APRICOT TREES, A NEW ATTRACTION FOR THE BROWN MARMORATED STINK BUG

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

Abstract. *Brown marmorated stink bug (Halyomorpha halys) is currently one of the most aggressive pentatomide species in Europe. In recent years, it has expanded both territorially and as host plants. A series of reports of stink bugs were made on host plants from the most varied, from herbaceous and ornamental crops, to cultivated and ornamental woods. Among them were mentioned until now species of trees of the genus Prunus, but not all. Through the observations made in spring-summer 2019 (in a private garden in western Romania), the set of host plants with another species, namely Prunus armeniaca (apricot), is supplemented. Observations have shown that the insect feeds on fruit that produces obvious damage. The fruits were damaged throughout the baking but also in the pre-baking stage. The stink bugs have also been observed on the leaves but it is not clear whether they are feeding on their sap or just searching for fruit. Numerous stages of development of the brown marmorated stink bugs have been quantified, from the earliest instars to the mature ones. Also the adults were observed, and their injuries led to the compromise of fruit production per tree. Their population level ranged from 1 individual to 5 individuals per fruit. From the observed ones, the symptomatology on the apricot fruits is different from the one mentioned so far in other fruits. This included both direct and indirect injuries. The direct ones were reflected in diffuse brown spots of various sizes, from small to united and extended spots on large surfaces of the fruit (sometimes encompassing all the fruit). In conclusion, the species is adaptable to new host plants regardless of the consistency or essence of the plant tissue. And this can be a big problem in the future in the context in which other factors (caused by climate change) contribute to the spread and multiplication of pests and implicitly the decrease of fruit production around the world.*

Keywords*: Invazive, brown marmorated stink bug, apricot, damage, fruit.*

INTRODUCTION

Apricot known as *Prunus armeniaca* (*Armeniaca vulgaris*) is a species of the subgenus Prunus. It is native to Asia, and in Romania it finds favorable conditions for development in the southern and western areas. It is a fruit tree of the Rosaceae family, called stone fruits (CHIRA ET AL., 2005).

Halyomorpha halys known as brown marmorated stink bug is an insect from family Pentatomidae, order Hemiptera (Rieder et al., 2002; CABI, 2020).

According to the EPPO report (2020), *H. halys* species has the status of unclassified on the *Prunus armeniaca* plant. The same report mentions that around 50 species of plants as host or possible host plants for pest, in European conditions (https://gd.eppo.int/taxon/HALYHA/hosts).

In the country of origin, Asia, the species is associated only occasionally with the fruit of the tree. Apples, pears, nectarines and nectarine peaches are especially attacked (FUNAYAMA, 2002). In the USA, it has been found that in apples and pears it damages the fruit and if it is present very quickly it multiplies and becomes predominant (LESKEY ET AL., 2012). The fruits are recognized by the appearance of sunken spots.

For our country, the species is relatively new, being considered a pest during the installation period. Studies and information have brought to attention some aspects related to host plants and especially temporary observations on certain plants or areas. Thus, in the western and southern area, the first scientific information was brought (Timisoara and

Bucharest) (MACAVEI ET AL., 2015; CICEOI ET AL., 2017; DEMICHELE AND GROZEA, 2018; NEACSU AND GROZEA, 2019).

In cold areas of Europe, *H. halys* is univoltine, but in the Mediterranean area two generations per year could be expected (EPPO, 2013). In closed spaces, species can develop a generation in time of 75 days at 30ºC. The development limits are possible between 15 and 35ºC (HAYE ET AL., 2014). It seems that the species adapts quickly to temperate areas (BRADSHAW ET AL., 2004).

The association between the 2 species (apricot and stink bug) is interesting and previously unnoticed. Even though it was mentioned in the fruit literature (PANIZZI, 1997; NIELSON AND HAMILTON, 2009), their number was quite low compared to other host plants. However, this interaction comes at a time of sudden and excessive observation of apricot bugs, probably due to the heat of recent years. As mentioned in the literature, the insect is a lover of heat and drought, and in recent years seems to have found favorable conditions for population growth and attack on other plant species such as apricots.

