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AUCHENORRHYNCHA FAUNA ASSOCIATED WITH ABANDONED APPLE AND PLUM ORCHARDS IN NORTHERN BUCHAREST IN 2020

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Abstract

The species of the Auchenorrhyncha group represent one of the most important risks for apple and plum orchards, some of them being the vectors of major pathogens such as phytoplasmas. This paper presents results on the presence and structure of species of the Auchenorrhyncha suborder recorded in two unmanaged orchards of apple and plum from the northern part of Bucharest (Băneasa area) in 2020. The insects were collected on yellow double-sticky traps (two traps / orchard) placed in the canopy of apple and plum trees and replaced every week from early April until late November. In total, 25 species have been identified in both orchards, accounting 4834 individuals (4036 in the apple orchard and 798 in the plum orchard). In apple, the most abundant species were Orientus ishidae with 3096 specimens (76.7%), followed by Erasmoneura vulnerata with 380 specimens (9.41%), Zygina flammigera with 177 specimens (4.38%) and Anoplotettix fuscovenosus with 156 specimens (3.86%). The most numerically relevant species in the plum orchard were Zygina flammigera with 371 specimens (46.49%), Erasmoneura vulnerata with 115 specimens (14.41%), Orientus ishidae with 106 specimens (13.28%) and Fieberiella florii with 91 specimens (11.4%). Dynamics of adult populations was performed for the most abundant species in both fruit orchards.

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

INTRODUCTION

Worldwide, apple and plum crops represent very important food sources. According to the Food and Agriculture Organization Corporate Statistical Database (FAOSTAT), in 2019, the total area harvested in the world for apples was 4,717,384 ha, and for plums and blackthorns 2,727,745 ha. In Romania, in 2019, the area harvested for apples was 52,740 ha and for plums and blackthorns 65,580 ha. For both crops, the Auchenorrhyncha fauna represent an economically important category of pests. Auchenorrhyncha with the common name 'true hoppers' is one of the largest groups of Hemiptera order and includes leafhoppers, planthoppers, treehoppers, froghoppers and cicadas. Currently, there are approximately 42,000 species of Auchenorrhyncha described worldwide (Deitz, 2008). In the European continent, more than 2000 species, mostly pests, have been reported. Among them, a total of 32 invasive species have been detected in Europe (Šćiban & Kosovac, 2020). They are phytophagous insects (Waloff, 1980) and equipped with piercing-sucking mouthparts. Their economically importance status is given by the fact that they cause direct damage by sucking the sap and indirect damage because some of them are vectors of pathogens, including phytoplasmas, bacteria and viruses. Over 200 species of 'true hoppers' are vectors of phytoplasmas and 70 species transmit viruses (Weintraub & Beanland, 2006). They can feed either with phloem, xylem or parenchyma (Bartlett et al., 2018) and both mature adults and nymphs can transmit plant pathogens (Weintraub & Beanland, 2006). The presence and role of abandoned orchards and crops have been studied in different papers, as they represent important sources of insect vectors and diseases (Altieri & Schmidt, 1986; Brown et al., 1988; Ricci et al., 2009; Grimová et al., 2016).

Investigations on the fauna of Auchenorrhyncha in fruit orchards in Romania are almost non-existent. The only study on this subject in autochthonous literature was in 2012 in a modern young pear orchard in Bucharest area (Cean & Cean, 2013). The authors described 6 species *Metcalfa pruinosa* (Say 1830), *Reptalus panzeri* (Low, 1883), *Fieberiella florii* (Stal, 1864), *Psammotettix notatus* (Melichar, 1896), *Zyginidia pullula*

(Boheman, 1845) and *Neoaliturus fenestratus* (Herrich-Schäfer, 1834) and 3 families, Flatidae, Cixiidae and Cicadellidae. Some of them were described as potential vectors of different diseases where they have been identified.

The aim of this paper was to comparatively evaluate the Auchenorrhyncha community in two abandoned orchards (apple and plum) in the northern Bucharest (44°30'21" N 26°04'01" E, 90 m), southern Romania in 2020. The species structure, abundance and adult population's dynamics of most abundant species and other ecological parameters have been calculated.

