

## What are pests?

- Alive
- Examples



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## Types of Homeowner Use Pesticides

- Bactericides
- Fungicides
- Herbicides
- Insecticides
- Miticides
- Molluscicides
- Repellents
- Rodenticides



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## What are not pesticides?

- Drugs used to control diseases of humans or animals.
  - U.S. Food and Drug Administration
- Fertilizers, nutrients and other substances used to promote plant survival and health (when not combined with pesticides).
- Biological control agents (except some microorganisms).
  - Includes beneficial insects that eat insect pests.
- Products which do not have to be registered as pesticides, as they contain certain low-risk ingredients.

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## Regulation of Pesticides

- All pesticides regulated by U.S. EPA.
- Tolerances (pesticide residue levels in food or feed crops) set by EPA, enforced by FDA.
- In Oregon...
  - Tolerances also enforced by ODA and U.S. Department of Agriculture.
  - Pesticide use regulated by ODA.
    - Pesticide licenses and training.
    - Pesticide Use Reporting System (PURS).
  - Hazardous waste regulated by DEQ.

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## Pesticide recommendations – OSU policy

"Oregon State University Extension Service encourages sustainable gardening practices. Always identify and monitor problems before acting. First consider cultural controls; then physical, biological, and chemical controls (which include insecticidal soaps, horticultural oils, botanical insecticides, organic and synthetic pesticides). Always consider the least toxic [*effective*] approach first."

How would you describe this approach to pest management?

What is one of the most effective ways to avoid the use of pesticides?

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## Do organic growers use pesticides?



Of course, but just certain ones

## Agricultural beginnings

- Location specific
- Susceptible to disruption in both production and storage
- Modest technology
- Modest understanding of crop loss causes



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## What happened when crops failed?



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## Early examples of crop protection

- Sulfur dust and olive oil for insect and disease management
- Salt and grain diseases
- Planting techniques that reduced pest pressure



## Other early crop protection options

- Plants (neem and others) used in India 4000 years ago
- Tobacco extract used as an insecticide once it came to Europe from the Americas
- Inorganic compounds based on lead, mercury, and arsenic were experimented with by the 1500's.



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## The potato story

- Introduced to Europe from South America by Spanish explorers
- Initial adoption slow but then faster
- Virtues of the potato?
- Potato demography and implications



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## What did the potato replace?

- Rye grain
- Any consequences of that?





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### Potato dependence

- High risk due to crop failure possibility
  - Insects
  - Disease
  - Rainfall



### The perfect storm: The Irish Potato Famine

- Colonial economy
- Huge dependence on one crop
- The problem from hell: potato late blight



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### Consequences?

- 1/3 died
- 1/3 emigrated
- 1/3 were left



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## The drive to find better tools to protect crops increased

- Bordeaux mixture (copper sulfate & lime)



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## Metallic-based compounds came into much greater use

- Lime-sulfur (still in use)
- Copper arsenate (Paris green) – insecticide no longer in use
- Lead arsenate – insecticide no longer in use
- Mercury as seed treatment
- Thallium as a rodenticide



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## So did botanicals

- Pyrethrums
- Rotenone
- Nicotine extracts



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## Early microbiological discovery

- *Bacillus thuringiensis* – an insecticide for larva of butterfly and moth pests
- Discovered in Japan on silkworm larva in 1901 and commercialized before WWII



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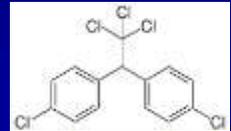
## Implications of better crop protection

- Dramatically improved yields
- Larger farms
- Fewer farmers
- Some acknowledged health issues

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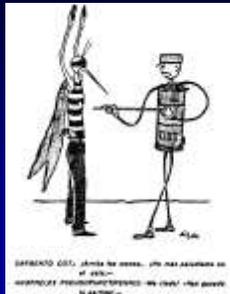
## Pesticides based on organic chemistry

- Many useful compounds discovered in the 1800's based on a hydrocarbon chemistry
- Potentials in agriculture slow to develop
- First products targeted insects
- Introduced in the 1940's in WWII



## DDT

- Used to reduce insect vectored diseases like malaria and typhus and body insects in WWII
- Adapted to agriculture after the war



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## DDT strengths (and issues)

- Long lasting
- Relatively broad spectrum
- Used extensively as the only control measure



DDT was mobile and didn't degrade easily into non-toxic products



## We had to learn a lot of biology fast

- Resistance management
- Reduction in persistence
- Better understanding of broad environmental & medical effects



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## What is integrated pest management (IPM)?

- Look at all available options to achieve a desired outcome
- Pick those methods that have the least collateral damage and produce a satisfactory outcome
- Useful approach with any pest problem (i.e. weeds, insects, diseases, etc.)