MATERIAL AND METHODS

The study, consisting in assessing the population level and the damages caused by brown marmorated stink bug to apricot trees, was carried out in a green space in west part of Romania, in Timis County.

The analyzed apricots were located on an area of 600 m^2 in a private garden located 400 m from the Green Forest. In this sense, the trees were established that will be analysed, in number of 5 (table 1), in fact all the apricots present in the studied area. Being a garden type space, with various species of plants, both woody and grassy, the plants under analysis have a different microhabitat, in terms of neighboring plants (possible or not to be host plants for stink bug.

At the first reading (R1) the GPS coordinates for each tree were established using the GPS coordinates application on the mobile phone; then at the other readings (R2-R15) the same coordinates were kept.

Table 1

The location and habitat conditions of the apricot trees analyzed for the evaluation of the population evolution and of the damages caused by *Halyomorpha halys*

Samples/ habitat	Location data	Analyzed trees	Development/habitat conditions*
Apricot trees/private garden	Lat: 45.78289401, Lng: 21.24217923	tree 1	located between coniferous plants
	Lat: 45.78289005, Lng: 21.2418601	tree 2	located next to an apple tree
	Lat: 45.7830579, Lng: 21.24185885	tree 3	located near a wooden fence
	Lat: 45.78301648, Lng: 21.24180254	tree 4	located next to a pear tree
	Lat: 45.78306536, Lng: 21.24194921	tree 5	located freely without fruit trees and shrubs around

** The distance between the analyzed trees was about 10 m*

The observations were extended over a period of 100 days (approximately 3.5 months) between April and July 2019.

A total of 13 periodic observations or readings were made (R1-R13) (figure 1) which were staggered over the vegetation period between flowering and fruit ripening. The principle

of this organization was to cover all the important phenophases of apricot tree but also to include the presence of active stages of the insect (larvae, nymphs and adults).

Readings were made on the same day for all trees studied (T1-T5) at each reading; for example, in reading R1, all apricot trees were evaluated (T1-T5). At the next R2 reading, all the trees were also analyzed, and so on.

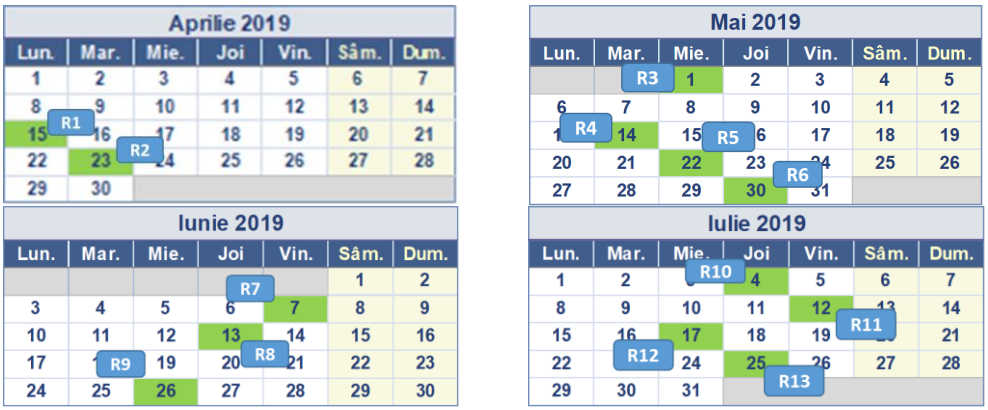

Figure 1. Representation of calendar data for making readings (R1-R13) on apricot trees in order to identify the pest and its damages; reading data is marked in green or the darker area and readings by R (in blue color)

RESULTS AND DISCUSSION

The data obtained from the observations made during 2019 showed that the species *Halyomorpha halys* is present on all apricot trees analyzed and causes damage to leaves and fruits. In table 2 it can be seen that on tree 1 and 2 the specimens were numerous, registering the highest average values (x = 11.38/T1 and x = 10.69/T2). On tree 5 the specimens were found in lower numbers (x = 3.23) and on T4 and T3 the lowest values were recorded (x = 1.54 and x = 0.85).

