Notas Científicas

Fertility life table of *Trichogramma pretiosum* and *Trichogramma acacioi* on eggs of *Anagasta kuehniella* at different temperatures

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Abstract – Species of the *Trichogramma* genus are among the most important ones for biological control. The objective of this research was to evaluate parasitism potential of two species of *Trichogramma* on eggs of *Anagasta kuheniella* through life fertility table, at temperatures between 15ºC and 35ºC. These species were collected in the State of Espírito Santo parasitising eggs of the avocado defoliator *Nipteria panacea*. *Trichogramma pretiosum* and *T. acacioi* showed adequate reproductive potential between 15ºC and 35ºC which indicates possibilities of using them in biological control programs in avocado plantations.

Index terms: *Nipteria panacea*, parasitoids, avocado, biological control, parasitism.

Tabela de vida de fertilidade de *Trichogramma pretiosum* e *Trichogramma acacioi* em ovos de *Anagasta kuehniella* sob diferentes temperaturas

Resumo – *Trichogramma* é um dos gêneros de insetos mais importantes no controle biológico. Este trabalho avaliou o potencial de parasitismo de duas espécies de *Trichogramma*, em ovos de *Anagasta kuehniella*, por meio da tabela de vida de fertilidade sob temperaturas entre 15°C e 35°C. Essas espécies foram coletadas no Estado do Espírito Santo parasitando ovos do desfolhador do abacateiro *Nipteria panacea*. *Trichogramma pretiosum* e *T. acacioi* mostraram potencial de reprodução em temperaturas entre 15°C e 35°C, podendo ser utilizados em futuros programas de controle biológico de *N. panacea* em plantios de abacate.

Termos para indexação: *Nipteria panacea*, parasitóide, abacate, controle biológico, parasitismo.

Plants of avocado can be damaged by the defoliator *Nipteria panacea* (Thierry-Mieg) (Lep.: Geometridae) in the Espírito Santo State, Brazil, and the aggressiveness of this pest has been preoccupying producers and authorities (Pratissoli & Fornazier, 1999). This pest could be controlled by ecological methods considering association of cultural, biological and chemical procedures (Pratissoli & Parra, 2000a) as two species of the genus *Trichogramma* were found parasitizing eggs of *N. panacea* (Pratissoli & Fornazier, 1999). *Trichogramma* species have been used against avocado pests in the United States and Israel and against other key-pests in more than 30 countries (Wajnberg & Hassan, 1994; Parra & Zucchi, 1997).

The success of *Trichogramma* species in biological control depends on their identification in the field, collections, maintenance and behaviour in laboratory, selection of adequate species and/or lineages, besides thermal requirements, liberation techniques and evaluation of efficiency and dynamic models for parasitoids and hosts in the field (Parra et al., 1987). Adequate alternative hosts such as eggs of *Sitotroga cerealella* (Olivier) (Lep.: Gelechiidae) and *Anagasta kuehniella* (Zeller) (Lep.: Pyralidae) are important to multiply *Trichogramma* (Flanders, 1930; Lewis et al., 1976) because they can affect their biological traits (Oliveira et al., 2000).

Fertility life table is used to evaluate biological performance and to compare development of insects such as lineage and/or species of *Trichogramma* (Maceda et al., 1994; Pratissoli & Parra, 2000b).

The objective of this research was to evaluate the reproductive potential of *Trichogramma pretiosum* (Riley) and *Trichogramma acacioi* (Brun, Moraes &

Soares) (Hym.: Trichogrammatidae) on the alternative host *A. kuehniella* through fertility life table at temperatures between 15°C and 35°C aiming to use those egg parasitoids in biological control programs of *N. panacea*.

The research was carried out in the Laboratory of Entomology of the Universidade Federal do Espírito Santo, Alegre, Espírito Santo State, Brazil. Specimens of *T. pretiosum* and *T. acacioi* were collected at altitudes of 800 and 1,000 m, respectively, in Venda Nova do Imigrante, Espírito Santo State, Brazil. Period from egg to adult, viability and sex ratio of these parasitoids were obtained on eggs of *A. kuehniella* at temperatures of 15, 20, 25, 30 and 35±1°C and used to estimate fertility life table for both *Trichogramma* species.

Recently emerged *T. acacioi* and *T. pretiosum* females were individualised in glass tubes (3.5x0.5 cm) sealed with plastic PVC film and fed with droplets of pure honey in their internal wall. Twenty tubes with 40 eggs each of the alternative host *A. kuehniella* glued in a cardboard (3.5x0.5 cm) were used per *Trichogramma* species and temperature. These eggs were turned unfeasible by exposing them to a germicidal lamp during 45 minutes (Parra & Zucchi, 1997). Parasitism was allowed during 24 hours in a chamber with relative humidity of 70±10% and photoperiod of 14 hours at the temperatures mentioned. After this period females of these parasitoids were removed under a stereoscopic microscope and the tubes were maintained in these chambers at the respective temperature.

