Using Integrated Pest Management (IPM) in Vegetable & Fruit Gardens




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Topics

- Management srategies
- Components of IPM
- Overview of tactics *

Insect roles

- The bad
  - —Pests
- The good
  - —Natural enemies
  - —Pollinators
  - —Decomposers
- The neutral

Types of pests: based on damage

- Direct damage
- Indirect damage
- Disease transmission (vector)
- Contamination

Types of pests: based on frequency of occurrence

- Key pest
- Occasional, sporadic pest
- Rare pest
- Potential pest

Strategies of Pest Management

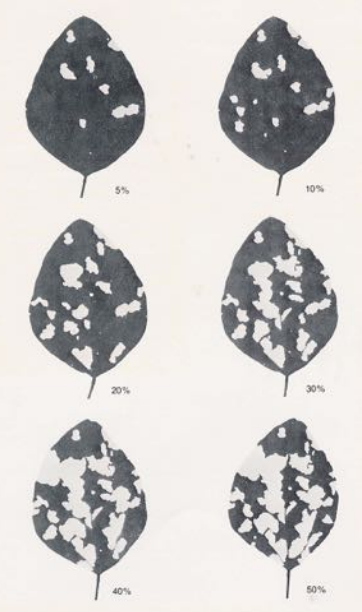
- **Acceptance (do nothing)**
- **Eradication**
  - —eliminate pest populations
- **Suppression**
  - —reduce pest to tolerable levels

Integrated Pest Management (IPM)

- a comprehensive approach to dealing with pests
  - strives to reduce pest status to tolerable levels
  - using multiple tactics
    - effective
    - economically sound
    - ecologically compatible

Components of IPM

- **Monitoring**
- **Action thresholds**
- **Multiple tactics**



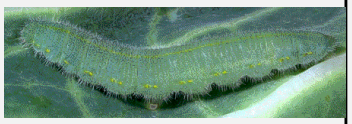
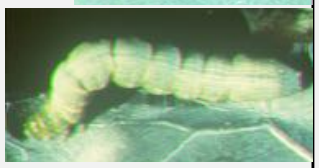
1) Monitoring

- **Techniques**
  - **—Scouting**
  - **—Knockdown**
  - **—Sweeping**
  - **—Trapping**

2) Action threshold

- **Pest density or amount of damage at which action should be taken to prevent an increasing pest population from causing economic damage**
- **More developed for farm crops than for garden crops**

Garden action thresholds: collards

Pest	*Threshold*	*Insecticide*	
		Natural	*Synthetic*
Flea beetles 	>5 beetle holes per leaf & >5 beetles per plant	pyreth-rins + PBO	carbaryl (Sevin)
Caterpillars: • Imported cabbageworm  • Diamondback moth  • Cabbage looper 	>1 larva/plant >2 larvae/plant >0.5 larva/plant	B.t. (DiPel)	esfenvale-rate (Bug-B-Gon)
Aphids 	>1 colony/leaf	soap	endosulfan (Thiodan)

3) Multiple tactics

IPM uses combination of tactics:

- **Mechanical**
- **Cultural**
- **Biological**
- **Microbial**
- **Chemical**

3) Multiple tactics

- Preventive options
- Remedial options

Do chemicals fit in IPM or not?

IPM Continuum

No Chemicals

Intensive Chemicals

Approaches to pest management by suppression: Organic *vs* other

- More concern with restoring checks & balances
- Willingness to use tactics:
  - More knowledge intensive
  - More labor intensive
  - More expensive
- Use chemicals or not???

Pest management:
the search for a weak link
in pest's life cycle

Mechanical Controls

- Exclusion
- Removal

Exclusion by barriers

- Row covers **
- Netting, screening
- Paper bags
- Localized shields
- Copper barriers
- Trenches (deep furrows)
- Plant collars
- Fences

Row covers to exclude pests

- Install on day of planting
- Remove
  - When first flowers appear (cucurbits)
  - At final harvest (broccoli, beans)

Row covers to exclude pests

- **Lightweight**
  - —**'Insect Barrier', 'Agri-bon 15'**
  - —**90% light transmission (vs 70-85% for heavier covers for frost protection)**
  - —**Sources:**
    - **Johnny's Selected Seed: $24. (10' x 50')**
    - **Gardens Alive: $10. (8' x 20')**

Row covers

- Use with or w/o hoops
- Must be anchored tightly
- Be prepared to mend rips

Cages to exclude garden pests

- **Bell cloche**
  - $30/3
- **Pest Control Pop-up**
  - $25 for 4’ x 4’ x 1’
  - $45 for 4’ x 4’ x 4’

(Gardeners Supply Company)

Exclusion by netting

- Periodical cicada
- Birds

Exclusion by fruit bagging

Paper bags:

- **Apples**
- **Grapes**

Mechanical Control by Removal

- Shelter traps
- Attraction traps
- By beating/shaking *
- Removal by vacuum
- By aspirator
- Removal by hand

Removal by shelter traps

- Board trap (shingle trap) for squash bug
- Tree bands for caterpillars

Squash bug

Gypsy moth

Codling moth

Removal by attraction traps

- Dish of beer for slugs
  - Catches many slugs
  - Often not significant decrease in population

Removal by tapping or shaking

- Tap plants by broom or hand
- Tap into bucket or tray
- Daily
- Example: Colorado potato beetle (adults, larvae)

Removal by aspirator

- Aspirator = Mouth-operated suction device
- $8 – 14 from:
  - –BioQuip
  - –Forestry Suppliers
  - –Gempler's
- Good for flea beetles, bean leaf beetle, cucumber beetle

Removal by hand

- Labor intensive
- Target pests:
  - Conspicuous pests
  - Pests not too active
  - In relatively restricted area
- Examples
  - Spinach leafminer (infested leaves)
  - Hornworms
  - Asparagus beetle (eggs)
  - Japanese beetle

