

Protecting the Good Guys from the Good Guys: Optimizing Multiple Predator Biological Control Systems

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Introduction

Amblyseius cucumeris and *Atheta coriaria* are important thrips biological control agents used in organic greenhouses. *A. cucumeris* is a foliar predatory mite of immature thrips (Fig. 1). *A. coriaria* is a predatory beetle that attacks thrips pupae, fungus gnat larvae, and other soil dwelling insects (Fig. 3). Mites may be applied on the soil surface in small breeder piles at the base of plants. These piles are a mixture of bran flakes, prey mites, and predatory mites (Fig. 2). Predatory mites feed on prey mites as an alternate food source before dispersing from the breeder pile; however, mite populations often collapse when *A. coriaria* invade. Mites may also be applied in hanging sachets.



Figure 1: *Amblyseius cucumeris*

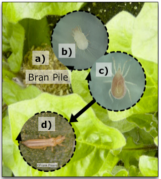


Figure 2: Interactions among mites in bran pile



Figure 3: *Atheta coriaria*

Objectives

1. Observe mite population dynamics in hanging sachets versus breeder piles.
2. Determine if hanging sachets prevent the invasion of *A. coriaria*.
3. Compare mite migration out of breeder piles versus hanging sachets.

Methods

Experiment 1 (Fig. 4):

- Treatments:
 1. Breeder piles (Fig. 8)
 2. Hanging sachets (Fig. 9)
 3. Bran piles without mites (Fig. 10)
 4. Sawdust (Fig. 11)
- Treatments were randomly placed into barley beds
- 200 *A. coriaria* were released
- Samples were collected weekly



Figure 4: Exp. 1 set-up

Experiment 2:

- Breeder piles and sachets were placed onto soil within a petri dish positioned on a sticky card in the center of barley plantings.
- The sticky cards were changed on a weekly basis
- No beetles were released

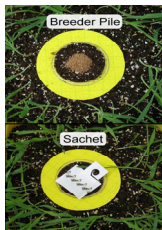


Figure 5: Exp. 2 set-up

Results

Experiment 1

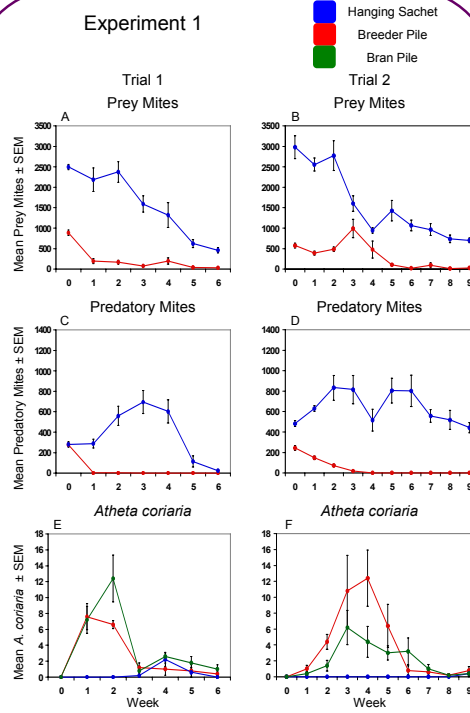


Figure 6: Results from exp. 1. Prey mites (mean ≤ 208) and predatory mites ($x \leq 5$) from bran piles and sawdust are not displayed. *A. coriaria* ($x \leq 4$) from sawdust is not displayed.

Experiment 2

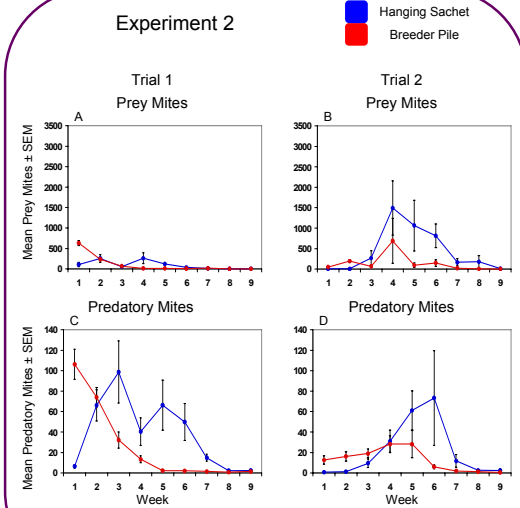


Figure 7: Results from exp. 2.

- Larger populations of prey mites were present in the hanging sachets than the breeder piles (Fig. 6A & 6B).
- Larger populations of predatory mites were present in the hanging sachets than the breeder piles (Fig. 6C & 6D).
- The hanging sachets did not prevent the invasion of *A. coriaria* (Fig. 6E & 6F).
- Similar amounts of prey mites left the sachets as the breeder piles (Fig. 7A & 7B).
- More predatory mites left the sachets than the breeder piles (Fig. 7C & 7D).

Conclusions



Figure 8: Breeder Pile



Figure 9: Hanging Sachet

- Breeder and bran piles often contained more soil mites and collembola than sawdust. Hanging sachets rarely contained anything besides prey and predatory mites.
- *Atheta coriaria* found breeder and bran piles more appealing than sawdust; perhaps bran piles offered more resources than sawdust (Fig 6E & 6F).
- Even though hanging sachets did not prevent invasion of *A. coriaria*, they did delay invasion.
- Breeder piles may be used to induce an impulse of predatory mites; whereas, hanging sachets may be used as a slow release method of predatory mites.



Figure 10: Bran Pile without Mites



Figure 11: Sawdust Pile

Next Steps

- Compare different irrigation systems with the different predatory mite delivery applications.
- Determine how leaf structure and plant canopy complexity effect predatory mite survival due to irrigation and predatory efficacy of thrips.



Figure 12: Boom irrigation system

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