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The occurrence of tydeoid mites (Acari: Tydeoidea) in Hungarian vineyards

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Abstract

A faunal survey was carried out in Hungary between 2011 and 2014 in order to monitor the occurrence of tydeoid species in 139 vineyards located in five distinctive wine regions. Twenty four tydeoid species belonging to the families Tydeidae, Iolinidae and Triophtydeidae have been identified, of which *Tydeus californicus* (Banks) was the most dominant species. The following thirteen species, viz. *Tydeus reticoxus* Ueckermann, *T. spathulatus* Oudemans, *Brachytydeus falsa* (Livshitz), *B. latiuscula* (Kuznetzov), *B. longiuscula* (Kuznetzov), *B. matura* (Livshitz), *B. opima* (Kuznetzov & Zapletina), *B. tuttlei* (Baker), *Metalorryia palpsetosa* (Karg), *Nudilorryia paraferula* Kaźmierski, *N. mariae* Kaźmierski, *Pseudolorryia striata* Momen & Lundqvist, and *Neopronematus neglectus* (Kuznetzov) were added to Hungarian fauna. Of the identified species, 18 were collected for the first time in vineyards, and this was also the first record of seven species since their original description.

Key words: Tydeidae, Iolinidae, Triophtydeidae, faunal survey, vineyards

Introduction

The mite superfamily Tydeoidea is worldwide in distribution, occurring from Antarctica to the tropics, from the seashores to alpine meadows, from the coldest areas to dry or hot deserts. Its species have successfully colonized a wide range of habitats, from soil to the nasal cavities of mammals (André & Fain 2000). Tydeoid mites are very frequently encountered in leaf litter, soil, and humus, on moss, lichens, mushrooms, grass, shrubs, cultivated and wild plants, and in stored products. They were also recorded on insects and in mammal and bird nests (Kaźmierski 1998; Stojnic *et al.* 2002). Tydeoid morphology, ontogeny and systematics are better known than their ecology, biology and economic importance (Kaźmierski 1998). Little is known about the ecological interactions between these mites and their habitats, and few have been categorized as generalists. Their feeding habits are not well known, some are reported to be plant feeders (phytophagous) and pollen feeders, others as predators but most as scavengers or fungivores (Stojnic *et al.* 2002; Silva *et al.* 2014a, b).

The knowledge of their feeding habits is fragmentary or characterised by conflicting observations (Duso *et al.* 2005). A number of species feed on pollen, fungi, honeydew, and sooty mould, but some of them can act as predators of small arthropods, in particular eriophyoids (Mendel & Gerson 1982; Hessein & Perring 1986, 1988a, b; Brodeur *et al.* 1997; Liguori *et al.* 2002; English-Loeb *et al.* 2007).

The superfamily Tydeoidea was reorganized by André & Fain (2000) and comprises four families: Ereynetidae, Iolinidae, Triophtydeidae (previously Meyerellidae), and Tydeidae (André *et al.* 2010; Silva *et al.* 2014a). The authors also accept this categorization and use it henceforth. The family Meyerellidae was renamed Edbakerellidae and the subfamily Meyerellinae was renamed

Edbakerellinae (André 2004). The Triophtydeidae name was retained by Walter *et al.* (2009) to designate Meyerellidae and the Edbakerellidae. The superfamily Tydeoidea comprises four families: Ereynetidae, Iolinidae, Edbakerellidae, and Tydeidae (Doncyk 2006; Theron *et al.* 2012). The family Triophtydeidae includes about 40 species placed in the two subfamilies Triophtydeinae and Edbakerellinae (Walter *et al.* 2009). This group includes soil, plant and cortically living species, but little is known about their feeding behaviour (Theron *et al.* 2012). The Iolinidae family includes about 125 known species in 36 genera (Walter *et al.* 2009). Free-living iolinids can occur in soil, on foliage or in association with, or dependent on, insects (Theron *et al.* 2012). The Tydeidae is the largest cosmopolitan family in the Tydeoidea and includes only three subfamilies: Tydeinae, Pretydeinae, and Australotydeinae, with 30 genera and 340 described species (Walter *et al.* 2009). Collection data of members of the Tydeoidea and especially that of the family Tydeidae, can be divided into two groups. Species of the first group were collected from various plants which were not in agroecosystems, but in parks and arboretums in natural or semi-natural biotopes (André 1986; Kulczycki 1992; Momen & Lundqvist 1996; Stojnic *et al.* 2002; Donczyk 2006; Komlovszky 1979, 1984; Bozai 1997; Ripka & Kaźmierski 1998; Ripka 2000; Bozai & Takács 2002; Ripka *et al.* 2002, 2005, 2013a, b). The data of the second group is from collections and studies carried out from agroecosystems, mainly among orchards and vineyards (Knisley & Swift 1972; Rasmy *et al.* 1972; Natchev & Simova 1978; Farrier *et al.* 1980; Momen 1987; Castagnoli 1989; Karg 1975, 1991, 1992; Çobanoğlu & Kaźmierski 1999; Niemczyk 2007; Kasap & Çobanoğlu 2007; Sabbatini Peverieri *et al.* 2009; Kulikova 2011; Silva *et al.* 2014a; Dellei & Szendrey 1989, 1991a,b; Szendrey & Voigt 2000; Molnár 1997, 2003; Tímár *et al.* 2004; Tempfli *et al.* 2012, 2014). This information serves as an indication of the species diversity in natural habitats as compared to the diversity in farming areas (e.g. vineyards) where agricultural practices such as chemical pest management, can influence it.

