Safety screening of Foreign Biological Control Agents

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Steps in Classical Biological Control

1. Assessment of the Pest Risk Potential
2. Foreign Explorations
3. Quarantine Screening Process
   a) Identification
   b) Host specificity testing – choice & no-choice tests
   c) Behavioral ecology
4. Field Release

1. Assessment of Pest Risk Potential

Life history & Ecology

Hoebeke et al. (2003) ProcEntomolSocWash$

Distribution – Current and Future Likelihood of Establishment

Economic & Environmental Effects

From: pioneer.com, BMSB photo by. T. Leskey

1. Assessment of Natural Biological Control

<u>Mid Atlantic States Parasitism Survey</u>

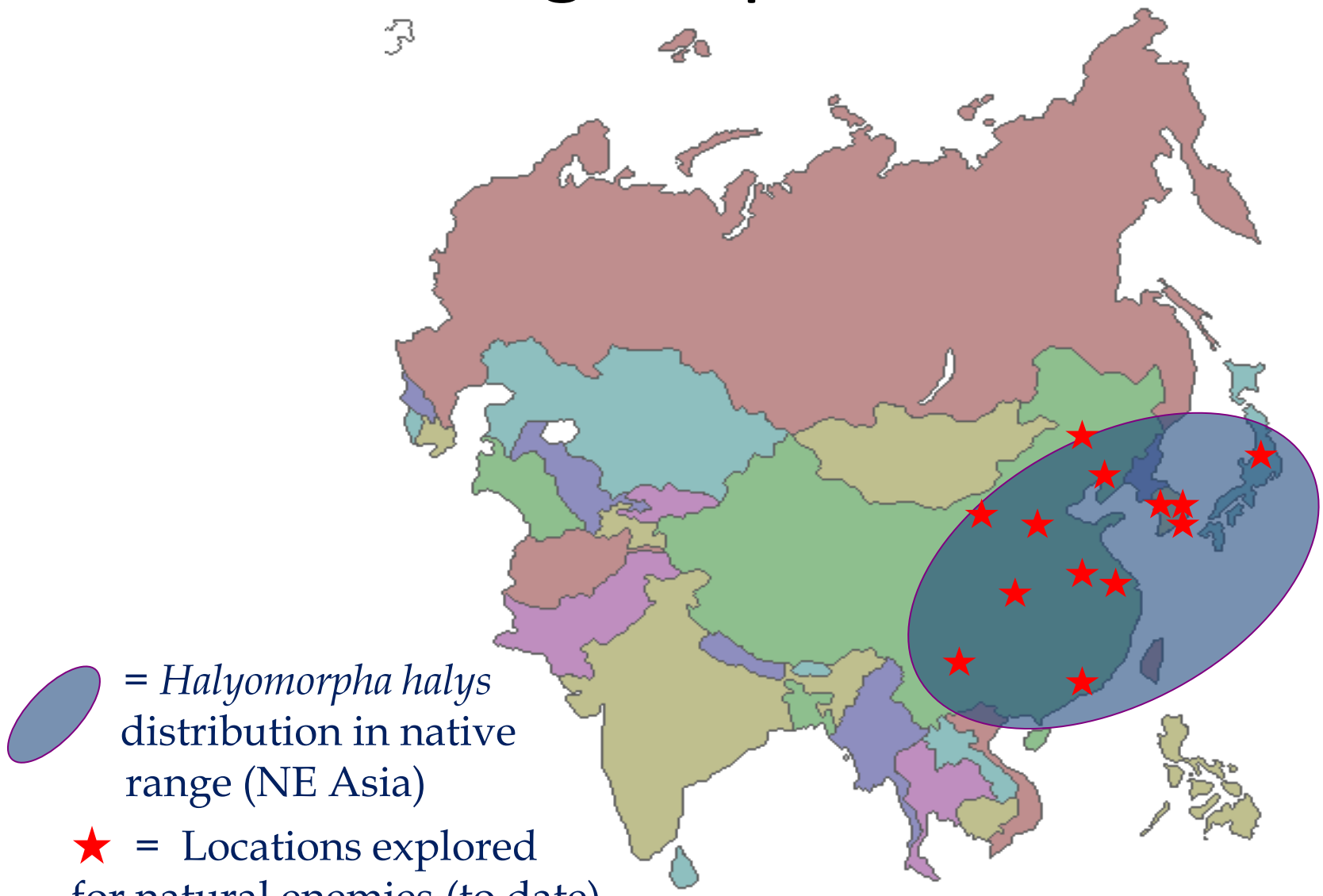
Goal: Evaluate the need for a classical biocontrol project for *H. halys*

