

Natural Enemies of the Brown Marmorated Stink Bug:

What are the Prospects for Biological Control?

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Photo: J. Wildonger USDA ARS

Pathogens

- No records from BMSB
- *Metarhizium* used with some impact on Sunn pests
- *Ophiocordiceps* spp. reported



*** all stages of BMSB potentially vulnerable**

Predators

... not yet well studied



of eggs:
ants, earwings, lacewings



of nymphs & adults:
assassin bugs, predatory stink bugs, spiders,
birds (starlings, chickens, geese)



Parasitoids of pentatomids



Many species of stink bug egg parasitoids:
Scelionids (1°), Chalcidoids (2°)

No parasitoids of
nymphs are known



Tachinid flies (1°) and
braconids (rarely) attack adults

Parasitoids of adult stink bugs: Tachinidae (Diptera)

Generally considered to be
not very host specific

- however -

- Recent taxonomic studies show considerable cryptic speciation in some tachinids
- Many hosts records likely based on erroneous ID of tachinids
- May be more specific than previously thought



Egg parasitoids:
*Many are generalists -
various chalcidoids*
(Eupelmidae, Encyrtidae)

Anastatus sp. ♀



Anastatus spp. attack eggs of many
insect orders;
habitat specialists rather than host
specialists

Anastatus sp. ♂



Specialist egg parasitoids:
Telenomus, Trissolcus, Gryon, Psix
(Scelionidae)

Trissolcus spp. are typically
specific to pentatomids



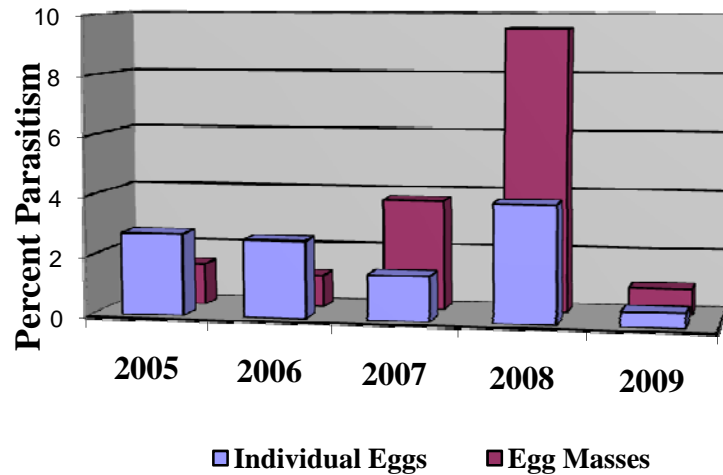
Photo: UC IPM/JK Clark

Mid Atlantic States Parasitism Survey

- to evaluate the need for a classical biocontrol project for
- Initiated in 2005 and continued through 2010 (summer months)
- 1^o conducted in Newark, DE & Allentown, PA
- Sentinel and wild-collected egg masses (N = 300- 600 per year) placed in the field for 2 - 3 days
- Parasitoids reared from egg masses and identified
- Tachinid parasitism (egg deposition) measured in Newark samples



