Scientific Papers. Series B, Horticulture. Vol. LXV, No. 1, 2021
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

ABUNDANCE OF INSECT SPECIES HARMFUL TO ORNAMENTAL PLANTS IN URBAN ECOSYSTEMS

Ana-Covilca MUNTEAN, Ioana GROZEA

Banat's University of Agricultural Sciences and Veterinary Medicine
"King Michael I of România" from Timisoara, 119 Calea Aradului,
Timisoara, Romania

Corresponding author email: ioana_entomol@yahoo.com

Abstract

Parks are the most important natural sources of fresh air and relaxation in a city like Timisoara. Therefore, in this paper we turned our attention to the factors that can disrupt the development of ornamental plants in the main parks. One of them is harmful insects that can affect in the medium or long term the species of plants. Thus, during 2020, between April and September, 125 observation points in 5 parks were analyzed to establish the level of abundance of insect populations. In this analysis, we considered 4 levels of evaluation: level I, extremely high (> 400 individuals), level II, high (250-400 individuals), level III, medium (100-250 individuals) and level IV, low (<100 individuals). Levels I and II included the species of Metcalfa pruinosa, Eriosoma lanigerum, Aphis rosae, Aphis gossypii, Trialeurodes vaporariorum, Corythucha ciliata and Halyomorpha halys, which had high and extremely high values in 2 parks (Botanical and Roses). Increased attention should be paid to these pests which in the absence of a control strategy can multiply excessively causing qualitative and quantitative losses of plant species.

Key words*: urban ecosystem, insect population, harmful, abundance.*

INTRODUCTION

In the current context of modernization and technological and economic evolution, it is obvious that the human population is becoming more and more urban (Ritchie and Roser, 2018). That is why tools to support urban planning and management are needed to reconcile the needs for building development (UN, 2019), to ensure a high quality of life and to protect urban biodiversity (Pauna, 2007).

Increasing the impact of conservation measures of green space and parks through actions that promote correlating combinations between diversity and vegetation structure has become a target (Nielsen et al., 2013). In this sense, the conservation of spaces could offer enormous benefits for other urban ecological components but also for urban inhabitants (Lopucki & Kiersztyn, 2015). That is why we set out in this paper to address one of the destructive factors, such as harmful insects, which destabilize their proper functioning.

It is known that insects are important elements of urban ecological ecosystems (Cardoso et al., 2020) and are strongly affected by anthropogenic activities (EEA, 2020).

A comparative assessment of the frequency of insect species in different urban ecosystems providing decorative and relaxing services showed that there is a wide variety of insect species (Jaganmohan et al., 2013). Mata showed that herbivores and predators bugs show strong positive responses to vegetation volume in those urban ecosystems and that the plant diversity is distinctly species specific, or, otherwise said, high occupancy of bugs is obtained in green spaces with specific combinations of vegetation structure and diversity (Mata et al., 2017).

Numerous species of insects, native or non-native, have been identified in parks in Europe to date (Lesieur, 2018) and in parks in Romania (Grozea & Muntean, 2019). By the end of 2016, 1418 non-native insect species had been identified as being introduced and established in Europe. This acceleration (> 90%) was mainly due to accidental introductions related to human activities and, mainly, to the exponential growth of the world trade in ornamental plants (Villa et al., 2001), which leads to the transport of plant-associated species (Roques et al., 2010). These landscaped ecosystems are permanent sources of new

species. The rapid evolution of their expansion can also be measured in the number of years from the first reporting (Roques and Auger-Rozenberg, 2021); for example, the species *Cydalima perspectalis* and *Leptoglossus occidentalis* recorded an annual increase of over 150 km (EPPO, 2012).

Arthropods are key elements of urban ecological areas that can be influenced by anthropogenic activities. New methods are continuously developed for detection and quantification of insect species, that ultimately could lead to a reduction in population levels below the damage thresholds (NAPPO, 2014). Some insect species can be easily quantified, such as *Cameraria ohridella* in which adult flight monitoring is performed by using pheromones traps (Kalinova et al. 2003). Other are difficult to detect and control, as *Nezara viridula* because it has an accentuated polyphagism and is in continuous adaptation to new host plants (Kamminga et al., 2006).

