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Tetranychidae (Acari) in forest fragments in the State of São Paulo, Brazil

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ABSTRACT — Tetranychidae is an important family of phytophagous mites, with some species considered agricultural pests. Nevertheless, there are few studies about the diversity of this mite family in natural environments. Thus, the objective was to record the species of spider mites associated with plants in forest fragments located in the Northwestern of the State of São Paulo, Brazil. Thirty-eight species belonging to 14 genera of Tetranychidae were recorded. Only *Tetranychus mexicanus* and *Eutetranychus banksi*, species recorded on plants of economic interest, in some cases causing damage to crops, were abundant and frequent in the forest fragments sampled in this study. The knowledge of plants that can serve as alternate hosts or plant-traps can assist in understanding the dynamics of these mites in agroecosystems. The great diversity of Tetranychidae registered, and the limited knowledge of these mites associated with plants in natural environments, reinforces the importance of surveys carried out in forest remnants. Future studies should be conducted to increase the knowledge of spider mites in natural areas.

KEYWORDS — conservation; forest remnants; phytophagous mites

INTRODUCTION

Tetranychidae, also known as spider mites, is a family of phytophagous mites which has about 1,288 valid species (Migeon and Dorkeld, 2015). Species of this family can cause severe economic effect on agriculture, and are considered as pests of more than a hundred crops (Bolland *et al.*, 1998; Migeon and Dorkeld, 2015).

Recently several studies have been conducted to understand the mite fauna associated with plants in natural environments in Brazil, most of these carried in State of São Paulo, Brazil. These studies showed mite fauna information as a whole, present

in natural environments (Demite and Feres, 2005; Feres *et al.*, 2005; Buosi *et al.*, 2006), or specific groups such as Oribatida (Oliveira *et al.*, 2005), Phytoseiidae (Feres and Moraes, 1998; Gondim Jr. and Moraes, 2001; Zacarias and Moraes, 2001; Lofego *et al.*, 2004; Demite *et al.*, 2011; Moraes *et al.*, 2013), Stigmaeidae (Arruda Filho and Moraes, 2002), Tarsonemidae (Lofego *et al.*, 2005). However, none of these studies addressed particularly the Tetranychidae. The lack of information related to this family in natural environments is very worrying, and conducting inventories in forest fragments in areas that suffer or have suffered strong anthropic pressure are extremely important (Demitte *et al.*, 2009).

TABLE 1: Localization of forest fragments sampled.

Localities	Coordinates
Barretos (Area 1)	20°29'05" S, 48°49'21" W
Barretos (Area 2)	20°38'14" S, 48°45'06" W
Bebedouro	20°53'06" S, 48°32'26" W
Macaubal	20°44'34" S, 49°55'55" W
Matão	21°37'14" S, 48°32'14" W
Nova Granada	20°32'37" S, 49°14'47" W
Novo Horizonte	21°31'15" S, 49°17'41" W
Palestina (Area 1)	20°17'18" S, 49°30'01" W
Palestina (Area 2)	20°19'16" S, 49°30'17" W
Pindorama	21°13'12" S, 48°55'04" W
Planalto	21°00'05" S, 49°58'26" W
Sales	21°24'17" S, 49°30'01" W
Sto. Antônio do Aracanguá	20°55'34" S, 50°20'55" W
S. J. de Iracema	20°28'25" S, 50°17'36" W
S. J. do Rio Preto (Area 1)	20°44'46" S, 49°17'48" W
S. J. do Rio Preto (Area 2)	20°50'26" S, 49°17'45" W
Taquaritinga	21°24'08" S, 48°41'14" W
Turmalina	20°00'13" S, 50°26'02" W
União Paulista	20°55'16" S, 49°55'34" W
Votuporanga	20°30'52" S, 50°05'12" W

These authors alert that mite species may become extinct before they are even known.

São José do Rio Preto region currently has only 3.3% of its native vegetation area (SMA/IF, 2005), most of which has been replaced by pasture, miscellaneous crops or urban areas (PROBIO, 1998). This is the most deforested and fragmented region in São Paulo State, and has the lowest concentration of conservation areas, creating a scenario that apparently will not be reversed without environmental management action (Kronka *et al.*, 1993).

The realization of these studies is important for conservation and also from the agricultural point of view. Native plants can act as reservoirs of phytophagous mites and their natural enemies that occur or may occur in crops (Moraes *et al.*, 2001).

The aim of this study was to identify the fauna of Tetranychidae in forest fragments located in the Northwestern of State of São Paulo, Brazil.

MATERIALS AND METHODS

Study areas

The samplings were realized in 20 forest fragments (Table 1) in Northwestern of State of São Paulo. The climate of the region is the type CWA-AW of Köppen, characterized by a prominent dry season, which receives only 15% of the total annual rainfall rate, varying between 1,100 and 1,250mm (± 225 mm) (Barcha and Arid, 1971), and by the unpredictability of rainy season's beginning (Rossa-Feres and Jim, 2001). Original vegetal composition of this region is formed by semideciduous seasonal forest and cerrado spots (Ab'Saber, 2003).

Sampling

The data presented in this study are for surveys conducted in two projects.

In the first project the samplings were carried out in two fragments located in São José do Rio Preto, São Paulo state. Samples were collected monthly from January 1985 to December 1990. At each sampling, a variable number of plants was sampled in each fragment.

