ANALYSIS OF NATIVE AND HARLEQUIN LADYBIRD POPULATIONS AND THEIR ASSOCIATION WITH THE PRESENCE OF PHYTOPHAGOUS APHIDS

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Abstract. *Ladybugs are increasingly present lately in agricultural crops, horticulture, gardens and parks, both in individual and mixed culture systems. The connection between them and plants is less supported because they are present where phytophagous aphids are also present. The role of ladybugs is beneficial, as they are known to reduce the populations of aphids that feed on plants. Bearing these things in mind, we proposed that through the present paper we will see what is the share of native and harlequin (Asian) species, the latter being invasive. It is also important to see what the ratio is between ladybugs and the aphid populations present. The study was carried out for 2 years (2021-2022) in a mixed space that combines various ornamental plants, corn, vegetables and fruit trees, dispersed over 1000 m2, located near the houses. From the ones analyzed, we found that the harlequin ladybugs had a higher percentage than the local ones (ie, 68% compared to 42%). Regarding their association with aphid populations, we found that the predator-phytophagous ratio was 1 ladybug to 20 aphids. This highlights that the populations of aphids in a mixed space that offers the possibility of shelter over the winter and implicitly large populations of ladybugs in the following year, can be managed only by ladybugs, no other control solutions are necessary.*

Keywords*: ladybugs, native, invasive, combined plants, aphids, control.*

INTRODUCTION

The importance of ladybugs has been mentioned since the 19th century, when they were widely used to reduce phytophagous aphid populations (HODEK, 1973; MAJERUS, 1985; MAJERUS, 1994; HODEK, 1996). Numerous researches have over time highlighted their value as an international biological control agent (DEBACH, 1974; CHAMBERS ET AL., 1983; BASKY, 2003; SNYDER ET AL., 2004; THIES ET AL., 2011; ANSARI POUR, 2012). Also, at the local level (western part of Romania), numerous researchers have focused their attention on the range of coccinellid present (VIRTEIU ET AL, 2015; FERICEAN AND CORNEANU, 2006) but also on their ability to reduce the number of aphids and other species harmful to plants in various agroecosystems (GOGAN AND GROZEA, 2013; GROZEA ET AL., 2015).

Regarding the species of coccinellids present in the west of the country, VIRTEIU ET AL. (2015) according to the classification of Vandenberg (2002) show that there are 4 species of the genus Coccinella (4 punctata, 7 punctata respectively 14 punctata and 24 punctata), 1 of the genus Tytthaspis (17 punctata), 2 from the genus Adalia (2 punctata and 10 punctata), 1 from the genus Propylaea (14 punctata) 1 from the genus Psylobora (22 punctata), 1 from Hippodamia (*tredecimpunctata*), 1 from the genus Adonia (*variegata*) 1 from genus Calvia (*deciguttata*), 2 from genus Chilocorus (*bipustulatus* and *renipustulatus*) and 1 from the genus Harmonia (axyridis).

The presence of ladybugs, known as coccinellids, is evident in gardens, cultivated plants, orchards, ponds, ornamental parks and in general where there is a nearby possibility of shelter over the winter. This should be taken into account in the specialized quantitative evaluations (GROZEA, 2022, personal observations).

With all this in mind, we proposed to update the situation and see what is the weight of native and respectively invasive ones, as well as the numerical level in relation to aphids that feed on plants.

MATERIAL AND METHODS

The study was carried out for 2 years (2021-2022) in a mixed space from Grabat village (Timis county) located in western part of Romania. In this are combined various ornamental plants, corn, vegetables and fruit trees (table 1), dispersed over an area of 1000 m^2, located near the houses.

We took into account 2 types of biological materials, i.e. host plants and active ladybugs and phytophagous aphids (adult and larva) on the other hand (figure 1). Observations were made between April and November, with bimonthly direct readings without their collection, in the 2 years previously mentioned. The species of ladybugs, their inclusion in the autochthonous and invasive category or their numerical level in relation to that of phytophagous aphids were aspects provided as targets in this work.

The scientific determination of the species and the correct classification in the genus was carried out taking into account the guidance of specialists with experience in this type of studies (BLACKMAN AND EASTOP, 2000).

Table 1

The plant species analysed in order to identify ladybug species (native and invasive) and phytophagous aphid populations

Plant species analysed	Family	Identification data
Zea mais	Poaceae	45°52'21.5"N 20°45'11.4"E
Solanum lycopersicum	Solanaceae	45°52'27.1"N 20°45'12.2"E
Solanum tuberosum	Solanaceae	45°52'22.9"N 20°45'11.7"E
Chaenomeles japonica	Rosaceae	45°52'23.6"N 20°45'12.1"E
Rosa sp	Rosaceae	45°52'24.3"N 20°45'14.8"E
Malus domestica	Rosaceae	45°52'26.4"N 20°45'13.3"E
Prunus armeniaca	Rosaceae	45°52'25.5"N 20°45'13.5"E
Prunus avium	Rosaceae	45°52'25.4"N 20°45'13.1"E

Figure 1. The biotic factors analyzed: ladybugs and aphids *on Chaenomeles japonica* (the Japanese quince) and ladybirds on *Rosa sp. (rose)*

RESULTS AND DISCUSSION

At the same time, both native and invasive ladybugs (known as harlequin or Asian) have been reported. Among the native ladybird species, we found the following in the studied area: *Coccinella septem punctata, Coccinella 22 punctata* and *Adalia bipunctata* (figure 2). Both active

stages (adults and larvae) and inactive stages (eggs and nymphs) were observed. The quantification, however, was done only on active stages considering the trophic link with phytophagous aphids.

