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# Biology and parasitism of *Trichogramma pretiosum* Riley (Hym., Trichogrammatidae) on *Ephestia kuehniella* (Zeller) (Lep., Pyralidae) and *Heliothis zea* (Boddie) (Lep., Noctuidae) eggs

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## Abstract

Biological aspects of *Trichogramma pretiosum* Riley, 1879, reared on artificial host *Ephestia kuehniella* (Zeller, 1879), were studied in incubators at 25 °C (±1 °C); 60 % (±10 %) RH and 14 h photophase with the aim of obtaining basic information for the biological control of *Heliothis zea* (Boddie, 1850) in corn crop. The average duration of the life cycle (egg-adult) of *T. pretiosum* was similar when reared on natural and factitious host. Sexual ratio of the parasitoid was not affected by the natural or factitious host. The longevity of *T. pretiosum* was higher when reared on factitious host relating to natural host. The parasitism capacity of the two strains of *T. pretiosum* on *E. kuehniella* eggs was similar, with a high rate of parasitism in the first four days of the female's life.

## 1 Introduction

The fall armyworm, *Spodoptera frugiperda* (J. E. Smith, 1797) and the corn earworm, *Heliothis zea* (Boddie, 1850) are the two major corn pests under field conditions in the State of São Paulo, Brazil (Gallo et al. 1988).

The losses caused by the first one may reach 20 % (Carvalho 1970) demanding, in several regions, the need for chemical control. For chemical control sprayings of organophosphorous, carbamates, and pyrethroides insecticides are used or in several cases, organophosphorous are applied with the irrigation.

However, although also causing considerable losses *H. zea* is difficult to be controlled, even chemically, since it occurs at the end of the corn crop cycle. There are obstacles regarding application technology because there are no adequate equipments available for insecticide spraying. Thus, other options are being researched, especially for *H. zea* in sweet corn, where in addition to spraying difficulties, there are also risks of insecticide residues. An alternative would be biological control and among the potential agents, the egg parasitoids would be very suitable since they interrupt the biological cycle of pests. In this case, parasitoids of the genus *Trichogramma* (Hym., Trichogrammatidae) would be an option specially for *H. zea*, as used in other countries (Neil and Specht 1990).

Since there are several factors affecting the development of *Trichogramma*, including biotic and abiotic ones, several biological aspects of *T. pretiosum* on the natural (*H. zea*) and factitious host (*E. kuehniella*) were studied viewing the biological control of *H. zea* in corn crop.

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## 2 Materials and methods

Biological studies on *T. pretiosum* were developed at the laboratory of the Department of Entomology, Escola Superior de Agricultura 'Luiz de Queiróz', University of São Paulo, Brazil. *H. zea* egg collections were obtained in corn fields located from seven counties of the State of São Paulo. All strains collected were identified as *T. pretiosum.* Based on the parasitoid aggressivity, strains 5 and 8 (numbering of the *Trichogramma* collection of ESALQ/USP Department of Entomology) collected in Santo Antonio de Posse were selected for study. The *T. pretiosum* strains were kept in the laboratory in glass tubes (10.0 cm height × 1.20 cm diam.) sealed with cotton. Eggs of artificial host *E. kuehniella* glued on 7.0 × 0.8 cm cards, and sterilized under germicidal light bulb (STEIN and PARRA 1987) were offered to the parasitoid. Adult parasitoids were fed with a drop of pure honey.

The biology of both strains of *T. pretiosum* was studied in incubators at 25 °C (± 1 °C), 60 % (± 10 %) RH, and a 14 h photophase. Plastic cards (8.0 × 1.0 cm) were kept in freezer for 10 min. After this period the cards were covered by a thin layer of condensed water which was used to fix the host eggs. These cards were sterilized under a germicide light bulb and then exposed to newly emerged *T. pretiosum* adults for 24 h. These eggs were removed from the plastic cards with the aid of a fine brush and individualized in a 7.0 × 1.0 cm glass tube sealed with cotton. Upon emergence the adults were separated according to sex based on the antennae (BOWEN and STERN 1966).

