

## ODA Progress Report December 2009

**TITLE:** Biological control of fungus gnats  
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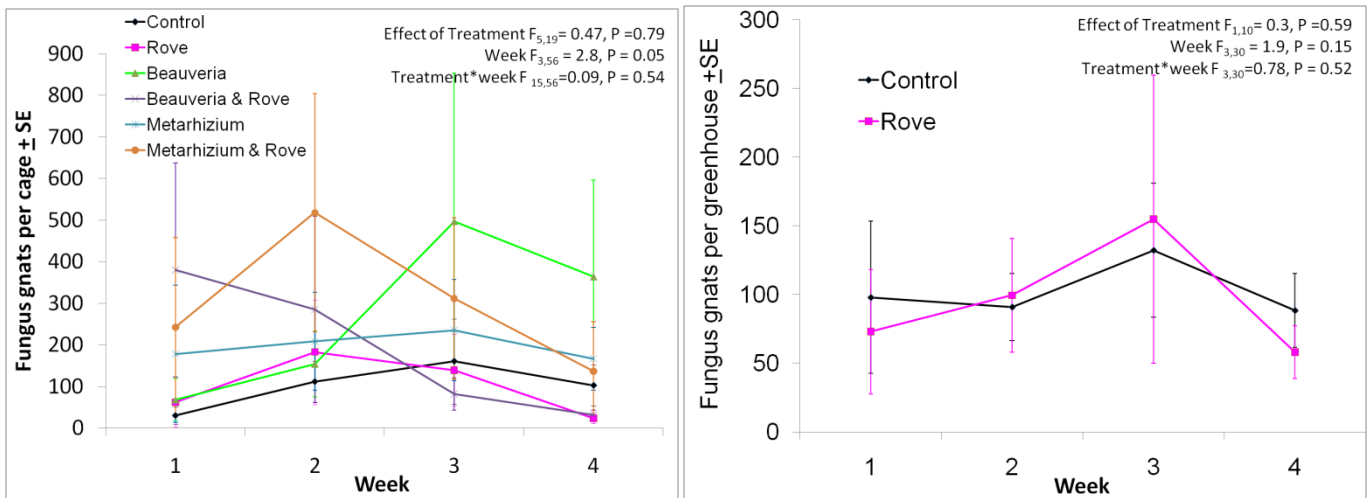
Fungus gnats (*Bradysia* spp.) can damage plants as the larvae feed on the root tissue and as the adults transmit soil-borne plant pathogens. Our project examines the effectiveness of two fungal pathogens *Metarhizium anisopliae* and *Beauveria bassiana* for controlling adults, the predatory rove beetle *Atheta coriaria* for controlling the immature stages of fungus gnats, and whether the combination of predators and pathogens will improve control.

Sources: Insects were from Evergreen Growers, *M. anisopliae* from Novozymes, and *B. bassiana* GHA strain from Mycotech were formulated in our laboratory with barley flakes.

*Objective 1. Determine the effectiveness of M. anisopliae and B. bassiana granules, predatory rove beetles, and pathogen-predator combinations on fungus gnat control.*

Effectiveness was assessed on two flats of alyssum kept in a large mesh cage (~1 m<sup>2</sup>) in the greenhouse. In each cage, 50 fungus gnat adults were released with 10 rove beetles, 1.4 g of *B. bassiana*, and/or 1.4 g of *M. anisopliae* (n = 4 replicate cages per treatment). Fungus gnat abundance was monitored weekly with yellow sticky traps.

- Due to large variation among the replications, none of the treatments consistently suppressed fungus gnats in caged arenas (below left). Rove beetles appeared to possibly be more effective and were further tested in greenhouse trials.



Effectiveness of rove beetle releases was also assessed in open greenhouses. 150 fungus gnats, and 0 or 20 rove beetles were released onto 6 alyssum seedling flats grown in a 16.3 m<sup>2</sup> greenhouse (n = 6 replicate greenhouses per treatment).

- Results have been variable over time in the six replications (above right). While not statistically significant, greenhouses with rove beetles have  $58 \pm 19.2$  fungus gnats and control greenhouses have  $88.5 \pm 26.9$  gnats total after four weeks of treatment.