Egg Mass Parasitism - Newark

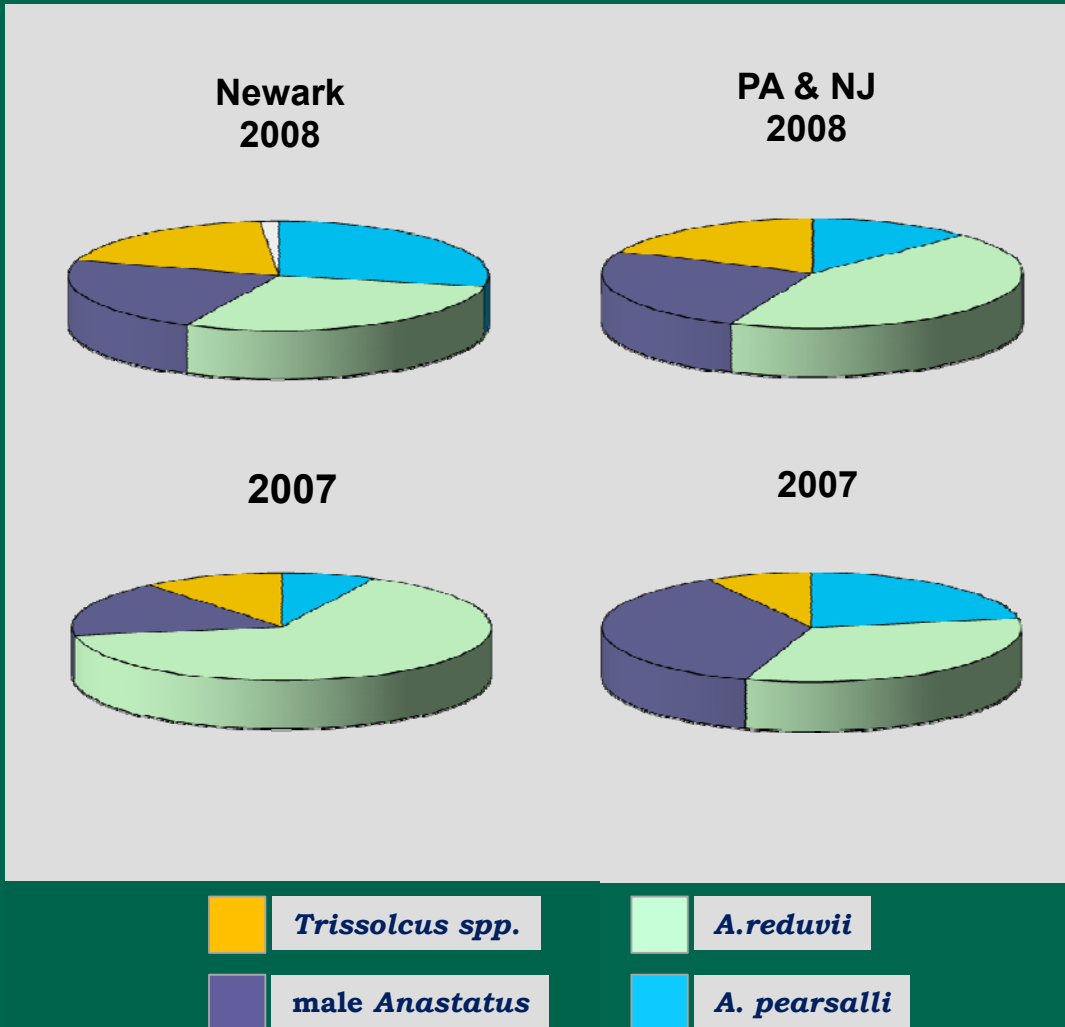


Individual eggs in sentinel masses were parasitized at a relatively low overall rate of 3- 4% or less.

The proportion of egg masses discovered (with any eggs attacked) was higher, but relatively few individual eggs per mass were attacked (low parasitism efficiency).

The rate of discovery of egg masses has not been increasing with time (2010 data not shown here).

Species composition of indigenous egg parasitoids



Parasitoids reared from sentinel egg masses & field-collected BMSB egg masses in PA, NJ & DE include:

3 species of *Anastatus*: *reduvii*, 'near' *pearsalli* and *mirabilis*.

3 native species of *Trissolcus* (*brochymenae*, *edessa*, *euschisti*) occur in lower numbers (1% or less).

Ooencyrtus sp. & *Telenomus podisi* (very rare).

Parasitoids of adult BMSB by Tachinae (Diptera)

- incidence of eggs on adult stink bugs ca. 1.7%
- no tachinid emergence from stink bugs with eggs
- indigenous North American tachinids may not be physiologically adapted to develop in *H. halys*



Percent of BMSB with Tachinid Eggs



Is parasitism greater in some habitats than others?



