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Integrated Pest Management for Bedding Plants

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Overview of Presentation

- Introduction
- Pest Management Tactics:
 - Scouting
 - Cultural
 - Sanitation
- Miticides: Properties and Limitations
- Mode of Action and Rotation
- Questions and Discussion






Major Arthropod Pests of Greenhouse-Grown Bedding Plants

- Aphids
- Thrips
- Fungus Gnats
- Whiteflies
- Shore Flies
- Leafminers
- Mealybugs
- Spider Mites















How Do You Know That You Have An Insect Or Mite Pest Problem?

Symptomatic Patterns


Typical symptom patterns are:

- * Random
- * Uniform
- * Clumped

Look at plant and plant parts including leaves.
 Examples:

- * Insect and mite pests : random or clumped
- * Environmental and cultural: uniform
- * Physiogenic: uniform or clumped



Pest Management Basics

- **Cultural Management:**

- Proper watering
- Proper fertility
- Sanitation: weeds, plant and growing medium debris



- **Physical Management:**

- Removal of infected plant material
- Screening greenhouse openings



- **Scouting:**

- Colored sticky cards
- Visual inspection



Scouting



Why Should You Scout?

- Can reduce the use of pesticides (insecticides and miticides) thus minimizing selection pressure placed on insect and/or mite populations, which avoids the potential for resistance and preserves existing products.
- Determine the effectiveness of pest management program.
- Assess population dynamics and trends of insect and/or mite pests throughout the growing season.
- Improves the use of pesticides by timing applications accordingly.



Eggs->Larvae (Nymphs)->Pupae->Adults



Colored Sticky Cards



Potato Disk/Wedge



Visual Inspection

Scouting Methods

Passive

- * Colored sticky cards and/or potato wedges
- * Adult thrips, fungus gnats, shore flies, whiteflies, and winged aphids
- * Fungus gnat larvae



Active

- * Visual inspection
- * Immature thrips, whitefly nymphs and eggs, and non-winged aphids



Cultural Pest Management

1. Watering
 - * Over and/or underwatering.
2. Fertility
 - * Over and/or underfertilizing.
3. Growing Medium
 - * Needs to drain well.
4. Sanitation
 - * Weed removal.
 - * Eliminating plant and growing medium debris from the greenhouse area.





Cultural control practices such as sanitation are typically the easiest and least expensive to implement because they are performed during normal operating procedures. They also avoid the problems associated with insecticides such as resistance and environmental contamination.

National Academy of Sciences, 1969. Principles of plant and animal pest control, Vol. 3, Insect-Pest Management and Control, publication 1695.

Moisture Management



Note: This may be easier said than done!!



Too Much Moisture Results in Dealing with Two Pests:


Fungus Gnat Adult



Shore Fly Adult



Importance of Weed Control

- Many weeds are susceptible too and serve as a refuge for insects such as western flower thrips, aphids, leafminers, and whiteflies. 
- Weeds may also serve as a reservoir for diseases. For example, oxalis, chickweed, dandelion, jewelweed, and bittercress are weeds that may harbor impatiens necrotic spot virus (INSV).

Weeds That Serve As A Reservoir For Western Flower Thrips



Common Groundsel



Creeping Woodsorrel



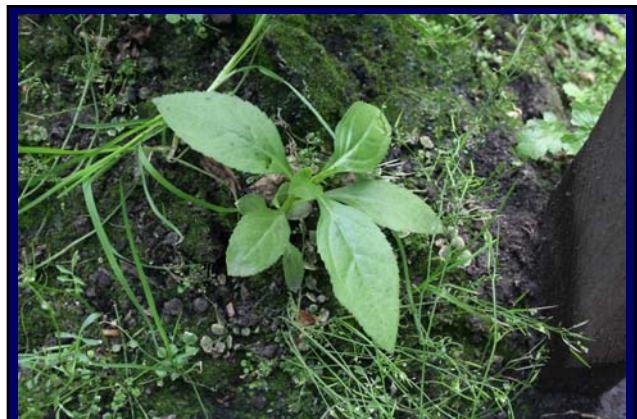
Pigweed in Greenhouse Harboring Western Flower Thrips

