Common Greenhouse Insects and Mites

Identification and Management

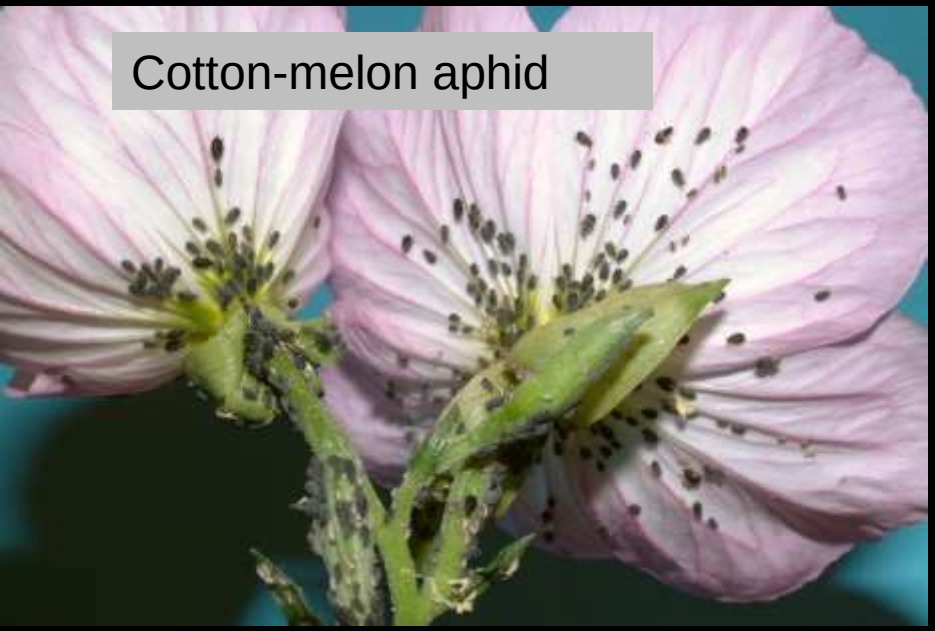
The list of common greenhouse insects and mites in Colorado is a fairly short one:

- Aphids (several species)
- Whiteflies (one species)
- Thrips (two common species)
- Twpspotted spider mite
- Fungus gnats
- Tomato/potato psyllid

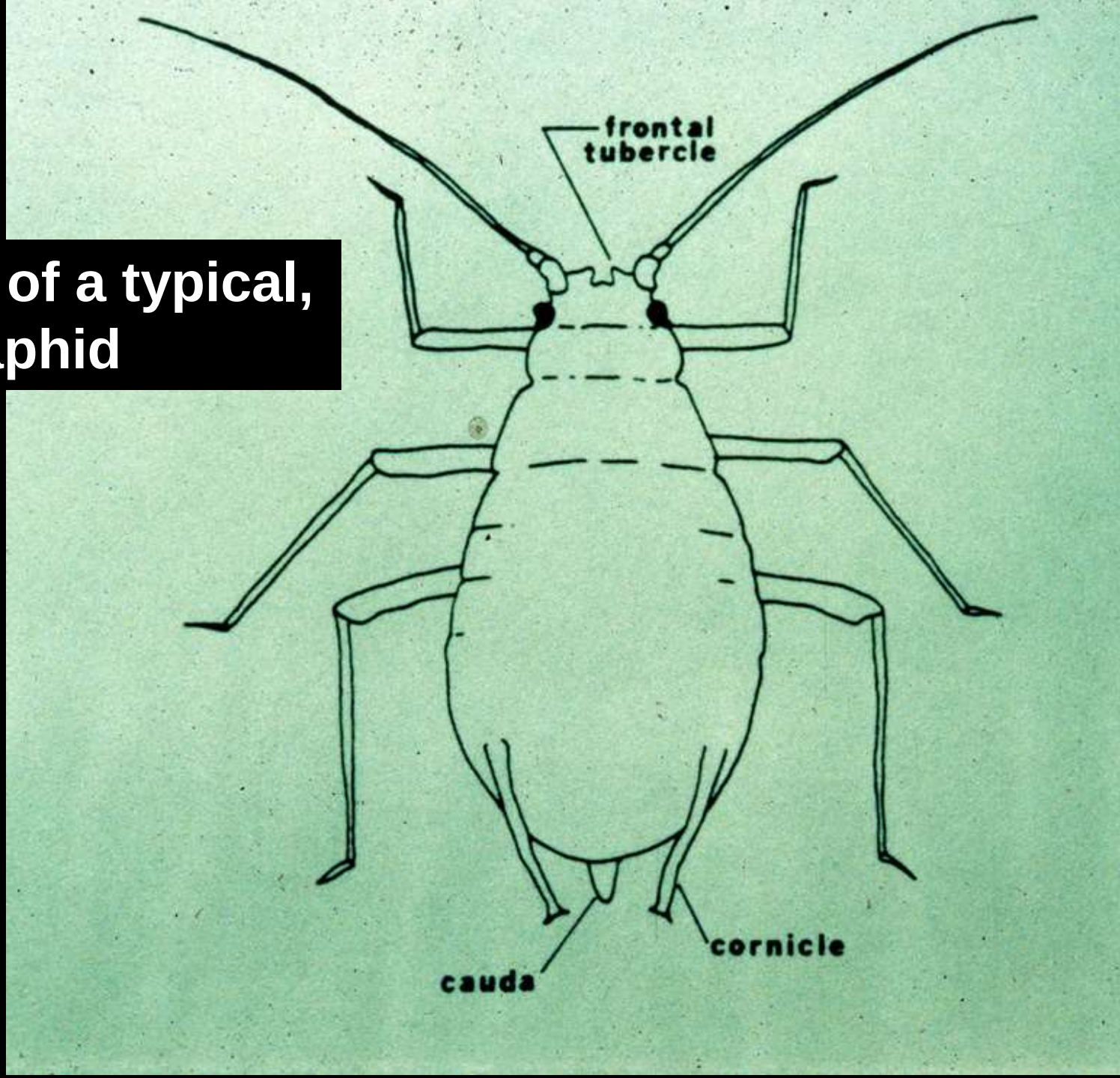
Aphids

Hemiptera: Aphididae

Primary aphid species found in greenhouses



Body plan of a typical, wingless aphid



All aphids go through three feeding stages, ***each punctuated with a molting event***

“Cast skins”, the discarded remnants of the exoskeleton after molting

Diagnostic: “Cast Skins” remain after aphids molt

Live birth and asexual reproduction are the norm with aphids

Aphid populations can increase rapidly

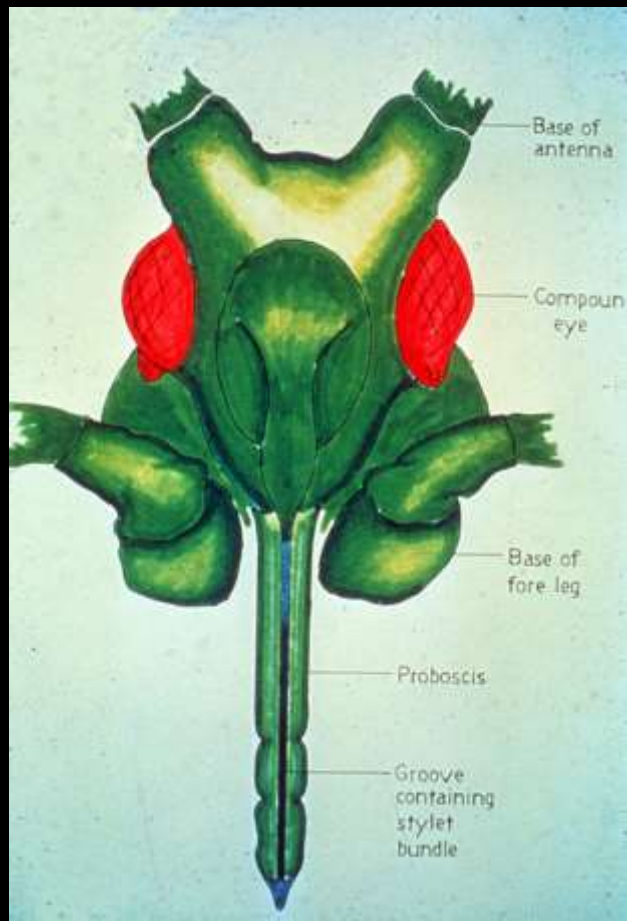
Adults may be winged or wingless

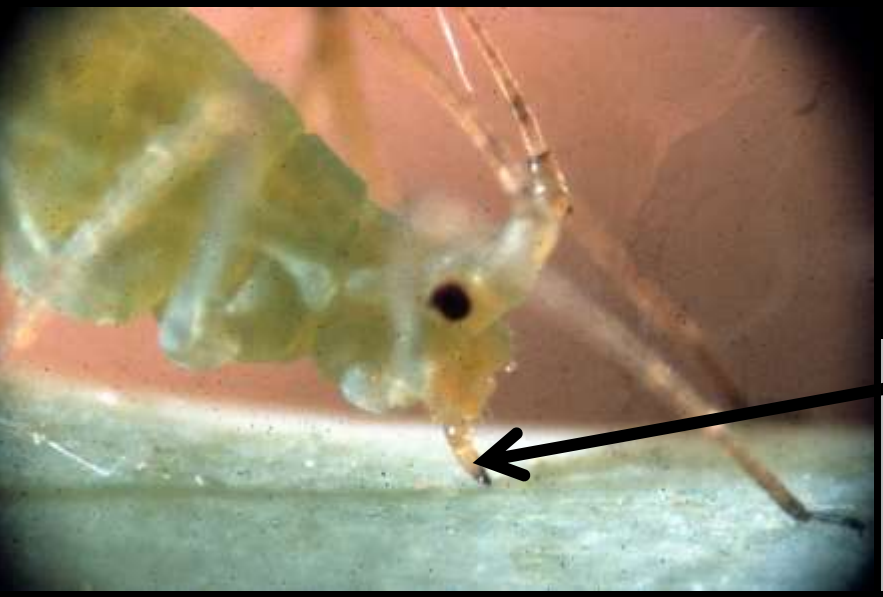

Wing pads of late
stage aphid nymph

Adults may be winged or wingless

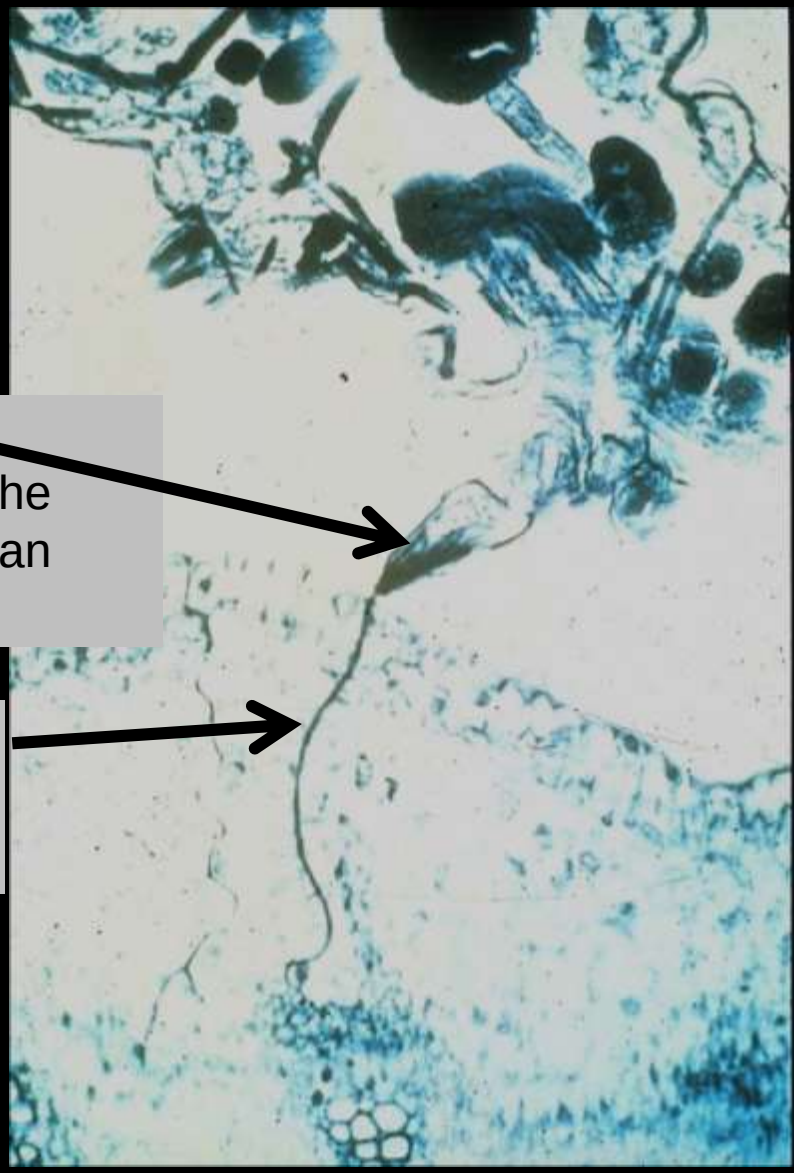
Piercing-sucking mouthparts of Hemiptera

(aphids, whiteflies, mealybugs, leafhoppers, etc.)





Probocis (primarily the labium) of an aphid



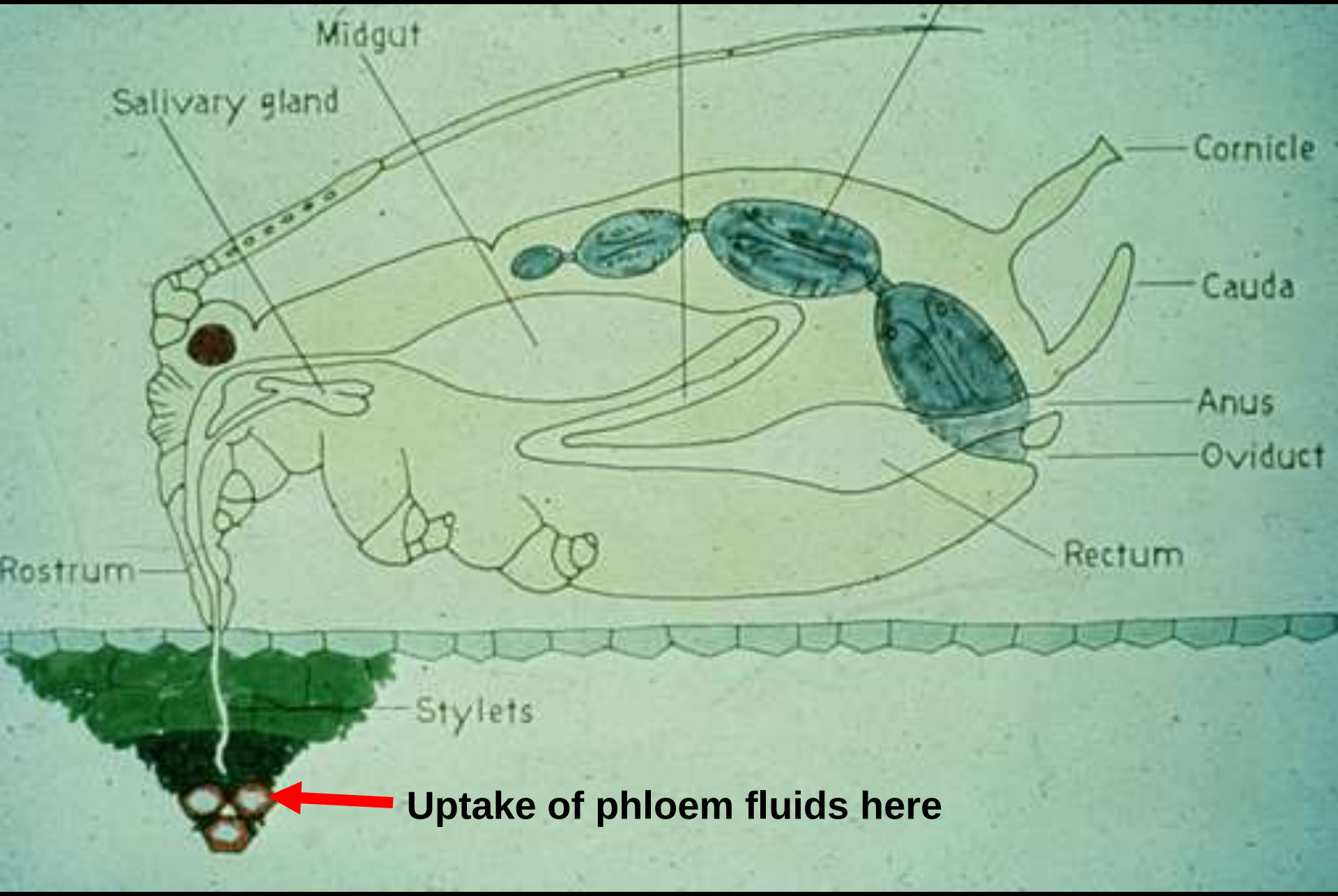
Stylet bundle (mandibles and maxillae) meandering through plant en route to phloem

