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Research Article

Invasive Insect Species Detected on Grapevines in Romania during 2016–2019 and First Record of *Erasmoneura vulnerata* (Fitch, 1851) (Hemiptera: Cicadellidae)

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Abstract: The paper presents the results of a four-year survey (2016–2019) on the presence and distribution of invasive insects on grapevines in Romania. Five pest species were detected on the grapevines at 11 localities in different regions in the country, as follows: the North American leafhopper of grapevine *Erasmoneura vulnerata*, the Japanese leafhoppers *Arboridia kakogawana*, the Asian leafhopper *Phlogotettix cyclops*, the vine bud moth *Theresimima ampellophaga* and the spotted-wing drosophila *Drosophila suzukii*. The species *E. vulnerata* is reported for the first time from Romania. We present and discuss data about distribution and abundance of all recorded invasive insect species, as well as data about the potential damage caused on the grapevines in Romania.

Key words: Romanian grapevines, invasive insect species.

Introduction

Romania is one of the largest grapevine growing countries in Europe and in the world (ANTOCE & CALUGARU 2017). In 2016, the surface of vineyards was about 180 thousand hectares and the country ranked 5th in Europe and 11th in the world. The development of viticulture in Romania is due to the favorable pedo-climatic and geographic conditions for the vine cultures and to massive financial inflows in this sector. Various non-native insect species with invasive behaviour, such as

leafhoppers, lepidopterans and fruit flies that have entered Romanian territory in the recent years are considered new threats for the grapevine agro-ecosystem. Early detection and monitoring are essential practices in preventing the spread of invasive alien species, as well as adopting the most appropriate management measures to established populations (BRITTON et al. 2010, SCHADE et al. 2019).

Our aim was to study the presence and distribution of some invasive species in Romanian grapevines.

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Materials and Methods

The study was conducted during the period 2016–2019.

The leafhoppers were collected during a survey programme in 2016–2018, aiming to detect the vectors associated with phytoplasmas in the grapevines. In total 80 vine plantations established under the national programme of reconversion in viticulture were subject to this survey. The sites were located in the Viticulture Region of Banat (Banat Hills), Crişana (Crişana Hills) and Maramureş (Maramureş Hills) in the northern and western parts of Romania and in the Viticulture Region of Moldova (Moldova Hills) in Eastern Romania (Fig. 1). Furthermore, different private yards and green areas of Bucharest with urban and spontaneous vegetation were monitored in the last decade to detect new invasive species and some results therefrom are included in this paper.

The sampling of insects was performed by different methods in accordance with the specifics of the target species. The leafhoppers were collected on yellow double-faced sticky traps of 20×30 cm

produced by the Research Institute of Chemistry ‘Raluca Ripan’, Cluj Napoca, Romania, from the end of May until the end of September/ beginning of October. Four traps per vineyard were used each year, placed inside on the row at the vine canopy level. They were replaced with new ones every two weeks.

To detect the vine bud moths, RAG type pheromones traps purchased from Csalomon (Plant Protection Institute Budapest, Hungary) were used. Five traps per year were placed at eight sites in 2018 and 2019. One trap per plantation was set up in vine-growing regions from the north-western (1), western (3) and eastern (1) parts of the country in 2018 and from the western (2), southern (1) and eastern (2) parts of the country in 2019. The placement of traps in the field was performed on different dates between the end of May and the beginning of July, maintained until the end of July or August. The baits were replaced once (after one month) for the cases in which the traps activity was longer.

The presence of the spotted-wing drosophila was monitored at five vine plantations located in vineyards from the western (3) and eastern (2) parts of the country in 2016–2018, using hand-made traps

