# Protecting Your Plants Using Plant-Mediated IPM Systems


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# The Entomology Research Laboratory

Team of 4 senior scientists and several technicians addressing growers' practical pest problems

## Primary Areas of Interest

Insect Pests of Greenhouse Ornamentals
* Western Flower Thrips

Insect-Killing Fungi
* *Beauveria bassiana*

# Topic Outline

Part 1: System Terminology / Examples

- Indicator/Sentinel Plants
- Trap Plants
- Banker Plants
- Habitat/Insectary Plants
- Guardian Plants


Banker Plant


Guardian Plant

Part 2: UVM Research

- Marigolds for Thrips in Ornamentals

# Integrated Pest Management ' IPM '

## Pest Prevention Not Eradication

- Cultural, physical and biological controls
- Scouting for pests and natural enemies
- Management decision system
  - Uses cost/benefit analyses and economic damage/action thresholds
- Chemical insecticides only if necessary

# Plant-Mediated IPM Systems

Plants used in combination with IPM tactics

For Example:

- Scouting aid (pest &/or nat. enemy attractant)
- Site for nat. enemy releases &/or production
- Management decision aid (action thresholds)

# Plant-Mediated IPM Systems

## Fundamental Concepts

Plants that are more attractive to pests &/or nat. enemies than the crop


Plants that provide prime real estate for nat. enemies & the pest

- Food (pests/hosts)
- Shelter & climate
- Big bedrooms (reproduction sites)
- Cheap rent (production costs)

# Indicator/Sentinel Plants

## What are they?

Plants that aid in early pest detection (insects, mites, diseases)

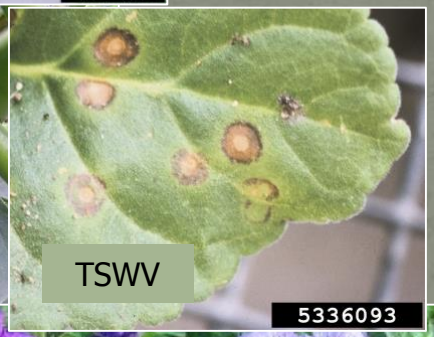
Types

- Pest attractive non-crop plants
- Crop plants prone to pests


# Indicator/Sentinel Plants

## Examples Diseases







Thrips Vectored Viruses

- Impatiens necrotic spot virus (INSV)
- Tomato spotted wilt virus (TSWV)

Petunia

- var. Calypso, Summer Madness, Super Blue Magic
- Will not act as virus source!

Fava Bean

- var. Aquadulce
- Cheap & easy to produce
- Will act as a virus source!

# Indicator/Sentinel Plants

## Examples Insects & Mites


Thunbergia or Lobelia
for Spider Mites



Verbena or
Osteos for Thrips

# Indicator/Sentinel Plants

## Examples Insects & Mites


Fuchsias or Calibrachoas for Aphids




Tomatoes, Salvia,
Lantana for Whiteflies

# Trap Plants

## What are they?

Plants that attract pests out of crop where they are then managed with nat. enemies, chemical insecticides or removal & disposal