MATERIALS AND METHODS

Two abandoned old orchards, apple and plum, in the former experimental field of the Research-Development Institute for Plant Protection in the northern Bucharest were sampled in 2020. The area which includes the two orchards contains a mixture of different other herbaceous and woody plants grown spontaneously: European dwarf elder (*Sambucus ebulus* L.), American pokeweed (*Phytolacca americana* L.), common privet (*Ligustrum vulgare* L.), old man's beard (*Clematis vitalba* L.), wild and common grapevine (*Vitis* spp.), species of *Parthenocissus*, common barberry (*Berberis vulgaris* L.), dog rose (*Rosa canina* L.), common hawthorn (*Crataegus monogyna* Jacq.), blackthorn (*Prunus spinosa* L.), mulberry (*Morus* sp. L.), common oak (*Quercus robur* L.), Turkey oak (*Quercus cerris* L.), common walnut (*Juglans regia* L.). In addition, different species of *Prunus* belonging to the former experimental fields were present, including apricot (*P. armeniaca* L.), sweet cherry (*P. avium* L.) and sour cherry (*Prunus cerasus* L.).

Insects were collected on yellow double-sticky traps (2 traps/orchard), fixed inside the trees canopy at approximately 2 m above ground level and replaced every week from May to late November. A total of 56 traps per plantation were used. The insects were identified under a stereomicroscope SZ 61 in laboratory, according to morphological features in literature. In some cases, the nymphs were not identified to the genus level and therefore were not included in the total captures of this study.

The ecological parameters of abundance (A), dominance (D%), constancy (C%) and ecological significance (W%) have been calculated using specific formulas (Simionescu, 1983; Stan, 1994; Baban, 2006).

$$D\% = \frac{A \times 100}{n},$$

where: A - number of individuals in a species (abundance);

n - total number of individuals of all species in a sample;

For the dominance values, species were classified as subreceding species (D1 < 1%), receding species (D2 = 1-2%), subdominant species (D3 = 2-5%), dominant species (D4 = 5-10%) and eudominant species (D5 > 10%).

$$C\% = \frac{ns \times 100}{n},$$

where: ns - number of samples with one species;

n - total number of samples.

Regarding constancy values, species were classified as accidental species (C1 = 1-25%), accessory species (C2 = 25-50%), constant species (C3 = 50-75%), and euconstant species (C4 = 75-100%).

$$W\% = \frac{D \times C}{100}$$

For the ecological significance, species were classified as accidental species (W1 < 1%), accessory species (W2 = 1-5%) and characteristic species (W3 > 5%).

To measure the specific diversity of the species collected in the two orchards, two equations of Shannon function were used, modified by Mac Arthur and corrected by Lloyd and Ghelardi (Baban, 2006).

$$H(S) = \frac{K}{N}\left(N \log_{10} N - \sum_{r=1}^{S} Nr \log_{10} Nr\right),$$

where: H(S) - real diversity (observed);

K - conversion factor for changing the base of the logarithm from 10 to 2, having the value: 3.321928;

N - total number of specimens;

S - total number of species;

Nr - number of individuals of the species r (abundance);

$$H(S)_{max} = K \log_{10} S$$

where: $H(S)_{max}$ - maximum diversity (hypothetical);

$$H_r = \frac{H(S)}{H(S)max}$$

H_r - relative diversity (equitability).

