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Article

Mite fauna (Acari) associated with apple orchards (*Malus domestica*) and spontaneous vegetation as reservoir for predatory mites

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Abstract: The aim of this study was to recognize the mite fauna associated with apple orchards in southern Brazil and present a dichotomous key of the species sampled and those already reported in apple trees in southern Brazil. The studies were carried out in the 2020/2021 harvest in seven apple orchards of the Eva, Fuji and Gala cultivars located in the municipalities of Muitos Capões, Antônio Prado (Rio Grande do Sul state) and São Joaquim (Santa Catarina state). The orchards were divided into quadrants and sampling was carried out monthly. In each orchard, 40 plants were sampled, with three leaves of each plant collected in apical, median and basal regions of a median branch. In addition, monthly five species of spontaneous plants per orchard were sampled. A total of 8,425 mites were found, with the greatest abundance in Antônio Prado (50%), followed by Muitos Capões (35.5%) and São Joaquim (14.5%). The specimens found belong to 29 families, 64 genera and 99 species, in addition to mites of the order Oribatida. The greatest diversity was found in spontaneous vegetation (59 species), being 19 exclusives to apple trees and 21 species common to apple trees and spontaneous vegetation. Phytoseiidae was the family that presented the greatest richness, with 16 species, of which seven were common in apple trees and spontaneous plants. The most abundant species was *Aculus schlechtendali* Nalepa (Eriophyidae) (39.5%), followed by *Panonychus ulmi* (Koch) (Tetranychidae) (14.6%), *Polyphagotarsonemus latus* (Banks) (Tarsonemidae) (9.4%) and *Neoseiulus californicus* (McGregor) (Phytoseiidae) (7.4%). These results suggest that the mite fauna present in apple orchards in different landscapes and management are distinct, with a greater diversity of phytoseiid mites present in organic areas. Therefore, to maintain a greater diversity of predatory mites in these orchards, organic management seems to be the most appropriate. Furthermore, the high acarine diversity found in spontaneous vegetation demonstrates the importance of maintaining these plants in orchards that serve as refuges and reservoirs, favoring the permanence of natural enemies in these environments.
Keywords: *Aculus schlechtendali; Eva; Fuji; Gala; Neoseiulus californicus; Panonychus ulmi.*

Acarofauna (Acari) associada a pomares de maçã (*Malus domestica*) e vegetação espontânea como reservatório de ácaros predadores

Resumo: O objetivo deste estudo foi reconhecer a acarofauna associada a pomares de macieira no sul do Brasil e apresentar uma chave dicotômica das espécies amostradas e daquelas já relatadas em macieiras no sul do Brasil. Os estudos foram realizados na safra 2020/2021 em sete pomares de macieiras das cultivares Eva, Fuji e Gala localizados nos municípios de Muitos Capões, Antônio Prado (RS) e São Joaquim (SC). Os pomares foram divididos em quadrantes e a amostragem foi realizada mensalmente. Em cada pomar foram amostradas 40 plantas, sendo três folhas de cada planta coletadas nas regiões apical, mediana e basal de um ramo mediano. Além disso, mensalmente foram amostradas cinco espécies de vegetação espontânea por pomar. Foram encontrados 8.425 ácaros, com maior abundância em Antônio Prado (50%), seguido por Muitos Capões (35,5%) e São Joaquim (14,5%). Os exemplares encontrados pertencem a 29 famílias, 64 gêneros e 99 espécies, além de ácaros da ordem Oribatida. A maior abundância foi encontrada em vegetação espontânea (59 espécies), sendo 19 exclusivas de macieiras e 21 espécies comuns a macieiras e vegetação espontânea. Phytoseiidae foi a família que apresentou maior riqueza, com 16 espécies, das quais sete eram comuns em macieiras e vegetação espontânea. A espécie

mais abundante foi *Aculus schlechtendali* Nalepa (Eriophyidae) (39,5%), seguida por *Panonychus ulmi* (Koch) (Tetranychidae) (14,6%), *Polyphagotarsonemus latus* (Banks) (Tarsonemidae) (9,4%) e *Neoseiulus californicus* (McGregor) (Phytoseiidae) (7,4%). Esses resultados sugerem que a acarofauna presente em pomares de macieira em diferentes paisagens e manejos são distintas, com maior diversidade de ácaros fitoseídeos presentes em áreas orgânicas. Portanto, para manter uma maior diversidade de ácaros predadores nesses pomares, o manejo orgânico parece ser o mais adequado. Além disso, a elevada diversidade de ácaros encontrada na vegetação espontânea demonstra a importância da manutenção destas plantas em pomares que servem como refúgios e reservatórios, favorecendo a permanência de inimigos naturais nestes ambientes.
Palavras-chave: *Aculus schlechtendali; Eva; Fuji; Gala; Neoseiulus californicus; Panonychus ulmi.*

Introduction

Brazil is among the largest apple producers (*Malus domestica* Borkh: Rosaceae) in the world (Kist et al. 2019), with cultivation concentrated in the highest regions of the states of Santa Catarina and Rio Grande do Sul, largest producers, followed by Paraná (Kist et al. 2019). There is a significant number of apple cultivars, with Gala and Fuji being the most important, but more recent cultivars, such as Eva, have achieved relevance in national production (Kist et al. 2019).

Conventional agriculture is widely used in several cultures due to its high productivity, but it presents risks that include loss of biodiversity, environmental pollution and risk to human health (Gomiero et al. 2011, Campbell et al. 2017). Aiming at sustainable development and better use of natural resources (Walker et al. 2017, Zhu et al. 2018, Willet et al. 2019) the organic agriculture system has stood out in several countries (Gomiero et al. 2011, Smith-Spangler et al. 2012, Caprio et al. 2015, Gomiero 2018). Pesticide spraying has been the main criterion used to differentiate organic from conventional management (Sumberg & Giller 2022). Another alternative to conventional agriculture is regenerative agriculture, which seeks to improve soil protection, not using machinery and maintaining cover with spontaneous or non-spontaneous vegetation (The Soil Association, 2021), if necessary, this system allows the use of pesticides for pest control in the Integrated Pest Management.

Landscape management can contribute to the sustainable control of pest species, as the composition of the environment can directly affect the abundance of a herbivore, affecting its dispersal, mortality or reproduction, or indirectly, affecting its natural enemies (Veres et al. 2013). Spontaneous growth vegetation occurs associated with orchards, usually between the rows of trees and can be native or exotic, with natural germination and rapid growth (Lykouressis et al. 2008, Diehl et al. 2012). The morphology of some of these plants consists of trichomes, domatia and nectaries, which are beneficial structures for the plant and offer refuge, a safe place for oviposition and provide alternative foods such as pollen and nectar to mite species (Agrawal & Karban 1997, Ferla & Moraes 2002, Prischmann & James 2003, Matos et al. 2006, Duso et al. 2010). Certain plants, associated with orchards, play an important ecological role as they host species that help in the biological control of agricultural pests, as they naturally migrate from this spontaneous vegetation to the main crop of the orchard (Tixier et al. 2000, Altieri 2002, Kreiter et al. 2003, Lykouressis et al. 2008, Ji et al. 2022).

The indiscriminate use of pesticides in orchards can lead to a reduction in natural enemies and, consequently, to an increase in the population of phytophagous mites, causing economic losses (Van Leeuwen & Dermauw 2016, Walker et al. 2017, Schmidt-Jeffris & Beers 2018). Mites of the suborders Prostigmata and Mesostigmata are of greatest agricultural economic importance (Evans 1992). Among the Prostigmata they were the phytophagous of the families Eriophyidae, Tarsonemidae, Tenuipalpidae and Tetranychidae, and the predators Stigmaeidae (Jeppson et al. 1975), respect to Mesostigmata, Phytoseiidae stood out (McMurtry et al. 2013, 2015, Demite et al. 2014). Eriophyidae and Tetranychidae are phytophagous mites found associated with apple orchards (Ferla et al. 2018, Nascimento et al. 2020). Among these stand out *Panonychus ulmi* (Koch), *Tetranychus urticae* Koch (Tetranychidae) and *Aculus schlechtendali* Nalepa (Eriophyidae) (Ferla et al. 2018, Nascimento et al. 2020, Kasap & Atlihan 2021, Corrêa et al. 2021, Silva et al. 2022). The record of the presence of *A. schlechtendali* in southern Brazil serves as a warning for the apple production chain, as it is a species of quarantine importance present in Brazil (Ferla et al. 2018, Nascimento et al. 2020, Corrêa et al. 2021, Silva et al. 2022).

The study of the diversity and seasonality of mite populations associated with plants is of great importance for the advancement of biological control methods for pests in agroecosystems and for the assessment of damage caused and biological changes in these habitats. The aim of this study was to recognize the mite fauna associated with apple orchards, in southern Brazil as well as to perform a dichotomous key with the species associated with these orchards and those already reported in previous works carried out in the same region.

Materials and Methods

1. Study area

The studies were carried out in the 2020/2021 season in seven apple orchards of the Eva, Fuji and Gala cultivars located in the municipalities of Muitos Capões (28°23’23”S 51°15’12”W) and Antônio Prado (28°22 ‘44”S 49°56’12”W), state of Rio Grande do Sul and São Joaquim (28°53’23”S 51°23’06”W), state of Santa Catarina (Figure 1).

1.1. Antônio Prado

Three organic orchards of Eva, Fuji and Gala cultivars were evaluated. To control herbivores, Bordeaux mixture, lime sulfur, neem oil and Cera Trap® attractant were used. Spontaneous vegetation was maintained, and mowing was only carried out when there was a need to move. In these orchards, the soil cover was preserved, with the presence of spontaneous vegetation, such as grasses and weeds, in association with litter maintained in the area.

