

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 phytophagous mites, species diversity, Balkans

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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; Eynhoven 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 turkestanii* found on cotton plants (Đurkić, 1955), *Tetranychus urticae* found on

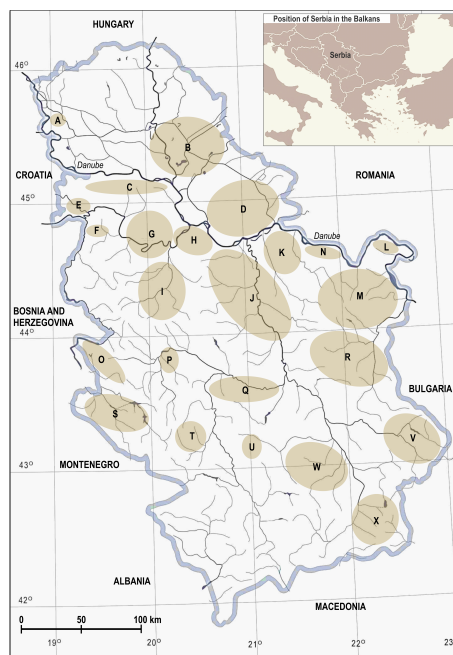


Figure 1 Areas in Serbia in which spider mites were collected (in brackets: number of sampling locations): A = Apatin (4), B = Srednji Banat-Potisje (9), C = Fruška Gora-Slankamen (12), D = Južni Banat (11), E = Zapadni Srem (13), F = Mačva (3), G = Srem-Posavina (17), H = Belgrade (33), I = Kolubara (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-Piroć (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. turkestanii*) 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							
<i>Bryobia angustisetis</i>					• B	•	•
<i>Bryobia graminum</i>				•	•		•
<i>Bryobia kissophila</i>					•		
<i>Bryobia lagodechiana</i>					• B		
<i>Bryobia longisetis</i>					•		•
<i>Bryobia praetiosa</i>							•
<i>Bryobia rubrioculus</i>			•	•	•	•	•
<i>Bryobia ulmophila</i>					•	•	
<i>Bryobia vasiljevi</i>					•	•	
<i>Tetranychopsis horridus</i>				•	•		•
Tetranychinae							
<i>Amphitetranychus viennensis</i>				•	•	•	•
<i>Eotetranychus aceri</i>							• B
<i>Eotetranychus carpini</i>					•		•
<i>Eotetranychus clitus</i>					• B		
<i>Eotetranychus coryli</i>				•	•		•
<i>Eotetranychus deflexus</i>					• B		
<i>Eotetranychus fraxini</i>							• B
<i>Eotetranychus populi</i>			•	•			
<i>Eotetranychus pruni</i>							•
<i>Eotetranychus rubiphilus</i>					• B		•
<i>Eotetranychus tiliarium</i>				•			•
<i>Eotetranychus uncatus</i>					• B		
<i>Eotetranychus weldoni</i>				• B			
<i>Eurytetranychus buxi</i>				• B			•
<i>Neotetranychus rubi</i>				• B	•		•
<i>Neotetranychus rubicola</i>			• B				
<i>Oligonychus</i> sp.							•
<i>Oligonychus brevipodus</i>				• B			
<i>Oligonychus ununguis</i>				•			
<i>Panonychus citri</i>							•
<i>Panonychus ulmi</i>		•		•	•	•	•
<i>Schizotetranychus garmani</i>				• B	•		•
<i>Schizotetranychus parasemus</i>					• B		
<i>Schizotetranychus schizopus</i>				• B	•	•	
<i>Tetranychus evansi</i>							•
<i>Tetranychus turkestanii</i>	•			•	•	•	•
<i>Tetranychus urticae</i>		•		•	•	•	•

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

• 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-Počkovina (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 artemisiifolia* (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-Ridage (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

Tetranychini 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 pyraister* (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. pyraister* 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-Golijaska 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 pyraister* (Rosaceae), 8♀ and 2♂, 14/05/2013; Area X: Vlasina-Došini (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 pumila* (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-Debrč (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 uncinat, 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_{2-3} , d_{2-3} and e_{2-3} 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. turkestan*
 — 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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