

CHAPTER 1

Pest Management

Chapter 1

National Pesticide Applicator Certification
Core Manual

CHAPTER 1

Pest Management

This module will help you:

- ❖ Understand the historical perspective of pest management
- ❖ Know the main groups of pests
- ❖ Learn about resources to identify specific pests and damage symptoms
- ❖ Understand Integrated Pest Management (IPM)

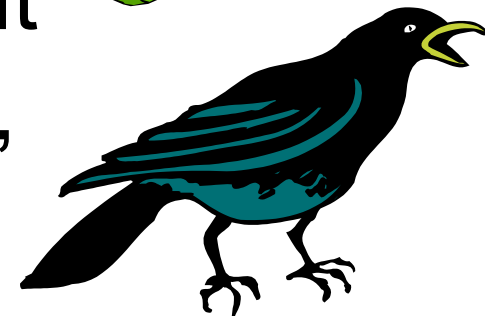
Pest Management

This module will help you:

- ❖ Understand the significance of preventive measures
- ❖ Understand pest population levels and environmental influences
- ❖ Understand pesticide resistance and what causes pesticides to fail

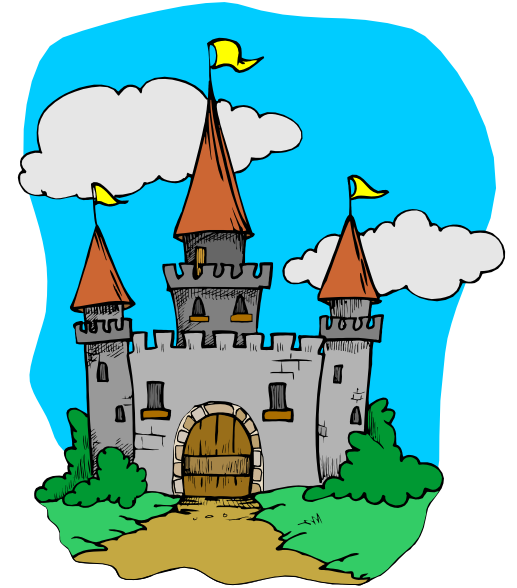
What is a Pest?

- ❖ any organism that is detrimental to humans
 - ❖ destroys crops & structures
 - ❖ poses threats to human health and livestock
 - ❖ reduces aesthetic and recreational value
- ❖ **Pests** include insects, mites, plant pathogens, weeds, mollusks, fish, birds, and mammals



History Lesson: Bubonic Plague

- ❖ 14th Century Europe: mysterious scourge kills millions
- ❖ Centuries later it was found that rat fleas became infected with disease-causing bacteria
- ❖ Fleas sought other warm-blooded hosts (humans) when rat numbers declined
- ❖ Plague is currently managed monitoring for plague and reducing the number of rodent-hosts for fleas



History Lesson: Potato Famine

- ❖ Late blight, a fungal disease, decimated Ireland's potato crops
- ❖ Thousands starved; over a million migrated to U.S.
- ❖ Today, late blight is still a major problem, but is managed by:
 - ❖ resistant cultivars
 - ❖ proper sanitation
 - ❖ fungicide applications



History Lesson: Pest Control

- ❖ Primitive: pulling weeds, clubbing rats, plucking insects from foliage
- ❖ **Sulfur** burning for mites/insects: 2500 B.C.
- ❖ **Lead arsenate** in orchards - 1892
- ❖ Lime and copper sulfate – **Bordeaux mixture**
- ❖ Early pesticides – plant extracts or inorganics
- ❖ World War II: **DDT** and low cost synthetic chemistry

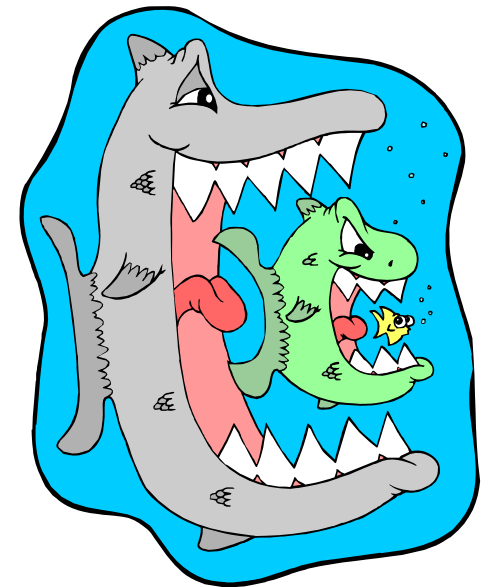


Concerns with Pesticide Dependence

- ❖ **Pest resistance**
- ❖ **Environmental persistence**
- ❖ **Bioaccumulation:** when a chemical accumulates in animal fat (historical fact)
- ❖ **Biomagnification:** when an organism accumulates residues at higher concentrations than the organisms they consume