Figure 2. Native ladybugs as *Coccinella 7 punctata* (leftt) and *Adalia bipunctata* (right)

Among the harlequins I found the following: *Harmonia axyridis and Harmonia conspicua* (figure 3).

Both native and invasive species were present on the same plant species or individually. In a few cases, however, there were associations of them on the same plant (vegetable, shrub, tree).

Figure 3. Harlequins' ladybugs as *Harmonia axyridis* (left) and *Harmonia conspicua* (right)

Following the numerical data for the 2 years of study, it was found that in 2021 more predatory ladybugs were seen than in 2022, more precisely 190 individuals in total compared to 89 (table 2).

Detailing by category (table 2), there were much more harlequin ladybirds in 2021 compared to 2022, as well as in the case of the native ones, i.e., 102 compared to 88. On the other hand, the native ladybirds had the same approach regarding the situation over the years i.e., 53 individuals compared to 36 individuals.

Analysing their presence on studied plant species, it can be seen that at least 1 individual ladybug, either native or harlequin, was observed on all those observed. So, from Table 2 it is possible to extract their numerical amount with the preponderance on the species of *Chaenomeles japonica* and *Rosa sp*. (as ornamental plants) with averages of x=20.25 individuals and 27.25 individuals respectively.

These predatory species were also present on vegetables, i.e., on *Solanum lycopersicum* (x=4.5 ind.) and *Solanum tuberosum* (x=2.5 ind.) but also on trees (*Malus domestica*, *Prunus armeniaca* and *Prunus avium*) (with values of x=4.75 ind., x=3 ind. and x= 2.75 ind.). They were also observed on grass plants, such as *Zea mais* with an average value recorded of x=4.75 ind.) (table 2).

Table 2

The number of individuals present in the period April-November, 2021-2022 in the analysed mixed space

Plant species analysed	The number of individuals				Average
	Native ladybugs		Harlequin ladybugs		
	2021	2022	2021	2022	
Zea mais	3	3	8	5	4.75
Solanum lycopersicum	4	2	7	5	4.5
Solanum tuberosum	2	0	5	3	2.5
Chaenomeles japonica	16	10	25	30	20.25
Rosa sp	24	16	40	29	27.25
Malus domestica	1	2	7	9	4.75
Prunus armeniaca	2	1	5	4	3
Prunus avium	1	2	5	3	2.75
Total/year	53	36	102	88	
Total/period	89		190		

Of those analysed, we found that harlequin (invasive) ladybirds had a higher percentage of frequency than native ones (ie, 68% versus 42%) (figure 4). However, both percentages are revealed for the biological control of phytophagous insects.

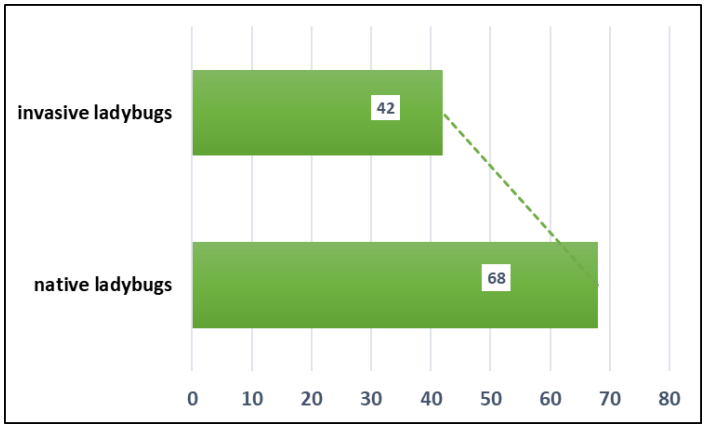

Figure 4. The percentage estimate of the populations of harlequin ladybugs compared to the native ones observed in the analyzed area

Regarding their association with aphid populations, we found that the predator-to-phytophagous ratio was 1 ladybug to 20 aphids (figure 5). In almost all cases where we observed more than 5 aphids and ladybugs were present nearby. They were observed either directly consuming the aphids or lying-in wait, generally at the top of the plant looking for sunny places.

In spring and summer, predatory ladybugs were observed throughout the garden, flying over all the plants. In autumn, they were observed more on the ornamental plants and we concluded that they came closer to the house, in sheltered places overnight.

