

# Management

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# Agricultural History

## The Green Revolution

- Between 1940's - 1960's
- "saved over a billion people from starvation"
- high-yielding varieties of cereal grains
- Expansion of irrigation infrastructure



- Modernization of management techniques
- Distribution of hybridized seeds, synthetic fertilizers, and pesticides to farmers

Norman Borlaug



# Agricultural History



## Agricultural History | Invasive species

502 Records  
\$ billions in economic impact

Spotted Wing Drosophila  
Estimated revenue loss in 2008  
\$511.3 million



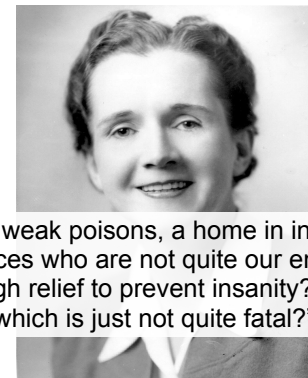
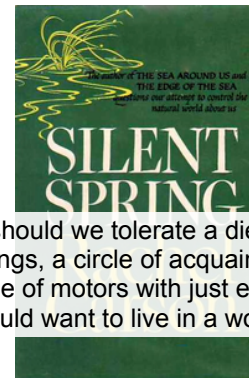
## Agricultural History



## Agricultural History



## Integrated Pest Management



“Why should we tolerate a diet of weak poisons, a home in insipid surroundings, a circle of acquaintances who are not quite our enemies, the noise of motors with just enough relief to prevent insanity? Who would want to live in a world which is just not quite fatal?”

1970's

USDA creates nationwide IPM program in Land  
Grant Universities

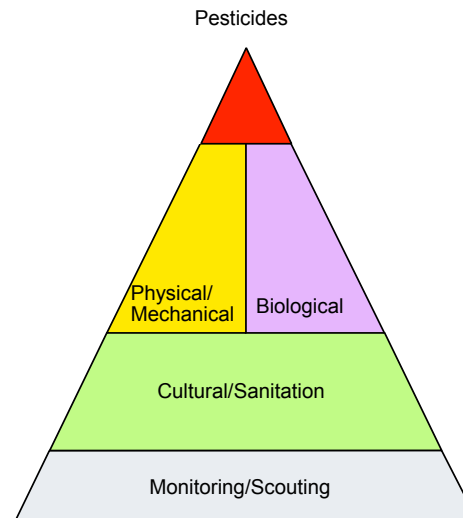




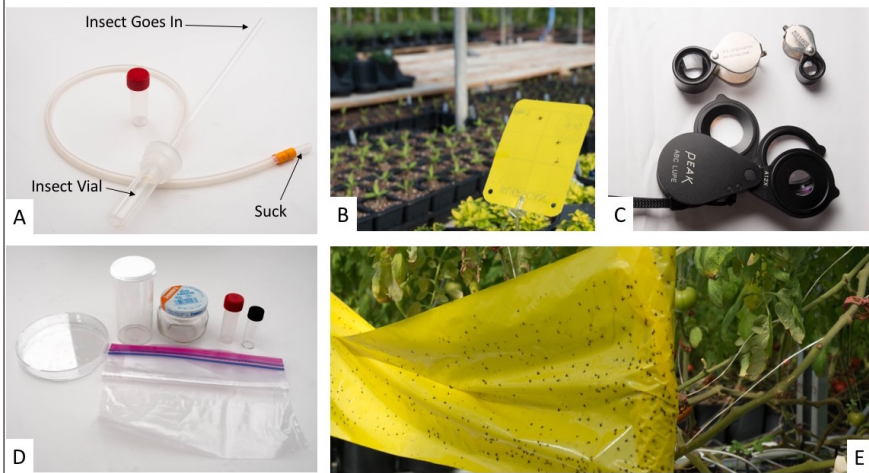
# Integrated Pest Management

- Minimize impact on the environment
- Minimize impact on human health
- Maintain or increase soil fertility
- Long-term pest management
- Prevent pesticide-resistant pests
- Strives to maximize long-term returns/savings