Colorado Potato Beetle



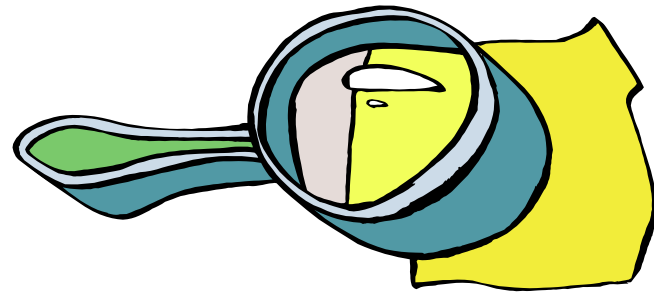
US Congress Concerned about Pesticides

- ❖ US Environmental Protection Agency (EPA) created in 1970
- ❖ Charged with protecting environment and health of humans and animals
 - ❖ DDT banned in 1972
- ❖ Public concern has led to stringent regulation of pesticides, as well as changes in types of pesticides used



Pest Management

- ❖ Is the pest really causing the problem?
- ❖ 1st Step: Always identify the pest before taking any action!
- ❖ Become familiar with its life cycle and habits
- ❖ Use the information to design a pest management plan
- ❖ Misidentification results in lack of knowledge = ineffective control of the real pest



Four Major Pest Categories

#1 - Weeds: undesirable plants



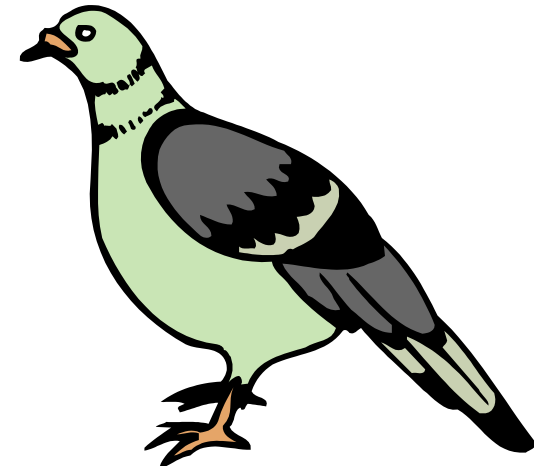
Four Major Pest Categories

❖ #2 - Invertebrates, such as:

- ❖ Insects
- ❖ Spiders and mites
- ❖ Sowbugs, pillbugs
- ❖ Snails, slugs, and mussels



Four Major Pest Categories



❖ #3 – Vertebrates, such as:

❖ Birds

❖ Snakes

❖ Fish

❖ Rodents and other mammals



Four Major Pest Categories

❖ #4 - Plant Diseases

❖ Pathogens – living agents

❖ Fungi

❖ Bacteria

❖ Viruses

❖ Nematodes

❖ Phytoplasmas

❖ **Non-living agents:** cold, heat, pollutants, dog urine



Pest Identification is Critical



- ❖ Understand that all stages of a pest do not look the same
- ❖ Know the host of the pest
- ❖ Use books, extension bulletins, field guides, Web, etc.
- ❖ Have pests examined by specialists
 - ❖ Handle samples carefully



Look for Characteristic Signs

- ❖ Birds and rodents: unique nests
- ❖ Insects: feeding damage
- ❖ Fecal materials are distinctive – insect frass or bat guano
- ❖ Weeds: particular flowers, seeds, or unusual growth habits
- ❖ Pathogens: unique patterns or growths on plant tissue



Natural Controls

❖ Wind



❖ Temperature

❖ Humidity, rain

❖ Rivers, lakes, mountains

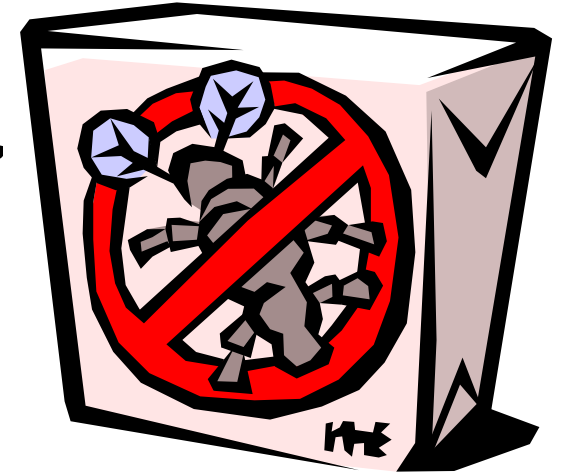
❖ Pathogens, predators

❖ Food supply of the pest



Human-applied Controls

- ❖ Biological
- ❖ Mechanical
- ❖ Cultural
- ❖ Physical
- ❖ Genetic
- ❖ Chemical
- ❖ Regulatory



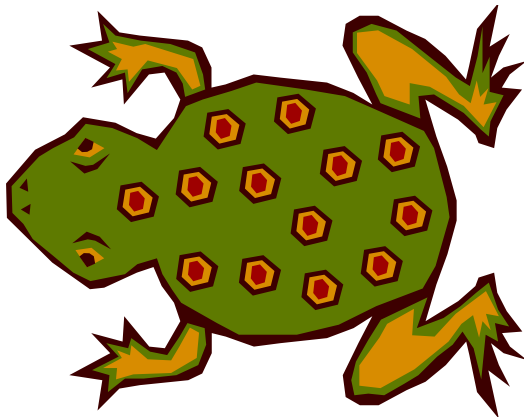
What is Biological Control?