Knowledge of the feeding habits, ecological, biological and economic role played by the majority of the tydeoid species occurring in agroecosystems is scrappy. Their role in orchards and vineyards, their influence on pest management through being a potential alternative food source for the phytoseiid mites is unexplored. In order to lay the foundations of further studies that could contribute to the knowledge about the ecology of tydeoid species, surveys were carried out in 139 vineyards of the biggest five wine areas of Hungary to assess tydeoid assemblages.

Materials and methods

Study areas. We conducted our studies between 2011 and 2014 in vineyards belonging to five major Hungarian wine regions (Eger, Badacsony, Kunság, Szekszárd, and Tokaj-Hegyalja), which makes up for a little more than half of the total Hungarian grapevine growing area (Figure 1). We collected samples from a total of 139 vineyards adjacent to 42 settlements. Samples were collected from plots of 1–3 ha in size and 10–30 years old vine plants. Vines were grown using mainly cordon and umbrella ("Pendelbogen") training systems. The majority of the selected vineyards used integrated pest management (IPM), but we also selected organic and conventional pest management vineyards as well as abandoned vineyards. Carbamates, organophosphates, pyrethroids and acaricidal products were not applied in any of the sampled vineyards.

Considering its zoogeographic classification, Hungary is part of the Holarctic fauna region, the Palearctic fauna sub region (Wallace 1876). Considering its biogeographic, Hungary is part of the Pannonian biogeographical region. Hungary's biogeographical region is characterized by a continental climate, with a median temperature of ca. 11 ˚C, average annual precipitation of 500–750 mm, summer absolute maximum temperatures reaching 40°C, and winter absolute minimum temperatures falling to -20°C (EEA 2002).

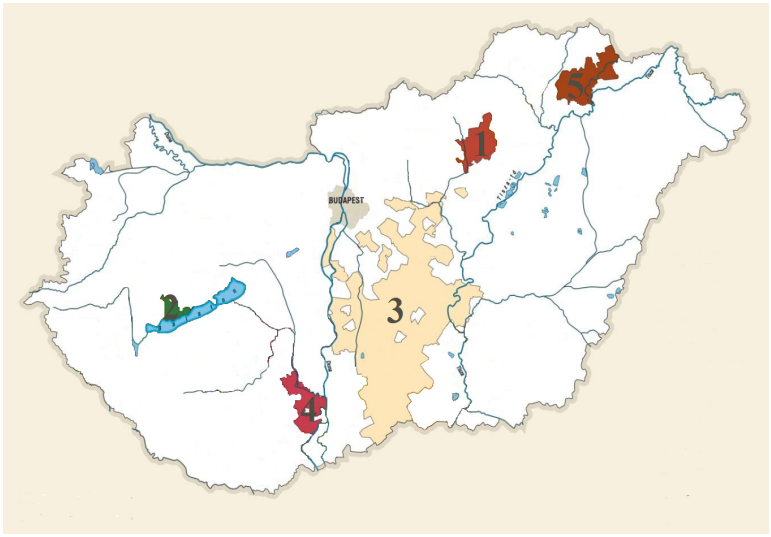

FIGURE 1. The location of the studied wine regions (1. Eger, 2. Badacsony, 3. Kunság, 4. Szekszárd, 5. Tokaj-Hegyalja) in Hungary (2011–2014)

Samples and identification. For our faunal study, we collected individuals of the Tydeoidea superfamily from the woody parts of grapevines only during the winter dormancy period. Sampling was conducted in January or February and every vineyard was sampled once during the study. We selected the grapevine varieties that were most characteristic of the respective wine regions (Table 1). The names of grape varieties are according to the Vitis International Variety Catalogue. We collected 100 woody parts, mainly spurs, measuring 10 cm in length, per vineyard, with random diagonal sampling. The mites were extracted with the use of "Berlese" (modified Tullgren) funnels (Brady 1969). Each sample was kept in the funnels for 24 hours under a 40 W bulb, trapping the mites in small containers positioned under the funnels and filled with ethanol (96%). The specimens were mounted in a Berlese-Hoyer solution and identified by the key of Kaźmierski (1998) and by original species descriptions. The material was identified by the first author. A Zeiss Axio Imager A2 microscope was used for the identifications and making digital microscopic images. Some of the specimens were deposited in the mite collection of the Corvinus University of Budapest's Faculty of Horticultural Science.

