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Parasitic capacity, longevity and development of *Trichogramma cordubensis* (Hym., Trichogrammatidae) at three temperature regimes

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Abstract

The effect of three different temperatures (15, 20 and 25°C) on lifetime parasitic capacity, longevity and development time of *T. cordubensis* is analyzed. No significant difference was found between the total parasitism at the three temperatures. However, the parasitism for the first seven days differed significantly between all the temperatures regimes. Parasitism percentages achieved in the first week were 40.3% (15°C), 67.5% (20°C) and 75.6% (25°C). A significant difference was also observed in the longevity and development time of *T. cordubensis* for all tested temperatures. The duration of development and longevity decreased as temperature increased.

Introduction

In June 1989, *Trichogramma cordubensis* Vargas & Cabello (Hymenoptera, Trichogrammatidae) was captured in the island of São Miguel, Azores (Pintureau *et al.*, 1990). Since then, this species has been studied in our laboratory in order to acquire a better knowledge for its future utilization in the control of the agricultural pests existing in the Azores islands.

The thelytokous reproduction of *T. cordubensis* can be reverted to a bisexual (i.e. arrhenotokous) reproduction when females are submitted to temperatures higher than 28°C, with the occurrence of males and sexual mosaics in the offspring (Cabello-Garcia & Vargas-Piqueras, 1985; Pintureau *et al.*, 1993). Such a mechanism, for this species, opens new perspectives to biological control programs. It leads both to the advantages of biparental reproduction and to those associated with uniparental ones (Chen *et al.*, 1992; Stouthamer, 1993).

According to this, we decided to study the temperature effects on the biology of *T. cordubensis*.

Material & methods

The *T. cordubensis* population used in this study was captured in November 1992 at Ribeira do Guilherme, São Miguel, Azores. Its rearing in the laboratory was made on eggs of the factitious host *Ephestia kuehniella* Zeller (Lepidoptera, Pyralidae), according to the methods described in Tavares & Vieira (1992). Lifetime parasitic capacity, adult emergence, longevity and egg to adult development time were compared at three different temperature regimes.

Experiments were carried out in temperature cabinets at 15 ± 0.5, 20 ± 0.5 and 25 ± 0.5°C, with the same R.H. (70 ± 5%) and photoperiod (L:D 16:8). For each temperature, 40 less than 24 hours old females were individually isolated in glass tubes (7x1 cm) containing a card with 200 ± 11 *E. kuehniella* eggs and a drop of honey. The host eggs were less than 24 hours old and were previously irradiated with UV light for 20 minutes. The egg cards were daily replaced by fresh ones, and parasitized eggs were allowed to develop at the same conditions than those used for their parents.

The number of parasitized eggs was counted (hatched and not hatched), as well as the number of emerging offspring. The number of dead females was daily registered. An analysis based on non-parametric tests (Kruskal-Wallis) was conducted on all data. When statistical differences were observed between data sets, a Kolmogrov-Smirnov test was used to separate the different groups.

Results and discussion

Parasitic capacity

Concerning total parasitism rate throughout lifetime, no significant difference was found between the three temperatures. The number of parasitized eggs per female was on average 93.1 (15°C), 82.7 (20°C) and 92.7 (25°C). Parasitism rate reached the highest values in the first day after emergence for all temperatures (>17% parasitized eggs). In the second day, the number of parasitized eggs per female strongly declined, specially under low temperatures. In the following days, the number of parasitized eggs tend to decrease to zero until females death (fig. 1).

