Fruit Growing Research, Vol. XXXVII, 2021 DOI 10.33045/fgr.v37.2021.16
https://publications.icdp.ro/index.php

INFLUENȚA DIFERITELOR SISTEME DE FITOPROTECȚIE ASUPRA FAUNEI ENTOMOFAGE ÎNTR-O PLANTAȚIE DE MĂR

THE INFLUENCE OF DIFFERENT PHYTOPROTECTION SYSTEMS ON ENTOMOFAGE FAUNA IN APPLE PLANTATION

Sumedrea Mihaela, Marin Florin Cristian, Călinescu Mirela
Research Institute for Fruit Growing Pitesti, Romania

Abstract

The paper presents data on the diversity of entomophagous fauna in an ecologically managed apple plantation, as well as aspects regarding the differences found in the structure of the entomophagous complex in three variants of phytoprotection technologies: "Ecological", "Biotechnical" and "Chemical standard". The study was carried out during the years 2019-2020, at the Research Institute for Fruit Growing Pitesti, in a plot aged 12 years. The evaluations were performed both in the field, visually and in the laboratory, at binocular magnifier. As a result of this study, a number of 6 species of predatory insects were identified: *Chrysopa carnea, Coccinella septempunctata, Adalia decempunctata, Anthocoris* sp*., Phytoseiulus persimilis* and *Aphidoletes aphidimyza*, were mainly from the Orders *Mesostigmata, Coleoptera, Neuroptera, Diptera* and *Hemiptera.*

Cuvinte cheie: insecte prădătoare, tratamente fitosanitare, ecologic, biotehnic, standard chimic.
Key words: predatory insects, phytosanitary treatments, ecological, biotechnical, chemical standard.

1. Introduction

In recent decades, concerns about the negative impact of agricultural activities on the environment, natural resources and even human health are growing. If until 1990, the objectives pursued by agriculture were to increase production in order to meet food requirements, today the aim is to find new solutions aimed at protecting the environment and natural resources (Geier B, 2000; Polesny, 2000; Sallai et al., 2000; Teodorescu et al., 2003; Sumedrea et al., 2010).

In addition, in the context of climate change, the range of pathogens and pests is also in a continuous dynamic, their biological cycle is undergoing changes, which require effective solutions to combat them (Butac et al., 2021).

In recent years, the efforts of specialists have focused on transforming plant protection technologies into very precise, environmentally friendly activities, using the latest monitoring tools, innovative agrochemicals, as well as the best application techniques, to minimize impact on the environment and get healthy fruits, according to consumer requirements.

Thus, in the integrated phytoprotection acts to optimize the number of treatments against pests, aiming to ensure a balance in the soil - plant - environment - human habitat - society, ultimately leading to the preservation of agro-ecosystem stability and environmental quality.

Our research has tried to highlight new elements that can be used in integrated apple protection systems, based on an ecological or biotechnical control approach.

2. Material and methods

The study was carried out during the years 2019-2020, at the Research Institute for Fruit Growing Pitesti, in a plot aged 12 years, belonging to the Laboratory of Fruit Technologies - Phytosanitary Protection.

The experiment was located on an area of 0.2 ha, Topaz cv. grafted on M9 - T337, planting distance 3.5 x 1.25 m, 2,286 trees/ha, drip irrigation system, soil cultural practices – mowing on the row and grass between rows.

The area belongs to national second climatic area, with solar radiation 114-128 Kcal/cm2, mean temperatures between 9.8-11.2 C, 3400-4100 degrees over 0 C, 2800-3500 degrees over 10 C, mean precipitations 450-700 mm; in dry years, from April until October. The vegetation on the neighboring hills consists in broad leaves forest species (*Quercus*, *Fagus, Carpinus, Betula*), the one along the waters is composed by soft wood species (*Populus, Salix, Alnus, Tamarix*), also *Typha, Phragmites* and *Carex*. The grass cover include species as: *Poa, Festuca, Alopecurus, Agrostis, Lolium, Dactylis*. The plot is located on poor loam-clay soil (Over 30% clay). Deep into the profile, the soil has sandy structure and include a variable amount of coarse material. Soil surface is prismatic and friable. The soil organic matter

represents 1.8% and drop with the deep. The soil is poor in nitrogen and phosphorus (nitrogen index 0.33-1.43; PAL 1.3-2.5 mg per 100g) and potassium supply is good up to 40 mg per 100g.

