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Occurrence and population distribution of *Withius* aff. *piger* (Simon, 1878) (Withiidae), in commercial laying hen poultry houses in southern Brazil

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ABSTRACT. Laying hen house settings are favorable sites for the presence of many arthropods, e.g. pseudoscorpions, which are arachnids that are predators of ecological importance and yet are poorly studied. The aim of this study was to investigate the population fluctuation of a pseudoscorpion found in a commercial laying hen house. Samplings were performed weekly, in two commercial laying hen houses (Céu Azul, PR, Brazil, between April and November 2021). Sampling was conducted using Avivet traps attached to the cages. Their content was analyzed in the laboratory. Pseudoscorpions were separated, counted, and individualized into plastic micro-tubes, containing a 70% alcohol solution. The species *Withius* aff. *piger* (Simon 1878) (Withiidae) was confirmed in all traps with presence of pseudoscorpions, mainly in August and September, associated to high populations of *Dermanyssus gallinae* (De Geer 1778) (Dermanyssidae).

Keywords: *Dermanyssus gallinae;* parasitism; pseudoscorpions; species interaction; biological control.

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Introduction

Pseudoscorpions are small arachnids with sizes ranging from 0.5 to 8 mm (Del-Claro & Tizo-Pedroso, 2009; Harvey, 2002; Weygoldt, 1969). There are currently approximately 496 genera and 4,347 species of pseudoscorpions known worldwide (World Pseudoscorpiones Catalog, 2025). In Brazil, there are 14 families, and 186 species currently reported. They have cryptic habits and are found in litter, under rocks, under tree barks, in caves, and in bird nests. They are predators, and feed primarily on mites, springtails (Collembola), and insect larvae (Bedoya-Roqueme & Tizo-Pedroso, 2021; Harms & Dunlop, 2017; Harvey, 2002).

The pseudoscorpion family Withiidae is distributed all over the world, except for the Polar Regions, and has currently 38 genera and 175 species. In Brazil, the family is represented by 6 genera and 18 species (WPC, 2025). Pseudoscorpions of this family are often associated with litter and surface soil layers and occasionally associated with tree trunks (García & Romero-Ortiz, 2021; Reis et al., 2024). They are found throughout Brazilian territory, in all biomes. The genus *Withius* is represented by 45 extant species (WPC, 2025). Species of this genus are found mainly in tropical and subtropical regions, such as South America, Africa, and Australia (Harvey, 2015). *Withius piger* (Simon, 1878) is a cosmopolitan and synanthropic species, having been reported in South America, in countries such as Brazil, Chile, and Ecuador (WPC, 2025). In Brazil, *W. piger* was previously reported by Pinto (2007) and Pinto et al. (2005). However, despite its wide distribution and history in previous studies conducted in different regions, little is still known about the biology, ecology, and behavior of this species.

Although they are anthropized settings, poultry houses are environments favorable to the presence and maintenance of arthropods due to the availability of shelter and food, especially commercial laying hen poultry houses (Roy et al., 2017). The presence of pseudoscorpions is known to occur in these environments, associated to the red mite *Dermanyssus gallinae* (De Geer 1778), one of the major birds ectoparasites (Pavan et al., 2022). Information available in Brazil about pseudoscorpions in poultry houses is outdated (early 2000).

Pinto et al. (2005) formally reported the occurrence and population fluctuation of the pseudoscorpion *W. piger* for the first time. On the other hand, recent information has been found in both the European and African continents (Roy et al., 2017; Zriki et al., 2020).

Pseudoscorpions have been frequently observed in biocontrol studies of *D. gallinae* conducted in commercial laying hen poultry houses by our research group, using traps to monitor the red mite population. Therefore, the present study aimed to characterize the occurrence and analyze the population fluctuation of *Withius* aff. *piger* in commercial laying hen poultry houses in the state of Paraná, Brazil, investigating its temporal association with the red mite *Dermanyssus gallinae*.

Material and methods

The study was conducted in two California poultry houses linked to Cooperativa Agro-industrial Lar, with two metallic battery cages and a wooden structure, and no control of photoperiod or temperature, in Céu Azul, PR, Brazil (25°10”38’S; 53°53”28’W). This poultry house housed approximately 11,000 hens (Isa Brown race, 50 weeks old, average of 4 to 5 hens per cage). Throughout the period, the fungus *Beauveria bassiana* Unioeste 88 was used for the control of *D. gallinae* (Nascimento et al., 2020; Oliveira et al., 2020), both in attract-and-infect traps and by spraying.

