

PLANT INHABITING PHYTOSEIID PREDATORS OF MIDWESTERN BRAZIL, WITH
EMPHASIS ON THOSE ASSOCIATED WITH THE TOMATO RED SPIDER MITE,
TETRANYCHUS EVANSI (ACARI: PHYTOSEIIDAE, TETRANYCHIDAE)

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ABSTRACT — The fauna of phytoseiid mites in the state of Mato Grosso do Sul, in midwestern Brazil, is poorly known. The tomato red spider mite, *Tetranychus evansi* Baker and Pritchard, is an important pest of Solanaceae in several countries, but it is usually found in low densities in Brazil. It has been hypothesized that this is due to the effect of natural enemies. The objective of this study was to identify phytoseiid mites from Mato Grosso do Sul associated with *T. evansi*, to identify promising biological control agents for *T. evansi* in Africa. A survey was conducted in October – November 2002, sampling more than 70 plant species of 30 families, including 16 solanaceous species. The results of this survey provide some additional information to the scant knowledge on the phytoseiids from Mato Grosso do Sul. In total, 471 phytoseiids were collected, belonging to 12 Amblyseiinae and two Phytoseiinae species. The most frequent and abundant species was *Euseius citrifolius* Denmark and Muma, followed by *Euseius concordis* (Chant). Also, 3,493 tetranychids were found. *Tetranychus evansi* was found in Aquidauna on *Solanum americanum* (Miller), associated with *E. citrifolius* and *Typhlodromalus aripo* De Leon; in Corumbá, on *S. americanum* associated with *E. concordis* and *Neoseiulus idaeus* Denmark and Muma; and in Dourados, on *Solanum lycopersicum* (L.), associated with *E. citrifolius*, *Proprioseiopsis mexicanus* (Garman) and *Proprioseiopsis ovatus* (Garman). However, none of the phytoseiids found are considered to be a promising biological control agent of *T. evansi*, based on both their inconsistent association with the pest and on available information about each species.

KEYWORDS — Biological control; predators; ecology

INTRODUCTION

Very little is known about the phytoseiid mites from the state of Mato Grosso do Sul, in the extensive region of midwestern Brazil. The only publication

available report the occurrence of only four phytoseiid species from that state (Rezende and Lofego, 2011).

The tomato red spider mite, *Tetranychus evansi* Baker and Pritchard (Tetranychidae), was reported

by Silva (1954) for the first time in Brazil, on tomato plants, *Solanum lycopersicum* (L.), under the name of *Tetranychus marianae* McGregor (Moraes *et al.*, 1987). The generally low levels at which this mite is found in Brazil led researchers to hypothesize that effective natural enemies of this species could be found in that country, as summarized by Navajas *et al.* (2012). Thus, a great effort was dedicated between 2000 and 2008 to evaluate this hypothesis, aiming to locate and collect promising species of natural enemies to send to Africa, where *T. evansi* causes severe damage to Solanaceae, especially to tomato (Sibanda *et al.*, 2000; Sarr *et al.*, 2002).

After the identification of the South American regions climatically more similar to those in which *T. evansi* had been found in Africa (Fiaboe *et al.*, 2006), various surveys were conducted in representative areas of those regions in search of natural enemies, in Brazil, Argentina and Peru [see Navajas *et al.* (2012) for details]. The natural enemies associated with *T. evansi* in Brazil were reported by Furtado *et al.* (2005, 2006) and Rosa *et al.* (2005), Fiaboe *et al.* (2007) and Vasconcelos *et al.* (2008). However, these reports do not include information about the predatory mites found in the survey conducted in midwestern Brazil. The objective of this publication is to provide that information.

MATERIALS AND METHODS

An expedition was conducted between October and November 2003 in the following locations of Mato Grosso do Sul: Anhanduí, Aquidauna, Bodoquena, Bonito, Campo Grande, Corumbá, Dourados, Jardim, Maracaju, Miranda, Nova Alvorada do Sul. These locations are within the priority regions for search of natural enemies to send to Africa (Fiaboe *et al.*, 2006).

Neighboring sampling sites were about 50-70 km apart, along the main highways and corresponded to areas of degraded vegetation, favorable to the natural occurrence of solanaceous plants. Each sample consisted of a volume of approximately 1 dm³ (cubic decimeter) of leaves of each selected plant species taken randomly. Each sample was placed in a paper bag in turn placed in a

polystyrene box for transportation to the laboratory, where the leaves were examined under a stereomicroscope to determine the presence of *T. evansi* and phytoseiids.

