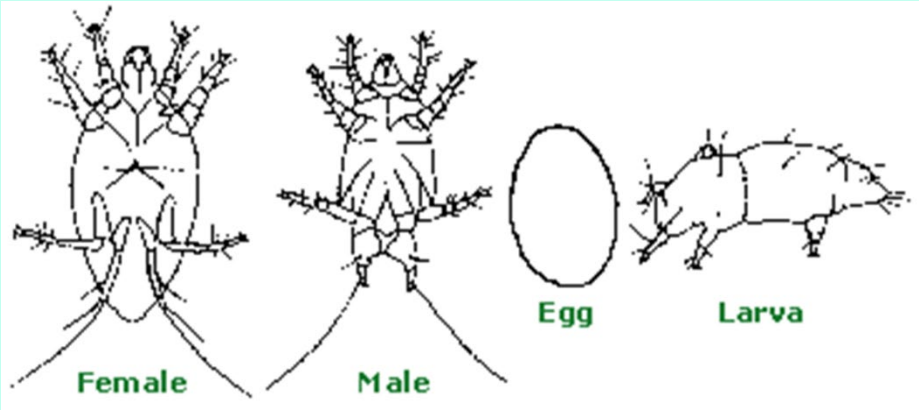
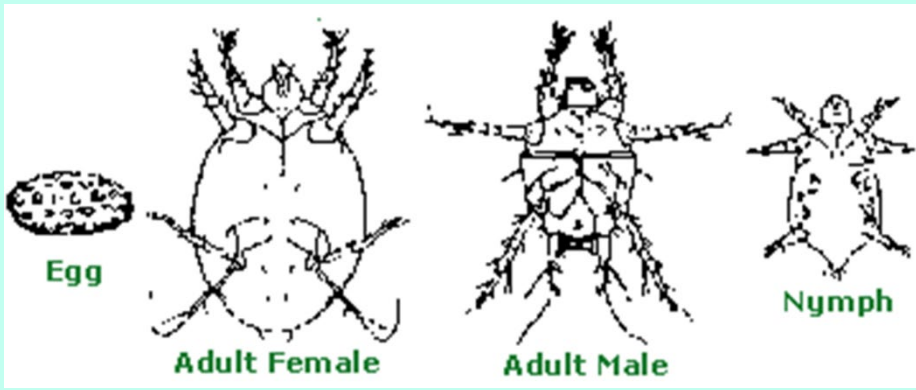
Greenhouse Mites



Cyclamen mite, in buds



Broad mite, in buds

Two spotted spider mite

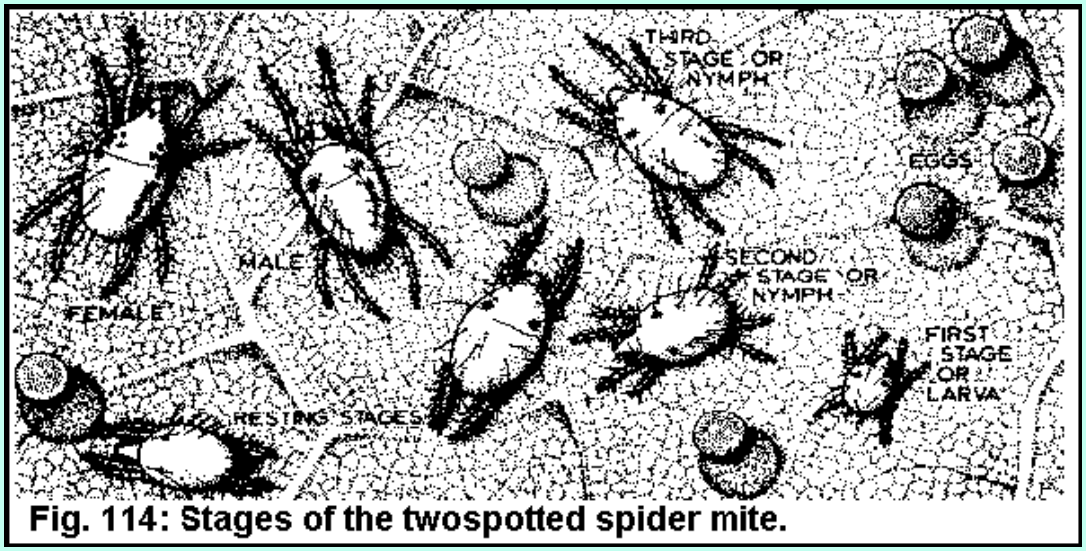


Fig. 114: Stages of the twospotted spider mite.

All drawing from NCSU
https://content.ces.ncsu.edu/insect-and-related-pests-of-flowers-and-foliage-plants/mites-found-on-flowers-and-foliage

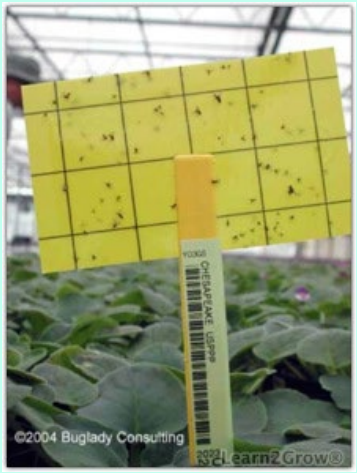
Dr. Vera Krischik, University of Minnesota, Department of Entomology,


windowbox.com

What is greenhouse IPM?

* A system utilizing multiple methods
* A decision making process
* A risk reduction system
* Information intensive
* Biologically based
* Cost effective
* Site specific
* Multiple tactics:
    legal, cultural, physical,
    genetic, biological, chemical

What is greenhouse IPM?



Preventative thinking

Assume cuttings will arrive with pests.

- **Misting weekly botanigard sprays (3x)**
- **Nematodes weekly**
- **Predatory mites weekly, bridges help mites move around**
- **Banker plants, for thrips use ornamental peppers for pollen feeding, for *Orius* use *Gerbera***

Use miticdes and insecticides that conserve beneficial insects and biocontrol agents

Summary: What is greenhouse IPM?

- When developing an IPM program, it is important to know what pests you have Learn the major characteristics for pest and damage identification and how to monitor for the pests.

- Determine threshold levels for each pest. At low densities, biological control and biorational pesticides may be used.

