± 0.55
6.	*T. remus*	*S. frugiperda*	100	86	94	90	90 ± 1.00

Mean± SD (n=100/host); SD - Standard deviation

CONCLUSIONS

The study investigated the parasitization behaviour and efficiency of three parasitoid species, namely *T. chilonis*, *T. pretiosum*, and *T. remus*, on the eggs of two hosts, *S. frugiperda* and *C. cephalonica*. All three parasitoids were found to accept both hosts for parasitization. *Trichogramma chilonis* and *T. pretiosum* demonstrated greater parasitization rates on *C. cephalonica* eggs (87 per cent and 89 per cent, respectively), with lower rates on *S. frugiperda* eggs (85 per cent and 80 per cent, respectively). Conversely, *T. remus* exhibited the highest parasitization rate on *S. frugiperda* eggs (90 per cent) and the lowest on *C. cephalonica* eggs (7 per cent). These findings suggest that *C. cephalonica* is more suitable for *T. chilonis* and *T. pretiosum* development, while *S. frugiperda* is the preferred host for *T. remus*. The study underscores the specificity of parasitoid-host interactions, highlighting the adaptability of each species to different host environments.

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