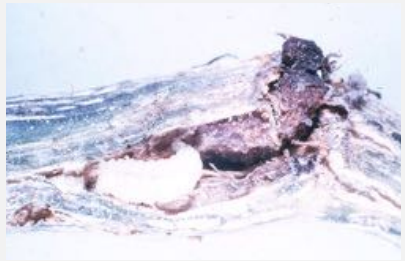
Sanitation

- Collect and destroy/compost:
  - —Culled fruit
  - —Crop residue (after harvest)
- Plant clean nursery stock

Cultural Control

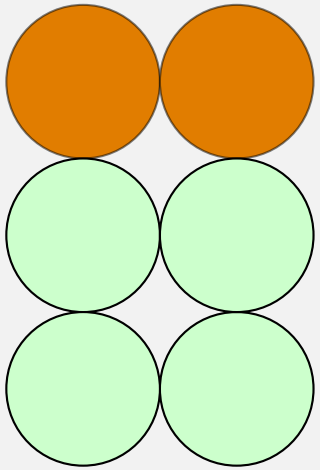
- How soil is prepared
  - Till vs no-till
- Which crops are planted
  - Trap cropping *
- Where crops are planted
  - Crop rotation
- When crops are planted
  - Delayed planting *
- How crop is maintained
  - Irrigation
  - Weeding

Delayed planting

- Cucumber beetle 
  - –Problem if plant in late May
  - –Less problem if plant in mid-June
- Squash vine borer 
  - –Same
- Bean leaf beetle
  - –Peak populations in May, July
  - –Fewer in June 

Trap cropping

- Lure pest away from main crop to a more attractive crop
- Then kill beetles in trap crop
  - —Mechanical
  - —Chemical



Squash (trap crop), planted 2 weeks early

Cantaloupe (main crop)

Cultural control: trade-offs

Example: Straw Mulch

- Benefits
  - —Moisture retention
  - —Weed suppression
  - —Reduces soil splash
  - —Reduces fungal spore dispersal
- Makes some pest problems worse
  - —E.g. cucumber beetles, slugs

Biological Control

- Control of pest by other organisms that act as natural enemies

- Common natural enemies

  - —Predators

  - —Parasitoids

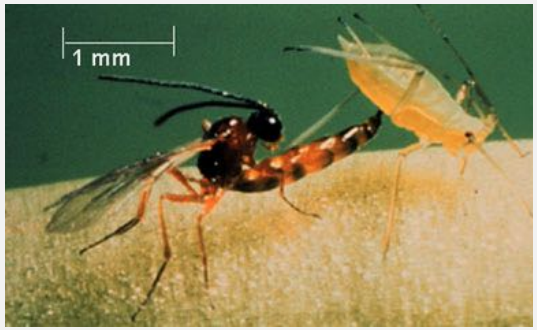
Biological Control: Predators

- Develop at expense of <u>more than one</u> prey item
- Predator often <u>larger</u> than prey
- Prey usually killed & consumed <u>quickly</u>

Predators

- Green lacewings
- Lady beetles
- Insideous flower bug
- Damsel & assassin bugs
- Hover flies

Biological Control: Parasitoids



- Develop at expense of a single host
- Lay egg in or on host insect
- Host is usually killed slowly

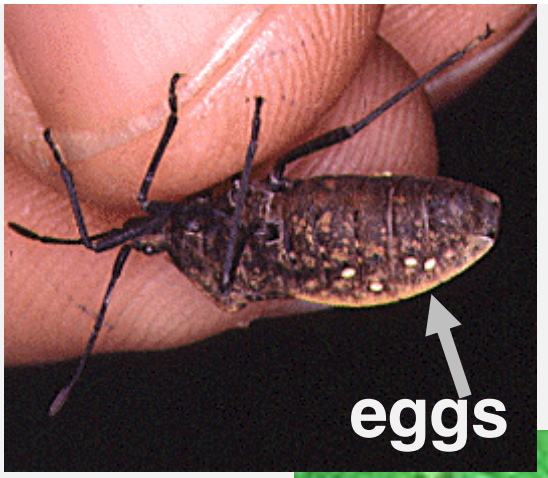
Parasitoids

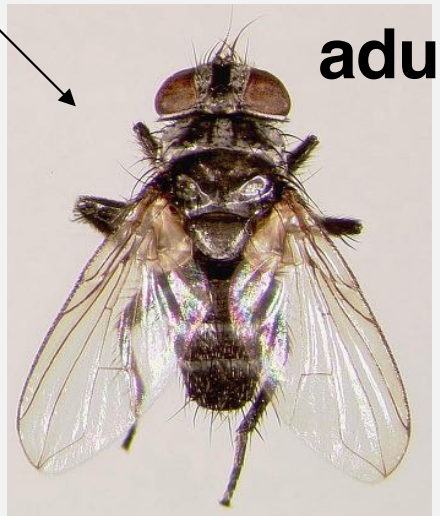
- Some wasps
  - Braconid wasps
    - On hornworm: *Cotesia congregata*
    - On imported cabbageworm: *Cotesia glomeratus*
    - On aphids: *Diaeretiella rapae*

  - Ichneumonid wasps
    - On diamondback: *Diadegma insulare*
  - Other wasps
    - On whiteflies: *Encarsia*
    - On caterpillar eggs: *Trichogramma*

Parasitoids

- Tachinid flies
  - –On squash bug: *Trichopoda pennipes*
  - –On striped cucumber beetle: *Celatoria setosa*





Natural enemy roles

- **Predators: many generalists**

- **Parasitoids: many specialists**

& Vertebrate predators eat insects!

