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PHYTOSEIIDAE (ACARI: MESOSTIGMATA) ON PLANTS OF THE CENTRAL REGION OF THE BRAZILIAN CERRADO

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ABSTRACT — Four surveys of Phytoseiidae species associated with native plants were conducted in ten fragments of Cerrado *sensu stricto* to determine the species associated with the plants of this region. Twelve of the most common plant species were sampled in each fragment. Twenty six phytoseiid species were recorded during the surveys. *Stryphnodendron adstringens* was the host plant that had the highest number of species (eight species). *Amblyseius neochiapensis* Lofego, Moraes and McMurtry, 2000 and *Neoseiulus tunus* (De Leon), 1967 were the most common phytoseiid species. These species occurred on 24 and 20 host species, respectively. Approximately 76 % of the phytoseiids found belonged to the subfamily Amblyseiinae Muma, 1961. Almost 27 % of phytoseiid species recorded were associated with only one plant species. In addition, approximately two thirds of species found in this study also occur in the Atlantic Forest. The comparison of our results from the central areas with previous surveys in peripheral areas of the Cerrado showed that only 12 phytoseiid species were common to both areas.

KEYWORDS — survey; mites; Neotropic region; Phytoseiidae; Brazil

INTRODUCTION

Many species of Phytoseiidae Berlese, 1913 are predators, some of which proved to be highly effective in controlling pest mites in various crops (McMurtry and Croft 1997; Moraes and Flechtmann 2008). Therefore, there is a strong need for more and comprehensive studies about phytoseiid species.

Surveys on Phytoseiidae in specific regions, biomes or crops constitute the first step to further studies about the use of predatory mites in the biological control (Gerson *et al.* 2003). Many surveys like these have been conducted in South America, being the bases for important programs to control

of pest mites such as *Aceria guerreronis* Keifer, 1965 (Gondim Jr. and Moraes 2001; Lawson-Balagbo *et al.* 2008), *Mononychellus tanajoa* (Bondar, 1938) (Farias *et al.* 1981; Moraes and McMurtry 1983; Moraes *et al.* 1991) and *Tetranychus evansi* Baker and Pritchard, 1960 (Furtado *et al.* 2004[2005]; 2006; 2007; Fiaboe *et al.* 2007; Guanilo *et al.* 2008c; 2010; Rosa *et al.* 2005).

In Brazil, surveys on phytoseiid species from natural areas are mostly concentrated in areas of Atlantic Forest of state of São Paulo (Buosi *et al.* 2006; Castro and Moraes 2010; Daud *et al.* 2007; Demite *et al.* 2011; Feres and Moraes 1998; Feres and Nunes 2001; Feres *et al.* 2005; Zacarias and Moraes 2002).

FIGURE 1: Location of study areas. 1 – Map of Brazil highlighting the region sampled. 2 – detailed map, with location of study points. Letters correspond to cities in the sampling areas: (A: Chapadão do Sul-MS, B: Chapadão do Céu-GO, C: Jataí-GO, D: Jataí-GO, E: Rio Verde-GO, F: Edealina-GO, G: Tupaciguara-MG, H: Brasília-DF, I: Unai, MG and J: Cristalina-GO).

Though the Cerrado is the second largest Brazilian biome, surveys were made only on peripheral areas (Lofego *et al.* 2004; Lofego and Moraes 2006; Demite *et al.* 2009) and so far no information is available on these predators in its central areas.

Moreover, the Cerrado is currently threatened by the rapid increase in agricultural activities and constant loss of natural areas (Ministério do Meio Ambiente 2007), which may consequently threat its characteristic mite fauna. So, the objective of this study was to do the inventory of phytoseiid species associated with native plants of this biome, specifically in fragments of cerrado *sensu stricto*.

MATERIALS AND METHODS

Study areas

This study was conducted in ten fragments of Cerrado, located in southeastern and central Brazil (Figure 1, Table 1). The climate in the region is characterized as Aw of Köppen (Ribeiro and Walter 1998) with two distinct seasons: a rainy season (October to March) and a dry season (April to September). The chosen areas are situated in the core region of biome, considered the original distribution of the Cerrado (Ministério do Meio Ambiente 2007).

Sampling

Samples were taken in fragments between October 2009 and June 2010. Twelve species of more abundant native plants were sampled in each area, belonging to different strata and plant families. Abundance of plants was evaluated visually. At least two individuals of each plant species selected were sampled, in total 57 plant species, in all fragments (Table 1).

The material collected from each plant species consist of leaves and flowers (when present). We used the following procedure for mite extraction: firstly, the material was washed separately in buckets containing eight liters of 30 % ethanol. After each wash, the ethanol was filtered through sieves with 25 μ m nylon mesh. With a wash-bottle, the debris on the mesh was washed with 67 % ethanol into vials filled with the same alcohol for preservation. These procedures were done in the fragments, immediately after the samplings. So, the vials were placed in plastic boxes and brought to laboratory by car.

The material was screened under a stereoscopic microscope in laboratory. Phytoseiids found were mounted in Hoyer's medium (Moraes and Flechtman 2008) and the slides labelled. The collection data is indicated in the following order for

TABLE 1: Areas of study with the plant species sampled for the survey of Phytoseiidae. Brazilian Cerrado 2009/2010.

Area code	Location	Coordinates	Sampled plants
A	Chapadão do Sul-MS	52° 35' W 18° 51' S	<i>Bauhinia</i> sp. 1 (Fabaceae)
			<i>Byrsonima intermedia</i> A. Juss. (Malphigiaceae)
			<i>Byrsonima pachyphylla</i> A. Juss. (Malphigiaceae)
			<i>Campomanesia pubescens</i> (DC.) Berg (Myrtaceae)
			<i>Caryocar brasiliense</i> Camb. (Caryocaraceae)
			<i>Didymopanax vinosum</i> Cham. & Schltdl. (Araliaceae)
			<i>Fuirena umbellata</i> Rottb. (Cyperaceae)
			<i>Miconia albicans</i> (Sw.) Triana (Melastomataceae)
			<i>Myrtaceae</i> sp. 1 (Myrtaceae)
			<i>Myrtaceae</i> sp. 2 (Myrtaceae)
			<i>Pouteria torta</i> (Mart.) Radlk. (Sapotaceae)
			<i>Roupala brasiliensis</i> Klotzsch (Proteaceae)
B	Chapadão do Céu-GO	52° 44' W 18° 15' S	<i>Bauhinia</i> sp. 2 (Fabaceae)
			<i>Campomanesia pubescens</i> (DC.) Berg (Myrtaceae)
			<i>Caryocar brasiliense</i> Camb. (Caryocaraceae)
			<i>Didymopanax vinosum</i> Cham. & Schltdl. (Araliaceae)
			<i>Fuirena umbellata</i> Rottb. (Cyperaceae)
			<i>Harconia speciosa</i> Gom. (Apocynaceae)
			<i>Miconia albicans</i> (Sw.) Triana (Melastomataceae)
			<i>Myrtaceae</i> sp. 1 (Myrtaceae)
			<i>Myrtaceae</i> sp. 2 (Myrtaceae)
			<i>Myrtaceae</i> sp. 3 (Myrtaceae)
			<i>Qualea grandiflora</i> Mart. (Vochysiaceae)
			<i>Xylopia aromatica</i> (Lam.) Mart. (Annonaceae)
C	Jataí-GO	51° 45' W 17° 51' S	<i>Byrsonima pachyphylla</i> A. Juss. (Malphigiaceae)
			<i>Caryocar brasiliense</i> Camb. (Caryocaraceae)
			<i>Cf. Dilleniaceae</i> sp. (Dilleniaceae)
			<i>Dimorphandra mollis</i> Benth. (Fabaceae)
			<i>Genipa americana</i> L. (Rubiaceae)
			<i>Melinis minutiflora</i> P. Beauv. (Poaceae)
			<i>Miconia albicans</i> (Sw.) Triana (Melastomataceae)
			<i>Qualea grandiflora</i> Mart. (Vochysiaceae)
			<i>Stryphnodendron adstringens</i> (Mart.) Coville (Fabaceae)
			<i>Tocoyena formosa</i> (Cham. & Schltdl.) K.Schum. (Rubiaceae)
			<i>Trachipogon</i> sp. (Poaceae)
			<i>Xylopia aromatica</i> (Lam.) Mart. (Annonaceae)

TABLE 1: Continued.