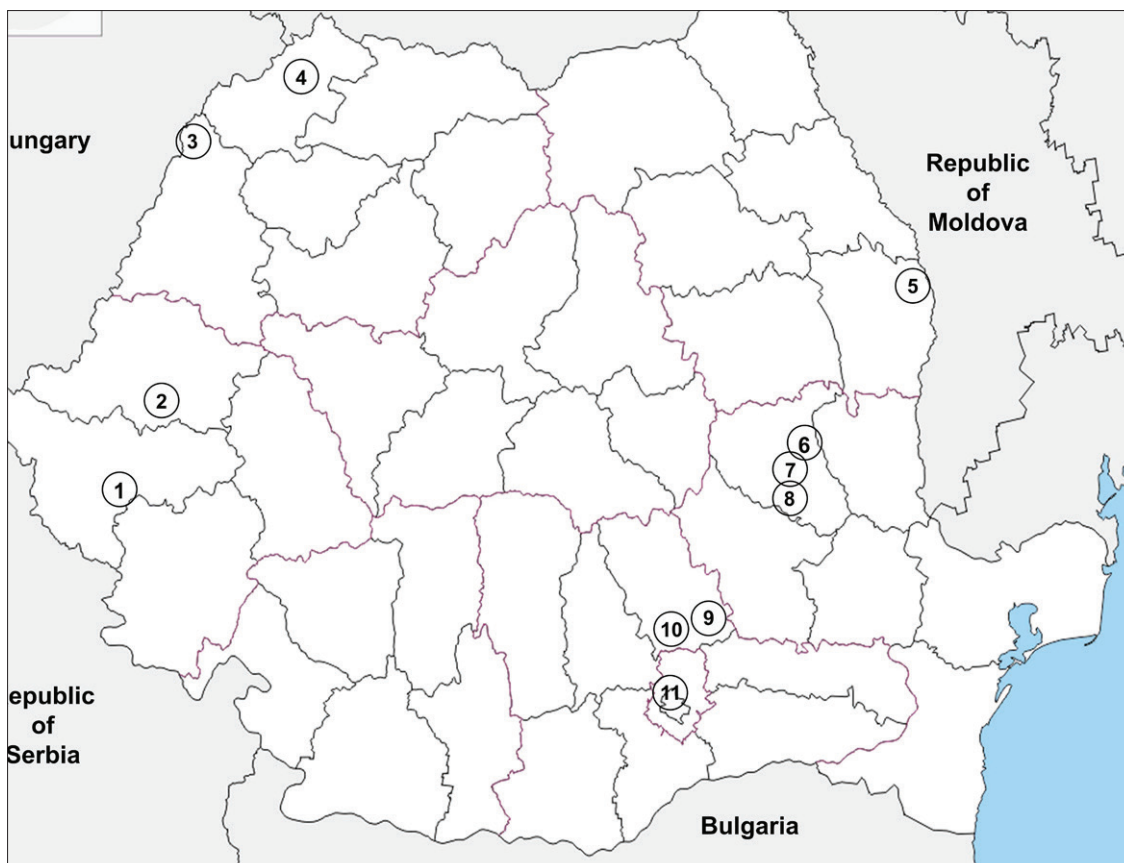


Fig. 1. Map of collection areas during the survey programme of Romania in the period 2016–2019. 1 – Recaş, 2 – Miniş-Măderat, 3 – Diosig, 4 – Răteşti, 5 – Huşi, 6 – Panciu, 7 – Odobeşti, 8 – Coteşti, 9 – Gura Vadului, 10 – Valea Călugărească, and 11 – Bucharest.



Fig. 2. The North American leafhopper of grapevine *Erasmoneura vulnerata* adults (a) and larvae (b).

consisting in 0.5 l plastic bottles baited with apple vinegar and red wine mixtures from commerce (3:2). The bottles had 6–8 holes with a diameter of about 3–5 mm in the upper half for the flies' entry. One trap per plot set up in the vines foliage was used. The insects were collected at the end of the trap activity. To check the berries for the presence of the fly, about 2 kg of grape bunches per monitored site were brought to the lab and placed on filter paper in glass vials closed with gauze. The samples were kept at around 25°C, RU 65% and 16:8 photoperiod.

The traps with the captured insects were analysed under an Olympys SZ 61 stereomicroscope in the laboratory and the insects were identified on the basis of the external morphological characters specified in literature. The identified specimens were counted.

Pictures of the living specimens were taken using an Olympus digital camera connected to the stereomicroscope.

Results

As a result of our survey during 2016–2019 on grapevines in Romania, the following five invasive insect species were detected: three species of Auchenorrhyncha leafhoppers, the North American leafhopper of grapevine *Erasmoneura vulnerata* (Fitch, 1851), the Japanese leafhoppers *Arboridia kakogawana* (Matsumura, 1932) and the Asian leafhopper *Phlogotettix cyclops* (Mulsant & Rey, 1855), belonging to the family Cicadellidae; one species of Lepidoptera, the vine bud moth *Theresimima ampelophaga* (Bayle-Barelle, 1808), belonging to the family Zygaenidae and one species of the vinegar fly, the spotted-wing drosophila *Drosophila suzukii* (Matsumura, 1931) from the family Drosophilidae.