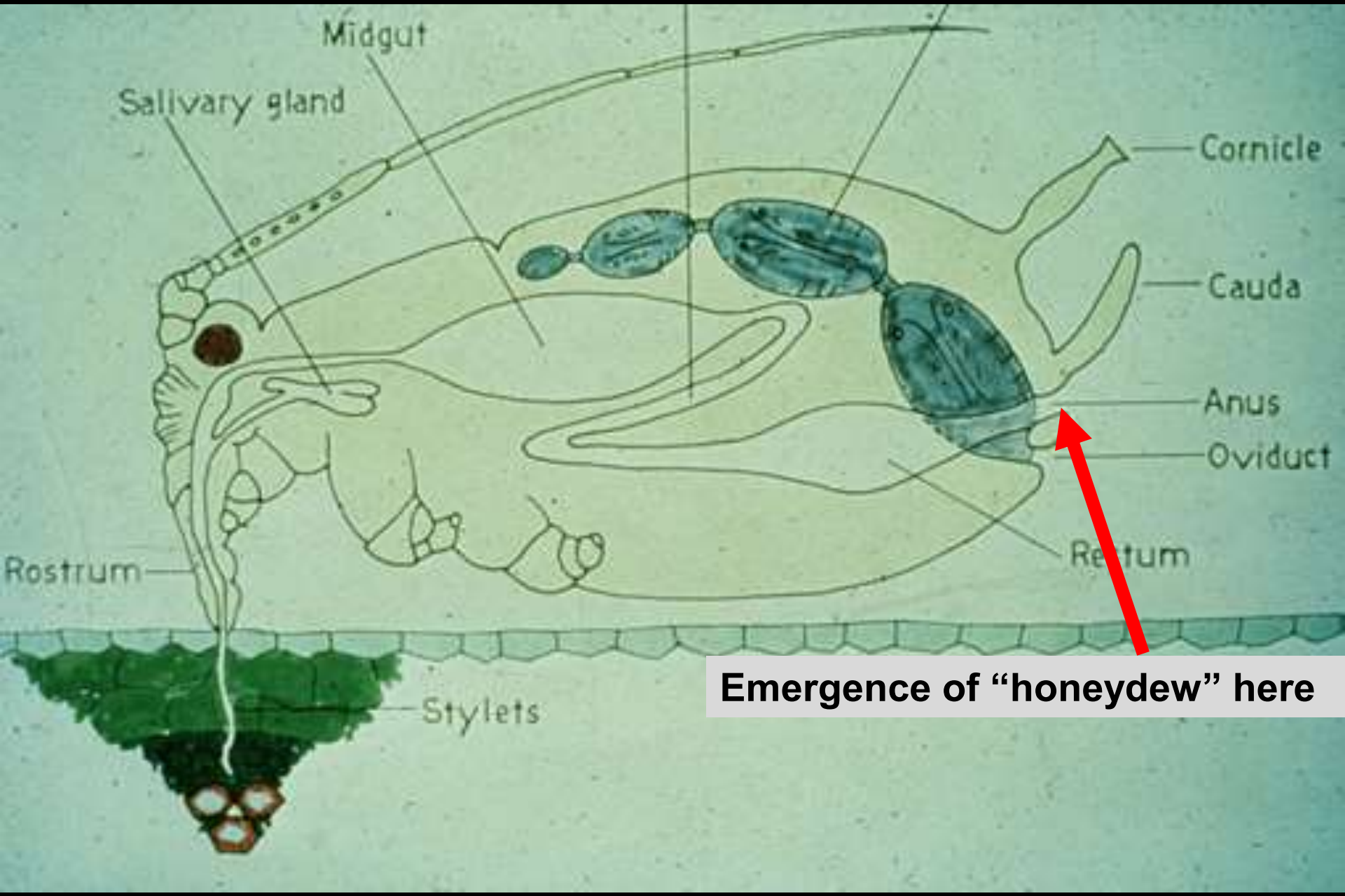
Aphids use their mouthparts to *access the fluids of the phloem*

Little, if any, cell injury is produced by most aphids

Important Note: Presence of aphids does not always equate to occurrence of plant injury!

Honeydew production


Midgut
Salivary gland
Cornicle
Cauda
Anus
Oviduct
Rectum
Rostrum
Stylets
Uptake of phloem fluids here

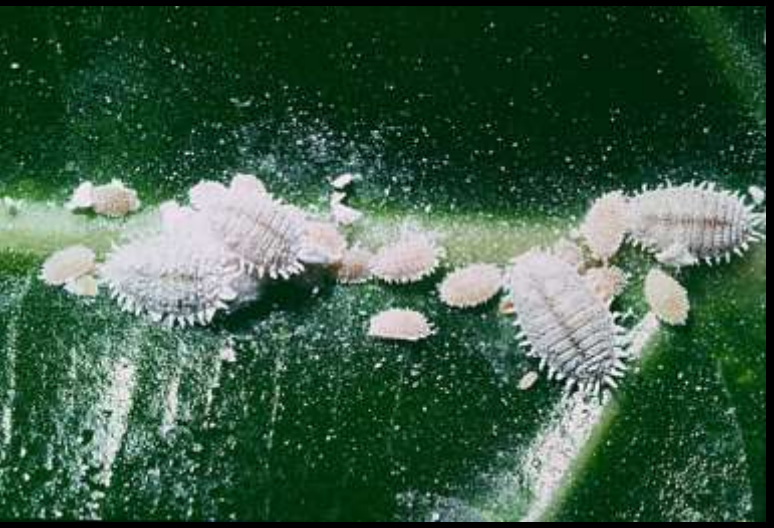

Midgut
Salivary gland
Cornicle
Cauda
Anus
Oviduct
Rectum
Rostrum
Stylets
Emergence of “honeydew” here

Leaf with sparkles of honeydew – *and cast skins*

The leaf above the honeydew – *an aphid colony*

Leaf with sparkles of honeydew – *and cast skins*

Some non-aphid honeydew producing insects



Mealybugs

Whiteflies

Soft Scales

Leafhoppers (some)

Sooty Molds

Fungi that grow on honeydew-contaminated surfaces

Sooty mold growing on linden aphid honeydew

Sooty mold growing on aspen *bark…and on the sidewalk under the aspen*

Cause: Honeydew excreted by aphids living on aspen leaves

Ants are commonly associated with honeydew producing insects

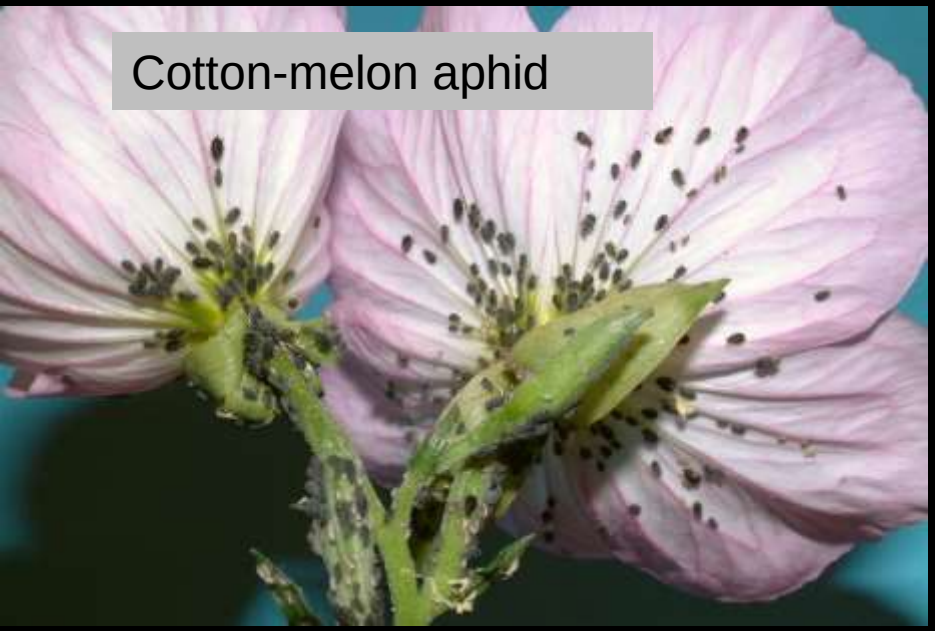
Ants and Aphids
A Mutualistic Relationship

-Aphids provide food – *honeydew*

-Ants provide protection

Photograph courtesy of Brian Valentine

Primary aphid species found in greenhouses



Cabbage Aphid

A species that produces a fine powder of wax

Rice root aphid

Rhopalosiphum rufiabdominalis

Cannabis Aphid

Phorodon cannabis

Plant Injuries Aphids May Produce

- Contamination of produce by insects, honeydew
- Reduced vigor from heavy, sustained feeding
  - Leaf yellowing, premature senescence
- Leafcurl distortions of new growth
- Vectors of some viral diseases

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- Leafcurl distortions of new growth
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Aphids as Contaminants of Produce

Red lettuce aphid on lettuce

Cabbage aphids on Brussels sprouts

Some aphids can cause the new leaves of some kinds of plants to become curled

Sustained feeding by high populations of aphids can produce wilting, leaf yellowing, retarded growth

However, *outdoors there are normally numerous natural enemies* usually curtail aphids before serious damage occurs

BIOLOGICAL CONTROL ORGANISMS FOR INSECTS AND MITES

Whitney Cranshaw, Austin Broberg, and Wendlin Burns
Colorado State University
May 31, 2017 Version

A wide variety of beneficial organisms are offered for sale by several suppliers to assist in management of insects and mites. The following is a listing of most of the US suppliers and it is organized into three sections. First is a brief description of organisms with potential applications followed by reference to sources where they may be purchased. This is followed by a brief summary listing of pest groups and the associated potential biological controls. At the end is a listing of addresses of many suppliers/producers.

Predators of Insects/Mites

Convergent Lady Beetle/Lady Beetles. When sold as "lady beetles" or "ladybugs" the species involved is the convergent lady beetle, *Hippodamia convergens*, a native lady beetle found throughout North America. Purchased lady beetles are all field collected insects, captured in high elevation areas of California where they periodically migrate to and mass aggregate, allowing easy collection. Ability of the collected lady beetles to reproduce is suspended (they are in "reproductive diapause") so eggs are not produced for several weeks after release. (Pre-feeding lady beetles prior to release can allow some egg maturation to start and a few companies provide such "pre-conditioned" lady beetles). Lady beetles tend to readily disperse from the area of release. Since they store well, lady beetles are available most of the year, although supplies often are limited by midsummer.

Sources: 1, 2, 4, 5, 8, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 23, 24, 25, 26, 27, 28, 30, 32, 33, 34

Natural Enemies Sold for Aphid Control

- **Predators**
  - Green lacewing larvae
  - Aphid predator midge
  - Convergent lady beetle?
- **Parasitoids**
  - Various *Aphidius* spp. wasps
- **Pathogens***
  - *Beauveria bassiana*
  - *Isaria fumosorosea*

*** These are registered pesticides applied as sprays**

Aphid Parasitoid Wasps

Aphid mummies

Insect Pathogenic Fungi

Beauveria bassiana, Isaria fumosoroseus

Trade names include Botanigard, Naturalis, Preferal, PFR-97

Green Lacewings

Neuroptera: Chrysopidae

Aphid predator midge

Aphidoletes aphidimyza

Purchasing lady beetles?

Whiteflies

Hemiptera: Aleyrodidae

Photograph courtesy of Jim Kalisch, University of Nebraska

Why are they called whiteflies?

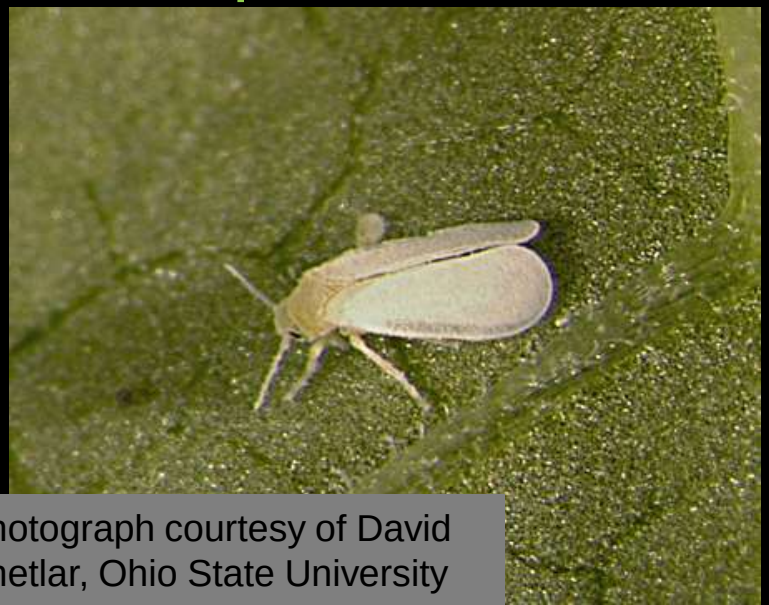
The adults are white. And they fly.