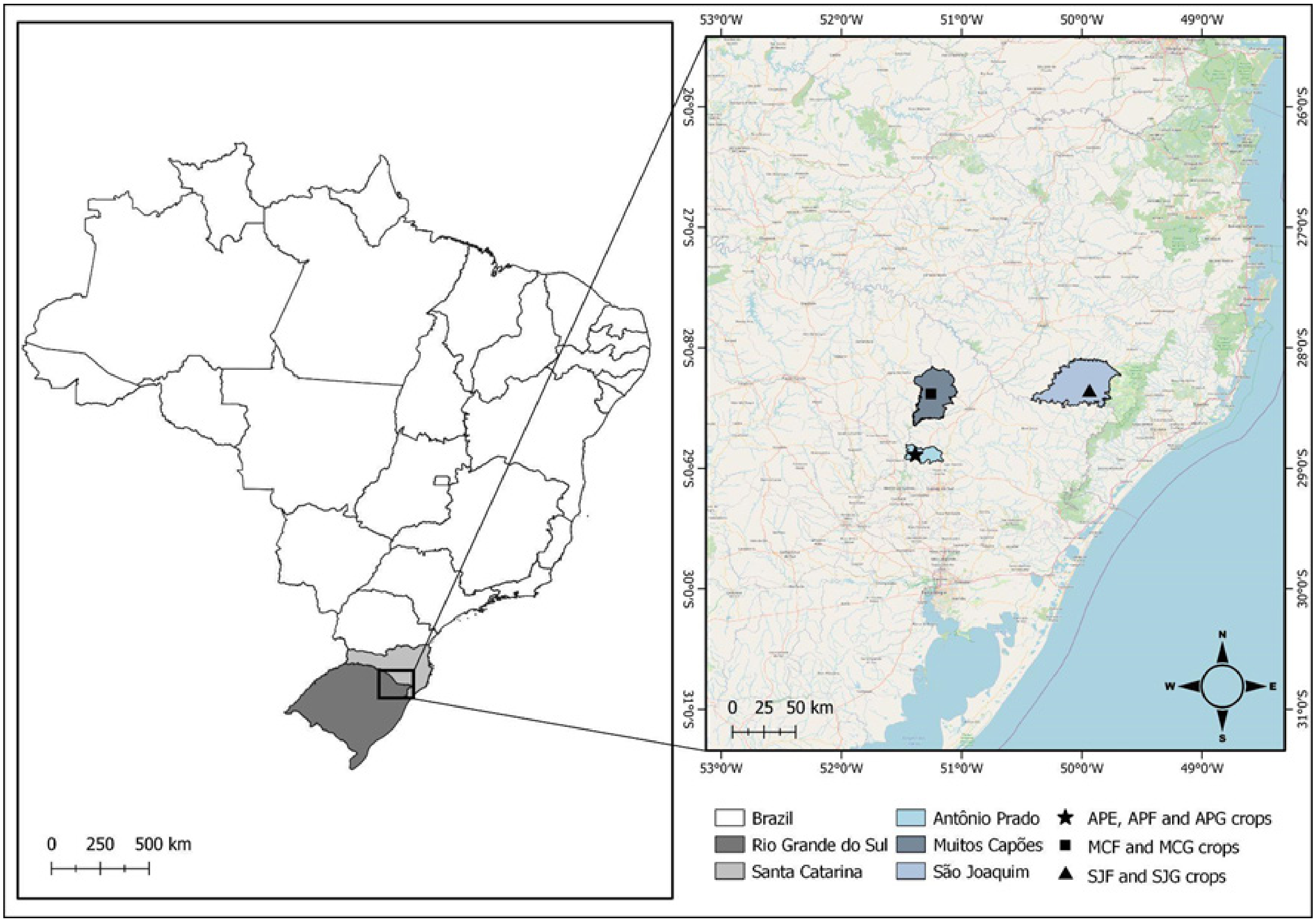

Figure 1. Collection points in apple-producing regions in the municipalities of Antônio Prado and Muitos Capões, Rio Grande do Sul, and São Joaquim, Santa Catarina, Brazil. Authorship: Castro, I. S.

1.2. Muitos Capões

Two conventional orchards were evaluated, one Fuji and the other Gala. In both orchards, the soil was kept unprotected with the use of herbicides and weeding to control pests in the orchards, as well as the spraying of pesticides to control pests.

1.3. São Joaquim

Two orchards with regenerative agriculture were evaluated, one Fuji and the other Gala. In these orchards, the soil was kept covered by spontaneous vegetation, grasses, in association with litter. Weeding was not carried out. Pigs, sheep and chickens were kept grazing throughout the area, feeding on weeds and aborted apple tree fruits. In these areas, when necessary, producers spray pesticides to control pests.

2. Sampling procedures

2.1. Apple tree plants

Samplings were carried out monthly from September 2020 to August 2021. The orchards were divided into quadrants and the sampled trees were marked to identify the origin of the sampled leaves. In each orchard, 40 plants were sampled, selected from the fifth row, counting from the edge, from which three leaves of a median branch of each plant in the apical, median and basal regions of the branch were detached, totaling 120 leaves/area. In the senescence period, branches were collected from the middle part of the plant and three buds selected from the apical, median and basal regions, totaling 120 buds/area. The material was individually packed in previously identified transparent plastic bags, kept at low temperature and taken to the Laboratory of Acarology (Labacari) of the University of Vale do Taquari – Univates, Lajeado, RS.

2.2. Spontaneous vegetation

Five species of spontaneous vegetation most frequent in each month, in the evaluated orchards, were collected in sufficient quantity for a sampling effort of one hour of screening (Diehl et al. 2012). The collected vegetation was packed separately in plastic bags identified with the name of the respective cultivar and the municipality of origin, stored in a styrofoam box with artificial ice (Gelox®) and immediately transported to Labacari.

3. Identification

3.1. Mite species

The material was examined with Leica S6E stereoscopic microscope, with a fine-tipped brush. The mites were mounted on microscope slides using Hoyer's medium (Jeppson et al. 1975) and kept in a stove at a temperature between 50 and 60 °C for approximately eight days, for medium drying, fixation and clarification of the specimens. Morphological identification was made with Zeiss Axio Scope A1 phase contrast optical microscope and proper bibliography (Baker & Tuttle 1994, Chant & McMurtry 1994, 2007, Amrine & Stasny 1994, Amrine et al. 2003, Fan & Zhang 2005, Johann et al. 2013, Skvarla et al. 2014, Silva et al. 2016). The species found in the study were deposited in the Reference Collection of Mites of the Museum of Science Univates (Sisgen: A8302CB and Sisgen: A05CB2A).

3.2. Spontaneous vegetation species

After sampling, a sample of each vegetation sampled was mounted on a specimen sheet for identification with specific bibliography (Moreira & Bragança 2011, Lorenzi 2014). Family determination was based on Angiosperm Phylogeny Group IV systems (APG IV, 2016).

4. Dichotomous key

A dichotomous key was performed with species sampled in this work and those already reported on apple trees (*Malus* spp.) from Brazil (Figueiredo 1950, Flechtmann 1966, Lorenzato et al. 1986, Lorenzato 1987, Lorenzato & Sechi 1993, Flechtmann 1996, Ferla & Moraes 1998, Lin & Zhang 2002, Monteiro 2002, Moraes & Flechtmann 2007, Ferla & Botton 2008, Oliveira et al. 2010, Mineiro et al. 2015, Ferla et al. 2018). The key was based partially on Muma (1963), André (1980), Denmark (1982), Baker (1990), Baker and Tuttle (1994), Lofego (1998), Krantz and Walter (2009), Walter et al. (2009), Johann et al. (2013), Rocha et al. (2014), Beard et al. (2015), Rezende et al. (2015), Demite et al. (2016), Fan et al. (2016), Paktinat-Saeij et al. (2016), Silva et al. (2016), Johann et al. (2017), Silva et al. (2020) and Sousa et al. (2020).

Results

A total of 8,425 mites were found, of which 1,908 were present in spontaneous vegetation. The highest abundance was found in Antônio Prado (50%), followed by Muitos Capões (35.5%) and São Joaquim (14.5%). 26 families with 67 species of spontaneous vegetation were collected. Among the plant families, eight had mites (Table 1).

The mite specimens found belong to 29 families, 64 genera and 99 species. In addition, 684 mites belonging to the suborder Oribatida were found. The greatest diversity of mite species was found in spontaneous vegetation (59 species). 19 species were exclusive from apple trees, and

Table 1. Spontaneous vegetation in apple orchards in the municipalities of Muitos Capões, Antônio Prado, state of Rio Grande do Sul and São Joaquim, state of Santa Catarina, Brazil, assessed between August 2020 and September 2021. Eating habits: P = Predator, G = Generalist and F = Phytophagous.

Botanical family	Botanical species	Abundance of mites
AMARANTHACEAE	*Amaranthus deflexus*	–
	Iresine diffusa	–
APIACEAE	*Centella asiatica*	–
	Conium maculatum	–
	Daucus pusillus	–
APOCYNACEAE	*Oxypetalum* sp.	–
ARALIACEAE	*Hydrocotyle leucocephala*	–
ASTERACEAE	*Baccharis anomala*	17
	Baccharis dracunculifolia	–
	Baccharis sp.	–
	Baccharis trimera	–
	Bidens pilosa	50
	Chromolaena laevigata	69
	Conyza bonariensis	–
	Conyza canadensis	1
	Elephantopus mollis	154
	Gamochaeta americana	–
	Hypochaeris sp.	9
	Koanophyllon sp.	–
	Senecio brasiliensis	–
	Sonchus oleraceus	1
	Taraxacum officinale	4
	Vernonanthura sp.	1
	Vernonanthura tweediana	322

Continue...

Continuation

Botanical family	Botanical species	Abundance of mites
BRASSICACEAE	*Raphanus sativus*	8
CARYOPHYLLACEAE	*Stellaria media*	–
COMMELINACEAE	*Commelina erecta*	–
CONVOLVULACEAE	*Ipomoea alba*	–
	Ipomoea indivisa	–
	Ipomoea sp.	–
CUCURBITACEAE	*Sicyos* sp.	–
EUPHORBIACEAE	*Euphorbia heterophylla*	26
FABACEAE	*Trifolium pratense*	6
	Trifolium repens	42
	Vicia cracca	1
HYPERICACEAE	*Hypericum caprifoliatum*	–
LAMIACEAE	*Cantinoa mutabilis*	12
	Leonurus japonicus	–
MALVACEAE	*Sida* sp.	–
	Sida rhombifolia	6
OXALIDACEAE	*Oxalis* sp.	–
PLANTAGINACEAE	*Plantago australis*	624
POACEAE	*Axonopus affinis*	–
	Bromus catharticus	–
	Bromus unioloides	12
	Eragrostis plana	–
	Holcus lanatus	73
	Lolium multiflorum	190
	Paspalum dilatatum	17
	Paspalum pumilum	12
	Paspalum urvillei	20
	Sporobolus indicus	1
	Steinchisma hians	8
	Urochloa plantaginea	34
POLYGONACEAE	*Rumex obtusifolius*	–
PTERIDACEAE	*Adiantopsis chlorophylla*	45
ROSACEAE	*Acaena eupatoria*	42
RUBIACEAE	*Richardia brasiliensis*	10
	Richardia sp.1	–
	Richardia sp.2	–
SCROPHULARIACEAE	*Scoparia* sp.	1
	Veronica persica	8
SOLANACEAE	*Solanum americanum*	–
	Solanum pseudocapsicum	2
TALINACEAE	*Talinum paniculatum*	73
VERBENACEAE	*Lantana camara*	–
	Verbena litoralis	7
		1.908

21 species were common to apple trees and spontaneous vegetation. Phytoseiidae was the family with the greatest diversity, with 16 species, seven of them common in both apple trees and spontaneous vegetation. Tarsonemidae was the second-diversity family with 12 species, followed by Cunaxidae with seven species and Ologamasidae, Stigmaeidae, Tetranychidae and Tydeidae, with six species each. The most abundant species was *A. schlechtendali* (39.5%), followed by *P. ulmi* (14.6%), *P. latus* (9.4%) and *Neoseiulus californicus* (McGregor) (7.4%). Of these, *A. schlechtendali* was exclusive from apple trees and the other species were found both in apple trees and spontaneous vegetation. Among the spontaneous vegetation, *Plantago australis* Lam. (Plantaginaceae) was the species with the highest mite abundance (32.7%), with 56.9% generalists and 41.7% predators. The second species was *Vernonanthura tweediana* (Baker) H. Rob. (Asteraceae) (16.9%). Among the mites recorded, the highest abundance of predatory mites was on *V. tweediana* (51.9%).

