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THE ECOLOGICAL STUDY OF THRIPS POPULATIONS IN A SOUTHERN ROMANIAN VINEYARD (INSECTA: THYSANOPTERA)

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Abstract

This paper aims to identify the specific structure of the Thysanoptera populations in the Ştefăneşti vineyard in the Argeş district of south-eastern Romania, a first scientific effort of its kind. The thrips were studied in an area of 2 hectares of Riesling grapes, from May-September 2007, in correlation with the phenology of the grapevine plants. 21 thrips species were identified. The research finds *Drepanothrips reuteri* Uzel, 1895 to be the dominant thrips species in the blooming phenophase, a time of optimal conditions for mass reproduction, as well as during one of the growth phases of berries (III), with a presence of 77.04% of all individuals collected during the study. Two other thrips species, namely *Thrips tabaci* Lindeman, 1888 (13.68 %) and the monophagous *Rubiothrips vitis* (Priesner, 1933), previously known as vineyard pests, were also identified within the thrips coenosis, the latter with a sporadic presence of 1. 55 %. The research reveals low values of ecological indices as well as a community structure dependent on abiotic factors, especially the high temperature of the summer season. The two blooming phenophases exhibit a maximal similarity of thrips populations. For the first time, the mites *Grandjeanella* as a Thysanoptera ectoparasite and a Tydeidae mite as a predator of thrips have been identified in Romania.

KEY WORDS: *Drepanothrips reuteri*, ecological indices, vineyard, phenophases, Romania.

Introduction

Among other pests, several species of the order Thysanoptera are noticeable in vineyards, especially in Europe and North America. Two of these pests, *Drepanothrips reuteri* Uzel, 1895 and *Rubiothrips vitis*

(Priesner, 1933), manifest their significant potential to cause damage the extent of which depends on the local microclimate.

Drepanothrips reuteri is spread throughout North America, Europe and western Asia; while *Rubiothrips vitis* is spread throughout Europe and north-eastern Asia; in the remaining Asian regions, *Ripiphorothrips cruentatus* Hood, 1919 is reported as a pest.

Unlike *D. reuteri*, which is a polyphagous species, *R. vitis* attacks grapevines exclusively.

Jenser & Voigt (1968) make observations on the damage caused by *D. reuteri* in vineyards in Hungary, where the species is common. *D. reuteri* was mentioned as a pest in vineyards in Crete, together with two other species of Thysanoptera, *Thrips tabaci* Lindeman, 1888 and *Frankliniella occidentalis* Pergande, 1895, the latter having the greatest damage potential (Roditakis & Roditakis, 2007).

Akbarzadeh Shoukat & Shayesteh (2006) reported on the damage caused by *Rubiothrips vitis* in vineyards in Azerbaijan, where it was identified on the vegetative and reproductive organs with presence percentages as high as 66-92%. *Thrips tabaci* was found only on the reproductive organs and represented 32% of the collected individuals.

Merk *et al*. (2004) identified *Thrips tabaci* as a pest in vineyards in Germany, with an attack frequency of 80%; the study also mentions *Drepanothrips reuteri*, but does not elaborate on its economic impact.

In Romania, Zinca (1964) reported *Rubiothrips vitis* as a grapevine pest species in vineyards in Drăgăşani. Dieter, 1964 mentions *Drepanothrips reuteri* as characteristic of the vineyards in southern France.

Material and Methods

The observations were conducted in Ştefăneşti over the period May-September 2007, in a vineyard plot of Riesling grapes of around 2 hectares. This vineyard is situated in the central-southern part of the Wallachia sub-Carpathian hills; besides Riesling the following grape varieties are also grown in this vineyard: Royal Fetească, White Fetească, Italian Riesling, Aligote, Chasselas, Muscat Ottonel, Pearl of Csaba and others.

In years before our research, several fungicide and insecticide chemical treatments were used in the vineyard to prevent a higher occurrence of diseases and pests. However, none were used during the period of research observations.

The collection of thrips from the crown of the vineyard was achieved by means of a 50 cm square frame, covered with white cloth. 10 samples were taken during each phenophase, a sample consisting of 50 shakes of randomly chosen vine shoots. 1,228 individuals were collected, including the larvae of *Drepanothrips reuteri*. Separately, grapevine leaves and inflorescences were collected in order to observe the severity of the attack, yet the small number of the thrips collected did not require statistical processing.