- Bats
- Toads
- Birds
- Geese
- Hogs

Biological control by conservation of local natural enemies

- Avoid broad-spectrum insecticides
- Provide supplemental food:
  - —Pollen & nectar (refuge planting)
  - —Spray sugar water
  - —Spray Wheast (whey + yeast)
  - —Alternate prey (banker plants)
- Provide winter shelter
- Attract with lures

Insectary planting as refuge for natural enemies

- Adult parasitoids need <u>nectar</u>
- Adult predators need <u>pollen</u>
- Plant **flowering border** to enhance biocontrol

Biological control by augmentation of local natural enemies

- **Buy from insectary**
  - **Planet Natural (MT)**
  - **Arbico (AZ)**
  - **GreenMethods (VT)**
- **Collect and transfer**

Augmentation: Collect & transfer

- What to do?
  - —Hunt for generalist predators
  - —Collect them
  - —Transfer them to crop
- Who, where, when?
  - —Ladybug larvae on Spirea in May
  - —Lacewings & aphid midges on apple leaves in early June
  - —Damsel bugs on alfalfa, April-June

Chemical control
&
Microbial control

- Toxins (insecticides)
- Repellents
- Attractants
- Microorganisms

Does chemical = nasty?

Trends in pesticides:

- **Current type of products**
  - More ‘Reduced-risk’ products
  - More ‘Biological’ products
  - More options for organic gardens
- **Characteristics**
  - More expensive
  - More narrow-spectrum
  - Not as persistent
  - Smaller dose per area

Disadvantages of chemical control

- Toxic to non-target organisms
  - —Natural enemies
  - —Pollinating bees
  - —Humans
  - —Wildlife & pets
- Environmental contamination
- Resistance can develop

Advantages of chemical control

- Dependable
- Easy to obtain & apply
- Kill pest quickly
- Cheap (?)

Chemical control: categories

- By origin
  - Natural
  - Synthetic
- By mode of action
  - Nerve poisons
  - Suffocation agents
  - Respiration disruptors
  - Insect growth regulators

OMRI: The Organic Materials Review Institute

- Certified organic growers
- List of products
- Crops & processing

Example of label with OMRI logo

Insecticides, by Origin

- **Natural**
  - Minerals & elementals
  - Oils & soaps
  - Abrasion agents: diatomaceous earth
  - Botanicals (plants)
  - Microbials
  - Compounds derived from microbes

  OMRI ok
- **Synthetic**
  - Mimics of natural insect hormones
  - Petroleum-based synthetic chemicals

  OMRI not ok

Note on natural insecticides

- Can be toxic to natural enemies
- “Natural” is not always good!

Insect control products on OMRI List

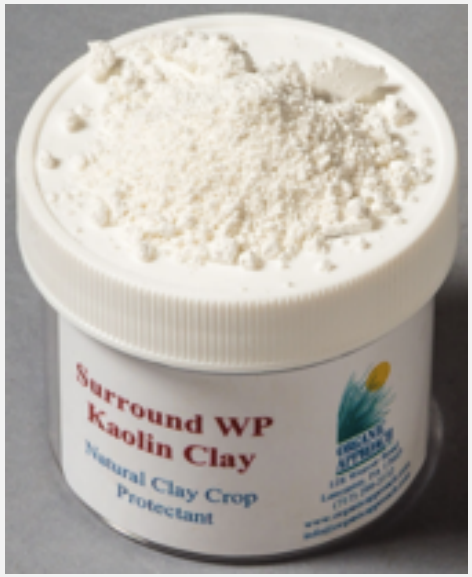
- **Behavioral control**
  - pheromone mating disruption
- **Microbial control**
  - viruses
  - bacteria: B.t. (DiPel)
- **Smothering agents**
  - soaps
  - oils
- **Nerve poisons**
  - spinosad (Entrust)
  - pyrethrins (PyGanic)
- **Repellents**
  - kaolin (Surround)
  - neem
  - garlic

Smothering or suffocation agents

- oils:
  - –from petroleum
  - –from plants
- insecticidal soaps:
  - –potassium salts of fatty acids

Minerals & elementals

- kaolin ('Surround')
- iron phosphate
- sulfur



‘Surround At Home’

- A.I. = kaolin (clay)
- ‘Particle film technology’
- Broad spectrum crop protectant
- Photosynthesis not affected

Abrasion agent: Diatomaceous earth

- Silicon dioxide = fossilized remains of algae
- Disrupts water balance
- For indoor pests: sold alone
- For food crops: sold in mix with pyrethrins
- Not rainfast

Insecticides from plants (botanicals)

- **pyrethrum** (chrysanthemum)
- **azadirachtin** (neem tree)

Not on OMRI list:

- **nicotine** (tobacco)

- **Pyrethrins**

- **= Pyrethrum?**
- **= Pyrethroids?**

- **Pyrethrum:** the raw natural product from dried flowers
  - Dalmatian Chrysanthemum (*Chrysanthemum cinerariaefolium*)
  - Persian Chrysanthemum (*Chrysanthemum coccineum*)
- **Pyrethrins:** the extracted active ingredients from pyrethrum
  - pyrethrin I
  - pyrethrin II
  - cinerin I
  - cinerin II
  - jasmolin I
  - jasmolin II
- **Pyrethroids:** synthetic mimics of pyrethrins

Examples of products available

- pyrethrins (alone)
  - MGK's 'PyGanic 1.4 EC'
- pyrethrins + soap
  - Safer 'Tomato & Vegetable Insect Killer'
  - Safer 'Yard & Garden Insect Killer'
- pyrethrins + oil
  - OHP's 'Pycana'
- pyrethrins + PBO
  - MGK's 'EverGreen Pro'
  - Bonide 'Pyrethrin Garden Insect Spray'
  - Bonide 'Japanese Beetle Killer'
  - FoxFarm 'Don't Bug Me'
  - Garden Safe 'Multi-Purpose Garden Insect Killer'
  - Garden Safe 'Houseplant & Garden Insect Killer'

What's PBO?