The similarity of Auchenorrhyncha species in the two orchards was appreciated calculating the Spearman index (r_s) and Jaccard coefficient (JC). In addition, the Venn diagram was carried out (Heberle et al., 2015).

$$r_s = 1 - \frac{6\sum d^2}{n^3 - n}$$

where: r_s - calculated Spearman coefficient; d = differences between the ranks of a registration, n = number of observations. Its value is between -1 and +1, indicating a perfect negative/positive relationship between the two communities. The statistical significance of the values of the Spearman index is represented by the correlation coefficient (r_s). This coefficient is an effect size which describe the strength of the correlation according to the following values: 0-0.19 (very weak), 0.20-0.39 (weak), 0.40-0.59 (moderate), 0.60-0.79 (strong), 0.80-1.0 (very strong).

$$JC\% = \frac{C}{(A+B)-C}$$

where: A - number of species found only in the apple orchard;
B - number of species found only in the plum orchard;
C - number of species found in both orchards;
When JC = 0, the samples are entirely different from each other; when JC = 1, the samples are entirely similar.
Seasonal dynamics was realized for first five most abundant species at least in one of the investigated orchards.

RESULTS AND DISCUSSIONS

In this study, the Auchenorrhyncha species collected from two old unmanaged orchards (apple and plum) was compared.
The two orchards have not been managed since 2009 in terms of phytosanitary treatments for pest and diseases control and technological maintenance, so they became abandoned.
A total of 4834 leaf and plant - hopper specimens (adults and larvae together) were captured on yellow double-sticky traps from May to October 2020, of which 4036 specimens (83.5%) in the apple orchard and 798 specimens (16.5%) in the plum orchard (Table 1).
These belonged to 25 species and six families Membracidae, Cixiidae, Aphrophoridae, Cicadellidae, Acanaloniidae and Flatidae.

Table 1. Auchenorrhyncha captures on yellow double-sticky traps on apple and plum trees in 2020

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	1	0.02	D_1	3.44	C_1	0.0006	W_1		-	-	-	-	-	-
Reptalus quinquecostatus Dufour, 1833	-	-	-	-	-	-	-	5	0.62	D_1	11.53	C_1	0.047	W_1
Membracidae/Smiliinae	-	-	-	-	-	-	-							
Stictocephala bisonia Kopp & Yonke, 1977	-	-	-	-	-	-	-	2	0.25	D_1	7.69	C_1	0.019	W_1
Aphrophoridae/Aphrophorinae														
Philaenus spumarius L., 1758	13	0.32	D_1	27.58	C_2	0.088	W_1	9	1.12	D_2	15.38	C_1	0.172	W_1
Cicadellidae/Agalliinae														
Anaceratagallia ribauti Ossiannilsson, 1938	2	0.04	D_1	6.89	C_1	0.002	W_1	13	1.62	D_2	19.23	C_1	0.311	W_1
Cicadellidae/ Deltocephalinae														
Scaphoideus titanus Ball, 1932	17	0.42	D_1	17.24	C_1	0.072	W_1	12	1.50	D_2	11.53	C_1	0.172	W_1
Fieberiella florii Stal, 1864	33	0.81	D_1	37.93	C_2	0.307	W_1	91	11.40	D_5	76.92	C_4	8.768	W_3
Anoplotettix fuscovenosus Ferrari, 1882	156	3.86	D_3	24.13	C_1	0.931	W_1	14	1.75	D_2	7.69	C_1	0.134	W_1
Neoaliturus fenestratus Herrich-Schäffer, 1834	-	-	-	-	-	-	-	1	0.12	D_1	3.84	C_1	0.004	W_1
Orientus ishidae Matsumura, 1902	3096	76.70	D_5	44.82	C_2	34.37	W_3	106	13.28	D_5	38.46	C_2	5.107	W_3
Euscelidius variegatus Kirschbaum, 1858	-	-	-	-	-	-	-	2	0.25	D_1	7.69	C_1	0.019	W_1
Platymetopius major Kirschbaum, 1868	3	0.07	D_1	10.34	C_1	0.007	W_1	-	-	-	-	-	-	-
Phlogotettix cyclops Mulsant & Rey, 1855	12	0.29	D_1	20.68	C_1	0.059	W_1	-	-	-	-	-	-	-
Allygus atomarius F., 1794	24	0.59	D_1	31.03	C_2	0.183	W_1	12	1.50	D_2	30.76	C_2	0.461	W_1
Allygus modestus Scott, 1876	2	0.04	D_1	6.89	C_1	0.002	W_1	4	0.50	D_1	15.38	C_1	0.076	W_1
Psammotettix sp.	1	0.02	D_1	3.44	C_1	0.0006	W_1	1	0.12	D_1	3.84	C_1	0.004	W_1
Cicadellidae/Typhlocybinae														
Zygina flammigera Fourcroy, 1785	177	4.38	D_3	65.51	C_3	2.869	W_2	371	46.49	D_5	65.38	C_3	30.39	W_3

