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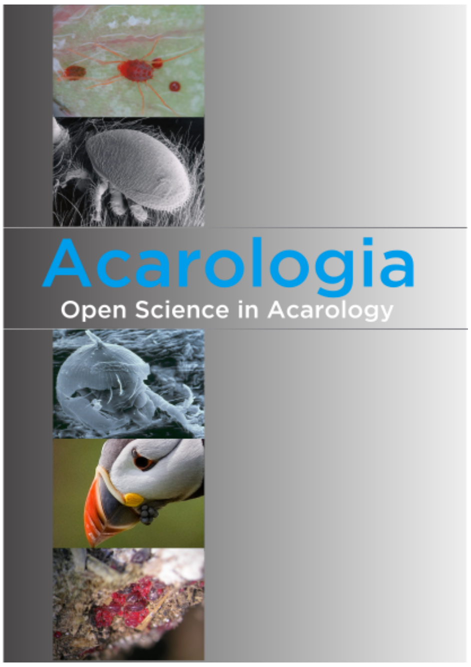

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Biodiversity of spider mites (Acari: Tetranychidae) in Serbia: a review, new records and key to all known species

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ABSTRACT

Despite the economic importance of spider mites (Acari: Tetranychidae), data on their biodiversity are scarce in some regions of Europe, such as Balkan Peninsula and particularly in Serbia. In this country, according to the Spider Mites Web database, only 17 spider mite species belonging to seven genera have been reported. This study provides a review of the Serbian literature dealing with spider mite species recorded in Serbia and presents results of a four-year faunistic survey in which spider mites were collected on cultivated plants and native vegetation throughout the country. In the survey, a total of 23 species were recorded, including six species new to Serbian acarofauna: *Bryobia praetiosa*, *Eotetranychus aceri*, *E. fraxini*, *E. pruni*, *Panonychus citri* and *Tetranychus evansi*. Together with previously reported data, it raises the number of known spider mite species in Serbia to 36. A total of 90 host plant species from 21 families that are favorable to spider mites were recorded in this study; there were 62 new host records for 20 spider mite species with 11 records of new plant species as hosts of spider mites. There were 63 new records for Serbia among host plant species, raising the number of Serbian hosts for tetranychid mites to 137. The spider mite species new to Serbian acarofauna were found on 17 newly recorded host plants from 11 families. A key to all known spider mites species from Serbia is provided.

Keywords phyophagous mites, species diversity, Balkans

Zoobank http://zoobank.org/3DFDC9E5-FCDF-4C35-AB32-CB9B2CE14A3F

Introduction

Spider mites (Acari: Tetranychidae) represent the most important pest mites with 1305 valid species and 3808 host plant records according to the Spider Mites Web database (Migeon and Dorkeld, 2017). This family includes species belonging to the most important mite pests of agricultural crops and ornamentals worldwide (Bolland *et al.*, 1988; Zhang, 2003; Hoy, 2011). Despite the economic importance of spider mites, data on their biodiversity are scarce in some regions of Europe, such as Balkan Peninsula. In Serbia, which is located in the center of Balkans, 17 spider mite species belonging to six genera have been reported, according to the Spider Mites Web database (Migeon and Dorkeld, 2017). In Balkan countries located to the west and south of Serbia, 7 species have been reported from Slovenia (Bohinc and Trdan, 2013); in Bulgaria and Romania, located in the eastern part of Balkans, 8 and 12 species have been reported, respectively. On the other hand, 56 spider mite species have been reported in Greece, the southernmost Balkan country (Migeon and Dorkeld, 2017).

The first scientific data on Serbian spider mites date back to 1950-60s (reviewed by Petanović and Filipi-Matutinović, 1988), when bioecological and morphological characteristics

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of several recorded pest species were described. Stojnić (1993) carried out the first faunistic survey and taxonomic analysis of spider mites in Serbia collected on cultivated and ornamental plants from a wider area surrounding Serbian capital Belgrade. Recently, Mladenović *et al.* (2013) and Mladenović (2014) provided data on species collected in forest habitats, while Stojnić *et al.* (2014) analyzed species diversity on cultivated and wild apple trees in Serbia. Considering geographic and plant diversities of Serbia, as well as that a comprehensive faunistic study of Tetranychidae from the whole country area has never been carried out, we assumed the list of spider mites species inhabiting Serbia could be extended by new records. This study provides a review of the literature dealing with spider mites species recorded in Serbia and presents results of a four-year faunistic and taxonomic survey in which spider mites were collected on cultivated plants and native vegetation throughout the country. A key to all known spider mites species from Serbia is provided as well.

Materials and methods

Mite sampling was carried out during four years (2013-2016) from April to October in 298 sampling locations. For the sake of simplicity, these locations are grouped in 24 sampling areas (Fig. 1) in which mites were collected from various habitats (agricultural, forest, grassland, ruderal and urban). The areas C, N, L, O and U include territories of national parks. Among each location a variable number of plants were sampled. Host plants were randomly chosen with several criteria. First of all we chose plants with obvious marks of spider mites infestation, then some typical plants for that sampling location, and also some typical host plants for spider mites species. We also collected samples from crops known to be usually infested by spider mites, and also those which were obviously infested. Mites were recovered from plant samples in two different ways: *i*) one by one, directly from field samples using a paint brush; *ii*) in the laboratory, mites were extracted from leave samples following the soaking-washing-filtering method (Boller, 1984). All the specimens were temporarily preserved in 70% ethyl alcohol and then cleared in lactic acid (50%) for 24-48 hours and mounted in Hoyer's medium (Krantz and Walter 2009). Mites were examined using a Leica DMLB II phase contrast microscope and for some specimens, when needed, measurements were performed using the imaging software Perfect Image® (Clara Vision) coupled with ProgRes® Capture Pro 2.6 software for image acquisition.

