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CONTRIBUTION TO THE KNOWLEDGE OF THE AUCHENORRHYNCHA FAUNA ASSOCIATED WITH APPLE AND PLUM ORCHARDS IN THE SOUTHERN PART OF ROMANIA IN 2022

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Abstract

The suborder Auchenorrhyncha is a diverse group of sap-feeding insect species, many of them of economic importance. The paper presents comparative results on the ecological characteristics of species communities of Auchenorrhyncha sampled in one apple orchard and one plum orchard that belong to the experimental field Moara Domnească Didactic Station in the year 2022. The insects were collected using dual-sided yellow sticky traps. A number of 9 traps/orchard was used from early April till mid-November (234 traps in total), replaced every two weeks. Altogether, 34 species have been identified, 30 in apple orchard and 32 in plum orchard, totaling 7403 specimens, 6058 (81.8%) in the apple orchard and 1345 (18.2%) in the plum orchard. The most abundant species found in the apple orchard was Empoasca decipiens with 3614 specimens (59.66%), with a constancy of 64.1%. In the plum orchard, two species were the most numerous, Fieberiella florii with 411 specimens (30.6%) and Zygina flammigera with 304 specimens (22.6%), having a constancy in the samples of 24.8 and 29.9% respectively. Adult populations dynamics were performed for relevant species in both orchards.

Key words*: apple and plum orchards, invasive insects, leafhoppers, planthoppers.*

INTRODUCTION

Apple and plum orchards are among the most important sources of food worldwide. They are affected by various pests and diseases, including insects from the suborder Auchenorrhyncha, also called “true hoppers”. There are over 42,000 described species of true hoppers characterized by insects that feed on plant sap and they can use the phloem, xylem and mesophyll as a food source, depending on the species (Mifsud et al., 2010). Through their way of feeding, by using specialized mouthparts that pierce and suck on plant sap, they can substantially damage the tissues of the attacked plants or be involved in the transmission of phytopathogens such as viruses, bacteria and phytoplasmas. According to Guglielmino et al. (2000), 73% of Auchenorrhyncha species are considered polyphagous, while the rest are oligophagous located mainly on woody plants. More than 150 species of true hoppers have been described as vectors of economically important phytopathogens (Purcell & Almeida, 2005; Resh & Carde, 2009). They can also secrete toxic substances while feeding on plant sap, causing abnormal development, damage or even death of the tissues and cells of the attacked plants (Karavin et al., 2021). On the other hand, a large number of true hoppers constitute considerable components of food webs in various ecosystems (Schmidt-Entling & Siegenthaler, 2009).

More importantly, many members of the Auchenorrhyncha suborder have acquired the status of invasive species, which, in addition to their economic impact on native vegetation and crops, can also be a threat to native biodiversity (Roques et al., 2009). In the European continent, several authors have identified different invasive species of true hoppers, with a total of 32, most of them with origins in North America and East Asia (Mifsud et al., 2010; Gjonov & Shishiniova, 2014; Šćiban & Kosovac, 2020).

Because of their economically important status, there are different studies of the

Auchenorrhyncha fauna in Europe in various especially in the case of bacterial and phytoplasma vectors (Bleicher et al., 2006; Tedeschi & Alma, 2006; Ricci et al., 2009; Bleicher et al., 2010; Ayaz & Yücel, 2010; Elbeaino et al., 2014; Lopes et al., 2014; Grimová et al., 2016; Ben Moussa et al., 2016; Cornara et al., 2017; Tsagkarakis et al., 2018; Fischnaller et al., 2020; Thanou et al., 2020; Theodorou et al., 2021; Karavin et al., 2021). The only studies carried out in Romania concerning the Auchenorrhyncha fauna refer to their presence on apple, pear and plum in the Bucharest area (Cean & Cean, 2013; Chireceanu et al., 2019; Teodoru et al., 2021).

The purpose of this paper was to evaluate the species belonging to the Auchenorrhyncha suborder identified in one apple orchard and one plum orchard in the experimental field of Didactic Station in Moara Domnească in 2022 in term of the ecological characteristics and the adult population dynamic for the most abundant species.