- ❖ Usually, pests are not native to area
- ❖ Locate pest's native homeland and find natural enemies
- ❖ Before releasing natural enemy, evaluate if suitable
- ❖ Rear, release, redistribute



Biological Control Results

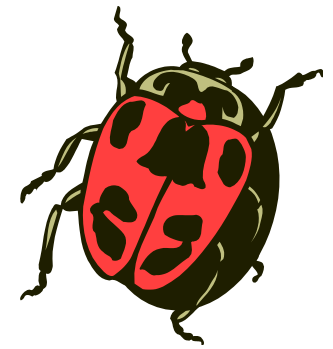
- ❖ Release natural enemies may become established and reduce infestation levels
- ❖ May not require any additional releases



BEWARE:

The cane toad was introduced in Australia in 1935 to control two pests of sugar cane, but later emerged as an invasive species itself!

Using Biological Control



- ❖ Periodic mass release from cultures
 - ❖ Natural areas, greenhouses, orchards
- ❖ Recognize naturally-occurring organisms
- ❖ Manage to conserve native beneficials
- ❖ Avoid broad-spectrum insecticides
- ❖ Use non-chemical strategies



Nabid eating a Lygus bug.

Applied Control: Mechanical

Use of devices, machines, and other physical methods to reduce pest populations or to alter the environment



Mechanical: Cultivation

- ❖ **Disrupt soil conditions** for weeds and insects

- ❖ Hoes

- ❖ Plows

- ❖ Disks



- ❖ **Control growth or destroy plants**

- ❖ Mowers



Mechanical: Exclusion

- ❖ Prevent pests from entering or traveling

- ❖ Nets, screens, air curtains
- ❖ Caulking, steel wool
- ❖ Metal tree collars
- ❖ Sticky materials
- ❖ Sharp objects



Mechanical: Trapping

- ❖ Use of mechanical or sticky device
- ❖ Captures pests in a holding device
 - ❖ Restrains the pest
 - ❖ Kills the pest



Applied Control: Cultural

Alter conditions or pest behaviors

- ❖ Mowing
- ❖ Irrigation
- ❖ Aeration
- ❖ Fertilization
- ❖ Mulching
- ❖ Tolerant crop varieties
- ❖ Planting timing
- ❖ Crop rotation
- ❖ Trap crops

Applied Control: Cultural

- ❖ **Sanitation:** eliminate food, water, and shelter
 - ❖ destroy infected crop residues or infected ornamental plant materials
 - ❖ weed to reduce pest harborage
 - ❖ manage manure
 - ❖ seal garbage cans
 - ❖ remove soil near siding



Applied Control: Physical

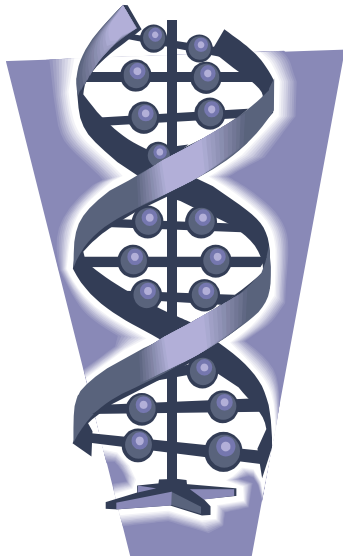
❖ Alter physical environment

- ❖ humidity
- ❖ temperature
- ❖ air movement
- ❖ water
- ❖ light



Refresh birdbath water weekly to manage for mosquitoes

Applied Control: Genetics or Host Resistance



- ❖ Add or modify genetic material in crops and ornamental plants

- ❖ Breed or select plants for resistance



Applied Control: Chemical

- ❖ **Pesticide:** any material that is applied to kill, attract, repel, or regulate pests
 - ❖ Disinfectants, fungicides, herbicides, insecticides, repellents, defoliants, piscicides, etc.
- ❖ Advantages: effective, fast, easy



Pesticides vary by...

- ❖ **Mode of action:** how they work to control the pest
 - ❖ **Systemic** pesticides are absorbed through tissues and transported elsewhere where the pest encounters it through feeding
 - ❖ Used on plants or livestock
 - ❖ **Contact** pesticides must come in direct contact with the target pest

Pesticides vary by...

- ❖ **Selectivity:** what range of pests they affect
 - ❖ **Non-selective** – kills all related pests – for example some herbicides kill all green plant that gets a sufficient dose
 - ❖ **Selective** – kills only certain weeds, insects, plant pathogens – for example other herbicides only kill broadleaf weeds not grasses

Pesticides vary by...

