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# The spread of brown marmorated stink bug, *Halyomorpha halys*, in Romania

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**Abstract** The brown marmorated stink bug, *Halyomorpha halys* Stal (Hemiptera: Pentatomidae) is an already dreadful invasive pest, highly polyphagous, spread on every Northern Hemisphere continent, with more than 300 reported hosts. The spread in Europe was silent until 2013 and explosive after 2014, currently being present in at least 15 EU countries. The distribution of *H. halys* in Romania probably strated around the year 2014 but its presence in the territory is difficult to be determined, as there is a lack of communication between different institutions and the citizen science initiatives scarce. Social media environment proved to be a promising tool in mapping the pest distribution and the notoriety of the persons writing posts about the pest triggers even more replies. Although not entirely specific on species determination, the evaluation of some answers on Facebook pages and media stars personal blogs allowed a more detailed mapping of *H halys*. in Romania. According to our findings, in 2017, the pest was spotted in 23 out of the 41 counties, with severe invasions reported by citizens in Buzau, Bucharest and Ilfov area.

**Key words**

*Halyomorpha halys*, pest distribution, mapping, social media reports, citizen science

The brown marmorated stink bug, *Halyomorpha halys* Stal (Hemiptera: Pentatomidae) is a highly polyphagous invasive pest, native to Asia, that rapidly spread all over the Northern Hemisphere since its first detection in the USA in the 1990`s and respectively in Europe, since 2004. Recently, the pest arrived in the Southern Hemisphere as well, Chile being the first South American country to report *H. halys*. (19). *H. halys* was mentioned in a research paper to be present in Nigeria by Borisade et al., 2017, but uncertainty still exists about the correct identification of the pest, as this would be the first mention of this species on the African continent. The pest was on the Alert List of the European and Mediterranean Plant Protection Organization (EPPO) from 2008 to 2013 and it was removed because there were not enough reports about the presence of the pest on EPPO territory at that time. Currently the pest is known to occur in more than 15 EU countries: Liechtenstein in 2004 (12, 32), Switzerland in 2008 (9, 38), Germany (Konstanz - Baden-Württemberg), in 2011 (11), Greece (Athens), in 2011 (13), in Italy (Emilia-Romagna – Modena), in 2012 (10, 18, 29), in France (Alsace region) in 2012 (11), in Hungary (Budapest) in 2013 (12, 36), in Romania (Bucharest) in 2014 (15, 28), in Russia (Sochi - Krasnodar region) in 2014 (16, 31), in Austria (Vienna) in 2015 (14, 23), in Serbia (Belgrade) in 2015 (17), Bulgaria (Sofia) in 2016 (33), Slovakia (Štúrovo ) in 2016 (24), Spain (Girona, Cataluña ) in 2017 (8), Giorgia in 2017 (22). Until the present moment, the most affected country in Europe is Italy where damages of over 1 billion Euro were estimated in 2016 (20). Another losses estimation comes from Mid-Atlantic region in USA, were these exceeded $37 million only in 2010 (34). The monitoring of this pest was done in many countries with the help of citizens, as reports in Global Biodiversity Information Facility (http://www.gbif.org/) (21) and the National fitosanitary agencies organize many raising awarness campains about the pest, fact that facilitates the gatehring of many data (3, 29) and scientists are also using the modeling programs, as Climex, to be aware were the pest might spread in the future (26).

The pest is threatening many agricultural and non-crop plants, as well as ornamentals, either due to its feeding behavior either to its physical presence during processing. When feeding, the stink bug is piercing plant tissues and sucks the cell content, causing fruits deformations, scars, discolorations that makes the agricultural products unmarketable and increase the probability of fungus infections (29). If present during processing, the quality of the final

product may be altered. Mohekar et al., in 2017 proved that for red wines, the presence of three stink bugs on a grape cluster during pressing in the winemaking process leads to the consumer rejection threshold for (E)-2-decenal, the aromatic stress compound released by H. halys. Also, *H. halys* is a major nuisance pest that invades people living areas and few cases of dermatitis to humans were also documented (2). These economic losses may be avoided with high cost for biodiversity and human safety, as most of the insecticides available to growers that are effective against *H. halys* are broad-spectrum (27). Researches on chemical ecology of H halys showed that the male-produced aggregation pheromone of BMSB, combined with the pheromone of *Plautia stali* represent a reliable attraction method throughout the growing season, fact the facilitate the monitoring and the eco friendly attract-and-kill control (37),

