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The first electronic polytomous key to the world species of the subgenus *Typhlodromus* (*Anthoseius*) De Leon (Acari: Phytoseiidae)

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Abstract

This paper describes the first polytomous computerised identification key within the family Phytoseiidae. It applies to the females of the world species of the subgenus *Typhlodromus* (*Anthoseius*) De Leon. This group is one of the largest within the family Phytoseiidae and the sub-family Typhlodrominae, with nearly 350 species currently recognised worldwide. No identification tool of these species exists at the world level, which makes their identification very difficult and unsecure. Thirty five characters were used to characterise each of the 343 species. Among these characters, 14 are discrete and 21 are continuous. The polytomous key was constructed using the free software DELTA 1.04 (DEscription Language for TAXonomy) and is freely available at the web site: <http://www1.montpellier.inra.fr/CBGP/phytoseiidae/anthoseiuskeypresentation.html>. We hope that this work will open new perspectives for the identification of species of other genera (especially the largest ones, e.g. *Neoseiulus*, *Euseius*, *Amblyseius*) which contains more than 150 species and for which no key presently exists. We also expect that the present work will make the identification of the world species of *Typhlodromus* (*Anthoseius*) easier and more secure. Finally, we expect a contribution from the whole Phytoseiidae scientist community to improve subsequent versions of the key.

Key words: Taxonomy, identification, Acari, predators

Introduction

Phytoseiidae Berlese (Acari: Mesostigmata) is a mite family that contains predatory species useful to control important insect and mite pests of cultivated plants worldwide (McMurtry & Croft 1997; Gerson *et al.* 2003). The correct identification of species of Phytoseiidae is thus of huge interest for biological control success. Species diagnostic is mainly based on morphological characters of females. Despite recent progresses in molecular systematics (Jeyaprakash & Hoy 2002; Tixier *et al.* 2006a, b, 2010, 2011, 2012; Okassa *et al.* 2009, 2010; Kanouh *et al.* 2010a, b), most species continue to be circumscribed based solely on morphology, since morphological data are often the only sort of information available. To facilitate Phytoseiidae diagnostics, identification keys have been developed. However, most of them are restricted to few genera and often apply to a single country or region and all follow the model of traditional dichotomous keys. Lastly, they rapidly become obsolete as new species are described and the keys not updated. These dichotomous keys are relatively simple and portable, but they oblige the user to follow a predetermined path in recognising characters or character states (Norton 2002, Hardwick 2010). Furthermore, if a critical character is obscured, damaged or missing at any step along the key pathway, the choice required by the couplet is unanswerable and the identification impossible. To overcome these problems, World Wide Web and computerisation tools have opened new opportunities, especially for more friendly and efficient identification tools. The so-called polytomous keys (matrix based) allow the user to select from characters which are more easily recognised, in any desired order (Lobanov 2003; Watson *et al.* 2003; Walter & Winterton 2007; Hardwick 2010). This means that users can by-pass characters that are unrecognisable, hidden, damaged or missing.

Here we describe the development of a computerised polytomous key to identify females of the world species of the subgenus *Typhlodromus* (*Anthoseius*) De Leon. This subgenus is one of the largest within the family Phytoseiidae, and the largest within the sub-family Typhlodrominae, currently comprising nearly 350 valid species (Moraes *et al.* 1986; 2004; Chant & McMurtry 2007). Despite efforts to build regional keys (Ueckermann & Loots