THE DIVERSITY OF VINEYARD THRIPS FAUNA IN ARGEŞ COUNTY (INSECTA: THYSANOPTERA)

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Abstract. The present study, conducted in the vineyard of Ştefăneşti-Argeş, in two separate plots of grapevines, different from the standpoint of the varieties grown and the maintenance treatments, has revealed a rich biodiversity for an anthropized ecosystem. The 25 species of thrips belong to different trophic links: 20 species are primary (phytophagous) consumers and 5 species are secondary (zoophagous) consumers. The specific structure is dominated by the Euro-Siberian species, whereas the cosmopolitan and west-palearctic species have a reduced weight. The species mentioned as pests of vineyards in various countries, *Drepanothrips reuteri* UZEL, *Rubiothrips vitis* PRIESNER şi *Thrips tabaci* LINDEMAN, which occurred in both sites, stood apart through the size of their populations, especially *Drepanothrips reuteri* UZEL, with maximal values of the numeric abundance in the vineyard not treated chemically, in the variety Riesling, without however exceeding the economic harming threshold. The low values of the structural indicators of the other species express their attachment to their characteristic trophic substratum, i.e. the herbaceous layer, so they only accidentally get on the stocks of *Vitis*, through anemochory. The Shannon-Weaver diversity index and equitability have low values, a situation which is typical of agro-ecosystems.

Keywords: vineyard, species richness, geographical distribution, ecological indicators, *Drepanothrips reuteri*.

Rezumat. Diversitatea faunei de tripşi din vie în regiunea Argeş (Insecta: Thysanoptera). Prezentul studiu, efectuat în podgoria Ştefăneşti-Argeş, în două vii, diferite din punct de vedere al soiurilor cultivate şi al tratamentelor de întreţinere, a relevat o biodiversitate bogată pentru un ecosistem antropizat. Cele 25 de specii de tripşi aparţin unor verigi trofice diferite: 20 specii consumatori primari (fitofagi) şi 5 specii consumatori secundari (zoofagi). Structura specifică este dominată de speciile euro-siberiene, speciile cosmopolite şi west-palearctice având o pondere redusă. Speciile menţionate ca dăunători ai viţei de vie în diferite ţări, *Drepanothrips reuteri* UZEL, *Rubiothrips vitis* PRIESNER şi *Thrips tabaci* LINDEMAN existente în ambele situri, s-au diferenţiat prin mărimea populaţiilor, în special la *Drepanothrips reuteri* UZEL, cu valori maxime ale abundenţei numerice în via netratată chimic, la soiul Riesling, fără să depăşească, însă, pragul economic de dăunare. Valorile mici ale indicatorilor structurali ale celorlalte specii exprimă ataşamentul acestora faţă de substratul lor trofic, caracteristic, stratul ierbos, ele ajungând accidental, prin anemochorie, pe butucii de *Vitis*. Indicele de diversitate Shannon-Weaver şi echitabilitatea au valori mici, situaţie specifică pentru agroecosisteme.

Cuvinte cheie: podgorie, bogăţie specifică, distribuţie geografică, indicatori ecologici, *Drepanothrips reuteri*.

INTRODUCTION

In natural ecosystems, there is a large number of species, as the diversity of the fauna in an ecosystem is a measure of its stability (VASILIU-OROMULU & TOTHMERESZ, 1995). Human intervention in nature, out of economic reasons, has led, as it generated anthropized ecosystems, to a reduction in their diversity, and consequently to the appearance of imbalance induced by the deterioration of the trophic relationships among organisms, so that there were created the premises for their manifestation of certain species as pests.

In the viticultural ecosystem, a number of thrips species manifest their harming potential according to the local and annual climatic conditions. Thus, *Drepanothrips reuteri* UZEL 1895 predominates in Hungarian vineyards (JENSER & VOIGT 1968), in southern France (DIETER, 1964), the USA (YOKOYAMA, 1977), *Thrips tabaci* LINDEMAN 1888 causes damage in the vineyards from Germany (MERK et al., 2004.) and Greece-Crete (RODITAKIS & RODITAKIS, 2007), *Rubiothrips vitis* PRIESNER 1933 in southern Romania (ZINCA, 1964), Turkey, Iran (AKBARZADEH & SHAYESTEH, 2006), *Frankliniella occidentalis* (PERGANDE 1895) in the USA (JENSEN et al., 1981), Mexico (GUERRA, 1989) etc., *Scirtothrips dorsalis* HOOD 1919 is a pest in the vineyards from Japan, while *Rhipiphorothrips cruentatus* HOOD 1919 produces damage in the vineyards in Pakistan, Afghanistan, and India (ANANTHAKRISHNAN, 1980).