# Trap Plants

## Examples

### Thrips



Gerberas


Yellow, flowering gerbera & chrysanthemums in non-flowering chrysanthemums

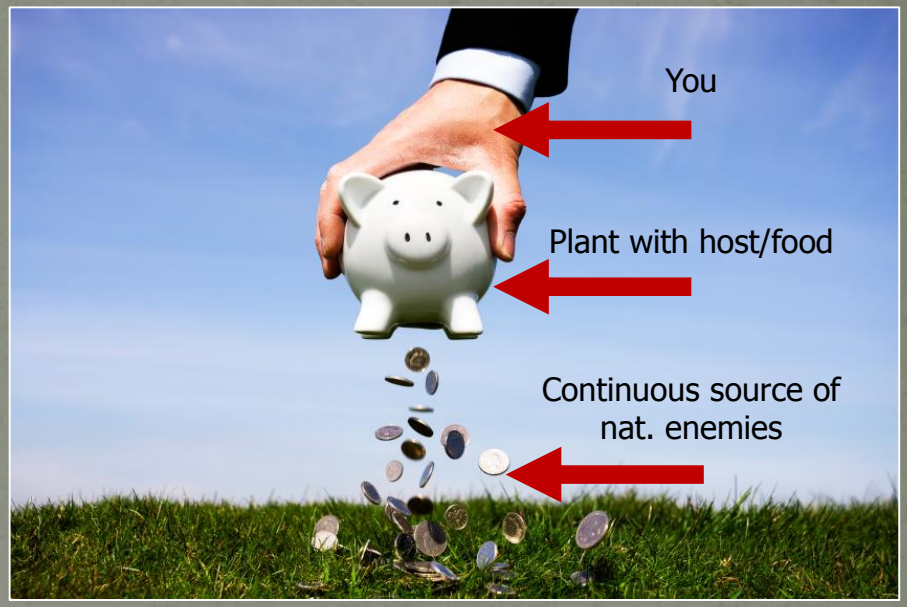
# Banker Plants

## What are they?

Plants that provide nutrition for an ongoing supply of nat. enemies

Nutrition Sources

- Hosts/pests that don't harm primary crop
- Hosts/pests that can harm primary crop
- Pollen/nectars




Saves $$$$$

# Banker Plants

## Examples

### Aphids

Barley Aphid Bankers


*Aphidius* adult parasitizing aphid

Parasitoid exit hole from 'mummy'

# Banker Plants

## Examples

### Thrips & Whiteflies

Ornamental Pepper

Ornamental Peppers (var. Black Pearl, Masquerade, Red Missile, Explosive Ember) provide pollen (& attract thrips) to sustain predators in ornamentals and vegetables

*A. swirskii*

*Orius* sp.