On account of the unusually high temperatures in May, July and August, a number of phenophases followed one another in rapid succession. The phenophases were established after ampelographical literature.

As a measure of the degree of similarity between two phenophases, Goodall's coefficient of probability (GOODALL, 1964; 1966) was used, adapted after Orloci (ORLOCI, 1978) and Legendre (LEGENDRE, 1998), in analysing the clusters of sites based on the numerical abundance of the species.

Results and Discussions

The results obtained from the samplings conducted in the period May-September 2007 for the Riesling variety in the vineyard of Ştefăneşti showed the following:

a. Specific diversity

As many as 21 species of Thysanoptera were identified (Tab. I), and they were organized on two trophic levels: primary consumers (16 species) and secondary consumers (*Aeolothrips* - 4 species and *Haplothrips kurdjumovi* Karny, 1913).

Two species known as grapevine pests were present, i.e. *Drepanothrips reuteri* Uzel, 1895 and *Rubiothrips vitis* Priesner, 1933. Among other sampled species, *Dictyothrips betae* Uzel, 1895 is a rare species in the Romanian fauna, and *Aeolothrips melaleucus* Haliday, 1852, *Dendrothrips saltatrix* Uzel, 1895, *Haplothrips kurdjumovi* Karny, 1913 are typically arboricolous species.

b. Ecological indices

Drepanothrips reuteri and *Thrips tabaci* are constant within the coenosis in the studied vineyard. The population of the thrips *D. reuteri* is best represented, dominating the collected individuals by 77.04%; the highest value of the numerical abundance for a stock was recorded at the beginning of the blooming period (Tab. II).

In the filed literature, it is generally held that the population of *D. reuteri* reaches maximum values in mid-summer, in the month of July. In our study, the maximum value, 88.69%, was reached at the end of May, during the blooming period; from that point on numerical abundance values for the population are on a generally decreasing trend, and the May levels are not matched even by the high values of July, phases I and II of the berry growing, 84.26% and 99.59% respectively. A possible cause is the unusually high temperature from mid-July to August 2007, which often reached values of 42-44 °C. This led to the conclusion that the thrips were entering aestival diapause.

Thrips tabaci was dominant when new shoots were appearing and flower buds were bursting, with values of 61.29%, and 50.0% respectively; *Thrips tabaci* was also found by MERK *et al*. (2004) to be a dominant species, at 80.0%. *Rubiothrips vitis*, although present, had a value of relative abundance of only 1.55%, in great contrast with the values previously recorded in the vineyards of Drăgăşani, Romania, with similar geographical and climate conditions, where ZINCA (1964) found it dominant.

The temporal dynamics present two different peaks, the first at the end of May with 557 individuals, and the second at the beginning of July, with 246 individuals. This leads to the conclusion that there are two *D. reuteri* generations a year.

Table I. The species of Thysanoptera identified in the Ştefăneşti vineyard, for Riesling variety grapes, 2007.

Suborder	Family	Species	No. of ind.	A%
Terebrantia	Aeolothripidae	*Aeolothrips fasciatus* (Linnaeus, 1758)	1	0.08
		Aeolothrips intermedius Bagnall, 1934	6	0.50
		Aeolothrips melaleucus Haliday, 1852	2	0.16
		Aeolothrips vittatus Haliday, 1836	1	0.08
	Thripidae	*Neohydatothrips gracilicornis* (Williams,1916)	2	0,16
		Drepanothrips reuteri Uzel, 1895	946	77.04
		Dictyothrips betae Uzel, 1895	2	0.16
		Dendrothrips saltatrix Uzel, 1895	1	0.08
		Chirothrips manicatus Haliday, 1836	1	0.08
		Chirothrips molestus Priesner, 1926	12	0.98
		Frankliniella intonsa (Trybom, 1895)	39	3.17
		Rubiothrips vitis Priesner, 1933	19	1.55
		Thrips fulvipes Bagnall 1923	3	0.24
		Thrips pillichi Priesner 1924	7	0.60
		Thrips physapus Linnaeus, 1758	3	0.24
		Thrips tabaci Lindeman, 1888	168	13.6
		Thrips validus Uzel 1895	9	0.73
Tubulifera	Phlaeothripidae	*Haplothrips acanthoscelis* (Karny, 1909)	1	0.08
		Haplothrips aculeatus (Fabricius, 1803)	3	0.24
		Haplothrips kurdjumovi Karny, 1913	1	0.08
		Haplothrips leucanthemi (Schrank, 1781)	1	0.08

Biomass production has low values, the curve of its temporal dynamics being correlated with that of numerical abundance (Tab. II).

