

# Plant Injuries Produced By Sucking Mouthparts (Fluid Feeding Insects and Mites)

- Aphids, leafhoppers, scales, whiteflies, mealybugs, etc.
- True bugs
- Thrips
- Mites



**Leafhoppers**



**Scale Insects**



**“Bugs” that Suck Plant Fluids - Hemiptera**

**Aphids**



**Squash bugs**





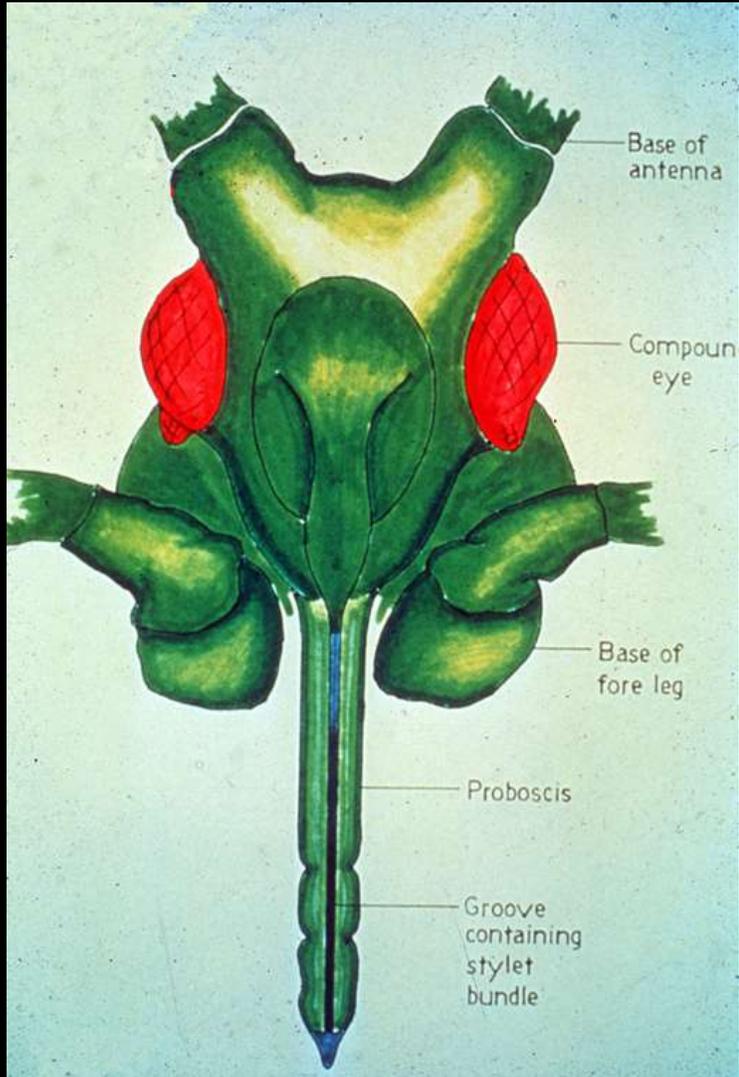
**Thrips**

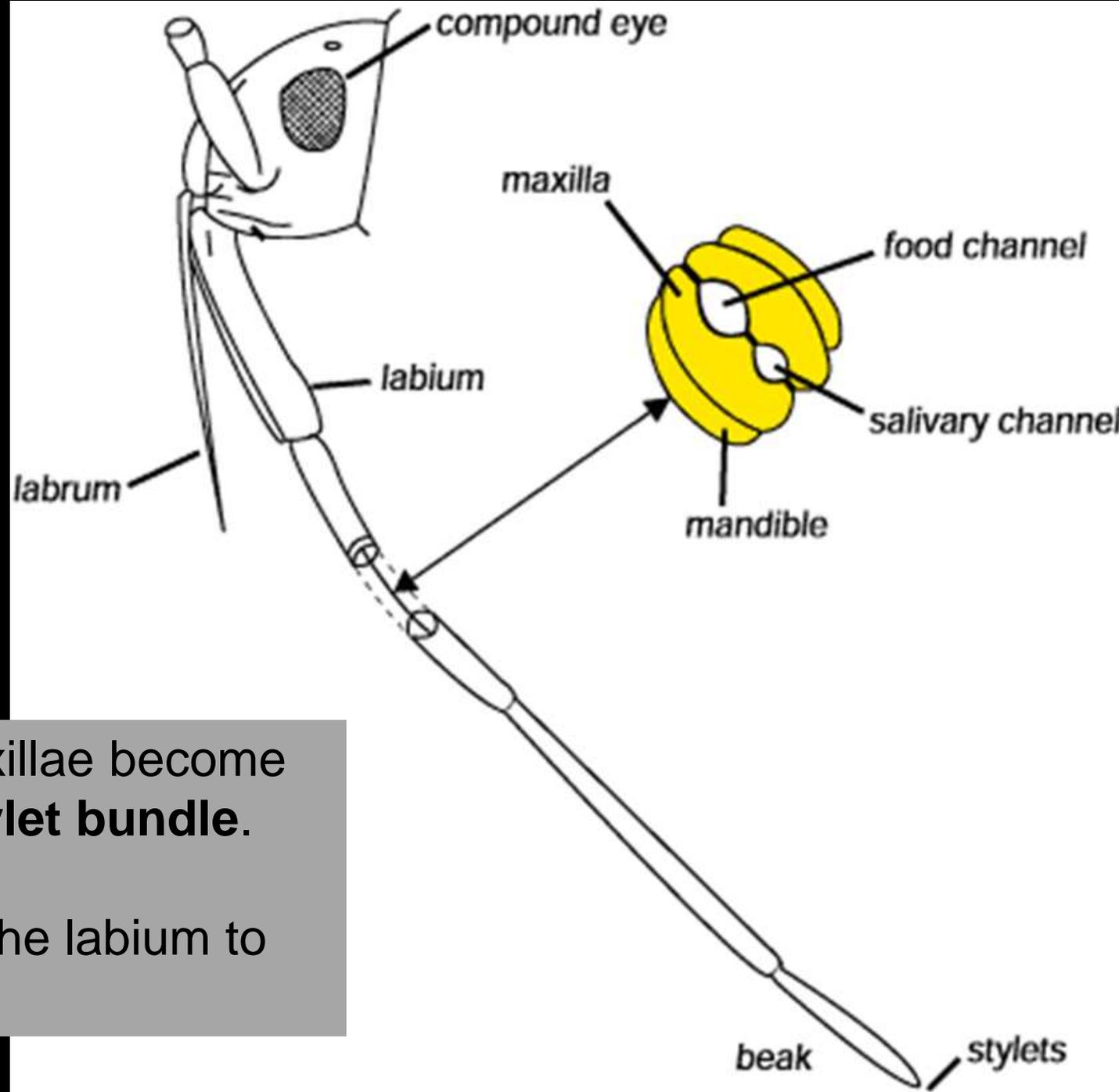
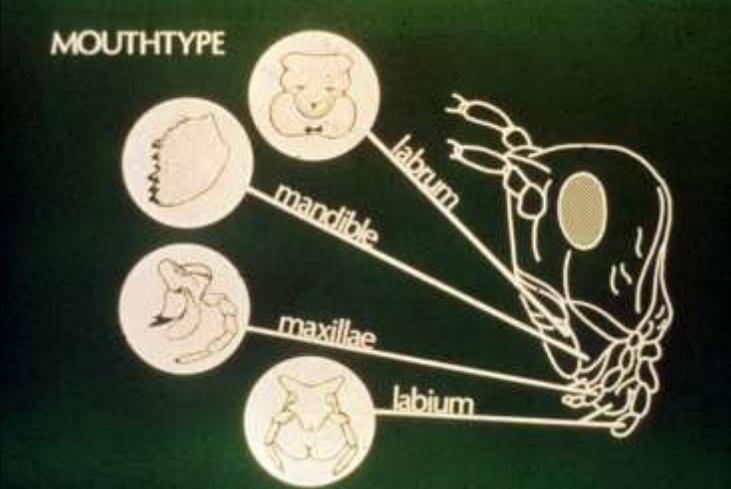
## Other “Bugs” that Suck Plant Fluids



**Spider Mites**

# Piercing-sucking mouthparts of Hemiptera





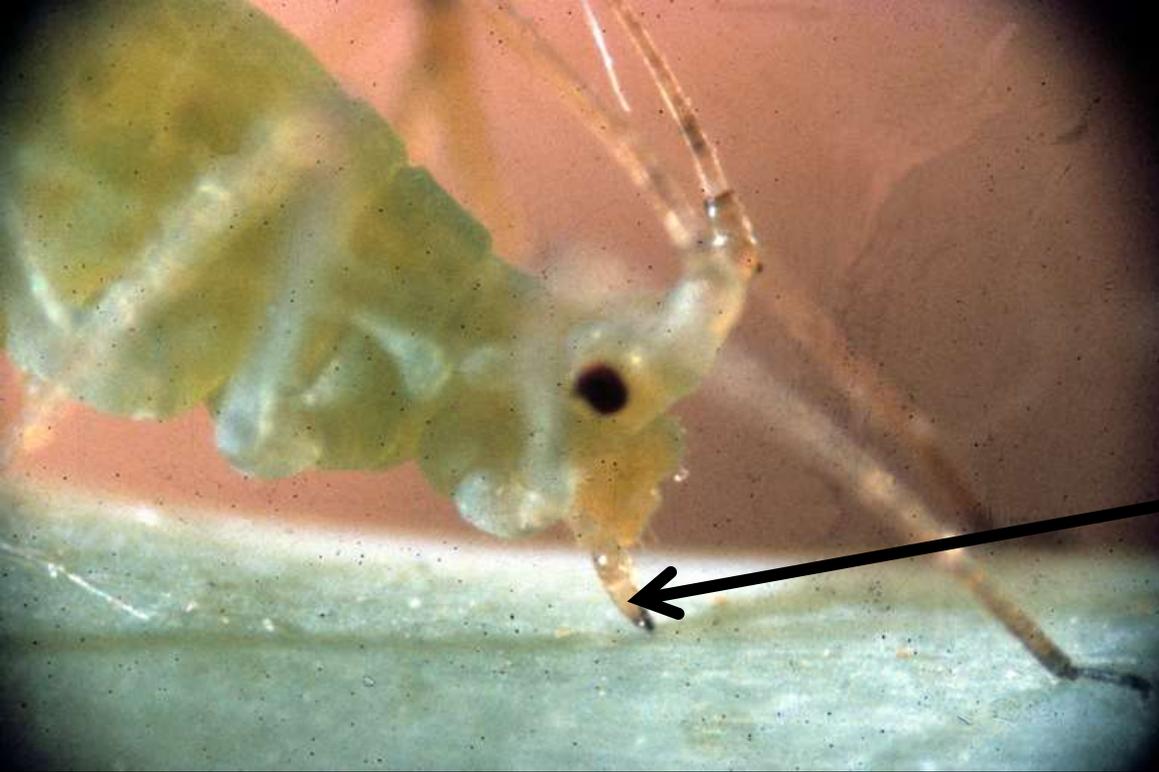
In Hemiptera, the mandibles and maxillae become extremely elongated to produce a **stylet bundle**.

The stylet bundle is sheltered within the labium to produce a “**beak**” (proboscis).



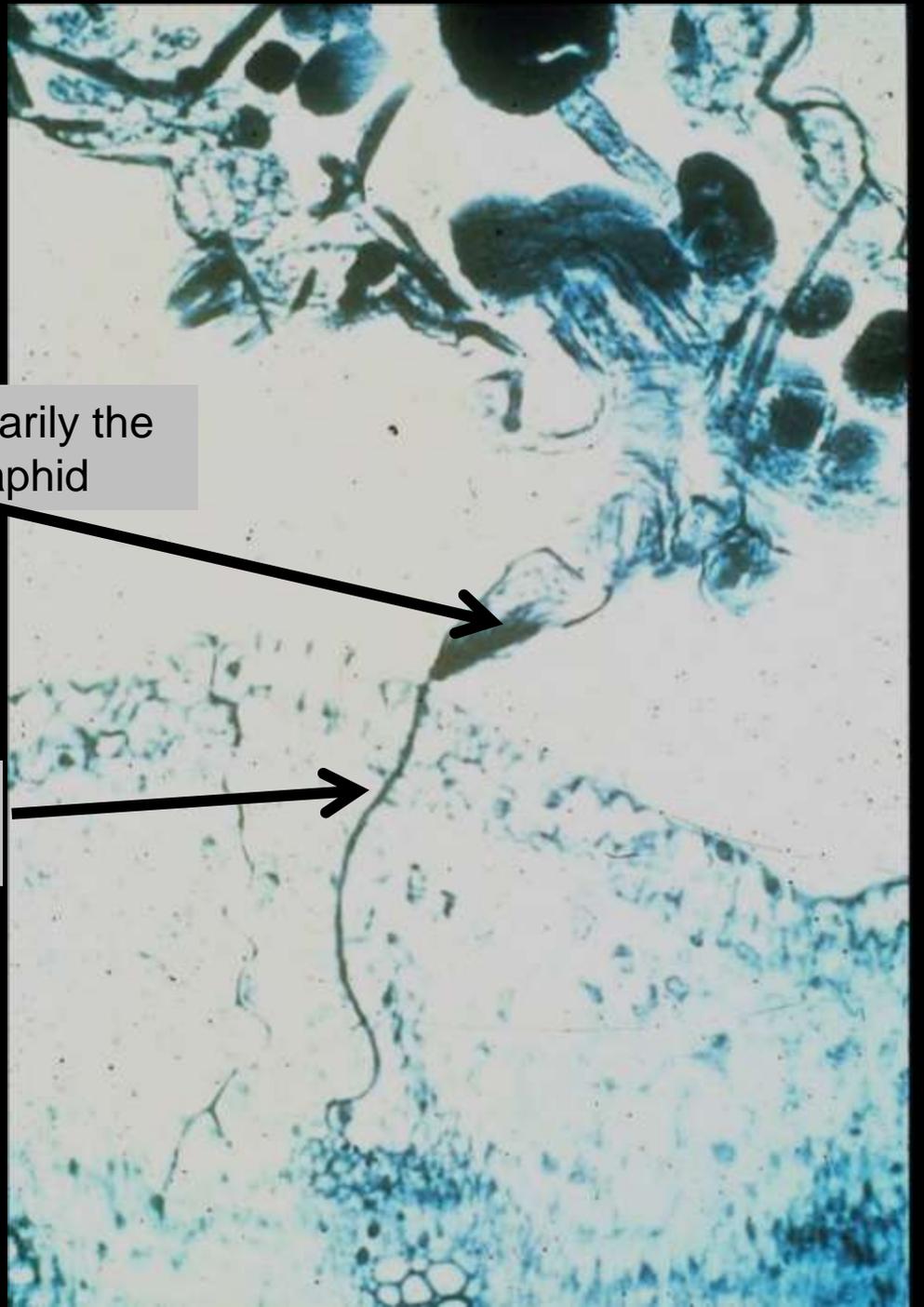
Some sort of "beak" is present on the underside of the head