In the second project the areas where the samplings were conducted and the schedule of collections were set by the Thematic Project Biota/FAPESP "Fauna and Flora of remnant forest fragments in Northwestern São Paulo: basis for studies of biodiversity conservation". The samplings were realized quarterly in two periods: (1) June 2007 to March 2008; (2) June 2008 to March 2009. In each of the two periods ten fragments were sampled, and two areas were sampled in both periods because they are the best preserved. Five plant species were selected in each fragment-period. In addition, two plant species, *Actinostemon communis* (Müll. Arg.) Pax (Euphorbiaceae) and *Trichilia casaretti* C. DC. (Meliaceae), common in forest remnants in the Northwestern of the State of São Paulo were sampled in eight fragments during the two periods.

General methods

Collected material was examined under stereomicroscope (40x) and the mites were mounted in microscop slides with Hoyer's medium (Krantz and Walter, 2009). In "Origin of the specimens examined" the locality, the host plant, collection date and the number of specimens (females and males) registered are indicated. The information related to geographical distribution (previous records) were obtained from the Spider Mites Web database (Migeon and Dorkeld, 2015). The voucher specimens were deposited in the Acari Collection of Departamento de Zoologia e Botânica (DZSJRP-Acari), Universidade Estadual Paulista (UNESP), Campus de São José do Rio Preto, São Paulo, Brazil – <http://splink.cria.org.br>.

RESULTS

A total of 38 tetranychid species belonging to 14 genera of two subfamilies were found (Table 2). Spi-

der mites were found in 73 plant species belonging to 31 botanical families (Table 3); five species of spider mites were recorded on undetermined plant families. Eight species could not be identified due to the low number of individuals: *Aponychus* sp., collected on *Helicteres brevispira* A. Juss. (Sterculiaceae) in Sales; *Eotetranychus* sp. on *Celtis* sp. (Cannabaceae) in Barretos (Area 2); *Mononychellus* sp.1 on *Anadenanthera peregrina* var. *falcata* (Benth.) Altschul (Leguminosae) in Palestina (Area 2); *Mononychellus* sp.2 on *Croton urucurana* Baill. (Euphorbiaceae) in Matão; *Oligonychus* sp.1 on *Struthanthus* sp. (Loranthaceae) and *Strychnos brasiliensis* (Spreng.) Mart. (Loganiaceae) in S.J. do Rio Preto (Area 1); *Oligonychus* sp.2 on *Mabea fistulifera* Mart. (Euphorbiaceae) in S.J. do Rio Preto (Area 2); *Oligonychus* sp.3 on *Cupania vernalis* Cambess. (Sapindaceae) in Sto. Antônio do Aracanguá; and *Tetranychus* sp. on *Pyrostegia venusta* (Ker Gawl) Miers (Bignoniaceae) in União Paulista.

Tetranychidae Donnadieu

Bryobiinae Berlese

Hystrihonychini Pritchard & Baker

Genus *Monoceronychus* McGregor

Monoceronychus bambusicola Feres & Flechtman, 1995

Origin of the specimens examined — **S.J. do Rio Preto – Area 2:** *Bambusa* sp. (Poaceae): V-1990 (2♀), VI-1990 (7♀ and 2♂).

Previous records — Brazil.

Tetranychiiinae Berlese

Eurytetranychini Reck

Genus *Eutetranychus* Banks

Eutetranychus banksi (McGregor, 1914)

Origin of the specimens examined — **Barretos – Area 2:** *Trichilia casaretti* D. DC. (Meliaceae): X-2007 (6♀ and 1♂); **Nova Granada:** *Trichilia casaretti*: I-2008 (1♂); **Palestina – Area 2:** *Aspidosperma subincanum* Mart. ex A.DC. (Apocynaceae): VI-2008

TABLE 2: Tetranychid species recorded in 20 forest fragments in the Northwestern of the São Paulo State, Brazil.

TETRANYCHIDAE	Localities*																			
	BA1	BA2	BEB	MAC	MAT	NGR	NHO	PA1	PA2	PIN	PLA	SAL	STA	SJI	RP1	RP2	TAQ	TUR	UPA	VOT
BRYOBIINAE																				
Hystrichonychini																				
<i>Monoceronychus bambusicola</i>																X				
TETRANYCHIIINAE																				
Eurytetranychini																				
<i>Aponychus</i> sp.												X								
<i>Eutetranychus banksi</i>		X				X			X			X		X	X		X	X		
<i>Eutetranychus nomurai</i>			X																	
Tenuipalpoidini																				
<i>Tenuipalponychus tabebuiae</i>							X													X
Tetranychini																				
<i>Allonychus braziliensis</i>						X														
<i>Allonychus reisi</i>					X								X	X	X	X				
<i>Atrichoproctus uncinatus</i>		X	X		X	X	X	X	X	X	X				X	X	X	X	X	X
<i>Eotetranychus tremae</i>	X							X								X		X		
<i>Eotetranychus</i> sp.		X														X		X		
<i>Mononychellus mcgregori</i>					X											X	X			
<i>Mononychellus planki</i>													X							
<i>Mononychellus</i> sp.1									X											
<i>Mononychellus</i> sp.2					X															
<i>Neotetranychus asper</i>									X							X				
<i>Neotetranychus granifer</i>																X	X		X	
<i>Oligonychus gossypii</i>									X					X						
<i>Oligonychus longipenis</i>																	X			
<i>Oligonychus peronis</i>																	X			
<i>Oligonychus poutericola</i>																X				
<i>Oligonychus psidium</i>				X					X							X				
<i>Oligonychus punicae</i>																				X
<i>Oligonychus santoantoniensis</i>																	X			
<i>Oligonychus steinhaueri</i>																X				
<i>Oligonychus yotheri</i>						X						X	X					X		
<i>Oligonychus</i> sp.1																X				
<i>Oligonychus</i> sp.2																	X			
<i>Oligonychus</i> sp.3													X							
<i>Panonychus citri</i>					X															
<i>Schizotetranychus longirostris</i>																	X			
<i>Schizotetranychus paraelymus</i>																	X			
<i>Sonotetranychus angipenis</i>	X				X								X							
<i>Tetranychus armipenis</i>																X	X			
<i>Tetranychus ludeni</i>					X											X	X	X		
<i>Tetranychus mexicanus</i>		X	X		X	X	X	X	X	X		X	X	X			X	X		
<i>Tetranychus riopretensis</i>		X			X	X	X		X					X	X	X	X	X		
<i>Tetranychus urticae</i>																		X		
<i>Tetranychus</i> sp.																				X