In Romania, the first mention of damages to agricultural products caused by *Halyomorpha halys* were found in 2016, on corn and goji crops, in northern area of Bucharest (6), although the first pest individuals were collected in September 2014, when the pest was first time reported in the Botanical Garden of Bucharest (28). For the moment no genetic analyses were performed in our country, which makes even more difficult to establish the entering pathway (35).

Our report aims to update the information available about *Halyomorpha halys* biology and ecology in Romania, in Bucharest area and to illustrate the range of geographical distribution on Romanian territory, based on reports found on different biodiversity web platforms as GBIF, INaturalist and on citizen reports found in social media environment, as media star Facebook pages and personal blogs and different online websites.

## Materials and Methods

The monitoring of *H. halys* biology and ecology was done on the campus of the University of Agronomic Science and Veterinary Medicine from Bucharest, an area of 38 ha which includes the experimental fields of different faculties, as corn, wheat, sunflower, apples, pears, cherry, goji, jujube, edible roses and many other experimental crops, the Botanical Garden and a dendrological parc, all these green areas including more than 300 plant species.

The biology observations were done mainly on irrigated P9911 corn hybrid while on goji on three biotypes - Biotype 1, Biotype 2 and Biotype Ua (4). We determined the first occurrence period in the spring, the oviposition and the hatching period, the host plant spectrum, the pest density on plants using the visual plant inspection method (1).

For mapping the geographical distribution in Romania in 2017, a survey of the online environment was performed, the more intensive search being done on different social media platforms as Facebook and media stars personal blog pages. All the posts, regardless if they were accompanied by photos or not, were screen-shouted and stored for future references. As not all the online reports of citizens could be documented and verified (with at least one picture), we choose to draw a map at the county level.

## Results

**Biology and ecology data**

In 2017, the first adult of *H. halys* was spotted on 8 March 2017 on the university campus and in several other places in Bucharest, in the following days, indicating a very early end of the overwintering period, in the unusual warm conditions in March, when daily maximum temperature exceeded 20°C. In a study performed in Italy, in Modena Province (44°31'59.4"N; 10°47'03.9"E, Bucharest 44° 26'22.78" N, 26°5'46.70" E), the successful exit from overwintering period was observed starting with March 27, when daily maximum temperature exceeded 14°C (7).

The first eggs clusters were found at the beginning of June (10-12 June) and the first larvae of 2$^{nd}$ and 3$^{rd}$ instar were spotted on 26 June, on *Ziziphus jujuba* trees, which confirms the nymph emergence period indicated by Medal et al, 2017. In the same study from Modena, the overwintered adults laid their first egg mass in mid-May and continued until mid-August (7). In Italy, the second generation was observed but in Romania no conclusion could be drawn yet, althgough the recent cliamte changes may induce multivoltinism also in our area (25).

The number of reproductive host plants (plants supporting all life stages, suitable for adult oviposition as well for the nymphal development, according to Bergmann, 2016) increased from three in 2016 – *Zea mays*, *Lycium barbarum, and Lycium chinense* to at least eleven in 2017 - *Ziziphus jujuba, Asimina triloba, Juglans regia, Prunus domestica, Prunus persica, Malus domestica, Rosa chinensis, Spiraea x vanhouttei, Zea mays, Lyciumn barbarum, Lycium chinense* (figure 1).

