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Phytoseiidae in European grape (*Vitis vinifera* L.): bio-ecological aspects and keys to species (Acari: Mesostigmata)

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Abstract

The family Phytoseiidae includes many species of predators involved in the control of mite pests of crops all over the world. In European vineyards, these natural enemies play a key role in plant protection as their presence usually makes the use of acaricides unnecessary. Each species has its specific biological features. It is thus of great interest to identify the species reported on grape, V*itis vinifera*. The present paper, based on a world database of the family Phytoseiidae and on an analysis of more than 250 publications, presents the 54 species of Phytoseiidae belonging to 15 genera reported on *V. vinifera* in Europe, and identification keys to species. Online versions of the key (dichotomous and polytomous) with illustrations are available at http://www1.montpellier.inra.fr/CBGP/phytoseiidae/sitewebvineyards2/index.htm. An analysis of the biogeographic distribution of these species and their prey has also been carried out. Most species reported on *V. vinifera* in Europe are rare; only five species are frequently observed: *Kampimodromus aberrans*, *Typhlodromus* (*Typhlodromus*) *pyri*, *Typhlodromus* (*Typhlodromus*) *exhilaratus*, *Euseius finlandicus* and *Phytoseius finitimus*. The 12 countries where Phytoseiidae have been reported from grapes have been unevenly surveyed, the most well-known faunas being from Italy, Greece and France. These species are reported to prey upon the main species of mite pests of grapes.

Key words: V*itis vinifera*, predatory mites, keys, biological control, Europe

Introduction

Recently, increasing concerns on the effects of pesticides on environment and human health have resulted in the development of non-chemical methods of pest control (e.g., Pimentel, 2009). In this context, many studies have focussed on the family Phytoseiidae because of their role as biological control agents of phytophagous mites (particularly of the Tetranychoidea and Eriophyoidea) and small insects such as thrips, coccids and whiteflies (McMurtry & Croft, 1997; Gerson *et al*., 2003; Serrano *et al*., 2004). A search on the CAB database indicates that from 1973 to 2012, 5,490 publications deal with the family Phytoseiidae. This family comprises more than 2,000 species worldwide; three sub-families and 90 genera are defined in the last world revision (http://www.lea.esalq.usp.br/phytoseiidae/index.php; Chant & McMurtry, 2007). McMurtry & Croft (1997) divided these species in four functional types according to their food requirements and developmental features. Most species are generalist predators, able to survive and develop feeding on prey (mites and / or insects) when they are present, but also capable of surviving on a great variety of foods (pollen, plant exudates, fungi, etc.). Biological control of grape mite pests using Phytoseiidae has been of interest for more than 30 years (e.g., McMurtry *et al*., 1970; McMurtry & Croft, 1997; Duso *et al*., 1994, 2012). Surveys have been carried out to determine the occurrence of Phytoseiidae on grapes and to assess the factors that affect their occurrence. The main species found are generalist predators, which is quite a common feature in perennial agrosystems (Rambier, 1972; Baillod & Venturi, 1980; Boller *et al*., 1988; Valentin & Kreiter, 1993; Kreiter *et al*., 2000, 2002; Tixier *et al*., 2000a,b, 2006a; Moraes *et al*., 2004; Barbar *et al*., 2005). Inoculative releases have also been carried out to increase densities of naturally occurring

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