MATERIALS AND METHODS

The study area consisted of two commercial orchards, apple and plum, that belong to the experimental field Moara Domnească Didactic Station (44°29'59.1"N/ 26°15'31.7"E, 81 m a.s.l) located at 15 km north-east from Bucharest in the southern part of Romania and the sampling took place in 2022. Both apple (22.5 ha) and plum (7 ha) orchards were established in 2005 and consisted in a mix of cultivars. The orchards were chemically treated for pests and diseases control, with the first treatment on March 1st and the last one on July 22nd. The orchards were neighboring with apricot and walnut orchards and sunflower and corn crops.

The insects were collected using dual-sided yellow optical sticky traps (A4 dimension) produced in Romania at the Chemistry Research Institute "Raluca Ripan" and placed in the canopy of trees. A number of 9 traps/orchard was used from early April till mid-November (234 traps in total), arranged diagonally across the orchards and replaced every two weeks. A SZ61 stereomicroscope types of orchards of fruit trees and shrubs, with camera mount was used for the identification of species in the Auchenorrhyncha suborder following morphological characteristics and identification keys found in literature (Dietrich, 2005; Biedermann & Niedringhaus, 2009; Mozaffarian, 2018; Karavin et al., 2021).

The ecological parameters of abundance (A), dominance (D%), constancy (C%) and ecological significance index (W%) of species communities of Auchenorrhyncha have been calculated using formulas in literature (Stan, 1994; Baban, 2006; Carmo et al., 2013). According to the values of the ecological parameters, species were classified as following: for dominance: subreceding species (D1 < 1%), receding species (D2 = 1-2%), subdominant species (D3 = 2-5%), dominant species (D4 = 5-10%), eudominant species (D5 > 10%); for constancy: accidental species (C1 = 1-25%), accessory species (C2 = 25-50%), constant species (C3 = 50-75%), euconstant species (C4 = 75-100%); for ecological significance index: accidental species (W1 < 1%), accessory species (W2 = 1-5%), characteristic species (W3 > 5%).

The population dynamic of adult insects was performed for the most abundant species in both orchards.

RESULTS AND DISCUSSIONS

In the year 2022, the Auchenorrhyncha complex in two studied orchards of apple and plum has been evaluated by comparing captured species on yellow sticky traps. A total of 7403 specimens were caught on yellow sticky traps in the April-November period, 2022 belonging to 34 species assigned to seven families of true hoppers, 30 in apple and 32 in plum (Table 1**).** The identified captured species were represented by all the groups from the Auchenorrhyncha suborder, namely leafhoppers (Cicadellidae family), planthoppers (Cixiidae, Delphacidae and Flatidae families), treehoppers (Membracidae family), spittlebugs (Aphrophoridae family) and cicadas (Cicadidae family).

Table 1. Number of species and specimens captured in 2022 on apple and plum

Families	Apple		Plum	
	Specimens	Species	Specimens	Species
Cixiidae	128	3	85	3
Flatidae	3	1	2	1
Delphacidae	3	1	1	1
Cicadidae	1	1	3	1
Membracidae	5	1	2	1
Aphrophoridae	15	1	3	1
Cicadellidae	5903	22	1249	24
Total	**6058**	**30**	**1345**	**32**

Concerning the number of specimens, the apple orchard totaled a much larger number, namely 6058 (82%), 4.5 times higher compared with the plum orchard, where 1345 specimens (18%) were found. In another study in Romania concerning the Auchenorrhyncha fauna on apple and plum, similar results were found, with the abundance of adults on apple being five times higher comparative to plum (Teodoru et al., 2021). For both orchards, by far the most abundant family was Cicadellidae, with 5903 specimens on apple (97.44% of all specimens from apple) and 1249 specimens on plum (92.86% of all specimens from plum). The most numerous species were also found in the Cicadellidae family (Table 1), this result being found in many recent scientific papers on the fauna of Auchenorrhyncha in fruit tree and shrub orchards of Europe (Teodorescu, 2018; Tsagkarakis et al., 2018; Fischnaller et al., 2020; Thanou et al., 2020; Theodorou et al., 2021; Karavin et al., 2021; Teodoru et al., 2021). Regarding the Cicadellidae family, leafhoppers from the Typhlocybinae and Deltocephalinae subfamilies had the highest abundance in both orchards. The Typhlocybinae subfamily percentage was 83.06% in apple and 60.36% in plum, while the Deltocephalinae subfamily was 16.83% in apple and 39% in plum. Although there were much fewer specimens in the plum orchard, in the case of the Cicadellidae family, two more additional species were found compared to the apple orchard. However, these species were considered accidental, as they comprised only a few specimens.