- ❖ **Persistence**: how long they remain active in the environment
 - ❖ **Residual pesticides** – remain active for weeks, months, years – for example herbicides used around road guard rails
 - ❖ **Non-residual** – inactivated immediately or within a few days – for example – some herbicides do not remain active in the soil once applied

Regulatory Pest Control

- ❖ **Quarantine** prevents pests from entry to an area or movement from infested areas.
 - ❖ Monitor airports, ocean ports, borders
 - ❖ Nursery stocks and other plant materials

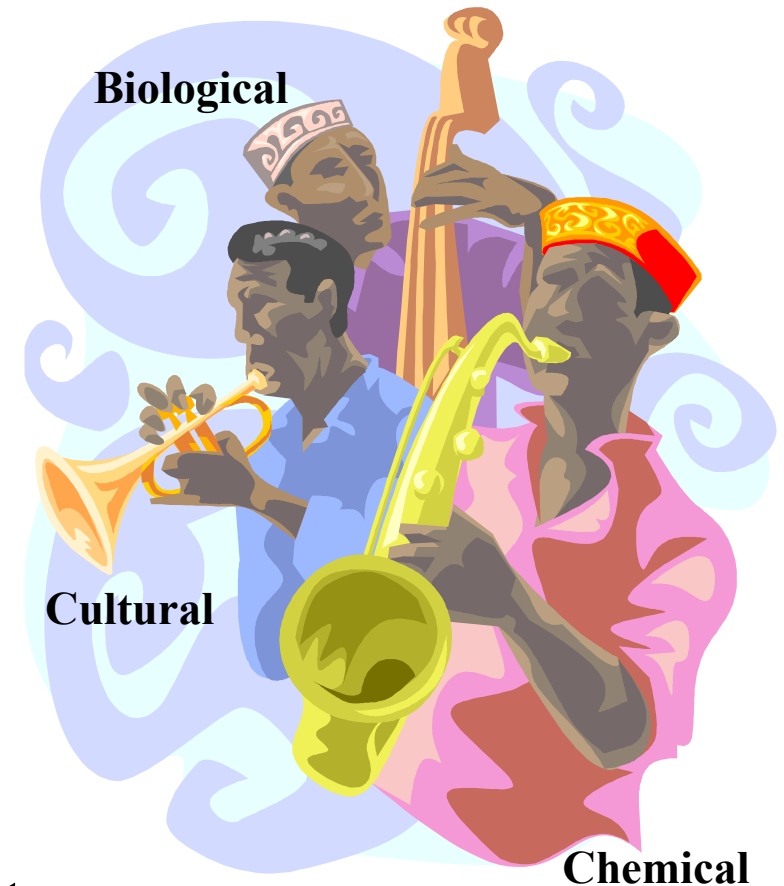


- ❖ **Eradication programs** eliminate a pest from a defined area
- ❖ **Mosquito Abatement** used for public health

Integrated Pest Management

IPM: a balanced, tactical approach

- ❖ Anticipates and prevents damage
- ❖ Uses several tactics in combination
- ❖ Improves effectiveness, reduces side effects
- ❖ Relies on identification, measurement, assessment, and knowledge



Why Practice IPM?

- ❖ Maintains balanced ecosystems
- ❖ Pesticides alone may be ineffective
- ❖ Promotes a healthy environment
- ❖ Saves money
- ❖ Maintains a good public image



Considerations for Choosing Control Methods

- ❖ Determine damage level you can withstand
- ❖ Determine desired control outcomes
 - ❖ Prevention of pest outbreaks
 - ❖ Suppression to acceptable level
 - ❖ Eradication of all pest organisms
- ❖ Manage for pesticide resistance
- ❖ Estimate costs
 - ❖ Monetary
 - ❖ Environmental impacts

Integrated Pest Management is Driven by Decisions

1. Identify the pest and know its biology
2. Monitor and survey for pests
3. Set IPM goal: prevent, suppress, eradicate
4. Implement
 1. Select control strategies
 2. Timing
 3. Economics
 4. Environmental impacts
 5. Regulatory restrictions
5. Evaluate