To prevent and control specific pests, three phytoprotection variants were established: "Ecological", "Biotechnical" and "Chemical standard", placed randomly, in 4 repetitions. The products used are mentioned in Table 1.

To determine the entomophagous complexes, 2 dynamic surveys were performed each year (June-August). At each survey, 100 shoots colonized with aphids and/or mites/variant were analyzed, respectively 25 shoots/repetition. The evaluations were performed both in the field, visually and in the laboratory, with a binocular magnifying glass.

3. Results and discussions

As a result of this study, a number of 6 species of arthropods were determined*: Chrysopa carnea, Coccinella, septempunctata, Adalia decempunctata, Anthocoris* sp*., Phytoseiulus persimilis* and *Aphidoletes aphidimyza,* noting the existing entomophages as number, species and biological stage on each variant and repetition (Tables 2-3). The identified entomophagous complex was separated into systematic groups and species (Table 4).

The data obtained were statistically analyzed by calculating standard deviations and coefficients of variation.

Regarding the structure of the entomophagous fauna, there was a predominance of predatory species from the Orders *Mesostigmata* (54.0%), respectively *Coleoptera* (34.0%), followed by the Orders *Neuroptera* (8.0%), *Diptera* (3.0 %) and *Hemiptera* (1.0%), (Figure 1).

Depending on the phytoprotection program applied for the control of specific pests, obvious differences were found between entomophagous complexes, both in the total number of specimens (Figure 2) and in structure, by species (Figure 3 - a, b and c).

Thus, the useful entomofauna from the ecological variant exceeds, through its total number, the one from the biotechnical variant and especially the one from the chemical standard variant.

The predatory insect species *Chrysopa carnea*, *Coccinella septempunctata*, *Adalia decempunctata* and *Phytoseiulus persimilis* were present in all three phytoprotection variants, while the species *Aphidoletes aphidimyza* and *Anthocoris* sp. were identified only in the ecological and biotechnical variants.

Figure 4 illustrates some of the entomophagous species identified in the ecological variant, as well as an overview with the location of the experience, at its beginning.

4. Conclusions

- The identified entomophagous complexes were mainly from the Orders *Mesostigmata* (54.0%), respectively *Coleoptera* (34.0%), followed by the Orders *Neuroptera* (8.0%), *Diptera* (3.0%) and *Hemiptera* (1.0%).
- Depending on the plant protection program applied for the control of specific pests, there were obvious differences in the number of specimens per species of predators.
- The useful entomofauna of the “ecological” variant has exceeded, through its total herd, the one of the “biotechnical” variant and significantly the one of the “chemical standard” variant.
- The use of organic or less polluting products, serves as a viable alternative for limiting or stopping the attack caused by specific pathogens and pests.
- By introducing these categories of products in the standard technology to control the complex of parasites, it was achieved, on the one hand, to keep harmful populations below the economic threshold, and on the other hand, the restoration of useful fauna and antagonistic microorganisms and therefore a biocenotic balance in the ecosystem.

Acknowledgments

This paper was elaborated at Research Institute for Fruit Growing Pitesti, inside **Thematic Plan - Implementation of „ASAS Strategy regarding Research – Development – Innovation in Fruit Growing”,** ASAS Theme 2: *New fruit growing technology, with favorable impact on environment and rural development*; Experience 2.5. *Bio-ecological study, symptomatology and measures to prevent and control the attack of the main pests in the plantations of trees, fruit bushes and strawberries*.