TABLE 1. The grape varieties per wine regions with the number of studied vineyards (2011–2014)

Eger Wine Region	Badacsony Wine Region	Kunság Wine Region	Tokaj-Hegyalja Wine Region	Szekszárd Wine Region
Blaufraenkisch (10)	Pinot gris (7)	Blaufraenkisch (8)	Muscat a petits grains blancs (14)	Blaufraenkisch (9)
Merlot noir (7)	Welschriesling (7)	Cserszegi fueszeres (9)	Harslevelue (13)	Merlot noir (8)
Cabernet Sauvignon (5)	Keknyelue (4)	Riesling weiss (1)	Furmint (14)	Kadarka kek (7)
Cabernet Franc (5)	Rozsakoe (2)		Kabar (1)	
Blauburger (3)			Kover szoeloe (1)	
Chardonnay blanc (3)			Zeta (1)	

Statistical analysis. The relative abundance of the tydeoid species was calculated using the combined number of individuals from all studied vineyards. Multiple comparisons between the relative abundance of species were completed by the Marascuilo's procedure at $p < 0.05$ significance level (Marascuilo 1966). The prevalence (the relative occurrence of at least a single individual in the studied vineyards) of a species was compared by a one-way block design ANOVA. The proportional occurrence of species in the vineyards within a wine region was calculated, then the data was ln(x+1) transformed before running ANOVA. Post-hoc pairwise comparisons were calculated by Games-Howell test at $p < 0.05$ significance level. Original (untransformed) means are reported for both response variables.

Results and discussion

In our study, we identified a total of 24 tydeoid mite species from the five studied wine regions, which belonged to a total of three families and eight genera within the superfamily Tydeoidea. This is the first report of the genera *Nudilorryia* and *Pseudolorryia* from Hungary and the species are indicated with an asterisk. The following includes an overview of the identified species.

Family TYDEIDAE Kramer
Subfamily TYDEINAE Kramer *sensu* André

Genus *Tydeus* Koch

Brachytydeus Thor 1933: 54 (in part).
Tydeus Koch 1836: 11–12; *sensu* Oudemans 1937: 922 (in part); *sensu* Kaźmierski 1989: 292.
Calotydeus Oudemans 1937: 923 (in part).
Orthotydeus André 1980: 127.

1. *Tydeus californicus* (Banks)

Tetranychoides californicus Banks 1904: 54.

Çobanoğlu & Kaźmierski (1999) described the species *T. californicus* as a likely cosmopolitan species which has been reported from many field crops. It is very common in southern countries on various plants, but especially on fruit, citrus and ornamental trees. This is supported by Natchev & Simova (1978); Momen (1987); Dellei & Szendrey (1989); Niemczyk (2007); Stojnic (2001); Kasap & Cobanoğlu (2007); Kulikova (2011) and Sadeghi *et al.* (2012) who also reported this species in orchards, while Kulczycki (1992); Bozai (1997); Ripka & Kaźmierski (1998); Ripka (2000) and Ripka *et al.* (2002, 2005, 2013b) found it on a wide variety of trees and shrubs.

T. californicus unequivocally surpassed the other tydeoid mite species in relative abundance as this species was the most dominant: 55% of all the tydeoid mites were *T. californicus* (Table 2) and it was among the most prevalent species: occurred in 78% of the 139 vineyards (Table 3). This was not a surprise as many Hungarian and foreign records on *T. californicus* in vineyards are available (Molnár 1990a, 1997, 2003; Dellei & Szendrey 1991a,b; Szendrey & Voigt 2000) (Rasmy *et al.* 1972; Castagnoli 1989; Çobanoğlu & Kaźmierski 1999; Sabbatini Peverieri *et al.* 2009; Silva *et al.* 2014a).

The common occurrence of *T. californicus* in vineyards and orchards may be because it preferred preying on rust mites (Eriophyidae) (Niemczyk 2007). The latter author also found that it feeds selectively on apple rust mites (*Aculus schlechtendali*) and blackcurrant gall mite (*Cecidophyopsis ribis*). Silva *et al.* (2014b) showed that this species also feeds on pollen, which is

an essential food supplement to reach adulthood. *Tydeus californicus* can survive for long periods of time on this diet and thus can play an important role in the management of rust mites.

