



ENEMIES BY NATURE
 The worst enemy of the Asian stink bug (on the other page) is the samurai wasp (here on the side), although it is 17 times smaller.

Elihu J. Tahvanainen/Arts Media

The **asian** stink bug has destroyed **€ 588 million worth** of italian fruit. We will fight it with its natural opponent, a wasp. An **army** of them is being bred in the lab for release this summer.

by Vito Tartamella

The bombers are deployed in hangars, ready to be launched toward enemy targets. X hour will take place just before summer, when thousands will appear in flight in the skies of the Italian countryside. They must find, target, and focus on opponents with millimetric precision. Literally. The targets, in fact, are greenish spheres 1 millimeter wide: Asian stink bug eggs. This insect, identified in Italy since 2012, is attacking our fruit production. According to estimates of the Fruit and Vegetable Service Center of Ferrara, which rallies the largest Italian producers, in 2019 the stink bug destroyed over 300 thousand tons of fruit: above all Abate Fetel pears, Golden Delicious and Granny Smith apples, nectarine peaches and green-fleshed kiwi. They add up to more than 13,000 Tiri, worth 588.36 million euros. This is without counting the damage to hazelnuts, cereals, and legumes, still not calculated. It was called “a true scourge” in the Senate resolution last April asking the government to give “highest priority” to the battle against the stink bug. Parliament allocated 80 million euro in the last budget law to compensate farmers for damages.

major difference: the *Halyomorpha halys*, its scientific name, can feed on 300 different plant species. It sucks the fruit pulp, injecting saliva that dissolves its plant cells. No insecticide can eliminate it in a targeted way, and with no specific enemies to counter it, it has invaded the whole country within a few years.

Discovered in the province of Modena in 2012, today it is present in all regions. This is a true invasion. It is very prolific: each female may lay 280 eggs; up to 215 young can hatch from each. Given that half of them are females, one pair alone would be enough to generate more than 30 thousand descendants in one year.

BREEDING BOMBERS

One remedy exists, however, and it was created by nature. In China, Asian stink bug populations are kept under control by a natural antagonist, the samurai wasp (*Trissolcus japonicus*). This tiny insect, which looks like a flying ant, is the size of a midge (1 mm), is harmless to humans and other insects, but has the habit of laying eggs inside those of the stink bug. It “parasitizes” them, exterminating its generations before they are born. They are the “bombers” cited at the beginning of the article. The “hangars” that host them are in the Florence countryside, in the laboratories of the Council for Research in Agriculture and ▶

Yet the one responsible for this attack is a little less than 2 cm long and very similar to the common and harmless native stink bug (different in colors and other details). There is a

Wasp
VS
 Stink bug

VIDEO
IN THE FLORENCE
LABORATORY THAT
BREEDS THE
SAMURAI WASP



OUR ALLY

Magnification of a samurai wasp (it is 1 mm long): it lays its eggs in those of the Asian stink bug, exterminating its population. On the left, test tubes with hundreds of specimens bred at the Crea of Florence.



Analysis of the Agricultural Economy (Crea), the main agency dedicated to agri-food chains. These wasps are bred with leaves soaked in honey inside small glass tubes stored in climate-controlled cells at 26 °C. Crea will provide thousands of specimens to the regions' plant protection services in June. Ready to target the stink bug eggs.

IT ALL STARTED WITH A COLLEGE EXAM...