References

1. Butac M., Chițu E., Militaru M., Sumedrea M., Călinescu M., Marin F. C., Sturzeanu M., Mazilu C.,Nicolae S., Gavăt C., Moale C., Sîrbu S., Iurea E., Botu M., Achim Gh., Asănică A., Zagrai I., Zagrai L., Moldovan C., Manea D., Ducu C., Bubueanu C., Bilegan M., 2021. Tehnologii ecologice]n pomiculture[- Ghid practic. Ed. INVEL - Multimedia, Bucureşti, ISBN: 978-606-764-063-2; 187 pp. (in Romanian).
2. Geier B., 2000. Organic agriculture worldwide - a fast growing reality for 100 % pesticide risk reduction. Acta Hort. 25: 31-38. DOI:10.17660/ActaHorticulturae2000.525.1. https://doi.org/10.17660/ActaHortic.2000.525.1.
3. Polensny F.D.r., 2000. New plant protection tools for use in integrated fruit production. Acta Hort. 525 : 359-359 DOI: 10.17660/Acta Horticulturae.2000.525.48**,** https://doi.org/10.17660/ActaHortic.2000.525.48.
4. Sallai P., Lantos J., Molnár M., Kajati I., Bubán T., Inántsy F., Eke, I., 2000. Developments of integrated fruit production in Hungary. Acta Hort. 525: 57-64, DOI: 10.17660/ActaHortic.2000.525.5, https://doi.org/10.17660/ActaHortic.2000.525.5.
5. Sumedrea M., Sumedrea D., Chiţu E., Tănăsescu N., Turek A., Marin Fl., Temocico G., Chiţu V., Murariu F., Murariu R., Nicola C., Călinescu M., Asănică C., A., Alecu E., 2010. Technology regarding the optimization of fertigation, the system for combating diseases and pests and the application of black coal in fruit growing. Ed. INVEL - Multimedia, Bucuresti, ISBN 978-973-1886-53-4; 268 pp.
6. Teodorescu G., Roman T., Sumedrea M., 2003. Horticultural entomology. Specific pests and control methods. Ed. Ceres, Bucuresti, ISBN 973-40-0631-2; 375 pp.

Tables and Figures

Table 1. The product used to control the damaging agents on apples (Research Institute for Fruit Growing Pitesti, Romania, 2019-2020)

Variant	Products used Conc. (%)/Rate (l; kg/ha)	Target damaging agents/ Way of action
Ecological	Bouillie Bordelaise conc. 0,5% Ovipron Top conc. 0,5% Microthiol Special conc. 0,3% Champ 77WG conc. 0,3% Cuproxat flowable conc. 0,35% Kerafol Evo conc. 0,3% Laser 240 SC dose 0,6 l/ha Bactospeine DF dose 1,0 kg/ha Prev-Am conc. 0,5% Capcane atraPOM	Mycotic and bacterial pathogens Pests (hibernating form) Powdery mildew - *Podosphaera leucotricha* Mycotic and bacterial pathogens Mycotic and bacterial pathogens Growing activator, healing agent Apple codling moth - *Cydia pomonella* Apple codling moth - *Cydia pomonella* Aphids - *Aphis* spp., mites - *Tetranychus* spp. Apple codling moth - *Cydia pomonella*
Biotechnical	Bouillie Bordelaise conc. 0,5% Ovipron Top conc. conc. 0,5 Microthiol Special conc. 0,3% Champ 77 WG conc. 0,2-0,3% Coragen conc. 0,01% Affirm Opti dose 2,0 kg/ha Delegate dose 0,3 kg/ha Voliam Targo dose 1,2 l/ha	Mycotic and bacterial pathogens Pests (hibernating form) Powdery mildew - *Podosphaera leucotricha* Mycotic and bacterial pathogens Apple codling moth - *Cydia pomonella* Apple codling moth - *Cydia pomonella* Apple codling moth - *Cydia pomonella* Mites - *Tetranychus* spp., *Lepidopterae*
Chemical standard	Topas 100 EC dose 0,5 l/ha Systhane forte conc. 0,02% Merpan 80 WDG conc. 0,15% Luna Experience dose 0,75 l/ha Karate Zeon conc. 0,015% Movento 100 SC dose 1,875 l/ha Vantex 60 CS conc. 0,01% Ortus 5 SC dose 1,0 l/ha	Powdery mildew - *Podosphaera leucotricha* Mycotic pathogens Mycotic pathogens Mycotic pathogens *Aphis* spp., *Lepidopterae* *Aphis* spp., *Eriosoma lanigerum* *Aphis* spp., *Lepidopterae* Mites - *Tetranychus* spp.

