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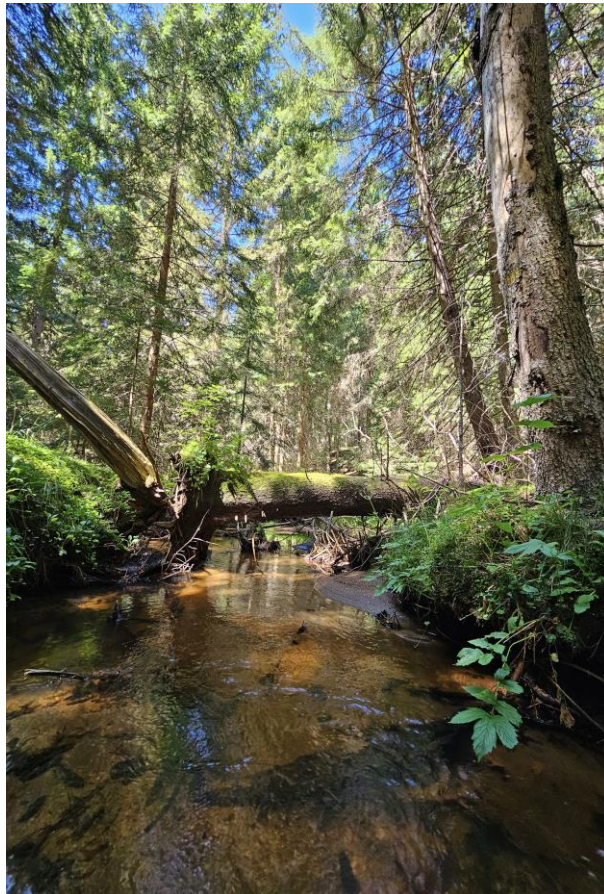
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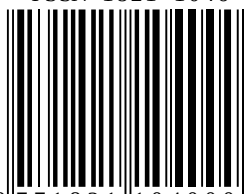
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A CONTRIBUTION TO THE KNOWLEDGE OF THE MITES (ACARI) FAUNA OF THE HORNBEAM IN SERBIA

Katarina MLADENović^{*1}, Aleksandar VEMIĆ¹, Sabahudin HADROVIĆ¹,
Milan KABILJO¹, Đorđe JOVIĆ¹

Abstract: This paper provides an analysis of the biodiversity of species within the families Phytoseiidae and Tetranychidae found on common hornbeam (*Carpinus betulus*) in both forest and horticultural habitats. For the first time worldwide, three predatory mite species from the family Phytoseiidae – *Amblyseius andersoni*, *Euseius finlandicus*, and *Phytoseius soleiger* – have been identified on hosts from the family Betulaceae, specifically within the genus *Carpinus* and the species *Carpinus betulus*. Additionally, the presence of a phytophagous mite species, *Eotetranychus carpini*, from the family Tetranychidae has been documented on hornbeam.

Keywords: predatory mites, spider mites, *Carpinus*.

PRILOG POZNAVANJU FAUNE GRINJA (ACARI) NA GRABU U SRBIJI

Sažetak: U radu je dat prikaz biodiverziteta vrsta fam. Phytoseiidae i fam. Tetranychidae utvrđene na običnom grabu u šumskim i hortikulturnim staništima. Prvi put u svetu su tri predatorske vrste grinja fam. Phytoseiidae - *Amblyseius andersoni*, *Euseius finlandicus* i *Phytoseius soleiger* utvrđene na fam. Betulaceae odnosno fam. Corylaceae rodu *Carpinus* i na vrsti *Carpinus betulus*. Na grabu je zabeleženo prisustvo i jedne vrste fitofagne grinje iz fam. Tetranychidae - *Eotetranychus carpini*.

Ključne reči: predatorske grinje, grinje paučinari, *Carpinus*.

1. INTRODUCTION

The prevailing spectrum of *Phytoseiidae* and *Tetranychidae* mite species on forest and horticultural broadleaf plants in Serbia has not yet been thoroughly investigated.

The importance of phytoseiid mites as potential biological control agents against phytophagous mites, particularly those in the *Tetranychoidae* and *Eriophyoidea* groups, as well as against thrips and whiteflies, continues to grow.