Probocis (primarily the labium) of an aphid

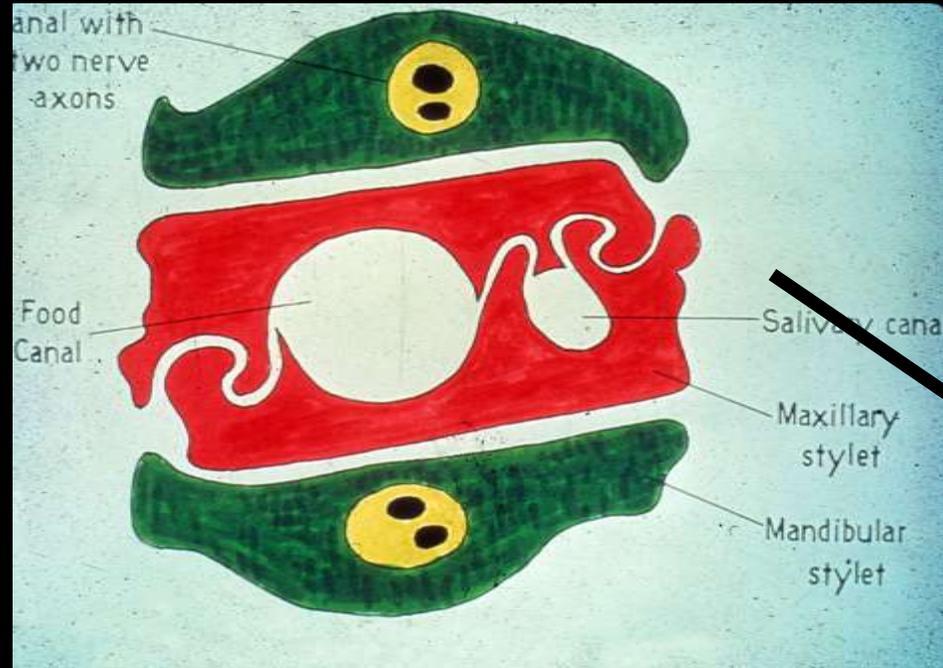
Stylet bundle (mandibles and maxillae) meandering through plant en route to phloem



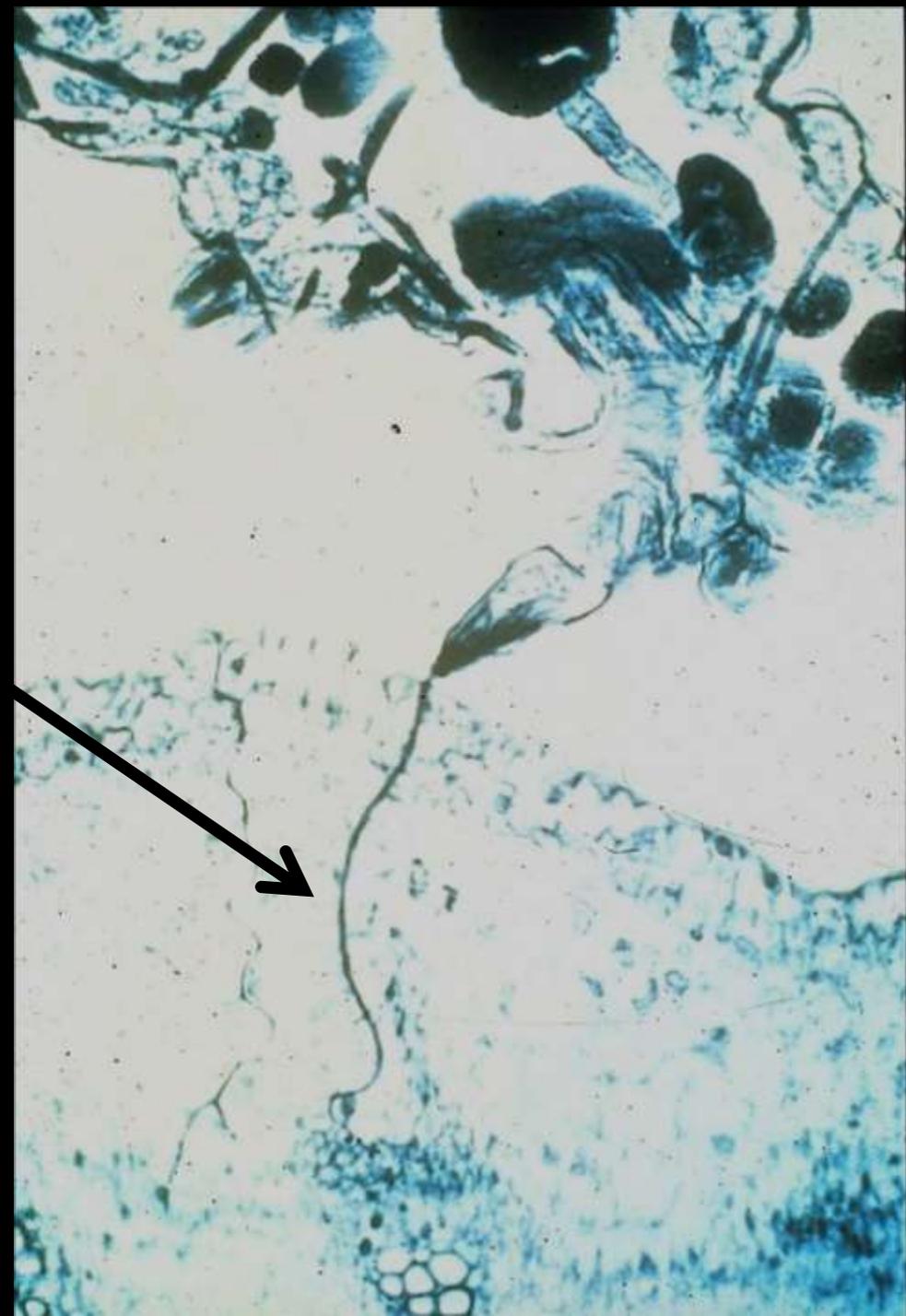
**Aphids use their mouthparts to access the fluids of the phloem.**

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

The mandibles are on the outside of the stylet bundle. They are used to penetrate the plant.

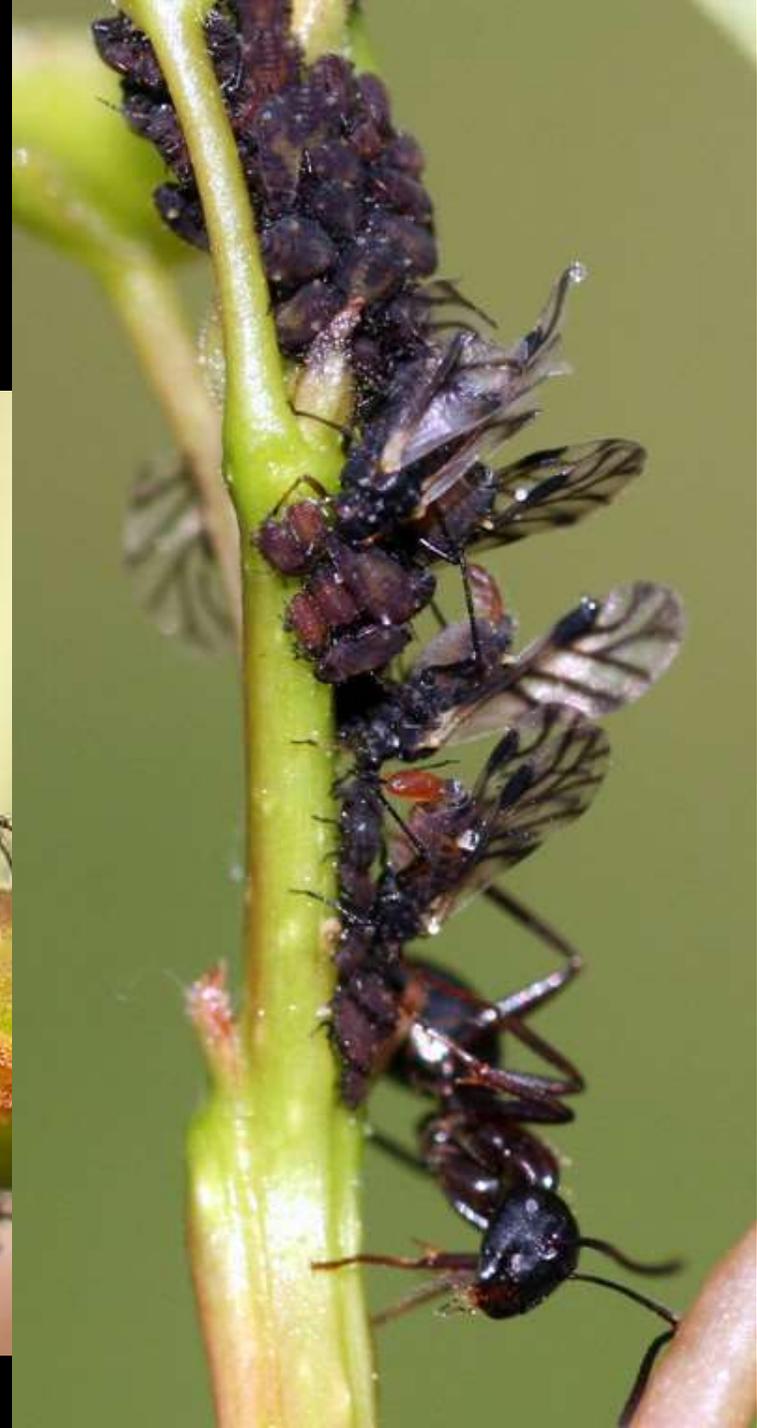


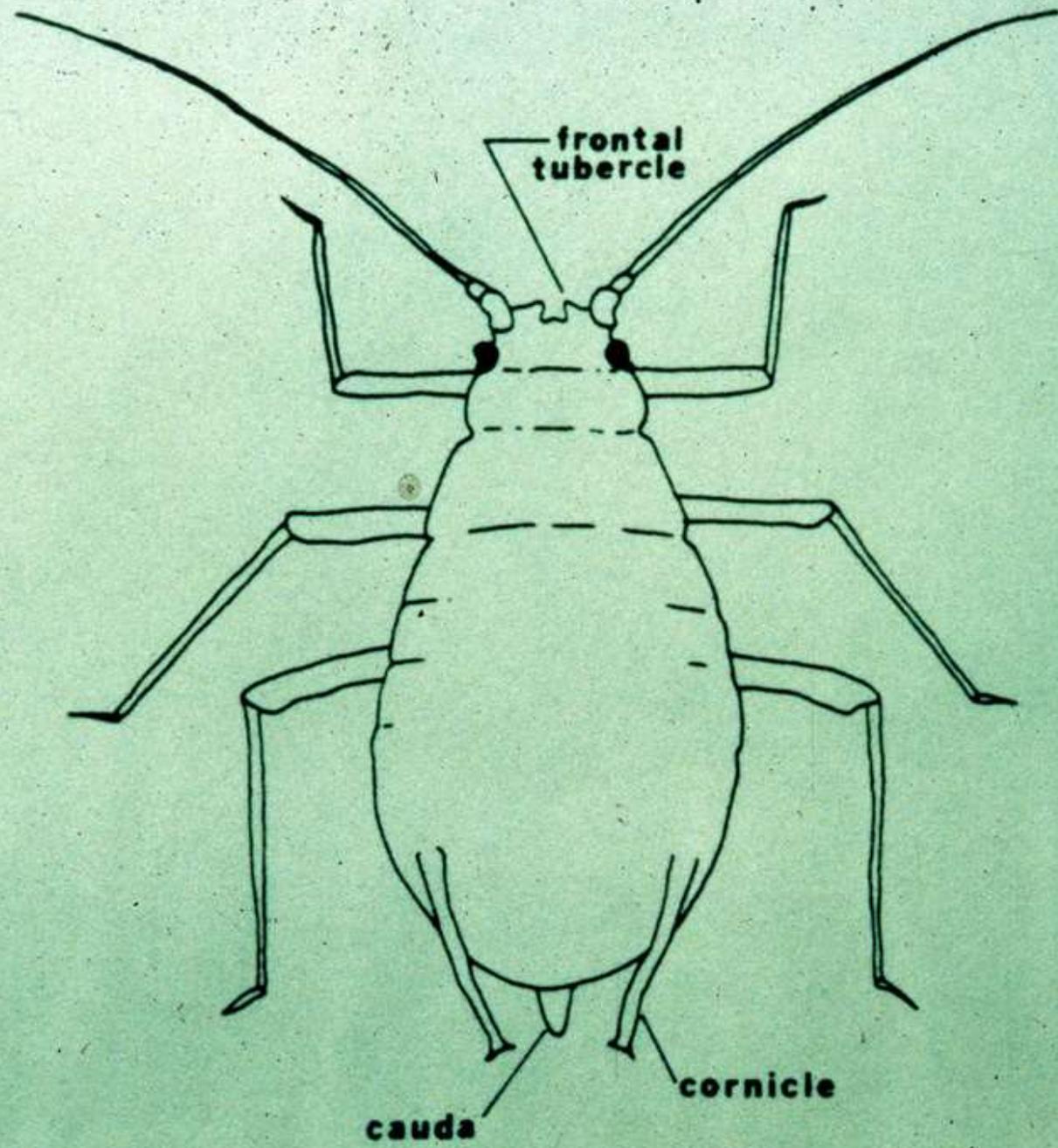
The maxillae are on the inside of the stylet bundle. They are paired and interlock. A food canal and parallel salivary canal are formed by the paired maxillae.