North American leafhopper of grapevine *Erasmoneura vulnerata* (Fitch, 1851) (Auchenorrhyncha, Cicadellidae, Typhlocybinae)

During the three-year period of the survey conducted in the vineyards (2016–2018) and the four-year survey in Bucharest area (2016–2019), the presence of the leafhopper *E. vulnerata* was confirmed in 2018 in 13 vine plantations situated in the vineyards of Odobești, Panciu, Cotești and Huși (areas 5–8 in Fig. 1) in the region of Moldova Hills in the eastern part of Romania (Table 1) and during all years of investigation on hybrids and wild *Vitis* in Bucharest City (data is not presented here) (area 11 in Fig. 1). There were no specimens of *E. vulnerata* trapped in the vineyards of the western parts of the country (areas 1–4 in Fig. 1). In total, 772 specimens were collected. The density of adults varied widely from one vine plantation to another. The two highest abundances were of 630 adults in one plantation of Odobești and 112 adults in one plantation of Cotești, reaching over 96.1% of all catches. Regarding the other vine plantations, the presence of *E. vulnerata* was much lower, ranging from one to 10 adults per plantation.

Adults, larvae as well as symptoms of their attack on the leaves of the wild *Vitis* and *Parthenocissus quinquefolia* were observed in a residential building yard in the southern part of Bucharest.

The adults of *E. vulnerata* (Fig. 2a) were easily recognised because of the presence of a white spot on the costal edge of the wing and a red transversal vein in front of the apical cell. According to the morphological description in the literature (SELJAK 2011), the adults of *E. vulnerata* are about 3 mm, with reddish and brownish colour pattern on the wings and head, presenting a seasonal colour dimorphism. Nymphs (Fig. 2b) are yellow-brown



Fig. 3. *Erasmoneura vulnerata*, attack on the leaves of wild *Vitis*.



Fig. 4. *Erasmoneura vulnerata*, attack on the leaves of *Parthenocissus quinquefolia*.

to brown with nuances of red and with light green legs (DUSO et al. 2005), flattened dorso-ventrally at vertex and thorax.

The signs and symptoms of the attack produced by *E. vulnerata* represented spots of chlorosis on the upper surface of the leaves of wild *Vitis* and *P. quinquefolia* (Figs. 3 and 4) and small black spots of excrements on the lower surface of the leaves of wild *Vitis* (Fig. 5).

Japanese grape leafhopper *Arboridia kakogawana* (Matsumura, 1932) (Auchenorrhyncha, Cicadellidae, Typhlocybinae)

According to the results of our study, *Arboridia kakogawana* was captured only in 2018, only at one of the 16 vine plantations investigated in the Moldova Hills Region in the eastern part of the country (Table 1). The plantation is situated in the Huși vineyard (Vaslui County) in the north-eastern Moldova Hills Region (area 5 in Fig. 1). The number of the species was 241 adults. The presence of *A. kakogawana* was not confirmed in the twelve vine plantations monitored in the western part of the country.

Asian leafhopper *Phlogotettix cyclops* Mulsant & Rey, 1855 (Auchenorrhyncha, Cicadellidae, Deltocephalinae)

Presence of *P. cyclops* was confirmed every year during the three-year survey (in 2016, 2017 and 2018) at 39 out of the 80 investigated plantations (Table 1), out of which 11 plantations were in the



Fig. 5. *Erasmoneura vulnerata*, black spots of excrements on the vine leaves.

western part of the country, the vineyards of Recaș-Tirol, Miniș-Măderat, Diosig and Rătești (areas 1–4 in Fig. 1) and 28 plantations in the eastern part of the country, the vineyards of Odobești, Panciu, Cotești and Huși (areas 5–8 in Fig. 1). The species had low population density in both viticultural regions. Totally 124 adults were caught on the yellow traps, of which 110 adults at the plantations monitored in the eastern part and 14 adults at the plantations monitored in the western part. By year, five adults were collected in 2016, five in 2018 and four adults in 2017 in the western plantations, while 44 adults were captured in 2016, 61 adults in 2018 and four adults in 2018 in the eastern plantations (Table 1).