Below, the mite species and its respective host plants, the municipality of origin of the samples, apple tree cultivar that was being cultivated in the orchard, month and year of collection and the number of specimens collected in parentheses.

Mesostigmata

Ascidae

Asca sp.1

Antônio Prado: EVA – *Elephantopus mollis* Kunth (Asteraceae) – I-2021 (1), IV-2021 (2), *Vernonanthura tweediana* (Baker) H. Rob. (Asteraceae) – IV-2021 (3). FUJI – *Elephantopus mollis* – II-2021 (1), III-2021 (2). GALA – *Hypochaeris* sp. (Asteraceae) – IX-2020 (1). Muitos Capões: FUJI – *Trifolium repens* L. (Fabaceae) – III-2021 (4). GALA – *Plantago australis* Lam. (Plantaginaceae) – V-2021 (2), *Vernonanthura tweediana* – V-2021 (2). São Joaquim: FUJI – *Lolium multiflorum* L. (Poaceae) – XI-2020 (5), *Plantago australis* – I-2021 (2), IV-2021 (2), V-2021 (8), VIII-2021 (1), *Verbena litoralis* Kunth (Verbenaceae) – IV-2021 (2). GALA – *Plantago australis* – I-2021 (10), III-2021 (1), VI-2021 (3).

Asca sp.2

Antônio Prado: EVA – *Vernonanthura tweediana* – V-2021 (1).

Asca sp.3

Antônio Prado: FUJI – *Malus domestica* Borkh (Rosaceae) – X–2020 (1).

Blattisociidae

Lasioseius sp.

Antônio Prado: FUJI – *Plantago australis* – IV-2021 (2). GALA – *Elephantopus mollis* – V-2021 (3), *Paspalum urvillei* Steud. (Poaceae) – I-2021 (1). Muitos Capões: FUJI – *Vernonanthura tweediana* – IV-2021 (2). GALA – *Plantago australis* – V-2021 (1). São Joaquim: FUJI – *Plantago australis* – XII-2020 (3), II-2021 (1), IV-2021 (1), *Trifolium repens* – XII-2020 (1), *Verbena litoralis* – IV-2021 (1). GALA – *Holcus lanatus* L. (Poaceae) – II-2021 (1).

Digamasellidae

Dendrolaelaps sp.

Antônio Prado: FUJI – *Plantago australis* – III-2021 (1). São Joaquim: FUJI – *Acaena eupatoria* Cham. & Schltdl. (Rosaceae) – V-2021 (2), *Lolium multiflorum* – III-2021 (1), *Plantago australis* – IV-2021 (2). GALA – *Plantago australis* – IV-2021 (3).

Laelapidae

Cosmolaelaps sp.1

Antônio Prado: EVA – *Elephantopus mollis* – III-2021 (1). FUJI – *Elephantopus mollis* – XII-2020 (2), *Lolium multiflorum* – XII-2020 (1), *Paspalum dilatatum* Poir. (Poaceae) – XI-2020 (1).

Cosmolaelaps sp.2

Antônio Prado: EVA – *Elephantopus mollis* – III-2021 (1). FUJI – *Steinchisma hians* (Elliott) Nash. (Poaceae) – V-2021 (1).

Gaeolaelaps aculeiferoides (Teng, 1982)

Hypoaspis (*Gaeolaelaps*) *aculeiferoides* Teng, 1982: 161.

Muitos Capões: GALA – *Urochloa plantaginea* (Link) R. D. Webster (Poaceae) – I-2021 (1).

Pseudoparasitus sp.

Muitos Capões: FUJI – *Lolium multiflorum* – IX-2020 (1).

Macrochelidae

Macrocheles sp.1

Antônio Prado: FUJI – *Plantago australis* – III-2021 (2). GALA – *Plantago australis* – III-2021 (1), VIII-2021 (1). Muitos Capões: GALA – *Urochloa plantaginea* – I-2021 (3).

Macrocheles sp.2

São Joaquim: FUJI – *Plantago australis* – V-2021 (1).

Macrocheles subbadius (Berlese, 1904)

Holostaspis subbadius Berlese, 1904: 264.

São Joaquim: FUJI – *Plantago australis* – V-2021 (1), GALA – III-2021 (1).

Melicharidae

Orolaelaps sp.1

Antônio Prado: EVA – *Adiantopsis chlorophylla* (Sw.) Fée (Pteridaceae) – VII-2021 (3), *Elephantopus mollis* – I-2021 (1), *Plantago australis* – IV-2021 (1). FUJI – *Elephantopus mollis* – III-2021 (1), *Lolium multiflorum* – VI-2021 (2), *Trifolium repens* – VI-2021 (1). GALA – *Elephantopus mollis* – V-2021 (4), *Lolium multiflorum* – X-2020 (4), *Paspalum pumilum* Nees. (Poaceae) – IX-2020 (3).

Orolaelaps sp.2

Antônio Prado: EVA – *Adiantopsis chlorophylla* – VII-2021 (1). FUJI – *Paspalum dilatatum* – XI-2020 (2).

Ologamasidae

Gamasiphis sp.

Antônio Prado: EVA – *Elephantopus mollis* – III-2021 (1). FUJI – *Elephantopus mollis* – III-2021 (1), *Paspalum dilatatum* – XI-2020 (2). GALA – *Lolium multiflorum* – IX–2020 (1). São Joaquim: FUJI – *Plantago australis* – VII-2021 (2).

Neogamasellevans ammonis Karg & Schorlemmer, 2009

Neogamasellevans ammonis Karg & Schorlemmer, 2009: 71–72

Antônio Prado: EVA – *Solanum pseudocapsicum* L. (Solanaceae) – IX-2020 (1). FUJI – *Conyza canadensis* (L.) Cronquist (Asteraceae) – X-2020 (1). GALA – *Paspalum urvillei* – II-2021 (1). Muitos Capões: GALA – *Bidens pilosa* L. (Asteraceae) – VI-2021 (1). São Joaquim: FUJI – *Lolium multiflorum* – III-2021 (1).

Neogamasellevans preendopodalis Loots & Ryke, 1967

Neogamasellevans preendopodalis Loots & Ryke, 1967: 14.

Muitos Capões: FUJI – *Lolium multiflorum* – X-2020 (1).

Ologamasus postpilus Karg & Schorlemmer, 2009

Ologamasus postpilus Karg & Schorlemmer, 2009: 77–78.

Antônio Prado: EVA – *Plantago australis* – VIII-2021 (1). FUJI – *Plantago australis* – VI-2021 (1). GALA – *Elephantopus mollis* – V-2021 (1).

Ologamasus margaridae Bizarro & Rode, 2023

Ologamasus margaridae Bizarro & Rode, 2023: 495–514.

Antônio Prado: FUJI – *Cantinoa mutabilis* (Rich.) Harley & J. F. B. Pastore (Lamiaceae) – VII-2021 (6), *Elephantopus mollis* – III-2021 (1), *Steinchisma hians* – V-2021 (1), *Plantago australis* – VI-2021 (2), *Paspalum dilatatum* – XI-2020 (8). GALA – *Elephantopus mollis* – V-2021 (1), *Hypochaeris* sp. – XII-2020 (2), *Lolium multiflorum* – X-2020 (1), *Paspalum dilatatum* – IX-2020 (1), III-2021 (4), *Trifolium repens* – VI-2021 (1), *Veronica persica* Poir. (Scrophulariaceae) – VIII-2021 (1). São Joaquim: GALA – *Holcus lanatus* – X-2020 (1), *Lolium multiflorum* – X-2020 (7), *Plantago australis* – X-2020 (1), VIII-2021 (2). FUJI – *Lolium multiflorum* – III-2021 (1), *Plantago australis* – I-2021 (1), III-2021 (1), V-2021 (2), VIII-2021 (1).

Ologamasus tuberculatus Bizarro & Rode, 2023

Ologamasus tuberculatus Bizarro & Rode, 2023: 495–514.

Antônio Prado: EVA – *Plantago australis* – III-2021 (2), IV-2021 (3). FUJI – *Elephantopus mollis* – III-2021 (3), *Lolium multiflorum* – VI-2021 (1), *Talinum paniculatum* (Jacq.) Gaertn. (Talinaceae) – VI-2021 (1). GALA – *Lolium multiflorum* – III-2021 (2), *Plantago australis* – VII-2021 (4), VIII-2021 (1), *Paspalum urvillei* – III-2021 (1), *Richardia brasiliensis* Gomes (Rubiaceae) – IV-2021 (1). Muitos Capões: FUJI – *Lolium multiflorum* – X-2020 (1). GALA – *Lolium multiflorum* – X-2020 (1), *Plantago australis* – V-2021 (1).

Pachylaelapidae

Zygoseius sp.

Antônio Prado: FUJI – *Plantago australis* – III-2021 (2).

Zygoseius furciger (Berlese, 1916)

Lasioseius (*Zygoseius*) *furciger* Berlese, 1916: 12: 19–67.

Antônio Prado: FUJI – *Cantinoa mutabilis* – VII-2021 (2). GALA – *Richardia brasiliensis* – IV-2021 (2). São Joaquim: FUJI – *Raphanus sativus* L. (Brassicaceae) – IX-2020 (1). GALA – *Holcus lanatus* – XII-2020 (1), *Plantago australis* – II-2021 (1), III-2021 (1). Muitos Capões: FUJI – *Lolium multiflorum* – VIII-2021 (1), *Plantago australis* – VIII-2021 (4).

Parasitidae

Eugamasus sp.1

Antônio Prado: GALA – *Hypochaeris* sp. – IX-2020 (2), *Paspalum pumilum* – IX-2020 (1). Muitos Capões: FUJI – *Trifolium repens* – III-2021 (1). São Joaquim: FUJI – *Plantago australis* – XII-2020 (1), III-2021 (1). GALA – *Plantago australis* – III-2021 (1).

