Integrated Pest Management

Oahu Master Gardener Training

20 March 2015

Fred Brooks

Integrated Pest Management

- Some history
- What is IPM?
- When do we use it?
- How do we use it?
  - Exclusion
  - Avoidance
  - Eradication
  - Protection
- Summary

Non-target species

Applying DDT in the 1950s

History of Pest Control (plants)

- 2500 BC: 1st insecticide (sulfur) by Sumerians
- 950 BC: Burning to control plant diseases
- 750 BC: Greeks spread wood ash on soil
- 300: 1st biocontrol, ants/caterpillars, citrus
- 1600s: nicotine, herbs, arsenic against insects
- 1732: crops grown in rows for weed control
- 1901: 1st success. weed biocontrol, lantana, HI

Integrated Pest Management is:

1. Protecting plants from *excessive* pest damage
2. Keeping pest populations at or below an *acceptable* level
3. *Minimizing* danger to people and the environment
4. *Efficient* (includes cost-effectiveness)

Mediterranean Fruit Flies

What Does IPM Mean?

Integrated: combining a *variety* of *science-based* methods to protect plants from pests

Pest: insects, mites, fungi, bacteria, viruses, nematodes, weeds, rodents, etc. that cause *injury* or are *unwanted*

Management: a *planned, systematic* way to control pest populations by keeping their numbers and damage at or below *acceptable* levels

IPM: A Fruit Fly Example

"Using a combination of techniques ranging from heightened field sanitation through lures and poison to eradicate fertile male flies, UH researchers were able to drastically reduce fly populations on local farms.

What they have come up with is not a "magic bullet," but rather a mix of techniques that change according to crop, terrain, and type of fly being targeted."

Honolulu Advertiser, 31 August 2004

How Did IPM Come About?

- WW II and organic pesticides (OPs, DDT, etc.)
- Early pesticides broad spectrum, long-lasting
- New technologies made application fast, easy, efficient
- Entomologists in the late 1950s were concerned about misuse of pesticides
- Rachel Carson's *Silent Spring* (1962)


Rachel Carson

Misuse of Pesticides Leads to:

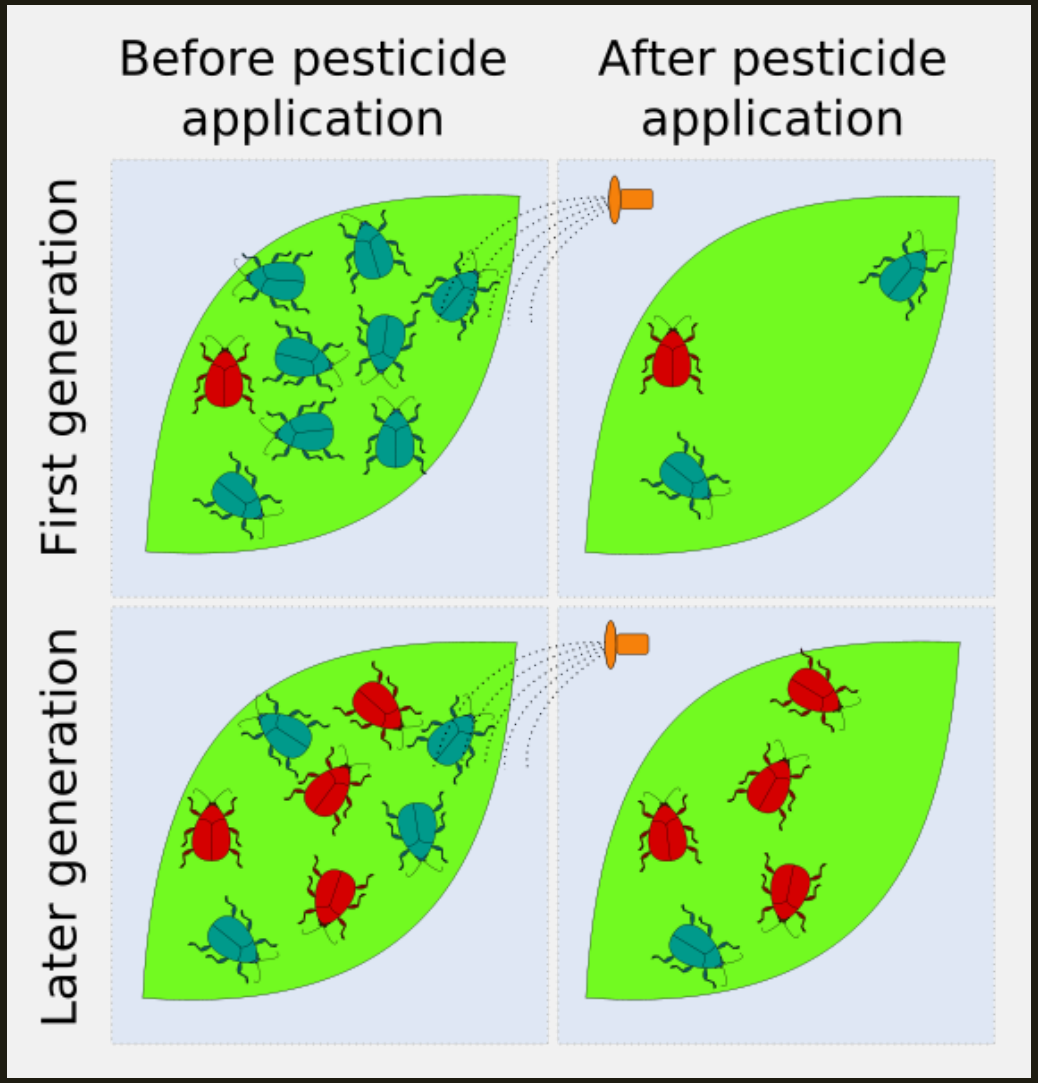
- Contamination of water, soil, air
- Bioaccumulation, biomagnification
- Pesticide resistance (next slide ➡)
- Secondary pests become a problem
- Natural enemies killed ➡ biological vacuum ➡ pest resurgence
- WHO and the flying cats

WHO and the Flying Cats of Borneo

- DDT sprayed in thatched houses to kill malarial mosquitoes
- Mosquitoes died = less malaria in village
- Parasitic wasps killed, thatch-eating caterpillars lived = roofs collapsed
- Dead mosquitoes, wasps eaten by geckos
- Geckos eaten by cats
- Cats died = increase in rat population = sylvatic plague and typhus
- WHO parachuted live cats into Borneo to control rats

Well, maybe it didn't happen *exactly* that way . . . !