Table 1. Distribution and number of adults captured on yellow sticky traps for *Phlogotettix cyclops*, *Arboridia kakogawana* and *Erasmoneura vulnerata* in grapevines from Western and Eastern Romania in 2016–2018.

County	Vineyard	Viticulture Centre	2016		2017		2018									
			<i>Phlogotettix cyclops</i>		<i>Phlogotettix cyclops</i>		<i>Arboridia kakogawana</i>		<i>Erasmoneura vulnerata</i>		<i>Phlogotettix cyclops</i>					
			Monitored plantations / presence	Number	Monitored plantations / presence	Number	Monitored plantations / presence	Number	Monitored plantations / presence	Number	Monitored plantations / presence	Number				
Western Romania	Arad	Mimiş – Măderat	Păuliş	1/1	1	1/1	2	-	-	-	-	-	-			
			Ghioroc	2/0	0	1/0	0	-	-	-	-	-	-	-		
			Mimiş	3/1	1	2/0	0	-	-	-	-	-	-	-		
	Satu Mare	Răteşti	Covăsânş	Măderat	2/1	1	2/1	2	2/0	0	2/0	0	2/1	1		
				Cuvin	1/1	1	2/0	0	-	-	-	-	-	-	-	
				Pâncota	-	-	-	-	1/0	0	1/0	0	1/0	0	1/0	0
				Belciug	-	-	-	-	5/0	0	5/0	0	5/2	2	2	
	Timiş	Recaş-Tirol	Diosig	Beltug	1/1	1	-	-	-	-	-	-	-	-		
				Recaş	-	-	2/0	0	2/0	0	2/0	0	2/0	0	2/1	1
				Biharia	-	-	-	-	1/0	0	1/0	0	1/0	0	1/1	1
Bihor	Diosig	Total	Diosig	-	-	-	-	1/0	0	1/0	0	1/0	0			
			Total	10/5	5	10/2	4	12/0	0	12/0	0	12/4	5			
			Total	4/4	20	4/4	17	4/0	0	4/4	630	4/4	4/1	2		
Eastern Romania	Vrancea	Odobeşti	Odobeşti	-	-	-	-	2/0	0	2/2	3	2/1	1			
			Jaristea	-	-	-	-	2/0	0	2/2	7	2/0	0			
			Tiţeşti- Sârbi	1/1	7	1/1	16	2/0	0	2/2	0	1/0	1	1		
	Coteşti	Huşi	Panciu	2/0	0	2/1	7	1/0	0	1/0	0	1/1	1			
			Vârteşcoiu	3/3	13	3/2	8	1/0	0	1/1	112	1/1	1			
			Cârligele	1/1	1	1/1	1	1/0	0	1/1	3	1/0	0			
	Buzău	Huşi	Total	Dumbrăveni	1/0	0	1/0	0	-	0	-	-	-	-		
				Beciu	-	-	-	-	1/0	0	1/1	6	1/0	0		
				Faraoanele	-	-	-	-	1/0	0	1/1	10	1/0	0		
				Grebănu	1/1	2	1/1	3	-	0	-	-	-	-		
Huşi	Total	Total	Huşi	3/1	1	3/3	9	3/1	241	3/1	1	3/0	0			
			Total	16/11	44	16/13	61	16/1	241	16/13	772	16/4	5			
			Total	26/16	49	26/15	65	28/1	241	28/13	772	28/8	10			
Total amount for both regions																

Vine bud moth *Theresimima ampellophaga* Bayle-Barelle, 1808 (Lepidoptera, Zygaenidae)

In our survey conducted two years (2018 and 2019), *T. ampellophaga* was captured each year, at three out of eight surveyed vine plantations (Table 2), two of them in the eastern part, the Odobești and Țifești-Sîrbi plantations (areas 6 and 7 in Fig. 1) and one in the southern part of Romania, the Gura Vadului plantation (area 9 in Fig. 1). There were no captures of *T. ampellophaga* recorded in the western and north-western parts of the country (areas 1, 2 and 3 in Fig. 1).

A total of 33 moths were caught, out of which 32 moths at two plantations from the Odobești (26 moths) and Țifești-Sîrbi (6 moths) from the Odobești and Panciu vineyards and one moth in the Gura Vadului plantation from the Dealu Mare-Tohani vineyard. Most of the moths (78.78%) were captured at the Odobești plantation where the pheromone traps were set earlier than the other sites.

