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Predation by Coccinellidae on *Glycaspis brimblecombei* (Hemiptera: Aphalaridae) eggs

Predação de ovos de *Glycaspis brimblecombei* (Hemiptera: Aphalaridae) por Coccinellidae

M. M. Domingues[a,b*], B. C. C. Gêa[a,b], A. C. S. Nascimento[c], T. D. S. Queiroz[b], E. P. Soliman[b], E. A. V. Zauza[b], M. C. C. Zonete[b], L. R. Barbosa[d], J. C. Zanuncio[e] and C. F. Wilcken[a]

[a]Universidade Estadual Paulista – UNESP, Faculdade de Ciências Agronômicas, Botucatu, SP, Brasil
[b]Suzano Papel e Celulose/Tecnologia Florestal, Três Lagoas, MS, Brasil
[c]Equilíbrio Florestal, Três Lagoas, MS, Brasil
[d]Empresa Brasileira de Pesquisa Agropecuária – Embrapa Florestas, Colombo, PR, Brasil
[e]Universidade Federal de Viçosa – UFV, Departamento de Entomologia/BIOAGRO, Viçosa, MG, Brasil

Abstract

Exotic *Eucalyptus* spp. are the most planted trees species in forest cultivation in Brazil. The red gum lerp psyllid *Glycaspis brimblecombei* Moore (Hemiptera: Aphalaridae), an invasive exotic pest, reduces the development and wood production of *Eucalyptus* spp. plantations. The search for natural enemies targeting the egg life stage is beneficial for the integrated pest management of *G. brimblecombei*. The objective of this work was to test a range of Coccinellidae species that potentially prey on *G. brimblecombei* eggs. *Cycloneda sanguinea* Linnaeus, *Eriopsis conexa* Germar, *Harmonia axyridis* Pallas, *Hippodamia convergens* Guerin-Meneville, *Jaguarita conjugata* Mulsant and *Olla v-nigrum* Mulsant (Coleoptera: Coccinellidae), reported to be associated with *G. brimblecombei* infestations, were evaluated. Newly emerged adults of *O. v-nigrum* and *J. conjugata* preyed on *G. brimblecombei* eggs, unlike *C. sanguinea*, *E. conexa*, *H. axyridis* and *H. convergens*. Predation of eggs by *O. v-nigrum* was highest, with a mean of 1,016 in 24 hours. These results, evaluating a range of Coccinellidae as predators of *G. brimblecombei* eggs, confirm the high predation rate of *G. brimblecombei* eggs by *O. v-nigrum* and that this ladybug may be important in the integrated management of this pest.

Keywords: biological control, ladybugs, natural enemies, *Olla v-nigrum*, red gum lerp psyllid.

Resumo

O gênero *Eucalyptus* ocupa a maior área plantada no setor florestal brasileiro com alta produtividade. O psilídeo de concha *Glycaspis brimblecombei* Moore (Hemiptera: Aphalaridae), praga exótica, reduz o desenvolvimento e produção de madeira nesses plantios. A busca de inimigos naturais para a fase de ovos de *G. brimblecombei* é essencial para complementar o manejo integrado e quebrar o ciclo da praga. O objetivo deste trabalho foi avaliar a predação de ovos de *G. brimblecombei* por seis espécies de Coccinelidae. A predação de ovos de *G. brimblecombei* por *Cycloneda sanguinea* Linnaeus, *Eriopsis conexa* Germar, *Harmonia axyridis* Pallas, *Hippodamia convergens* Guerin-Meneville, *Jaguarita conjugata* Mulsant e *Olla v-nigrum* Mulsant (Coleoptera: Coccinellidae), comumente associadas com infestações por essa praga, foi avaliada. Adultos recém emergidos de *O. v-nigrum* e *J. conjugata* predaram ovos de *G. brimblecombei*, mas isto não foi observado para *C. sanguinea*, *E. conexa*, *H. axyridis* e *H. convergens*. A predação de ovos, dessa praga, por *O. v-nigrum* foi maior em todas as avaliações, com 1.016 após 24 horas. Estes resultados são pioneiros na utilização de coccinelídeos no manejo de pragas do eucalipto. A maior predação de ovos de *G. brimblecombei* por *O. v-nigrum* indica que este predador pode ser importante para complementar o manejo integrado dessa praga.