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### How do gardener and farmer approaches necessarily differ?



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### How do you (as an MG) approach plant protection questions?



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### What is the damage?

- Black spots
- Defoliation
- Weakening
- Rarely death



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### Get a good diagnosis

- Fungus: Black spot on roses



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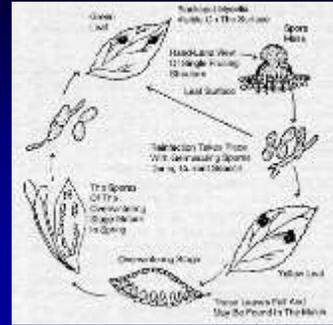
## Does any thing need to be done?

- Client's expectations
- What they are willing to do



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## Where are the weak links that can be worked with?



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## In the broadest sense, what are the options?

- Sanitation
- Preventative sprays
- Relocation to area with more sun and better air circulation
- Tolerance
- Resistant varieties
- Intolerance (no more stinking roses!!)

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## Home & Garden Pesticide Stats

By weight of active ingredient, homeowner pesticide use by category was:

- Herbicides: 65%
- Insecticides: 21%
- Fungicides: 11%
- Other: 3%

**Source:** Pesticide Industry Sales and Usage: 2006 and 2007. U.S. EPA report

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## Pesticide Terminology

- Broad pesticide groups
  - Inorganic (metal based, e.g. copper, sulfur, etc.)
  - Synthetic (organic chemistry – hydrocarbons with twists)
  - Biological (living organisms or their products)
  - Botanical (derived from plants)

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## Pesticide terms

- Broad vs. narrow spectrum of activity
- Selective vs non-selective
- Contact vs residual vs systemic
- Curative vs protectant
- Organic vs synthetic
- Home vs commercial

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## Pesticide Terminology

- Broad spectrum
  - Controls a wide range of pest organisms
    - e.g., Bayer Tree and Shrub Insect Control (imidicloprid)
- Narrow spectrum
  - Controls a narrow range of pest organisms
    - e.g., *Bacillus thuringiensis* (B.t.)

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## Pesticide Terminology

- Commercial
  - These products are either designated as Restricted Use Pesticides (RUPs) or are packaged in quantities that are too large (and too expensive!) for home use.
- Home
  - These products are not designated as RUPs and are readily available in small packaging.

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## Pesticide Terminology

- Contact
  - Pesticide must be sprayed directly on the target (weed, disease, insect, etc.).
    - e.g., Bug-B-Gon (esfenvalerate)
- Residual
  - Pesticide will persist after application, offering control for a period of time.
    - e.g., Casoron (dichlobenil)
- Systemic
  - Pesticide can be translocated throughout the target plant to either protect it (fungicides, insecticides) or kill it (herbicides).
    - Roundup (glyphosate)

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## Pesticide Terminology

- Curative
  - Also known as *eradicants*, this type of pesticide can kill target pests if present.
    - e.g., almost all insecticides
- Protectant
  - This type of pesticide protects healthy plant parts from attack by pest organisms.
    - e.g., most fungicides and bacteriacides

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## Pesticide Terminology

- Non-selective
  - Provides broad-spectrum control of pest organisms.
    - e.g., Microcop (copper)
- Selective
  - Targets specific organisms while doing no harm to many other organisms that may be present.
    - e.g., Weed-B-Gon (2,4-D)

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## Pesticide Terminology

- Organic
  - Naturally derived pesticides, including botanical, biological and microbial classes.
- Synthetic
  - Manufactured (synthesized) products.

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## When are you as the applicator at the greatest risk?

- Mixing?
- Applying?
- Why?



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## What kind of risk are we talking about?

- Acute exposure?
- Chronic exposure?
- Why?



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## Pesticide Hazards

- The toxicity of a substance is defined as its capacity to cause injury to a living system.
- Acute toxicity – damage resulting from a one-time or limited exposure.
- Chronic toxicity – damage resulting from long-term (repeated) exposure.

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## Product risk factors

- Nature of the active ingredient
- Type of formulation
- Safe use (or not) of the product according to the label
- Frequency of exposure

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## Why are pesticides formulated?

- Mixing issues
  - Active ingredient won't go directly into solution
  - Measuring issues
  - Delivery technique
- Formulation = active ingredient (a.i.) + carrier + other "adjuvants" like spreaders, stickers, drift control agents, etc.