Identification of mites at the genus level was performed using the key to the spider mites genera of the world (Bolland *et al.*, 1989). For species identification, available keys and some relevant books and papers were used (Bagdasarian, 1954; Mathys, 1957; Pritchard and Baker, 1955; Reck, 1959; Baker and Pritchard, 1960; Livshitz and Mitrofanov, 1971; Jeppson *et al.*, 1975; Gutierrez and Helle, 1983; Gutierrez and Schicha, 1983; Eyndhoven and Vacante, 1985; Meyer, 1987; Gupta and Gupta, 1994; Ochoa *et al.*, 1994; Ehara, 1999; Flechtmann and Knihinicki, 2002; Auger *et al.*, 2003; Zhang, 2003; Vacante, 2010, 2016; Seeman and Beard, 2011; Flechtmann 2012; Auger *et al.*, 2013; Auger and Migeon 2014). Geographical coordinates, altitude, host plant and date of collection were recorded for each sample. The voucher specimens are deposited in the Institute of Pesticides and Environmental Protection, Department of Applied Entomology, Belgrade.

Results and discussion

A review of spider mite studies in Serbia

Table 1 provides a review of spider mites species records in Serbia composed of data from scientific literature published in Serbian (older references) and English (newer references). The first recorded spider mites were cosmopolitan and economically important species such as *Tetranychus turkestani* found on cotton plants (Đurkić, 1955), *Tetranychus urticae* found on

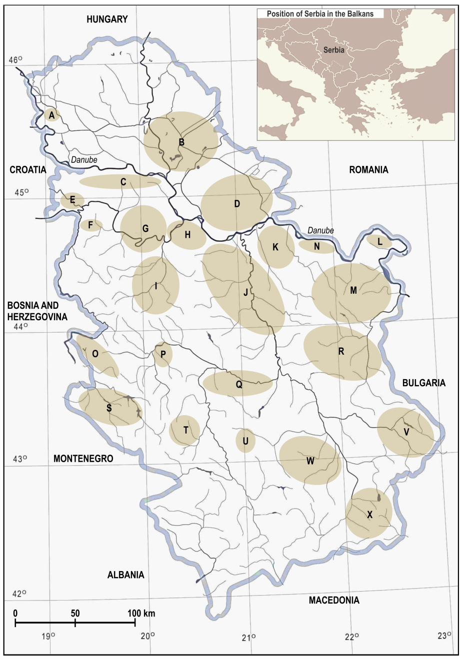

Figure 1 Areas in Serbia in which spider mites were collected (in brackets: number of sampling locations): A = Apatin (4), B = Srednji Banat-Potisje (9), C = Fruška Gora-Slankamen (12), D = Južni Banat (11), E = Zapadni Srem (13), F = Mačva (3), G = Srem-Posavina (17), H = Belgrade (33), I = Kolubara (6), J = Šumadija-Pomoravlje (13), K = Požarevac-Kučevo (7), L = Kladovo (3), M = Bor-Majdanpek-Negotin (8), N = Golubac-Lepenski Vir (4), O = Tara-Zlatibor (26), P = Čačak (12), Q = Goč-Trstenik (5), R = Zaječar-Knjaževac-Sokobanja (15), S = Priboj-Prijepolje-Nova Varoš (22), T = Golija (5), U = Kopaonik (7), V = Stara Planina-Pirot (19), W = Prokuplje-Leskovac (25), X = Vranje-Vlasina (19).

beans and cotton, and *Panonychus ulmi* found on plum trees (Grujičić and Tomašević, 1956). Morphological and bioecological characteristics of another cosmopolitan species, *Bryobia rubrioculus*, were described by Tomašević (1965). This author also reported *Eotetranychus populi*, found on white poplar trees and *Neotetranychus rubicola*, recorded on raspberry (Tomašević, 1964, 1967).

The first survey of spider mites in Serbia was carried out by Stojnić (1993) who collected tetranychid mites on cultivated and ornamental plants in various habitats from a wider area surrounding Serbian capital Belgrade (Table 1). The presence of above mentioned cosmopolitan species was confirmed and their host ranges were extended to 7 (*B. rubrioculus*), 10 (*P. ulmi*), 21 (*T. turkestani*) and 23 (*T. urticae*) plant species, belonging to Rosaceae and several other plant families. In addition to these species, 12 additional tetranychid species belonging to 9 genera were also recorded. Two of them are considered as pests of economic plants: *Amphitetranychus viennensis*, found on 10 host plants from the family Rosaceae and *Oligonychus ununguis*, recorded on several conifers. The species *Neotetranychus rubi*, potential pest of *Rubus* plants in Serbia, was recorded as well. The others were mostly oligophagous species of minor economic importance, found on ornamental and shade trees (for details see Table 1). Diapausing individuals of *B. graminum* were found in fallen cones of Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco). A total of 58 plant species from 26 families were recorded as hosts of 17 spider mite species in the survey.