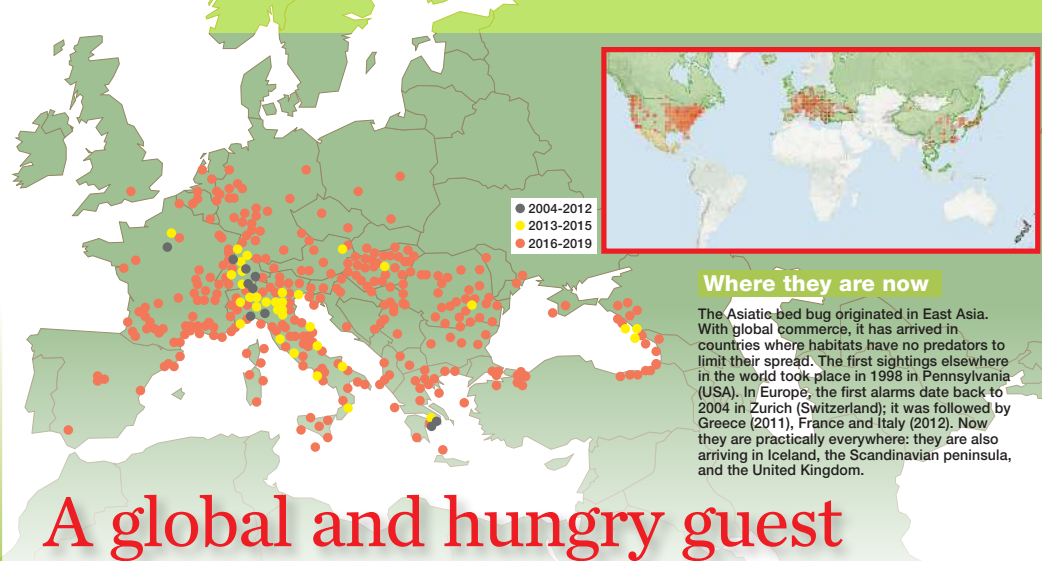
But how did we get to this point? The first specimen was found 8 years ago by a university student, Simone Berselli, who was preparing for an entomology and plant pathology exam with Professor Lara Maistrello of the University of Modena and Reggio Emilia. "It was September 13, 2012, my birthday. And it marked my life," the entomologist recalls. "I had asked my students to bring a box with at least 30 different insects to the exam. Among them was also a *Halyomorpha halys*. And I reported it immediately to the Regional Phytosanitary Service. The stink bug had been found in Magreta, in the province of Modena, but we did not know if it was an isolated case. So we started a citizen science investigation: we asked citizens to report stink bugs by sending a photo via the Internet to me and to the regional plant health authorities. In just a few months 377 reports came in: 200 were positive. The invasion had begun. Something had to be done." But how did an insect native to China and Korea get to Italy? "It's one of the side effects of globalization," the entomologist replies. "The stink bug takes refuge anywhere for winter shelter. If it enters a warehouse that ships goods around the world, it can slip into a container or box and travel across continents. It is an invasive hitchhiker. The first specimen in Europe was found in Zurich (Switzerland) in 2004. To celebrate their Chinese sister city, the Swiss had imported several pagodas for an exhibition; with them had also come stink bugs. But they did not cause serious problems: the mountain climate does not promote their proliferation and their agriculture is undeveloped." On the other hand, stink bugs have found their Eldorado: the climate is mild, and Emilia-Romagna is the orchard of Italy. From the north, they spread everywhere: reports exceeded 1,900 thanks to a phone app, "BugMap," created by the Mach Founda-

The **samurai wasp** lays its eggs in those of the bed bug, exterminating them

tion of San Michele all'Adige (Trento). "In Palermo, a person found one in a kitchen cabinet made in Friuli. In Naples, it was found in a used car that arrived from Lombardy. And so on," Professor Maistrello recounts. "With genetic analyses, then, we realized that these stink bugs were of 13 different haplotypes (variants): in Italy we have the world's greatest biodiversity of stink bugs after Asia. The specimens found in the North-East (Friuli, Veneto, Trentino) are different from those in the North-West (Lombardy and Piedmont): this means that these two areas trade with different areas of Asia. However, this also means that eradicating the stink bug becomes more complicated: variants have different biological characteristics and can give rise to previously unknown genetic combinations."

INSECTICIDES AND EUROPE

It is not the only complication of this invader, which manages to resist different insecticides. Only those with a wide spectrum can be used. "which risk also killing beneficial insects such as bees and ladybugs. A few days after the treatment, they become ineffective," the entomologist states. "Not to mention that some pesticides have problems of toxicity to humans: they had been severely reduced in our fruit, and now, by reintroducing them, we are in danger of going back 10 years." Last December, among other things, Europe banned the use of two insecticides, chlorpyrifos and chlorpyrifos-methyl, which had been demonstrated as effective against the Asian stink bug: they would present neurotoxic risks to children. "These products have been used for decades," counters Davide Vernocchi, president of Apo Conserpo in Bologna, the largest organization of fruit and vegetable producers. "Their toxicity, as with all chemicals, depends on the dose used. In fact, we fear that there are large trade interests behind this ▶



Where they are now

The Asiatic bed bug originated in East Asia. With global commerce, it has arrived in countries where habitats have no predators to limit their spread. The first sightings elsewhere in the world took place in 1998 in Pennsylvania (USA). In Europe, the first alarms date back to 2004 in Zurich (Switzerland); it was followed by Greece (2011), France and Italy (2012). Now they are practically everywhere: they are also arriving in Iceland, the Scandinavian peninsula, and the United Kingdom.

