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## PHYTOPHAGOUS AND PREDATORY MITES IN SLOVENIA

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**ABSTRACT** — A chronology and review of previous publications on the occurrence and description of plant-inhabiting mites in Slovenia is presented. The list of mites recorded in Slovenia includes six species of Tetranychidae, which were first recorded by Janežič in 1951 and 1975. Thirty-eight mites of the superfamily Eriophyoidea were first reported by Janežič in 1989; seven additional species from the same superfamily were first reported by Vrabl in 1999, and one species was reported by Celar and Valič (2003). One species belonging to the Tarsonemidae family and one belonging to the family Tetranychidae were reported by Vrabl (1999). Four species of predatory Phytoseiidae mites were reported by Tojnko *et al.* in 1998, and 15 species of predatory mites were reported in 2006 by Miklavc – 11 of them for the first time. *Calepitrimerus vitis*, *Colomerus vitis*, *Panonychus ulmi* and *Tetranychus urticae* are among the most important agricultural pests. The most important predatory mites in Slovenia include *Typhlodromus pyri*, *Neoseiulus cucumeris*, and *Amblyseius andersoni*.

**KEYWORDS** — phytophagous mites; Prostigmata; predatory mites; Phytoseiidae; ornamental plants; vegetable crops; fruit crops

### INTRODUCTION AND METHODS

In this paper, we provide an overview of the knowledge of plant-inhabiting mites, mainly of the families Phytoseiidae and Tetranychidae and the superfamily Eriophyoidea, derived from research performed on cultivated plants in Slovenia. The influence of predatory and phytophagous mites in Slovenian agricultural systems was first mentioned by Franjo Janežič in 1951 (Janežič, 1951). He collected plant galls from a wide variety of plants, mostly from wild-growing plants. In 1975, he also described some Tetranychidae species on cultivated plants. In the last few years, studies of mites have mostly focused on cultivated and ornamental plants

(Vrabl *et al.*, 1981; Celar and Valič, 2003; Remic *et al.*, 2009). The Phytoseiidae is a mite family in the order Mesostigmata (Tixier, 2012), and many species in this family are predators of phytophagous mites (Palevsky *et al.*, 1999). Phytoseiid mites are important biological control agents of pest mites affecting many crops in different countries (Greco *et al.*, 2005). The acarine family Phytoseiidae includes a large number of generalist predators that can develop and reproduce using various food sources as alternatives to pest mites in orchards, citrus, grapes, field crops and in glasshouses (Palevsky *et al.*, 1999).

In this mini review, we focused on mites, which are important from an agricultural point of view.

TABLE 1: Plant inhabiting mites recorded in Slovenia.