- High pest densities may call for conventional pesticides, but these should be avoided whenever possible to conserve beneficials.

Understanding why miticides are different chemcials than insecticides.

1. Mites are related to insects, but in a different class.
2. Mites have different physiology.
3. Insecticides do not work as well on mites as on insects.
4. Specific miticides were developed in different pesticide classes.

5. Since miticides work on mites and not insects.

6. Some miticides are compatible with pollinators and against.

7. However, some miticides are more toxic to good bugs.

8. Use the Krischik "Toxicity of pesticides to pollinators" bulletin on the course page under 1 to determine what miticides are good to use when biocontrol agents are present.
https://pesticidecert.cfans.umn.edu/sites/pesticidecert.cfans.umn.edu/files/2022-03/1.%202020-Understanding-pesticide-toxicity-to-pollinators.pdf

9. Go to the Biobest and Koppert sites to search for compatible pesticides.

IRAC numbers

- The Insecticide Resistance Action Committee (www.irac-online.org) has assigned IRAC numbers for each chemical class, and these numbers are on labels to make it easier to rotate classes of insecticides and prevent resistance

Neonicotinoid class, 4A

Carbamates, class 1A

Organophosphates, class 1B are in the same group as the mode of action (cholinesterase inhibition) is the same.

Toxicity to Pollinators of Insecticides Bulletin, Vera Krischik, Dept Entomology, UMinnesota

Systemic neonicotinoid insecticides (imidacloprid, clothianidin, dinotefuran, and thiamethoxam) and others in pink, enter the pollen and nectar and can occur in high enough levels to kill pollinators after 15 weeks.

Contact insecticides should not be translocated to pollen and nectar and should not be present in new flowers. Contact insecticides are toxic to bees and do not spray directly on foraging bees or flowers. In greenhouse contact insecticides residue should be minimal after 5 weeks.

Chemical class	Examples of common names	Beneficial insect Toxicity			
		Non	Low	Mod	High
Miticides	acequinocyl, extoxazole, fenpyroximate, fenbutatin-oxide	x,x,x,x			
	clofentezine, hexythiazox	x,x			
	bifenazate		x		
	pyridaben				x
	chlorfenapyr			x	
	spiromesiifen	x			
Spinosyns	spinosad, less toxic when dry		x		
Tetronic acids	spirotetramat			x	
GABA-channel	fipronil				x

What is greenhouse biological control?

There are several types of biological control. Augmentative biological control involves periodic releases of biological control agents. This is the type of biological control most likely to be used in greenhouses.

When should biological control be used?

Biological control is most effective when enemies are release during low pest densities.

When using biological control agents in the greenhouse, it is important to avoid broad-spectrum pesticides; these may be detrimental to biological control agents. Carefully choose biorational insecticides to conserve specific natural enemies in the greenhouse.

Predatory mites
Family Phytoseiidae:

Predatory mites:
Phytoseiulus persimilis

Predatory Mite, *Hypoaspis miles*

Class Arachnida
Order Acari
Family Phytoseiidae

This mite attacks fungus gnats and thrips pupae in the soil.

Females lay eggs in soil. Eggs hatch in 1 to 2 days. Each mite consumes 5 to 20 prey per day and algae or plant debris when prey is scarce. The entire life cycle is 7 to 11 days.

Swirski Spider Mite Predator
Amblyseius swirksii

Class Arachnida
Order Acari
Family Phytoseiidae

Predatory Mite: Used for control of broad mites in greenhouses. Use as a preventive method and when the first signs of a pest appear. More effective under warm season conditions.

Amblyseius swirskii (predator)

Spider Mite Predator, *Phytoseiulus persimilis*

Class Arachnida
Order Acari
Family Phytoseiidae

This mite was accidentally introduced into Germany from Chili in 1958 and then shipped to other parts of the world. Individuals consume 5 to 10 adult spider mites or up to 20 eggs per day. It

Phytoseiulus persimilis **eating a two-spotted spider mite egg.**

Spider Mite Predator, *Phytoseiulus persimilis*

P. persimilis **need a relative humidity greater than 60%. This mite dies when food runs out, so if reinfestation occurs, release every 3 to 5 weeks. Spider mites are controlled in 2 to 3 weeks during low infestations.**

Works best in cooler temperatures.

Spider Mite Predator,

Neoseiulus (= Amblyseius) *californicus*

Class Arachnida
Order Acari
Family Phytoseiidae

This mite attacks spider mites and tarsonemid mites. Individuals consume one adult or a few eggs per day and can survive longer under starvation conditions.

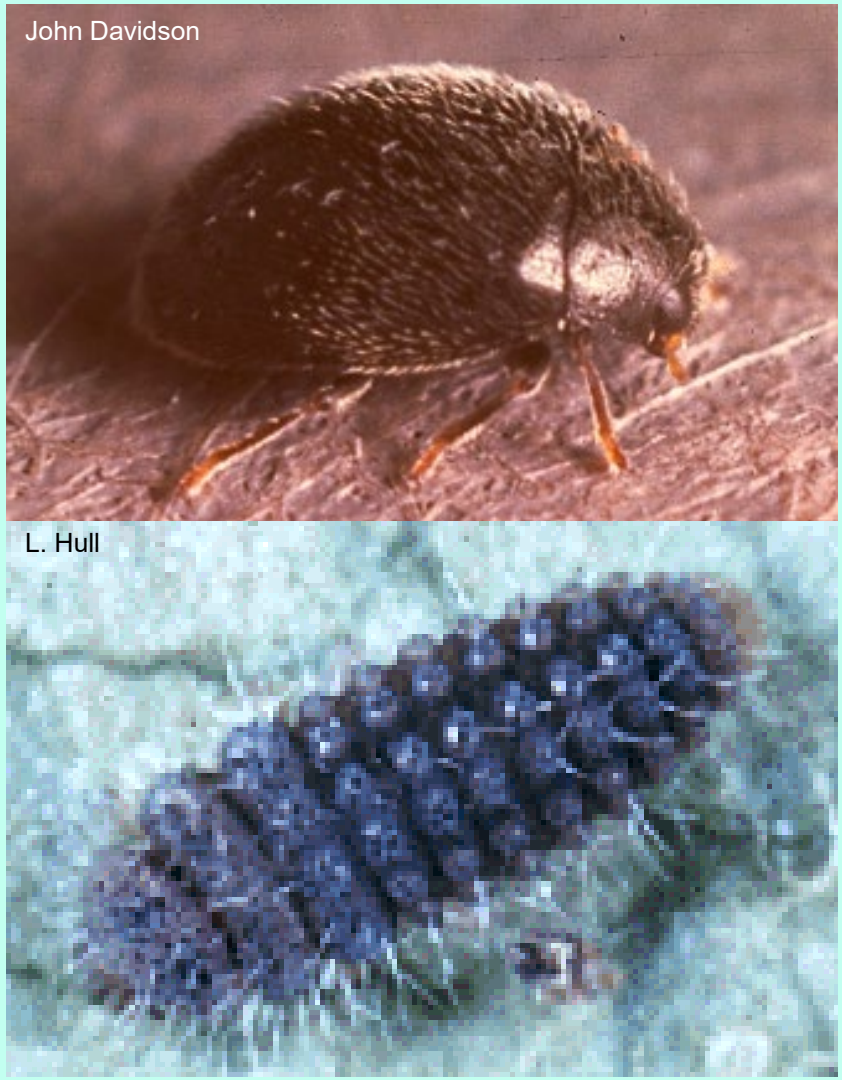
***N. californicus* prefer a minimum of 60% humidity and temperatures 60 to 85 degrees F.**