# IPM Pyramid

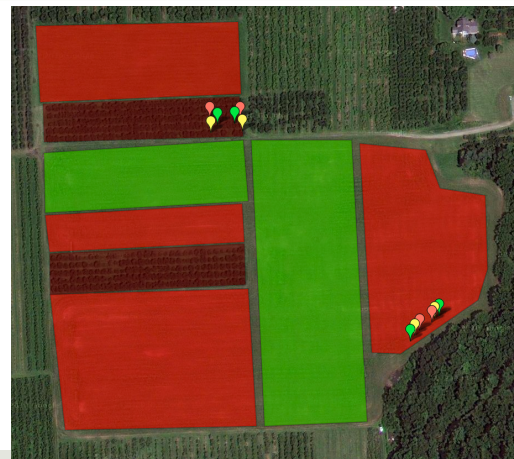


# Monitor Tools of the Trade



# Monitoring/Scouting

PM Units Presence-absence Indicator plants Traps/Lures Control efficacy



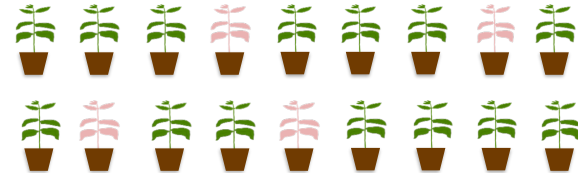
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# Monitoring/Scouting

PM Units    **Presence-absence**    Indicator plants    Traps/Lures    Control efficacy

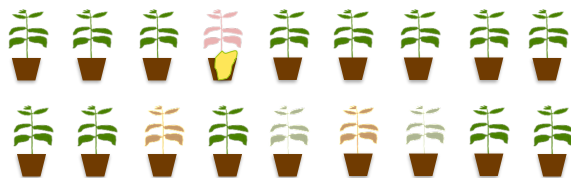


$1/6 = 17\%$

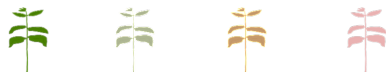
$4/20 = 20\%$

# Monitoring/Scouting

PM Units    Presence-absence    **Indicator plants**    Traps/Lures    Control efficacy



Higher infestation →



# Scouting Tools

White piece of paper

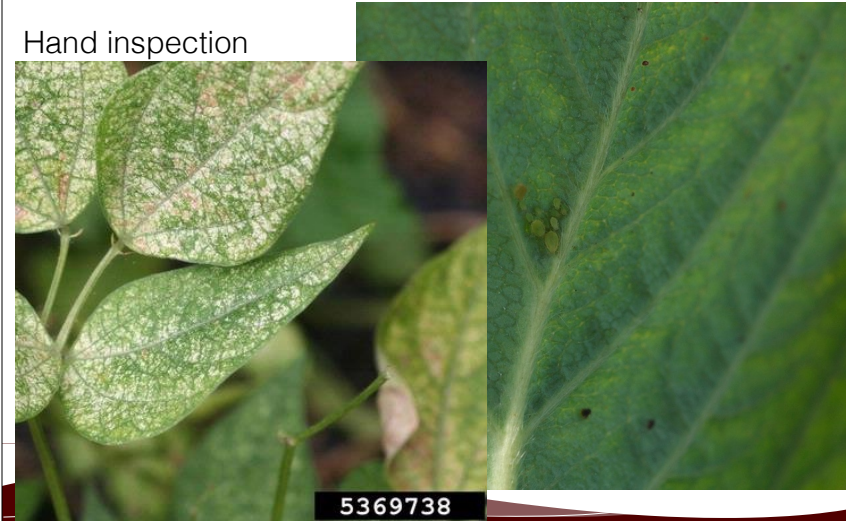


Scot Nelson



# Scouting Tools

Hand inspection



# Monitoring/Scouting

PM Units    Presence-absence    Indicator plants    **Traps/Lures**    Control efficacy

Creds: Chelsea Eby & Mark Gardiner



# Monitoring/Scouting

PM Units    Presence-absence    Indicator plants    **Traps/Lures**    Control efficacy