Area code	Location	Coordinates	Sampled plants
D	Jataí-GO	51° 41' W 17° 49' S	<i>Anacardium occidentale</i> L. (Anacardiaceae) <i>Byrsonima coccolobifolia</i> Kunth (Malphigiaceae) <i>Byrsonima pachyphylla</i> A. Juss. (Malphigiaceae) <i>Caryocar brasiliense</i> Camb. (Caryocaraceae) <i>Cf. Dilleniaceae</i> sp. (Dilleniaceae) <i>Dimorphandra mollis</i> Benth. (Fabaceae) <i>Harconia speciosa</i> Gom. (Apocynaceae) <i>Miconia albicans</i> (Sw.) Triana (Melastomataceae) <i>Plenckia populnea</i> Reissek (Celastraceae) <i>Qualea grandiflora</i> Mart. (Vochysiaceae) <i>Tabebuia aurea</i> (J.Silva Manso) Benth. & Hook. (Bignoniaceae) <i>Trachipogon</i> sp. (Poaceae)
E	Rio Verde-GO	51° 02' W 17° 40' S	<i>Xylopia aromatica</i> (Lam.) Mart. (Annonaceae) <i>Byrsonima coccolobifolia</i> Kunth (Malphigiaceae) <i>Byrsonima intermedia</i> A. Juss. (Malphigiaceae) <i>Caryocar brasiliense</i> Camb. (Caryocaraceae) <i>Davilla elliptica</i> A. St.-Hil. (Dilleniaceae) <i>Doliocarpus cf. dentatus</i> Standl. (Dilleniaceae) <i>Genipa americana</i> L. (Rubiaceae) <i>Himatanthus obovatus</i> (Müll.Arg.) Woodson (Apocynaceae) <i>Matayba elaeagnoides</i> Radlk. (Sapindaceae) <i>Miconia albicans</i> (Sw.) Triana (Melastomataceae) <i>Ouratea spectabilis</i> (Mart.) Engl. (Ochnaceae) <i>Sclerobium paniculatum</i> Vogel (Fabaceae)
F	Edealina-GO	49° 45' W 17° 24' S	<i>Alibertia edulis</i> (A. Rich.) A. Rich. (Rubiaceae) <i>Astronium</i> sp. (Anacardiaceae) <i>Bauhinia</i> sp. 3 (Fabaceae) <i>Byrsonima verbascifolia</i> (L.) Rich. ex A.Juss. (Malphigiaceae) <i>Caryocar brasiliense</i> Camb. (Caryocaraceae) <i>Davilla elliptica</i> A. St.-Hil. (Dilleniaceae) <i>Erythroxylum deciduum</i> A. St.-Hil. (Erythroxylaceae) <i>Guettarda viburnoides</i> Cham. & Schltdl. (Rubiaceae) <i>Qualea grandiflora</i> Mart. (Vochysiaceae) <i>Rhamnidium elaeocarpum</i> Reissek (Rhamnaceae) <i>Roupala brasiliensis</i> Klotzsch (Proteaceae) <i>Solanum lycocarpum</i> St. Hil. (Solanaceae)

TABLE 1: Continued.

Area code	Location	Coordinates	Sampled plants
G	Tupaciguara-MG	48° 54' W 18° 31' S	<i>Caryocar brasiliense</i> Camb. (Caryocaraceae)
			<i>Cf. Dilleniaceae</i> sp. (Dilleniaceae)
			<i>Cf. Moraceae</i> sp. (Moraceae)
			<i>Davilla elliptica</i> A. St.-Hil. (Dilleniaceae)
			<i>Miconia albicans</i> (Sw.) Triana (Melastomataceae)
			<i>Qualea grandiflora</i> Mart. (Vochysiaceae)
			<i>Roupala brasiliensis</i> Klotzsch (Proteaceae)
			<i>Sclerobium paniculatum</i> Vogel (Fabaceae)
			<i>Stryphnodendron adstringens</i> (Mart.) Coville (Fabaceae)
			<i>Tabebuia ochracea</i> (Cham.) Standley (Bignoniaceae)
			<i>Vochysia cinnamomea</i> Pohl (Vochysiaceae)
H	Brasília-DF	47° 44' W 15° 38' S	<i>Xylopia aromatica</i> (Lam.) Mart. (Annonaceae)
			<i>Brosimum gaudichaudii</i> Trécul. (Moraceae)
			<i>Caryocar brasiliense</i> Camb. (Caryocaraceae)
			<i>Cf. Dilleniaceae</i> sp. (Dilleniaceae)
			<i>Echinolaena inflexa</i> (Poir.) Chase (Poaceae)
			<i>Hymenaea stigonocarpa</i> Mart. ex Hayne (Fabaceae)
			<i>Kielmeyera</i> sp. (Clusiaceae)
			<i>Palicourea rigida</i> Kunth (Rubiaceae)
			<i>Plenckia populnea</i> Reissek (Celastraceae)
			<i>Qualea grandiflora</i> Mart. (Vochysiaceae)
			<i>Rapanea</i> sp. (Myrsinaceae)
I	Unaí-MG	46° 41' W 15° 59' S	<i>Roupala brasiliensis</i> Klotzsch (Proteaceae)
			<i>Stryphnodendron adstringens</i> (Mart.) Coville (Fabaceae)
			<i>Trachypogon</i> sp. (Poaceae)
			<i>Byrsonima coccolobifolia</i> Kunth (Malthaceae)
			<i>Caryocar brasiliense</i> Camb. (Caryocaraceae)
			<i>Cf. Dilleniaceae</i> sp. (Dilleniaceae)
			<i>Chamaecrista orbiculata</i> (Benth.) H. S. Irwin & Barneby (Fabaceae)
			<i>Duguetia furfuracea</i> (A. St.-Hil.) Benth. & Hook.f. (Annonaceae)
			<i>Echinolaena inflexa</i> (Poir.) Chase (Poaceae)
			<i>Kielmeyera cf. coriacea</i> (Spreng.) Mart. (Clusiaceae)
			<i>Ouratea spectabilis</i> (Mart.) Engl. (Ochnaceae)
			<i>Pouteria ramiflora</i> (Mart.) Radlk. (Sapotaceae)
			<i>Qualea grandiflora</i> Mart. (Vochysiaceae)
			<i>Rapanea</i> sp. (Myrsinaceae)
			<i>Stryphnodendron adstringens</i> (Mart.) Coville (Fabaceae)

TABLE 1: Continued.

Area code	Location	Coordinates	Sampled plants
J	Cristalina-GO	47° 27' W 16° 17' S	<i>Annona crassiflora</i> Mart. (Annonaceae) <i>Byrsonima coccolobifolia</i> Kunth (Malphigiaceae) <i>Caryocar brasiliense</i> Camb. (Caryocaraceae) <i>Cf. Dilleniaceae</i> sp. (Dilleniaceae) <i>Davilla elliptica</i> A. St.-Hil. (Dilleniaceae) <i>Kielmeyera cf. coriacea</i> (Spreng.) Mart. (Clusiaceae) <i>Ouratea spectabilis</i> (Mart.) Engl. (Ochnaceae) <i>Piptocarpha rotundifolia</i> (Less.) Baker (Asteraceae) <i>Qualea grandiflora</i> Mart. (Vochysiaceae) <i>Stryphnodendron adstringens</i> (Mart.) Coville (Fabaceae) <i>Tabebuia ochracea</i> (Cham.) Standley (Bignoniaceae) <i>Trachypogon</i> sp. (Poaceae)

each species: locality (in bold), host name, date of sample, and number of individuals in parentheses. The mites are deposited in the Acari collection (DZSJRP), Department of Zoology and Botany, Universidade Estadual Paulista (UNESP), São José do Rio Preto, São Paulo, available at: <http://www.splink.cria.org.br>.

RESULTS

Twenty six phytoseiid species belonging to thirteen genera were recorded. *Amblyseius neochiapensis* Lofego, Moraes and McMurtry, 2000 was the most common species, occurring on 24 host species. *Neoseiulus tunus* (De Leon 1967) occurred on 20 species. *Stryphnodendron adstringens* was the host plant that harbored the highest richness (eight species). No phytoseiid species were encountered on these plants: *Anacardium occidentale*, cf. *Moraceae* sp., *Matayba elaeagnoides*, *Palicourea rigida*, *Piptocarpha rotundifolia*, *Rapanea* sp., *Tabebuia aurea* and *Tocoyena formosa*.

SUBFAMILY AMBLYSEIINAE MUMA, 1961

Amblyseius aerialis (Muma, 1955)

Amblyseius aerialis Muma 1955: 264; Garman 1958: 75.

Amblyseius aerialis; Athias-Henriot 1957: 338; Moraes *et al.* 1986: 6; 1991: 117; 2004: 13; Moraes and Mesa 1988: 71; Kreiter and Moraes 1997: 377; Feres and Moraes 1998: 126; Gondim Jr. and Moraes 2001: 67; Chant and McMurtry 2004: 203; 2007: 75; Feres *et al.* 2005: 45; Buosi *et al.* 2006: 3; Vasconcelos *et al.* 2006: 92; Guanilo *et al.* 2008a: 3; 2008b: 3; Mineiro *et al.* 2009: 40; Demite *et al.* 2011:34. *Typhlodromus (Amblyseius) aerialis*; Chant 1959: 88. *Amblyseius (Amblyseius) aerialis*; Denmark and Muma 1989: 15.