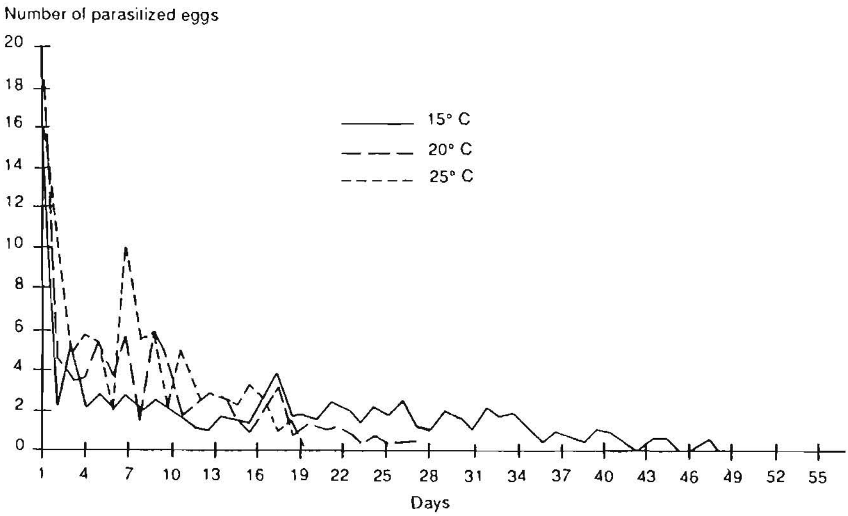

Figure 1: *T. cordubensis* daily average parasitism at 15, 20 and 25°C.

Concerning the first seven days of parasitism, a significant difference can be observed between the three temperatures ($p<0.0001$). The parasitism percentages achieved in the first week were 40.3% (15°C), 67.5% (20°C) and 75.6% (25°C). No cases of superparasitism occurred at all temperatures.

Longevity

A significant difference was found between all temperatures for longevity ($p<0.0001$), which increases with the decrease of temperature. The average longevities are 37.4 ± 15.1 days at 15°C, 15.7 ± 6.1 days at 20°C and 10.5 ± 4.4 days at 25°C (fig. 2). The observed longevity, at 20°C, is higher than the ones obtained by Pinto & Tavares (1991) for the same species. This difference can be due to a better adaptation of our *T. cordubensis* population to *E. kuehniella*, which is the factitious hosts used for rearing this parasitoid in the laboratory.

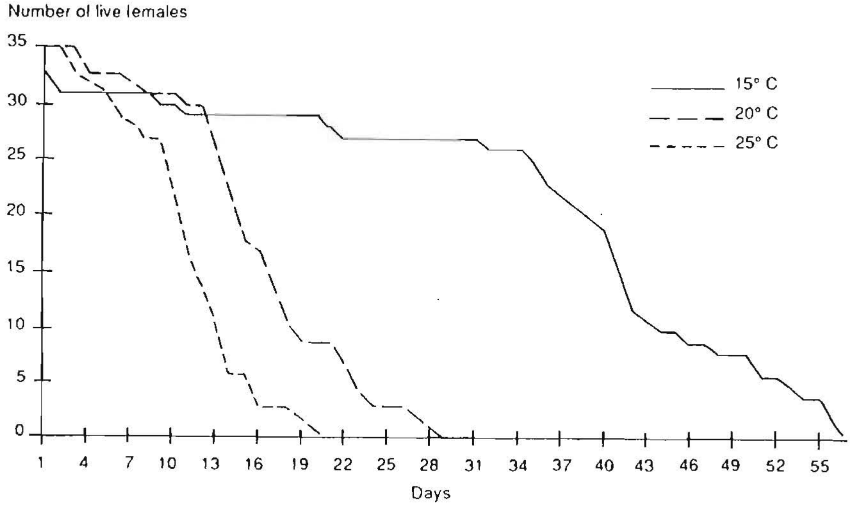

Figure 2: *T. cordubensis* survival curves at 15, 20 and 25°C.

Development time

For development time, a significant difference was observed between the three temperatures ($p<0.0001$). As for longevity, the development time increases with the decrease of temperature. The average values are: 33.60 ± 0.64 days at 15°C, 15.30 ± 0.47 at 20°C and 10.10 ± 0.28 at 25°C. The heterogeneity of development time is higher at low temperatures, which is in agreement with the results obtained by Tavares (1985).