Taxa	Apple							Plum						
	A (no)	D		C		W		A (no)	D		C		W	
		Class	%	Class	%	Class	%		Class	%	Class	%	Class	%
Zyginella pulchra Löw, 1885	13	0.32	D_1	20.68	C_1	0.066	W_1	-	-	-	-	-	-	-
Erasmoneura vulnerata Fitch, 1851	380	9.41	D_4	55.17	C_3	5.191	W_3	115	14.41	D_5	34.61	C_2	4.987	W_2
Arboridia sp.	93	2.30	D_3	44.82	C_2	1.030	W_2	25	3.13	D_3	23.07	C_1	0.722	W_1
Cicadellidae/Cicadellinae	-	-	-	-	-	-	-							
Cicadella viridis Linnaeus, 1758	-	-	-	-	-	-	-	2	0.25	D_1	7.69	C_1	0.019	W_1
Cicadellidae/Eurymelinae														
Macropsis fuscula Zetterstedt, 1828	2	0.04	D_1	6.89	C_1	0.002	W_1	-	-	-	-	-	-	-
Acericerus ribauti Nickel & Remane, 2002	-	-	-	-	-	-	-	5	0.62	D_1	7.69	C_1	0.047	W_1
Acanaloniidae														
Acanalonia conica Say, 1830	5	0.12	D_1	17.24	C_1	0.020	W_1	1	0.12	D_1	3.84	C_1	0.004	W_1
Flatidae/Flatinae														
Metcalfa pruinosa Say, 1830	6	0.14	D_1	13.79	C_1	0.019	W_1	7	0.87	D_1	23.07	C_1	0.200	W_1

The range of species was about the same for both orchards, 19 in the apple and 20 in the plum orchard, and were members of 5 and 6 families respectively.

The insect catches in the apple orchard were five times higher comparative to plum, although the two orchards are very close (approximately 70 m distance between them).

Seasonal trend of the number of species and specimens captured during the growing season from May until November are illustrated in Figure 1.

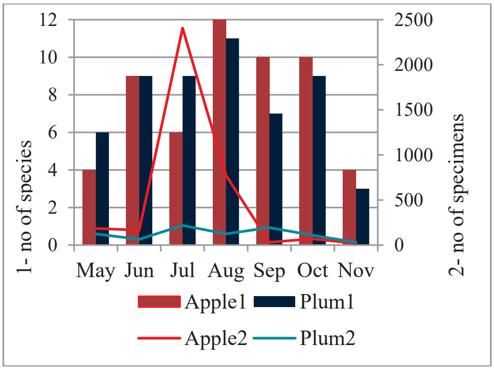

Figure 1. Number of species and specimens on yellow sticky traps recorded in the abandoned apple and plum orchards monitored in 2020

By comparing the collecting data from the two orchards we can observe that both number of species and captures were variable throughout the collecting period. The maximum number of species was in August for both orchards but high values were also reached in the first two months of autumn. Few species were found in May and November for both orchards.

Seasonal dynamics of the captures on yellow traps showed a maximum in July for both orchards, with a higher density of Auchenorrhyncha activity in this period. In terms of percentage, this maximum accounted 59.61% and 27.32% of all Auchenorrhyncha insects captured in apple and in plum, respectively.

The Cicadellidae family was the most abundant in both orchards, constituting 99.38% in apple and 96.99% in plum and included 15 species in apple but also in plum. Under this family, the leafhoppers of the Deltocephalinae and Typhlocybinae subfamilies were the most abundant in both orchards: Deltocephalinae accounted 82.86% in apple and 30.45% in plum and Typhlocybinae recorded 64.04% in plum and 16.43% in apple orchard.

