

# 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**

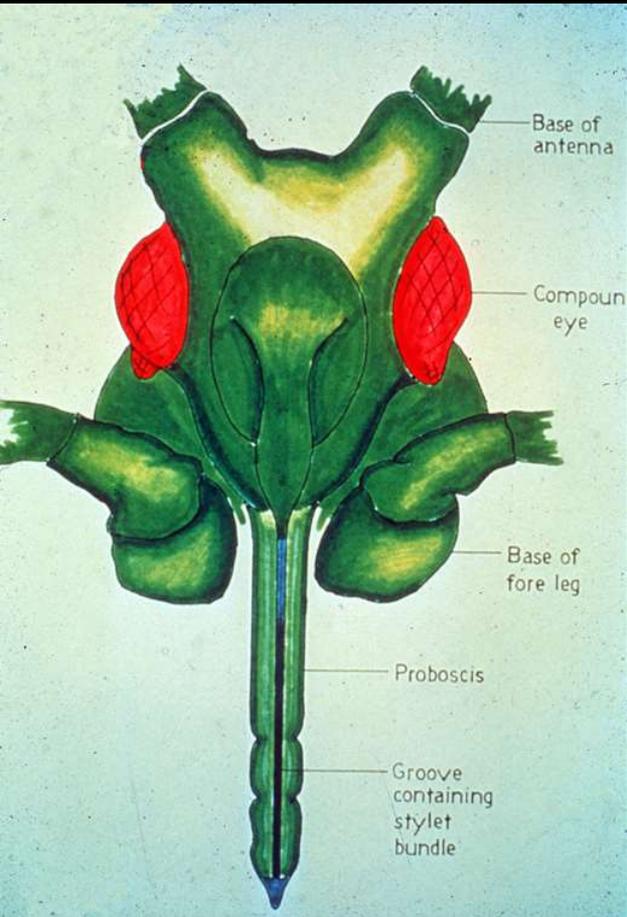
## **Other “Bugs” that Suck Plant Fluids**



**Spider Mites**



# Piercing-sucking mouthparts of Hemiptera



# Aphids

Hemiptera: Aphididae





**Aphids can range in size, shape and patterning**



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



**Aphids associated with *Acer* spp.**



# Rose 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**



**Some aphids are covered with finely powdered wax**



**Some aphids – known as “woolly aphids” – have wax that form long filaments and may cover their body**



# Woolly Apple Aphid



# Leafcurl Ash Aphid





**Sugarbeet root aphid**

**Some aphids  
are associated  
with roots of  
plants**



**Rice root aphid**



**Aphids on dandelion roots**



**Root-infesting  
aphids are often  
surrounded by  
wax**



**Aphid life cycles** – All aphids go through three feeding stages, each punctuated with a molting event

Aphids will molt 3 or 4 times in their life, becoming an adult after the last molt

**Diagnostic: Cast skins remain after aphids molt**



Toothache plant infested with green peach aphid



Aphids on stem (left)  
and cast skins  
dropped onto leaf  
(right)

**Asexual reproduction – giving live birth to a genetically identical daughter – is the norm for aphid reproduction**





**Aphid  
populations  
can increase  
rapidly**

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



**Adults may be winged  
or wingless**



Developing wing pads  
on aphid nymph



**Adults may be winged  
or wingless**



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



- **Outdoors**

- **Eggs** that remain dormant through winter

- Survives on perennial host or crop debris

- Nymphs, adults in continuous reproduction

- Rare and requires living hosts through winter

- **Indoors**

- Nymphs, adults in continuous reproduction

**Outdoors, almost all aphids have a holocyclic life cycle and produce eggs in autumn. That is normally the stage that survives between seasons.**



Overwintered eggs of rose aphid



Rose aphids on flower buds

**Most aphids lay the overwintering eggs on a perennial (often woody) plant**



Late September on a hemp leaf

# Sexual forms of cannabis aphid and eggs

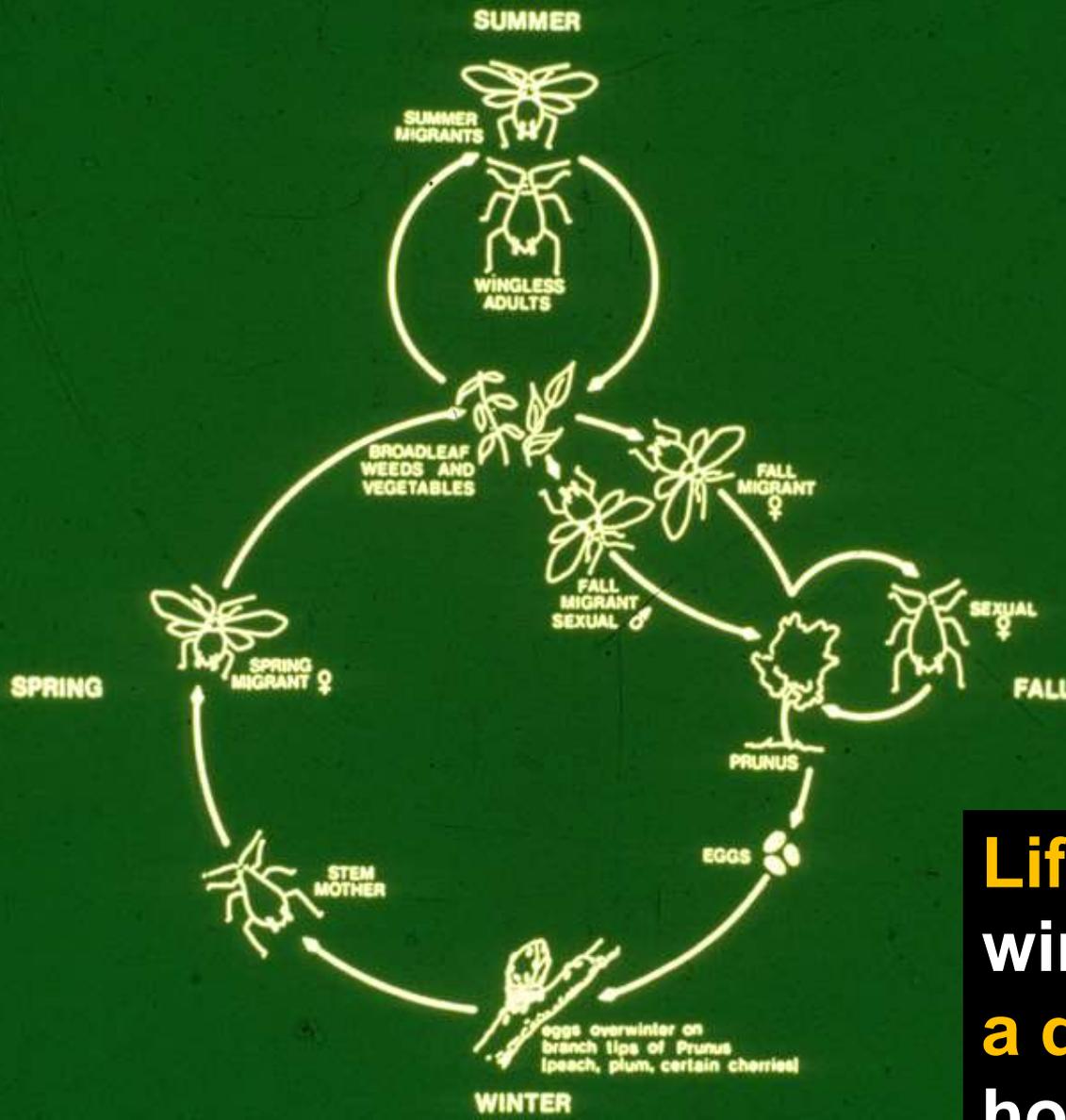
Egg producing form  
female mating with  
winged male