Twenty-hour old females of *T. pretiosum* and *T. acacioi* were used to evaluate parasitism capacity of these species. Each female of these species was fed by honey droplets inside a glass tube (13x1 cm) sealed with PVC plastic film. Each parasitoid female received daily a blue cardboard (3.5x0.5 cm) with 40 eggs of *A. kuehniella* glued with Arabic glue. These cardboards were removed after 24 hours and individualised in plastic bags (23x4 cm) at the respective temperatures until emergence of the parasitoids. Number of parasitized eggs, accumulated percentage of parasitism, total number of eggs parasitized per female and longevity of parasitoid females were evaluated. Data obtained were used to calculate duration of a generation and to elaborate fertility life tables for *T. acacioi* and *T. pretiosum* by calculating their liquid reproductive rate (Ro), and infinitesimal (rm) and finite (λ) rates of increase (Silveira Neto et al., 1976).

Fertility life table of *T. pretiosum* showed an inverse duration of a generation (T) as temperature increased from 15°C to 35°C with values of 49.76 and 7.54 days, respectively (Table 1). This was similar to that found for *T. acacioi* with 50.66 and 7.55 days for one generation at these temperatures. These *Trichogramma* species showed an inverse relationship between temperature and duration of a generation what was similar to that of other *Trichogramma* species (Pratissoli & Parra, 2000b).

Liquid reproductive rate (Ro) of *T. pretiosum* varied from 13.98 to 54.97 times as function of temperature with maximum population increase at 30°C while these values varied from 9.36 to 62.89 times for *T. acacioi* with maximum capacity of increase at 20°C (Table 1). These *Trichogramma* species showed lower liquid

Table 1. Duration of a generation (T), liquid reproductive rate (Ro), infinitesimal rate of increase (rm) and finite rate of increase (λ) of *Trichogramma pretiosum* and *Trichogramma acacioi* (Hymenoptera: Trichogrammatidae) on eggs of *Anagasta kuehniella* (Lepidoptera: Pyralidae) at different temperatures, relative humidity of 70±10% and photoperiod of 14 hours.

Temperature (°C)	T (days)	Ro	rm	λ
		Trichogramma pretiosum		
15	49.76	13.98	0.05	1.05
20	17.57	39.44	0.21	1.23
25	10.86	31.53	0.32	1.37
30	8.42	54.97	0.47	1.61
35	7.54	15.54	0.36	1.43
		Trichogramma acacioi		
15	50.66	11.85	0.05	1.05
20	18.56	62.89	0.22	1.25
25	11.07	50.67	0.35	1.42
30	8.95	20.42	0.34	1.40
35	7.55	9.36	0.30	1.34

reproductive rate at extreme temperatures (15°C and 35°C). Population increase of *T. pretiosum* and *T. acacioi* was higher between 20°C and 30°C and 20°C and 25°C, respectively, with values 1.6 times higher than the first one.

The infinitesimal rate of increase (rm) of *T. pretiosum* increased between 15°C and 30°C and decreased at 35°C. *Trichogramma pretiosum* and *T. acacioi* showed maximum capacity of population increase at 25°C and 30°C, respectively. The second species had a direct relationship with temperature increase between 15°C and 25°C. The finite rate of increase of *T. pretiosum* showed a direct relationship with its liquid reproductive and infinitesimal rate of increase between 15°C and 30°C and a decrease at 35°C. However, the finite rate of increase of *T. acacioi* presented a direct relationship with temperature between 15°C and 25°C (Table 1). *Trichogramma pretiosum* presented higher finite rate of increase (number of females added to the population per female) at 30°C while this was registered between 25°C and 30°C for *T. acacioi*.

Life fertility tables can be used to compare biological traits of insects submitted to variations on biotic and abiotic factors (Silveira Neto et al., 1976) such as temperature, adaptability to host and reproductive potential of species or lineages of *Trichogramma* (Maceda et al., 1994; Pratissoli & Parra, 2000b). *Trichogramma cordubensis* (Vargas & Cabello) (Hym.: Trichogrammatidae) showed better biological performance at higher temperatures while the reproductive potential of *T. pretiosum* in natural and alternative hosts was evaluated through parameters of life fertility table. *Trichogramma pretiosum* showed better adaptation to the host *Phthorimaea operculella* (Zeller) (Lep.: Gelechiidae) than to *Tuta absoluta* (Zeller) (Lep.: Gelechiidae) (Pratissoli & Parra, 2000b).

