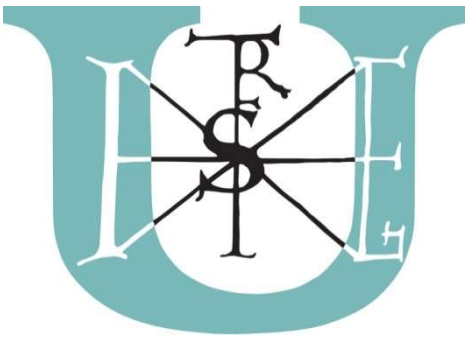

Szent István University

THE OCCURRENCE OF TYDEOID MITES (ACARI: TYDEOIDEA) IN HUNGARIAN VINEYARDS

Thesis of doctoral (Ph.D) dissertation

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1. BACKGROUND AND OBJECTIVES

Despite the fact that in the past two decades there have been an increased number of studies involving the mite faunas of horticultural permanent crops, there are still countless areas that remain unexplored. The pest composition of horticultural crops is constantly undergoing changes as a result of developments in both plant production technologies and plant protection methods. Over time, certain species end up being pushed into the background while other species call attention to themselves by causing increased damages. More in-depth and broader studies may help supplement our incomplete knowledge and can point out additional possibilities for increasing the role of zoophagous species in limiting populations. A number of Hungarian researchers have also carried out studies involving fauna, the primary purpose of which was to assess the mite population of horticultural cultures and to determine their dominance relationships. The primary goal of these studies was to gain information on and map the mite species affecting Hungarian vineyards and apple orchards as well as the predatory mites (mainly Phytoseiidae species) that are able to decimate their numbers. However, the literature dealing with the occurrence of species in the Tydeoidea superfamily in Hungary is extremely spotty. Until now, acarology studies have unfortunately not dealt with species in the Tydeoidea superfamily: to this day, there have been no comprehensive studies regarding their occurrence in Hungarian orchards. Until we know the exact species that are present, we will be unable to determine the role played by Tydeoidea mites, which are a significant secondary food source for predatory mite species.

Once we are familiar with the species composition of Tydeoidea mites, we will be able to study their role in plant protection. Moreover, regular sampling can also provide a possibility for observing the population dynamics of species and thereby for uncovering the lifestyles of the most common species. One of the possible methods is to clarify the role of Tydeoidea species, which are a possible (alternative) food source for zoophagous mite species and which are often present in large numbers in Hungarian orchards. In other parts of the world, much more detailed research has been started in the field; however, their results can only be adapted to Hungary after suitably thorough examinations.

In the present work, I undertook to provide a presentation of a new, extremely interesting, niche area, the backbone of which consists of mapping and introducing the Tydeoidea species occurring in Hungarian vineyards (~60,000 ha) and organising the knowledge collected in Hungary thus far. The primary goal of the study is to identify the Tydeoidea species that occur in vineyards and to determine if there is any dominant species. I would like to provide faunistic data that are more detailed than previously available regarding the distribution of mites in the Tydeoidea superfamily occurring in Hungarian wine regions.

During the course of my work, another important goal that I set was to study, as far as possible, the Tydeoidea species identified in previous Hungarian collections. The most significant collection in Hungary is attributed to Dr. József Bozai, who compiled a vast collection of Tydeoidea species over the course of his expansive work. I consider it essential that this extremely valuable work be preserved and used to supplement the results of my research.

2. MATERIALS AND METHODS

2.1. Collecting in vineyards and processing samples

I conducted my studies between 2011 and 2014 in vineyards belonging to five major Hungarian wine regions (Eger, Badacsony, Kunság, Szekszárd, and Tokaj-Hegyalja). When selecting the examined vine growing regions, a factor that was taken into consideration was that they should be located in various parts of the country and should include both mountainous and lowland wine regions. Another target during selection was to include regions in the study or for which no faunistic data was yet available, as well as regions where earlier data could be compared to current data. Since there was data from the Eger wine region regarding the occurrence of Tydeoidea species, this wine region was the first to be examined. We also had earlier data from the vineyards of the Balaton Highlands and Veszprém County, so the Badacsony wine region was named the second vine producing area to be studied. This is the first time data on Tydeoidea species is being published from the Kunság, Szekszárd, and Tokaj-Hegyalja wine regions.