Origin of the material examined — Chapadão do Céu-GO (B): Myrtaceae sp. 1: I-10 (1); Myrtaceae sp. 3: X-09 (2).

Amblyseius neochiapensis Lofego, Moraes and McMurtry, 2000

Amblyseius neochiapensis Lofego *et al.* 2000: 462; Zacarias and Moraes 2001: 580; Chant and McMurtry 2004: 199; Lofego *et al.* 2004: 4; Moraes *et al.* 2004: 40; Demite *et al.* 2011:38.

Origin of the material examined — Chapadão do Céu-GO (B): *Harconia speciosa*: I-10: (1); *Miconia albicans*: XII-09 (1). Jataí-GO (C): *Cf. Dilleniaceae* sp.: VI-10 (3); *Dimorphandra mollis*: XII-09 (1); *Genipa americana*: I-10 (1), VI-10 (1); *Miconia albicans*: X-09 (1); *Qualea grandiflora*: X-09 (1), XII-09 (3), I-10 (2), VI-10 (6). Jataí-GO (D): *Miconia albicans*: XI-09 (1). *Byrsonima intermedia*: X-09 (3), XII-09

(1); *Davilla elliptica*: X-09 (2); *Miconia albicans*: XII-09 (1); *Sclerobium paniculatum*: XII-09 (1); *Xylopia aromatica*: X-09 (2), XII-09 (4). Brasília-DF: *Brosimum gaudichaudii*: XII-09 (2), I-10 (1); cf. Dilleniaceae: XII-09 (1), VI-10 (3); *Echinolaena inflexa*: VI-10 (3); *Hymenaea stigonocarpa*: VI-10 (8); *Kielmeyera* sp.: VI-10 (8); *Plenckia populnea*: VI-10 (6); *Qualea grandiflora*: I-10 (7); *Roupala brasiliensis*: XII-09 (2), VI-10 (5); *Trachipogon* sp.: I-10 (1), VI-10 (1). Unaí-MG (I): cf. Dilleniaceae sp.: I-10 (1); *Chamaecrista orbiculata*: X-09 (1), XII-09 (2); *Duguetia furfuracea*: X-09 (1); *Ouratea spectabilis*: X-09 (1), I-10 (1); *Pouteria ramiflora*: X-09 (1); *Qualea grandiflora*: XII-09 (8), I-10 (2); *Stryphnodendron adstringens*: XII-09 (1). Cristalina-GO (J): *Annona crassiflora*: I-10 (2), VI-10 (3); *Davilla elliptica*: VI-10 (6); *Ouratea spectabilis*: VI-10 (1); *Qualea grandiflora*: I-10 (1), VI-10 (5); *Tabebuia ochracea*: I-10 (1).

Amblyseius sp.

Origin of the material examined — Jataí-GO (C): *Melinis minutiflora*: XII-09 (1).

cf. *Graminaseius* sp.

Origin of the material examined — Brasília-DF (H): *Echinolaena inflexa*: I-10 (1). Cristalina-GO (J): *Trachipogon* sp.: XII-09 (1).

Euseius citrifolius Denmark and Muma, 1970

Euseius citrifolius Denmark and Muma 1970: 222; Moraes and McMurtry 1983: 138; Moraes *et al.* 1986: 38; 1991: 131; 2004: 64; Feres and Moraes 1998: 127; Gondim Jr. and Moraes 2001: 74; Zacarias and Moraes 2001: 580; Noronha and Moraes 2002: 1114; Lofego *et al.* 2004: 4; Demite *et al.* 2009: 47; 2011: 40.

Origin of the material examined — Chapadão do Sul-MS (A): *Byrsonima intermedia*: VI-10 (2); *Caryocar brasiliense*: XII-09 (1); *Fuirena umbellata*: VI-10 (1); Myrtaceae sp. 1: XII-09 (2). Chapadão do Céu-GO (B): *Campomanesia pubescens*: X-09 (5); Myrtaceae sp. 2: X-09 (4). Jataí-GO (C): *Caryocar brasiliense*: I-10 (1), VI-10 (3); *Dimorphandra mollis*: XII-09 (1); *Genipa americana*: VI-10 (2); *Miconia albicans*: XII-09 (1); *Stryphnodendron adstringens*: X-09 (6), XII-09 (1), VI-10 (9); *Xylopia aromatica*: XII-09 (1), I-10 (1). Jataí-GO (D): *Caryocar brasiliense*: X-09 (1), XI-09 (1);

Harconia speciosa: XI-09 (4); *Qualea grandiflora*: X-09 (2), XI-09 (2). Rio Verde-GO (E): *Sclerobium paniculatum*: XII-09 (4). Edealina-GO (F): *Erythroxylum deciduum*: X-09 (2), XII-09 (5); *Qualea grandiflora*: XII-09 (3). Brasília-DF (H): *Caryocar brasiliense*: X-09 (1), I-10 (1); *Plenckia populnea*: I-10 (1); *Stryphnodendron adstringens*: X-09 (12), I-10 (1), VI-10 (13).

Euseius concordis (Chant, 1959)

Typhlodromus (*Amblyseius*) *concordis* Chant 1959: 69. *Amblyseius* (*Iphiseius*) *concordis*; Muma 1961: 288. *Amblyseius concordis*; Chant and Baker 1965: 22. *Euseius concordis*; Denmark and Muma 1973: 264; Moraes and Oliveira 1982: 317; Moraes and McMurtry 1983: 138; Moraes *et al.* 1986: 39; 2004: 64; Feres and Moraes 1998: 127; Gondim Jr. and Moraes 2001: 74; Noronha and Moraes 2002: 1116; Lofego *et al.* 2004: 5; Demite *et al.* 2009: 48; 2011: 41. *Euseius flechtmani*; Denmark and Muma 1970: 223; 1973: 261 (synonymy according to Moraes *et al.* 1982).

Origin of the material examined — Chapadão do Céu-GO (B): *Harconia speciosa*: VI-10 (2).

Euseius plaudus Denmark and Muma, 1973

Euseius plaudus Denmark and Muma 1973: 263. Moraes *et al.* 2004: 78.

Origin of the material examined — Tupaciguara-MG (G): *Caryocar brasiliense*: XII-09 (1).

Euseius sibelius (De Leon, 1962)

Amblyseius (*Typhlodromalus*) *sibelius* De Leon 1962: 21. *Euseius sibelius*; Muma *et al.* 1970: 98; Moraes and McMurtry 1983: 140; Moraes *et al.* 1986: 54; 1999 [2000]: 243; 2004: 83; Moraes and Mesa 1988: 81; Feres and Moraes 1998: 128; Chant and McMurtry 2005a: 216; 2007: 123; Lofego *et al.* 2004: 6; 2009: 45; Guanilo *et al.* 2008a: 22; Feres *et al.* 2009: 467. Demite *et al.* 2011: 42. *Euseius subalatus*; De Leon 1965a: 127 (synonymy according to Muma *et al.* 1970).

Origin of the material examined — Jataí-GO (C): *Dimorphandra mollis*: X-09 (1); *Qualea grandiflora*: VI-10 (2). Tupaciguara-MG (G): *Sclerobium paniculatum*: I-10 (2); *Stryphnodendron adstringens*: X-09 (8). Brasília-DF (H): *Kielmeyera* sp.: XII-09 (2), I-10 (1). Unaí-MG (I): cf. Dilleniaceae: XII-09 (1).

***Iphiseiodes zuluagai* Denmark and Muma, 1972**

Iphiseiodes zuluagai Denmark and Muma 1972: 23; 1973: 251; 1975: 287; Moraes *et al.* 1982: 18; 1986: 61; 2004: 91; Aponte and McMurtry 1995: 165; Kreiter and Moraes 1997: 377; Feres and Moraes 1998: 127; Gondim Jr. and Moraes 2001: 76; Zacarias and Moraes 2001: 581; Lofego *et al.* 2004: 7; Guanilo *et al.* 2008a: 9; Demite *et al.* 2009: 48; 2011: 43.

Origin of the material examined — Chapadão do Céu-GO (B): *Campomanesia pubescens*: X-09 (2), XII-09 (1), I-10 (2); *Didymopanax vinosum*: X-09 (2); *Harconia speciosa*: X-09 (3), VI-10 (2); Myrtaceae sp. 2: X-09 (3), VI-10 (4); Myrtaceae sp. 3: VI-10 (1); *Xylopia aromatica*: VI-10 (6). Rio Verde-GO (E): *Byrsonima coccolobifolia*: XII-09 (2); *Byrsonima intermedia*: X-09 (1), XII-09 (2); *Doliocarpus cf. dentatus*: X-09 (2), XII-09 (9); *Ouratea spectabilis*: X-09 (2). Cristalina-GO (J): *Annona crassiflora*: VI-10 (2); *Kielmeyera cf. coriacea*: VI-10 (1); *Ouratea spectabilis*: VI-10 (4); *Qualea grandiflora*: VI-10 (3).