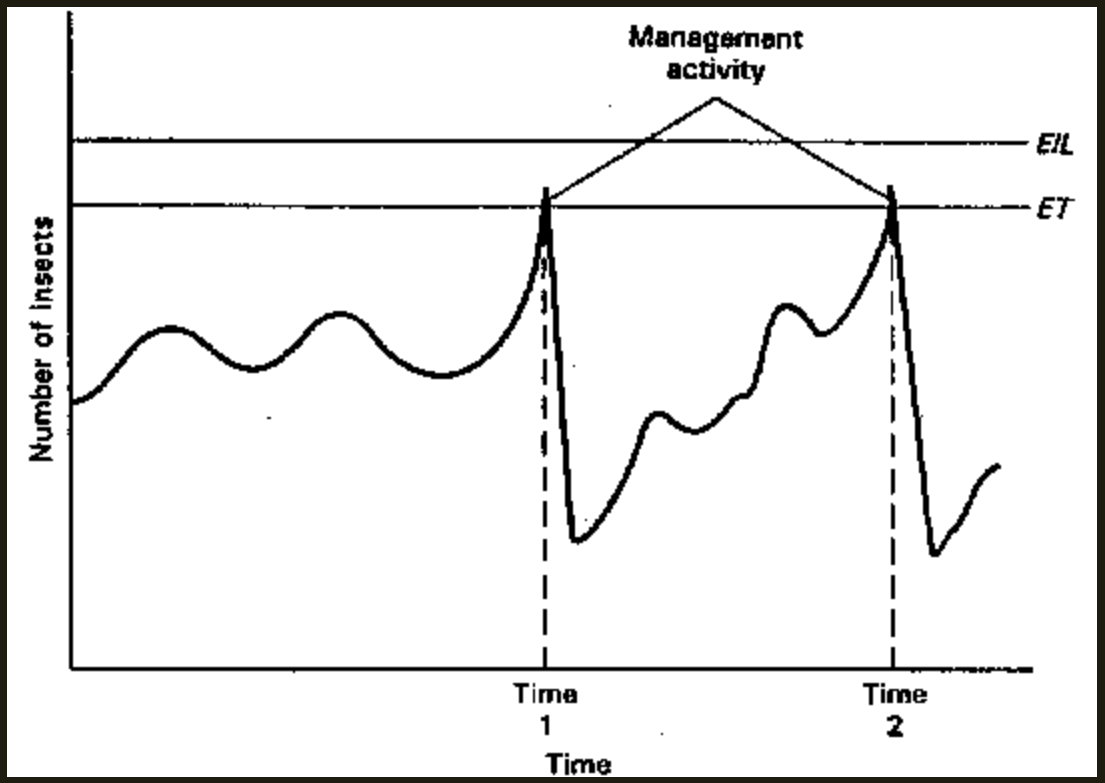
"Artificial Selection" for Pesticide Resistance



When Do I Use a Pesticide in IPM?

When pest levels reach an Economic (Action) Threshold

SCOUTING



(Econ. Injury Level)
(Econ. Threshold)

ET: # pests that trigger a control measure(s) to prevent reaching EIL.

EIL: losses caused by pest ≥ cost of control measures

Integrated Pest Management

Maintains pests at "acceptable" levels by:

Exclusion

Eradication

Avoidance

Protection

Exclusion

- Exclusion: managing a pest by preventing its introduction into an area
- Quarantines
  - 1) International, national, state
  - 2) Local (nurseries, etc.)

Department of Agriculture
STATE OF HAWAII

USDA

Exclusion

Quarantine Limitations

- Natural dispersal of the pest (wind, water, vectors)

- Cannot see pathogens, early infections, pest eggs, etc.

- Insufficient resources or technical training of inspectors

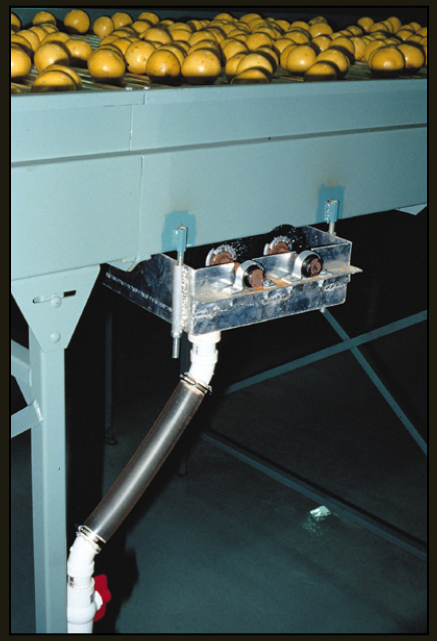
Eradication

- Difficult – pest outbreak must be *located* and *contained* quickly
- **Destroy** all infested/infected plants
- **Disinfest** all containers, tools, soil, etc.
- **Monitor** surrounding area for 2 to 3 years

- 18 Jan. 2015: Red palm weevil eradicated in California

Eradication

- Chemicals
  - Disinfestants
  - Herbicides
  - Insecticides
  - Nematicides
  - Soil fumigants
  - Seed treatments