Spotted-wing drosophila *Drosophila suzukii* (Matsumura, 1931) (Diptera: Drosophilidae)

A total of 233 specimens (59.66% males and 40.34% females) of *D. suzukii* were captured at the five vine plantations monitored in the western (3) and eastern (2) parts of Romania during the three-year period of the monitoring of this pest (Table 3). Most of the flies (94.42%) were in the Miniș-Măderat vineyard (area 2 in Fig. 1) in the western part of Romania. The first specimens of *D. suzukii* in this area were trapped in 2016 in the Amphelographic collection of the Research Station for Viticulture Miniș at Ghioroc (Arad County) and were represented by seven flies. The number of adults in traps increased to 14 in 2017 and to 110 in 2018. Adults of *D. suzukii* were found at other two plantations in this vineyard in 2018, at Covăsânț and Pauliș, 14 and 75 flies, respectively. Only 13 specimens of *D. suzukii* were trapped in the western part of Romania, in the Amphelographic collection of the Research Station for Viticulture Odobești (Vrancea County) in 2017 and 2018. There were no adults recorded at Țifești-Sîrbi (area 6 in Fig. 1) from this zone. No adults of *D. suzukii* emerged from the grape samples, collected in the investigated areas, in the laboratory conditions.

Discussion

In this study, we present the results of the four-year survey (2016–2019) on the presence and distribution of five species of invasive harmful insects confirmed on the grapevines in Romania. We present new data

on the distribution of the leafhoppers *E. vulnerata*, *A. kakogawana* and *P. cyclops*, the bud moth *T. ampellophaga* and the spotted wing vinegar fly *D. suzukii*. The species *E. vulnerata* is reported for the first time for Romania.

Erasmoneura vulnerata

This was the most abundant species, accounting for 67.89% of the leafhopper species sampled in this study. It has a natural distribution in the USA, Canada and Mexico, where it is present mainly on the wild and cultivated vine, but also on other plants considered as secondary hosts (DUSO et al. 2005, 2019). The first detection of this species in Europe was in 2004, in North-Eastern Italy, the Veneto and Friuli-Venezia Giulia regions (DUSO et al. 2005). Slovenia is the second European country that recorded *E. vulnerata* in 2010 (SELJAK 2011) around Nova Gorica City, situated in the western part of the country, close to the North-Eastern Slovenian-Italian border. Abundant populations of the species were recorded on the American vine (*Vitis labrusca* L.) and on the ornamental Judas tree (*Cercis siliquastrum* L.). Only few individuals were found on a cultivated vine (*V. vinifera* L.) despite the fact that this is considered the most suitable host for the pest.

Our survey showed that *E. vulnerata* is present in two regions of Romania, the vineyards of the Moldova Hill Region in the eastern part and Bucharest City in the southern part of the country. In Moldova, it was captured of different abundance at thirteen plantations during only one of three years of the survey, while in Bucharest, the species was caught during all the three years of survey. *Erasmoneura vulnerata* was not found in the vineyards from the western part of the county, although this region is situated within the spreading geographical area of the species from Western Europe (Italy and Slovenia).

With regard to the presence of *E. vulnerata* in Bucharest, adults of the species have been trapped since 2015 on the yellow sticky traps used to detect invasive species in this area (unpublished personal data). Since then, the species has constantly been observed on plants of *Vitis*, cultivated for different purposes in home gardens or randomly grown in the city's urban area. In view of this finding, we presume that this leafhopper has well adapted to the climatic conditions of this area and can be considered as an established species in Romania. To the best of our knowledge, these are the first records of *E. vulnerata* in Romania and the third in Europe, after Italy and Slovenia.

Table 2. Total captures of *Theresimima ampellophaga* in vineyards surveyed in Romania, in 2018 and 2019.