During the monitoring period, the peak activity of total Auchenorrhyncha fauna reached values of 1031 specimens in early July-late August in the apple in relation to the plum orchard that reached 343 specimens in late September-mid-October (Figure 1). The smallest flight activity was in May-early June and late October-November for both orchards.

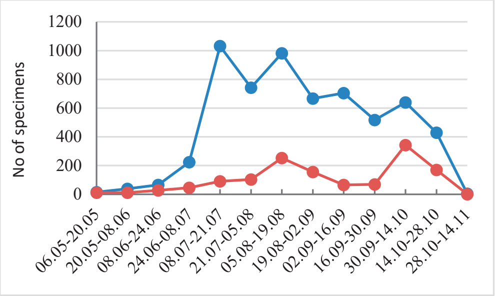

Figure 1. Auchenorrhyncha adults flight activity in the two orchards in 2022

Regarding invasive species and vectors of phytopathogenic organisms, 16 species were identified as confirmed and potential vectors of phytoplasma, totaling 77% in the apple orchard and 49% in the plum orchard (Table 2). The high abundance of phytoplasma vectors is explained by the fact that the family with the most numerous species of true hoppers is Cicadellidae, and most phytoplasma vectors belong to this family (Weintraub & Beanland, 2006; Wilson & Weintraub, 2007). An additional five species were identified as vectors of bacteria (two species) and viruses (three species). Among invasive species, seven species in our study were identified as new for the territory of Romania, with five of them playing an important role as phytoplasma vectors. Table 2 shows the list of invasive and/or vector species captured in the apple and plum orchards in 2022.

Table 2. Invasive and/or vector Auchenorrhyncha species identified in apple and plum in 2022