# “True” Aphids

Hemiptera: Aphididae





frontal  
tubercle

cauda

cornicle

**Aphids associated  
with *Populus* spp.**



**Aphids associated  
with *Prunus* spp.**



# Aphids associated with *Acer* spp.



# Rose Aphids



# Linden Aphids



**Aphids associated with  
willow (*Salix* spp.)**





**Largest Aphid in RM Region – Giant Willow Aphid**

# Giant conifer aphids, *Cinara* species



**Different species are present on junipers, spruce and pines**



# Cabbage Aphid

A species that produces a fine powder of wax



# Leafcurl Ash Aphid



# Woolly Apple Aphid





**Root-infesting  
aphids area also  
surrounded by  
wax**



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

**Diagnostic: Cast Skins Remain after Aphids Molt**



**Live birth and asexual reproduction are the norm with aphids**





**Aphid populations can increase rapidly**



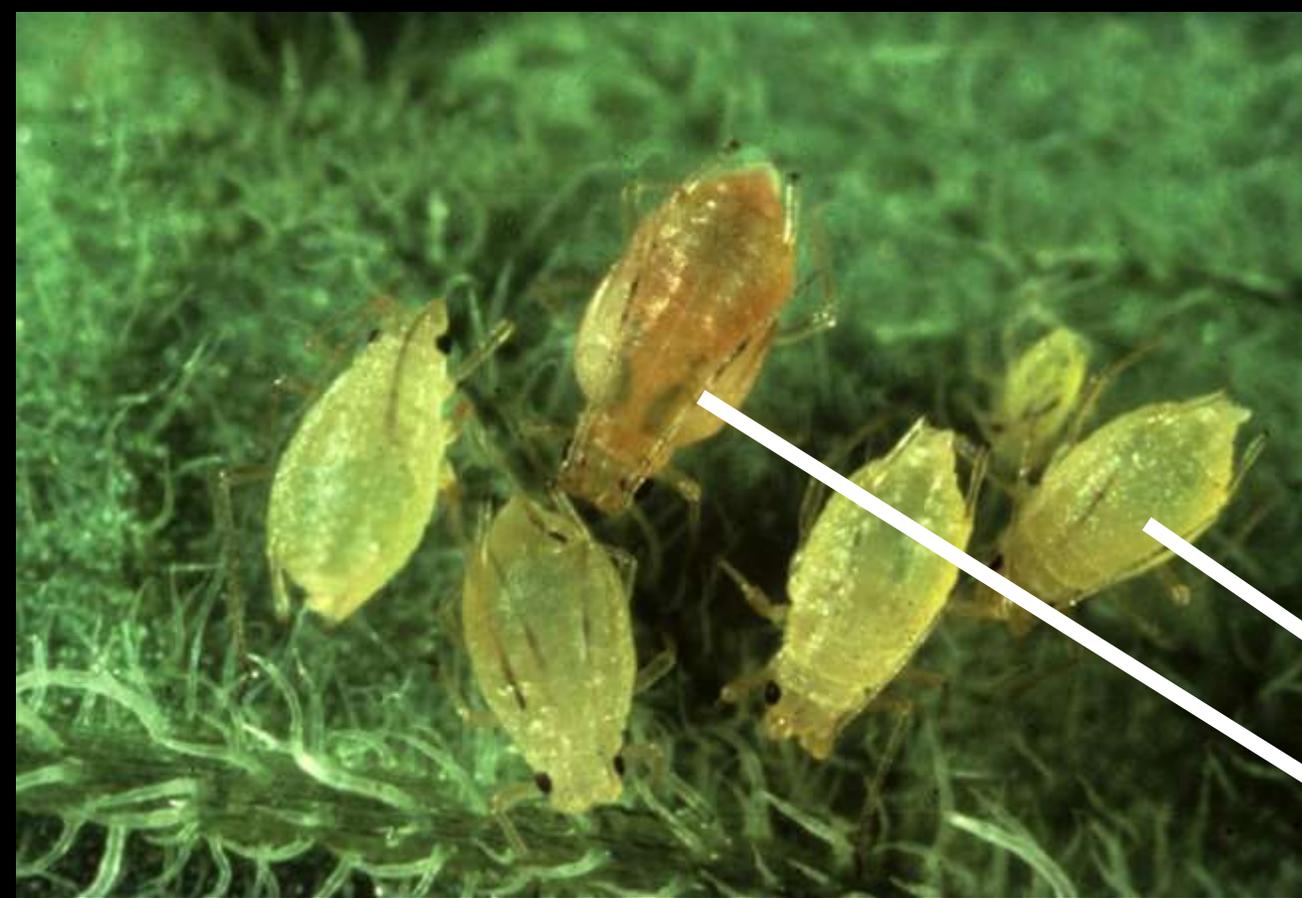
**Adults may be winged  
or wingless**



Wing pads of late stage aphid nymph



**Adults may be winged or wingless**



# How do aphids survive winter in areas with long freezing temperatures?

- **Outdoors**

- Eggs (normal)
- Nymphs, adults in continuous reproduction (uncommon)

- **Indoors**

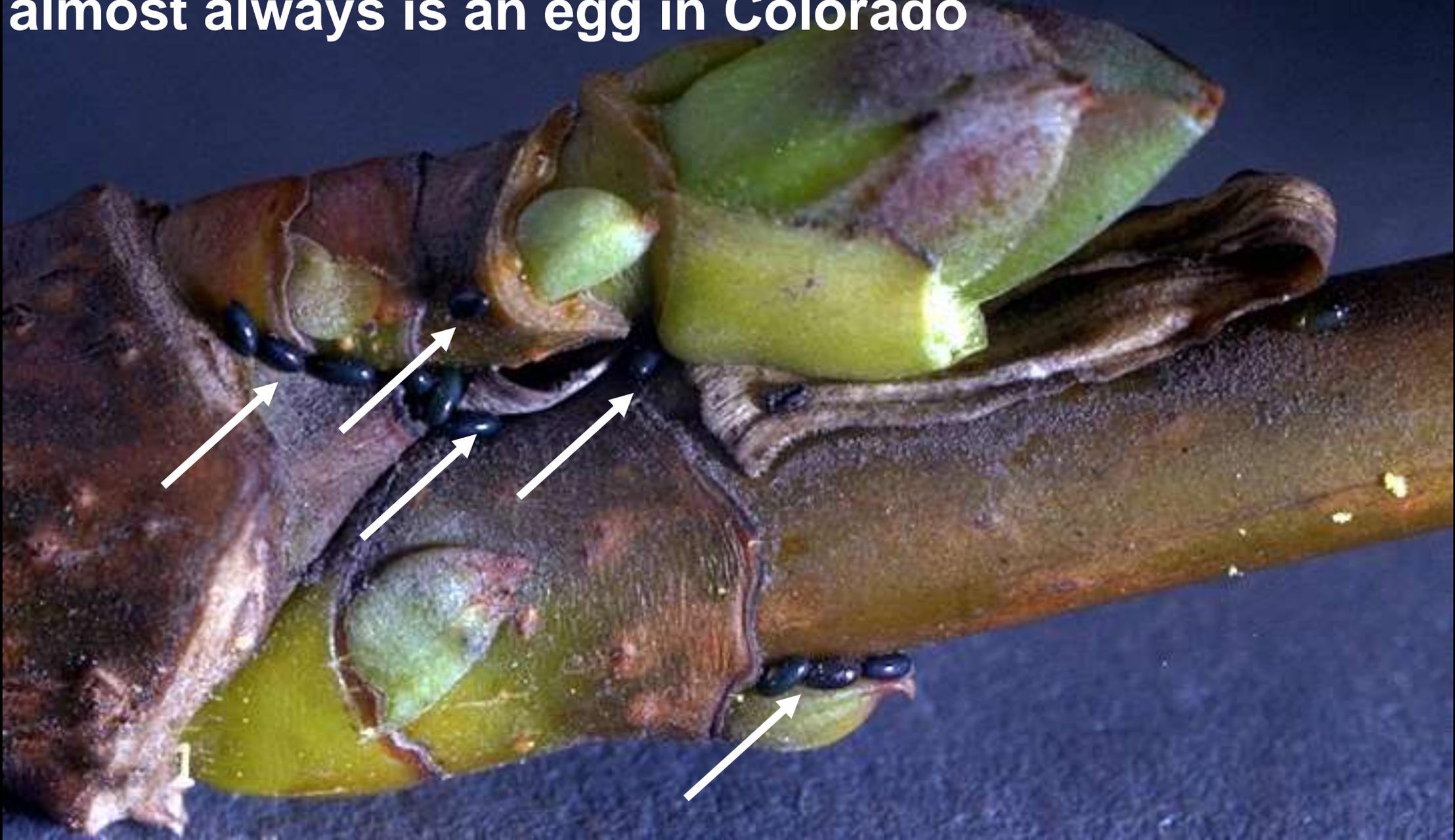
- Nymphs, adults in continuous reproduction



# Life History Patterns of Aphids

- **Holocyclic life cycle**
  - **Overwintering stage – and egg**
  - **Some have alternation of host plants (heteroecious)**
    - **Winter host (Fall-late Spring)**
    - **Summer host**
  - **Some remain on same host (autoecious)**
- **Anholocyclic life cycle**
  - **No egg production**
  - **Sustained year-round on live host**

**The overwintering stage of aphids on outdoor plants almost always is an egg in Colorado**

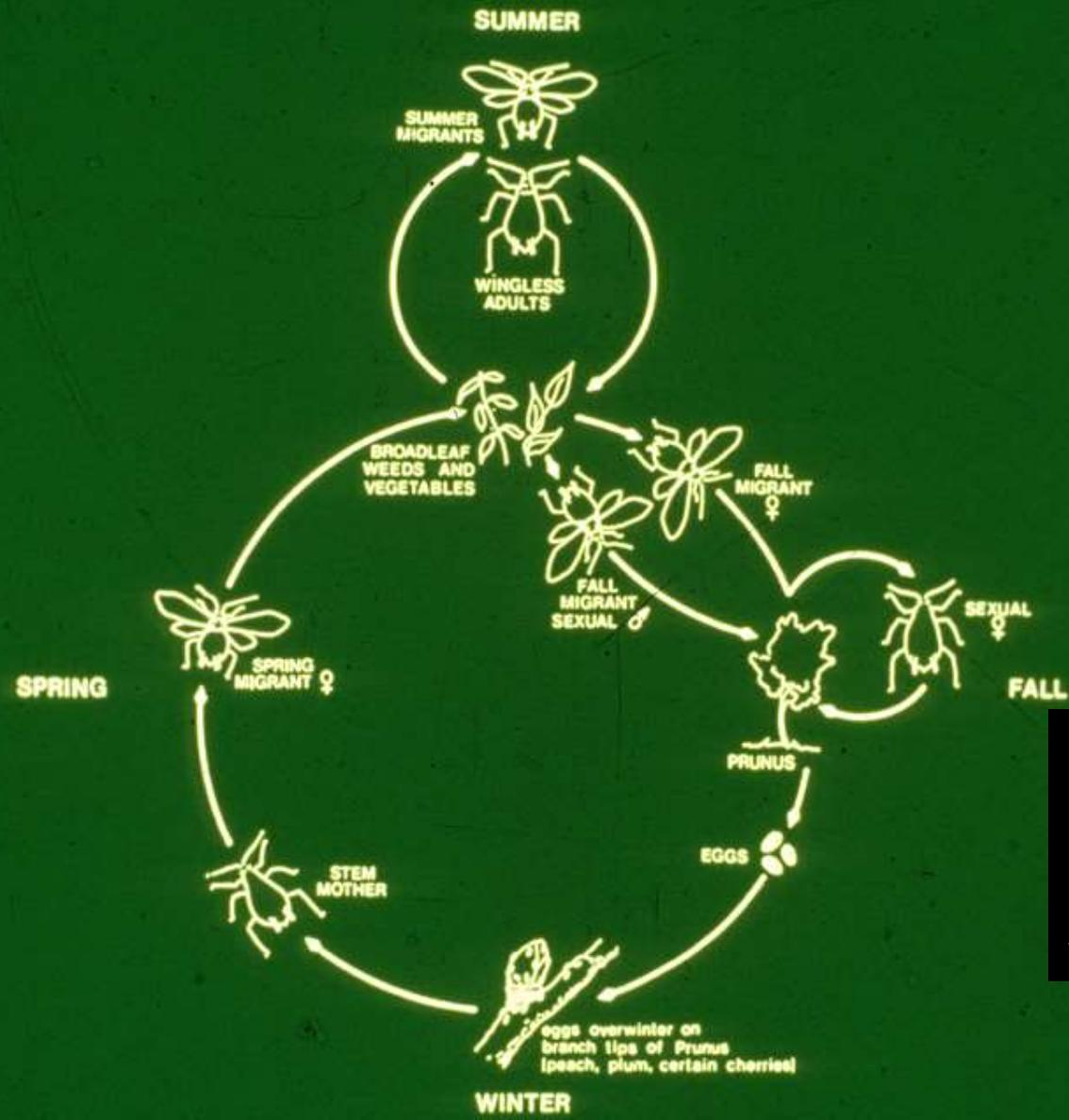


# Overwintered eggs of rose aphid



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LIFE CYCLE OF THE GREEN PEACH APHID

Some aphid life cycles involve alternation of host plants

Life cycle involves a winter host plant and a different summer host plant(s)



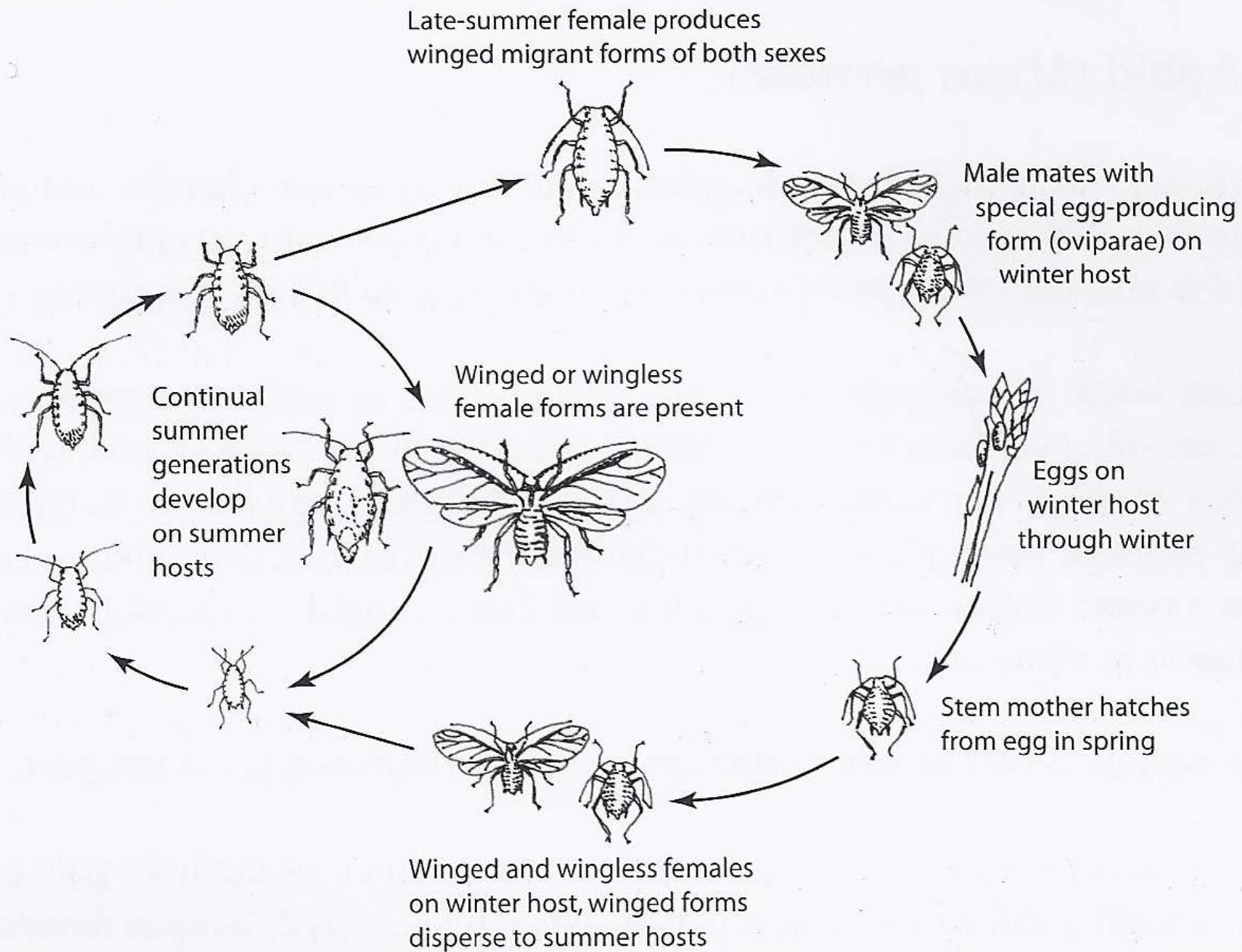
## Green Peach Aphid

*Myzus persicae*

An example of an aphid that undergoes a **holocyclic life cycle** outdoors



May have an anholocyclic life cycle in a greenhouse



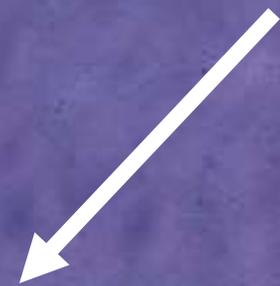
In the case of green peach aphid, the winter host on which eggs are laid are certain *Prunus* species (peach, nectarine, some plums)