*Localities: BA1: Barretos (Area 1); BA2: Barretos (Area 2); BEB: Bebedouro; MAC: Macauba; MAT: Matão; NGR: Nova Granada; NHO: Novo Horizonte; PA1: Palestina (Area 1); PA2: Palestina (Area 2); PIN: Pindorama; PLA: Planalto; SAL: Sales; STA: Sto. Antonio do Aracanguá; SJI: S. J. de Iracema; RP1: S. J. do Rio Preto (Area 1); RP2: S. J. do Rio Preto (Area 2); TAQ: Taquaritinga; TUR: Turmalina; UPA: União Paulista; VOT: Votuporanga.

TABLE 3: Richness of Tetranychidae mites by host plant.

Host Family	Host Species	Tetranychidae
Anacardiaceae	<i>Astronium</i> sp.	1
	<i>Myracrodruon urundeuva</i> Allemão	1
Annonaceae	<i>Annona</i> sp.	2
	<i>Xylopia aromatica</i> (Lam.) Mart.	3
Apocynaceae	<i>Aspidosperma subincanum</i> Mart. ex A. DC.	3
	<i>Tabernaemontana catharinensis</i> A. DC.	1
Arecaceae	<i>Acrocomia aculeata</i> (Jacq.) Lodd. ex Mart.	1
	<i>Syagrus</i> sp.	2
Asteraceae	<i>Vernonia</i> sp.	2
Bignoniaceae	<i>Arrabidaea</i> sp.	2
	<i>Handroanthus chrysotrichus</i> (Mart. ex DC.) Mattos	1
	<i>Pyrostegia venusta</i> (Ker Gawl) Miers	1
	<i>Tabebuia roseoalba</i> (Ridl.) Sandwith	1
	<i>Zeyheria montana</i> Mart.	1
Boraginaceae	<i>Cordia sellowiana</i> Cham.	1
Cannabaceae	<i>Celtis</i> sp.	2
Caryocaraceae	<i>Caryocar brasiliense</i> A.St.-Hil.	1
Convolvulaceae	<i>Ipomoea tubata</i> Nees	1
Dilleniaceae	<i>Dolioscarpus dentatus</i> (Aubl.) Standl.	2
Euphorbiaceae	<i>Actinostemon communis</i> (Müll. Arg.) Pax	2
	<i>Alchornea glandulosa</i> Poepp.	1
	<i>Croton floribundus</i> Spreng.	2
	<i>Croton urucurana</i> Baill.	2
	Euphorbiaceae spp.	2
	<i>Mabea fistulifera</i> Mart.	3
	<i>Pera glabrata</i> (Schott) Poepp. ex Baill.	1
Leguminosae	<i>Anadenanthera peregrina</i> var. <i>falcata</i> (Benth.) Altschul	1
	<i>Bauhinia forficata</i> Link	5
	<i>Bauhinia</i> sp.	2
	<i>Centrolobium tomentosum</i> Benth.	2
	<i>Copaifera langsdorffii</i> Desf.	1
	<i>Dipteryx alata</i> Vogel	1
	<i>Platypodium elegans</i> Vogel	1
	<i>Pterodon emarginatus</i> Vogel	3
	<i>Stryphnodendron adstringens</i> (Mart.) Coville	2
Loganiaceae	<i>Strychnos brasiliensis</i> (Spreng.) Mart.	1
Loranthaceae	<i>Struthanthus</i> sp.	1
Malpighiaceae	<i>Banisteria</i> sp.	1
	Malpighiaceae sp.	1
Malvaceae	<i>Sida</i> sp.	1
Melastomataceae	<i>Miconia</i> sp.	1
Meliaceae	<i>Guarea kunthiana</i> A. Juss.	1

TABLE 3: Continued.

Host Family	Host Species	Tetranychidae
	<i>Trichilia casaretti</i> C. DC.	3
	<i>Trichilia clausenii</i> C. DC.	1
Myrtaceae	<i>Psidium guajava</i> L.	1
Poaceae	<i>Bambusa</i> sp.*	4
Rosaceae	<i>Prunus myrtifolia</i> (L.) Urb.	1
Rubiaceae	<i>Guettarda uruguensis</i> Cham. & Schltdl.	2
	<i>Guettarda viburnoides</i> Cham. & Schltdl.	1
	<i>Psychotria</i> sp.	1
Rutaceae	<i>Zanthoxylum monogynum</i> A. St.-Hil.	1
	<i>Zanthoxylum rhoifolium</i> Lam.	1
Sapindaceae	<i>Cardiospermum grandiflorum</i> Sw.	2
	<i>Cupania vernalis</i> Cambess.	2
	<i>Dilodendron bipinnatum</i> Radlk.	1
	<i>Magonia pubescens</i> A. St.-Hil.	1
	<i>Matayba</i> cf. <i>guianensis</i>	1
	<i>Serjania</i> sp.	2
Siparunaceae	<i>Siparuna guianensis</i> Aubl.	1
Solanaceae	<i>Solanum paniculatum</i> L.	1
Sterculiaceae**	<i>Guazuma ulmifolia</i> Lam.	2
	<i>Helicteres brevispira</i> A. Juss.	1
	<i>Helicteres sacarolha</i> A. Juss.	1
	<i>Sterculia striata</i> St. Hil. & Naudin	2
Tiliaceae**	<i>Luehea speciosa</i> Willd.	1
	<i>Triumfetta</i> sp.	1
Verbenaceae	Verbenaceae sp.	1
Vochysiaceae	<i>Qualea grandiflora</i> Mart.	4
	<i>Qualea</i> sp.	1