Figure 2. Immature active stages of *Halyomorpha halys* present on the fruits during the ripening period: nymphs (left and middle); larvae (right) (photos taken by Grozea during the period June-July, 2019)

At the beginning of the observation period (R1-R7) corresponding to April-May, the number of stink bugs per apricot was relatively low (0-5 individuals). Starting with reading 8, their number started to increase gradually from 7 to 40 individuals/tree (June-July) (table 2).

Table 2

Number of specimens of *Halyomorpha halys* on apricot trees; Timis County, from April 15 to July 25, 2019

Readings	Number of specimens of *H. halys* on apricot trees (all stages)*				
	Tree 1	Tree 2	Tree 3	Tree 4	Tree 5
R1	0	0	0	0	0
R2	3	1	0	1	3
R3	2	3	1	1	2
R4	3	4	1	3	3
R5	6	4	3	3	1
R6	6	1	0	4	3
R7	5	2	0	1	1
R8	9	7	0	1	5
R9	6	12	1	0	2
R10	17	15	2	1	4
R11	33	40	2	5	13
R12	38	36	1	0	5
R13	11	23	0	0	0

	T1**	T2**	T3**	T4**	T5**
X	10.69	11.38	0.85	1.54	3.23
s	11.88	13.56	0.99	1.66	3.37
Sx	3.29	3.76	0.27	0.46	0.93
CV	111.08	119.07	116.66	108.17	104.32
Sx%	30.81	33.02	32.35	30.00	28.93

**all stages of development of the active insect (mature and immature) were observed*
***T1-tree 1; T2- tree 2; T3- tree 3; T4- tree 4; T5-tree 5*

The results also show (table 3) that in the period April-May (R1-R6) on the analyzed trees were present only adults (hibernating) while the immature forms (larvae and nymphs) appeared only starting with reading 7 (R7-R13), in mixed colonies (larvae and nymphs) or individual (either larvae or nymphs).

Table 3

Number of adults, larvae and nimphs of *Halyomorpha halys* on apricot trees; Timis county, from April 15 to July 25, 2019

Readings	Number of specimens of *H. halys* on apricot trees (all stages)*				
	Tree 1	Tree 2	Tree 3	Tree 4	Tree 5
R1	0	0	0	0	0
R2	3(A)*	1(A)*	0	1(A)*	3(A)*
R3	2(A)*	3(A)*	1(A)*	1(A)*	2(A)*
R4	3(A)*	4(A)*	1(A)*	3(A)*	3(A)*
R5	6 (A)*	4(A)*	3(A)*	3(A)*	1(A)*
R6	6(A)*	1(A)*	0	4(A)*	3(A)*
R7	5(L)**	2(L)**	0	1(L)**	1(L)**
R8	9(L)	7(L)**	0	1(L)**	5(L)**
R9	6(L+N)***	12(L+N)***	1(L)**	0	2(L+N)***
R10	17(L+N)	15(L+N)	2(N)****	1(N)****	4(L+N)***
R11	33(N)****	40(N)****	2(N)****	5(N)****	13(N)****
R12	38 (N)****	36(N)****	1(N)****	0	5(N)****
R13	11(N)****	23(N)****	0	0	0

** (A)-adults; ** (L)-larvae; *** (L+N)-larvae+nymphs; ****(N)-nymphs*

Table 4

Types of damage caused to apricot leaves and fruits by harmful forms of *H. halys*

Apricot trees analysed	Types of injuries				
	Leaves		Fruit		
	discoloration	necrotic areas	discoloration	sunken spots	lesions
Tree 1	+	+	+	+	+
Tree 2	+	+	+	+	+
Tree 3	+	-	-	+	-
Tree 4	+	-	+	-	-
Tree 5	+	+	+	+	-

Regarding the injuries caused by the active stages of the harmful insect, it can be seen in table 3 that they were caused to the leaves and fruits. The most obvious damage was to the fruit (table 4). The types of damage identified consisted of discoloration and necrotic areas (on both fruits and leaves) and on the other side the sunken spots and lesions (only on fruits) (figure 3).

