

Beware the brown marmorated stink bug!

>>> The brown marmorated stink bug (BMSB), *Halyomorpha halys* (Stål, 1855) is a hemipteran insect in the Pentatomidae family native to eastern Asia. This extremely polyphagous species is spreading rapidly worldwide. It is responsible for important economic damage to various agricultural crops, including wine grapes. Available data suggest that the current range of the BMSB is likely to expand in the near future which calls for more research and exploration of management options and biocontrol. Citizen science is a promising way forward on monitoring the BMSB expansion. <<<

■ Host range

H. halys is a highly polyphagous species that can feed on more than 120 wild or cultivated plant species and poses threat to many fields, fruit and vegetable crops such as citrus, apple, peach, bean, corn, tomato¹. *H. halys* also feeds on blackberries, blueberries, raspberries and wine grapes.

■ Damage on grapes and wine

Nymphs and adults can feed on grapes inducing two kinds of damages: direct injury to grapes and contamination of wine at crush. *H. halys* feeds by pricking the berries and injuries depend on varietal susceptibility and developmental stage of grape². On immature berries, *H. halys* causes fruit deformations; at ripening and pre-harvest fruit stage, injuries are more severe; on ripening berries, necrotic spot are observed around the feeding site that spread and facilitate infection by microorganisms. However, *H. halys* is not a vector of important grapevine diseases such as *Candidatus Phytoplasma vitis* or *Xylella fastidiosa*. Grape varieties with thin skin and berries with high sugar content may be attractive to *H. halys* and would thus be more exposed.

When stink bugs are crushed with the fruits, they compromise the quality of the wine and juice products. *H. halys* releases stress compounds (volatile molecules) that cause a noticeable change in the flavor, detectable by humans at very low concentration³.

■ How to recognize BMSB?

Adults and nymphs of BSMV can be misidentified with a large number of stink bugs that are likely to be found in vineyards. A few characters can be used to recognize the adults (Figures 1A and 1B): no spine under the abdomen + 3 white rings on the antennae (one at the base of the segment V and two, one at the base and one at the end of the IV) + elongated spots on the fore wings membrane + alternating black and white triangular spots on the abdominal edges + size 12-17 mm.

Nymphs in the last two larval stages bear spines on the sides of the head and thorax (Figure 1C).

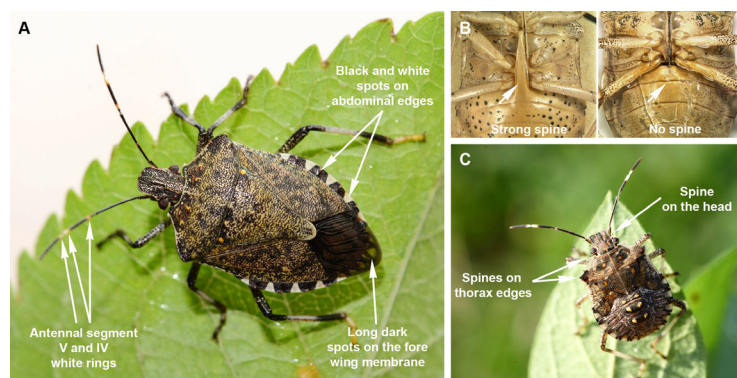


Figure 1. A: adult of *H. halys*; B: ventral sides of two stink bugs: left a species with a strong abdominal spine; right *H. halys* without spines at this location; C: Nymph of *H. halys*.

■ Geographical distribution

H. halys is native to eastern Asia: it is common in the temperate regions of China, Japan and the Republic of Korea¹. The BMSB has spread outside its native range during the past decades. In North America, the first breeding population was detected in 2001 but the species is considered to be present since 1996 and has now expanded in numerous US states and Canada¹. In Europe, the BMSB was first detected in Lichtenstein in 2004 and has since expanded in more than 20 countries from the Netherlands to Greece and Spain to Turkey⁴. Records have also been published for Russia, Abkhazia, and Georgia. At present, the expansion in South America is limited to Chile where breeding populations were recorded in 2017.

■ Potential range

Geographical spread of *H. halys* is mainly driven by human-mediated dispersal as a result of its ability to enter and hide in various types of transported material particularly during the overwintering period (luggage, shipping containers, cars or aircrafts). Such discrete hitchhiker pests are difficult to manage because they often remain undetected during routine phytosanitary inspections. As an emerging pest with a broad range of hosts worldwide and a quick human-driven dispersal, the question of the potential geographical expansion has emerged as a key issue¹. Different authors have used ecological niche modelling to identify regions at risk. Such models are based on climate matching and seek to identify which areas harbour suitable climate conditions for BMSB breeding populations. Figure 2 shows the output of a model-based of the Maxent algorithm calibrated with the occurrences of breeding populations worldwide.