Region	Viticultural Region / Vineyards / Sites	Number of captures of <i>Theresimima ampellophaga</i> and dates of traps setting	
		2018	2019
North-western Romania	Dealurile Maramureşului Maramureş Hills / Diosig / Diosig	0 (3 July – 27 August)	–
West Romania	Dealurile Crişanei Crişana Hills / Miniş-Măderat / Covăsânt	0 (3 July – 27 August)	0 (3 June – 30 July)
Western Romania	Dealurile Crişanei Crişana Hills / Miniş-Măderat / Ghioroc	0 (3 July – 27 August)	0 (3 June – 30 July)
Western Romania	Dealurile Banatului Banat Hills / Recaş-Tirol / Recaş	0 (3 July – 27 August)	–
Eastern Romania	Dealurile Moldovei Moldova Hills / Odobeşti / Odobeşti	11 (25 May – 26 June)	15 (1 July – 25 August)
Eastern Romania	Dealurile Moldovei Moldova Hills / Panciu / Ţifeşti-Sîrbi	–	6 (1 July – 25 August)
Southern Romania	Dealurile Munteniei Muntenia Hills / Dealu Mare-Tohani / Gura Vadului	–	1 (22 May – 11 August)
Southern Romania	Dealurile Munteniei Muntenia Hills / Dealu Mare-Tohani / Valea Călugărească	–	0 (22 May – 11 August)

Table 3. Grapevine sites and captures of *Drosophila suzukii* adults in traps baited with apple vinegar and red vine mixture.

Region	Viticulture Region / Vineyards / Sites	Period of traps activity	Number of adults of <i>Drosophila suzukii</i>	
			♂	♀
Western Romania	Dealurile Crişanei Crişana Hills / Minis-Măderat / Ghioroc (Amphelographic collection of RDSVV Minis)	10.08–09.09.2016	4	3
		15. 08–10.10.2017	9	5
		09.07–30.08.2018	61	49
Western Romania	Dealurile Crişanei Crişana Hills / Minis-Măderat / Covăsânt	10.08–09.09.2016	0	0
		15. 08–10.10.2017	0	0
		09.07–30.08.2018	8	6
Western Romania	Dealurile Crişanei Crişana Hills / Minis-Măderat / Pauliș	09.07–30.08.2018	45	30
Eastern Romania	Dealurile Moldovei Moldova Hills / Odobeşti / Odobeşti (Amphelographic collection of RDSVV Odobeşti)	25. 08–20.10.2017	1	0
		09.10–12.11.2018	11	1
Eastern Romania	Dealurile Moldovei Moldova Hills / Panciu / Ţifeşti-Sîrbi	09.10–12.11.2018	0	0

Some time ago, due to its sporadic presence, *E. vulnerata* was considered as a less important pest, but having real potential to become a significant one for the grapevine agriculture in Europe (DUSO et al. 2010). Recent studies have shown that this species can induce direct and indirect damage to the grapevines. The direct damage is produced by the adults and nymphs that suck from the mesophyll tissue (SELJAK 2011) and cause discoloured spots on the leaves. At higher level of pest infestation

the spots extend over the entire surface of the leaf, hence, the leaves have a low photosynthetic activity and fall prematurely. Small black spots of excrements present on the leaves as a consequence of nymphs feeding activity could be associated with the growing of the sooty molds fungus that affects foliage and fruits quality.

The indirect damage of *E. vulnerata* is linked to its possible involvement in the grapevine phytoplasmas epidemiology. In the study of OLIVIER

et al. (2014), the Aster yellow phytoplasma is detected in 1.4% of *E. vulnerata* adult population collected in the Canadian commercial vineyards in 2006–2008. The authors explain this finding with the fact that according to published reports, phytoplasmas can be found not only in the plant phloem, but also in the mesophilic cells, from which the mesophyll-suckers leafhoppers as *E. vulnerata* could take them.

Arboridia kakogawana

This species is one of the fifteen species belonging to the genus *Arboridia* described in Europe and one of the two species depicted from Asia that have been detected in Europe recently (ENDRESTØL 2011). Until 1999, this species has been known in Japan, Korea and the Russian Far East only. In 1999, GNEZDILOV (2000) detected *A. kakogawana* in the Krasnodar zone in Southern Russia and this finding represents the first report of the species for Europe. According to GNEZDILOV et al. (2008a), its introduction into Southern Russia (Eastern Europe) from the Far East (Eastern Asia) was a result of the shipping of goods. The species continued to spread rapidly in new territories of Eastern Europe, so that, it has been reported in the North Caucasus (BALAKHNINA et al. 2009), the Rostov Province (ARTOKHIN 2009), the South Coast of the Crimean Peninsula (RADIONOVSKAYA & DIDENKO 2014) and the Donbass Region (MARTINOV et al. 2019). New records of *A. kakogawana* in its native area of Eastern Asia have also been published after 2000. AHN et al. (2005) and LEE et al. (2014) published studies from South Korea and CAO et al. (2017) from China.

