



# Understanding Pesticides

## *IPM Training for Retail Nurseries & Garden Centers*

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# Why are we talking about pesticides?

- Sold in many retail stores; widely available
- Commonly used for pest problems
- Most consumers do not fully understand pesticides
- So you can better educate clients
- To protect people, pets, wildlife, and the environment (minimize harm)



# Outline

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Basic pesticide knowledge and terms

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Registration and certifications

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Pesticide safety and toxicity

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Less-toxic pesticides

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Homemade pesticides

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Talking pesticides with clients

# IPM and pesticides

- IPM uses a combination of control methods
  - Biological, mechanical, cultural, and chemical
- Less-toxic pesticides
- Pesticides can be an important tool when used **appropriately**



# Are pesticides necessary?

- Use an IPM approach and ask questions
  - Determine the pest or what is causing the damage
  - What are the easy fixes? (cultural, mechanical, biological controls)
  - Does it pose a risk?
- Sometimes pesticides are the best option
  - Cost, time, efficiency, physical ability, level of infestation, health risks from the pest

# Pesticide basics & terminology



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# How can you tell?

- **Pesticidal claim**
  - “Kills 158 listed insects”
  - “Kills 99.9% of germs”
- **EPA registration number**
  - Most all pesticides must be registered by EPA
- **Active ingredients listed**
- **Signal word**
  - CAUTION, WARNING, DANGER



Can Be Used on  
Day of Harvest

Monterey

# Bug Buster-0

for organic  
production

• Kills More than 100  
Listed Insects

• Provides Rapid  
Knockdown & Kill of  
Listed Plant Pests



Active Ingredient:

Pyrethrins *a botanical insecticide* ....1.40%  
Other Ingredients: .....98.60%  
Total: .....100.00%

EPA Reg. No. 1021-1771-54705  
EPA Est. No. 48498-CA-1  
(MGK-082213A) 0913(01)

KEEP OUT OF REACH OF CHILDREN  
CAUTION/PRECAUCIÓN

See Attached Booklet for First Aid, Precautionary  
Statements and Directions for Use in English and Spanish

NET CONTENTS: 1 PINT/473.16 mL

## What is a pesticide?

- Any substance intended to control, prevent, kill, or reduce pests
- Types:
  - Insecticides
  - Herbicides
  - Fungicide
  - Rodenticide
  - Molluscicide
  - Antimicrobials (disinfectants)



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OMRI  
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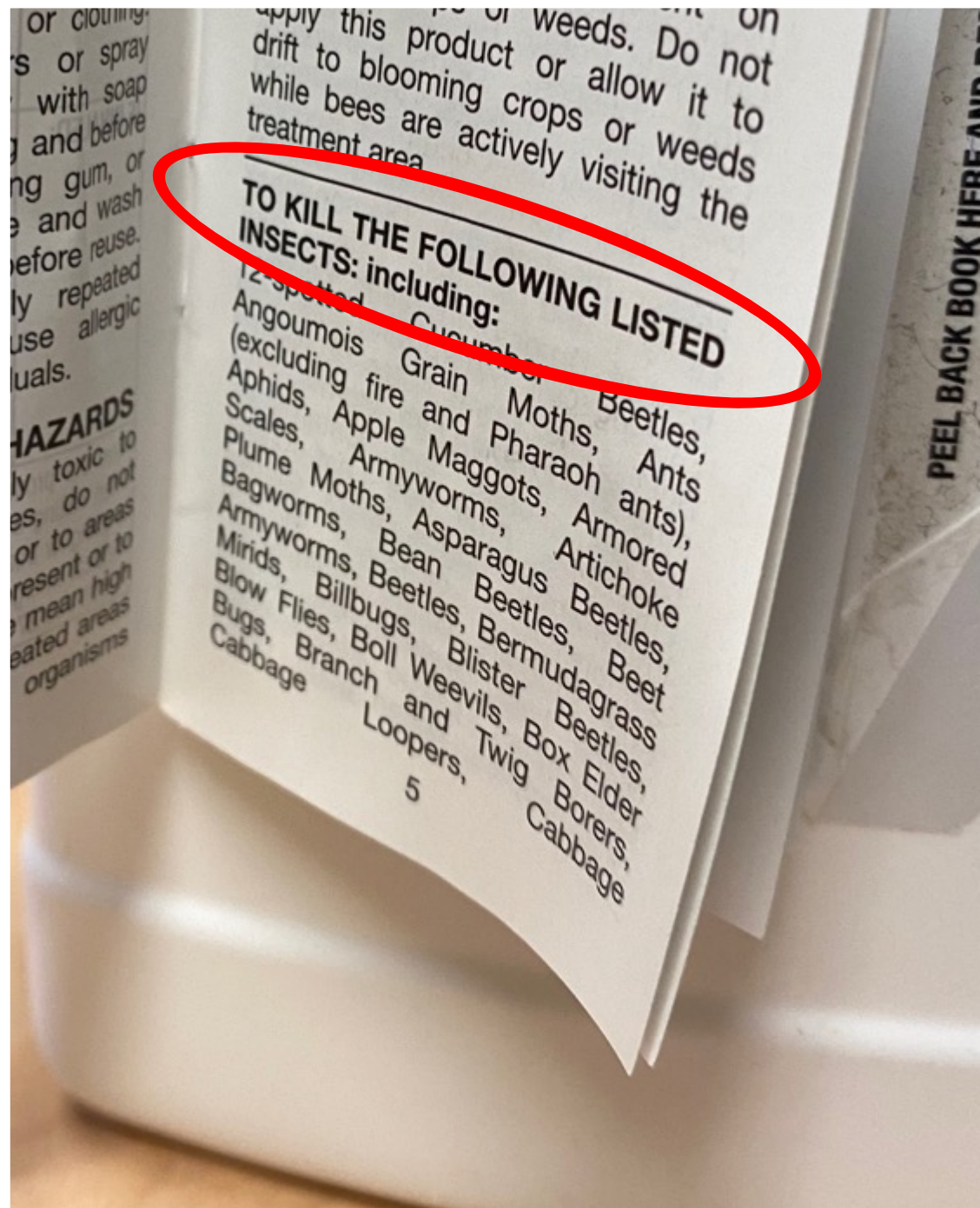
NET CONTENTS: 1 PINT/473.16 mL