To detect specimens of *Halyomorpha halys*, INRA launched a participatory detection program requested the assistance of the public (Streito, 2017).

One species for which monitoring involves diverse methods for adults and larval and nymph forms is *Metcalfa pruinosa*. Thus, adult specimens were quantified using traps and larvae and nymphs by cutting leaves and shoots directly from parks and gardens and placing them in plastic bags (Gogan, 2013; Vlad & Grozea, 2016).

In the following we will present the results of monitoring observations in order to highlight the species of problem insects, which due to the large number of individuals endanger the species of ornamental plants in public parks in the city of Timisoara.

MATERIALS AND METHODS

Observations for quantification and evaluation of the population level of insects were made during 2020, between April and September, in several parks in the city of Timisoara. Out of the 15 urban parks of the city, five were chosen mostly near the historic central area: Botanical Park, Central Park, Roses Park, Ion Creangă Park and Justice Park.

The above-mentioned parks were the main research areas. These areas were divided into 5 sectors each (S1-S5), and in each sector 5 observation points (OP) were established (Figure 1) depending on the presence of mixed plants, both woody plants (like trees and shrubs) and grasses (as periodic decorative plants).

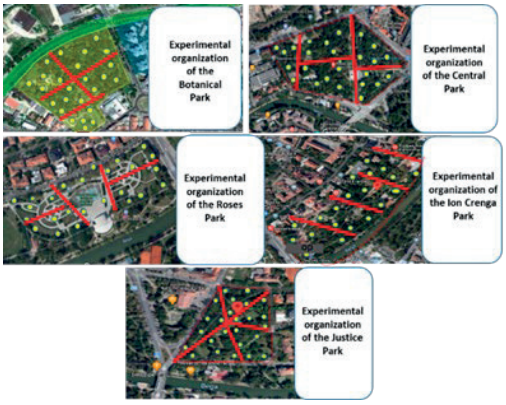

Figure 1. Geographical representation of the experimental organization by dividing the 5 parks in the city of Timisoara into observation points (OPs)

The direct readings (Figure 2) from the observation points included plants present on a radius of 4-6 m and where the free spaces without plants predominated, the observation surface was extended by 1-2 m. The observations were made on already existing plants. All plants in the observation points were analysed only at the aerial parts (stem, shoots, leaves, inflorescences, fruiting). The underground part (root) was not analyzed because we were not allowed to uproot the plants.

The categories of plants existing in parks and otherwise analysed were woody plants (shrubs and trees), shrubby woody plants, perennial woody plants (roses, ivy), herbaceous plants, annuals (flower layers) and perennial herbaceous plants (lawn). The monthly observations made in each OP/parks were focused on the following aspects: quantification of specimens of each insect species present, framing the population level at each observation and finally establishing the level and abundance curve (total number per monitored period).

We considered 4 levels of evaluation: level I, extremely high (> 400 individuals), level II, high (250-400 individuals), level III, medium (100-250 individuals) and level IV, low (<100 individuals).

Figure 2. Moments of observations to quantify the number of the insect species present in the five parks in Timisoara (a - Botanical Park; b - Ion Creangă Park; c- Roses Park; d - Central Park; e - Justice Park)

As working materials, in the pre-monitoring phase, in the Laboratory of Diagnosis and Phytosanitary Expertise within USAMVB "King Michael I of Romania" from Timisoara, the observation panels, collection containers, etc. were prepared. Post-monitoring, samples (insects, shoots with symptoms of attack, leaves and flowers with different forms of harmful insects) collected from parks were subjected to a more detailed analysis of determination and identification. Also, binocular magnifiers and other utensils like Petri dishes, tweezers, entomological needles, anaesthetic solutions, cutters and insect fixation substrate are used.