Winged male

Egg producing form  
female with recently  
laid eggs



# Holocyclic Life Cycle – *with host alternation*



LIFE CYCLE OF THE GREEN PEACH APHID

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

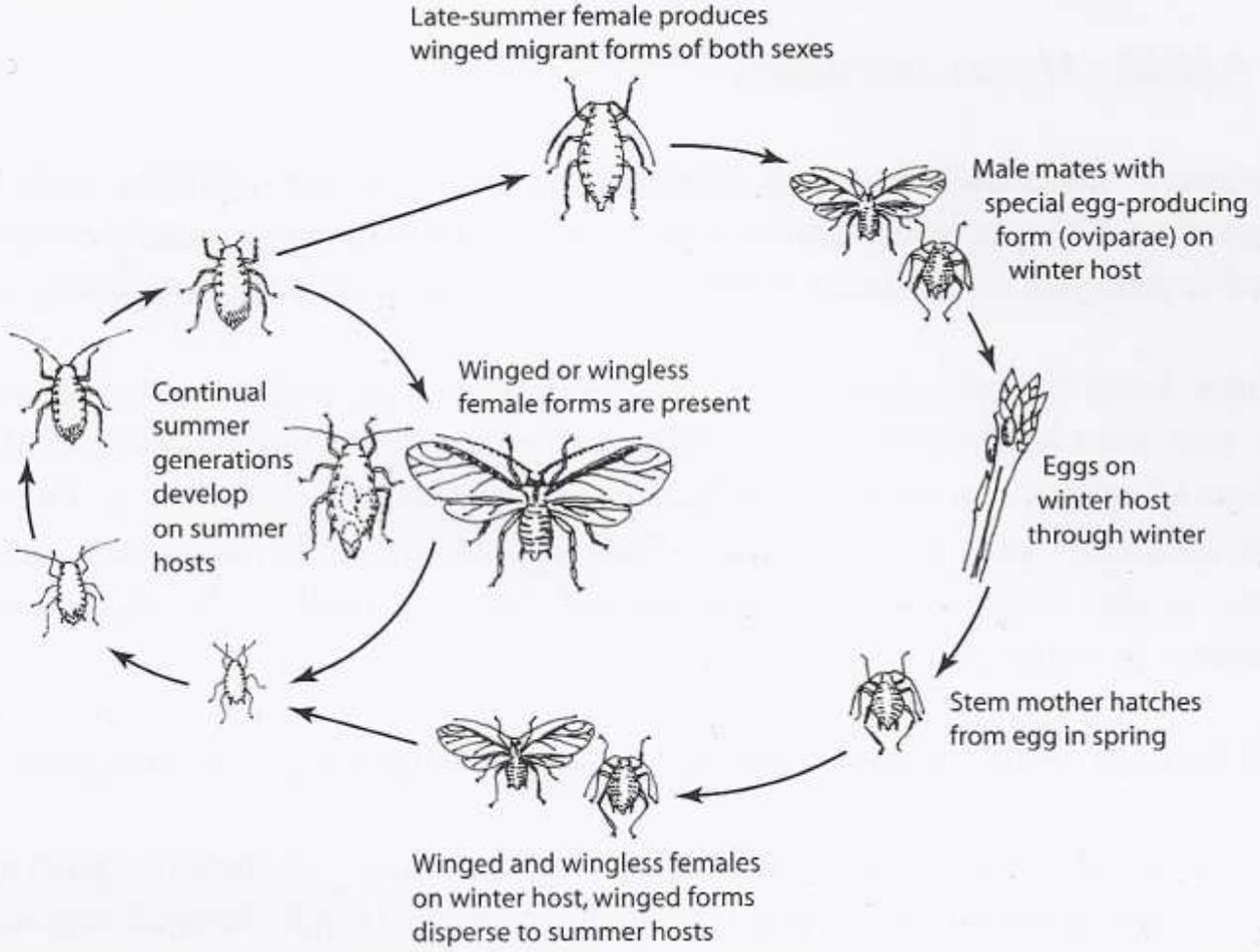


# Green Peach Aphid

*Myzus persicae*

An example of an aphid that undergoes a **holocyclic life cycle** outdoors – *and alternates hosts*



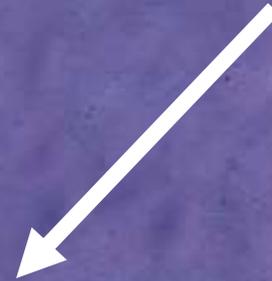




**Overwintering egg  
laid near the bud**



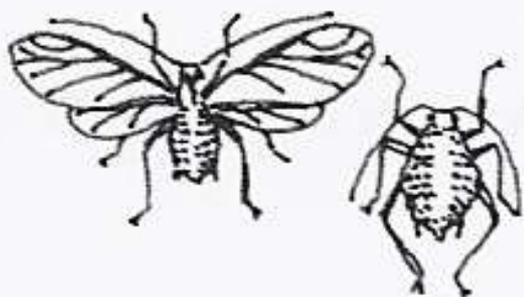
**Stem mother, the stage that hatches from the overwintering egg**





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”**



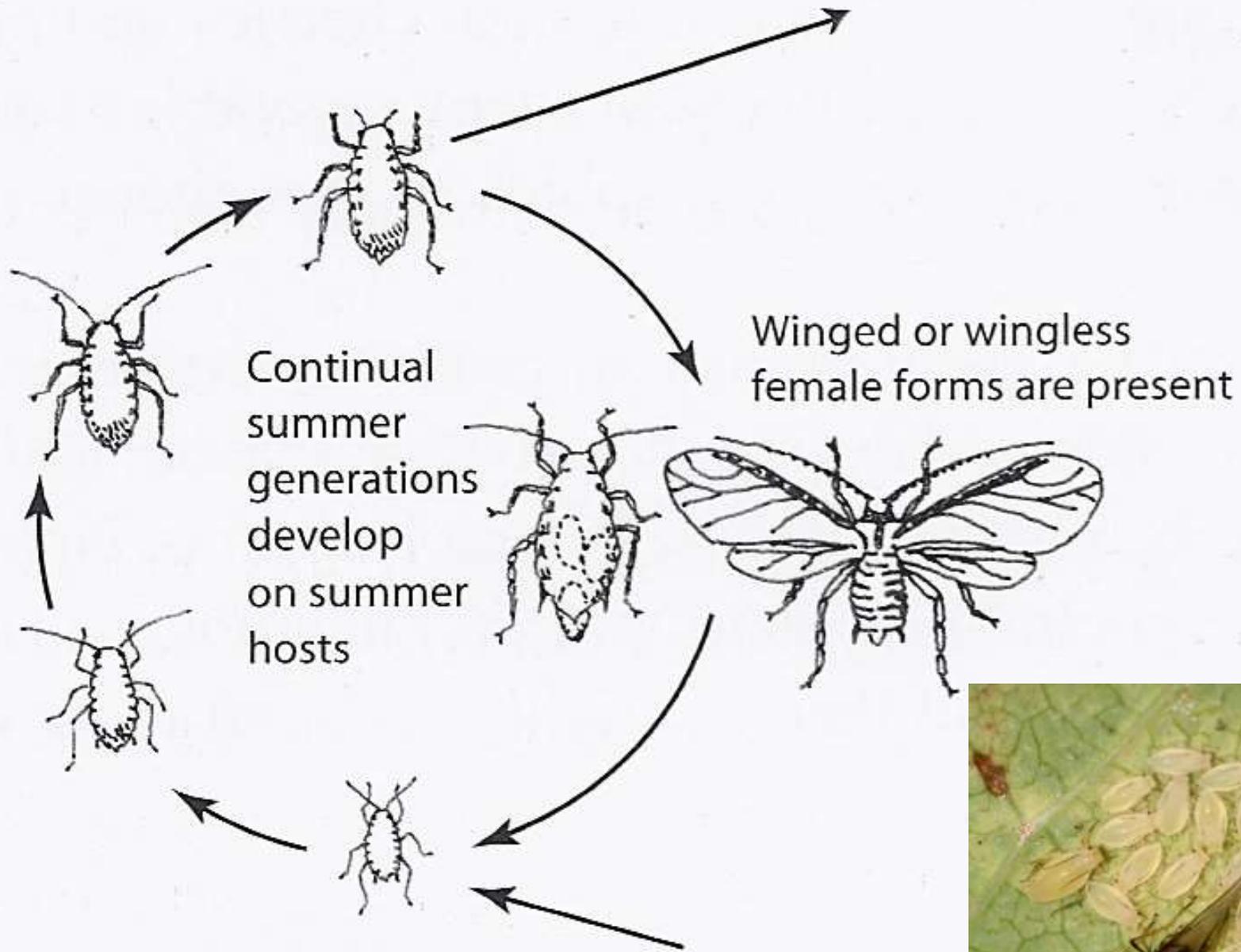
Winged and wingless females on winter host, winged forms disperse to summer hosts



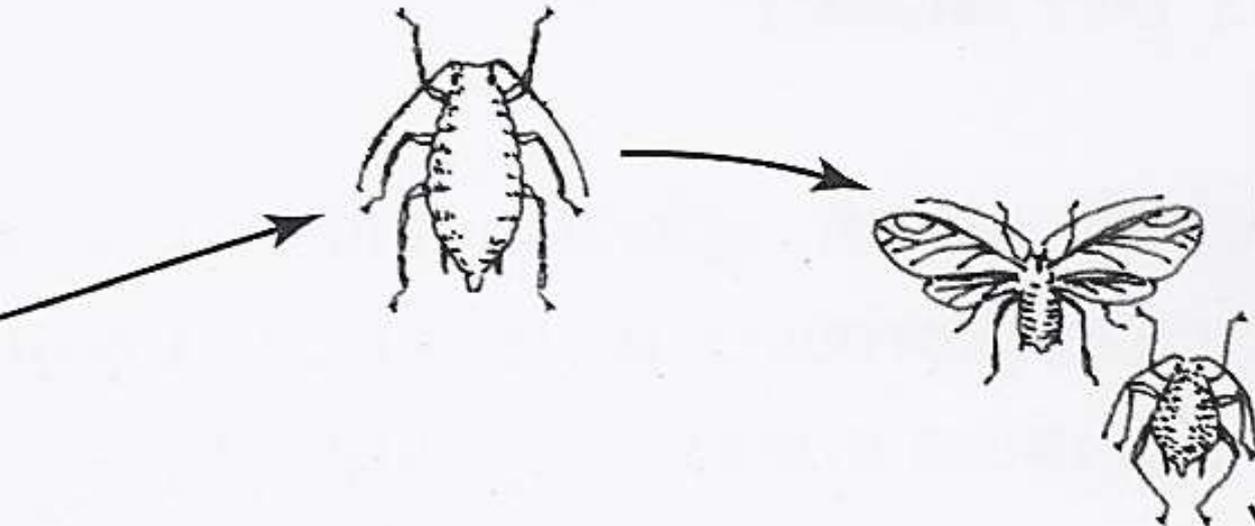
**Summer hosts  
include various  
vegetables and  
weeds**

Spinach, lettuce, peppers,  
potato, cabbage, pigweed,  
and lambsquarters are  
common summer hosts





