Acarologia is proudly non-profit, with no page charges and free open access

Please help us maintain this system by encouraging your institutes to subscribe to the print version of the journal and by sending us your high quality research on the Acari.

Subscriptions: Year 2021 (Volume 61): 450 €
http://www1.montpellier.inra.fr/CBGP/acarologia/subscribe.php
Previous volumes (2010-2020): 250 € / year (4 issues)
Acarologia, CBGP, CS 30016, 34988 MONTFERRIER-sur-LEZ Cedex, France
ISSN 0044-586X (print), ISSN 2107-7207 (electronic)

The digitalization of Acarologia papers prior to 2000 was supported by Agropolis Fondation under the reference ID 1500-024 through the « Investissements d’avenir » programme (Labex Agro: ANR-10-LABX-0001-01)

Acarologia is under free license and distributed under the terms of the Creative Commons-BY.
Biodiversity of spider mites (Acari: Tetranychidae) in Serbia: a review, new records and key to all known species

Ivana Marić¹, Dejan Marčić¹, Radmila Petanović²,³, Philippe Auger⁴

¹Institute of Pesticides and Environmental Protection, Department of Applied Entomology, Banatska 31b, 11080, Belgrade, Serbia.
²University of Belgrade, Faculty of Agriculture, Nemanjina 6, 11080 Belgrade, Serbia.
³Serbian Academy of Sciences and Arts, Knez Mihailova 35, 11000 Belgrade, Serbia.
⁴CBGP, INRA, CIRAD, IRD, Montpellier SupAgro, Univ Montpellier, Montpellier, France.

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 faunistics 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 mite species from Serbia is provided.

Keywords phytophagous 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...
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; Ebara, 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 turkestan* found on cotton plants (Durkić, 1955), *Tetranychus urticae* found on
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 *Eotetranynchus populi*, found on white poplar trees and *Neotetranynchus 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 *Neotetranynchus 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*,

**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 = Golo-Braničevac-Sokobanja (15), R = Zaječar-Kruševac-Sokobanja (15), S = Priboj-Prijepolje-Nova Varoš (22), T = Golija (5), U = Kopaonik (7), V = Stara Planina-Piroj (19), W = Prokuplje-Leskovac (25), X = Vranje-Vlasina (19).
## Table 1 Review of spider mites species records in Serbia.

| Spider mite species * | Đurkić Grujičić and Tomašević (1955) | Grujičić and Tomašević (1956) | Tomašević (1964, 1965, 1967) | Stojnić et al. (1955) | Stojnić et al. (1964, 1965, 1967) | Mladenović et al. (2013) | Mladenovic (2014) | This study ** |
|-----------------------|--------------------------------------|--------------------------------|-----------------------------|---------------------|-------------------------------|-------------------|--------------|-------------|
| Bryobiinae            | * B                                  | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| * Bryobia angustisetis | * B                                  | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| * Bryobia graminum    | * B                                  | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| * Bryobia kissophila  | * B                                  | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| * Bryobia lagodechiana | * B                                 | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| * Bryobia longisetis  | * B                                  | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| * Bryobia praetiosa   | * B                                  | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| * Bryobia rubrioculus | * B                                  | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| * Bryobia ulmophila   | * B                                  | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| * Bryobia vasiljevi   | * B                                  | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| * Tetranychinae       | * B                                  | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| Amphotetranycus vieniensis | * B                              | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| * Eotetranychus aceri | * B                                  | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| Eotetranychus carpini | * B                                  | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| Eotetranychus clitus  | * B                                  | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| Eotetranychus deflexus | * B                             | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| Eotetranychus fraxini | * B                                  | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| * Eotetranychus populi | * B                                | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| * Eotetranychus pruni | * B                                  | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| * Eotetranychus rubribus | * B                            | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| Eotetranychus tiliarium | * B                           | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| * Eotetranychus urticae | * B                             | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| * Neotetranychus rubi | * B                                  | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| Neotetranychus rubincola | * B                           | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| Oligonychus sp.       | * B                                  | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| Oligonychus brevipodus | * B                                | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| Oligonychus ununguis  | * B                                  | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| Panonychus citri       | * B                                  | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| * Panonychus ulmi     | * B                                  | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| Schizotetranychus garmani | * B                          | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| Schizotetranychus paranemus | * B                         | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| Schizotetranychus schizopus | * B                         | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| Tetranycus evansi     | * B                                  | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| Tetranycus turkestani  | * B                                 | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |
| Tetranycus urticae     | * B                                 | ●                             | ●                          | ●                   | ●                             | ●                 | ●            | ●           |