Figure 3. First injuries to fruit during the ripening phase by larvae and nymphs (photos taken by Grozea during the period June-July, 2019)

In the early stages of fruit attack, larvae and nymphs produce a slight discoloration, which extends up to 3-4 mm. In a next phase, the discolored tissue deepens creating the impression of a brown cavity. The tissue thus affected may stabilize, but if lesions are created (by rupture of the tissue), then pathogens may enter through them that amplify the initial attack. Often, the deep spots converge and in the last phase affect the fruit in a percentage of over 70% (figure 4) and then the fruit is compromised. It can no longer be consumed or used as a base for other foods.

Figure 4. Obvious damage to fruit compromised by the larvae and nymphs (photos taken by Grozea during the period June-July, 2019)

CONCLUSIONS

The insect penatomide *Halyomorpha halys* is a species being installed on new host plants and spreading in new areas in Europe and implicitly in Romania. The negative effect on fruit plants is obvious, especially on apricot, where it can affect the fruit to the point of compromise, given the increase in air temperature. Stopping measures with periodic monitoring in advance, in each area and year are necessary because there are colder years when the species may be missing from the landscape, then no intervention against the species is necessary.

ACKNOWLEDGEMENT

The paper is a study of some apricot trees belonging to an owner who owns 20 trees, which is why we want to thank him for our access in order to make observations.

BIBLIOGRAPHY

BRADSHAW W.E., ZANI P.A., HOLZAPFEL C.M., (2004). Adaptation to temperate climates. Evolution 58:1748–1762.

CABI, 2020. Invasive Species Compendium. Detailed coverage of invasive species threatening livelihoods and the environment worldwide. Report on https://www.cabi.org (accessed on May, 2020).

CHIRA L., CHEREJI V., ROMAN M., 2005. Caisul și piersicul. Editura MAST. 268 p. Apricot and peach. Publisher MAST. 268 p.

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

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 (RO).h

EPPO, 2013. EPPO Reporting Service No 5—Pest & Diseases, pp 10–11.

EPPO, 2020. EPPO Global Database. *Halyomorpha halys* (HALYHA). Available on: https://gd.eppo.int/taxon/HALYHA/hosts. Accesed in 19.05.2020.

FUNAYAMA K., 2002. Comparison of the susceptibility to injury of apple cultivars by stink bugs. Japanese Journal of Applied Entomology and Zoology, 46(1): 37- 40.

HAYE T., ABDALLAH S., GARIEPY T., WYNIGER D., 2014. Phenology, life table analysis, and temperature requirements of the invasive brown marmorated stink bug, *Halyomorpha halys*, in Europe. Journal of Pest Science, 87:407–418.

LESKEY T.C., SHORT B.D., BUTLER B.R., WRIGHT S.E., 2012. Impact of the invasive brown marmorated stink bug, *Halyomorpha halys* (Stal), in mid-Atlantic tree fruit orchards in the United States: case studies of commercial management. Psyche: A Journal of Entomology, Article ID 535062.

MACAVEI L. I., BAETAN R., OLTEAN I., FLORIAN T., VARGA M., COSTI E., MAISTRELLO LARA, 2015. First detection of *Halyomorpha halys* Stal a new invasive species with ahigh potential of damage on agricultural crops in Romania. Lucrari Stiinþifice seria Agronomie.58, (1):105-108 (RO).

NEACSU M., GROZEA I., STEF R., 2019. Pre-Wintering behavior of *Halyomorpha alys* (Insecta: Hemiptera: Pentatomidae). Research Journal of Agricultural Science, 51 (4): 97-103.

NIELSEN A.L., HAMILTON G.C., 2009. Seasonal occurrence and impact of *Halyomorpha halys* (Hemiptera: Pentatomidae) in tree fruit. Journal of Economic Entomology, 102(3):1133-1140.

PANIZZI A.R., 1997. Wild hosts of pentatomids: ecological significance and role in their pest status on crops. Annual Review of Entomology, 42: 99-122.

RIDER D.A., ZHENG L.Y., KERZHNER I.M., 2002. Checklist and nomenclatural notes on the Chinese Pentatomidae (Heteroptera). II. Pentatominae. Zoosystematica Rossica, 11(1):135-153.