## What's in a pesticide?

- **Active ingredients (AI)** are the materials that affect the target pest
- **Other (inert) ingredients** are materials added to a pesticide to improve its efficacy, ease of application, and shelf-life

# What are target pests?

- Pests that the pesticide is designed to harm and be effective against
- Listed on the pesticide label
- Non-target organism: any species that is not the targeted pest of a pesticide treatment; can include birds, bees, people, and natural enemies



# How do pesticides work?

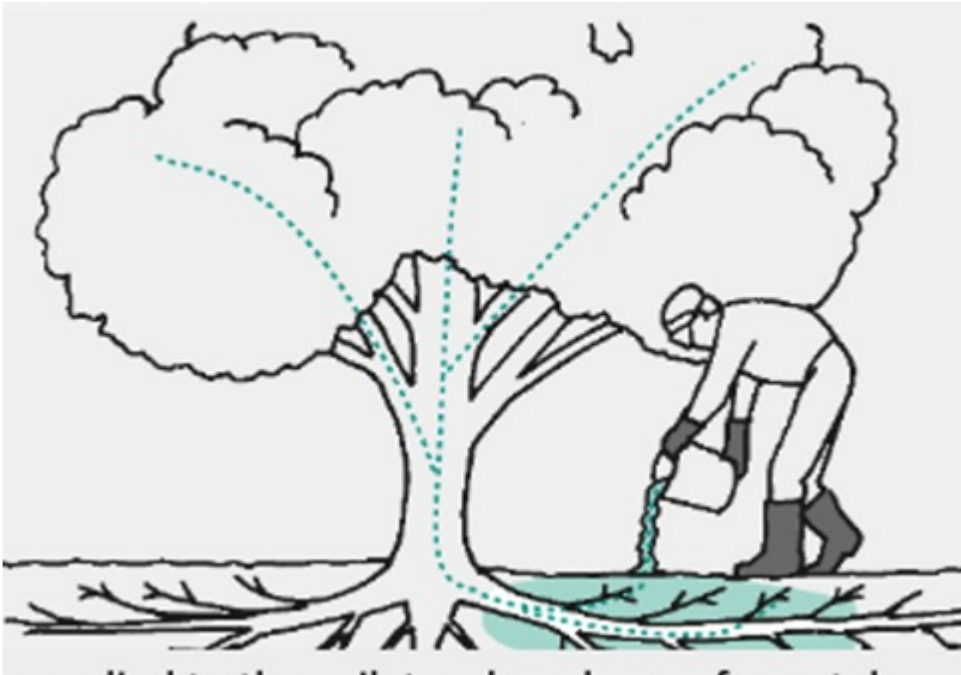
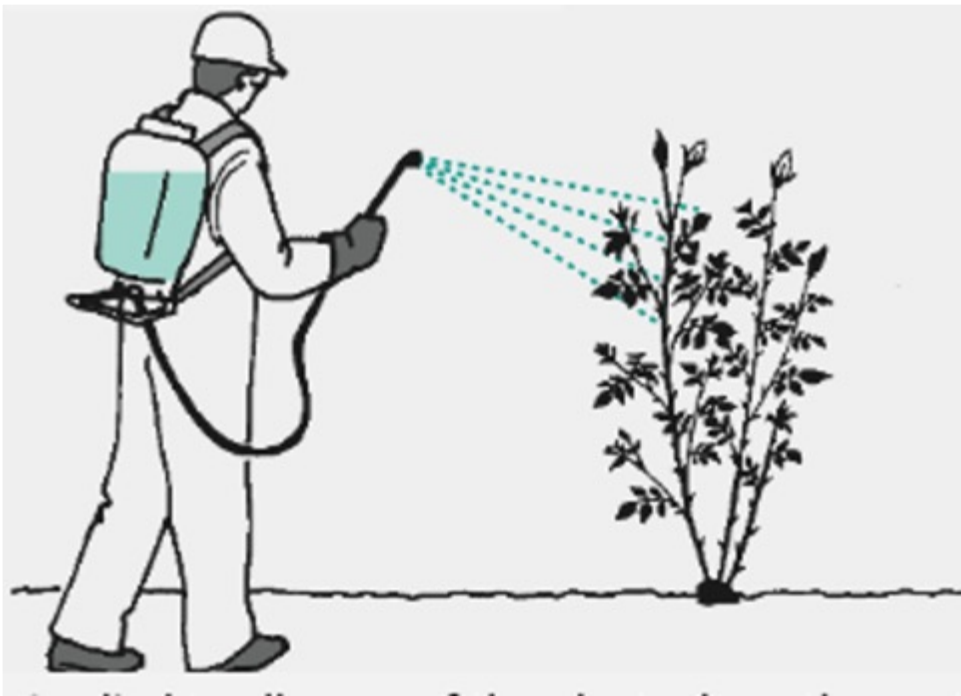
- The mode of action (MOA) describes how certain active ingredients work
- Important in understanding how to use/apply effectively
- Active ingredients can be broken down into categories:
  - Selective vs broad-spectrum
  - Contact vs systemic
  - Single vs multi-dose
  - Insect growth regulators
  - Plant growth regulators
  - Pheromones





## Selective vs broad-spectrum

- **Selectivity:** *the range of organisms killed or injured by a pesticide's active ingredient*
- **Broad-spectrum pesticides** kill a wide range of pests
  - Spinosad, pyrethrins, chlorothalonil, glyphosate
- **Selective pesticides** kill only a targeted group of pests
  - Potassium salts of fatty acids, *Bacillus thuringiensis* (Bt), dicamba