Plants of other families found in the vicinities of the sampled Solanaceae were also examined, to determine possible alternative habitats of predators eventually found in association with *T. evansi*. These leaves were examined in the field, immediately after collection, by using a hand lens, and the mites found were transferred to tubes with 70 % ethanol. Plant species not identified in the field were photographed and collected for later identification.

In the laboratory, all mites found were mounted on microscope slides with Hoyer's medium for identification under phase contrast microscopy (Zeiss, DMLB). The generic phytoseiid classification of Chant and McMurtry (2007) is used in this paper. Terminology for setal notation follows that of Lindquist and Evans (1965) as adapted by Rowell *et al.* (1978) for the Phytoseiidae.

RESULTS

More than 70 plant species of 30 families were sampled, 16 of which were solanaceous species. A total of 471 phytoseiids was collected, from 97 samples. These belong to 14 species, as follows:

Amblyseiinae

Amblydromalus limonicus (Garman and McGregor)

Specimens examined: Bonito (21°10' S, 56°26' W; 223 m), on *Inga uruguensis* (6♀); Jardim (21°28' S, 56°08' W; 254), on *Solanum palinacanthum* (1 immature).

Amblyseius chiapensis De Leon

Specimens examined: Bonito (21°10' S, 56°26' W; 223 m), on *I. uruguensis* (1♀); (20°36' S, 56°40' W; 303 m), on *Bauhinia* sp. (1♀).

Euseius alatus De Leon

Specimens examined: Campo Grande (20°27' S, 54°34' W; 584 m), on *Paullinia* sp. (1♀) and unidentified plant (1♀).

Euseius citrifolius Denmark and Muma

Specimens examined: Anhanduí (20°59' S, 54°30' W; 415 m), on *Bixa orellana* (3♀ and 2 immature), *Passiflora* sp. (1♀), *Psidium guajava* (4♀ and 1 immature); Aquidauana (20°28' S, 55°48' W; 139 m), on *Codiaeum variegatum* (2♀), *I. uruguensis* (8♀ and 1♂), *Solanum americanum* (3♀ and 1♂); (20°28' S, 55°45' W; 175 m), on *Rhamnidium elaeocarpus* (7♀ and 1♂) and *S. americanum* (1♀, 1♂ and 1 immature); Bodoquena (20°29' S, 56°39' W; 182 m) on *Physalis* sp. (1♂); Bonito (21°16' S, 56°15' W; 244 m) on *Trema micrantha* (5♀ and 1♂); (21°60' S, 56°26' W; 282 m) on *Cordyline terminalis* (2♀), *S. americanum* (2♀); (20°36' S, 56°40' W, 303 m) on *P. guajava* (1♀); Campo Grande (20°25' S, 55°09' W 242 m) on unidentified plant (2♀, 2♂ and 1 immature); (20°27' S, 54°34' W, 584 m) on *Ficus gomelleira* (3♀), *Guarea guidonea* (2♀ and 5♂), *Guazuma tomentosa* (5♀, 4♂ and 1 immature), *Morus* sp. (8♀ and 1♂), *Paullinia* sp. (2♀), *P. guajava* (14♀ and 2♂), Fabaceae (1♀ and 1 immature); Corumbá (19°15' S, 57°38' W, 102 m) on *Cecropia pachystachya* (4♀), *Celtis* sp. (2♀), *Solanum paniculatum* (3♀); Dourados (22°14' S, 54°46' W, 397 m) on *Solanum lycopersicum* (2♀ and 5 immature), *Solanum tabacifolium* (8♀); (22°13' S, 54°46' W, 409 m) on *Morus* sp. (1♀), *P. guajava* (9♀ and 3 immature); (22°11' S, 54°49' W, 430 m) on *S. americanum* (3♀, 1♂ and 7 immature); Jardim (21°28' S, 56°08' W, 254 m) on *Hibiscus rosasinensis* (1♀, 1♂ and 2 immature), *Mangifera indica* (5♀), *Ocinum* sp. (5♀ and 1 immature), *S. palinacanthum* (2♀), *Terminalia catapa* (1♀, 1♂ and 1 immature); Maracaju (21°38' S, 55°36' W, 513 m) *Acalypha hispida* (1♀), *Brugmansia suaveolens* (1♀); Miranda (22°14' S, 56°22' W, 101 m) on *Maclura tinctoria* (4♀ and 1♂), unidentified plant (2♀ and 1 immature).