Begun in 2005 and continued through 2011

- placed Sentinel Egg Masses (N = 300- 600 per year) in the field for 2-3d and also monitored Wild BMSB Egg Masses
  - *Paulownia tomentosa* was the host plant
- measured Tachinid parasitism

Low overall parasitism rates: < 5%

2. Foreign Explorations



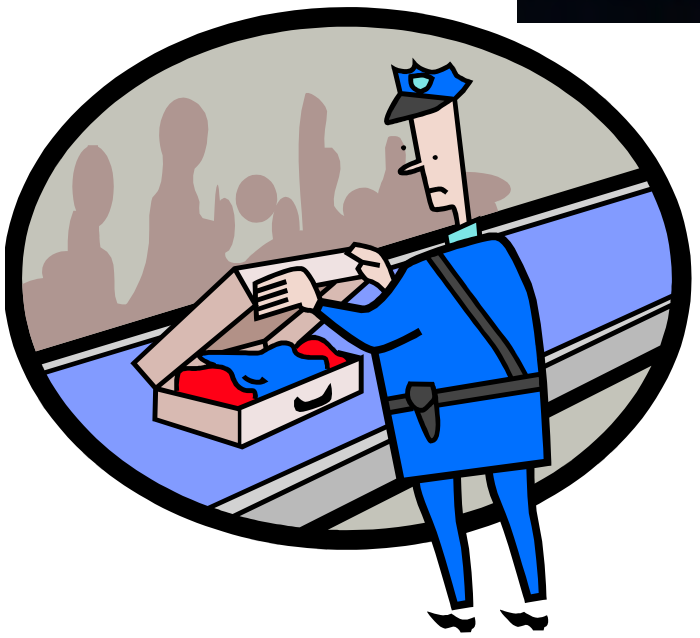
= *Halyomorpha halys* distribution in native range (NE Asia)

★ = Locations explored for natural enemies (to date)