MATERIAL AND METHODS

The observations were carried out over the period May-September 2007, in two private vineyards from Ştefăneşti-Argeş, located about 400 meters one from another and separated from other vineyards by grass-covered spaces. In the course of time, numerous fungicide and insecticide chemical treatments have been applied in these vineyards to prevent diseases and pests.

Within the vineyard cultivated with Riesling variety, of about one hectare, no chemical treatment or any other maintenance procedures specific to grapevine was applied during the study period, as that vineyard plot had been abandoned; in the present paper, it is considered the “no treatment area”. In the almost two hectare wide vineyard, with Chasselas variety, the specific procedures were applied, and on the 21st of May and on the 20th of June fungicide treatments were applied; that site was designated as “chemically treated”. Generally, the microclimate in this area is rather unfavorable to the development of pests specific to the vineyard (BĂRBUCEANU et al., 2007), so that the owners of those vineyards apply only the necessary treatments for fighting against acarians.

The collecting of the thrips from the crown of the vineyard was done by means of a square frame of 50 cm long side, covered with white cloth. In accordance with the phenophases of the grapevine, 10 samples were taken from each; a sample consisted of 50 shakes of the vine shoots on a stock, which were chosen randomly. A number of 1,931 individuals were collected, including the larvae of *Drepanothrips reuteri* and *Thrips tabaci.* Separately, grapevine leaves and inflorescences were collected in order to observe the severity of the attack, yet the small number of the collected thrips did not need any statistical processing.

The phenophases were established in accordance with the ampelographical literature.

According to the data provided by the National Meteorological Administration, in the summer of 2007, there were recorded the highest temperatures in the last 100 years (TAIEX, oral communication), which limited samplings in July and August because the species of thrips entered the aestival diapause, while in May and June it caused a rapid succession of the grapevine phenophases.

In order to assess the diversity of the ecosystem, the Shannon-Weaver diversity index was calculated, using the formula improved by LLOYD and GHELARDI:

$$H(S) = \frac{K}{N}\left(N\log10N - \sum_{p=1}^{S} Nr\log10Nr\right) \quad \text{where:}$$

H = index; S = total number of species; K = 3, 321928; N = total number of individuals; Nr = total number of individuals in species r. (SIMIONESCU, 1984).

RESULTS AND DISCUSSIONS

The results obtained after the samplings conducted in the period May-September 2007 for the varieties Chasselas - the chemically treated area - and Riesling in the vineyard of Ştefăneşti-Argeş - the untreated area - showed the following aspects:

Species richness

During the year 2007, 1,931 individuals were collected from the two grapevine plots belonging to Ştefăneşti-Argeş vineyard, individuals that belonged to 25 species (Table 1). Out of those species, only one is monophagous, *Rubiothrips vitis*; the majority of the species are phytophagous and only the species of *Aeolothrips* and *Haplothrips kurdjumovi* KARNY 1913 are zoophagous. Moreover, most of those species are to be found in the herbaceous layer, especially on Asteraceae and Gramineae, only accidentally getting on the grapevine stocks, while the species *Aeolothrips melaleucus* HALIDAY 1852*, Dendrothrips saltatrix* UZEL 1895, and *Haplothrips kurdjumovi* are typically arboricolous.

Although the studies were made in two vineyards that are different as grape variety and manner of maintenance, no significant difference was noticed in the number of species. Thus, in the plot with Chasselas variety, where chemical treatments were conducted, 20 species of thrips were identified, while in the Riesling variety vineyard, where no maintenance work was done, there were 21 species, probably due to the anemochoric distribution of insects and to the proximity of the two plots.

