# First Global Record of Podisus nigrispinus (Hemiptera: Pentatomidae) as Predator of Gonipterus platensis (Coleoptera: Curculionidae) Larvae and Adults

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# First global record of *Podisus nigrispinus* (Hemiptera: Pentatomidae) as predator of *Gonipterus platensis* (Coleoptera: Curculionidae) larvae and adults

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The genus *Gonipterus* (Coleoptera: Curculionidae) is originally from Australia (Mally 1924; Mapondera et al. 2012) and has a wide geographic distribution, having been reported in Africa, Europe, North America, Asia, and South America (Lanfranco & Dungey 2001; EPPO 2005). *Gonipterus* was detected for the first time in Brazil in 1928, but in field manuals, the first scientific report was given in 1982 from the state of Santa Catarina with the species *Gonipterus platensis* Marelli and *Gonipterus gibberus* Boisduval (Fenilli 1982), which later spread to the state of São Paulo (Rosado-Neto 1993).

The introduction of *G. platensis*, the main eucalyptus leaf-eating beetle in the world, causes economic losses in various regions. The larvae feed on young leaves and defoliate the top parts of the plant canopy (Mansilla-Vázquez 1992), and the adults feed on the edges of mature leaves (Mally 1924), impairing the growth of the plant. The larval stage has 4 instars, each lasting approximately 1 wk (Santolomazza-Carbone 2002). The females lay up to 800 eggs (Arzone & Meotto 1978). Since the discovery of this pest in Brazil, this scientific report is the first to document the action of a predatory species, *Podisus nigrispinus* Dallas (Hemiptera: Pentatomidae), preying on larvae and adults of *G. platensis*.

Predators in the order Hemiptera and the family Pentatomidae, such as *Supputius cincticeps* Stål (Souza et al. 2012), *Brontocoris tabidus* (Signoret) (Zanuncio et al. 2000), and *P. nigrispinus* (Torres et al. 2008) are reported as biological control agents of forest pests. *Podisus nigrispinus* also preys on various agricultural pests in Brazil, being a significant natural enemy and widespread in the whole country (Zanuncio et al. 2008; Torres et al. 2006). This paper evaluates the potential of *P. nigrispinus* to be used in an integrated pest management program following the first worldwide observation of *P. nigrispinus* nymphs preying on *G. platensis* larvae in a commercial plantation near Itararé, São Paulo, Brazil. *Gonipterus* species are currently being controlled in Brazil, and in other countries where they occur, with the egg parasitoid *Anaphes nitens* (Girault) (Hymenoptera: Mymaridae) (Wilcken et al. 2008; Reis et al. 2012) and the entomopathogenic fungus *Beauveria bassiana* (Bals.-Criv.) Vuill. (Cordycipitaceae) (Berti-Filho et al. 1992). Additionally, the larva parasitoid *Entendon magnificus* (Girault & Dodd) (Hymenoptera: Eulophidae) has been studied in Chile (Gumovsky et al. 2015). The introductions of new parasitoid species highlight the limitation of the current biological control efforts with *A. nitens*.

In this study, we evaluated the predation efficiency of *P. nigrispinus* on *G. platensis* in the Forest Protection Laboratory of Suzano Pulp and Paper Company. Larvae and adults of *G. platensis* were collected 3 d before the experiment from an infested field site and were kept on *Eucalyptus urophylla* S. T. Blake × *Eucalyptus grandis* W. Hill ex Maiden (Myrtaceae) leaves at a constant temperature of 24 ± 2°C. Nymphs and adults of the predator *P. nigrispinus* were reared at the Forest Protection Laboratory and fed *Tenebrio molitor* L. (Coleoptera: Tenebrionidae) larvae.