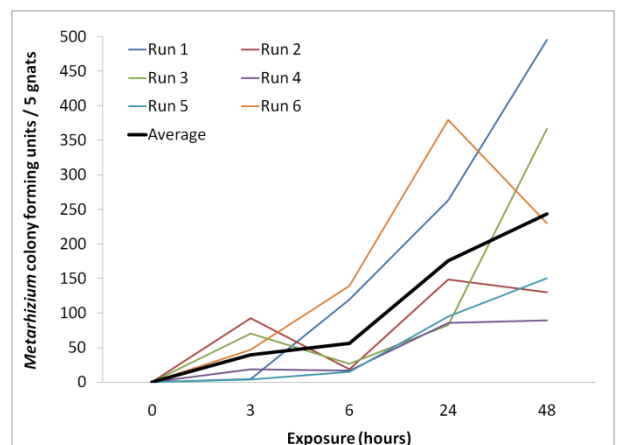
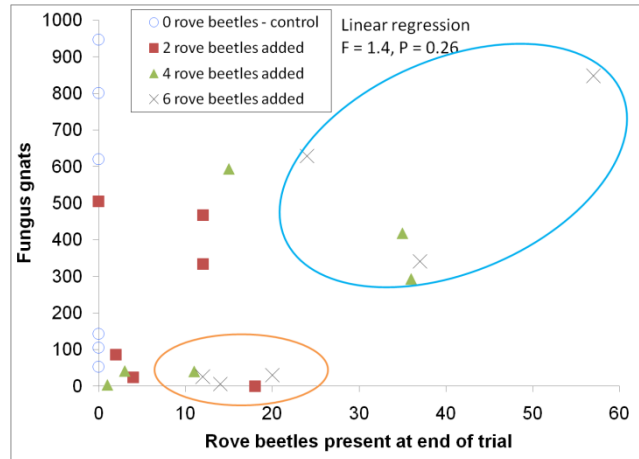
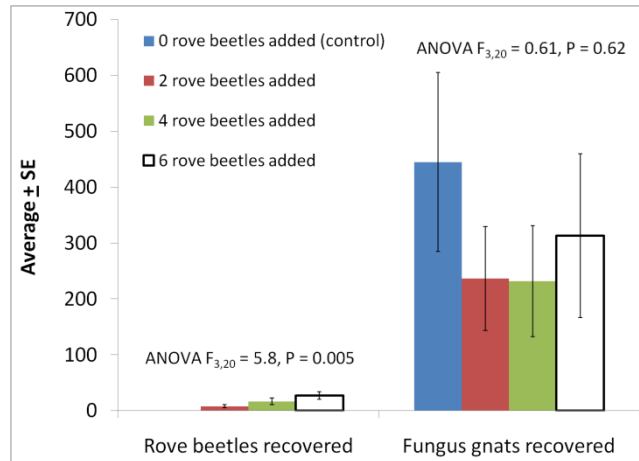
Lastly, various predator:pest ratios were tested in small containers. With 110 mL of soil media, 20 fungus gnat adults and 0, 2, 4, and 6 rove beetles were released and checked two weeks later (n = 6 replicates).

- As expected, the number of rove beetles recovered after two weeks was higher when more rove beetles were initially released (right, right columns). Rove beetles multiplied by 4-fold in two weeks.
- Fungus gnat recovery appeared twice as high when rove beetles were absent versus present, but differences were not significant (right, left columns).
- The relationship between how many predatory rove beetles and fungus gnats are present after two weeks does not follow a consistent trend (below right). In five cases, more than 10 rove beetles and less than 50 fungus gnats were present (orange circle). In five other cases, more than 20 rove beetles and more than 290 fungus gnats were present (blue circle).

*Objective 2a. Determine the viability of B. bassiana and M. anisopliae granules and infectivity rate to fungus gnats over time.*

To determine infectivity rate, fungus gnat adults were exposed to granules placed on soil in a 2 ft<sup>2</sup> cage. Adults were collected after 3, 6, 24, and 48 hr, and plated on agar to confirm infection (n = 6 replicates).