Auchenorrhyncha species	Invasive species/first report in Romania	Vector species - the transmitted phytopathogenic organism and the associated host plant	Authors
Cixiidae/Cixinae			
Cixius wagneri China, 1942	-	Confirmed vector: proteobacteria - Marginal Chlorosis of Strawberry (*Ca. Phlomobacter fragariae*) - strawberry	Danet et al., 2003
		Potential vector: proteobacteria - Disease Syndrome "Basses Richesses" (*Ca. Arsenophonus phytopathogenicus*) - sugar beet	Bressan et al., 2008
Hyalesthes obsoletus Signoret 1865	-	Confirmed vector: phytoplasma - stolbur (*Ca. Phytoplasma solani*) - grape vine, potato	Mitrović et al., 2016 Kosovac et al., 2019
Reptalus quinquecostatus Dufour, 1833	-	Potential vector: phytoplasma - stolbur (*Ca. Phytoplasma solani*) - grape vine	Pinzauti et al., 2008 Chuche et al., 2016
Flatidae/Flatinae			
Metcalfa pruinosa Say, 1830	Yes (2009)	Potential vector: phytoplasma - aster yellows (*Ca. Phytoplasma asteris*) - *Tagetes patula* (French marigold)	Grozea et al., 2011 Mergenthaler et al., 2020
Delphacidae/Criomorphinae			
Laodelphax striatellus Fallén, 1826	-	Confirmed vector: virus - Rice stripe virus - rice	Otuka et al., 2010
Membracidae/Smiliinae			
Stictocephala bisonia Kopp & Yonke, 1977	Yes (1955)	Potential vector: phytoplasma - apple proliferation (*Ca. Phytoplasma mali*) - apple	Popescu-Gorj, 1955 Duduk et al., 2008
Aphrophoridae/Aphrophorinae			
Philaenus spumarius Linnaeus, 1758	-	Confirmed vector: bacteria - *Xylella fastidiosa* - a wide range of agricultural crops and ornamental plants	Godefroid et al., 2022
		Potential vector: phytoplasma - apple proliferation (*Ca. Phytoplasma mali*) - apple, celery	Hegab & El-Zohairy, 1986
Cicadellidae/Aphrodinae			
Aphrodes makarovi Zachvatkin, 1948	-	Potential vector: phytoplasma – stolbur (*Ca. Phytoplasma solani*) - grape vine	Quaglino et al., 2019
		Potential vector: phytoplasma - Flavescence dorée (*Ca. Phytoplasma vitis*) - grape vine	Bressan et al., 2006
Cicadellidae/Agalliinae			
Anaceratagallia ribauti Ossiannilsson, 1938	-	Potential vector: phytoplasma - stolbur (Candidatus *Phytoplasma solani*) - broad bean	Riedle-Bauer et al., 2008
Cicadellidae/Typhlocybinae			
Empoasca decipiens Paoli, 1930	-	Confirmed vector: phytoplasma - Lime witches' broom (*Ca. Phytoplasma aurantifolia*) - lime, *Ranunculus* sp.	Parrella et al., 2008 Alhudaib et al., 2009
		Confirmed vector: phytoplasma - European stone fruit yellows (*Ca. Phytoplasma prunorum*) – apricot	Pastore et al., 2004
		Confirmed vector: phytoplasma - aster yellows (*Ca. Phytoplasma asteris*) - *Ranunculus* sp.	Parrella et al., 2008
Erasmoneura vulnerata Fitch, 1851	Yes (2018)	-	Chireceanu et al., 2020
Eupteryx atropunctata Goeze, 1778	-	Potential vector: phytoplasma - stolbur (*Ca. Phytoplasma solani*) - grape vine	Riedle-Bauer et al., 2006
		Potential vector: viroid - Potato spindle tuber viroid - potato, sunflower, beans	Patschke et al., 1997
Cicadellidae/ Deltocephalinae			
Fieberiella florii Stål, 1864	-	Confirmed vector: phytoplasma - Peach X-disease (*Ca. Phytoplasma pruni*) - apple	Krczal et al., 1988
		Potential vector: phytoplasma - apple proliferation (*Ca. Phytoplasma mali*) - apple	Tedeschi & Alma, 2006
		Potential vector: phytoplasma - European stone fruit yellows (*Ca. Phytoplasma prunorum*) - cherry	Landi et al., 2007
Anoplotettix fuscovenosus Ferrari, 1882	-	Potential vector: phytoplasma - Flavescence dorée (*Ca. Phytoplasma vitis*) - grape vine	Alma, 1995
Orientus ishidae Matsumura, 1902	Yes (2016)	Confirmed vector: phytoplasma - Flavescence dorée (*Ca. Phytoplasma vitis*) - grape vine	Alma et al., 2015 Chireceanu et al., 2017
		Potential vector: phytoplasma - Peach X-disease (*Ca. Phytoplasma pruni*) - celery	Davis et al., 2013
		Potential vector: phytoplasma – apple proliferation (*Ca. Phytoplasma mali*) - apple	Oppedisano, 2017
Phlogotettix cyclops Mulsant & Rey, 1855	Yes (2016)	Potential vector: phytoplasma - Flavescence dorée (*Ca. Phytoplasma vitis*) - grape vine	Strauss & Reisenzein, 2018 Chireceanu et al., 2020
Scaphoideus titanus Ball, 1932	Yes (2009)	Confirmed vector: phytoplasma - Flavescence dorée (*Ca. Phytoplasma vitis*) - grape vine	Chireceanu et al., 2011 Alma et al., 2015
Neoaliturus fenestratus Herrich-Schäffer, 1834	-	Confirmed vector: phytoplasma - stolbur (*Ca. Phytoplasma solani*) - grape vine, green salad, carrot Confirmed vector: phytoplasma - aster Yellows (*Ca. Phytoplasma asteris*) - grape vine	Orenstein et al., 2003 Mitrović et al., 2019
Japananus hyalinus Osborn, 1900	Yes (1961)	-	Arzone, 1987
Psammotettix sp. Haupt, 1929	-	Confirmed vector: virus - Wheat dwarf virus - wheat, barley	Manurung et al., 2004
Allygidius atomarius Fabricius, 1794	-	Confirmed vector: phytoplasma - Elm yellows (*Ca. Phytoplasma ulmi*) - elm	Pavan, 2000

The four most abundant species in studied orchards, in descending order were *Empoasca decipiens* (59.66%), *Fieberiella florii* (11.18%), *Zyginidia pullula* (6.82%) and *Zygina flammigera* (6.54%) in the apple orchard (Figure 2) and *Fieberiella florii* (30.6%), *Zygina flammigera* (22.6%), *Zyginidia pullula* (15.46%) and *Empoasca decipiens* (9.22%) in the plum orchard (Figure 3).