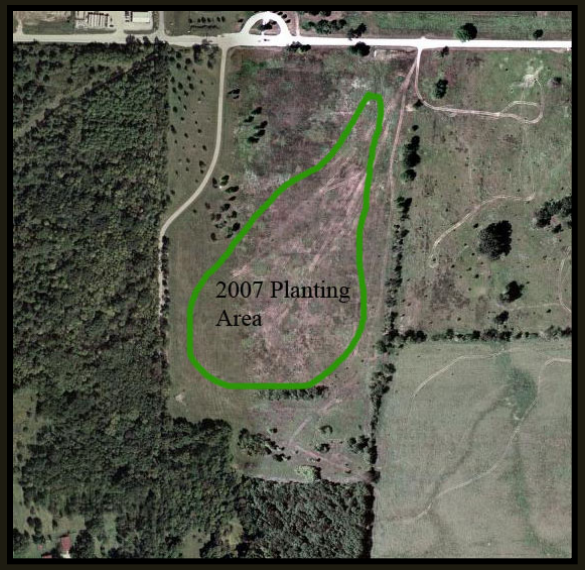


Disinfection rollers

Soil fumigation (not in field)

Avoidance

- Avoid infested areas
- Best plants in best sites
- Healthy plants
- Resistant varieties, non-host
- Planting/harvest time



Do not plant in an area with previous known disease problems

- Usually cannot completely exclude, eradicate, or avoid pests, so to protect plants you must manage the pest population.

Protection

- Physical and cultural control
- Biological control
- Genetic resistance
- Chemicals

"Plant Disease Triangle"

Host

Pest

Environment

Protection

- General Practices
  - Plant nutrition, soil pH
  - Barriers and mulches
  - Traps, attractants

Web blight before and after applying an organic mulch

Plastic mulch on raised rows

Protection

- Temperature
  - Burning stubble, debris
  - Steam heat
  - Composting
  - Solarization (clear plastic)
  - Greenhouse (indoor) temperature control

Protection

Water Management

- Overwatering
- Underwatering
- Poor air circulation
- Overhead irrigation
- Poor drainage

trees block air circulation

Poor drainage

overhead irrigation

Protection

Other Physical and Cultural Practices

Field in fallow

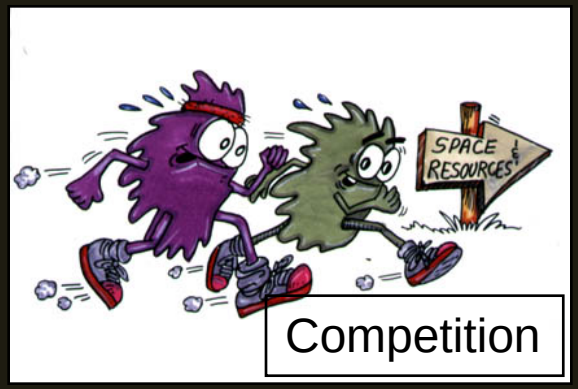
Crop rotation

Roguing (weeding)