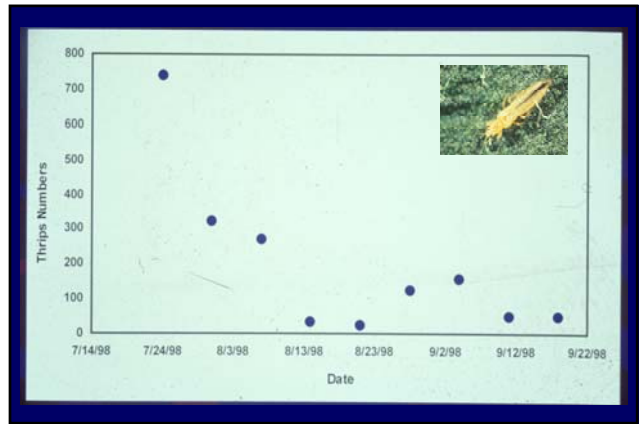


Annual Sowthistle



What's For Sale?





Weed Control Options In Greenhouses



- Hand-Pulling 
- Concrete Floors 
- Weed Barriers 
- Herbicides* 





Herbicides Registered For Use In Greenhouses

- Clethodim (Envoy)
- Diquat (Reward)
- Glufosinate (Finale)
- Glyphosate (Roundup Pro)
- Pelargonic Acid (Scythe)

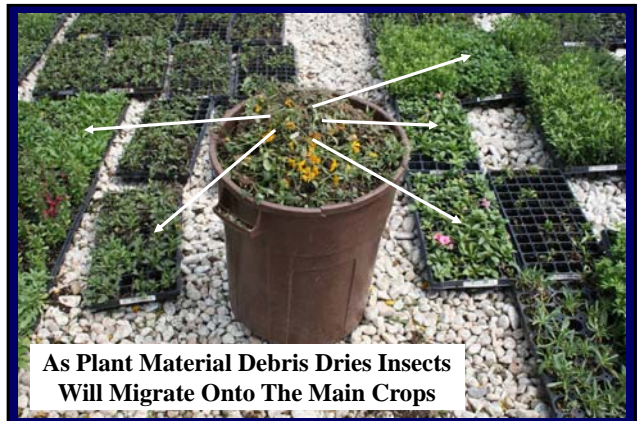



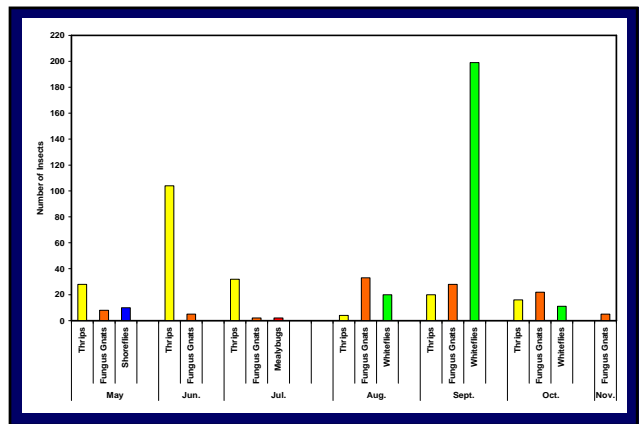
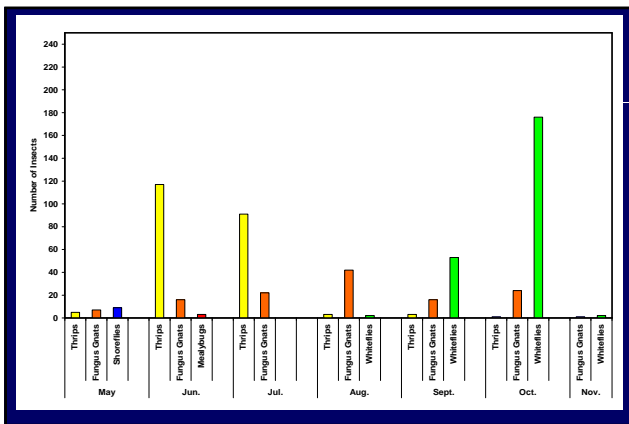
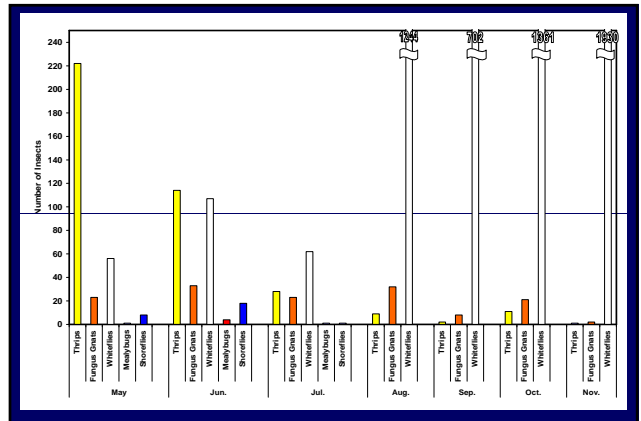
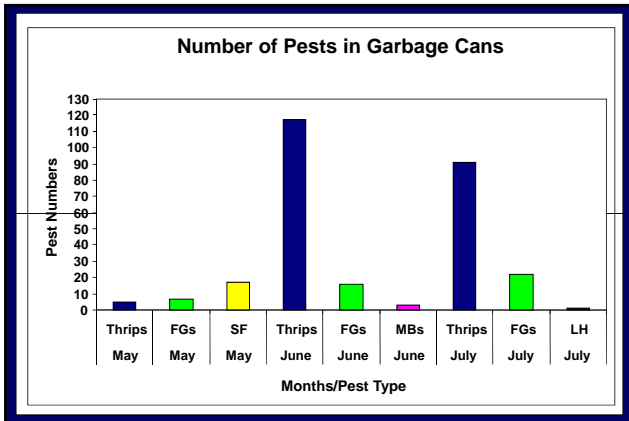
Remember: There Are No Pre-Emergent Herbicides Labeled For Use In Greenhouses!!




