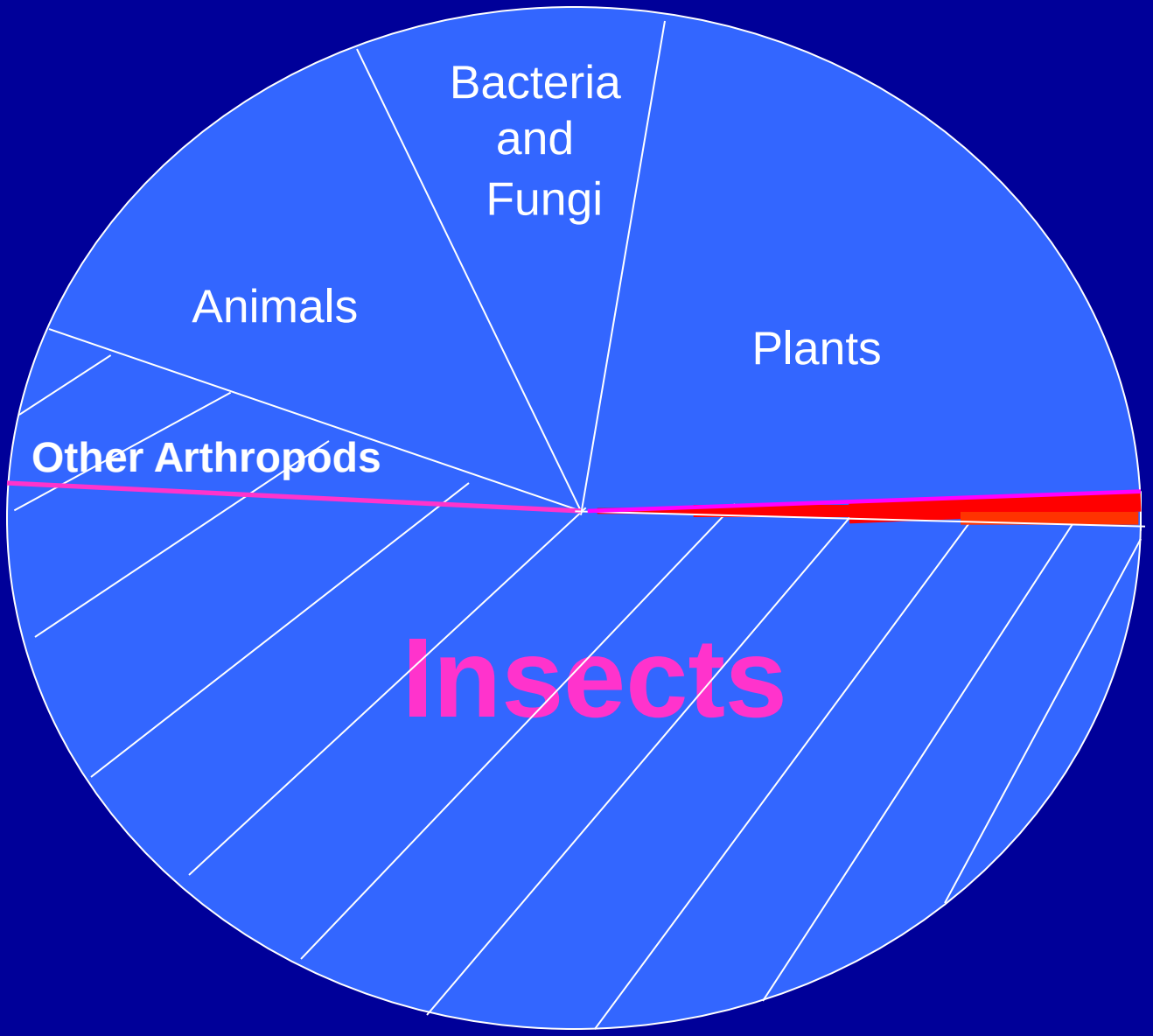
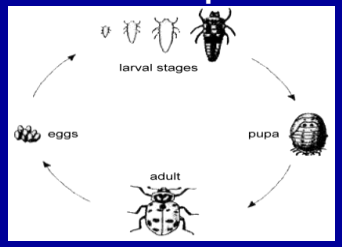
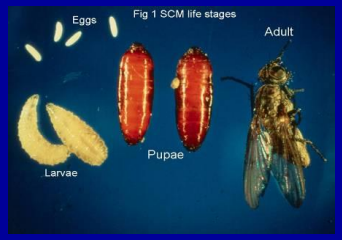
# Vegetable Pest Management