Parasitoids of BMSB previously reported from Asia

Scelionidae

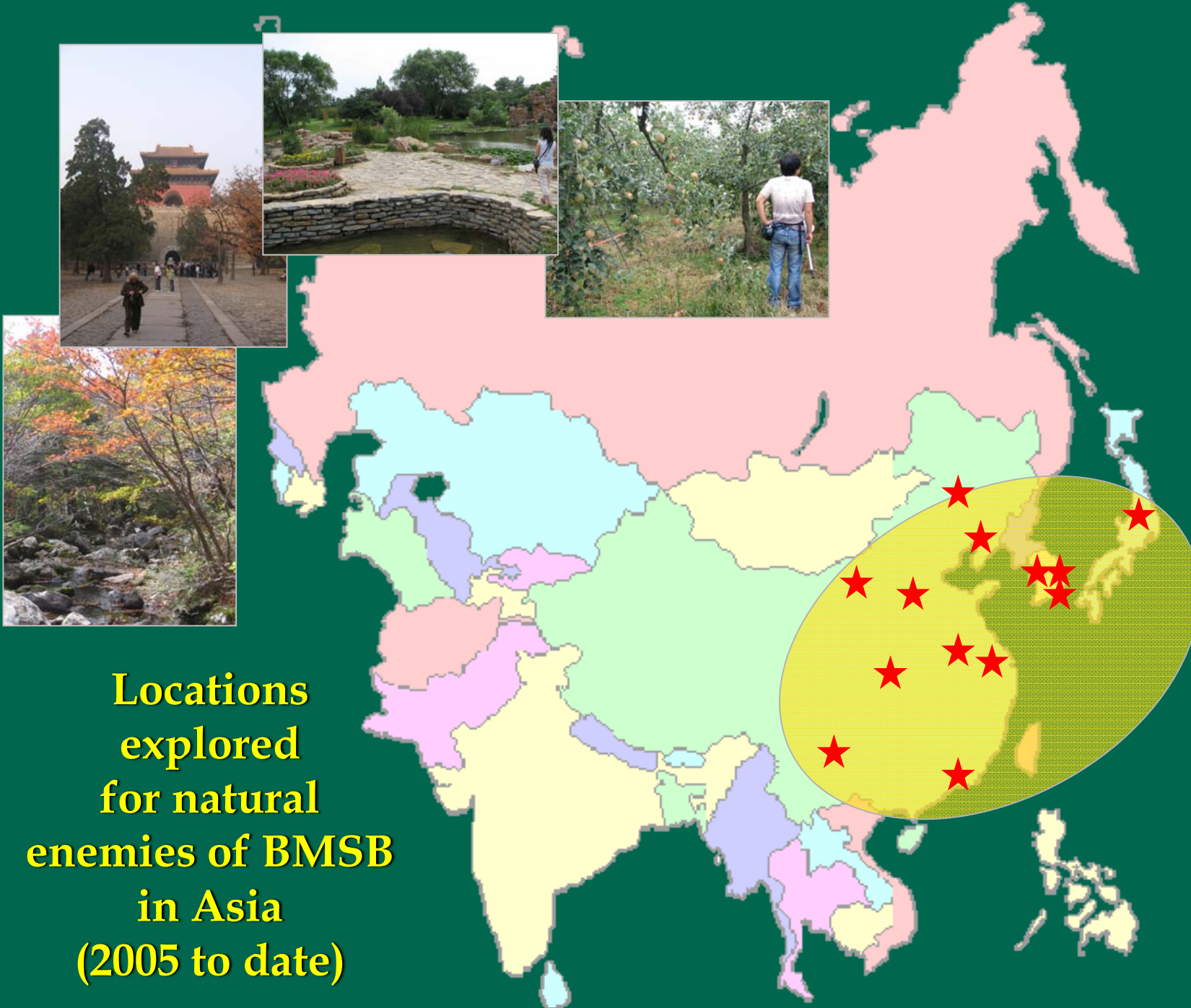
- * *Trissolcus itoi*, *T. mitsukurii*, *T. plautiae* (Japan)
- * *Trissolcus halyomorphae* (China)
- * *Trissolcus* sp. & *Gryon japonicum* (Korea)

Chalcidoidea

- * occasional generalist chalcidoids (found in low numbers)

Tachinidae

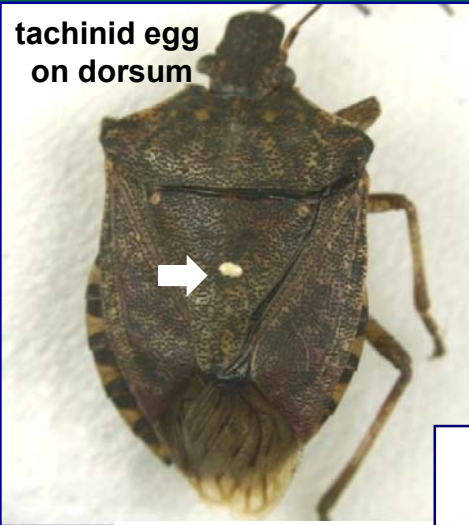
- * *Bogusia* sp. reported to attack adult BMSB (Japan)



**Locations
explored
for natural
enemies of BMSB
in Asia
(2005 to date)**

Tachinid attacking BMSB in Korea: *Pentatomophaga latifascia*

Biology is not well known; most specimens collected fail to develop to emergence





Parasitoid cultures at ARS BIIR in Newark maintained for host range and efficacy evaluations:

- **12+** populations representing at least **4 species of *Trissolcus***

Japan: *T. mitsukurii* (Tskuba 2007)
T. plautiae (Tskuba 2007)
T. flavipes (Tskuba 2007)

China: *T. halyomorphae*
(Beijing 2007, Beijing 2008, Nanjing 2009)