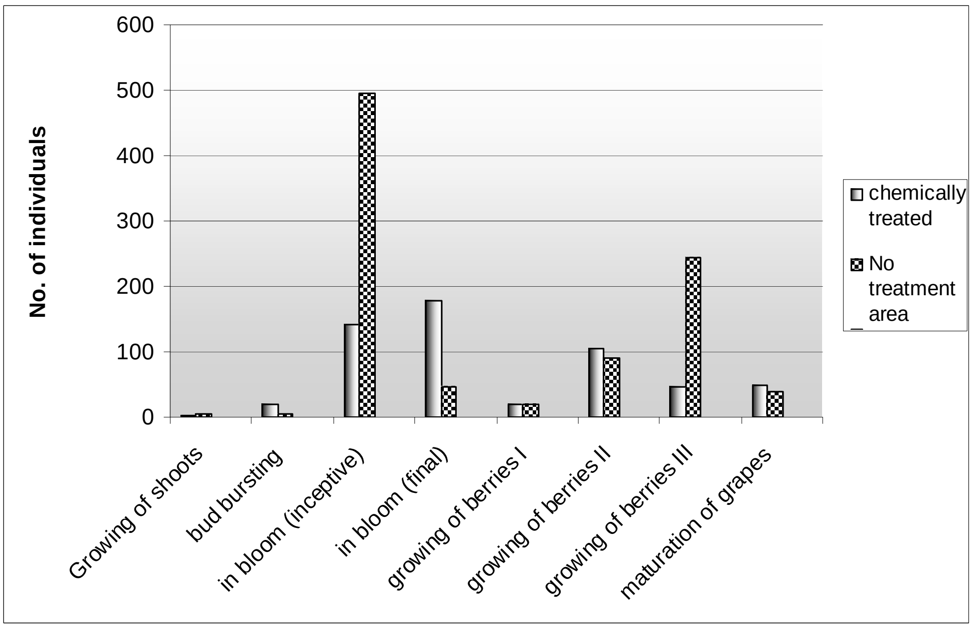

Figure 1. Dynamics of the populations of *Drepanothrips reuteri* UZEL in Ştefăneşti, 2007, in various phenophases of the vine.
Figura 1. Dinamica populaţiilor de *Drepanothrips reuteri* UZEL în viile din Ştefăneşti, 2007, în diferite fenofaze ale viţei de vie.

Three of the species the literature records as grapevine pests were found: *Drepanothrips reuteri*, *Rubiothrips vitis,* and *Thrips tabaci*. In both vineyards, the populations of *D. reuteri* registered the highest values of numeric abundance compared to the other species. At the same time, it could be noticed that, in all the identified species, the females were prevalent, as many species of thrips are only known through their parthenogenetic females.

Although the population of *D. reuteri* had double values in the untreated vineyard (Fig. 1), the collected grape leaves and berries did not show visible marks of the attack, and the level of the populations remained below the economic harming threshold. According to YOKOYAMA (1977), grapevine can stand high densities of the populations of *D. reuteri*.

In both vineyards, there could be noticed high values of the numeric abundance, during the blooming period, and the period when the berries grew (2nd and 3rd); the dynamics of the populations of *D. reuteri* evinces two flight curves, corresponding to the two generations. As a matter of fact, in both the treated and the untreated plots, on June 21 and 29, there were collected females of *D. reuteri* bearing eggs. Although, according to the literature in the field, the highest values of the populations of that species are reached in mid-summer, in both vineyards, those values were lower, perhaps due to the excessively high temperatures.

Table 1. Thrips species in the two vineyards of Ştefăneşti, 2007.
Tabel 1. Speciile de thripşi din cele două vii din Ştefăneşti, 2007.