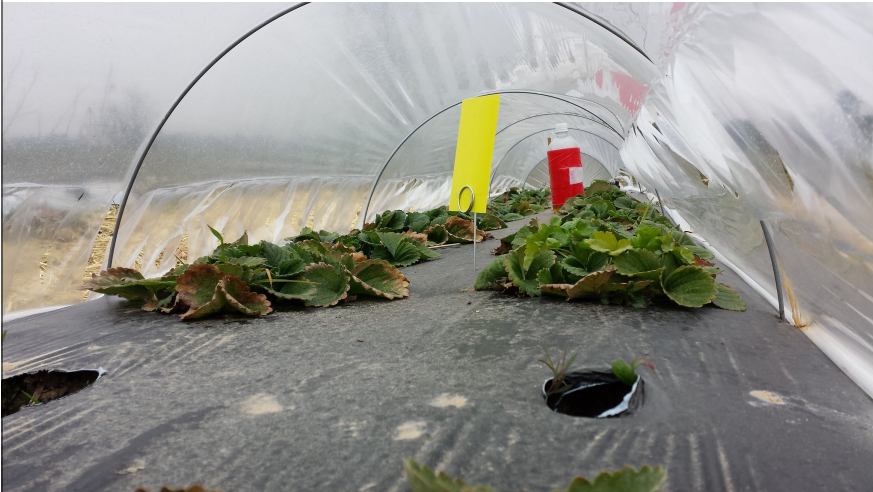


# Scouting Tools

Yellow/Blue Sticky Cards



## Monitor



## Monitor



TEXAS A&M  
AGRI LIFE  
EXTENSION

## Scouting Tools

TEXAS A&M  
AGRI LIFE  
EXTENSION

Sweep Nets



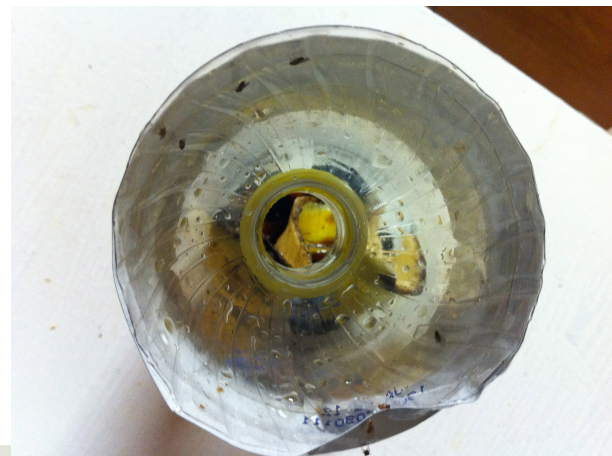
Figure 15. Proper use of a sweep net.

Photo: NC State University

## Monitoring/Scouting

TEXAS A&M  
AGRI LIFE  
EXTENSION

PM Units    Presence-absence    Indicator plants    **Traps/Lures**    Control efficacy







## Cultural/Sanitation

- Keep a clean environment
- Remove weeds/alternative hosts
- Reduce unnecessary moisture
- Companion planting
- Banker Plants
- Trap Plants
- Crop Rotation
- Nutrient management
- Plant defense

## Physical/Mechanical

- Hand weed
- Hand remove insect pests
- High pressure water spray
- Exclusion nets and barriers
- Pitfall traps
- Yellow sticky cards

## Cultural & Mechanical Control

Sanitation



## Cultural & Mechanical Control

Companion planting

**Efficacy of three natural substances against apple aphid (*Acphis pomi* De**

**Geer, 1868) using Marigold (*Tagetes erecta* L.) as an attractive crop to natural enemies in onion fields**

**Effect of marigold on aphid population dynamics in onion fields**

**Beata Jankó; Cravo-de-defunto (*Tagetes erecta* L.) como cultura atrativa para inimigos naturais em cultivo de cebola**

<sup>1</sup> Department of Entomology, University of Kraków, Poland

1-425

<sup>2</sup> Department of Entomology, University of Kraków, Poland

in Kraków,

**Luís Cláudio Paterno Silveira<sup>I</sup>; Evoneo Berti Filho<sup>II, \*</sup>; Leonardo Santa Rosa Pierre<sup>II</sup>; Fernanda Salles Cunha Peres<sup>III</sup>; Julio Neil Cassa Louzada<sup>IV</sup>**