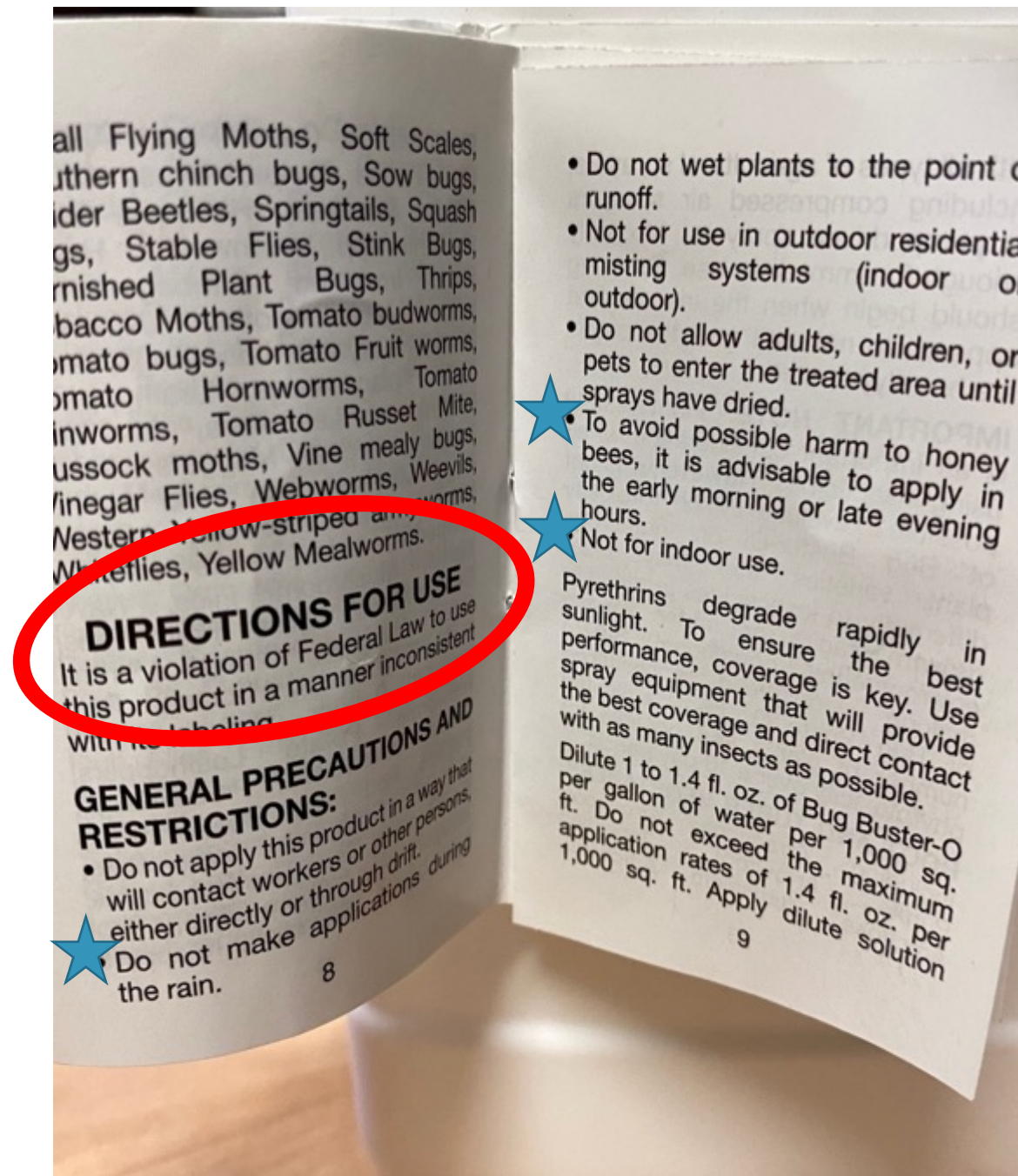
## Contact vs systemic

- **Residual:** remains effective for a period of time after application
- **Contact pesticides** kill or affect pests that come in direct contact with or feed on the product
  - No residual control
- **Systemic pesticides** are absorbed by plants and moved to the leaves, roots, seeds, and stems
  - Provides residual control