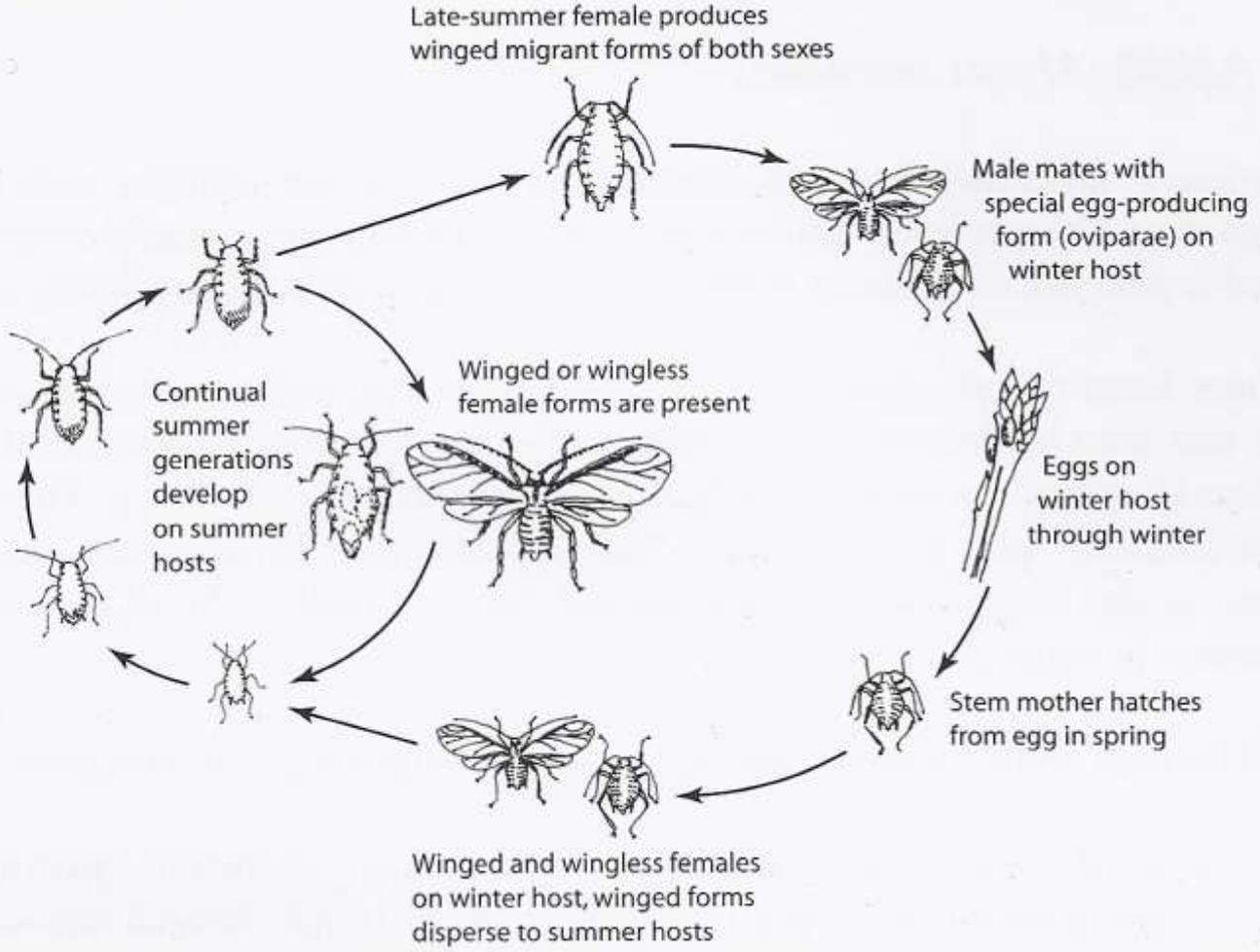
Late-summer female produces winged migrant forms of both sexes



Male mates with special egg-producing form (oviparae) on winter host



Eggs on winter host through winter



# “Double or Nothing Aphids”

**Aphids that require two kinds of host plants to complete the life cycle – *and are not a problem if one host is absent***



# Willow-Carrot Aphid

*Caveriella aegopodii*

**Winter Host:** Certain European willows



**Summer Hosts:** Various Carrot Family (Apiaceae) plants (parsley, dill, carrot)



# Lysimachia Aphid

*Thecabius lysimachiae*

Winter Host: Black poplar (*P. nigra*)



Summer Host: *Lysimachia* (moneywort, creeping jenny)



# Cabbage Aphid

*Brevicoryne brassicae*

One of the very few aphids that may survive Idaho winters outdoors as actively developing stages (nymphs, adults)



No eggs are produced no males and mating occurs – anholocyclic life cycle

# Life History of Aphids

- **Holocyclic life cycle**
  - Involves one sexual generation (sexual form female and male)
  - Results in externally laid egg to survive winter
  - Often involves alternation of host plants
    - Winter host (Fall-late Spring)
    - Summer host
- **Anholocyclic life cycle**
  - Continuous reproduction without sexual reproduction or externally laid eggs

# How Do Aphids Survive Winter in Areas with Freezing Temperatures?



- **Outdoors**

- Eggs that remain dormant through winter
  - Survives on perennial host or crop debris
- Nymphs, adults in continuous reproduction
  - Rare and requires living hosts through winter

- **Indoors**

- Nymphs, adults in continuous reproduction

# Primary aphid species found in greenhouses



Green peach aphid



Potato aphid



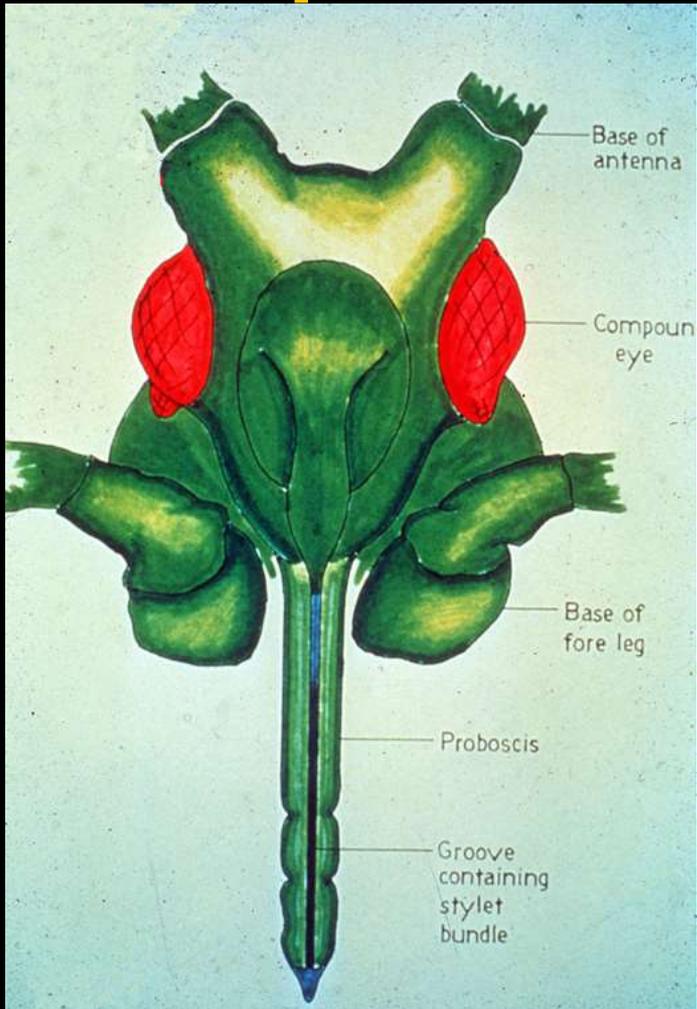
Cotton-melon aphid

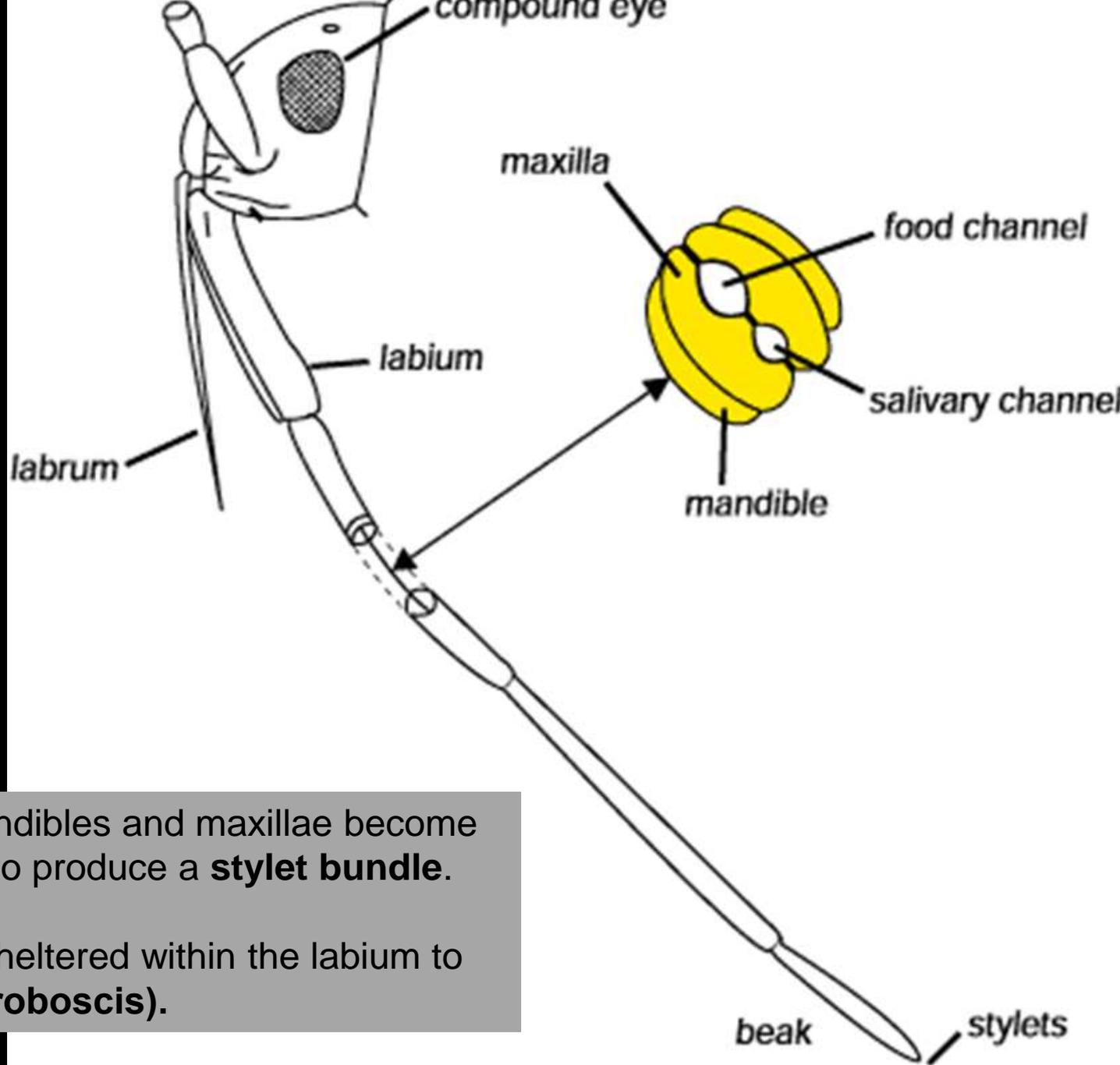
Indoors there is continuous, asexual reproduction. There are no eggs produced, nor sexual forms (males, sexual form females) [anholocyclic life cycle]