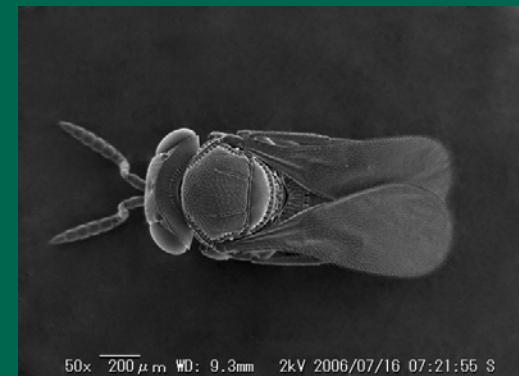
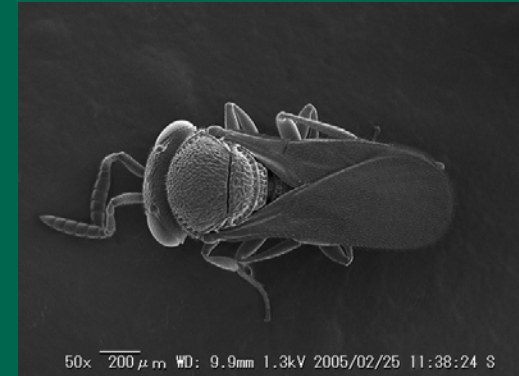
S. Korea: *T. plautiae* (Seoul 2009, 2010)

Species Characterization

Morphology

Molecular characterization

Cross-mating studies





Plautia crossota



Nezara antennata



Dolycoris baccarum

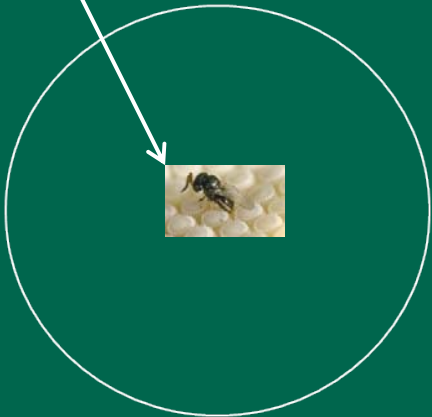


Piezodorus hybneri

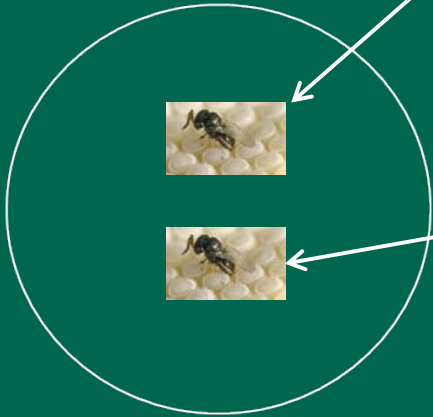
The Japanese *Trissolcus* spp. from BMSB are known to attack other Asian pentatomid pests, including the species shown above, indicating they are not absolutely host specific. The full extent of their host range in Asia is unknown.

HOST RANGE TESTING

Attack & Development



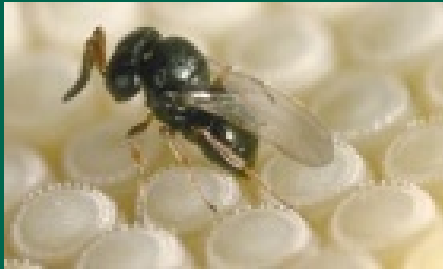
No Choice



Choice



HOST RANGE TESTING



Physiological Selectivity

- Complete development
- Successful emergence
- Sex ratio of progeny
- Fitness of progeny
(size, fecundity)

Behavioral Selectivity

- Egg recognition
- Length of time probing
 - Oviposition time
- Patch residence time

Ecological Selectivity

- Residence time
- Searching behavior

PEST SPECIES

Euschistus servus



Acrosternum hilare

Piezodorus guildinii



BENEFICIAL SPECIES

Stiretrus anchorago



Podisus maculiventris

Brochymena spp.



Phylogenetics of Pentatomidae

- Aphylinae
- Asopinae
- Cyrtocorinae
- Discocephalinae
- Edessinae
- Pentatominae**
- Phyllocephalinae
- Podopinae
- Serbaninae
- Stirotarsinae