# Insects

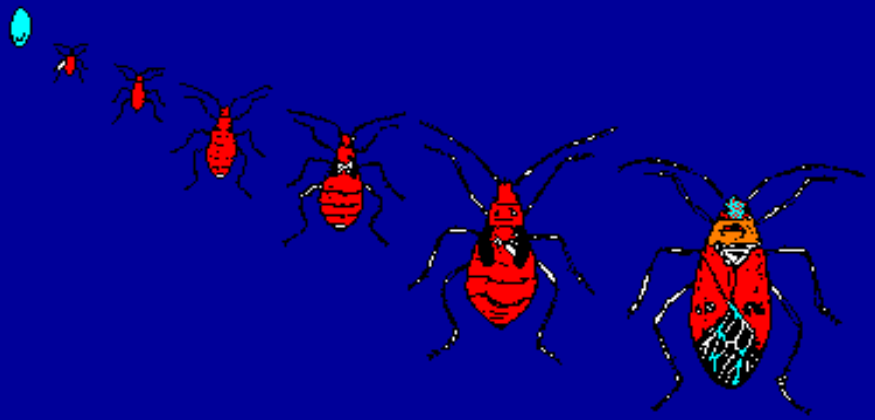

Bacteria
and
Fungi
Animals
Plants
Other Arthropods
Insects

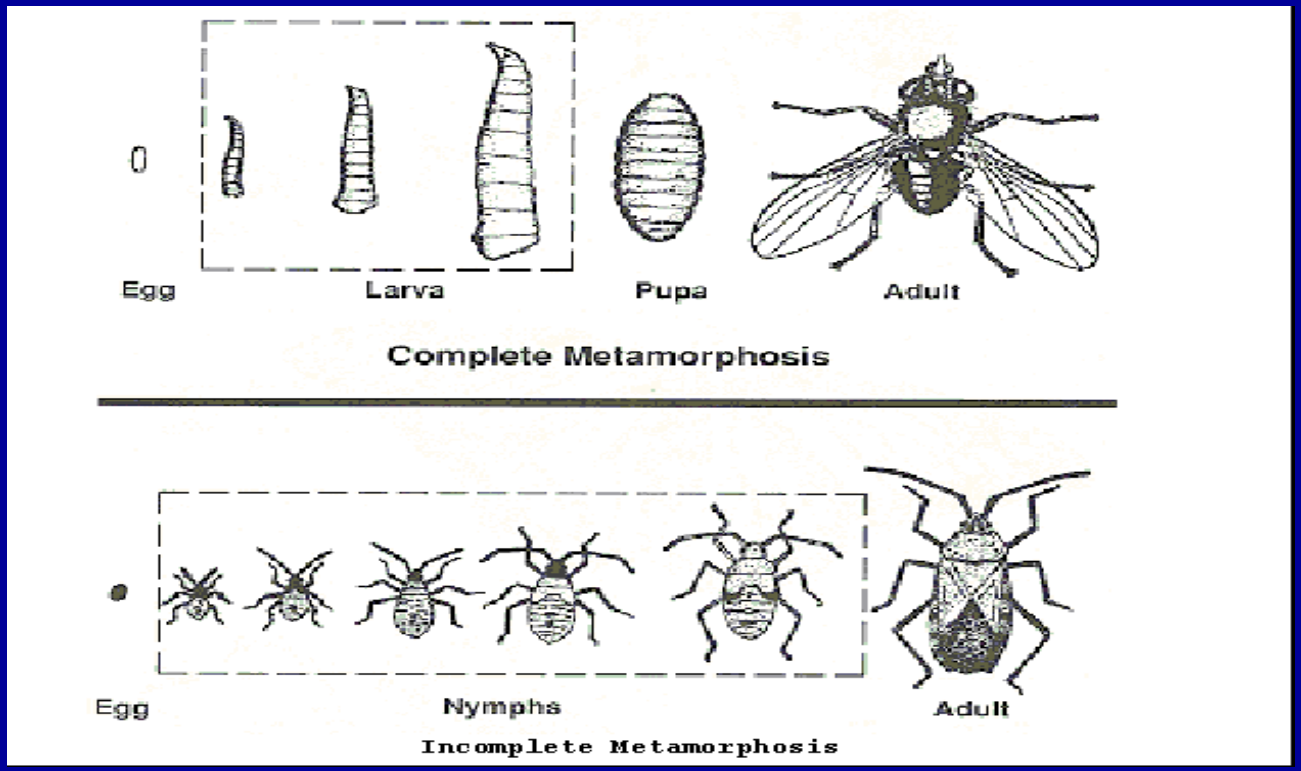
# Metamorphosis: Complete



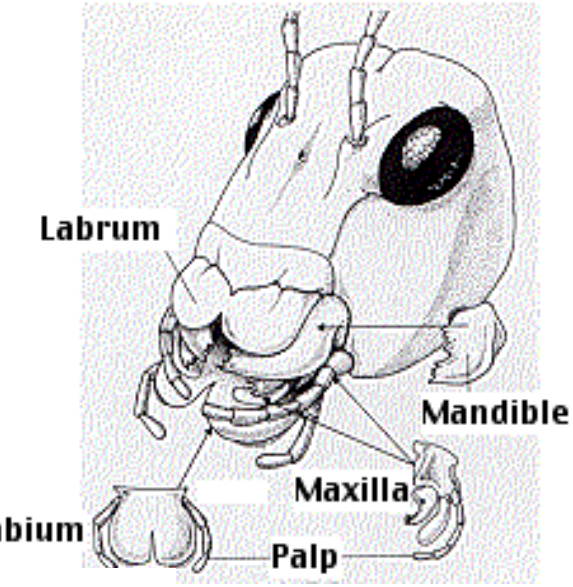

# Metamorphosis: Incomplete



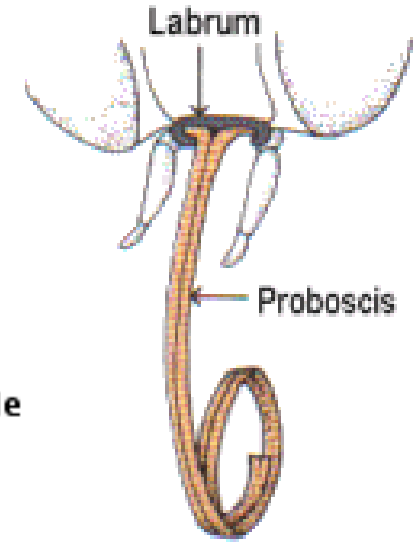


# Exoskeleton

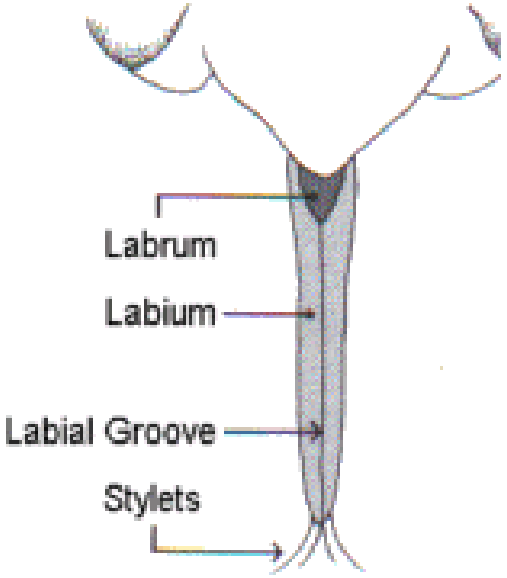
# Mouthparts



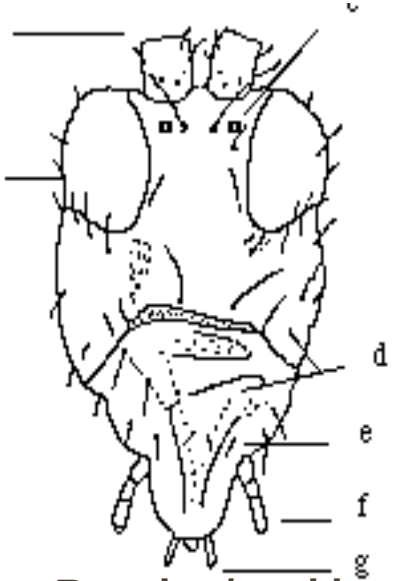

**Chewing**
**(Beetle)** (caterpillars)




**Sucking**
**(Butterfly)**




**Piercing-Sucking**
**(Bug)**



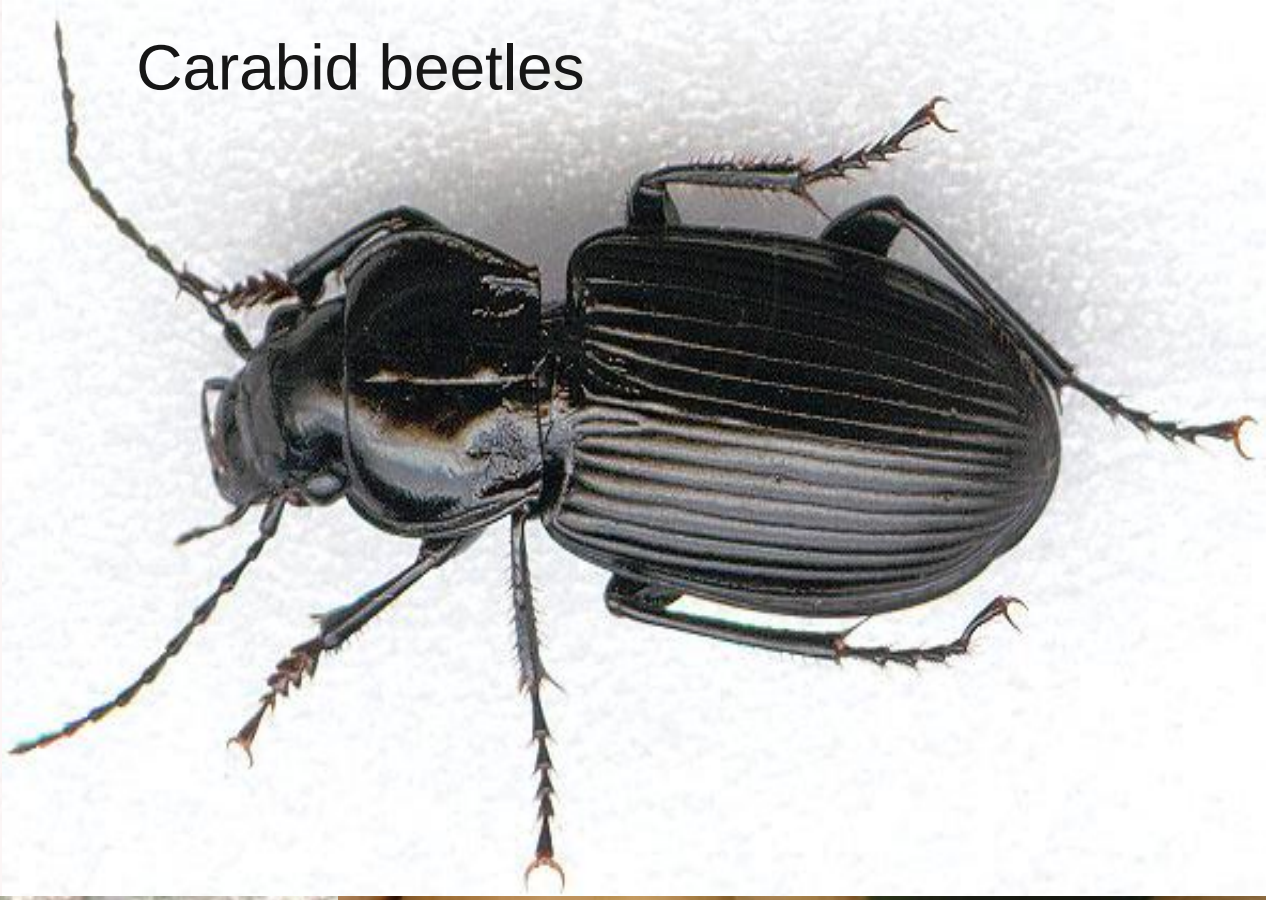

**Rasping/sucking**
**(Thrips and mites)**


Stippling of foliage from thrips feeding, also can look like mite feeding

# Natural Enemies

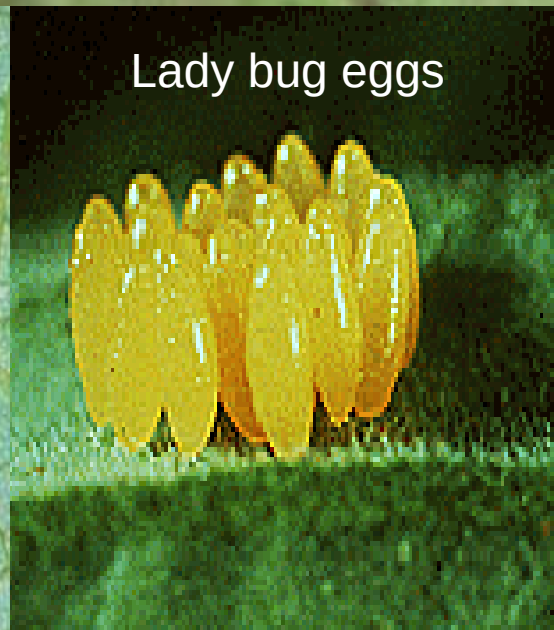
of insect pests

# Carabid beetles



# Carabids like mulched areas

# Lady bug larva


Lady bug eggs

Lacewing eggs

# Lacewing adult

# Lacewing larva


G254-37

# *Orius insidiosus* - insidious flower bug

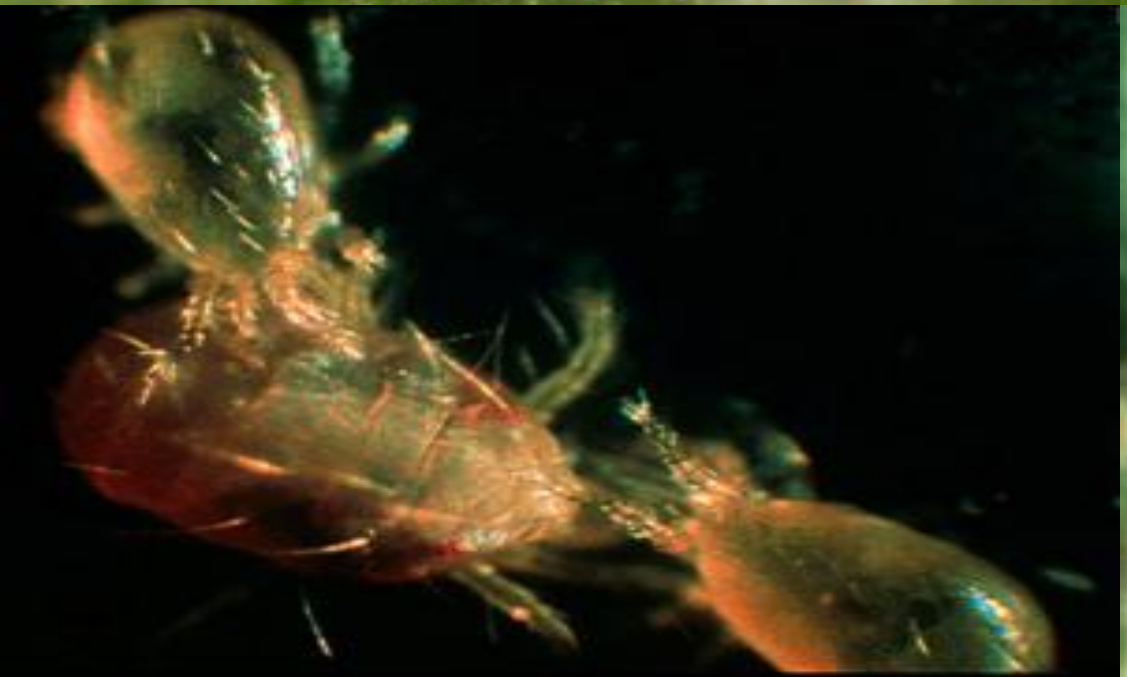

Syrphid fly adult

# Syrphid fly adult

Syrphids look like bees and wasps

Syrphid fly maggot

# Predatory Mites



# Tachinids

Tachinid eggs are always laid on the outside of host
Look for something that looks like rice stuck to sides of caterpillar

Another type of Tachinid fly

**Tachinid larva inside stink bug adult**

# Parasitoids come in many shapes and sizes

These brown bloated aphids have been parasitized by a wasp


Wasp lays egg inside aphid host

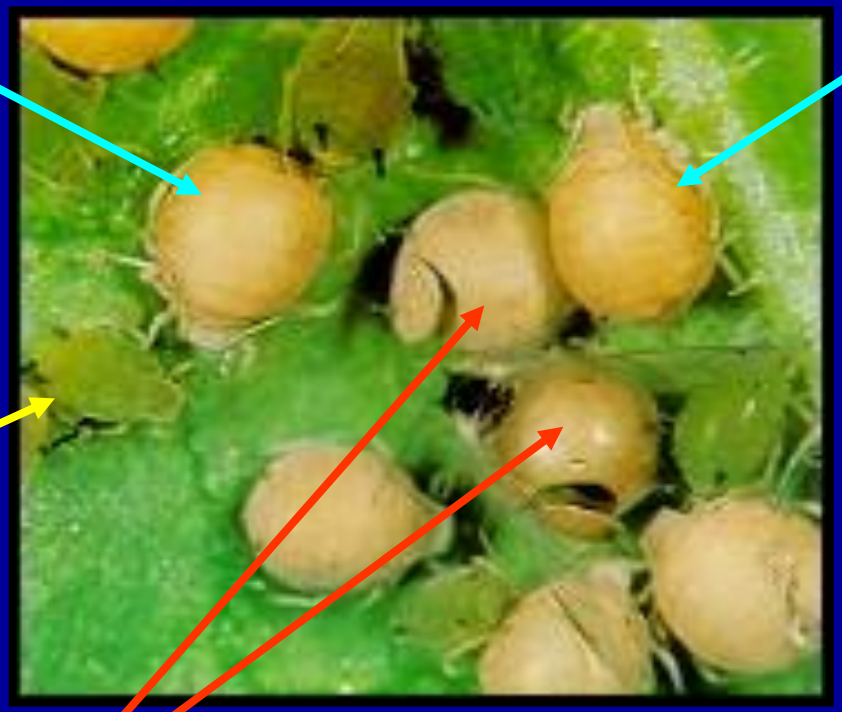
# The egg hatches and the little wasp eats the aphid from the inside out

When ready it pupates inside the aphid's old skin and emerges from the pupa and cuts a hole in the aphid skin with its jaws

It pushes the cut flap back and emerges and starts to lay eggs on other aphids. Can lay 50-150 eggs


Size of parasitized aphid

What are blue lines pointing to?
What are red lines pointing to?
What is yellow line pointed to?




A mix of flower types are good to have to bring these natural enemies into your garden or field.

# Mulch will attract soil dwelling predators

| Synthetic Chemical Controls | | | | |
|---|---|---|---|---|