*The formulation of a pesticide can have significant implications for safe and effective use.*

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## Pesticide formulations

- The formulation describes the physical attributes of a pesticide product. It is comprised of:
    - active ingredient(s) (ai)
    - Solvents (sometimes)
    - dry carriers
    - water
    - adjuvants
- } "Inert" ingredients

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## Liquid Pesticide Delivery Methods for Home Use

- Aerosols (A)
- Solutions (S) (All mixed with water)
  - Water soluble concentrates
  - Ready-To-Use (RTU) - premixed
  - Emulsifiable concentrates (EC)
  - Wettable powders (WP)
  - Dry flowables (DF) and Flowables (F)

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## Solid Pesticide Delivery Methods for Home Use

- Baits (B)
- Dusts (D)
- Granules (G)
- Pellets (P or PS)



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## The Pesticide Label

Contains information essential for effective, safe, and legal use of pesticide products.

“The label is the law.”

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## The Pesticide Label

- Read the label...
  - Before purchasing the product.
  - Before using the product.
  - Before storing the product.
  - Before disposing of the product or empty container.

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Pesticide labels are legal documents which describe:

- Brand name
- Common name
- Chemical name
- Ingredient statement
- Type of formulation
- Net contents
- Name and address of manufacturer
- Registration number
- Establishment number
- Precautionary statements
- Environmental hazards
- Physical & chemical hazards
- Signal words and symbols
- Statement of practical treatment
- Directions for use
- Preharvest interval
- Restricted entry interval
- Storage & disposal directions
- Misuse statement

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## The Pesticide Label

- Type of pesticide
  - Insecticide, herbicide, etc.
  - Gives general indication of purpose of product.
- Active ingredients and concentration (%)
- Common and/or chemical names
  - Ortho (brand name)
  - Sevin (trade/product name)
  - Carbaryl (common chemical name)
  - 1-naphthyl N-methylcarbamate (IUPAC chemical name)
- Inert ingredients listed by %

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## Pesticide Names

- Different manufacturers may market the same active ingredient under different trade names and different concentrations.
- Do not choose products based on brand name alone. Read the active ingredients on the label and instructions for use. The label is the law!!

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## The Pesticide Label

- Net contents
  - Amount in container.
- Name and address of manufacturer
- EPA registration number
  - Good to have in case of accidental poisoning.
- Signal words and symbols
  - Printed in large letters on front panel.
  - Indicates acute toxicity.

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## The Pesticide Label

- Directions for use (Approved uses)
  - Crops and pests.
  - Application rates.
  - Application timing.
  - Maximum quantity to apply over time.
  - Re-entry interval.
  - Pre-harvest interval.
- Other use precautions
  - Avoid treatment of sensitive plants.
  - Avoid sprays under certain conditions.

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## The Pesticide Label

- Precautionary statements
  - Hazards to humans and others.
  - Indicates route of entry of particular concern.
  - Indicates required clothing and PPE.
- Statement of practical treatment
  - Instructions for dealing with accidental exposure.
- Environmental hazards
  - Lists particularly sensitive organisms.
  - Birds, fish, endangered species, etc.

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## The Pesticide Label

- Storage and disposal
  - Storage conditions (e.g., temperature).
  - Disposal of empty containers.
- Physical or chemical hazards
  - Corrosive, flammable, etc.

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## Label exercise

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## How is toxicity determined?

- Acute toxicity is usually determined by animal testing.
- LD<sub>50</sub> stands for "lethal dose fifty percent."
  - This is the dose that killed half of the animals in a dose-response study.
  - The smaller this number, the more poisonous the pesticide.

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## Signal Words

<u>Toxicity category</u>	<u>Signal word</u>
Category 1: 0-50 mg/kg	<b>Danger-Poison</b>
Category 2: 51-500 mg/kg	Warning
Category 3: 501-5000 mg/kg	<b>Caution</b>
Category 4: 5001+ mg/kg	Caution

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## Signal word/LD 50 exercise

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## Examples of LD<sub>50</sub>

- table salt 3750 mg/kg
- glyphosate 5600 mg/kg
- aspirin 1750 mg/kg
- spinosad 3738 mg/kg
- caffeine 200 mg/kg
- rotenone 130 mg/kg
- imidiclopid ~1000 mg/kg

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## Routes of Entry

- There are 4 main routes:
  - Dermal
  - Inhalation
  - Eye
  - Oral
- Dermal and inhalation are the most common routes of pesticide exposure.
- Once a pesticide enters your body, it doesn't matter how it got there!

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## PPE

Personal Protective Equipment (PPE)  
Several types of coats made of different fabrics, with and without hoods.





