



# *Harmonia axyridis* (Pallas, 1773) (Coleoptera: Coccinellidae) as a predator of the leaf-galling form of the grape phylloxera *Daktulosphaira vitifoliae* (Fitch, 1856) (Hemiptera: Phylloxeridae) in Brazil

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**Abstract.** *Harmonia axyridis* (Pallas, 1773) (Coleoptera: Coccinellidae) is an Asian species intentionally introduced in many countries as a biological control agent for insect pests. In Brazil, it was introduced accidentally and recorded for the first time in Curitiba, Paraná State, in 2002. An inventory of natural enemies of the leaf-galling form of the grape phylloxera *Daktulosphaira vitifoliae* (Fitch, 1856) (Hemiptera: Phylloxeridae) carried out in Bento Gonçalves, Rio Grande do Sul, the occurrence of predation of all stages of development of *D. vitifoliae* by larvae and adults of *H. axyridis*. The presence of *H. axyridis* preying on *D. vitifoliae* in vineyards is important because it identifies an exotic species acting as a predator of vine phylloxera populations in Brazil.

**Keywords:** Grapevine; Grapevine phylloxera; Natural enemy; Ladybird; Predation.

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### Article Full Open Access

*Daktulosphaira vitifoliae* (Fitch, 1856) (Hemiptera: Phylloxeridae) is an insect that attacks the vine by forming galls on the leaves (leaf-galling form) and roots (root-galling form) (Forneke & Huber 2009; Powell *et al.* 2013; Ji *et al.* 2021; Andzeiewski *et al.* 2021). Known for its high destructive potential, it occurs in most grape-growing countries and can cause plant death (Powell *et al.* 2013; Ji *et al.* 2021).

Little information is available on the natural enemies associated with phylloxera (Kögel *et al.* 2013), partly due to the complex life cycle that includes asexual and sexual forms of reproduction, cryptic habit and development stages in the soil (Powell 2012; Powell *et al.* 2013). Some of the natural enemies in their native range belong to the families Coccinellidae (Coleoptera), Cecidomyiidae, Chamaemyiidae and Syrphidae (Diptera), Anthocoridae (Hemiptera), Chrysopidae (Neuroptera), Thripidae (Thysanoptera) and Acaridae (Acari), most of which were observed preying on its leaf-galling form (Benheim *et al.* 2012; Yin *et al.* 2019; Kwong 2020). So far, no natural enemies of *D. vitifoliae* have been recorded in Brazil on grapevines.

Knowledge of the relationship between natural enemies and different phytophagous species is important for developing control methods or strategies to preserve biocontrol agents in agricultural ecosystems. In the case of phylloxera, knowing them has the potential to reduce the risk of dispersal, especially in the spring and summer periods, when dispersive life stages are most active (Benheim *et al.* 2012).

In order to investigate the natural enemies associated with *D. vitifoliae* in grapevine cultivation, leaves infested by the leaf-galling form were collected every 15 days from December to March of the 2021/22 and 2022/23 harvests, in nurseries of the Paulsen 1103 rootstock and the BRS Bibiana cultivar, located at Embrapa Uva e Vinho in Bento Gonçalves, Rio Grande do Sul (-29.1655555555556; -51.5341666666667).

The leaves with galls were placed in closed cardboard boxes (37 x 45.5 x 29.5 cm), which were kept in the Entomology Laboratory at Embrapa Uva e Vinho at 25 °C for 30 days. A glass tube containing a drop of honey diluted in water was inserted into the side and near the top of the box. The developing insects inside were attracted to the illuminated glass tube, removed daily and placed in containers with 70% alcohol for conservation and later identification (Schauff 1986).

The predator species recorded was *Harmonia axyridis* (Pallas, 1773) (Coleoptera, Coccinellidae); 382 specimens were collected in the two years of evaluation. Identification was carried out using taxonomic keys for larval and adult stages (Koch 2003; Celli *et al.* 2021), voucher specimens deposited in the entomological collections of Embrapa Uva e Vinho, Bento Gonçalves, Rio Grande do Sul and of Museu de Ciências Naturais, DPMCC/

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*Harmonia axyridis* is a polyphagous insect, native to Asia, which feeds mainly on adults of Aphididae, Psyllidae, Coccoidea (Hemiptera) and Tetranychidae (Acari), immatures of Coleoptera and Lepidoptera, and also plant materials such as damaged fruit (Koch 2003). It also stands out for being an effective predator of aphids and mealybugs (Adriaens et al. 2008; Angelidou et al. 2022), used to control aphids on various crops around the world, including pecans, hops, alfalfa, cotton, tobacco and ornamentals (Almeida & Silva 2002; Santos et al. 2014; Castro-Guedes & Almeida 2016; Roy et al. 2016).

The species has been intentionally introduced into many countries as a biological control agent (Koch 2003; Kögel et al. 2013; Roy et al. 2016; Angelidou et al. 2022), resulting in rapid spread and establishment (Camino et al. 2020; Angelidou et al. 2022). The first record of *H. axyridis* in Brazil was in 2002 in the city of Curitiba, Paraná, as a result of accidental introduction, and since then the predator has spread to various regions of

the country (Almeida & Silva 2002; Guedes & Almeida 2013; Paula et al. 2020).

The ability of *H. axyridis* to prey on phylloxera was evaluated in Germany by Kögel et al. (2013), who found that individuals completed their development using the aphid as a food source; in 24 hours, individuals consumed up to 1,400 eggs of *D. vitifoliae*. During observations made in the field over a period of two years, *H. axyridis* was observed feeding on the galls of the phylloxera, which indicates that it uses it as prey, the insect being more abundant on leaves with galls than without. In this sense, they concluded that the species is a predator of *D. vitifoliae* and can help reduce the population of phylloxera in its galled form.

In this study, observations and field collections revealed that both larvae and adults of the coccinellid visited leaves with phylloxera galls and actively fed on all stages of development (Figure 1). This report is the first to record the predation of *D. vitifoliae* by larvae and adults of *H. axyridis* under



**Figure 1.** Predation of *Harmonia axyridis* on *Daktulosphaira vitifoliae*. A. Predation overview. B. Predation view in focus.

natural conditions in Brazilian vineyards, contributing to the knowledge of predators of phytophagous insects in vineyards.

### AUTHORS CONTRIBUTION

All the authors contributed equally to the preparation of the manuscript.

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### CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

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