| | Product Name | Active Ingredient | Controls | Poor control of |
| 1 | Baythroid, or Decis<br><br>Sevin | Cyfluthrin or Deltamethrin<br><br>Carbaryl | Caterpillars, Japanese beetle, most beetles, flies, fleas, ants, wasps, stinkbugs, flea beetles, leaf beetles (i.e. asparagus, cucumber beetles, etc.) | Aphids, scales, leaf miner, seed corn maggot |
| 2 | Warrior | Lambda cyhalothrin (pyrethroid) | As in no. 1 + thrips | Same as no. 1 |
| 3 | Ambush, Mustang, Pounce | Pyrethroid | As in no. 1 | As in no 1 |
| 4 | Capture | Bifenthrin (pyrethroid) | As in no. 1 | As in no. 1 |
| 5 | Admire, Provado, Cruiser, Poncho, Assail, | Imidacloprid other neonicotinoids Thiamethoxam Clothianidin Acetamiprid | Aphids, scales, beetles- Japanese beetles and their grubs | Thrips, stinkbugs |

## Organic Chemical Controls

| | Product Name | Active Ingredient | Controls | Suppresses | Reported to suppress |
|---|---|---|---|---|---|
| 1 | Neemix | Azadirachtin, Neem oil | | Beetles, caterpillars | Most insects and mites |
| 2 | Entrust | Spinosad | Thrips, some beetles-CPB, most caterpillars | | |
| 3 | Various names | garlic tea or garlic/pepper tea, lemon juice | | Some beetles, caterpillars | Aphids, mites |
| 4 | Dipel, or Xentari | *Bacillus thuringiensis kurstaki* or *aizawa* | Caterpillars--very good control of many species | Large caterpillars | |
| 5 | ------- | Diatomaceous Earth | | Fleas, aphids | |
| 6 | Safer Soap | K fatty acids | | aphids, mites small caterpillars | |
| 7 | Pyrenone Crop Spray | Rotenone and/or pyrethrum | | Japanese beetles, some caterpillars, aphids | True bugs |
| 8 | Surround | Kaolin clay | Aphids, mites, worms, thrips | True bugs | |
| 9 | Horticultural Oils | Dormant (trees, shrubs)<br><br>horticultural or summer oil (use during season) | Scales, aphids<br>Aphids, mites<br>Mealy bugs | Thrips, small caterpillars | |
| 10 | Botanigard | Beauveria bassiana | Aphids, mites, small worms | | |


Kaolin clay sprayed on one cucumber, but not the other.
Clay acts as a physical barrier. If mixed with pyrethrum
it works even better to keep pests from feeing on plants

