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Update on Biological Control of *Drosophila suzukii*

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Beneficial Insects Introduction Research Lab

Drosophila species and habitat diversity

ca. 1500 species:

- Fruit-feeding
  - fermenting fruit
  - fresh undamaged fruit (2 spp)
- Mushroom-feeding
- Feed in decaying leaves
- Feed in flowers

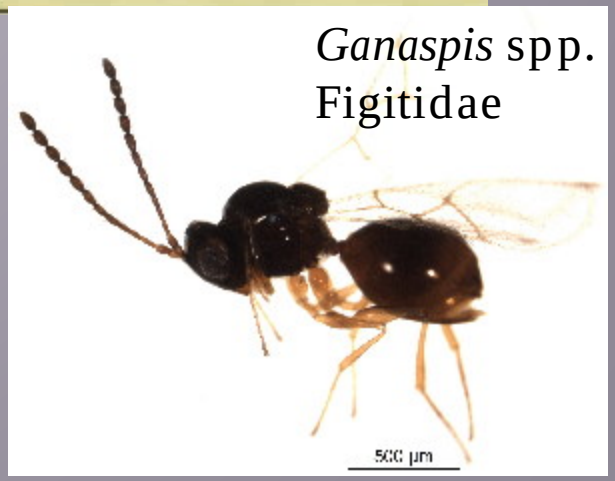
Parasitoids believed important in regulating populations

Larval Parasitoids of *Drosophila*

May have broad or narrow host ranges

Leptopilina spp.
Figitidae

Asobara spp.
Braconidae



Ganaspis spp.
Figitidae

Pupal parasitoids of *Drosophila*

Host-generalists

Pachycrepoideus vindemmiae
Pteromalidae

Trichopria spp.
Diapriidae

Asian parasitoids of *D. suzukii* (reported spp.)

In Japan, *Ganaspis* sp. near *xanthopoda* (Figitidae) is the most active parasitoid with 4-7% parasitism reported. Endophagous parasitoid of larvae, thought to be highly specific for *D. suzukii*.

Leptopilina japonica (Figitidae) & *Asobara japonica (*Braconidae) (shown) are generalist parasitoids in Japan of drosophilid larvae and pupae. Parasitism rate on *D. suzukii* < 1%.

Pachycrepoideus vindemmiae (Pteromalidae), generalist ectoparasitoid of *Drosophila* pupae (*D. suzukii, D. melanogaster)* reported in the USA, Europe and Asia (cosmopolitan).

Host specificity of natural enemies

- Habitat selection cues
  - Arboreal vs. herbaceous hosts
  - Fresh vs. fermenting fruits
  - open vs. wooded vs. margins
  - microclimate

- Host fly defensive capability
  - Host immune response (strong in SWD)
  - Venoms with oviposition
  - Microbial associates – viruses, bacteria, etc.

Distribution of SWD in China

Drosophila suzukii is widespread

(Known) Hosts of SWD:

Rosaceae – *Fragaria ananassa, Rubus idaeus, R. fruticosus* **& other spp. & hybrids of** *Rubus; Prunus avium; P. armeniaca, P. persica, P. domestica, Eriobotrya japonica*
Ericaceae – spp. & hybrids of *Vaccinium*
Grossulariaceae –*Ribes spp.*
Moraceae - *Ficus carica, Morus spp.*
Rhamnaceae - *Rhamnus alpina ssp. fallax, Rhamnus frangula*
Cornaceae - *Cornus spp.*
Actinidiaceae - *Actinidia arguta*
Ebenaceae - *Diospyros kaki*
Myrtaceae – *Eugenia uniflora, Myrica rubra*
Rutaceae - *Murraya paniculata*
Myricaceae - *Myrica rubra*
Caprifoliaceae - *Lonicera spp.*
Elaeagnaceae - *Elaeagnus spp.*
Adoxaceae - *Sambucus nigra*
Vitaceae - *Vitis vinifera, Vitis labrusca*


Cultivated fruit farm
& wild margin


Cultivated fruit farm


Cultivated fruit farm
adjacent to natural
vegetation


Wild hosts in natural areas

Simple baited trap for parasitoids

- bore 15 holes (5-10 mm in diameter) along sides of plastic box (ca. 750 ml)
- add slices of fruit (banana or berries) & hang the trap in a shaded area
- retrieve trap after 3- 7 days & hold for reared parasitoids




Advantages:

- inexpensive
- effective for field-capturing parasitoids

Disadvantages:

- not specific for SWD
- Very messy

If a lab culture of *D. suzukii* is available, the fruit bait may be exposed to the culture for 72 hr and then placed in the field

- retrieve from field after several days
- material from the trap should be transferred to an aerated box and held in laboratory until the emergence of parasitoids

Foreign exploration for natural enemies of *D. suzukii* in its native range

2013 Asian surveys

Surveys in natural areas & cultivated fruit
- baited traps & collected fruits

ARS BIIR & Italian team in China & Korea, July-August : 3-4 spp. each of braconids 7 figitids collected
- 2 species placed in culture at Newark
- 1 braconid & 1 figitid from Korea

Oregon State Univ. team in Korea, mid-August
- 4 species at UC Berkeley (IDs not known)

Cultures, Exploration & Laboratory Screening

Emory University, Atlanta, Georgia (T. Schlenke)

University of California, Berkeley & Parlier (K. Daane)

Oregon State University, Corvallis & research stations (V. Walton)

USDA-ARS BIIR, Newark DE & EBCL, Montferrier, France (K Hoelmer & K. Hopper)

Screening Procedures

No Choice Test

Exposure of non-target species only:

Followed by a SWD control for an additional period:

no attack of non-target

no parasitism recorded

X

no further testing required

Screening Procedures

No Choice Test

Exposure of non-target species only:

Followed by a SWD control for an additional period:

Non-target attacked

Parasitism recorded

Choice Test

Larvae of SWD and non-target species, presented together :

Screening Procedures

Measures of host acceptibility

& non-target impact:

- Attack rate (# hosts parasitized)
- Proportion of undeveloped parasitoids in hosts
- No. of viable adult parasitoids emerged
- Size (fitness) of emerged adult parasitoid
- Sex ratio (proportion adult males : females)

Developing projects with EU partners

- Major new invasive pest of small fruits in Europe
- USDA ARS collaboration with INRA (France) and NRC (Italy) to discover and evaluate new biocontrol agents
- EU IRSES (Marie Curie) scientific exchange program
- Institute for Plant Protection, National Research Council of Italy, Portici, Italy

Projects will support interagency biological control programs throughout the U.S.

Collaboration with Asian partners

- New ARS - funded cooperative agreements with Yunnan Academy of Agricultural Science (Kunming, Yunnan Prov.) & Seoul Nat'l. University (S. Korea) to conduct surveys and establish cultures of natural enemies for further research.
- CABI (Delémont) leads BC component of new EU - funded project (with Yunnan Agricultural University, Kunming)
- Italian project (submitted by Institute for Plant Protection, National Research Council, Portici) with YAAS
- UC Berkeley collaboration (ongoing) with Yunnan Agricultural University
- OR State Univ. cooperation with Korean colleagues

Thank you!