Sampling was conducted with 80 Avivet traps (Lammers et al., 2017), identified and installed alternatively in the upper and the lower row of cages, in zigzag, attached with nylon clamps on the frontal part of the cages, distributed in an equidistant manner. In the period from April to November 2021, the traps were weekly removed and replaced by identical ones. The traps were opened in the laboratory. Both pseudoscorpions and *D. gallinae* were separated using a brush and entomological pliers, counted, and individualized in centrifugation micro-tubes containing 70% alcohol solution. The sampling date was identified. Pseudoscorpions were forwarded to the Laboratory of Diversity, Behavior and Conservation of Arachnids of the *Universidade Estadual de Goiás*, Brazil, for identification.

Species identification

The specimens were cleared by slow diffusion with 70% lactic acid for 24 hours (Judson, 1992). After that, the left chelicera, leg I, IV, and the left pedipalp were removed for examination. The specimens were temporarily mounted in slides with glycerin and observed under a compound Nikon microscope. After the study, the specimens were rinsed in water, transferred to 70% ethanol, and the dissected parts were stored in a plastic tube together with the original specimens.

Multifocal photographs were taken at the Laboratory of Diversity, Behavior and Conservation of Arachnids, of the *Universidade Estadual de Goiás*, Anápolis, Brazil, using an HD digital camera attached to the compound microscope. Measurements were performed using ImageJ v.1.53k (Rasband, 2015), calibrated with a micrometer attached to the compound microscope.

Terminology and measurements mostly follow (Chamberlin, 1931), except for the nomenclature of pedipalps, legs, and with some minor modifications to the terminology of the trichobothria (Harvey, 1992), chelicera (Harvey & Edward, 2007; Judson, 2007), and the faces of appendages (Harvey et al., 2012). The ratios (mm) given are length/width for carapace, chelicera, and pedipalps, and length/depth for legs. Species were confirmed by comparing characters and measurements based on Heurtault (1971b), and based on the morphology of the spermatheca, as described by Heurtault (1971a).

Results

Species diagnosis

The pseudoscorpions found in the traps of all samplings belonged to the species *Withius* aff. *piger* (Simon 1878) (Withiidae) (Figure 1). The specimens analyzed in this study were compared with the publications by (Vachon, 1970) and (Heurtault, 1971a, 1971b). Although the body measurement analysis of the specimens does not fully agree with the data presented by these authors, the other characteristics agree well. The distribution of trichobothria agrees well, as does the morphology of the spermathecae. Thus, considering the differences in pedipalp measurements (♂, mean femur length/width ratio = 2.79, Patella = 3.04, Chela = 3.67, N = 20; ♀, mean femur length/width ratio = 2.82, Patella = 2.33, Chela = 3.35, N = 20), we consider the material in this study to be *Withius* aff. *piger*.

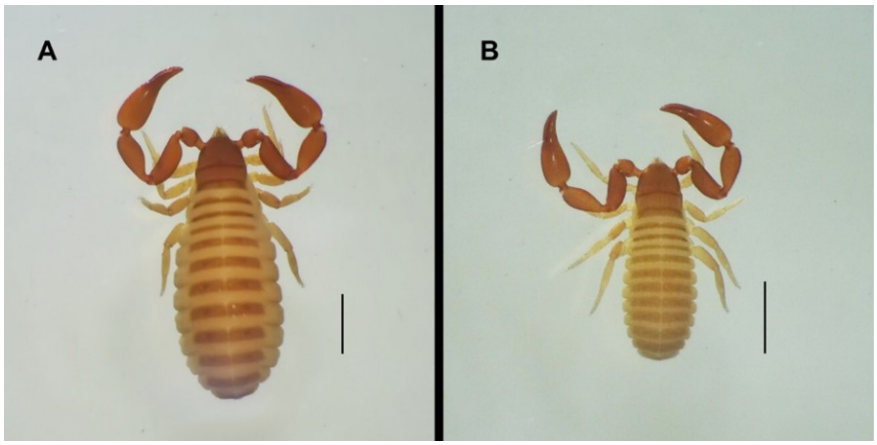

Figure 1. Adult individuals of *Withius* aff. *piger*. A) Female; B) Male. Scale bar = 1 mm.

Population fluctuation

Dermanyssus gallinae were found in all their life stages, as well as pseudoscorpions (Figure 2). However, despite the apparent relationship between population growth curves of the red mite and of the pseudoscorpion, it was not possible to correlate the populations statistically due to environmental variables and to interference by the treatment with fungus for the control of *D. gallinae* in the poultry houses.

Withius aff. *piger* was observed to have low population density from May to July, and the highest occurrences were reported in April, August, and September, which represent the beginning of autumn, end of winter, and beginning of spring (Figure 2).