Components of IPM

1. Identify and Understand

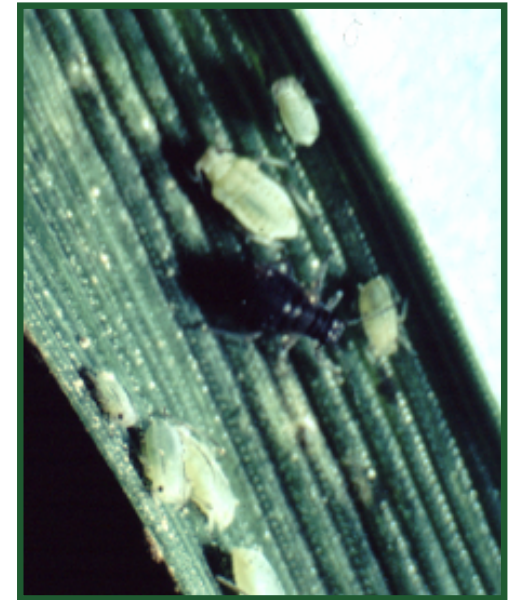
- ❖ Is it a pest, beneficial, or just there?
- ❖ Study pest biology
 - ❖ Pest classification
 - ❖ Life cycle
 - ❖ Over-wintering stage
 - ❖ Damage impacts
 - ❖ Environmental needs
 - ❖ Vulnerable control stages/timing

Components of IPM

1. Identify and Understand

❖ **Key pests**

- ❖ Prior knowledge of which common pests may pose a problem
- ❖ Recognition of damage symptoms
- ❖ Recognition of diseases
- ❖ Recognition of beneficial insects
- ❖ Frequent monitoring



Components of IPM

1. Identify and Understand

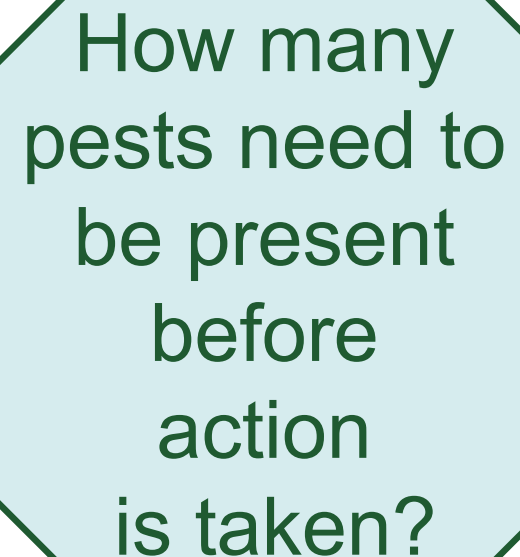
- ❖ **Occasional pests** may become troublesome from time to time
- ❖ **Secondary pests** become problems when key pests are controlled or eliminated
 - ❖ such as spider mites



Components of IPM

2. Monitor the Pest

- ❖ Use scouting, trapping, weather data, models
- ❖ Economics or aesthetics trigger need for action
 - ❖ Pest population
 - ❖ Beneficial population
 - ❖ Geographic location
 - ❖ Plant variety
 - ❖ Plant type & stage of growth
 - ❖ Cost of control measure(s)
 - ❖ Value of plant or crop

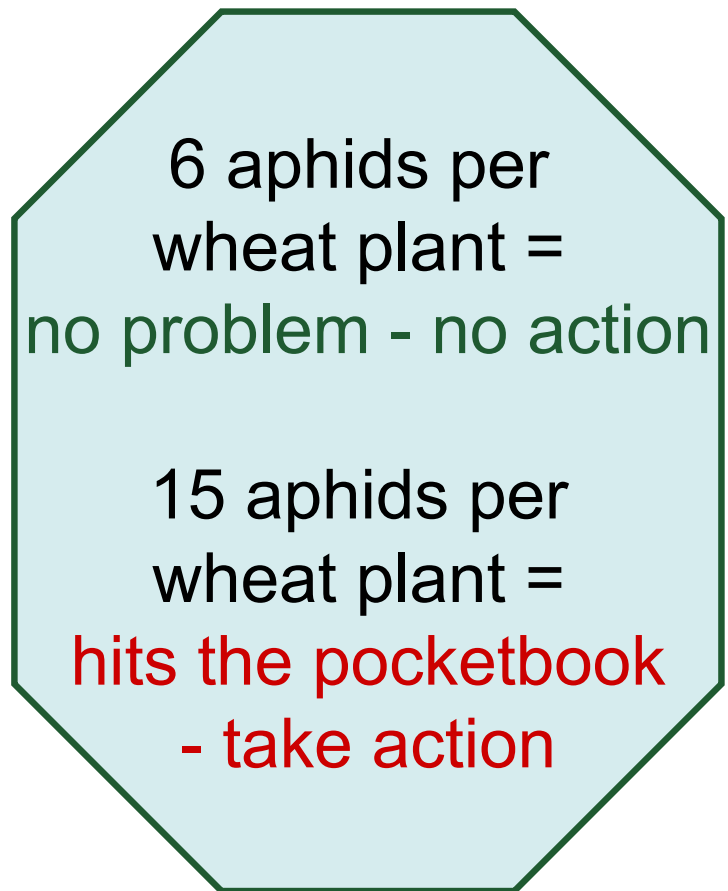


How many pests need to be present before action is taken?