***Neoparaphytoseius sooretamus*
(El-Banhawy, 1984)**

Amblyseius sooretamus El-Banhawy 1984: 128. *Amblyseiuslella sooretama*; Moraes *et al.* 1986: 5. *Neoparaphytoseius sooretamus*; Chant and McMurtry 2003b: 215; Moraes *et al.* 2004: 98.

Origin of the material examined — Chapadão do Sul-MS (A): *Byrsonima intermedia*: XII-09 (1).

***Neoseiulus anonymus* (Chant and Baker, 1965)**

Amblyseius anonymus Chant and Baker 1965: 21; Schicha and Elshafie 1980: 32; McMurtry 1983: 254. *Neoseiulus anonymus*; Denmark and Muma 1973: 27; Moraes and Mesa 1988: 76; Moraes *et al.*, 1991: 126; Kreiter and Moraes 1997: 378; Moraes *et al.* 1999 [2000]: 245.

Origin of the material examined — Jataí-GO (C): *Stryphnodendron adstringens*: VI-10 (1). Brasília-DF (H): *Stryphnodendron adstringens*: VI-10 (1); *Trachipogon* sp.: X-09 (2), I-10 (2). Cristalina-GO (J): *Trachipogon* sp.: VI-10 (1).

***Neoseiulus benjamini* (Schicha, 1981)**

Amblyseius benjamini Schicha 1981: 203; Schicha 1987: 119; Ueckermann and Loots 1988: 142. *Neoseiulus benjamini*; Beard 2001: 131; Chant and McMurtry 2003a: 27; Lofego *et al.* 2009: 46; Demite *et al.* 2011: 43.

Origin of the material examined — Jataí-GO (C): *Trachipogon* sp.: I-10 (3). Jataí-GO (D): *Trachipogon* sp.: XII-09 (3). Tupaciguara-MG (G): *Stryphnodendron adstringens*: XII-09 (1). Brasília-DF (H): cf. *Dilleniaceae* sp.: X-09 (4); *Echinolaena inflexa*: VI-10 (2); *Trachipogon* sp.: VI-10 (1).

***Neoseiulus idaeus* Denmark and Muma, 1973**

Neoseiulus idaeus Denmark and Muma 1973: 266; Moraes *et al.* 1986: 83; 2004: 124; Chant and McMurtry 2003a: 21; 2007: 29. *Amblyseius idaeus*; Moraes and McMurtry 1983: 134; Demite *et al.* 2011: 43.

Origin of the material examined — Unaí-MG (I): *Echinolaena inflexa*: X-09 (2).

***Neoseiulus melinis* Lofego and Moraes, 2003**

Neoseiulus melinis Lofego and Moraes 2003: 113; Moraes *et al.* 2004: 133; Lofego *et al.* 2009.

Origin of the material examined — Jataí-GO (C): *Caryocar brasiliense*: I-10 (1); *Melinis minutiflora*: I-10 (6); *Trachipogon* sp.: X-09 (4), XII-09 (2).

***Neoseiulus tunus* (De Leon, 1967)**

Typhlodromips tunus De Leon 1967: 29; Denmark and Muma 1973: 253; Moraes *et al.* 1986: 151. *Amblyseius tunus*; McMurtry and Moraes 1989: 181; Feres and Moraes 1998: 126. *Neoseiulus tunus*; Ferla and Moraes 2002a: 872; 2002b: 1018; Chant and McMurtry 2003a: 21; 2007: 31; Moraes *et al.* 2004: 148; Lofego *et al.* 2004: 8; Bellini *et al.* 2005: 37; Feres *et al.* 2005: 45; Buosi *et al.* 2006: 5; Hernandez and Feres 2006: 4; Guanilo *et al.* 2008a: 29; 2008b: 21; Demite *et al.* 2009: 48; 2011: 44.

Origin of the material examined — Chapadão do Sul-MS (A): *Bauhinia* sp. 1: I-10 (4); *Byrsonima pachyphylla*: XII-09 (1), I-10 (2); *Campomanesia pubescens*: XII-09 (1); *Didymopanax vinosum*: XII-09 (1); *Fuirena*

umbellata: I-10 (2); *Miconia albicans*: XII-09 (1); *Pouteria torta*: XII-09 (11). Chapadão do Céu-GO (B): *Bauhinia* sp. 2: XII-09 (1); *Fuirena umbellata*: XII-09 (1). Jataí-GO (C): *Caryocar brasiliense*: I-10 (1). Rio Verde-GO (E): *Doliocarpus* cf. *dentatus*: XII-09 (2). Edealina-GO (F): *Alibertia edulis*: I-10 (3); *Astronium* sp.: XII-09 (6); *Bauhinia* sp. 3: XII-09 (2); *Byrsonima verbascifolia*: XII-09 (1); *Davilla elliptica*: XII-09 (2); *Guettarda viburnoides*: XII-09 (3); *Qualea grandiflora*: XII-09 (2), I-10 (2); *Rhamnidium elaeocarpum*: I-10 (1); *Roupala brasiliensis*: XII-09 (3), I-10 (1). Tupaciguara-MG (H): *Miconia albicans*: XII-09 (3); *Qualea grandiflora*: VI-10 (1); *Roupala brasiliensis*: VI-10 (8); *Stryphnodendron adstringens*: XII-09 (2).

***Proprioseiopsis dominigos* (El-Banhawy, 1984)**

Amblyseius dominigos El-Banhawy 1984: 130; McMurtry and Moraes 1989: 185; Moraes *et al.* 1991: 126; Feres and Moraes 1998: 126. *Proprioseiopsis dominigos*; Moraes *et al.* 1986: 114; 2004: 175; Gondim Jr. and Moraes 2001: 81; Zacarias and Moraes 2001: 582; Chant and McMurtry 2005b: 15; 2007: 89; Buosi *et al.* 2006: 5; Hernandez and Feres 2006: 5; Guanilo *et al.* 2008a: 10; Demite *et al.* 2009: 48; 2011: 45; Mineiro *et al.* 2009: 42.

Origin of the material examined — Chapadão do Céu-GO (B): *Xylopia aromatica*: X-09 (4). Rio Verde-GO (E): *Xylopia aromatica*: XII-09 (1). Cristalina-GO (J): *Trachipogon* sp.: VI-10 (1).

***Proprioseiopsis ovatus* (Garman, 1958)**

Amblyseiopsis ovatus Garman 1958: 78. *Amblyseius ovatus*; Muma 1961; Moraes and McMurtry 1983: 133; Moraes *et al.* 1991: 127. *Typhlodromus* (*Amblyseius*) *ovatus*; Chant 1959: 90. *Proprioseiopsis ovatus*; Denmark and Muma 1973: 237; Moraes *et al.* 1986: 121; 2004: 184; Gondim Jr. and Moraes 2001: 82.

Origin of the material examined — Chapadão do Sul-MS (A): *Byrsonima intermedia*: XII-09 (2). Chapadão do Céu-GO (B): Myrtaceae sp. 2: X-09 (2); *Qualea grandiflora*: X-09 (1). Edealina-GO (F): *Roupala brasiliensis*: XII-09 (3).

***Ricoseius loxocheles* (De Leon, 1965)**

Amblyseius (*Ricoseius*) *loxocheles* De Leon 1965a: 128. *Ricoseius loxocheles*; Denmark and Muma 1970: 119; 1973: 249; Lofego *et al.* 2004: 9.

Origin of the material examined — Chapadão do Céu-GO (B): Myrtaceae sp. 1: XII-09 (2). Cristalina-GO (J): *Kielmeyera* cf. *coriacea*: VI-10 (2).

***Typhlodromalus aripo* De Leon, 1967**

Typhlodromalus aripo De Leon 1967: 21; Denmark and Muma 1973: 257; Moraes *et al.* 1986: 128; 1999 [2000]: 252; 2004: 195; Feres and Nunes 2001: 1255; Zacarias and Moraes 2001: 582; Chant and McMurtry 2005a: 199; 2007: 199; Feres *et al.* 2005: 46; Buosi *et al.* 2006: 6; Lofego *et al.* 2004: 10; 2009: 54; Demite *et al.* 2009: 49; 2011: 46. *Amblyseius aripo*; Moraes and McMurtry 1983: 132; Moraes and Mesa 1988: 73; Feres and Moraes 1998: 126.

Origin of the material examined — Rio Verde-GO (E): *Byrsonima intermedia*: XII-09 (2). Cristalina-GO (J): *Davilla elliptica*: VI-10 (2).