Palavras-chave: controle biológico, joaninha, inimigos naturais, *Olla v-nigrum*, psilideo-de-concha.

1. Introduction

The area planted with *Eucalyptus* species is the largest in Brazil and with high productivity (Duarte and Ribeiro, 2023). The red gum lerp psyllid *Glycaspis brimblecombei* Moore (Hemiptera: Aphalaridae), an exotic pest with high invasive potential, has been reported in different countries in high infestations (Barbosa et al., 2023). This sap-sucking insect reduces the photosynthetic area and causes dryness of pointers and reduction of the development and wood production of *Eucalyptus* plantations (Del-Piero et al., 2022).

*e-mail: mauriciomdomingues@gmail.com
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The integrated management of third and fourth instar *G. brimblecombei* nymphs is carried out using the parasitoid *Psyllaephagus bliteus* Riek (Hymenoptera: Encyrtidae) (Favoreto et al., 2021), and for nymphs and adults of this insect, the predatory bug *Atopozelus opsimus* Elkins (Hemiptera: Reduviidae) (Dias et al., 2012), entomopathogenic fungi (Domingues et al., 2022) and chemical control (AGROFIT, 2024) are employed. Genetic resistance has limitations in managing *G. brimblecombei* due to its high adaptability to different plant hosts, as this pest damages most commercial clones used in Brazil (Dal-Pogetto et al., 2024). Identifying and utilizing egg predators could further enhance the effectiveness of integrated management strategies for *G. brimblecombei*.

Coccinellidae species prey on a wide range of pests (Zazycki et al., 2015; Li et al., 2021). Species of this family have been reported associated to native psyllids such as *Triozoida* sp. (Barbosa et al., 2003) and *Psylla* sp. (Hemiptera: Psyliidae) (Ferreira and Almeida, 2000), as well as to exotic species like *Diaphorina citri* Kuwayama (Hemiptera: Liviidae) (Michaud, 2001) and *G. brimblecombei* with *Cycloneda sanguinea* Linnaeus and *Harmonia axyridis* Pallas (Rodas-Ávalos et al., 2021). Given their association with *G. brimblecombei* and other similar pests, understanding their role in targeting specific developmental stages, such as eggs, is critical to enhance integrated pest management strategies. The objective of this study was to evaluate the predation of *G. brimblecombei* eggs by Coccinellidae species.

2. Materials and Methods

2.1. Glycaspis brimblecombei rearing

Glycaspis brimblecombei was reared on *Eucalyptus urophylla* saplings planted in 1-liter pots, housed in standardized cages with two plants each (40 cm × 45 cm × 80 cm), to collect its eggs (Wilcken et al., 2010). The rearing conditions included a controlled temperature of 25 ± 2 °C, relative humidity of 60 ± 10%, and a 13-hour photophase. Each cage received 80 to 100 *G. brimblecombei* adults, and saplings were replaced per cycle of this insect. Daily irrigation was performed using a 500 ml laboratory wash bottle (Domingues et al., 2022 adapted).

2.2. Predation assay of Glycaspis brimblecombei eggs by Coccinellidae

The predation of *G. brimblecombei* eggs was evaluated by the coccinellid species: *Cycloneda sanguinea* Linnaeus, *Eriopsis conexa* Germar, *Harmonia axyridis* Pallas, *Hippodamia convergens* Guérin-Méneville, *Jaguarita conjugata* Mulsant and *Olla v-nigrum* Mulsant (Coleoptera: Coccinellidae) was evaluated (Figure 1).