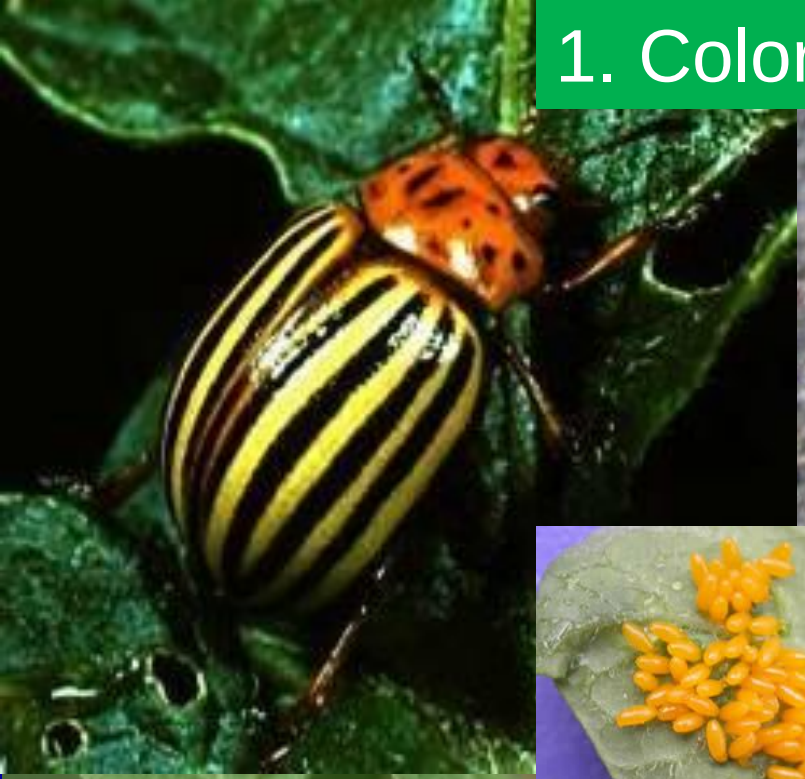
| Product Name | Chemical Name | How it works | What it controls |
|---|---|---|---|
| Confirm, Intrepid | tebufenozide, methoxyfenozide | IGR – ecdysone agonist causes a premature lethal molt. Mostly through ingestion, some contact, feeding ceases in 24 hrs, death in 2-3 days | Small Lepidoptera larvae (worms or caterpillars) such as armyworms, beet AW, tomato fruit worm, loopers, hornworm, |
| Spintor | Spinosad | Microbial metabolite-- fermentation product (interferes with nicotine-like receptors in nerve endings) of soil bacteria-Actinomycetes | Lepidoptera larvae, leaf miners, certain thrips species, Colorado potato beetle |
| Fullfill | Avermectins-emamectin benzoate Pymetrozine | Microbial metabolite, Mostly through ingestion. Disruption of nerve impulses causes paralysis in hours, death in days<br>Stops aphids from feeding quickly after initial contact. Aphids may remain alive for days, but don't feed. Translaminar and systemic | Lepidoptera larvae<br>Aphids, some activity on whiteflies |
| Avaunt | Indoxacarb | Inhibits $Na^+$ entry into nerve cells, paralysis and death 6-48 hours. Contact and ingestion | Lepidoptera larvae, beet AW, diamond back moth, fruit worms |
| Courier, Applaud | Buprofezin | IGR – Chitin synthesis inhibitor, contact and ingestion | White flies, leaf hoppers |
| Agri-Mek | Avermectins | Fermentation product of soil bacterium *Steptomyces avermitilis*, via ingestion. Inhibits signal transmission at neuromuscular junctions | Colorado potato beetle, mites, thrips, some Lepidoptera larvae |
| Knack | Pyriproxyfen – slow acting | IGR- Jh mimic<br>sterilizes whitefly adults and eggs | Lepidoptera larvae, good on large beet armyworms |
| Rimon | Novaluron | IGR – chitin inhibitor, enters via ingestion | Immature: Whitefly, thrips, some Lept larvae |
| Oberon | Spiromesifen | Tetronic acid derivatives interfere with lipid biosynthesis | Mites, whiteflies |
| Admire, Provado Actara, Platinum, Assail | Imidacloprid Thiamethoxam-neonicotinoids | Interferes with nerve endings, keeps nerve receptor channels open | Sucking insects, Colorado potato beetle, beetles, other chewing insects |
| Agree, Cutlass, Deliver, DiPel, Javelin, XenTari | *Bacillus thuringiensis kurstaki, aizawa* | Protein toxin attaches to gut of insect causing rupture and death in 24-48 hours | Many Lepidopteran larvae such as hornworm, cabbage looper, fruitworm, armyworms |

| Crop | Pest | Organic Control | Reduced Risk | High Risk |
|---|---|---|---|---|
| Tomato Pepper Eggplant Potato | Worm/Army worm complex - Beet, cut, pm, tree, hornworm B,RR,Ch | Bt or Entrust | Spintor/Bt | Pyrethroids |
| | Colorado Potato Beetle C, RR,Ch | Entrust | Spintor/ Neonicotinoids | Agrimek |
| | Stinkbug Ch | Poor controls, soap, pyrethrum | Poor controls | Pyrethroids |
| | Thrips B,RR, Ch | Entrust, Soaps, hort oil | Spintor | Pyrethroids |
| | Flea beetles Ch | Soaps, hort oil, poor control | Neonicotinoids | Pyrethroids |
| | Aphids B, RR, Ch | Soaps, hort oil, biocontrol | Neonicotinoids | Thionex, Orthene |
| | Leafminer B, RR, Ch | Biocontrols, soaps | Spintor | Trigard/Agrimek |
| | Mites C, B, RR, Ch | Soaps/hort oils | Oberon | Pyrethroids/Kelthane |
| Pumpkins Squash Cantaloupe Watermelon Cucumber | Worm/Army worm complex -pickle, melon, vineborer, looper, cut | Bt or Entrust | Spintor/Bt | Pyrethroids, Carbaryl (Sevin) |
| | Cucumber beetle RR, Ch | Difficult to control – trap crop, screen mesh out crop | Neonicotinoid drench | Neonicotinoid drench/pyrethroids, Sevin |
| | Seed corn maggot Ch | Screen mesh over crop, plant later into season | Plant when ground is warmer | Lorsban seed treatment |
| | Aphids – green peach/ melon B, RR, Ch | Soaps/hort oils | Neonicotinoids/ Pymetrozine | Thionex |
| | Squash bug ~C, Ch | Difficult control – biocontrol | Neonicotinoid drench | Pyrethroids/Sevin |
| | Thrips B, RR, Ch | Soaps, hort oils | Spintor | Pyrethroids |
| | Mites C, B, RR, Ch | Soaps, hort oils | Oberon | Pyrethroids/ Kelthane |
| Cabbage Broccoli Cauliflower | Worm complex – cabbage looper, diamondback moth, cabbage worm | Bt or Entrust | Spintor/Bt | Pyrethroids |
| | Flea beetles | Soaps/hort oils – poor control | Foliar neonicontinoids | Pyrethroids |
| | Aphids | Soaps/hort oils – biocontrol | Neonicontinoids/ pymetrozine | Orthene |
| Lettuce Endive Escarole | Worm Complex | Bt/Entrust | Spintor/Bt | Pyrethroids |
| | Leafhopper | Difficult, screen over crop | Neonicotinoid drench | Pyrethroids/Thimet |
| | Aphids | Soaps, hort oil – biocontrol | Pymetrozine, Neonicotinoids | Thimet/Orthene |
| | Tarnished plant bug C, Ch | Difficult to control | Difficult to control | Pyrethroids/Sevin |

# Top 10 Insect Pests for Vegetables

1. Description, damage, life cycle, etc. of pest
2. Cultural Management
3. Organic Management
4. Synthetic Management

# 1. Colorado potato beetle



## Cultural

- Rotate away from solanaceous crops
- Use straw mulch around plants

## Organic

- Entrust
- Kaolin clay
- Btt-*Bacillus thuringiensis tenebrionis*

## Synthetic

- Pyrethroids
- SpinTor
- Abamectin
- Neonicotinoids

# 2. Caterpillars


UM Extension


5368088

## Cultural

- Use straw mulch around plants
- Sweet corn-plant early as possible
- Use corn earworm pheromone trap >10/night

## Organic

- Entrust
- Bt-*Bacillus thuringiensis*
  *Bt aizawai*
  *Bt kurstaki strain HD-1*
- Kaolin clay applied to ‘tomato’ plant not fruit

## Synthetic

- Pyrethroids
- SpinTor
- Lannate
- Coragen

# 3. Thrips and Spider mites

# *Orius insidiosus* - insidious flower bug


Thrips Predator Mite

## Cultural

- Make sure plants not heat stressed
- Use straw mulch around plants
- Heavy water-spray application - wash off

## Organic

- Entrust-thrips ONLY
- Hort oils, soaps-both
- K-clay

## Synthetic

- Pyrethroids-both**
- SpinTor-thrips only
- Abamectin-mites only
- Neonicotinoids-thrips only
- Spiromesifen-mites only