Adult whiteflies, some old “cast skins” in the background, and some droplets of honeydew covered with wax

Extremely heavy infestation of greenhouse whitefly on squash leaf

Common Whiteflies found in Greenhouses in North America

- **Greenhouse whitefly** *(Trialeurodes vaporariorum)*
- **Sweetpotato whitefly** *(Bemisia tabaci)*
  - B & Q Biotypes exist with differences in pesticide sensitivity

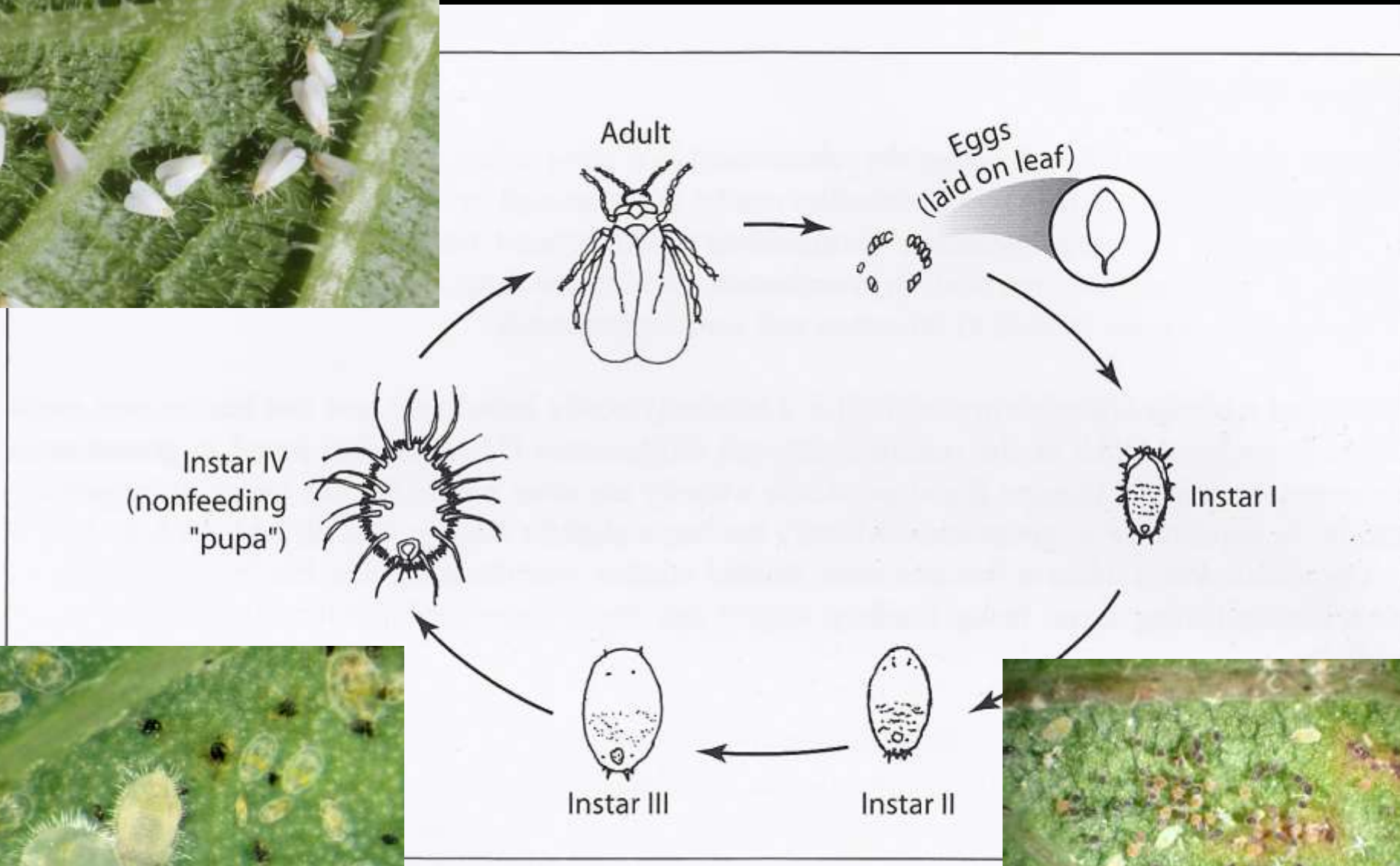


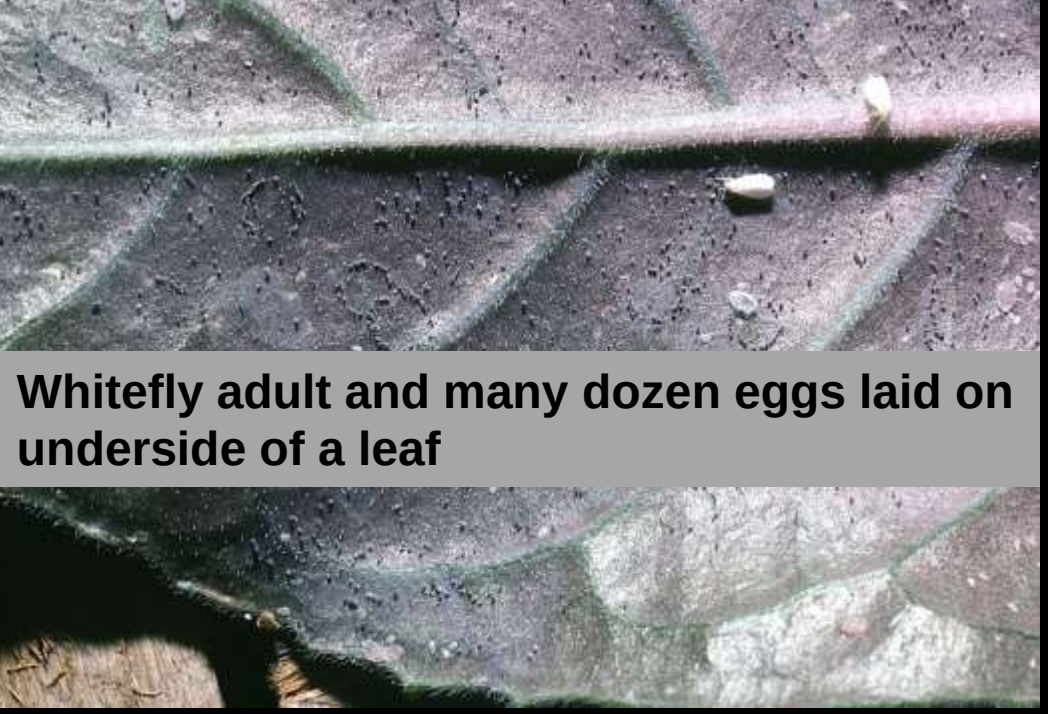
Photograph courtesy of David Shetlar, Ohio State University

Photograph courtesy of David Shetlar, Ohio State University

Whiteflies have simple metamorphosis – but have considerable differences in appearance and habit in adult and nymphal stages.

Generalized Life History of a Whitefly





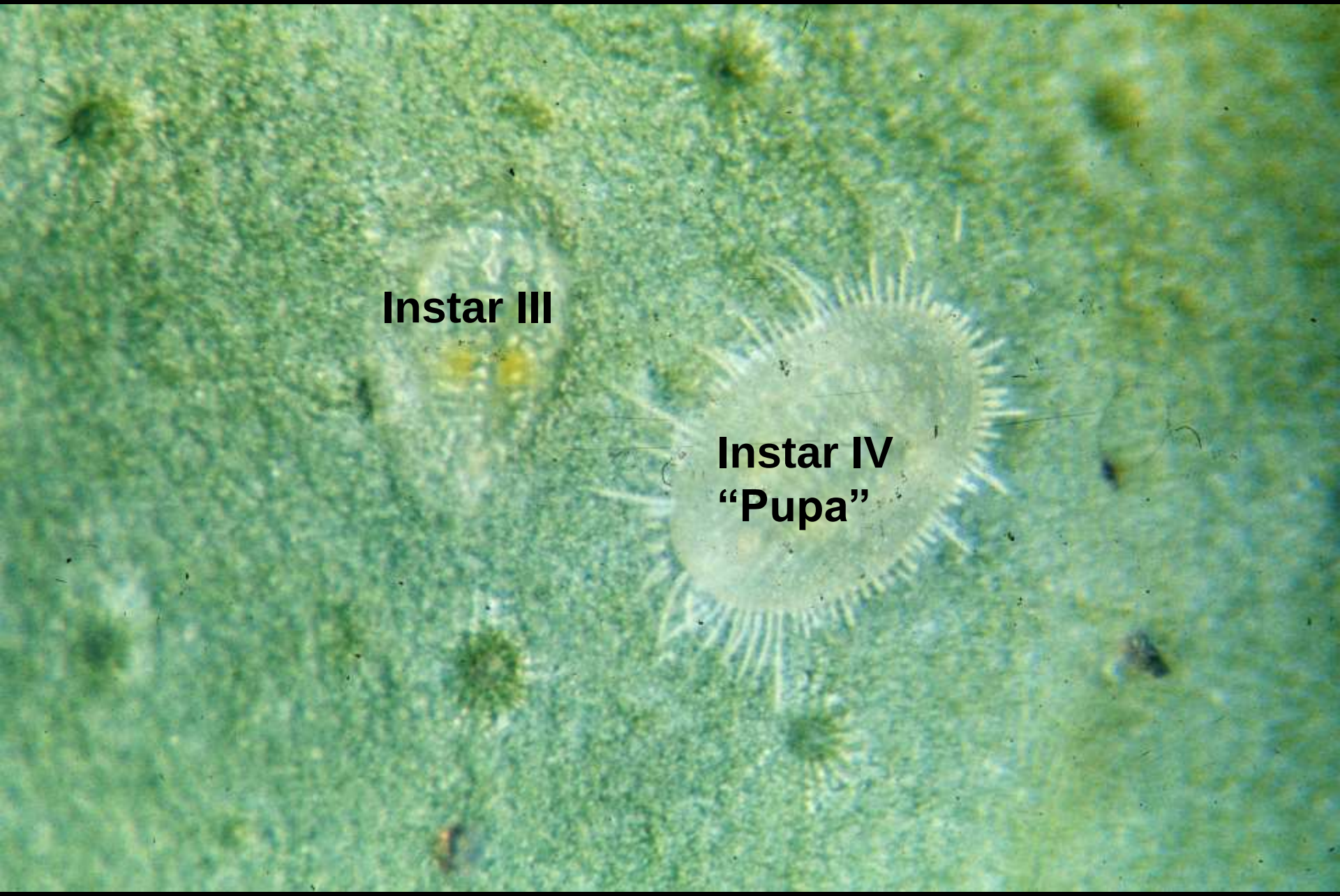
Whitefly adult and many dozen eggs laid on underside of a leaf

Whitefly eggs

Whitefly eggs on leaf

Greenhouse whitefly eggs laid in a semicircular pattern

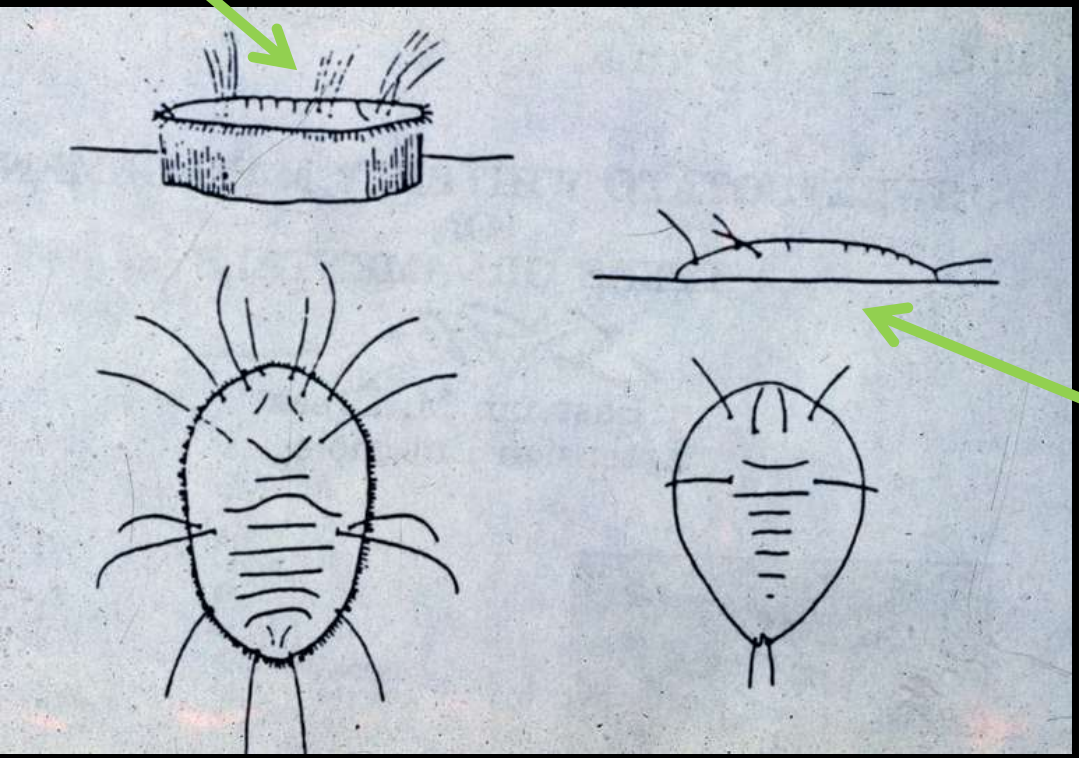
Mixed stages of whitefly nymphs


Instar III
Instar IV
“Pupa”

Instar IV nymphs of whiteflies – “whitefly pupae”

The Instar IV pupa is the stage that can be best used to determine which species of whitefly is present

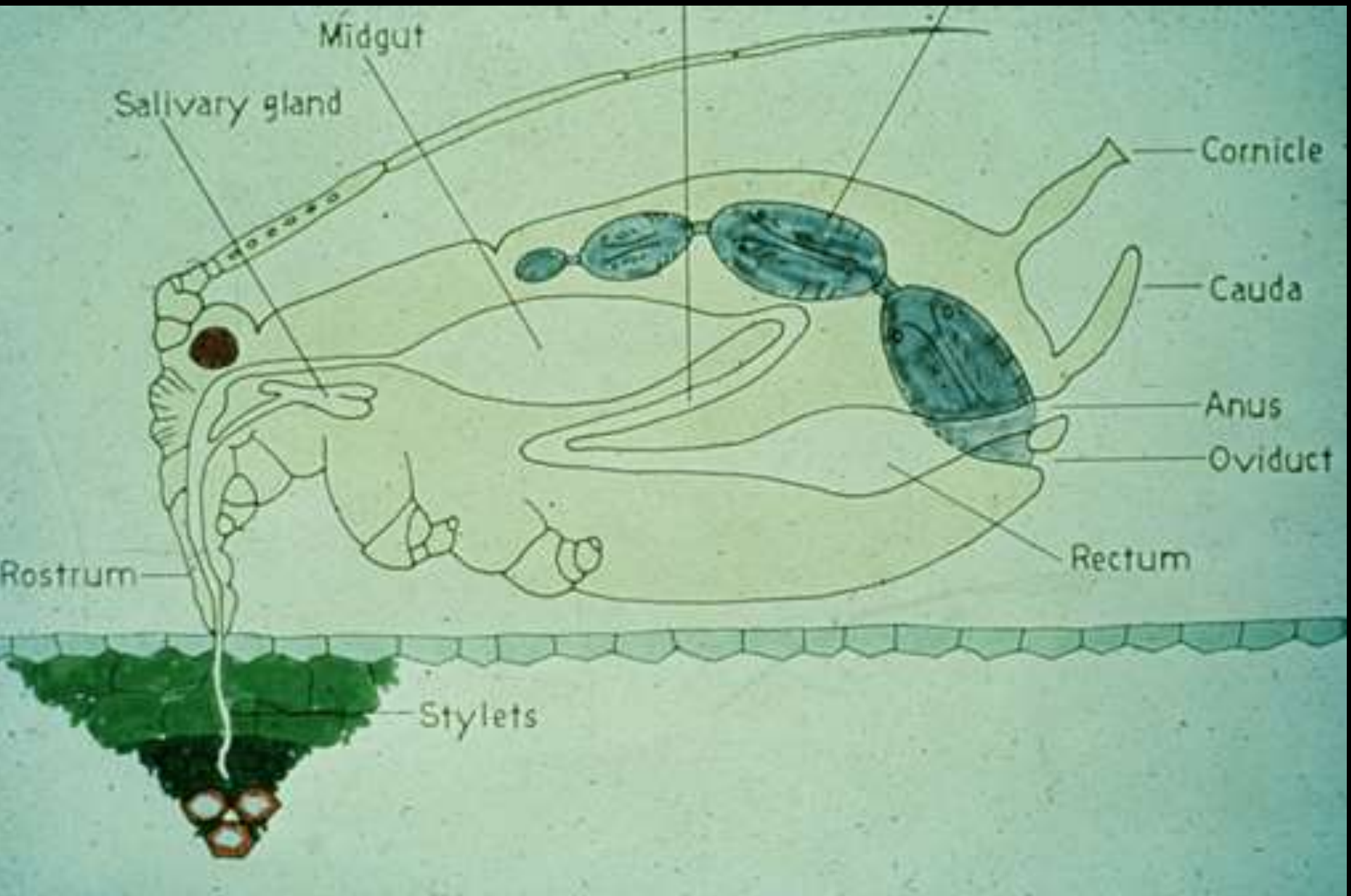
Greenhouse whitefly



Sweetpotato whitefly

Adults, last stage nymphs and old skins of nymphs of whiteflies

Whiteflies (like aphids) suck fluids from the phloem



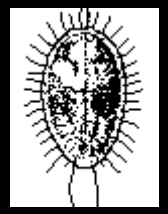
Whiteflies do excrete some honeydew as a waste product