# **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**

# Piercing-sucking mouthparts of Hemiptera



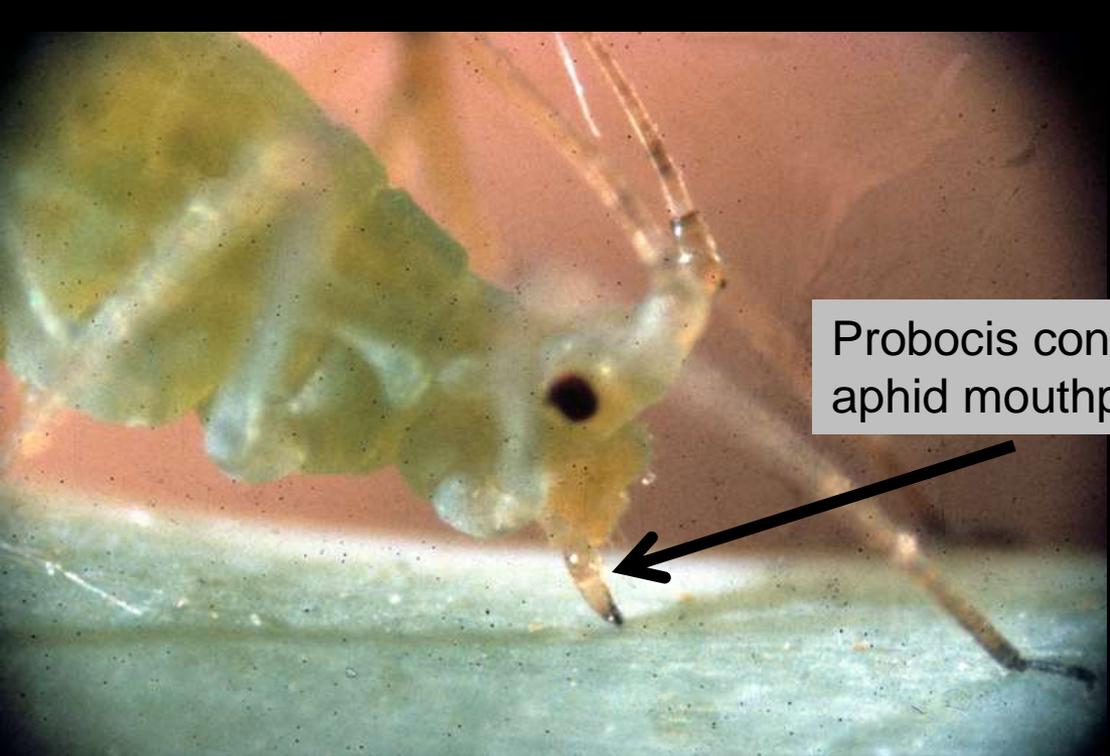


In Hemiptera, the mandibles and maxillae become extremely elongated to produce a **stylet bundle**.

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

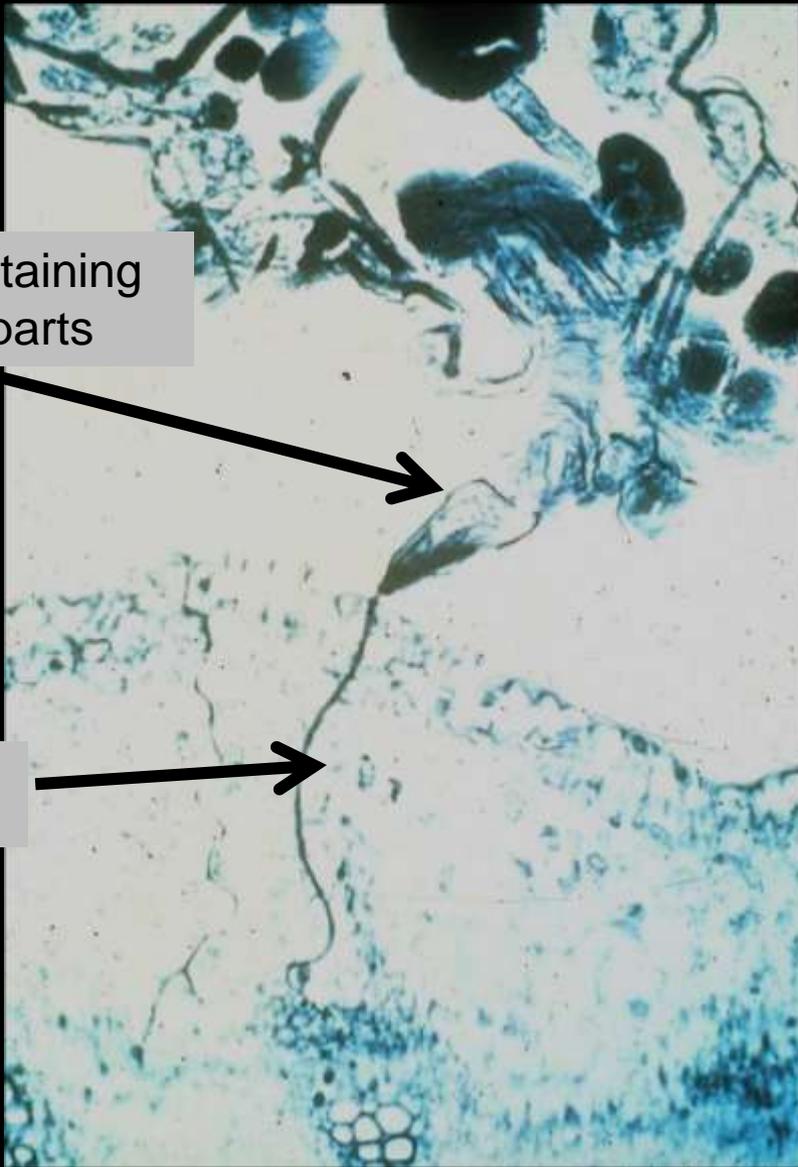


Some sort of  
“beak” is present  
on the underside  
of the head



Proboscis containing  
aphid mouthparts

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!