RESULTS AND DISCUSSIONS

The monitoring data obtained from the analysis of the five sectors (S1-S5) showed that in 2020, the following harmful insect species were present in the analyzed parks: *Metcalfa pruinosa, Nezara viridula, Cydalima perspectalis, Cameraria ochridella, Trialeurodes vaporariorum, Aphis gossypii, Eriosoma lanigerum, Leptoglossus occidentalis, Aphis rosae, Halyomorpha halys, Phylotreta sp., Cossus cossus, Lymantria dispar, Scudderia sp. and Corythucha ciliata*. These are part of the orders: Hemiptera, Orthoptera, Coleoptera and Lepidoptera. Each sector of the 5 analyzed had positive or negative results (+)/(-).

The periodic numerical evolution in Botanical Park showed that the highest size population of species and individuals (ind.) was registered in the summer and autumn period (July, August, and September), with average values (where x = 46.60, ind., x = 72.93 ind. and x = 42.93 ind.). Very high values (x > 50) were recorded only in August.

The abundance of species shows their inclusion in all 4 levels of population assessment. Figure 3 shows that in category IV, entered the species: *Cydalima perspectalis, Leptoglossus occidentalis, Lymantria dispar, Cossus cossus, Phylotreta* sp. and *Scudderia* sp. In the category middle level (III), the species *Cameraria ohridella* and *Nezara viridula* entered. High-level category II included *Aphis gossypii, Trialeurodes vaporariorum* and *Halyomorpha halis*, and category I, extremely dangerous species of *Eriosoma lanigerum, Aphis rosae, Metcalfa pruinosa* and *Corythucha ciliata* were identified.

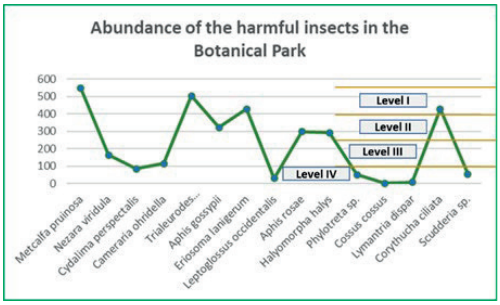

Figure 3. Abundance of harmful insect species present in the Botanical Park, in the city of Timisoara, in 2020 during April-September

For the Central Park, the sectors with positive values expressing the periodic numerical evolution highlighted the presence concentrated especially in the summer months (June, June, July and August), when the average values were between x = 12.87 and x = 13.87 individuals (x < 30).

Only 2 species *Metcalfa pruinosa* and *Aphis gossypii* entered in the category of medium-level III and all the other species with positive values entered in the category of level IV (low): *Nezara viridula, Aphis rosae, Trialeurodes vaporariorum, Halyomorpha halis, Cameraria ohridella, Cydalima perspectalis, Eriosoma lanigerum, Corythucha ciliata* and *Phylotreta* sp. (Figure 4). Unlike the Botanical Park, in the Central Park were identified fewer species but also fewer individuals.

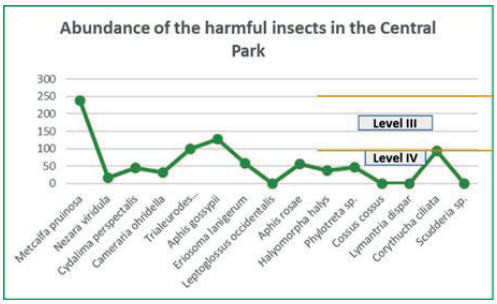

Figure 4. Abundance of harmful insect species present in the Central Park, in the city of Timisoara, in 2020 during April-September

In the Roses Park, several species identified in the Botanical Park (as a reference park) presented negative values, with the value x = 0/S1-S5; these were the species of *Leptoglosus occidentalis, Aphis gossypii, Phylotreta* sp., *Cameraria ohridella, Cossus cossus* and *Lymantria dispar*.

The periodic numerical evolution of species with positive values was concentrated in June, July and September (x = 44.40; x = 32.87; x = 30.13 individuals), where x > 30.