***Typhlodromalus peregrinus* (Muma, 1955)**

Typhlodromus peregrinus Muma 1955: 270. *Typhlodromus* (*Amblyseius*) *peregrinus*; Chant 1959: 97. *Typhlodromalus peregrinus*; Muma *et al.* 1970: 88; Moraes *et al.* 1986: 132; 2004: 202; Zacarias and Moraes 2001: 582; Chant and McMurtry 2005b: 199; 2007: 11. *Amblyseius peregrinus*; McMurtry 1983: 255; Moraes *et al.* 1991: 130. *Typhlodromus* (*Amblyseius*) *robineae*; Chant 1959: 98 (synonymy according to Muma 1964). *Typhlodromus* (*Amblyseius*) *evansi*; Chant 1959: 99 (synonymy according to Muma 1964). *Typhlodromus* (*Amblyseius*) *primulae*; Chant 1959: 99 (synonymy according to Muma 1964).

Origin of the material examined — Chapadão do Céu-GO (B): Myrtaceae sp. 2: X-09 (2).

SUBFAMILY PHYTOSEIINAE BERLESE, 1916

***Phytoseius guianensis* De Leon, 1965**

Phytoseius guianensis De Leon 1965b: 18; Denmark and Muma 1973: 269; Moraes and McMurtry 1983: 144; Lofego *et al.* 2004: 11; Moraes *et al.* 2004: 239;

Feres *et al.* 2005: 46; Chant and McMurtry 2007: 129; Guanilo *et al.* 2008b: 23. *Phytoseius* (*Pennaseius*) *guianensis*; Moraes *et al.* 1986: 211. *Phytoseius* (*Phytoseius*) *guianensis*; Denmark 1966: 23; Demite *et al.* 2011: 47.

Origin of the material examined — Rio Verde-GO (E): *Xylopi aromaticata*: XII-09 (2).

***Phytoseius intermedius*
Evans and MacFarlane, 1962**

Phytoseius (*Dubininellus*) *intermedius* Evans and MacFarlane 1962: 588. *Phytoseius* (*Phytoseius*) *intermedius*; Ehara 1972: 170. *Phytoseius intermedius*; Moraes *et al.* 2004: 242; Chant and McMurtry 2007: 129; Ueckermann *et al.* 2007: 12; Demite *et al.* 2008: 17; 2011: 47. *Phytoseius* (*Phytoseius*) *yira*; Pritchard and Baker 1962: 227 (synonymy according to Denmark 1966).

Origin of the material examined — Tupaciguara-MG (G): *Miconia albicans*: XII-09 (1). Brasília-DF (H): *Caryocar brasiliense*: VI-10 (1).

***Phytoseius nahuatlensis* De Leon, 1959**

Phytoseius nahuatlensis De Leon 1959: 147; Chant and Baker 1965: 56; Feres and Moraes 1998: 128; Moraes *et al.* 2004: 248; Feres *et al.* 2005: 46; Chant and McMurtry 2007: 129; Demite *et al.* 2011: 48. *Phytoseius* (*Phytoseius*) *nahuatlensis*; Chant 1959: 106; Chant and Athias-Henriot 1960: 217; Denmark 1966: 25. *Phytoseius* (*Pennaseius*) *nahuatlensis*; De Leon 1965b: 14; Moraes *et al.* 1986: 213.

Origin of the material examined — Jataí-GO (C): *Byrsonima pachyphylla*: I-10 (1); *Caryocar brasiliense*: VI-10 (1); *Xylopi aromaticata*: XII-09 (1), I-10 (1). Rio Verde-GO (E): *Sclerobium paniculatum*: XII-09 (8); *Xylopi aromaticata*: X-09 (3), XII-09 (3). Edealina-GO (F): *Astronium* sp.: XII-09 (2); *Byrsonima verbascifolia*: X-09 (1); *Caryocar brasiliense*: X-09 (1), I-10 (1); *Davilla elliptica*: I-10 (1); *Guettarda viburnoides*: I-10 (1); *Solanum lycocarpum*: XII-09 (1). Tupaciguara-MG (G): *Caryocar brasiliense*: I-10 (2); cf. Moraceae sp.: VI-10 (11); *Sclerobium paniculatum*: XII-09 (3), VI-10 (8); *Stryphnodendron adstringens*: XII-09 (1); *Xylopi aromaticata*: X-09 (1), XII-09 (5), I-10 (1).

**SUBFAMILY TYPHLODROMINAE
SCHEUTEN, 1857**

***Galendromus* (*Galendromus*) *annectens*
(De Leon, 1958)**

Typhlodromus annectens De Leon 1958: 78; Moraes and McMurtry 1983: 142; Moraes *et al.* 1991: 134. *Galendromus annectens*; Muma 1961: 298. *Galendromus* (*Galendromus*) *annectens*; Muma 1963: 30; Denmark and Muma 1973: 274; Moraes *et al.* 1982: 21; 2004: 265; Chant and McMurtry 2007: 167; Demite *et al.* 2011: 49.

Origin of the material examined — Jataí-GO (C): *Stryphnodendron adstringens*: I-10 (2). Rio Verde-GO (E): *Himatanthus obovatus*: XII-09 (2).

***Metaseiulus* (*Metaseiulus*) *ferlai*
Moraes, McMurtry and Lopes, 2006**

Metaseiulus (*Metaseiulus*) *ferlai* Moraes *et al.* 2006: 352; Chant and McMurtry 2007: 174; Demite *et al.* 2011: 50.

Origin of the material examined — Rio Verde-GO (E): *Caryocar brasiliense*: X-09 (2). Tupaciguara-MG (G): *Tabebuia aurea*: X-09 (1).

***Typhlodromus* (*Anthoseius*) *neobakeri*
Prasad, 1968**

Typhlodromus neobakeri Prasad 1968: 1369; Schicha 1987: 130. *Amblydromella neobakeri*; Tenorio *et al.* 1985: 303; Moraes *et al.* 1986: 168. *Amblydromella* (*Aphanoseia*) *neobakeri*; Denmark and Welbourn 2002: 308. *Typhlodromus* (*Anthoseius*) *neobakeri*; Moraes *et al.* 2004: 339; Lofego *et al.* 2009.

Origin of the material examined — Brasília-DF (H): *Echinolaena inflexa*: X-09 (1), I-10 (1), VI-10 (14); *Trachipogon* sp.: VI-10 (1).

DISCUSSION

Amblyseius neochiapensis and *N. tunus* were found on a large number of hosts (24 and 20 host species, respectively). However, Lofego and Moraes (2006) classified these mites as infrequent due to the small number of hosts on which they were found, in the periphery of the Cerrado, in São Paulo. Demite *et al.* (2009) also found *N. tunus* in peripheral areas of

Cerrado at Mato Grosso, but associated with only one host. The differences between the results of this study and the above cited may be related to geographical position, climatic differences or floristic composition among fragments, which may alter species composition from one region to another (Felfili *et al.* 2002; Reis *et al.* 2000; Bridgewater *et al.* 2004).

According to some authors, leaf structures are important factors determining the composition of phytoseiid species in plants (Beard and Walter 2001; Hadamar *et al.* 1986; Moraes *et al.* 1993). Our data partially agree with this statement, since 27 % of mite species did not occur in more than one host, suggesting a very specific mite-host relationship. Furthermore, some species groups had preference for some kind of leaf structure. For example, species of the genus *Phytoseius* almost always occurred in plants with trichomes, such as *C. brasiliense* and *X. aromatica*.

However, other species did not show any preference at all for specific host. *Amblyseius neochiapensis*, *E. citrifolius*, and *N. tunus* occurred in plants with diverse leaf structures, such as smooth leaves of *M. albicans*, leaves with trichomes of *Q. grandiflora* and leaves with domatia of *S. adstringens*. Lofego and Moraes (2006) found similar results in Cerrado-Atlantic forest transition area, in which *Amblyseius acalyphus* Denmark and Muma, 1973 occurred in host with different foliar structures, whereas the majority of *Transeius belotti* (Moraes and Mesa), 1988 occurred in only one host.

Therefore, we conclude that the occurrence of some phytoseiid in the Cerrado may be restricted to some plant species. This restricted distribution is likely related to foliar structures or feeding resources available in the hosts. Nonetheless, other species apparently are not affected by these characteristics, and occur in a wide variety of plants in the region. Taken together, these results point to the highly complex distribution of phytoseiid mites in the Cerrado and reinforce the importance of the conservation of this biome. Most of species found in this study (17 in total) were previously recorded in Atlantic Forest remnants (Castro and Moraes 2010; Demite *et al.* 2011; Feres and Moraes 1998; Feres *et*

al. 2005; Zacarias and Moraes 2002). Comparing our results with previous records from peripheral areas of Cerrado (Lofego *et al.* 2004; Lofego and Moraes 2006; Demite *et al.* 2009), only 12 species are common between these two areas.

In conclusion, the results suggest that few Phytoseiidae species are endemic from Cerrado, a fact also pointed out by Tixier and Kreiter (2009). However, due to the small number of surveys and the high rate of endemic plants in this biome (Myers *et al.* 2000), these results show probably only a fraction of the real diversity of phytoseiid in the region, since the richness of animal groups tend to increase as plant diversity increases (Brose 2003; Dennis *et al.* 1998; MacArthur and MacArthur 1961). Therefore, more surveys should be conducted in the Cerrado, including physiognomies and hosts not considered in this study. This would improve the knowledge about phytoseiid species richness from this Neotropical savannah.