Peppers in Action

# Banker Plants

## Examples

### Thrips



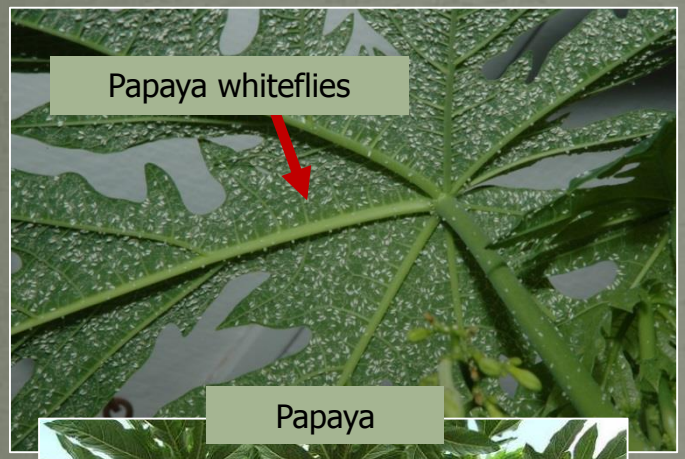


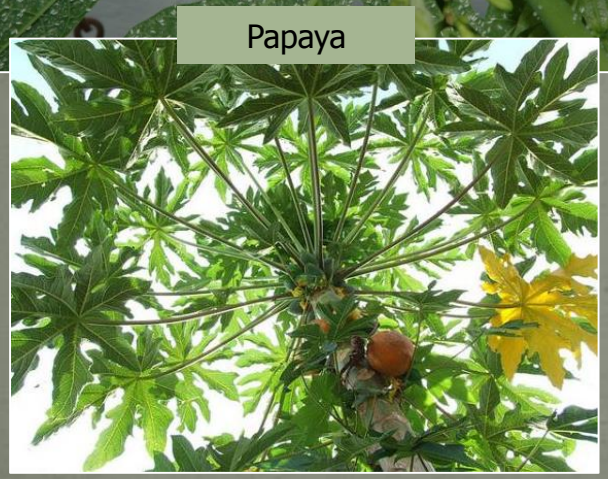
Images from Ron Valentin, BioBest

# Banker Plants

## Examples

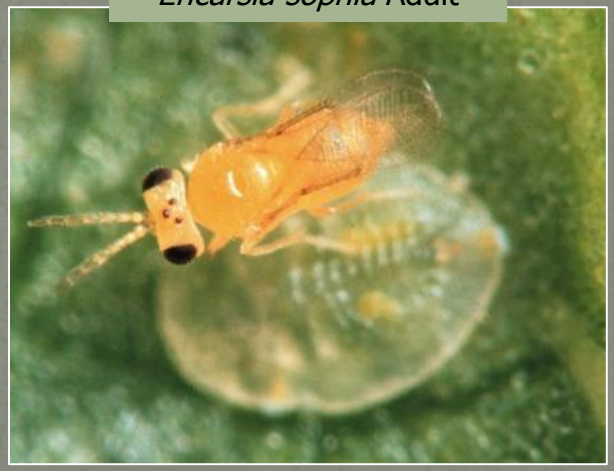
### Silverleaf Whiteflies




Papaya sustains the papaya whitefly for a native whitefly parasitoid for use in poinsettias and vegetables

*Encarsia sophia* Adult



# Banker Plants

## Examples

### Spider Mites

Corn sustains Banks grass mite (*Oligonychus pratensis* [Banks]) for several spider mite predators in greenhouse vegetables

*Feltiella* sp.

*N. californicus*

*P. persimilis*

# Habitat/Insectary Plants

## What are they?

Plants that provide food & shelter to attract & sustain naturally occurring &/or released nat. enemies

# If You Build It, They Will Come!

Syrphids/Hoverflies


Lady Beetles

Orius

Lacewings

Spiders

$$ Free Bios!! $$

# BYOB!

## ~ Build Your Own Baskets ~

Fennel & Dill

Zinnias

Marigolds

Alyssum/Lobularia

Sunflowers

Ornamental Peppers

# Habitat/Insectary Plants

## Examples

Mixed Ornamentals

Mums

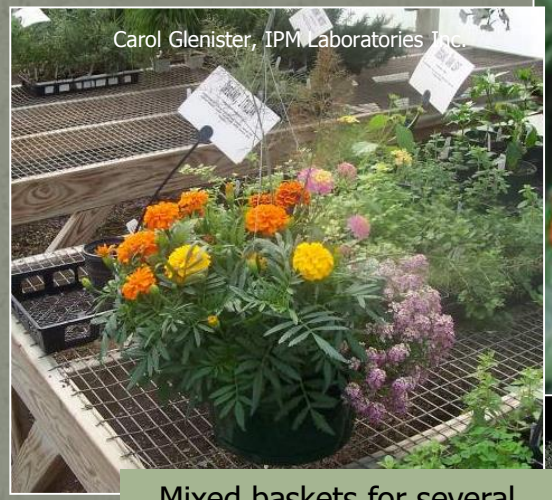
Tomatoes

# Guardian Plants

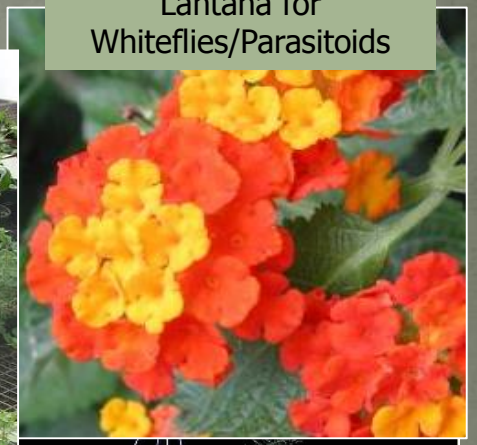
## What are they?

Plants that encompass all functions of indicator, trap, banker and habitat plants simultaneously

- Pulls pests from crop
- Assures nat. enemy reproduction & survival
- Provides monitoring site for pests & nat. enemies
- Supports pest management decisions