- PBO = piperonyl butoxide
- Semi-synthetic derivative of safrole
- Safrole is extracted from sassafras
- A synergist: when mixed with some insecticides, makes them more active
  - —Most common with pyrethrins
  - —Also with pyrethroids & carbamates
- Prevents enzymes from detoxifying the a.i. before it acts on target site

Allowed for organic? Effective?

ingredient(s)	status	efficacy in lab tests
pyrethrum	on OMRI list	n/a
pyrethrins alone	on OMRI list	fair/poor
pyrethrins + soap	on OMRI list	fair/poor
pyrethrins + oil	on OMRI list	fair/poor
pyrethrins + PBO	not OMRI list	good
pyrethroids	not OMRI list	excellent

Repellents from plants:

capsaicin

garlic

Microbial insecticides:

cause disease in insects

- Bacteria
- Viruses
- Fungi
- Protozoans
- Nematodes

Insecticides derived from microorganisms: spinosad

- Dow: **Entrust**
- Bonide: **Capt. Jack's Deadbug Brew**
- Fertilome: **Borer, Bagworm, Leafminer & Tent Caterpillar spray**
- GreenLight: **Lawn & Garden Spray Spinosad Concentrate**
- Monterey: **Garden Insect Spray**
- Gardens Alive: **Bulls-Eye Bioinsecticide**

Insecticides derived from microorganisms:

spinosad in 'Entrust'

- Excellent for caterpillar control
- Use 3 - 6 fl oz/acre
- $403 - 489/quart!

Nerve poisons

- **pyrethroids** (6)
- **neo-nicotinoids** (imidacloprid, acetamiprid)
- **carbamates** carbaryl (Sevin)
- **organo-phosphates** (malathion)

RTU

RTS

RTU *vs* RTS

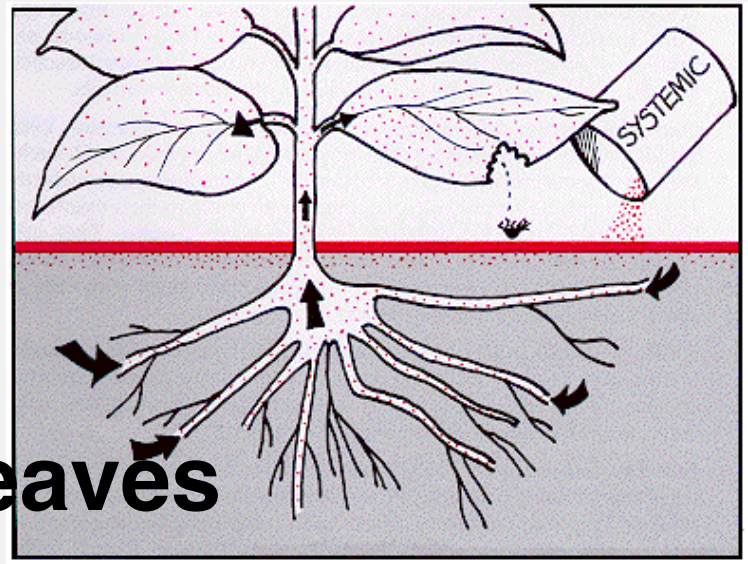
Systemic pesticides

- Chemical that moves from the point of application to another part of target
- Two types
  - —True
  - —Translaminar

Systemics for gardens

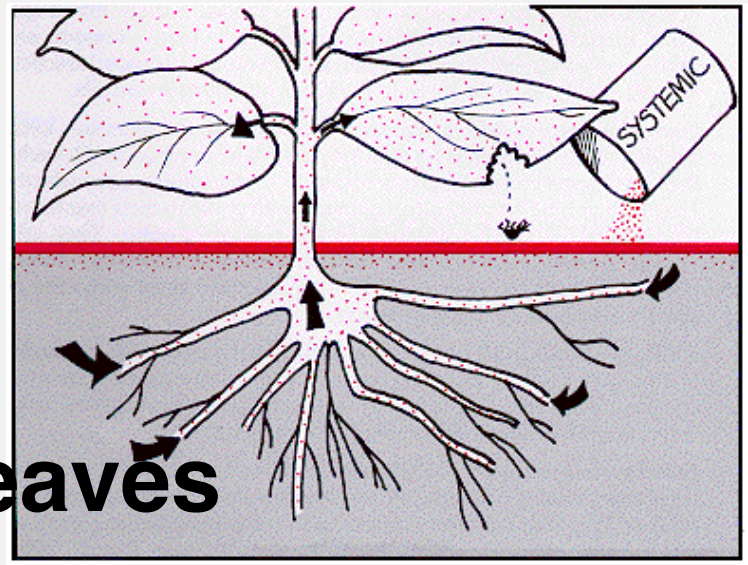
- **imidacloprid**
- **acetamiprid**

Types of Systemics



- **True systemic:**
  - —Apply to root, moves to leaves
  - —Apply to leaf, moves to root