# 4. Aphids


UC Statewide IPM Project
© Regents, University of California

## Cultural

- Non stressed plants
- Use straw mulch around plants
- Reflective mulch

## Organic

- Hort oils, soaps
- K-clay

## Synthetic

- Neonicotinoids
- Pyrethroids
- Pymetrozine

# 5. Flea beetles

## Cultural

- Floating row covers
- Trap cropping-radish and mustard greens
- Crop Rotation
- Yellow sticky traps

## Organic

- Hort oils, soaps
- Pyrethrums + K-clay

## Synthetic

- Neonicotinoids
- Pyrethroids

# Row Covers

# Trap crops

# Sticky traps

# 6. Stink bugs and Harlequin bug

# Stinkbug damage

# Harlequin bug damage


# BMSB damage to fruit and vegetables

## Cultural

- Floating row covers

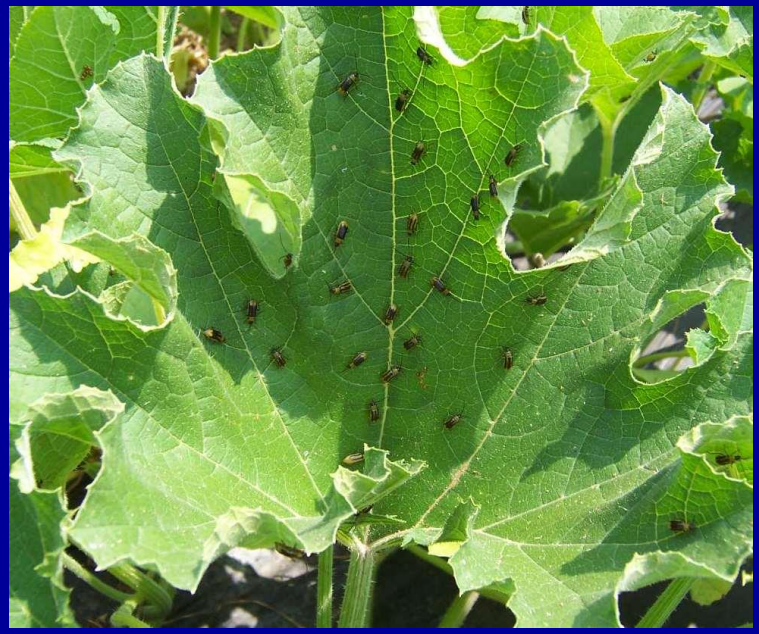
## Organic

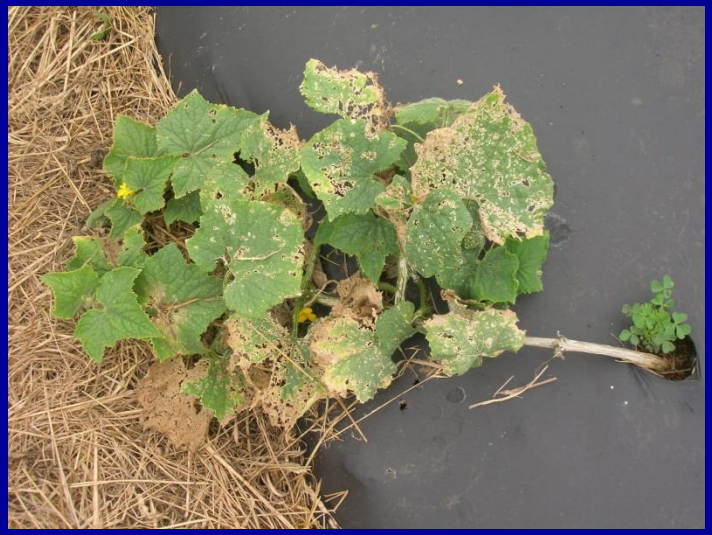
- Pyrethrums and
- K-clay + Pyrethrums

## Synthetic

- Neonicotinoids+Pyrethroids
- Pyrethroids

# 7. Striped cucumber beetle






G Brust

## Cultural

- Floating row covers
- Trap cropping

## Organic

- Pyrethrums
- Py + K-clay

## Synthetic

- Neonicotinoids
- Pyrethroids

# 8. Squash bug

## Cultural

- Floating row covers
- Trap cropping

## Organic

- Pyrethrins or Py + K-clay directed at base of plant- early season

## Synthetic

- Pyrethroids
- Carbaryl
- Neonicotinoids

# 9. Squash vine borer

## Cultural

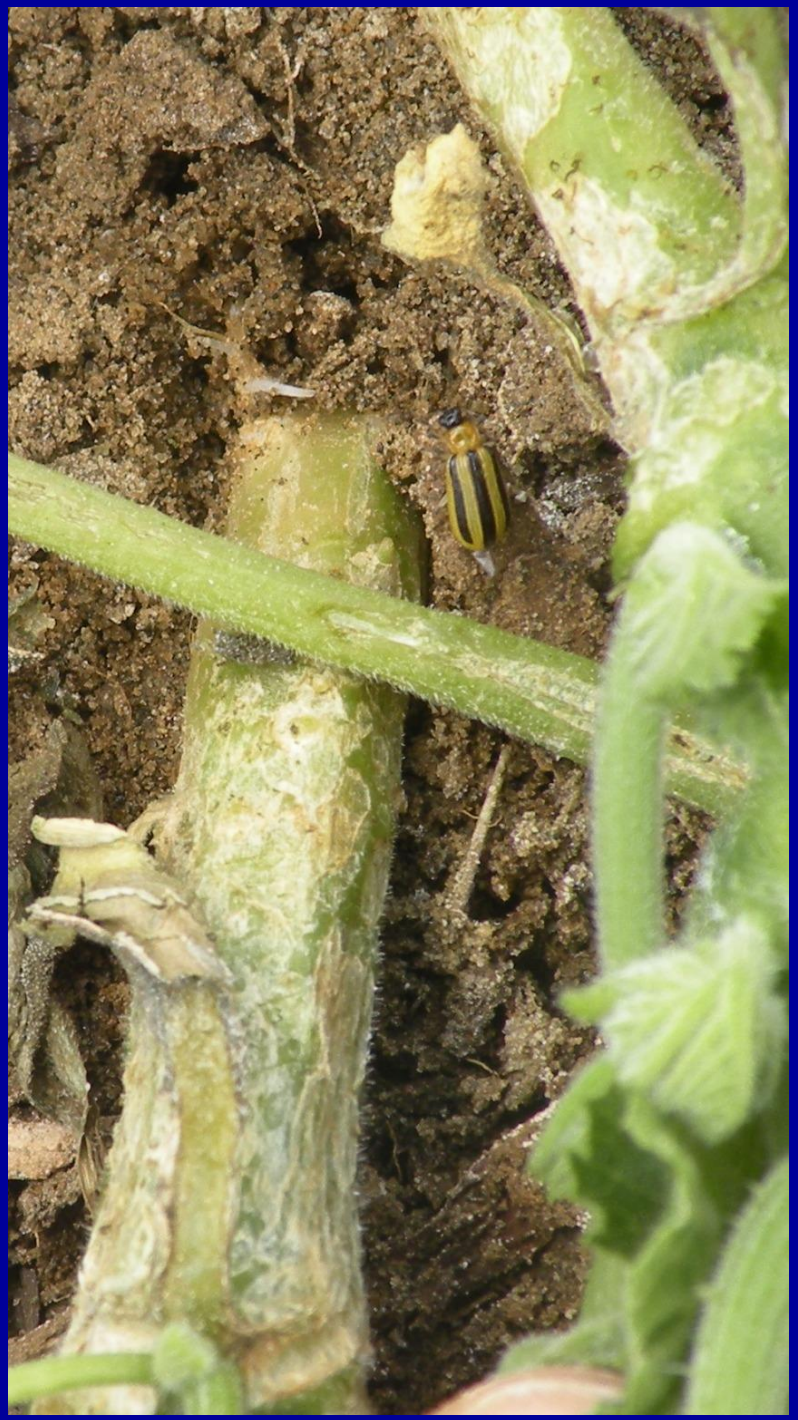
- Floating row covers
- Pheromone trap monitoring
- Cover 1st 12 inches of vine

## Organic

- Pyrethrums or Py + K-clay directed to base of plant

## Synthetic

- Pyrethroids directed at base of plant



# 9. Mexican bean beetle and bean leaf beetle

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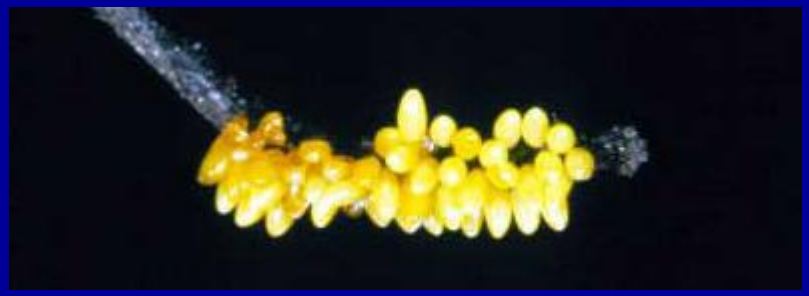
©MARLIN E. RICE



***Pediobius foveolatus***

# Cultural

- Floating row covers
- Hand-pick
- Clean-up debris
- Several varieties of bean show some level of tolerance.  They are: Wade, Logan, and Black Valentine.