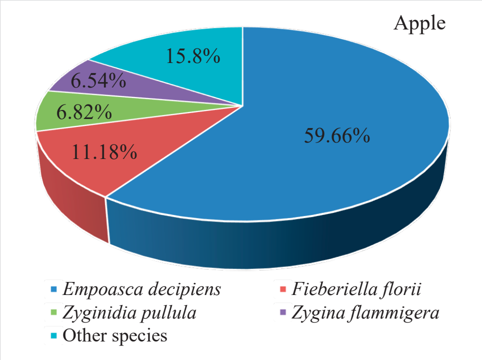

Figure 2. The abundance of the main species of true hoppers on apple

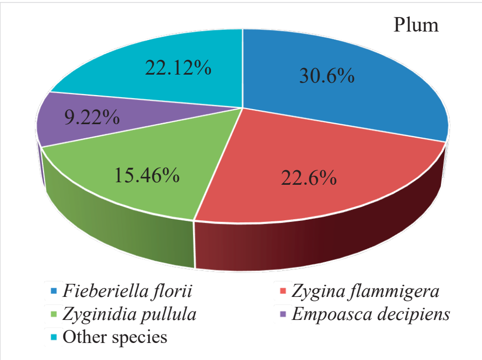

Figure 3. The abundance of the main species of true hoppers on plum

The abundance and the values of dominance, constancy and ecological significance of the two species communities, on apple and plum, are presented in Table 3.

By far the most specimens captured in total belonged to the species *Empoasca decipiens* (Cicadellidae, Typhlocybinae), which totaled 3738 specimens (50.5%), so more than half of all the specimens collected in both orchards (3614 on apple and 124 on plum). As for the ecological parameters, *E. decipiens* was found to be eudominant (D5), constant (C3) and characteristic (W3) in the apple orchard and dominant (D4) and accessory (C2 and W2) in the plum orchard. The second most numerous species was *Fieberiella florii* (Cicadellidae, Deltocephalinae), with 1088 specimens in total (14.7%), 677 on apple and 411 on plum. For the ecological parameters, on both apple and plum orchards, the species was identified as eudominant (D5), accessory (C2) and characteristic (W3). *Zygina flammigera* (Cicadellidae, Typhlocybinae) also had a considerable number of specimens (700), representing 9.45% (396 on apple and 304 on plum). The species was dominant (D4) and accessory (C2 and W2) in the apple orchard and eudominant (D5), accessory (C2) and characteristic (W3) in the plum orchard. *Zyginidia pullula* (Cicadellidae, Typhlocybinae), with 621 specimens (8.39%), 413 on apple and 208 on plum, was the fourth most numerous species. The species was dominant (D4) and accessory (C2 and W2) on apple and eudominant (D5), accidental (C1) and accessory (W2) on plum. After the fourth most abundant species (*Z. pullula*), each of the following species in descending order *Edwardsiana rosae*, *Reptalus quinquecostatus*, *Arboridia sp.*, *Orientus ishidae* and *Neoaliturus fenestratus* represented below 5% in terms of abundance. Of these, *O. ishidae* is invasive species and *R. quinquecostatus*, *O. ishidae* and *N. fenestratus* three are vectors of phytoplasmas.