Types of Systemics

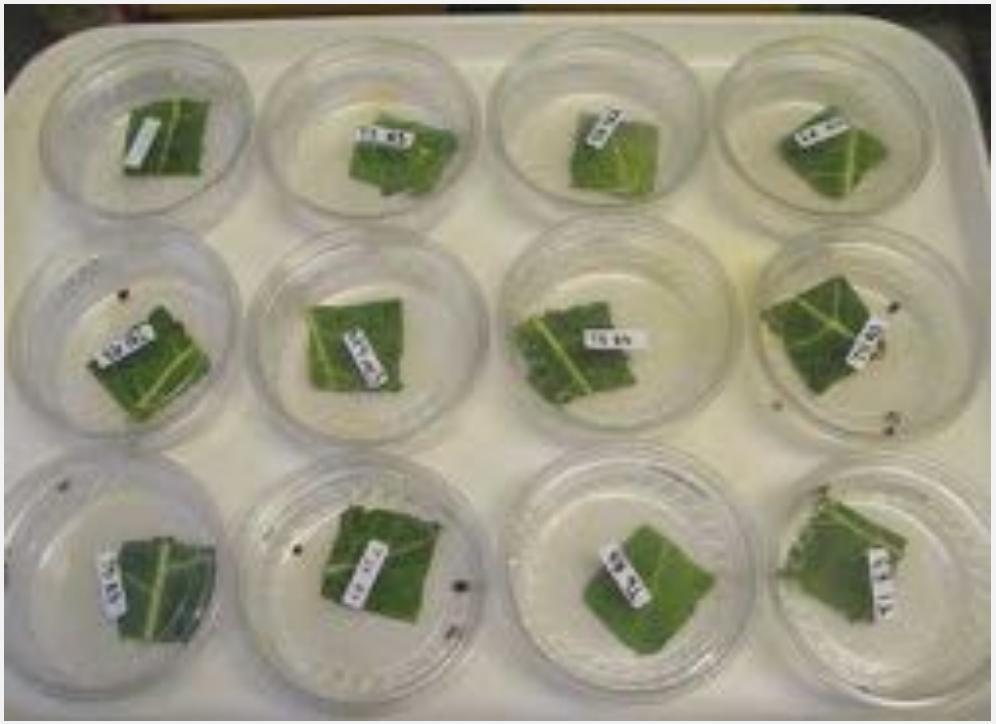


- **True systemic:**
  - —Apply to root, moves to leaves
  - —Apply to leaf, moves to root
- **Translaminar:**
  - —Or ‘limited systemic’
  - —Apply to top of leaf
  - —Moves inside leaf or to underside of leaf

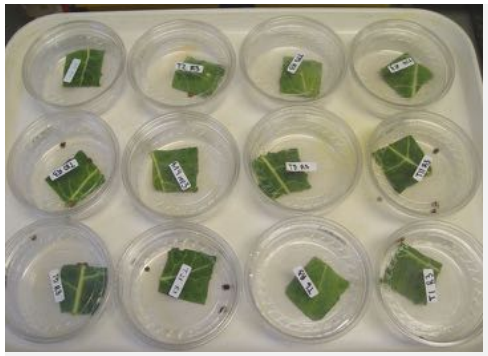
Types of Systemics

- Some products can be **both** types
- E.g. imidacloprid insecticide:
  - —True systemic when applied to roots, active for several weeks
  - —Translaminar when applied to foliage, active for only 1-2 weeks

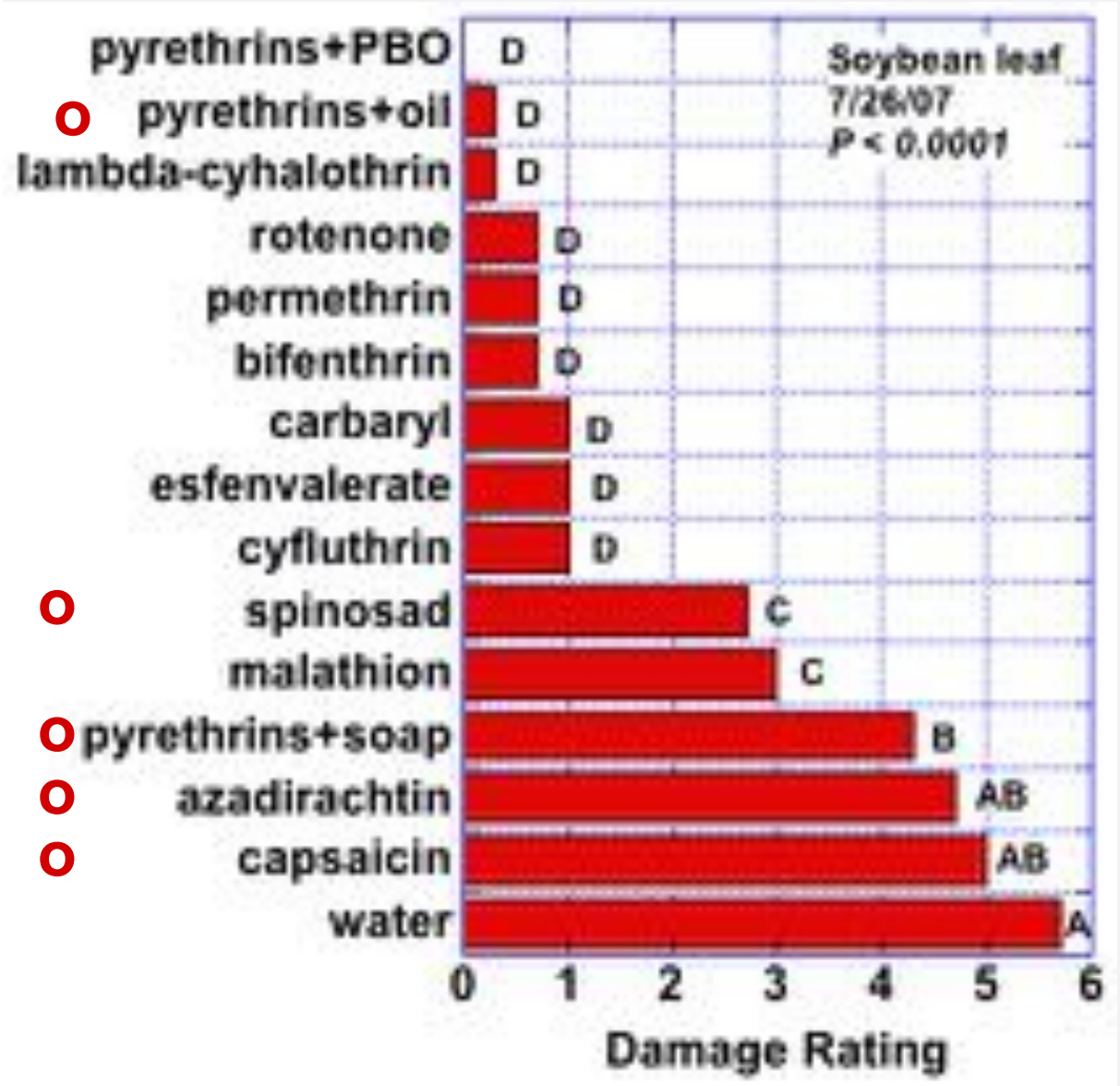
Lab bioassays to evaluate insecticide efficacy