  Beans very susceptible are the State, Bountiful, and Dwarf varieties.

Organic

- Pyrethrums

Synthetic

- Pyrethroids

# 10. Seed corn maggot and Pickleworm/Melonworm

## Cultural

- Floating row covers-Both; off during day on at night - worms Cover early season for SCM; later season for worms
- Plant after soil warms (70º F)-SCM
- Manure and decomposing cover crop attract flies-till in 3-4 weeks before planting-SCM

## Organic

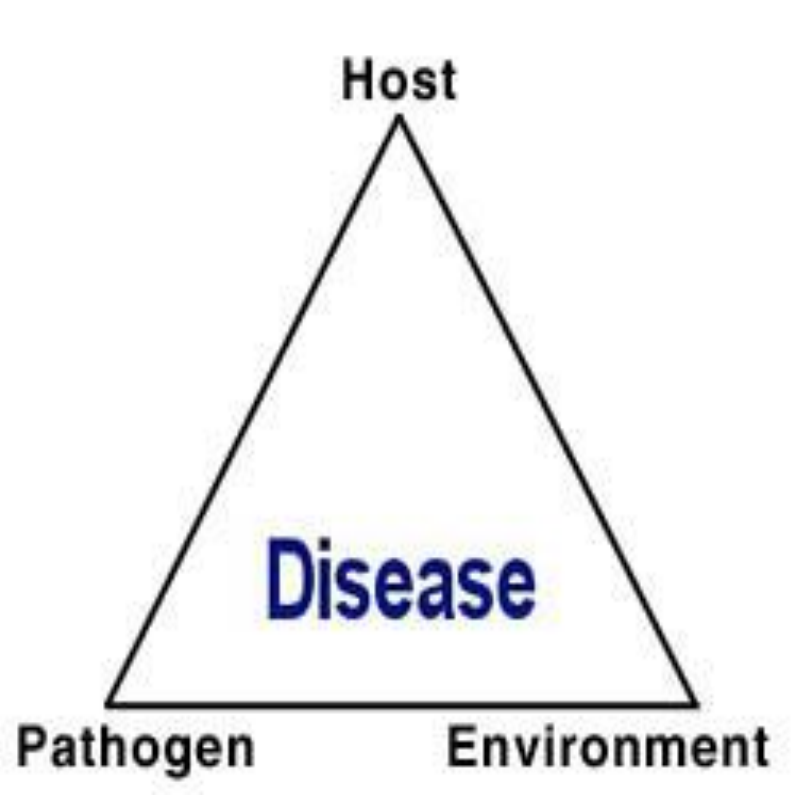
- *Pyrethrums or diatomaceous earth directed to base of plant before damage is observed*-SCM
- Pyrethrums at flowering-worms

## Synthetic

- *Pyrethroids directed at base of plant-SCM*
- Pyrethroids at flowering - worms

# Plant Diseases

# The Disease Triangle




Successful disease management strategies are aimed at managing these three components