Table 3. Ecological parameters for Auchenorrhyncha species captured in 2022

Taxa	Apple							Plum						
	A	D		C		W		A	D		C		W	
	(no)	Class	%	Class	%	Class	%	(no)	Class	%	Class	%	Class	%
Cixiidae/Cixinae														
Cixius wagneri China, 1942	36	0.59	D1	18.12	C1	0.1	W1	4	0.29	D1	2.56	C1	0.007	W1
Hyalesthes obsoletus Signoret 1865	1	0.01	D1	0.85	C1	0.00008	W1	8	0.59	D1	4.27	C1	0.02	W1
Reptalus quinquecostatus Dufour, 1833	91	1.5	D2	27.62	C2	0.41	W1	73	5.42	D4	17.94	C1	0.97	W1
Flatidae/Flatinae														
Metcalfa pruinosa Say, 1830	3	0.05	D1	2.56	C1	0.001	W1	2	0.14	D1	1.7	C1	0.002	W1
Delphacidae/Criomorphinae														
Laodelphax striatellus Fallén, 1826	3	0.05	D1	2.56	C1	0.001	W1	1	0.07	D1	0.85	C1	0.0005	W1
Cicadidae/Cicadettinae														
Dimissalna dimissa Hagen, 1856	1	0.01	D1	0.85	C1	0.00008	W1	3	0.22	D1	1.7	C1	0.003	W1
Membracidae/Smiliinae														
Stictocephala bisonia Kopp & Yonke, 1977	5	0.08	D1	3.41	C1	0.002	W1	2	0.14	D1	1.7	C1	0.002	W1
Aphrophoridae/Aphrophorinae														
Philaenus spumarius Linnaeus, 1758	15	0.24	D1	7.69	C1	0.01	W1	3	0.22	D1	2.56	C1	0.005	W1
Cicadellidae/Aphrodinae														
Aphrodes makarovi Zachvatkin, 1948	3	0.05	D1	1.7	C1	0.0008	W1	4	0.29	D1	1.7	C1	0.004	W1
Cicadellidae/Agalliinae														
Anaceratagallia ribauti Ossiannilsson, 1938	3	0.05	D1	2.56	C1	0.001	W1	3	0.22	D1	2.56	C1	0.005	W1
Cicadellidae/Eupelicinae														
Eupelix cuspidata Fabricius, 1775	-	-	-	-	-	-	-	1	0.07	D1	0.85	C1	0.0005	W1
Cicadellidae/Typhlocybinae														
Zyginella pulchra Löw, 1885	17	0.28	D1	8.54	C1	0.02	W1	3	0.22	D1	2.56	C1	0.005	W1
Empoasca decipiens Paoli, 1930	3614	59.65	D5	64.1	C3	38.23	W3	124	9.22	D4	33.33	C2	3.07	W2
Zygina flammigera Fourcroy, 1785	396	6.53	D4	47	C2	3.06	W2	304	22.6	D5	41.88	C2	9.46	W3
Erasmoneura vulnerata Fitch, 1851	48	0.79	D1	15.38	C1	0.12	W1	17	1.26	D2	9.4	C1	0.11	W1
Eupteryx atropunctata Goeze, 1778	18	0.29	D1	10.25	C1	0.03	W1	12	0.89	D1	5.98	C1	0.05	W1
Zyginidia pullula Boheman, 1845	413	6.81	D4	29.91	C2	2.03	W2	208	15.46	D5	14.52	C1	2.24	W2
Edwardsiana rosae Linnaeus, 1758	307	5.06	D4	29.05	C2	1.46	W2	31	2.3	D3	7.69	C1	0.17	W1
Arboridia sp.	90	1.48	D2	28.2	C2	0.41	W1	55	4.08	D3	17.94	C1	0.73	W1
Cicadellidae/ Deltocephalinae														
Fieberiella florii Stål, 1864	677	11.17	D5	47.86	C2	5.34	W3	411	30.55	D5	25.64	C2	7.83	W3
Anoplotettix fuscovenosus Ferrari, 1882	21	0.34	D1	9.4	C1	0.03	W1	4	0.29	D1	3.41	C1	0.009	W1
Orientus ishidae Matsumura, 1902	113	1.86	D2	23.93	C1	0.44	W1	7	0.52	D1	4.27	C1	0.02	W1
Phlepsius ornatus Perris, 1857	-	-	-	-	-	-	-	3	0.22	D1	0.85	C1	0.001	W1
Platymetopius rostratus Herrich-Schäffer, 1834	9	0.14	D1	6.83	C1	0.009	W1	-	-	-	-	-	-	-
Platymetopius major Kirschbaum, 1868	29	0.47	D1	15.38	C1	0.07	W1	3	0.22	D1	2.56	C1	0.005	W1
Phlogotettix cyclops Mulsant & Rey, 1855	8	0.13	D1	3.41	C1	0.004	W1	-	-	-	-	-	-	-
Scaphoideus titanus Ball, 1932	7	0.11	D1	4.27	C1	0.004	W1	1	0.07	D1	0.85	C1	0.0005	W1
Selenocephalus obsoletus Germar, 1817	-	-	-	-	-	-	-	2	0.14	D1	1.7	C1	0.002	W1
Neoaliturus fenestratus Herrich-Schäffer, 1834	102	1.68	D2	24.78	C1	0.41	W1	6	0.44	D1	3.41	C1	0.01	W1
Japananus hyalinus Osborn, 1900	3	0.05	D1	1.7	C1	0.001	W1	2	0.14	D1	1.7	C1	0.002	W1
Psammotettix sp. Haupt, 1929	14	0.23	D1	10.25	C1	0.02	W1	37	2.75	D3	12.82	C1	0.35	W1
Penthimia nigra Goeze, 1778	-	-	-	-	-	-	-	1	0.07	D1	0.85	C1	0.0005	W1
Allygidius atomarius Fabricius, 1794	3	0.05	D1	2.56	C1	0.001	W1	4	0.29	D1	2.56	C1	0.007	W1
Allygus modestus Scott, 1876	8	0.13	D1	6.83	C1	0.009	W1	6	0.44	D1	4.27	C1	0.02	W1

