

Within strain competition of *Trichogramma cordubensis* (Hymenoptera: Trichogrammatidae)

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Abstract: Competition between one, two, three and four *T. cordubensis* females is evaluated in the present paper, regarding parasitism and emergence rate at 20°C, using *Ephesia kuehniella* Zeller (Lep., Pyralidae) eggs as host. As the number of females increased, a decrease in the female average parasitism was demonstrated by a negative linear regression. However, the parasitism difference was only found to be significant ($p < 0.05$) between the population with only one female per egg card (± 200 host eggs) and the populations with three and four females per egg card. On the contrary, emergence rate was not affected by the number of females per egg card. No cases of superparasitism occurred.

INTRODUCTION

In June 1989, *Trichogramma cordubensis* Vargas & Cabello (Hymenoptera, Trichogrammatidae) was captured in the island of São Miguel - Açores (PINTUREAU *et al.*, 1990). Since then, this species is under study at our laboratory with the goal of its future utilization for biological control of agricultural pests existing in the Azores islands. In mass rearing and inundative releases, which involve a large number of parasitoids, the relations between individuals are very important with consequences on the species biology; such effects depend on the number of suitable hosts for oviposition, influencing the fecundity and longevity of the parasitoids populations (BABAULT & PINTUREAU, 1984).

When the number of available hosts is not enough for the parasitoids, intra or interspecific competition occurs giving rise to superparasitism situations. According to WAJNBERG *et al.* (1989) and NENON (1993) there is superparasitism when supranumerary eggs are allocated in a host by one female (self-superparasitism) or by several of the same species (conspecific superparasitism). One way or the other, when superparasitism occurs the offspring development is affected with the production of a weaker progeny. However, superparasitism is eventually avoided through the recognition and rejection of previously parasitized host eggs (VAN ALPHEN & VAN DIJKEN, 1987; TAVARES & VOEGELÉ, 1990).

In the present work, the effects of within strain competition on the parasitic capacity and emergence rates of *T. cordubensis* are described.

MATERIAL AND METHODS

The strain of *T. cordubensis* was captured in November 1992 at Ribeira do Guilherme - São Miguel and its rearing in laboratory was made on eggs of the host *Ephestia kuehniella* Zeller (Lepidoptera, Pyralidae) according to the methods of TAVARES & VIEIRA (1992). Within strain competition effects on the parasitic capacity, superparasitism and adult emergence were analyzed at different parasitoid densities.

Groups with one (A), two (B), three (C) and four (D) females with less than 24 hours old were isolated in glass tubes (7x1 cm) containing a card with 200 ± 10.7 *E. kuehniella* eggs and a drop of honey as food. The host eggs were less than 24 hours old and had been previously ultra-violet irradiated for 20 minutes. Each case was replicated thirty times. As *T. cordubensis* females lay most of the eggs on the first day after emergence (PINTO & TAVARES, 1991), parasitism was only allowed during the first 24 hours after parasitoid's emergence. The experiment ran in temperature cabinets at $20 \pm 0.5^\circ\text{C}$, with R.H. $75 \pm 5\%$ and a photoperiod of L:D 16:8. At the end of this period the females were eliminated from each glass tube. The cards with parasitized eggs were maintained under the same conditions for development. The number of parasitized eggs (hatched or not hatched) was counted, as well as the number of offspring. The parasitized eggs were detected by the dark colour of the chorion (VOEGELÉ *et al.*, 1974).

An analysis of variance (ANOVA) was conducted on all parasitism and emergence data. When statistical differences existed between data sets, a Sheffé test was made to separate the differing means. Females that did not parasitize during the period of 24 hours were eliminated from statistical analysis. Finally, correlation and linear regression between the average number of parasitized eggs per female and the parasitoid density in the glass tube was calculated.

RESULTS AND DISCUSSION

Parasitic capacity

The number of eggs parasitized did not increase proportionally with the increasing female density. On the contrary, the average number of parasitized eggs per female and the female density were negatively correlated ($r = -0.969$,

$p < 0.0001$), which is demonstrated by a significant ($F = 22.22$, $p < 0.0001$) negative linear regression (Figures 1, 2). According to HASSEL *et al.* (1985) the inverse density dependent parasitism can be explained by the interaction of the allocation of foraging time with parasitoid's searching efficiencies and host handling times. In this experiment such interaction is probably augmented by the increasing parasitoid densities.

The deviation from the average number of parasitized eggs per female is lower in the group with highest density (Figure 1). This might be due to the naturally higher competition occurring in this group, where the rearing conditions led the females to parasitize a more similar number of host eggs thus increasing the probability of equal offspring production per parasitoid. This strategy might attenuate the within strain competition. The differences among parasitism means were significant only between group A (with one female) and group C (with three females) and between group A and group D (with four females) (Table 1). No cases of superparasitism occurred which demonstrates the high discriminative capacity of *T. cordubensis* females towards previous parasitized eggs.