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



**Outdoors there are normally *numerous natural enemies* usually control aphids before serious damage occurs**

Lady beetle larva



Flower fly larva

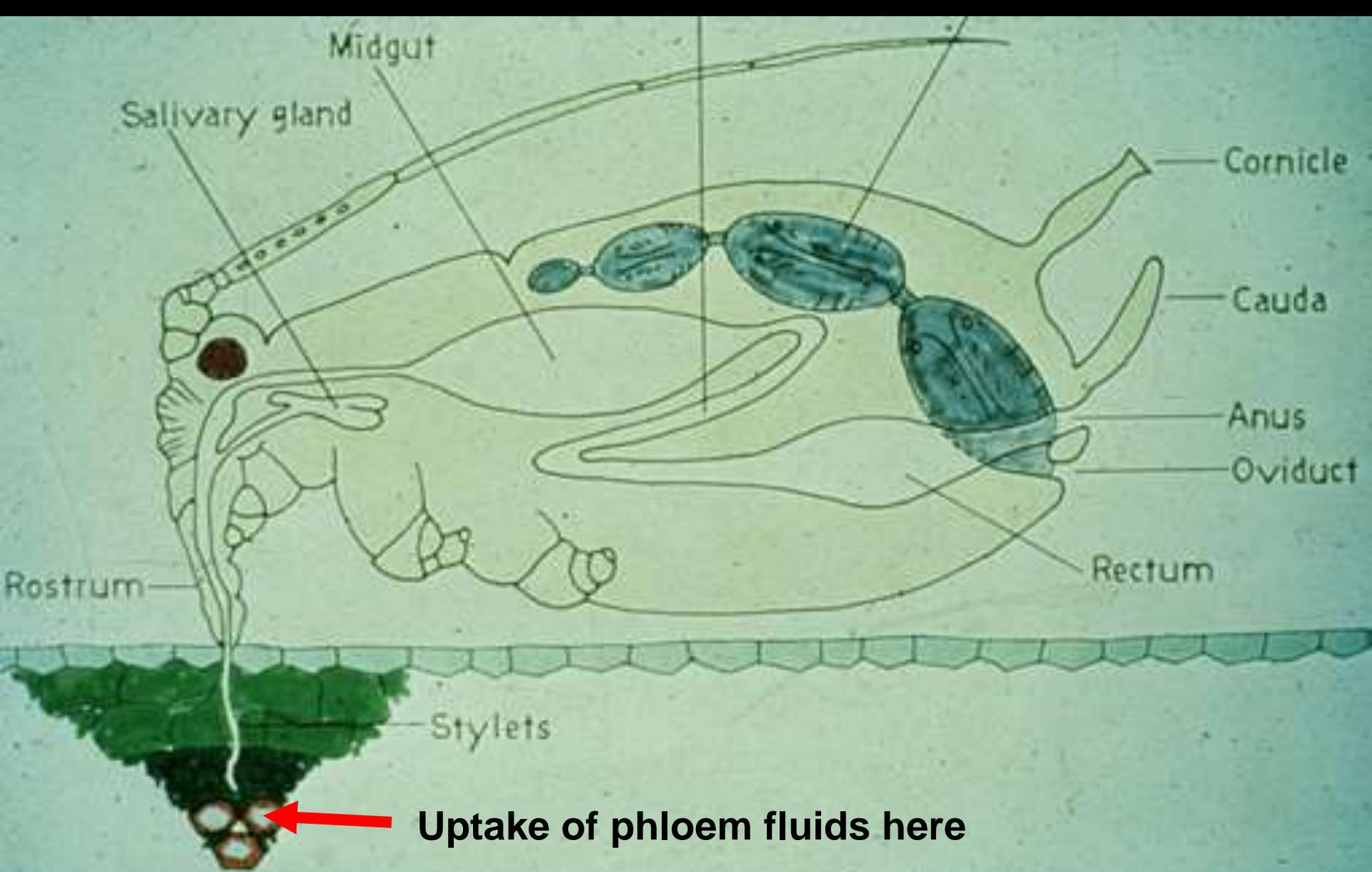


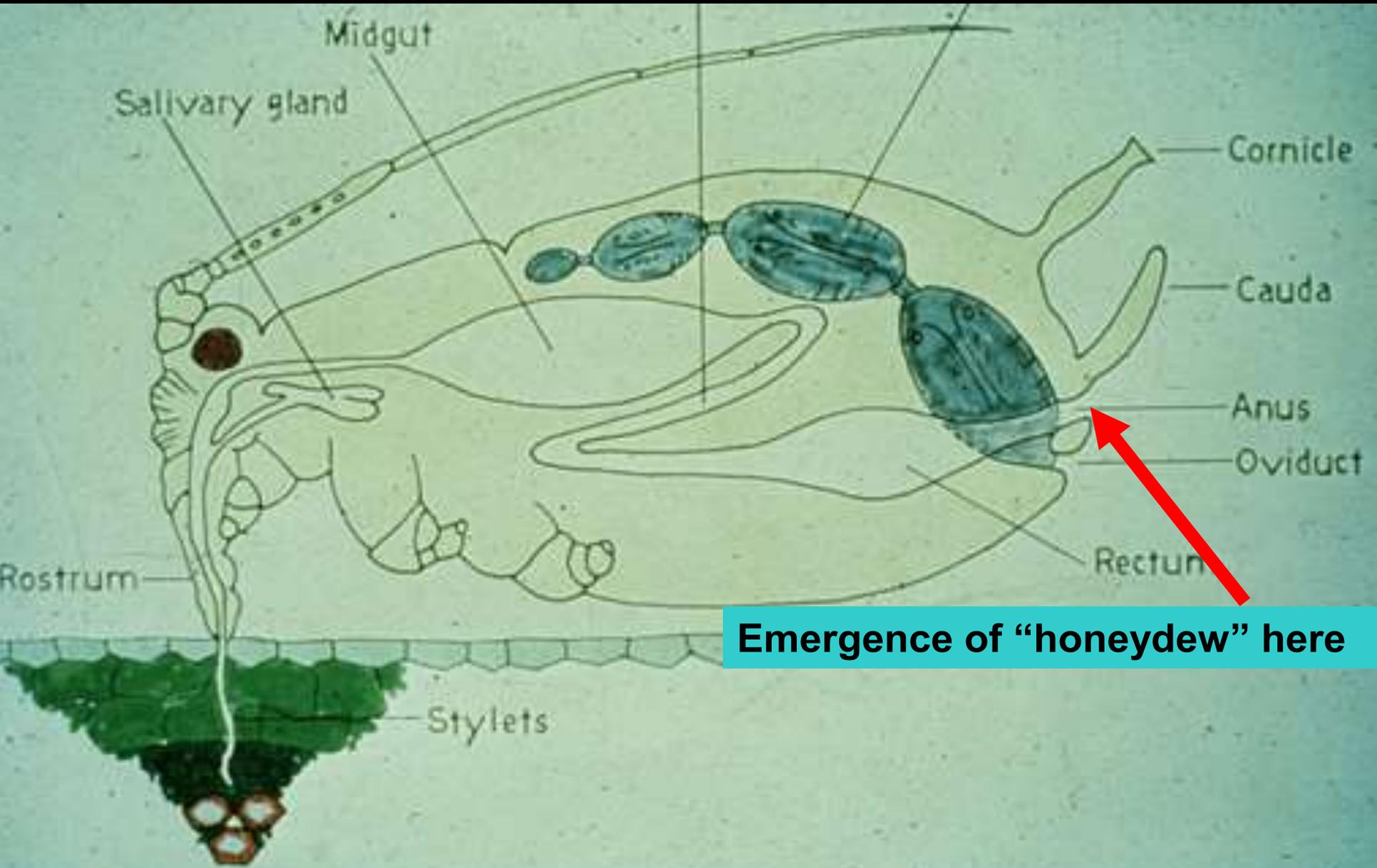
Green lacewing larva



# Honeydew production







# Leaf with sparkles of honeydew – *and* cast skins





The leaf above  
the honeydew –  
*an aphid colony*



Leaf with sparkles of honeydew – *and* cast skins



# Honeydew Producing Insects\*

- Aphids
- Soft scales
- Whiteflies
- Mealybugs
- Psyllids (some)
- Leafhoppers (phloem feeding species)



**\*All suck sap from the phloem**



**Mealybugs**  
**Soft Scales**



**Whiteflies**  
**Psyllids (some)**





**Brown Soft Scale**  
*Coccus hesperidum*







**Honeydew on underside of leaf – no insect on leaf**



**Soft brown scale can flick its honeydew**

**Soft brown scales were on the leaf below**

**Some soft scales, mealybugs, leafhoppers and whiteflies have an “anal cannon” that can direct honeydew some distance**



**The scale insect is here**

**The honeydew was expelled about about one inch**

**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**

# Sooty Molds

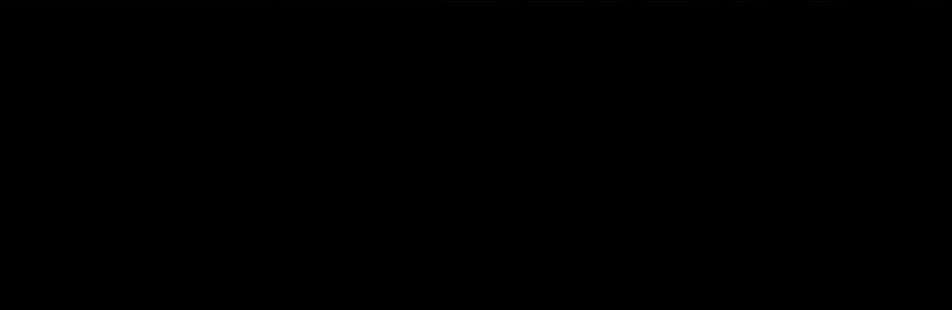
Fungi that grow on honeydew-contaminated surfaces





**Sooty mold  
growing on  
linden aphid  
honeydew**







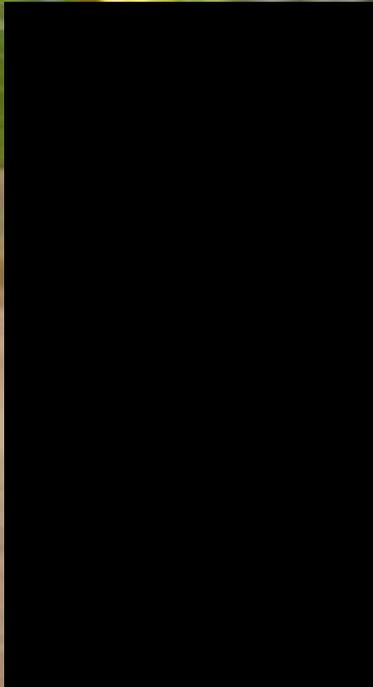


# Leafcurl Injuries

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



# Aphid Control - Scenario One

**Aphids are Exposed  
on the Plant**



# **Different Levels of Control Response to Aphids**

- **Do nothing. Natural controls will ultimately take care of things.**
  - Indoor production will require introduction of natural enemies
- **Treat the plants with a strong jet of water to kill aphids**
- **Use a soap/detergent spray to kill aphids**
- **Use some other effective ‘aphicide’**