Mladenović *et al.* (2013) and Mladenović (2014) provided faunistic data on tetranychids collected mostly on wild fruit trees and shrubs in forest habitats. They found 12 species new to Serbian acarofauna (Table 1) and 14 new plant species and three new families were recorded as hosts of tetranychids in Serbia. Stojnić *et al.* (2014) studied spider mites diversity on cultivated and wild apple trees in Serbia and reported two wild apple species as new hosts of *A. viennensis*,

Table 1 Review of spider mites species records in Serbia.

Spider mite species *	Đurkić (1955)	Grujičić and Tomašević (1956)	Tomašević (1964, 1965, 1967)	Stojnić (1993)	Mladenović et al. (2013) Mladenović (2014)	Stojnić et al. (2014)	**This study** **
Bryobiinae							
Bryobia angustisetis					• B	•	•
Bryobia graminum				•	•		•
Bryobia kissophila					•		
Bryobia lagodechiana					• B		
Bryobia longisetis					•		•
Bryobia praetiosa							•
Bryobia rubrioculus			•	•	•	•	•
Bryobia ulmophila					•	•	
Bryobia vasiljevi					•	•	
Tetranycopsis horridus				•	•		•
Tetranychinae							
Amphitetranychus viennensis				•	•	•	•
Eotetranychus aceri							• B
Eotetranychus carpini					•		•
Eotetranychus clitus					• B		
Eotetranychus coryli				•	•		•
Eotetranychus deflexus					• B		
Eotetranychus fraxini							• B
Eotetranychus populi			•	•			
Eotetranychus pruni							•
Eotetranychus rubiphilus					• B		•
Eotetranychus tiliarium				•			•
Eotetranychus uncatus					• B		
Eotetranychus weldoni				• B			
Eurytetranychus buxi				• B			•
Neotetranychus rubi				• B	•		•
Neotetranychus rubicola			• B				
Oligonychus sp.							•
Oligonychus brevipodus				• B			
Oligonychus ununguis				•			
Panonychus citri							•
Panonychus ulmi		•		•	•	•	•
Schizotetranychus garmani				• B	•		•
Schizotetranychus parasemus					• B		
Schizotetranychus schizopus				• B	•	•	
Tetranychus evansi							•
Tetranychus turkestani	•			•	•	•	•
Tetranychus urticae		•		•	•	•	•

* Spider Mites Web records (Migeon and Dorkeld, 2017) are marked bold; compiled records for Serbia and former Yugoslavia (records from Serbia)

** New records are highlighted in gray B = the first record in the Balkan Peninsula

S. schizopus and *T. urticae*.

The survey and new records

In the present study, a total of 23 spider mites species (*Oligonychus* sp. was identified to the generic rank only) were recorded, including 6 species new to Serbian acarofauna: *B. praetiosa*, *E. carpini*, *E. fraxini*, *E. pruni*, *P. citri* and *T. evansi* (Table 1). Together with previously reported data, a total of 36 spider mite species have been recorded in Serbia to date. Not counting Greece, this is the highest recorded number of tetranychid species in Balkans, considering that there have been 0-12 records in other countries (Migeon and Dorkeld, 2017). Among 36 Serbian species, 16 have not been recorded in any other Balkan country, including four species (*B. angustisetis*, *E. weldoni*, *N. rubicola* and *S. parasemus*) with only one Palearctic record besides Serbia and two species (*E. clitus*, *E. deflexus*) with no other records in Palearctic region.

A total of 90 host plant species from 21 families bearing mite species were recorded in this study; there were 62 new host records in the world for 20 spider mite species with 11 first records of plant species as hosts of spider mites (Table 2).

Two species, *T. urticae* and *T. turkestani*, were found on 19 plant families and they had the highest recorded number of host plant species, 65 and 57, respectively. Host plant ranges

Table 2 Spider mites species records on different host plants in Serbia collected in this study.