Large parts of Western Eurasia, North America, South America (Brazil and Uruguay, Chili), Western coast of Australia and New Zealand appears to be climatically suitable for the BMSB. The model indicates favourable conditions in several tropical regions (see boxes in Figure 2)

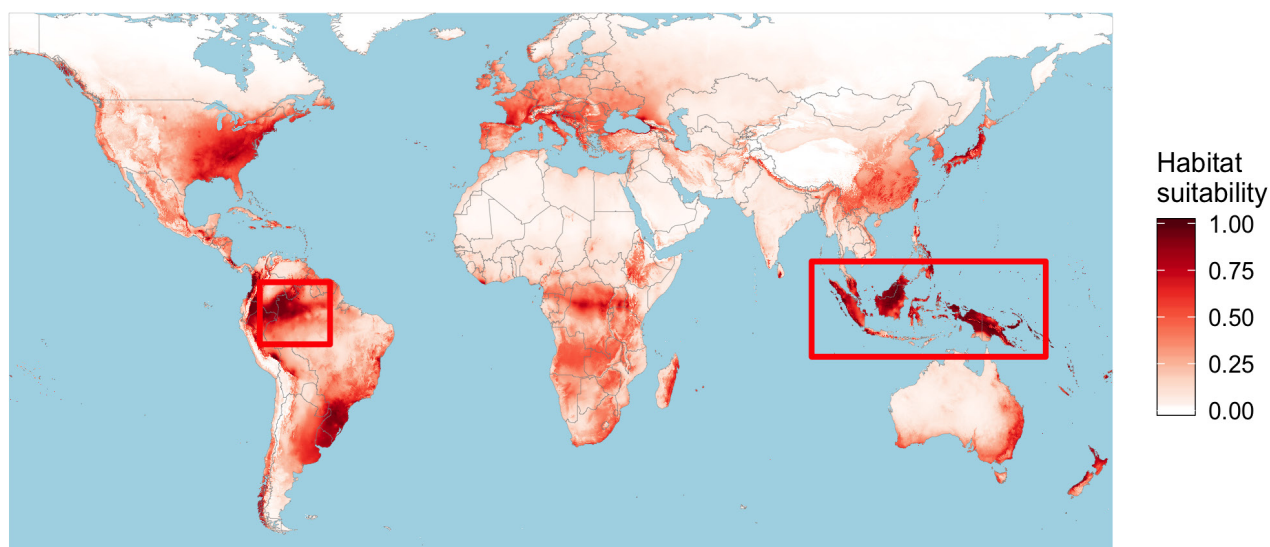


Figure 2. Potential distribution of the brown marmorated bug *H. halys*. The map depicts the average habitat suitability index derived from 50 replicate Maxent models calibrated using various climate descriptors. The index varies from 0 (very bad climate conditions) to 1 (very good climate conditions). Boxes indicate tropical regions where the model performances are questionable and thus should not be interpreted.

but these results should be taken with caution. Indeed, climate conditions prevailing in these areas significantly differ from those measured at places where breeding populations are present making it difficult to interpret the model outputs. Published species distribution models all indicate that the present range of *H. halys* is smaller than its potential distribution¹. It can be noticed that numerous vineyards in the world are located in areas where BMSW is likely to establish.

■ Citizen science to the rescue!

Authorities' ability to undertake appropriate management decisions is contingent on the availability of data accurately depicting species' distribution. In the case of *H. halys*, a survey in Italia showed that citizen science allows to quickly obtain valuable information about the spatial dynamics and habitat preference of the bug⁵. In 2014, after *H. halys* was detected in France, our institute launched a citizen science campaign supported by a smartphone application (AGIIR: <http://ephytia.inrae.fr/fr/P/128/Agir>) allowing citizens to report occurrences of the BMSB⁶.

H. halys is a good case study for citizen science in as much as it seeks shelters to overwinter in man-made buildings

and thus can easily be noticed and photographed. Based on citizen sightings and reports from entomological associations and internet forums, we monitored the range expansion of the BMSB in France. The results illustrated its dramatic spread in France (2012-2019) as is the case elsewhere in Europe (Figure 3).

■ Conclusion

Both ecological niche models and observational data suggest that the BMSB could possibly find suitable climate conditions in large regions of the world. Given its high dispersal abilities, its expansion in new areas (including much of the world's vineyards) is very likely. Whether it could become a crop pest, like in the US for instance, depends on different ecological factors such as available host plants, number of generations, population dynamics, potential local competitors and the presence of natural enemies, notably parasitoids. More research is thus needed to decipher the ecological factors driving the population dynamics with a peculiar effort to be dedicated to biocontrol techniques. ■

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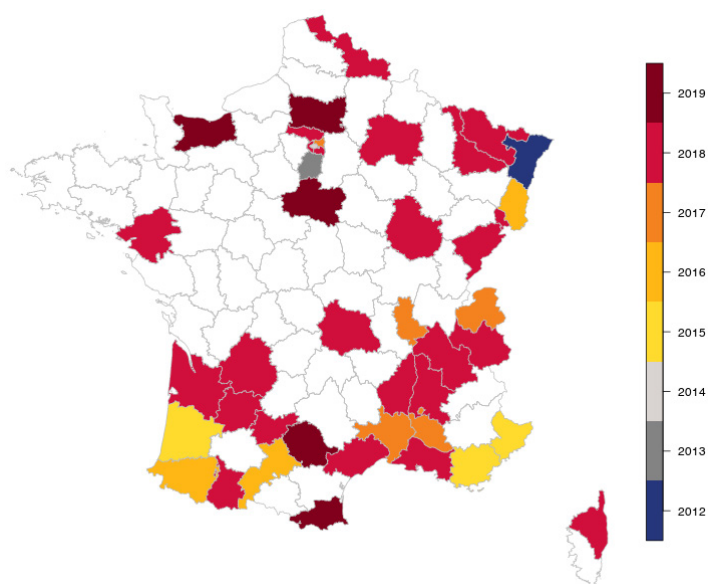


Figure 3. Map of the French departments represented with different colors according to the year of *H. halys* detection based on the AGIIR citizen science network (2014-2019). Data from 2012 and 2013 were provided by naturalists.

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- 4 EPPO. 2020. EPPO Global Database. <https://gd.eppo.int/taxon/HALYHA>
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