39%±12% (ci

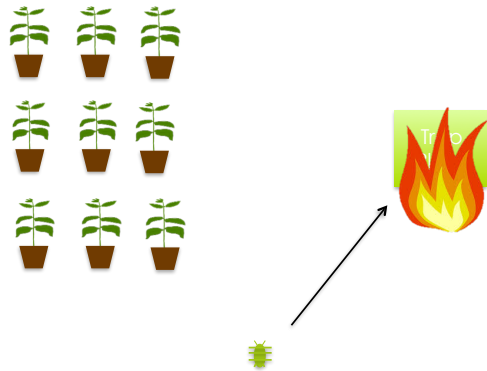
±2)% of

the substances tested was found at highest concentrations.



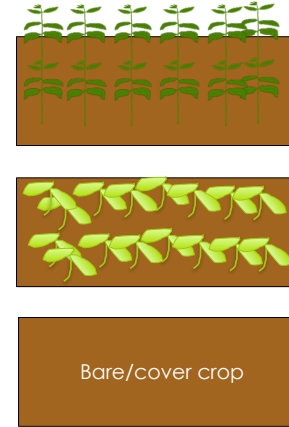
## Cultural & Mechanical Control

Trap Plants



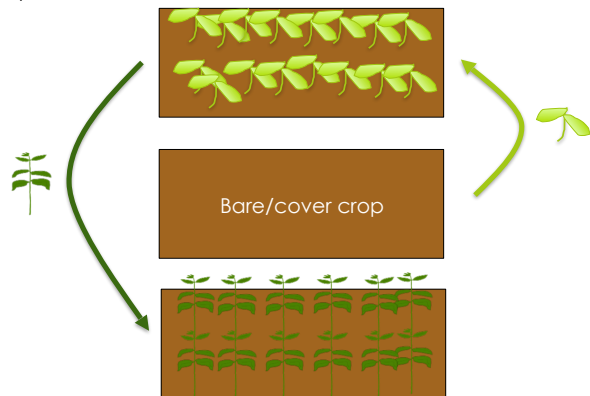
## Cultural & Mechanical Control

Crop rotation



## Cultural & Mechanical Control

Crop rotation



## Cultural & Mechanical Control

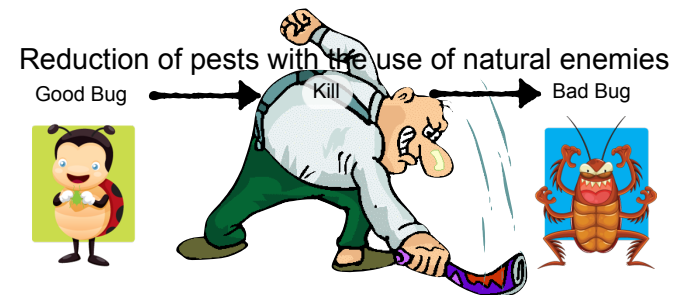
Mechanical removal



## Biological Control

- Conservation
- Classical
- Augmentation
- Rear/purchase and release
- Insect pathogens (i.e. Bt)
- Pheromone traps/mating disruption
- Sterile Insect Release

## Biological Control



## Biological Control

Conservation, Classical and Augmentation

Conservation	Classical	Augmentation
<ul style="list-style-type: none"> <li>• <i>Conserve natural enemies</i></li> <li>• <i>Reduce sprays</i></li> <li>• <i>Better timed sprays</i></li> <li>• <i>Keep natural enemy habitats and alternative hosts</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Introduce an 'alien' predator for control of an invasive pest</i></li> <li>• <i>Establish predator-prey interaction</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Supplemental release of natural enemies</i></li> <li>• <i>Inundative vs. inoculative</i></li> </ul>

## Biological Control

### Advantages

- Reproduce
- Target & find the pest
- Evolve with the pest
- Can be economic
- No environmental toxicity
- Don't harm other beneficials
- No pesticide residue
- No phytotoxicity
- Insects are super cool!