Spider Mite Destroyer, *Stethorus* spp.

Order Coleoptera
Family Coccinellidae

Aduts and larvae of this lady beetle feed on spider mites. Adults are shipped. Works best in low pest densities.

Release rate: 200 to 500/acre



***Stethorus punctum* adult (top) and larva**

Spider Mite Destroyer, *Stethorus* spp.

Above: left to right: spider mite and three life stages of *Stethorus*: larva, pupa, adult

Right: *Stethorus* eggs in mite colony

Midge, *Feltiella acarisuga*

This small (1/16 inches or 2.0 mm) predatory midge feeds on twospotted mite. Adults live up to three days, and are active at night, resting during the day on leaf undersides. Females lay orange-to-red eggs among twospotted mite colonies that hatch in 3–5 days. The larvae are the only predaceous stage, feeding on all life stages (eggs, larvae, nymphs, and adults) of twospotted mite. After 5–7 days, larvae transition into a white, pupal stage, on the underside of leaves. Adults emerge from pupae, and although they do not feed, they can fly, allowing them to locate twospotted mite populations on hanging baskets or other locations within the greenhouse that are not accessible to predatory mites. *Feltiella acarisuga* is active year-round. When scouting, look for the nearly white pupal cases near the mid- rib on leaf undersides.

Larval predatory gall-midge

Adult predatory gall-midge

Phylum Arthropoda

- Segmented body.
- Paired segmented appendages.
- Bilateral symmetry.
- Chitinous exoskeleton.
- Tubular alimentary canal with mouth and anus.
- Open circulatory system, a tubular dorsal blood vessel.
- Body cavity or coelom.
- Nervous system of anterior ganglia and paired nerve cords.
- Striated muscles in skeletal system.
- Respiration by gills, tracheae, or spiracle.

Phylum Arthropoda

- Class Insects
- Class Arachnids (spiders, ticks, mites, etc.)
- Class Crustaceans
- Class Millipedes
- Class Centipedes

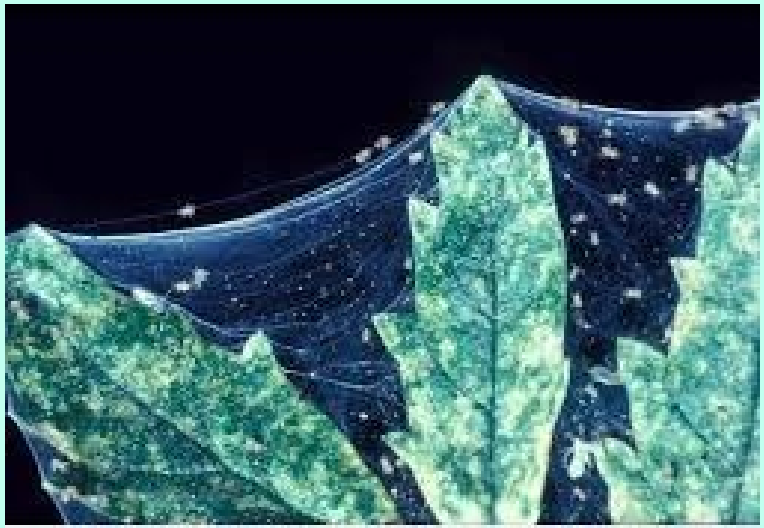
CUES, http://www.entomology.umn.edu/cues/IPM-turf/sodwebworms.htm

Sod Webworm Moth, *Crambus* sp.

Cottonwood Leaf Beetle, *Chrysomela scripta*

Class Insecta and Arachnida

- Class Insects
- Class Arachnids (spiders, ticks, mites, etc.) Insects and arachnids have different morphology, physiology, and nervous systems so insecticides do not work effectively on mites.Which means many miticdes do not kill good insects as pollinators or biocontrol agents.



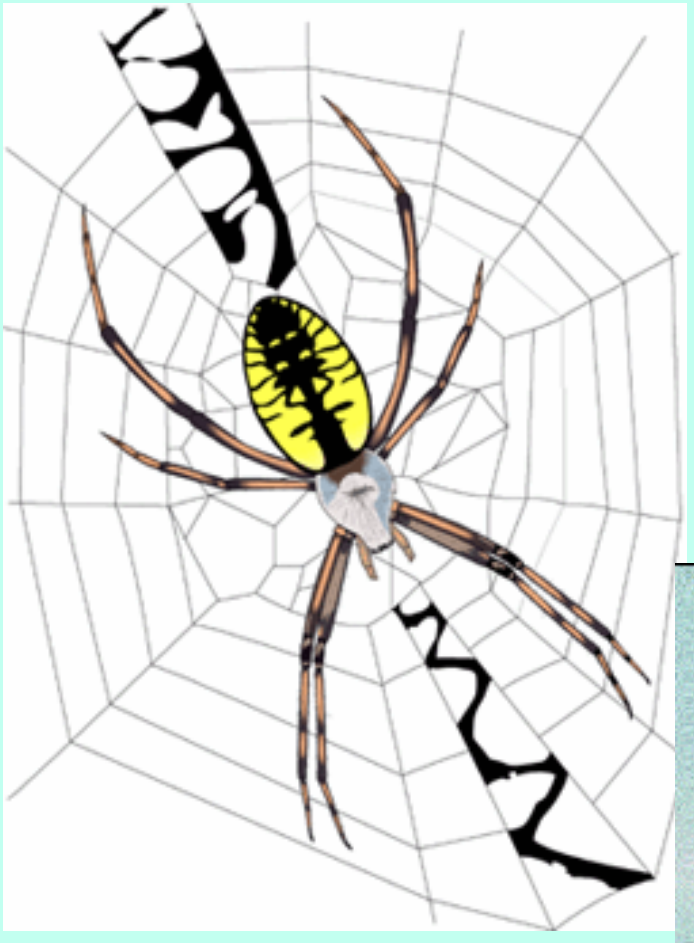
Twospotted spider mites and webbing on marigold.

