Chemical Pest Management

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Pesticides and OPM

Why Use Pesticides in Organic Agriculture?
Pesticides and OPM

Advantages of Pesticides

• Well developed thresholds
• Density independent control
• Fast Acting
• Labor saving
• Psychology
<table>
<thead>
<tr>
<th>Advantages of Pesticides</th>
<th>Disadvantages</th>
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<tbody>
<tr>
<td>• Well developed thresholds</td>
<td>• Disruptive</td>
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<tr>
<td>• Density independent control</td>
<td>• Rarely precisely controlled</td>
</tr>
<tr>
<td>• Fast Acting</td>
<td>• Expensive (OMRI Approved)</td>
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<tr>
<td>• Labor saving</td>
<td>• Promote reactive rather than proactive farming practices</td>
</tr>
<tr>
<td>• Psychology</td>
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Pesticides

- What is a pesticide?
- Pest = Plague (L.) + Cide = To kill (L.)
- Literal definition = Plague Killer
- What is the LEGAL definition?
EPA on Pesticides

"A pesticide is any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest. Pests can be insects, mice and other animals, unwanted plants (weeds), fungi, or microorganisms like bacteria and viruses. Though often misunderstood to refer only to insecticides, the term pesticide also applies to herbicides, fungicides, and various other substances used to control pests. Under United States law, a pesticide is also any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant."
Pesticides by Pests

- Herbicides: Plants
- Fungicides: Fungi
- Antibiotics: Bacteria
- Insecticide: Insect
- Nematicide: Nematodes
- Rodenticide: Rodents
- Avecide: Birds
Legal Classification

• Restricted Use vs. Unrestricted
• Restricted Use can only be purchased/applied by licensed personnel
• Unrestricted are "over the counter"
OMRI Classification

- OMRI register's pesticides that are compliant with the NOP
- OMRI Classifies inputs as Allowed or Restricted
- Almost all pesticides are Restricted
- NOP accredited certifiers have the last say
- MOST synthetics banned
OMRI Listed Pesticides

- >50% Insecticides
- >28% Fungicides
- <5% Herbicides
- >70% pesticide use are herbicides???
Example Pesticide Label
• **Danger–Poison** – it can kill you!
• **Danger** – usually associated with skin or eye damage
• **Warning** -moderately toxic
• **Caution** - least toxic
Importance of REI, PHI, PPE
Pesticide Formulation

- WP: Wettable Powders
- EC: Emulsifiable Concentrates
- F: Flowables
- A: Aerosols
- G: Granules
- PB: Poison Baits
- Fumigants

Concentrates

Ready to use
Pesticide Application

Surface Application: Boom Sprayers
Pesticide Application

Surface Application: Blast Sprayers
Pesticide Application

Surface Application: Backpack Sprayers
Pesticide Application

**Chemigation:** Through Irrigation Systems
Organic Herbicides

- Citrus and other essential oils
- Citric/Acetic acid
- Some have crop restrictions
- All are contact post emergent herbicides

Clove Oil

Citric Acid

Thyme and Clove Oil
Organic Fungicides

- Elemental: Sulfur, Copper, Oxidate
- Oils: Mineral oils, citrus oils
- Biological: Trichoderma or B. subtilis, Compost Tea
Limitations of Organic Fungicides

- Copper, Sulfur broadly toxic
  - Arthropods, Earthworms, Beneficial Microbes
- Short residual
- Biologicals require careful timing and reapplication
- Lack of systemic action
Organic Insecticides

Many Organic Insecticides are similar to conventional in terms of application and level of disruption

3 Major Categories:

- Non-living Pesticides
- Biological Pesticides
- Behavioral Modifying compounds
Non-Living Pesticides

- Typically naturally occurring compounds
- Mostly Neurotoxins
  - Entrust®, Pyganic®, Neemix®
- Also include some minerals/elements
  - Diatomaceous Earth, Sulfur, Copper, Kaolin Clay
- Many may have unwanted effects on soil and ecosystem health
Biological Pesticides

- Bacteria (B.T.)
- Viruses
- Fungi (Milky Spore)
- Nematodes

- Typically more selective = less harmful to overall system health
Behavioral Compounds

- Semiochemicals used to confuse or attract pests
- Sex pheromones for Mating Disruption
- Pheromones and plant scents for trapping
- Ovipositional Disruptants
Pesticides as Ecological Disturbance
Pesticides as Ecological Disturbance

- SUN & CLIMATE
- CROP
- PEST
- HARVEST
- HEAT LOSS
Pesticides as Ecological Disturbance

Diagram:
- Sun & Climate
- Crop
- Pest
- Harvest
- Heat Loss
The Three R's

• IPM was in part borne in response to 3 R's

• **Resistance**: Pre-evolved biochemical pathways for detoxification

• **Resurgence**: Trophic disturbance and pest pop. rebounds

• **Replacement**: New pests filling an ecological vacuum
- DDT was first used in the US in 1943
- By 1947 resistant houseflies identified
- DDT is a stable molecule
- Metabolites are also very toxic
- STRONG SELECTION PRESSURE
Insecticide Resistance

Before pesticide application

After pesticide application

First generation

Later generation
### Table 16.2 Numbers of Pesticide-Resistant Arthropod Species According to Pesticide Group in 2004.

<table>
<thead>
<tr>
<th>Pesticide group</th>
<th>Numbers of compounds and mixtures</th>
<th>Percent of total (list of 332)</th>
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<tbody>
<tr>
<td>Organophosphates</td>
<td>117</td>
<td>35.2</td>
</tr>
<tr>
<td>Pyrethroids</td>
<td>41</td>
<td>12.3</td>
</tr>
<tr>
<td><strong>Bacteria</strong></td>
<td>39</td>
<td>11.7</td>
</tr>
<tr>
<td>Carbamates</td>
<td>33</td>
<td>9.9</td>
</tr>
<tr>
<td>Organochlorines</td>
<td>28</td>
<td>8.4</td>
</tr>
<tr>
<td>Insect Growth Regulators</td>
<td>10</td>
<td>3.0</td>
</tr>
<tr>
<td>Fumigants</td>
<td>6</td>
<td>1.8</td>
</tr>
<tr>
<td>Neonicotinoids</td>
<td>4</td>
<td>1.2</td>
</tr>
<tr>
<td>Formamidines</td>
<td>2</td>
<td>0.6</td>
</tr>
<tr>
<td>Other</td>
<td>52</td>
<td>15.9</td>
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</tbody>
</table>

*Includes transgenic CRY cultivar sources.

Resurgence

- When a pest population rebounds after treatment
- Slower developing predators removed from the system
- Often times "cured" with additional insecticide treatments

Figure 16.7 Diagrammatic representation of insect numbers as they would respond during pest resurgence. Note that numbers are higher after population recovery than before treatment.
• When a sub-economic pest replaces a key pest
• Example: Two spotted spider mite in MI apple

Figure 16.8 Diagrammatic representation of insect numbers of two pest species as they would respond during pest replacement. Species 2 was a subeconomic pest before replacing species 1.