# When and where to apply

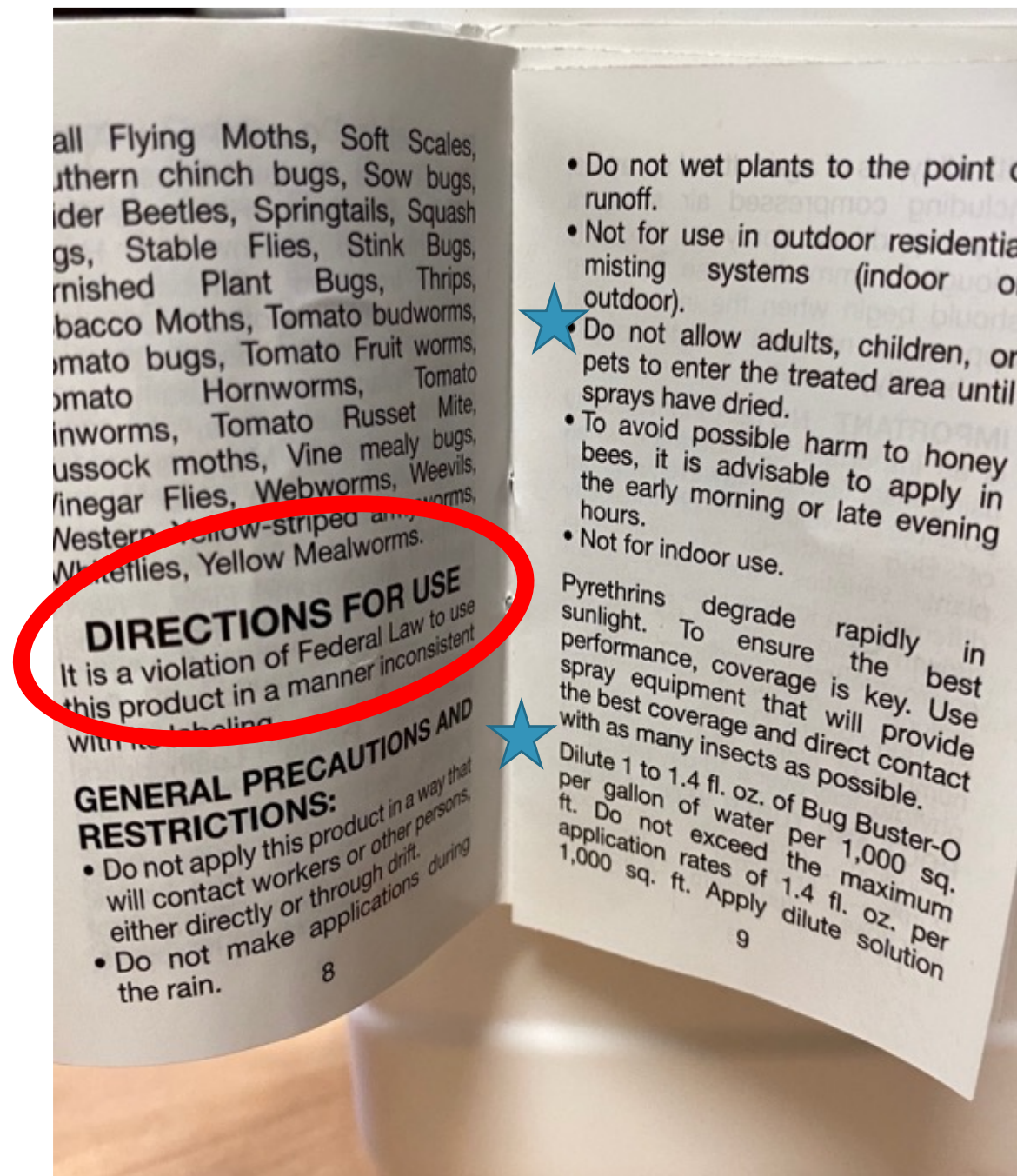
- Read the Directions for Use
- Look for:
  - Conditions to/to not apply in (rain, wind, high temp)
  - Time to apply to protect bees (early morning/late evening)
  - If you can use indoors or outside
  - If it's for use on edible or ornamentals





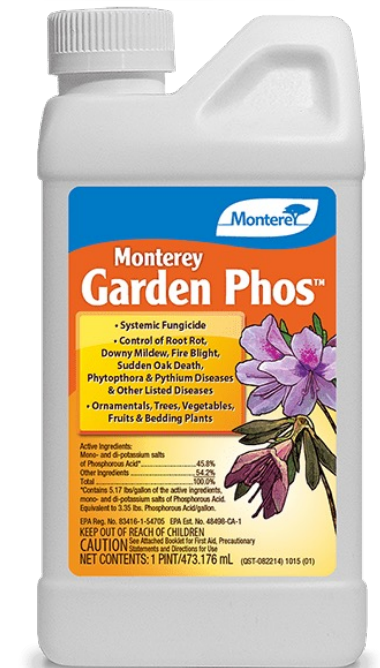
# How to apply and mix

- Read the Directions for Use
- Look for:
  - How much to apply (rate)
    - Do not exceed! Can cause injury and resistance
  - Mixing instructions
    - Don't use household items or containers
    - Cannot make for later use
  - How long after apply you can harvest or enter the area
    - Until dry or other specified length of time; keep children and pets out



# Application types

- Pre-mixed products better for home use
- Different application instructions



# Pesticide registration & certifications



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# Pesticide registration



Most pesticides are registered by the U.S. EPA and carry EPA Registration Numbers  
Must submit safety and efficacy data to EPA



To be sold and used in CA, most must also be registered with CA Department of Pesticide Regulation (DPR)



Some products & active ingredients are **exempt** from EPA registration and CDPR:  
“minimal risk” pesticides (Ex. Peppermint oil, citric acid)



USDA National Organic Program (NOP) determines **organically acceptable** active ingredients. These are often derived from natural products such as plants or minerals (including petroleum oil), but not always. Some have the OMRI logo or “for organic gardening” language, but not all do



# Pesticide label reading activity

- What are the active ingredients?
- What plants can it be used on?
  - Edible or ornamentals?
  - Indoor or outdoor?
- Find 3 pests it targets.
- How often can you apply?
- Is it labeled as organic?
- What is the application type?