Associated tetranychids: *Tetranychus evansi* in Aquidauana (20°28' S, 55°48' W; 139 m), on *S. americanum* (312 specimens); in Dourados (22°14' S, 54°46' W, 397 m) on *S. lycopersicum* (832 specimens).

Euseius concordis (Chant)

Specimens examined: Anhanduí (20°59' S, 54°30' W; 415 m), on *Passiflora* sp. (1♀); Bonito (21°10' S, 56°26' W; 223 m) on *Citrus* sp. (2♀, 1♂ and 1 immature), *G. tomentosa* (3♀), *Morus* sp. (3♀ and 1♂), *R. communis* (5♀ and 1♂), *T. micrantha* (3♀); Bonito

(21°07' S, 56°29' W; 282 m) on *C. terminalis* (2♀ and 1 immature); Campo Grande (20°27' S, 54°34' W; 584 m) on *Lantana camara* (2♀), *Odontonema strictum* (4♀ and 1 immature), *Piper tuberculatum* (10♀ and 1♂), Rubiaceae, (1♀, 1♂ and 3 immature), *Syngonium podophyllum* (2♀ and 1 immature); Corumbá (19°00' S, 57°39' W; 121 m) on *C. pachystachya* (1♀), *Celtis* sp. (1♀), unidentified plant (1♀), *Polyscias balfouriana* (4♀), *S. americanum* (3♀ and 2♂); Dourados (22°14' S, 54°46' W; 397 m) on *Solanum granulosoleprosum* (3♀ and 1♂); (22°11' S, 54°49' W, 430 m) on *S. americanum* (4♀, 3♂ and 2 immature); (22°12' S, 54°56' W; 440 m) on *M. indica* (2♀, 1♂ and 1 immature), *S. podophyllum* (2♀); Jardim (21°28' S, 56°08' W, 254 m) on *Ocinum* sp. (1♀), *Petunia* sp. (1♀, 1♂ and 3 immature), *Petuvaria alliacea* (4♀, 4♂ and 1 immature), *S. palinacanthum* (1 immature); Maracaju (21°38' S, 55°36' W; 513 m) on *A. hispida* (2♀, 2♂ and 1 immature); Miranda (20°17' S, 56°17' W; 240 m) on unidentified plant (2♀).

Associated tetranychids: *T. evansi* in Corumbá (19°00' S, 57°39' W; 121 m) on *S. americanum* (2.209 specimens).

Euseius sibelius (De Leon)

Specimens examined: Aquidauana (20°30' S, 55°40' W; 191 m) on *Hymenaea stigonocarpa* (3♀ and 1 immature), *Luehea* sp. (4♀ and 1 immature), Bignoniaceae (4♀ and 2 immature); Bonito (21°16' S, 56°15' W; 244 m) on *T. micrantha* (10♀ and 2 immature); (20°36' S, 56°40' W; 303 m) on *Cissus* sp. (1♀), *P. guajava* (5♀); Campo Grande (20°27' S, 54°34' W; 584 m) on *T. micrantha*, (11♀), *Ormosia* sp. (6♀ and 1 immature); Corumbá (19°15' S, 57°38' W; 102 m) on Unidentified plant (1♀), *S. paniculatum* (5♀); (19°00' S, 57°39' W; 121 m) on *Celtis pubescens* (3♀ and 1 immature).

Iphiseiodes zuluagai Denmark and Muma

Specimens examined: Campo Grande (20°27' S, 54°34' W; 584 m) on *P. tuberculatum* (1♀).

Neoseiulus idaeus Denmark and Muma

Specimens examined: Corumbá (19°00' S, 57°39' W; 121 m) on *S. americanum* (1♀).

Proprioseiopsis mexicanus (Garman)

Specimens examined: Dourados (22°14' S, 54°46' W; 397 m) on *S. lycopersicum* (1♀); (22°13' S, 54°36' W, 409 m) on *S. paniculatum* (1♀).

Proprioseiopsis ovatus (Garman)

Specimens examined: Dourados (22°14' S, 54°46' W, 397 m) on *S. lycopersicum* (1♀); (22°13' S, 54°36' W; 409 m) on *S. paniculatum* (1♀).

Transeius bellottii (Moraes and Mesa)

Bodoquena (22°29' S, 56°39' W; 182 m) on *Combretum* sp. (1♀), *Guazum ulmifolia* (3♀), unidentified plant (2♀); Bonito (20°36' S, 56°40' W; 303 m) on *Lantana trifolia* (1♀).