Mixed baskets for several pests/nat. enemies



Lantana for Whiteflies/Parasitoids

# Merry Marigolds

## Thrips

Habitat or Guardian Plant

Indicator or Trap Plant

Marigolds (var. hero yellow or bonanza)
in ornamentals

*French varieties preferred over African

# Benevolent Beans

Spider Mites



Bush beans (Strike or Provider)
in tomatoes

Habitat or Guardian Plant

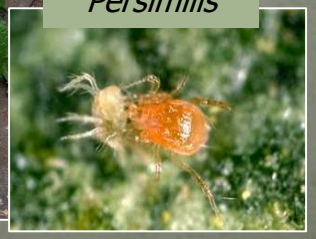
*Feltiella*



Indicator or Trap Plant



*Persimilis*

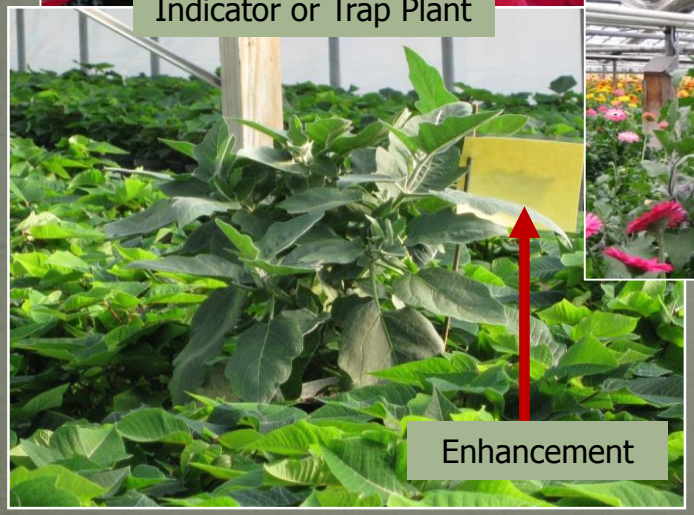


# Eager Eggplants

## Whiteflies

Habitat or Guardian Plant

Indicator or Trap Plant



Enhancement

Eggplants (Fairy Tale Hybrid or Baby Bell)
in poinsettias & gerberas

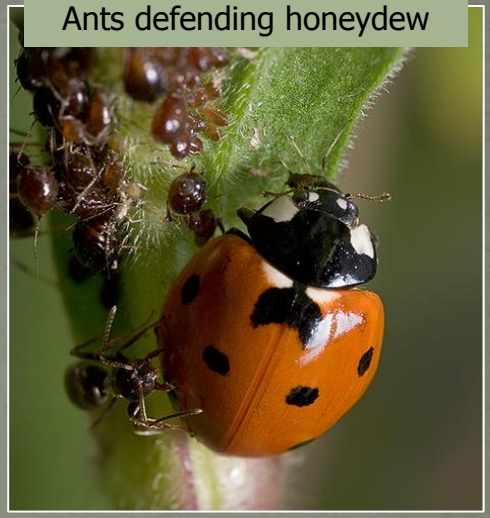
# Plant-Mediated IPM System Advantages

- Saves time monitoring pests & nat. enemies
- Promotes higher quality nat. enemies
  - Skips storage and shipping stage
- Saves money!
  - Sustains released nat. enemies
  - Attracts wild nat. enemies
  - Seeds cheap & easy to grow for many systems (beans, marigolds)
- Reduced chemical insecticide use
- Increases customer awareness of IPM

# Plant-Mediated IPM System Challenges

- Labor (planting, watering, rotating, etc.)
- Could harbor non-target pests
  - Monitoring essential!
- Timing & Scheduling
  - Bankers established, traps flowering at the right times.
    - 3 wks to est. aphids on bankers before purchasing wasps
    - 12 wks for marigolds to flower
  - Some nat. enemies are seasonally active
- Hyper-parasitism or predation
  - Ants or hyper-parasitoids
- Compatibility with other crops
  - Aphid banker plants in monocts (like lilies)
- Customers continuously try to purchase them!

Ants defending honeydew



Hyper-parasitoid exit hole in aphid mummy (indicated by jagged edge)

# How Do I Get Started?

- Pick target pest and crop
- Select system, plant(s) & function
  - Trap, banker, etc.
- Schedule
  - Planting (how many to use)
  - Nat. enemy release timing
  - Stage of crop plant at deployment
- Setup monitoring plan
  - Action thresholds
  - Bail out actions
- Call nat. enemy supplier, other growers or extension personnel for advice

Remember, the system's function is up to you!