Sooty mold associated with high numbers of whiteflies

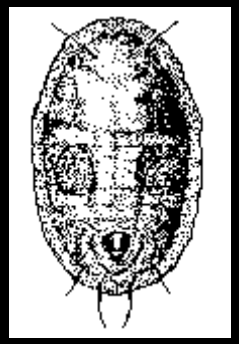
Slide courtesy of **David Shetlar**, the Ohio State University

Whitefly Life Cycles

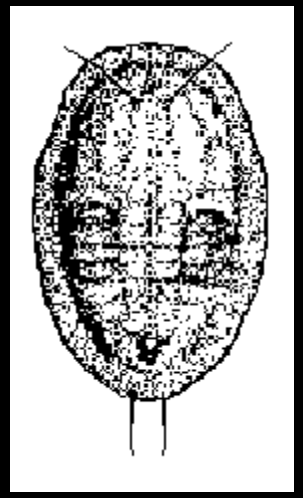
Egg



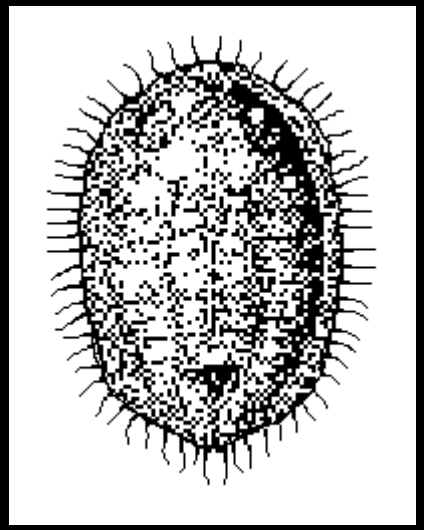
Nymph I (=crawler)



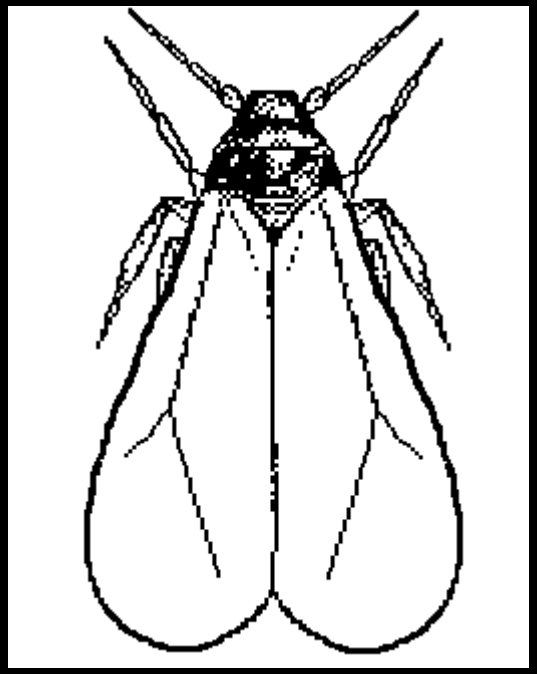
Nymph II (=“scale”)



Nymph III (=“scale”)



Nymph IV (=“Pupa”)



Adult

At 70ºF, the greenhouse whitefly life cycle takes: 6-10 days for egg hatch, 3-4 days as a nymph I, 4-5 days as nymph II, 4-5 days as nymph III, 6-10 days for the pupa. Adults can live for 30 to 40 days.

Development Times for Greenhouse Whitefly

Temp (ºF)	Egg Hatch	Nymphs I-II-III	"Pupa" (nymph IV)	Female Preoviposition
85º	3	7	7	1
75º	6	8	7	1
70º	8	11	8	1
65º	11	17	12	2
60º	18	25	24	2

Period from egg laying to first eggs being laid: 85F - 18 days; 75F - 22 days; 70F - 28 days; 65F - 42 days; 60F - 69 days

Slide courtesy of **David Shetlar**, the Ohio State University

Host-free periods can be used to eliminate greenhouse whitefly

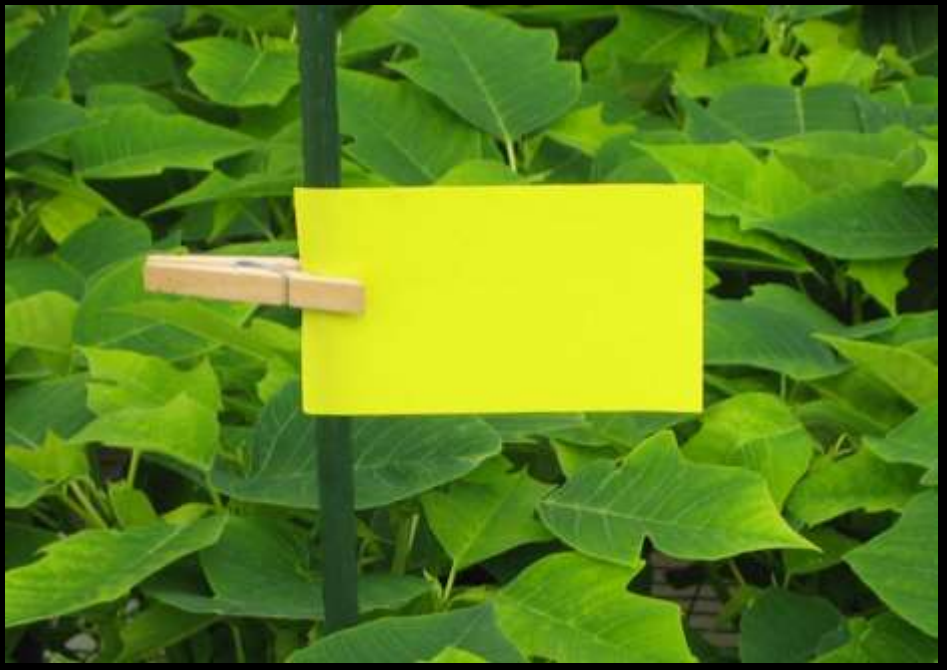
- Greenhouse whitefly is a tropical/ subtropical species
  - Outdoor survival does not occur where there are cold winters
  - Developing stages require living plants
  - Adults survive about 3 days without plants


5368250
CAREFULLY
INSPECT TRANSPLANTS


JUST SAY NO!

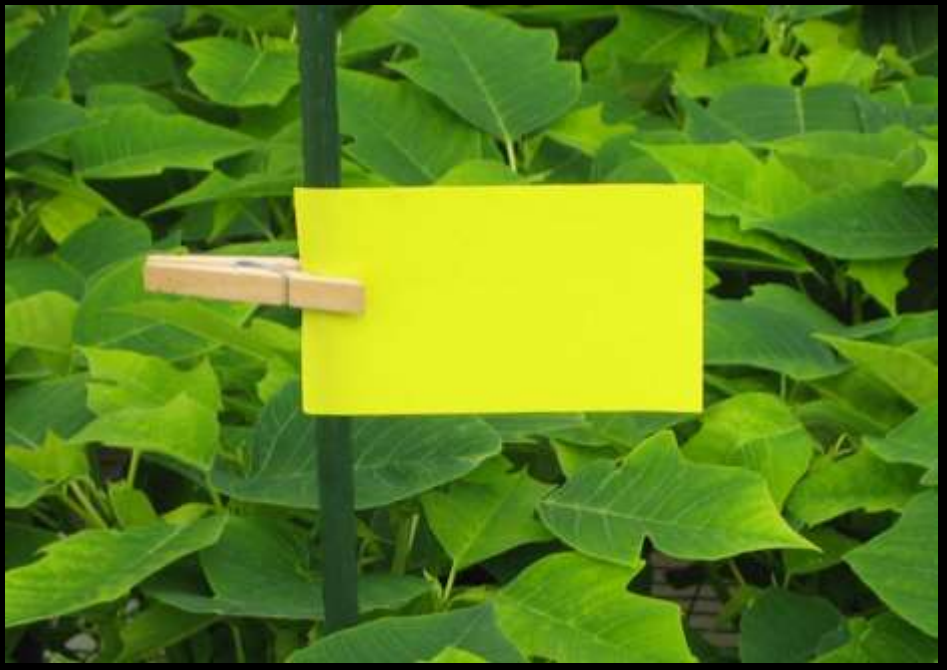
Sticky Traps for Whiteflies

Can sticky traps control whiteflies?



Sticky traps for whiteflies can:

- Capture some adult whiteflies
- Be used to monitor changes in populations of whiteflies



Sticky traps for whiteflies *can not:*

- Capture immature stages of whiteflies
- Capture all adult whiteflies

Sticky traps can be one component of a whitefly control program.

Whiteflies

Biological Controls

- **Parasitic Wasps**
  - *Encarsia formosa*
  - *Eretmocerus eremicus*
- ***Beauveria bassiana***

Whitefly parasites – Parasitic wasps that selectively attack whiteflies

***Encarsia formosa*-parasitized whitefly 'pupae'**

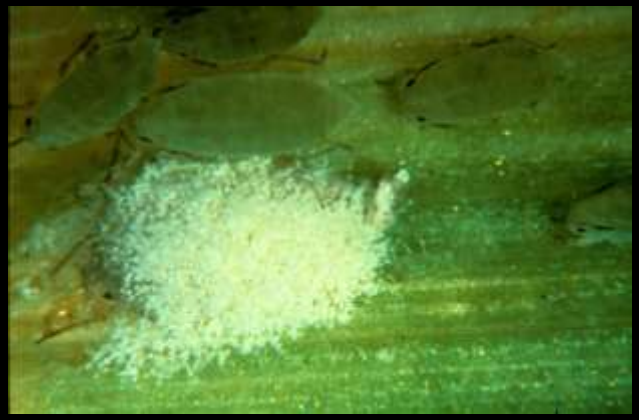
Left: Card containing parasitized whiteflies for release

Whitefly parasite –
Effective only in warm temperature greenhouses – Above about 72F average

Whiteflies

Biological Controls

- **Parasitic Wasps**
  - ***Encarsia formosa***
  - ***Eretmocerus californicus***
- ***Beauveria bassiana***



Beauveria bassiana Products (Naturalis, Botanigard)

Thrips

Thysanoptera: Thripidae

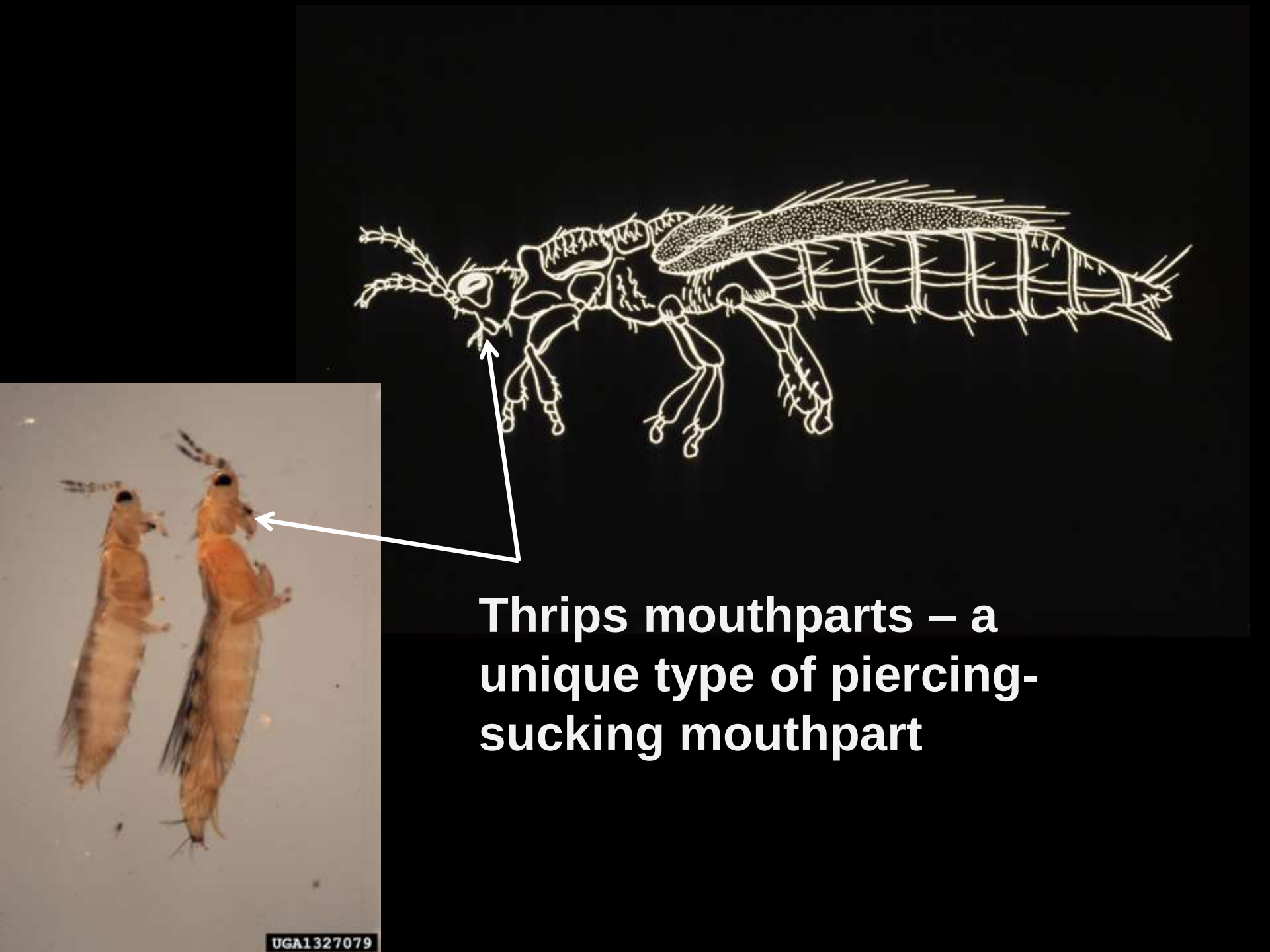
Two species of thrips predominate in greenhouses. Both are very common insects on outdoor plants in Colorado

Western flower thrips

Frankliniella occidentalis

Onion thrips

Thrips tabaci



Thrips mouthparts – a unique type of piercing-sucking mouthpart

Thrips Mouthparts

- Single *mandible*
  - 2nd mandible vestigial
  - penetrates leaf surface
- Paired *maxillae*
  - punctures cells below surface
- Labium forms a supporting cone
- **Functions to** "puncture – poke – suck"