Related to the abundance of species, in Figure 5 it can be seen that in category of the level I, due to the large number of individuals present on the plants entered the species *Aphis rosae, Trialeurodes vaporariorum* and *Eriosoma lanigerum.* In category of the level II, the species *Metcalfa pruinosa* entered to a high level. Category of the level III (medium) included the species *Halyomorpha halys* and the category of the level IV (low) included the species *Cydalima perspectalis, Nezara viridula and Scudderia* sp. and *Corythucha ciliata.*

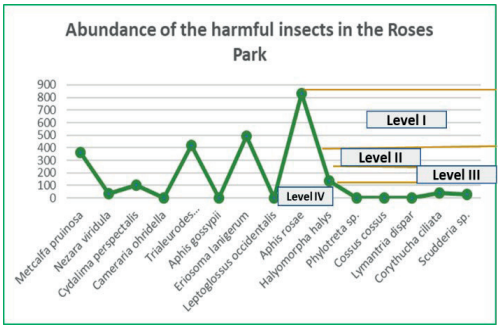

Figure 5. Abundance of harmful insect species present in the Roses Park, in the city of Timisoara, in 2020 during April-September

In Ion Creangă Park, in 2020 the species of *Lymantria dispar, Cossus cossus, Leptoglossus occidentalis* and *Scudderia* sp. were not present, their values in all the analyzed sectors being zero S (-) (x = 0). A concentration of species with positive values and individuals present in July was observed with an average value of 20.53 where x > 20.

In this park the abundance was expressed through 3 levels (level II, III and IV) (Figure 6). Only the species *Metcalfa pruinosa* entered in the level II. Level III included the species *Trialeurodes vaporariorum* and *Aphis gossypii*, and level IV included most other species with positive values: *Halyomorpha halys, Cameraria ochridella, Eriosoma lanigerum, Nezara viridula, Cydalima perspectalis* and *Corythucha ciliata.*

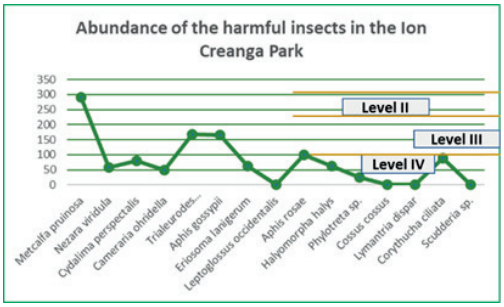

Figure 6. Abundance of harmful insect species present in the Ion Creanga Park, in the city of Timisoara, in 2020 during April-September

In the Justice Park, the observations highlighted the presence of a smaller number of species than in the other monitored parks. The absent species were: *Halyomorpha halys, Phylotreta sp., Cossus cossus, Lymantria dispar, Corythucha ciliata* and *Scudderia* sp. where (x = 0)/S (-). Their massive presence-was observed especially in June and July, with average values of x = 24.67 and x = 24.93 where x < 30.

The abundance of species represented in figure 7 shows that only one species (*Metcalfa pruinosa*) entered the high-level category II. In level III, medium, were included the species: *Cameraria ochridella, Trialeurodes vaporariorum, Aphis rosae* and in the category of level IV (low) entered *Nezara viridula, Eriosoma lanigerum, Aphis gossypii* and *Cydalima perspectalis*

The explanation for the high values registered in the Botanical Park compared to the other parks consists in the fact that it is a larger and more diversified park in Timisoara, being also known as the Botanical Garden (Ciupa et al, 2005). Another reason why the species of insects that feed on roses predominates in the Rose Park is the extremely varied range of rose species present in it.

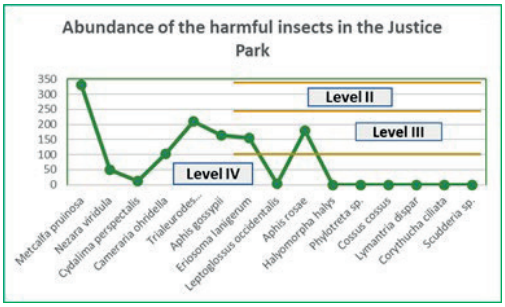

Figure 7. Abundance of harmful insect species present in the Justice Park, in the city of Timisoara, in 2020 during April-September

The species *Metcalfa pruinosa* and *Eriosoma lanigerum* species identification were easily identified and recognized, even remotely chosen after white secretions, fine whitish cloth left after attack for a long time on leaves, shoots, petiole and after glossy leaves due to transparent sticky liquid excrement deposited on them. Upon careful analysis, even adults, good jumpers, were observed on the stems or petiole of the leaves, placed in a longitudinal row (Figure 8).