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REFERENCES

- Aponte O., McMurtry J.A. 1995 — Revision of the genus *Iphiseiodes* De Leon (Acari: Phytoseiidae) — *Int. J. Acarol.*, 21: 165-183. doi:10.1080/01647959508684056
- Athias-Henriot C. 1957 — Phytoseiidae et Aceosejidae (Acarina, Gamasina) d'Algerie. I. Genres *Blattisocius* Keegan, *Iphiseius* Berlese, *Amblyseius* Berlese, *Phytoseius* Ribaga, *Phytoseiulus* Evans — *Bull. Soc. Hist. Nat. Afr. N.*, 48: 319-352.
- Beard J.J. 2001 — A review of Australian *Neoseiulus* Hughes and *Typhlodromips* De Leon (Acari: Phytoseiidae: Amblyseiinae) — *Invert. Taxon.*, 15: 73-158. doi:10.1071/IT99017

- Beard J.J., Walter G.H. 2001 — Host plant specificity in several species of generalist mite predators — *Ecol. Entomol.*, 26: 562-570. doi:10.1046/j.1365-2311.2001.00367.x
- Bellini M.R., Moraes G.J. de, Feres R.J.F. 2005 — Plantas de ocorrência espontânea como substrato alternativos para fitoseídeos (Acari, Phytoseiidae) em cultivos de seringueira *Hevea brasiliensis* Muell. Arg. (Euphorbiaceae) — *Rev. Bras. Zool.*, 22: 35-42. doi:10.1590/S0101-81752005000100005
- Bridgewater S., Ratter J.A., Ribeiro J.F. 2004 — Biogeographic patterns, β -diversity and dominance in the Cerrado biome of Brazil — *Biodivers. Conserv.*, 13: 2295-2318. doi:10.1023/B:BIOC.0000047903.37608.4c
- Brose U. 2003 — Bottom-up control of carabid beetle communities in early successional wetlands: mediated by vegetation structure or plant diversity? — *Oecologia*, 135: 407-413.
- Buosi R., Feres R.J.F., Oliveira A.R., Lofego A.C., Hernandes F.A. 2006 — Ácaros plantícolas (Acari) da "Estação Ecológica de Paulo de Faria", Estado de São Paulo, Brasil — *Biota Neotrop.*, 6: 1-20.
- Castro T.M.M.G. de, Moraes G.J. de 2010 — Diversity of phytoseiid mites (Acari: Mesostigmata: Phytoseiidae) in the Atlantic Forest of São Paulo — *Syst. Biodivers.*, 8: 301-307. doi:10.1080/14772001003801375
- Chant D.A. 1959 — Phytoseiid mites (Acarina: Phytoseiidae). Part I. Bionomics of seven species in southeastern England. Part II. A taxonomic review of family Phytoseiidae, with descriptions of 38 new species — *Can. Entomol. Suppl.*, 91: 1-166. doi:10.4039/entm9112fv
- Chant D.A., Athias-Henriot C. 1960 — The genus *Phytoseius* Ribaga, 1902 (Acarina: Phytoseiidae) — *Entomophaga*, 5: 213-228. doi:10.1007/BF02383272
- Chant D.A., Baker E.W. 1965 — The Phytoseiidae (Acarina) of Central America — *Mem. Entomol. Soc. Can.*, 41: 1-56. doi:10.4039/entm9741fv
- Chant D.A., McMurtry J.A. 2003a — A review of the subfamily Amblyseiinae Muma (Acari: Phytoseiidae): Part I. Neoseiulini new tribe — *Int. J. Acarol.*, 29: 3-46. doi:10.1080/01647950308684319
- Chant D.A., McMurtry J.A. 2003b — A review of the subfamily Amblyseiinae Muma (Acari: Phytoseiidae): Part II. The tribe Kampimodromini Kolodochka — *Int. J. Acarol.*, 29: 179-224. doi:10.1080/01647950308684331
- Chant D.A., McMurtry J.A. 2004 — A review of the subfamily Amblyseiinae Muma (Acari: Phytoseiidae): Part III. The tribe Amblyseiini Wainstein, subtribe Amblyseiina n. subtribe — *Int. J. Acarol.*, 30: 171-228. doi:10.1080/01647950408684388
- Chant D.A., McMurtry J.A. 2005a — A review of the subfamily Amblyseiinae Muma (Acari: Phytoseiidae): Part VI. The tribe Euseiini n. tribe, subtribes Typhlodromalina n. subtribe, Euseiina n. subtribe, and Ricoseiina n. subtribe — *Int. J. Acarol.*, 31: 187-224. doi:10.1080/01647950508684424
- Chant D.A., McMurtry J.A. 2005b — A review of the subfamily Amblyseiinae Muma (Acari: Phytoseiidae): Part V. Tribe Amblyseiini, subtribe Proprioseiopsina Chant and McMurtry — *Int. J. Acarol.*, 31: 3-22. doi:10.1080/01647950508684412
- Chant D.A., McMurtry J.A. 2007 — Illustrated keys and diagnoses for the genera and subgenera of the Phytoseiidae of the world (Acari: Mesostigmata) — Michigan: Indira Publishing House. pp. 219.
- Daud R.D., Feres R.J.F., Bousi R. 2007 — Ácaros (Arachnida: Acari) Associados a *Bauhinia variegata* L. (Leguminosae) no Noroeste do Estado de São Paulo — *Neotrop. Entomol.*, 36: 322-325. doi:10.1590/S1519-566X2007000200025
- De Leon D. 1958 — Four new *Typhlodromus* from southern Florida (Acarina: Phytoseiidae) — *Fla. Entomol.*, 41: 73-76. doi:10.2307/3492363
- De Leon D. 1959 — A new genus and three new species of phytoseiid mites from Mexico with collection records on *Phytoseius plumifer* (C. and F.) and *P. macropilis* (Banks) — *Entomol. News*, 70: 147-152.
- De Leon D. 1962 — Twenty-three new phytoseiids, mostly from southeastern United States — *Fla. Entomol.*, 45: 11-27. doi:10.2307/3492899
- De Leon D. 1965a — Phytoseiid mites from Puerto Rico with descriptions of new species (Acarina: Mesostigmata) — *Fla. Entomol.*, 48: 121-131. doi:10.2307/3493102
- De Leon D. 1965b — Ten new species of *Phytoseius* (Penna-seius) from Mexico, Trinidad, and British Guiana with a key to species (Acarina: Phytoseiidae) — *Entomol. News*, 76: 11-21.
- De Leon D. 1967 — Some mites of the Caribbean Area. Part I. Acarina on plants in Trinidad, West Indies. — Lawrence: Allen Press Inc. pp. 66.
- Demite P.R., Lofego A.C., Feres R.J.F. 2008 — Three new species of *Phytoseius* Ribaga (Acari: Phytoseiidae), and a new record from Brazil — *Zootaxa*, 1909: 16-26.
- Demite P.R., Feres R.J.F., Lofego A.C., Oliveira A.R. 2009 — Plant inhabiting mites (Acari) from the Cerrado biome of Mato Grosso State, Brazil — *Zootaxa*, 2061: 45-60.
- Demite P.R., Lofego A.C., Feres R.J.F. 2011 — Phytoseiidae (Acari) in Forest fragments in the State of São Paulo, Brazil — *Zootaxa*, 3089: 31-56.