The following biological parameters were observed: duration of egg-adult period, % of emergence, adults (male and female) longevity, sexual ratio, and parasitism capacity. The duration of the egg-adult period was determined for both strains of *T. pretiosum* on *E. kuehniella* and *H. zea* eggs. The experimental design was completely randomized with factorial design and the averages were compared by the Tukey test. The % of emergence was determined by the number of eggs (200) with emergence holes. The experimental design was completely randomized with factorial design and the averages were compared by the Tukey test. After the death of the parasitoids they were sexed to determine the sexual ratio, and analysed by the $\chi^2$ test. Longevity and mortality of *T. pretiosum* (strain 8) were observed on *E. kuehniella* and *H. zea* eggs. The survival curves of *T. pretiosum* (strain 8) adults kept on eggs of the factitious and natural hosts were assessed through Weibull's distribution (SGRILLO 1982). The capacity of parasitism of *T. pretiosum* strains on *E. kuehniella* eggs was evaluated. In order to determine the capacity of parasitism on *E. kuehniella* eggs, 25 recently emerged virgin females were individualized and fed with pure honey in 7.0 × 1.0 cm glass tubes sealed with plastic film (Magipack)®. About 50 newly layed *E. kuehniella* eggs on blue cards (2.5 × 0.5 cm) and sterilized with germicidal light bulb were exposed to the parasitoids. The cards were daily removed, stored at 25 °C for counting the parasitized eggs. The number of parasitized eggs and the percentage of accumulated parasitized eggs were daily observed.

## 3 Results and discussion

The average duration of the egg-adult period of *T. pretiosum* was similar in the natural and artificial host (table) for both studied strains. In spite of the little variations in the % of emergence within each host the strains presented the same behaviour regarding the studied biological parameters, including sexual ratio, which was not altered regardless if the parasitoid was reared on *H. zea* or *E. kuehniella.* The values recorded in the present research are in the range of those observed by other authors using different *T. pretiosum* strains (GOODENOUGH et al. 1983; BLEICHER and PARRA 1990).

The longevity of *T. pretiosum* (virgin females of strain 8) was higher when reared on artificial host in comparison to the natural host (figs 1A, B). About 50 % of *T. pretiosum* virgin females (strain 8) died on the 15th day when reared on *E. kuehniella* while such a value was observed on the 10th day for the parasitoid reared on the natural host (figs 1A, B). The survival curves were similar for *T. pretiosum* (strain 8) and followed Weibull's distribution (fig. 1) on both hosts (natural or factitious).

The results obtained for *T. pretiosum* in the factitious host are close to those reported by ORPHANIDES and GONZALES (1971) but differ from those reported by BLEICHER and PARRA (1990), who recorded values much lower than the ones obtained in this research. The results for the natural host (*H. zea*) were similar to those recorded by NORDLUND et al. (1976).

The parasitism capacity of *T. pretiosum* on *E. kuehniella* eggs was 51 eggs per female for both strains (figs 2A, B). Similar results were reported by ORPHANIDES and GONZALES

**Mean life cycle duration, emergence percentage and sexual ratio of *T. pretiosum* (strains 5 and 8) reared in *E. kuehniella* and *H. zea* eggs at 25 ± 1 °C, 60 ± 10 % RH and 14 h photophase**

| Strains | Mean duration of life cycle (days) | | Percentage of emergence | | Sexual ratio | |
|---|---|---|---|---|---|---|
| | *E. kuehniella* | *H. zea* | *E. kuehniella* | *H. zea* | *E. kuehniella* | *H. zea* |
| 5 | 13.18 ± 0.18aA* | 11.97 ± 0.15aA | 86.66 ± 4.62aA | 95.00 ± 2.00aA | 0.44 I** | 0.56 I |
| 8 | 13.04 ± 0.16aA | 11.47 ± 0.14aA | 88.66 ± 16.89aA | 88.00 ± 2.00aA | 0.57 I | 0.25 I |

* Means followed by the same lower case letters in the column and capitals in the line do not differ statistically by the Tukey test at the 5 % probability level;
** means followed by the same roman algarism do not differ statistically by the $\chi^2$ test at the 5 % probability level.