A global and hungry guest

Profile

The Asiatic stink bug (brown marmorated stink bug, *Halyomorpha halys*) is an insect originating from China, Korea, Japan and Taiwan. The adults are 1.7cm long and 1 cm wide (the males are smaller and narrower). They have the typical shield shape of other stink bugs and are differentiated by their marbled brown and gray color and the presence of two white bands on their antennae.



Life cycle

From the egg clusters, usually consisting of 28 eggs, hatch juveniles called "neanids:" they remain on the open eggs to feed on the bacteria released by the mother during laying. Within 5 days after hatching, they are ready to attack the fruit. After 3 neanid stages (15 days), the stink bug passes to the "nymph" stage characterized by the presence of hints of wings. A mere 30-40 days from hatching, the stink bug becomes an adult: it can fly and reproduce. The stink bug lives from 3 to 12 months (those born in late summer). In autumn, adults look for a dry, sheltered place to spend the winter, often choosing our houses). Their hibernation will end in spring, and reproduction begins at about the end of May.



Over a life time, a stink bug can generate more than **thousand descendants**

Reproduction

The male causes a vibration in the branches or leaves on which it perches, issuing special signal, to which the female responds to indicate her own presence. On reaching the female, he does a little dance and then brings the point of his abdomen closer to that of the female, latching onto her with a sort of pincer. Then, his aedeagus (penis) releases the sperm that will fertilize the eggs. Every female lays 28 eggs at once, as seen on the bottom of the page, mating several times with different partners. Over a lifetime, a hibernating stink bug can generate 280 descendants, which in turn can generate up to 215. Within a lifespan, a single pair of stink bugs can generate more than 30 thousand descendants unless affected by predators or an adverse climate.





University of Modena

INEDIBLE

“Corked” pears: they shrink this way after the sting of Asian stink bugs. Their saliva dissolves the fruit’s plant tissues. Once it is pierced, the fruit must be thrown away.

ban: these substances have been prohibited by Belgium, the Netherlands, Poland and Germany; that is, our main export rivals for pears and apples. As long as we have the stink bug emergency, we will ask for a waiver to use one of those products, in compliance with the limits imposed by Community rules.”

Another strategy that was rather ineffective was to lure stink bugs into mechanical traps primed with pheromones, biochemicals that usually signal sexual availability. Stink bugs, on the other hand, arrived in the area without entering the traps, because pheromones are used generally used by these insects to indicate an area rich in food or suitable for wintering. They are aggregation signals and not sexual.

VIBRATING TRAPS, LAWS AND ENEMIES

Researchers at the Mach Foundation have come up with another way of attracting stink bugs by exploiting their specific sexual signals. They found that these insects woo each other by emitting low-frequency sounds: they produce them to signal their position by vibrating the branches and leaves on which they rest. So scientists invented traps capable of reproducing these sounds: with these vibrating traps, the amount of males caught rose 2 to 5 times. To work, however, these traps need electricity, and photovoltaic panels are too heavy and cumbersome. Researchers count on succeeding in producing a marketable model for 2021. Meanwhile, other avenues have been attempted. It turned out that the *Anastatus bifasciatus*, a hymenopteran already present in our countryside, manages to parasitize stink bug eggs.

So in 2018/2019, the University of Modena and Reggio Emilia tried to raise them and release them en masse in orchards.

But it only attacked 9% of Asian stink bug eggs. “It is a generalist parasite: it would be an ineffective weapon,” says Maistrello. The samurai wasp, however, is more precise: it manages to eliminate up to 90% of Asian stink bug eggs. It is not possible to use it, however because a law of 2003 prohibited the use of exotic organisms for biological control. Last year a new law was launched (Dpr 102/2019) which authorized the release of a new species as antagonists of harmful organisms only for “reasoned reasons of relevant public interest,” and as long as they do not harm local flora and fauna.

