Pest Ecological Relationships

- Matthew J. Grieshop
- MSU Entomology
Give me any word, I’ll show the Greek root....
Agroecology: An uneasy marriage?

Agronomy
- Applied Science
- Human Practices
- Artificial Patterns
- Economic Valuation (Yield)

Ecology
- Biological Mechanisms
- Natural Process
- Measures of system productivity

• Basic Science
• Natural Patterns
• Energetic or Elemental Valuation (Productivity)
Ecosystem Trophic Structure

**The Soil Food Web**

1° Consumers

- **Nematodes**
  - Root-feeders

- **Nematodes**
  - Fungal- and bacterial-feeders

- **Arthropods**
  - Shredders

- **Arthropods**
  - Predators

2° Consumers

- **Birds**

- **Animals**

**Producer**

- **Plants**
  - Shoots and roots

- **Organic Matter**
  - Waste, residue and metabolites from plants, animals and microbes.

**Detritivores**

**First trophic level:** Photosynthesizers

**Second trophic level:**
- Decomposers
- Mutualists
- Pathogens, parasites
- Root-feeders

**Third trophic level:**
- Shredders
- Predators
- Grazers

**Fourth trophic level:**
- Higher level predators

**Fifth and higher trophic levels:**
- Higher level predators
Systems Theory

- Ecosystems are one type of system
- *System*: a group of independent but interrelated elements comprising a unified whole
- Systems are composed of *components* linked by *flows* enclosed in a *boundary*
- Systems typically exhibit "emergent properties"
- Complex behaviors that appear from simpler interactions
- *Energy flow, nutrient cycles, dynamic equilibrium*
Often used for energy but can be adapted to any type of flow
Trophic Interactions of Pests

Direct

Indirect
Multiple Attack

Leafhopper

Alfalfa

Alfalfa plants (number per 15 m²)

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Crop Pest and Weed Interactions

• Consumers that feed on weeds but not crops are beneficial

• Consumers that feed on both crops and weeds vary in their impact
  • The pest may have higher impacts than the crop (unlikely)
  • The weed may serve as a reservoir for pests (think nightshades and Colorado Potato Beetle)

• Weeds external to the Cropping System
Indirect Interactions

Variegated Cutworm

Alfalfa

- Yield (kg/ha) vs. Duration of defoliation (days)
  - Alfalfa (line A)
  - Weeds (line B)

- Cutworm density (larvae 0.1 m⁻²) vs. Duration of defoliation (days)
  - Alfalfa (line A)
  - Weeds (line B)
Weeds as host refuges

- Vineyard (summer)
  - Anagrus epos
  - Grape leafhopper
  - Grapevines
- Riparian habitat (winter)
  - Anagrus epos
  - Dikrella leafhopper
  - Wild blackberry

- Spring
- Fall

Beneficial parasite

Host plant for prey
Soybean Aphid

Soybean Aphids Life Cycle

- Winged Female (Emigrants)
- Wingless Female
- Stem Mother
- Overwintering Egg
- Soybean Aphids on Buckhorn
- Female
- Sexual Winged Female (Fall Migrant)
- Male
- Soybean Aphids on Soybean

Spring

Summer

Winter

Autumn
Figure 1. Volatile compounds are released by plants in response to insect feeding triggered by an interaction of elicitors from the oral secretions of insect herbivores with damaged plant tissue. These volatiles are used by some parasitoid wasps to locate their hosts.
Habitat Modification

• When pest activities result in:
  • Altered resource concentration
  • Altered apparency
  • Altered Microenvironment
Resource Concentration

- Pests reproduce best on contiguous habitat
- Varying habitat (host prevalence) lowers their reproductive potential
- What are the assumptions?
Apparency

• Crop is “Hidden” from pest
• Perimeter Trap Cropping
• Used in Cucurbit production for striped cucumber beetle
FIGURE 4.6 Light attenuation under the canopy of a squash monoculture, a corn monoculture, and a corn/squash intercrop. The data for each crop show the percentage of full sunlight remaining at each of six horizontal levels. (From Fujiyoshi, 1997)
Pest Management

- **Positive:** Net benefit on TOTAL pest injury
- **Neutral:** no net benefit on TOTAL pest injury
- **Detrimental:** Net detriment on TOTAL pest injury