Typhlodromalus aripo De Leon

Specimens examined: Aquidauana (20°28' S, 55°48' W; 139 m) on *S. esculentum* (1♀, 1♂ and 2 immature), *S. americanum* (1♀); Bonito (21°17' S, 56°27' W; 204 m) on *Sida* sp. (1♀); (21°10' S, 56°26' W; 223 m) on Fabaceae (5♀, 2♂ and 1 immature).

Phytoseiinae Berlese

Phytoseius guianensis De Leon

Specimens examined: Aquidauana (20° 28 S, 55° 45 W; 175 m) on *S. palinacanthum* (1♀ and 1♂), *S. paniculatum* (3♀); (20°30 S, 55°40 W; 191 m) on *S. paniculatum* (3♀); Bonito (21°10' S, 56°26' W; 223 m) on *G. tomentosa* (1♀), *S. palinacanthum* (1♀); (21°16' S, 56°15' W; 244 m) on *Pavonia sidifolia* (6♀ and 1♂), *S. granuloseprosum* (1♀), *S. palinacanthum* (23♀, 2♂ and 1 immature), *S. paniculatum* (2♀), *T. micrantha* (10♀ and 2♂), *Vernonia scabra* (6♀ and 1 immature); (21°00' S, 56°15' W, 282 m) on *S. palinacanthum* (2♀), *S. paniculatum* (1♀); (20°36' S, 56°40' W; 303 m) on *L. trifolia* (2♀); Campo Grande (20°27' S, 54°34' W; 191m) on *S. palinacanthum* (1♀ and 1♂); Dourados (22°11' S, 54°49' W; 430 m) on *S. tabacifolium* (2♀ and 1♂); Nova Alvorada do Sul (21°50' S, 54°32' W; 275 m) on *S. paniculatum* (2♀).

Phytoseius nahautlensis De Leon

Specimens examined: Campo Grande (20°25' S, 55°09' W; 242 m) on *Bauhinia* sp. (1♀); (20°27' S, 54°34' W; 584 m) on *Ormosia* sp. (1♀); Miranda (20°17' S, 56°17' W; 240 m) on *Curatella americana* (4♀), *P. guajava* (2♀); Nova Alvorada do Sul (21°50' S, 54°32' W, 275 m) on *Solanum lycocarpum* (1♀).

A summary of the abundance and diversity of localities and plant species on which each species was found is given in Table 1. The most abundant species were also those found in largest numbers of localities and largest number of plant species. The most diverse genera were *Euseius*, with four species, as well as *Proprioseiopsis* and *Phytoseius* with two species each. The most frequent and abundant phytoseiid was *E. citrifolius*, followed by *E. concordis*, *E. sibeli* and *P. guianensis*, ranging in numbers between 61 and 181 mites. All other predacious species were represented by 14 or fewer specimens. *Phytoseius guianensis* was also among the most frequent and abundant in the southern and southeastern Brazil (Furtado et al., 2006, Fiaboe et al., 2007), as well as in the northeastern (Furtado et al., 2005, Rosa et al., 2005, Fiaboe et al., 2007) part of the country in similar surveys.

A total of 3,493 tetranychid mites was observed in association with those phytoseiids, most of them (3,353 specimens) were *T. evansi*, found in the surroundings of Aquidauana on *S. americanum* together with *E. citrifolius* and *T. aripo*, in Corumbá, on *S. americanum* together with *E. concordis* and *N. idaeus*, and in Dourados, on *S. lycopersicum* together with *E. citrifolius*, *P. mexicanus* (Garman) and *P. ovatus*.

Solanum palinacanthum was the most frequently solanaceous plant found; *T. evansi* was not found on this plant, but four phytoseiid species were found, namely *A. limonicus*, *E. citrifolius*, *E. concordis* and *P. guianensis*.

DISCUSSION

The great predominance of Amblyseiinae was also observed in previous surveys for natural enemies of *T. evansi* conducted in other parts of Brazil (Furtado et al., 2005, 2006; Rosa et al., 2005, Fiaboe et al.,

TABLE 1: Phytoseiid mites collected from plants in surveys conducted in 27 sites in Mato Grosso do Sul, midwestern Brazil in October and November 2003.