Overwintering egg laid near the bud



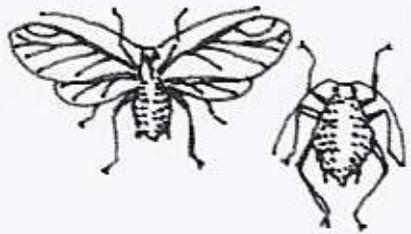
**Stem mother, the stage that hatches from the overwintering egg**





On the winter host plant the first generations may cause leaf curling injuries to the new growth

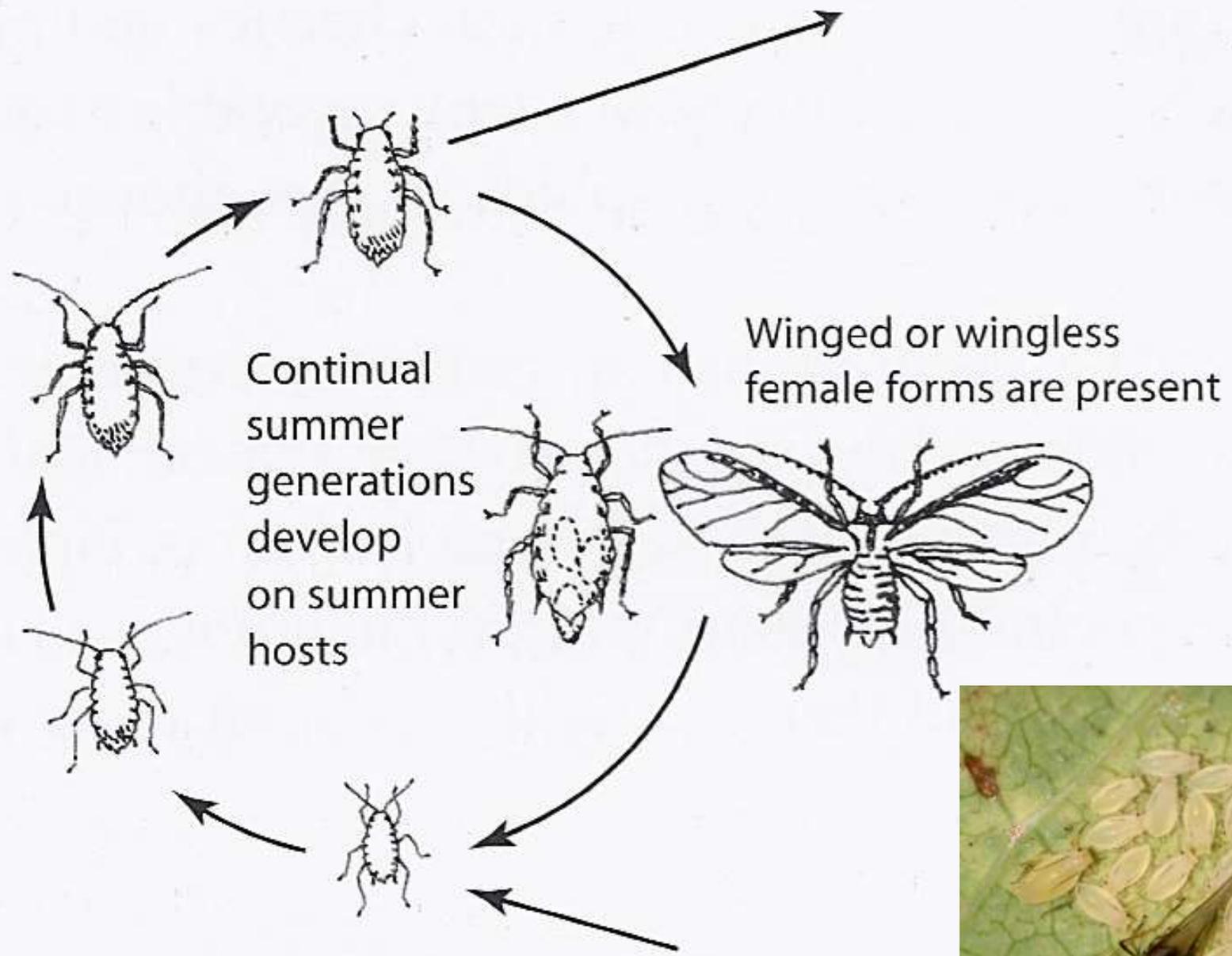
**Sometime, usually in June, the green peach aphids on the winter host switch to becoming all winged forms – that then disperse to the “summer hosts”**



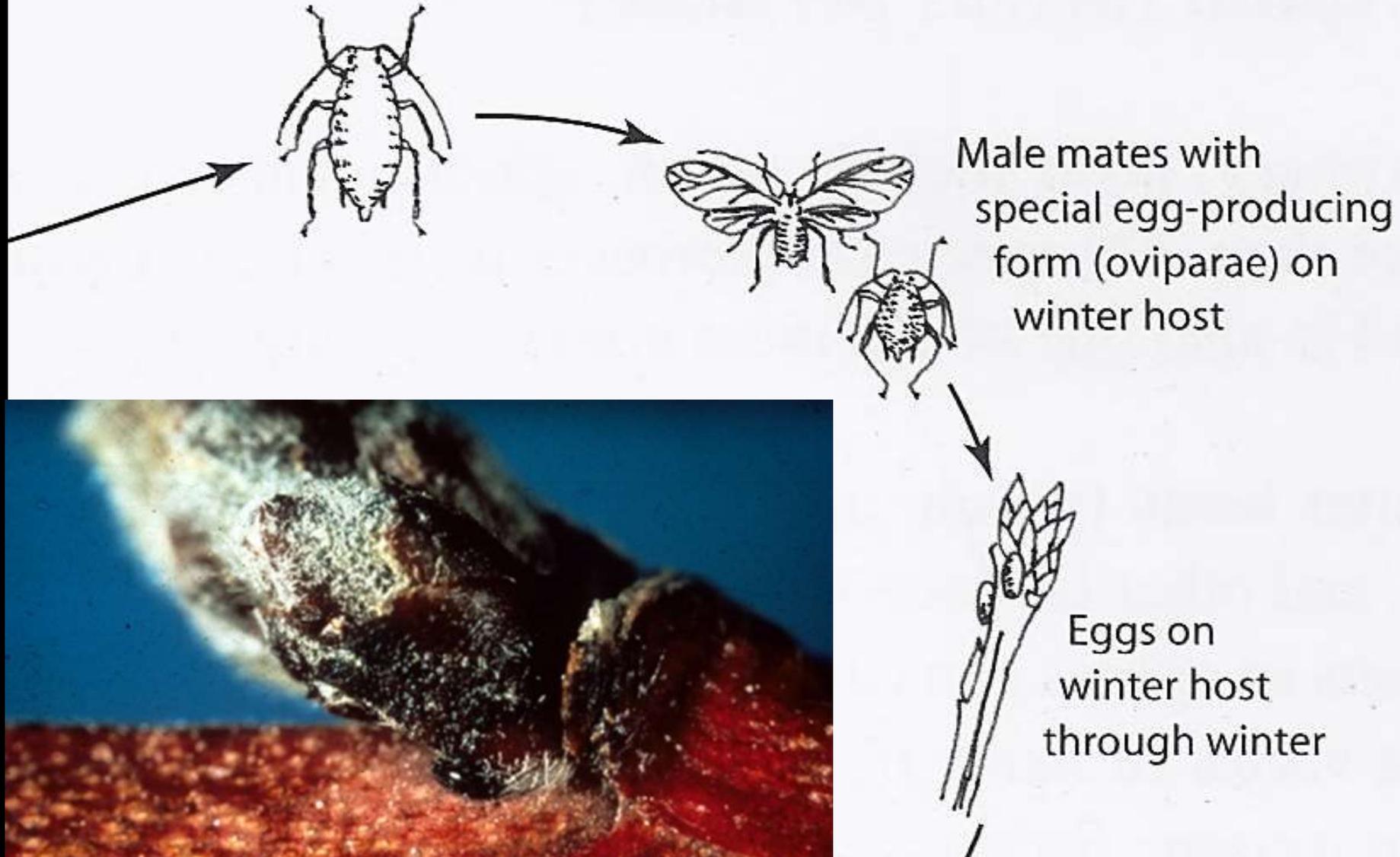
Winged and wingless females on winter host, winged forms disperse to summer hosts

**Summer hosts of green peach aphid include many different kinds of vegetables and weeds**





Late-summer female produces  
winged migrant forms of both sexes

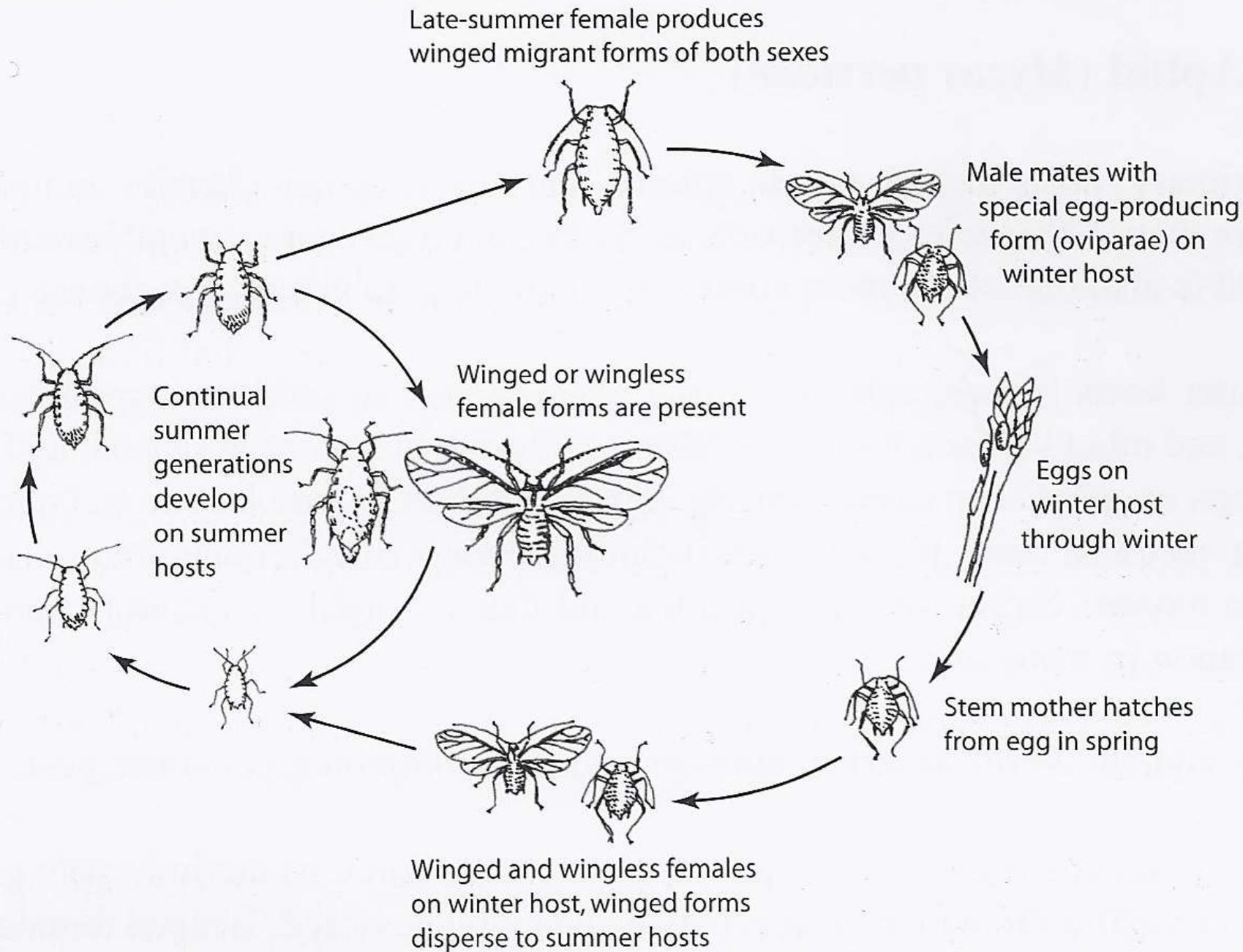




**Winged males mate with wingless egg-producing females (oviparae) on the overwintering host plant**

**Mated oviparae lay the overwintering eggs**







# Rose Aphid

*Macrosiphum rosae*

An example of an aphid that does not alternate host plants – it only occurs on rose



# Cabbage Aphid

*Brevicoryne brassicae*

One of the very few aphids that may survive winter outdoors in actively developing stages (nymphs, adults)



# How Do Aphids Survive Winter in Places such as Colorado?

- **Outdoors**

- Eggs

- Nymphs, adults in continuous reproduction

- **Indoors**

- Nymphs, adults in continuous reproduction

# Primary aphid species found in greenhouses



Green peach aphid



Potato aphid



Cotton-melon aphid

**Indoors there is continuous, asexual reproduction.** There are normally no eggs nor sexual forms (males, sexual form females) produced

