

QUANTITATIVE EVALUATION OF THE PEST *HALYOMORPHA HALYS* IN THE ADULT STAGE IN THE WINTERING PLACES NEAR THE FORESTS

Denisa-Daliana SFIRCULUS (MOROCILA)¹, Maroua DAHBI², Ioana GROZEA¹

¹University of Life Sciences "King Mihai I" from Timisoara, Romania

²University of Ain Temouchent, Algeria

Corresponding author: ioana_entomol@yahoo.com

Abstract. One of the most present pests in the last 5-6 years in various sectors (agricultural, horticultural, forestry) is definitely the *Halyomorpha halys* insect from the Pentatomidae family. The insect is somewhat established in Romania, 8 years have passed since its first reporting. Mainly, it is considered a species that lives near houses and the active life of people and feeds on leaves, inflorescences and fruits from urban spaces, that's why we thought of analyzing the wintering places with more interest. In this sense, we analyzed 5 spaces (marginal strips) along the Green Forest in the city of Timisoara in order to establish number of hibernating adults, both at the end of autumn-beginning of winter (November) and at the end of winter-beginning of spring (March), then in April to see if they are still present. The analyzed substrate consisted of foliage on an area of 1m² with leaves of deciduous trees and shrubs with deciduous leaves. From the findings, we realized that the population of hibernating individuals in the samples from the spring of 2024 had limits from 2 to 5 compared to 6 to 12 in autumn of the year 2023, in all 5 places subject to observation. As such, we can assume that this, being polyphagous, has left its wintering places and headed for other places to ensure its polyphagous feeding and implicitly the damage of various crops. It is worth it, therefore, taken into consideration in the future and the possibility of easily invading vegetable sources of food.

Keywords: *Halyomorpha halys*, pest, forest, hibernating adults.

INTRODUCTION

The forest is a particularly complex ecosystem with multiple functions, providing ecosystem services such as biodiversity, climate regulation services, soil stabilization and erosion control (KRISTRÖM ET AL., 2001). The Green Forest, as a subject of study, covers 700 hectares near Timisoara and has an important ecological and recreational role, being an ideal space for spending free time in nature, walking, jogging, cycling or picnicking (CIUPA, 2010).

The predominant tree species in the forest is oak, followed by maple, elm, hornbeam, many of the trees are over 100 years old (TANASESCU, 2015). A number of vertebrate and invertebrate animal organisms live in this forest, including deer, rabbits, squirrels, numerous birds and insects.

Harmful phytophagous insects that create major imbalances among trees and shrubs are on the rise. Among all animal organisms, representatives of the class Insecta participate in the highest proportion in quantitative and qualitative declines (DE GRANDPRÉ ET AL., 2022). Pest insects have experienced changes in composition over time, some new ones adapting to new forest areas (OLTEAN, 2005; GROZEA 2015).

One of the newly introduced species in our country is *Halyomorpha halys* known as Brown marmorated stink bug (Pentatomidae, Hemiptera), which appeared in 2014, (MACAVEI ET AL., 2015; CICEOI ET AL., 2017).

The species has a great capacity to adapt especially to landscaped urban spaces (parks and green spaces), mixed gardens with vegetables and fruit trees, but also to agricultural fields and forests (WIMAN ET AL., 2015; GYAWALI ET AL., 2019, KESZTHELYI ET AL. 2022; DAHER ET AL., 2023). In 2019, approximately 100 plant species were known as hosts for the *Halyomorpha* species (KAPANTAIDAKI ET AL., 2019; GROZEA AND STAN, 2019).

Going through the winter of *Halyomorpha* adults is conditioned by the existence of sheltered places, such as people's houses, sheds, forests (DE MICHELE AND GROZEA, 2018; NEACSU AND GROZEA, 2019).

As such, through the present study we set out to see if the Green Forest constitutes a suitable habitat for the hibernation and overwintering of *Halyomorpha halys* adults. All of these being imported mainly due to the fact that there are numerous species of host plants from the agro-horticultural category nearby.

MATERIAL AND METHODS

The study area was the Green Forest located on the edge of the city of Timisoara.

To assess the hibernating population, we surveyed 5 spaces (marginal strips) along this forest, both in early winter (November) and late winter (March), then in April to see if they were still present (Figure 1). The analysed substrate consisted of fallen leaves on the ground and grass, mixed on a surface of 1m² with deciduous leaves and leafy shrubs. The thickness of the fallen foliage layer was taken into account, from 3 cm to 9 cm.