How Important Is Sanitation In Reducing Problems With Insect Pests?

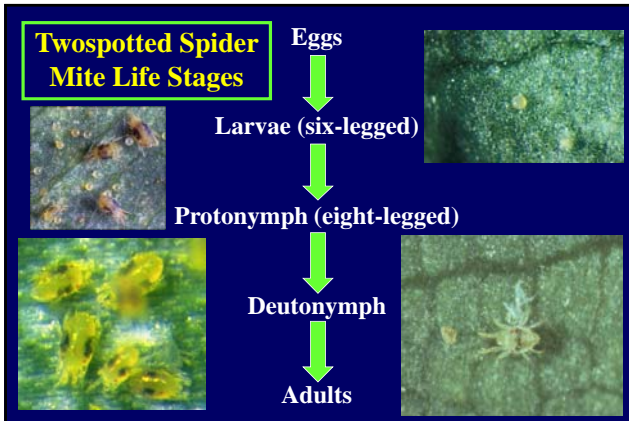




- ### Relationship Between Amount of Plant Debris and Insect Abundance
- **Poinsettia:**
 - 100% plant debris=98% adult whiteflies
 - **Yellow Sage:**
 - 15% plant debris=96% adult whiteflies
 - **Garden Verbena:**
 - 20% plant debris=96% adult whiteflies
 - **Fuchsia:**
 - 10% plant debris=96% adult whiteflies





MITICIDES (ACTIVE INGREDIENT AND TRADE NAME) AND TWOSPOTTED SPIDER MITE LIFE STAGES MOST EFFECTIVE ON.
C=Contact and T=Translaminar

| ACTIVE INGREDIENT | TRADE NAME | ACTIVITY TYPE | EGG | LARVA | NYMPH | ADULT |
|-------------------|------------|---------------|-----|-------|-------|-------|
| Abamectin | Avid | T and C | | X | X | X |
| Acequinocyl | Shuttle | C | X | X | X | X |
| Bifenazate | Floramite | C | X | X | X | X |
| Chlorfenapyr | Pylon | T and C | | X | X | X |
| Clofentezine | Ovation | C | X | X | X | |
| Etoxazole | TetraSan | T and C | X | X | X | |
| Fenbutatin-Oxide | ProMite | C | | X | X | X |
| Fenpyroximate | Akari | C | X | X | X | X |
| Hexythiazox | Hexygon | C | X | X | X | |
| Pyridaben | Sanmite | C | X | X | X | X |
| Spiromesifen | Judo | T and C | X | X | X | |