# Plant Diseases

**Pathogens – living agents**

- Fungi
- Bacteria
- Viruses
- Nematodes

**Non-living agents:** cold, heat


Know your crop

- Optimum growing conditions
- Common diseases

Know biology of pathogens

- How pathogen spreads
- Environmental requirements

# General Management Strategies

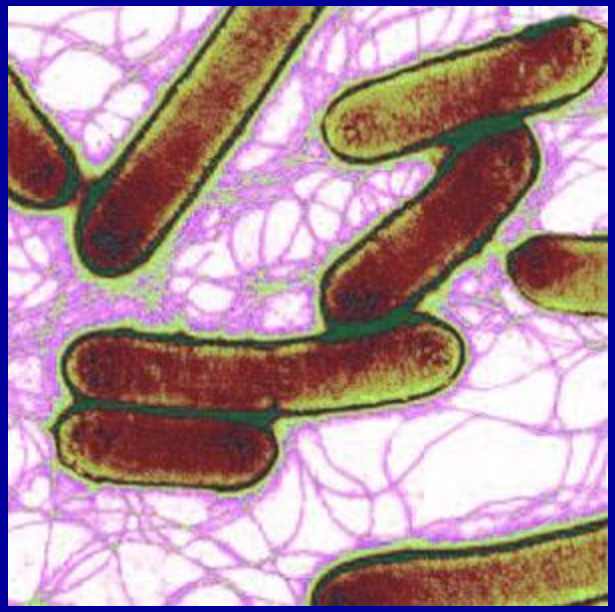
Resistance

Sanitation and Eradication

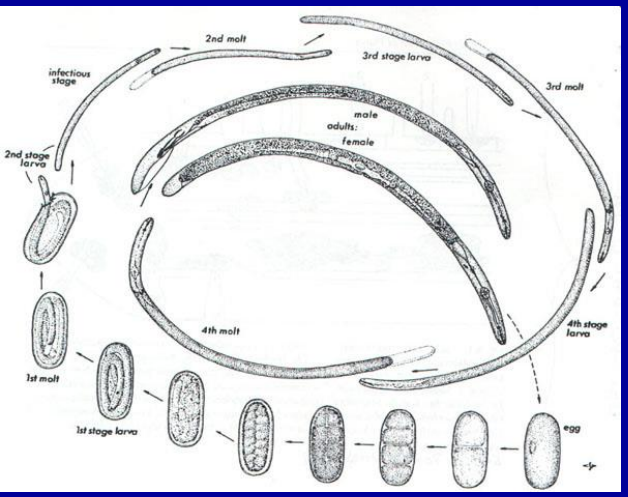
Environmental Modification

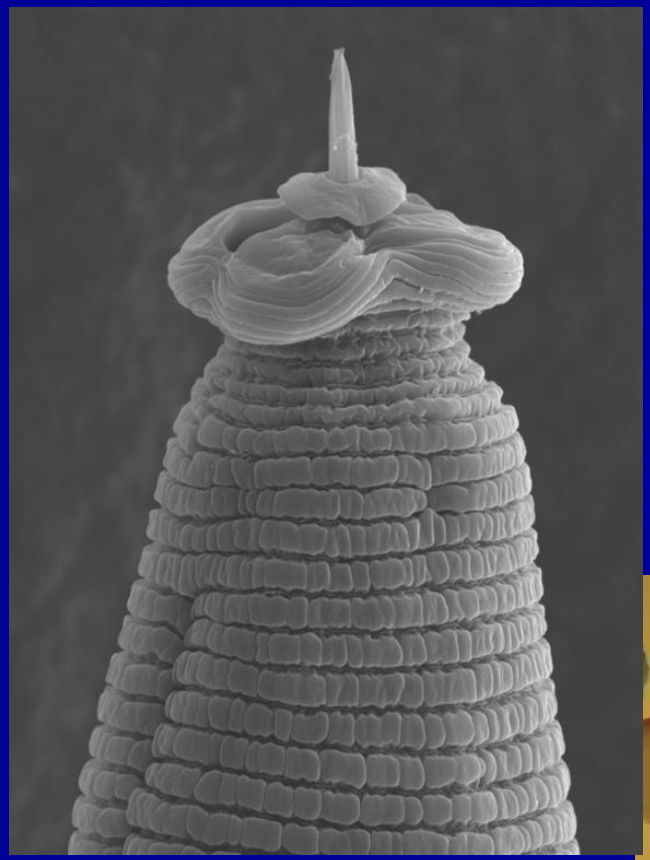
Cultural Modification

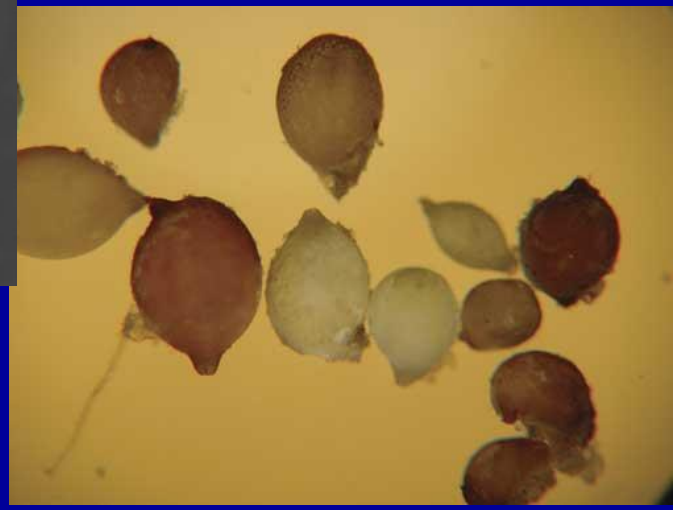
Pesticide Application



# Plant Parasitic Nematodes






Predatory Nematode
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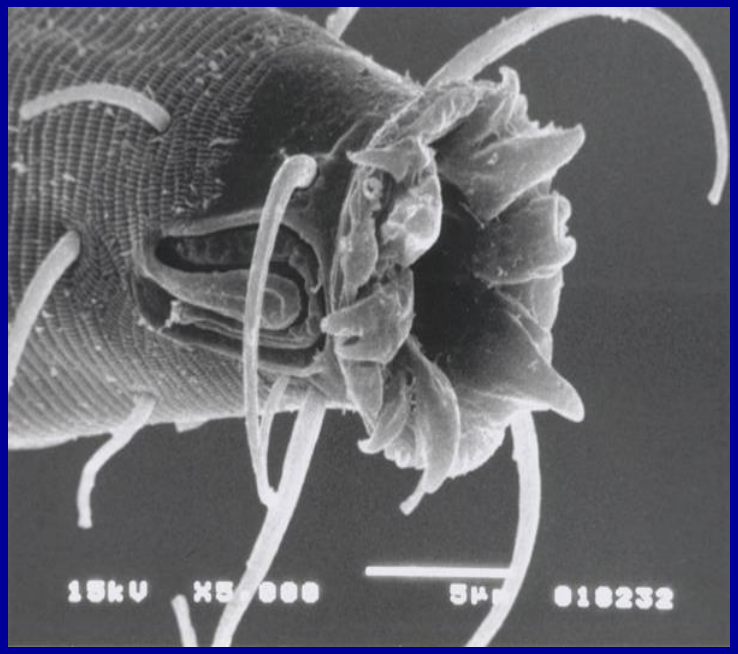
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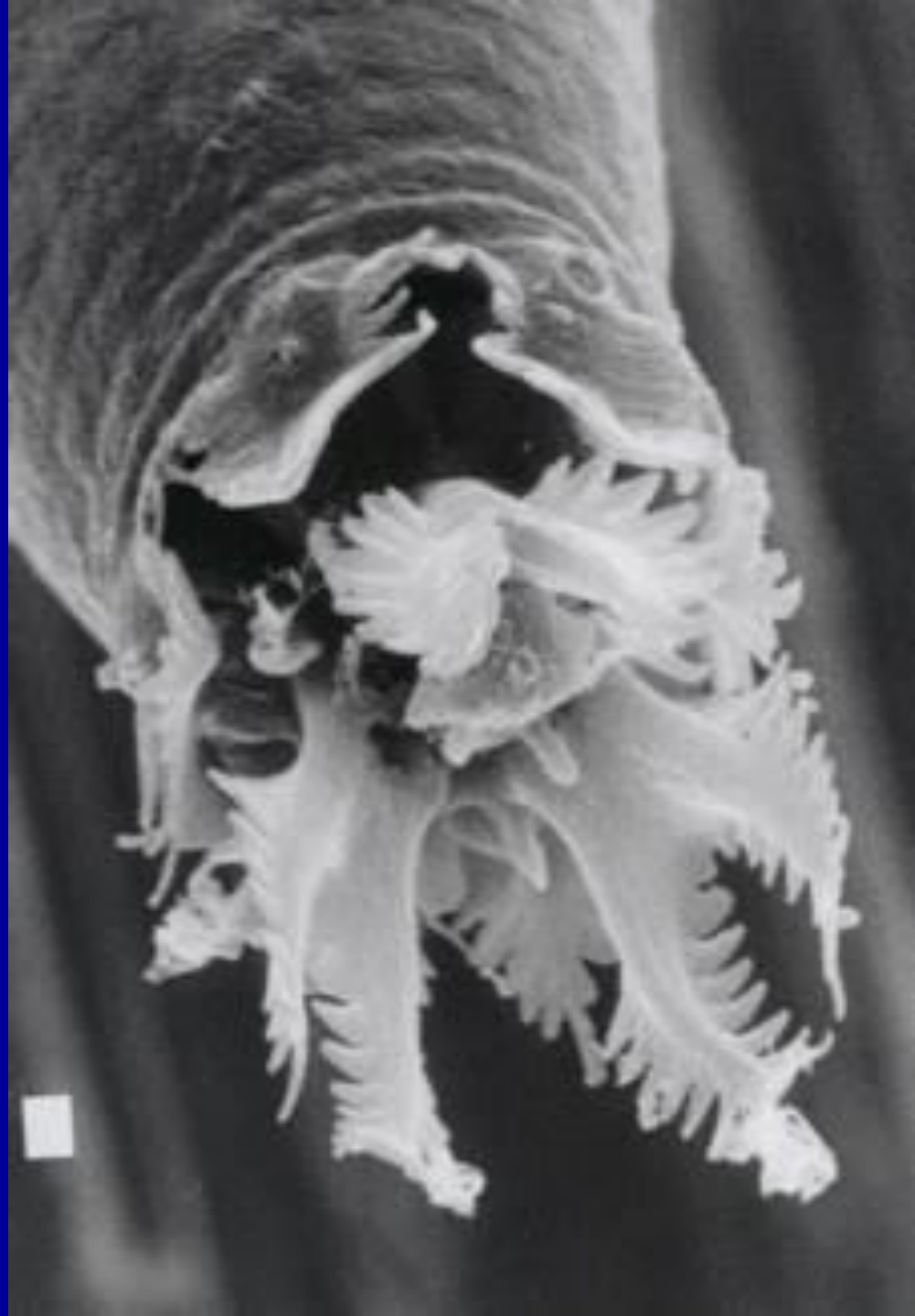
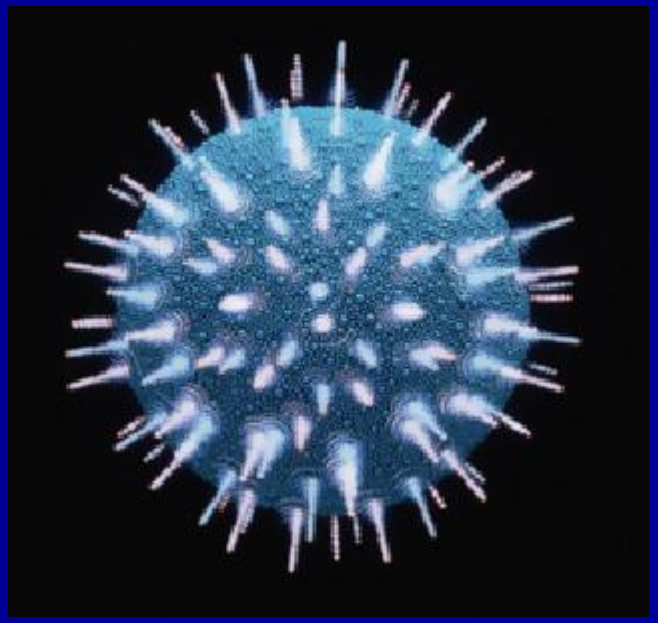
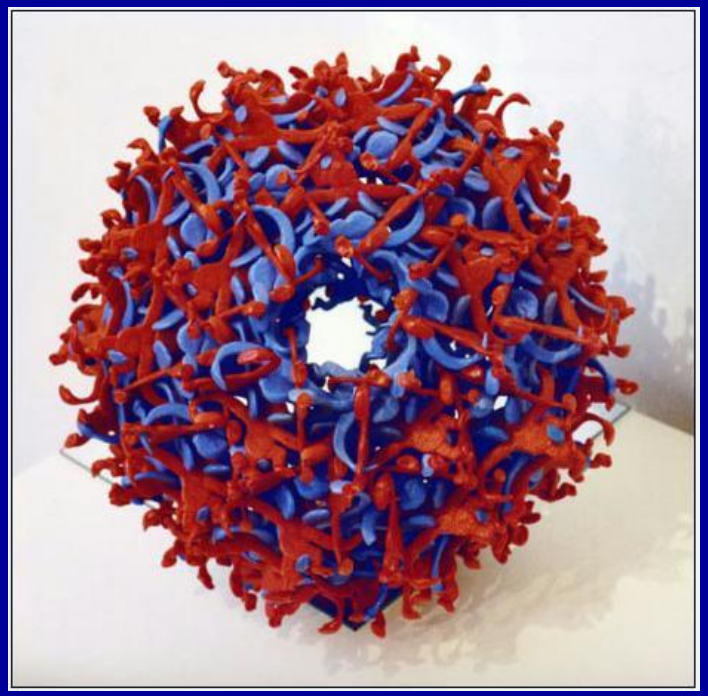


# Viruses and Phytoplasmas





# 1. Alternaria, Septoria leaf spots

## Cultural

- Rotation
- Keep foliage dry as possible
- Destroy plant residue
- Tolerant varieties- Mt: Fresh, Belle, Supreme, Pride, Gold

