The Agricultural Research Service (USDA), and cooperators nationwide, are researching safe and sustainable means of BMSB biological control.

Our hero, *Trissolcus*!

Species in this genus range from just under 1mm to 2mm in length as adults. These tiny wasps are egg parasitoids; the female wasp lays her eggs in the eggs of shield or stink bugs (Pentatomidae), of which BMSB is a member. *Trissolcus* are particularly effective biological control agents since a developing wasp larva consumes the entire host before it can hatch, so there will be no later instars of BMSB capable of feeding. *Trissolcus* wasps can be found worldwide, and several of our native species have been reared from BMSB. However, Asian species of *Trissolcus*, which co-evolved with BMSB, are far more effective natural enemies. Cooperative work is currently underway between the Systematic Entomology Laboratory (Washington DC), The Ohio State University (Columbus, OH), and the Beneficial Insects Introduction Research Unit (Newark, DE) to understand the species limits of Asian *Trissolcus* wasps, their impact on BMSB and their host specificity. This work is essential for the safe release of *Trissolcus* wasps for the future of biological control of BMSB.

Beneficial Insects Introduction Research Unit (BIIR) Mission:

Addresses pest problems of regional and national importance including Russian wheat and soybean aphids, brown marmorated stink bug, emerald ash borer, tarnished plant bug, and Asian longhorned beetle.

Imports new natural enemies into the U.S. to solve pest problems, using environmentally friendly and self-sustaining biological control methods.

Studies the biology and ecology of parasites and predators of insect pests.

Evaluates establishment and impact of natural enemies.

Systematic Entomology Laboratory (SEL) Mission:

To develop comprehensive classification systems for insects and mites on a world basis based on structural, biological and molecular characteristics.

To furnish taxonomic services to Federal, state, and private organizations.

To cooperate with the Smithsonian Institution on a daily basis in the continuing development and maintenance of the National Collection of insects as a working tool to support systematic studies and identification.

To develop digital information, storage, and retrieval systems for systematic and biological information.

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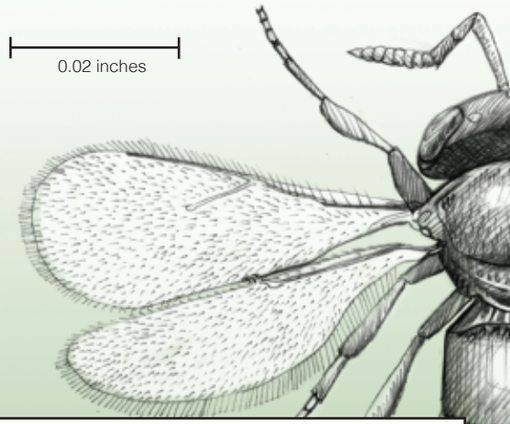
Mighty matadors:

Trissolcus wasps

as biological control agents

of the invasive and destructive

Brown Marmorated Stink Bug



What is BMSB?

Adult invasive Asian brown marmorated stink bugs (BMSB), *Halyomorpha halys* Stål, (Pentatomidae) emerge from overwintering sites from late March through June depending on location. They immediately begin to feed. Females lay clusters of 20-30 light green, barrel-shaped eggs on the undersides of leaves from June through August. There are 5 nymphal stages or instars. While this species has become a major pest in the Mid Atlantic Region, causing $37 million worth of damage in 2010, the species has also invaded 39 states where it has been recorded feeding on soybean, corn and grapes, and poses a major threat to US agriculture. The species is still spreading to other states.

What are parasitoid wasps and biological control?

Often considered the perfect pest-killing machine, these typically tiny wasps cannot harm humans (most species are only a few millimeters, or less than 1/8th inch, in length). Female parasitoid wasps lay their eggs inside the egg, larval, nymphal, pupal or adult stage of their host insect. Each species of parasitoid typically attacks a specific stage of its host. The wasp larva feeds internally on the host, eventually killing it before it reproduces. Because the immature wasp must kill its host to complete its own life cycle, we use the term parasitoid (instead of parasite, which needs to keep its host alive). This intimate relationship between wasp and host has taken millions of years of evolutionary time to achieve, resulting in many species of wasps possessing a very high degree of host specificity; most species of wasp can only exploit a single species of host. After extensive lab testing, we can use this specificity in agriculture to reunite a pest insect with its natural enemy. We call this process biological control.

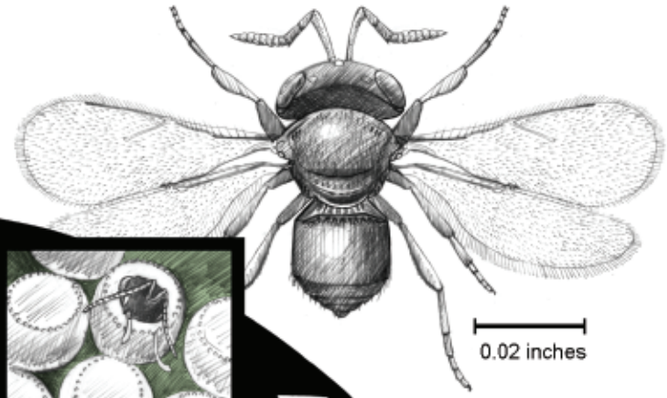
USDA

BMSB nymphs and adults feed on and damage fruit, vegetables, beans and grains

Nymphs grow and molt 3 more times

BMSB adult ready to mate

Male wasps usually emerge first from the BMSB eggs and wait for females to emerge



Adult wasps mate

Female BMSB deposits an average of 28 eggs in a cluster, usually on the underside of a leaf

Eggs hatch - 1st instar nymphs (hatchlings) aggregate around the eggs and do not feed before molting

Wasp eggs hatch inside the BMSB eggs and larvae feed on the BMSB embryos

Eggs darken as the wasps mature inside

Wasp searches for an egg mass, is drawn to host plant by volatiles and other chemical traces

Wasp evaluates egg mass

Oviposition - Female wasp lays one egg into each BMSB egg

After oviposition, wasp often defends the egg mass from other wasps

T. Litwak

Life Cycle of *Trissolcus* wasps: natural enemies of stinkbugs

The invasive Asian brown marmorated stinkbug (BMSB), *Halyomorpha halys* Stål, (Pentatomidae) has become a widespread urban nuisance pest and serious threat to United States agriculture since it invaded the U.S. more than a decade ago. Among its natural enemies are parasitic *Trissolcus* wasps (Platygastridae) which lay their eggs into the eggs of stink bugs. Like a bloodhound after an escaped felon, the wasp finds its host by homing in on chemical traces left by the adult stink bugs and present on its egg masses. Developing wasp larvae consume their host eggs before stink bugs can hatch. Cooperative research by ARS, university, and state entomologists, is underway to evaluate and develop *Trissolcus* wasps as biological control agents of BMSB.