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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).

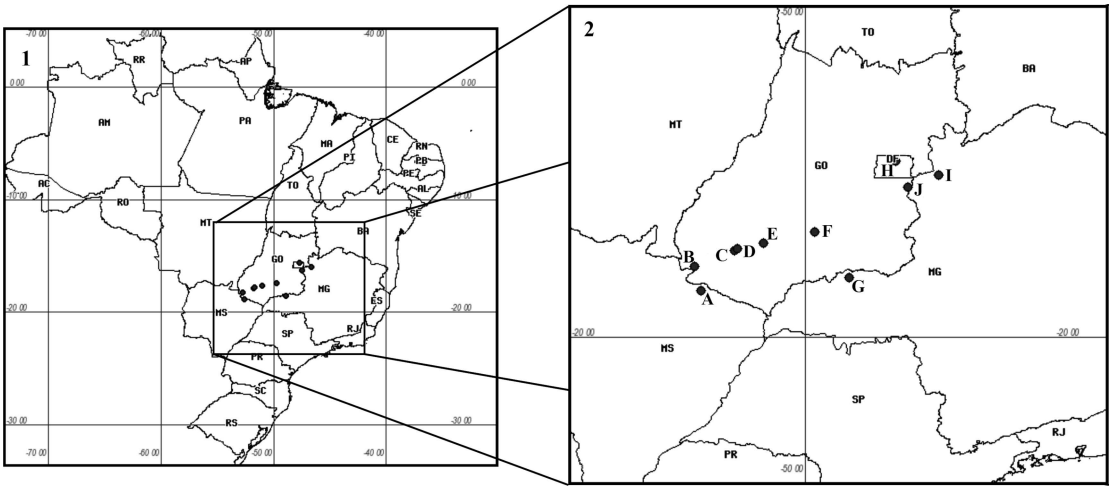


FIGURE 1: Location of study areas. 1 – Map of Brazil highlighting the region sampled. 2 – detailed map, with location of study points. Letters correspond to cities in the sampling areas: (A: Chapadão do Sul-MS, B: Chapadão do Céu-GO, C: Jataí-GO, D: Jataí-GO, E: Rio Verde-GO, F: Edealina-GO, G: Tupaciguara-MG, 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 μm 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 Flechtmann 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	Coordenates	Sampled plants
A	Chapadão do Sul-MS	52° 35' W 18° 51' S	*Bauhinia sp.* 1 (Fabaceae)
			Byrsonima intermedia A. Juss. (Malphigiaceae)
			Byrsonima pachyphylla A. Juss. (Malphigiaceae)
			Campomanesia pubescens (DC.) Berg (Myrtaceae)
			Caryocar brasiliense Camb. (Caryocaraceae)
			Didymopanax vinosum Cham. & Schltdl. (Araliaceae)
			Fuirena umbellata Rottb. (Cyperaceae)
			Miconia albicans (Sw.) Triana (Melastomataceae)
			Myrtaceae sp. 1 (Myrtaceae)
			Myrtaceae sp. 2 (Myrtaceae)
			Pouteria torta (Mart.) Radlk. (Sapotaceae)
			Roupala brasiliensis Klotzsch (Proteaceae)
B	Chapadão do Céu-GO	52° 44' W 18° 15' S	*Bauhinia sp.* 2 (Fabaceae)
			Campomanesia pubescens (DC.) Berg (Myrtaceae)
			Caryocar brasiliense Camb. (Caryocaraceae)
			Didymopanax vinosum Cham. & Schltdl. (Araliaceae)
			Fuirena umbellata Rottb. (Cyperaceae)
			Harconia speciosa Gom. (Apocynaceae)
			Miconia albicans (Sw.) Triana (Melastomataceae)
			Myrtaceae sp. 1 (Myrtaceae)
			Myrtaceae sp. 2 (Myrtaceae)
			Myrtaceae sp. 3 (Myrtaceae)
			Qualea grandiflora Mart. (Vochysiaceae)
			Xylopia aromatica (Lam.) Mart. (Annonaceae)
C	Jataí-GO	51° 45' W 17° 51' S	*Byrsonima pachyphylla* A. Juss. (Malphigiaceae)
			Caryocar brasiliense Camb. (Caryocaraceae)
			Cf. Dilleniaceae sp. (Dilleniaceae)
			Dimorphandra mollis Benth. (Fabaceae)
			Genipa americana L. (Rubiaceae)
			Melinis minutiflora P. Beauv. (Poaceae)
			Miconia albicans (Sw.) Triana (Melastomataceae)
			Qualea grandiflora Mart. (Vochysiaceae)
			Stryphnodendron adstringens (Mart.) Coville (Fabaceae)
			Tocoyena formosa (Cham. & Schltdl.) K.Schum. (Rubiaceae)
			Trachipogon sp. (Poaceae)
			Xylopia aromatica (Lam.) Mart. (Annonaceae)

TABLE 1: Continued.

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

TABLE 1: Continued.

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

TABLE 1: Continued.

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

Amblyseiopsis 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 flechtmanni*; 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. *Amblyseiulella 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; Hernandes 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; Hernandes 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. *Amblyseiulus 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): *Xylopia aromatica*: 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); *Xylopia aromatica*: XII-09 (1), I-10 (1). Rio Verde-GO (E): *Sclerobium paniculatum*: XII-09 (8); *Xylopia aromatica*: 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); *Xylopia aromatica*: 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 apparentely 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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