The low value of equitability expresses the numerical disproportion of the individuals belonging to the species present in the samples, a fact that impacts the Shannon-Weaver index values. The highest value of equitability is recorded at full ripening, when diversity is minimal, with only 2 species and an extremely low number of individuals; the lowest value is reached when the berries grow, i.e. in July, because of the significant disproportion between the individuals of the two species.

This situation is frequent in agro-ecosystems because of faulty management of the pest populations, with irresponsible chemical treatments leading first of all to the destruction of the natural enemies.

c. Similarity of phenophases

The data resulting from the research provides a starting point to determine whether or not there are similarities between phenophases.

Table II. The structural indicators of the thrips populations, 2007.

Species	Σ	$\overline{x}$	s^2	SD	mg. s. us /vine	A%	C%	$p_i \log p_i$
May 9th - Growing of shoots								
Aeolothrips intermedius	1	0.1	0.1	0.3	0.10	1.61	10	-0.029
Dictyiothrips betae	2	0.2	0.2	0.4	0.20	3.23	10	-0.048
Drepanothrips reuteri	**4**	0.4	1.6	1.3	0.40	6.45	10	-0.077
Rubiothrips vitis	2	0.2	0.4	0.6	0.20	3.23	10	-0.048
Frankliniella intonsa	8	0.8	4.8	2.2	0.80	12.90	20	-0.115
Thrips tabaci	38	3.8	12.8	3.6	3.80	61.29	70	-0.130
Thrips validus	7	0.7	2.5	1.6	0.70	11.29	30	-0.107
Σ	**62**	6.2	13.5	3.7	**6.20**	100.00		-0.55
		H(S)=2			**Hmax=3**			**E%=66**
May 14th - Bud bursting								
Aeolothrips fasciatus	1	0.10	0.1	0.3	0.1	4.55	10	-0.061
Neohydatothrips gracilicornis	1	0.1	0.1	0.3	0.10	4.55	10	-0.061
Drepanothrips reuteri	**6**	0.6	3.6	1.9	0.60	27.27	10	-0.154
Rubiothrips vitis	1	0.1	0.1	0.3	0.10	4.55	10	-0.061
Thrips fulvipes	1	0.1	0.1	0.3	0.10	4.55	10	-0.061
Thrips pillichi	1	0.1	0.1	0.3	0.10	4.55	10	-0.061
Thrips tabaci	11	1.1	5.2	2.3	1.10	50.00	30	-0.151
Σ	**22**	**2.2**	7.5	2.7	**2.20**	100.00		-0.61
		H(S)=2			**Hmax=3**			**E%=72**
May 28th - In bloom (inceptive)								
Drepanothrips reuteri	**494**	49.4	3176.9	56.4	49.40	88.69	70	-0.046
Rubiothrips vitis	2	0.2	0.4	0.6	0.20	0.36	10	-0.009
Frankliniella intonsa	3	0.3	0.9	0.9	0.30	0.54	10	-0.012
Thrips physapus	3	0.3	0.5	0.7	0.30	0.54	20	-0.012
Thrips tabaci	55	5.5	100.1	10.0	5.50	9.87	60	-0.099
Σ	**557**	55.7	4335.8	65.8	**55.70**	100.00		-0.179
		H(S)=0.9			**Hmax=2**			**E%=26**
June 6th - In bloom (final)								
Aeolothrips melaleucus	2	0.2	0.4	0.6	0.20	1.42	10	-0.034
Drepanothrips reuteri	**47**	4.7	33.1	5.8	4.70	33.33	60	-0.155
Chirothrips molestus	1	0.1	0.1	0.3	0.10	0.71	10	-0.02
Rubiothrips vitis	13	1.3	14.2	3.8	1.30	9.22	20	-0.115
Frankliniella intonsa	27	2.7	15.8	4.0	2.70	19.15	50	-0.153
Thrips pillichi	6	0.6	3.6	1.9	0.60	4.26	10	-0.073
Thrips tabaci	45	4.5	12.7	3.6	4.50	31.91	80	-0.156