* 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. citius, 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.  | Apiaceae          | Apium graveolens  | Bgr Bgr Tur Tur |
| 3.  | Apiaceae          | Coriandrum sativum | Ttu Tur |
| 4.  | Apiaceae          | Daucus carota     | Ttu Tur |
| 5.  | Apiaceae          | Patrinia sativorum | Ttu Tur |
| 6.  | Asteraceae        | Achillea millefolium | Ban Tur |
| 7.  | Asteraceae        | Ambrosia artemisiifolia | Bbr Brr Tur Tur |
| 8.  | Asteraceae        | Artemisia vulgaris | Bgr Tur |
| 9.  | Asteraceae        | Arctium lappa     | Ban Tur |
| 10. | Asteraceae        | Carduus acanthoides | Y Tur Ttu |
| 11. | Asteraceae        | Chamomilla recutita | Ttu Tur |
| 12. | Asteraceae        | Cirsium arvense   | Ban Tur Tur |
| 13. | Asteraceae        | Helianthus annuus | Ttu |
| 14. | Araceae           | Taroacetum officinale | Ban Brr Avi |
| 15. | Betulaceae        | Betula pendula    | Brn Ecu Tur |
| 16. | Betulaceae        | Betula pubescens | Bbr Eca Tur Tur |
| 17. | Betulaceae        | Corylus avellana | Tho Ecu Epr Tho |
| 18. | Betulaceae        | Corylus colurnus | Brr Tho Epr Tur |
| 19. | Betulaceae        | Corylus maxima   | Brn Tho Ecr |
| 20. | Betulaceae        | Carpinus betulus | Brn Eca Eco Epr |
| 21. | Buxaceae          | Buxus sempervirens | Ecr |
| 22. | Brassicaceae      | Brassica nigra     | Trr Tur |
| 23. | Brassicaceae      | Brassica oleracea | Tho Tur |
| 24. | Brassicaceae      | Brassica juncea   | Tur |
| 25. | Brassicaceae      | Lepidium draba    | Tho |
| 26. | Brassicaceae      | Raphanus sativus  | Tho |
| 27. | Buxaceae          | Buxus semperviren | Ecr |
| 28. | Convolvulaceae    | Calystegia sepium | Brr Tho Tur |
| 29. | Convolvulaceae    | Convolvulus arvensis | Brr Tho Tur |
| 30. | Cucurbitaceae     | Cucumis sativus   | Tho Tur |
| 31. | Cucurbitaceae     | Cucumis melo      | Tho |
| 32. | Cucurbitaceae     | Cucurbita pepo    | Tho |
| 33. | Cucurbitaceae     | Citrullus lanatus | Tho |
| 34. | Cucurbitaceae     | Citrullus vulgaris | Tho |
| 35. | Euphorbiaceae     | Euphorbia cyprisias | Y Brr Tur |
| 36. | Euphorbiaceae     | Euphorbia helioscopia | Brr |
| 37. | Euphorbiaceae     | Euphorbia polygona | Brr |
| 38. | Fabaceae          | Glycinum max      | Pal Tho Tur |
| 39. | Fabaceae          | Medicago lupulina | Ttu Tur |
| 40. | Fabaceae          | Pisum sativum     | Brr Pbl Tur Tur |
| 41. | Fabaceae          | Phaseolus vulgaris | Tho Tur |
| 42. | Fabaceae          | Robinia pseudoacacia | Ban |
| 43. | Fabaceae          | Pyrostegia sinensis | Tur |
| 44. | Fabaceae          | Vicia faba        | Tho |
| 45. | Grossulariaceae   | Ribes rubrum      | Brr Avi Epr |

Spider mite species:
- Ttu = Tetranychus urticae
- Bgr = Bryobia graminum
- Bpr = Bryobia praetiosa
- Bru = Bryobia rubrioculus
- Tho = Tetranycopsis horridus
- Avi = Ambrosettes species
- Efr = Ephiella fructus
- Brl = Bryobia longisetis
- Bbr = Bryobia rubrioculus
- Brr = Bryobia rubrioculus
- Eca = Eriophyes species
- Eru = Eriophyes species
- Epr = Eriophyes species
- Eac = Eriophyes species
- Ban = Bryobia angustisetis
- Bgr = Bryobia graminum
- Blo = Bryobia longisetis
- Bpr = Bryobia praetiosa
- Bru = Bryobia rubrioculus
- Tho = Tetranycopsis horridus

The number of host plants for spider mites species varied, with four species not recorded in other Balkan countries: B. angustisetis, E. acerii, E. rubphilus 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 on one each host plant species.

There were 63 new records for Serbia among host plants 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. | Lamiales          | Lamium purpureum   |
| 6.  | Asteraceae *      | Achillea millefolium| 37. | Mentha longifolia |                    |
| 7.  | Bromeliaceae      |                    | 38. | Liliaceae         | Lilium bulbiferum  |
| 8.  | Artemisia vulgaris|                    | 39. | Tulipa turkestanica|                |
| 9.  | Arctium lappa     |                    | 40. | Malvaceae         | Abutilon theophrasti|
| 10. | Cardusus acaenthoides|                | 41. | Althaea officinalis|                |
| 11. | Chamomilla recutita|                  | 42. | Hibiscus trionum  |                    |
| 12. | Cirsiium 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. | Brassicae *       | 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 pulcherrina|                | 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