 DOI 10.33045/fgr.v37.2021.16

Table 2. Determination of entomophagous species in experimental variant under the condition of the year 2019 (Research Institute for Fruit Growing Pitesti, Romania)

Variant	Replicate	Assessed shoots	Entomophagous identified		
			Species	Biologic stage	Total (No.)
Ecological	*R1*	25	*Chrysopa carnea*	egg; larva	5
			Coccinella septempunctata	larva; adult	11
			Anthocoris sp.	adult	1
			Phytoseiulus persimilis	adult	25
	R2	25	*Coccinella septempunctata*	larva; adult	10
			Phytoseiulus persimilis	adult	20
			Adalia decempunctata	adult	2
			Anthocoris sp.	adult	1
	R3	25	*Coccinella septempunctata*	egg; adult	7
			Adalia decempunctata	adult	2
			Phytoseiulus persimilis	adult	11
			Chrysopa carnea	egg; larva	4
	R4	25	*Phytoseiulus persimilis*	adult	12
			Coccinella septempunctata	larva; adult	10
			Chrysopa carnea	egg; larva	7
			Aphidoletes aphidimyza	larva	3
Biotechnical	*R1*	25	*Coccinella septempunctata*	larva; adult	8
			Adalia decempunctata	adult	2
			Phytoseiulus persimilis	adult	15
			Chrysopa carnea	egg; larva	3
	R2	25	*Coccinella septempunctata*	larva; adult	12
			Phytoseiulus persimilis	adult	20
	R3	25	*Coccinella septempunctata*	larva; adult	7
			Phytoseiulus persimilis	adult	10
	R4	25	*Phytoseiulus persimilis*	adult	18
			Coccinella septempunctata	larva; adult	5
			Adalia decempunctata	adult	2
Chemical standard	*R1*	25	*Phytoseiulus persimilis*	adult	7
	R2	25	*Phytoseiulus persimilis*	adult	5
			Coccinella septempunctata	adult	3
			Chrysopa carnea	egg	2
	R3	25	*Phytoseiulus persimilis*	adult	5
			Coccinella septempunctata	adult	3
			Adalia decempunctata	adult	1
	R4	25	*Phytoseiulus persimilis*	adult	6
			Coccinella septempunctata	adult	4

Table 3. Determination of entomophagous species in experimental variant, under the condition of the year 2020 (Research Institute for Fruit Growing Pitesti, Romania)

Variant	Replicate	Assessed shoots	Entomophagous identified		
			Species	Biologic stage	Total (No.)
Ecological	*R1*	25	*Chrysopa carnea* *Coccinella septempunctata* *Adalia decempunctata* *Anthocoris* sp. *Phytoseiulus persimilis*	egg; larva larva; adult adult adult adult	8 20 3 2 33
	R2	25	*Aphidoletes aphidimyza* *Coccinella septempunctata* *Phytoseiulus persimilis*	larva larva; adult adult	9 12 21
	R3	25	*Coccinella septempunctata* *Adalia decempunctata* *Phytoseiulus persimilis*	egg; adult adult adult	19 4 12
	R4	25	*Anthocoris* sp. *Phytoseiulus persimilis* *Coccinella septempunctata* *Chrysopa carnea*	adult adult larva; adult egg; larva	2 17 12 9
Biotechnical	*R1*	25	*Coccinella septempunctata* *Adalia decempunctata* *Phytoseiulus persimilis*	larva; adult adult adult	9 1 17
	R2	25	*Aphidoletes aphidimyza* *Coccinella septempunctata* *Phytoseiulus persimilis* *Anthocoris* sp.	larva larva; adult adult adult	4 12 33 1
	R3	25	*Coccinella septempunctata* *Phytoseiulus persimilis* *Chrysopa carnea*	larva; adult adult egg; larva	12 12 5
	R4	25	*Phytoseiulus persimilis* *Coccinella septempunctata* *Adalia decempunctata* *Aphidoletes aphidimyza*	adult larva; adult larva larva	17 7 1 4
Chemical standard	*R1*	25	*Phytoseiulus persimilis* *Coccinella septempunctata*	adult adult	5 3
	R2	25	*Phytoseiulus persimilis*	adult	5
	R3	25	*Phytoseiulus persimilis* *Coccinella septempunctata*	adult adult	4 4
	R4	25	*Phytoseiulus persimilis* *Chrysopa carnea* *Coccinella septempunctata*	egg larva	6 3 2