The experiment was conducted at a temperature of 24 ± 2 °C, relative humidity of 60 ± 10%, and a photoperiod of 12:12 h L:D. The experimental setup was completely randomized with 4 replications of the following treatments: 20 adults of *G. platensis* (T1, control), 20 larvae of *G. platensis* (T2, control), 2 adults (1 male and 1 female) of *P. nigrispinus* with 20 adults of *G. platensis* (T3), 2 adults (1 male and 1 female) of *P. nigrispinus* with 20 larvae of *G. platensis* (T4), 2 nymphs of *P. nigrispinus* with 20 larvae of *G. platensis* (T5), and 2 nymphs of *P. nigrispinus* with 20 adults of *G. platensis* (T6). The insects were kept in plastic pots (250 mL) covered with a voile cloth lid, upon which a damp

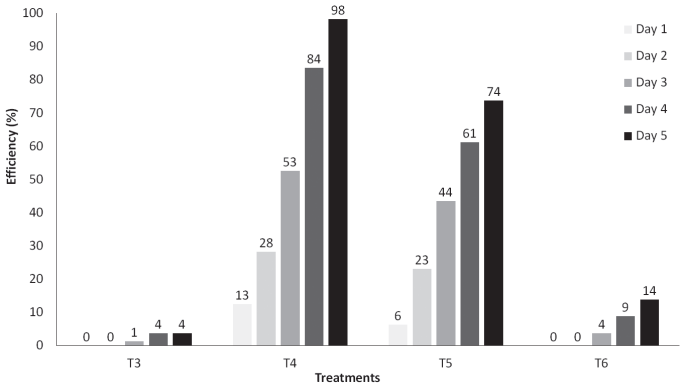


**Fig. 1.** Cumulative efficiency of predation (%) by *Podisus nigrispinus* nymphs and adults on of *G. platensis* larvae and adults over a period of 5 d: 2 adults (1 male and 1 female) of *P. nigrispinus* with 20 adults of *G. platensis* (T3), 2 adults (1 male and 1 female) of *P. nigrispinus* with 20 larvae of *G. platensis* (T4), 2 nymphs of *P. nigrispinus* with 20 larvae of *G. platensis* (T5), and 2 nymphs of *P. nigrispinus* with 20 adults of *G. platensis* (T6)

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**Table 1.** Average number ± SE of dead *Gonipterus platensis* larvae or adults on each evaluation day of predation by *Podisus nigrispinus* nymphs or adults tested in the laboratory (temperature of 24 ± 2 °C, photoperiod of 12:12 h L:D, and total duration of predation of 5 d).

| | | | Number of dead prey insects | | | | | Statistics | |
|---|---|---|---|---|---|---|---|---|---|
| Treatment | Prey | Predator | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | *F* value | C.V.[a] |
| T1 | Adults | none | 0.0 ± 0.0aA | 0.3 ± 0.0aA | 0.0 ± 0.0aA | 0.0 ± 0.0aA | 0.0 ± 0.0aA | 1.0 | 15.8 |
| T2 | Larvae | none | 0.0 ± 0.0aA | 0.5 ± 0.5aA | 0.0 ± 0.0aA | 2.8 ± 0.3bcB | 1.5 ± 0.6aAB | 9.6 | 27.8 |
| T3 | Adults | Adults | 0.0 ± 0.0aA | 0.3 ± 0.3aA | 0.3 ± 0.3aA | 0.5 ± 0.3abA | 0.0 ± 0.0aA | 1.1 | 26.1 |
| T4 | Larvae | Adults | 2.5 ± 0.3cA | 3.5 ± 0.6bA | 4.8 ± 1.5cA | 6.5 ± 0.6cA | 2.5 ± 1.0aA | 3.0 | 23.0 |
| T5 | Larvae | Nymphs | 1.3 ± 0.3bA | 3.8 ± 0.5bA | 4.0 ± 2.0bcA | 4.5 ± 1.5cA | 2.5 ± 1.0aA | 1.5 | 31.7 |
| T6 | Adults | Nymphs | 0.0 ± 0.0aA | 0.3 ± 0.3aA | 0.8 ± 0.5abA | 1.0 ± 0.6abA | 1.0 ± 0.4aA | 1.3 | 36.1 |
| Statistics | | | | | | | | | |
| *F* value | | | 77.7 | 15.6 | 8.1 | 15.2 | 3.2 | | |
| C.V.[a] | | | 10.2 | 24.4 | 38.1 | 24.5 | 38.8 | | |

Original values are presented; data were transformed by $(x + 0.5)^{0.5}$ for statistical analysis. Means ± SD followed by the same lowercase letter in a column and uppercase letter in a row did do not differ significantly according to the Tukey test ($P > 0.05$). Four replicates with 20 prey insects per replicate were conducted.