# Aphids as Contaminants of Produce



Red lettuce aphid on  
lettuce

Cabbage aphids on  
Brussels sprouts



# Plant Injuries Aphids May Produce

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



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**



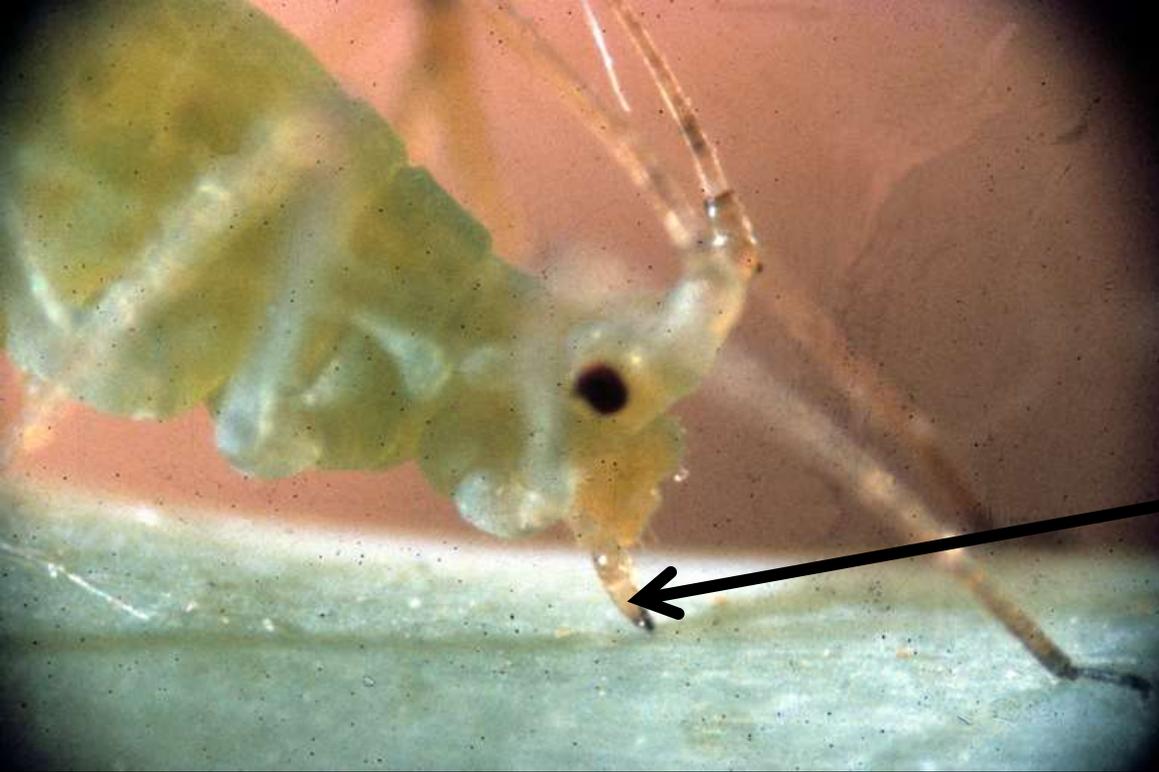
Flower fly larva



Green lacewing larva

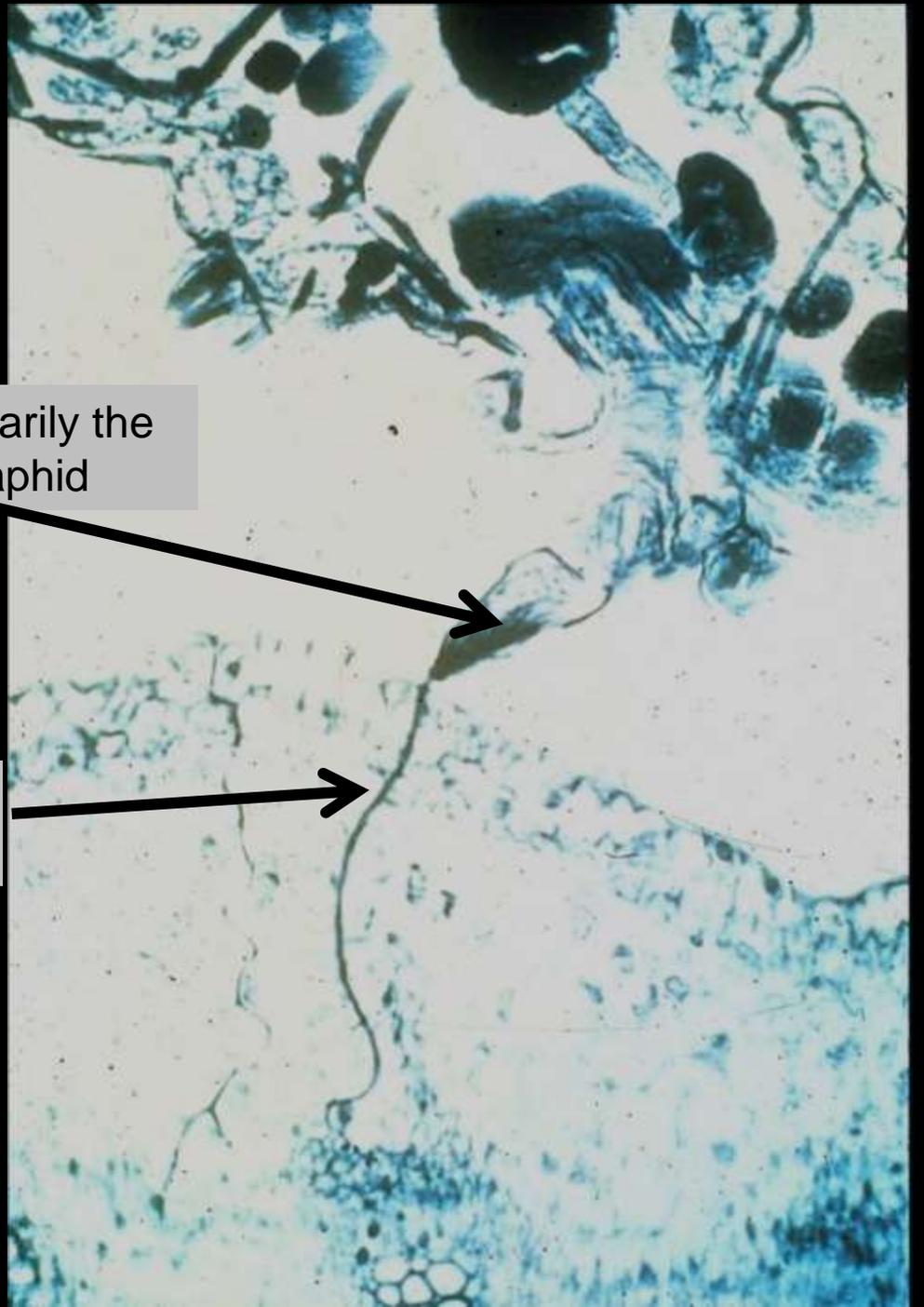


Lady beetle larva



Probocis (primarily the labium) of an aphid

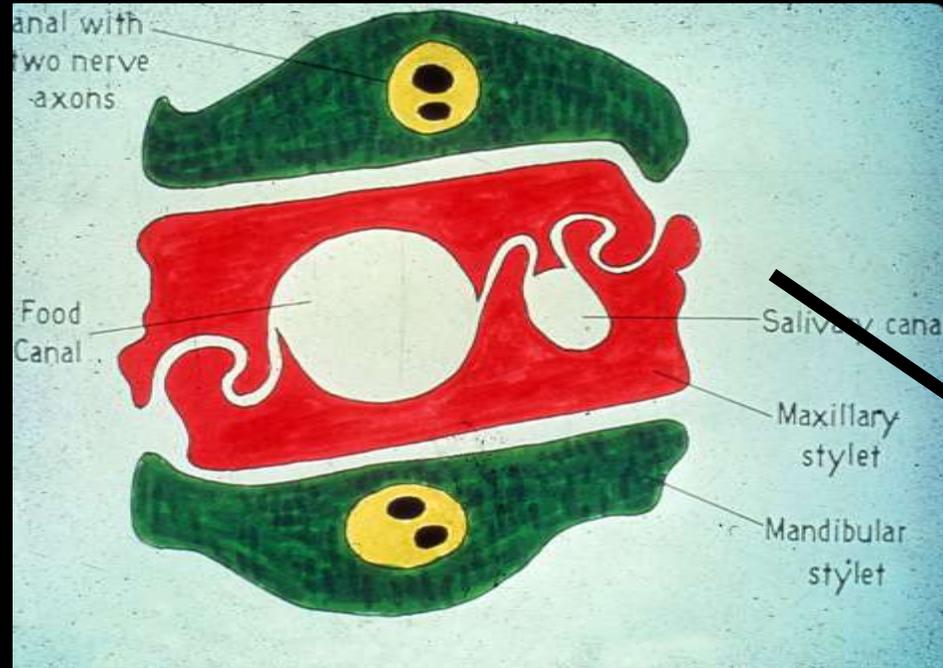
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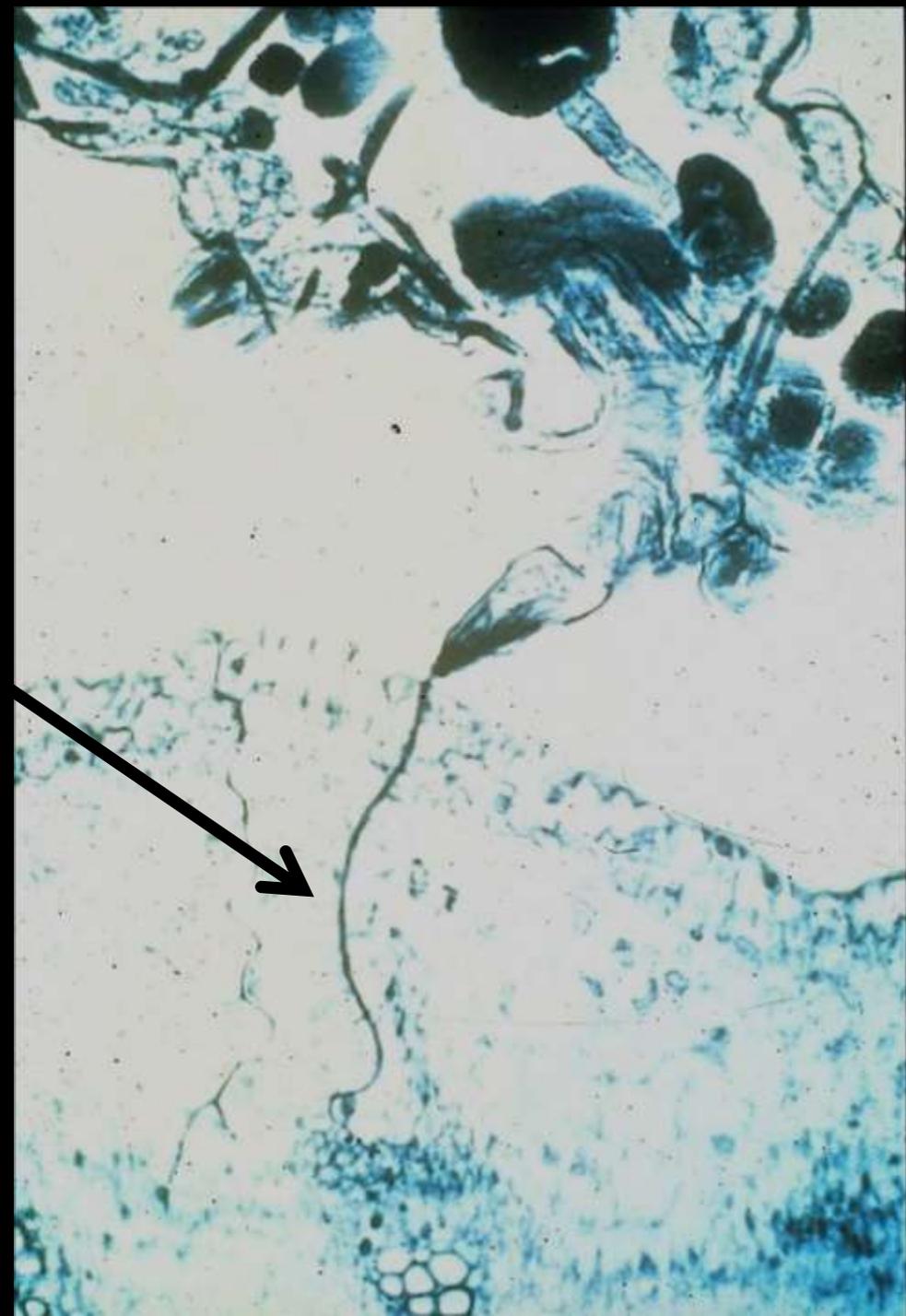
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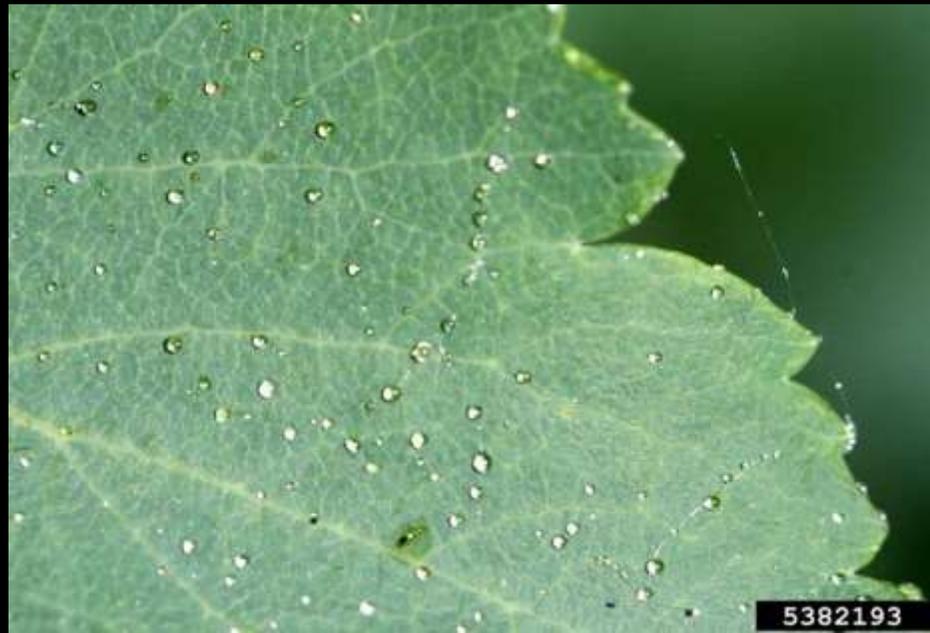