*Introduced plant; **Currently Malvaceae

(1♂), III-2009 (5♀ and 5♂); **Sales:** *Annona* sp. (Annonaceae): VI-2007 (2♂), IX-2007 (3♀ and 1♂), III-2008 (2♀ and 1♂); **S. J. de Iracema:** *Sterculia striata* St. Hil. & Naudin (Sterculiaceae): XII-2007 (5♀ and 1♂); **S.J. do Rio Preto – Area 1:** two unidentified species of Euphorbiaceae: IV-1986 (9♀ and 7♂); *Luehea speciosa* Willd. (Tiliaceae): V-1986 (1♀), *Bauhinia forficata* Link (Leguminosae): VI-1990 (3♀ and 2♂); **Taquaritinga:** *Trichilia casaretti*: VII-2007 (1♂), X-2007 (3♀ and 2♂); **Turmalina:** *Acrocomia aculeata* (Jacq.) Lodd. ex Mart. (Arecaceae): IX-2008 (4♀); *Guazuma ulmifolia* Lam. (Sterculiaceae): VI-2007 (2♀); *Trichilia casaretti*: VII-2007 (1♀), *Zanthoxylum rhoifolium* Lam. (Rutaceae): IX-2008 (10♀ and 5♂).

Previous records — Cosmopolitan.

Eutetranychus nomurai
Flechtmann, 1997

Origin of the specimens examined — **Bebedouro:** *Syagrus* sp. (Arecaceae): VI-2008 (3♀ and 5♂), XII-2008 (4♀ and 6♂), III-2009 (1♂).

Previous records — Brazil.

Tenuipalpoidini Pritchard & Baker

Genus *Tenuipalponychus* Channabasavanna & Lakkund

Tenuipalponychus tabebuiae
(Flechtmann, 1971)

Origin of the specimens examined — **Novo Horizonte:** *Handroanthus chrysotrichus* (Mart. ex DC.) Mattos (Bignoniaceae): VI-2007 (2♀ and 1♂), XII-2007 (1♀ and 1♂), III-2008 (9♀ and 5♂); **Votuporanga (P3):** *Tabebuia roseoalba* (Ridl.) Sandwith (Bignoniaceae): VI-2007 (3♀ and 2♂), IX-2007 (3♀).

Previous records — Brazil and Costa Rica.

Tetranychini Reck

Genus *Allonychus* Pritchard & Baker

Allonychus braziliensis
(McGregor, 1950)

Origin of the specimens examined — **Nova Granada:** *Prunus myrtifolia* (L.) Urb. (Rosaceae): VI-2008 (21♀ and 5♂), IX-2008 (14♀ and 4♂).

Previous records — Brazil, Colombia, Cuba, Nicaragua and Venezuela.

Allonychus reisi
Paschoal, 1970

Origin of the specimens examined — **Matão:** *Croton floribundus* Spreng. (Euphorbiaceae): IX-2007 (17♀ and 10♂); **Sto. Antônio do Aracanguá:** *Cupania vernalis* Cambess. (Sapindaceae): VI-2007 (1♀), IX-2007 (1♀ and 1♂), III-2008 (13♀ and 6♂); **S. J. de Iracema:** *Sterculia striata*: VI-2007 (20♀ and 15♂); **S.J. do Rio Preto – Area 1:** *Banisteria* sp. (Malpighiaceae): VII-1990 (12♀ and 7♂); unidentified plant: VI-1990 (7♀ and 6♂), VII-1990 (7♀ and 4♂); **S.J. do Rio Preto – Area 2:** *Banisteria* sp.: V, VI, VII, IX-1988, IV, V, VI and VII-1990 (38♀ and 27♂); *Bauhinia forficata*: VI-1990 (2♀ and 1♂); *Xylopia aromatica* (Lam.) Mart. (Annonaceae): VI-1988 (5♀ and 1♂).

Previous records — Brazil and Colombia.

Genus *Atrichoproctus* Flechtmann

Atrichoproctus uncinatus
Flechtmann, 1967

Origin of the specimens examined — **Barretos – Area 2:** *Trichilia casaretti*: VII-2007 (2♀), X-2007 (2♀), I-2008 (1♀), IX-2008 (1♀), I-2009 (1♀); **Bebedouro:** *Matayba* cf. *guianensis* (Sapindaceae): IX-2008 (1♀); **Matão:** *Croton floribundus*: XII-2007 (1♀); *Cardiospermum grandiflorum* Sw. (Sapindaceae): XII-2008 (1♀), III-2009 (1♀), *Trichilia casaretti*: VII-2007 (3♀), X-2007 (7♀), I-2009 (2♀); **Nova Granada:** *Stryphnodendron adstringens* (Mart.) Coville (Leguminosae): VI-2008 (2♀); *Trichilia casaretti*: VII-2007 (5♀), I-2009 (2♀), IV-2009 (2♀); **Novo Horizonte:** *Trichilia casaretti*: X-2007 (1♀), I-2008 (1♀), VII-2008 (1♀), IX-2008 (2♀), I-2008 (2♀), IV-2008 (8♀); *Guettarda uruguensis* Cham.

