## Integrated Pest Management for Greenhouse and Nursery



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\*Best Management Practices (BMP)

Traditional Pest Control	Integrated Pest Management
Chemical intensive	Knowledge intensive
Reactive to pest outbreaks	Long-term pest suppression tactics
Killing pests emphasized	Preventing pests emphasized
Most site visits include spraying	Most site visits include inspection/monitoring



Prevention	Sanitation	Cultural
Screens and double access doors*	Footbaths (disinfectant)*	Soilless media
Inspections of plant stock (propagation)	Hand/equipment washing stations (soap)	Solorization
Remove weeds/ mow turf) (pest reservoir)	Remove/dispose of contaminated plants	Mulching
Avoid 'dew point' conditions*	Monitor/treat reclaimed water**	Select resistant plants/cultivars

\*greenhouse; \*\* nursery



Insect screening on equipment

#### Photos Nexas Greenhouse Systems

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Insect pest	mm
Aphids	$0.34 - 0.341^{1}$
	$0.266 \times 0.818^2$
	$0.266 \times 0.818^3$
Whiteflies	$0.46 - 0.462^{1}$
	$0.266 \times 0.818^2$
	$0.230 \times 0.900^3$
Dipteran leafminers	$0.61 – 0.64^{1}$
	$0.266 \times 0.818^2$
	$0.530 \times 0.530^3$
Thrips	$0.19 - 0.192^{1}$
	$0.150\times0.150^2$
	$0.135 \times 0.135^3$

Table 1. Insect exclusion screening hole-size recommendations

<sup>1</sup>Bethke and Paine (1991), <sup>2</sup>Green-Tek (2015), and <sup>3</sup>Stansly and Naranjo (2010).





Sanitation between crop cycles





Nursery planting media under double-layer plastic for solarization. Photo James J. Stapleton.

### SCOUTING/MONITORING



### Timely detection can answer questions

- 1. What kinds of pests? Something to worry about?
- 2. Are they causing damage?
- 3. When to control (if needed)?
- 4. Have control methods worked?

Good reasons to do this!

- 1. Deal with pest infestation early
- 2. Identify hot spots and reduce pesticide costs
- 3. Record keeping allows prediction of future pest problems

### • Visual inspection





### **Visual inspection**

#### inspect terminals and flip leaves



Scouting container nurseries



Z Pattern

Scouting container nurseries



### Triangular Pattern

## Useful equipment for sampling, digging and monitoring













### **Tips for Scouts**

- Enter each block looking for abnormal plant symptoms
- Remove some suspect plants out of the pot (check moisture and root decay)
- Examine foliage for trouble, both new and old growth and upper and lower surfaces
- Count or estimate # plants per block with symptoms



### Tips for scouts (cont.)

- Look for problem areas (i.e. weeds, irrigation problems or plant spacing)
- Are symptoms irregular (pest problem) or more regular (environmental problem)?
- Flag problem areas for later inspection and pesticide applicator attention
- Record the number and life stage of pests present and any beneficial insects present.



# Mites: signs and symptoms



### Thrips signs and symptoms



Red-banded thrips on mango



Gladiolus thrips

Photos: bugwood.org



Signs of scales and mealybugs include waxy deposits, chlorotic leaves, honeydew, sooty mold, and distorted growing terminals



- Simple and versatile
- Relative inexpensive
- Use: aphids, thrips, whiteflies, some flies and small moths
- Issues: need frequent replacement, and identification can be difficult due to sticky mess

Yellow sticky card





### Ambrosia beetle traps





## Scale insect 'tape' trap



## Lacebug signs and symptoms



Look for stippling on upper surface and 'tar spots' on lower surface



### **BIOLOGICAL CONTROL**

- 2 types:
- Biopesticides
- Natural enemies (native or released)



### What are Biopesticides?

https://www.epa.gov/pesticides/biopesticides

- Microbials: Bacteria, fungi and viruses
- **Biochemicals**: Fermentation products, plant extracts, plant growth regulators, minerals (non-toxic Mode of Action)
- Insecticides, fungicides, nematicides, herbicides, molluscicides, bacteriocides
- Industry growth: CAGR of 14%, reaching \$1.25 billion by 2020 in USA
- > 40 active ingredients registered by EPA for greenhouse/ nursery







Examples of bioinsecticides/miticides registered for greenhouse use



Examples of Biofungicides registered for greenhouse use



#### Examples of Bioherbicides registered for greenhouse use

<b>Conventional pesticides</b>	Biopesticides
Residue concerns (export)	Few residue concerns
Often toxic to beneficials	Compatible with beneficials and pollinators
Often used curatively	Often used preventatively
12-48 hr REI	4 hr or less REI, no PHI (generally)
Few organic registered	Many organic registered
Often kills a variety of pests	Often more selective
Market 3% growth	Market > 10% growth
Shelf life > 1 year	Shelf life often < 1 year

### **Releasing Beneficial Insects**

 Predators and parasitoids, such as lady beetles and various wasps





### **Predatory mites**



Predatory mites are faster moving and have longer legs compared with plant feeding mites



Spot application versus broadcast application of predator mites. Credit Bill Lewis Delray



### Spider Mite Biological Control

- Controlled release sachets
- Sprinkle cans



Buckets







Predator release sachets for hanging baskets..



Slow release sachets of predator mites in hydroponic cucumber

# Whitefly Biological Control with parasitoids

- Pupae glued to hanging cards
- Pupae loose in a bottle



Large whitefly infestations may be targeted by the predatory beetle *Delphastus pusillus*, which more quickly reduces whitefly hot spots compared with parasitoids



### Using beneficial insects

- Some bigger suppliers:
  - Kopperthttp://www.koppert.com/BioBesthttp://www.biobest.ca/
  - Syngenta Bioline http://www.syngenta.com/
- Successful program requires study and adjustment of the production system
- Reduce or avoid insecticides, particularly broad-spectrum insecticides.
- Achieves long-term, sustainable control of insect and mite pests when executed properly



### CHEMICAL CONTROL

- Select appropriate material for the job (use soaps, oils and biologicals where possible)
- Spray during calm weather (drift)
- Use economic or aesthetic threshold to make spraying decisions
- Calibrate based on label rate for that pest
- Spot treat where practicable
- Rotate chemicals by class

### Treat pest problem, not the symptom



Sooty mold can persist after pest problem is gone

Try not to spray anything more toxic than needed to contr the target pest(s)



Koppert and Biobest have compatibility guides and APPS, google "side effects guide"

### Relatively safe for natural enemies

- Microbials
  - Bt (Dipel), Beauveria (Botanigard), spinosad (Conserve)
- Insect growth regulators IGRs (15-18)
  - bufprofezin (Talus), haflofenzamide (Mach-2)
- Azadirachtin (Aza-direct, Azatin, Molt-X)
- Acequinocyl (Shuttle)
- Chlorantraniprole (Mainspring/Acelepryn)(28)
- Pymetrozine (Endeavor)
- Soaps/oils