**Check for aphid  
natural enemies!**





Photograph courtesy of David Cappaert



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

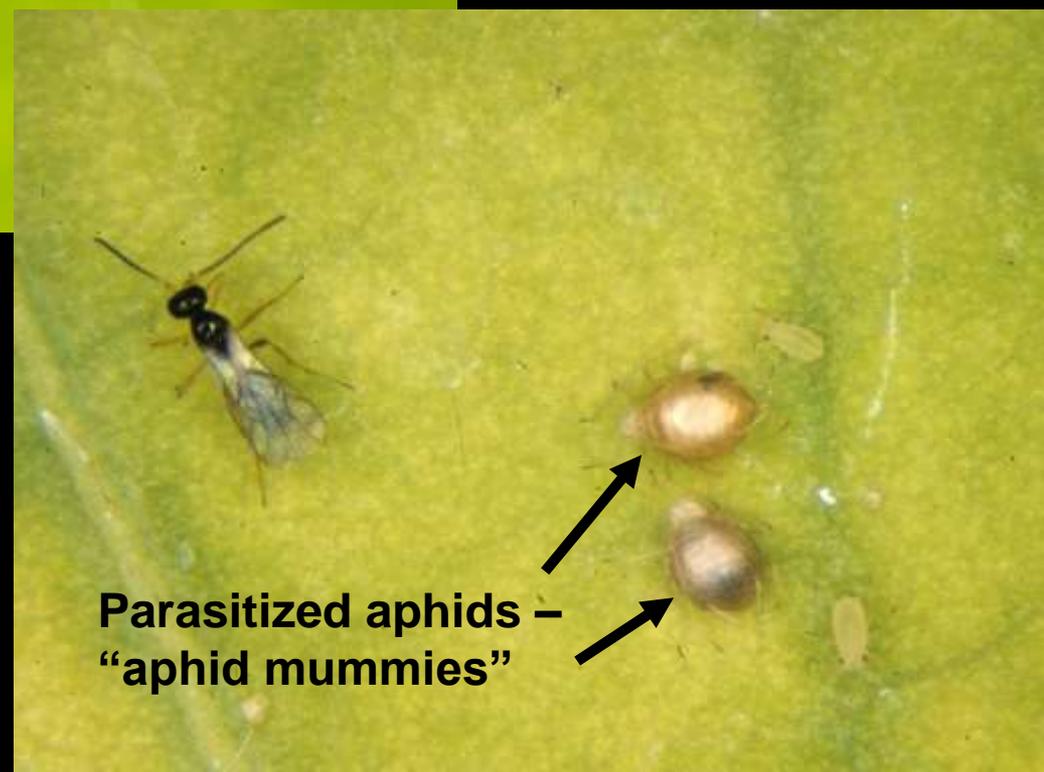




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# Aphid Parasitoids



Parasitized aphids –  
“aphid mummies”



Parasitoid wasp larva  
inside aphid mummy



Parasitoid wasp emerging  
from aphid mummy



Old aphid mummy with exit  
hole made by emerging wasp



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**Lady beetle larvae**



Adults



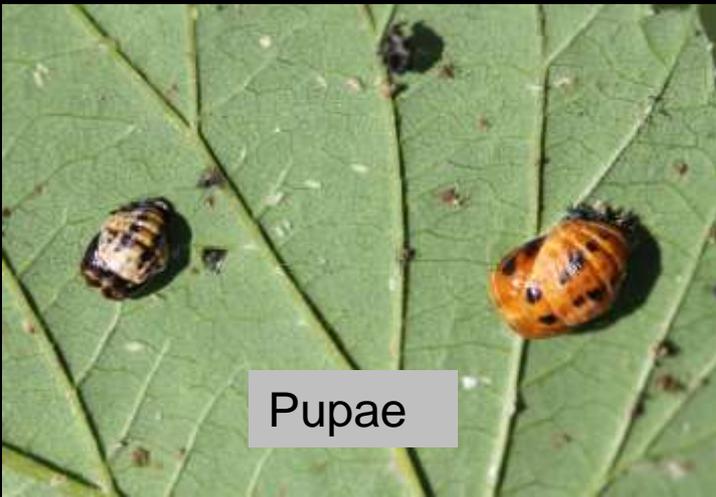
Eggs



Larvae



Pupae



# Lady Beetle Life Stages



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# **There can be different levels of response to an aphids infestation**

- **Do nothing. Natural controls will ultimately take care of things.**
- **Treat the plants with a strong jet of water to kill aphids**
- **Use an effective 'aphicide'**
  - **Contact sprays**
  - **Systemic insecticides**



**Hosing for aphid control**

# Rose Aphids - Before





# Rose Aphids - After



# **There can be different levels of response to an aphids infestation**

- **Do nothing. Natural controls will ultimately take care of things.**
- **Treat the plants with a strong jet of water to kill aphids**
- **Use an effective ‘aphicide’**
  - **Contact sprays**
  - **Systemic insecticides**

# Some aphid control products – Exposed Aphids

- **Insecticidal Soaps**
- **Pyrethroids**
  - Bifenthrin, cyhalothrin, cyfluthrin, etc.
- **Neonicotinoids**
  - Imidacloprid
  - Acetamiprid



## Over-the-Counter Insecticides for Home, Yard and Garden Use 2018 Survey, Fort Collins, Colorado

The following is a list of all insecticides found in a survey conducted June 4-11, 2018 in Fort Collins. These are arranged by common name of the active ingredient(s).

The survey included 3 nurseries, 3 hardware stores and 3 box stores. Following each product are indicated the type of store(s) in which it was found (**n** = nursery; **h** = hardware store; **b** = box store).

### **ACEPHATE (Orthene)**

Bonide Systemic Insect Control (h)

Bayer Advanced 2 in 1 Systemic Rose & Flower Care (b)

### **ACETAMIPRID**

Ortho Flower, Fruit & Vegetable Ready-to-Spray (n)

Ortho Rose and Flower Insect Killer Ready-to-Use (h,h,n)

Ortho Rose & Flower Insect & Disease Control Concentrate (with triticonazole) (n)

### **ALLETHRIN/TRANS-ALLETHRIN**

Raid House and Garden (with d-phenothrin) (c)

### **AVERMECTIN/ABAMECTIN**

Maggie's Farm Roach Killer Gel Bait (h,b)

Raid Ant Baits III (h,h,b)

### **AZADIRACTIN (NEEM EXTRACT)**

Safer Grub Killer Ready-to-Spray (n)

### **BACILLUS THURINGIENSIS (var. KURSTAKI)**

ferti-lome Dipel Dust Biological Insecticide (h,n,n,n)

Monterey B t Ready-to-Use (h,n)

**OMRI**  
Listed  
Organic Materials  
Review Institute

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  
NET CONTENTS

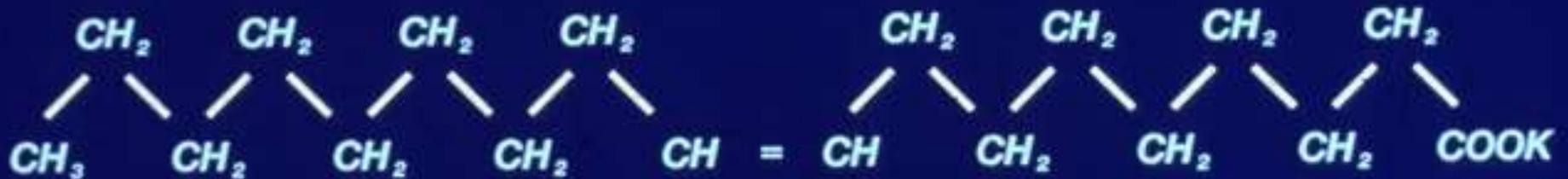
# Soaps as Insecticides

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<br>C <sub>14</sub> | Palmitic<br>C <sub>16</sub> | Stearic<br>C <sub>18</sub> | Oleic<br>C <sub>18-1</sub> | Linoleic<br>C <sub>18-2</sub> | Linolenic<br>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