Branches of *Eucalyptus urophylla*, infested by *G. brimblecombei* and with coccinellid pupae, were collected in Suzano plantations in the Mato Grosso do Sul state, Brazil, and placed in standard rearing cages. The ladybug species were identified using identification keys (Vandenberg, 2002; Celli et al., 2021). Adults of these Coccinellidae were collected immediately after

Figure 1. Adults of *Cycloneda sanguinea* (a), *Eriopsis conexa* (b), *Harmonia axyridis* (c), *Hippodamia convergens* (d), *Jaguarita conjugata* (e), *Olla v-nigrum* (f) (Coleoptera: Coccinellidae) evaluated for predation on *Glycaspis brimblecombei* (Hemiptera: Aphalaridae) eggs.

completing the pupal stage, identified, and individually placed in Petri dishes with ten replications (25 ± 2 °C, relative humidity of 60 ± 10%, and a 12-hour photophase), without sex separation.

Eucalyptus urophylla leaves, cut into disks with a diameter of 4 cm and with a known number of *G. brimblecombei* eggs (around 100 eggs) collected from a laboratory rearing, were provided in each dish, and the eggs were counted using a stereoscopic microscope. The leaves with *G. brimblecombei* eggs were replaced according to the predation by these insects. The number of eggs preyed was counted after one, two, three, four, five, six, seven and 24 hours. The data were subjected to ANOVA using the F-test and the means compared using Tukey's test ($P \leq 0.05$), all performed with the Minitab software (version 19) (Minitab, 2010).

3. Results

Newly emerged adults of *O. v-nigrum* and *J. conjugata* preyed on eggs of *G. brimblecombei*, unlike *C. sanguinea*, *E. conexa*, *H. axyridis*, and *H. convergens*. The predation of *G. brimblecombei* eggs by *O. v-nigrum* was higher in all evaluations ($F = 375.47$, $p < 0.001$), with an average of 1,016 eggs after 24 hours, while predation by *J. conjugata* started after four hours of evaluation (Table 1, Figure 2).

4. Discussion

The reproductive system of newly emerged Coccinellidae adults is not fully mature, making feeding during the early life stages crucial. The predation rate during this period is essential for prey association and ovarian development, directly impacting future reproductive fitness (Osawa, 2005). This increases the importance of feeding for the ovarian development of these natural enemies (Hatt and Osawa, 2021).

The predation of *G. brimblecombei* eggs by *O. v-nigrum* and *J. conjugata* confirms reports of these natural enemies in infestations of native psyllids on *Caesalpinia peltophoroides* plants in Brazil (Machado, 1982) and that the eggs of these pests may be part of their diet in the field. Furthermore, *O. v-nigrum* has been reported in several South American regions, including some in Brazil (Silva et al., 2013), and even North America (Maffei et al., 2001). This is important and demonstrates that the insect is present naturally in different regions, making it possible to breed and release them in forest areas, as a biological control strategy, within Integrated Pest Management.

The lack of predation by *C. sanguinea*, *E. conexa*, *H. axyridis*, and *H. convergens* on *G. brimblecombei* eggs is related to these natural enemies preferring other prey, such as mites and aphids (Sarmento et al., 2007; Milléo et al., 2019; Rodríguez-Palomera et al., 2019). Their presence in *G. brimblecombei* infestations may be associated with other stages of this insect or other pests in the same area (Evans and England, 1996).

The reduced predation of *G. brimblecombei* eggs by *J. conjugata*, starting after four hours of evaluation, may be related to this food source not being ideal for the ovarian development of this natural enemy (Lima et al., 2020), and this resource may be secondary to maintaining the survival of this predator until finding suitable prey (Mercer et al., 2020).

The higher predation of *G. brimblecombei* eggs by adults of *O. v-nigrum* explains the frequent presence of this natural enemy in infestations of this pest (Sanchez-Martinez et al., 2005; Oliveira et al., 2010; Rodas-Ávalos et al., 2021), and this resource may be primary for the development of this predator, similar to what has been reported for *Psylla* sp. (Kato et al., 1999). Therefore, this natural enemy is important to reduce *G. brimblecombei* populations (Hoy, 2019). The development, oviposition, and viability of these natural enemies vary with the quality of prey, making them potential secondary sources for the maintenance of some Coccinellidae species.