Photo by J. R. Baker

https://content.ces.ncsu.edu/twospotted-spider-mite-3

Cottonwood Leaf Beetle,
Chrysomela scripta

Class Arachnida: Spiders, ticks, mites, harvestman, scorpions, etc.



Yellow Garden Spider

Tick

Mite

Class Arachnida

- Mouthparts are called chelicerae.
- Most contain venom.
- Antennae are absent.
- Four pairs of legs.
- Book lungs for respiration.

Blacklegged Tick, *Ixodes scapularis*

Scott Bauer, USDA Agricultural Research Service, www.insectimages.org

Yellow Garden Spider, *Argiope aurantia*

Class Arachnida: Order Araneae: Spiders

David Cappaert, www.insectimages.org

Jumping Spider, *Phidippus audax*

- Two body regions (cephalothorax, abdomen).
- Fangs (chelicerae), most are venomous.
- Most are not dangerous.
- Most make webs.
- Most have poor eyesight; hairs compensate for it (jumping spiders are an exception).
- Potentially dangerous spiders (bites are uncommon):
  Brown recluse spider, Black widow spider

Class Arachnida:
Order Opiliones: Harvestman
(Daddy Longlegs)

- One apparent body region.
- Abdomen and cephalothorax short.
- Common and harmless.
- Nocturnal.
- Feed on detritus, fruit, or other animals.

Leiobunum sp.

Class Arachnida:
Order Scorpiones: Scorpions

- Long tail with sting.
- Pedipalps are modified as pinchers.
- Most scorpion stings are no worse than bee stings; only a minority of species are potentially dangerous.
- Nocturnal.
- Common in warm climates.
- Feed on other animals.

Striped Bark Scorpion,
Centruroides vittatus,
gravid female from Texas

Class Arachnida:
Order Acari: Chiggers

Chigger Bites on Human

- Attach to skin using two claws.
- Two blade-like beaks enter the skin.
- Injected fluid dissolves skin tissue around beaks, but hardens surrounding tissue so that a stylostome, or tube is formed.
- Chigger sucks up liquid through stylostome.
- Tube remains after chigger leaves, causing itching.

Class Arachnida: Order Acari: Ticks

- Ticks have two body regions.
- Young have six legs, adults have eight.
- There are hard and soft-bodied ticks.
- Ticks are much larger than mites, some females as large as a nickel.

Blacklegged Tick, *Ixodes scapularis*

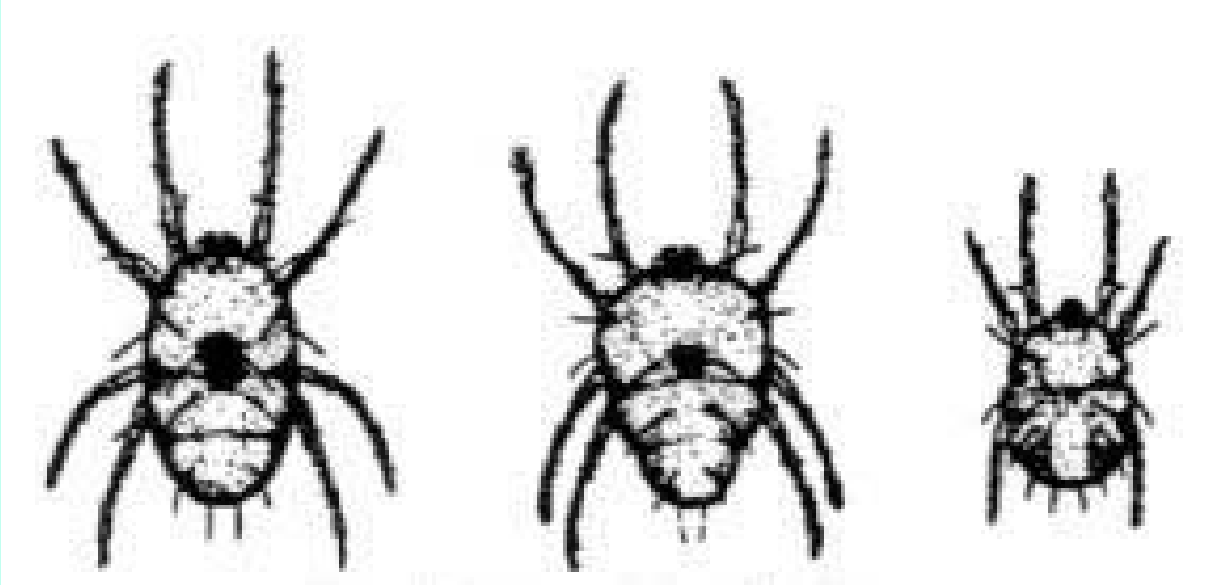
Class Arachnida:
Order Acari: Mites

- Mites have only one noticeable body region.
- Many are microscopic or close to it.