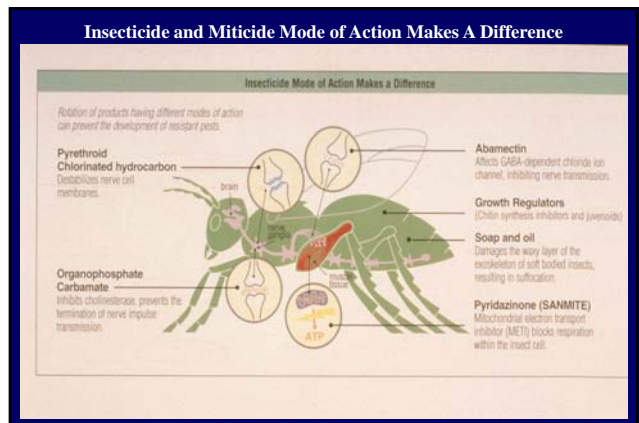
Mode of Action and Rotation

This section highlights the importance of understanding the mode of action and rotating pesticides to prevent resistance. It includes an illustration of various pesticide containers and a person in a white coat using a spray wand on a plant.

The primary (and best) way to prevent insect and mite populations from developing resistance is **rotate insecticides and miticides with different modes of action!!**

Mode of Action

- How a pest control material such as an insecticide or miticide affects the metabolic and physiological processes in an insect or mite.



Spinetoram shares a mode of action with spinosad. While spinosad resistance is rare in agroecosystems, users should be aware that resistance to spinosad will negatively affect spinetoram. Dow AgroSciences strongly supports the principles of insecticide resistance management and encourages all users to incorporate these principles, including rotation of insecticides with different modes of action, into their pest-management programs.

| Example of products that affect: | |
|----------------------------------|------------------------------------|
| Na ⁺ channel | Pyrethroids, DDT |
| AChE | Organophosphates, Carbamates |
| Nicotinic ACh Receptor | Imidacloprid, Thiamethoxam |
| GABA Receptor | Avermectin, Fipronil, Cyclopyridox |
| Unique Target Site | Spinetoram, Spinosad |

Insecticide Modes of Action

| Insecticide Resistance Action Committee (IRAC) Mode of Action Designations (n=26) | | | | | | | | | | |
|--|---|----------------|---|-------------|--------------|-------------|--------------|------------|-------------|--------------|
| 4A | Nicotinic Acetylcholine receptor agonists / antagonists | Neonicotinoids | <table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="padding: 2px;">Acetamiprid</td></tr> <tr><td style="padding: 2px;">Clothianidin</td></tr> <tr><td style="padding: 2px;">Dinotefuran</td></tr> <tr><td style="padding: 2px;">Imidacloprid</td></tr> <tr><td style="padding: 2px;">Nitenpyram</td></tr> <tr><td style="padding: 2px;">Thiacloprid</td></tr> <tr><td style="padding: 2px;">Thiamethoxam</td></tr> </table> | Acetamiprid | Clothianidin | Dinotefuran | Imidacloprid | Nitenpyram | Thiacloprid | Thiamethoxam |
| Acetamiprid | | | | | | | | | | |
| Clothianidin | | | | | | | | | | |
| Dinotefuran | | | | | | | | | | |
| Imidacloprid | | | | | | | | | | |
| Nitenpyram | | | | | | | | | | |
| Thiacloprid | | | | | | | | | | |
| Thiamethoxam | | | | | | | | | | |

Mode of Action of Greenhouse Pest Control Materials

Acetylcholine Esterase Inhibitors

- * Acephate (Orthene/Precise) [1B]
- * Chlorpyrifos (DuraGuard) [1B]
- * Methiocarb (Mesuro) [1A]

GABA-Gated Chloride Channel Blockers

- * Endosulfan (Thiodan) [2A]

Mode of Action of Greenhouse Pest Control Materials

Sodium Channel Blockers

- * Bifenthrin (Talstar) [3]
- * Cyfluthrin (Decathlon) [3]
- * Fenpropathrin (Tame) [3]
- * Fluvalinate (Mavrik) [3]
- * Lambda-cyhalothrin (Scimitar) [3]

Mode of Action of Greenhouse Pest Control Materials

Nicotinic Acetylcholine Receptor Disruptors

- * Acetamiprid (TriStar) [4A]
- * Dinotefuran (Safari) [4A]
- * Imidacloprid (Marathon) [4A]
- * Thiamethoxam (Flagship) [4A]