TABLE 2. The total number of tydeoid mites recorded per wine region (a: Eger, b: Badacsony, c: Kunság, d: Tokaj-Hegyalja, e: Szekszárd) (2011-2014)

Species	a.	b.	c.	d.	e.	Total	%	Sig.[a]
	2936	**2664**	**4168**	**2396**	**213**	**12377**		
Tydeus californicus	310	2162	3346	946	69	6833	55	a
Tydeus reticoxus	408	36	64	726	82	1316	11	c
Tydeus caudatus	3	166			1	170	1	fg
Tydeus kochi		7				7	<1	ijk
Tydeus spathulatus			111	1		112	1	gh
Brachytydeus reticulata	2171	211	102	14	23	2521	20	b
Brachytydeus cf. italica	16	45	19	37	2	119	1	gh
Brachytydeus tuttlei	14	15	15			44	<1	hi
Brachytydeus falsa					1	1	<1	k
Brachytydeus matura					2	2	<1	jk
Brachytydeus obliqua		1			1	2	<1	jk
Brachytydeus paraobliqua				1		1	<1	k
Brachytydeus longiuscula		1				1	<1	k
Brachytydeus latiuscula	1					1	<1	k
Brachytydeus ocellata	6	1	1	4		12	<1	ijk
Brachytydeus opima			11	229	1	241	2	ef
Brachytydeus amica			11	2	1	14	<1	ijk
Pseudolorryia striata	1	15	1			17	<1	ijk
Metalorryia palpsetosa				1		1	<1	k
Nudilorryia paraferula			164	2	8	174	1	efg
Nudilorryia mariae			297			297	2	de
Homeopronematus staerki			11	409	6	426	3	d
Neopronematus neglectus				19		19	<1	ijk
Triophtydeus triophthalmus	6	4	15	5	16	46	<1	hi

[a] Different letters indicate significant differences ($p<0.05$) between relative abundance of species according to the multiple comparison of proportion (Marascuilo's procedure)

TABLE 3. The number of vineyards in which a given species was represented per wine region (a: Eger, b: Badacsony, c: Kunság, d: Tokaj-Hegyalja, e: Szekszárd) (2011–2014).

Species	a.	b.	c.	d.	e.	Total	%	Sig.[a]
Number of studied vineyards:	**33**	**20**	**18**	**44**	**24**	**139**		
Tydeus californicus	27	20	16	31	15	109	78	a
Tydeus reticoxus	32	10	13	38	14	107	77	ab
Tydeus caudatus	2	7			1	10	7	abcdef
Tydeus kochi		3				3	2	cdef
Tydeus spathulatus			9	1		10	7	abcdef
Brachytydeus reticulata	31	15	10	9	7	72	52	abc
Brachytydeus cf. italica	9	12	2	16	2	41	30	abcd
Brachytydeus tuttlei	2	3	7			12	9	abcdef
Brachytydeus falsa					1	1	<1	f
Brachytydeus matura					1	1	<1	f
Brachytydeus obliqua		1			1	2	1	def
Brachytydeus paraobliqua				1		1	<1	f
Brachytydeus longiuscula		1				1	<1	ef
Brachytydeus latiuscula	1					1	<1	f
Brachytydeus ocellata	2	1	1	2		6	4	cdef
Brachytydeus opima			9	36	1	46	33	abcdef
Brachytydeus amica			3	2	1	6	4	abcdef
Pseudolorryia striata	1	2	1			4	3	abcdef
Metalorryia palpsetosa				1		1	<1	f
Nudilorryia paraferula			15	2	3	20	14	abcdef
Nudilorryia mariae			13			13	9	abcdef
Homeopronematus staerki			3	35	5	43	31	abcdef
Neopronematus neglectus				7		7	5	bcdef
Triophtydeus triophthalmus	5	3	3	4	3	18	13	cde
Number of tydeoid species per wine region	10	12	14	14	13	24		

[a] Different letters indicate significant differences ($p<0.05$) between relative occurrence of species by Games-Howell test

2. *Tydeus caudatus* (Dugès)
Tetranychus caudatus Dugès 1834: 29.

As *T. californicus*, *T. caudatus* is also widespread (probably cosmopolitan) species characterized by Baker (1970) and Stojnic *et al.* (2002) and revised by André (2005). It occurs on a wide range of host plants in the more temperate areas of the world and was reported from Greece, Germany, Portugal, Ireland, Italy, Bulgaria, Hungary, Sweden, and even Canada, Egypt, Georgia, Crimea, and Ukraine. The species was often collected from leaves of fruit trees (Natchev & Simova 1978; Momen 1987; Dellei & Szendrey 1989; Karg 1991, 1992; Çobanoğlu & Kaźmierski 1999; Niemczyk 2007; Kulikova 2011) as well as other trees and herbaceous plants (Komlovszky 1979; Castagnoli 1984; Kulczycki 1992; Momen & Lundqvist 1996; Bozai 1997; Ripka & Kaźmierski 1998; Stojnic *et al.* 2002; Ripka *et al.* 2002, 2005, 2013b; Donczyk 2006) from all over the world (Çobanoğlu & Kaźmierski 1999).