The quantification of the number of adults was carried out between November 2023 and April 2024 (Figure 2). More precisely, at the beginning of winter (on November 29) it was done by delimiting the analysed space and identifying it with the help of GPS to facilitate the following observations. The other 2 analyses of the substrate were done at the end of winter (on March 4 and April). Glass containers, like jars with hermetic closure, were used to store them until the laboratory.



Figure 1. Adults of *Halyomorpha halys* collected in various marginal places in the Green Forests: 1- in November 2023; 2,3-in March and April 2024



Figure 2. Samples of adults of *Halyomorpha halys* collected from the 5 wintering places during the analyzed period

The identification of adults by sexual category was made through phenotypic observations of size (females larger than males) and on the color of the ventral part (the red pigmentation of the sternum in the males) in accordance with those described by Pajac et al (2022).

The choice of wintering places was based on the principle of proximity to houses with mixed gardens and preferred host plants, from where they would migrate more easily.

RESULTS AND DISCUSSIONS

From the results of the observations, it can be seen that both males and females of *Halyomorpha halys* were present in the 5 hibernation sites (Table 1 and Table 2). The sex ratio (females: males) at the beginning of winter (in autumn, 2023) in Place A with an 8 cm layer of foliage was 0.8: 1.2, in Place B with 7 cm substrate it was 1:1, in Place C with 9 cm foliage substrate the ratio was 1.83: 1.16, in Place D with 4 cm foliage on the ground, the ratio was 0.85: 1.14 and in Place E with 3 cm foliage as wintering substrate it was 1 :1 (Table 1).

The situation at the end of winter (in the spring of the following year, 2024) was as follows: in Place A and B the sex ratio between females and males was 1:1, in Place C, 0.8:1:2, in Place D, 0.66 :0.75 and in Place D the ratio was 0:1 (Table 2).

Table 1

The sex ratio between females and males of *Halyomorpha halys* at the beginning of winter (in autumn)

Place/sample	The thickness of the foliage layer (cm)	Female	Male	Ratio Female:male
Place A (sample 1)	8	4	6	0.8: 1.2
Place B (sample 2)	7	5	5	1:1
Place C (sample 3)	9	5	7	1.83: 1.16
Place D (sample 4)	4	3	4	0.85: 1.14
Place E (sample 5)	3	3	3	1:1
	n	45	45	
	X	4.00	5.00	
	s	1.00	1.58	
	Sx	0.15	0.24	
	CV	25.00	31.62	

Table 2

The sex ratio between females and males of *Halyomorpha halys* at the exit from winter (in spring)

Place/sample	The thickness of the foliage layer (cm)	Female	Male	Ratio: female/male
Place A (sample 1)	8	2	2	1.1
Place B (sample 2)	7	2	2	1:1
Place C (sample 3)	9	2	3	0.8:1:2
Place D (sample 4)	4	1	2	0.66:0.75
Place E (sample 5)	3	0	2	0:1
	n	18	18	
	X	1.40	2.20	
	s	0.8.9	0.45	
	Sx	0.21	0.11	
	CV	63.89	20.33	

Comparing the wintering layers with fallen foliage on the ground, it was observed that the thicker the substrate, the higher the number of adult individuals. At a thickness of 9 cm (the thickest layer in fact), the most hibernating specimens were recorded both at the beginning of winter and at

the end of winter, i.e. 12 and 5 respectively. The fewest specimens were found in the thinnest substrate, of 3 cm, with limits of 6 individuals found in autumn and 2 in spring (Figure 3).

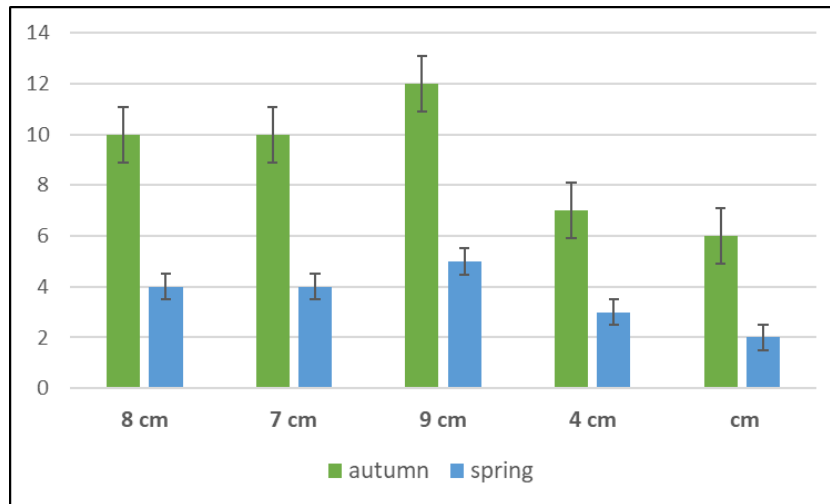


Figure 3. The numerical number of individuals in function of the thickness of the foliage layer on the ground