Stiretrus
Perillus
Podisus
Euthyrhynchus

Edessa

Euschistus
Meneclis
Oebalus
Proxys
Mormidea

Nezara
Chlorochroa

- Aeliini
- Aeptini
- Aeschrocorini
- Agaeini
- Agonoscelidini
- Amyntorini
- Antestiniini
- Aulacetrini
- Axiagastini
- Bathycoeliini
- Cappaeini**
- Carpocorini
- Catacanthini
- Caystrini
- Chlorocorini
- Coquereliini
- Degonetini
- Diemeniini
- Diplostirini
- Diploxyini
- Eurysaspidini
- Eysarcorini
- Halyini
- Hoplistoderini
- Lestonocornini
- Mecideini
- Memmiini
- Menidini
- Myrocheini
- Mealeriini
- Nezarini
- Opsitomini
- Pentatomini
- Phricodini
- Piezodorini
- Procliticini
- Rhynchocorini
- Rolstoniellini
- Sciocornini
- Sephalini
- Strachiini
- Triplatyxiini

Halyomorpha

Brochymena

Nezara
Chlorochroa

Piezodorus

Bagrada
Murgantia

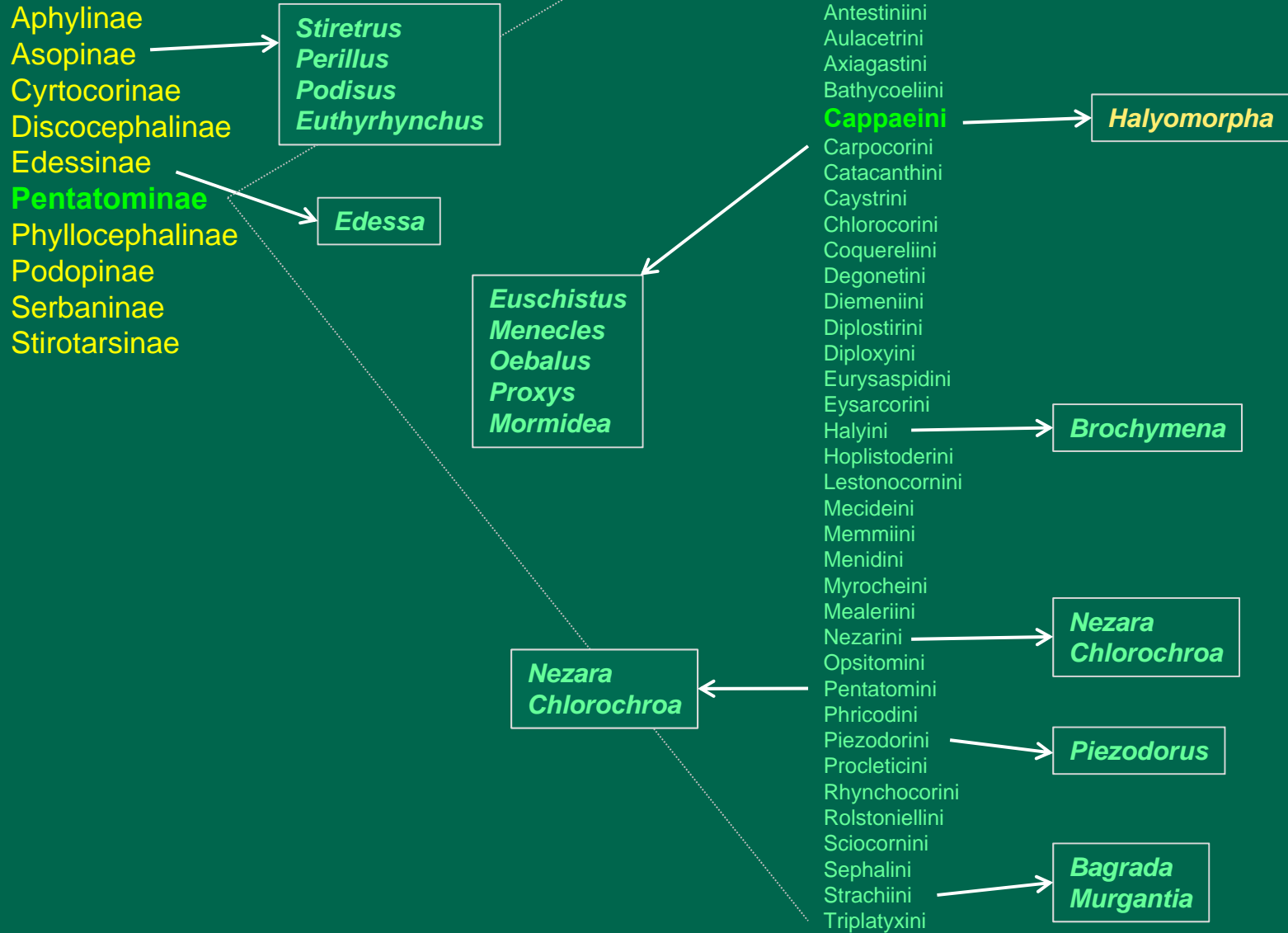




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