## Organic

- Oxidate applied to foliage
- There are biopesticides available

## Synthetic

- Chlorothalonil rotated with Quadris or Endura

# 2. Phytophthora blight, wilt




S.A. Johnson, Rutgers


© G. J. Holmes

| Host | Plant part affected |
| --- | --- |
| Pepper, especially bell and cherry types; also many pungent types | Blight (foliar phase); damping off, crown rot, root rot, fruit rot Damping off |
| Tomato, all types; some varieties differ in susceptibility | Buckeye fruit rot Phytophthora root rot |
| Eggplant | Phytophthora fruit rot; also collar rot and stem canker |
| Cucurbits: | |
| Summer squash | Phytophthora root rot stem and leaf collapse |
| Winter squash (Butternut, Hubbard, etc.) and pumpkins (small and large types); cucumber and watermelon | Phytophthora fruit rot Phytophthora blight |

## Cultural

- Crop rotation-2-4 years with grain or crucifers
- Avoid wet areas, create a crown in bed
- Break up hard pans-increase drainage
- Prevent soil splash
- Select resistant varieties-pepper Paladin, Aristotle and Revolution

## Organic

- See above

## Synthetic

- Mefenoxam* (Ridomil Gold, Ultra Flourish), mixes of mefenoxam and copper hydroxide (Ridomil Gold/copper), famoxadone plus cymoxanil (Tanos), zoxamide plus mancozeb (Gavel), or copper plus maneb

# 3. Late blight

## Cultural

- Rotation
- Destroy plant residue-sanitation
- Destroy volunteer plants

## Organic

- Oxidate applied to foliage-poor

## Synthetic

- Chlorothalonil or mancozeb rotated with Curzate or Forum or Ranman or Revus

# 4. Bacterial spot and speck

## Cultural

- Rotation-2-3 years to non solanaceous crops
- Destroy plant residue-sanitation

## Organic

- Copper applications
- Oxidate applied to foliage-poor

## Synthetic

- Actigard or fixed copper and mancozeb or ManKocide or Cuprofix MZ
- Streptomycin on transplants only

# 5. Powdery and Downey Mildews

Different races of both

## Cultural

- Reduce overhead watering-PM, DM
- No late season N additions-PM
- Do not compost infected leaf material-PM
- Resistant or tolerant cultivars-PM, DM
- http://cdm.ipmpipe.org/ -DM

## Organic

- Oxidate applied to foliage-poor

## Synthetic

- PM – chlorothalonil + Rally or Folicur or Procure
- DM – chlorothalonil + Presidio or Ranman or Tanos

# 6. Fruit Rots



## Cultural

- Good field drainage
- Clean seed
- Keep fruit from contacting soil
- Do not over apply nitrogen
- Destroy crop residue

## Organic

- Oxidate applied to foliage/fruit - very poor

## Synthetic

- Chlorothalonil + Revus or Presidio or Gavel or Ranman or Tanos or Forum

# 6. Fusarium and Verticillium Wilts

## Cultural

- Rotation-4-6 years to non solanaceous crops and if VW no straw- or raspberries, no weeds
- Destroy plant residue-sanitation
- Resistant tomato cultivars-for races 1, 2 ,3, but few other vegetables have resistance

## Organic

- Use cover crops to reduce incidence of fusarium

## Synthetic

- Soil Fumigation

# 7. Gummy stem blight


## Cultural

- Rotation-3 yrs no cucurbits
- Use clean seed
- Destroy crop residue

## Organic

- Oxidate applied to foliage – moderate - poor

## Synthetic

- Do not use FRAC 11 group-Cabrio, Quadris
  Use: Chloro + Pristine or Switch or Folicur or Inspire Super

# 8. Viruses and Bacterial wilt

# 9. Damping-off

*Rhizoctonia solani*, *Pythium* spp., *Phytophthora* spp., *Sclerotinia* spp., and *Botrytis* spp.

## Cultural

- Plant seed in warm soil
- Do not over water
- Use clean seed

## Organic

- Mycostop: *Streptomyces griseoviridis*
  Plantshield: *Trichoderma harzianum* strain T-22
  Both colonize plant roots to provide preventative biological protection

## Synthetic

- Use treated seed
- Use in a band-mefenoxam or metalaxyl

# 10. Root knot nematode

## Cultural

- Fallowing-no crop or weed for 3-5 months
- Crop rotation to broccoli, cauliflower
- Resistant cultivars-VFN

## Organic

- Canola or brassicas as cover crops tilled under and allowed to sit for a few days-week

## Synthetic

- Soil fumigation
- Vydate

# Weeds

Physical

Chemical

# Physical:

- Hand Pulling
- Cultivating
  - Machine
  - Hand
- Smother-mulching
  - Organic
  - Plastic


Market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# Chemical Controls

# Cantaloupe

## Preplant Incorporated

Apply 1 gallon per acre Alanap 2SC as a preplant incorporated (2 inches) treatment before seeding or transplanting. Weed control may not be satisfactory on sandy soils with less than 1 percent organic matter.

*Apply 1 to* 1.5 gallons of Prefar 4EC *plus 1 gallon Alanap 2SC as a* preplant incorporated (2 inches or less) treatment.

# Preemergence

Apply 1 to 2 pints per acre Curbit 3E preemergence to control annual grasses and certain annual broadleaf weeds, including carpetweed and pigweed. Control of many other broadleaf weeds, including common lambsquarters, jimsonweed, morning glory, ragweed, mustard, and others may not be acceptable.

Dry weather following application may reduce weed control. Cultivate to control emerged weeds if rainfall or irrigation does not occur prior to weed emergence. DO NOT preplant incorporate. DO NOT apply under plastic mulch or tunnels. DO NOT use when soils are cold or wet. Crop injury may result!

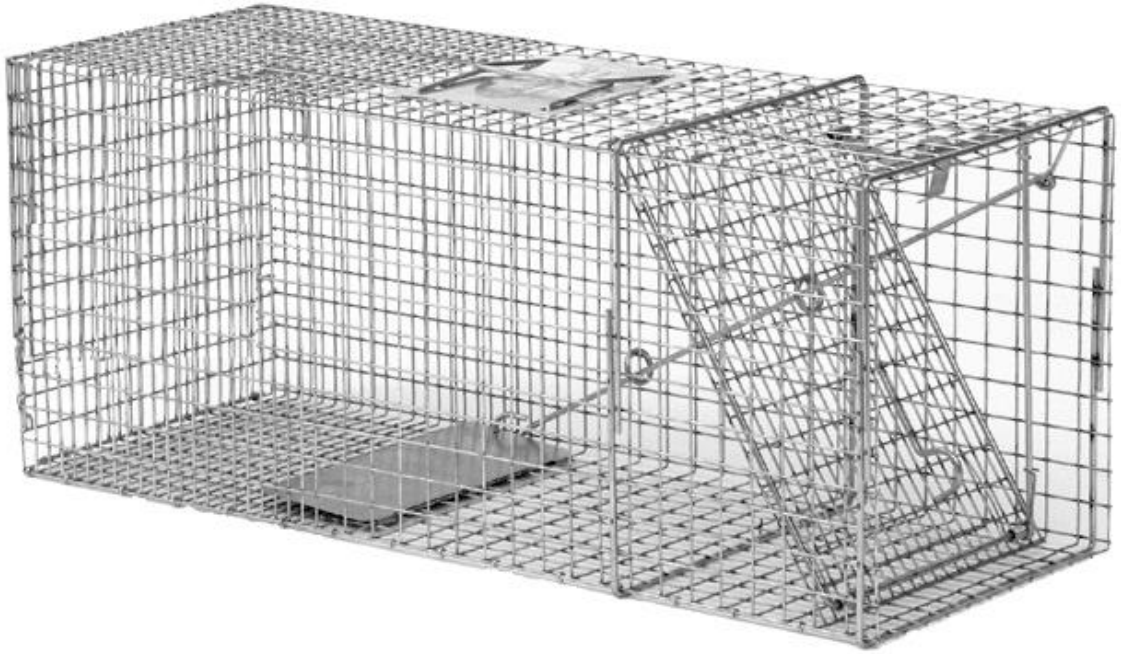
# Animal Pests

*Benner's Deer Fencing is a high-strength, wire fence-like mesh (1.75 inch) material constructed of UV stable black polypropylene plastic. This deer fence comes in rolls that are 7.5 feet high ... and provides long-term deer protection without changing the appearance of the property.*

*The ultimate installed height of the fencing is approximately 7'. Six inches of the plastic fence grid is "flared" out onto the ground away from the protected area to keep deer from pushing underneath the fencing.*

*When Benner's Deer Fencing is first installed, white flagging streamers (included) need to be temporarily tied to the fencing every 10 feet so the deer do not run right into it.*


MAKES 2.5 GALLONS!
SUPER LONG LASTING! MINTY FRESH SCENT!
100% NATURAL
DEER OUT
DEER REPELLENT
"WORKS GREAT SUMMER, SPRING, WINTER, AND FALL"
WON'T WASH OFF!



# Questions

UNIVERSITY OF MARYLAND EXTENSION

*Solutions in your community*

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http://extension.umd.edu/mdvegetables