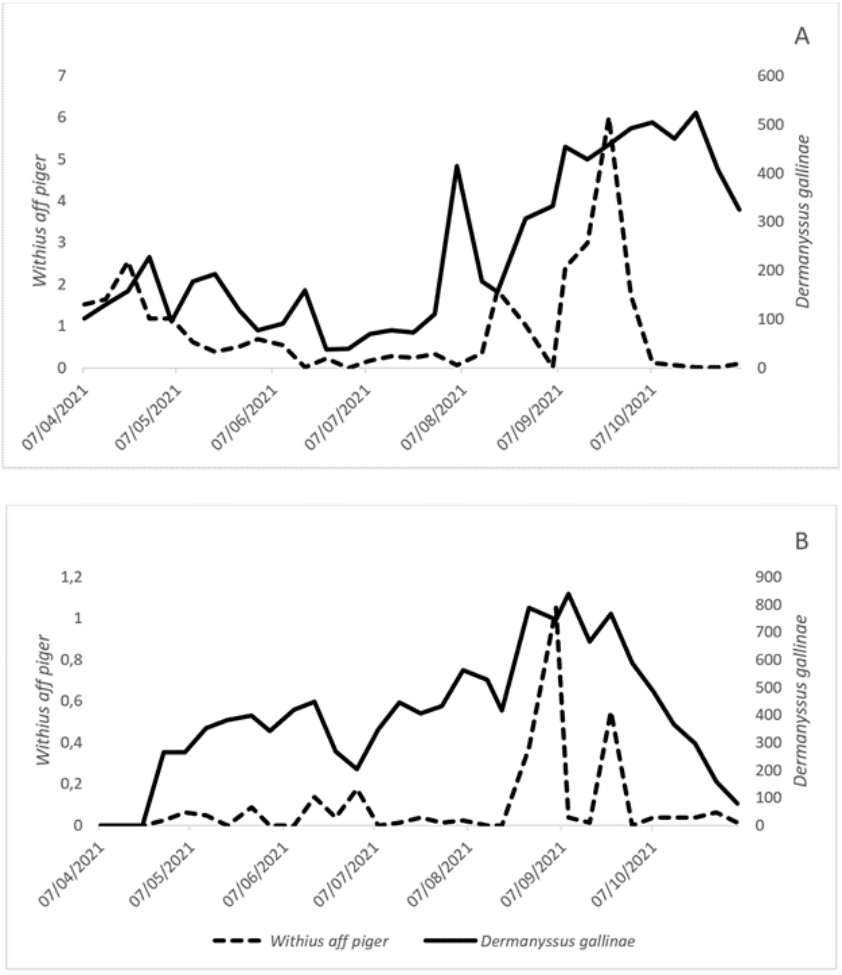

Figure 2. Population fluctuation of *Withius* aff. *piger* and *Dermanyssus gallinae* (mean individuals per trap) in commercial laying hen poultry houses, between April and November 2021: A – poultry house 1; B – poultry house 2.

Discussion

Aside from the present study, Pinto et al. (2005) reported the pseudoscorpion *W. piger* as a predator of the red mite. Additionally, Alves et al. and Johann et al. (data not published or personal observation) maintained pseudoscorpions *in vitro*, collected from commercial laying hen poultry houses for over two generations, feeding the individuals with nymphs and adults of *D. gallinae*. Recently, Zriki et al. (2020) confirmed the predatory action of pseudoscorpions on the red mite *in vitro*.

Considering the role of pseudoscorpions as predators, further studies in the laboratory are required on the biological aspects and the behavior of *W. piger*, as well as their potential for control of the red mite. In other systems, pseudoscorpions are present in the nests of different bird species in Argentina (Turienzo et al., 2010). Some species of pseudoscorpions can associate with nests of rodents, which act as their phoretic vectors, and they can feed on ectoparasites, or other arthropods present in the nests (Okabe et al., 2020). On the other hand, other pseudoscorpion species associate with ant or bee nests, where they can feed on other commensals or parasites arthropods (Fombong et al., 2016; Gonzalez et al., 2007; Lin et al., 2020). In addition, recent studies have highlighted the potential of these arachnids as control agents of *Varroa* infestations (Donovan & Paul, 2015; van Toor et al., 2016). Therefore, pseudoscorpions may represent potential agents for the biological control of red mites.

Further field studies should be conducted aiming to relate the occurrence of pseudoscorpions with relative humidity and ambient temperature, as well as with red mite populations. Moreover, given its natural occurrence, and considering control measures for the red mite are usually adopted in commercial laying hen poultry houses, we recommend that the survival practices by the predator should be identified, and that measures are taken for its preservation, aiming at the augmentative biological control of the red mite.

Conclusion

The species *Withius* aff. *piger* (Simon 1878) (Withiidae) was confirmed in all traps with presence of pseudoscorpions, mainly in August and September, associated with high populations of *Dermanyssus gallinae* (De Geer 1778) (Dermanyssidae).

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