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The eucalypt defoliator *Thyrinteina arnobia* (Lepidoptera: Geometridae) protects its eggs from parasitism

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Abstract: *Eucalyptus* plantations in Brazil can be damaged by insect pests from the native Myrtaceae, such as the moth *Thyrinteina arnobia* (Lepidoptera: Geometridae), which is considered the main defoliating caterpillar of this plant in Brazil. Eggs of *T. arnobia* reared with *E. grandis*, guava or mulberry plants were collected and offered to the parasitoid *Trichogramma maxacalii* (Hymenoptera: Trichogrammatidae). All individuals of this parasitoid died within 24 h after contact with unwashed eggs of this moth, independent of its rearing host. Most parasitoids survived when exposed to solvent-washed eggs, but still could not parasitize them. This means that the moth covers its eggs with some compounds that are toxic to the parasitoid *T. maxacalii*. This phenomenon helps to explain the population explosion of this pest in eucalypt plantations and the fact that egg parasitism was not recorded in *Thyrinteina arnobia*.

Keywords: crop protection, eucalypt, *Thyrinteina arnobia, Trichogramma maxacalii*

INTRODUCTION

The Brazilian reforestations are made mainly with eucalypt species, and monocultures of these plants allow the establishment and multiplication of insect pests, including defoliating lepidopterans, which come from native plant species (ZANUNCIO et al. 1993, GROSMAN et al. 2005, OLIVEIRA et al. 2005).

Damage by lepidopteran defoliators of eucalypt species are reported in many regions of Brazil, and these insects are divided into primary and secondary pests. The group includes the genus *Thyrinteina* with the species *T. arnobia* (Stoll), *T. leucoceraea* (Rindge) and *T. schadeana* Schaus (Lepidoptera: Geometridae). The first species is considered the main defoliating lepidopteran pests of eucalypts (ZANUNCIO et al. 2001) in many regions of Brazil (GUEDES et al. 2000, PEREIRA et al. 2001).

Egg parasitoids of the genus *Trichogramma* are important for biological control in more than 30 countries, against key pests of 34 cultures (BRUN et al. 1984, SOARES et al. 2007). Species of this genus parasitise eggs of many eucalypt pests, such as *Glena bipennaria* (Guenée) (Lepidoptera: Geometridae), *Euselasia euploea eucerus* (Hewitson) and *Euselasia hygenius oculta* (Hewitson) (Lepidoptera: Riodinidae), *Sarsina violascens* (Herrich-Schaeffer) (Lepidoptera: Lymantriidae), *Apatelodes sericea* Schaus (Lepidoptera: Eupterotidae) (MORAES et al. 1983), *Psorocampa denticulata* Schaus (Lepidoptera: Notodontidae) (BRUN et al. 1984), and *Oxydia vesulia* Cramer (Lepidoptera: Geometridae) (OLIVEIRA et al. 2003). *Thyrinteina arnobia* pupae are parasitized by Eulophidae (PEREIRA et al. 2008) but there are no reports of parasitism on its eggs.

The aim of this study was to find out if *Trichogramma maxacalii* Voegelé and Pointel (Hymenoptera: Trichogrammatidae) can parasitise eggs of *Thyrinteina arnobia* reared on leaves of the exotic eucalypt, mulberry or the native guava plants.

MATERIAL AND METHODS

All experiments were carried out at 25±3°C, 70±10% relative humidity, and 12-h photoperiod. One-day-old eggs of moths of *T. arnobia*, reared from caterpillars fed on various leaves, were collected (Table 1).

Table 1. Origin of the moth eggs used as hosts for the parasitoid *Trichogramma maxacalii* (Hymenoptera: Trichogrammatidae)

Group	Host origin
T1	*Thyrinteina arnobia* eggs from caterpillars fed on eucalypt leaves
T2	*Thyrinteina arnobia* eggs from caterpillars fed on eucalypt leaves and washed with a 0.1% xylene solution for 10 min, followed with washing in distilled water
T3	*Thyrinteina arnobia* eggs from adults of 1st generation caterpillars fed on guava leaves
T4	*Thyrinteina arnobia* eggs from adults of 4th generation caterpillars fed on guava leaves
T5	*Thyrinteina arnobia* eggs from adults of 15th generation caterpillars fed on guava leaves
T6	*Thyrinteina arnobia* eggs from adults of 1st generation caterpillars fed on mulberry leaves
Control	*Anagasta kuehniella* eggs

Twenty *Trichogramma maxacalii* females with maximum age of 24 h were used per treatment every day. These females were added to 4.0 × 0.7 cm tubes with droplets of honey and a 3.5 × 0.5 cm sky blue cardboard containing 20 moth eggs. A female of the parasitoid was added to each tube for 24 h to evaluate the rate of parasitism and the longevity of this natural enemy.