UGA1327079

Thrips injuries – Silvery scars with small dark fecal spots

Leaf injuries by thrips

Photograph courtesy of USDA Forest Service

Fruit scars caused by thrips feeding

Photograph courtesy of University of California

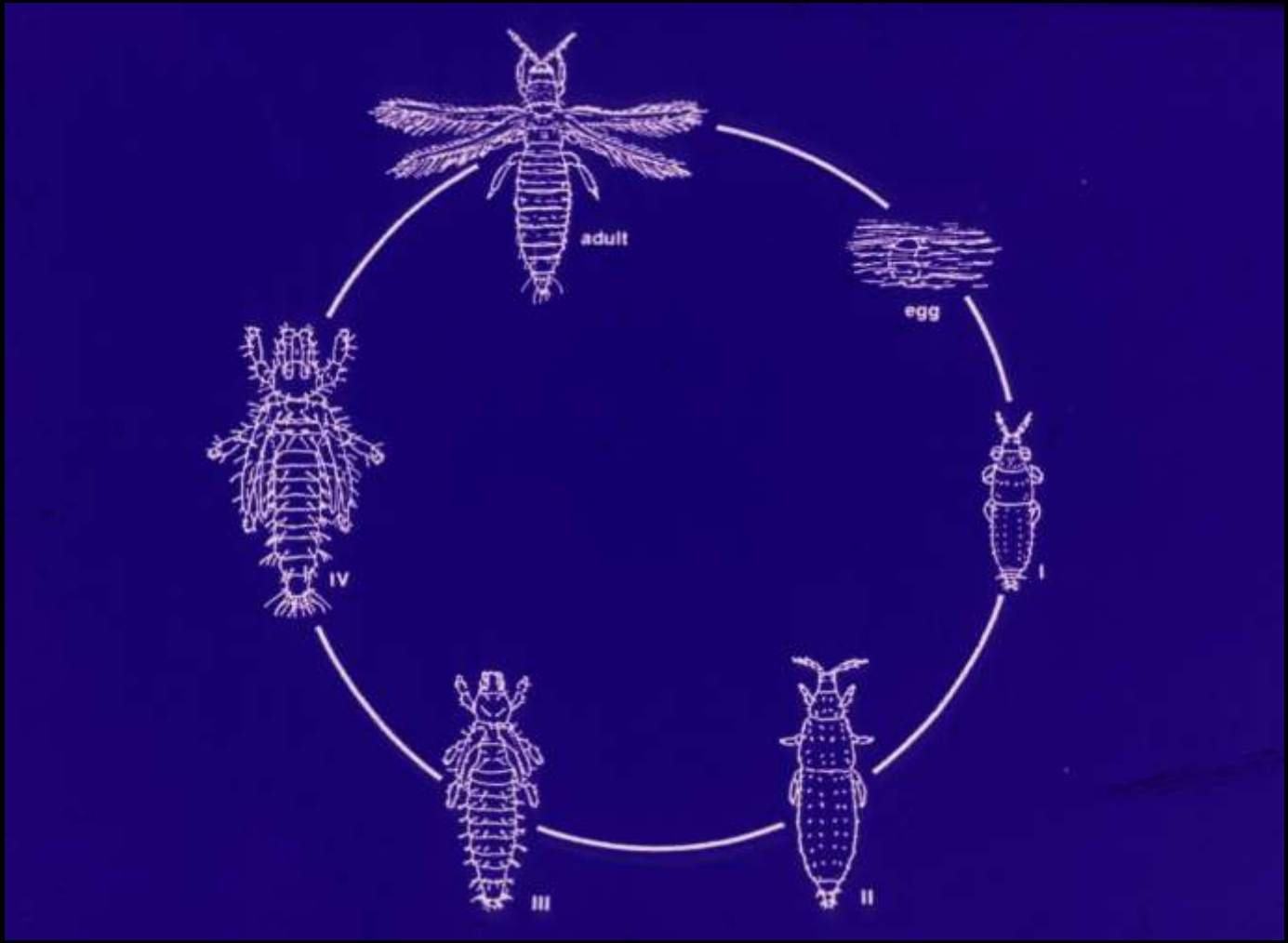
Photograph courtesy of University of California

Photograph courtesy of Utah State University

Several species of thrips feed on flower buds and flowers.

Most are in the genus *Frankliniella*

Thrips Life Cycle



Simple type, with a twist (non-feeding stages)

Life stages of a thrips

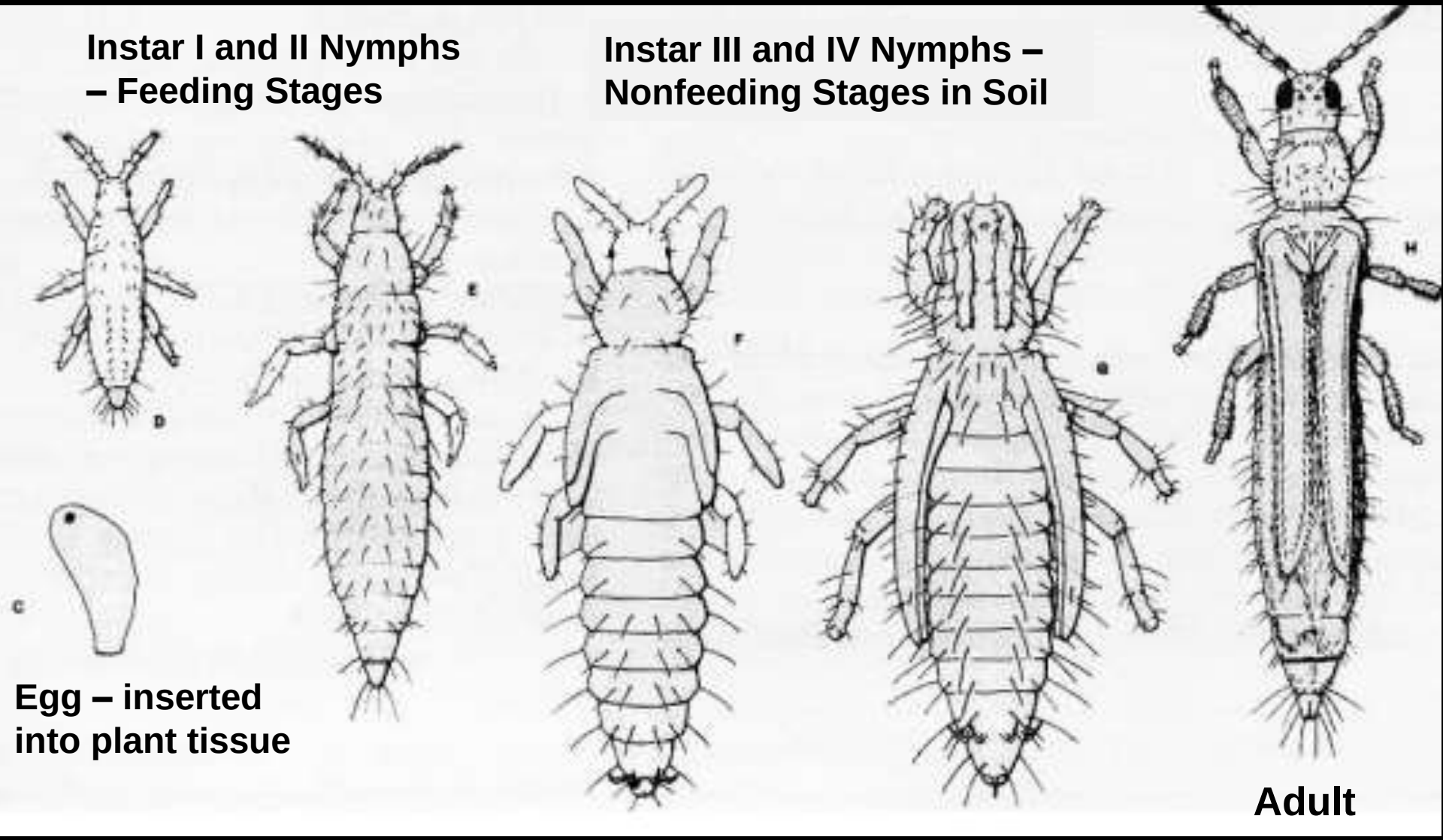


Figure drawing courtesy of Oregon State University

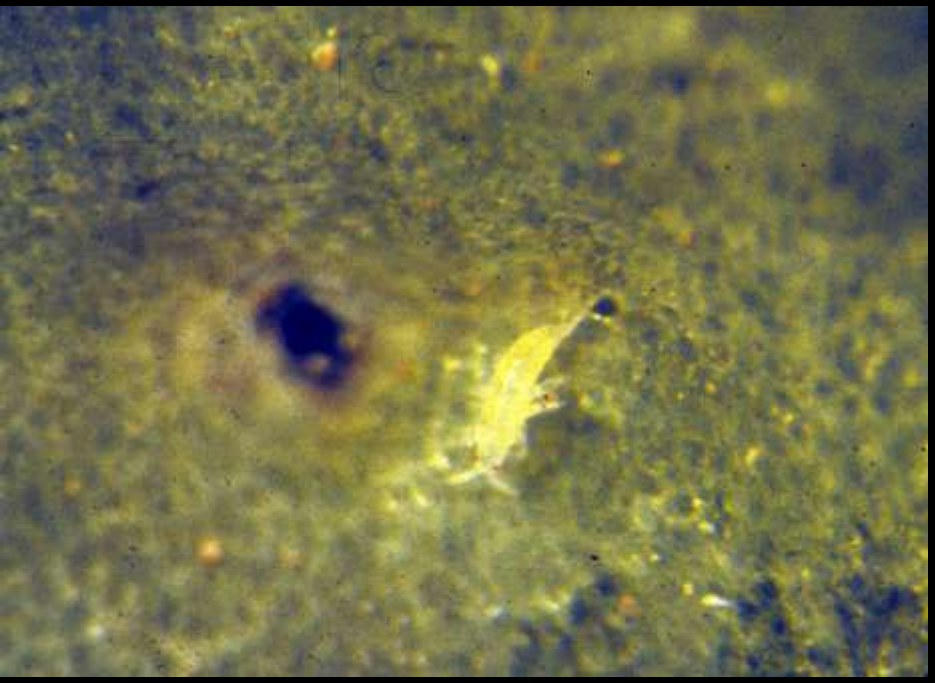
Eggs are inserted into leaves, petals

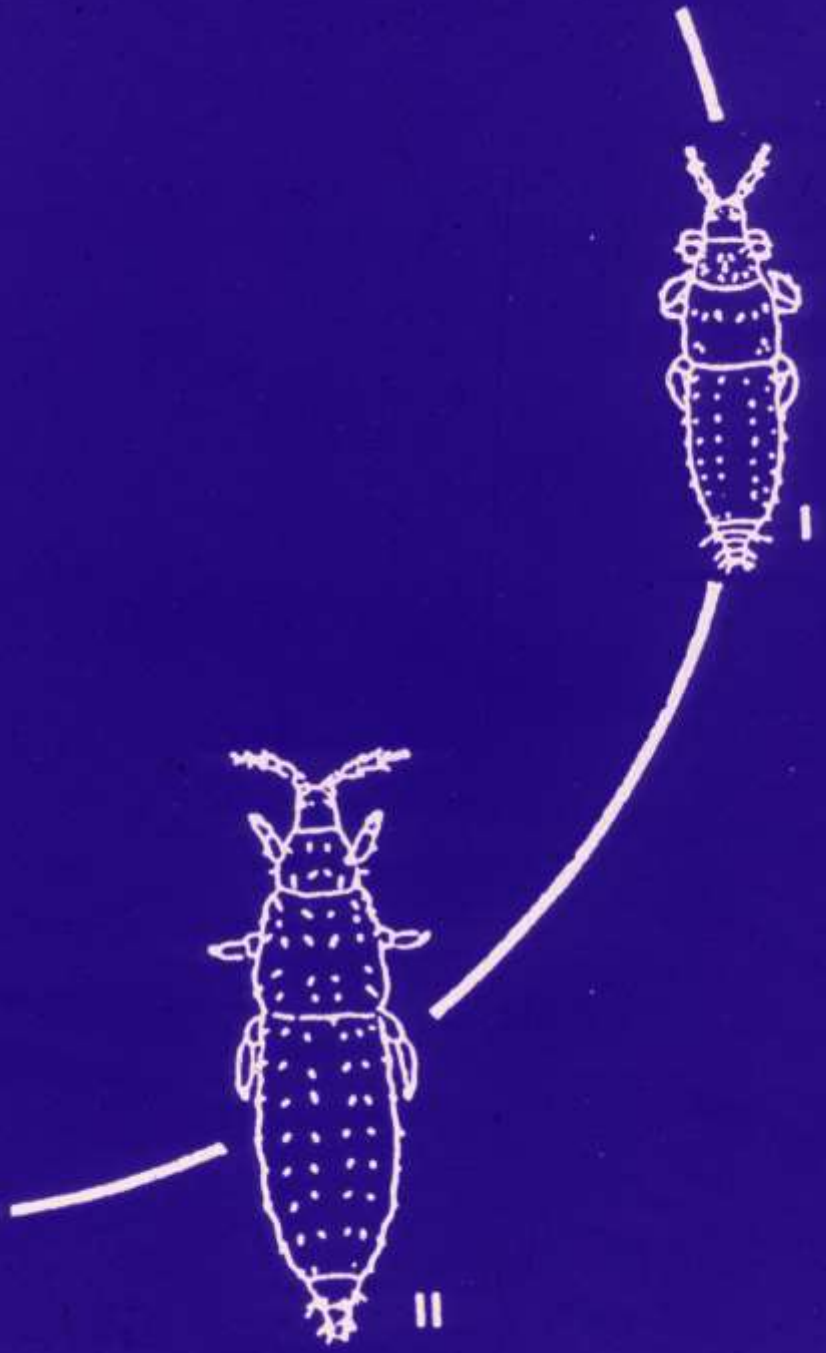
Ovipositor (used to insert eggs into leaf tissues)

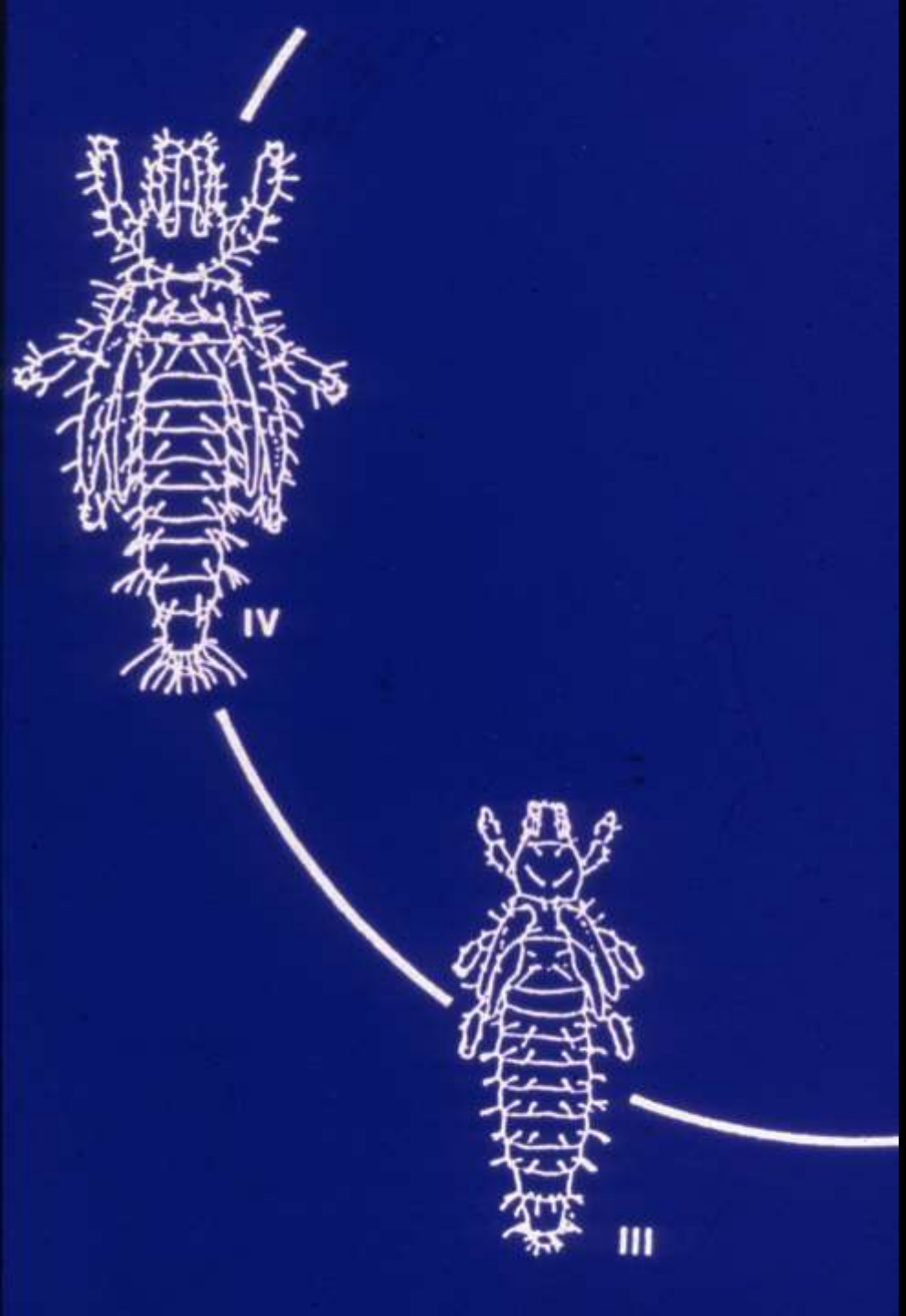
Thrips oviposition wounds

Thrips "pansy spot" on mature Idared apples (Utah State University).