The first four species per plantation, considered as main species, in descending order of relative abundance, were *Orientus ishidae* (76.7%), *Erasmoneura vulnerata* (9.41%), *Zygina flammigera* (4.38%) and *Anoplotettix fuscovenosus* (3.86%) in the apple orchard, and *Z. flammigera* (46.49%), *E. vulnerata* (14.41%), *O. ishidae* (13.28%) and *Fieberiella florii* (11.4%) in the plum orchard.

The values of dominance, constancy and ecological significance of the Auchenorrhyncha species collected from apple and plum orchards are presented in Table 1.

In the apple orchard, *O. ishidae* was found to be eudominant species and *E. vulnerata* dominant. Also, 3 subdominant species and 14 subreceding species were evaluated. Values of constancy highlighted the constant presence in samples of 2 species (*Z. flammigera* and *E. vulnerata*), 5 accessory and 12 accidental species. The ecological significance index showed 2 characteristic species (*O. ishidae*,

E. vulnerata), 2 accessory species (*Arboridia* spp., *Z. flammigera*) and 15 accidental species.
In the plum orchard, four species were evaluated to be eudominant (*F. florii*, *O. ishidae*, *Z. flammigera*, *E. vulnerata*). The *Arboridia* genus was subdominant and the other species were subreceding and receding. The highest two values of the frequency in the samples had *F. florii* (euconstant species) and *Z. flammigera* (constant species). The other 18 species were accessory and accidental. The ecological significance index indicated 3 characteristic species (*F. florii*, *O. ishidae*, *Z. flammigera*), one accessory (*E. vulnerata*) and 16 accidental species.
The relative diversity and equitability of the Auchenorrhyncha species collected in the apple and plum orchards are presented in Table 2.
The comparative analysis of the Shannon diversity index [H(S)] and equitability (Hr) values showed that these varied during the vegetation period for both orchards.
Overall, the community from plum plantation proved to be more stable, registering a total value of the Shannon index (2.57) and equitability (0.59) higher than the community from apple plantation (1.37 and 0.32, respectively).
The high relative abundance of only one species (*O. ishidae* 76.7%) in apple trees has led to a reduction in the Shannon index.
Generally, the ecological imbalance of the two Auchenorrhyncha communities was mainly influenced by large populations of 1-2 species.

Table 2. Trend of number of species, relative diversity and equitability of the Auchenorrhyncha community in abandoned apple and plum in 2020

Month	No of species/S		H(S)		H(S)max		Hr	
	Apple	Plum	Apple	Plum	Apple	Plum	Apple	Plum
May	4	6	0.71	0.98	1.99	2.55	0.35	0.38
June	9	9	1.53	2.61	3.15	3.15	0.48	0.82
July	6	9	0.20	1.80	2.55	3.15	0.07	0.57
Aug	12	11	0.49	2.20	3.55	3.45	0.13	0.63
Sept	10	7	2.80	0.77	3.32	2.79	0.84	0.27
Oct	10	9	2.34	1.84	3.32	3.15	0.70	0.58
Nov	4	3	1.81	1.42	1.99	1.56	0.90	0.91
May-Nov	19	20	1.37	2.57	4.21	4.31	0.32	0.59

The intensity of association degree of the two insect communities given by the values of Spearman coefficient (r_s) and Jaccard coefficient is presented in Table 3. Compared by the total value of the r_s index (0.87), the two communities can be appreciated to be in a good direct proportional interdependence. The significance of the correlation coefficient was examined by comparing the obtained values of t_{calc} and F_{calc} with the tabulated values available in the books of Snedecor (1956) and Ceapoiu (1968) in limits of 0.05% at n-1 degrees of freedom.
The result of similarity Jaccard coefficient showed a good resemblance of the two communities, more than half of the total of 25 species identified being common.