In Romania, *A. kakogawana* was first identified in 2018 in a very high abundance (>60,000 adults) on yellow sticky traps in an experimental grapevine field in Bucharest (CHIRECEANU et al. 2019).

The present survey confirmed the presence of *A. kakogawana* in 2018 in one vine plantation from the Moldova Hills Region in the eastern part of the country. The occurrence of this species in an area, other than the one in Bucharest, provides new challenges for assessing the spreading territory of this pest in the country. The present report can be considered the first record of *A. kakogawana* for viticulture in the Moldova Region (Eastern Romania) and the second for the country.

According to the results in the relevant literature, *A. kakogawana* causes serious damage to the cultivated grapevines both in the native and the invaded area (AHN et al. 2005, GNEZDILOV et al. 2008b, LEE et al. 2014, RADIONOVSKAYA & DIDENKO 2015, CAO et al. 2017). The damage of

this pest is evident mainly on the grapevine leaves and is caused by the nymphs and adults through the feeding activity (GNEZDILOV et al. 2008b). Similar to *E. vulnerata*, *A. kakogawana* feeds by piercing and sucking on the lower side of the leaves. The affected tissue becomes chlorotic by the loss of photosynthetic green pigments (GNEZDILOV et al. 2008a, 2008b).

Phlogotetix cyclops

This species originates from Asia and is present in the Middle East and Europe (CHUCHE et al. 2010). In the recent years it has spread rapidly in the countries from the Central, Southern and Eastern Europe, namely in Italy (GUGLIELMINO et al. 2005), Hungary (BLEICHER et al. 2007), Austria (SÁRA & RIEDLE-BAUER 2009), France (CHUCHE et al. 2010), Slovenia (SELJAK 2016) and Croatia (PLAVEC et al. 2019).

Phlogotetix cyclops is known in the Romanian fauna and the oldest report dates back to 1977 (DLABOLA 1977). Since then no other report on this leafhopper was published until 2017, when CHIRECEANU et al. (2017) provided observations on the presence of this species on urban woody vegetation in Bucharest (south part of the country), a total number of 170 adults captured on yellow sticky traps in 2016.

The results in the present study are the first evidence of the presence of *P. cyclops* on the grapevines in Romania. The species generally showed low abundance, with higher values in the eastern parts, with more than seven times the number of specimens trapped in the grapevine in the western parts. The annual abundance of *P. cyclops* was much lower as compared to the data from CHIRECEANU et al. (2017), presumably showing a possible preference of the species for urban areas in the city.

The results of our study regarding the small number of *P. cyclops* on the grapevines are in line with those reported in other areas of Europe. It is about the studies of STRAUSS & REISENZEIN (2018) and PLAVEC et al. (2019) which highlighted the low densities of this species in the grapevines in Austria and Croatia. Despite its low populations in the grapevines in Europe, *P. cyclops* is considered as a seriously threatening pest. Over 35% of the adult population of *P. cyclops* collected on *Clematis vitalba* (L.) and *Vitis vinifera* (L.) in Austria were found to be naturally infected with Flavescence Doree phytoplasma (FDp), the 16SrV-C subgroup (STRAUSS & REISENZEIN 2018). One out of six specimens of *P. cyclops* collected in Croatia on FD

affected grapevines was infected with FDp (PLAVEC et al. 2019). The significant role of this species in the epidemiology of Aster yellows phytoplasma (16Srl group) in periwinkle (*Catharanthus roseus* L.) was pointed out in 2011 (CHEN et al. 2011).

Although the density of *P. cyclops* on the Romanian grapevines was low and FD disease is not present in the country, this species should be assessed as an important pest which could reach large populations in few years and, therefore, control measures are necessary.

Theresimima ampelophaga

This is a species of Palearctic origin, reported to be an important pest for the vineyards in Southern Europe (NAHIRNIĆ et al. 2015). It is described to be present in the western, central and eastern parts of the continent (TOSHOVA et al. 2017). The grapevine *Vitis vinifera* and the species of the genus *Parthenocissus* like the decorative vine *P. quinquefolia* are the main host plants for this pest (EMBACHERUND & TARMANN 2002).

The first collections of *T. ampelophaga* in Romania were in 1865 by J. Mann from the vineyards in the Tulcea County (Eastern Romania) and by L. Aigner and J. Pavel from the vineyards in the Banat Region (Western Romania). In 1889, N. Schandor collected other specimens of this species from the vineyards in Costischa (the Neamț County, Eastern Romania) (FLECK 1899). All specimens were reported as *Ino ampelophaga* by CARADJA (1895) and by FLECK (1899).