RESULTS

No parasitism by *Trichogramma* was found in the groups T1, T3, T4, T5 and T6 after 24-h exposure of moth eggs. A high mortality of *Trichogramma* was ob-

served after 6 h, and it reached 100% within 24 h after being added to the tubes with moth eggs.

Eggs of *Thyrinteina arnobia* washed with 0.1% xylene (group T2) were also not parasitized by *Trichogramma maxacalii*, but no death of individual parasitoids was observed until 6 h later, and about 70% of them were still alive after 24 h. The survival rate of *T. maxacalii* in this treatment was not different from that of parasitoids exposed to *A. kuehniella* eggs (Fig. 1).

DISCUSSION

The use of xylene to remove the protective layer around the eggs of *Thyrinteina arnobia* is based on the report of SHU et al. (1990). Those authors reported that nanograde hexane extracted substances from scales of *Ostrinia nubilalis* (Hubner) (Lepidoptera: Notodontidae). Similarly, pentane was used to obtain semiochemicals from egg masses of *O. nubilalis* (RENOU et al. 1992). The present study suggests that xylene removed some chemical(s) from the surface of *T. arnobia* eggs, which affected the parasitoid *Trichogramma maxacalii.*

Substances covering the eggs of *Sitotroga cerealella* Olivier (Lepidoptera: Pyralidae), *Diatraea sacharalis* (Fabr.) (Lepidoptera: Pyralidae), *Heliothis virescens* (Fabr.) (Lepidoptera: Noctuidae), *Spodoptera frugiperda* (Smith) (Lepidoptera: Noctuidae) and *Anticarsia gemmatalis* Hubner (Lepidoptera: Noctuidae) help to fix eggs of these species to the substratum, but they also help the parasitoids recognize and accept the eggs as a host (CONSOLI et al. 1999). The present work indicates the presence of a toxic layer on the surface of *Thyrinteina arnobia* eggs, which may be responsible for the death of *Trichogramma maxacalii.* The parasitoid develops normally on eggs of other eucalypt defoliators (OLIVEIRA et al. 2000, 2003). Reduction in the longevity and the higher mortality of *T. maxacalii* indicates that *Thyrinteina arnobia* secretes a toxic layer over its egg surface, irrespective of the plants its caterpillars were fed on. This suggests that the toxic compound was not sequestered from the plants but perhaps the alkaloids were synthesized by the insect, such as those found in high concentration in the eggs of *Uteheisa ornatrix* (Lepidoptera: Arctiidae), which protect it from natural predators (EISNER et al. 2000). The production of these defence compounds probably does not depend on specific materials, such as essential oils from eucalypts (FOX & MACAULEY 1977). Other chemical defences may act as repellents or inhibitors of digestive enzymes (MAURICIO & RAUSHER 1997), so chemical compositions of plants can influence the feeding habit preferences of herbivores (PRICE 1981). The toxins present on the eggs of *T. arnobia* protect them from parasitism and/or reduce the longevity of *Trichogramma* species, and appear to be *de novo* synthesized by *Thyrinteina arnobia.* This observation indicates that the hypothesis that herbivores switched from the native Myrtaceae to eucalypts to obtain toxic materials for protection (HOLTZ et al. 2003) may not be entirely true. However, it is possible that some compounds that are needed for the synthesis of the final toxin can be obtained from eucalypts plants.

Other features of *T. arnobia* egg shells also protect it from parasitism, because sometimes even after the eggs of this pest were washed with 0.1% xylene, parasitism did not occur. Parasitism by *Trichogramma* species can be reduced by factors