No.	Host plant family	Host plant species	Spider mite species
1.	Amaranthaceae	*Amaranthus retroflexus*	*Ttu Tur*
2.		*Atriplex patula* ■▼	***Bpr Ttu Tur***
3.	Apiaceae	*Apium graveolens* ■	***Blo Bpr*** *Ttu Tur*
4.		*Coriandrum sativum* ■	***Ttu*** *Tur*
5.		*Daucus carota*	*Ttu Tur*
6.		*Pastinaca sativa*	*Ttu*
7.	Asteraceae	*Achilea milefolium* ■	*Ban* ***Ttu***
8.		*Ambrosia artemiisifolia* ■	***Bpr*** *Bru Ttu* ***Tur***
9.		*Artemisia vulgaris* ■	***Bpr***
10.		*Arctium lappa* ■	***Ban*** *Ttu*
11.		*Carduus acanthoides* ■▼	***Ban Tur***
12.		*Chamomilla recutita* ■▼	***Ttu Tur***
13.		*Cirsium arvense* ■	***Ban*** *Ttu* ***Tur***
14.		*Helianthus annuus*	*Ttu*
15.		*Taraxacum officinale* ■	***Ban*** *Bpr* ***Avi***
16.	Betulaceae	*Betula pendula* ■	***Bru*** *Eco Tur*
17.		*Betula pubescens* ■	***Bru Eca Ttu Tur***
18.		*Corylus avellana*	*Tho Eco Epr Ttu*
19.		*Corylus colurna* ■	***Tho*** *Eco* ***Epr Tur***
20.		*Corylus maxima* ■	***Bru*** *Tho* ***Eco***
21.		*Carpinus betulus* ■	*Bru Eca Eco* ***Epr***
22.	Brassicaceae	*Armoracia rusticana* ■	***Tur***
23.		*Brassica oleracea*	*Ttu Tur*
24.		*Brassica juncea*	*Tur*
25.		*Lepidium draba*	*Ttu*
26.		*Raphanus sativus* ■	***Tur***
27.	Buxaceae	*Buxus sempervirens*	*Ebu*
28.	Convolvulaceae	*Calystegia sepium* ■	***Blo Ttu*** *Tur*
29.		*Convolvulus arvensis*	*Ttu Tur*
30.	Cucurbitaceae	*Cucumis sativus*	*Ttu Tur*
31.		*Cucumis melo*	*Ttu*
32.		*Cucurbita pepo* ■	***Ttu***
33.		*Citrullus lanatus*	*Ttu*
34.		*Citrullus vulgaris* ■	***Ttu Tur***
35.	Euphorbiaceae	*Euphorbia cyparissias* ■▼	***Bpr Tur***
36.		*Euphorbia helioscopia* ■	***Ttu*** *Tur*
37.		*Euphorbia pulcherrima* ■	***Ttu***
38.	Fabaceae	*Glycine max*	*Pul Ttu Tur*
39.		*Medicago lupulina* ■	***Ttu*** *Tur*
40.		*Pisum sativum* ■	***Bgr*** *Pul* ***Ttu*** *Tur*
41.		*Phaseolus vulgaris*	*Ttu Tur*
42.		*Robinia pseudoacacia* ■	***Ban***
43.		*Trifolium pratense*	*Tur*
44.		*Vicia faba*	*Ttu*
45.	Grossulariaceae	*Ribes rubrum* ■	***Bru Avi Epr***
46.	Lamiaceae	*Lamium purpureum* ■	***Bgr Blo Ttu*** *Tur*
47.		*Salvia nemorosa* ■	***Bgr*** *Blo* ***Ttu*** *Tur*
48.		*Mentha longifolia* ■	***Bgr Tur***
49.	Liliaceae	*Lilium bulbiferum* ■ ▼	***Tur***
50.		*Tulipa turkestanica* ■▼	***Ttu Tur***
51.	Malvaceae	*Abutilon theophrasti*	*Tur*
52.		*Althaea officinalis* ■▼	***Bgr Ttu Tur***
53.		*Hibiscus trionum* ■	***Blo Pul***
54.		*Malva sylvestris*	*Ttu Tur*
55.		*Malva alcea* ■▼	***Bru Ttu***
56.		*Tilia cordata*	*Eti Tur*
57.		*Tilia tomentosa* ■	***Bru*** *Eti* ***Ttu*** *Tur*
58.		*Tilia platyphyllos* ■	***Bru Avi Epr*** *Eti* ***Tur***
59.	Oleaceae	*Fraxinus excelsior* ■	***Bru*** *Efr* ***Epr***
60.		*Fraxinus ornus* ■	*Efr* ***Ttu Tur***
61.	Poaceae	*Cynodon dactylon* ■	***Bgr Ttu*** *Tur*
62.		*Hordeum murinum* ■	***Bpr Ttu Tur***
63.		*Zea mays*	*Ttu Tur*
64.	Ranunculaceae	*Clematis vitalba* ■▼	***Ttu Tur***
65.		*Ranunculus aconitifolius* ■▼	***Bgr Bpr Ttu Tur***
66.	Rosaceae	*Fragaria vesca* ■	*Bpr* ***Bru Ttu*** *Tur*
67.		*Malus domestica*	*Bru Avi Eca Epr Pul Ttu Tur*
68.		*Malus sylvestris* ■	*Bru Avi* ***Pci Pul Ttu*** *Tur*
69.		*Malus pumilla* ■	***Bpr*** *Bru Avi* ***Pci*** *Pul Ttu Tur*
70.		*Potentilla argentea* ■	***Epr Ttu Tur***
71.		*Prunus avium* ■	*Ban Avi Epr* ***Pci*** *Ttu Tur*
72.		*Prunus cerasifera* ■	***Ban*** *Bru Avi* ***Eca*** *Ttu Tur*
73.		*Prunus domestica* ■	*Bru Avi* ***Eac*** *Epr Tur*
74.		*Pyrus pyraster* ■ ▼	***Bru Avi Eac Epr Ttu***
75.		*Pyrus communis*	*Bpr Avi Epr*
76.		*Rosa sp.*	*Bru Avi Epr Eru Pul Tur*
77.		*Rubus ideaus* ■	*Avi* ***Eru*** *Nru Ttu Tur*
78.		*Rubus fruticosus* ■	***Bpr*** *Eru Nru* ***Ttu*** *Tur*
79.		*Rubus hirtus* ■	***Avi*** *Eru Nru Ttu*
80.		*Rubus parviflorus* ■	***Eru Nru Ttu Tur***
81.		*Rubus ulmifolius* ■	*Eru* ***Nru*** *Tur*
82.	Sapindaceae	*Acer pseudoplatanus* ■	***Bru Avi Eac Eti Sga Ttu*** *Tur*
83.		*Acer campestre* ■	***Avi*** *Eac Eca Oli* ***Sga***
84.	Solanaceae	*Datura stramonium*	*Tur*
85.		*Solanum lycopersicum*	*Tev Ttu Tur*
86.		*Solanum melongena*	*Ttu Tur*
87.		*Solanum tuberosum*	*Ttu Tur*
88.	Ulmaceae	*Ulmus minor* ■	*Ban* ***Avi Eca Epr Ttu*** *Tur*
89.		*Ulmus rubra* ■	***Epr*** *Tur*
90.		*Ulmus glabra* ■	***Eca Ttu***