Just as *T. californicus*, *T. caudatus* also has a common occurrence in vineyards (Castagnoli 1989; Molnár 1990b, 1997, 2003; Dellei & Szendrey 1991a; Szendrey & Voigt 2000; Ferragut *et al.* 2008; Sabbatini Peverieri *et al.* 2009). The present study showed that its relative abundance and occurrence (although, the difference in the latter response variable was non significant) in vineyards is much lower and less than those of *T. californicus* (Table 2, 3). Since these two species appeared to mutually exclude each other in a study (Niemczyk 2007), the dominance of *T. californicus* could explain the scarcity of *T. caudatus*. A better adaptation potential of *T. californicus* to feed on alternative food sources might be responsible for the observed difference in the relative abundance.

3. *Tydeus kochi* Oudemans
Tydeus kochi Oudemans 1928: 378.

This species has a world-wide distribution and was found in all types of climatic zones (Baker 1970). Kaźmierski (1990) confirmed this and reported that in all likelihood *T. kochi* is a cosmopolitan species. This is also supported by the fact that the species has been found in both the Old World (Ireland: Momen (1987); Ukraine: Kulczycki (1992); Sweden: Momen & Lundqvist (1996); Poland: Donczyk (2006), Niemczyk (2007); Moldavia: Kulikova (2011); Netherlands; Georgia; Azerbaijan; Iran: Sadeghi *et al.* (2012)), and the New World (USA: Knisley & Swift (1972); Canada: Momen & Sinha (1991)).

Previously, only three articles reported on its occurrence in Hungary (Bozai 1997; Ripka *et al.* 2005, 2013b) but not from farming areas. We only have data on its occurrence in vineyards from Italy (Castagnoli 1989; Sabbatini Peverieri *et al.* 2009). In this study, *T. kochi* was scarcely found in the vineyards. Being previously found only in Italian vineyards and due to its scarcity in Hungarian vineyards it was concluded that it plays only a minor role on grapevine.

4. *_Tydeus reticoxus_ Ueckermann
Tydeus reticoxus Ueckermann 1988: 13.

The only previous record of this species is its original description (Meyer & Ueckermann 1988), in which the authors found it on *Protasparagus laricinus* (Burch.) in Mountain Zebra National Park, located in the Republic of South Africa, in 1986.

This is a huge and surprising leap for *T. reticoxus* and what was more surprising that it was present in 77% of the vineyards, about equal to *T. californicus* (78 %) and it even surpassed the latter in two wine regions (Table 3). However, the number of *T. reticoxus* individuals (1316) was far less than those of *T. californicus* (6833) (Table 2). It is important to note that of the five studied wine

regions, there was only one that was not dominated by *T. californicus* or *T. reticoxus*. The presence of this species in Hungarian vineyards may be because of the ever increasing cross-continental traffic in plant material and in this case vinicultural products. Studies of the mite species compilation in the vineyards of other countries might produce very interesting information for pest control and prevention of the introduction of exotic pests.

To confirm the identity of *T. reticoxus* we requested the type material and original description of this species to compare it with our specimens. Final confirmation was obtained by returning the type material together with Hungarian specimens to the South African specialist, Prof E.A. Ueckermann for his approval. Ripka *et al.* (2013a) described a new species *Tydeus martae* Kaźmierski, which closely resembles *T. reticoxus*. However, we considered them as separate species; therefore *T. retixocus*, is a new record for the Hungarian, but also European fauna.

5. ****Tydeus spathulatus* **Oudemans
Tydeus spathulatus Oudemans 1928: 380.

During the past years, innumerable questions have been raised regarding the identity of this species which was addressed by André (2005) with a re-description of the type specimen in the National Museum of Natural History, Leiden, The Netherlands. Ueckermann & Grout (2007) reported this species from Zimbabwe on *Citrus* sp., but André *et al.* (2010) described these specimens as a new species, *Tydeus mvurwiensis* André. We also used the description published by André *et al.* (2010) for identification. Only one individual was found in the four hilly wine regions. However, more specimens were found in half of the vineyards, located in the Kunság wine region, at the lowest altitude. The reasons for this phenomenon may be the differences in temperatures (higher summer maximum and lower winter minimum temperature) and the topographical variations among the wine regions. The climatological and topographical conditions of Kunság wine region most probably favoured the presence of this species in this region.

Genus *Brachytydeus* Thor
Brachytydeus Thor 1931: 102.
Raphitydeus Thor 1933:54
Lorryia Oudemans 1925: 32 *sensu* Kaźmierski 1989, 1998.

6. *Brachytydeus amica* (Kaźmierski)
Lorryia amica Kaźmierski 1998: 312.

This species was first described in Hungary and was found in a young deciduous forest (*Quercus* sp., *Robinia* sp., scrubs) (Kaźmierski 1998). Çobanoğlu & Kaźmierski (1999) found the species on the plant species *Cotoneaster bullatus* Bois when studying the mite fauna of Turkish commercial orchards. During the course of our studies, we found individuals of the species in low numbers in only three studied wine regions. This is the first report of this species from Hungarian vineyards, however, occurring in only three regions with very low relative abundance suggested that it did not play a significant role in these vineyards.