Components of IPM

2. Monitor the Pest

- ❖ **Action threshold:**
unacceptable pest level
– **do something**
- ❖ Sometimes the action threshold may be **zero!**
- ❖ Action thresholds vary by pest, site, and season



Treatment or Action Threshold

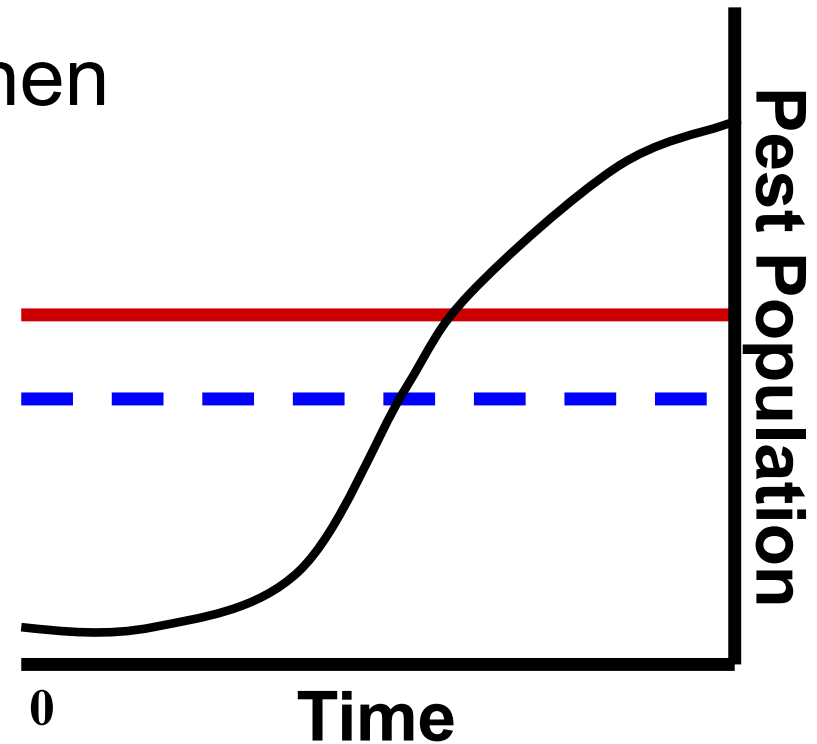
❖ Economic Threshold

- ❖ pest population density when *control is necessary* to prevent economic injury

❖ Economic Injury Level

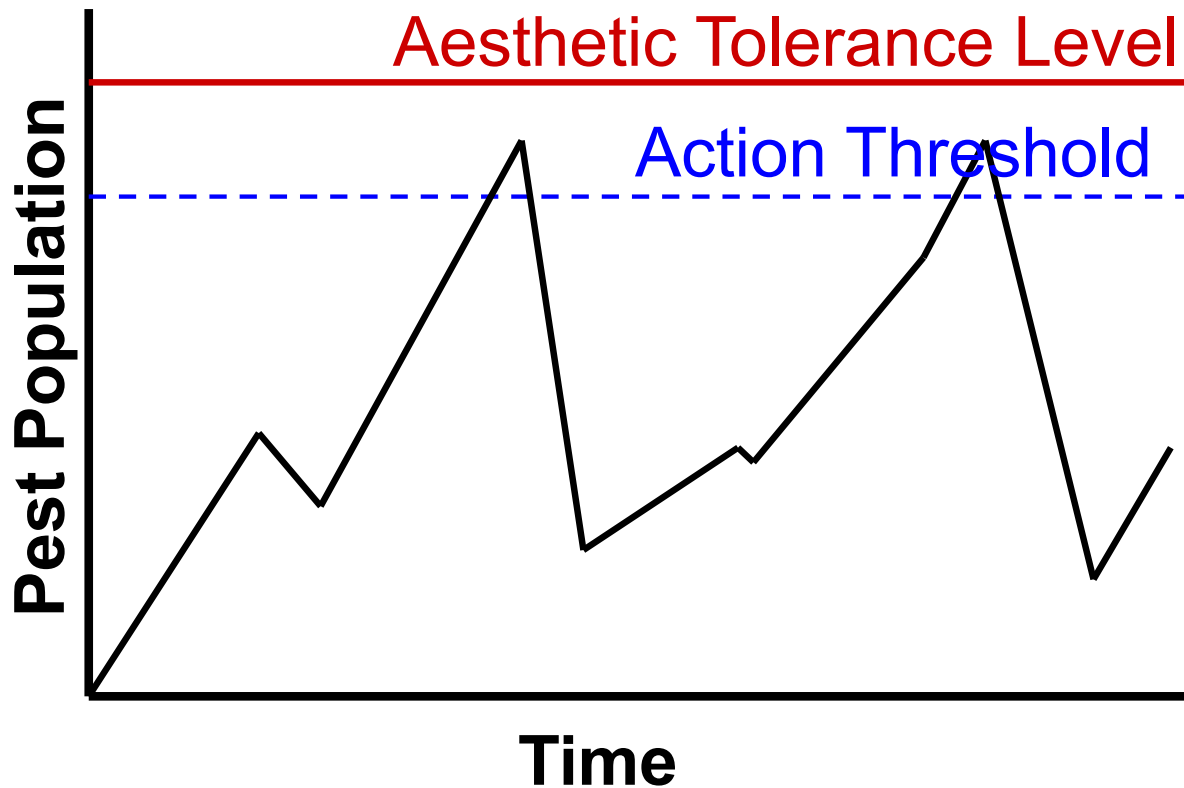
- ❖ when the cost of losses equals the cost of control measures