Table 3. Nominal and calculated values of the Spearman similarity index and their statistical significance (F and t tests)

Comparative communities	Spearman index		Significance test				Signification	Jaccard
	Obs.	Correct.	t test		F test			
	r_s	r_c 0.05	calc.	0.05%	calc.	0.05%		
May A/P	0.50	-	0.57	4.30	0.32	19.0	ns	0.42
June A/P	0.30	0.90	0.54	2.77	0.29	6.39	ns	0.38
July A/P	0.40	-	0.61	3.18	0.37	9.12	ns	0.36
Aug. A/P	0.85	0.82	3.20	2.57	10.24	5.05	*	0.45
Sept. A/P	0.83	0.90	2.53	2.77	6.40	6.38	*	0.31
Oct. A/P	0.67	0.71	1.99	2.44	3.96	4.28	ns	0.58
Nov. A/P	0.50	-	0.57	4.30	0.32	19.0	ns	0.75
A/P	0.87	0.46	6.02	2.16	36.24	2.46	ns	0.56

r_c - corrected Spearman coefficient.

The seasonal relationship established between the two Auchenorrhyncha communities can be visualized in the Venn diagram in Figure 1.

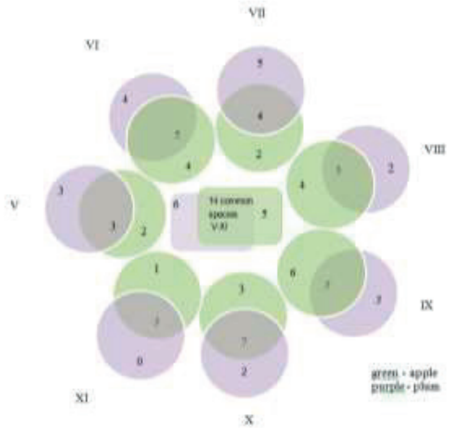

Figure 1. The Venn diagram

Seasonal dynamics of the captures were calculated only for principal species with high relative abundance in at least one of the investigated orchards. These species were *Orientus ishidae, Erasmoneura vulnerata*, *Zygina flammigera, Anoplotettix fuscovenosus* and *Fieberiella florii*.

O. ishidae (Cicadellidae, Deltocephalinae) was the most abundant species (3202 specimens, 76.04%) in apple orchard while in plum this was the third most abundant species (106 specimens, 13.28%). The presence of this invasive species of Asian origin was confirmed in Romania since 2016 (Chireceanu et al., 2017) even in the area where this study was carried out. This is considered an economically important pest especially after it was associated with the Flavescence dorée phytoplasma in Italy and Slovenia (Mehle et al., 2010; Gaffuri et al., 2011). Moreover, this species was already reported as potential vector of the peach yellow leafroll phytoplasma in U.S.A. (Rosenberger and Jones, 1978) and recently have been found to be infected with '*Ca. Phytoplasma mali*' (Oppedisano et al., 2017). It is a highly polyphagous species on many dicotyledonous plants in Europe including the genera *Malus* and *Prunus* (Seljac, 2004; Guglielmino, 2005; Nickel, 2010; Lessio et al., 2016).

The dynamics of *O.ishidae* (Figure 2) showed that the flight activity of adults started at the end of June-beginning of May and ended in mid-September for both orchards. For the apple orchard, the number of specimens was much higher with a massive increase in population during July. Fot both orchards, the population peak was reached at the end of July, with 894 specimens in apple and only 37 specimens in plum.

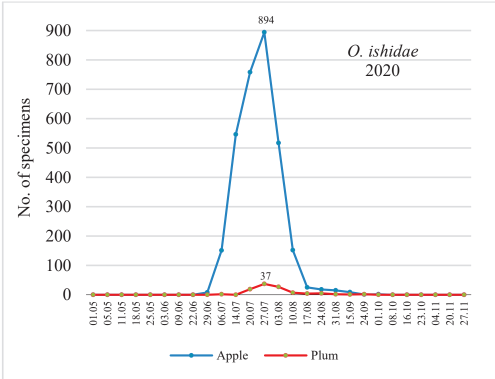

Figure 2. Population dynamics of *O. ishidae* in 2020

Zygina flammigera (Cicadellidae, Typhlocybinae) (Figure 3) was first the most abundant species in plum (371 specimens, 46.49%) and the third in apple orchard (177 specimens, 4.38%). This leafhopper is a polyphagous species native to Europe, considered a common species of fruit trees. It was reported as minor pest of peach in Italy (Viggiani et al., 1992) and Spain (Torres et al., 2000) and serious pest on peach and almond in Tunisia (Chaieb et al., 2011).