Eugamasus sp.2

Antônio Prado: EVA – *Adiantopsis chlorophylla* – VII-2021 (1). FUJI – *Paspalum dilatatum* – XI-2020 (1).

Phytoseiidae

Amblyseius chiapensis De Leon, 1961

Amblyseius chiapensis De Leon, 1961: 85.

Antônio Prado: EVA – *Malus domestica* – III-2021 (1).

Amblyseius nicola Chant & Hansell, 1971

Amblyseius nicola Chant & Hansell, 1971: 714.

São Joaquim: FUJI – *Acaena eupatoria* – IX-2020 (1), *Lolium multiflorum* – I-2021 (3), *Plantago australis* – I-2021 (12). GALA – *Acaena eupatoria* – VIII-2021 (1), *Lolium multiflorum* – X-2020 (6), *Plantago australis* – I-2021 (16), II-2021 (1), IV-2021 (3).

Amblyseius vitis Ferla & Silva, 2009

Amblyseius vitis Ferla & Silva, 2009: 509–10.

Antônio Prado: EVA – *Taraxacum officinale* F. H. Wigg. (Asteraceae) – IX-2020 (2). FUJI – *Elephantopus mollis* – XII-2020 (1), *Paspalum dilatatum* – XI-2020 (1). GALA – *Lolium multiflorum* – X-2020 (1).

Arrenoseius gaucho Ferla, Silva & Moraes, 2010

Arrenoseius gaucho Ferla, Silva & Moraes, 2010: 15.

Antônio Prado: EVA – *Adiantopsis chlorophylla* – VII-2021 (6), *Elephantopus mollis* – I-2021 (2), II-2021 (1), III-2021 (8), IV-2021 (1), *Plantago australis* – IV-2021 (38), VIII-2021 (4), *Vernonanthura tweediana* – XII-2020 (2). FUJI – *Elephantopus mollis* – XII-2020 (11), II-2021 (1), III-2021 (6), *Lolium multiflorum* – XII-2020 (4), VI-2021 (4), *Plantago australis* – III-2021 (2), IV-2021 (3), *Paspalum urvillei* – I-2021 (1), *Talinum paniculatum* – VI-2021 (2), *Vernonanthura* sp. – XI-2020 (1). GALA – *Elephantopus mollis* – V-2021 (1), *Hypochaeris* sp. – XII-2020 (2), *Lolium multiflorum* – X-2020 (1), *Plantago australis* – VII-2021 (5), VIII-2021 (5), *Paspalum urvillei* – I-2021 (1), *Veronica persica* – VIII-2021 (1). São Joaquim: FUJI – *Bromus unioloides* H.B.K. (Poaceae) – X-2020 (2), *Holcus lanatus* – XII-2020 (1), *Plantago australis* – I-2021 (3), II-2021 (2), III-2021 (6), V-2021 (6), VI-2021 (2). GALA – *Acaena eupatoria* - XI-2020 (2), *Holcus lanatus* – XI-2020 (1), II-2021 (1), *Lolium multiflorum* – IX-2020 (1), I-2021 (2), III-2021 (2), *Plantago australis* – XII-2020 (1), I-2021 (3), II-2021 (2), III-2021 (2), *Raphanus sativus* – IX-2020 (6). Muitos Capões: FUJI – *Vernonanthura tweediana* – IV-2021 (2).

Arrenoseius sp.

Antônio Prado: EVA – *Adiantopsis chlorophylla* – VII-2021 (2), *Malus domestica* – IV-2021 (1), *Vernonanthura tweediana* – V-2021 (1). FUJI – *Elephantopus mollis* – III-2021 (1), *Lolium multiflorum* – VI-2021 (2), *Plantago australis* – III-2021 (2), IV-2021 (1), *Steinchisma hians* – V-2021 (1).

Euseius inouei (Ehara & Moraes, 1998)

Amblyseius (*Euseius*) *inouei* Ehara & Moraes, 1998: 59.

Antônio Prado: EVA – *Chromolaena laevigata* (Lam.) R. M. King & H. Rob. (Asteraceae) – III-2021 (3), *Malus domestica* – XI-2020 (6), XII-2020 (1), II-2021 (4), III-2021 (13), IV-2021 (12), V-2021 (1). FUJI – *Malus domestica* - XI-2020 (1). GALA - *Malus domestica* – XI-2020 (1).

Euseius mesembrinus (Dean, 1957)

Typhlodromus mesembrinus Dean, 1957: 165.

Antônio Prado: EVA – *Chromolaena laevigata* – I-2021 (1), II-2021 (1), III-2021 (28), *Malus domestica* – XII-2020 (3), I-2021 (14), II-2021 (3), III-2021 (4), IV-2021 (23), V-2021 (2).

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

Typhlodromus annectens De Leon, 1958: 75.

Antônio Prado: EVA – *Malus domestica* – I-2021 (1). GALA – *Malus domestica* – II-2021 (4), III-2021 (1), IV-2021 (4).

Metaseiulus (*Metaseiulus*) *eiko* (El-Banhawy, 1984)

Typhlodromus eiko El-Banhawy, 1984: 138.

Antônio Prado: EVA – *Malus domestica* – XII-2020 (3), I-2021 (1), II-2021 (4), V-2021 (3), *Vernonanthura tweediana* – III-2021 (4).

FUJI – *Malus domestica* – XII-2020 (1), I-2021 (1), III-2021 (2), IV-2021 (2). GALA – *Malus domestica* – I-2021 (4), II-2021 (10), III-2021 (1), VI-2021 (2), VIII-2021 (1).

Neoseiulus sp.

São Joaquim: GALA – *Plantago australis* – VIII-2021 (1).

Neoseiulus californicus (McGregor, 1954)

Neoseiulus californicus McGregor, 1954: 89.

Antônio Prado: EVA – *Malus domestica* – X-2020 (1), XII-2020 (3), II-2021 (3), FUJI – *Malus domestica* – X-2020 (1), I-2021 (3), III-2021 (1). GALA – *Malus domestica* – XII-2020 (1), I-2021 (7), II-2021 (3). Muitos Capões: FUJI – *Lolium multiflorum* – XI-2020 (1), *Malus domestica* – XII-2020 (6), I-2021 (27), II-2021 (31), III-2021 (66), IV-2021 (14), V-2021 (7), VI-2021 (10), *Plantago australis* – II-2021 (1), VI-2021 (1), V-2021 (1), *Vernonanthura tweediana* – V-2021 (16). GALA – *Bidens pilosa* – V-2021 (1), *Malus domestica* – XI-2020 (2), XII-2020 (8), I-2021 (85), II-2021 (37), III-2021 (36), IV-2021 (10), V-2021 (8), VI-2021 (7), *Vernonanthura tweediana* – IX-2020 (1), XII-2020 (12), V-2021 (1). São Joaquim: FUJI – *Lolium multiflorum* – III-2021 (6), *Malus domestica* – I-2021 (11), II-2021 (5), III-2021 (32), IV-2021 (7), V-2021 (8), *Plantago australis* – I-2021 (1), IV-2021 (4), V-2021 (1), *Verbena litoralis* – IV-2021 (1). GALA – *Acaena eupatoria* – IV-2021 (2), V-2021 (1), *Holcus lanatus* – II-2021 (1), *Lolium multiflorum* – III-2021 (21), V-2021 (1), *Malus domestica* – XII-2020 (1), II-2021 (18), III-2021 (47), IV-2021 (26), V-2021 (14), *Plantago australis* – IV-2021 (3), V-2021 (1).

Neoseiulus fallacis (Garman, 1948)

Iphidulus fallacis Garman, 1948: 13.

Antônio Prado: FUJI – *Malus domestica* – X-2020 (1).

Neoseiulus mumai (Denmark, 1965)

Cydnodromus mumai Denmark, 1965: 91.

Antônio Prado: FUJI – *Lolium multiflorum* – XI-2020 (1).

Neoseiulus tunus (De Leon, 1967)

Typhlodromips tunus De Leon, 1967: 29.

Antônio Prado: EVA – *Baccharis anomala* DC. (Asteraceae) – I-2021 (2), *Malus domestica* – I-2021 (1), II-2021 (2), III-2021 (3), IV-2021 (4). FUJI – *Malus domestica* – VI-2021 (1).

Phytoseius sp.

São Joaquim: GALA – *Plantago australis* – II-2021 (1).

Proprioseiopsis ovatus (Garman, 1958)

Amblyseius ovatus Garman, 1958: 78.

Antônio Prado: EVA – *Sporobolus indicus* (L.) R. Br. (Poaceae) – IV-2021 (1). FUJI – *Veronica persica* – VIII-2021 (1). Muitos Capões: FUJI – *Malus domestica* – XI-2020 (1). GALA – *Malus domestica* – I-2021 (1), *Plantago australis* – XII-2020 (1), V-2021 (2), *Vernonanthura tweediana* – XI-2020 (1), V-2021 (1). São Joaquim: FUJI – *Holcus lanatus* – II-2021 (3), *Plantago australis* – I-2021 (9), II-2021 (1). GALA – *Acaena eupatoria* – IV-2021 (1), V-2021 (1), *Lolium multiflorum* – III-2021 (1), *Plantago australis* – I-2021 (3).

Uropodina

Antônio Prado: GALA – *Lolium multiflorum* – X-2020 (1). Muitos Capões: GALA – *Urochloa plantaginea* – I-2021 (1).

Veigaiidae

Antônio Prado: GALA – *Paspalum pumilum* – IX-2020 (1).

Trombidiformes

Alycidae

Amphialycus (*Amphialycus*) *pentophthalmus* Zachvatkin, 1949

Amphialycus pentophthalmus Zachvatkin, 1949: 30: 292–97

Antônio Prado: FUJI – *Paspalum urvillei* – I-2021 (1).

Laminamichaelia sp.

Antônio Prado: FUJI – *Lolium multiflorum* – XII-2020 (1).

Cunaxidae

Armascirus sp.

Antônio Prado: GALA – *Elephantopus mollis* – V-2021 (1), *Plantago australis* – VII-2021 (1).

Cunaxoides lajeadensis Wurlitzer & Monjarás-Barrera, 2020.

Cunaxoides lajeadensis Wurlitzer et al. 2020: 402–07.

Antônio Prado: EVA – *Baccharis anomala* – I-2021 (1), *Vernonanthura tweediana* – X-2020 (1), III-2021 (4), IV-2021 (1).

Dactyloscirus sp.

Antônio Prado: FUJI – *Elephantopus mollis* – III-2021 (1).