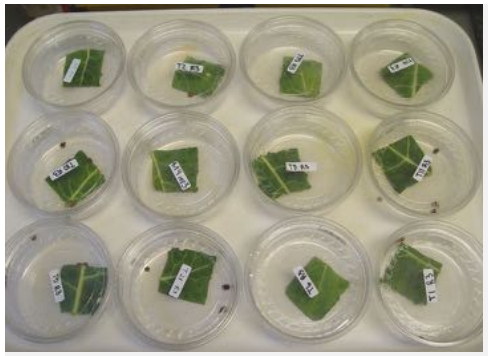


- Defoliation
- Mortality

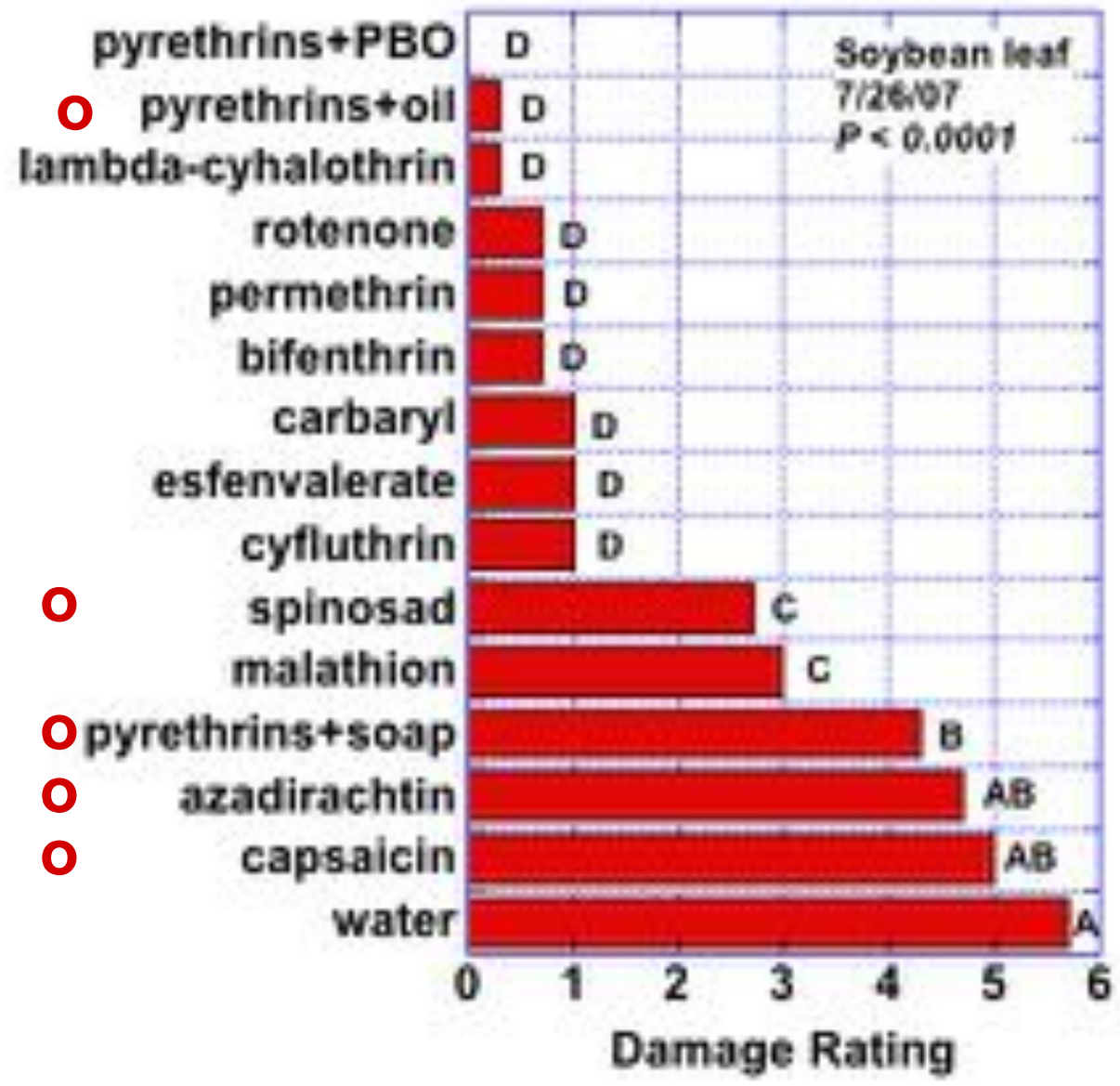


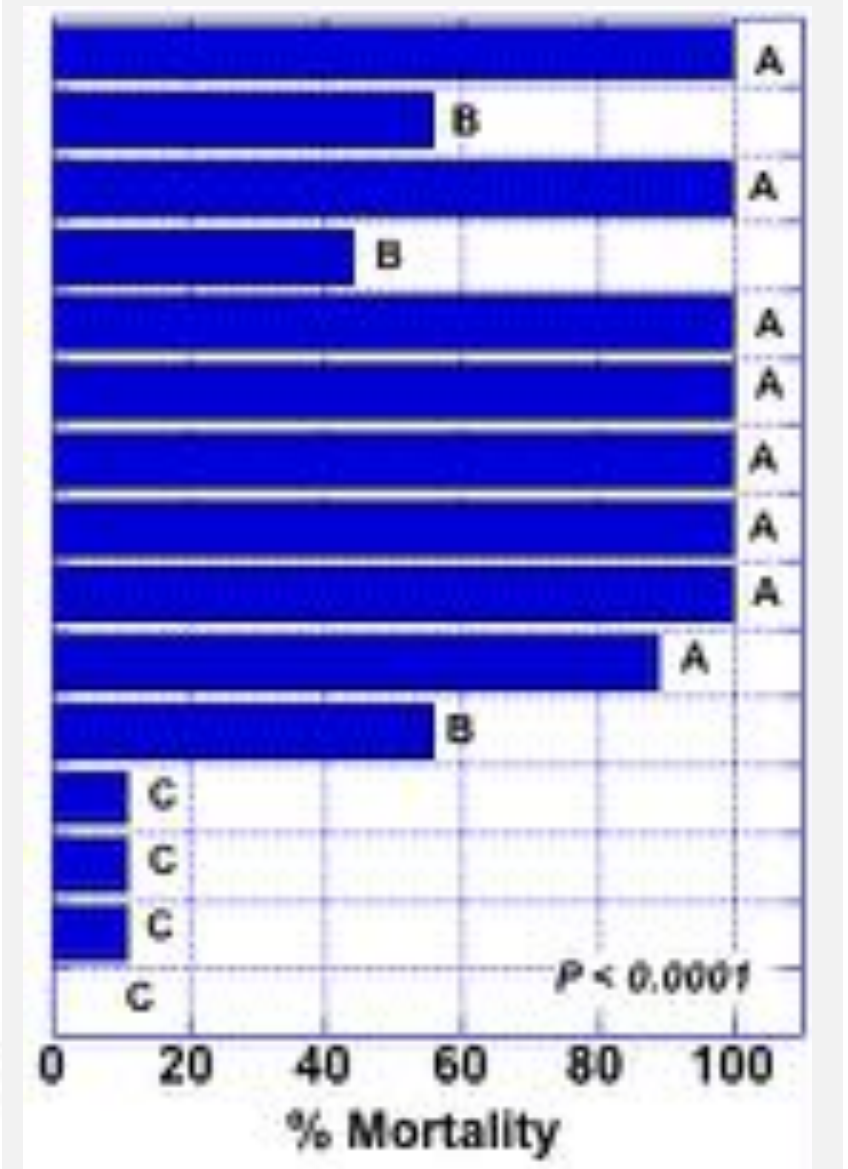
Bean leaf beetle





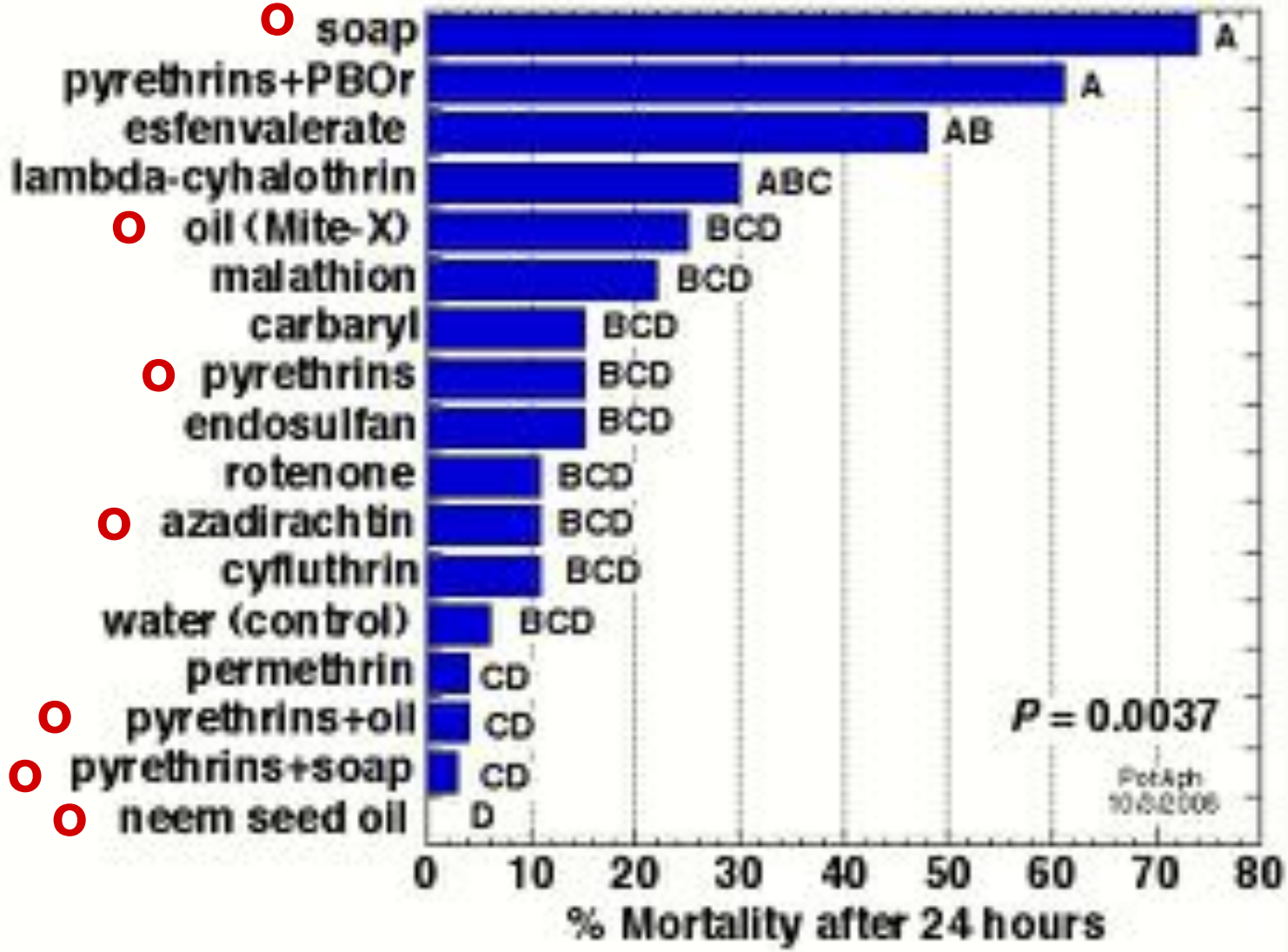
Bean leaf beetle





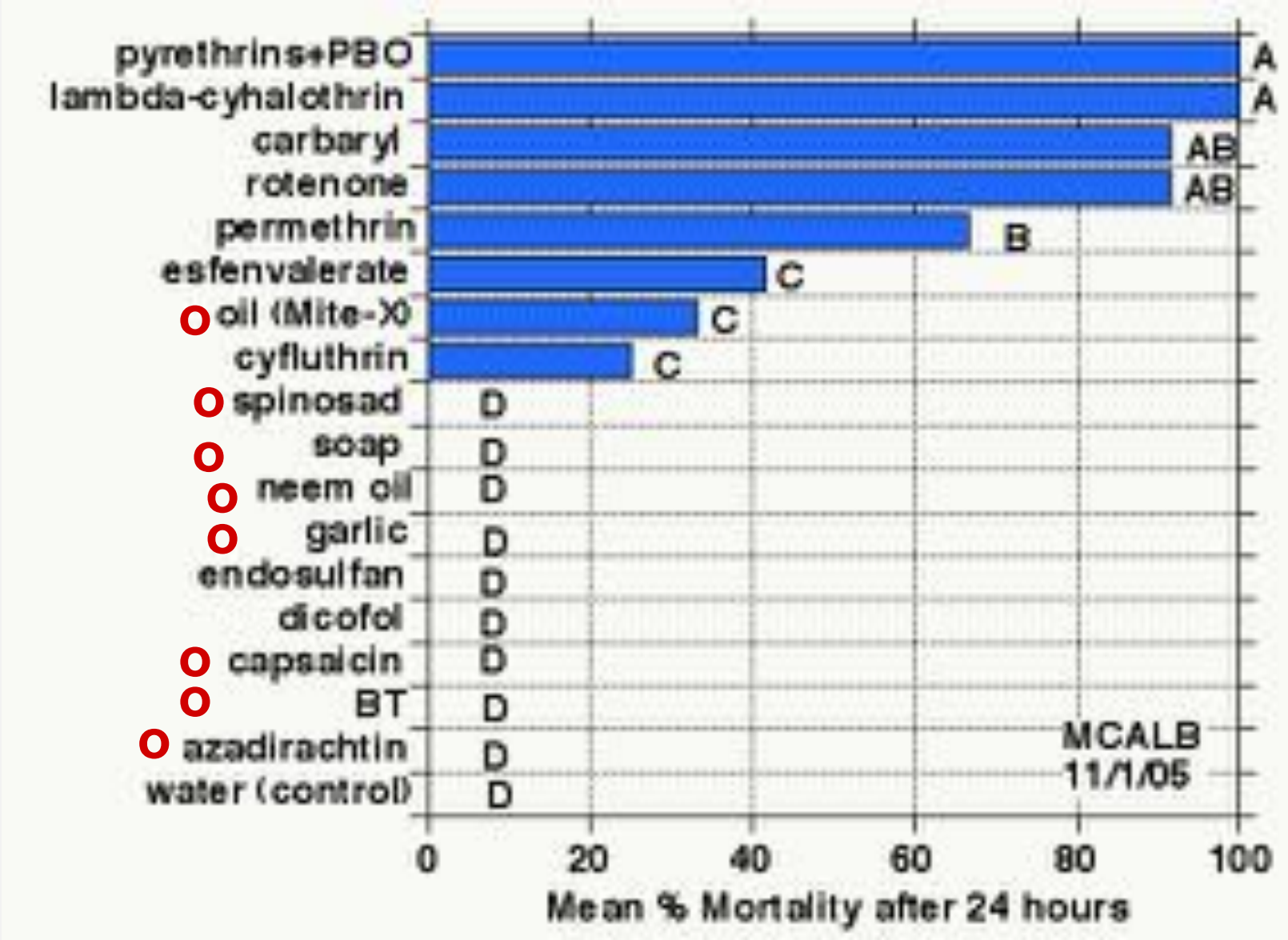
Potato Aphid

tested on tomato leaves, 10/3/2006
3 replicates/treatment, 10 aphids/replicate



What about harm to natural enemies?

Ladybug



Trends in insecticide efficacy

spectrum	*Exc./Good*	*Good/Fair*	*Fair/Poor*
broad	acetamiprid bifenthrin carbaryl cyfluthrin esfenvalerate lambda-cyhalothrin pyrethrins + PBO	azadirachtin malathion permethrin pyrethrins + oil pyrethrins + soap	pyrethrins neem seed oil garlic capsaicin