Trichogramma pretiosum and *T. acacioi* had lower liquid reproductive rate at temperatures below 20°C and above 30°C (Table 1). This was similar to that reported for *T. pretiosum* with the host *P. operculella* (Pratissoli & Parra, 2000b) but it differs from results for this parasitoid with *Alabama argillacea* (Hübner) (Lep.: Noctuidae). Maximum population increase (Ro) of *T. pretiosum* and *T. acacioi* occurred at different temperatures (30°C and 20°C, respectively). This fact can be related to adaptation of these species to conditions of their habitat where they were collected and also to the host used to rear them (Parra et al., 1987; Fernandes et al., 1999). The infinitesimal rate of increase showed maximum population increase of *T. pretiosum* and *T. acacioi* at different temperatures and lower values at extreme ones. This is important because temperature is one of the main factors affecting the adaptability of egg parasitoids to climatic conditions of their habitat.

Fertility life table represents an important biological tool to evaluate the behaviour of *T. pretiosum* and *T. acacioi* at different temperatures. These parasitoids have potential to control the Lepidoptera defoliator of avocado, *N. panacea* due to their high reproductive potential at different temperatures. This behaviour increases the possibilities of using these species in integrated management programs of *N. panacea* in avocado plantations.

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References

FERNANDES, M.G.; BUSSOLI, A.C.; DEGRANDE, P.E. Parasitismo natural de ovos de *Alabama argillacea* Hüb. e *Heliothis virescens* Fab. (Lep.: Noctuidae) por *Trichogramma pretiosum* Riley (Hym.: Trichogrammatidae) em algodoeiros no Mato Grosso do Sul. **Anais da Sociedade Entomológica do Brasil**, v.28, p.695-701, 1999.

FLANDERS, S.E. Mass production of egg parasites of the genus *Trichogramma*. **Hilgardia**, v.4, p.465-501, 1930.

LEWIS, W.J.; GROSS JUNIOR, H.R.; PERKINS, W.D.; KNIPLING, E.F.; VOEGELÉ, J. Production and performance of *Trichogramma* reared on eggs of *Heliothis zea* and other hosts. **Environmental Entomology**, v.5, p.449-452, 1976.

MACEDA, A.; HOHMANN, C.L.; SANTOS, H.R.; SANTOS, H.R. Comparative life table for *Trichogramma pretiosum* Riley and *Trichogramma annulata* De Santis (Hym.: Trichogrammatidae). **Revista do Setor de Ciências Agrárias**, v.13, p.279-281, 1994.

OLIVEIRA, H.N.; ZANUNCIO, J.C.; PRATISSOLI, D.; CRUZ, I. Parasitism rate and viability of *Trichogramma maxacalii* (Hym.: Trichogrammatidae), parasitoid of the *Eucalyptus* defoliator *Euselasia apisaon* (Lep.: Riodinidae), on eggs of *Anagasta kuehniella* (Lep.: Pyralidae). **Forest Ecology and Management**, v.130, p.1-6, 2000.

PARRA, J.R.P.; ZUCCHI, R.A. ***Trichogramma* e o controle biológico aplicado**. Piracicaba: Fealq, 1997. 324p.

PARRA, J.R.P.; ZUCCHI, R.A.; SILVEIRA NETO, S. Biological control of pests through egg parasitoids of the genera *Trichogramma*

and/or *Trichogrammatoidea*. **Memórias do Instituto Oswaldo Cruz**, v.82, p.153-160, 1987.

PRATISSOLI, D.; FORNAZIER, M.J. Ocorrência de *Trichogramma acacioi* Brun, Moraes e Soares (Hym.: Trichogrammatidae) em ovos de *Nipteria panacea* Thierry-Mieg (Lep.: Geometridae), um geometrídeo desfolhador do abacateiro. **Anais da Sociedade Entomológica do Brasil**, v.28, p.347-349, 1999.

PRATISSOLI, D.; PARRA, J.R.P. Desenvolvimento e exigências térmicas de *Trichogramma pretiosum* Riley criado em duas traças do tomateiro. **Pesquisa Agropecuária Brasileira**, v.35, p.1281-1288, 2000a.

PRATISSOLI, D.; PARRA, J.R.P. Fertility and life table of *Trichogramma pretiosum* (Hym.: Trichogrammatidae) in eggs of *Tuta absoluta* and *Phthorimaea operculella* (Lep.: Gelechiidae) at different temperatures. **Journal of Applied Entomology**, v.124, p.330-342, 2000b.

SILVEIRA NETO, S.; NAKANO, O.; BARBIN, D.; VILLA NOVA, N.A. **Manual de ecologia dos insetos**. São Paulo: Ceres, 1976. 419p.

WAJNBERG, E.; HASSAN, A. **Biological control with egg parasitoids**. Wallingford: British Library, 1994. 286p.

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