The population dynamic of adults for the most abundant species in both orchards insects was performed. The dynamics of *E. decipiens* is presented in Figure 4. In the apple orchard, *Empoasca decipiens* reached its maximum peak in the first half of July (953 specimens), with considerable populations during the following months, until October. In the plum orchard, population of this species was very low throughout the year, peaking at only 40 adults in August. *E. decipiens* is a common occurrence in orchards (Emam et al., 2020) and one of the most important pests in greenhouses in Europe (Tounou et al., 2003).

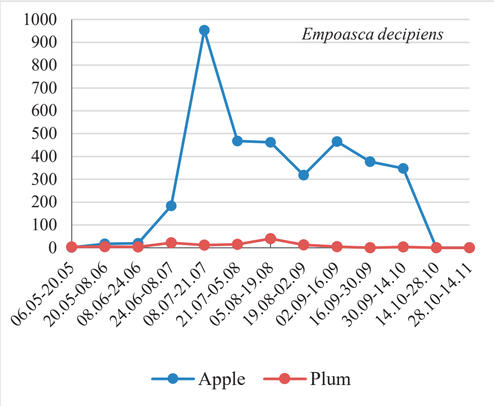

Figure 4. Population dynamics of *E. decipiens* in 2022

E. decipiens generally causes direct damage through feeding and the symptoms on host plants consist of chlorotic or necrotic areas also called "hopperburn" (Darwish, 2018). It is a highly polyphagous species and has been recorded on a wide variety of cultivated and spontaneous plants such as vines, tomatoes, cucumbers, potatoes, maize, beans, sesame and various ornamental plants (Raupach et al., 2002; Emam et al., 2020). In addition, this species has been identified as a potential vector of the following phytoplasmas: lime witches' broom (*Ca. Phytoplasma aurantifolia*) (Alhudaib et al., 2009), European stone fruit yellows (*Ca. Phytoplasma prunorum*) (Pastore et al., 2004) and aster yellows (*Ca. Phytoplasma asteris*) (Parrella et al., 2008).

The population dynamics of *Fieberiella florii* (Figure 5) reached one maximum peak, in the second half of October on apple (397 adults) and in the first half of the same month on plum (225 adults).As a pest species, it is one of the main vectors of peach X-disease (*Ca. Phytoplasma pruni*) on apple, especially in North America (Krczal et al., 1988). Tedeschi & Alma (2006) demonstrated using the molecular method that *F. florii* can be a potential vector of the apple proliferation phytoplasma (*Ca. Phytoplasma mali*), while Landi et al. (2007) detected European stone fruit yellows phytoplasma (*Ca. Phytoplasma prunorum*) in individuals captured in affected cherry orchards.