Mites

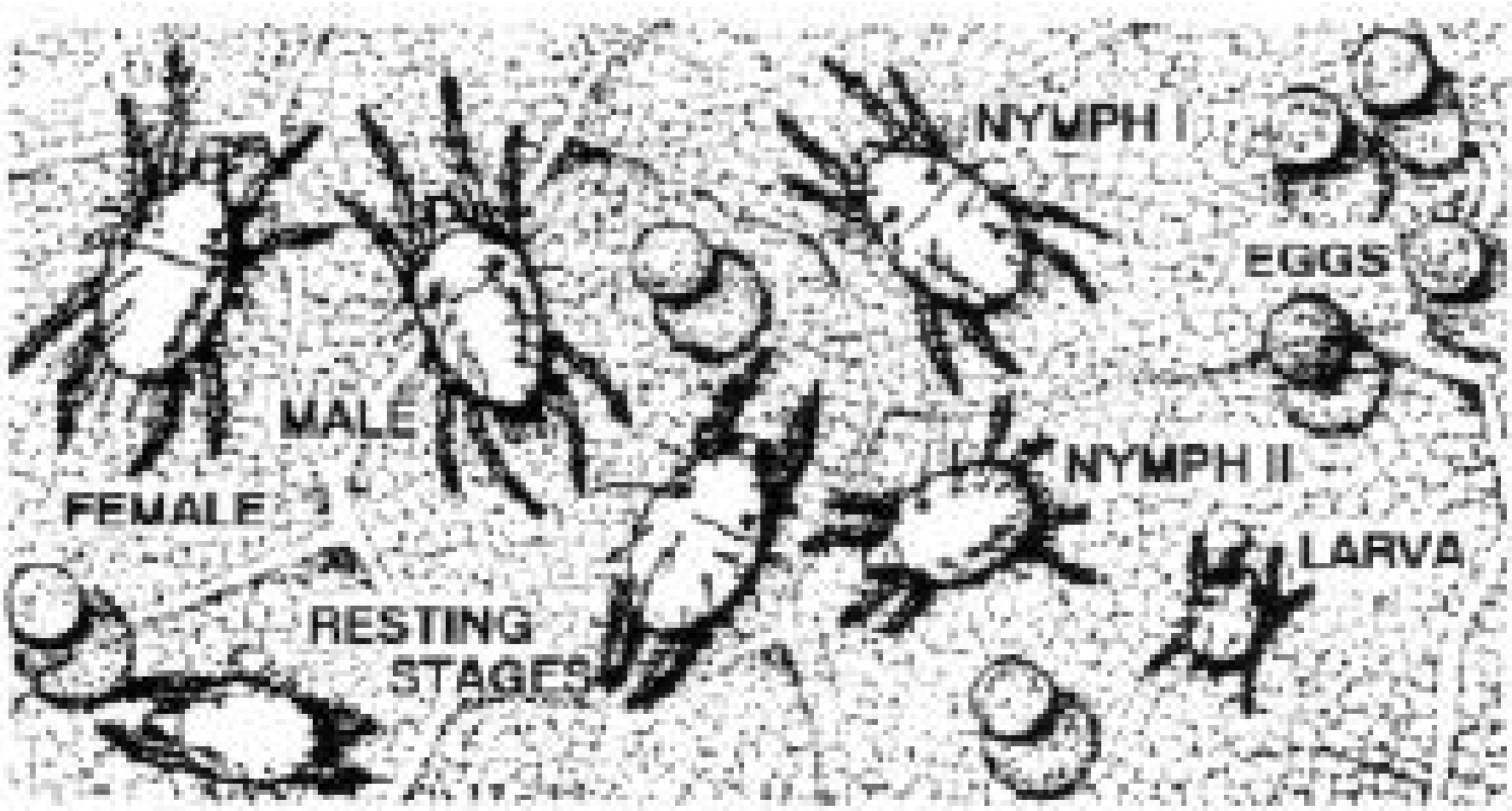
- Egg, larva, protonymph, deutonymph, adult.
- Four pair legs; three pairs on larvae.
- Two body segments: head, thorax.
- Chelicerae: fangs like spiders.
- Suck cells.
- Cause chlorosis; yellowing of foliage.
- Transmit disease.
- Diagnostics: chlorosis, webbing, rusetting, galls.

Mites



- Female: round abdomen
- Male: pointed abdomen
- Larva 3 pairs of legs

Mite Life Cycles



Twospotted Spider Mite Stages

Warm/Cool Season Mites

Warm season

- Twospotted spider mite
- European red mite
- Bulb mite
- Gall, rust mite
- Cyclamen mite
- Swirski predatory mite

Twospotted Spider Mite,
Tetranychus urticae

Cool season

- Spruce spider mite
- Clover mite

Mites in the Greenhouse

Family Tetranychidae:

- Twospotted spider mite
- Lewis mite

Family Tarsonemidae:

- Cyclamen mite
- Broad mite

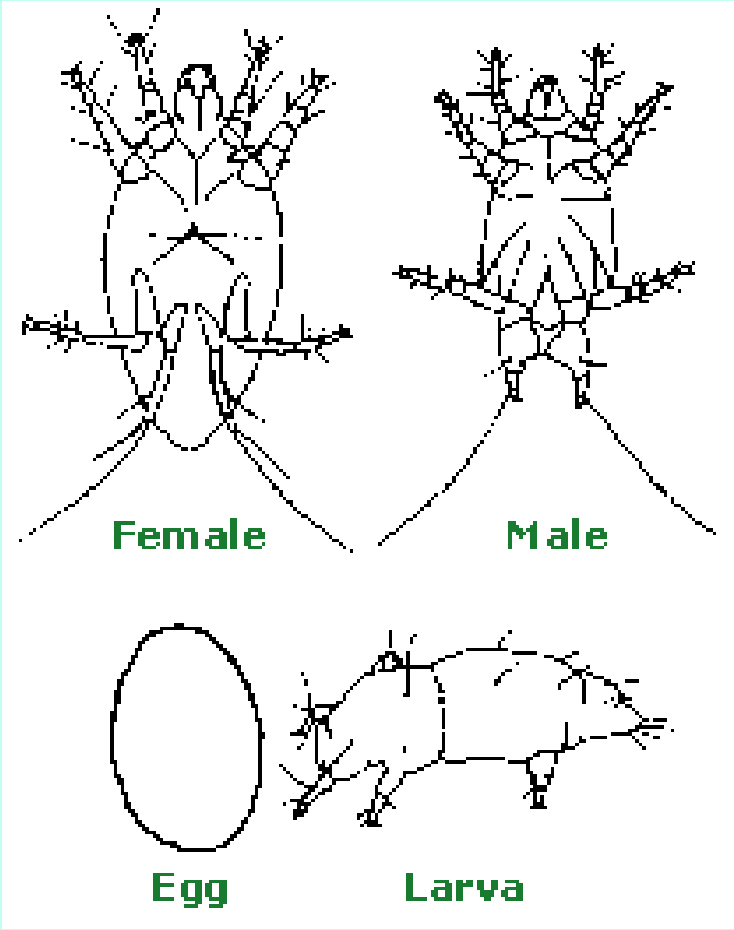
Family Acaridae:

- Bulb mite

Family Eriophyidae:

- Gall, rust mite

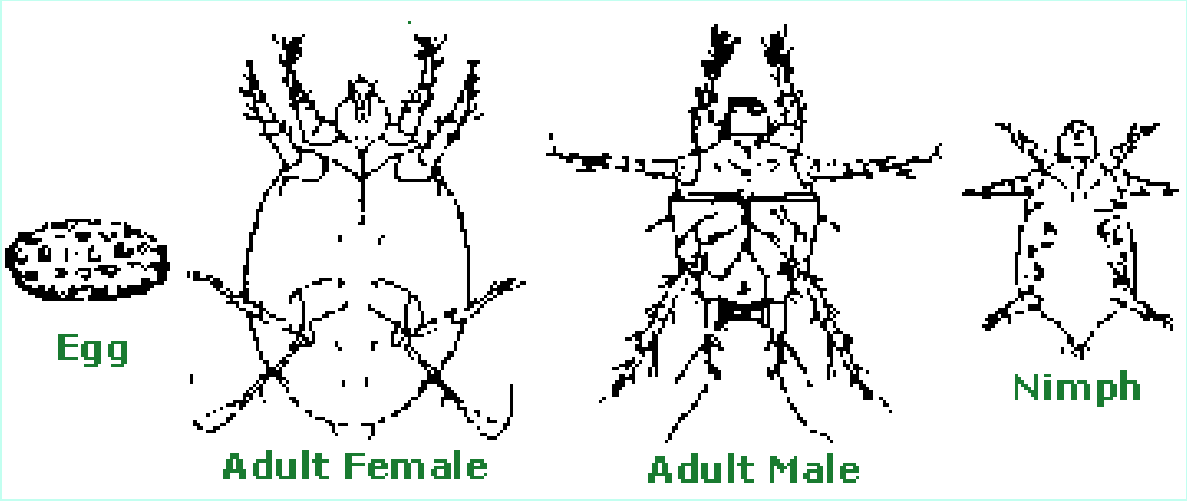
CUES
http://www.entomology.umn.edu/cues/inter/inmine/Mitesc.html



Cyclamen Mite

Mites in the Landscape

- Family Eriophyidae: gall or vagrant mites
- Family Tetranychidae: spider mites
- Family Tarsonemidae: cyclamen/broad mites
- Family Phytoseiidae: predatory mites
- Family Acaridae: bulb mite
- Family Oribatidae: soil mites



Broad Mite

CUES, http://www.entomology.umn.edu/cues/inter/inmine/Mitesc.html

Predatory mites
Family Phytoseiidae:

Predatory mites:
Phytoseiulus persimilis

Family Tetranychidae: Spider mites

Clover Mite, *Bryobia praetiosa*

- Found in greenhouse and landscape.
- Long front legs.
- Make webbing.

Spider Mites

Class Arachnida
Order Acari
Family Tetranychidae

These common pests attack many different plant species. Feeding causes stippling, yellowing, and leaf drop. In addition, spider mites web profusely on plants.

Two-spotted spider mite (*Tetranychus urticae*)

Twospotted Spider Mite

Tetranychus urticae
Class Arachnida
Order Acari
Family Tetranychidae

Description: Adults are 0.4 mm long and pale green or yellowish with two (sometimes four) black spots.

Hosts: Over 300 hosts; annuals, perennials, and woody plants.

Twospotted Spider Mite

Life History: Many generations can occur in the greenhouse. Early instars have 6 legs.

Damage: Stippling, yellowing, leaf drop, and profuse webbing.

Stippling caused by spider mites

Twospotted Spider Mite

Monitoring: Look for damage and webbing.

Cultural Control: Remove weeds and infested plants. Spray with water to remove mites.

Chemical Control: Oils, soaps, miticides.

Spider mite colony

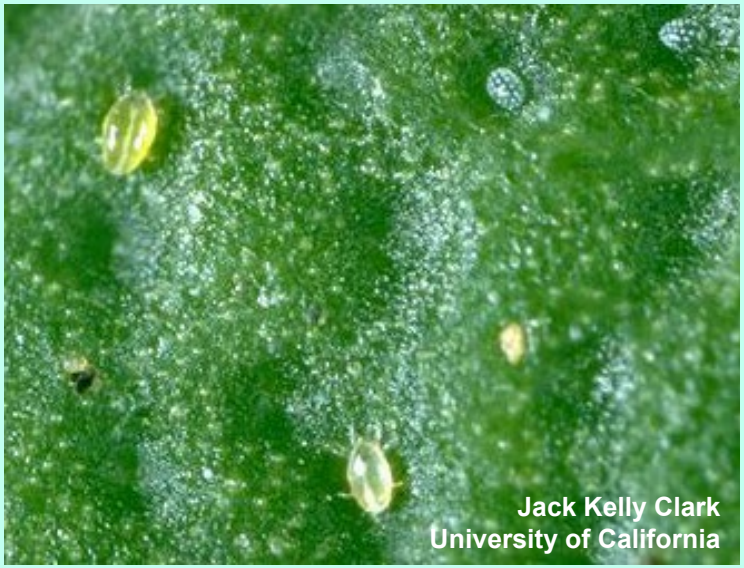
Twospotted Spider Mite

Biological Control: Predatory mites ***Neoseiulus californicus, Phytoseiulus persimilis***, and **Swirski Spider Mite Predator, *Amblyseius swirksii;*** the lady beetle ***Stethorus punctum***, ***Orius*** sp., lacewing larvae, and predatory midge.