7. * *Brachytydeus falsa* (Livshitz)
Paralorryia falsa Livshitz 1973: 282.

This species was originally described as *Paralorryia falsa* from the bark of a giant redwood (*Sequoiadendron giganteum* (Lindl.) Buchholz) in the Nikitsky Botanical Gardens (Livshitz & Kuznetzov (1973a). We only found a single individual of this species in a vineyard of one region.

8. * *Brachytydeus latiuscula* (Kuznetzov)
Paralorryia latiuscula Kuznetzov 1972: 30.

Kuznetzov (1972a) described this species as *Paralorryia latiuscula* from *Robinia pseudoacacia* L. in the Crimea. Only one specimen of this species was found in one of the wine regions.

9. * *Brachytydeus longiuscula* (Kuznetzov)
Paralorryia longiuscula Kuznetzov 1972: 32.

Kuznetzov (1972a) described this species as *Paralorryia longiuscula* from *Cerasus avium* (L.) Moench and *Pseudosasa japonica* (Siebold & Zucc. ex Steud.) Makino ex Nakai in the Crimea. Donczyk (2006) reported it from Poland from ten different habitats of two different protected landscapes. As the previous two species, this species was also represented by only one specimen in one of the regions.

10. * *Brachytydeus matura* (Livshitz)
Tydeus maturus Livshitz 1973: 17.

The species was first described from the Crimean Peninsula as *Tydeus maturus* (Kuznetzov & Livshitz 1973). Stojnić (2001) reported it from Serbia as *Lorryia maturus* and Kaźmierski (2008) from Poland. Two specimens were found in a single vineyard.

11. *Brachytydeus obliqua* (Kuznetzov)
Paralorryia obliqua Kuznetzov 1973: 604.

This species was first described as *Paralorryia obliqua* from *Spirea* sp. in the Nikitsky Botanical Gardens (Livshitz & Kuznetzov 1973b). Ripka & Kaźmierski (1998) reported it in Hungary on *Prunus domestica* L., while Ripka *et al.* (2005) collected it from *Quercus rubra* L. in Hungary. Stojnić *et al.* (2002) found this species on *Tilia* sp. in Serbia. We found two specimens in two different wine regions.

12. *Brachytydeus ocellata* (Kuznetzov)
Paralorryia ocellata Kuznetzov 1972: 34.

This species was originally described as *Paralorryia ocellata* and was collected on *Hibiscus syriacus* L. in the Crimean Peninsula (Kuznetzov 1972a). Kulikova (2011) reported it from apple (*Malus domestica* Borkh.) in the Republic of Moldova and also used the name *P. ocellata*. In Hungary Bozai (1997) reported it from two ornamental plants and Tímár *et al.* (2004) from garlic (*Allium sativum* L.); both authors referred to the species as *P. ocellata*. Recently Ripka *et al.* (2013a, b) provided more information on this species in Hungary. Although we only collected them in small numbers, we did find the species in four wine regions. Grapes can now also added to the list of host plants.

13. * *Brachytydeus opima* (Kuznetzov & Zapletina)
Tydeus opimus Kuznetzov & Zapletina 1973: 1252.

Livshitz *et al.* (1973) first described this species as *Tydeus opimus* on apple (*Malus domestica* Borkh.) in what is today Azerbaijan. This is the second report of this species and the first for Hungary and surprisingly we found them in significant numbers. We found individuals of the species in a total of three wine regions, and the species appeared to be one of the dominant species in the Tokaj-

Hegyalja Wine Region. Identifying the possible cause(s) for its high abundance and the role it plays in the Hungarian vineyards warrant additional studies.

14. *Brachytydeus paraobliqua* (Panou & Emmanouel)
Lorryia paraobliqua Panou & Emmanouel 1996: 91.

Panou & Emmanouel (1996) were the first to describe this species, from *Prunus cerasus* L. and *Cornus* sp. in Greece. Ripka *et al.* (2002) reported it for the first time from leaves of *Tilia tomentosa* Mönch. in Hungary. This is the first report from Hungarian vineyards from only one sample.

15. *Brachytydeus reticulata* (Oudemans)
Tydeus reticulatus Oudemans 1928: 380.

This is a widespread (probably cosmopolitan) species (Baker 1968; Kaźmierski 1998; Çobanoğlu & Kaźmierski 1999). It has been collected in many European countries (Ukraine: Kulczycki (1992); Poland: Kaźmierski (1980, 1990), Donczyk (2006); Germany: Karg (1975, 1991, 1992); Ireland: Momen (1987); Britain: Evans (1952); Netherlands: Oudemans (1929); Belgium: André (1986); Norway: Thor (1931); Turkey: Çobanoğlu & Kaźmierski (1999); Moldavia: Kulikova (2011)), but it is also known from the United States: Garman (1948), Farrier *et al.* (1980), Baker (1965, 1968); Canada: Sinha (1962), Marshall (1970); Momen & Sinha (1991), and even Iran: Sadeghi *et al.* (2012). This species was also reported from a wide range of host plants in Hungary (Bozai 1997; Ripka & Kaźmierski 1998 and Ripka *et al.* 2002, 2013b).