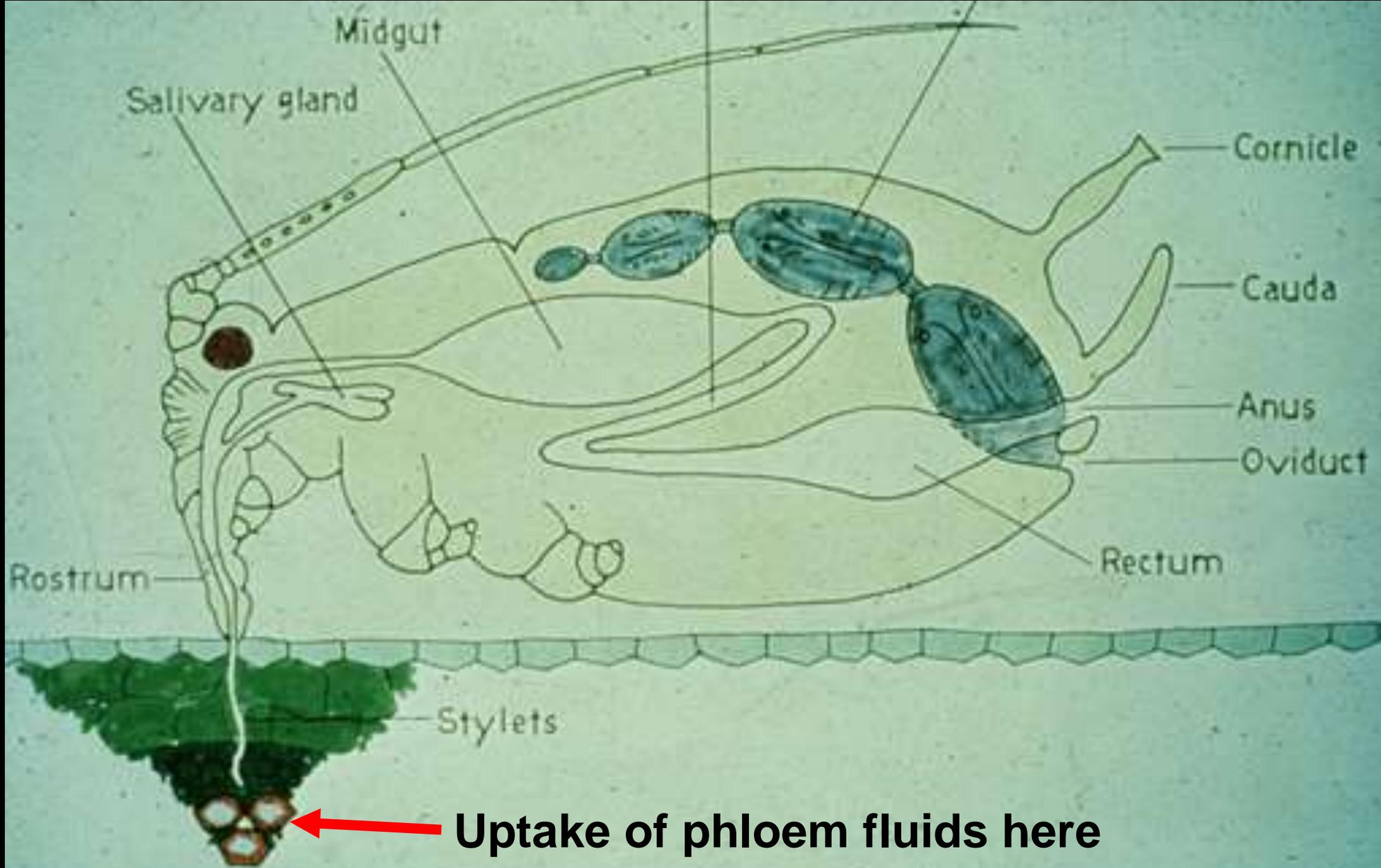
**Important Note:** Presence of aphids does not always equate to occurrence of plant injury!

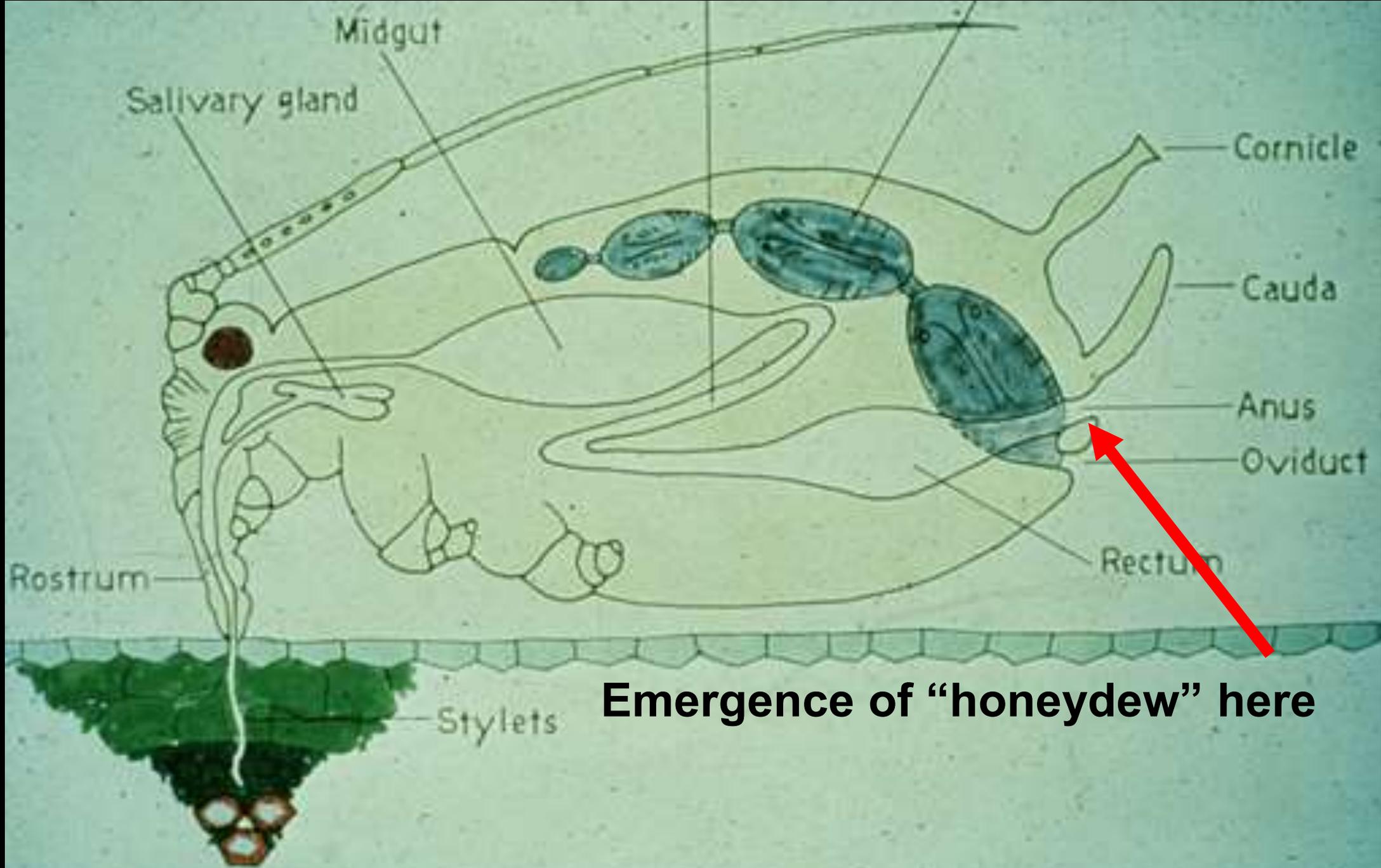


# Honeydew production



5382193





**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



# Sooty Molds

Fungi that grow on honeydew-contaminated surfaces





**Sooty mold  
growing on  
linden aphid  
honeydew**











**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

# Ants on the peonies?







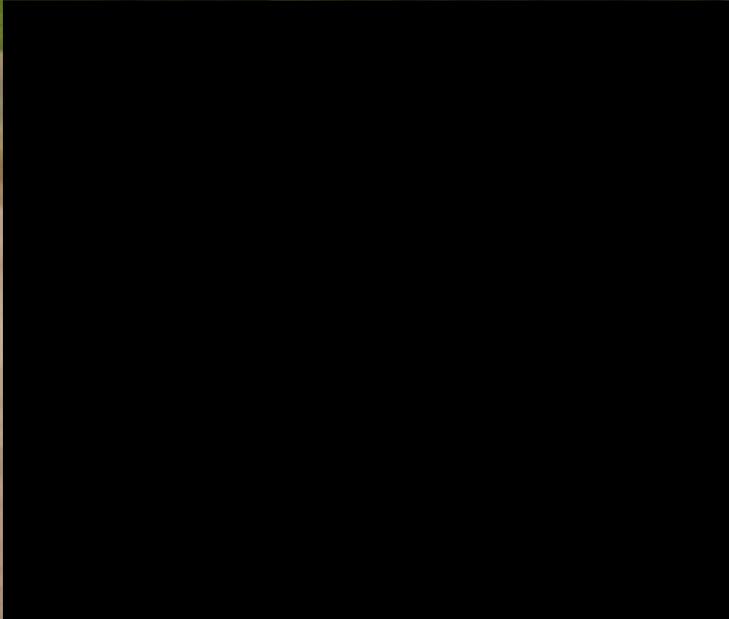
**Western  
yellowjacket  
visiting aphid  
honeydew**

# Leafcurl Injuries

Produced by aphid feeding on emergent growth,  
producing distortion



# Leafcurl Plum Aphid Injury





**Hawthorn**

**Chokecherry**



**Peach**



**Leafcurl Ash Aphid**

**Honeysuckle Witches'  
Broom Aphid**



**Leaf curling produced by snowball (viburnum) aphid**





**Dill**

# Carrot-Willow Aphid



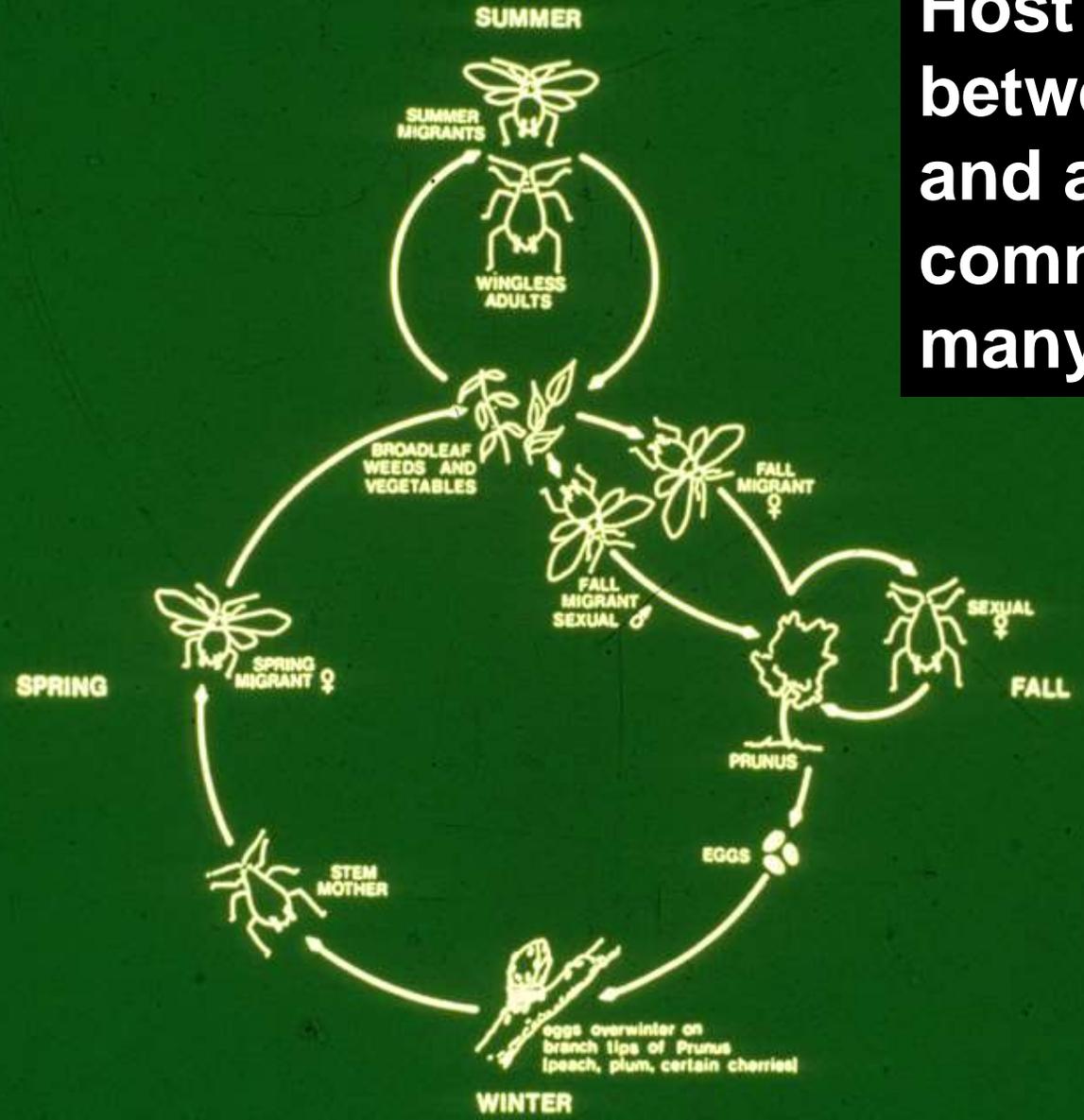
Winter hosts are certain  
European willows

# “Double or Nothing Pests”

**Organisms that** *require two kinds of host plants to complete the life cycle*



Host alternation between a winter host and a summer host is a common life cycle with many species of aphids



LIFE CYCLE OF THE GREEN PEACH APHID

**Annual problem – leafcurling aphids on dill, parsley**



# Carrot-Willow Aphid

*Caveriella aegopodii*



Woolly elm aphid, *Eriosoma americanum*



*Amelanchier*, alternate  
host of the woolly elm  
aphid



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TAKE THAT,  
APHIDS!



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## Aphid Control - Scenario One

# Aphids are Exposed on the Plant



# Different Levels of Control Response

- **Do nothing. Natural controls will ultimately take care of things.**
- **Treat the plants with a strong jet of water to kill aphids**
- **Use a soap/detergent spray to kill aphids**
- **Use an effective 'aphicide'**



**Check for aphid  
natural enemies!**



# Recognizing and Working with Natural Enemies of Insect Pests





UGA2131063



UGA2131063

**Diagnostic: Cast Skins Remain after Aphids Molt**





UGA2131063

# Aphid Parasitoids



Aphid mummies

**Parasitoid wasp larva exposed from within aphid mummy**



**Exit holes in aphid mummies produced by parasitoid wasps**



**Parasitoid wasp emerging from aphid host**



UGA2131063

Adults



# Lady Beetle Life Stages

Eggs



Larvae



Pupae



# Lady beetle larvae



## Lady beetle larvae



Predators of small soft-bodied arthropods (aphids, etc.)