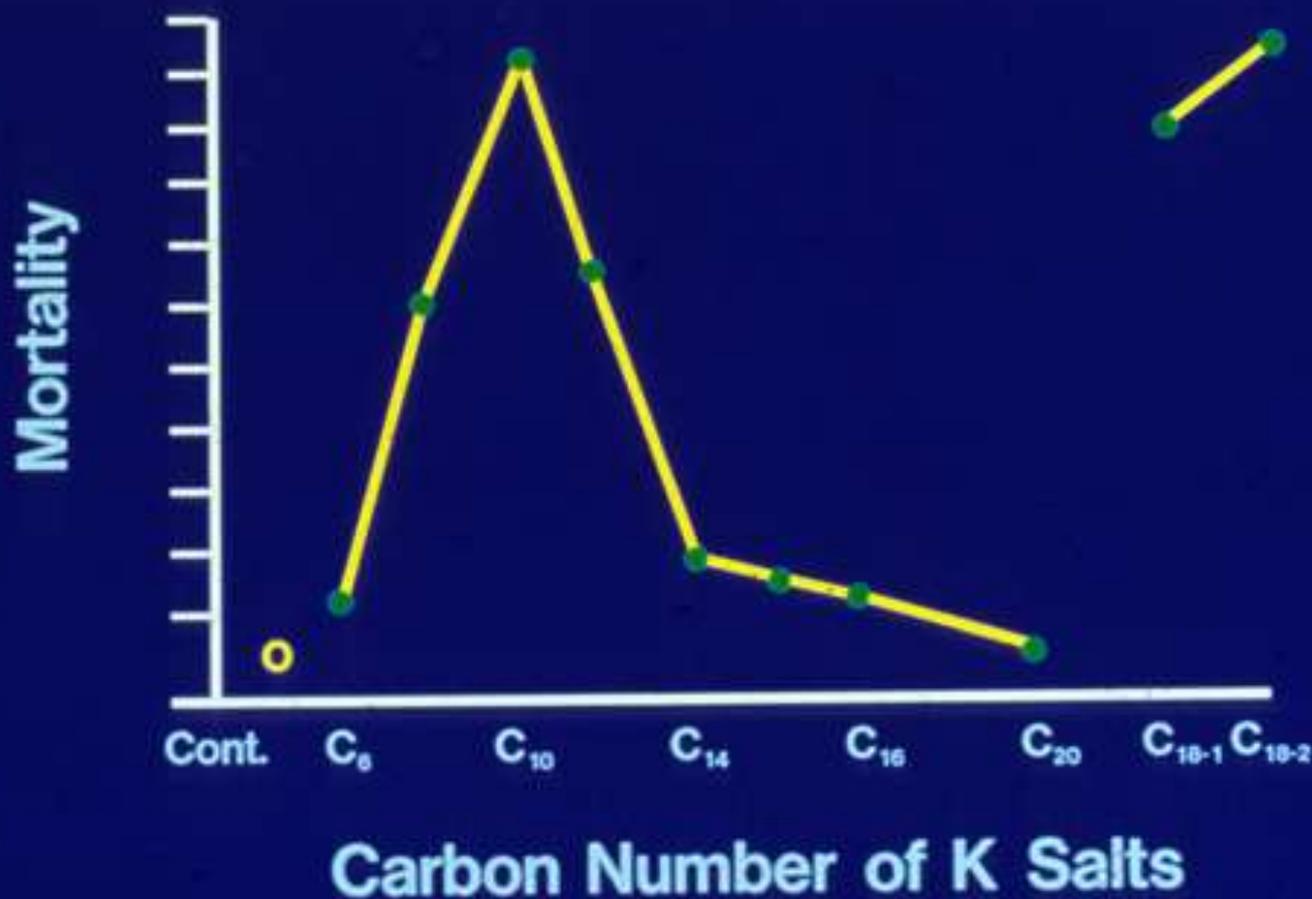
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# Relative Toxicity to Insects of Soaps of the Most Naturally Occuring Fatty Acids on Insects



**OMRI**<sup>®</sup>  
Listed  
Organic Materials  
Review Institute

FOR  
**organic  
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ACTIVE INGREDIENT: BY WT.  
Potassium Salts of Fatty Acids... 49.52%  
OTHER INGREDIENTS:..... 50.48%  
TOTAL..... 100.00%

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0109

**KEEP OUT OF**  
**WARNING**  
See back panel for  
Precautionary Sta  
NE

# Soaps as Insecticides

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

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



# **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**

# Insecticidal Soap (potassium salts of fatty acids)



Note: There may be **phytotoxicity warnings** – e.g., nasturtiums, sweet pea, delicate ferns





9294

|                                     |         |
|-------------------------------------|---------|
| ACTIVE INGREDIENT:                  | BY WT.  |
| Potassium Salts of Fatty Acids..... | 3.0%    |
| OTHER INGREDIENTS:.....             | 97.0%   |
| TOTAL.....                          | 100.00% |

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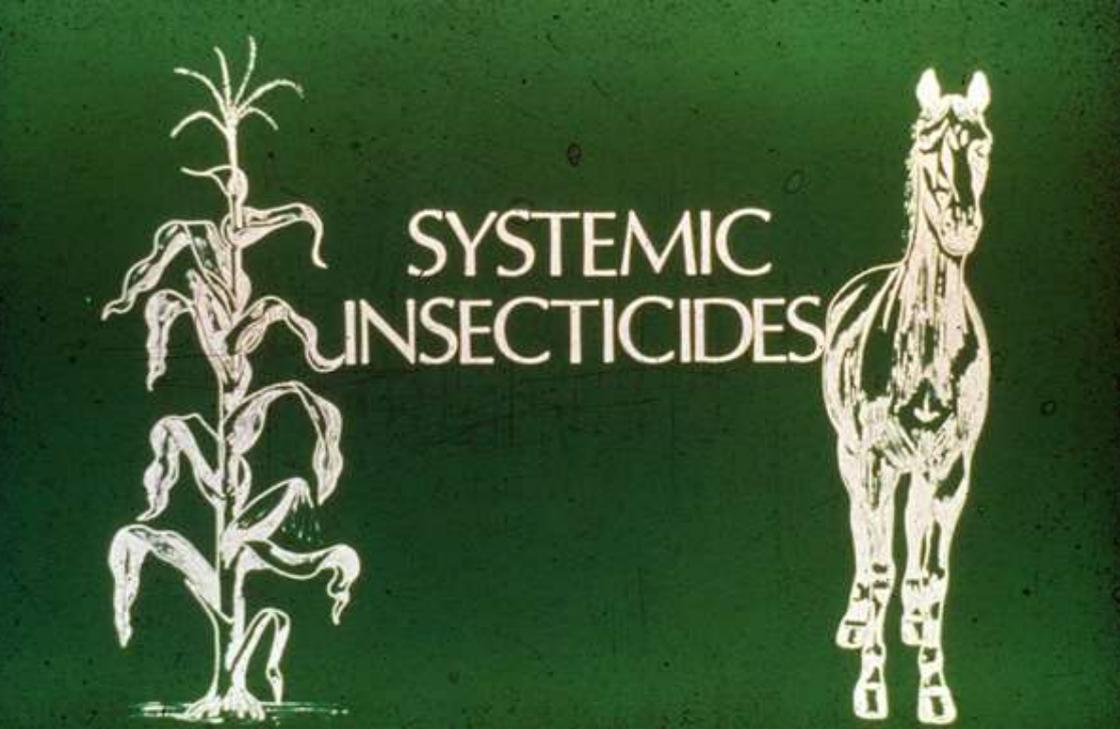
KEEP OUT OF REACH OF CHILDREN  
**CAUTION**  
 (See back panel for additional  
 Precautionary Statement)  
 INSTRUCCIONES EN ESPAÑOL EN REVERSO  
 NET CONTENTS 32 FL. OZ.

**Some soaps will  
 damage plants  
 (herbicidal soaps)**

## Aphid Control - Scenario Two

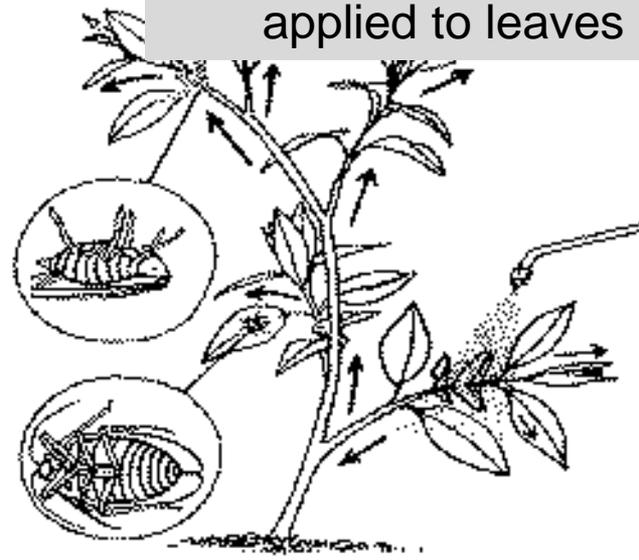
# Aphids Have Already Produced A Leaf Curl



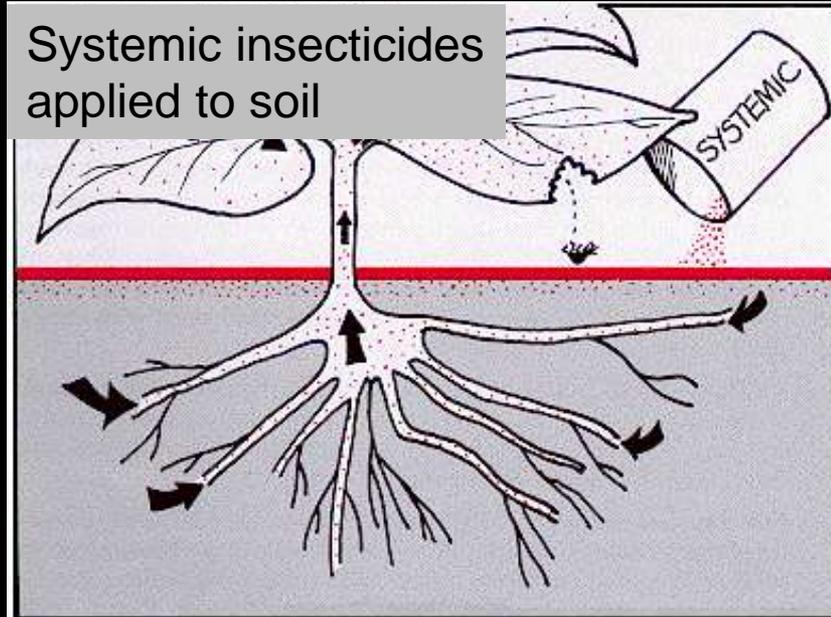


For control of aphids in existing leafcurls *only an insecticide that moves systemically in plants will provide control*