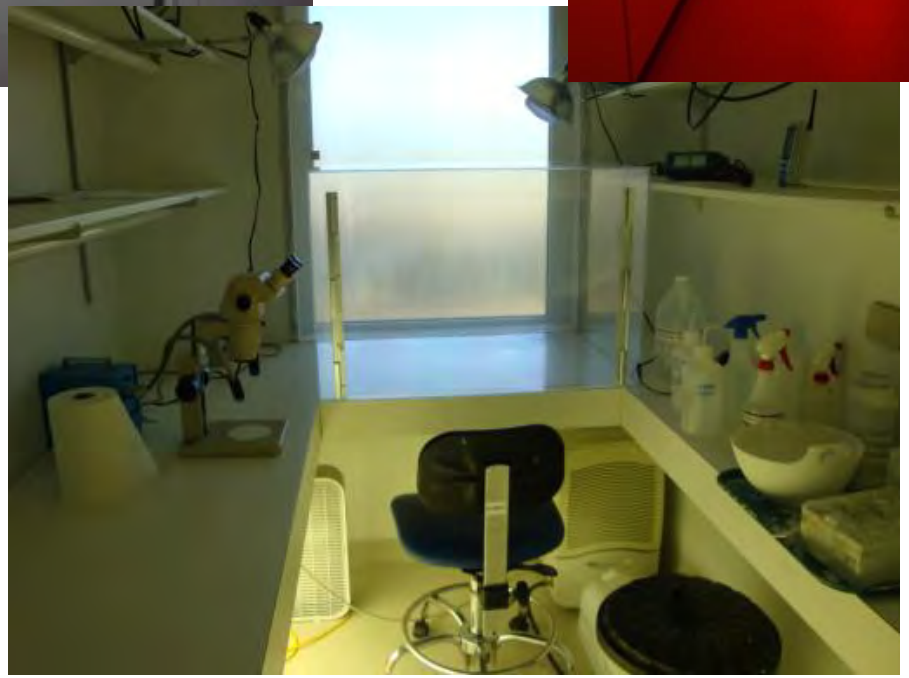
2. Foreign Explorations

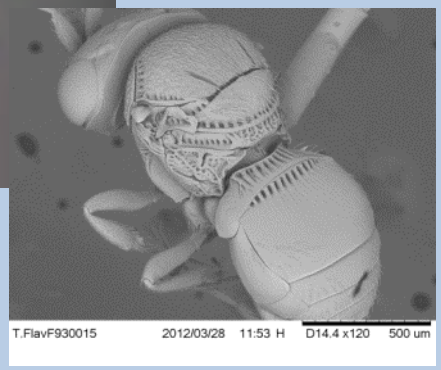
Finding BMSB

Importation of Potential Agents

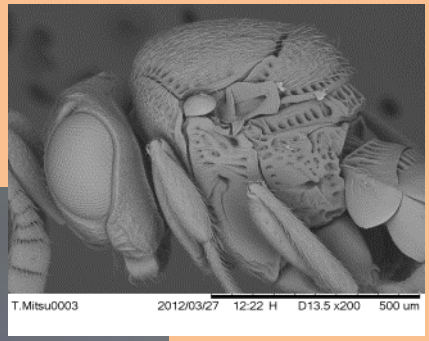


3. Quarantine Screening Process



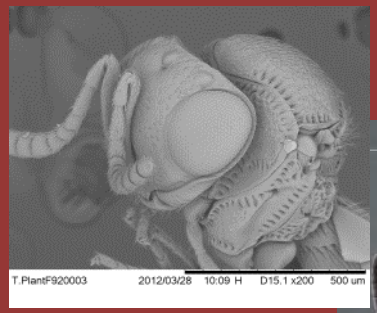


Trissolcus flavipes

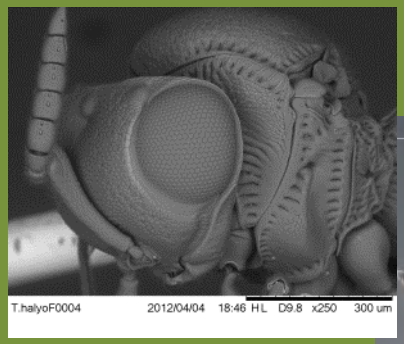


Trissolcus mitsukurii

14 Colonies in total



Trissolcus plautiae



Trissolcus halyomorphae

Host Specificity

Assessment of the suitability of a native (non-target) species as host of the potential biological control agent (i.e. *physiological host range*)

➔ Compilation of a list of potential non-target hosts in the introduced range for screening

Prioritize species by:

a) degree of phylogenetic relation to the target pest,

b) ecological and economic importance (beneficial, keystone species, endangered),

c) public perception

Host Specificity

BENEFICIAL SPECIES

Stiretrus anchorago

Podisus maculiventris

Brochymena spp.

PEST SPECIES

Euschistus servus

Acrosternum hilare

Piezodorus guildinii

Host Specificity Screening

- Host specificity tests currently conducted in 5 locations (DE, FL, MI, MS, OR)
  - FL, MI, MS, OR: *Trissolcus halyomorphae* (Beijing)
  - DE: All parasitoid cultures currently in culture

Host Specificity Screening

- Each location compiled a list of potential non-target species found in their area
  - Species of interest belong to the families: **Pentatomidae**, Scutelleridae, Thyreocoridae, Cydnidae, Acanthosomatidae
  - 19 species in total are considered beneficial

- Each location depends on availability of native species

Screening Procedures

A single, mated, naïve, 24-h old female parasitoid is exposed to a Choice or a No-Choice Test for 24 hours.

No-Choice Test

Single egg mass of non-target species:

Followed by a BMSB control for and additional 24 hours:

Choice Test

One egg mass each of the target and non-target species:

Screening Procedures

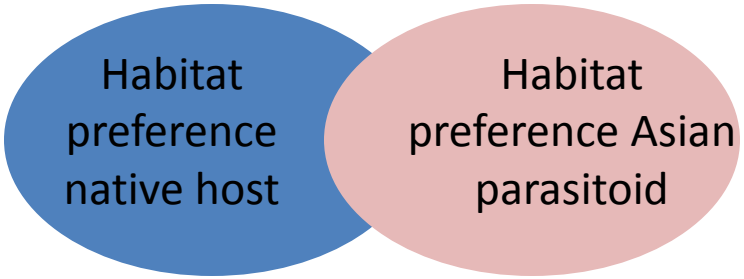
- Physiological Variables recorded:
  - Parasitism rate (# eggs parasitized/egg mass)
  - # adult parasitoids (offspring)
  - Dissection of “unsuccessfully” parasitized eggs
  - Sex ratio of progeny (i.e. percentage adult males)

Screening Procedures

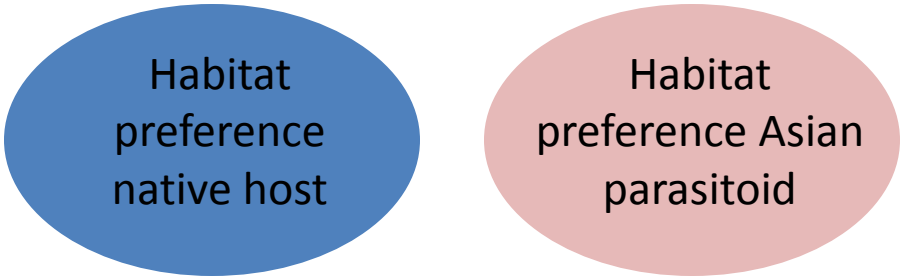
- In the event of parasitism of a non-target species