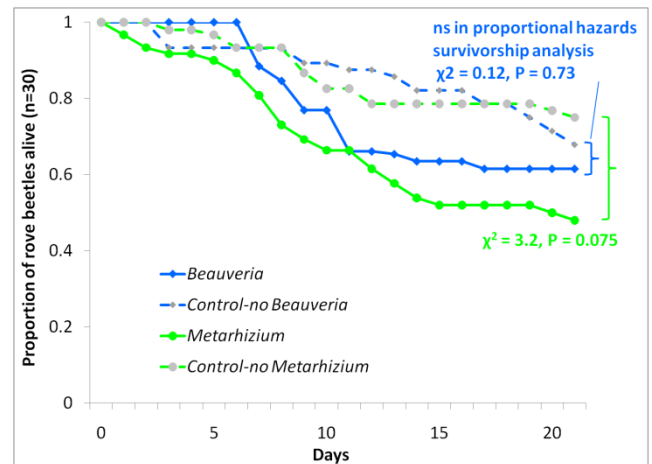
- Fungus gnats were observed to visit granules during exposure.
- Fungus gnats picked up spores of *M. anisopliae*, five fungus gnats picked up  $244 \pm 64$  spores after 48 hours.
- No fungus gnats were found to pick up *B. bassiana* granules from two trials.



*Objective 2b. Determine the compatibility of the fungal pathogens and predatory control agents.*

To determine if *B. bassiana* and rove beetles are compatible, 0.5 g of *B. bassiana* granules ( $1.25 \times 10^7$  viable spores) were placed with rove beetle adults in a petri dish. Three beetles were placed on wet filter paper with dog food on each dish with *B. bassiana* or 'control' dish without *B. bassiana*, (n = 10 replicate dishes per treatment).

- Rove beetle longevity was not affected by the presence of *B. bassiana* granules (blue lines).

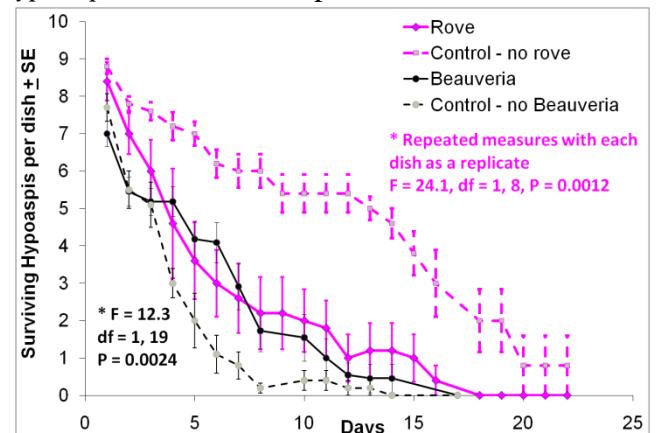


To determine if *M. anisopliae* and rove beetles are compatible, ~0.05 g of *M. anisopliae* granules were placed with adult rove beetles as described above in a petri dish (n = 10 replicates).

- Rove beetle survivorship was marginally reduced by *M. anisopliae* (green lines). Nevertheless, 50% of rove beetles survived 20 days of exposure. Trials conducted in a petri dish represent the worst-case scenario as they expose insects to higher inoculum levels than expected in a greenhouse.

To determine if *B. bassiana* and the predatory mite *Hypoaspis miles* are compatible, 10 mites were placed in a petri dish with moist filter paper, dog food, and 0.1-0.4 g of *B. bassiana* granules (n = 10 replicates).

- H. miles* was not negatively impacted by *B. bassiana*, and survived better in the presence of *B. bassiana* granules (black lines).



To determine if rove beetles and *Hypoaspis miles* are compatible, 1 rove beetle was placed with 10 predatory mites per dish (n = 5 replicates).

- H. miles* was negatively impacted by rove beetles when confined to a petri dish. Rove beetles were not observed to directly feed on *H. miles*, but *H. miles* appeared to move more in the presence of a rove beetle possibly leading to earlier death. Interactions between the two predators in an open environment may be minimal and should be further investigated.