■ indicates new records in the world for spider mite species highlighted bold; ▼indicates new hosts for spider mites in the world (based on Migeon and Dorkeld, 2017)

Ban = Bryobia angustisetis; Bgr = Bryobia graminum; Blo = Bryobia longisetis; Bpr = Bryobia praetiosa; Bru = Bryobia rubrioculus; Tho = Tetranycopsis horridus; Avi = Amphitetranychus viennensis; Eac = Eotetranychus aceri; Eca = Eotetranychus carpini; Eco = Eotetranychus coryli; Efr = Eotetranychus fraxini; Epr = Eotetranychus pruni; Eru = Eotetranychus rubiphilus; Eti = Eotetranychus tiliarium; Ebu = Eurytetranychus buxi; Nru = Neotetranychus rubi; Oli = Oligonychus sp.; Pci = Panonychus citri; Pul = Panonychus ulmi; Sga = Schizotetranychus garmani; Tev = Tetranychus evansi; Ttu = Tetranychus turkestani; Tur = Tetranychus urticae

of *B. rubrioculus* and *A. viennensis* were well extended as well. On the other hand, nine tetranychid species and *Oligonychus* sp. were found on only one host plant family. The highest number of host plants (16) was recorded in the family Rosaceae, one of the most important families of economic plants. This family had 13 records of spider mite species, with four species not recorded in other Balkan countries: *B. angustisetis*, *E. aceri*, *E. rubiphilus* and *N. rubi* (these species were previously recorded in several Palearctic countries and may be present in neighboring countries of Serbia). In this family three spider mite species, *T. urticae*, *T. turkestani* and *A. viennensis*, were found on 10 hosts or more; on the other hand, five new tetranychid species were recorded, at least one on each host plant species.

There were 63 new records for Serbia among host plant species (Table 3), raising the number of Serbian potential hosts for tetranychid mites to 137; six plant families were newly recorded as well. The spider mite species new to Serbian acarofauna were found on 17 newly recorded host plants from 11 families.

Table 3 New host plants for spider mites in Serbia.

No.	Host plant family	Host plant species	No.	Host plant family	Host plant species
1.	Amaranthaceae	*Amaranthus retroflexus*	32.	Fabaceae	*Medicago lupulina*
2.		*Atriplex patula* ●	33.		*Pisum sativum*
3.	Apiaceae	*Apium graveolens* ●	34.		*Trifolium pratense*
4.		*Coriandrum sativum*	35.		*Vicia faba*
5.		*Pastinaca sativa*	36.	Lamiaceae	*Lamium purpureum*
6.	Asteraceae *	*Achilea milefolium*	37.		*Mentha longifolia*
7.		*Ambrosia artemiisifolia* ●	38.	Liliaceae	*Lilium bulbiferum*
8.		*Artemisia vulgaris* ●	39.		*Tulipa turkestanica*
9.		*Arctium lappa*	40.	Malvaceae	*Abutilon theophrasti*
10.		*Carduus acanthoides*	41.		*Althaea officinalis*
11.		*Chamomilla recutita*	42.		*Hibiscus trionum*
12.		*Cirsium arvense*	43.		*Malva sylvestris*
13.		*Helianthus annuus*	44.		*Malva alcea*
14.		*Taraxacum officinale* ●	45.		*Tilia cordata*
15.	Betulaceae	*Betula pendula*	46.		*Tilia tomentosa*
16.		*Betula pubescens*	47.	Oleaceae *	*Fraxinus excelsior* ●
17.		*Corylus maxima*	48.		*Fraxinus ornus* ●
18.		*Carpinus betulus* ●	49.	Poaceae	*Cynodon dactylon*
19.	Brassicaceae	*Armoracia rusticana*	50.		*Hordeum murinum* ●
20.		*Brassica juncea*	51.	Ranunculaceae *	*Clematis vitalba*
21.		*Lepidium draba*	52.		*Ranunculus aconitifolius* ●
22.		*Raphanus sativus*	53.	Rosaceae	*Potentilla argentea* ●
23.	Convolvulaceae *	*Calystegia sepium*	54.		*Pyrus pyraster* ●
24.		*Convolvulus arvensis*	55.		*Rubus fruticosus* ●
25.	Cucurbitaceae	*Cucumis melo*	56.		*Rubus parviflorus*
26.		*Cucurbita pepo*	57.		*Rubus ulmifolius*
27.		*Citrullus lanatus*	58.	Sapindaceae	*Acer pseudoplatanus* ●
28.		*Citrullus vulgaris*	59.	Solanaceae	*Datura stramonium*
29.	Euphorbiaceae *	*Euphorbia cyparissias* ●	60.		*Solanum melongena*
30.		*Euphorbia helioscopia*	61.		*Solanum tuberosum*
31.		*Euphorbia pulcherrima*	62.	Ulmaceae	*Ulmus minor* ●
			63.		*Ulmus rubra* ●