Neocunaxoides ovatus Lin, 2003

Neocunaxoides ovatus Lin, Zhang & Ji, 2003: 103–05.

Antônio Prado: EVA – *Adiantopsis chlorophylla* – VII-2021 (1). FUJI – *Elephantopus mollis* – II-2021 (1), III-2021 (2), *Plantago australis* – V-2021 (3). GALA – *Elephantopus mollis* – V-2021 (1), *Plantago australis* – VII-2021 (2). Muitos Capões: FUJI – *Bidens pilosa* – V-2021 (1). GALA – *Vernonanthura tweediana* – V-2021 (2).

Pulaeus mormacensis Wurlitzer & Silva, 2021

Pulaeus mormacensis Wurlitzer et al. 2021: 1255–60.

Antônio Prado: FUJI – *Plantago australis* – IV-2021 (1). Muitos Capões: GALA – *Plantago australis* – V-2021 (1).

Rubroscirus grilloi Wurlitzer & Ferla, 2020

Rubroscirus grilloi Wurlitzer et al. 2020: 2228–33.

Muitos Capões: GALA – *Plantago australis* – XII-2020 (1).

Scutopalus tomentosus Rocha, Skvarla & Ferla, 2013

Scutopalus tomentosus Rocha et al. 2013: 39–42.

Antônio Prado: EVA – *Vernonanthura tweediana* V-2021 (1). FUJI – *Talinum paniculatum* – VI-2021 (1). GALA – *Elephantopus mollis* – V-2021 (1).

Eriophyidae

Aculus schlechtendali (Nalepa, 1890)

Phyllocoptes schlechtendali Nalepa, 1890: 99: 40–69.

Antônio Prado: EVA – *Malus domestica* – X-2020 (13), XI-2020 (457), XII-2020 (898), I-2021 (2), VIII-2021 (1). FUJI – *Malus domestica* – XII-2020 (46), I-2021 (36), II-2021 (3), VIII-2021 (1). GALA – *Malus domestica* – XII-2020 (17), I-2021 (206), II-2021 (100), VI-2021 (56). Muitos Capões: FUJI – *Malus domestica* – X-2020 (24), XI-2020 (12), XII-2020 (154), I-2021 (4), II-2021 (1), IV-2021 (24), VIII-2021 (5). GALA – *Malus domestica* – X-2020 (124), XI-2020 (424), XII-2020 (656), I-2021 (1), VIII-2021 (2). São Joaquim: FUJI – *Malus domestica* – I-2021 (1), III-2021 (4). GALA – *Malus domestica* – I-2021 (56), VI-2021 (1), VIII-2021 (1).

Erythraeidae

Leptus sp.

Antônio Prado: FUJI – *Plantago australis* – IV-2021 (2).

Eupodidae

Benoinyssus sp.1

Antônio Prado: EVA – *Elephantopus mollis* – III-2021 (3). FUJI – III-2021 (4), *Plantago australis* – III-2021 (1), *Richardia brasiliensis* – IV-2021 (1). GALA – *Euphorbia heterophylla* – III-2021 (2), *Plantago australis* – VII-2021 (1), VIII-2021 (1). Muitos Capões: FUJI – *Euphorbia heterophylla* – V-2021 (1), *Plantago australis* – VIII-2021 (1), *Trifolium repens* – IV-2021 (2). GALA – *Vernonanthura tweediana* – V-2021 (2). São Joaquim: GALA – *Plantago australis* – XI-2020 (1), IV-2021 (1).

Benoinyssus sp.2

Antônio Prado: GALA – *Malus domestica* – IV-2021 (1), VIII-2021 (1), *Paspalum urvillei* – III-2021 (1).

Eupodes sp.

Muitos Capões: GALA – *Bidens pilosa* – VI-2021 (1), *Plantago australis* – V-2021 (1).

Iolinidae

Pseudopronematulus sp.

Antônio Prado: EVA – *Baccharis anomala* – I-2021 (8), *Chromolaena laevigata* – III-2021 (1), *Malus domestica* – XI-2020 (2), XII-2020 (8), I-2021 (12), II-2021 (10), III-2021 (5), IV-2021 (3), *Paspalum urvillei* – II-2021 (1), *Vernonanthura tweediana* – III-2021 (3), IV-2021 (5). FUJI – *Malus domestica* – XI-2020 (3), IV-2021 (1), *Steinchisma hians* – V-2021 (2), *Talinum paniculatum* – VI-2021 (1). GALA – *Euphorbia heterophylla* – III-2021 (1), *Malus domestica* – XI-2020 (2), XII-2020 (1), I-2021 (1), II-2021 (2), III-2021 (2) – VI-2021 (1). Muitos Capões: FUJI – *Vernonanthura tweediana* – IV-2021 (1). GALA – *Bidens pilosa* – IV-2021 (4), *Euphorbia heterophylla* – IV-2021 (10), *Malus domestica* – I-2021 (1), III-2021 (1).

Scutacaridae

Scutacarus sp.

Antônio Prado: EVA – *Adiantopsis chlorophylla* – VII-2021 (1). São Joaquim: FUJI – *Plantago australis* – IV-2021 (1).

Stigmaeidae

Agistemus brasiliensis Matioli, Ueckermann & Oliveira, 2002

Agistemus brasiliensis Matioli, Ueckermann & Oliveira, 2002: 106.

Antônio Prado: EVA – *Baccharis anomala* – I-2021 (1), *Chromolaena laevigata* – I-2021 (1), III-2021 (3), *Malus domestica* – XI-2020 (3), XII-2020 (10), I-2021 (69), II-2021 (40), IV-2021 (50), V-2021 (3), *Vernonanthura tweediana* – III-2021 (29), IV-2021 (31), V-2021 (24). FUJI – *Malus domestica* – XI-2020 (1), XII-2020 (1), I-2021 (2), II-2021 (4), IV-2021 (2). GALA – *Elephantopus mollis* – V-2021 (1), *Malus domestica* – XII-2020 (1), IV-2021 (2), VI-2021 (12). Muitos Capões: FUJI – *Bidens pilosa* – IV-2021 (1), *Malus domestica* – II-2021 (1), IV-2021 (1), V-2021 (1), VI-2021 (10), *Plantago australis* – VI-2021 (17), *Vernonanthura tweediana* – IV-2021 (7). GALA – *Bidens pilosa* – IV-2021 (1), *Malus domestica* – II-2021 (1), III-2021 (3), IV-2021 (1), V-2021 (2), VI-2021 (17). São Joaquim: GALA – *Malus domestica* – III-2021 (1).

Agistemus floridanus Gonzalez, 1965

Agistemus floridanus Gonzalez, 1965: 42.

Antônio Prado: FUJI – *Malus domestica* – VI-2021 (3). GALA – *Malus domestica* – II-2021 (4). São Joaquim: FUJI – *Malus domestica* – I-2021 (1). GALA – *Malus domestica* – II-2021 (1).

Agistemus riograndensis Johann & Ferla, 2013

Agistemus riograndensis Johann et al. 2013: 247.

Antônio Prado: EVA – *Chromolaena laevigata* – II-2021 (2), *Elephantopus mollis* – IV-2021 (5), *Malus domestica* – II-2021 (30), III-2021 (123), IV-2021 (49), V-2021 (8). FUJI – *Malus domestica* – III-2021 (1), IV-2021 (5), V-2021 (1). GALA – *Malus domestica* – II-2021 (6), III-2021 (5), IV-2021 (6), V-2021 (10). Muitos Capões: FUJI – *Malus domestica* - III-2021 (2), V-2021 (3). GALA – *Euphorbia heterophylla* – V-2021 (4), *Malus domestica* – III-2021 (2), IV-2021 (9), *Plantago australis* – V-2021 (1), *Vernonanthura tweediana* – V-2021 (6). São Joaquim: FUJI – *Malus domestica* – III-2021 (3), IV-2021 (4), V-2021 (9). GALA – *Malus domestica* – III-2021 (4), IV-2021 (15), V-2021 (23), *Plantago australis* – IV-2021 (1), V-2021 (2).

Agistemus sp.

Antônio Prado: FUJI – *Malus domestica* – V-2021 (1).

Eustigmaeus segnis (Koch, 1836)

Caligonus segnis Koch, 1836: 5(10).

São Joaquim: FUJI – *Acaena eupatoria* – IV-2021 (1), V-2021 (1), *Plantago australis* – V-2021 (5). GALA – *Plantago australis* – V-2021 (1), VI-2021 (4). Muitos Capões: GALA – *Vernonanthura tweediana* – V-2021 (2).

Ledermuelleriopsis punctata Soliman, 1975

Ledermuelleriopsis punctata Soliman, 1975: 244.

Muitos Capões: FUJI – *Plantago australis* – IX-2020 (1).

Tarsonemidae

Daidalotarsonemus esalqi Rezende, Lofego & Ochoa, 2015

Daidalotarsonemus esalqi Rezende, Lofego & Ochoa, 2015: 436–41.

Antônio Prado: EVA – *Malus domestica* – III-2021 (1). Muitos Capões: GALA – *Malus domestica* – XI-2020 (1).

Daidalotarsonemus savanicus Rezende, Lofego & Ochoa, 2015

Daidalotarsonemus savanicus Rezende, Lofego & Ochoa, 2015: 441–46.

Antônio Prado: EVA – *Chromolaena laevigata* – III-2021 (4), *Malus domestica* – I-2021 (1), III-2021 (2), IV-2021 (6), *Vernonanthura tweediana* – IV-2021 (1).

Fungitarsonemus sp.

São Joaquim: FUJI – *Malus domestica* – V-2021 (1).

Polyphagotarsonemus latus (Banks, 1904)

Tarsonemus latus Banks, 1904: 55.

Antônio Prado: EVA – *Baccharis anomala* – I-2021 (1), *Malus domestica* – I-2021 (1), II-2021 (16). FUJI – *Malus domestica* – XII-2020 (62), I-2021 (72), II-2021 (54). GALA – *Malus domestica* – XII-2020 (2), I-2021 (302), II-2021 (278).

Rhynchotarsonemus sp.

Antônio Prado: EVA – *Malus domestica* – III-2021 (1).

Tarsonemus confusus Ewing, 1939

Tarsonemus confusus Ewing, 1939: 26.

Antônio Prado: EVA – *Malus domestica* – IV-2021 (5). Muitos Capões: FUJI – *Vernonanthura tweediana* – IV-2021 (10). São Joaquim: FUJI – *Malus domestica* – II-2021 (2).

Tarsonemus merus Lin & Zhang, 2002

Tarsonemus merus Lin & Zhang, 2002: 248.