A gender analysis of the hibernating individuals is shown in Figure 4 and shows that males predominated in both autumn and spring samples, i.e. 25 and 11 male individuals and 20 and 7 female individuals, respectively.

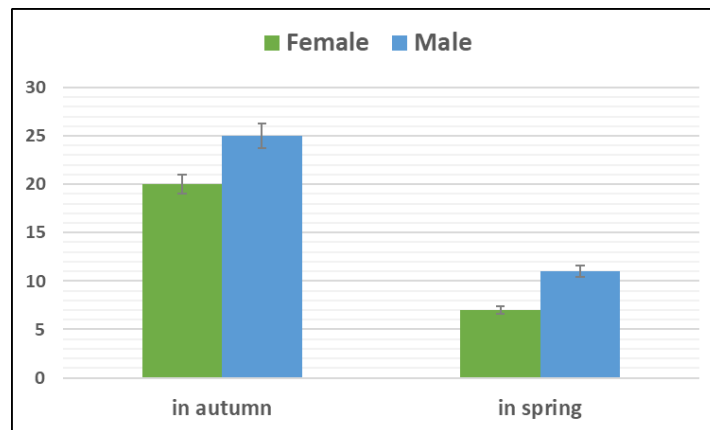


Figure 4. Quantitative difference between females and males found in wintering places in November 2023 vs April 2024

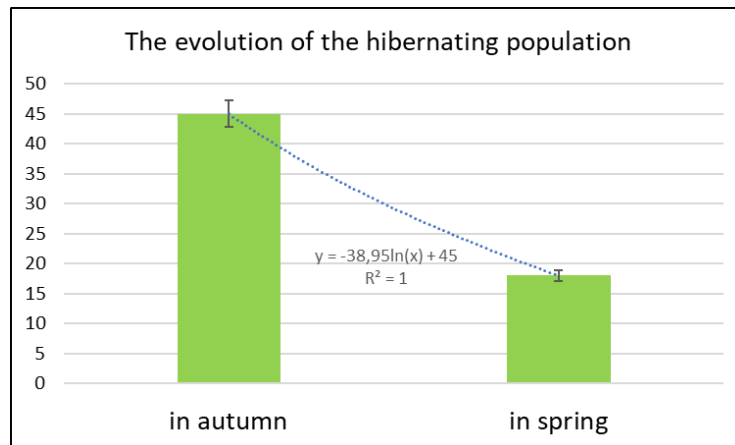


Figure 5. The evolution of the hibernating adult population of Halyomorpha from winter to spring

The evolution of hibernating individuals was clearly decreasing during the period November 2023-April 2024. In autumn, 45 Halyomorpha adults without gender distinction were quantified from the 5 samples taken from the wintering sites, while in spring only 18 individuals remained (Figure 5). We deduce from this that in November both females and males that fed in gardens, agricultural crops and green spaces with houses (considered preferred places) located at short distances from the Green Forest (between 10-200 m from the forest) they retreated under the marginal fallen foliage. We suspect that a part remained in the places where they fed, therefore we cannot say that the amount found represents the complete amount.

In the spring, the adults left their wintering places (they probably started their migration in March) and headed towards their preferred host plants to feed and lay their eggs.

CONCLUSIONS

In the light of what was observed, we can conclude that Halyomorpha is an extremely dangerous phytophagous insect for inhabited areas with mixed gardens, spaces and urban parks, but also for agricultural crops such as corn due to its high capacity for migration, adaptation and feeding. The existence of suitable wintering places such as deciduous forests influences these capacities and especially hibernation so that a thick substrate of fallen leaves on the ground can attract many individuals but can ensure their passage through the winter and re-infestation of the surrounding plants and crops. As such, special attention must be paid especially to the host plants around the Green Forest, which will be continuously infested and re-infested even if control measures are taken.