# Pesticide safety and toxicity



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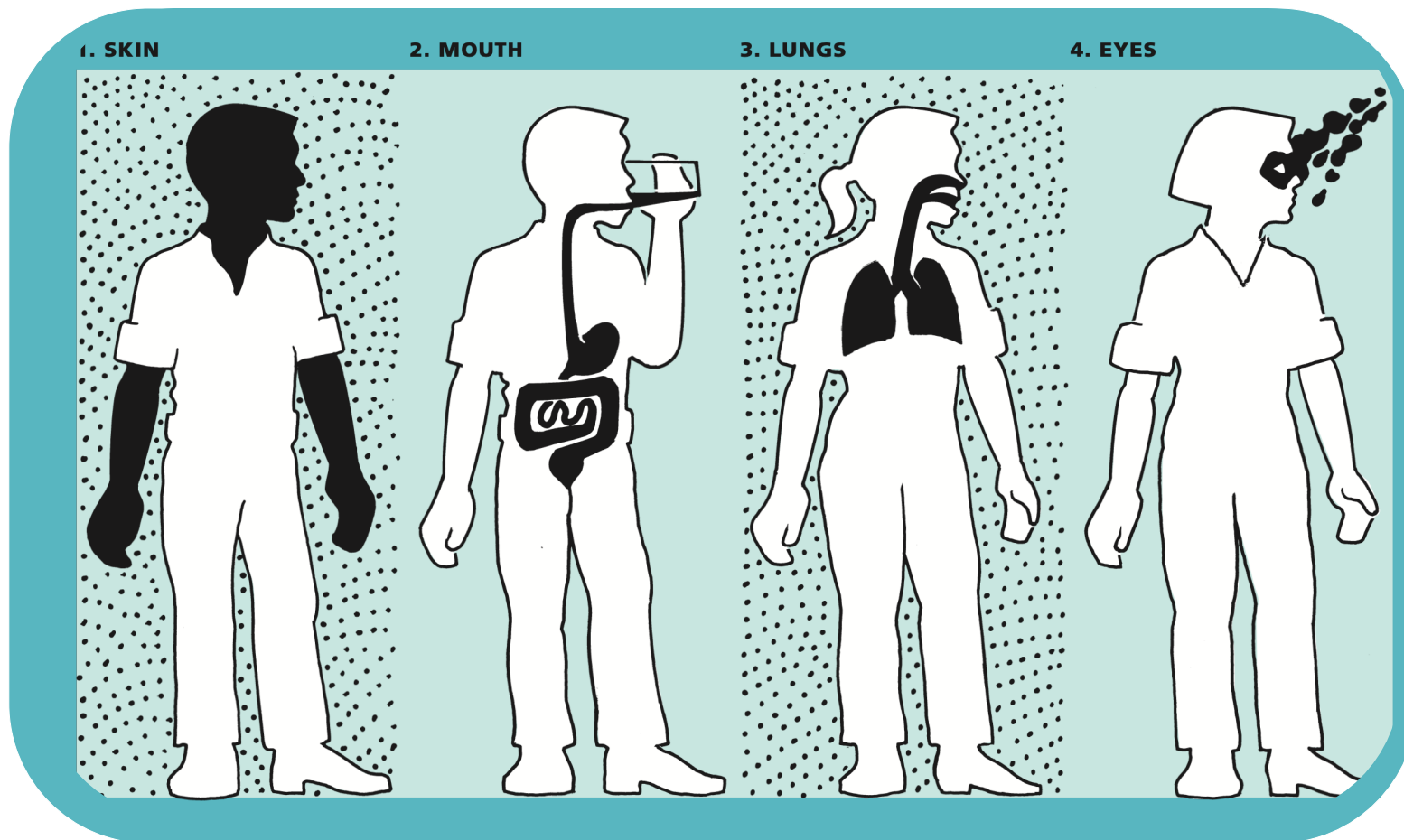




# Pesticide Toxicity

- **Toxicity:** *ability of a chemical to injure a person, animal, plant, or other organism*
- All chemicals are toxic to some organisms to some degree
  - Pesticides are designed to be toxic; natural materials can also be toxic
- Toxicity varies among organisms
- Acute and chronic toxicity

# Toxicity can occur when exposed to pesticides



# Acute toxicity

- The ability of a chemical to cause harm in a short period of time
  - Burning, itching, pain, coughing after pesticide exposure
- Indicated by signal words (CAUTION, WARNING, DANGER) on the pesticide label
- Based on LD-50 measurements of the active AND inert ingredients
  - LD-50 is the lethal dose to kill 50% of exposed individuals
  - Manufacturers must study oral, dermal, and inhalation toxicity