Species	Σ	$\overline{x}$	s^2	SD	mg. s. us /vine	A%	C%	$p_i \log p_i$
June 6th - In bloom (final)								(Table II - continued)
Σ	**141**	14.1	145.0	12.0	**14.10**	100.00		-0.705
		H(S)=2.3			**Hmax=3**			**E%=83**
June 10th - Growing of berries I								
Aeolothrips vittatus	1	0.1	0.1	0.3	0.10	2.38	10	-0.039
Drepanothrips reuteri	**20**	2.0	6.2	2.5	2.00	47.62	60	-0.153
Thrips fulvipes	2	0.2	0.4	0.6	0.20	4.76	10	-0.063
Thrips tabaci	15	1.5	4.7	2.2	1.50	35.71	40	-0.160
Thrips validus	1	0.1	0.1	0.3	0.10	2.38	10	-0.039
Haplothrips aculeatus	2	0.2	0.4	0.6	0.20	4.76	10	-0.063
Haplothrips kurdjumovi	1	0.1	0.1	0.3	0.10	2.38	10	-0.039
Σ	**42**	**4.2**	6.6	2.6	**4.20**	100.00		-0.555
		H(S)=2			**Hmax=3**			**E%=66**
June 29th - Growing of berries II								
Aeolothrips intermedius	1	0.1	0.1	0.3	0.10	0.93	10	-0.019
Neohydatothrips gracilicornis	1	0.1	0.1	0.3	0.1	0.93	10	-0.019
Drepanothrips reuteri	**91**	9.1	76.99	8.8	9.1	84.26	80	-0.063
Chirothrips molestus	11	1.1	12.1	3.5	1.1	10.19	10	-0.101
Chirothrips manicatus	1	0.1	0.1	0.3	0.1	0.93	10	-0.019
Thrips validus	1	0.1	0.1	0.3	0.10	0.93	10	-0.019
Haplothrips acanthoscelis	1	0.1	0.1	0.3	0.1	0.93	10	-0.019
Haplothrips leucanthemi	1	0.1	0.1	0.3	0.10	0.93	10	-0.019
Σ	**108**	10.8	67.96	8.2	**10.80**	100.00		-0.277
		H(S)=0.9			**Hmax=3**			**E%=31**
July 7th - Growing of berries III								
Drepanothrips reuteri	**245**	24.5	220.1	14.8	24.50	99.59	100	-0.002
Frankliniella intonsa	1	0.1	0.1	0.3	0.10	0.41	10	-0.01
Σ	**246**	24.6	217.2	15	**24.60**	100.00		-0.011
		H(S)=0.04			**Hmax=1**			**E% = 4**
August 9th - Maturation of grapes (inceptive ripening)								
Aeolothrips intermedius	4	0.4	0.7	0.8	0.40	8.51	20	-0.091
Drepanothrips reuteri	**39**	3.9	29.7	5.4	3.90	82.98	60	-0.067
Dendrothrips saltatrix	1	0.1	0.1	0.3	0.10	2.13	10	-0.036
Thrips tabaci	2	0.2	0.4	0.6	0.20	4.26	10	-0.058
Haplothrips aculeatus	1	0.1	0.1	0.3	0.10	2.13	10	-0.036
Σ	**47**	**4.7**	26.0	5.1	**4.70**	100.00		-0.288
		H(S)= 1			**Hmax=2**			**E%= 41**

Species	Σ	$\bar{x}$	s^2	SD	mg. s. us /vine	A%	C%	$p_i \log p_i$
September 14th - Maturation of grapes (full ripening)								(Table II - continued)
Rubiothrips vitis	1	0.1	0.1	0.3	0.10	33.33	10	-0.159
Thrips tabaci	2	0.2	0.4	0.6	0.20	66.67	10	-0.117
Σ	**3**	**0.3**	0.9	0.9	**0.30**	100.00		-0.276
		H(S) =1			**Hmax=1**			**E%= 92**

In the present case, the average value per phenophase of each species was used in calculating the similarity matrix (Tab. II). Figure 1 represents the average species distributions per phenophase.

The phenophases were grouped according to their similarity. The analysis shows that the maximal degree of similarity is displayed by the moments V3 and V4, i.e. the blooming phenophases, irrespective of whether they are inceptive or final. Moment V1 corresponds to the first collection of samples, on May 9th (Figs. 1 & 2).