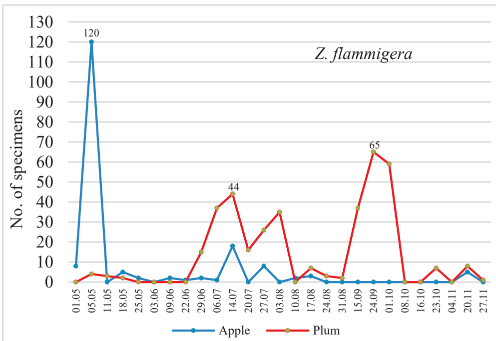

Figure 3. Population dynamics of *Z. flammigera* in 2020

The population dynamics of this species showed different peaks throughout the year. Its adults on yellow traps were present in the beginning of May, when there is the principal peak in the apple orchard. In the plum orchard there were three peaks of the captures, the first one coinciding with the second one of the apple orchard (middle of July). The second peak was in the beginning of august and the third peak was in the end of September. Last adults were captured in both orchards until the end of November.

Erasmoneura vulnerata (Cicadellidae, Typhlocybinae) reached the second large captures on apple (9.41%) and on plum (14.41%) being represented by 380 specimens and 115 specimens respectively. The population dynamics of this leafhopper (Figure 4) indicates an activity of adults more intense in May. In the plum orchard, it was only one peak that coincided with the second peak in the apple orchard (beginning of May), with a maximum of 59 adults. Adults were also sparsely captured from the beginning of June until the middle of November with numbers varying between 1 and 4. This is an invasive species from North America detected on Italian grapevine in 2004 (Duso et al., 2005). *E. vulnerata* is mentioned as a new pest of grapevine in Europe with an increasing damage potential (Duso et al., 2020). Presence of this species in Romania was observed in the area of this study from 2016 and also on grapevine in various sites in the country (Chireceanu et al., 2020). The host plants for this species are mainly plants of the *Vitis* and *Parthenocissus* genera (Girolami et al., 2006; Duso et al., 2019).

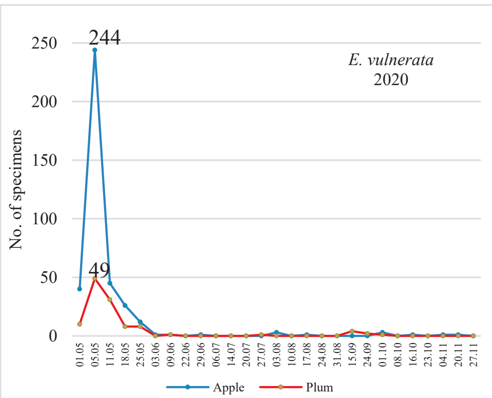

Figure 4. Population dynamics of *E. vulnerata* in 2020

Although this species was not yet associated with apple and plum, the number of specimens captured in this study was relevant. The presence of adults on traps in these orchards is probably the result of the yellow color of the traps attractive to them. The adults on their specific host plants voluntary grown in or close to monitored orchards were possibly lured in the orchards.

Anoplotettix fuscovenosus (Cicadellidae, Deltocephalinae) amounted 156 specimens in apple orchard. Native to Europe, this species is associated with grapevine and considered a potential vector of yellows phytoplasmas (Alma, 1995). This leafhopper was found to be associated to shrubs, trees but also to herbaceous hosts from urban ecosystems (Guglielmino et al., 2015). The flight activity of adults (Figure 5) on apple was between early June and the middle of August. The first peak was on late June with a maximum of 63 adults and a smaller peak on early August with a maximum of 5 adults. In plum, adults were captured very sparsely with only one maximum of 11 adults in the middle of June.