The first two stages feed on plants







The last two stages do not feed.

They typically occur in the soil or at the base of leaves and similar protected sites.

Thrips Transmission of Viruses* to Plants

- Tomato spotted wilt
- Impatiens necrotic spot
- Iris yellow spot

* Viruses transmitted by thrips are in the virus family Tospoviruses

Photograph courtesy of Paul Bachi, University of Kentucky Research and Education Center

Photograph courtesy of John Fisher, Ohio Department of Agriculture

Ring spot symptoms on foliage – tomato spotted wilt virus (TSWV)

Photograph courtesy of John Fisher, Ohio Department of Agriculture

Photograph courtesy of Robert Wick, University of Massachusetts

Ring spot symptoms on foliage – Impatiens necrotic spot virus (INSV)

Ring spot symptoms on fruit

Photograph courtesy of Jennifer Olson, Oklahoma State University

Leaves may show necrotic lesions without ringspots

Photograph courtesy of Mary Ann Hansen, VPI and SU

Necrotic lesions on stems resulting from tomato spotted wilt infection

Wilting and stunting associated with tomato spotted wilt virus

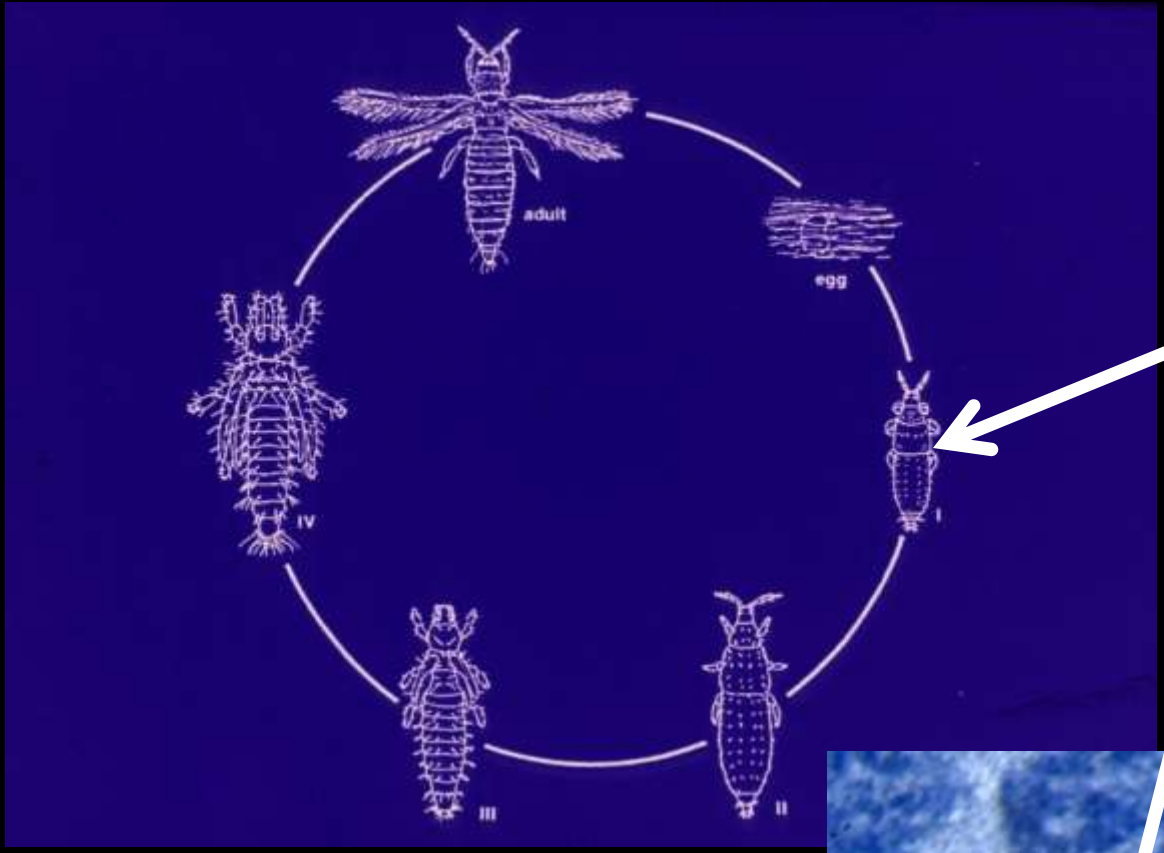
Photograph courtesy of Gerald Holmes CA Polytechnic University, San Luis Obispo

Characteristics of Thrips Transmitted Viruses

- Thrips are the only insect vector
  - Humans do not spread the virus

Characteristics of Thrips Transmitted Viruses

- Thrips are the only insect vector
  - Humans do not spread the virus
- Thrips can only acquire the virus if they feed on an infected plant in their first nymphal stage (Instar I)
  - Adult stages can not acquire the virus



Thrips can only spread viruses if the first stage nymphs were developing on a plant that was infected with the plant virus

Characteristics of Tnrips Transmitted Viruses

- Thrips are the only insect vector
  - Humans do not spread the virus
- Thrips can only acquire the virus if they feed on an infected plant in their first nymphal stage (Instar I)
  - Adult stages can not acquire the virus
- Thrips that have acquired the virus can transmit it for the rest of their life

Management of Thrips-transmitted Viruses in a Greenhouse

- Make intensive effort to identify all sources of the virus and destroy them
- Make intensive effort to identify all sources of the virus and destroy them
- Make intensive effort to identify all sources of the viruses and destroy them

Management of Thrips in a Greenhouse

- Exclude thrips
- Trap adults thrips for some suppression and monitoring
- Consider use of biological controls to produce some suppression
- Use insecticides effective against thrips to produce some suppression

Thrips

Biological Controls

- **Life stages on foliage**
  - **Some predatory mites**
- **Life stages in soil**
  - **Insect parasitic nematodes (*Steinernema feltiae*)**
  - **Soil predator mites (*Hypoaspis* spp.)**

Neoseiulus cucumeris

Amblysieus swirskii

Some predators used to control leaf feeding stages of thrips

Minute pirate bugs (*Orius* spp.)

Insect parasitic nematode
Steinernema feltiae

Dalotia coriaria (rove beetle)

Some predators used to control soil dwelling stages of thrips (Instar III-IV)

Soil predator mite *Stratiolaelaps scimitus* (= *Hypoaspis miles*)

Key diagnostic:
Silvery scars with small dark fecal spots

Thrips have:

- Unique wing type
- Unique form and function of mouthparts
- Unique metamorphosis pattern
- Odd name

Stop this!

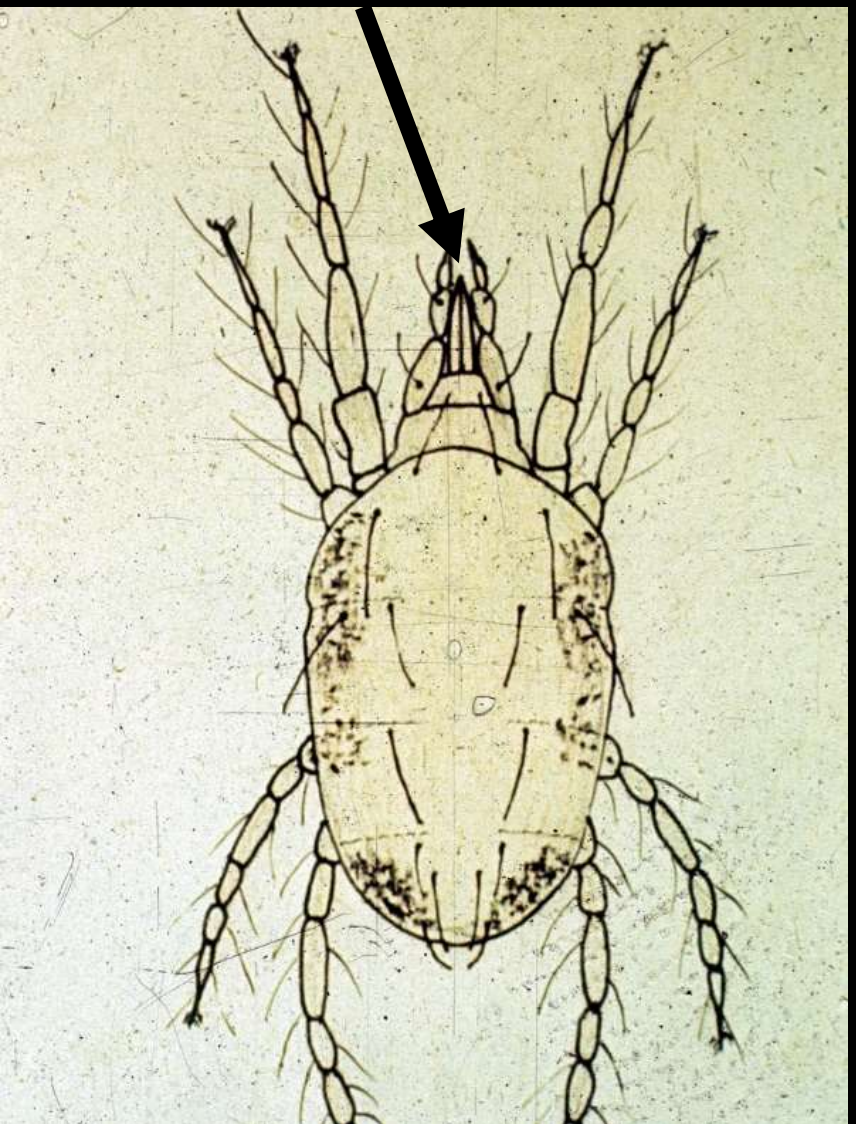
Thrips is both singular and plural

One thrips, two thrips, ….. million thrips

Twospotted spider mite

Tetranychus urticae

Spider mites pierce cells with their whip-like chelicerae



Typically they will destroy 1 to 2 dozen cells at each feeding site – then move on


POWER TRAC

Each feeding site produces a small area of dead cells – a type of stippling injury

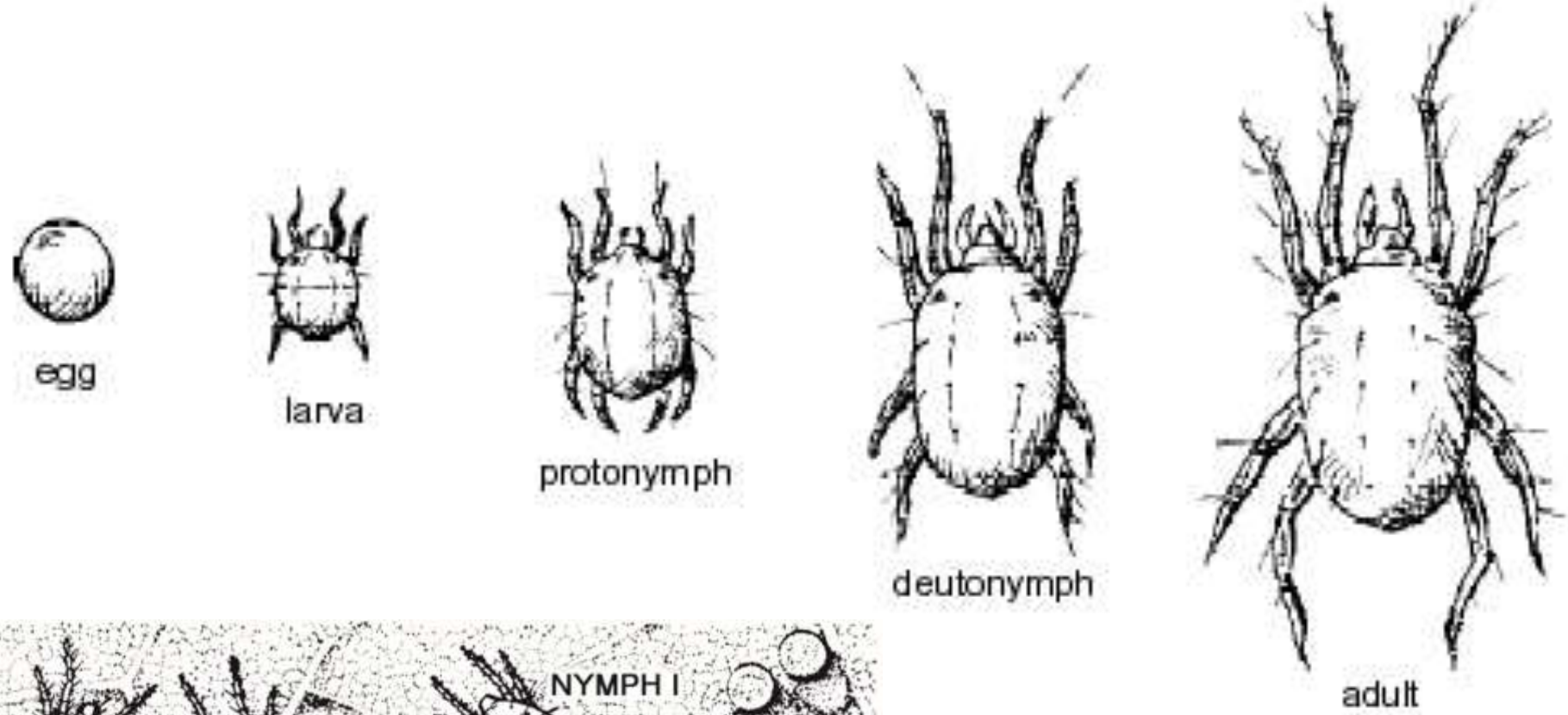
With high mite populations, the stippling injuries may cover much of the leaf area.