Phytoseiid species	Number of Specimens	Number of Localities
Amblyseiinae Muma		
<i>Amblydromalus limonicus</i> (Garman & McGregor)	7	2
<i>Amblyseius chiapensis</i> De Leon	2	1
<i>Euseius alatus</i> De Leon	2	1
<i>Euseius citrifolius</i> Denmark & Muma	181	19
<i>Euseius concordis</i> (Chant)	104	11
<i>Euseius sibeli</i> (De Leon)	61	6
<i>Iphiseiodes zuluagai</i> Denmark & Muma	1	1
<i>Neoseiulus idaeus</i> Denmark & Muma	1	1
<i>Proprioseiopsis mexicanus</i> (Garman)	2	2
<i>Proprioseiopsis ovatus</i> (Garman)	2	2
<i>Transeius bellottii</i> (Moraes & Mesa)	7	2
<i>Typhlodromalus aripo</i> De Leon	14	3
Phytoseiinae Berlese		
<i>Phytoseius guianensis</i> De Leon	77	9
<i>Phytoseius nahautlensis</i> De Leon	9	4

2007) and Argentina (Furtado *et al.*, 2007b; Guanilo *et al.*, 2010). The most frequent and abundant phytoseiid species in the present study, *E. citrifolius*, was also the most frequent and abundant on different plant species in faunistic studies conducted in the Cerrado ecosystem of the western part of the state of São Paulo (Feres and Moraes, 1998; Feres and Nunes, 2001; Feres *et al.*, 2003; Bellini *et al.*, 2005; Daud and Feres, 2005), a few hundred km away from the region where the present work was conducted. But with a similar natural vegetation and climatic conditions. In laboratory studies on the biology *E. citrifolius* with different food types, this predator performed best when fed with pollen of different plant species (Moraes and McMurtry 1981, Furtado and Moraes 1998).

Euseius concordis, the second phytoseiid most commonly found in this study, was the most frequent and abundant phytoseiid in similar studies conducted in northern (Guanilo *et al.*, 2010) and the second most frequent and abundant in north-

western Argentina (Furtado *et al.*, 2007b). In north-west Argentina, *E. concordis* was found in association with *T. evansi*, but it was probably feeding on other organisms on the same plants. Moraes and Lima (1983) reported a low rate of reproduction when it was fed with *T. evansi* but considered it to be a promising predator of the tomato russet mite *Aculops lycopersici* Trybom. *Euseius* species are considered generalist predators with high preference for pollen as food (McMurtry and Croft, 1997; McMurtry *et al.*, 2013).

Phytoseius guianensis was the most frequent and abundant phytoseiid found in northeastern (Furtado *et al.*, 2005, Fiaboe *et al.*, 2007), southern and southeastern (Furtado *et al.*, 2006, Fiaboe *et al.*, 2007) Brazil. It was the second most frequent and abundant species in a similar search conducted by Rosa *et al.* (2005) in the state of Pernambuco, northeastern Brazil. However, *P. guianensis* was not found in association with *T. evansi* in southern, southeastern and northeastern Brazil. Thus, it does not seem to

contribute significantly to the biological control of *T. evansi*.

The results of the survey conducted in this study provide additional information on the phytoseiids from the state of Mato Grosso do Sul, in midwestern Brazil. Until now, only four species of this mite group had been reported from that state (Rezende and Lofego, 2011), namely *E. citrifolius*, *P. ovatus*, *Neoparaphytoseius sooretamus* (El-Banhawy) and *Neoseiulus tunus* (DeLeon), the first two also found in the present study. Thus, 17 phytoseiid species are now known from Mato Grosso do Sul. However, none of the phytoseiid species found in this study showed up as promising for the biological control of *T. evansi*, based on their inconsistent association with the pest and on what is known about their biology. The levels of occurrence of *T. evansi* on tomato or other solanaceous crops have not been evaluated in this state, but the levels on the naturally occurring solanaceous plants were generally low; all specimens of *T. evansi* were collected from only two solanaceous species, *S. americanum* and *S. lycopersicum*.

Many phytoseiid species were found on solanaceous plants in the extensive surveys conducted in South America. However, only one species of those, *Phytoseiulus longipes* Evans, has been shown (Furtado *et al.*, 2007a; Silva *et al.*, 2010) promising for the biological control of *T. evansi*. The population in natural association with *T. evansi* was found in Brazil, next to the border with Argentina and Uruguay. Works conducted so far indicate that it is potentially useful for use against that pest in other parts of the globe.

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