Table 1. Number of *Glycaspis brimblecombei* (Hemiptera: Aphalaridae) eggs preyed by *Cycloneda sanguinea* (*Cs*), *Eriopsis conexa* (*Ec*), *Harmonia axyridis* (*Ha*), *Hippodamia convergens* (*Hc*), *Jaguarita conjugata* (*Jc*) and *Olla v-nigrum* (*Ov*) (Coleoptera: Coccinellidae) during 24 hours after the emergence of adults of these predators.

Period (h)	*Ov*	*Jc*	*Cs*	*Ec*	*Ha*	*Hc*
1	39.0 ± 7.6	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
2	86.2 ± 11.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
3	131.1 ± 9.6	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
4	182.5 ± 12.6a	1.9 ± 1.3b	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
5	257.0 ± 14.6a	6.9 ± 4.6b	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
6	352.5 ± 21.0a	12.2 ± 8.1b	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
7	428.3 ± 26.6a	33.2 ± 14.4b	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
24	1,016.0 ± 29.4a	167.7 ± 32.4b	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0

Means followed by the same lower-case letter, per line, do not differ by the Tukey test ($p \leq 0.05$).

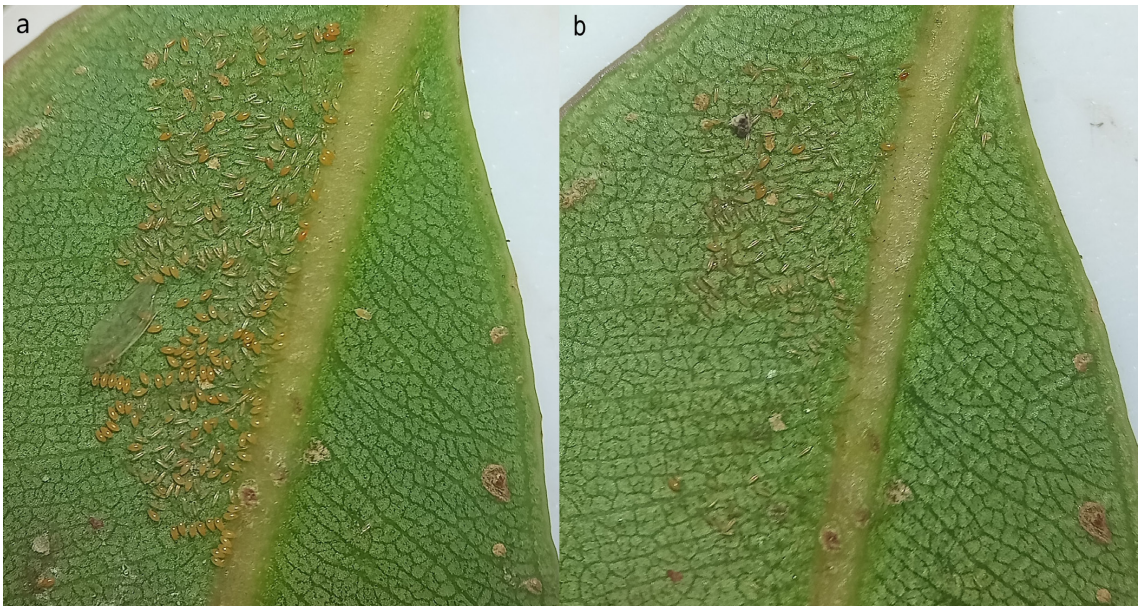

Figure 2. *Eucalyptus* leaf before (a) and after (b) predation of *Glycaspis brimblecombei* (Hemiptera: Aphalaridae) eggs by *Olla v-nigrum* (Coleoptera: Coccinellidae).

5. Conclusions

The high predation of *G. brimblecombei* eggs by *Olla v-nigrum* indicates that this natural enemy is a promising alternative for the integrated management of this pest.

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