**Common Symptoms of Pesticide Poisoning**

<p><u>Mild or early symptoms:</u></p> <ul style="list-style-type: none"> <li>Fatigue</li> <li>Headache</li> <li>Dizziness</li> <li>Blurred vision</li> <li>Excessive sweating</li> <li>Excessive salivation</li> <li>Nausea and vomiting</li> <li>Stomach cramps</li> <li>Diarrhea</li> </ul>	<p><u>Moderate symptoms:</u></p> <ul style="list-style-type: none"> <li>Inability to walk</li> <li>Weakness</li> <li>Chest discomfort</li> <li>Muscle twitches</li> <li>Pupil constriction</li> </ul> <p><u>Severe symptoms:</u></p> <ul style="list-style-type: none"> <li>Unconsciousness</li> <li>Convulsions</li> <li>Difficulty breathing</li> <li>Death</li> </ul>
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## Pesticide Poisoning

- Plainly and simply, beware of ANY unusual symptoms!
- Read labels carefully prior to use so that you know what to expect and how symptoms may be treated.
  - Statement of practical treatment
- Call 911 for immediate medical attention
  - Keep label accessible
    - EPA registration number
- Poison Control Center: 1-800-222-1222

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Heat stroke can have some symptoms in common with pesticide poisoning.

It is just as serious!

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## Application Equipment

- There are several types of application equipment.
- You should choose equipment that allows you to make safe and effective pesticide applications.

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Some pesticides are pre-mixed or packaged in containers that double as applicators.



## Hose-end Sprayers



- Hose-end sprayers are proportioners that mix a concentrated pesticide with water and emit a spray of diluted pesticide.
- These may be very useful when making applications to the ground with high volumes of water.
- This type of sprayer may be the only non-mechanical way of spraying trees and large shrubs.
- Don't buy a cheap one (see Handbook for reasons why).

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## When using a hose-end sprayer:

- Place anti-siphon device between sprayer and water source to prevent back siphoning of pesticides into your water system.



Anti-backflow device →

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## Compression Sprayers

- Pressurized sprayers with a hand-operated pump.
- Require agitation for effective spray application.
- For tank capacities greater than ~1.5 gallons, consider a backpack sprayer.
- May not be suitable for spraying large shrubs and trees.



## Mixing & Loading

1. Fill tank with half of the water required.
2. Add pesticide(s).
3. Add remaining water.
  - Use this water to rinse measuring cups/spoons.

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## Calibration & Calculating Amounts

- Two common types of applications:
  1. Apply to wet the plant or foliage.
  2. Apply to cover a surface of known area (sometimes this is on the label).
  3. Practice with a water solution

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## Drift

- Drift is the movement of visible spray particles or droplets away from the target site.
- Drift is affected by:
  - Nozzle size
  - Nozzle height
  - Pressure
  - Wind
  - Temperature



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## Cleanup & Disposal



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## Washing PPE

- Wash pesticide-contaminated items separately from uncontaminated clothing and laundry.
- Avoid direct contact with contaminated items, and work in a well-ventilated area.
- If in doubt about ability to clean an item, discard it!

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## Pesticide Storage

- Keep pesticides in original containers!
- Store out of reach of children and pets.
- Avoid temperature extremes and moisture.
- Keep out of direct sunlight.
- Avoid contamination of wells and surface water.
- Store in leak-proof containers.



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## Disposal of Pesticide Containers

- Empty containers (not banned):
  - Cardboard containers in trash (not burned).
  - Triple rinse glass/plastic; apply rinse water.
  - Dispose of empty container in trash, or recycle/return to dealer if possible.
  - Poke holes in plastic/cardboard containers and wrap in newspaper to discourage reuse.
- Leftover pesticide or banned products:
  - Check DEQ Home Hazardous Waste collection schedule...do not dispose!

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## Cleaning Pesticide Spills

- Keep the area well ventilated.
- Wear gloves and protective clothing.
- Contain the spill with absorbent material (cat litter, clay or sawdust).
- Scoop materials into a sealed container.
- Wash the surface with soap and water.
- Dispose of materials as HHW.

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## Common Label Violations

- If a little is good, more is better.
- If the label says it works great in the driveway, it should be dynamite in the garden!
- If it says to use it every 2 weeks, it should work even better every week!
- There's just a little bit left over...I'll pour it down the drain.
- Gloves are for sissies.

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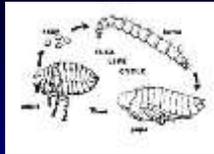
## What you can do...

- Apply at a dose, concentration or frequency less than that listed on the label, but never more!
- Apply a pesticide for a pest not listed on the label if the plant or other target is listed.
- Use any appropriate equipment not specifically prohibited by the label.
- Mix with pesticide(s) and/or fertilizer(s) not specifically prohibited.
  - Always test for compatibility!

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## Modern IPM examples

- Codling moth
- Fleas



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