Regarding the pest density/plant on corn, when compared with the data obtained in 2016, it decreased from 3.4 in 2016 to 1.5 in 2017 on the border area and from 1.3 to 0.3 in the interior area (6). The cohabitation with *Nezara viridula* was similar as in 2016 (6), but in 2017 the dock bug, *Coreus marginatus* (Hemiptera: Coreidae) (figure 2) and *Metcalfa pruinosa* (Hemiptera: Flatidae) were also present in the corn field, at low densities, as well as some not yet identified members of Cicadidae family.

On goji plants, the densities/plant and population evolution were similar with those observed in 2016 (6).

On jujube, eggs clusters were found on few leaves and the first 3$^{rd}$ instar larvae were at the end of June, situation which differ from 2016, when the first individuals were found in September (6). Despite the

earliness of its presence, the jujube fruit did not show major signs of damages. In 2017, the dock bug was also found on jujube, although in 2016 no individual was found.

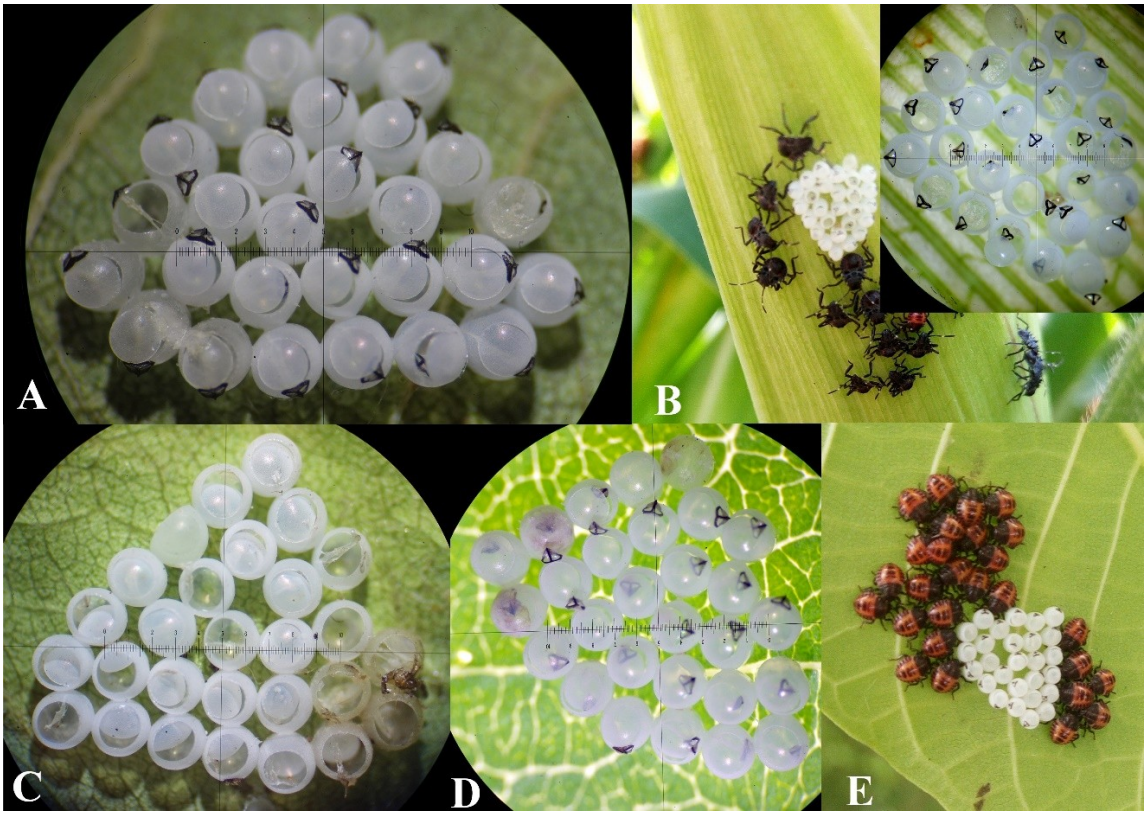


Fig. 1. Egg masses laid by overwintering adults on different hosts plants. A – on *Rosa chinensis* (21 July 2017); B – on Zea mays (03 August 2017), C – on *Asimina triloba* (7 July 2017), D – on *Ziziphus jujuba* (26 June 2017), E – on *Juglans regia* (27 July 2017).

