MONITORING OF PHYTOPHAGOUS HEMIPTERAN SPECIES FROM THE MAIN PARKS OF TIMISOARA

Ana-Covilca MUNTEAN, Ioana GROZEA

Banat's University of Agricultural Sciences and Veterinary Medicine "King Michael I of Romania" Timisoara, Romania
Corresponding author: ioana_entomol@yahoo.com

Abstract. *Based on the observations from the last two years, on the plants present in the parks near the central area of Timisoara, we decided to focus on phytophagous insect species of the order Hemiptera. This order considered in this paper are represented by stink bugs, seed bugs from Coreidae, aphids and flatid planthoppers. The reason why we focused on this category of insects was primarily based on the analysis of recent years and implicitly their increasing evolution, also on the attention paid to dangerous invasive species. Lately, they have started to be more and more present in big cities and especially in green spaces, parks and gardens, usually near people's houses or near buildings. Observations were made directly in the parks, approaching an adapted methodology, by dividing each park into sectors and establishing observation points. The study periods were April 1, 2019 - September 30, 2019 and April 1, 2020 - September 30, 2020. Depending on the species, the stage observed at a given time (during predetermined periodic readings) was either in the adult or larval or nymph level or both. Also, the plants subject to observation were grassy and/ or woody depending on their presence in the analyzed sector/ park. Thus, by periodically monitoring five main parks in the city of Timisoara, we found that there are differences between them in terms of identified species, population level and damage to plants. Some species of Hemiptera (Metcalfa pruinosa. Nezara viridula, Aphis sp. and Eriosoma lanigerum) have been present in high and medium populations and others (such as Leptoglosus occidentalis) in smaller populations. Of the species present, the following species have been identified as invasive ones, namely Metcalfa pruinosa, Nezara viridula and Halyomorpha halys. The aggressiveness of harmful insects on ornamental plants was described in terms of the level of abundance and symptoms observed. In conclusion, through the monitoring activity, which is a continuous update depending on numerous external factors and in the context of climate change, new dangerous species can be identified and new management solutions can be taken.*

Keywords*: Insects, Hemiptera, phytophagous, monitoring, invasive.*

INTRODUCTION

Landscaped urban ecosystems are the result of human intervention (STANDISH ET AL., 2012). Among them we can mention parks, botanical gardens and green spaces (LIXANDRU, 2003). They aim to ensure the conditions for relaxation and scientific study for modern man.

Rapid urbanization has led to changes in land use, climate and biodiversity. Thus, forms of ecological protection measures to facilitate sustainable development and to protect urban biodiversity and implicitly the health of the ecosystem have been made by specialists (ZHIYUAN ET AL., 2019). In order to maintain the health of the parks, disturbing factors (such as harmful insects) are taken into account, which destabilize the ornamental plant as the main component. Often found in parks are species included in the orders Hemiptera, Coleoptera, Lepidoptera, Orthoptera, Thysanoptera and Diptera (TOROS, 1996; GROZEA, 2006; KAYGIN, 2008).

It is difficult to assess whether the densities of all insect populations are positively correlated with the park area, but associations can be made for individual species. The overall positive correlation observed between the population density of individual animal species and

area is best explained in the context of the resource concentration hypothesis (CONNOR ET AL., 2000).

Every year new pests spread rapidly and cause great damage in public parks. The trade in ornamental plants plays an important role and this is the main cause of the spread of invasive insects in Europe, so we must consider especially those species that do not have natural enemies in the new areas (ROQUES ET AL., 2010; SALVATORE B., 2014).

Among the invasive species present in the parks in Europe, we can mention especially those of the order Hemiptera, which have become very present in recent years, precisely due to the movements from one country to another of ornamental plants (CVETKOVSKA-GJORGIEVSKA ET AL., 2019).

Among the invasive hemipteran insects, also mentioned in Invasive Species Compendium (ISC), we can list some that are present in our country such as southern green stink bug is the most widespread invasive species, occupying extremely varied ecosystems and geographical areas of the most diverse (MARCU AND GROZEA, 2018).

Another species worth mentioning is the white flatid planthopper, which has a high polyphagism in continuous change and adaptation to new plant species including ornamental plants (GOGAN, 2013; VLAD, 2016).

The brown marmorated stink bug is another hemipteran species that has become a real problem for woody plants in green spaces and implicitly parks (HAYE ET AL., 2014; BERGMANN ET AL., 2016).