After *T. californicus*, *B. reticulata* was the second most common species in our studies of Hungarian wine regions. With close to twice the number of collected individuals, *B. reticulata* surpassed *T. reticoxus*, and there was no significant difference between the 3 most abundant species in terms of their relative occurrence in vineyards (Table 2, 3). There was one wine region in which the individuals of *B. reticulata* dominated the tydeoid assemblages. Since it is considered to be a cosmopolitan species, we expected to encounter the species, but finding such prevalence in the vineyards was surprising. It was especially so since this mite had not yet been described on grapevines. In light of the data described herein, it is thus justified to conduct additional studies with the species to shed light on its possible role in pest management.

16. *_Brachytydeus tuttlei_ (Baker)
Tydeus tuttlei Baker, 1965:100.

The species was originally described by Baker (1965) as *Tydeus tuttlei*, from Bermuda grass (*Cynodon dactylon* (L.)). Farrier *et al.* (1980) reported it from apple orchards in North Carolina and Reichert *et al.* (2014) from soybean. We report it from three of the wine regions in low numbers.

17. *Brachytydeus* cf. *italica* (Oudemans)
Tydeus italicus Oudemans 1928: 379.

The species *B. mali* (Oudemans), *B. ferula* (Baker) and *B. italica* (Oudemans) are very closely related to each other, however, the latter two species seem to be most closely related (Kaźmierski 1998). *B. italica* was present in all the studied wine regions in rather high numbers, the exact description or correct identification of this species warrant further research.

Genus *Metalorryia* André
Metalorryia André 1980: 118.

18. ****Metalorryia palpsetosa* **(Karg)
Lorryia palpsetosa Karg 1975: 97.

The species was described by Karg (1975) as *Lorryia palpsetosa* from an apple orchard near Potsdam, Germany. Niemczyk (2007) reported this species from Polish apple orchards and referred to it as *Metalorryia* sp. n. cf. *palpsetosa*. Only a single individual was collected during this study.

Genus *Nudilorryia* Kaźmierski
Nudilorryia Kaźmierski 1996: 200.

19. ****Nudilorryia mariae* **Kaźmierski
Nudilorryia mariae Kaźmierski 1996: 208.

The species was described by Kaźmierski (1996) from Szydlow in Kielce province, Poland, where it was collected from mosses and detritus on a rocky xerothermic slope above an old sandstone quarry. Our report is the second for the species but the first outside Poland and from vineyards. It was found only in the Kunság Wine Region, where it was present in 72% of the vineyards, in significantly high numbers. The reasons for this may be the same as for those mentioned in the case of *T. spathulatus:* the differences in temperatures (winter minimum and summer maximum) and the topographical variations among the wine regions.

20. ****Nudilorryia paraferula* **Kaźmierski
Nudilorryia paraferula Kaźmierski 1996: 204.

The first and thus far the only mention of this species is its original description (Kaźmierski 1996). The species was first found in the nest of a fieldfare (*Turdus pilaris* L.) in a common alder (*Alnus glutinosa* (L.)) forest on the floodplain of the river Warta, between the settlements of Lad, Ladek, and Zagorow. It should be noted that the work of Stojnić (2001) already hinted at the occurrence of *Nudilorryia cf. paraferula* sp. nov. in Serbia. Similarly to *Nudilorryia mariae*, the individuals of this species were also represented in surprisingly high numbers. In this case, this species was found in three of the wine regions, but the majority of specimens were concentrated in the Kunság Wine Region. The individuals of *N. paraferula* were found in even more vineyards than *N. mariae*, suggesting that members of the *Nudilorryia* genus might be better adapted to the conditions of the Kunság Wine region.

Genus *Pseudolorryia* Kaźmierski
Pseudolorryia Kaźmierski 1989: 292.

21. ****Pseudolorryia striata* **(Momen & Lundqvist)
Pseudolorryia striatus Momen & Lundqvist 1996: 290.

The first and thus far the only mention of this species is its original description (Momen & Lundqvist 1996). The first individuals of the species were found on moss located on ground level, on the bark of apple trees, and the bark of *Salix fragilis* L. in Sweden. During this study we found it in four vineyards of three wine regions, at low numbers. It is assumed that this mite species is rare and is not common in vineyards.

Family IOLINIDAE Pritchard
Subfamily PRONEMATINAE André
Genus *Neopronematus* Panou, Emmanouel & Kaźmierski
Neopronematus Panou, Emmanouel & Kaźmierski 2000: 322.