Fig. 2. Adults of dock bug, *Coreus marginatus,* found in cohabitation with *Halyomorpha halys* on corn and jujube crops.

**Geographical distribution**

Despite the different approaches that were tested, people were still reluctant in reporting the pest. The only possible approach to find the geographic distribution at the country level was a survey of the online media posts. According to the number of replies, the most "effective" in gather citizens responses were the media stars Delia (figure 3) and Cabral on Facebook and personal blog pages, Delia gathering more than 3200 replies to her post about the *H. halys* invasion and 246 thousands visualisations. Our post on Facebook hardly reached 10 replies. Based on the data gathered, the pest was spotted in 23 out of the 41 Romanian counties, with severe invasions reported by citizens in Buzău, Bucharest and Ilfov area (figure 3). The counties were the pest was mentioned as a nuissance pest by citizens are Timiș, Arad. Bihor, Cluj, Mureș, Sibiu, Neamț, Iași, Galați, Vrancea, Buzău, Brăila, Prahova, Dâmbovița, Argeș, Olt, Teleorman, Giurgiu, București, Călărași, Ialomița, Tulcea, Constanța.

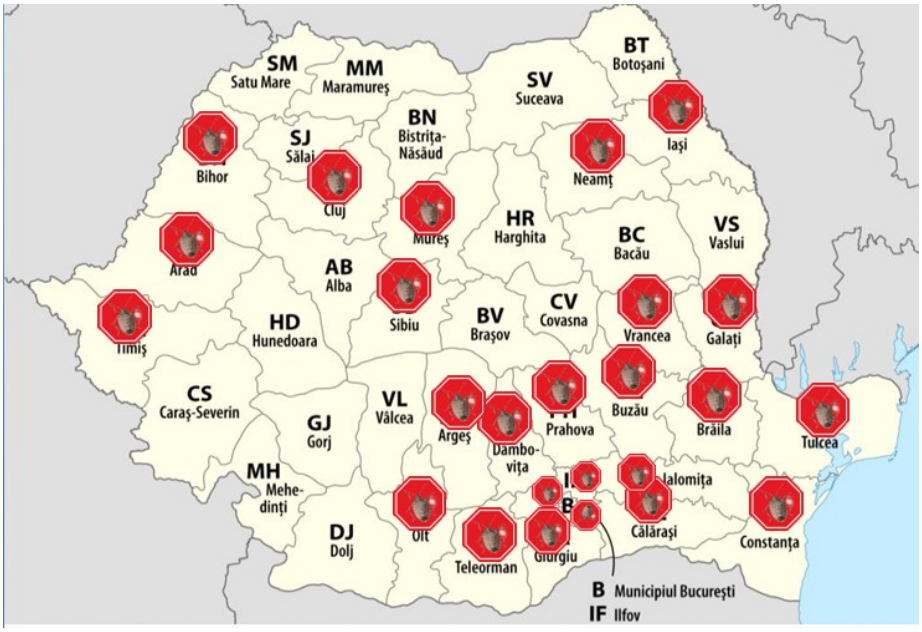


Fig. 3. The geographical distribution of the *Halyomorpha halys in Romania, in 2017*

## Conclusions

Despite lack of data, it is obvious that Halyomorpha halys continues its spread in Romania at an alarming speed and if serious control measures are not implemented, Romania will soon report damages similar with those from Northern Italy. Collaboration between researchers, phytosanitary agents, policy makers and citizens is the only possible way of slowing the spreading of this threatening invasive pest.

It seems that the only chance to shoot an alarm signal regarding the Halyomorpha halys invasion is that Romanian celebrities start posting and discussing in the media as much as possible, they can be a key partner in raising people awareness about the pest and maybe also the ways to limit its spread. Some of this celebrities have already begun to post on the online environment about the issue and people reacted in a very large number, also starting to complain about its presence, fact that allows us to draw a current distribution map.

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