- ❖ Apply control measure **prior** to reaching economic injury level



Components of IPM

2. Monitor the Pest



Action Threshold is also based on aesthetics or public health issues

At what point does the cost of control ward off future expenses

Components of IPM

3. Develop the IPM Goal

- ❖ **Prevention:** weed-free seed, resistant plants, sanitation, exclusion, pesticide treatments
- ❖ **Suppression=reduction** cultivation, biological control, pesticides
- ❖ **Eradication=elimination** small, confined areas, or government programs



Components of IPM

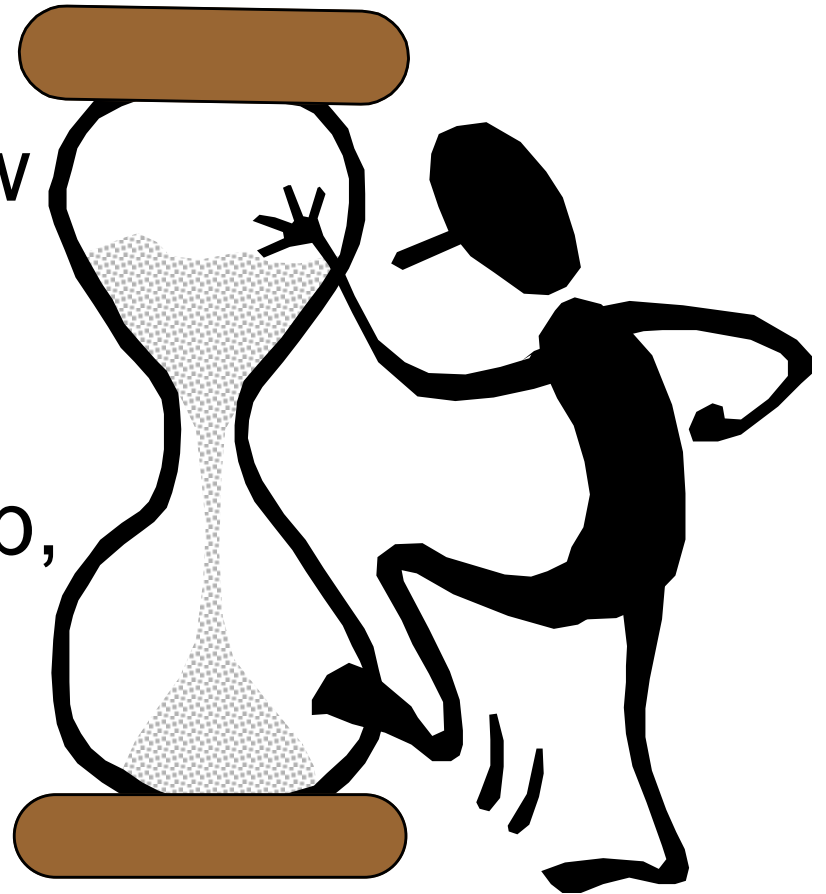
4. Implement the IPM Program

- ❖ Make sure you have taken initial steps
 - ❖ Identification and monitoring
 - ❖ Set action thresholds
 - ❖ Know what control strategies will work
- ❖ Select effective and least harmful methods!
- ❖ Observe all local, state, federal regulations!

Components of IPM

5. Record and Evaluate Results

- ❖ Know what worked and what did not
- ❖ Some aspects may be slow to yield results
- ❖ Might be ineffective or damaging to the target crop, beneficial insects, etc.
- ❖ Use gained knowledge in future planning efforts



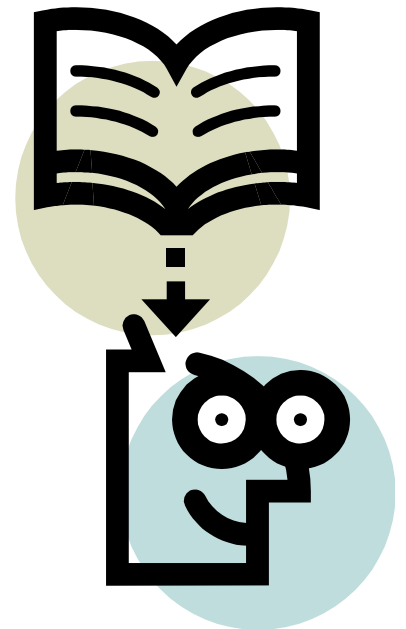
Considerations for Pesticide Use

- ❖ Identify the pest and select the appropriate product
 - ❖ old or new infestation
- ❖ Avoid developing resistant pest populations
- ❖ If using pesticides, use the correct application rate (dose) and timing