During the winter months, I collected samples from a total of 139 vineyards located in the outskirts of 42 settlements. The majority of the selected vineyards use integrated pest management (IPM), though the selection also included, in much smaller numbers, vineyards that use organic or conventional plant protection methods, as well as abandoned vineyards. When selecting the vineyards, care was taken to ensure that they grow the vine variety most characteristic of the given wine region (Table 1) and used the most common training systems.

Samples were always taken during the winter dormancy period from the woody parts of vines. I collected 100 woody parts, mainly “spurs”, measuring 10 cm in length, per vineyard, with random diagonal sampling. (Figure 1).

Figure 1. Woody part (“spurs”), the basic unit of sample collection

Table 1. 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)	

The mites were extracted with the use of "Berlese" (modified Tullgren) funnels. This setup was provided by the Department of Entomology and I had previously obtained extensive experience in its use. 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 (98%).

2.2. Mite preparation

The collected animals were preserved and processed with the traditional methods and tools used in the Department of Entomology, as these are best suited for the purpose. After they were removed from the funnel apparatus, the contents of the receptacles were poured into petri dishes and the animals swimming in the etanol were transferred to slides using a micropipette under a stereo microscope (Zeiss, Stemi 2000). As the alcohol quickly evaporated, only the dry mites remained on the plates. The specimens were mounted in a Berlese-Hoyer solution with the help of a thin needle under the stereo microscope; the medium was then covered. Care was taken to ensure that the animals in the alcohol were prepared as soon as possible, as storage in the alcohol can have negative effects on the mites' integuments, in turn leading to difficulties in identification. After labelling, the slides were placed in a drying oven until the solution solidified, where they were kept at 40°C for one month.

2.3. Identification

The tools and instruments necessary for identification (light microscope with a magnification of 1,000, imaging equipment, library, and IT infrastructure) were available at the Department of Entomology and the Faculty. In the interest of exact and successful identification, I compiled a literary database of more than 250 articles (original species descriptions, identification keys, nomenclature works, and morphology descriptions) in connection with this group. Of these, Professor Andrźej Kaźmierski's identification key was used as the basis of identification, supplemented with the original species descriptions where necessary. I accepted Professor Henri M. André's concept regarding the use of the *Brachytydeus* genus and based the naming of the species in the Tydeinae subfamily on it. Henri M. André's nomenclature, terms, and system were used for identification, including Andrźej Kaźmierski's detailed morphological works.

A Zeiss Axio Imager A2 microscope (magnification: 50× – 1000×) was used for identification and taking digital microscopic images. Digital pictures were taken of the main features used to identify the species. The results were then stored on a computer. A collection was compiled with the use of the best examples from each species, which is available at the Szent István University's Department of Entomology. Paint was used to provide the covers of the specimen slides with an airtight seal (frame) prior to being placed in the collection. Professor Andrźej Kaźmierski, performing research work at the Adam Mickiewicz University in Poznań, helped in expanding my knowledge regarding identification and checking the examples that I identified; I visited him in person on two separate occasions.

2.4. The revision of Tydeoidea species obtained from earlier Hungarian collections

During my work, I had the opportunity to borrow and study the largest collection of Tydeoidea species available in Hungary. Two boxes of slides contained the Tydeoidea species identified by Professor József Bozai. I inspected each of the slides in the collection, documented their labels, and identified the animals they contained, taking photographs as necessary. A summary of my notes regarding the various slides is included in the Results.

