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The *Lasioseius phytoseioides* species group (Acari: Blattisociidae): new characterisation, description of a new species, complementary notes on seven described species and a taxonomic key for the group

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Abstract

The *Lasioseius phytoseioides* species group was first characterised over 50 years ago. Two species of this group, *Lasioseius chaudhrii* (Wu & Wang) and *Lasioseius parberlesei* Bhattacharyya, have been considered potentially effective as biological control agents of pest mites of the family Tarsonemidae on rice (*Oryza sativa* L.) in Asia. A new characterisation of the species group is presented, taking into account a new species here described, *Lasioseius piracicabensis* Moraes & Pérez-Madruga **n. sp.**, as well as other species mostly described since the first characterisation of the group. The main characteristics of the included species are the reduced number of dorsal idiosomal setae, including the absence of *j1* and *z1*; antiaxial surface of fixed cheliceral digit with a subterminal pointed process; and males with broad lateral expansion of the peritrematic shield in the region between coxae II–III, bearing a pore and a lyrifissure. Complementary notes are presented for *Lasioseius annandalei* Bhattacharyya & Bhattacharyya, *Lasioseius chaudhrii* (Wu & Wang), *Lasioseius parberlesei* Bhattacharyya, *L. phytoseioides* Chant, *Lasioseius punjabensis* Bhattacharyya & Sanyal, *Lasioseius terrestris* Menon & Ghai and *Lasioseius youcefi* Athias-Henriot. New synonymies are proposed and possible misidentifications in the literature are discussed. A dichotomous key is presented to help the identification of the species of the group, and the distribution of the species is summarised.

Key words: Predators, taxonomy**,** biological control

Introduction

With nearly 200 species, *Lasioseius* Berlese 1916 is the most diverse genus of Blattisociidae (Christian & Karg, 2006). Most species of this genus are found in litter and in the upper soil layer (Karg, 1993), but some species have been reported from rodent and bird nests (Christian & Karg, 2006) as well as from aerial plant parts (Walter & Lindquist, 1997). They have been reported as predators of mites, insects, springtails and nematodes, but some have also been reported to feed on fungi (Walter & Lindquist, 1989; Christian & Karg, 2006; Britto *et al*., 2012). Biological and ecological studies on the species of this group have been summarised by Moraes *et al*. (2015).

Surveys conducted in a rice (*Oryza sativa* L.) and a strawberry (*Fragaria x ananassa*) field in southeastern Brazil led to the finding of a new species of *Lasioseius*. It was found to be most similar to species placed by Lindquist (1964) in his *phytoseioides* species group and to several other species of the same group described since then. Species with similar morphological characteristics have also been found in rice fields in other countries, and some have been reported to be effective biological control agents of pest mites of the family Tarsonemidae, including *Steneotarsonemus spinki* Smiley (Tseng, 1984; Zhang & Lin, 1991). The latter species was described from southern USA but it has been mentioned as a major rice pest in Asia since the early 1960s and in the Caribbean area since the late 1990s. It has more recently spread and caused problems to rice growers in Central and South America (Hummel *et al*., 2009).

One of the main interests in conducting the work described in this paper refers to the reported potential of mites of the *phytoseioides* group as biological control agents of tarsonemids mites on rice. The objective of this paper are to provide an updated characterisation of this group, describe a new species, provide complementary descriptions of six other described species, as well as a dichotomous key to help in the identification of the included species.

Material and methods

Mites from plant and soil samples collected in Brazil, Dominican Republic and Taiwan were mounted in Hoyer's medium for examination and description under phase and/ or interference contrast microscopes.

Specimens previously collected by other authors were examined, as follows: type females of *Lasioseius annandalei* Bhattacharyya & Bhattacharyya, *Lasioseius phytoseioides* Chant and *Lasioseius punjabensis* Bhattacharyya & Sanyal; type males of *Lasioseius parberlesei* Bhattacharyya and *Lasioseius terrestris* Menon & Ghai; and males and/or females here identified as *Lasioseius chaudhrii* (Wu & Wang), *L. parberlesei* and *Lasioseius youcefi* Athias-Henriot. Despite our efforts, we could not examine the types of *Lasioseius albatus* (Parvez, Iqbal & Akbar), *L. extremus*, *Lasioseius faustus* (Parvez, Iqbal & Akbar), *Lasioseius indicus* Bhattacharyya, Sanyal & Bhattacharya, *Lasioseius jamali* Bhattacharyya, Sanyal & Bhattacharya, *Lasioseius*