Nicotinic Acetylcholine Receptor Agonist and GABA Chloride Channel Activator

- * Spinosad (Conserve) [5]

GABA Chloride Channel Activators

- * Abamectin (Avid) [6]

Spinosyn Suspension

- Dow AgroSciences voluntarily suspended the sale and use of multiple spinosyn insecticides in Broward County and Palm Beach County in the state of Florida due to evidence of western flower thrips having developed resistance to products containing the active ingredient—spinosad (August 14, 2008).
- www.ThripsManagement.com

Mode of Action of Greenhouse Pest Control Materials

Juvenile Hormone Mimics

- * Fenoxycarb (Preclude) [7B]
- * Kinoprene (Enstar II) [7A]
- * Pyriproxyfen (Distance) [7C]

Chitin Synthesis Inhibitors

- * Buprofezin (Talus) [16]
- * Cyromazine (Citation) [17]
- * Diflubenzuron (Adept) [15]
- * Etoxazole (TetraSan) [10B]
- * Novaluron (Pedestal) [15]

Ecdysone Antagonists

- * Azadirachtin (Azatin/Ornazin) [18B]



Mode of Action of Greenhouse Pest Control Materials

Growth and Embryogenesis Inhibitors

- * Clofentezine (Ovation) [10A]
- * Hexythiazox (Hexygon) [10A]

Selective Feeding Blockers

- * Flonicamid (Aria) [9C]
- * Pymetrozine (Endeavor) [9B]

Disruptors of Insect Midgut Membranes

- * *Bacillus thuringiensis* spp. *israelensis* (Gnatrol) [11A1]
- * *Bacillus thuringiensis* spp. *kurstaki* (Dipel) [11B2]



Mode of Action of Greenhouse Pest Control Materials

Oxidative Phosphorylation Uncoupler

- * Chlorfenapyr (Pylon) [13]

Oxidative Phosphorylation Inhibitor

- * Fenbutatin-oxide (ProMite) [12B]

Beauveria bassiana (BotaniGard/Naturalis)

Sodium tetraborohydrate decahydrate (TriCon)



Mode of Action of Greenhouse Pest Control Materials

Mitochondria Electron Transport Inhibitors

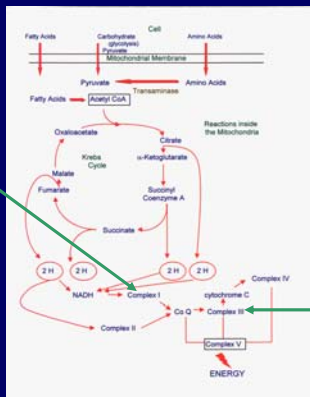
- * Acequinocyl (Shuttle) [20B]
- * Fenpyroximate (Akari) [21]
- * Pyridaben (Sanmite) [21]

Desiccation or Membrane Disruptors

- * Neem oil (Triact)
- * Paraffinic oil or Petroleum oil (Ultra-Pure Oil/PureSpray Green)
- * Potassium salts of fatty acids (Insecticidal Soap)



Akari and Sanmite



Shuttle

Mode of Action of Greenhouse Pest Control Materials

GABA-Gated Antagonist

- * Bifenazate (Floramite) [25]

Lipid Biosynthesis Inhibitor

- * Spiromesifen (Judo) [23]



Neonicotinoids

- Imidacloprid (Marathon)
- Thiamethoxam (Flagship)
- Acetamiprid (TriStar)
- Dinotefuran (Safari)



Realistic Rotation Programs

- Aphids
 - Endeavor->Marathon*->PureSpray Green >Orthene
- Thrips
 - Conserve->Avid->Pylon->Novaluron
- Twospotted Spider Mite
 - Floramite->Pylon->Shuttle->TetraSan
- Whiteflies
 - Safari*->Distance->Judo->Talus
- Mealybugs
 - TriStar->Orthene->Insecticidal Soap->Enstar II
- Fungus Gnats
 - Distance->Citation->Pylon->DuraGuard



Summary

- Implementing **scouting, cultural, and sanitation practices** is an important component of any pest management program; however, this practice must be used in conjunction with alternative management strategies including the use of pesticides (insecticides and miticides) or natural enemies in order to minimize problems with insect and mite pests.



Thank You For Your Attention!



Contact Information

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Questions?