MATERIAL AND METHODS

The observations that are the object of the present work were made in five parks located near the central area of the urban locality Timisoara from Timis county (located in western Romania) (figure 1). The five parks are in fact the most sought after by the citizens of the city but also in the county or other areas. These are the following: Botanical Park, Central Park, Roses Park, Ion Creanga Park and Justice Park (figure 1).

Each park was divided into 5 sectors, which covered various categories of plants (table 1). In each park were analysed 25 plants, 5 for each sector (a total of 125 plants/ all parks).

Table 1

Association of different categories of plants for each monitored park

Nr. Crt.	Category of plants present/ park	Name of monitored parks				
		Botanical Park	Central Park	Roses Park	Ion Creanga Park	Justice Park
1	Herbaceous plants	x*	x		x*	-
2	Annual plants (flower layers)	x*	x*	x	x	-
3	Woody plants (shrubs and trees)	x*	x*	-	-	-
4	Woody plants (arboreal)	x	-	x	x*	x*
5	Perennial woody plants (ivy)			x*		
6	Perennial woody plants (roses)	-	-	x*	-	-
7	Woody plants (shrubs)	-	-		x*	x*
8	Grass	x*	x*	x	x*	x*

* category of plants present in abundance/ park

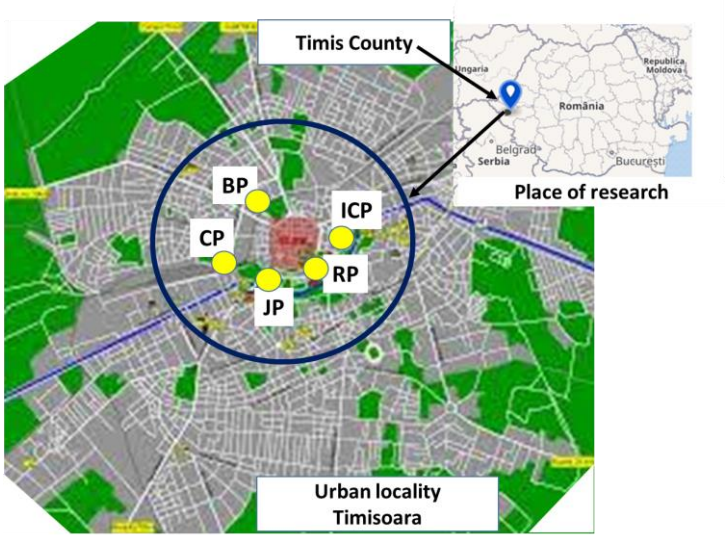

Figure 1. Representation of the locations of the parks from Timisoara (Timis county, Romania) where the monitoring observations were made: BP-Botanical Park, CP-Central Park; RP-Roses Park, ICP- Ion Creanga Park, JP-Justice Park (image processed on maps taken from https://www.welcometoromania.ro/Timisoara/Timisoara_Harta_Obiective)

The monitoring activity consisted of movement to the aforementioned parks, then direct observations (or readings) and the collection of materials/ samples of plants (plant parts) and insects (in various stages) (figure 2).

The readings were made monthly (April-September), in all sectors of each park, in the period 2019-2020.

Figure 2. Direct observations on plants in order to identify the stages of insects present (photo taken in 2019 and 2020, in the parks of Timisoara)

RESULTS AND DISCUSSION

Species present. Population level. Periodic dynamics. From the analysis of the monitoring results performed in the representative parks from Timiosara, we will further present some essential aspects in outlining an opinion about the population level of hemipteran species, the periodic dynamics of each species and some characteristics of the effect produced on plants.

We found that of the hemipteran species found in the five monitored parks, 4 belong to the Heteroptera suborder and 6 to the Homoptera suborder (table 2). Among the heteropteran families, representatives were identified from Pentatomidae, Coreidae and Tingidae. Among the homopteran families, we found species from: Aleyrodidae, Flatidae, Aphididae and Eriosomatidae (table 2).

A detailed analysis of the status of the species present throughout the monitoring period, in each park (table 2), shows that in the Botanical Park were present all the species of Hemiptera that we focused on, namely: southern green stink bug, brown marmorated stink bug, western conifer seed bug, sycamore lace bug, greenhouse whitefly, white flatid planthopper, chrysanthemum aphid, woolly aphid, cotton aphid and rose aphid.