● indicates hosts of spider mite species new to Serbian acarofauna
* indicates new records for Serbia

Spider mite species new to Serbian acarofauna

Tetranychidae Donnadieu

Bryobiinae Berlese

Bryobiini Reck

Genus *Bryobia* Koch

Bryobia praetiosa **Koch, 1836**

Origin of the specimens examined — Area I: Valjevo-Jovanje (44°15’39”N, 19°49’10”E), on *Atriplex patula* (Amaranthaceae), 7♀, 23/05/2013; Area Q: Trstenik-Počekovina (43°35’23”N, 21°05’35”E), on *Apium graveolens* (Apiaceae), 12♀, 27/06/2015; Area D: Bavanište (44°49’44”N, 20°53’06”E), on *Ambrosia artemisifolia* (Asteraceae), 6♀, *Taraxacum of-*

ficinale (Asteraceae), 2♀, 04/09/2013; Area B: Lukićevo (45°20’20”N, 20°29’56”E), on *Artemisia vulgaris* (Asteraceae), 7♀, 26/07/2015; Area W: Prokuplje, Rastovnica (43°12’03”N, 21°35’38”E), on *Euphorbia cyparissias* (Euphorbiaceae), 6♀, 12/08/2010; Area K: Kučevo-Rabrovo (44°33’37”N, 21°31’52”E), on *Hordeum murinum* (Poaceae), 2♀, *Ranunculus aconitifolius* (Ranunculaceae), 12♀, 21/08/2015; Area O: Tara-Kaluđerske Bare (43°52’22”N, 19°24’41”E), on *Malus pumilla* (Rosaceae), 21♀, 19/05/2013, Zlatibor-Dobroselica, on *Fragaria vesca* (Rosaceae), 3♀, 23/07/2014; Area S: Nova Varoš-Draglica (43°34’45”N, 19°46’56”E), on *Pyrus communis* (Rosaceae), 3♀, 28/09/2015; Area P: Čačak-Riđage (43°53’52”N, 20°16’18”E), on *Rubus fruticosus* (Rosaceae), 4♀, 31/08/2015.

Remarks — This species was found on 12 host plants from seven families, with nine plant species as its new hosts in the world (*A. patula*, *E. cyparissias* and *R. aconitifolius* are new hosts for spider mites). It is a worldwide distributed species of some economic importance, found on 269 host plants from 70 families. In Palearctic region it was recorded in 29 countries, including Greece and Romania in the Balkans (Vacante, 2016; Migeon and Dorkeld, 2017).

Tetranychinae Berlese

Tetranychiini Reck

Genus *Eotetranychus* Oudemans

***Eotetranychus aceri* Reck, 1948**

Origin of the specimens examined — Area H: Boljevci (44°49’02”N, 20°26’05”E), on *Prunus domestica* (Rosaceae), 7♀ and 5♂, 17/06/2013; Area Q: Goč-Dobre vode (43°34’13”N, 20°45’03”E), on *Pyrus pyraster* (Rosaceae), 2♀ and 4♂, 28/09/2013; Area R: Rtanj-Valakonje (43°52’14”N, 21°58’48”E), on *Acer pseudoplatanus* (Sapindaceae), 7♀ and 5♂, 03/08/2013; Area V: Stara Planina-Temska (43°15’40”N, 22°33’09”E), on *Acer campestre* (Sapindaceae), 3♀ and 2♂, 12/08/2015.

Remarks — This is the first record in the Balkan Peninsula. The species was found on four host plants from two families, with three plants species as its new hosts in the world (*P. pyraster* is new host for spider mites). It is a Palearctic species found in Spain, France, Italy and Georgia, previously recorded only on host plants from *Acer* spp. (Migeon and Dorkeld, 2017).

***Eotetranychus fraxini* Reck, 1948**

Origin of the specimens examined — Area C: Fruška Gora-Kraljeva stolica (45°09’16”N, 19°49’10”E), on *Fraxinus excelsior* (Oleaceae), 3♀ and 6♂, 17/09/2015; Area M: Negotin-Karabulovo (44°13’00”N, 22°25’48”E), on *Fraxinus ornus* (Oleaceae), 7♀ and 2♂, 17/08/2015.

Remarks — This is the first record in the Balkan Peninsula. It is a Palearctic species found in Armenia, Georgia, Ukraine, Hungary and Italy on host plants from *Fraxinus* spp. (Migeon and Dorkeld, 2017).