ACKNOWLEDGEMENT

We thank the Timis Forest Management for making available the organization of the sectors and the plant composition of the Green Forest.

BIBLIOGRAPHY

CICEOI R., BOLOCAN I.G., DOBRIN I. (2017). The spread of brown marmorated stink bug, *Halyomorpha halys*, in Romania. Journal of Horticulture, Forestry and Biotechnology, 21(3): 15-20.

- CIUPA V. (2010). Cadrul natural și peisagistic al Municipiului Timișoara, Primăria Municipiului Timișoara, Volumul I -Cadrul Peisagistic Timișoara (https://www.primariatm.ro/wp-content/uploads/2021/02/Cadrul_Natural_Timisoara_vol.1.pdf).
- DAHER E., CHERICI E., URBANI S., CINOSI N., RONDONI G., SERVILI M., FAMIANI F., CONTI E. (2023). Characterization of olive fruit damage induced by invasive *Halyomorpha halys*. *Insects*, 14, 848. <https://doi.org/10.3390/insects14110848>.
- DE GRANDPRÉ L., MARCHAND M., KNEESHAW D.D. ET AL. (2022). Defoliation-induced changes in foliage quality may trigger broad-scale insect outbreaks. *Communication Biology*, 5, 463 <https://doi.org/10.1038/s42003-022-03407-8>.
- DE MICHELE A., GROZEA I. (2018). Review of the spreading of *Halyomorpha halys* in Italy and confirmation of presence in Romania. *Research Journal of Agricultural Science* 50 (4): 111-115.
- GROZEA I. (2015). *Entomologie generală*, Editura Eurobit, 155 p.
- GROZEA I., STAN COSTEA A. (2020). Apricot Trees, A new attraction for the Brown marmorated stink bug. *Research Journal of Agricultural Science*, 52, 1:122-127.
- GYAWALI A., REGMI B., PUDASAINI R., ACHARYA N. (2019). Diversity and abundance of insect pest of low land rice field in Lamahi, Dang district of Nepal. *Journal of Agriculture and Natural Resources*, 2 (1): 238-243.
- KAPANTAIKAKI D.E., EVANGELOU V.I., MORRISON W.R., LESKEY T.C BRODEUR J., MILONAS P. (2019). *Halyomorpha halys* (Hemiptera: Pentatomidae) Genetic Diversity in North America and Europe. *Insects*, 10, 174.
- KESZTHELYI S., GIBICSÁR S., JÓCSÁK I., FAJTAI D., DONKÓ T. (2022). Analysis of the destructive effect of the *Halyomorpha halys* saliva on tomato by computer tomographical imaging and antioxidant capacity measurement. *Biology*, 11, 1070. <https://doi.org/10.3390/biology11071070>.
- KRISTRÖM B., BOMAN M., KENGEN S. (2001). Valuing the multiple functions of forests. In: Palo, M., Uusivuori, J., Mery, G. (eds) *World Forests, Markets and Policies*. World Forests, vol 3. Springer, Dordrecht. https://doi.org/10.1007/978-94-010-0664-4_11.
- MACAVEI L.I., BAETAN,R., OLTEAN I., FLORIAN T., VARGA M., COSTI E., MAISTRELLO L. (2015). First detection of *Halyomorpha halys* Stal, a new invasive species with a high potential of damage on agricultural crops in Romania. *Lucrari Stiintifice seria Agronomie*, 58, (1):105-108.
- NEACSU M., GROZEA I., STEF R. (2020). Pre-wintering behavior of *Halyomorpha halys* (Insecta: Hemiptera: Pentatomidae). *Research Journal of Agricultural Science* 51 (4): 97-103.
- OLTEAN I. (2005). *Entomologie specială, Dăunătorii pădurilor*. Editura Academic Pres, Cluj Napoca, 266 p.
- PAJAČ ŽIVKOVIĆ I., MULAMEHMEDOVIĆ J., GÖLDE B.L, LEMIĆ D. (2022). Sexual dimorphism of brown marmorated stink bug 23 (1) p. 62-68.
- TANASESCU C. (2015). Pădurea Verde (<https://merg.in/timisoara/de-vizitat/natura/padurea-verde-2731.html>).
- WIMAN N.G., PARKER, J.E., RODRIGUEZ-SAONA, C., WALTON, V.M. (2015). Characterizing damage of Brown Marmorated Stink Bug (Hemiptera: Pentatomidae) in blueberries. *J. Econ. Entomol.* 108: 1156–1163.