And in the Rose Park, the abundance of species was high, except western conifer seed bug and cotton aphid which were missing. A similar situation was observed in Ion Creanga Park, where the species of western conifer seed bug and chrysanthemum aphid were not reported but neither the abundance of any other species.

Table 2

Association of hemipteran species present on plants in each monitored park

Nr. crt.	Species systematics			The park where the monitoring was done				
	Latin scientific name	Common name	Family	Botanical Park	Central Park	Roses Park	Ion Creanga Park	Justice Park
				Species status throughout the monitoring period (present/ absent) (+) * / (-) **				
1	*Nezara viridula*	southern green stink bug***	Pentatomidae	+ (a)	+	+	+	+
2	*Halyomorpha halys*	brown marmorated stink bug***	Pentatomidae	+	-	+	+	-
3	*Leptoglossus occidentalis*	western conifer seed bug	Coreidae	+	-	-	-	+
4	*Corythucha ciliata*	sycamore lace bug	Tingidae	+	-	+	+	-
5	*Trialeurodes vaporariorum*	greenhouse whitefly	Aleyrodidae	+	+	+	+	-
6	*Metcalfa pruinosa*	white flatid planthopper***	Flatidae	+ (a)	+ (a)	+(a)	+	+ (a)
7	*Macrosiphoniella sanborni*	chrysanthemum aphid	Aphididae	+	+	+	-	-
8	*Eriosoma lanigerum*	woolly aphid	Eriosomatidae	+ (a)	+	+ (a)	+	+
9	*Aphis gossypii*	cotton aphid	Aphididae	+ (a)	+	-	+	-
10	*Macrosiphum rosae*	rose aphid	Aphididae	+	+	+ (a)	+	-

*(+) the species was observed in the park; **(-) the species was not observed at any reading in the monitoring activity carried out during 2019-2020; *** - invasive species; (a) - abundant presence of the species;

Fewer species than other previously mentioned parks have been observed in Central Park (where species of brown marmorated stink bug, western conifer seed bug and sycamore lace bug were missing). In the Justice Park were observed the fewest species, only those of southern green stink bug, western conifer seed bug, white flatid planthopper and woolly aphid (table 2).

Of all the species observed, the species *Metcalfa pruinosa* was noted to be abundant (a total of 1260 individuals) in almost all parks subject to monitoring (4 out of 5) (table 2, figure 3). Also in the category of abundant hemipteran species falls *Macrosiphum rosae* (about 900 individuals), *Eriosoma lanigerum* (855 individuals) and *Nezara viridula* (about 525 individuals) (figure 3, figure 4).

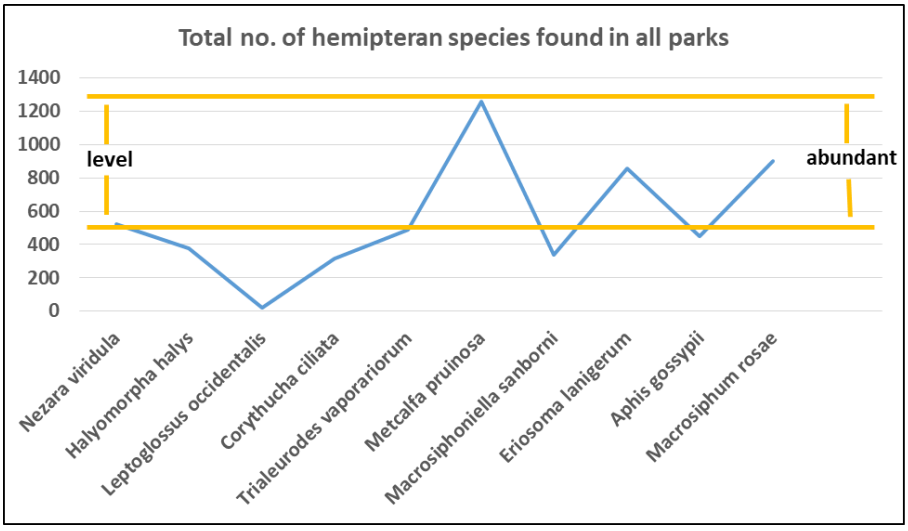

Figure 3. Records of hemipteran insect species found in all monitored parks, highlighting those present in abundance

Figure 4. Insect species in various stages observed on plants at the time of monthly readings: a, larvae and nymphs of *Metcalfa pruinosa*; b, larvae and adult forms of *Aphis sp.*; c, larvae and adult forms of *Eriosoma lanigerum*; d, adult of *Nezara viridula* (original photo taken in 2019 and 2020)

Regarding the monthly evolution of the already identified species, it can be seen from the graph (figure 5) that in April, when we evaluated the first individuals that appeared after hibernation, not all species were observed. Some of them appeared

only in May. The months with the most specimens observed in the activity were June, July and September.

