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Rearing of *Trichogramma cordubensis* Vargas & Cabello (Hym.: Trichogrammatidae) on Mediterranean flour moth cold-stored eggs

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Abstract

The influence of *Ephestia kuehniella* Zeller (Lep.: Pyralidae) cold-stored eggs on several biological parameters of *Trichogramma cordubensis* Vargas & Cabello is studied. These eggs, stored at 0.7°C for 4.5 months, proved acceptable as well as suitable for longevity and rate of emergence of the parasitoid. Moreover, no differences were found between the number of parasitized eggs by *T. cordubensis* females reared during seven consecutive generations on cold-stored eggs and by females reared on UV-irradiated eggs. Suitability declined as storage time increased. This result is likely due to a lost of host egg weight. However, treatment of *E. kuehniella* eggs leads to some advantages, including an enlargement of the duration of storage, and a reduction of the associated cost (suppression of UV irradiation).

Introduction

Following a previous work (Vieira & Tavares, 1992), we intend to find the maximum time *Ephestia kuehniella* Zeller (Lep.: Pyralidae) eggs can be cold-stored without significant effect on *Trichogramma cordubensis* Vargas & Cabello (Hym.: Trichogrammatidae) biology.

Material & methods

The *T. cordubensis* population was captured in Ribeira do Guilherme (Nordeste, São Miguel island), and its rearing, in the laboratory, was done on *E. kuehniella* eggs according to the methods of Tavares (1989) and Tavares & Vieira (1992). This species shows a thelytokous parthenogenesis under such laboratory conditions. Adult longevity, parasitic capacity and emergence percentage were the *T. cordubensis* biological parameters studied in this work.

From 19 April 1993 onwards, nine continuous generations of *T. cordubensis* were analyzed (one generation takes approximately 15 days). For each generation, two groups ("Treatment" and "Control") were made, each group consisted of 40 less than 24 h old females, isolated in glass tubes (1x7 cm). Each female, fed with honey, was offered 200 *E. kuehniella* eggs. The eggs were less than 24 h old and were either previously irradiated with UV ("Control") or cold-stored at 0.7°C, 60±5% R.H., in total darkness ("Treatment"). Cold-stored eggs were placed in open plastic vials (1x2 cm) in order to avoid an excess of humidity and, therefore, fungus multiplication.

T. cordubensis generations were held in temperature cabinets at 24±0.5°C, 65-70% H.R., L:D 16:8. During the first seven days of females' life, we recorded: (1) the number of dead females;

(2) the number of parasitized eggs; (3) emergence rate (emerging adults were immediately killed to avoid interference with parasitism); and (4), eventually, the number of eclosed *E. kuehniella* larvae. All data were analyzed using an analysis of variance and, if significant, the means were separated using the Scheffé test.

Results and discussion

Table 1 contains results for the three studied biological parameters.

Table 1: Mean longevity in days (± standard deviation), number of parasitized eggs, and percentage of emergence, for the first seven days of life of *T. cordubensis* reared on *E. kuehniella* eggs, either treated with UV (Control) or cold-stored (Treatment).

Generations	N	Longevity	Attack rate	% Emergence
Control				
1	38	3.84±0.72	35.13± 8.14	94.8±6.2
2	40	5.63±1.10	37.50± 8.97	97.1±3.9
3	40	4.33±1.25	32.15± 9.05	95.6±4.0
4	40	5.13±1.38	35.80± 7.64	·97.7±2.9
5	39	4.52±1.17	40.00± 9.72	96.2±3.9
6	38	4.90±1.20	38.76± 9.83	97.6±3.4
7	34	5.79±1.42	30.21±11.41	95.0±5.9
8	37	6.30±1.54	26.51± 9.27	95.8±4.8
9	36	6.64±0.99	28.25± 9.12	96.5±3.7
Treatment				
Generations	N	Longevity	Attack rate	% Emergence
1	40	3.95±0.55	30.88± 4.73	94.8±4.9
2	38	5.90±1.18	47.76± 8.71	97.5±2.5
3	38	4.87±1.30	39.95± 9.13	95.6±4.4
4	38	5.37±1.26	43.00± 8.56	94.5±3.9
5	39	4.85±0.93	29.66± 8.39	97.8±3.6
6	40	5.60±0.71	40.35± 8.02	97.1±2.8
7	36	5.36±1.59	24.03±10.93	95.3±7.2
8	23	6.22±1.04	10.52± 6.02	95.6±6.8
9	33	5.85±2.15	12.85± 9.94	97.0±7.4

T. cordubensis longevity

Mean longevity ranged from 3.84 to 6.64 and from 3.95 to 6.22 days, for the " Control " and " Treatment ", respectively (table 1). All females of the two groups of *T. cordubensis* almost always live at least two days. After this period, survival rates tend to drop slowly in the two groups. The analysis of variance revealed a significant difference between the generations for each group ($F = 5.23$; $p < 0.001$), but no difference between " Control " and " Treatment " can be observed for each generation.

T. cordubensis parasitic capacity

Parasitic capacity differs significantly between the two groups ($F=38.72$, $p<0.001$). It was, on average, higher for the " Control " than for the " Treatment " (table 1). No case of superparasitism were observed in both groups. These results are in accordance with those observed by Vieira & Tavares (1992) (São Miguel population, at 25°C) and Garcia *et al.* (1995) (São Miguel, Pico and São Jorge populations, at 15°C). According to these authors, the species studied here is pro-ovogenic, the majority of the host eggs being attacked during the first two days of parasitism. Similar results were obtained for this species, captured in other localities of the island of São Miguel (Pinto & Tavares, 1990), as well as in Spain (Cabello & Vargas, 1986).

T. cordubensis emergence rate

High emergence percentages were observed for the two groups (table 1). A significant difference was found between the generations ($F=2.782$, $p<0.001$). On the contrary, no difference was observed between the two data groups (table 1).

Mediterranean flour moth cold-stored eggs

Cold-stored (0.7°C) *E. kuehniella* eggs were suitable for the rearing of *T. cordubensis* during four and a half months, although there was a reduction in the parasitism after three and a half months of egg storage (table 1). The low parasitoid/host ratio eventually allowed good development of *T. cordubensis*. In the first, second and third generations, the percentage of emergence of *E. kuehniella* larvae from non-parasitized eggs in the " Treatment " group were 19.0%, 5.5% and 0.5%, respectively; and this occurred only at the 5th, 6th and 7th days of parasitism. On the contrary, for the " Control " group, there was no emergence of host larvae.

So, beyond the casual development of host larvae, the drop of *T. cordubensis* parasitic capacity might be due to the loss of the eggs nutritional value. Indeed, there was a significant decrease ($p<0.05$) of the eggs weight with time (i e.: from $2.62.10^{-2} \pm 1.68 \times 10^{-4}$ mg (fresh eggs) to $2.07.10^{-2} \pm 2.00.10^{-3}$ mg (eggs cold-stored for 3.5 months). The rate of egg weight loss was 15.93%, 3.4% and 1.7%, in the first, second and third and a half month, respectively.

Time limit for cold-storage, allowing the continuous development of *T. cordubensis*, is almost the double than the one obtained by Vieira & Tavares in 1992. However, it is not known if the biology of *Trichogramma* is disturbed under a continuous mass rearing with only cold-stored host eggs. This is a subject to further study.

Due to enlargement of the storage time and a reduction in the manual labor cost (i.e.: through the elimination of the UV irradiation), the cold storage of *E. kuehniella* eggs certainly contributes to a higher rentability of the parasitoids mass production units (Azorean biofactory or others).

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