Neoseiulus californicus attacking mite egg

Broad Mite

Polyhagotarsonemus latus
Class Arachnida
Order Acari
Family Tarsonemidae

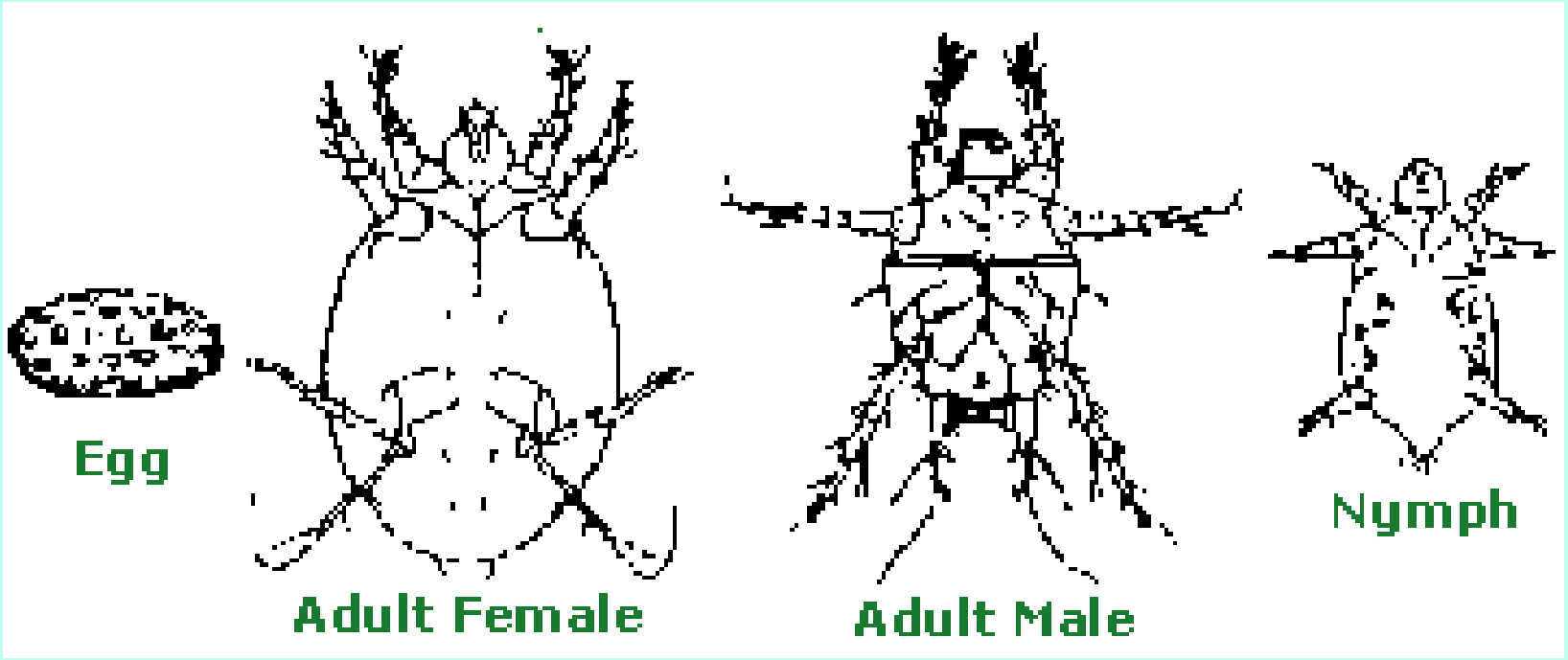


Description: Less than 0.2 mm long, clear to pale brown with eight legs; the last pair ends in a hair (female) or claw (male). Young have six legs.

Hosts: African violet, ageratum, azalea, begonia, cyclamen, dahlia, gerbera, gloxinia, ivy, jasmine, impatiens, lantana, marigold, peperomia, snapdragon, verbena, zinnia, and many others.

Broad Mite

Life History: Unmated females can lay male eggs. Mated females lay four female eggs to every male egg. Young have only six legs.



Broad Mite

Damage: Leaf curl, distortion, discoloration, stunted growth, shorter internodes, leaf and flower death.

Monitoring: Look for damage.

Cultural Control: Remove weeds, immerse plants in hot water.

Broad Mite

Chemical Control: Oils, soaps, and miticides.

Biological Control: *Neoseiulus californicus*.

Tarsonemid mites

Cyclamen Mite

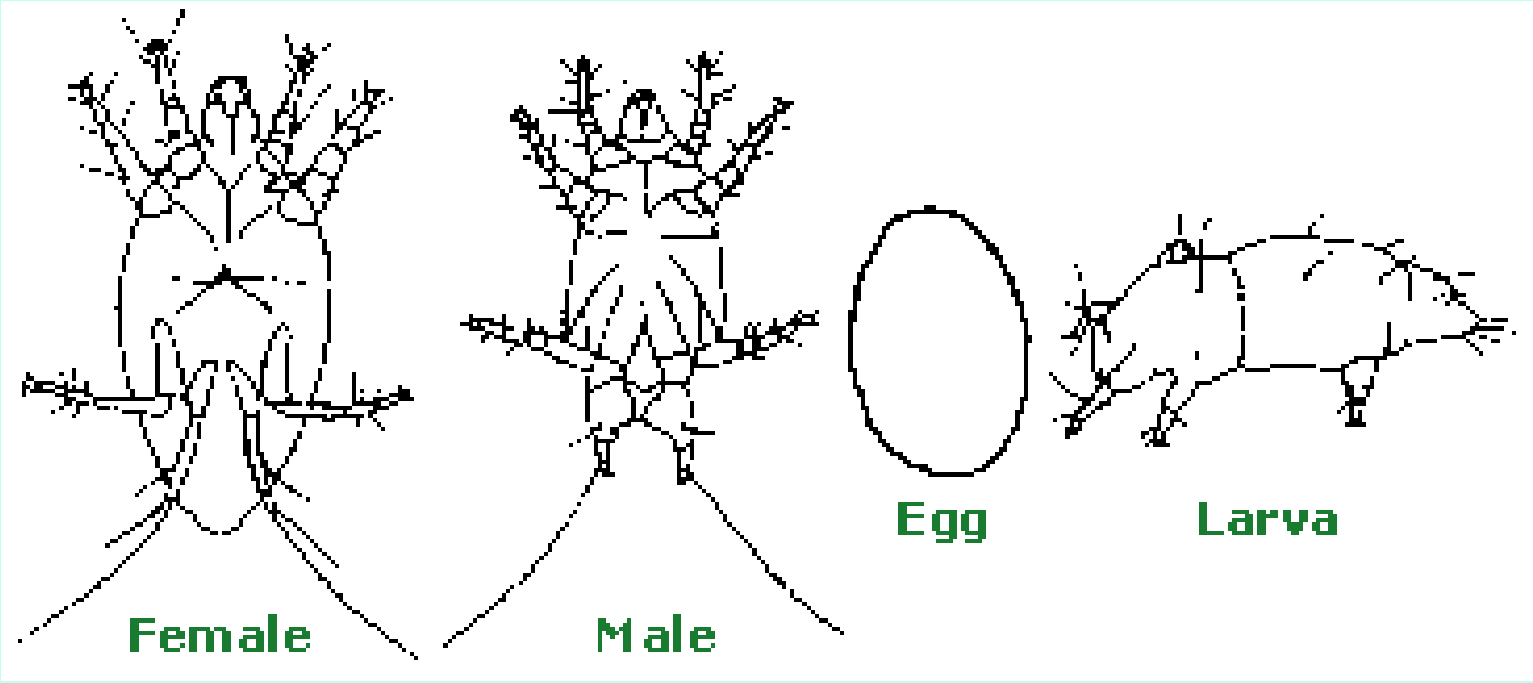
Stenotarsonemus pallidus
Class Arachnida
Order Acari
Family Tarsonemidae