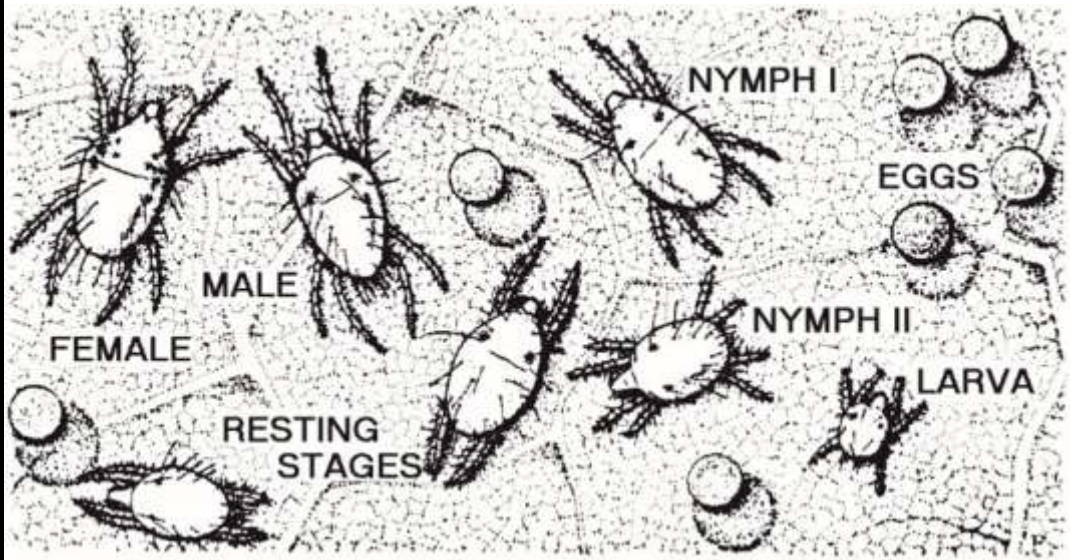
Webbing may be produced by spider mites and becomes visible when they are in high populations

Photographs courtesy of David Shetlar, Ohio State University

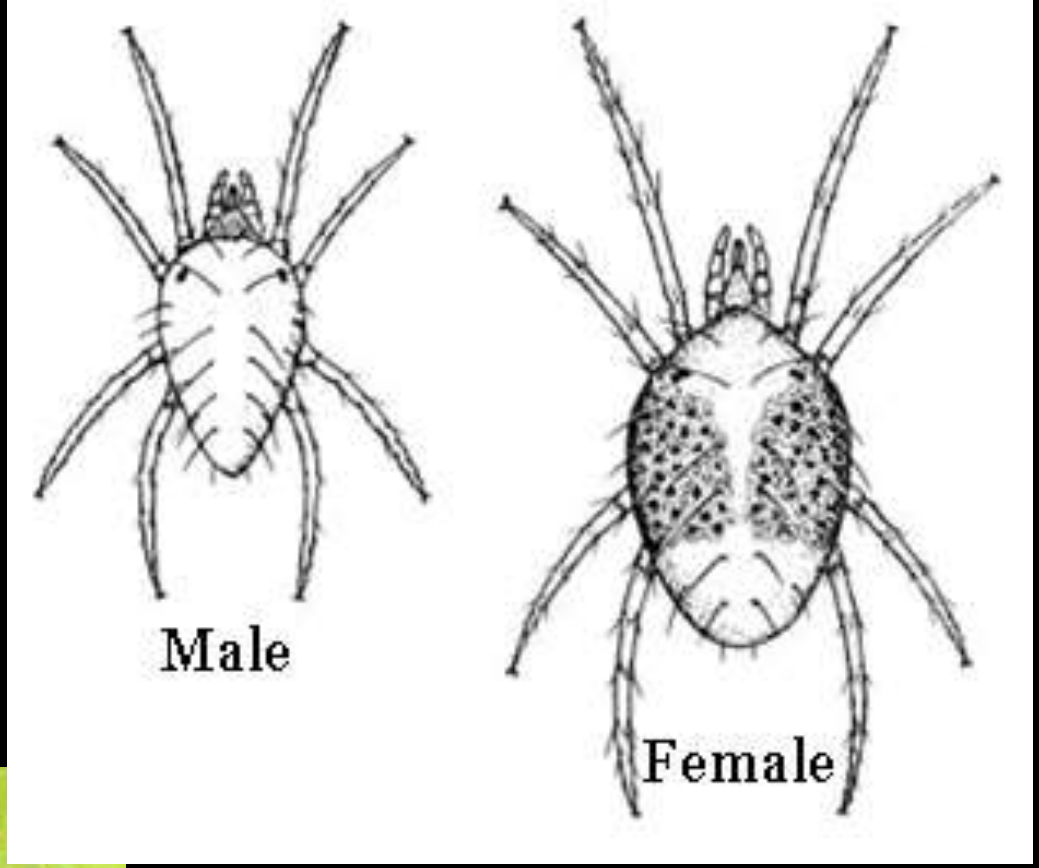
Spider mites travelling along webbing

Life Stages of the Twospotted Spider Mite





Male spider mites are smaller than females and have an abdomen that tapers



Female spider mite with eggs

Male spider mite

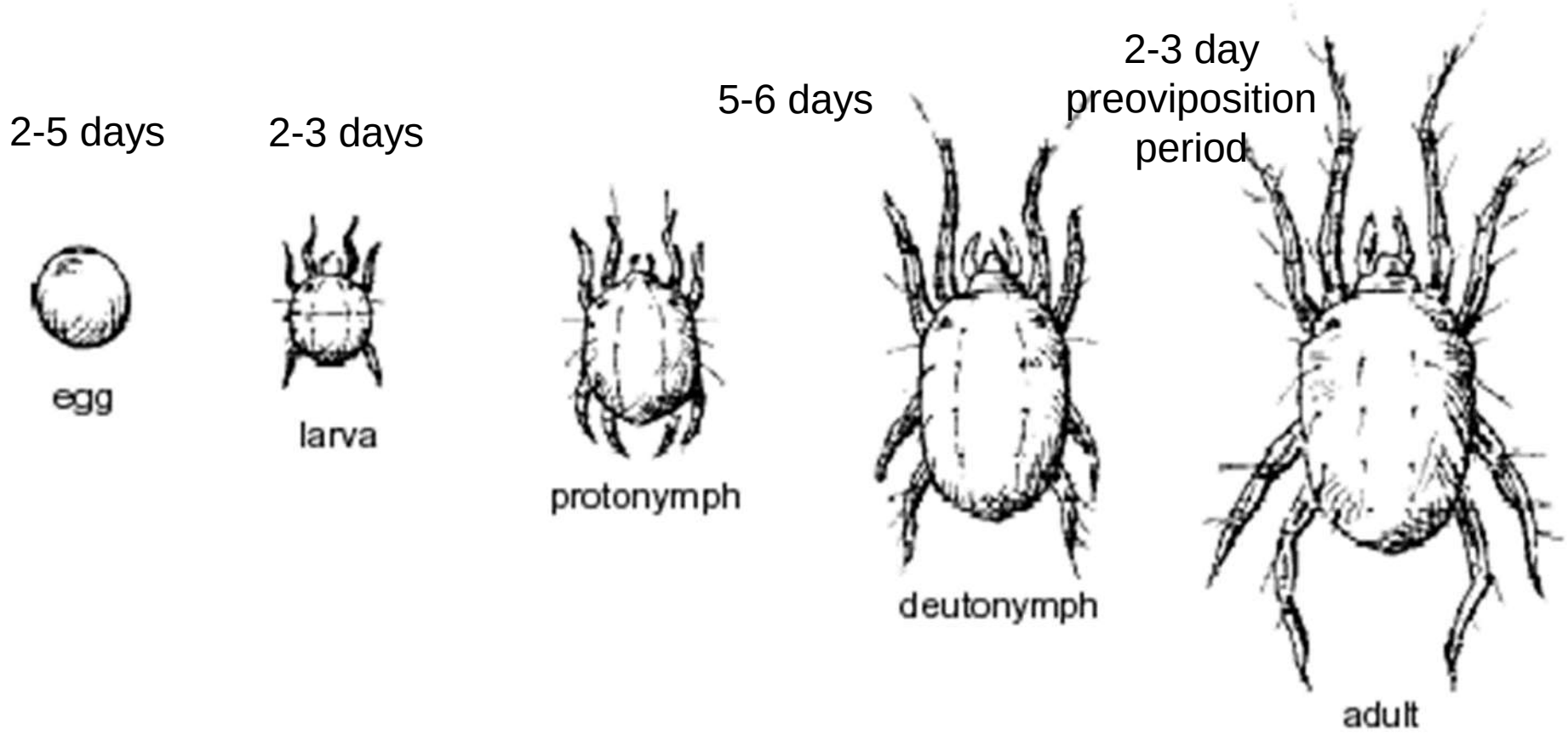
Photographs courtesy of David Shetlar

A high population of honeylocust spider mite (on a honeylocust leaf)

Length of time to complete a Life Cycle – Egg being laid to Adult form present

65 F - about 17 days
75 F - about 10 days
85 F - about 7 days

Adults will typically lay eggs over a 2-4 week period



Photograph by David Shetlar, Ohio State University

Mites can disperse some distance by being wind blown – (ballooning)

Color change in mites going into dormancy (Diapause)

Dormancy is broken following a chill period and increasing day length (photoperiod)

Green summer form on leaves

Orange-red overwintering form around buds

Changes in color can occur during the year

Twospotted Spider Mite (*Tetranychus urticae*)

Spider Mite Management

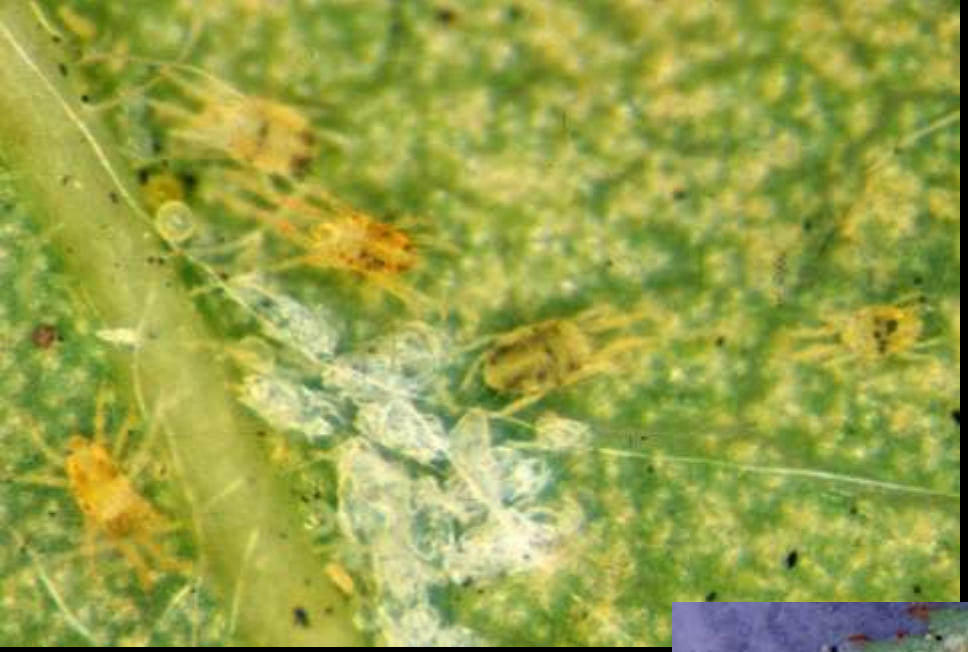
- Monitor high risk plants
- Minimize drought stress
- Increase humidity
- Consider introduction of mite predators
- Use effective miticides/avoid pesticides that aggravate mite problems

Monitor to detect incipient outbreaks

Detect symptoms at this point

Before it progresses to this..

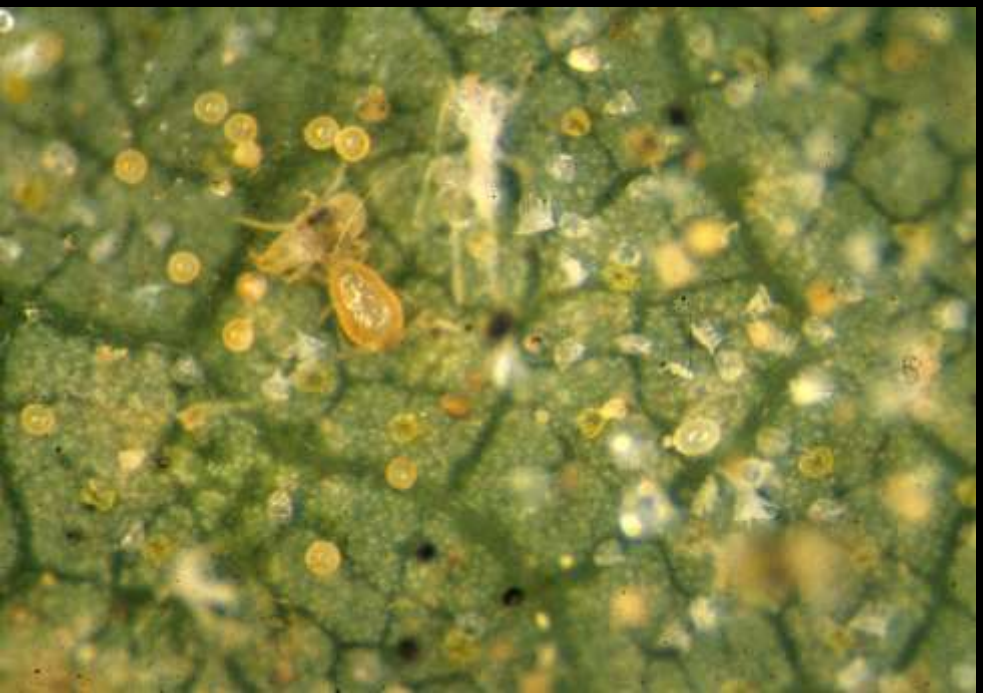
…and then this.



Old cast skins and egg shells are good diagnostics

Drought and low humidity can contribute to spider mite problems

Predators of spider mites include minute pirate bugs (left), predatory mites (below left) and predatory thrips (below)



Predatory Mites

Some Predatory Mites of Spider Mites that are Commonly Used in Greenhouse Production

- ***Mesoseiulus longipes***
- ***Neoseiulus californicus***
- ***Galendromus occidentalis***

Note: The above species are the predatory mites that are most tolerant of low humidity. However, performance of all is reduced under low humidity.