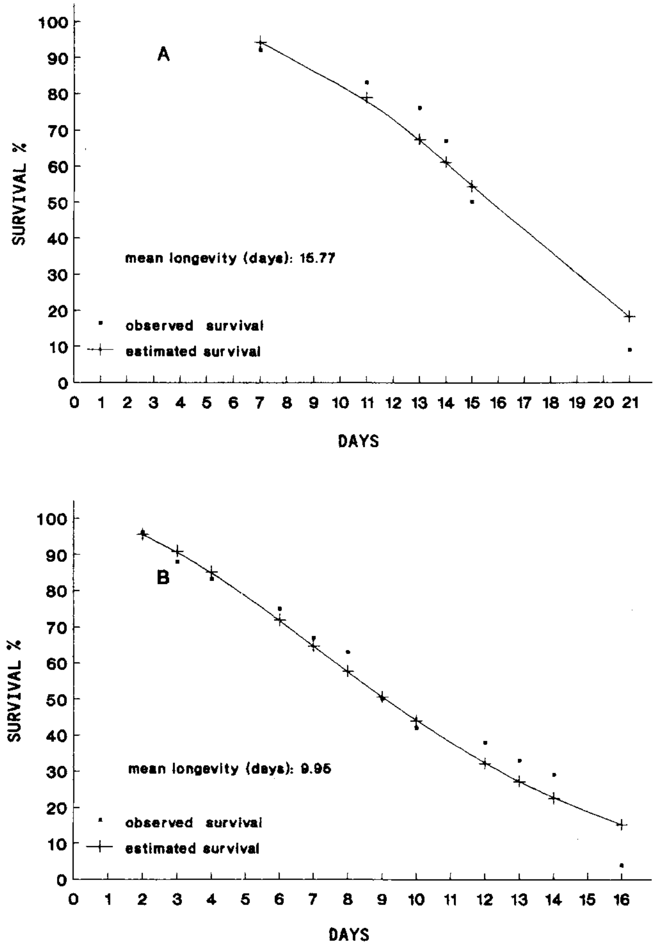
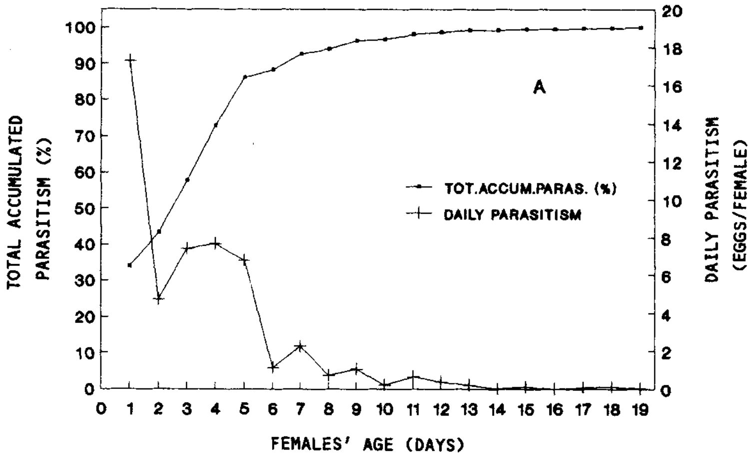



*Fig. 1.* Survival of *T. pretiosum* (strain 8) adults maintained with nourishment (pure honey) and eggs of *E. keuhniella* (A) and *H. zea* (B). Values observed and estimated by Weibull's equations. Temperature of 25 ± 1 °C, 60 ± 10 % RH, and 14 h photophase

(1971) and ASHLEY et al. (1974) on *E. kuehniella* and *Sitotroga cerealella* eggs. On the other hand, LEWIS et al. (1975) and BLEICHER and PARRA (1990) obtained much higher values for parasitism and first authors found such values as 148 eggs/female and BLEICHER and PARRA (1990) observed 76 to 102 eggs/female for two populations of *T. pretiosum* reared on *E. kuehniella. Trichogramma* species usually lay 70 to 120 eggs and ALMEIDA and PARRA (1989) observed that the *T. pretiosum* female collected in *Heliothis virescens* parasitized 87 *E. kuehniella* eggs. The different results may be related to the rearing conditions [natural host; strains' origin; laboratory generation; temperature, humidity, and photoperiod conditions of rearing (NOLDUS 1989)].

The *T. pretiosum* parasitism period was 17–19 days (figs 2A, B) and for both strains the parasitism was higher (70 %) in the first 4 days. The results were similar to those obtained by BLEICHER and PARRA (1990) for this species on cotton pests eggs.



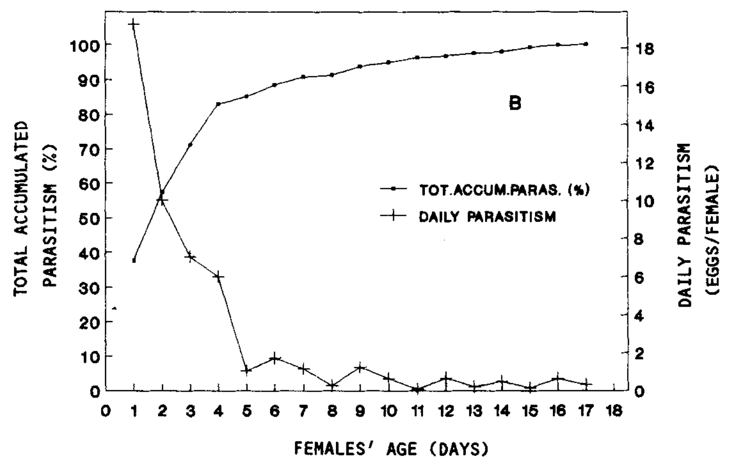




*Fig. 2.* Accumulated percentage of parasitism of *T. pretiosum*—strains 5 (A) and 8 (B)—maintained on *E. kuehniella* eggs. Temperature 25 ± 1 °C, 60 ± 10 % RH, and 14 h photophase

An average of 2.26 (ranging from 2.17 to 2.32) parasitoids emerged from each *H. zea* egg, close to the value observed by Lewis et al. (1976), 2.5 parasitoids per egg.