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Certain species of predatory mites are now used as commercial biocontrol agents in agriculture (Gerson et al., 2003; McMurtry et al., 2013). Natural reservoirs of predatory mites include native plant species in uncultivated ecosystems, as well as introduced species in urban habitats (Papaioannou-Souliotis et al., 2000; Tixier et al., 1998, 2000ab). The diversity of the *Phytoseiidae* family includes 2,880 described species across 101 genera (Demite et al., 2024). In Serbia, 51 species of phytoseiids from 15 genera have been recorded (Stojnić et al., 2023).

Spider mites are obligate phytophages and constitute the most significant group of pest mites in agriculture and forestry, currently comprising 1,356 phytophagous species, with over a hundred classified as pests and approximately ten as major pests (Migeon and Dorkeld 2024). Research on spider mites in Serbia has intensified over the past decade, with a total of 44 species documented to date (Đurkić 1955; Grujičić and Tomašević 1956; Marić et al., 2018; Mladenović et al., 2010ab, 2013ab, 2021ab; Petanović et al., 1983; Petanović and Stojnić 1995; Radivojević and Petanović 1984; Stojnić et al., 2002, 2014, 2018; Stojnić 1993; Tomašević 1964, 1965, 1967).

Carpinus betulus L., commonly known as the common or European hornbeam, was previously classified within the family *Corylaceae* Mirbel (Vukićević 1996). However, more recent classifications place the genus *Carpinus* within the family *Betulaceae* Gray (Cvijetićanin et al., 2016). This deciduous tree, growing up to 25 m tall, has a branched crown and spirally arranged leaves that are smooth on both sides. It is widely distributed across southern Europe (excluding the Iberian Peninsula), central Europe extending to southern England and southern Sweden, and, to the east, from the Black Sea to the Caucasus and northern Iran. Its altitudinal range reaches up to 700 m in central Europe, 1,000 m in the western Alps, and 1,800 m in Iran (Sikkema et al., 2016).

In Serbia, hornbeam is a common species, though it rarely forms pure stands, and is primarily found in mixed forests alongside oaks such as pedunculate oak and sessile oak. As a shade-tolerant species, it thrives in soils with excess moisture and is highly frost-resistant, playing an essential role in various mesophilic plant communities across lowland and hilly regions. These communities include sessile oak-hornbeam forests, pedunculate oak-hornbeam forests, Turkey oak and Hungarian forests, and montane beech forests up to 800 m a.s.l., where its leaf litter contributes mildly humic soil, which makes it a valuable understory species in oak forests (Cvijetićanin et al., 2016; Vukićević 1996).

Hornbeam wood is extremely hard and durable—the hardest among Serbia's woody species (Cvijetićanin et al., 2016)—and is used for making tool handles, wooden pegs, drumsticks, billiard cues, piano mechanisms, and more. With its high calorific value, it is also an excellent firewood choice and sometimes serves as a substitute for maple (Sikkema et al., 2016). Numerous horticultural forms of hornbeam are locally cultivated, and its robust sprouting and suitability for pruning make it popular for hedging (Vukićević 1996).

2. MATERIALS AND METHODS

Leaf samples of comon hornbeam were collected during the 2020 growing season from forest and horticultural habitats at five locations on Mt. Goč and in the Vršac municipality.

Each sample, comprising 100 leaves, was treated with ethyl acetate (Stojnić et al., 2021) and then carefully examined under a Leica Wild M3Z binocular microscope to isolate mites. After clearing (Evans and Browning 1955), the mites were mounted on slides in Hoyer’s medium (Baker and Wharton 1964; Krantz and Walter 2009).

Mite identification was conducted using a Leica DMLS phase contrast microscope, along with relevant keys and catalogs for the families *Phytoseiidae* and *Tetranychidae* (Baker and Tuttle 1994; Begljarov 1981; Bolland et al., 1998; Chant and McMurtry 2007; Karg 1993; Mitrofanov et al., 1987; Moraes et al., 2004; Pritchard and Baker 1955; Tixier et al., 2012).