22. *Neopronematus neglectus* (Kuznetzov)
Pronematus neglectus Kuznetzov 1972: 12.

Kuznetzov (1972b) was the first to describe *Pronematus neglectus* from tamarisk (*Tamarix* sp.) and peach (*Persica vulgaris* Mill.) in the Black Sea region. Khodayari *et al.* (2008) reported this species on apple trees in East Azerbaijan Province (Maragheh region). We found it only in the Tokaj-Hegyalja Wine Region in a few vineyards at very low numbers and therefore we considered its presence coincidental. This species was collected for the first time in Hungary.

Genus *Homeopronematus* André
Homeopronematus André 1980: 113.

23. *Homeopronematus staerki* (Schruft)
Pronematus staerki Schruft 1972: 129.

Schruft (1972) was the first to describe this species as *Pronematus staerki*, on grapevines in Germany where it preyed on *Calepitrimerus vitis* (Nalepa). Stojnić (2001) mentioned finding a *Homeopronematus* cf. *staerki* sp. nov. in Serbia. Ripka & Kaźmierski (1998) and Ripka *et al.* (2005) reported it from Hungary. They reported this species from 11 additional host plants. We located individuals of the species in three wine regions, but it was mainly concentrated in the Tokaj-Hegyalja Wine Region. *Homeopronematus staerki* occurred in relatively high numbers and therefore we assume that it is common in both vineyards and on other host plants.

Family TRIOPHTYDEIDAE André
Subfamily TRIOPHTYDEINAE André
Genus *Triophtydeus* Thor
Triophtydeus Thor 1932: 88.

24. *Triophtydeus triophthalmus* (Oudemans)
Tydeus triophthalmus Oudemans 1929: 482.

The type species of the genus was re-described by André (1985). *Triophtydeus triophthalmus* was commonly found in various habitats but its feeding habits are not sufficiently known—as for other *Triophtydeus* species (Çobanoğlu & Kaźmierski 1999). This species has been found in Germany (Thor 1933), Sweden (Momen & Lundqvist 1996) on *Picea abies* (L.), Turkey (Çobanoğlu & Kaźmierski 1999) on *Juniperus arizonica* (R. P. Adams) and *Berberis vulgaris* L., and Italy (Sabbatini Peverieri *et al.* 2009) in vineyards. Ripka & Kaźmierski (1998) and Ripka *et al.* (2002, 2005) reported it from Hungary on an additional 21 plant species. Previous studies reported it in very low numbers in farming areas as well as in the present study though it was represented in all the wine regions.

Discussion

An important result of this study is the expansion of the known Hungarian Tydeoidea fauna with the addition of first reports of 13 species, increasing the number of reported tydeoid mite species in Hungary to 64. For some of the species in our study, no data pertaining to their occurrence on grapevines was previously available from Hungary with the exception of *Tydeus californicus* and *Tydeus caudatus*. This means that the additional species found in the course of this study were collected from grapevine for the first time, which thus increases the number of mite species known from grapevines in Hungary to 27. Numerous species were collected from grapevine world-wide. According to the available literature the following species were reported for the first time from grapevine: *T. reticoxus*, *T. spathulatus*, *B. amica*, *B. falsa*, *B. longiuscula*, *B. latiuscula*, *B. matura*, *B. obliqua*, *B. ocellata*, *B. opima*, *B. paraobliqua*, *B. reticulata*, *B. tuttlei*, *M. palpsetosa*, *N. mariae*, *N. paraferula*, *P. striata*, or *N. neglectus*. The present study is also the first mention of the species *T. reticoxus*, *B. falsa*, *B. latiuscula*, *B. opima*, *N. mariae*, *N. paraferula*, and *P. striata* since their first descriptions.

In regard to the occurrence of these species, it can be stated that only 1-3 species were found in 37% of the studied vineyards; however, 4-6 tydeoid mite species were found in half of the vineyards (Table 4). There were also 12 vineyards in the study where seven or more species were recovered from the samples. Regarding the occurrence of the species in wine regions, it is concluded that there were five mite species that were found in all five of the studied wine regions and at least ten mite species were found in each of the wine regions (Table 3).

TABLE 4. Diversity of the tydeoid fauna in wine regions of Hungary represented by the number of vineyards at every level of species richness (Wine regions: a: Eger, b: Badacsony, c: Kunság, d: Tokaj-Hegyalja, e: Szekszárd) (2011–2014).

Wine regions	Number of studied vineyards	Number of found species per vineyards										
		0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**11**
		Number of vineyards on the given species richness level										
a.	**33**		1	4	14	9	5					
b.	**20**			5	3	6	3	1	2			
c.	**18**		1	1		3	5		3	3	1	1
d.	**44**		1	7	5	10	13	6	2			
e.	**24**	6	3	5	2	4	4					
Total	**139**	6	6	22	24	32	30	7	7	3	1	1
%		4	4	16	17	23	22	5	5	2	<1	<1

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