***Eotetranychus pruni* Oudemans, 1931**

Origin of the specimens examined — Area D: Bela Crkva-Jezero (44°53’40”N, 21°24’41”E), on *Corylus colurna* (Betulaceae), 7♀ and 4♂, 21/10/2015; Area E: Morović-Bosut (45°00’29”N, 19°13’10”E), on *Corylus avellana* (Betulaceae), 3♀ and 4♂, 01/08/2015; Area H: Belgrade-Tašmajdan (44°48’28”N, 20°28’18”E), on *Carpinus betulus* (Betulaceae), 2♀ and 6♂, 10/09/2015; Area V: Pirot-Slavinja (43°09’37”N, 22°52’38”E), on *Ribes rubrum* (Grossulariaceae), 9♀ and 4♂, 11/08/2015; Area M: Negotin (44°14’08”N, 22°31’43”E), on *Tilia platyphyllos* (Malvaceae), 5♀ and 3♂, 17/08/2015, *Fraxinus excelsior* (Oleaceae), 8♀ and 3♂, 18/08/2015; Area T: Golija-Gradac (43°20’29”N, 20°17’42”E), on *Malus domestica* (Rosaceae), 5♀ and 8♂, 02/08/2016; Area T: Golija-Golijska reka (43°21’09”N, 20°15’20”E), on *Potentilla argentea* (Rosaceae), 7♀ and 6♂, *Prunus avium* (Rosaceae), 2♀ and 9♂, 02/08/2016; Area O: Tara-Rastište (43°56’27”N, 19°21’58”E), on *Prunus domestica* (Rosaceae), 7♀ and 2♂, 21/06/2013; Area O: Tara-Rača (43°55’45”N, 19°31’3”E), on *Pyrus pyraster* (Rosaceae), 8♀ and 2♂, 14/05/2013; Area X: Vlasina-Đošini (42°42’48”N, 22°19’08”E), on *Pyrus communis* (Rosaceae), 2♀ and 2♂, Area U: Kopaonik-Brzeće (43°17’55”N, 20°53’10”E), on *Rosa* sp. (Rosaceae), 12♀ and 3♂, 24/08/2013; Area K: Kučevo-Srpce (44°33’13”N, 21°35’01”E), on *Ulmus minor* (Ulmaceae), 8♀ and 4♂, 21/08/2015; Area H: Belgrade-Ada Huja (44°49’23”N, 20°31’35”E), on *Ulmus rubra* (Ulmaceae), 15♀ and 6♂, 11/10/2015.

Remarks — In our study this species was found on 15 host plants from six families, with nine plant species as its new hosts in the world. It is a species with 32 records in Palearctic countries (including, Slovenia, Romania, Bulgaria and Greece in the Balkans) and it is considered to be a pest of economic plants, found on 30 hosts (Bohinc and Trdan, 2013; Vacante, 2016; Migeon and Dorkeld, 2017).

Genus *Panonychus* McGregor

Panonychus citri **McGregor, 1916**

Origin of the specimens examined — Area C: Slankamenački Vinogradi (44°49’02”N, 20°26’05”E), on *Malus pumilla* (Rosaceae), 12♀ and 8♂, 12/08/2013; Area O: Tara (43°56’60”N, 19°22’09”E), on *Malus sylvestris* (Rosaceae), 11♀ and 4♂, 22/05/2013; Area W: Radan-Ivanje (44°49’02”N, 20°26’05”E), on *Prunus avium* (Rosaceae), 3♀ and 2♂, 26/07/2013.

Remarks — This species was found on three host plants from the family Rosaceae, which are its new host records in the world. It is a worldwide distributed species with 69 records (including Albania, Bulgaria, Croatia and Greece in the Balkans), found on 108 host plants from 38 families, mostly on Rutaceae, Rosaceae and Moraceae. The species is a severe pest of *Citrus* plants (Vacante, 2016), also described in former Yugoslavia (Petanović and Filipi-Matutinović, 1988), but these data are not related to Serbia, which is not a citrus producing country due to unfavorable climate.

Genus *Tetranychus* Dufour

Tetranychus evansi **Baker & Pritchard, 1960**

Origin of the specimens examined — Area F: Šabac-Debrc (44°37’44”N, 19°54’11”E), on *Solanum lycopersicum* (Solanaceae), 3♀ and 2♂, 22/08/2013.

Remarks — This species has been found in 42 countries from various regions on 136 host plants from 36 families, with a preference for Solanaceae (Migeon and Dorkeld, 2017). The species is native to South America and currently an invasive pest species in Europe, found in Portugal, Spain, France, Italy, Greece and Turkey (Boubou *et al.*, 2011; Kazak *et al.*, 2017). According to the modeling distribution of *T. evansi*, as a tropical nondiapausing species (Migeon *et al.*, 2009), its northward outdoor establishment in Eurasia appears to be mainly limited by cold stress. In this area, Mediterranean Basin corresponds to climatic borders for this mite where quite mild winters can explain its establishment, but this species could be able to survive in protected environments. In Serbia, this species was found on tomato grown in two greenhouses near Belgrade. Its possible introduction with infested plant materials would explain why this species is present in a country where the climatic conditions should not allow to this species to survive and settle.

Key to known spider mites from Serbia (based on female, unless otherwise specified)*

1. Empodium with tenent hairs . . . . Bryobiinae – 2
— Empodium without tenent hairs . . . . Tetranychinae – 11

Bryobinae

2. True claws uncinate, empodium pad-like, lobes over the gnathosoma present 3
— Claws and empodium pad like, 4 pairs of prodorsal setae, 12 pairs of strong dorsal setae set on strong tubercles, setae $c_{2\text{-}3}$, $d_{2\text{-}3}$ and $e_{2\text{-}3}$ paired and of unequal lengths . . . . *T. horridus*

3. Prodorsal lobes poorly developed, inner lobes base fused, dorsal setae elongate, duplex setae on tarsus IV dissociate, distal end of peritreme very small . . . . *B. longisetis*
— Prodorsal lobes over gnathosoma well developed 4

4. On tarsus IV duplex setae dissociate, solenidion proximal and shorter 5
— On tarsus IV duplex setae associate, tactile member shorter and proximal 7