Thus, after 18 months of study, the Crea of Florence confirmed that the wasp would not cause damage to the environment. And now there are technical tables to put them in action this summer. “We hope that the Ministry of the Environment will sign the decree with the regulation and that the release will then be authorized,” says Pio Rovarsi, director of the Crea Defense Research and Certification Center. “In a month and a half, starting from 600 females, we could obtain a first nucleus of 360 thousand wasps to be distributed to plant health services in the regions, which in turn will multiply them to obtain an important mass. The whole operation will cost at most a million euros. To restore the ecological balance in the fruit, it is plausible that it will take from 2 to 6 years.”

Will it work? Farmers hold their breath.

In the United States, the stink bug arrived earlier than it did here, in 1998, and no one has yet managed to stop it. It is now widespread in 44 of the 50 states,

especially on the east coast. “Federal laws prohibit releases of exotic species on a national scale,” says Tracy Leskey, entomologist director of the U.S. Department of Agriculture research service. “So each state used different methods. Some released the samurai wasp; others relied on insecticides. But without a unique strategy, the stink bug has continued to spread. If it finds an unfavorable environment, it moves and invades others. It can travel from 2 to 100 km in a day.”

THAT INVASION IN THE EARLY 1900S...

That is why the eyes of the world are on Italy. Past history, however, bodes well.

“At the beginning of 1900, another exotic insect, the San Jose cochineal insect (*Pseudaulacaspis pentagona*) arrived in Italy. It sucked the sap of mulberry trees, killing them. A million families that raised silkworms with the leaves of this plant found themselves out on the street,” recalls Rovarsi del Crea. “So in 1906, the entomologist Antonio Berlese imported a hymenopteran, a relative of the samurai wasp, which was its natural antagonist. In 3 years, it managed to control the cochineal, which in his honor was named *Prospaltella berlesesi*. We hope to see this feat succeed.”

They are a scourge: they travel with goods from the East. They resist insecticides and destroy every fruit

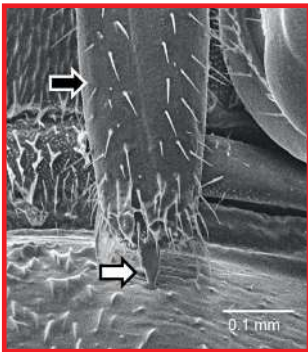


Foto: B. Barina

CLOSE UP VIEW

On the side, Lara Maistrello, entomologist from the University of Modena and Reggio Emilia. It was she who discovered the Asian stink bug's arrival in Italy.

Further to the left, a magnification of the stiletto-like proboscis with which the stink bug stings the fruit and injects them with its destructive saliva.

ITS WEAPON OF MASS DESTRUCTION: A THIN NEEDLE

Defenses: The stink bug emits a pungent smell from its chest, to keep away vertebrate predators (lizards and mammals). This is its only weapon of defense: to humans it is harmless.

Foods: It is polyphagous; that is, it eats everything. It feeds on over 300

species of plants, including many agricultural crops: peach and apple trees, green beans, soy, cherries, raspberries, hazelnuts and pears.

Damages: to feed, the stink bug stings vegetable tissues with its stiletto, a needle 5 mm long and 0.01 mm wide

(see photo above left) and injects it with saliva rich in enzymes that kill the plant cells. In this way, the fruit releases its own liquids, from which the bug feeds. But after this puncture, the plant cells turn into cork, making the fruit inedible.

EUROPE INVADED BY 66 SPECIES OF HARMFUL ALIENS

The Asian stink bug is not the only enemy. In Europe, invasive exotic species, in a degree to threaten ecological balances, cause damage of over 12 billion euros every year. The blacklist includes 66 organisms, from mammals (nutria), to reptiles (turtle American marsh), from invertebrates (American crayfish), to plants (American yarrow).

And, of course, also insects: in addition to the Asian stink bug, recalls Piero Genovesi, coordinator of Wildlife in Ispra, “in the past, Italy has seen the arrival of the red palm weevil and the Asian woodworm, which digs into the trunk of trees. And recently, they were joined by two insects that threatened the production of pine nuts, since they attack the pine trees: the maritime pine bark cochineal (from Morocco) and the American pine stink bug (from Canada).”



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ON THE ATTACK
Stink bug with a nymph on an apple: note the stiletto penetrating the fruit. Through this proboscis it injects saliva that dissolves plant tissues, ruining the fruit.