Bryobilini 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: Lukčev (45°20’20″N, 20°29’56″E), on Artemisia vulgaris (Asteraceae), 7♀, 26/07/2015; Area W: Prokuplje, Rastovnica (43°1’2’’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♀, on 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°53’52″N, 20°16’18″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: Boljevei (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-Kraljevastolica (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 (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).
22°19′08″E), on Pyrus communis (Rosaceae), 2♀ and 2♂, Area U: Kopaonik-Brzeče (43°17′55″N, 20°53′10″E), on Rosa sp. (Rosaceae), 12♀ and 3♂, 24/08/2013; Area K: Kučevo-Srpe (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-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 nondiapause 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_{2,3}, 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 split 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 ...........................................  
— 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 ..............  
— Male aedeagus up turned, knob with both projection acute, posterior one well developed, elongate, tapering, forming an angle about 45° with the shaft axis ...................  

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 ............  
— Palptibial claw shorter than palptarsus, stylophore notched anteriorly ..................  

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 .... 
— Aedeagus sigmoid, without knob ........................................................... 22

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

23. Peritreme straight distally, male spinneret tiny ...........................................  
— Peritreme hooked distally, male spinneret well developed ....................  

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

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

26. Aedeagus long, slender, nearly straight ...................................................  
— Aedeagus sinuous ................................................................. 27

27. Aedeagus slightly sinuous, stout, tapering gradually to tube-like tip, down directed distally  
— 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 ..................................................  
— Distal part of peritreme bent posteriorly ........................................... 29

29. Aedeagus with last straight portion equal to 0.3 time the total length ...........  
— 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 .......  
— Female palptarsal terminal sensillum 3 times or more as long as broad ......  

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 ............
— Empodium split distally................................................................. O. ununguis

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. 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) toptype material should be collected to redescribe this species.

**Acknowledgements**

This research was funded by the Ministry of Education, Science and Technological Develop-
ment of the Republic of Serbia (grant TR31043). The authors are very grateful to Professor
Carlos H. W. Flechtmann for his valuable suggestions and help in preparation of the manuscript.
We are also very grateful to Maria Navajas for providing us lab accommodation for the biggest
part of this research, and to Philipp Chetverikov who provide us translations of some important
manuscripts.

**References**

Auger P., Migeon A., Flechtmann C.H.W. 2003 — A new species of *Eotetranychus* from France (Acari,
Prostigmata: Tetranychidae) — Zootaxa, 206: 1-7. doi:10.11646/zootaxa.206.1.1
Auger P., Migeon A., Ueckermann E.A., Tiedt L., Navajas M. 2013 — Evidence for synonymy between
*Tetranychus urticae* and *Tetranychus cinnabarinus* (Acari, Prostigmata, Tetranychidae): Review and
new data — Acarologia, 53(4): 383-415. doi:10.1051/acarologia/20132012
Auger P., Migeon A. 2014 — Three new species of Tetranychidae (Acari: Prostigmata) from the French
alps (South-Eastern France) — Acarologia, 54(1): 15-37. doi:10.1051/acarologia/20132111
Bagdasarian A.T. 1954 — New species of tetranychid mites from Armenia (in Russian) — Dok. Akad.
Nauk. Arm. S.S.R., 18(2): 51-56.
Baker E.W., Pritchard A.E. 1960 — The Tetranychoid mites of Africa — Hilgardia 29: 455-574.
Bohinc T., Trdan S. 2013 — Phytophagous and predatory mites in Slovenia. Acarologia, 52(2): 145-150.
doi:10.1051/acarologia/20132084
Bolland H.R., Gutierrez J., Flechtmann C.H.W. 1998 — World catalogue of the spider mite family (Acari:
Tetranychidae) — Leiden: Brill Academic Publishers, pp. 392.
Boller E.F. 1984 — Eine einfache Ausschwemm-Methode zur schnellen Erfassung von Raubmilben,
Thrips und anderen Kleinarthropoden im Weinbau — Schweiz. Zeitschr. Weinbau, 12: 16-17.
Boubou A., Migeon A., Roderick G.K., Navajas M. 2011 — Recent emergence and worldwide spread of
the red tomato spider mite, *Tetranychus evansi*: genetic variation and multiple cryptic invasions —
Biol. Invasions, 13: 81-92. doi:10.1007/s10530-010-9791-y
Durkić J. 1955 — *[Tetranychus atlanticus]*, a pest of cotton in Serbia] — Zaštita bilja, 6: 121-122. [In
Serbian]
Ehara S. 1999 — Revision of the Spider Mite Family Tetranychidae of Japan (Acari: Prostigmata) —
Species Diversity, 4: 63-141.
Eyndhoven G.L., Vacante V. 1985 — The Berlesei group of the genus *Bryobia* Koch (Acari, Tetranychidae)
— Redia, 18: 377-437.
Flechtmann C.H.W., Knihinicki D.K. 2002 — New species and new record of *Tetranychus Dufour* from
Australia, with a key to the major groups in this genus based on females — Aust. Entomol., 41:
120-127. doi:10.1046/j.1440-6055.2002.00289.x