5. Peritremal distal enlargement elongate . . . . *B. rubrioculus*
— Peritremal distal enlargement small oval to rounded-shaped 6

6. Distance between dorsal setae c_1 and d_1 about 1.5–1.6 longer than distance between setae d_1 and e_1 . . . . *B. angustisetis*
— Distance between dorsal setae c_1 and d_1 similar to distance between setae d_1 and e_1 . . . . *B. ulmophila*

7. 4 to 5 setae present on genu I . . . . *B. lagodechiana*
— 7-8 setae present on genu I 8

8. 5 setae present on genu II . . . . *B. vasiljevi*
— 6 setae on genu II 9

9. Larval dorsal setae elongate, narrow, and acute . . . . *B. graminum*
— Larval dorsal setae subspatulate 10

10. Larval dorsal setae enlarged distally . . . . *B. praetiosa*
— Larval dorsal setae not enlarged distally . . . . *B. kissophila*

Tetranychinae

11. Empodium claw-like, small; duplex setae not closely associated, dorsohysterosomal setae nearly as long as intervals between them . . . . *E. buxi*
— Empodium claw-like or spit distally, 2 pairs of duplexes present on tarsus I, f_1 setae in normal position 12

12. 2 pairs of ventrocaudal (para-anal) setae 13
— 1 pair of ventrocaudal setae 31

13. Empodium claw-like 14
— Empodium split into up to 3 pairs of hairs 18

14. Empodium a single claw-like structure, with proximoventral hairs 15
— Empodium split into 2 claw-like structures 16

15. f_2 and h_1 setae similar in length . . . . *P. citri*
— f_2 setae about 1.5 longer than h_1 setae . . . . *P. ulmi*

16. Dorsocentral hysterosomal setae far longer than intervals between two consecutive rows, reaching past second seta caudad . . . . *S. parasemus*
— Dorsocentral hysterosomal setae about as long or slightly longer than intervals between two consecutive setae 17

17. Male aedeagus without knob, needle like, sinuous, tapering distally . . . . *S. garmani*
— Male aedeagus up turned, knob with both projection acute, posterior one well developed, elongate, tapering, forming an angle about 45° with the shaft axis . . . . *S. schizopus*

18. Empodium split distally, dorsal body setae set on strong tubercles 19
— Empodium split near the middle 20

19. Palptibial claw longer than palptarsus, stylophore rounded anteriorly . . . . *N. rubi*
— Palptibial claw shorter than palptarsus, stylophore notched anteriorly . . . . *N. rubicola*

20. Male aedeagus obviously downcurved posteriorly 21
— Male aedeagus long, tapering, straight or sinuous 24

21. Aedeageal knob present, anterior and posterior projections acute, male spinneret tiny . . . . *E. rubiphilus*
— Aedeagus sigmoid, without knob 22

22. Aedeagus tip upturned, not tapering . . . . *E. fraxini*
— Aedeagus tip not upturned and acute 23

23. Peritreme straight distally, male spinneret tiny . . . . *E. deflexus*
— Peritreme hooked distally, male spinneret well developed . . . . *E. clitus*

24. Distal end of peritreme branched or anastomosing . . . . *E. populi*
— Peritremal end straight or bent 25

25. Peritreme straight, bulbous distally . . . . *E. carpini*
— Peritreme bent distally or U-shaped 26

26. Aedeagus long, slender, nearly straight . . . . *E. tiliarium*
— Aedeagus sinuous 27

27. Aedeagus slightly sinuous, stout, tapering gradually to tube-like tip, down directed distally *E. weldoni*
— Aedeagus long, slender, obvious undulation present 28

28. Distal part of peritreme strongly hooked with several compartments, female spinneret about 2.5 as long as wide . . . . *E. uncatus*
— Distal part of peritreme bent posteriorly 29

29. Aedeagus with last straight portion equal to 0.3 time the total length . . . . *E. pruni*
— Aedeagus with last straight portion more than 0.4 time the total length 30

30. Female palptarsal terminal sensillum less than 3 times as long as broad . . . . *E. aceri*
— Female palptarsal terminal sensillum 3 times or more as long as broad . . . . *E. coryli*

31. Empodium claw like with proximoventral hairs, dorsal setae longer than intervals, 7 and 5 tactile setae present on tarsi I and II, respectively, live females dark red to reddish-brown in

color; male aedeagus bent ventrad at a right angle tapering gradually to a slender tip . . . . *O. ununguis**
— Empodium split distally 32

32. Peritreme bent distally, hook-like 33
— Peritremal distal enlargement anastomosed . . . . *A. viennensis*

33. Female tarsus I with proximal pair of duplex setae in line with all 4 proximal tactile setae; knob of male aedeagus with both projections acute, anterior projection small, posterior one well developed, dorsocaudally directed, acute, deflexed distally . . . . *T. evansi*
— Female tarsus I with proximal pair of duplex setae distad the four proximal tactile setae 34

34. Dorsal margin of the knob angulate, knob large . . . . *T. turkestani*
— Dorsal margin of the knob rounded, knob small . . . . *T. urticae*

**Oligonychus brevipodus* was not included in the key because there is no reliable data available to separate this species from other members belonging to the genus *Oligonychus*. As proposed by Pritchard & Baker (1955) topotype material should be collected to redescribe this species.

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