Description: Less than 0.3 mm long, clear or brown tinted and waxy looking with eight legs; the last pair ends in a hair (female) or claw (male). Young have six legs.

Cyclamen Mite

Hosts: African violet, ivy, snapdragon, daisy, chrysanthemum, cyclamen, delphinium, azalea, larkspur, geranium, fuchsia, begonia, petunia.

Life History: Young have 6 legs and molt once.



Cyclamen Mite

Damage: Puckering, crinkling, and curling of leaves, brittle leaves, distorted flowers.

Monitoring: Look for damage.

Cyclamen Mite

Cultural Control: **Remove weeds, immerse plants in hot water.**

Chemical Control: **Oils, soaps, and miticides.**

Biological Control: ***Neoseiulus californicus*.**

IPM Program For Spider Mites

Class Arachnida
Order Acari
Family Tetranychidae
Twospotted spider mite, *Tetranychus urticae*

DESCRIPTION OF THE PEST

Twospotted spider mites are web-forming mites that pierce plant cells and remove their contents. All spider mites have two body segments and four pairs of legs as adults. Twospotted spider mite adults, as the name suggests, have two large dark spots on the sides of their yellowish green bodies. These mites lay round eggs that hatch into six-legged larvae. The subsequent stages, the protonymph and deutonymph stages, are eight-legged as are the adults. Since the entire life cycle can take as little as 8 (77° to 95°F) to 28 (50° to 68°F) days, spider mites have many generations per year and can rapidly increase in number.

IPM Program For Spider Mites

DAMAGE

Twospotted mites suck cell contents from leaves, initially stippling leaves with a fine pale green mottling. As feeding continues, the stippling increases and leaves turn yellow with bronze or brown areas; damaged leaves may fall. Undersides of leaves may have many cast skins of mites, and webbing on the foliage is unaesthetic. Plants may become stunted when large mite populations feed and the plants may die.

Infestation

IPM Program For Spider Mites

BIOLOGICAL CONTROL

Many different species of predatory mites are available for control of these mites under different conditions. *Phytoseiulus persimilis* is a commercially available predator of twospotted spider mite, and it has been used to control mite populations in greenhouses and field situations. It can reproduce faster than its prey, yet best results have been obtained when it is released into the crop well before the spider mite populations have built up. *Amblyseius swirskii,* the Swirski mite attacks prey mites in warm conditions. *Feltiella acarisuga,* the predatoyr midge attach mites as a larvae. The lady beetle, *Stethorus* sp., also attacks spider mites.

CULTURAL CONTROL

Because spider mites feed on a large variety of plants, keep production areas free of weeds, which can serve hosts to the mites. Carefully inspect plants being brought in to start a new crop to ensure that they are free of mites. Immediately treat infested plants.

IPM Program For Spider Mites

MONITORING and WHEN TO TREAT

Monitor the crop regularly, as indirect sampling methods (such as sticky cards) are ineffective. Observe the undersides of leaves with a 10X hand lens, and watch for changes in plant foliage, which is characteristic of mite feeding. Except as noted, the materials listed on the following slides only kill active stages of mites, so more than one treatment may be necessary to break the life cycle. Follow label directions regarding reapplication times.

IPM Program For Spider Mites

MITICIDES

Read and follow the instructions on the label. Before using a pesticide for the first time or on a new crop or cultivar, treat a few plants and check for phytotoxicity.

Miticide commercial name	Miticide chemical/MOA	Toxicity to beneficials
Avid	abamectin/6	high
Sirocco	bifenazate/20D+ abamectin/6	high
Akari, Vendex	fenpyroximate/21A	high
Pylon	chlorfenapyr/13	high
Sanmite	pyridaben/21A	high
Floramite	bifenazate/20D	moderate
Magus, Magister	fenazaquin/21A	moderate

IPM Program For Spider Mites

MITICIDES

Read and follow the instructions on the label. Before using a pesticide for the first time or on a new crop or cultivar, treat a few plants and check for phytotoxicity.

Miticide commercial name	Miticide chemical/MOA	Toxicity to beneficials
Shuttle	acequinocyl/20B	non
Notavo, Ovation	clofentezine/10A	non
Sultan	cyflumetofen/25A	non
TetraSan, Beethoven	etoxazole/10B	non
Mach II	fenbutatin-oxide/12B	non
Akari, Vendex	fenpyroximate/21A	non
Heygon	halofenozide/18	non
	hexythiazox/10A	non
Engulf	tebufenpyrad/21A	non
Judo, Forbid	spiromesifen/23	non

Summary: What is greenhouse IPM?

- When developing an IPM program, it is important to know what pests you have Learn the major characteristics for pest and damage identification and how to monitor for the pests.

- Determine threshold levels for each pest. At low densities, biological control and biorational pesticides may be used.

- High pest densities may call for conventional pesticides, but these should be avoided whenever possible to conserve beneficials.