# Different Levels of Control Response

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**Hosing for aphid control**

A close-up photograph of a rose branch heavily infested with aphids. The branch is covered in a dense layer of small, dark, fuzzy insects. The leaves are green with serrated edges, and some show signs of damage or discoloration. The background is a plain, light-colored surface.

**Rose Aphids - Before**





**Rose Aphids - After**

# **Some aphid control products – Exposed Aphids**

- **Insecticidal Soaps**
- **Pyrethroids**
  - bifenthrin, cyhalothrin, cyfluthrin, etc.
- **Neonicotinoids**
  - imidacloprid, acetamiprid, etc.

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Listed  
Organic Materials  
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FOR  
**organic  
gardening**

ACTIVE INGREDIENT: BY WT.  
Potassium Salts of Fatty Acids...49.52%  
OTHER INGREDIENTS:.....50.48%  
TOTAL.....100.00%  
LBL5118F-2 0109

**KEEP OUT OF REACH OF CHILDREN**  
**WARNING**  
See back panel for  
Precautionary Statements  
NEVER

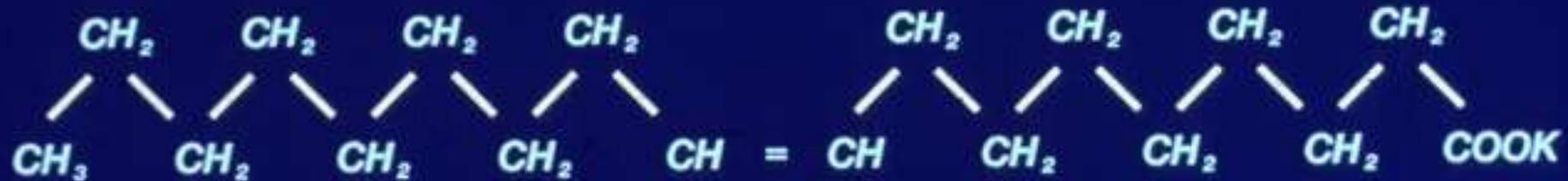
# Soaps as Insecticides

Note: These are applied as a dilute (2-3% concentration) spray

**Insecticidal Soap =  
Potassium Salts of  
Fatty Acids**



# Soaps are Salts of the Fatty Acids Found in Plant Oils and Animal Fats.



## Fatty Acid Components of Some Common Fats and Oils

Component Acids (percent)*							
FATS	Myristic C <sub>14</sub>	Palmitic C <sub>16</sub>	Stearic C <sub>18</sub>	Oleic C <sub>18-1</sub>	Linoleic C <sub>18-2</sub>	Linolenic C <sub>18-3</sub>	Eleostearic
Butter	7-10	24-26	10-13	28-31	1.0-2.5	0.2-0.5	
Lard	1-2	28-30	12-18	40-50	7-13	0-1	
Tallow	3-6	24-32	20-25	37-43	2-3		
<b>EDIBLE OILS</b>							
Olive oil		9-10	2-3	73-84	10-12	trace	
Corn oil	1-2	8-12	2-5	19-49	34-62	trace	
Soybean oil		6-10	2-5	20-30	50-60	5-11	
Cottonseed oil	0-2	20-25	1-2	23-35	40-50	trace	
Peanut oil		8-9	2-3	50-65	20-30		
Safflower oil		6-7	2-3	12-14	75-80	0.5-0.15	
<b>NONEDIBLE OILS</b>							
Linseed oil		4-7	2-4	25-40	35-40	25-60	
Tung oil		3-4	0-1	4-15			75-90

\* Totals less than 100% indicate the presence of lower or higher acids in small amounts.

Pesticidal Fatty Acid  $\longleftrightarrow$  Pesticidal Soap



Fatty acid + base

Soap (salt of fatty acid) + a bit of water



+



=



# Pesticidal fatty acid?



Pesticidal Fatty Acid  $\longleftrightarrow$  Pesticidal Soap



Fatty acid + base

Soap (salt of fatty acid) + a bit of water



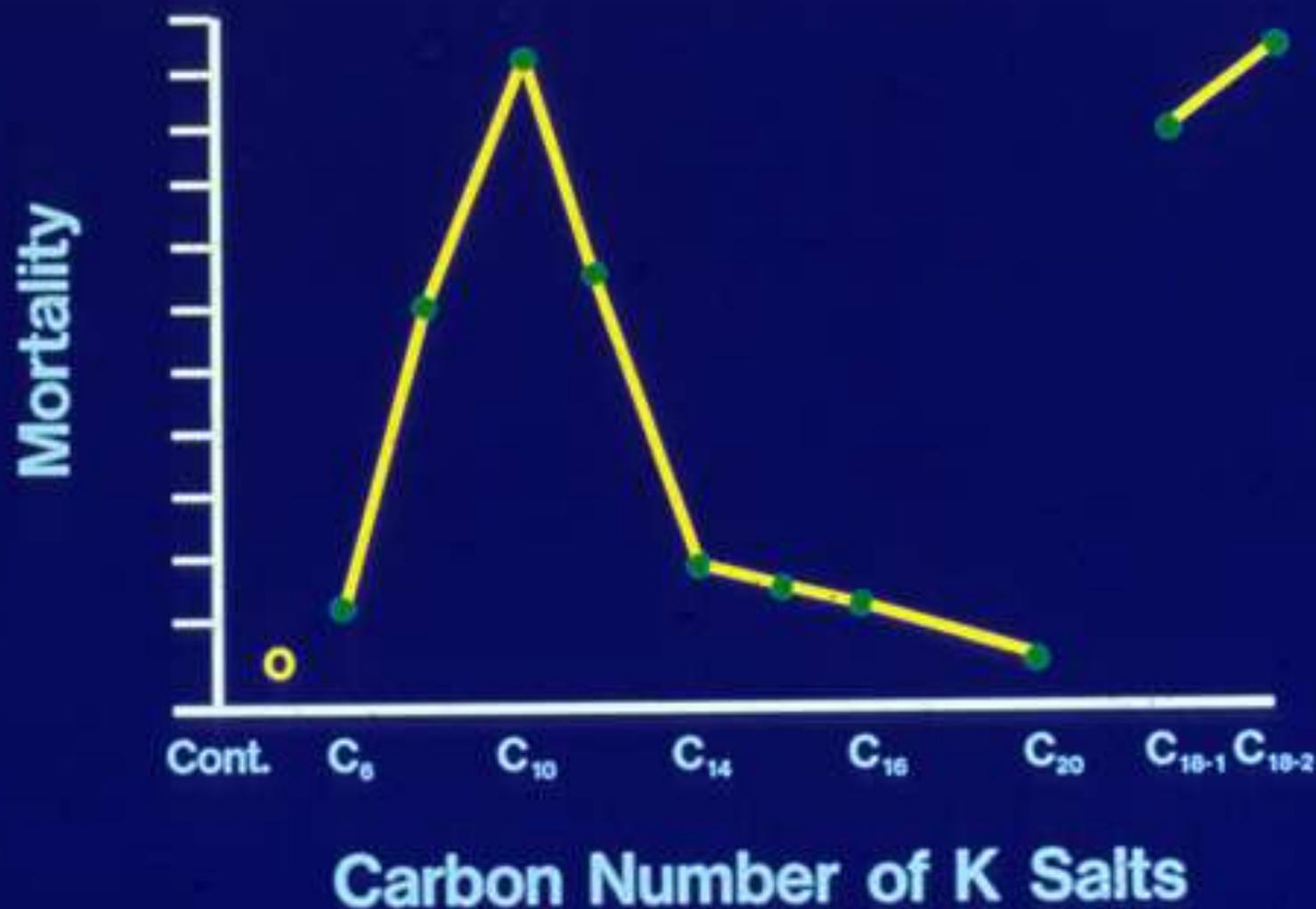
+



=



# Relative Toxicity to Insects of Soaps of the Most Naturally Occuring Fatty Acids on Insects



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# Soaps as Insecticides

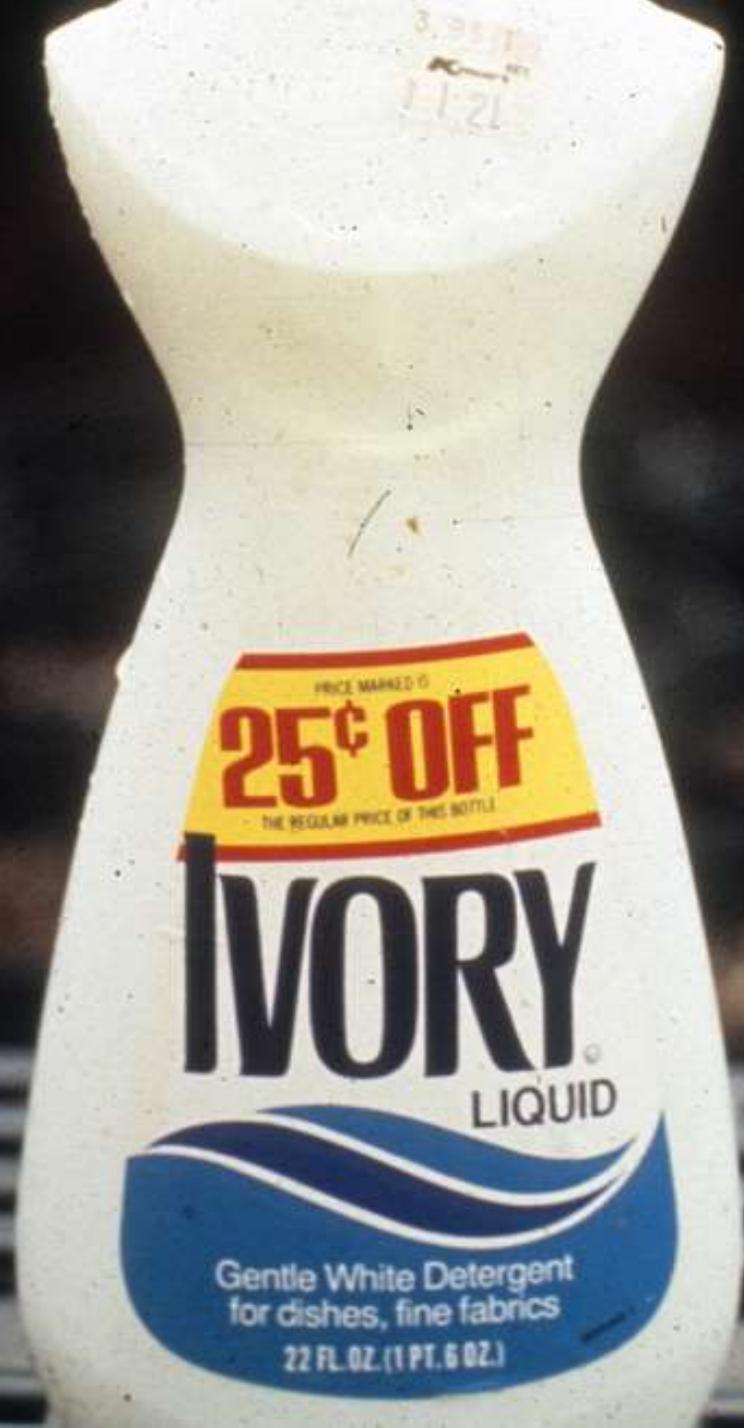
Note: These are applied as a dilute (2-3% concentration) spray

**Insecticidal Soap =  
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# **Environmental Limitations to Effective Use of Insecticidal Soaps**

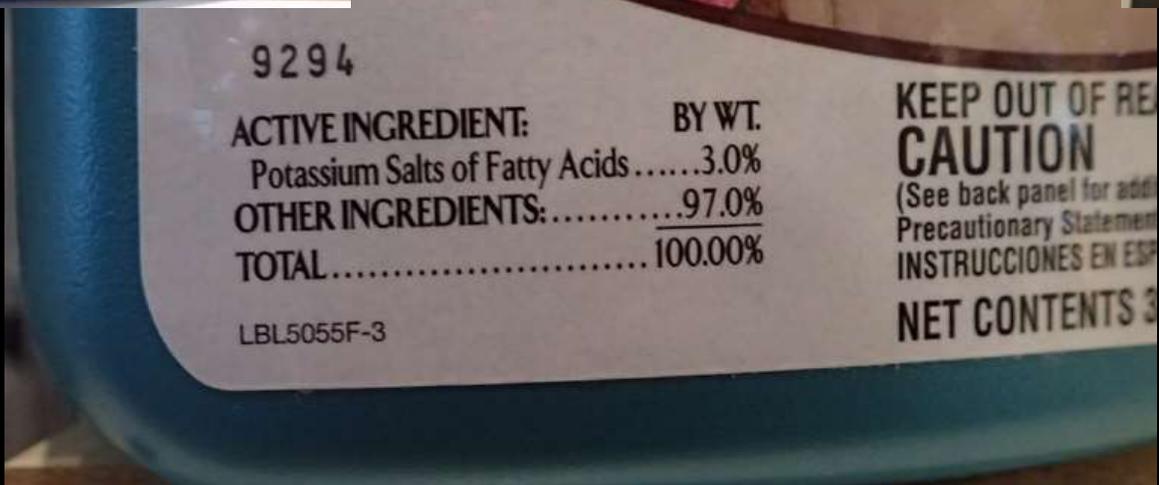
- **Soaps are strictly contact insecticides**
  - **No residual activity**
- **Efficacy degrades in ‘hard water’**
  - **Minerals combine to make insoluble soaps**
- **Rapid drying may decrease uptake and efficacy**



**What about household products for insect control?**



**Some soaps – based on different fatty acids - will damage plants (herbicidal soaps)**



## Aphid Control - Scenario Two

# Aphids Produce Spring Leaf Curls

*... and they overwinter as  
eggs on the plant*



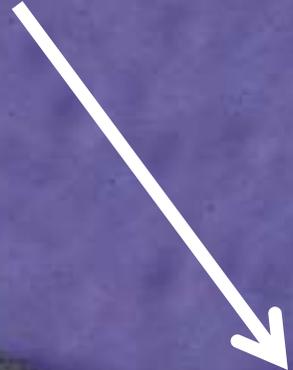
# Horticultural Oils



**Overwintered  
aphid egg**



**Stem mother from  
overwintered egg**





# Horticultural Oils

- Highly refined petroleum (mineral) oils
- Cottonseed oils
- Soybean oils
- Neem oils
- Fish oils