3. Results

3.1. Results of the faunistic studies

In my study, I 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 Tydeoidea superfamily. This is the first report of the genera *Nudilorryia* and *Pseudolorryia* from Hungary. Of the collected twenty four Tydeoidea species, eleven species (*Tydeus californicus* (Banks, 1904), *T. caudatus* (Dugés, 1834), *T. kochi* Oudemans, 1928, *Brachytydeus amica* (Kaźmierski, 1998), *B. obliqua* (Kuznetzov, 1973), *B. ocellata* (Kuznetzov, 1972), *B. paraobliqua* (Panou et Emmanuel, 1996), *B. reticulata* (Oudemans, 1928), *B.* cf. *italica*, *Homeopronematus staerki* (Schruft, 1972), *Triophtydeus triophthalmus* (Oudemans, 1929)) were already known in Hungary; however, thirteen species (*T. reticoxus* Ueckermann, 1988, *T. spathulatus* Oudemans, 1928, *B. falsa* (Livshitz, 1973), *B. longiuscula* (Kuznetzov, 1972), *B. latiuscula* (Kuznetzov, 1972), *B. matura* (Livshitz, 1973), *B. opima* (Kuznetzov et Zapletina, 1973), *B. tuttlei* (Baker, 1965), *Metalorryia palpsetosa* (Karg, 1975), *Nudilorryia mariae* Kaźmierski, 1996, *N. paraferula* Kaźmierski, 1996, *Pseudolorryia striata* (Momen et Lundqvist, 1996), *Neopronematus neglectus* (Kuznetzov, 1972)) were new to Hungary. With the exception of *T. californicus* and *T. caudatus,* no Hungarian data had previously been available about their occurrence on vine. This means that this is the first time that the other species identified by the study were collected from vine, thus increasing the number of Tydeoidea species known to occur on vine in Hungary to 28. This is also the first time a number of these species were collected from vine not only in Hungary, but also the rest of the world. Studying international literature, I found no references to *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*, and *N. neglectus* having been found on vine. Continuing the perusal of literature, I also determined that *T. reticoxus*, *B. falsa*, *B. latiuscula*, *B. opima*, *N. mariae*, *N. paraferula,* and *P. striata* had not been found on a single occasion since they were originally described, meaning the collections I performed led to their repeated finding. A further result of my work is that I managed to collect the male individuals of five species (*B. matura, B. opima, B.* cf. *italica, N. mariae*, *N. paraferula*) where literature indicates that only the females had been previously collected.

As regards the occurrence of mite species in vineyards, it can be determined that 37,5 % of the studied vine growing areas contained only 1-3 species; however, individuals from 4-6 Tydeoidea species were identified in half of all vineyards. The study also included 12 vineyards where individuals from seven or more species were collected.

In connection with the occurrence of mite species in wine regions, it can be determined that there are five species (*T. californicus*, *T. reticoxus*, *B. reticulata*, *B.* cf. *italica*, *T. triophthalmus*) that occurred in the samples from all five examined wine regions, and there were at least ten Tydeoidea species that were found in all studies wine regions (Table 3).

When analysing the species I identified during my studies, *T. californicus* was found to clearly surpass the others in its numbers, both as regards prevalence in vineyards and the number of individuals. This is shown by the fact that 55 % of all identified individuals (12,377 individuals) were *T. californicus* (Table 2), with individuals of the species present in 78 % of the 139 studied vineyards (Table 3). Continuing the examination of the data, it was also found that *T. reticoxus* (77 %) was close behind *T. californicus* (78 %) and even surpassed its numbers in two wine regions (Eger and Tokaj-Hegyalja) (Table 3). However, the total number of *T. reticoxus* individuals (1,316) was far behind the number of *T. californicus* individuals (6,833) (Table 2). It must be emphasised that of the five examined wine regions, there was only one where the individuals of *T. californicus* and *T. reticoxus* were not dominant. In the case of the Eger wine region, *B. reticulata* was the dominant species. In aggregate, *B. reticulata* was found to be the third most common Tydeoidea species in Hungarian vineyards. Although *B. reticulata* surpassed the number of *T. reticoxus* individuals with almost twice as many individuals collected, it significantly lagged behind as regards its occurrence in vineyards.