The cluster analysis, instead of the similarity matrix S, uses the distance matrix D, defined as D = 1 − S. Figure 2 represents the cluster dendrogram as obtained through the complete linkage method, and the clusters obtained through the principal coordinate analysis method (PCoA) (R DEVELOPMENT CORE TEAM, 2007).

d. Sex ratio

The large number of individuals of *D. reuteri* allowed the calculation of the sex ratio for this species. The sex ratio has a subunit value, and this is actually true for most of the insect species, with females being much more numerous than males, over the entire period of the observations (Tab. III).

Table III. Sex ratio for the species *Drepanothrips reuteri.*

♂		♀		♂/♀	
No.	**%**	**No.**	**%**	**No.**	**%**
150	16.4	765	83.6	150/765	0.2

e. Natural enemies

The filed literature mentions various species of zoophagous mites that contribute to a varying extent to the reduction of the populations of phytophagous thrips.

The present study identifies a mite from the genus *Grandjeanella* in a parasite attack on an individual of *Frankliniella intonsa* (cf. verbal communication from Dr. GOLDARAZENA, Spain). It is the first time *Grandjeanella* sp. is mentioned as an ectoparasite for thrips in Romania.

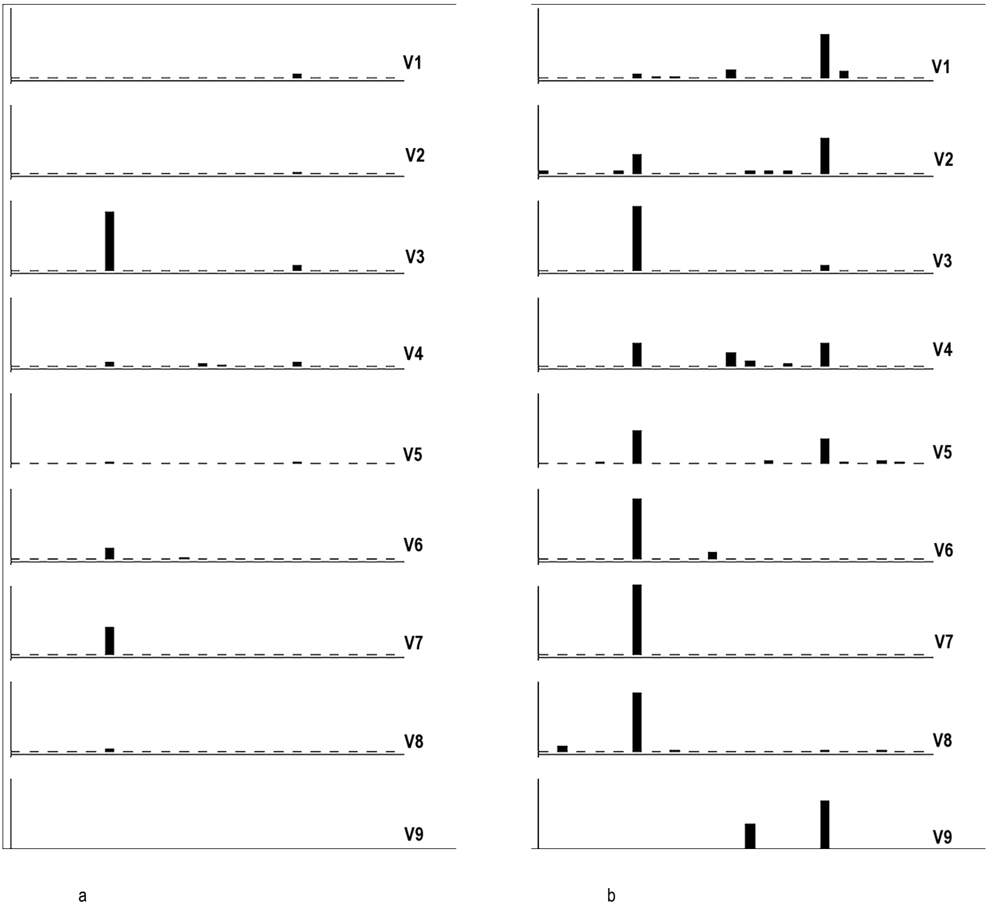

Figure 1. Distribution of thrips populations per phenophase: relative representation for the whole set of phenophases (a) and frequency of species for each phenophase (b). The phenophases are labelled in ascending order; V1 corresponds to the first phenophase and V9 to the last phenophase.