# UVM RESEARCH

## A Plant-Mediated IPM System for Thrips in Commercial Greenhouses

# Research Goal

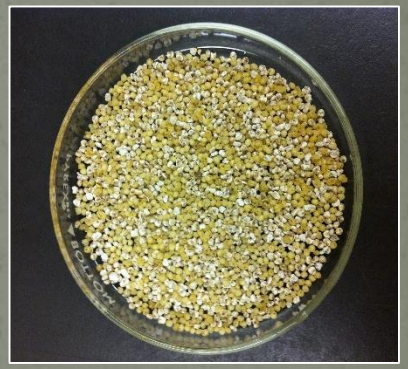
Assess marigold guardian plant (GPS) with a thrips pheromone lure, predatory mites & granular formulations of insect-killing fungi in commercial greenhouses

Marigolds

Lures

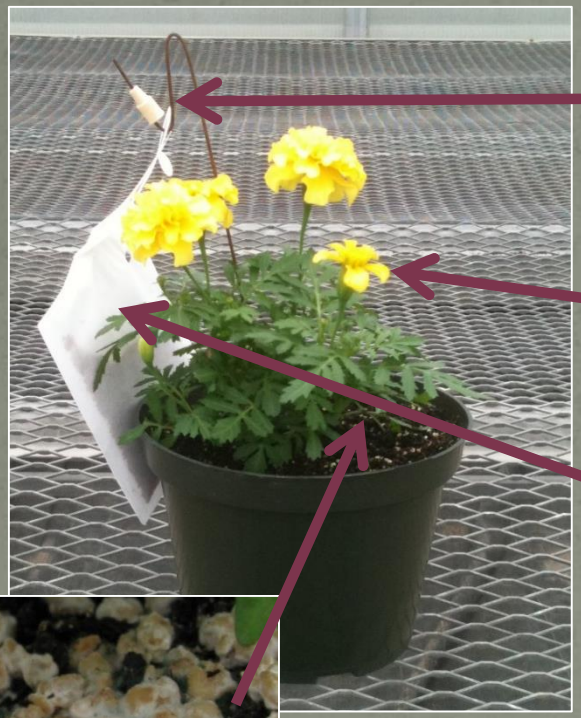
Mites

Fungi



# The Grand Vision

## ATTRACT – SUSTAIN – KILL



Marigolds with lures attract thrips out of crop

Predatory mites (*N. cucumeris*) released to feed on thrips & reproduce on marigolds

Granular fungal material applied to potting mix infect pupating thrips

# Why Marigolds, Fungi & Mites?

- Marigolds cheap, easy to produce, have abundant flowers & thrips love them!
- Fungi & mites easy to release/incorporate
- Potential for persistence
  - Growth in soil (fungi)
  - On pollen in absence of thrips (mites)
- Low impact on environment & human health
- Compatible with most other parasites & predators

# Research Objectives

1. Evaluate effectiveness of marigold GPS to manage thrips in greenhouse-grown bedding plants
2. Observe attractiveness of pheromone lure to thrips on sticky cards
3. Assess persistence of predatory mites & fungi over time to determine reapplication rates

# Methods

12 Trial Greenhouses
Across 6 Sites

6 Treatments x 3 Reps/Greenhouse

1) Mg with EXP strain of *B. bassiana*, thrips lure & pred. mites
2) Mg with GHA strain of *B. bassiana*, thrips lure & pred. mites
3) Mg with thrips lure only
4) Mg CONTROL without thrips lure, fungi, or mites
5) Yellow sticky card with thrips lure
6) Yellow sticky card without lure

# Methods

- Produced marigolds (var. Hero Yellow)
  - Dec-Feb/Mar
- Bi-wkly Sampling – 12 wks
  - Mar-June
- Marigold & Random Plant Inspections
  - # Thrips adults & larvae
  - # Pred. mites
  - Damage rating
- Blossom samples (2 per marigold)
  - # Thrips adults & larvae
  - # Pred. mites
- Sticky Cards
  - # Thrips adults
- Fungal samples (each marigold, 0 & 12 wks)
  - # Spores/gram soil