& Schltdl. (Rubiaceae): III-2008 (5♀); **Palestina – Area 1:** *Xylopia aromatica*: VI-2008 (1♀); **Palestina – Área 2:** *Aspidosperma subincanum*: III-2009 (3♀); *Trichilia casaretti*: I-2008 (2♀), IV-2008 (1♀), VII-2008 (1♀), IX-2008 (3♀), I-2009 (1♀), IV-2009 (1♀); **Pindorama:** *Guarea kunthiana* A. Juss. (Meliaceae): IX-2008 (1♀); **Planalto:** *Bauhinia* sp. (Leguminosae): XII-2007 (1♀); *Pera glabrata* (Schott) Poepp. ex Baill. (Euphorbiaceae): VI-2007 (6♀), XII-2007 (4♀); **S. J. de Iracema:** *Trichilia casaretti*: VII-2007 (5♀), X-2007 (4♀), I-2008 (1♀), IV-2008 (2♀), VII-2008 (1♀), IX-2008 (2♀), IV-2009 (3♀); **S.J. do Rio Preto – Area 1:** *Serjania* sp. (Sapindaceae): IV and VI-1990 (7♀); *Bauhinia forficata*: V, VI and VII-1990 (5♀); **S.J. do Rio Preto – Area 2:** unidentified plant: X-1986 (2♀), *Bauhinia forficata*: V-1990 (1♀); *Serjania* sp.: VI-1990 (7♀); **Taquaritinga:** *Trichilia casaretti*: I-2008 (1♀), I-2009 (2♀); **Turmalina:** *Dilodendron bipinnatum* Radlk. (Sapindaceae): III-2008 (1♀); *Trichilia casaretti*: X-2007 (1♀), I-2008 (1♀), VII-2008 (1♀), IX-2008 (1♀), I-2009 (1♀), IV-2009 (1♀); **Votuporanga:** *Magonia pubescens* A. St.-Hil. (Sapindaceae): III-2008 (1♀).

Previous records — Brazil, Colombia and Cuba.

Genus *Eotetranychus* Oudemans

Eotetranychus tremae DeLeon, 1957

Origin of the specimens examined — **Barretos – Area 1:** *Caryocar brasiliense* A.St.-Hil (Caryocaraceae): IX-2008 (1♂); **Palestina – Area 1:** *Myracrodruon urundeuva* Allemão (Anacardiaceae): VI-2008 (13♀ and 1♂), XII-2008 (5♂), III-2009 (3♀ and 1♂); **S.J. do Rio Preto – Area 2:** *Mabea fistulifera* Mart. (Euphorbiaceae): V, VI-1986, VI, VII, VIII-1988, I, II, IV, V, VI and VII-1990 (54♀ and 20♂); unidentified Malpighiaceae: V-1989 (1♂); unidentified plant: VI-1990 (7♂); **Turmalina:** *Astronium* sp. (Anacardiaceae): IX-2008 (2♀ and 1♂); *Guazuma ulmifolia*: VI-2007 (1♀), III-2008 (6♀ and 1♂), IX-2008 (7♀ and 1♂).

Previous records — Brazil, Colombia, Ecuador, Cuba, Honduras, Mexico, Nicaragua and USA.

Genus *Mononychellus* Wainstein

Mononychellus mcgregori (Flechtmann & Baker, 1970)

Origin of the specimens examined — **Matão:** *Cardiospermum grandiflorum*: IX-2008 (1♀); **S.J. do Rio Preto – Area 1:** *Bauhinia forficata*: VI-1990 (17♀ and 10♂); *Serjania* sp., VI-1990 (9♀ and 1♂); **S.J. do Rio Preto – Area 2:** *Bauhinia forficata*: VII-1987, IV, V, VI and VII-1990 (13♀ and 13♂); *Vernonia* sp. (Asteraceae): IV-1989 (2♂).

Previous records — Argentina, Brazil, Colombia, Trinidad and Tobago and Venezuela.

Mononychellus planki (McGregor, 1950)

Origin of the specimens examined — **Sto. Antônio do Aracanguá:** *Pterodon emarginatus* Vogel (Leguminosae): VI-2007 (1♀).

Previous records — Argentina, Brazil, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Guadeloupe, Honduras, Mexico, Paraguay, Puerto Rico, Trinidad and Tobago, USA and Venezuela.

Genus *Neotetranychus* Trägårdh

Neotetranychus asper Feres & Flechtmann, 2000

Origin of the specimens examined — **Palestina – Area 2:** *Aspidosperma subincanum*: VI-2008 (1♀); **S.J. do Rio Preto – Area 1:** *Alchornea glandulosa* Poepp. (Euphorbiaceae): II 1989 (11♀ and 4♂), IV-1989 (8♂), V-1989 (3♀ and 2♂), VI-1989 (3♀), I-1990 (2♀ and 2♂), IV-1990 (4♀ and 3♂), V-1990 (5♀) VI-1990 (6♀ and 2♂), VII-1990 (2♀); **Turmalina:** *Actinostemon communis* (Müll. Arg.) Pax (Euphorbiaceae): VII-2007 (1♀).

Previous records — Brazil.

Neotetranychus granifer Feres & Flechtmann, 2000

Origin of the specimens examined — **S.J. do Rio Preto – Area 1:** *Bauhinia forficata*: VII-1990 (1♀); **S.J. do Rio Preto – Area 2:** *Bauhinia forficata*: V-1990 (10♀ and 8♂), VII-1990 (7♀ and 6♂).

Previous records — Brazil.

Genus *Oligonychus* Berlese

***Oligonychus gossypii*
(Zacher, 1921)**

Origin of the specimens examined — **Palestina – Area 2:** *Dipteryx alata* Vogel (Leguminosae): VI-2008 (5♀ and 5♂), IX-2008 (3♀ and 1♂); **Sto. Antônio do Aracanguá:** *Pterodon emarginatus*: VI-2007 (1♀), III-2008 (6♀ and 3♂).