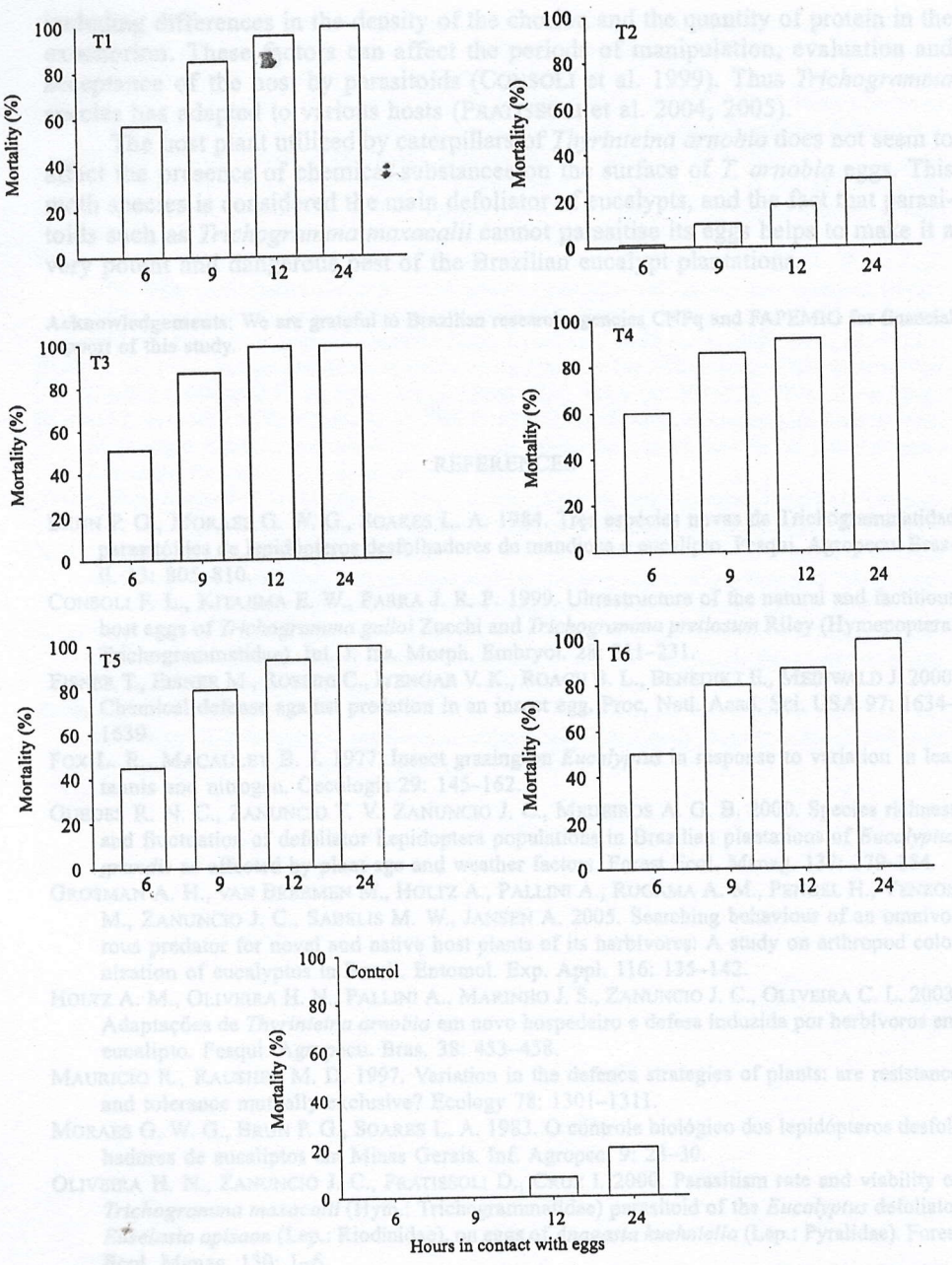

Fig. 1. Mortality of *Trichogramma maxacalii* (Hymenoptera: Trichogrammatidae) on eggs of *Thyrinteina arnobia* (Lepidoptera: Geometridae) fed on eucalypt leaves (T1), fed on eucalypt leaves and washed with 0.1% xylene (T2), 1st generation caterpillars fed on guava leaves (T3), 4th generation caterpillars fed on guava leaves (T4), 15th generation caterpillars fed on guava leaves (T5), fed on mulberry leaves (T6), or eggs of *Anagasta kuehniella* (Lepidoptera: Pyralidae) (control)

including differences in the density of the chorion and the quantity of protein in the exochorion. These factors can affect the periods of manipulation, evaluation and acceptance of the host by parasitoids (CONSOLI et al. 1999). Thus *Trichogramma* species has adapted to various hosts (PRATISSOLI et al. 2004, 2005).

The host plant utilized by caterpillars of *Thyrinteina arnobia* does not seem to affect the presence of chemical substances on the surface of *T. arnobia* eggs. This moth species is considered the main defoliator of eucalypts, and the fact that parasitoids such as *Trichogramma maxacalii* cannot parasitise its eggs helps to make it a very potent and dangerous pest of the Brazilian eucalypt plantations.

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