# Signal words

<b>CAUTION</b>	<b>Slightly toxic either orally, dermally, or through inhalation; causes slight eye or skin irritation.</b>
<b>WARNING</b>	<b>Moderately toxic either orally, dermally, or through inhalation; causes moderate eye or skin irritation.</b>
<b>DANGER</b>	<b>Can cause severe eye damage or skin irritation.</b>
<b>DANGER-POISON</b>	<b>Highly toxic by any route of entry into the body.</b>

Routes of Exposure	Toxicity Category			
	I	II	III	IV
Oral LD <sub>50</sub>	Up to and including 50 mg/kg	50-500 mg/kg	500-5,000 mg/kg	>5,000 mg/kg
Inhalation LC <sub>50</sub>	Up to and including 0.2 mg/l	0.2-2 mg/l	2-20 mg/l	>20 mg/l
Dermal LD <sub>50</sub>	Up to and including 200 mg/kg	200-2,000 mg/kg	2,000-20,000 mg/kg	>20,000 mg/kg
Eye Effects	Corrosive corneal opacity not reversible within 7 days	Corneal opacity reversible within 7 days; irritation persisting for 7 days	No corneal opacity; irritation reversible within 7 days	No irritation
Skin Effects	Corrosive	Severe irritation at 72 hours	Moderate irritation at 72 hours	Mild or slight irritation at 72 hours
Signal Word	DANGER POISON	WARNING	CAUTION	CAUTION
Adapted from 40 CFR Part 156.				

All pesticide toxicity values, including the LD<sub>50</sub>, can be found on the product's Material Safety Data Sheet (MSDS). Pesticide labels and MSDS can be obtained from retailers or manufactures. In addition, most products also have information that can be found on the Internet.



## Chronic toxicity

- Long-term toxicity: ability of a chemical to cause chronic damage or illness
  - Repeated exposure over a long period of time, or result of high acute toxicity
  - Birth defects, cancers, sterility, blood disorders, nerve damage, etc.







# UC IPM Active Ingredient Database

## Active ingredient: Imidacloprid

**Pesticide type: insecticide (neonicotinoid)**

See [example products](#) below.

Potential Hazard <sup>1</sup> to				
<u>Water quality</u> <sup>2</sup> (aquatic wildlife)	<u>Natural enemies</u> (beneficials)	<u>Honey bees</u> <sup>3</sup>	People and Other Mammals	
			<u>Acute</u> <sup>4</sup>	<u>Long Term</u> <sup>5</sup>
 L	 MH	 VH	 M	Not listed

# How can we prevent pesticide exposure?

- Follow the pesticide label
  - Paying attention to re-entry time or harvest timing
- Wear PPE!
- The label may state what PPE is necessary
  - May just say not to get on skin; don't breathe in
- In general, always wear chemical-resistant gloves, long-sleeve shirts, long pants, eye protection, and closed-toe shoes

# Pesticide storage

- Follow label specific instructions
  - Cool, dry place
  - Locked cabinet
  - In original container
  - Sealed or closed
- Triple rinse mixing and application equipment before storing





# Pesticide disposal

- **Excess diluted/mixed pesticides:** apply to plants/sites listed on label or take to household hazardous waste (HHW) site
- **Partially filled or unused pesticide containers:** take to HHW site
- **Empty pesticide containers:** place in trash or recycle if accepted in your area
- **Don't:** Flush down toilet or sink drains, dump in street gutter or outside, reuse containers
- Find HHW site
  - Check city website
  - Call **(1-800 CLEANUP)** or look up at [earth911.com](http://earth911.com)



# Pesticide label reading activity

- What is the signal word?
- What does the label say about PPE?
- Are there any environmental hazards? (toxic to bees, fish, etc.)

# Less toxic pesticides



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## What are less toxic pesticides?