Previous records — Angola, Benin, Brazil, Cameroon, Central Africa Republic, Colombia, Congo, Costa Rica, DR Congo, Ecuador, Ethiopia, Guinea-Bissau, Honduras, Kenya, Madagascar, Nigeria, San Tome and Principe, Senegal, Sierra Leone, Tanzania, Togo, Uganda and Venezuela.

***Oligonychus longipenis*
Feres & Flechtmann, 1995**

Origin of the specimens examined — **S.J. do Rio Preto – Area 2:** *Qualea grandiflora* Mart. (Vochysiaceae): VI-1990 (2♀ and 2♂).

Previous records — Brazil.

***Oligonychus peronis*
Pritchard & Baker, 1955**

Origin of the specimens examined — **S.J. do Rio Preto – Area 2:** *Siparuna guianensis* Aubl. (Siparunaceae): VI-1989, V and VI-1990 (27♀ and 8♂); *Qualea grandiflora*: VI-1990 (2♂).

Previous records — Brazil, Costa Rica and Ecuador.

***Oligonychus poutericola*
Feres & Flechtmann, 1986**

Origin of the specimens examined — **S.J. do Rio Preto – Area 1:** *Zeyheria montana* Mart. (Bignoniaceae): VI-1990 (2♂).

Previous records — Brazil.

***Oligonychus psidium*
Estebanes & Baker, 1968**

Origin of the specimens examined — **Macaubal:** *Psidium guajava* L. (Myrtaceae): VI-2007 (4♀), IX-2007 (16♀ and 1♂), XII-2007 (1♀), III-2008 (11♀ and

2♂); *Qualea grandiflora*: VI-2007 (16♀ and 3♂), IX-2007 (4♀ and 1♂); **Palestina – Area 2:** *Qualea* sp. (Vochysiaceae): VI-2008 (6♀ and 1♂); **S.J. do Rio Preto – Area 1:** *Qualea grandiflora*: VI-1990 (2♀ and 1♂).

Previous records — Brazil, Colombia, Mexico and Venezuela.

***Oligonychus punicae*
(Hirst, 1926)**

Origin of the specimens examined — **União Paulista:** *Cordia sellowiana* Cham. (Boraginaceae): VI-2007 (2♀ and 3♂); *Mabea fistulifera*: III-2008 (10♀ and 6♂).

Previous records — Cosmopolitan.

***Oligonychus santoantoniensis*
Feres & Flechtmann, 1995**

Origin of the specimens examined — **S. J. do Rio Preto – Area 2:** *Bambusa* sp.: VI-1990 (3♀ and 1♂), VII-1990 (3♀ and 4♂).

Previous records — Brazil.

***Oligonychus steinhaueri*
Flechtmann & Baker, 1970**

Origin of the specimens examined — **S. J. do Rio Preto – Area 1:** unidentified plant: VI-1990 (19♀ and 4♂).

Previous records — Brazil.

***Oligonychus yothersi*
(McGregor, 1914)**

Origin of the specimens examined — **Nova Granada:** *Guettarda viburnoides* Cham. & Schltdl. (Rubiaceae): IX-2008 (1♀ and 2♂), XII-2008 (1♂); **Sales:** *Copaifera langsdorffii* Desf. (Leguminosae): III-2008 (4♀ and 2♂); **Sto. Antônio do Aracanguá:** *Doliocarpus dentatus* (Aubl.) Standl. (Dilleniaceae): IX-2007 (3♀ and 4♂); *Miconia* sp. (Melastomataceae): III-2008 (3♀ and 3♂); **Taquaritinga:** *Trichilia clausenii* C. DC. (Meliaceae): IX-2008 (11♀ and 3♂).

Previous records — Cosmopolitan.

Genus *Panonychus* Yokoyama

***Panonychus citri*
(McGregor, 1916)**

Origin of the specimens examined — **Matão:** *Croton urucurana* Baill. (Euphorbiaceae): III-2009 (1♀).

Previous records — Cosmopolitan.

Genus *Schizotetranychus* Trägårdh

***Schizotetranychus longirostris*
Feres & Flechtmann, 1995**

Origin of the specimens examined — **S. J. do Rio Preto – Area 2:** *Bambusa* sp.: IV-1990 (1♂), V-1990 (5♀ and 2♂), VI-1990 (5♀ and 2♂), VII-1990 (17♀ and 3♂).

Previous records — Brazil.

***Schizotetranychus paraelymus*
Feres & Flechtmann, 1995**

Origin of the specimens examined — **S. J. do Rio Preto – Area 2:** *Bambusa* sp.: XI-1989 (3♀), V-1990 (1♀), VI-1990 (1♀).

Previous records — Brazil.

**Genus *Sonotetranychus* Tuttle, Baker &
Abbatiello**

***Sonotetranychus angiopenis*
Feres & Flechtmann, 1995**

Origin of the specimens examined — **Barretos – Area 1:** *Platypodium elegans* Vogel (Leguminosae): VI-2008 (1♀ and 1♂), III-2009 (1♀); **Matão:** *Centrolobium tomentosum* Benth. (Leguminosae): XII-2007 (4♀ and 3♂); **Sto. Antônio do Aracanguá:** *Pterodon emarginatus*: VI-2007 (14♀ and 6♂), XII-2007 (3♀ and 1♂); **S. J. do Rio Preto – Area 1:** *Bauhinia* sp.: XI-1989 (12♀ and 6♂).

Previous records — Brazil.