Adult emergence

A significant difference ($p<0.05$) was found for emergence percentages between the development at 25°C and the development at the two other temperatures. At 25°C, the average emergence percentage was lower (88.2%) than at 15°C (91.7%) and 20°C (95.2%). Besides this, at 15°C and after the 20th day of parasitism, some males appeared in the offspring of *T. cordubensis*. The long submission to a low temperature (15°C) of the parental generation, might have an inactivation effect on the Rickettsia of the species *Wolbachia trichogrammae*, which, according to Stouthamer & Werren (1993) and Pintureau *et al.* (1993), are associated with the thelytokous parthenogenetic reproduction. However, further studies are necessary in order to confirm such an hypothesis.

Conclusion

T. cordubensis total parasitism did not differ at the three temperatures regimes. However, if only the first seven days of parasitism are taken into account, a significant difference is observed between the temperatures, revealing that the parasitism percentages in the first week increase with temperature. This augmentation in the parasitism velocity can be considered as a specific survival strategy, because a faster oviposition at higher temperatures will allow this pro-ovogenic parasitoid to lay most of its available eggs in a short lifetime period (as temperature increases, longevity of *T. cordubensis* decreases).

As the highest level of parasitism occurs in the first day after emergence, for all temperatures, this will be the most adequate period for inundative releases of this parasitoid as a biocontrol agent. The analysis of parasitic capacity, longevity, development time and emergence rate, reveal that *T. cordubensis* is well adapted to the Azorean climate with medium/low temperatures. This gives us good perspectives for its future use in the biological control of agricultural pests in these islands.

References

Cabello-Garcia & Vargas-Piqueras (1985). Temperature as a factor influencing the form of reproduction of *Trichogramma cordubensis* Vargas & Cabello (Hym., Trichogrammatidae). *Sonderdruck aus Bd., 100: 434-441.*

Chen B., R. Kfir & C.N. Chen (1992). The thelytokous *Trichogramma chilonis* in Taiwan. *Entomologia Experimentalis & Applicata, 65: 187-194.*

Pinto F.P. & J. Tavares (1991). Longevity and parasitic capacity of the Azorean type of *Trichogramma cordubensis* Vargas & Cabello (Hym., Trichogrammatidae). *in: " Trichogramma and other Egg Parasitoids. 3rd International Symposium ". Wajnberg E. & S.B. Vinson (eds.). Les colloques de l'INRA, 56: 89-91.*

Pintureau B., C. Louis & L. Chapelle (1993). Symbiose entre microorganismes et trichogrammes (Hym: Trichogrammatidae): Intérêt pour la lutte biologique. *Bulletin de la Société Zoologie de France, 118: 159-167.*

Pintureau B., L. Oliveira & L. Anunciada (1990). Contribution to the study of the egg parasitic Hymenoptera of the Azores islands. *in: " Trichogramma and other Egg Parasitoids. 3rd International Symposium " Wajnberg E. & S.B. Vinson (eds.). Les colloques de l'INRA, 56: 115-118.*

Stouthamer R. (1993). The use of sexual versus asexual wasps in biological control. *Entomophaga, 38: 3-6.*

Stouthamer R. & J.H. Werren (1993). Microbes associated with parthenogenesis in wasps of the genus *Trichogramma. Journal of Invertebrate Pathology, 61: 6-9.*

Tavares J. (1985). Etude comparée de trois espèces de trichogrammes: *T. maidis* Pintureau & Voegelé, *T. buesi* Voegelé et *T. embryophagum* Hartig (Hym., Trichogrammatidae). *Thèse de Docteur-Ingénieur en Ecologie, Université de Droit, d'Economie et des Sciences de Marseille III, 122 pp.*

Tavares J. & V. Vieira (1992). Produção em massa de *Ephestia kuehniella* Zeller (Lep., Pyralidae). IV- Técnicas de recolha dos adultos e ovos. *Açoreana, 7: 461-470.*