## References

Almeida, R. P.; Parra, J. R. P., 1989: Capacidade de parasitismo de ovos de *Heliothis virescens* (Fabr., 1781) e *Anagasta kuehniella* (Zeller, 1879) por duas linhagens de *Trichogramma pretiosum* Riley, 1879. In: Congresso Brasileiro de Entomologia, **12.** Belo Horizonte, 1989. Resumos. Belo Horizonte, SEB. p. 193.

Ashley, T. R.; Allen, J. C. L.; Gonzalez, D., 1974: Successful parasitization of *Heliothis zea* and *Trichoplusia ni* eggs by *Trichogramma*. Environ. Ent. **3** (2), 315–323.

Bleicher, E.; Parra, J. R. P., 1990: Espécies de *Trichogramma* parasitóides de *Alabama argillacea.* III. Determinação das exigências térmicas de três populações. Pesquisa Agropecuária Brasileira, Brasília, **25** (2), 215–219.

Bowen, W. R.; Stern, V. M., 1966: Effect of temperature on the production of males and sexual

mosaics in a uniparental race of *Trichogramma semifumatum* (Hymenoptera: Trichogrammatidae). Ann. Entomol. Soc. Am. **59** (4), 823–834.
CARVALHO, R. P. L., 1970: Danos, flutuação da população, controle e comportamento de *Spodoptera frugiperda* (J. E. Smith, 1797) e susceptibilidade de diferentes genótipos de milho. Piracicaba, ESALQ/USP. 170 p. Ph.D. Thesis.
GALLO, D.; NAKANO, O.; SILVEIRA NETO, S.; CARVALHO, R. P. L.; BATISTA, G. C. DE; BERTI FILHO, E.; PARRA, J. R. P.; ZUCCHI, R. A.; ALVES, S. B.; VENDRAMIM, J. D., 1988: Manual de entomologia agrícola. São Paulo, Agronômica Ceres. 649 p.
GOODENOUGH, J. L.; HARTSTACK, A. W.; KING, E. G., 1983: Developmental models for *Trichogramma pretiosum* (Hymenoptera: Trichogrammatidae) reared on four hosts. J. Econ. Ent. **76**, 1095–1102.
LEWIS, W. J.; JONES, R. L.; NORDLUND, D. A.; GROSS jun., H. R., 1975: Kairomones and their use for management of entomophagous insects. II. Mechanisms causing increase in rate of parasitization by *Trichogramma* spp. J. Chem. Ecol. **1**, 349–360.
LEWIS, W. J.; NORDLUND, D. A.; GROSS jun., H. R.; PERKINS, W. D.; KNIPLING, E. F.; VOEGELÉ, J., 1976: Production and performance of *Trichogramma* reared on eggs of *Heliothis zea* and other hosts. Environ. Ent. **5** (3), 449–452.
NEIL, K. A.; SPECHT, H. B., 1990: Field releases of *Trichogramma pretiosum* Riley (Hymenoptera: Trichogrammatidae) for suppression of corn earworm, *Heliothis zea* (Boddie) (Lepidoptera: Noctuidae), egg populations on sweet corn in Nova Scotia. Can. Entomol. **122**, 1259–1266.
NOLDUS, L. P. J. J., 1989: Chemical espionage by parasitic wasps; how *Trichogramma* species exploit moth sex pheromone systems. Wageningen, Grafisch Bedrijf Ponsen & Looijen. 252 p.
NORDLUND, D. A.; LEWIS, W. J.; JONES, R. L.; GROSS jun., H. R., 1976: Kairomones and their use for management of entomophagous insects: IV. Effect of kairomones on productivity and longevity of *Trichogramma pretiosum* Riley. J. Chem. Ecol. **2**, 62–72.
ORPHANIDES, G. M.; GONZALEZ, D., 1971: Fertility and life table studies with *Trichogramma pretiosum* and *T. retorridum* (Hymenoptera: Trichogrammatidae). Ann. Entomol. Soc. Am. **64** (4), 824–834.
SGRILLO, R. B., 1982: A distribuição de Weibull como modelo de sobrevivência de insetos. Ecossistema, Espírito Santo do Pinhal, **7**, 10–13.
STEIN, C. P.; PARRA, J. R. P., 1987: Aspectos biológicos de *Trichogramma* sp. em diferentes hospedeiros. Anais da Sociedade Entomológica do Brasil, Porto Alegre, **16** (1), 163–171.

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