In the insect activity curve three peaks were observed, the maximum in July, the second maximum in June and the third in September.

Basically, the population evolution starting with April was one with a gradual increase, progressive until June-July-August, then gradually a decrease started.

However, an analysis of each species shows a particular dynamic (figure 5). For example, for *Metcalfa pruinosa* it registered a gradual increase until July, then a sudden decrease in August, and finally a sudden increase in September.

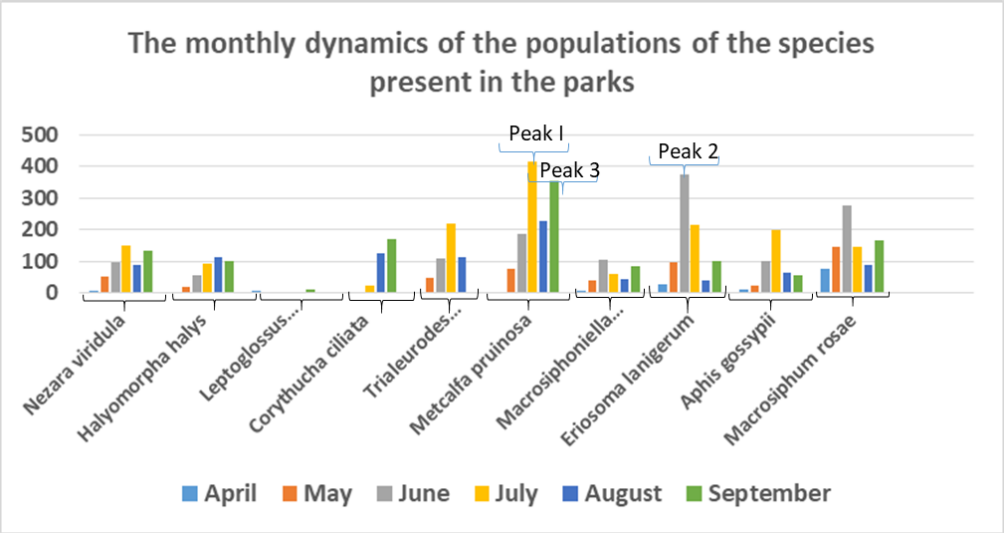

Figure 5. The evolution of hemipteran species represented by the monthly dynamics of populations (April-September)

Involvement of various stages of the species and symptomatology. The stages in the development of an insect are known to be immature and mature, ie eggs, larvae, nymphs and adults. The focus was on the active stages of a species of hemipteran present (larvae and adults, sometimes nymphs) (figure 4), so if we refer to flatid insects (Homoptera) we noticed the abundant presence of larvae and nymphs on plants and less adults (due to hiding during the day). For the other species of homopteran insects (aphids, woolly aphids, whiteflies) attention was directed to the stages observed during monitoring, namely adults and their larvae.

And for the heteropteran species of the genus Nezara, Halyomorpha and Leptoglossus, the active stages observed were larva, nymph and adult.

The damage caused differs from species to species (figure 4). All hemipteran feed by the same mechanism of extracting plant sap and producing the effect of dehydration and discoloration of the plant, sometimes swelling of the tissue (as in the case of woolly aphid).

Flatids of the genus Metcalfa cover the organs of the plant with a fine whitish cloth affecting both directly the plant (through the feeding process) but also indirectly by covering the plant.

Some heteropteran insects like stinky bugs, in addition to dehydration and discoloration secreting a foul-smelling repellent that remains impregnated in the plant.

Whiteflies also cause primary damage by dehydrating the leaves and secondary by covering the plants with large mixed colonies (eggs, larvae, adults) on which fungi then settle.

Aphids dehydrate and discolour as the main effect of feeding but also wrinkle the leaves in a characteristic and harmful way to the photosynthesis process of the plant.

CONCLUSIONS

The presence of numerous species of hemipteran insects in the parks located near the historical centre of the urban locality Timisoara is obvious. Of these species, some are even invasive for Europe and implicitly Romania and probably require more attention in the future. Park monitoring, as a result of this work, is a first step in the management strategy, by identifying the species present and those that cause obvious damage to ornamental plants.

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