I also consider it important to note in connection with the *T. reticoxus* species that I did not find a single reference to the locations where the species had previously been found. The first and thus far the only mention of the species is its original species description, which the authors found in 1986 on a *Protasparagus laricinus* (Burch.) in Mountain Zebra National Park in South Africa. The fact that the found individuals were *T. reticoxus* was confirmed by the fact that the animals' morphological features were entirely the same as the data provided by the species description; however, to obtain further proof, I contacted the original describer of the species (Prof. E.A. Ueckermann) as well as Professor Andrźej Kaźmierski, both of whom confirmed my identification. It should be noted that a new species, *Tydeus martae* Kaźmierski, was recently described, in 2013, by Dr. Géza Ripka et al. which is very similar to the *T. reticoxus* species. Even in light of this fact, I consider the animals that I identified to be *T. reticoxus* individuals, which is thus a new species as regards not only Hungarian, but also European fauna.

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	%
	2936	**2664**	**4168**	**2396**	**213**	**12377**	
Tydeus californicus	310	2162	3346	946	69	6833	55
Tydeus reticoxus	408	36	64	726	82	1316	11
Tydeus caudatus	3	166			1	170	1
Tydeus kochi		7				7	<1
Tydeus spathulatus			111	1		112	1
Brachytydeus reticulata	2171	211	102	14	23	2521	20
Brachytydeus cf. *italica*	16	57	19	37	2	131	1
Brachytydeus tuttlei	14	3	15			22	<1
Brachytydeus falsa					1	1	<1
Brachytydeus matura					2	2	<1
Brachytydeus obliqua		1			1	2	<1
Brachytydeus paraobliqua				1		1	<1
Brachytydeus longiuscula		1				1	<1
Brachytydeus latiuscula	1					1	<1
Brachytydeus ocellata	6	1	1	4		12	<1
Brachytydeus opima			11	229	1	241	2
Brachytydeus amica			11	2	1	14	<1
Pseudolorryia striata	1	15	1			17	<1
Metalorryia palpsetosa				1		1	<1
Nudilorryia paraferula			164	2	8	174	1
Nudilorryia mariae			297			297	2
Homeopronematus staerki			11	409	6	426	3
Neopronematus neglectus				19		19	<1
Triophtydeus triophthalmus	6	4	15	5	16	46	<1

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**	**%**
Number of studied vineyards:	**33**	**20**	**18**	**44**	**24**	**139**	
Tydeus californicus	27	20	16	31	15	109	78
Tydeus reticoxus	32	10	13	38	14	107	77
Tydeus caudatus	2	7			1	10	7
Tydeus kochi		3				3	2
Tydeus spathulatus			9	1		10	7
Brachytydeus reticulata	31	15	10	9	7	72	52
Brachytydeus cf. *italica*	9	12	2	16	2	41	30
Brachytydeus tuttlei	2	3	7			12	9
Brachytydeus falsa					1	1	<1
Brachytydeus matura					1	1	<1
Brachytydeus obliqua		1			1	2	1
Brachytydeus paraobliqua				1		1	<1
Brachytydeus longiuscula		1				1	<1
Brachytydeus latiuscula	1					1	<1
Brachytydeus ocellata	2	1	1	2		6	4
Brachytydeus opima			9	36	1	46	33
Brachytydeus amica			3	2	1	6	4
Pseudolorryia striata	1	2	1			4	3
Metalorryia palpsetosa				1		1	<1
Nudilorryia paraferula			15	2	3	20	14
Nudilorryia mariae			13			13	9
Homeopronematus staerki			3	35	5	43	31
Neopronematus neglectus				7		7	5
Triophtydeus triophthalmus	5	3	3	4	3	18	13
Number of Tydeoid species per wine region	**10**	**12**	**14**	**14**	**13**	**24**	

If I compare the species that occurred most frequently and with the greatest abundance from the aspect of which species is dominant and which is subdominant in the various wine regions, *T. californicus* continues to appear to be the leading species in Hungary's vineyards. It is followed closely by *T. reticoxus*. *B. reticulata* is worth mentioning as the third species (Table 4).