# Damage Evaluation

0

1
<10%

2
10-25%

3
26-50%

4
51-75%

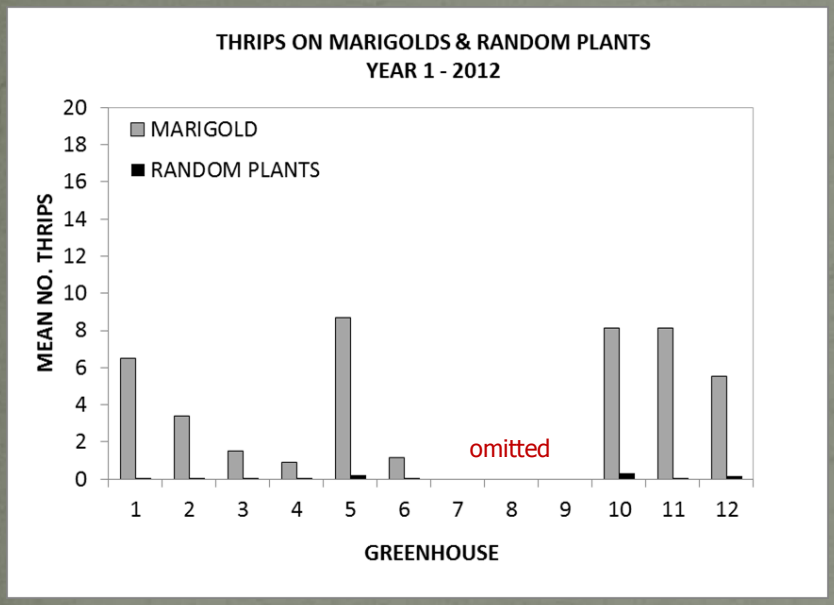
5
76-100%

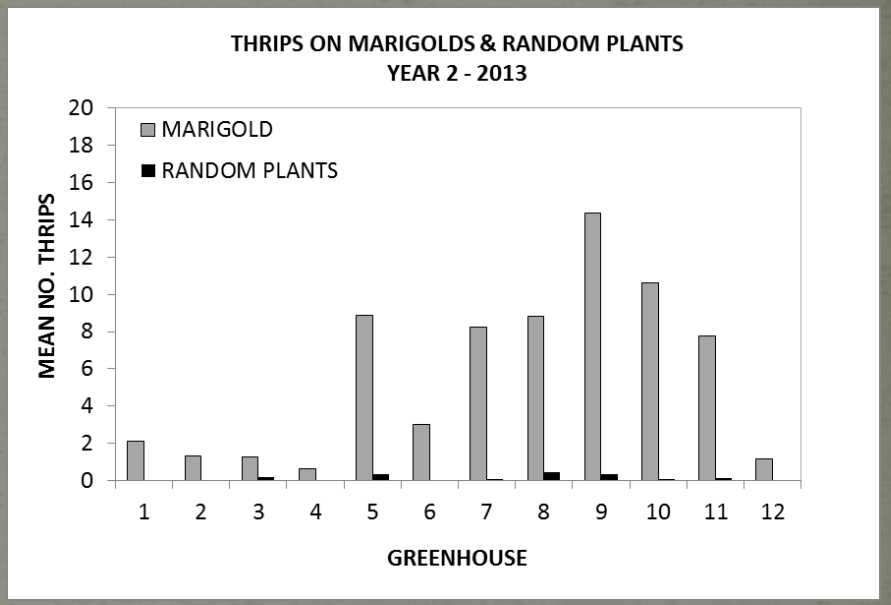
# Results – Objective 1

## Marigold GPS effectiveness against thrips

### Part 1

### Thrips on Marigolds vs. Randomly Inspected Plants



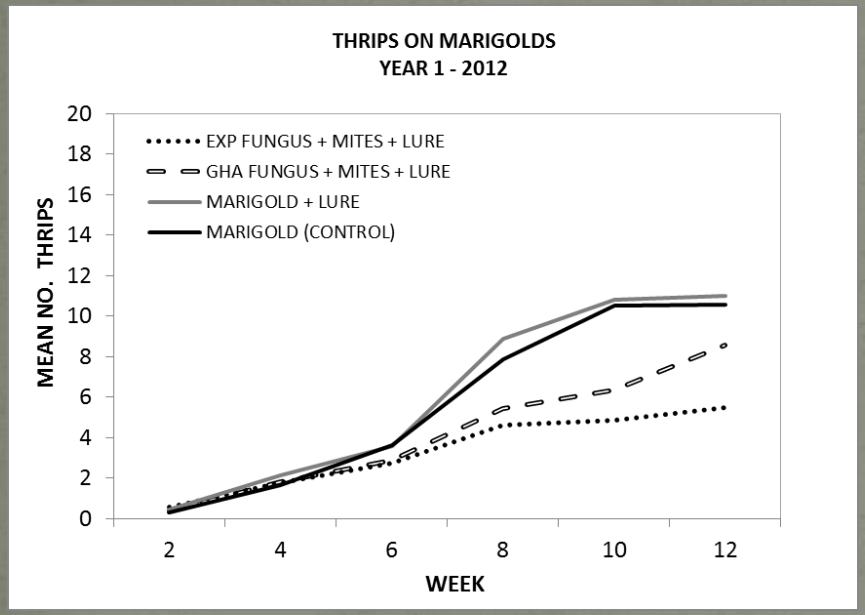

- GPS was effective at attracting thrips from the crop
- Over 95% of observed thrips found on marigolds!