Genus *Tetranychus* Dufour

***Tetranychus armipenis*
Flechtmann & Baker, 1970**

Origin of the specimens examined — **S. J. do Rio Preto – Area 1:** *Sida* sp. (Malvaceae): II-1985, IV, IX,

XI-1989, IV and V-1990 (47♀ and 19♂); **S. J. do Rio Preto – Area 2:** *Vernonia* sp.: IV-1989 (16♀ and 6♂).

Previous records — Argentina, Brazil and Venezuela.

***Tetranychus ludeni*
Zacher, 1913**

Origin of the specimens examined — **Matão:** *Centrolobium tomentosum*: VI-2007 (69♀ and 10♂), IX-2007 (20♀ and 7♂), XII-2007 (1♂); *Ipomoea tubata* Nees (Convolvulaceae): XII-2008 (2♀ and 1♂), III-2009 (2♀); **S. J. do Rio Preto – Area 1:** *Helicteres sacarolha* A. Juss. (Sterculiaceae): IV, IX-1989 and I-1990 (21♀ and 10♂); *Qualea grandiflora*: VI-1989 (3♀ and 2♂); **S. J. do Rio Preto – Area 2:** *Triumfetta* sp. L. (Tiliaceae): IV-1988 (4♀ and 7♂); *Arrabidaea* sp. (Bignoniaceae): VI-1989 (4♀ and 1♂); unidentified Verbenaceae: I-1990 (3♀ and 2♂); **Taquaritinga:** *Solanum paniculatum* L. (Solanaceae): IX-2008 (6♀ and 1♂).

Previous records — Cosmopolitan.

***Tetranychus mexicanus*
(McGregor, 1950)**

Origin of the specimens examined — **Barretos – Area 2:** *Celtis* sp. (Cannabaceae): VI-2008 (2♀), IX-2008 (1♂), III-2009 (3♀ and 1♂), *Trichilia casaretti*: VII-2007 (1♀ and 2♂), X-2007 (2♀ and 1♂), I-2008 (7♀ and 3♂), VII-2008 (4♀ and 2♂); **Bebedouro:** *Syagrus* sp.: VI-2008 (2♀), III-2009 (12♀ and 3♂); *Zanthoxylum monogynum* A. St.-Hil. (Rutaceae): VI-2008 (4♀), III-2009 (2♀ and 1♂); **Matão:** *Trichilia casaretti*: VII-2007 (1♂), X-2007 (3♀); **Nova Granada:** *Stryphnodendron adstringens*: IX-2008 (2); *Trichilia casaretti*: VII-2007 (1♀), X-2007 (4♀ and 1♂), I-2008 (2♀ and 1♂), IV-2008 (1♀), VII-2008 (24♀), IX-2008 (2♀ and 1♂), I-2009 (3♀ and 1♂); **Novo Horizonte:** *Guettarda uruguensis*: XII-2007 (7♀ and 3♂); *Trichilia casaretti*: VII-2007 (1♀), X-2007 (1♀ and 1♂), I-2008 (4♀ and 1♂), IV-2008 (1♀), VII-2008 (4♀ and 1♂), IX-2008 (1♀), I-2009 (2♀); **Palestina – Area 1:** *Xylopia aromatica*: VI-2008 (1♀ and 3♂), IX-2008 (3♀ and 3♂); **Palestina – Area 2:** *Trichilia casaretti*: VII-2007 (4♀), X-2007 (1♀), IV-2008 (1♀), VII-2008 (1♀ and 1♂), IX-2008 (1♀), I-2009 (1♀), IV-2009 (1♀ and 1♂); **Pindorama:** *Taber-*

naemontana catharinensis A. DC. (Apocynaceae): VI-2008 (3♀), IX-2008 (1♀ and 1♂); **Sales:** *Annona* sp.: XII-2007 (1♀ and 2♂), III-2008 (2♀ and 1♂); **Sto. Antônio do Aracanguá:** *Doliocarpus dentatus*: III-2008 (1♂); **S. J. de Iracema:** *Trichilia casaretti*: VII-2007 (2♀ and 2♂), X-2007 (76♀ and 14♂), I-2008 (4♀ and 3♂), IV-2008 (5♀ and 1♂), VII-2008 (2♀ and 1♂), IX-2008 (2♀ and 1♂); **Taquaritinga:** *Trichilia casaretti*: VII-2007 (4♀), X-2007 (1♀), IV-2008 (1♀), VII-2008 (2♀ and 1♂), IX-2008 (1♀), I-2009 (1♀), IV-2009 (1♀ and 1♂); **Turmalina:** *Psychotria* sp. (Rubiaceae): IX-2007 (2♀ and 6♂); *Trichilia casaretti*: VII-2007 (3♀ and 1♂), X-2007 (16♀ and 7♂), I-2008 (1♀), VII-2008 (2♀), IX-2008 (14♀ and 1♂).

Previous records — Argentina, Brazil, Colombia, Costa Rica, Cuba, El Salvador, Guadeloupe, Honduras, Mexico, Nicaragua, Paraguay, Peru, Uruguay, USA and Venezuela.