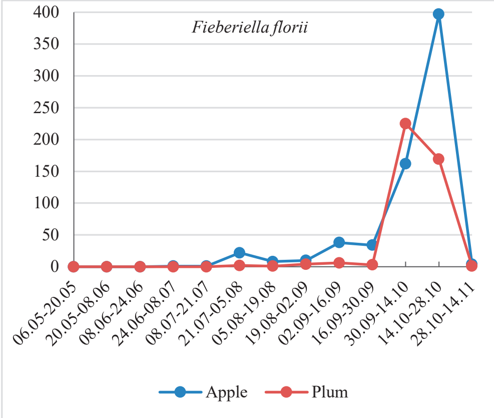

Figure 5. Population dynamics of *F. florii* in 2022

The population dynamics of *Zygina flammigera* (Figure 6) showed that in the apple orchard the species reached two peaks, the first between the end of July and the beginning of August (82 specimens) and another one, in the second half of August (99 specimens). In plum, the species reached one maximum peak only, in the first half of October (92 specimens).

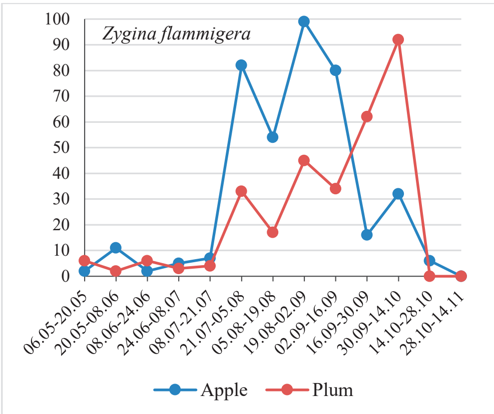

Figure 6. Population dynamics of *Z. flammigera* in 2022

Although this species has not been confirmed as a vector of phytopathogens, it can still cause direct damage through feeding on the sap of host plants. It is a polyphagous species that is common in fruit tree orchards (Teodoru et al., 2021). It has been reported as a minor pest in peach orchards of Italy (Viggiani et al., 1992) and Spain (Torres et al., 2000) but also as a major pest of peach and almond in Tunisia (Chaieb et al., 2011).

The population dynamics of *Zyginidia pullula* (Figure 7) showed that in both orchards, the species reached a single maximum peak in the first half of August, with 183 adults on apple and 157 adults on plum.

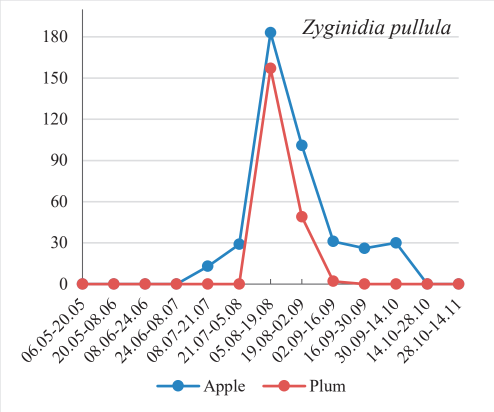

Figure 7. Population dynamics of *Z. pullula* in 2022

Like most of the leafhoppers from the Typhlocybinae subfamily, it causes direct damage to cultivated plants. It feeds on the mesophyll, so it directly affects the photosynthesis process of plants. This species is more common on grasses, including corn crops (Verzé & Mazzoglio, 1994; Negri et al., 2006).

CONCLUSIONS

Data on the Auchenorrhyncha fauna studied in two managed orchards of apple and plum in April-November 2022 showed that a total of 34 species were identified (30 on apple and 32 on plum) with a total of 7403 specimens (6058 on apple, 1345 on plum). The species belonged to a total of six families, namely Cixiidae, Flatidae, Delphacidae, Cicadidae, Membracidae, Aphrophoridae and Cicadellidae, with the later family being by far the most abundant in both apple (97.44%) and plum (92.86%) orchards. The species with the highest number of individuals were cicadellids *Empoasca decipiens*, *Fieberiella florii*, *Zygina flammigera* and *Zyginidia pullula*. *E. decipiens* alone was so abundant that it accounted more than a half of all the other species collected in both orchards (50.5%).

Of the 34 species captured on yellow sticky traps, 16 are cited in literature as phytoplasma vectors, 3 virus vectors and 2 vectors of bacteria. Moreover, seven species among them were identified as invasive in Europe and Romania: *Metcalfa pruinosa*, *Stictocephala bisonia*, *Erasmoneura vulnerata*, *Orientus ishidae*, *Phlogotettix cyclops*, *Scaphoideus titanus* and *Japananus hyalinus*.

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