- Products that pose less risks to humans and the environment
- Often break down quickly in the environment; limited residual control
- Most are contact pesticides; good coverage is essential
- Usually signal word CAUTION or none





## Pesticidal oils

- **Insecticide/miticide-** kills by smothering
  - Works best on soft bodied insects (aphids, mealybugs, whiteflies)
  - Requires good coverage; thoroughly cover insects don't just mist
- **Fungicide-** suppresses/smothers fungi and bacteria
- **Read the label!**
  - Sunlight or extreme temperature
  - May damage waxy plants, or change color of evergreens

# Petroleum-based pesticidal oils

- Horticultural oil, mineral oil, supreme oil
- **Dormant oil-** for use on trees and woody plants before buds open in spring
  - Highly concentrated (mostly oil, less water)
  - Don't use in summer; will kill leaves
- **Summer oil-** for use in summer, but can be used year-round
  - Very low concentration (more water, less oil)
  - Read label; some may not be used at temp. extremes



# Plant-based pesticidal oils

- Neem oil, canola oil, rosemary oil, clove oil
- Botanical oils contain trace amounts of chemicals that are extracted and used as active ingredients: limonene, eugenol, azadirachtin, etc.
- Limited information about effectiveness



# Pesticidal soaps

- **Insecticide-** kills insects by covering/smothering
  - Works best on soft bodied insects (aphids, mealybugs, whiteflies)
  - Requires good coverage; thoroughly cover insects don't just mist
- **Fungicide-** interferes with cellular processes of fungi and bacteria
- **Herbicide-** causes leaves to dry out and die
  - Doesn't kill roots; works best on young, small plants
- Some soaps may react to sunlight or extreme temperature, so read the product label



# Pesticidal soaps

- **Potassium salts of fatty acids** (insecticide or miticide)
- **Copper octanoate** (fungicide)
- **Ammoniated soap of fatty acids** (herbicide)



# Microbial pesticides

- Derived from microorganisms like bacteria, fungi, and viruses
- Good coverage essential
- **Active ingredients:**
  - *Bacillus thuringiensis var. kurstaki* and *aizawa*– for caterpillars
  - *Bacillus thuringiensis var. israelensis* – for mosquito, gnat, and fly larvae
  - Spinosad – for caterpillars, thrips, leafrollers and leaf miners



# Other less toxic pesticides

- Insecticides:
  - **Borate** (Boric acid or borax)
  - **Pyrethrins** – from chrysanthemum flowers
- Fungicides:
  - **Copper formulations**
  - **Sulfur**



# Pesticide toxicity to natural enemies

Insecticide	Contact Toxicity	Persistence of Toxic Residue
Bacillus thuringiensis	None	None
Oils/Soaps	Moderate	None
Botanicals (pyrethrins/ azadiractin)	Moderate to high	Short
Spinosad	Moderate	Medium
Organophosphates/ carbamates/ pyrethroids	High	Medium to long
Imidacloprid: foliar spray	Variable: most natural enemies affected	Medium
Imidacloprid: soil applied or root/trunk injected	Bees, predatory beetles, and nectar-feeding parasites affected	Long



# Homemade pesticides

- Not tested for safety or effectiveness
- No instructions for use
- Can be harmful to people and plants
- Liability



# Communicating with customers about pesticides



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# Talking pesticides with customers



- Use IPM process
- Accurately identify pest or diagnose problem

# Talking pesticides with customers

- **Encourage use of non-chemical solutions**
  - Can they modify the environment, hand pick or hose off?
  - Can natural enemies help?
  - Direct them to UC IPM Pest Notes factsheet or Quick Tips
- **Suggest a pesticide**
  - Less-toxic, RTU products
  - For indoor or outdoor use?
  - Edible or ornamentals?
  - Still discuss non-chemical solutions
  - Refer to UC IPM Pest Notes factsheet or Quick Tips





# Talking pesticides with customers

- **Educate on pesticides**

- Review the label with them or the importance of reading it
- Use only as the label says (more is not better!!)
- If mixing is required, discuss what to use and how
- Discuss proper PPE and where they can find it in the store
- How to apply to minimize risks to pollinators or runoff and drift
- Warn on use of homemade pesticides

# Talking pesticides with customers

- **Promoting informed customer decisions and safety!**
  - Give them options
  - Discuss the risks
  - Keep judgement and bias out





## Wrap up

- Pesticides can be an important tool in IPM
- All pesticides/chemicals have the potential to cause harm
  - Even organic or “natural products”
  - Use less toxic products to reduce risks
  - Apply in ways that minimize harm
- Always read and follow the label!
  - Wear PPE to protect yourself
- Pesticide education is essential to pesticide safety

# Disclaimers

- **No endorsements of named products are intended, nor is criticism implied of products not mentioned.** Always read and carefully follow all precautions and safety instructions provided on the pesticide container label, as well as any other regulations regarding the use of pesticides. Not following label directions, even if they conflict with information provided herein, is a violation of state and federal law.
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What's  
PPE?!

## Questions?

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