## Biological Control

### Disadvantages

- Not immediate
- Requires more human involvement
- Initially more costly; time to establish biocontrol program
- Must tolerate some damage
- Challenging in the face of new invasive pests
- Requires effective monitoring program
- Won't magically 'fix' pest problems



TEXAS A&M  
AGRI LIFE  
EXTENSION

## Main Suppliers to Consider

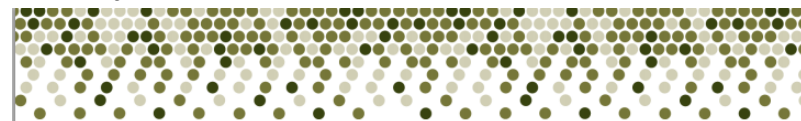


## Most Commonly Used Natural Enemy List

- Cryptolaemus* | Mealybug
- Trichogramma* | T. pretiosum
- Steinernema* | Caterpillars/Grubs/fungus gnats/Thrips
- Atheta coriaria* | Fungus Gnats
- Hypoaspis* | Fungus Gnats
- Amblyseius cucumeris* (breeding sachet or bran) | Thrips
- Orius* | Thrips, aphids, whiteflies, mealybugs, two spotted spider mites
- Amblyseius swirskii* (breeding sachet or tube) | Thrips, whitefly
- Amblyseius andersoni* (breeding sachet or tube) | two-spotted spider mites
- Amblyseius californicus* (breeding sachets or tube) | two-spotted spider mites
- Amblyseius fallacis* | two-spotted spider mites
- Phytoseiulus persimilis* (tube/bottle) | two-spotted spider mites
- Encarsia formosa* | whitefly
- Eretmocerus eremicus* | whitefly
- Aphidius colemani* | aphids
- Aphidoletes aphidimyza* | aphids
- Chrysoperla carnea* | aphids
- Aphidius ervi* | aphids
- Aphidius matricariae* | aphids

## Quality Control

- Macroorganism
- Eat, lay eggs in, or decrease survival of pests
- Typically applied manually/by hand, in specialized release packets
- Quality control:



### Grower Guide: Quality Assurance of Biocontrol Products

Compiled by Rose Buitenhuis, PhD, Research Scientist, Biological Control,  
Vineland Research and Innovation Centre, 2014

## Eretmocerus eremicus



## Eretmocerus eremicus

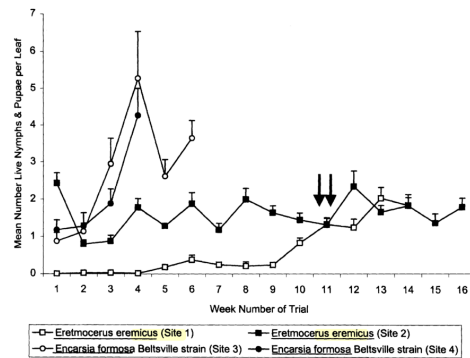


Fig. 2. The mean number of live *Bemisia argentifolii* nymphs and pupae ( $\pm$  SE) per leaf on uncaged poinsettia plants in the biological control greenhouses treated with *Eretmocerus eremicus* (sites 1 and 2) or *Encarsia formosa* Beltville strain (sites 3 and 4). Trial duration times at sites 3 and 4 were reduced because growers intervened with chemical treatments to suppress *B. argentifolii* population growth. Arrows indicate times of insecticide applications at site 2.

Hodde et al. 1999

if whitefly  
*ialeurodes*  
*(T. abutlonea)*

## Chemical Pesticide Control

Role of chemical control in IPM

Yes	No
<ul style="list-style-type: none"> <li>Use judiciously based on monitoring data</li> <li>Time sprays to prevent harm to beneficials</li> <li>Time sprays for effectiveness</li> <li>Use low persistence high specificity pesticides</li> <li>Target infestation area only if infestation is localized</li> <li>Rotate chemicals to prevent resistance</li> </ul>	<ul style="list-style-type: none"> <li>Spray based on calendar spray schedule</li> <li>Spray when flowers are in bloom</li> <li>Spray them when you see them</li> <li>Spray with the most effective pesticide over and over again</li> <li>Feed your plants pesticides for breakfast, lunch and dinner (and dessert, if they deserve it).</li> </ul>