Suborder	Family	Species	No. ind.	
			No treatment area	Chemically treated
Terebrantia	Aeolothripidae	*Aeolothrips fasciatus* (LINNAEUS 1758)	1♀	-
		Aeolothrips intermedius BAGNALL 1934	6♀♀	1♀
		Aeolothrips melaleucus HALIDAY 1852	2♀♀	2♀♀
		Aeolothrips vittatus HALIDAY 1836	1♀	1♀
	Thripidae	*Anaphothrips obscurus* (O. F MÜLLER 1776)	-	1♀; 1♂; 2 larvae
		Chirothrips manicatus HALIDAY 1836	1♀	1♀
		Chirothrips molestus PRIESNER 1926	10♀♀; 2♂♂	-
		Drepanothrips reuteri UZEL 1895	**765**♀♀; **150**♂♂, **31** larvae	**446**♀♀; **115**♂♂, **16** larvae
		Dictyothrips betae UZEL 1895	2♀♀	-
		Dendrothrips saltatrix UZEL 1895	1♀	-
		Frankliniella intonsa (TRYBOM 1895)	37♀♀; 2♂♂	18♀♀
		Hemianaphothrips articulosus PRIESNER 1925	-	2♀♀
		Neohydatothrips gracilicornis (WILLIAMS1916)	2♀♀	1♂
		Rubiothrips vitis PRIESNER 1933	**15♀♀; 4♂♂**	**13♀♀; 3♂♂**
		Taeniothrips picipes (ZETTERSTEDT 1828)	-	1♂
		Thrips fulvipes BAGNALL 1923	3♀♀	5♀♀; 1♂
		Thrips pillichi PRIESNER 1924	4♀♀; 3♂♂	6♀♀; 1♂
		Thrips physapus LINNAEUS 1758	3♀♀	1♀
		Thrips tabaci LINDEMAN 1888	**161**♀♀; **7** larvae	**57**♀♀
		Thrips validus UZEL 1895	8♀♀; 1♂	13♀♀; 1♂
Tubulifera	Phlaeothripidae	*Haplothrips acanthoscelis* (KARNY 1909)	1♀	2♀♀
		Haplothrips aculeatus (FABRICIUS 1803)	2♀♀; 1♂	2♀♀; 1♂
		Haplothrips angusticornis PRIESNER 1921	-	3♀♀; 1♂
		Haplothrips kurdjumovi KARNY 1913	1♀	1♀
		Haplothrips leucanthemi (SCHRANK 1781)	1♀	1♀

Geographical distribution

According to the biogeographical characteristics of the ecosystems they inhabit, Thysanoptera belongs to various types of geographical distribution (STRASSEN, 2003). From that standpoint, in Romania there is a prevalence of the European species, followed by the West-Palearctic species, and the Euro-Siberian species (VASILIU-OROMULU, 1998). In the viticultural ecosystem under study, we noticed the prevalence of the Euro-Siberian species. The lowest percentage is represented by the cosmopolitan and West-Palearctic species (Fig. 2). The polyphagous *Drepanothrips reuteri*, a holarctic species, finds optimal development conditions in the Romanian vineyards.

Ecological indicators

While in the untreated vineyard the basic nucleus of the Thysanoptera association is made up of the species *Drepanothrips reuteri* and *Thrips tabaci* (VASILIU-OROMULU et al., 2009), in the treated vineyard *D. reuteri* is the only constant species, which prevails in all the phenophases: it records values of relative abundance that range between 33.3% and 94.12% (Table 2). High values of the structural indicators were recorded in the phenophases of blooming and the inception of grape berry maturation.

T. tabaci, often mentioned as a pest in the European vineyards, has a reduced weight in the structure of the thysanoptera fauna, i.e. 2.55-33.3%. The monophagous species *Rubiothrips vitis*, although present in the samplings specific to the phenophases, has values of the relative abundance of only 0.51% - 13.51%. In the competition between the different species, it is *D. reuteri* that is singled out as the winning species, as it is better adapted to the local microclimate. The low values of the structural indicators of the other species express their attachment to their trophic characteristic substratum, the herbaceous layer, as they only accidentally get on the stocks of *Vitis*, through anemochory.

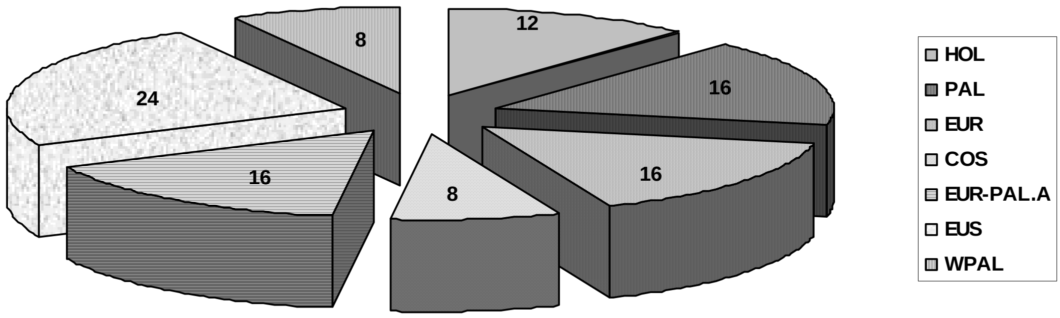

Figure 2. Geographical distribution of the thrips species. (Cos= Cosmopolitan species; Eur= European species; Eus= Euro-Asian species; Eur-pal. A= European-Palearctic Asian species; Hol= holarctic species; Wpal= west-palearctic species).
Figura 2. Distribuția geografică a speciilor de tripşi.