Table 4. The species identified by the study as dominant and subdominant in the various wine regions

	Eger Wine Region	**Badacsony Wine Region**	**Kunság Wine Region**	**Tokaj-Hegyalja Wine Region**	**Szekszárd Wine Region**
Dominant	*B. reticulata*	*T. californicus*	*T. californicus*	*T. reticoxus*	*T. reticoxus*
Subdominant	*T. reticoxus*	*B. reticulata*	*N. paraferula* *N. mariae*	*T. californicus*	*T. californicus*

3.2. The results of the revision of Tydeoidea species obtained from earlier Hungarian collections

When summarising the results obtained by studying the collection, the species can be classified into two groups. The first group contains the species that were clearly found not to have been identified by the Professor. These included *T. inclutus* Livshitz, 1973, *T. kochi*, *B. wainsteini* (Kuznetzov, 1973), *B. praefata* (Kuznetzov et Zapletina, 1973), *B. obnoxia* (Kuznetzov et Zapletina, 1972), *B. elinguis* (Kuznetzov, 1973), *B. incrustata* (Kuznetzov, 1972), *B. electra* (Kuznetzov, 1973), and *Tyndareus rostratus* Kuznetzov, 1972. The second group contained the individuals where I was able to confirm their identification. These were *B. dumosa* (Kuznetzov, 1973), *B. visenda* (Kuznetzov, 1973), *B. ocellata,* and *B. reticulata*. During the course of studying the species in the collection, two species new to Hungarian fauna were identified: ***Metalorryia armaghensis*** (Baker, 1968) and ***Neoapolorryia kristinae*** Momen et Lundqvist, 1996.

I would like to note that during my time spent at the Department with my scholarship, I was able to identify another species new to Hungary. During the course of reviewing the various plant materials submitted to the Department of Entomology for the purpose of identifying pests and the damage they cause, I often prepared Tydeoidea individuals, as a result of which I identified a female ***Brachytydeus zaheri*** (Baker, 1968) individual on a *Lilium candidum* L. No data is available on anyone having found this species since its original description.

3.3. New scientific results

1. I identified *Tydeus californicus* as the dominant species in Hungary's wine regions.

2. I was the first to identify the occurrence of twenty one species on vine in Hungary (*T. kochi*, *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*, *N. neglectus*, *H. staerki*, *T. triophthalmus*). This is the first time data on Tydeoidea fauna is being published from the Kunság, Szekszárd, and Tokaj-Hegyalja wine regions.

3. I was the first to find eighteen species (*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*, *N. neglectus*) on vine and to publish these results.

4. Of the Tydeidae family, I was the first to find *Tydeus reticoxus*, *Tydeus spathulatus*, *Brachytydeus falsa*, *Brachytydeus longiuscula*, *Brachytydeus latiuscula, Brachytydeus matura*, *Brachytydeus opima*, *Brachytydeus tuttlei, Brachytydeus zaheri, Metalorryia palpsetosa*, *Metalorryia armaghensis, Neoapolorryia kristinae, Nudilorryia mariae*, *Nudilorryia paraferula*, and *Pseudolorryia striata* in Hungary and the first to find *Neopronematus neglectus* in the Iolinidae family. I was the first to report having found species in the genera *Nudilorryia* and *Pseudolorryia* in Hungary.

5. I collected hitherto unknown male examples of five species (*B. matura, B. opima, B.* cf. *italica, N. mariae*, *N. paraferula*).