 DOI 10.33045/fgr.v37.2021.16

Table 4. The structure of entomophagous fauna according to the phytoprotection program applied, 2019-2020 (Research Institute for Fruit Growing Pitesti, Romania)

Variant	Entomophagous identified		Total (No.)	
	Systematic structure	Species	2019	2020
Ecological	O. *Neuroptera*; Fam. *Chrysopidae*	*Chrysopa carnea*	16	17
	O. *Coleoptera*; Fam. *Coccinellidae*	*Coccinella septempunctata*	38	63
	O. *Coleoptera*; Fam. *Coccinellidae*	*Adalia decempunctata*	4	7
	O. *Hemiptera*; Fam. *Anthocoridae*	*Anthocoris* sp.	2	4
	O. *Mesostigmata*; Fam. *Phytoseiidae*	*Phytoseiulus persimilis*	68	83
	O. *Diptere;* Fam. *Cecidomyiidae*	*Aphidoletes aphidimyza*	3	9
		Average	**21.83**	**30.50**
	Indicators	**Standard deviation**	**26.43**	**30.80**
		Variation	**121.06**	**110.81**
Biotechnical	O. *Neuroptera*; Fam. *Chrysopidae*	*Chrysopa carnea*	3	5
	O. *Coleoptera*; Fam. *Coccinellidae*	*Coccinella septempunctata*	32	40
	O.*Coleoptera*; Fam. *Coccinellidae*	*Adalia decempunctata*	4	2
	O. *Hemiptera*; Fam. *Anthocoridae*	*Anthocoris* sp.	0	1
	O. *Mesostigmata*; Fam. *Phytoseiidae*	*Phytoseiulus persimilis*	63	79
	O. *Mesostigmata*; Fam. *Phytoseiidae*	*Aphidoletes aphidimyza*	0	8
		Average	**17.00**	**22.50**
	Indicators	**Standard deviation**	**25.63**	**31.30**
		Variation	**150.75**	**139.10**
Chemical standard	O. *Neuroptera*; Fam. *Chrysopidae*	*Chrysopa carnea*	2	3
	O. *Coleoptera*; Fam. *Coccinellidae*	*Coccinella septempunctata*	10	9
	O. *Coleoptera*; Fam. *Coccinellidae*	*Adalia decempunctata*	1	0
	O. *Hemiptera*; Fam. *Anthocoridae*	*Anthocoris* sp.	0	0
	O. *Mesostigmata*; Fam. *Phytoseiidae*	*Phytoseiulus persimilis*	23	20
	O. *Mesostigmata*; Fam. *Phytoseiidae*	*Aphidoletes aphidimyza*	0	0
		Average	**6.00**	**5.33**
	Indicators	**Standard deviation**	**9.14**	**7.99**
		Variation	**152.39**	**149.34**