(Super) families and species	Host plant	Host plant - common name	Reference
<b>Eriophyoidea</b>			
<i>Aceria schmarldai</i> (Nal.)	<i>Campula glomerata</i> (Nal.)	clustered bellflower	Janežič, 1989
<i>Aceria drabae</i> (Nal.)	<i>Cardaria draba</i> (L.) (Desv.)	whitetop	Janežič, 1989
<i>Epitremus heterogaster</i> (Nal.)	<i>Clematis recta</i> L.	old man's beard	Janežič, 1989
<i>Aceria convolvuli</i> (Nal.)	<i>Convolvus arvensis</i> L.	field bindweed	Janežič, 1989
<i>Vasates convolvuli</i> (Nal.)	<i>Convolvus arvensis</i> L.	field bindweed	Janežič, 1989
<i>Vasates coronillae</i> (Can. et Mass.)	<i>Coronilla varia</i> L.	Crown vetch	Janežič, 1989
<i>Cecidophyes galii</i> (Karp.)	<i>Gallium mollugo</i> L.	wild matter	Janežič, 1989
<i>Aceria geranii</i> (Can.)	<i>Geranium palustre</i> Torner	marsh cranesbill	Janežič, 1989
<i>Aceria euaspis</i> (Nal.)	<i>Dorycnium herbaceum</i> Vill.	bird's foot trefoil	Janežič, 1989
<i>Aceria laticincta</i> (Nal.)	<i>Lysimachia vulgaris</i> L.	garden loosestrife	Janežič, 1989
<i>Eriophyes mali</i> (Nal.)	<i>Malus domestica</i> Borkh.	apple tree	Janežič, 1989
<i>Aceria plicator trifolii</i> (Nal.)	<i>Medicago carstiensis</i> Wull.	yellow floweralfalfa	Janežič, 1989
<i>Aceria megacera</i> (Can et Mass.)	<i>Mentha longifolia</i> (L.) Briq.	horse mint	Janežič, 1989
<i>Aceria peucedani</i> (Can.)	<i>Orlaya grandiflora</i> (L.) Hoffm.	white lace flower	Janežič, 1989
<i>Aceria picridis</i> (Can. et Mass.)	<i>Picris echioides</i> L.	bristly ox-tongue	Janežič, 1989
<i>Aceria phloeocoptes</i> (Nal.) (Nal.)	<i>Prunus domestica</i> L.	European plum	Janežič, 1989
<i>Eriophyes padi prunianus</i> (Nal.)	<i>Prunus domestica</i> L.	European plum	Janežič, 1989
<i>Eriophyes similis</i> (Nal.)	<i>Prunus domestica</i> L.	European plum	Janežič, 1989
<i>Eriophyes piri marginemtorquens</i> (Nal.)	<i>Pyrus communis</i> L.	common pear	Janežič, 1989
<i>Eriophyes piri</i> (Pgst.)	<i>Pyrus domestica</i> L.	pear tree	Janežič, 1989
	<i>Cydonia oblonga</i> Mill.	quince	
<i>Eriophyes gibbosus</i> (Nal.)	<i>Rubus caesius</i> L.	European dewberry	Janežič, 1989
<i>Eriophyes gracilis</i> (Nal.)	<i>Rubus caesius</i> L.	European raspberry	Janežič, 1989
<i>Aceria truncata</i> (Nal.)	<i>Pyrus domestica</i> L.	pear tree	Janežič, 1989
<i>Eriophyes triradiatus</i> (Nal.)	<i>Pyrus domestica</i> L.	pear tree	Janežič, 1989
<i>Aceria salviae</i> (Nal.)	<i>Salvia pratensis</i> L.	meadow sage	Janežič, 1989
<i>Aceria peucedani</i> (Can.)	<i>Sellinum carvifolia</i> L.	little-leaf angelica	Janežič, 1989
<i>Vasates rigidus</i> (Nal.)	<i>Serratula tinctoria</i> L.	saw-wort	Janežič, 1989
<i>Aceria drabae</i> (Nal.)	<i>Sisymbrium altissimum</i> L.	tumbling mustard	Janežič, 1989
<i>Aceria tuberculata</i> (Nal.)	<i>Tanacetum vulgare</i> L.	common tansy	Janežič, 1989
<i>Vasates rigidus</i> (Nal.)	<i>Taraxacum officinale</i> Web.	common dandelion	Janežič, 1989
<i>Aceria minor</i> (Nal.)	<i>Thymus serpyllum</i> L.	Breckland thyme	Janežič, 1989
<i>Aceria thomasi</i> (Nal.)	<i>Thymus serpyllum</i> L.	Breckland thyme	Janežič, 1989
<i>Aceria anceps</i> (Nal.)	<i>Veronica chamaedrys</i> L.	germander speedwell	Janežič, 1989
<i>Vasates retiolatus</i> (Nal.)	<i>Vicia cracca</i> L.	tufted vetch	Janežič, 1989
<i>Aceria plicator trifolii</i> (Nal.)	<i>Viccia hirsuta</i> (L.) Gray	tiny vetch	Janežič, 1989
<i>Epitremus vitis</i> (Nal.)	<i>Vitis vinifera</i> L.	common grape vine	Janežič, 1989
<i>Eriophyes vitis</i> (Pgst.)	<i>Vitis vinifera</i> L.	common grape vine	Janežič, 1989
<i>Phyllocoptes vitis</i> (Nal.)	<i>Vitis vinifera</i> L.	common grape vine	Janežič, 1989

TABLE 1: Continued.