6. I have established that the *B. praefata, B. obnoxia*, *B. elinguis,* and *T. rostratus* species cannot be considered to have been found in Hungary.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1. Discussion of the faunistic results

The dominance of *T. californicus* was confirmed by the Hungarian wine regions included in the study. This did not come as a surprise as numerous Hungarian publications had already mentioned the occurrence of the species; however, these studies had only included the vineyards of two counties (Heves and Veszprém Counties) and did not identify the dominant species. From foreign vineyards, we have data of the species' occurrence in vineyards from Italy and Brazil. Of these works, only the Italian publications dealt with defining any possible dominant species; they noted the dominance of *T. caudatus* in addition to *T. californicus*. This is not surprising either, as, similarly to the *T. californicus* species, *T. caudatus* individuals are also commonly found in vineyards. Accordingly, I found *T. caudatus* individuals, though they were present in the samples in significantly smaller numbers than *T. californicus* and only less frequently.

Based on earlier studies, the reason behind this enormous difference could be that it seems these two related species are mutually exclusive. They can both be present in large numbers and be widespread, but only one can be dominant. The reason behind the difference in the two species may be in their ability to adapt to the consumption of Eriophyidae mites or other alternative food sources. If we are looking to uncover the reasons behind the frequent and abundant occurrence of *T. californicus* in vineyards and orchards, the results of the observations made in Poland may be of some help. According to these results, *T. californicus* preferred feeding on Eriophyidae mites as opposed to other food sources, in certain cases even selectively consuming apple rust mite (*Aculus schlechtendali* (Nalepa, 1890)) and blackcurrant gall mite (*Cecidophyopsis ribis* (Westwood, 1869)). The experiences of the study show that consuming these species significantly increased mite longevity and productivity. The results also show that by consuming these leaf mite species, *T. californicus* contributes to thinning their numbers. The presence of leaf mites could result in increasing the number of *T. californicus* individuals. Although it is difficult to determine the importance this has from the aspect of plant protection, it may be a reason behind the abundant and frequent occurrence of *T. californicus*.

As much as I was not surprised by the dominant species, I was astonished to find that *T. reticoxus* was the subdominant species in Hungary's vineyards. It is quite remarkable that this work is the first mention of this species since it was originally described in South Africa and that the species is not only present but also so abundant. I believe that the reasons for its occurrence in Hungary include the results of international shipping, the increasing spread of vinicultural products, and the increasing, transcontinental effects of globalism. Since the species occurs in such large numbers in the studied vineyards, it would be interesting to examine its occurrence in the

wine growing regions of other countries. The role it plays in vineyards and its possible significance or use in plant protection also await clarification. My thesis contains more details on the other two species identified from the *Tydeus* genus.

After the dominant and subdominant species mentioned above, *B. reticulata* proved to be the third most common species in Hungarian wine regions. As this is a cosmopolitan species, I had expected the animal to turn up, but its prevalence in vineyards came as a surprise, especially in light of the fact that it had not yet been found on vine. Given the data described above, it would be justified to conduct further studies in connection with the species to clarify its possible uses in plant protection.

Of the other species identified in the *Brachytydeus* genus, the small number of individuals and the rare occurrence of the *B. amica*, *B. falsa*, *B. latiuscula*, *B. longiuscula*, *B. matura*, *B. paraobliqua*, and *B. obliqua* species leads me to believe that these cannot be considered frequent species determinant in vineyards; the role they play in vineyards is assumed to not be significant. These species are not expected to be common occurrences in vineyards in the future, either. The *B. ocellata* and *B. tuttlei* species were also rare in their occurrences, but they are expected to show up in the future, as well. The study showed *B. opima* to be a species present in greater abundance and frequency. I provide more details about this species in my thesis.

B. cf. *italica* had high numbers in both abundance and frequency in vineyards, and was among those few species that were found in samples from all of the wine regions. If this were clarified, the species could be considered to be a species frequent in vineyards and is assumed to be determinant.