Antônio Prado: EVA – *Malus domestica* – XI-2020 (1), XII-2020 (1), II-2021 (1), III-2021 (10), IV-2021 (3). FUJI – *Malus domestica* – VIII-2021 (9). GALA – *Malus domestica* – II-2021 (3), IV-2021 (4), VI-2021 (3), VIII-2021 (7). Muitos Capões: FUJI – *Lolium multiflorum* – IX-2020 (1), *Malus domestica* – III-2021 (1), *Plantago australis* – II-2021 (1), *Vernonanthura tweediana* – V-2021 (16). GALA – *Malus domestica* – IX-2020 (2), XI-2020 (1), II-2021 (1), III-2021 (2), VIII-2021 (1), *Sida rhombifolia* – VIII-2021 (2), *Vernonanthura tweediana* – XII-2020 (1). São Joaquim: FUJI – *Malus domestica* – IX-2020 (11), III-2021 (12), V-2021 (1), VI-2021 (10), VII-2021 (8), VIII-2021 (2). GALA – *Malus domestica* – IX-2020 (3), II-2021 (3), III-2021 (7), IV-2021 (9), V-2021 (3), VI-2021 (17), VII-2021 (7).

Tarsonemus waitei Banks, 1912

Tarsonemus waitei Banks, 1912: 96.

Antônio Prado: EVA – *Malus domestica* – XI-2020 (3), XII-2020 (25), I-2021 (3), III-2021 (2), IV-2021 (5). FUJI – *Malus domestica* – IV-2021 (3), VII-2021 (9), VIII-2021 (1). GALA – *Adiantopsis chlorophylla* – V-2021 (1), *Malus domestica* – XII-2020 (1), I-2021 (1), II-2021 (5), IV-2021 (2), VII-2021 (4), VIII-2021 (3). Muitos Capões: FUJI – *Malus domestica* – IX-2020 (1), XI-2020 (2), XII-2020 (3), IV-2021 (4), VII-2021 (1), VIII-2021 (2), *Scoparia* sp. – IX-2020 (1). GALA – *Malus domestica* – IX-2020 (1), X-2020 (1), XI-2020 (3), XII-2020 (1), II-2021 (4), VI-2021 (2), VIII-2021 (13). São Joaquim: FUJI – *Malus domestica* – IX-2020 (2), IV-2021 (3), VIII-2021 (1). GALA – *Malus domestica* – I-2021 (2), II-2021 (6), III-2021 (2), IV-2021 (3), VII-2021 (3).

Xenotarsonemus sp.1

Muitos Capões: FUJI – *Malus domestica* – IX-2020 (1), VIII-2021 (12).

Xenotarsonemus sp.2

Antônio Prado: EVA – *Vernonanthura tweediana* – III-2021 (1). FUJI – *Talinum paniculatum* – VI-2021 (25). Muitos Capões: FUJI – *Bidens pilosa* – V-2021 (3), *Lolium multiflorum* – XI-2020 (1), *Plantago australis* – IX-2020 (3), VIII-2021 (2), *Trifolium pratense* L. (Fabaceae) – VI-2021 (5), *Vernonanthura tweediana* – IV-2021 (18), V-2021 (2). GALA – *Plantago australis* – V-2021 (43), *Vernonanthura tweediana* – V-2021 (17). São Joaquim: FUJI – *Plantago australis* – II-2021 (2), IV-2021 (2), *Verbena litoralis* – IV-2021 (1), GALA – *Acaena eupatoria* – IV-2021 (1), *Lolium multiflorum* – III-2021 (1).

Xenotarsonemus sp.3

Antônio Prado: EVA – *Elephantopus mollis* – IV-2021 (1). Muitos Capões: GALA – *Plantago australis* – V-2021 (15), *Vernonanthura tweediana* – V-2021 (33).

Xenotarsonemus sp.4

Antônio Prado: EVA – *Elephantopus mollis* – IV-2021 (1), *Plantago australis* – IV-2021 (26), *Vernonanthura tweediana* – IV-2021 (2). GALA – *Plantago australis* – VII-2021 (2). São Joaquim: FUJI – *Acaena eupatoria* – VIII-2021 (1), *Plantago australis* – I-2021 (1), II-2021 (1), VI-2021 (7), *Verbena litoralis* – VII-2021 (2). GALA – *Plantago australis* – IV-2021 (2), V-2021 (1).

Tenuipalpidae

Brevipalpus sp.1

Antônio Prado: EVA – *Malus domestica* – I-2021 (1), III-2021 (2), IV-2021 (1). FUJI – *Malus domestica* – III-2021 (7), V-2021 (2). GALA – *Malus domestica* – XII-2020 (1), I-2021 (1), IV-2021 (4), V-2021 (1), VI-2021 (1). Muitos Capões: FUJI – *Malus domestica* – III-2021 (1). GALA – *Malus domestica* – V-2021 (1).

Brevipalpus sp.2

Antônio Prado: EVA – *Elephantopus mollis* – IV-2021 (1). Muitos Capões: FUJI – *Trifolium repens* – VI-2021 (2). GALA – *Bidens pilosa* – IV-2021 (33).

Tenuipalpus sp.

Antônio Prado: EVA – *Malus domestica* – I-2021 (1).

Tetranychidae

Aponychus mauritianum Ferla & Ferla, 2020

Aponychus mauritianum Ferla et al. 2020: 1069–73.

Muitos Capões: FUJI – *Plantago australis* – VI-2021 (9).

Mononychellus planki (McGregor, 1950)

Tetranychus planki McGregor, 1950: 300.

Antônio Prado: EVA – *Sida rhombifolia* – I-2021 (1).

Panonychus ulmi (Koch, 1836)

Tetranychus ulmi Koch, 1836: 11.

Antônio Prado: EVA – *Malus domestica* – I-2021 (1). FUJI – *Malus domestica* – XI-2020 (2), II-2021 (1), III-2021 (8), IV-2021 (4), V-2021 (3), VI-2021 (1). GALA – *Malus domestica* – III-2021 (8), IV-2021 (11), VI-2021 (2). Muitos Capões: FUJI – *Malus domestica* – XI-2020 (2), XII-2020 (13), I-2021 (33), II-2021 (10), III-2021 (36), IV-2021 (227), V-2021 (143), VI-2021 (42). GALA – *Malus domestica* – IX-2020 (2), X-2020 (1), XI-2020 (5), XII-2020 (11), I-2021 (40), II-2021 (58), III-2021 (11), IV-2021 (30), V-2021 (26), VI-2021 (11), *Trifolium repens* – V-2021 (1). São Joaquim: FUJI – *Malus domestica* – IX-2020 (1), XI-2020 (4), XII-2020 (5), I-2021 (326), II-2021 (2), III-2021 (1), V-2021 (1), VIII-2021 (5). GALA – *Acaena eupatoria* – I-2021 (1), *Malus domestica* – XI-2020 (2), XII-2020 (17), I-2021 (105), II-2021 (2), III-2021 (5), IV-2021 (1), V-2021 (1), VIII-2021 (2).

Tetranychus sp.1

Antônio Prado: EVA – *Chromolaena laevigata* – II-2021 (6), *Elephantopus mollis* – IV-2021 (1). GALA – *Trifolium pratense* – VI-2021 (1). Muitos Capões: FUJI – *Bidens pilosa* – IV-2021 (2).

Tetranychus urticae Koch, 1836

Tetranychus urticae Koch, 1836.

Antônio Prado: EVA – *Malus domestica* – XII-2020 (4), I-2021 (1), III-2021 (1). FUJI – *Malus domestica* – X-2020 (3), XII-2020 (6), I-2021 (3), II-2021 (1). GALA – *Malus domestica* – XII-2020 (1). Muitos Capões: GALA – *Malus domestica* – XII-2020 (1).

Triophtydeidae

Triophtydeus sp.

Antônio Prado: EVA – *Malus domestica* – I-2021 (1). GALA – *Malus domestica* – VIII-2021 (1).

Trombidiidae

Antônio Prado: FUJI – *Lolium multiflorum* – VI-2021 (1).

Tydeidae

Lorryia aberrans (Oudemans, 1932)

Tydeus aberrans Oudemans, 1932: 350.

São Joaquim: FUJI – *Malus domestica* – IX-2020 (2).

Lorrya parvireticuli Mondin, Nuvoloni & Feres, 2016

Lorrya parvireticuli Mondin, Nuvoloni & Feres, 2016: 475.

São Joaquim: FUJI – *Plantago australis* – I-2021 (1).

Pretydeus henriandrei Kaźmierski, 1996

Pretydeus henriandrei Kaźmierski, 1996: 173.

Antônio Prado: FUJI – *Malus domestica* – VIII-2021 (1).

Quasitydeus sp.

Antônio Prado: FUJI – *Malus domestica* – II-2021 (1), III-2021 (1).

Tydeus californicus (Banks, 1904)

Tetranychoides californicus Banks, 1904: 54.

Antônio Prado: EVA – *Baccharis anomala* – I-2021 (2), *Chromolaena laevigata* – II-2021 (1), III-2021 (17), *Malus domestica* – X-2020 (1), XI-2020 (1), I-2021 (23), II-2021 (12), III-2021 (31), IV-2021 (31), V-2021 (5), VII-2021 (1), *Plantago australis* – IV-2021 (2), *Sida rhombifolia* – I-2021 (1), *Vernonanthura tweediana* – X-2020 (1), III-2021 (4). FUJI – *Malus domestica* – IV-2021 (2), V-2021 (1), VI-2021 (2). GALA – *Malus domestica* – II-2021 (1), III-2021 (1), V-2021 (3), VI-2021 (2), VIII-2021 (2).

São Joaquim: FUJI – *Malus domestica* - III-2021 (1), IV-2021 (2), *Plantago australis* – V-2021 (1). GALA – *Malus domestica* – IV-2021 (1).

Tydeus manoi Silva, Rocha & Ferla, 2014

Tydeus manoi Silva et al. 2014: 504–06.

São Joaquim: FUJI – *Acaena eupatoria* – IX-2020 (1), V-2021 (5), VIII-2021 (2), *Plantago australis* – VI-2021 (8). GALA – *Acaena eupatoria* – VI-2021 (5), *Plantago australis* – VI-2021 (4).

Sarcoptiformes

Acaridae

Tyrophagus putrescentiae (Schrank, 1781)

Acarus putrescentiae Schrank, 1781: 552.