- Denmark H.A. 1966 — Revision of the genus *Phytoseius* Ribaga, 1904 (Acarina: Phytoseiidae) — Fla. Dep. Agric. Bull., 6: 1-105.
- Denmark H.A., Muma M.H. 1970 — Some phytoseiid mites of Paraguay (Phytoseiidae: Acarina) — Fla. Entomol., 53: 219-227. doi:10.2307/3493192
- Denmark H.A., Muma M.H. 1972 — Some Phytoseiidae of Colombia (Acarina: Phytoseiidae) — Fla. Entomol., 55: 19-29. doi:10.2307/3493637
- Denmark H.A., Muma M.H. 1973 — Phytoseiidae mites of Brazil (Acarina, Phytoseiidae) — Rev. Bras. Biol., 33: 235-276.
- Denmark H.A., Muma M.H. 1975 — The Phytoseiidae (Acarina: Mesostigmata) of Puerto Rico — J. Agr. Univ. Puert. Rico, 59: 279-304.
- Denmark H.A., Muma M.H. 1989 — A revision of the genus *Amblyseius* Berlese, 1914 (Acari: Phytoseiidae) — Occas. Pap. Fla. State Collect. Arthropods, 4: 1-149.
- Denmark H.A., Welbourn W.C. 2002 — Revision of the genera *Amblydromella* Muma and *Anthoseius* De Leon (Acari: Phytoseiidae) — Int. J. Acarol., 28: 291-316. doi:10.1080/01647950208684308
- Dennis P., Young M.R., Gordon I.J. 1998 — Distribution and abundance of small insects and arachnids in relation to structural heterogeneity of grazed, indigenous grasslands — Ecol. Entomol., 23: 253-264. doi:10.1046/j.1365-2311.1998.00135.x
- Ehara S. 1972 — Some phytoseiid mites from Japan, with descriptions of thirteen new species (Acarina: Mesostigmata) — Mushi, 46: 137-173.
- El-Banhawy E.M. 1984 — Description of some phytoseiid mites from Brazil (Acarina: Phytoseiidae) — Acarologia, 25: 125-144.
- Evans G.O., MacFarlane D. 1962 — A new mites of the genus *Phytoseius* Ribaga (Acari: Mesostigmata) — Annu. Mag. Nat. Hist., Ser. 13, 4: 587-588.
- Farias A.R.N., Flechtman C.H.W., Moraes G.J.de, McMurtry J.A. 1981 — Predadores do ácaro verde da mandioca, no nordeste do Brasil — Pesq. Agropec. Bras., 16: 313-317.
- Felfili J.M., Nogueira P.E., Silva Júnior M.C. da, Marimon B.S., Delitti W.B.C. 2002 — Composição florística e fitossociologia do cerrado sentido restrito no município de Água Boa-MT — Acta Bot. Bras., 16: 103-112.
- Feres R.J.F., Moraes G.J. 1998 — Phytoseiid mites (Acari: Phytoseiidae) from woody areas in the state of São Paulo, Brazil — Syst. Appl. Acarol., 3: 125-132.
- Feres R.J.F., Nunes M.A. 2001 — Ácaros (Acari, Arachnida) associados à euforbiáceas nativas em áreas de cultivo de seringueiras (*Hevea brasiliensis* Muell. Arg., Euphorbiaceae) na região noroeste do Estado de São Paulo, Brasil — Rev. Bras. Zool., 18: 1253-1264. doi:10.1590/S0101-81752001000400020
- Feres R.J.F., Lofego A.C., Oliveira A.R. 2005 — Ácaros plantícolas (Acari) da "Estação Ecológica do Noroeste Paulista", Estado de São Paulo, Brasil — Biota Neotrop., 5: 1-14.
- Feres R.J.F., Vieira M.R., Daud R.D., Pereira Jr. E.G., Oliveira G.F., Dourado C. 2009 — Ácaros (Arachnida, Acari) de plantas ornamentais na região noroeste do Estado de São Paulo, Brasil: inventário e descrição dos sintomas causados pelos fitófagos — Rev. Bras. Entomol., 53: 466-474. doi:10.1590/S0085-56262009000300024
- Ferla N.J., Moraes G.J. 2002a — Ácaros (Arachnida, Acari) da seringueira (*Hevea brasiliensis* Muell. Arg.) no Estado de Mato Grosso, Brasil — Rev. Bras. Zool., 19: 867-888. doi:10.1590/S0101-81752002000300025
- Ferla N.J., Moraes G. J. 2002b — Ácaros predadores (Acari) em plantas nativas e cultivadas do Estado do Rio Grande do Sul, Brasil — Rev. Bras. Zool., 19: 1011-1031. doi:10.1590/S0101-81752002000400006
- Fiaboe K.K.M., Gondim M.G.C. Jr., Moraes G.J. de, Ogol C.K.P.O., Knapp M. 2007 — Surveys for natural enemies of the tomato red spider mite *Tetranychus evansi* (Acari: Tetranychidae) in the northeastern and south-eastern Brazil — Zootaxa, 1395: 33-58.
- Furtado I.P., Kreiter S., Moraes G.J. de, Tixier M.-S., Flechtman C.W.H., Knapp M. 2004 [2005] — Plant mites from northeastern Brazil, with descriptions of two new species of the family Phytoseiidae (Mesostigmata) — Acarologia, 45: 131-143.
- Furtado I.P., Moraes G.J. de, Kreiter S., Knapp M. 2006 — Search for effective natural enemies of *Tetranychus evansi* in south and southeast Brazil — Exp. Appl. Acarol., 40: 157-174. doi:10.1007/s10493-006-9045-y
- Furtado I.P., Toledo S. E., Moraes G.J. de, Kreiter S., Knapp M. 2007 - Search for effective natural enemies of *Tetranychus evansi* (Acari: Tetranychidae) in north-west Argentina - Exp. Appl. Acarol., 43: 121-127. doi:10.1007/s10493-007-9104-z
- Garman P. 1958 — New species belonging to the genera *Amblyseius* and *Amblyseiopsis* with keys to *Amblyseius*, *Amblyseiopsis* and *Phytoseiulus* — Ann. Entomol. Soc. Am., 51: 69-79.
- Gerson U., Smiley R.L., Ochoa R. — Mites (Acari) for pest control — Oxford: Blackwell Science Ltd. pp. 539.
- Gondim Jr. M.G.C., Moraes G.J. 2001 — Phytoseiid mites (Acari: Phytoseiidae) associated with palm trees (Arecaceae) in Brazil — Syst. Appl. Acarol., 6: 65-94.
- Guanilo A.D., Moraes G.J. de, Knapp M. 2008a — Phytoseiid mites (Acari: Phytoseiidae) of the subfamily Am-

- blyseiinae Muma from Peru, with description of four new species — *Zootaxa*, 1880: 1-47.
- Guanilo A.D., Moraes G.J. de, Knapp M. 2008b — Phytoseiid mites (Acari: Phytoseiidae) from Argentina, with description of a new species — *Zootaxa*, 1884: 1-35.
- Guanilo A.D., Moraes G.J. de, Toledo S., Knapp M. 2008c — Phytoseiid mites (Acari: Phytoseiidae) from Argentina, with description of a new species — *Zootaxa*, 1884: 1-35.
- Guanilo A.D., Moraes G.J. de, Toledo S., Knapp M. 2010 — New records of *Tetranychus evansi* and associated natural enemies in northern Argentina — *Syst. Appl. Acarol.*, 15: 3-20.
- Hadamard J.J., AliNiazee M.T., Croft B.A. 1986 — Phytoseiid mites of major crops in the Willamette Valley, OR, and pesticide resistance in *Typhlodromus pyri* Scheuten — *Environ. Entomol.*, 15: 1255-1262.
- Hernandes F.A. and Feres R.J.F. 2006 — Review about mites (Acari) of rubber trees (*Hevea* spp., Euphorbiaceae) in Brazil — *Biota Neotrop.*, 6: 1-24.
- Kreiter S., Moraes G.J. 1997 — Phytoseiid mites (Acari: Phytoseiidae) from Guadeloupe and Martinique — *Fla. Entomol.*, 80: 376-382. doi:10.2307/3495770
- Lawson-Balagbo L.M., Gondim Jr. M.G.C., Moraes G.J. de, Hanna R., Schausberger P. 2008 — Exploration of the acarine fauna on coconut palm in Brazil with emphasis on *Aceria guerreronis* (Acari: Eriophyidae) and its natural enemies — *Bull. Entomol. Res.*, 98: 83-96. doi:10.1017/S0007485307005421
- Lofego A.C., Moraes G.J. 2003 — Two new species of *Neoseiulus* Hughes (Acari: Phytoseiidae) from Brazil — *Int. J. Acarol.*, 29: 113-117. doi:10.1080/01647950308683647
- Lofego A.C., Moraes G.J. 2006 — Ácaros (Acari) associados à Mirtáceas (Myrtaceae) em áreas de Cerrado no Estado de São Paulo com análise faunística das famílias Phytoseiidae e Tarsonemidae — *Neotrop. Entomol.*, 35: 731-746. doi:10.1590/S1519-566X2006000600003
- Lofego A.C., Moraes G.J. de, Castro L.A.S. 2004 — Phytoseiid mites (Acari: Phytoseiidae) on Myrtaceae in the State of São Paulo, Brazil — *Zootaxa*, 516: 1-18.
- Lofego A.C., Moraes G.J. de, McMurtry J.A. 2000 — Three new species of phytoseiid mites (Acari: Phytoseiidae) from Brazil — *An. Soc. Entomol. Bras.*, 29: 461-467. doi:10.1590/S0301-80592000000300008
- Lofego A.C., Demite P.R., Kishimoto R.G., Moraes G.J. 2009 — Phytoseiid mites on grasses in Brazil (Acari: Phytoseiidae) — *Zootaxa*, 2240: 41-59.
- MacArthur R. H., MacArthur J. W. 1961 — On bird species diversity — *Ecology*, 42: 594-598.
- McMurtry J.A. 1983 — Phytoseiidae mites from Guatemala, with descriptions of two new species and redefinitions of the genera *Euseius*, *Typhloseiopsis*, and *Typhlodromus occidentalis* species group (Acari: Mesostigmata) — *Int. J. Entomol.*, 25: 249-272.
- McMurtry J.A. and Croft B.A. 1997 — Life-styles of phytoseiid mites and their roles in biological control — *Annu. Rev. Entomol.*, 42: 291-321. doi:10.1146/annurev.ento.42.1.291
- McMurtry J.A., Moraes G.J. de 1989 — Some phytoseiid mites from Peru with descriptions of four new species (Acari: Phytoseiidae) — *Int. J. Acarol.*, 15: 179-188. doi:10.1080/01647958908683843
- Mineiro J.L. de C., Raga A., Sato M.E., Lofego A.C. 2009 — Ácaros associados ao cafeeiro (*Coffea* spp.) no estado de São Paulo, Brasil. Parte I. Mesostigmata — *Biota Neotrop.*, 9: 37-46.
- Ministério do Meio Ambiente 2007 — Cerrado e Pantanal: áreas e ações prioritárias para conservação da Biodiversidade — Brasília: Ministério do Meio Ambiente. pp. 397.
- Moraes G.J. de, Flechtmann C.H.W. 2008 — Manual de Acarologia: acarologia básica e ácaros de plantas cultivadas no Brasil — Ribeirão Preto: Holos Editora. pp. 228.
- Moraes G.J. de, McMurtry J. A. 1983 — Phytoseiid mites (Acarina) of northeastern Brazil with descriptions of four new species — *Int. J. Acarol.*, 9: 131-148. doi:10.1080/01647958308683326
- Moraes G.J. de, Mesa N.C. 1988 — Mites of the family Phytoseiidae (Acari) in Colombia, with descriptions of three new species — *Int. J. Acarol.*, 14: 71-88. doi:10.1080/01647958808683790
- Moraes G.J. de, Oliveira J.V. 1982 — Phytoseiid mites of coastal Pernambuco in northeastern Brazil — *Acarologia*, 23: 315-318.
- Moraes G.J. de, Denmark H.A., Guerrero J.M. 1982 — Phytoseiidae mites of Colombia (Acarina: Phytoseiidae) — *Int. J. Acarol.*, 8: 15-22. doi:10.1080/01647958208683273
- Moraes G.J. de, Kreiter S., Lofego A.C. 1999 [2000] — Plant mites (Acari) of the French Antilles. 3. Phytoseiidae (Gamasida) — *Acarologia*, 40: 237-264.
- Moraes G.J. de, McMurtry J.A., Denmark H.A. 1986 — A catalog of the mite family Phytoseiidae: references to taxonomy, synonymy, distribution and habitat — Brazil: Embrapa-DDT. pp. 356.
- Moraes G.J. de, McMurtry J.A., Lopes P.C. 2006 — Redefinition of *Metaseiulus* Muma (Acari: Phytoseiidae) and description of a new species from Brazil — *Int. J. Acarol.*, 32: 351-354. doi:10.1080/01647950608684481