The low values of the diversity index Shannon-Weaver H(S) are correlated with reduced values of equitability, in the phenophases of "in bloom", 2nd and 3rd "growing of berries", and "maturation of grapes" (Table 2). The number of individuals of *D. reuteri* is responsible for the numeric disproportion in the samples, in most of the phenophases.

Table 2. The structural indicators of the thrips populations, in the chemically treated vineyard, 2007.
Tabel 2. Indicatorii structurali ai populațiilor de tripşi, în via tratata chimic, 2007.

May 9 Growing of shoots	□	$\bar{x}$	s^2	SD	mg.s.us /vine	A%	C%	$p_i \log p_i$
Aeolothrips melaleucus	1	0..1	0.1	0.3	0.10	16.67	10	-0.130
Anaphothrips obscurus	1	0.1	0.1	0.3	0.10	16.67	10	-0.130
Drepanothrips reuteri	**2**	0.2	0.4	0.6	0.20	33.33	10	-0.159
Thrips tabaci	2	0.2	0.4	0.6	0.20	33.33	10	-0.159
□	**6**	0.6	0.7	0.8	0.60	100.00		-0.577
May 14		**H(S)=1.9**			**Hmax=2**			**E%= 95.91**
bud bursting								
Drepanothrips reuteri	**20**	2.00	11.11	3.3	2	40.00	60	-0.159
Frankliniella intonsa	15	1.5	11.6	3.4	1.50	30.00	40	-0.157
Rubiothrips vitis	2	0.2	0.2	0.4	0.20	4.00	20	-0.056
Thrips pillichi	1	0.1	0.1	0.3	0.10	2.00	10	-0.034
Thrips tabaci	9	0.9	2.5	1.6	0.90	18.00	40	-0.134
Haplothrips angusticornis	2	0.2	0.4	0.6	0.20	4.00	10	-0.056
Haplothrips kurdjumovi	1	0.1	0.1	0.3	0.10	2.00	10	-0.034
□	**50**	**5.0**	24.9	5.0	**5.00**	100.00		-0.63
		H(S)= 2.09			**Hmax=3**			**E%= 75**
May 24 In bloom (inceptive)	□	$\bar{x}$	s^2	SD	mg.s.us /vine	A%	C%	$p_i \log p_i$
Drepanothrips reuteri	**141**	14.10	147	12.1	14.1	84.43	80	-0.062
Rubiothrips vitis	4	0.4	0.9	1.0	0.40	2.40	20	-0.039
Taeniothrips picipes	1	0.1	0.1	0.3	0.10	0.60	10	-0.02
Thrips physapus	1	0.1	0.1	0.3	0.10	0.60	10	-0.013
Thrips pillichi	6	0.6	0.9	1.0	0.60	3.59	30	-0.052
Thrips tabaci	14	1.4	4.3	2.1	1.40	8.38	40	-0.090
□	**167**	**16,7**	136.7	11.7	**16.70**	100.00		-0.276
June 3		**H(S) =0.92**			**Hmax=3**			**E% =35**
In bloom (final)								
Aeolothrips vittatus	1	0.1	0.1	0.3	0.1	0.51	10	-0.012