Antônio Prado: EVA – *Malus domestica* – IX-2020 (1), X-2020 (1), VII-2021 (5). FUJI – *Lolium multiflorum* – VI-2021 (1), *Malus domestica* – IX-2020 (1). Muitos Capões: FUJI – *Bidens pilosa* - IV-2021 (1), *Lolium multiflorum* – IX-2020 (1), *Malus domestica* – IX-2020 (4), XI-2020 (1), *Plantago australis* – VIII-2021 (1), *Trifolium repens* – X-2020 (2), IV-2021 (3). GALA – *Lolium multiflorum* – X-2020 (2), XII-2020 (3), *Malus domestica* – XI -2020 (1), *Vernonanthura tweediana* – XII -2020 (1). São Joaquim: FUJI – *Lolium multiflorum* – III-2021 (6), *Plantago australis* – I-2021 (1). GALA – *Holcus lanatus* – X-2020 (1), *Lolium multiflorum* – III-2021 (2), *Malus domestica* – VIII-2021 (2), *Plantago australis* – XI-2020 (1).

Histiostomatidae

Histiostoma sp.

São Joaquim: FUJI – *Plantago australis* – V-2021 (2).

Oribatida

Antônio Prado: EVA – *Adiantopsis chlorophylla* – VII-2021 (16), *Baccharis anomala* – I-2021 (2), *Elephantopus mollis* – I-2021 (5), II-2021 (2), III-2021 (17), IV-2021 (10), *Plantago australis* – IV-2021 (8), VIII-2021 (8), *Solanum pseudocapsicum* – IX-2020 (1), *Sida rhombifolia* – I-2021 (2), *Taraxacum officinale* – IX-2020 (2), *Vernonanthura tweediana* – X-2020 (1), XII-2020 (5). FUJI – *Cantinoa mutabilis* – VII-2021 (4), *Elephantopus mollis* – II-2021 (1), III-2021 (18), *Lolium multiflorum* – X-2020 (4), XI-2020 (1), XII-2020 (10), VI-2021 (14), *Plantago australis* – III-2021 (7), IV-2021 (6), VI-2021 (2), *Paspalum dilatatum* – XI-2020 (2), I-2021 (2), *Richardia brasiliensis* – IV-2021 (3), *Steinchisma hians* – V-2021 (3), *Talinum paniculatum* – VI-2021 (43), *Urochloa plantaginea* – V-2021 (1), *Veronica persica* – VIII-2021 (1). GALA – *Adiantopsis chlorophylla* – V-2021 (13), *Euphorbia heterophylla* – III-2021 (1), *Elephantopus mollis* – V-2021 (18), *Hypochaeris* sp. – IX-2020 (1), XII-2020 (1), *Lolium multiflorum* – IX-2020 (1), X-2020 (10), *Plantago australis* – VII-2021 (18), VIII-2021 (3), *Paspalum dilatatum* – III-2021 (2), *Trifolium repens* – I-2021 (3), *Richardia brasiliensis* – IV-2021 (3), *Urochloa plantaginea* – I-2021 (28), *Veronica persica* – VIII-2021 (2). Muitos Capões: FUJI – *Bidens pilosa* – V-2021 (1), *Euphorbia heterophylla* – V-2021 (3), *Lolium multiflorum* – X-2020 (16), *Plantago australis* – IX-2020 (2), XII-2020 (1), II-2021 (2), V-2021 (10), VIII-2021 (1), *Sonchus oleraceus* – I-2021 (1), *Trifolium repens* – X-2020 (1), IV-2021 (12), VI-2021 (1), VII-2021 (5), *Veronica persica* – IX-2020 (2), *Vernonanthura tweediana* – V-2021 (1), IV-2021 (8). GALA – *Euphorbia heterophylla* – I-2021 (2), IV-2021 (1), V-2021 (1), *Lolium multiflorum* – X-2020 (3), *Plantago australis* – X-2020 (2), XII-2020 (1), V-2021 (26), VII-2021 (3), VIII-2021 (3), *Paspalum dilatatum* – IX-2020 (6), II-2021 (3), *V. cracca* – VI-2021 (1), *Vernonanthura tweediana* – II-2021 (1), V-2021 (25). São Joaquim: FUJI – *Acaena eupatoria* – V-2021 (7), VI-2021 (2), *Bromus unioloides* – X-2020 (10), *Holcus lanatus* – X-2020 (9), XII-2020 (1), II-2021 (19), *Lolium multiflorum* – XI-2020 (1), III-2021 (8), *Malus domestica* – IX-2020 (9), X-2020 (1), III-2021 (1), IV-2021 (2), VII-2021 (2), *Plantago australis* – XII-2020 (2), I-2021 (4), II-2021 (10), III-2021 (12), IV-2021 (1), V-2021 (20), VIII-2021 (2), *Raphanus sativus* – IX-2020 (1). GALA – *Acaena eupatoria* – IX-2020 (1), XI-2020 (1), IV-2021 (1), V-2021 (2), *Holcus lanatus* – X-2020 (7), XII-2020 (7), II-2021 (19), *Lolium multiflorum* – IX-2020 (1), X-2020 (5), III-2021 (9), *Malus domestica* – IX-2020 (1), VI-2021 (3), VII-2021 (5), VIII-2021 (1), *Plantago australis* – XI-2020 (9), XII-2020 (1), II-2021 (12), III-2021 (11), IV-2021 (3), V-2021 (5), VII-2021 (3), VIII-2021 (1), *Trifolium repens* – X-2020 (1), XII-2020 (1).

Winterschmitiidae

Czenskinspia transversostriata (Oudemans, 1931)

Donndorffia transversostriata Oudemans, 1931: 203.

Antônio Prado: EVA – *Chromolaena laevigata* – III-2021 (1), *Malus domestica* – IV-2021 (3), *Vernonanthura tweediana* – III-2021 (4), IV-2021 (3). GALA – *Malus domestica* – VI-2021 (1). Muitos Capões: FUJI – *Plantago australis* – II-2021 (1). GALA – *Vernonanthura tweediana* – V-2021 (1). São Joaquim: FUJI – *Malus domestica* – III-2021 (6), V-2021 (2). GALA – *Malus domestica* – IV-2021 (1), V-2021 (3).

Dichotomous key for the identification of the mite fauna associated with apple plants in Brazil

1. Chelicerae stylet shaped, curved blades or toothed chelae. Palp with a thumb-claw complex or simple and with 1-5 segments; Stigma, when present, at the base or between bases of chelicerae, at base of gnathosoma, on the anterior margin of the propodosoma or laterally to coxal region between legs III and IV…………………………………………………………………………………………………2
– Chelicerae ending in toothed chelae; Simple palpus; Opening of the tracheas absent or indistinct……………………………………54
2. With stigma laterally, between legs III and IV region.……………………Order Mesostigmata……………………………………...3
– Stigma, when present, at the base or between bases of chelicerae, at the base of gnathosoma, on the anterior margin of the propodosoma……………………………………Order Trombidiforme………………………………………………………...26
3. Adults with more than 20 pairs of dorsal shield setae……………………………………Ascidae……………………………………*Asca*
Adults with less than 20 pairs of dorsal shield setae………………………………………..Phytoseiidae……………………………………4
4. Podonotal region of dorsal shield with 5 or 6 pairs of lateral setae……………………………………………………………………..5
– Podonotal region of dorsal shield with 4 pairs of lateral setae………Amblyseiinae……………………………………………………9
5. Setae *Z1*, *S2*, *S4* and *S5* absent; Setae *r3* usually inserted into the dorsal shield………………………………………………………
Phytoseiinae……………………………………………………………………………………………...*Phytoseius guianensis* De Leon
– At least one of the following setae present: *Z1*, *S2*, *S4* or *S5*; Setae *r3* usually inserted into the body cuticle……………………………...
Subfamily Typhlodrominae……..6
6. Setae *R1* absent and *S2* present………………………………………………………………………*Galendromus* (*G*.) *annectens* (De Leon)
– Setae *R1* present and *S2* usually absent………………………………………………………………………………………………7
7. Setae long on the margin of dorsal shield; Setae *R1* much smaller than *s6*………………………………*Typhlodromina tropica* (Chant)
– Setae short on the margin of the dorsal shield; Setae *R1* and *s6* with similar length……………………………………………………8
8. Sternal shield with 2 pairs of setae………………………………………………....*Metaseiulus* (*M*.) *camelliae* (Chant & Yoshida-Shaul)
– Sternal shield with 3 pairs of setae…………………………………………………………………*Metaseiulus* (*M*.) *eiko* (El-Banhawy)
9. Sternal shield with median posterior projection………………………………………………………………………………………10
– Sternal shield without median posterior projection……………………………………………………………………………………17
10. Chelicerae of normal size and shape, with prominent teeth distributed evenly along the fixed digit; peritreme usually extending to *j1* level…………………………………………………...*Typhlodromalus*…………………………………………………………...11
– Chelicerae reduced in size, with small teeth at the distal tip of the fixed digit; peritreme usually not extending to *j3* level ………………………………………………………………*Euseius*…………………………………………………………...13
11 Spermatheca with visible ductus major, swollen bifid atrium and thick cervix…………………………………………………………
………*T. marmoreus* (El-Banhawy)
– Spermatheca not as above…….12
12 Setae *z4* at most 20% longer than *z2*……………………………………………………………………………… *T. peregrinus* (Muma)
– Setae *z4* about twice longer than *z2*…………………………………………………………………………...*T. aripo* De Leon
13. Dorsal shield smooth………14
Dorsal shield reticulated……..15
14. Setae *z4* as long or longer than the distance between their bases and bases of setae *z2* ....…
………*E. concordis* (Chant)
– Setae *z4* approximately half the distance between their bases and the bases of setae *z2* ....…
………*E. mesembrinus* (Dean)
15. Genu III without macroseta…………………………………………………………………………………………*E. sibelius* (De Leon)
– Genu III with macroseta……………………………………………………………………………………………………16
16. Setae *r3* inserted on unsclerotised cuticle and *R1* on dorsal shield…………………………………..........................…*E. alatus* De Leon
– Setae *r3* and *R1* inserted on unsclerotised cuticle ....……………………………..............*E. inouei* (Ehara & Moraes)
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– Setae *S4* present……18
18. Proportion of setae size *s4*:*Z1*>3.1………………………………………………………………………………………………19
– Proportion of setae size *s4*:*Z1*<3.1……………………………………………………………………………………………...23
19. Setae *J2* present or if absent then *j5* also absent……………………………………………………………………………...20
Setae *J2* absent and setae *j5* present……………………………………………………………*Proprioseiopsis ovatus* (Garman)
20. Sternal shield usually as long as wide; all shields lightly sclerotized ……………………………………………………………
………………………………………………………………………………………………………*Amblyseius chiapensis* De Leon
– Sternal shield usually wider than long; all shield heavily sclerotinized……………………………………………………………...21
21. Leg I with macrosseta……………………………………………… *Iphiseiodes* ………………………………………………...22
– Leg I without macrosseta…………………………………………………………………………………………………*Arrenoseius*