narrow	B.T. spinosad soap	oil	

in red if on OMRI list

Trends in insecticide efficacy

spectrum	*Exc./Good*	*Good/Fair*	*Fair/Poor*
broad	acetamiprid ★ bifenthrin carbaryl cyfluthrin esfenvalerate lambda-cyhalothrin pyrethrins + PBO ★	azadirachtin ★ malathion permethrin pyrethrins + oil pyrethrins + soap	pyrethrins neem seed oil garlic capsaicin
narrow	B.T. ★ spinosad ★ soap ★	oil	

★ *Best bet for organic*

★ *Best bet for not organic*

in red if on OMRI list

Conclusions: insecticide choices

User's general preference	*Best bets*
Natural products only (OMRI)*	1) spinosad 2) soap
Natural-based products only (non-OMRI)	pyrethrins+PBO
Conventional products only	carbaryl (Sevin) or permethrin (Eight)
Anything goes	pyrethrins+PBO

** Note lack of effective beetle control product*

How can pests be managed organically?

- **Maximize non-chemical tactics:**
  - **Knowledge & labor intensive**
- **Can include chemical control**
  - **Only if biorational products chosen**
  - **Usually as last resort**
  - **Efficacy mostly fair at best**
  - **Do not assume that "natural" = good**

the end

Info on fruit & veg. pests

u.osu.edu/pestmanagement

Questions?

e-mail: welty.1@osu.edu

office phone: 614 292 2803

cell phone: 614 746 2429