[3]C.V. = Coefficient of variation.

cotton ball was placed as a water source for the predator. Leaves of *E. urophylla* × *E. grandis* served as a food source for *Gonipterus* and were replaced daily throughout the assay. In the treatments with prey larvae (T2, T4, and T5) 11, 6, and 3 larvae in the 2nd, 3rd, and 4th instar were offered, respectively. Adults of *P. nigrispinus* were newly emerged and the nymphs were in the 4th instar.

The numbers of dead prey insects were recorded 1, 2, 3, 4, and 5 d after pest–predator contact. Mean numbers of insects preyed per d were compared by analysis of variance and means separated with the Tukey test at 5% probability, using SISVAR® Version 5.6 software (Ferreira 2008). The efficiency of predation was calculated based on the number of live insects using the Abbott formula: efficiency (%) = [1 – (number of live insects in the predation treatment / number of live insects in the predation-free control)] × 100 (Abbott 1925).

The results showed that adults and nymphs of *P. nigrispinus* were efficient in preying on *G. platensis* larvae, causing 98 and 74% mortality, respectively, after 5 d (Fig. 1). Observation over time showed a gradual daily increase in the consumption of prey insects (Table 1) indicating that *P. nigrispinus* could be a suitable biocontrol agent in the integrated management of *G. platensis*. However, the preying on *G. platensis* adults by adults and nymphs of *P. nigrispinus* was lower, with efficiency rates of 4 and 14%, respectively, after 5 d (Fig. 1). Other species of Pentatomidae, such as *Podisus mucronatus* Uhler and *Podisus maculiventris* (Say), were reported preying on Curculionidae (Costello et al. 2002; Medal & Santa Cruz 2014).

This first laboratory evidence of *P. nigrispinus* as an efficient native predator of *G. platensis* larvae in Brazil is an important step in the development of integrated management tactics to control this exotic pest. At Suzano Pulp and Paper Company, *P. nigrispinus* is being studied for simultaneous releases with *A. nitens* and applications of *B. bassiana* to target various life stages of *G. platensis* and ultimately combine these biological control agents in an efficient integrated pest management program against *G. platensis*.

## Summary

Native to Australia *Gonipterus platensis* Marelli (Coleoptera: Curculionidae) is the main beetle defoliator of eucalyptus worldwide, causing damage in various regions in which it was introduced, where its management relies mostly on biological control with the parasitoid *Anaphes nitens* (Girault) (Hymenoptera: Mymaridae). In this report, we present the first laboratory evidence of efficient predation by *Podisus nigrispinus* Dallas (Hemiptera: Pentatomidae) on *G. platensis* larvae. This predatory species is native to Brazil and a promising biological control agent for use in the integrated pest management of *G. platensis.*

Key Words: *Eucalyptus*; biological control; integrated management; Brazil

## Sumário

Nativo da Austrália *Gonipterus platensis* Marelli (Coleoptera: Curculionidae) é o principal besouro desfolhador do eucalipto no mundo, causando danos em diferentes regiões em que foi introduzido, locais onde seu manejo integrado é predominantemente biológicamente com o parastióide de ovos *Anaphes nitens* (Girault) (Hymenoptera: Mymaridae). No presente trabalho apresentamos a primeira evidência de campo e estimative da eficiência laboratorial do predador *Podisus nigrispinus* Dallas (Hemiptera: Pentatomidae) predando larvas de *G. platensis*. Este predador é nativo do Brasil e promissor para ser usando no controle biológico da praga dentro do manejo integrado de *G. platensis*.

Palavras Chave: *Eucalyptus*; controle biológico; manejo integrado; Brasil

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