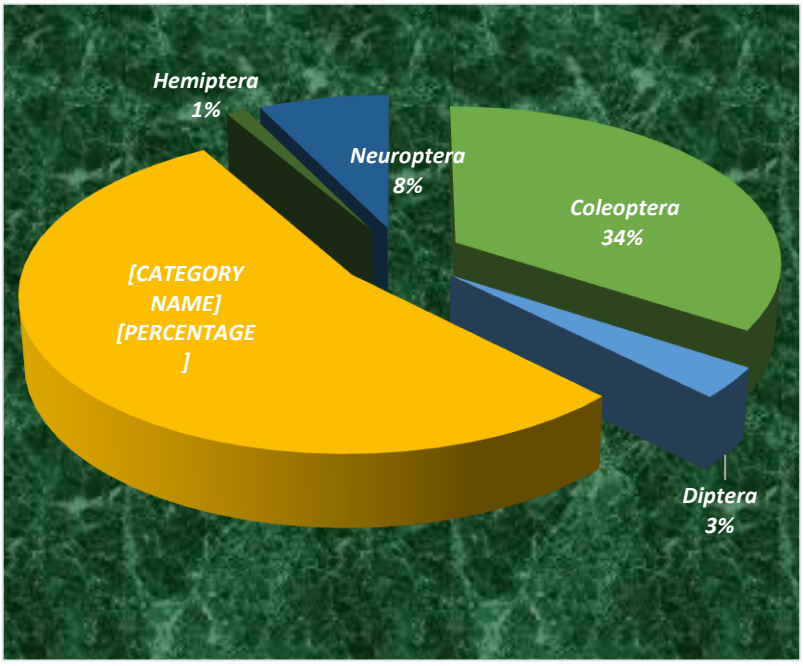

**Fig. 1. Structure of entomophagous fauna in apple orchards, %
(Research Institute for Fruit Growing Pitesti, Romania, 2019-2020)**

 DOI 10.33045/fgr.v37.2021.16

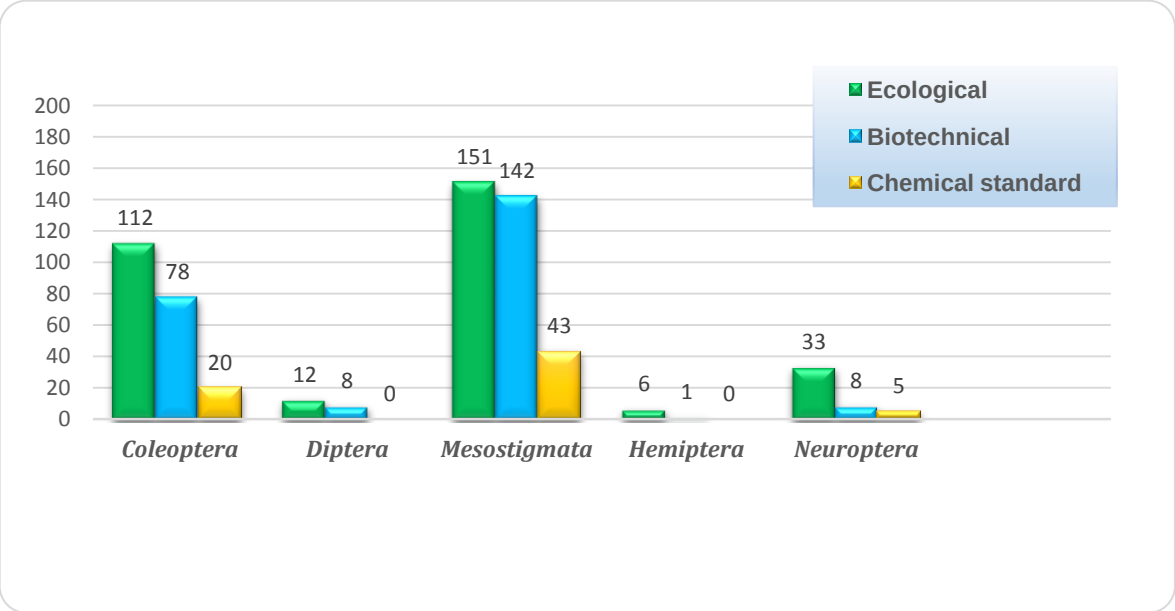

Fig. 2. Evolution of entomophagous populations under different phytoprotection systems of apple (Research Institute for Fruit Growing Pitesti, Romania, 2019-2020)