(Super) families and species	Host plant	Host plant - common name	Reference
<i>Cecidophyopsis ribis</i> (Westw.)	<i>Ribes nigrum</i> L.	black currant	Vrabl <i>et al.</i> , 1981
<i>Phytoptus avellanae</i> (Nal.)	<i>Corylus avellana</i> L.	common hazel	Beber, 1993
<i>Aculops lycopersici</i> (Masse) (Masse)	<i>Lycopersicon esculentum</i> L.	tomato	Celar, 2003
<i>Phytoptus similis</i> (Nal.)	<i>Prunus domestica</i> L.	European plum	Vrabl, 1999
<i>Eriophyes padi</i> (Nal.)	<i>Prunus domestica</i> L.	European plum	Vrabl, 1999
<i>Acalitus essigi</i> (Hassan)	<i>Rubus fruticosus</i> L.	redberry	Vrabl, 1999
<i>Epirimerus pyri</i> (Nal.)	<i>Pyrus communis</i> L.	pear	Vrabl, 1999
<i>Aculus schlechtendali</i> (Nal.)	<i>Malus domestica</i> Borkh.	apple tree	Vrabl, 1999
<i>Calepitrimerus vitis</i> (Nal.)	<i>Vitis vinifera</i> L.	common grape vine	Vrabl, 1999
<i>Colomerus vitis</i> (Pagst.)	<i>Vitis vinifera</i> L.	common grape vine	Vrabl, 1999
<b>Tarsonemidae</b>			
<i>Tarsonemus pallidus</i> (Banks)	<i>Fragaria x ananasa</i> Duchesne ex Rozier	strawberry	Janežič, 1989
<b>Tenuipalpidae</b>			
<i>Chenopalpus pulcher</i> (Can. et Fanz.)	<i>Cornus mas</i> L.	European cornel	Janežič, 1989
<b>Tetranychidae</b>			
<i>Tetranychus urticae</i> (Koch)		fruit crops, ornamental plants, vegetable crops	Janežič, 1951
<i>Bryobia rubrioculus</i> (Scheut.)	<i>Malus domestica</i> Borkh., <i>Prunus domestica</i> L.	apple tree european plum	Janežič, 1975
<i>Panonychus ulmi</i> (Koch)	<i>Malus domestica</i> Borkh., <i>Vitis vinifera</i> L., <i>Pyrus communis</i> L., <i>Prunus avium</i> L., <i>Prunus spinosa</i> L., <i>Prunus persica</i> L.	apple tree, common grape vine, pear, sweet cheery, black thorn, peach	Janežič, 1975
<i>Neotetranychus rubi</i> (Träg.)	<i>Rubus idaeus</i> L.	red raspberry	Janežič, 1975
<i>Eotetranychus carpini</i> (Oud.)	<i>Vitis vinifera</i> L.	common grape vine	Janežič, 1975
<i>Eotetranychus pruni</i> (Oud.)	<i>Malus domestica</i> Borkh.	apple tree	Janežič, 1975
<i>Bryobia ribis</i> (Thom.)	<i>Ribes uva-crispa</i> L.	gooseberry	Vrabl, 1999
<b>Phytoseiidae</b>			
<i>Amblyseius andersoni</i> (Chant)	<i>Malus domestica</i> Borkh.	apple tree	Miklavc, 2006
<i>Neoseiulus cucumeris</i> (Oud.)	<i>Malus domestica</i> Borkh.	apple tree	Miklavc, 2006
<i>Thyphlodromus (Anthoseius) bakeri</i> (Gar.)	<i>Malus domestica</i> Borkh.	apple tree	Miklavc, 2006
<i>Amblyseius rademacheri</i> Dosse	<i>Malus domestica</i> Borkh.	apple tree	Miklavc, 2006

TABLE 1: Continued.