• Controls Spider Mites, And Other  
• Controls Powdery Mildew, Rust,  
ACTIVE INGREDIENT:  
Clarified Hydrophobic Extract of Neem Oil .....  
OTHER INGREDIENTS: .....  
TOTAL: .....  
KEEP OUT OF REACH OF CH

Neem oil, the oil fraction (without azadirachtin) from crushed neem seed

## Aphid Control - Scenario Three

**Aphids Have Already Produced A Leaf Curl**



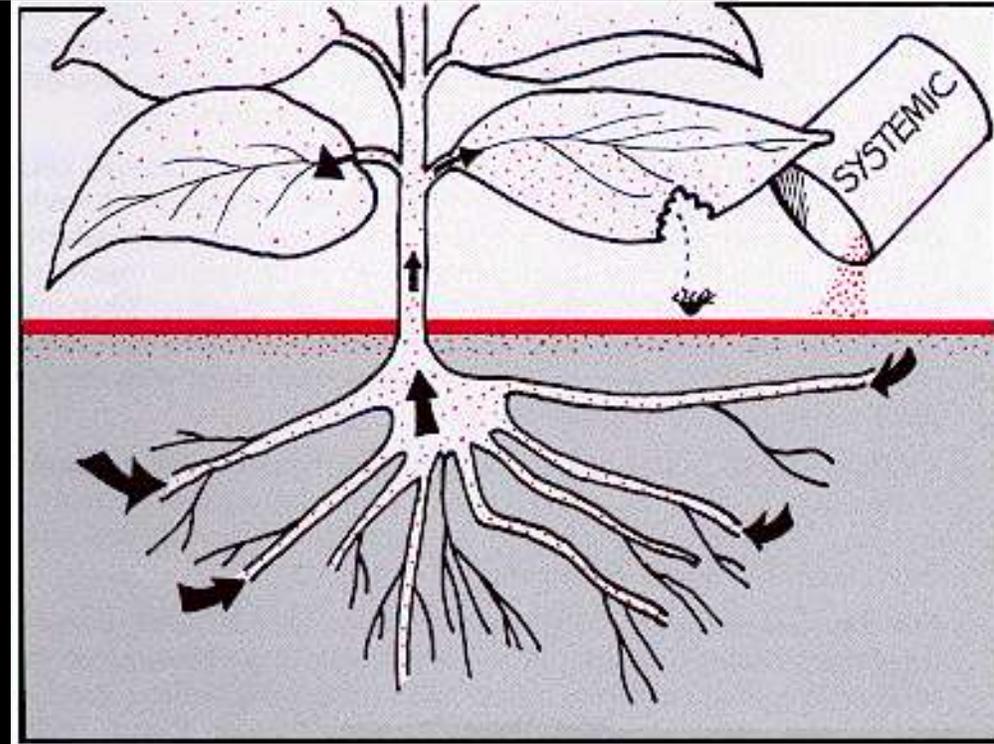


# Systemic Insecticides - A few insecticides have the ability to move into a plant and move systemically within the plant

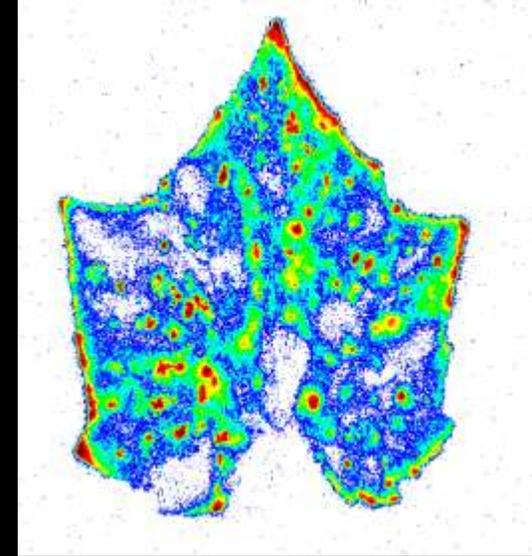
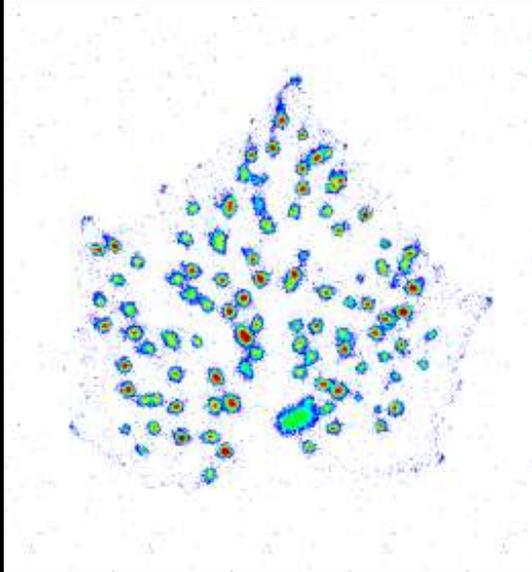
Systemic insecticides applied to leaves



Systemic insecticides applied to soil

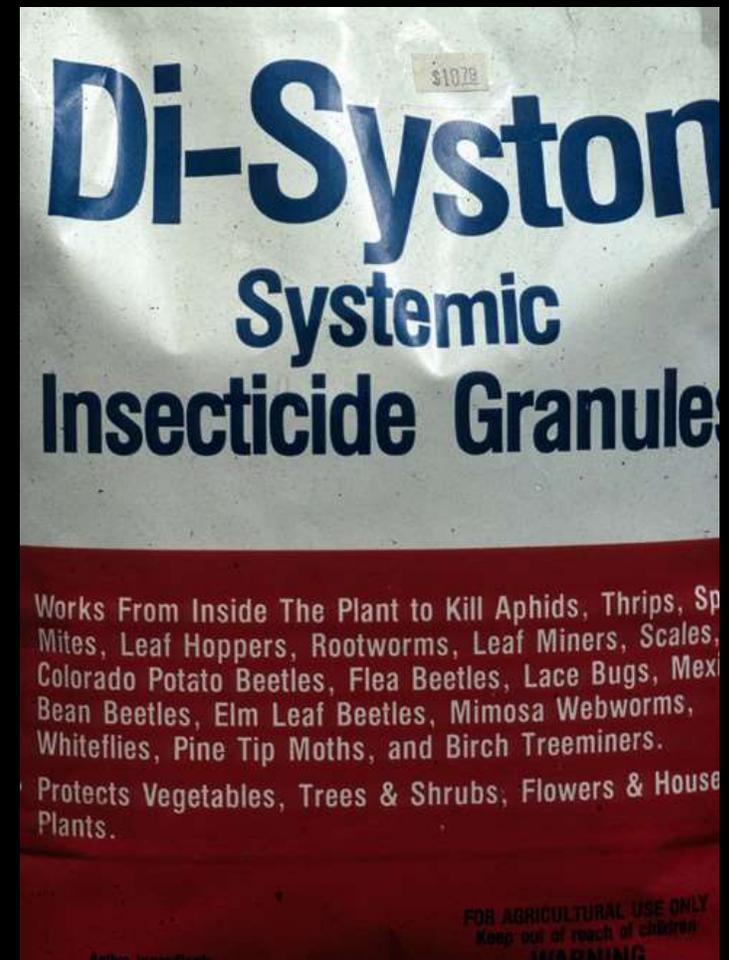


# Systemic insecticides can move within the plant and kill aphids within curled leaves





Some older organophosphate insecticides with systemic activity



# **Systemic Insecticides Used to Control Leafcurling Aphids – Retail Sales**

- **Imidacloprid**

- **Most common soil applied systemic insecticide.  
Neonicotinoid class**

- **Acetamiprid**

- **New foliar applied systemic insecticide for foliar  
application. Neonicotinoid class**

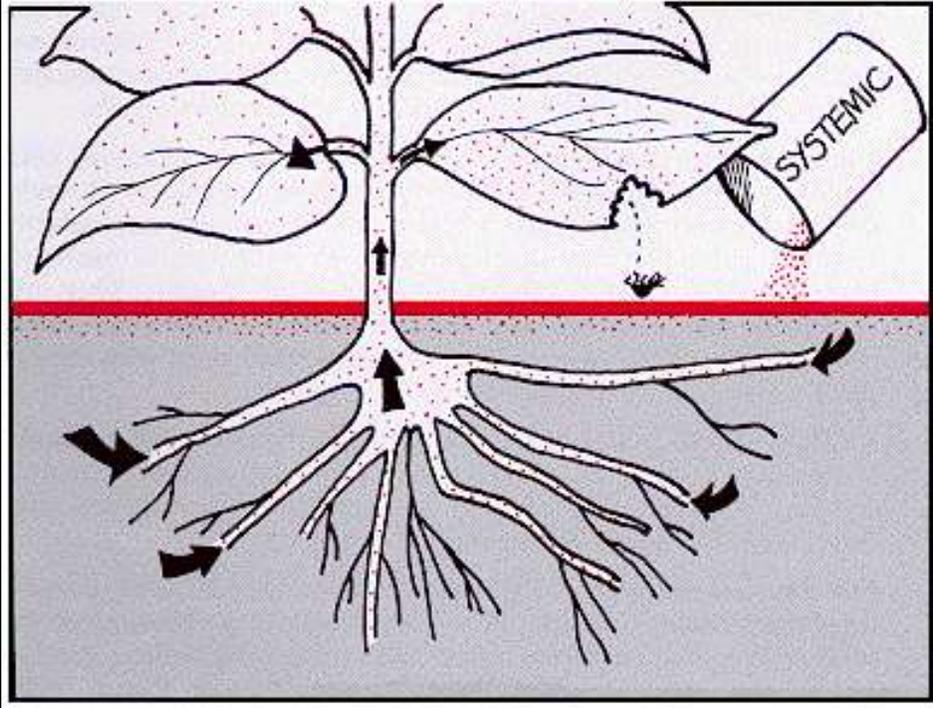
# Systemic Insecticides

## – Soil Applications



Imidacloprid  
has displaced  
Di-System  
from the retail  
market





## Common method of applying systemic insecticides – soil applications for root uptake



Soil injections



Soil drenches

# Applying systemic insecticides to the soil of trees



**Soil drench**

**Soil injection**





**Drench applications should be applied to the fine feeder roots that often grown densely around the trunk**





**Soil applications of systemic insecticides *should not be made* if there are flowering plants at the point of application that can pick up the insecticide!!**



# Systemic Insecticides – Foliar Applications



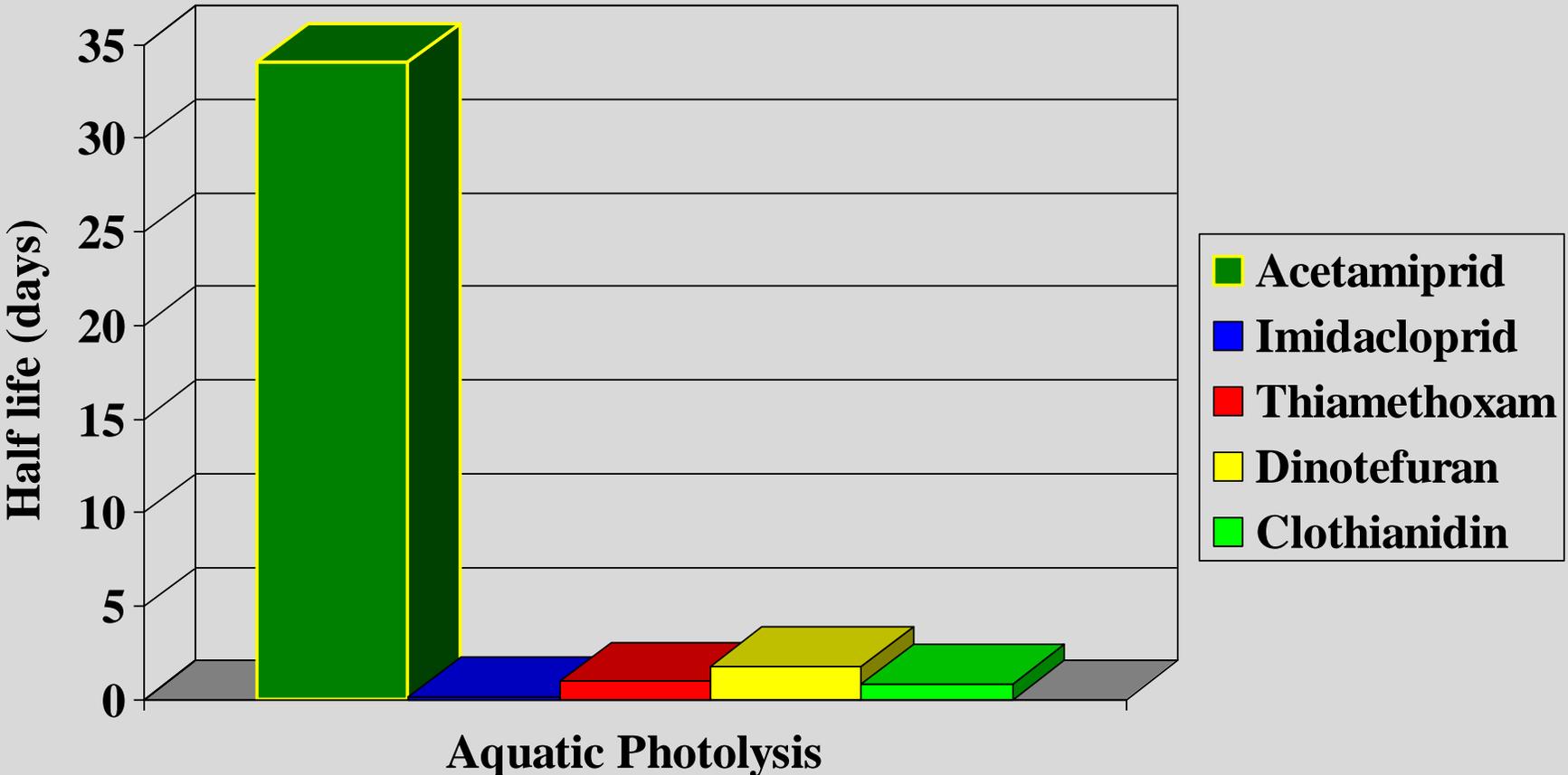


Acetamiprid  
Systemic  
insecticide used  
as a spray



# Acetamiprid is used as a spray because it better resists degradation by ultraviolet light

## Comparison of UV Stability



Data obtained from published EPA registration documents

# Acute Toxicity of Neonicotinoid Insecticides to Adult Honey Bees

(Oral LD50\* – micrograms/bee)



• Acetamiprid	14.53
• Imidacloprid	0.005
• Dinotefuran	0.056
• Thiamethoxam	0.005
• Chlothianidin	0.0003

\*The lower the LD50, the more acutely toxic is the insecticide