After those first records, there is only one published report about the presence of *T. ampelophaga* in Romania by SUBCHEV et al. (2008). SUBCHEV together with a Romanian research team performed a two-year study (2005 and 2006) at three locations in the Viticultural Region of Muntenia in the southern part of the country, using a synthetic pheromone [(2R)-butyl (7Z)-tetradecenoate] developed by the same author (SUBCHEV et al. 1998). The presence of the moth was confirmed only in 2006 at one of the three locations, in the Valea Călugărească Center (area 10 in Fig. 1) in the Dealu Mare Vineyard. The other two locations without moth captures were near Tohani (area 9 in Fig. 1) and Bucharest (area 11 in Fig. 1).

During the two-year period of monitoring at eight vine plantations in Romania, we detected *T. ampelophaga* in low abundance in two viticultural zones, namely in the eastern and in the southern parts of the country. It was not detected in vine plantations monitored in the western and north-western parts of the country. Most of the moths (96.97%) were caught

in the eastern part of Romania and 81.25% out of those were in a single vine plantation at Odobești, where the pheromone traps were set earlier than those at the other sites. Compared to the previous study of SUBCHEV et al. (2008) when no specimens of *T. ampelophaga* were trapped in the Dealu Mare Vineyard (in the plantation at Tohani), in the present study, one moth was trapped in this vineyard (in the plantation at Gura Vadului).

The results generated in this study represent the first evidence of the presence of *T. ampelophaga* on grapevines in the eastern part of Romania and the second in the country after 1900s, the first being in 2006 (SUBCHEV et al. 2008).

Drosophila suzukii

This is a vinegar fly species native to Southeast Asia that has rapidly spread in the European countries after its first detection in Italy in 2008 (CINI et al. 2014). In Romania, it was first recorded in 2013 in the southern part of the country (CHIRECEANU et al. 2015). In addition to the report in 2015 confirming the presence of *D. suzukii* in Romania and of its larvae inside the wild fruits of *Rubus caesius* (L.) and *Phytolacca americana* (L.), new presence of the pest was detected in other areas, in traps baited with vinegar and red wine, placed on various fruit tree species in farms, backyards (unpublished personal data) and on vineyards (data in this report). The new records on grapevine in this survey, are three records in the Miniș-Măderat vineyard in the western and one record in the Odobești Vineyard in the eastern parts. These findings suggest that since its first record in 2013, the fly has continued to extend its geographical range from the South to the North-West and East in the country.

Data of this survey revealed that the abundance of the species was higher in the western parts compared to the eastern areas. Most of the flies (94.42%) were trapped from the Miniș-Măderat Vineyard in the western part, where the captures increased from year to year. Very few specimens were trapped in the eastern part, only in one of the two monitored plantations.

The grape samples collected from the surveyed regions and kept in the laboratory conditions did not generate adults of *D. suzukii*. Consequently, the grapes were not considered as a host for this species even though its adults were captured in traps in the vineyards. Despite the fact that *D. suzukii* is present in Romania since 2013, no case of damage to cultivated fruits has been reported until now. However, the threat of the pest for the vine culture exists. The occurrence of the insect in the vineyards

and its threat for the grape bunches is widely presented in many studies in Europe (IORIATTI et al. 2015, DELBAC et al. 2017, ENTLING et al. 2019) and in Asia (KASAP & ÖZDAMAR 2019), as well as in the North and South America (ANDREAZZA et al. 2016, SHRADER et al. 2017) and in Canada (SAGUEZ et al. 2013). Grape cultivars with high skin hardness are less attacked (ANDREAZZA et al. 2016, ENTLING et al. 2019). Increased sugar content of berries during the ripening period causes a higher oviposition of the fly (IORIATTI et al. 2015). The preference of SWD for the grape bunches of red grapevine cultivars was shown in the studies of SAGUEZ et al. (2013) in Canada and of DELBAC et al. (2017) in France. Among the red grapevine cultivars, Merlot, Cabernet-Sauvignon and Gamay were found to be damaged by *D. suzukii*.

The results presented in this study complement the previously published data in other scientific articles on the grapevine pests in Romania and are of high relevance for the protection of the national viticulture heritage.

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