22 Ventri-anal shield with 4 pairs of preanal setae……………………………………………………………..….. *I. metapodalis* (El-Banhawy)
– Ventri-anal shield with 3 pairs of preanal setae………….………………………………………….........*I. zuluagai* Denmark & Muma
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……*N. californicus* (McGregor)
– Most dorsal setae short, not reaching the bases of nearby setae…………………………………………………......... *N. fallacis* (Garman)
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Eriophyidae…………………....……………………………………………………………………....*Aculus schlechtendali* (Nalepa)
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– Aedeagus head curved hook, with pointed tip…………………………………………………………………………......*T. ludeni* Zacher
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………*A. riograndensis* Johann & Ferla
36. Gnatosoma with quadrangular or circular contour; Leg IV slender without pretarsus and claws in females, but, usually with a sessile single claw in males, leg IV with three-segmented in females with femurgenu and tibiotarsus fused, in male with three or four segments with tibia and tarsus usually separate……………………………………..……………...Tarsonemidae ………………………….…………... 37
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38. Some of the dorsal idiossomal setae enlarged…………….………………….....….*Daidalotarsonemus*…….………………….…………39
– Dorsal idiossomal setae not enlarged………………….…………………………………………………………………….…………40
39 Setae *e* thin (± 3 µm); palp long (± 18 µm)...................................………………………………........*D. esalqi* Rezende, Lofego & Ochoa
– Setae *e* broad (± 17 µm); palp short (± 10 µm)............................……………………………......*D. savanicus* Rezende, Lofego & Ochoa
40 Gnathosornal palpi markedly elongated…………………….………………………………………………………*Rhynchotarsonemus*
– Gnathosornal palpi not markedly elongated……………………….………………………………………….………...……..41
41 Tegula enlogated…………………………….…………………………………………………………………….....*Xenotarsonemus*
– Tegula not elongated……………………………………………………………………………………………………….………….42
42 Tarsi I-III relatively long…………………………………….……………………………………………………………*Fungitarsonemus*
– Tarsi I-III normal……………………………………………...*Tarsonemus*……………………………………………….…...…...…..43
43. Setae *sc2* at least 1.5 times longer than the distance between their bases…………………………………………….....…...*T. waitei* Banks
Setae *sc2* about as long as or shorter than distance between their bases………………………………………………….…………....…44
44. Poststernal apodeme not bifurcated anteriorly at the level of setae *3a* …………………………………………………………...…………
……*T. merus* Lin & Zhang
Poststernal apodeme bifurcated anteriorly at the level of setae *3a*…………………………………………..………........*T. confusus* Ewing

45. Posterior part of opistho dorsum with setae *f1* as a trichobothrium…………………………………………………………………… Eupodidae……..*Benoinyssus*
– Setae *f1* not like this………..46
46. Chelicerae fused at base and with movable digit further modified into an elongate stylet……………………………………………….. 47
– Chelicerae not fused at base and capable of moving scissor-like over gnathosoma…………………………………………………….. Cunaxidae……...*Cunaxoides*
47. Prodorsum without trichobothria…………………………………………...Tenuipalpidae……………………………………………. 48
Prodorsum with trichobothria……49
48. Setae *h2* elongate, much longer than other dorsal setae…………………………………………………………………...*Tenuipalpus*
– Setae *h2* not elongate, similar in shape and length of other dorsal setae………………………………………………………...*Brevipalpus*
49. Adults with 1 pair of genital papillae or papillae absent…………………………………………Iolinidae………………*Pseudopronematulus*
– Adults with 2 pairs of genital papillae………………………………………………………………………………………………..50
50. Leg I with vestigial or no apotele………………………...Triophtydeidae……………………………………………………*Triophtydeus*
– Leg I with apotele ……………………………………………………...Tydeidae………………………………………………………….51
51. Up to three seta on genu II…..………………………………...52
– No setae on genu II………………………………...…………………………………………………....*Pretydeus henriandrei* Kaźmierski
52. Femur III with two setae……………………………………………………………………………….....*Lorryia aberrans* (Oudemans)
– Femur III with no setae……53
53. Femur II with three setae…………………………………………………………………………………………………….*Quasitydeus*
– Femur II with two setae ……………………………………………………………………………………….*Tydeus californicus* (Banks)
54. Prodorsum without specialized sensory organs other than setiform setae; adult idiosoma weakly sclerotized…………………………..... Suborder Oribatida, Cohort Astigmatina……………………………………………………………………………………………...55
– Prodorsum usually with a pair of specialized setae arising from sensory pits or bothridia (pseudostigmatic organs); adult idiosoma usually well sclerotized……… Suborder Oribatida (excluding Astigmatina)
55. One pair of short and strong condilophores…………………………………….Acaridae…………………*Tyrophagus putrescentiae* (Schrank)
– Condilophores fused into v-shaped sclerites.……………………………Winterschmidtiidae …………………………………………… *Czenspinskia transversostriata* (Oud.)

Discussion

After a long period of absence of studies on mites in apple cultivation (Lorenzato et al. 1986, Ferla & Moraes 1998, Monteiro 2002, Monteiro et al. 2006, 2008), this study presents relevant results on the mite fauna, especially after the recent record of *A. schlechtendali* in culture (Ferla et al. 2018, Nascimento et al. 2020). Understanding the predators and prey species associated with this crop would facilitate management practices, aiming to improve the apple production. In addition, this is also the first study that evaluates the mite fauna in producing organic apple orchards in Brazil.

The data presented here show the mite fauna associated with apple orchards in southern Brazil. The greatest acarine abundance was observed in the municipality of Antônio Prado, possibly because one more orchard was sampled than in the other municipalities. However, it is worth noting that greater diversity was presented in organic orchards, in addition to low populations of phytophagous mites, suggesting that native predatory mites have the capacity to control *P. ulmi* and *A. schlechtendali*, two exotic phytophagous species.

Aculus schlechtendali was the most abundant phytophagous species, suggesting that it is a species with the potential to cause economic damage to the crop. Recent records of the species in the country (Ferla et al. 2018, Nascimento et al. 2020), together with the findings of this study, warn about the possibility of this species reaching the status of a pest in culture. According to a study predicting the potential distribution of *A. schlechtendali*, in addition to the states in the southern region of the country, other areas in the state of São Paulo and possibly in Minas Gerais were shown to be potentially suitable for its occurrence (Corrêa et al. 2021). This species is considered an important pest of apple trees in several countries (Duso et al. 2010), mainly in nurseries and orchards, where it can be found feeding on flowers, fruits and leaves, affecting the plants physiological activity, quality and aesthetics of plants (Easterbrook & Palmer 1996, Walde et al. 1997, Spieser et al. 1998, Duso et al. 2010).

Spontaneous vegetation present in the orchards showed high acarine diversity, with emphasis on predatory species. Thus, it can be stated that the maintenance of spontaneous vegetation in orchards favors the permanence of predators, acting as a refuge and reservoir for these natural enemies (Altieri 1999, 2002, Prischmann & James 2003). Certain plants associated with orchards play an important ecological role as they are hosts of species that help in the biological control of agricultural pests, as they naturally migrate from this spontaneous vegetation to the main crop of the orchard (Tixier et al. 2000, Lykouressis et al. 2008, Ji et al. 2022). These plants can provide shelter and food, such as pollen, for predatory mites, keeping them in these areas even in periods with unfavorable abiotic conditions or when there is a shortage of prey (Landis et al. 2000, Tixier et al. 2000, Demite & Feres 2005), assisting in the colonization of these areas through aerial dispersal (Tixier et al. 2000, Jung & Croft 2001). *Plantago australis* and *V. tweediana* harbored a greater abundance of mites and presented a higher proportion of predators, demonstrating that they are species with the potential to be maintained in orchards. Faoro (2022) cites *Plantago major* L. (Plantaginaceae), plantain, a species of the same genus as the main species found in the orchards of this study, as a plant with the potential to harbor predatory mites and recommends its maintenance in orchards. However, further studies on the potential of these plants as reservoirs of natural enemies of phytophagous mites must be carried out.

Phytoseiidae is an important family for apple cultivation (Monteiro et al. 2008, Silva et al. 2022), this study presented the greatest diversity, with species that may be migrating from spontaneous vegetation to apple trees. This mite family can feed on phytophagous mites and have other alternative food sources, such as pollen, fungi, plant exudate and insects (McMurtry et al. 1970, McMurtry & Rodriguez 1987). The most abundant predator species observed in the orchards evaluated was *N. californicus*, a species that occasionally uses pollen as food (Pascua et al. 2020). In Antônio Prado orchards, maintained under organic management, *N. californicus* was found only on apple plants, however in these orchards there was a greater diversity of predatory mite species. In orchards in the municipalities of Muitos Capões and São Joaquim, under conventional and regenerative management, *N. californicus* was present both in apple trees and in spontaneous vegetation, however, these orchards showed lower diversity of Phytoseiidae. While 13 species of Phytoseiidae were found in Antônio Prado, in São Joaquim there were only five and in Muitos Capões three. As the last two areas use pesticide spraying to control pests, more frequently in conventional than in regenerative areas, it is likely that the low acarine diversity in these areas compared to organic management areas is related to the use of pesticides. According to Maeyer et al. (1992), less intensive agricultural management allows greater conservation of the diversity of natural enemies. The spraying of pesticides is one of the main factors responsible for reducing the diversity of arthropods, especially natural enemies (Kropczyn & Tuovinen 1988, Meyer et al. 2009).

The findings of this study indicate that the different management systems used in orchards influence the occurrence of predatory species, mainly Phytoseiidae, with greater diversity being found in organic orchards. Therefore, to maintain a greater diversity of phytoseiid mites in apple orchards, organic management appears to be the most appropriate to be used. Furthermore, the high acarine diversity, mainly predators, found in the spontaneous vegetation, demonstrated the importance of maintaining these plants in orchards serving as a refuge and reservoir, favoring the permanence of natural enemies in these environments.

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Authors Contributions

Priscila de Andrade Rode: substantial contribution in the concept and design of the study, contribution to data collection, contribution to data analysis and interpretation, and contribution to manuscript preparation.

Júlia Jantsch Ferla: contribution to dichotomous key confection, to critical revision, and adding intellectual content.

Gabriel Lima Bizarro: contribution to data collection, mite identification, to critical revision, and adding intellectual content.

Matheus Schussler: contribution to data collection, and to mite identification.

Noeli Juarez Ferla: substantial contribution in the concept and design of the study, contribution to critical revision, and to adding intellectual content.

Conflicts of Interest

The authors declare that they have no conflict of interest related to the publication of this manuscript.

Data Availability

Supporting data are available at <https://doi.org/10.48331/scielodata.JBIZS9>.

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