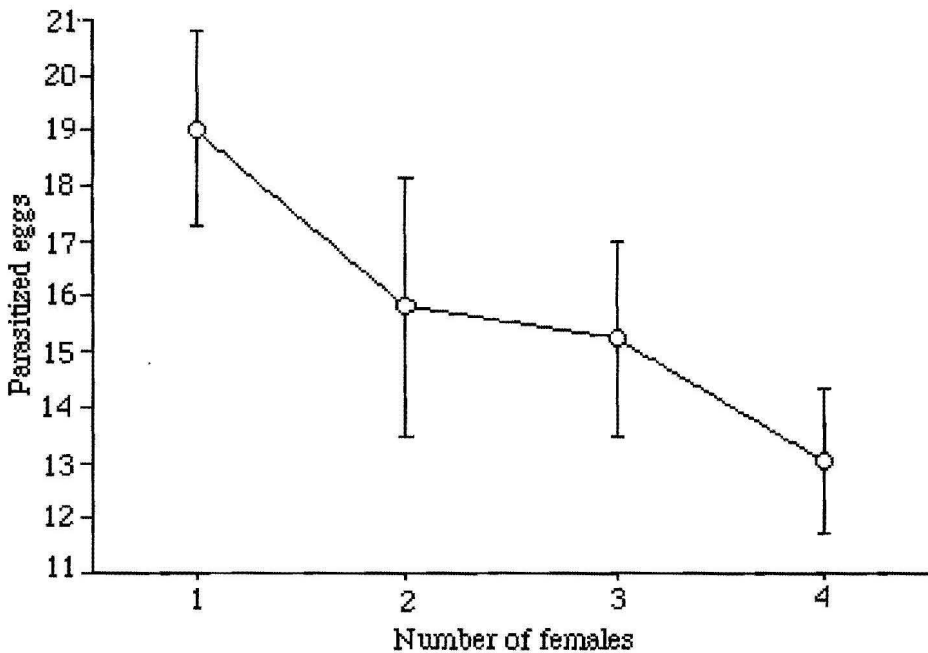


Figure 1. Relation between the number of parasitized eggs per female and the parasitoid density.

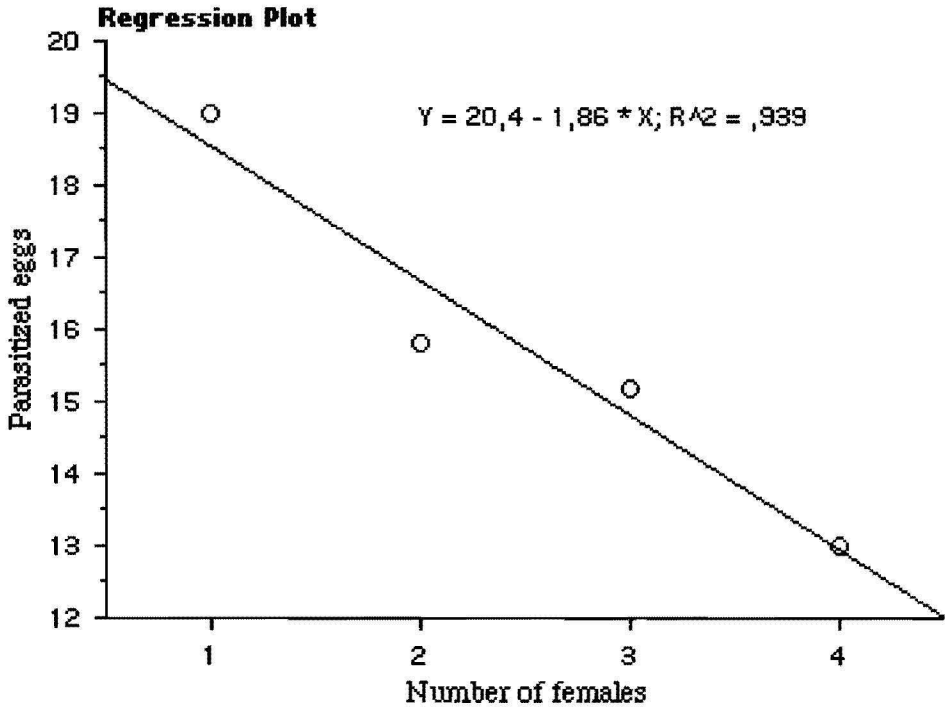


Figure 2. Regression plot between per female average parasitism and parasitoid density.

Table 1
Statistical comparison (Sheffé test) between per female average parasitism and parasitoid density

Number of females	1	2	3	4
1	1			
2	0.0941	1		
3	0.0320 S	0.9755		
4	<0.0001 S	0.1806	0.3788	1

Emergence rates

No significant difference ($F = 1.403$, $p = 0.2457$) was found between the emergence rates from the A, B, C, and D groups. The average emergence rates were: 100% for groups A and D, 99.9% for C and 99.8 % for B.

CONCLUSION

There is a decrease in the average number of parasitized eggs per female as the parasitoid density increases. However, such an effect on the parasitism is only found to be significant between the group with one female and those with three or four females per egg card. The lower parasitism heterogeneity in the group with four females per egg card might be a consequence of a higher competition effect on female oviposition.

T. cordubensis females have a high discriminative capacity towards previous parasitized eggs when the host eggs are in excess. If host availability is limited the parasitoid discriminative capacity for previous parasitized eggs would probably disappear under the effect of egg-pressure in the ovaries giving rise to superparasitism (TAVARES, 1985).

Both the lack of superparasitism, and the low effect of the within strain competition on parasitism, are promising characteristics for the mass rearing of *T. cordubensis*. In the future it would be interesting to study the competition effects at higher parasitoid densities, as well as other parameters, such as offspring longevity and parasitic capacity.

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