- Moraes G.J. de, Mesa N.C., Braun A. 1991 — Some phytoseiid mites of Latin America (Acari: Phytoseiidae) — *Int. J. Acarol.*, 17: 117-139. doi:10.1080/01647959108683892
- Moraes G.J. de, de Alencar J.A., Lima J.L.S., Yaninek J.S. 1993 — Alternative plant habitats for common phytoseiid predators of the cassava green mite (Acari: Phytoseiidae. Tetranychidae) in northeast Brazil — *Exp. Appl. Acarol.*, 17: 77-90.
- Moraes G.J. de, McMurtry J.A., Denmark H.A., Campos C.B. 2004 — A revised catalog of the mite family Phytoseiidae — *Zootaxa*, 434: 1-494.
- Muma M.H. 1955 — Phytoseiidae (Acarina) associated with citrus in Florida — *Ann. Entomol. Soc. Am.*, 48: 262-272.
- Muma M.H. 1961 — Subfamilies, genera and species of Phytoseiidae (Acarina: Mesostigmata) — *Bull. Fla. State Museum, Biol. Science*, 5: 267-302.
- Muma M.H. 1963 — The genus *Galendromus* Muma, 1961 (Acarina: Phytoseiidae) — *Fla. Entomol., Suppl.* 1: 15-41. doi:10.2307/3493355
- Muma M.H. 1964 — Annotated list and keys to Phytoseiidae (Acarina: Mesostigmata) associated with Florida citrus — *Fl. Agric. Exp. Stn. Bull.*, 685: 1-42.
- Muma M.H., Denmark H.A., De Leon D. 1970 — Phytoseiidae of the Florida. *Arthropods of Florida and neighboring land areas — USA: Florida Department of Agriculture and Consumer Services, Division of Plant Industry.* pp. 150.
- Myers N., Mittermeier R.A., Mittermeier C.G., da Fonseca G.A.B., Kent J. 2000 — Biodiversity hotspots for conservation priorities — *Nature*, 403: 853-858.
- Noronha A.C. da S., Moraes G.J. 2002 — Variações morfológicas intra e interpopulacionais de *Euseius citrifolius* Denmark and Muma e *Euseius concordis* (Chant) (Acari, Phytoseiidae) — *Rev. Bras. Zool.*, 19: 1111-1122.
- Prasad V. 1968 — Some *Typhlodromus* mites from Hawaii — *Ann. Entomol. Soc. Am.*, 61: 1369-1372.
- Pritchard A.E., Baker E.W. 1962 — Mites of the family Phytoseiidae from Central Africa, with remarks on genera of the world — *Hilgardia*, 33: 205-309.
- Reis P.R., Chiavegato L.G., Alves E.B., Sousa, E.O. 2000 — Ácaros da Família Phytoseiidae Associados aos Citros no Município de Lavras, Sul de Minas Gerais — *An. Soc. Entomol. Bras.*, 29: 95-104. doi:10.1590/S0301-80592000000100012
- Ribeiro J.F., Walter B.M.T. 1998 — Fitofisionomias do bioma Cerrado — In: Sano M.S., Almeida, S.P. (Eds), *Cerrado: ambiente e flora.* Brasília: Embrapa. p. 89-106.
- Rosa A.A., Gondim M.G.C.Jr., Fiaboe K.K.M., Moraes G.J. de, Knapp M. 2005 — Predatory mites associated with *Tetranychus evansi* Baker and Pritchard (Acari: Tetranychidae) on native solanaceous plants of coastal Pernambuco State, Brazil — *Neotrop. Entomol.*, 34: 689-692.
- Schicha E. 1981 — A new species of *Amblyseius* (Acarina: Phytoseiidae) from Australia compared with ten closely related species from Asia, America and Africa — *Int. J. Acarol.*, 7: 203-216. doi:10.1080/01647958108683262
- Schicha E. 1987 — Phytoseiidae of Australia and neighboring areas — Michigan: Indira Publishing House. pp. 187.
- Schicha E., Elshafie M. 1980 — Four new species of phytoseiid mites from Australia, and three species from America redescribed (Acari: Phytoseiidae) — *J. Aust. Entomol. Soc.*, 19: 27-36. doi:10.1111/j.1440-6055.1980.tb00957.x
- Tenorio J.M., Denmark H.A., Swift S.F. 1985 — Catalog of Acari in the Hawaiian Islands. I. Mesostigmata (or Gamasida) (Acari) — *Int. J. Entomol.*, 27: 297-309.
- Tixier M.-S., Kreiter S. 2009 — Arthropods in biodiversity hotspots: the case of Phytoseiidae (Acari: Mesostigmata) — *Biodivers. Conserv.*, 18: 507-527. doi:10.1007/s10531-008-9517-y
- Ueckermann E.A., Loots G.C. 1988 — The African species of the subgenera *Anthoseius* De Leon and *Amblyseius* Berlese (Acari: Phytoseiidae) — *Entomol. Mem., Depart. Agric. Water Supply, Repub. S. Afr.*, 73: 1-168.
- Ueckermann E.A., Zannou I.D., Moraes G.J. de, Oliveira A.R., Hanna R., Yaninek J.S. 2007 — Phytoseiid mites of the subfamily Phytoseiinae (Acari: Phytoseiidae) from sub-Saharan Africa — *Zootaxa*, 1658: 1-20.
- Vasconcelos D.E., Silva F.R., Barbosa D.G.F., Gondim Jr. M.G.C., Moraes G.J. 2006 — Diversidade de fitoseídeos (Acari: Phytoseiidae) em fruteiras tropicais no Estado de Pernambuco, Brasil — *Magistra*, 18: 90-101.
- Zacarias M.S., Moraes G.J. 2001 — Phytoseiid mites (Acari) associated with rubber trees and other euphorbiaceous plants in southeaster Brazil — *Neotrop. Entomol.*, 30: 579-586. doi:10.1590/S1519-566X2001000400011
- Zacarias M.S., Moraes G.J. 2002 — Mite diversity (Arthropoda: Acari) on euphorbiaceous plants in three localities in the State of São Paulo — *Biota Neotrop.*, 2: 1-12.

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