Potato/Tomato Psyllid

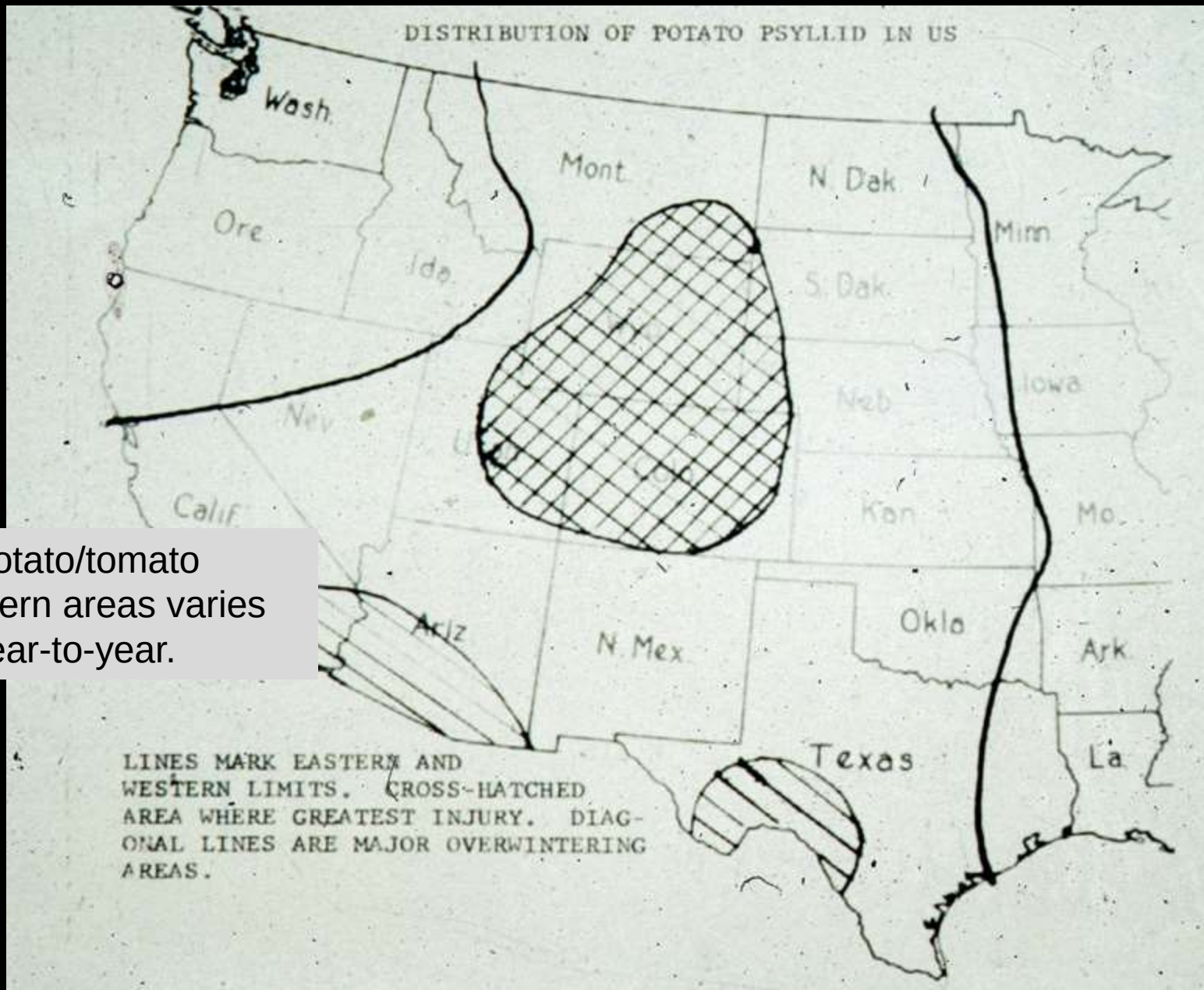
Bactericera cockerelli

Hemiptera: Triozidae

…..and psyllid yellows disease

Potatoes and tomatoes are susceptible. Other plants that this insect feeds on (e.g., peppers, tomatillo) do not seem to be seriously injured.

The potato/tomato psyllid annually migrates northward from overwintering areas in the southwestern US and Mexico



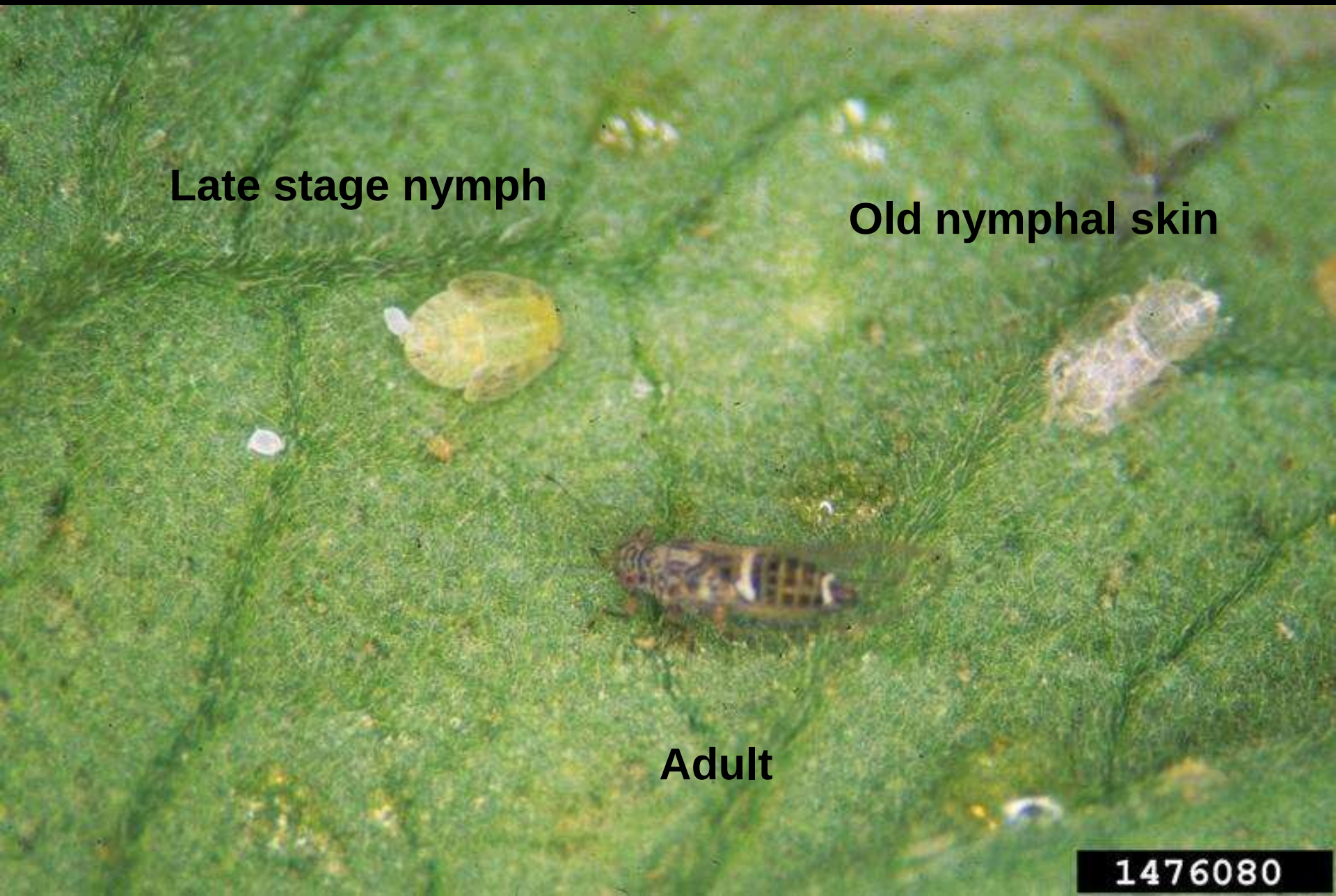
Incidence of potato/tomato psyllid in northern areas varies greatly from year-to-year.

Adult potato psyllids

Note: They jump when disturbed

Eggs are laid leaves.
They have a tiny stalk.

Young nymphs tend to be light brown; older nymphs green


Late stage nymph
Old nymphal skin
Adult
1476080

“Psyllid sugar” is a unique and diagnostic excrement it produces.

Psyllid sugar collected on leaves of in hoop house-grown tomatoes

Psyllid Yellows

A plant disease produced from the effects of toxic saliva introduced by the potato/tomato psyllid. (Plant toxemia)

Color change (yellowing, purpling) is a common symptom.

Internode thickening and ‘aerial tubers’ are a common symptom

Yields can be greatly reduced from effects of psyllid yellows

Premature Sprouting

Symptoms to new growth of tomato

Effects on tomato yield

Dull color of fruit. Often associated with reduced flavor.

Reduced fruit size

Key diagnostic: Psyllid sugar

Photograph courtesy of David Cappaert, Michigan State University

Fungus Gnats

Diptera: Sciaridae

These are extremely common insects that occur outdoors in areas of decaying plant matter

Potential Concerns Associated with Fungus Gnats

- Nuisance problems with adults in vicinity of infested plants
- Some root feeding by larvae
  - Wounding may allow colonization of roots by rot rotting fungi

Adult fungus gnats

Fungus gnats on sticky card

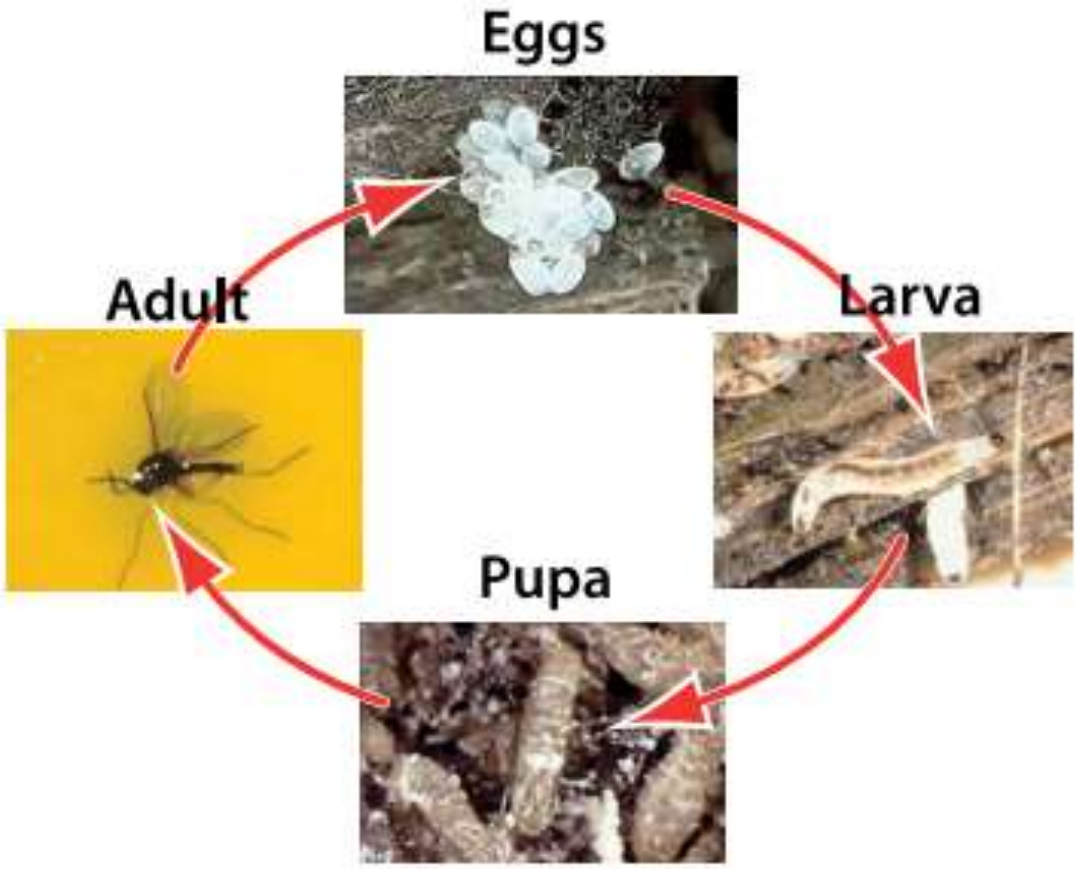


Figure 1. Fungus gnat life cycle

Fungus gnat life cycle

Figure credit: Raymond Cloyd, Kansas State University

Adult fungus gnats usually live for only 4-5 days. Females lay eggs in soil cracks along surface.

Photograph courtesy of Raymond Cloyd, Kansas State University

Fungus gnat larvae **require 3-4 weeks or more before being full grown.** **They primarily eat fungi and decaying plant matter.**

Fungus gnat larvae on a potato slice


Springtails

Fungus Gnat – Cultural Controls

- Reduce soil moisture (if possible) to limit growth of decay fungi in soil
- Eliminate sources of decaying vegetation
  - Waste plant material piled in greenhouse
  - Incompletely decayed compost

Fungus Gnats

Biological Controls (Larvae)

- **Soil predator mite (*Stratiolaelaps scimitus*)**
- **Rove beetle (*Dalotia coriaria*)**
- **Entomopathogenic nematodes (*Steinernema feltiae*)**
- ***Bacillus thuringiensis* var. *israelensis***

Insect parasitic nematode
Steinernema feltiae

Dalotia coriaria (rove beetle)

Some predators used to control soil dwelling stages of fungus gnats

Soil predator mite *Stratiolaelaps scimitus* (= *Hypoaspis miles*)

Bacillus thuringiensis

- Derived from a widely distributed soil bacterium
- Active ingredient a toxic protein crystal that destroys cells of the midgut
- Used as a stomach poison

Several strains are present, each with specific activity

- ***kurstaki, aizawi*** strains (leaf feeding Lepidoptera larvae
- ***tenebrionis*** strain (leaf beetles)
- ***israelensis*** strain (mosquito, gnat, black fly larvae)

Bacillus thuringiensis israelensis strain

Can be used as a soil drench to suppress populations of fungus gnat larvae

Small Flies Incidentally Associated with Growing Plants

- Fungus gnats (Mycetophilidae, Sciaridae)
- Shore flies (Ephydridae)
- Moth flies (Psychodidae)
- Humpbacked flies (Phoridae)

Shore Fly (left) versus Fungus Gnat (right)

Shore Flies

‘Fly specks’ associated with shore flies

Algae is the food of larval stages of shore flies

Some Differences Between Fungus Gnats and Shore Flies

	Fungus Gnats	Shore Flies
Food	Fungi	Algae
"Fly Specks"	No	Yes
Bt - Susceptible	Yes	No

Psychodidae –

Moth Flies

aka Drain flies

Associated with bacterial slime coating surfaces with high amounts of fertilization

Phoridae –

Humpbacked Flies

aka “Drain Flies”

Associated with all manner of moist decaying organic matter

Small Flies Incidentally Associated with Growing Plants

- Fungus gnats (Mycetophilidae, Sciaridae)
- Shore flies (Ephydridae)
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- Humpbacked flies (Phoridae)

This presentation will be posted at the Insect Information web site

- Housed at Department of Bioagricultural Sciences and Pest Management
  - Search "BSPM CSU"
- Within "Outreach"
- "Insect Information"
  - Extension presentations for 2018 posted at bottom of page – this one will be the last

Insect Information

All materials needed in another accessible format can be made available upon request.

Arthropods of Colorado Fact Sheets

This is a listing of about 200 downloadable fact sheets related to insects and other "bugs" found in in Colorado. It contains fact sheets that are written for the Colorado Arthropods of Interest series and the Extension fact sheets that are related to insects.

Fact Sheets

Some Entomology Hot Links:

- Colorado Hemp Insect Website
- Western Colorado Entomology Website
- IPM Images/Bugwood (Cranshaw)
- IPM Images/Bugwood (Peairs)
- Entomology Resources List
- Honey Bee Swarm Hotlines

Miscellaneous Insect Information

Master Gardener Information

This includes the handouts and PowerPoint presentations (as PDF) used in Master Gardener Entomology training. These will get updated annually at the end of the winter/spring training programs.

Handouts

PowerPoint Presentations Used in 2018

Recent Extension Presentations

This is a listing that provides the PowerPoint presentations (as PDF) of most Extension entomology programs conducted during the past 12 months.

PowerPoint Presentations/Webinars