Voucher specimens have been deposited in the Department of Forest Protection at the Institute of Forestry, Belgrade, and in the Department of Entomology and Agricultural Zoology at the Institute of Phytomedicine, University of Belgrade – Faculty of Agriculture.

3. RESULTS AND DISCUSSION

Three species of phytoseiid mites were identified on *C. betulus* leaf samples: *Amblyseius andersoni* (Chant, 1957), *Euseius finlandicus* (Oudemans, 1915), and *Paraseiulus soleiger* (Ribaga, 1904) (Table 1). These identified species represent the first recorded occurrence on the families *Betulaceae* and *Corylaceae*, as well as the genus *Carpinus* and the species *C. betulus* globally. According to the Phytoseiidae Database, 22 species of phytoseiid mites have been found on *Betulaceae* and eight species on *Corylaceae* to date, with only one species, *Typhlodromus* (*Typhlodromus*) *tulinae*, recorded on *C. betulus* in Turkey (Demite et al., 2024; Döker et al., 2023).

The species *A. andersoni* was found exclusively in the horticultural habitat in the Vršac location, while *E. finlandicus* and *P. soleiger* were identified in the forest ecosystems on Mt. Goč.

Table 1. Phytoseiid mites (Acari: Phytoseiidae) found on hornbeam

Host	Phytoseiidae Species	Habitat
<i>Carpinus betulus</i>	<i>Amblyseius andersoni</i>	Horticultural
	<i>Euseius finlandicus</i>	Forest
	<i>Paraseiulus soleiger</i>	Forest

Our research identified one species of spider mite, *Eotetranychus carpini* (Oudemans, 1905) on *C. betulus*, confirming earlier findings by Stojnić (1993) and

Marić et al. (2018). This tetranychid mite was found on hornbeam in both forest and horticultural habitats. To date, 37 species of spider mites have been recorded on the family *Betulaceae*, with 13 species on the genus *Carpinus* and nine species on *C. betulus*. In Serbia, in addition to *E. carpini*, three other tetranychid mite species from two subfamilies have been identified on hornbeam (Marić et al., 2018), bringing the total number of species to four.

A prey-predator complex was observed between *E. carpini* and *E. finlandicus* in the forest habitat, as well as between *E. carpini* and *A. andersoni* in the horticultural habitat.

The most common phytoseiid species in Serbia are *E. finlandicus* and *A. andersoni* (Stojnić et al., 2023). *E. finlandicus* is classified as a Type IV generalist predator that prefers pollen, with spider mites serving as a supplementary food source (McMurtry and Croft 1997; McMurtry et al., 2013). This species has been noted as a regulator of *Panonychus ulmi* (Koch, 1836), the European red mite, in temperate zones (McMurtry 1982). It is most commonly found on smooth leaves and hides in domatia when disturbed (Kabiček 2005, 2008). Furthermore, it is a cosmopolitan species (Demite et al., 2024).

A. andersoni is classified as a III-b subtype generalist, primarily preying on spider mites and eriophyids, with alternative food sources including pollen, honeydew, and phytopathogenic fungi (McMurtry et al., 2013; Pozzebon and Duso 2008). This species is frequently found on smooth leaves and has been documented as an efficient predator of various spider mites, including *E. carpini* (Camporese and Duso 1995; Duso et al., 2003; Duso and Camporese 1991). It is present in the Palearctic and Nearctic regions (Demite et al., 2024).

P. soleiger belongs to I-c subtype and is a specialised predator of tydeoids (*Tydeoidea*) (McMurtry et al., 2013). It is also found in the Palearctic and Nearctic regions (Demite et al., 2024).

E. carpini, commonly known as the yellow vine spider mite, has been recorded on 31 plant species across 15 families. It is distributed in the Palearctic and Nearctic regions (Migeon and Dorkeld 2024). It has been identified as a pest in vineyards in southern Europe (Malagnini et al., 2012).

4. CONCLUSIONS

This study contributes to the understanding of the species diversity of phytoseiid and tetranychid mites identified on the significant forest and horticultural woody species *C. betulus* in Serbia.