Figure 8. Larval and adult colonies of *Metcalfa pruinosa* on park plants (a, b); Larval colonies of *Eriosoma lanigerum* on plants (c)

The other species were recognized either after direct observation (Figure 9) of adults (*Phyllotreta, Leptoglossus*) of larvae (*Cydalyma, Lymantria, Cameraria, Cossus*) and sometimes after direct observation of all active stages, ie larvae, nymphs and adults (*Nezara, Corhythuca, Halyomorpha*) and sometimes the damage caused helped to search and identify (such as *Scudderia*). In the case of aphids (*Aphis* sp.), they were permanently present on plants, in complex colonies (winged adults, non-winged adults, fundatrigens and virginogens, sexupares, eggs).

Figure 9. Virginogens colonies of *Aphis rosae* (a), young and larvae of *Cameraria ochridella* (b), adult form of *Nezara viridula* (c), larval attack of *Cydalima perspectalis* (d); mining by *Cameraria ochridella* (e)

CONCLUSIONS

In all monitored parks, the insects present were identified as various lepidopteran, hemipteran, coleopteran and orthopteran species, that varied both in terms of diversity and abundance.

The parks where the most diverse species were identified but also the most individuals were found were the Botanical Park and the Rose Park.

Among the most common species, the following are worth mentioning: *Metcalfa pruinosa, Aphis rosae, Trialeurodes vaporariorum, Eriosoma lanigerum, Aphis gossypii, Corythucha ciliata* and *Halyomorpha halys*. They recorded values between 250 and 400 individuals, but also values higher than 400 individuals.

Due to their presence in large populations, these species can cause considerable damage to ornamental plants in parks in Timisoara in the coming years. Therefore, it is recommended that the monitoring activity already started and presented through this paper, to continue in order to clearly establish their evolution. Also, a control strategy to keep problematic insect populations below the level of damage is necessary, and this must include environmentally friendly methods taking into account the presence of humans.

ACKNOWLEDGEMENTS

We would like to express our gratitude to the people who manage the parks in the city of Timisoara because they allowed us to make observations on the plants. Part of this paper belongs to the doctoral thesis "Effective

management of harmful insects in the green spaces of Timisoara through monitoring and biological control strategies".

REFERENCES

Avery, P.B., Kumar, V., Simmonds, M.S.J., Faull, J. (2015). Influence of leaf trichome type and density on the host plant selection by the greenhouse whitefly, *Trialeurodes vaporariorum*. *Appl Entomol Zool, 50*, 79–87.

Cardoso, P., Barton, P. S., Klaus, B., Filipe, C., Charl, D., Thomas, F., Fukushima, C. S., Habel, R.G, Hallmann, C.A., Hill M.J., Hochkirch, A., Mackenzie, L. K., Mammola, S., Noriega, et al. (2020). Scientists' warning to humanity on insect extinctions. *Biological Conservation,* 242, 108426, doi.org/10.1016/j.biocon.2020.108426.

Ciupa, V., Oarcea, C., Radoslav, R., Oarcea, Z. (2005). Timisoara green. The system of green spaces of Timişoara, Timişoara, *Marineasa Publishing House.*

EEA (2020). Biodiversity – Ecosystems. Retrieved from: https://www.eea.europa.eu/themes/biodiversity/intro [Online Resource]

EPPO (2012). EPPO Study on the risk of imports of plants for planting. *EPPO Technical Document No.1061*. (www.eppo.int/QUARANTINE/EPPO_Study_on_Plants_for_planting.pdf).

Gogan, A (2013). Monitoring and host plants identify of invasive species Metcalfa pruinosa Say (Insecta:Homoptera:Flatidae) in western Romania. Doctoral Thesis. 310 p.