Chirothrips manicatus	1	0.1	0.1	0.3	0.1	0.51	10	-0.012
Drepanothrips reuteri	**179**	17.9	64.54	8	17.9	91.33	90	-0.036
Hemianaphothrips articulosus	2	0.2	0.4	0.6	0.20	1.02	10	-0.02
Rubiothrips vitis	1	0.1	0.1	0.3	0.1	0.51	10	-0.012
Thrips fulvipes	5	0.5	0.5	0.7	0.50	2.55	40	-0.041
Thrips tabaci	5	0.5	0.722	0.8	0.5	2.55	30	-0.041
Haplothrips angusticornis	2	0.2	0.4	0.6	0.20	1.02	10	-0.020
□	**196**	19.6	80.04	8.9	**19.60**	100.00		-0.193
June 10		**H(S) =0.64**			**Hmax=3**			**E% = 21**
Growing of berries I								
Anaphothrips obscurus	1	0.1	0.1	0.3	0.10	2.70	10	-0.042
Drepanothrips reuteri	**20**	2.0	2.7	1.6	2.00	54.05	70	-0.144
Frankliniella intonsa	1	0.1	0.1	0.3	0.10	2.70	10	-0.042
Rubiothrips vitis	5	0.5	0.3	0.5	0.50	13.51	50	-0.117
Thrips tabaci	7	0.7	3.6	1.9	0.70	18.92	20	-0.137
Haplothrips aculeatus	3	0.3	0.5	0.7	0.30	8.11	20	-0.088
□	**37**	3.7	9.6	3.1	3.70	100.00		-0.572
June 29		**H(S) =2**			**Hmax=3**			**E%= 73.5**
Growing of berries 2nd								
Aeolothrips melaleucus	1	0.1	0.1	0,3	0.10	0.69	10	-0.015
Drepanothrips reuteri	**105**	10.5	141.6	12	10.5	72.92	90	-0.064
Frankliniella intonsa	1	0.1	0.1	0,3	0.1	0.69	10	-0.015
Rubiothrips vitis	3	0.3	0.45	0,7	0.3	2.08	20	-0.035
Thrips validus	14	1.4	11.82	3,4	1.4	9.72	20	-0.098
Thrips tabaci	18	1.8	32.4	5,7	1.80	12.5	10	-0.113
Neohydatothrips gracilicornis	1	0.1	0.1	0,3	0.1	0.69	10	-0.017
Haplothrips leucanthemi	1	0.1	0.1	0.3	0.10	0.69	10	-0.015
□	**144**	14.4	**213.8**	**15**	**14.40**	100.00		-0.372
July 7		**H(S) =1.23**			**Hmax=3**			**E% = 41**
Growing of berries 3rd								
Anaphothrips obscurus	2	0.2	0.4	0.6	0.2	3.85	10	-0.054
Drepanothrips reuteri	**46**	4.6	18.93	4.4	4.6	88.46	90	-0.047
Frankliniella intonsa	1	0.1	0.1	0.3	0.1	1.92	10	-0.033
Rubiothrips vitis	1	0.1	0.1	0.3	0.1	1.92	10	-0.033
Thrips fulvipes	1	0.1	0.1	0.3	0.1	1.92	10	-0.033
Haplothrips acanthoscelis	1	0.1	0.1	0.3	0.1	1.92	10	-0.033
□	**52**	5.2	17.73	4.2	5.2	100.00		-0.234
August 9		**H(S)= 0.78**			**Hmax=3**			**E% =30**
Maturation of grapes (inceptive ripening)								
Aeolothrips intermedius	1	0.1	0.1	0,3	0,10	1,96	10	-0,033
Drepanothrips reuteri	**48**	4.8	48.4	7.0	4.80	94.12	80	-0.025
Thrips tabaci	2	0.2	0.2	0.4	0.20	3.92	10	-0.055
□	**51**	5.1	51.0	7.1	5.10	100.00		-0.113
		H(S)=0.37			**Hmax=2**			**E% =23.78**

CONCLUSIONS

In the grapevine plots studied in the vineyard of Ştefăneşti-Argeş, the structure of the Thysanoptera fauna is made up of 25 species, grouped along two trophic levels: 20 species – primary consumers and 5 species – secondary consumers. This fact reveals a rich biodiversity for an anthropized ecosystem

The Euro-Siberian species predominate, while the Cosmopolitan species and the West-Palearctic species have the lowest representation.

Drepanothrips reuteri is the constant and prevalent species in all the phenophases, and in the chemically treated vineyard there recorded values of the relative abundance ranging between 33.3% and 94.12%, while the species *Thrips tabaci* and *Rubiothrips vitis*, known to be pests of the grapevine, have low values of the structural indicators.

The lowest values of the Shannon-Weaver diversity indicator were recorded in the phenophases of “in bloom”, “growing of berries” 2nd and 3rd, and “maturation of the grapes”, a situation which characterizes the agro-ecosystems, as a result of the fact that the development of certain species is favoured in monocultures.

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