In Serbia, three species of predatory mites from the family *Phytoseiidae* were identified on hornbeam. They are *A. andersoni*, *E. finlandicus*, and *P. soleiger*, along with one species of phytophagous mite from the family *Tetranychidae*: *E. carpini*.

The findings of *A. andersoni*, *E. finlandicus* and *P. soleiger* represent the first recorded occurrences of these species globally within the family *Betulaceae* (formerly *Corylaceae*), the genus *Carpinus*, and the species *C. betulus*.

Associations between predatory and phytophagous mites were observed in both examined habitats—forest and horticultural—specifically between *E. carpini* and *E. finlandicus*, as well as between *E. carpini* and *A. andersoni*.

Further research on acarofauna in Serbia is essential, particularly focusing on the fauna of phytoseiids as significant biological agents in forest and urban ecosystems.

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CONTRIBUTION TO THE STUDY OF MITE FAUNA (ACARI) ON HORNBEAM IN SERBIA

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Summary

This study explores the diversity of mites associated with hornbeam in Serbia, offering a comprehensive overview of predatory and phytophagous mite species from the families *Phytoseiidae* and *Tetranychidae* identified in forest and horticultural habitats. We documented three predatory mite species from the *Phytoseiidae* family: *Amblyseius andersoni*, *Euseius finlandicus*, and *Phytoseius soleiger*, as well as one phytophagous mite species from the *Tetranychidae* family: *Eotetranychus carpini*. The three identified predatory species from the family *Phytoseiidae* represent the first documented findings for the family *Betulaceae*, specifically for the genus *Carpinus* and the species *Carpinus betulus*.

Our samples revealed a complex of prey-predator interactions between *E. carpini* and *E. finlandicus* in the forest habitat, as well as between *E. carpini* and *A. andersoni* in the horticultural setting. Both *A. andersoni* and *E. finlandicus* were categorised as generalist predators of different subgroups, effective against spider mites, including *E. carpini*. Conversely, *P. soleiger* is classified as a specialist predator that exclusively feeds on tydeid mites, a group not found in association with spider mites in our observations.

Further research on the diversity of *Phytoseiidae* and *Tetranychidae* on forest plant species, which serve as natural reservoirs for predatory mites, is necessary, as they regulate the populations of economically significant phytophagous mite pests.

PRILOG POZNAVANJU FAUNE GRINJA (ACARI) NA GRABU U SRBIJI

Katarina MLADENović, Aleksandar VEMIĆ, Sabahudin HADROVIĆ, Milan KABILJO, Đorđe JOVIĆ

Rezime

U radu je prikazan diverzitet grinja na grabu u Srbiji gde je dat pregled vrsta predatorskih i fitfagnih grinja iz familije *Phytoseiidae* i *Tetranychidae* utvrđenih na šumskim i hortikulturnim staništima. Na grabu je zabeleženo prisustvo tri vrste predatorskih grinja iz fam. *Phytoseiidae* - *Amblyseius andersoni*, *Euseius finlandicus* i *Phytoseius soleiger* i jedne vrste fitofagne grinja iz fam. *Tetranychidae* - *Eotetranychus*

carpin. Tri determinisane predatorske vrste fam Phytoseiidae su u svetu prvi nalaz za fam. Betulaceae odnosno fam. Corylaceae, rod *Carpinus* i vrstu *Carpinus betulus*.

U uzorcima utvrđen je specijski kompleks plen-predator između *E. carpini* i *E. finlandicus* u šumskom staništu odnosno *E. carpini* i *A. andersoni* na hortikulturnom staništu. *A. andersoni* i *E. finlandicus* su prema životnom stilu grupisani u predatore generaliste različitih podgrupa koje su zabeleženi kao efikasni predatori paučinaru među kojima je plen i *E. carpini*. *P. soleiger* je u grupi predatora specijalista koja se hrani tideidama, vrsta koja u našim nalazima nije nadjena u zajednici sa paučinaima. Potrebno je nastaviti dalja istraživanja diverziteta fitozeida I tetranihida na šumskim biljnim vrstama koje su prirodni rezervoari predatorskih grinja a koje su regulatori brojnosti fitofagnih grinja koje su ekonomski značajne štetočine.

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