Grozea, I., Muntean, A.C. (2019). Western conifer seed bug (*Leptoglossus occidentalis*) present in ornamental landscapes of the Romania. *Research Journal of Agricultural Science, 51* (1), 125-131.

Jaganmohan M., Vailshery L.Sujay, Nagendra H. (2013). Patterns of Insect Abundance and Distribution in Urban domestic Gardens in Bangalore, India. *Diversity*, 5, 767-778; doi:10.3390/d5040767.

Kalinova, B., Svatos, A., Kindl, J., Hovorka, O., Hrdy, I., Kuldova, J., Hoskovec, M. (2003). Sex pheromone of horse-chestnut leafminer Cameraria ohridella and its use in a pheromone-based monitoring system. *Journal of Chemical Ecology*, 29, 2, 387-404.

Kamminga K. L., Koppel A. L., Herbert, D. A. Jr., Kuhar T. P., (2006). Biology and Management of the Green Stink Bug. *Journal of Integrated Pest Management*, 3(3):C1–C8, https://doi.org/10.1603/IPM12006.

Lesieur, V., Lombaert, E., Guillemaud, T., Courtial, B., Strong, W. (2018). The rapid spread of Leptoglossus occidentalis in Europe: a bridgehead Invasion. *Journal of Pest Science,* doi.org/10.1007/s10340-018-0993-x.

Lopucki, R., Kiersztyn, A. (2015). Urban green space conservation and management based on biodiversity of terrestrial fauna – A decision support tool. *Urban Forestry & Urban Greening*, 14 (3), 508-518.

Nielsen, A.B., Van den Bosch, M., Maruthaveeran, S., Van den Bosch, K., (2013). Species richness in urban parks and its drivers: A review of empirical evidence. *Urban Ecosystems* 17(1), DOI: 10.1007/s11252-013-0316-1.

Mata, L., Threlfall, C., Williams, N. (2017). Conserving herbivorous and predatory insects in urban green spaces. *Sci Rep 7*, 40970; doi.org/10.1038/srep40970.

Pauna, C.B. (2007). The role of urban development in achieving the objectives of the cohesion policy of the European Union. *I.E.R. Study Collection*, no. 21.

NAPPO (2014). Morphological Identification of Spider Mites (Tetranychidae) Affecting Imported Fruits; Prepared by the members of the NAPPO Expert Group (previous Technical Advisory Group) on Fruit Tetranychus Mites; *Raport DP 03*; (https://www.nappo.org/files/3714/3782/0943/DP_03_Tetranychidae-e.pdf).

Ritchie H., Roser M. (2018). Urbanization. Published online at OurWorldInData.org. Retrieved from: 'https://ourworldindata.org/urbanization' [Online Resource]

Roques, A., Rasplus, J.Y., Rabistch, W., Lopez-Vaamonde, C., Kenis, M (2010). Alien Terrestrial Arthropods of Europe. *BioRisk 4* (1 and 2), 1-1024.

Roques, A., Auger-Rozenberg, M-A. (2021). Climate change and globalization, drivers of insect invasions. *Encyclopedia of the Environment*, [online ISSN 2555-0950].

Streito J., 2017. Halyomorpha halys (Stål, 1855) - diabolical bug shield. Retrieved from: http://ephytia.inra.fr/fr/Contents/view/20532/Agiir-Punaise-diabolique [Online Resource].

United Nations, Department of Economic and Social Affairs, Population Division (2019). World Urbanization Prospects: The 2018 Revision (ST/ESA/SER.A/420). New York: United Nations.

Villa, M., Tescari, G., Taylor, S.J. (2001). Nuovi dati sulla presenza in Italia di *Leptoglossus occidentalis* (Heteroptera, Coreidae). *Bollettino della Società Entomologica Italiana, 133*, 101 -112.

Vlad, M., Grozea, I. (2016). Host plant species of the cicada *Metcalfa pruinosa* in Romania. *Bulletin UASVM series Agriculture*, 73 (1), 131-137.