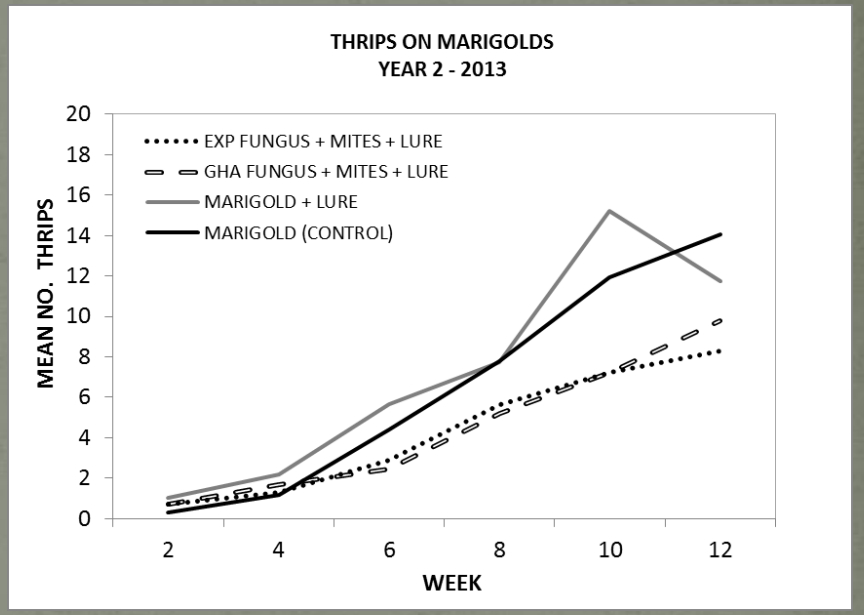
# Results – Objective 1

## Marigold GPS effectiveness against thrips

### Part 2

### Thrips Management on GPS

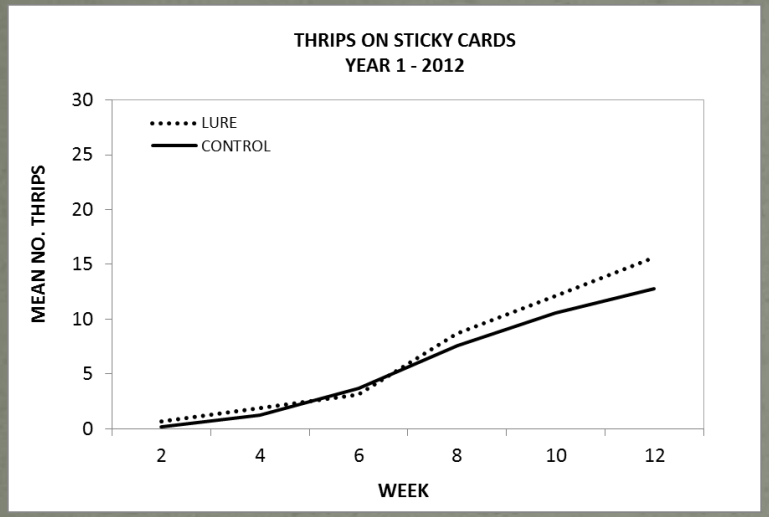


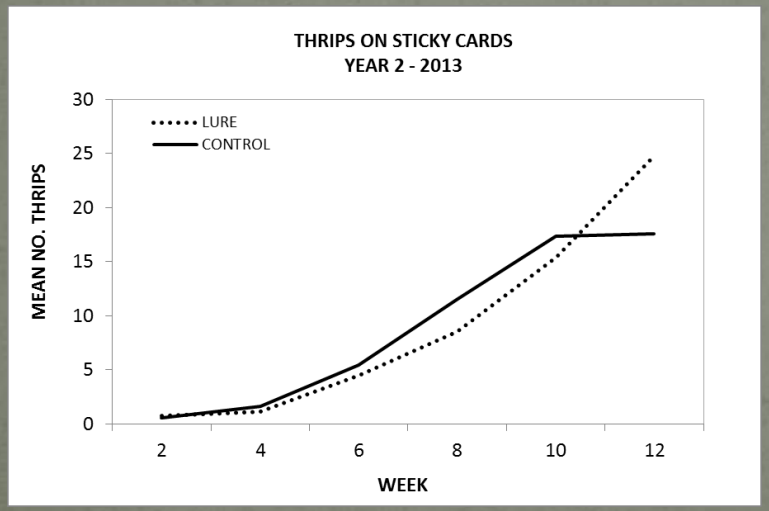




- GPS with lures, fungi & mites had fewer thrips than those without
- Marigolds with the lures were just as attractive as those without

# Results – Objective 2

## Attractiveness of pheromone lure to thrips on sticky cards

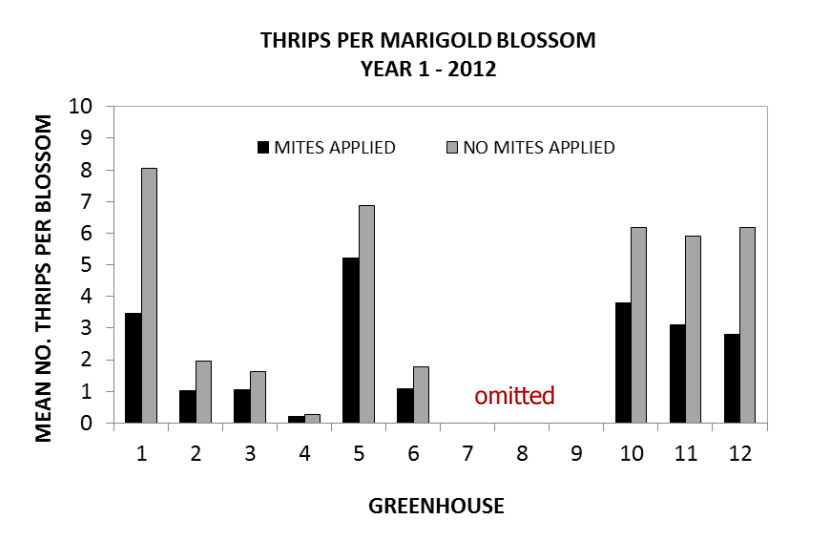



There were no differences in attractiveness

# Results – Objective 3

## Predatory Mite & Fungal Persistence




- Predatory mites and fungi persisted for 12 wks
- Fewer thrips were observed in marigold blossoms that had mite treatments applied

# General Conclusions

The PROOF is in the plants!


- Marigold GPS is a useful IPM tool
  - Fewer thrips on marigold GPS over time than controls
  - Fewer thrips on crop plants surrounding marigolds
  - How many thrips can the GPS handle?
- Foliar damage after 12 wk was less on marigold GPS than the controls
  - Several untreated marigolds were removed prior to reaching 12 wks
- The lures do not enhance the attractiveness of sticky cards or marigolds to thrips
  - Are they worth the expense?
- Predatory mites & fungi persisted for 12 wks
  - One application needed per season?

# Supporting Information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# Questions?



## THANK YOU!!!

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Several images in this presentation were taken by UVM, Jack Kelley Clark, UC IPM Program & from several biological control vendor websites