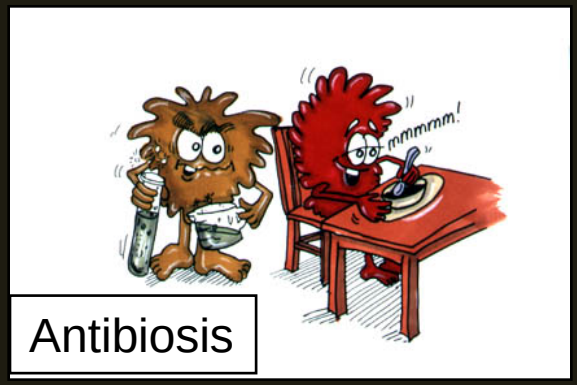
Flooding

Protection

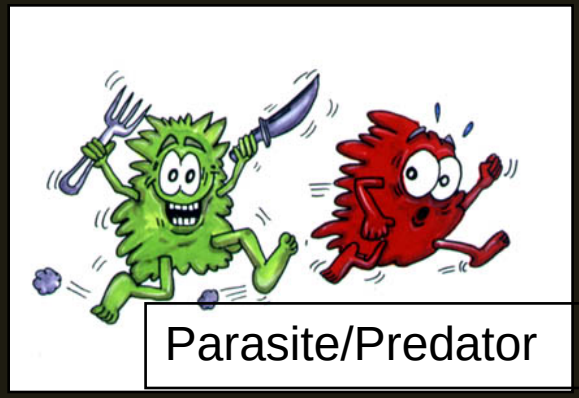
Classic Biological Control*



Competition



Antibiosis


Parasite/Predator


Resistance

*Classic biocontrol uses natural enemies to control pests

Protection

Biological Control (cont.)

- Crop rotation (soil)
- Green manure
- Composts, teas
- Suppressive soils

Green manure: plowing under living plants changes the soil microbiota

Protection

Biocontrol of Strawberry Guava

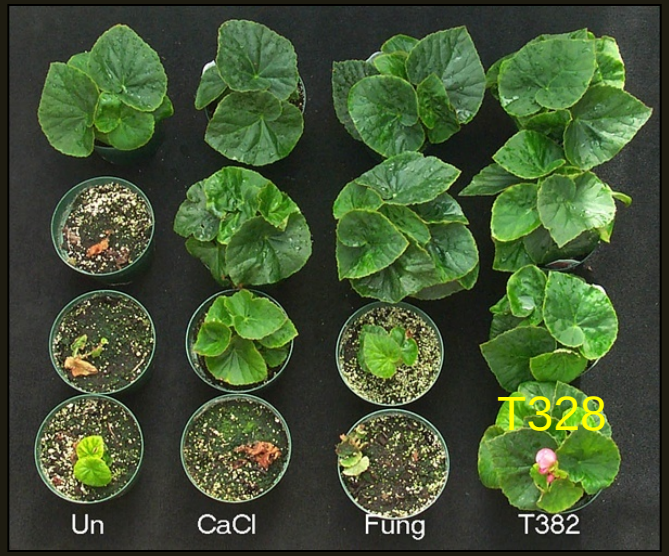
Tectococcus ovatus

T. ovatus leaf galls

Protection

Biocontrol of Botrytis

- Top row: healthy plants
- Un: untreated control
- CaCl: calcium chloride
- Fungicide: chlorothalonil
- T382: Trichoderma hamatum T382



induced systemic resistance

Protection

Biological control (cont.)

- Traditional breeding
  - Exchanges genes from like organisms
- Genetic engineering
  - Uses genes from any living organism
  - Uses inherited mechanisms
  - DNA → genes → proteins

Specific resistance (PRSV)

General resistance vs. susceptible

Protection

- Chemicals
  - Right pest
  - Right stage of pest
  - Right pesticide
  - Correct dosage
  - Effective application
  - Protectants
  - Systemics
  - Pesticide resistance

IPM, in summary . . .

- *Planned, science-based* pest control
- Correctly identifies and monitors pests
- Sets a *personalized* economic threshold
- Considers best *practical* options to:
  - Exclude, Eradicate, Avoid, or Protect

Protection

General Methods

- Plant nutrition
- Soil pH
- Barriers and mulches
- Traps, attractants
- Fallowing
- Crop rotation
- Roguing (plant removal)
- Flooding (pots and planters?)

Protection

Water Management

- Overwatering, underwatering
- Poor drainage
- Poor air circulation
- Use of overhead irrigation

Temperature

- Burning stubble, debris
- Soil solarization
- Steam heat
- Composting
- Greenhouse (indoor) temperature regulation

Protection

Biological Control

- Competition
- Antibiosis
- Parasite/predator
- Resistance
- Crop rotation
- Green manure
- Compost/teas
- Suppressive soild
- Induced systemic resistance

Protection

Chemical Control

- Right pest
- Right stage of the pest
- Right pesticide
- Correct dosage
- Effective application
- Protectant pesticides
- Systemic pesticides
- Be aware of pest resistance

Thank You
and
Good Luck