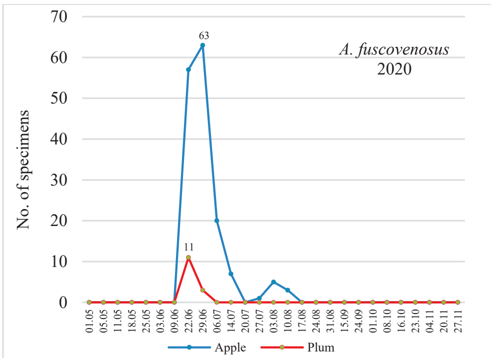

Figure 5. Population dynamics of *A. fuscovenosus* in 2020

The privet leafhopper *Fieberiella florii* (Cicadellidae, Deltocephalinae) was relatively abundant with 91 specimens in plum and only 33 specimens trapped in apple. This species is a major vector of the apple proliferation phytoplasma, one of the most economically important pathogens in apple orchards in Europe (Tedeschi & Alma, 2006). *F. florii* was found on many woody plants near hedges, including *Prunus* species but also on fruit trees

(*Prunus mahaleb* L., *P. avium* L., *Malus domestica* Borkh, *Cydonia oblonga* Mill.) and grapevine (*Vitis vinifera* L.). The dynamics of captures (Figure 6) showed visible fluctuations in the flight activity of adults in both orchards. In apple, there was only one maxim of only 8 adults in the middle of October. In plum, two maximums have been reached, one throughout the first half of July with 11 adults and another one in mid-October with 9 adults. For both orchards, the maximum values were very low compared to the population dynamics of the other 4 dominant species of leafhoppers.

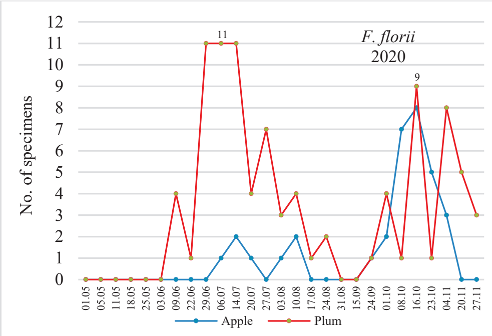

Figure 6. Population dynamics of *F. florii* in 2020

Other species sporadically captured were the invasive species *Scaphoideus titanus*, *Phlogotettix cyclops*, *Acanalonia conica* and *Metcalfa pruinosa*.
Regarding *S. titanus*, while living exclusively on grapevine (*Vitis vinifera* L.), it was also observed occasionally on other plants that grow in close proximity to vines. Chuche & Thiéry (2014) observed it on basket willow (*Salix viminalis* L.) and peach (*Prunus persica* Batsch). In North America, it was also recorded in various environments including forests, meadows, orchards and bogs (Chuche & Thiéry, 2014).

CONCLUSIONS

Comparative analyses of the Auchenorrhyncha communities monitored in 2020 in two old unmanaged orchards (apple and plum) revealed follows:
A total of 4834 specimens (adults and larvae together) belonging to 25 species and six families Membracidae, Cixiidae, Aphrophoridae, Cicadellidae, Acanaloniidae and Flatidae were captured on yellow double-sticky traps from May to October 2020, of which 4036 specimens (83.5%) in the apple orchard and 798 specimens (16.5%) in the plum orchard.
The most abundant species belonged to the Cicadellidae family: *Orientus ishidae*, *Zygina flammigera*, *Erasmoneura vulnerata*, *Anoplotettix fuscovenosus* and *Fieberiella florii*.
According to the Shannon diversity index and equitability values, the Auchenorrhyncha community from plum plantation proved to be more stable than those in apple plantation.
The two insect communities can be appreciated to be in a good direct proportional interdependence.
The high relative abundance of only one species (*O. ishidae* 76.7%) in apple trees has led to a reduction in the Shannon index. Generally, the ecological imbalance of the two Auchenorrhyncha communities was mainly influenced by large populations of 1-2 species.

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