(Super) families and species	Host plant	Host plant - common name	Reference
<i>Neoseiulus reductus</i> (Wain.)	<i>Malus domestica</i> Borkh.	apple tree	Miklavc, 2006
<i>Typhlodromus (Anthoseius) rhenanus</i> (Oud.)	<i>Malus domestica</i> Borkh.	apple tree	Miklavc, 2006
<i>Phytoseiulus macropilis</i> (Banks)	<i>Malus domestica</i> Borkh.	apple tree	Miklavc, 2006
<i>Euseius finlandicus</i> (Oud.)	<i>Malus domestica</i> Borkh.	apple tree	Miklavc, 2006
<i>Kampimodromus aberrans</i> (Oud.)	<i>Malus domestica</i> Borkh.	apple tree	Miklavc, 2006
<i>Paraseiulus soleiger</i> (Rib.)	<i>Malus domestica</i> Borkh.	apple tree	Miklavc, 2006
<i>Paraseiulus talbii</i> (Athias-Henriot)	<i>Malus domestica</i> Borkh.	apple tree	Miklavc, 2006
<i>Paraseiulus triporus</i> (Chant & Shaul)	<i>Malus domestica</i> Borkh.	apple tree	Miklavc, 2006
<i>Neoseiulella tiliarum</i> (Oud.)	<i>Malus domestica</i> Borkh.	apple tree	Miklavc, 2006
<i>Typhlodromus (Typhlodromus) pyri</i> (Scheut.)	<i>Malus domestica</i> Borkh.	apple tree	Miklavc, 2006
<b>Stigmaeidae</b>			
<i>Zetzellia mali</i> (Eving)	<i>Malus domestica</i> Borkh.	apple tree	Miklavc and Miklavc, 2001

Since the current state of knowledge on phytophagous and predatory mites and their occurrence in Slovenia is relatively poor and scattered, this paper aims at providing a summary of previous reports and a knowledge base for future efforts to diminish the damages caused by phytophagous mites by proper control measures, including the use of indigenous predatory mites. We found and review the relevant records of four books and eight articles written by Slovenian authors.

## RESULTS AND DISCUSSION

The first Slovenian studies on phytophagous mites date back to 1951, when Janežič recorded the two-spotted spider mite, *Tetranychus urticae* Koch (Janežič, 1951) (Table 1). In the mid 1970's, he recorded five phytophagous mites not previously reported in Slovenia, all belonging to the spider mite family Tetranychidae (Janežič, 1975). In the late 1980's, Janežič performed a survey of plants with agricultural value and reported the discovery of 38 eriophyid species (Janežič, 1989) (Table 1). In addition, one eriophyid species was reported by Beber (1993) and one by Celar and Valič (2003). In 1999, seven eriophyid species were first reported by Vrabl (1999). All eriophyid species listed in Table 1

are of relatively high economic importance in Slovenia. The cyclamen mite (*Tarsonemus pallidus* Banks), which is a key pest of horticultural plants in many countries (Raudonis, 2006), was first identified in Slovenia in 1999 by Vrabl (Table 1).

The worldwide inventory of the mite family Phytoseiidae (predatory mites) currently includes 2,122 valid species described between 1839 and 2010 (Tixier *et al.*, 2012). A survey performed by Miklavc (2006) identified 11 Phytoseiidae species in Slovenia (Table 1). These predatory mites can be divided into two groups: indigenous and exotic species (Phytosanitary Administration of The Republic of Slovenia, 2006). However, regarding the list of commercially available biological control agent products (Phytosanitary Administration of The Republic of Slovenia, 2011) in Slovenia, we discovered that there is no product available that contains predatory mites. Phytoseiidae mites can be highly efficient biological control agents against a wide spectrum of pests of ornamental and vegetable crops worldwide – such as eriophyid mites (Shimoda *et al.*, 2010), western flower thrips (Rahman *et al.*, 2011), and tarsonemid species (Raudonis *et al.*, 2006). For this reason, we initiated a comprehensive survey of predatory mites in Slovenia, with

the aim of using these mites to improve food production systems in this country.

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