Species from the *Nudilorryia* genus were found mainly in the vineyards of the Kunság Wine Region. I was quite surprised to find that *Nudilorryia* species were present in such large numbers in the samples, which assumes that the genus's species are better adapted to the conditions of the Kunság Wine Region. I believe the reasons behind this include the differences stemming from the wine regions' temperature (winter minimum and summer maximum) and geographic characteristics. The features of the Kunság Wine Region are assumed to have had a beneficial effect on the species and provided the animals an opportunity to become more widespread. The examination of the effects these features have on Tydeoidea mites could yield further interesting results that could contribute to identifying additional habitats where the various species occur. Additional studies are required to determine the factors that influence the occurrence of the species in this genus.

In light of the previous and the current data, the *M. palpsetosa*, *P. striata,* and *N. neglectus* species can be assumed to be non-determinant mites that occur only seldom in vineyards, and so I do not expect them to be frequent or present in large numbers in the future, either. However,

previous and current data show that the occurrence of the *H. staerki* and *T. triophthalmus* species is to be expected in the future, as well.

4.2. Conclusions and recommendations drawn from the results of revising the collection

Instead of *B. praefata,* I identified the individuals of other species on the slides. Dr. József Bozai was the only person to mention finding this species in Hungary. However, as it can be determined that the animals he identified are not actually individuals of the *B. praefata* species, my opinion is that the occurrence of the species in Hungary cannot be proven.

I was not able to identify the individual on the slide labelled *B. obnoxia*. As the work of Dr. József Bozai again contains the first and only mention of *B. obnoxia* in Hungary, my opinion is that this is another species that cannot be considered to have been identified in Hungary.

Instead of the *B. elinguis* species, I identified mainly *B.* cf. *italica* adults as well as a species entirely new to Hungary, *M. armaghensis*. As the work of Dr. József Bozai is again the first and only mention of *B. elinguis* in Hungary, my opinion is that this species is another that cannot be considered to have been identified in Hungary.

None of the slides labelled *B. electra* contained the individuals of this species. Two slides were placed in the collection by Dr. József Bozai, as shown by their labels. The animals on the third slide were collected from a *Vitis vinifera*. The question arises as to whether this could be the *B. electra* specimen identified by Mrs. Júlia Molnár Győrffy. If yes, then *B. electra* is yet another species that cannot be considered to have been found either on vine or in Hungary. This needs further clarification.

Instead of the *T. rostratus* species, I identified a *B.* cf. *zebramontana* adult and a *N. kristinae* tritonymph individual. This *N. kristinae* individual proved to be new to Hungarian fauna. As Dr. József Bozai's publication is again the first and only mention of *B. rostratus* in Hungary, my opinion is that this species is another that cannot be considered to have been identified in Hungary.

Prior to my work, 52 Tydeoidea species had been identified in Hungary. As a result of my collection performed in vineyards, I was able to add thirteen new species to the number of species identified in Hungary. During the course of studying Professor Bozai's collection, I was able to identify two species new to Hungary, with one more new species identified during the course of reviewing the plants submitted to the Department. Based on the above, my opinion is that four species cannot be considered to have been found in Hungary. Accordingly. I consider a total of 64 Tydeoidea species to have been found and identified in Hungary.

PUBLICATIONS RELATED TO THE TOPIC OF THE THESIS

Publications with impact factor

Tempfli, B., Pénzes, B., Fail, J. and Szabó, Á. (2015): The occurrence of tydeoid mites (Acari: Tydeoidea) in Hungarian vineyards. Systematic & Applied Acarology, 20 (8) 937–954. IF:1.253

Other publications

Tempfli, B., Szabó, Á. és Pénzes, B. (2012): The occurrence of Tydeoid mites (Acari: Triophtydeidae, Iolinidae, Tydeidae) in the Eger wine region. (Poratkák (Acari: Tydeoidea) előfordulása az Egri borvidéken.) Növényvédelem, 48 (12) 550-558.

Tempfli, B., Szabó, Á. Varga, M. és Pénzes, B. (2014): The occurrence of Tydeoid mites (Acari: Tydeoidea) in the Badacsony wine region. (Poratkák (Acari: Tydeoidea) előfordulása a Badacsonyi borvidéken.) Növényvédelem, 50 (3) 115-120.

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