Be A Professional IPM Practitioner

- ❖ Careful observation
- ❖ Knowledge of the pest, control options
- ❖ Professional attitude



Pesticide Resistance:

the ability of a pest to tolerate a pesticide that once controlled it

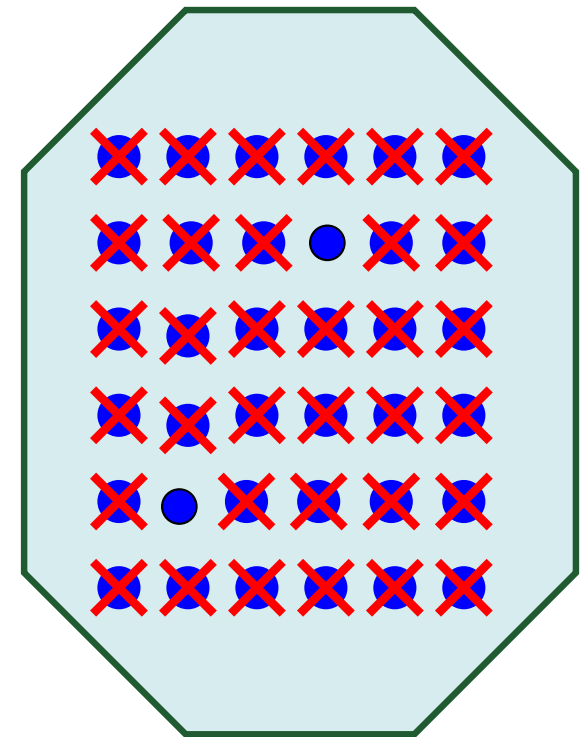
❖ Intensive pesticide use kills susceptible pests in a population, leaving some resistant ones to reproduce

❖ Use of similar modes of action

❖ Frequency of applications

❖ Persistence of the chemical

❖ Pest rate of reproduction & offspring numbers



Resistance Management

- ❖ Do not use products repeatedly that have similar modes of action
- ❖ Allow some pests to survive
 - ❖ Limit treatment areas
 - ❖ Consider using lower dosages
- ❖ Use caution: new compounds having very specific actions - may develop resistance more quickly
- ❖ Use non-chemical means to control resistant pest populations

Summary

- ❖ Use Integrated Pest Management
- ❖ Identify and understand the pest
- ❖ Monitor pest populations
- ❖ Know when to apply control measures
- ❖ Evaluate results
- ❖ Manage for pesticide resistance
- ❖ Use good judgment to avoid harmful effects

CHAPTER 1

Q1. Which of the following are legally classified as pesticides?

1. insecticides
2. nematicides
3. growth regulators
4. disinfectants

- A. 1 only C. 1, 2, and 4 only
B. 1 and 2 only D. 1, 2, 3, and 4

CHAPTER 1

Q2. You have used a selective herbicide to manage a weed infestation. You are concerned that the weeds are herbicide-resistant. What tactic should you consider to control resistant weeds?

1. use a herbicide with a different mode of action
2. use cultivation strategies to manage the weed
3. use the same herbicide, but apply at double the highest label rate
4. mix in a spreader-sticker with the same herbicide and apply using smaller droplets to achieve better coverage

A. 1 and 2 only

C. 1 and 4 only

B. 2 and 3 only

D. 2 and 4 only

CHAPTER 1

Q3. Following are two scenarios that employ the same pest control strategy. 1. Draining standing water to manage for mosquitoes. 2. Closing garbage lids to eliminate food access by rodents. What type of pest control strategy was employed?

- A. Exclusion
- B. Sanitation
- C. Biological
- D. Mechanical

Acknowledgements

- ❖ Authors: Carol Ramsay, Carrie Foss, Becky Hines, and Brett Johnson, Washington State University Urban IPM and Pesticide Safety Education Program
- ❖ Illustrations were provided by Nevada Dept. of Agriculture, University of Missouri-Lincoln, Virginia Tech., Washington Dept. of Agriculture, Washington State University



Acknowledgements

- ❖ Presentation was reviewed by Ed Crow, Maryland Dept. of Agriculture; Jeanne Kasai, US EPA; Beth Long, University of Tennessee; and Susan Whitney King, University of Delaware.
- ❖ Narration was provided by Carrie Foss, Washington State University Urban IPM and Pesticide Safety Education Program

CHAPTER 1

Support for this project was made possible through EPA Office of Pesticide Program cooperative agreements with the Council for Agricultural, Science and Technology, and the National Association of State Departments of Agriculture Research Foundation. The views expressed herein are those of the authors and do not necessarily represent the views and policies of the EPA.

The logo for CAST (Council for Agricultural, Science and Technology) features the word "CAST" in white, bold, sans-serif capital letters, centered within a dark green rectangular background.