

First occurrence of *Euneura sopolis* (Hymenoptera, Pteromalidae) hyperparasiting *Xenostigmus bifasciatus* (Hymenoptera, Braconidae) in Brazil: implications for biological control of pine aphids

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Received: November 11, 2014 – Accepted: June 29, 2015 – Distributed: August 31, 2016

It is estimated that the planting of pinus in Brazil exceeds 2 million hectares comprising mainly two species *Pinus taeda* and *P. elliottii*. Due to the expansion of this culture and the often inappropriate cultural methods, this crop became increasingly susceptible to pest insects (Zaleski et al., 2005). Among these the aphids are outstanding due to their characteristics such as high fertility, presence of both wingless and winged forms, thus facilitating dispersal, parthenogenetic reproduction that coupled to the favorable Brazilian climatic conditions make them one of the most important pests of *Pinus* spp. plantations (Penteado et al., 2004).

Because aphids are easily dispersed, several species some of the genus *Cinara* occur in the regions with conifers plantations, usually of the families Pinaceae and Cupressaceae as hosts. They are observed feeding on pine branches, sprouts and even the roots (Penteado et al., 2004). In this genus there are ca. 200 species (Costa et al., 1993). According to Sousa-Silva and Ilharco (1995), the species *Cinara atlantica*, *C. cupressi*, *C. fresai*, *C. maritimae*, *C. piniformosana*, *C. pinivora* and *C. tujafilina* occur in Brazil.

Infestations of aphids on pine can cause considerable decrease on growth and morphological changes that significantly reduces the economic value of wood (Zaleski et al., 2005). The control of aphids is based mainly on biological methods using predators, parasitoids and entomopathogenic fungi.

Predators as the coleopterans (Coccinellidae), neuropterans (Chrysopidae) and the larvae of the dipterans (Syrphidae), are found near the colonies of aphids, which occur in abundance in the winter, when the number of predators decreases and the control of large pest populations decreases as well. Therefore, the use of parasitoids, besides being specific is also more efficient (Penteado et al., 2004). The parasitoids species belonging to the genera *Pauesia*

and *Xenostigmus* (Hymenoptera: Braconidae) are the most frequently used to control aphids attacking pine plantations.

To control populations of *C. atlantica* and *C. pinivora* in pinus plantations in Paraná state, Brazil, a program was started to introduce the parasitoid *Xenostigmus bifasciatus* from the USA east coast. The mummified aphids were collected in North America and a quarantined was carried out in Brazil before these parasitoids were cultured and released in the field (Penteado et al., 2004). The release occurred between 2002 and 2004 in different municipalities of Paraná and Santa Catarina states. Shortly thereafter, this parasitoid was recorded in several areas attacked by the pine aphid and its dispersion was estimated at approximately 80 km per year, and so its establishment in Brazil was confirmed (Penteado et al., 2004).

This study aimed to determine the occurrence of aphid species in a *P. elliottii* plantation in a Cerrado area at the São Carlos region and the possible occurrence of their natural enemies. Ten samplings were carried out from October 2013 to August 2014 in *P. elliottii* plantation area of approximately 4,000 square meters at the 21° 58'24.02"S, 47° 53'7.39"W. The collected aphids were placed in bottles containing 100% alcohol and later mounted on microscope slides, according to the methodology described by Ilharco and Lemos (1981). They were subsequently identified under an optical microscope using the key of Costa et al. (1993). The mummies were placed in Eppendorf tubes and after the emergence the parasitoids were preserved in 70% ethanol and then mounted and identified.

Cinara maritimae was the aphid with the highest frequency of occurrence during the collection period. From the 63 mummies of *C. maritimae* collected, the parasitoid *Xenostigmus bifasciatus* (Ashmead) emerged from only two, whereas the hyperparasitoid *Euneura sopolis* (Walker) emerged from 23 mummies.

Xenostigmus bifasciatus was introduced in 2002 in Paraná state to control the species *C. atlantica* and *C. pinivora*,

pests of pine, and its occurrence has also been reported in several regions of the states of Santa Catarina, Minas Gerais and São Paulo. However this is the first report of *X. bifasciatus* parasitizing *C. maritimae*.

Euneura sopolis is widely distributed in Europe, Japan and Eastern United States. Its presence in Brazil is here recorded for the first time. This species parasitizes microhymenopterans of the genera *Pauesia* and *Xenostigmus* (Garrido Torres and Nieves-Aldrey, 1999), parasitoids of aphids belonging to the Lachnidae family.

In the quarantine period before the introduction of *X. bifasciatus* in Brazil, in 2002, several hyperparasitoids emerged from mummies of *C. atlantica* brought from the USA: *Alloxysta lachni*, *Anastastus* sp., *Asaphes suspensus*, *Dendrocerus* sp., *Diaretus* sp., *Syrphosagrus* sp., *Tetrastichus* sp., *Euneura lachni* and *Euneura sopolis*. These hyperparasitoids were destroyed and samples of *X. bifasciatus* free from parasitoids were introduced in Paraná state (Penteado et al., 2004).

Acknowledgements

We are grateful to the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) for financial support.

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