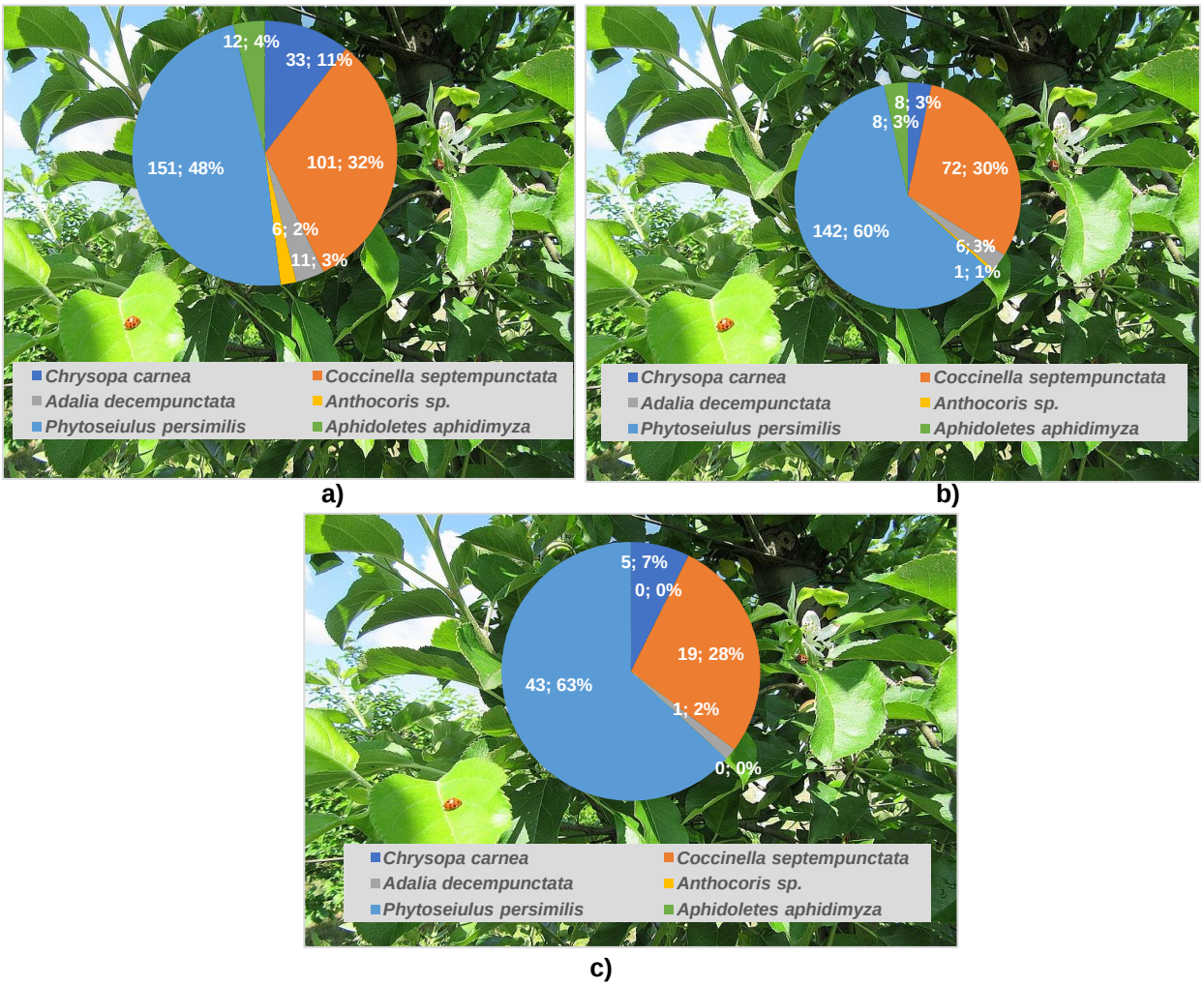

Fig. 3. Entomophagous species identified in different phytoprotection technologies, number and % (a - ecological; b - biotechnical and c - chemical standard)

 DOI 10.33045/fgr.v37.2021.16

a)

b)

c)

d)

Fig. 4. Some aspects regarding the location of the experience and details with the species identified in the ecological variant: a – The location of the experience, March 2019; b - *Coccinella septempunctata* - adults; c - *Chrysopa carnea* - eggs; d - *Aphidoletes aphidimyza* - larvae