Maybe that's why ladybugs are more common in mixed spaces near people's houses, and not necessarily because there are a lot of aphids.

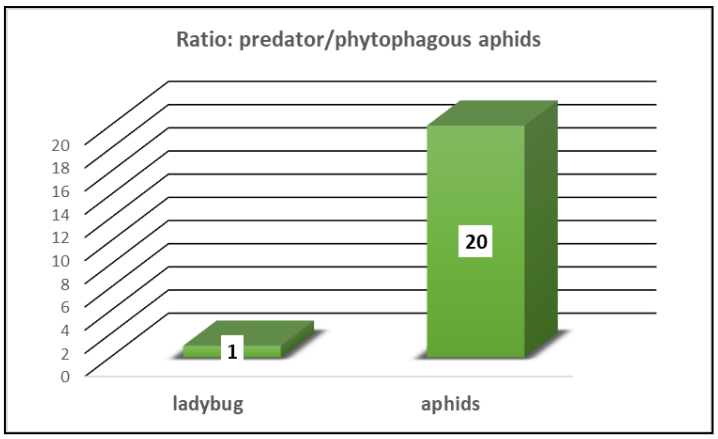

Figure 5. The ratio between the number of ladybugs (predators) and aphids (phytophagous pests) found in the area under study

CONCLUSIONS

The predominance of Asian ladybirds in the mixed spaces that also offer the possibility of shelter is highlighted, which clearly ensures an increase every year. This is good because invasive species are more aggressive and feed on more plant-damaging aphids, so they are efficient biocontrol agents. On the other hand, it could have a negative impact for the native populations.

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BIBLIOGRAPHY

ANSARI POUR A., SHAKARAMI J. (2012). Recognition ofladybirds fauna (Col: coccinellidae) in the alfalfa fieldsof Khorramabad. Journal of Animal & Plant Science. 22(4):939–943.

BASKY Z. (2003). Predators and parasitoids on different cereal aphid species under caged and no caged conditions in Hungary, in Proceedings of the 8th International Symposium on Ecology of Aphidophaga: Biology, Ecology and Behaviour of Aphidophagous Insects, Suppl. 5, 95–102.

BLACKMAN R.L., EASTOP V.F. (2000). Aphids on the World's Crops. An Identification and Information Guide. (Eds). John Wiley and Sons, Ltd. Hoboken. Elsevier. New Jersey. (1), 1095 pp.

CHAMBERS R. J., SUNDERLAND K.D., WYATT I.J., VICKERMAN G.P. (1983). The effects of predator exclusion and caging on cereal aphids in winter wheat. Journal of Applied Ecology, 20, 209–224.

DEBACH P. (1974). Biological control by natural enemies.Cambridge University Press, Cambridge

FERICEAN L.M., CORNEANU M. (2016). The Variability of Some Phenotypic Features and Life Cycle in Two Aphis Pomi Populations from Western Romania, Muzeul Olteniei Craiova. Oltenia. Studii si Comunicări. Ştiinţele Naturii. Tom. 32, No. 1, 61-66.

GOGAN A., GROZEA I. (2013). Metcalfa pruinosa (monografy). Ed. Eurobit, 200 pp.

GROZEA I. (2006). Entomologie generala. Ed Eurobit, 155 pp.

GROZEA I., VLAD M., VIRTEIU A.M., STEF R., CARABET A., MOLNAR L., MAZARE V. (2015). Biological control of invasive species Metcalfa pruinosa Say (Insecta: Hemiptera: Flatidae) in ornamentals plants by using Coccinelids. Journal of Biotechnology, S112.

HODEK I. (1996). Food relations. In: Hodek I., Honek A. (Eds.), Ecology of Coccinellidae. Kluwer Academic Publishers,Dordrecht, 143–238 pp.

HODEK, I. (1973). Biology of Coccinellidae. The Hague: Junk and Prague, Academia.

MAJERUS M.E. (1994). New Naturalists: Ladybirds. London: Collins in Messina, F. J., and Sorenson, S. M. (2001). Effectiveness of lacewing larvae in reducing Russian wheat aphid populations on susceptible and resistant wheat. Biological Control 21, 19–26.

SNYDER W.E., BALLARD S.N., YANG S., CLEVENGER G.M., MILLER T.D., ET AL. (2004). Complementary biocontrol of aphids by the ladybird beetle Harmonia axyridis and the parasitoid Aphelinus asychis on greenhouse roses. Biological Control, 30, 229–235.

THIES C., HAENKE S., SCHERBER C., BENGTSSON J., BOMMARCO R., CLEMENT L. W., ET AL. (2011). The relationship between agricultural intensification and biological control: experimental tests across Europe. Ecology Applied, 21, 2187–2196.

VIRTEIU AM, GROZEA I, STEF R., VLAD M., DOBRIN I. (2015). Faunistic Study of Ladybirds (Coleoptera:Coccinellidae) in the Banat Region, RomaniaAna –Bulletin USAMV series Agriculture 72(2), doi 10.15835/buasvmcn-agr: 11489.