Tetranychus riopretensis
Feres & Flechtmann, 1996

Origin of the specimens examined — **Barretos – Area 2:** *Actinostemon communis*: VII-2007 (2♀ and 3♂), X-2007 (192♀ and 77♂), I-2008 (1♀), IX-2008 (192♀ and 52♂); **Matão:** *Actinostemon communis*: X-2007 (3♀ and 2♂); **Nova Granada:** *Actinostemon communis*: X-2007 (8♀ and 3♂), I-2008 (3♀ and 1♂), VII-2008 (1♀), IX-2008 (5♀ and 1♂), I-2009 (1♂); **Novo Horizonte:** *Actinostemon communis*: X-2007 (3♀), IV-2007 (1♀), IX-2007 (1♀), I-2009 (1♀); **Palestina – Area 2:** *Actinostemon communis*: X-2007 (4♀), I-2008 (2♀ and 2♂), IX-2008 (3♀ and 6♂); **S. J. de Iracema:** *Actinostemon communis*: X-2007 (60♀ and 20♂), I-2008 (1♀), VII-2008 (3♀), IV-2009 (1♂) (64♀ and 21♂); **S. J. do Rio Preto – Area 1:** unidentified plant: XI-1985 (3♀ and 2♂), XI-1989 (1♀); **S. J. do Rio Preto – Area 2:** unidentified Euphorbiaceae: XI-1989 and IV-1990 (7♀ and 5♂), **Taquaritinga:** *Actinostemon communis*: X-2007 (1♀ and 2♂); **Turmalina:** *Actinostemon communis*: VII-2007 (1♀ and 3♂), X-2007 (55♀ and 67♂), I-2008 (4♀ and 1♂), VII-2008 (1♀), IX-2008 (25 and 26) (86♀ and 97♂).

Previous records — Brazil.

Tetranychus urticae
Koch, 1836

Origin of the specimens examined — **S. J. do Rio Preto – Area 2:** *Arrabidaea* sp.: VI, XI-1986, I, IV, V and VI-1990 (46♀ and 24♂).

Previous records — Cosmopolitan.

DISCUSSION

A large number of tetranychid species was recorded in forest fragments in the Northwestern São Paulo State. Despite the worrying situation of the remaining forests of the region, the diversity of mites Tetranychidae family recorded in this study was high. One reason for this may be the diversity of plants of the region. Ranga *et al.* (2012) reported 468 plant species in 18 forest fragments of the region (the same fragments analyzed during the second sampling period of this study). Of these species, 27 are considered threatened (vulnerable or endangered). In addition to the Tetranychidae family, these same fragments sampled in the second sampling period harbored several members of other families, including Tarsonemidae (52 species), Eriophyidae (51 species), Phytoseiidae (46 species) and Tenuipalpidae (20 species) (Demite *et al.*, 2011, 2012). In addition, the Northwestern region of the State of São Paulo is the type locality of nine species of Tetranychidae (*Monoceronychus bambusicola*, *Neotetranychus asper*, *Neotetranychus granifer*, *Oligonychus longipenis*, *Oligonychus santoantoniensis*, *Schyzotetranychus longirostris*, *S. paraelymus*, *Sonotetranychus angiopenis* and *Tetranychus riopretensis*) (Feres and Flechtmann, 1995a, b, 1996, 2000), and some of these species have never been recorded elsewhere. The region is also the type locality of species of Bdellidae, Cunaxidae, Phytoseiidae, Stigmaeidae, Tarsonemidae and Tenuipalpidae (Castro & Feres, 2013; Castro *et al.*, 2015; Demite *et al.*, 2007, 2008a, b, 2009, 2011; Den Heyer and Castro, 2009; Feres and Hernandez, 2006; Hernandez and Feres, 2005, 2006; Lofego and Feres, 2006a, b, Lofego *et al.*, 2011). However, our results show a great disparity regarding the frequency of the mites species. Two species were very abundant and found more than 10 times, i.e. in more than 50% of the samples on

a variety of plant species: *A. uncinatus* and *T. mexicanus*. *Tetranychus riopretensis* was also often found but only on one plant species. In a lesser extent *E. banksi* was relatively abundant. Among these frequent species, only *T. mexicanus* and *E. banksi*, were recorded on plants of economic interest, in some cases causing damage to crops. Other species of spider mites also registered on crops, such as *Mononychelus planki*, *Panonychus citri* and *Tetranychus ludeni* were recorded in a few areas and/or plants. *Tetranychus urticae*, which is often recorded causing damage on economically important plants (Moraes and Flechtmann, 2008) was registered only on a single host in this study.

Some papers reported the occurrence of spider mites on both native, cultivated and ornamental plants in the Northwestern of São Paulo State (Bellini *et al.*, 2005a, b, 2008; Buosi *et al.*, 2006; Daud and Feres, 2005; Daud *et al.*, 2007, 2010; Demite and Feres, 2005; Feres, 2000; Feres & Flechtmann, 1995c; Feres and Nunes, 2001; Feres *et al.*, 2002, 2003, 2005, 2009, 2010; Nuvoloni *et al.*, 2011). All but two species identified nominally registered in these studies were recorded in the present study: *Oligonychus zeae* (McGregor), recorded in a native plant in São José do Rio Preto municipality (Feres *et al.*, 2005) and *Oligonychus pratensis* (Banks) registered on two species of ornamental plants in Ilha Solteira municipality (Feres *et al.*, 2009).

Despite the great importance of this family, few studies have focused on the occurrence of spider mites on native plants in Brazil, with the exception of papers bringing species descriptions. Flechtmann and Baker (1970) reported 35 spider mite species on native and cultivated plants for the Brazil. Aranda (1974) reported 12 spider mite species on native plants of one area of Cerrado of São Paulo State.

In addition to the importance of knowing the richness of spider mites on native plants, know the plants that can serve as alternate hosts or plant-trap can help understand the dynamics of these mites in agroecosystems.

Forest fragments located in the Northwestern region of São Paulo State harbor a high richness of Tetranychidae mites, as well as other families, as

seen in studies published. Many of these species are scarce and found on a small number of plant species and a small number of localities. Therefore, conducting survey studies of mite (phytophagous and predators) in natural environments is important and should be encouraged as many species may remain undiscovered. Thus conserving these few and valuable fragments is important for the conservation of native species of mites, both those already known and those that may still be discovered.

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