Systemic insecticides applied to leaves

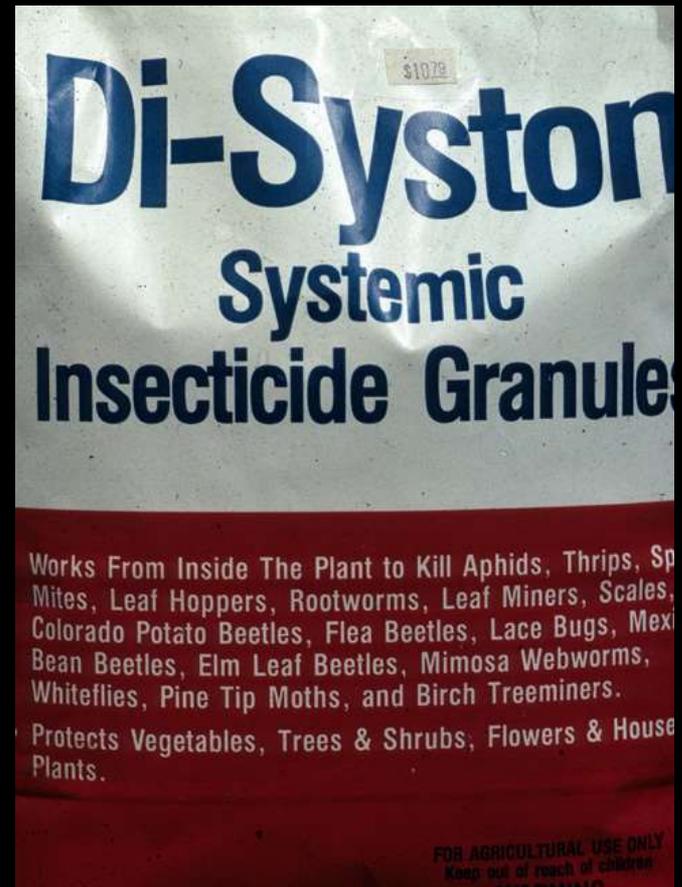


Systemic insecticides applied to soil



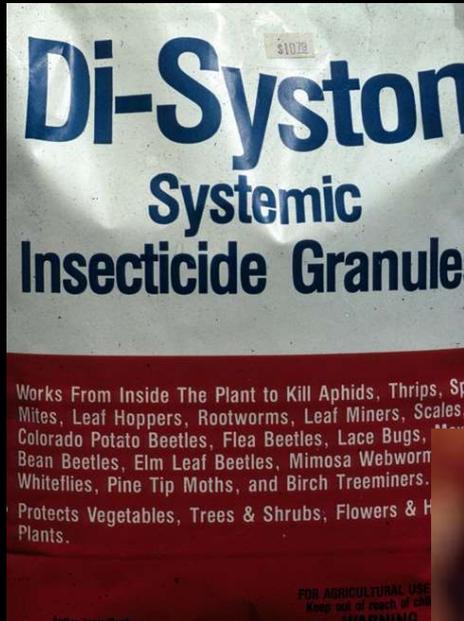


**Some older organophosphate insecticides with systemic activity**



# Systemic Insecticides

## – Soil Applications



**Insecticide control options for aphids**

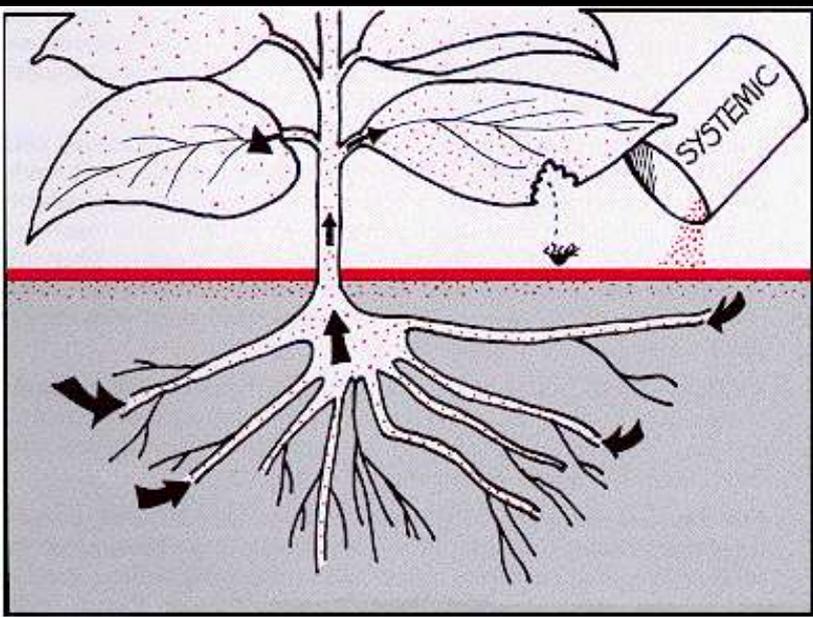
## **Imidacloprid for Aphid Control**



- **Best used as a soil application**
- **Has systemic activity in plant**
- **Slow uptake/Extended residual activity**
  - **May kill aphids for weeks- months?**
  - **Conservative of some natural enemies**

Imidacloprid  
has displaced  
Di-Syston  
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 grow densely around the trunk**



**Soil applications of systemic insecticides *should not be made* if there are flowering plants at the application site**





**Aphids have  
already produced  
a leaf curl?**

**Insecticides that  
work only by contact  
will not control this  
problem – *and can  
easily make it worse***



# Systemic Insecticides – Foliar Applications





Acetamiprid  
Systemic  
insecticide used  
as a spray

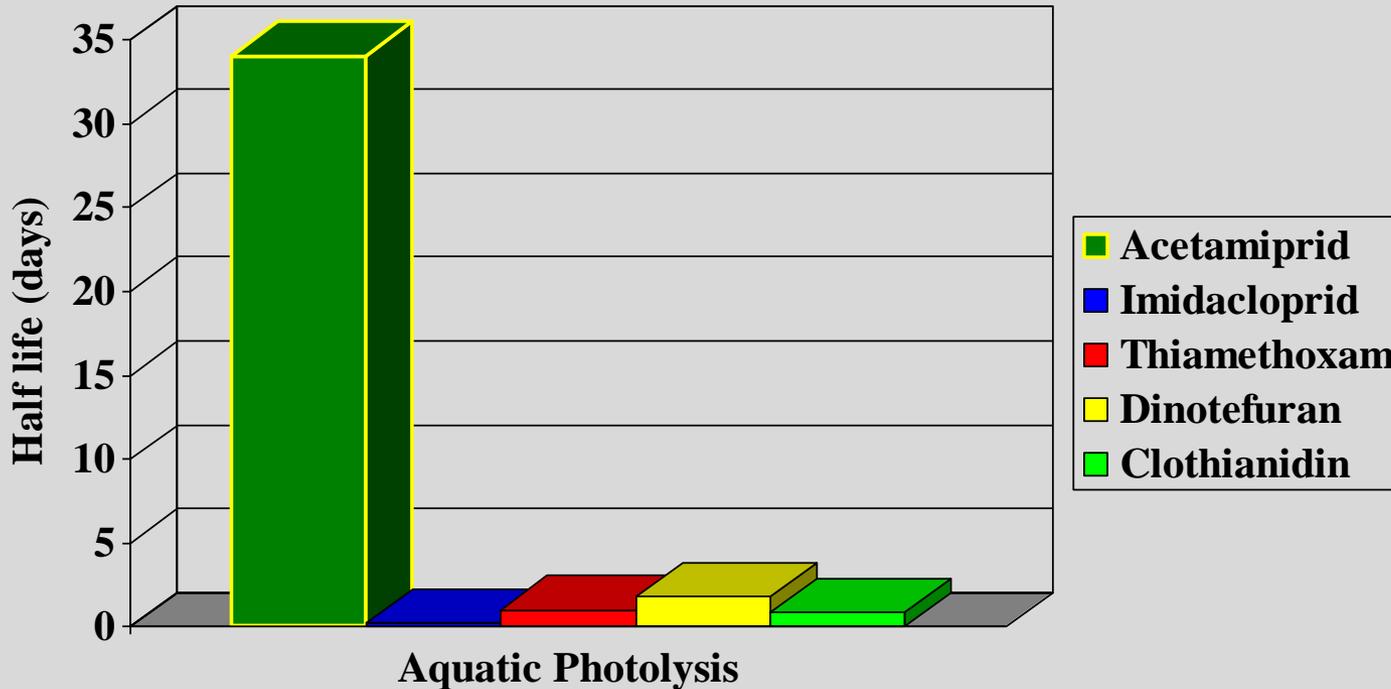


# Acetamiprid for Aphid Control



- **Best used as a spray**
- **Has systemic activity in plant**
  - May kill through ingestion or contact
- **Extended residual activity**
  - May kill aphids for days-week?
  - Fairly conservative of natural enemies

# Comparison of UV Stability among Neonicotinoid Insecticides



Data obtained from published EPA registration documents

# Acute Toxicity of Neonicotinoids to Adult Honey Bees (Oral LD50 – micrograms/bee)

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



## Aphid Control - Scenario Three

# Aphids Produce Spring Leaf Curls

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



# Horticultural Oils



# Dormant Oils?

May manage many spring aphid problems – *if they spend winter as eggs on the plant*

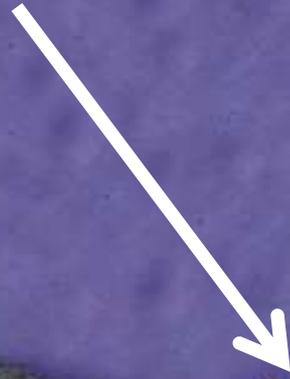


Oils can kill overwintering eggs of aphids. The application must cover the egg, which can then be killed by suffocation.



Aphid  
egg

**No overwintered egg  
– no stem mother**



**No overwintering egg, no spring leaf curl**