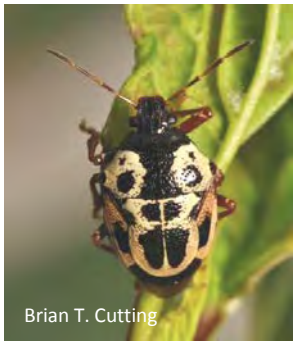
  → assess the availability and accessibility of this species in the proposed release area (from literature and field surveys, additional tests in quarantine if feasible)

Scenario 1



Scenario 2





Stiretrus anchorago

Host Specificity Screening Newark, DE

Podisus maculiventris

Stink bug species	No-Choice Test	Choice Test
Acrosternum hilare	x	x
Cosmopepla lintneriana	x	
Edessa florida		x
Euschistus servus	x	x
Euschistus tristigmus	x	x
Holcostethus limbolarius	x	x
Mormidea lugens	x	
Murgantia histrionica	x	x
Podisus maculiventris	x	x
Stiretrus anchorago	x	
Thyanta custator accera	x	x
Thyanta custator custator	x	x
Trichopepla semivittata	x	x

Behavioral Ecology of the Parasitoid

Oviposition Behavior

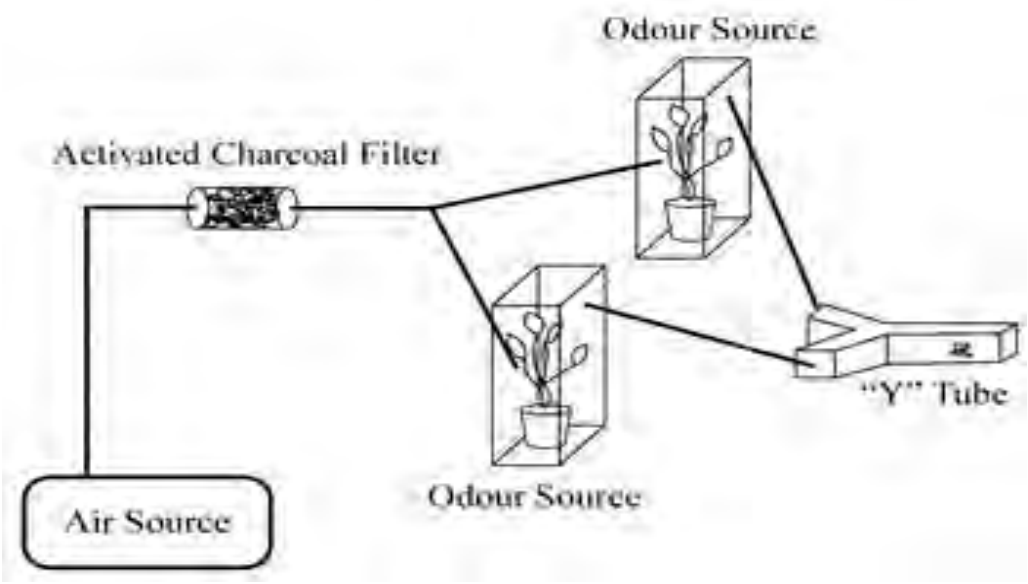
- Egg Recognition
- Patch Residence Time
- Oviposition Time
- Probing Time
- Marking

➔ with both Target and Non-Target Species egg masses

Behavioral Ecology of the Parasitoid

Searching Behavior

- Role of surface texture of the plant that an egg mass is attached to
- Role of chemical cues in the search for and detection of host egg masses (e.g. oviposition-induced volatiles, host plant volatiles, cues associated with egg mass)



Costa et al. (2009)
ChileanJAgrRes

Behavioral Ecology of the Parasitoid

- Physiological Aspects (e.g. egg load development, longevity, overwintering behavior, diapause)
- Intraspecific Behavior
  - Competition
  - Patch Defense Behavior
  - Superparasitism
- Interference Competition with resident (native) egg parasitoid species

4. Release

Well, not so fast …

- Petition for release
- Depending on the outcome of the petition
  - Back to the lab – more tests
  - Release permit granted → mass-rearing and release in selected locations → monitoring of establishment and pest suppression

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