Also, the study found a female *Drepanothrips reuteri* to be attacked by another mite belonging to the Tydeidae family. Besides being a phytophagous species, this mite is also known as a predatory species (KRANTZ, 1978). However, the present research is the first to identify it as a predator of thrips in Romania.

Conclusions

The present research found the richness of thrips species in the Ştefăneşti vineyard of the Argeş district to have high values, i.e. 21 species. Three species previously mentioned in the field literature as grapevine pests, namely *Drepanothrips reuteri*, *Rubiothrips vitis* and *Thrips tabaci,* were present in the study.

With 77.04%, *Drepanothrips reuteri* is the constant and dominant species within the coenosis. The highest values of the numerical abundance are reached during the blooming phenophase. *Thrips tabaci* is also a constant presence, but with a value of relative abundance of only 13.68%, while *Rubiothrips vitis* is present only sporadically, i.e. 1.55%. The maximal similarity was reported for the blooming phenophases, irrespective of it being inceptive or final. The presence of thrips predator thrips is indicative of a dynamic coenosis, with a positive evolution.

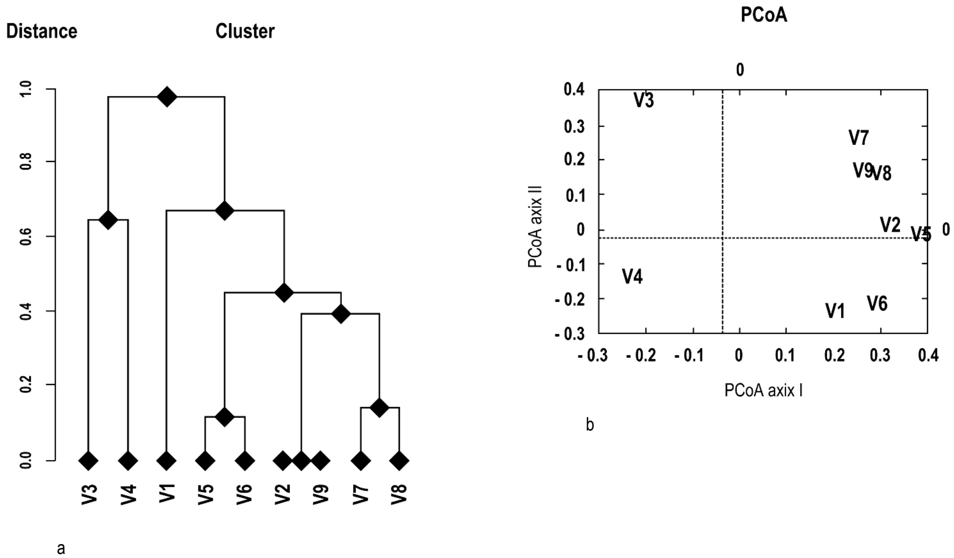

Figure 2. The clusters of phenophases: dendrogram (a) and the association of phenophases within the range of the first two principal coordinates (b).

The temporal dynamics display two maximal numerical values for the species *D. reuteri*, which leads to the conclusion that this species produces two generation per-year.

This research is the first to mention the mite *Grandjeanella* sp. as an ectoparasite for thrips in Romania. The identification of a Tydeiedae mite as a predator of *Drepanothrips reuteri* is also a first record for Romania.

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ЕКОЛОШКА СТУДИЈА ПОПУЛАЦИЈА ТРИПСА У ЈЕДНОМ ВИНОГРАДУ У ЈУЖНОЈ РУМУНИЈИ (INSECTA: THYSANOPTERA)

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Извод

У раду је приказан састав популација трипса у Ştefăneşti виноградима у области Argeş у северо источном делу Румуније. Установљена је 21 врста, међу којима је *Drepanothrips reuteri* доминантна, са највећом бројношћу у периоду цветања. Присуство врста *Thrips tabaci* и *Rubiothrips vitis,* које се сматрају штеточинама винове лозе, је такође констатовано, али са мањом бројношћу, монофагна врста *Rubiothrips vitis* чак спорадично. Максимална сличност у популацији трипса забележена је у две фенофазе цветања. Гриња *Grandjeanella* sp., као ектопаразит на трипсима, забележена је први пут у Румунији. Као предатор врсте *Drepanothrips reuteri* утврђена је гриња из фамилије Tydeidae, такође први пут у Румунији.

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