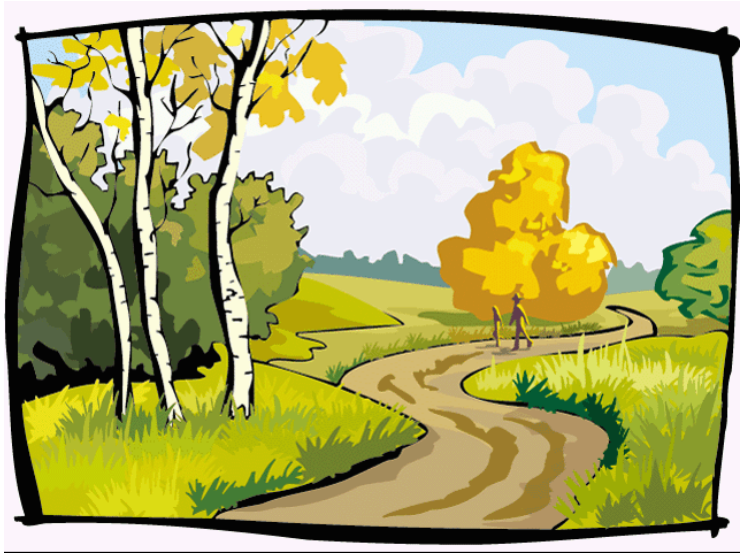
Natural Insecticides

Lesson 4.4



Learning Objectives

- Know the major categories of natural products and microbial insecticides; give examples of each
- Describe the general traits and give examples of botanical insecticides
- Explain the differences, and pros/cons of soaps and oils
- Know the difference between minimum and reduced risk products

Going Green!

EARTH FRIENDLY PRODUCTS
FOR HOME, LAWN AND GARDEN

SafeLawns.org
FOR A HEALTHIER PLANET

LetsGoGreen.biz
Eco-friendly Home, Office & Business Products™

A. Natural Products

- Major Categories:
  - Botanical products
  - Soaps and oils
  - Minerals
  - Microbials

**** Just because a pesticide is <u>natural</u> doesn't mean it's safe!**

1. Botanical Products

- General traits:
  - Fast breakdown
  - Fast activity
  - IPM-friendly
  - Low toxicity (most)
  - Not phytotoxic
  - Expensive

Some Botanical Products

- Limonene
- Linalool
- Rotenone
- Ryania
- Sabadilla
- Neem
- Pyrethrum/Pyrethrins

d-Limonene

- Citrus extract (e.g., steam distilled orange peel oil)
- Effective against external pests of pets, cockroaches, ants, fleas, locusts, weevils
- Repellent, contact spray

http://agriculturegeuide.org/wp-content/uploads/citrus-tree-wallpaper.jpg

Linalool

- Naturally-occurring terpene alcohol in many flowers & spice plants (>200 plant species)
- Used as a scent in 60-80% of perfumed hygiene products & cleaning agents (e.g., soaps, detergents, shampoos, lotions)
- Flea, tick, and mosquito control

Rotenone

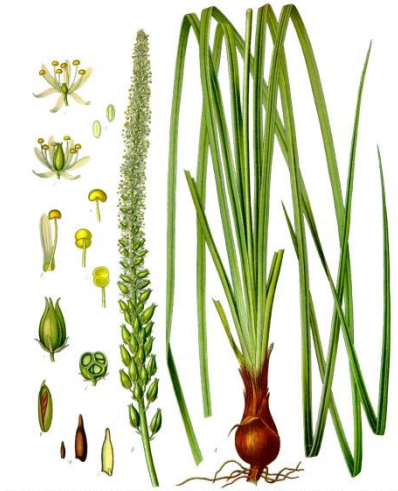
- Acutely toxic alkaloid extracted from roots of a tropical legume
- Inhibits energy production affecting electron transport
- Used in garden dusts, flea powders
- Very toxic to fish

Ryania

- Extracted from the stem of a woody S. American plant
- Stimulates calcium channels – paralysis
- Active against pests of fruit trees

http://bibliotecas.csic.es/galeria/ryania.jpg

Sabadilla


Schoenocaulon officinale (Schltdl. & Cham.) A. Gray ex Benth.
Image processed by Thomas Schoepke
www.plant-pictures.de

- Extracted from seeds of a lily
- Neurotoxin – binds to the sodium channels
- Breaks down quickly in light
- Target pests: caterpillars, leafhoppers, stink bugs, squash bugs, thrips
- Crops: vegetables, citrus, avocado, mango

Neem

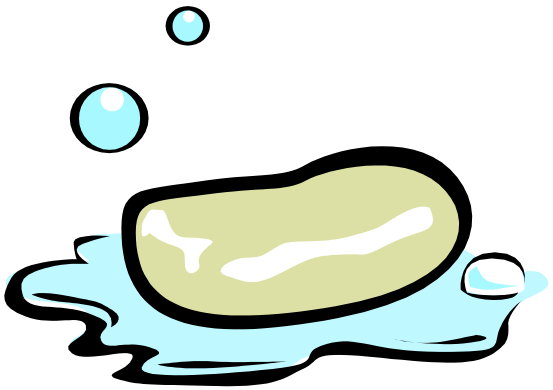
- From seeds of the tropical neem tree
- Broad spectrum (e.g., aphids, caterpillars, leafminers, thrips, whiteflies, mealybugs, scales, spider mites, crane flies, chinch bugs, billbugs, hyperodes weevil)
- Active by contact or ingestion; kills and repels; disrupts feeding, insect reproduction, and molting ability
- Soft on pollinators and other beneficial insects

Pyrethrum, Pyrethrins

- Derived from chrysanthemum flowers
- Low mammalian toxicity
- Rapid “knockdown” of flying insects; paralyzes CNS
- Synergized by piperonyl butoxide (PBO)
- Breaks down quickly in sunlight; no residual
- Expensive, but widely used

2. Soaps and Oils

- Insecticidal soaps
- Horticultural oils



Insecticidal Soaps

- Made from salts in the fats and oils of animals and plants (very safe)
- Contact toxicity only – no residual
- Kill by disrupting insect cuticle
- Good vs. small, soft-bodied insects (aphids, caterpillars, crawlers)

Horticultural Oils

- Highly refined petroleum-based oils
- Useful vs. small or slow-moving, soft-bodied pests, (aphids, leafhoppers, scales, overwintering eggs, mites)
- May prevent gas exchange through egg membranes, clog insect mouthparts, deter feeding or egg-laying

Horticultural Oils

- **Advantages:**
  - Non-toxic to vertebrates
  - No resistance has developed
  - Use is compatible with biological control

- **Disadvantages:**
  - Must contact pests to have efficacy (no residual)
  - May cause phytotoxicity (leaf burning) if too concentrated

Phytotoxicity on loquat leaves

3. Mineral Insecticides

- Sulfur
- Diatomaceous earth

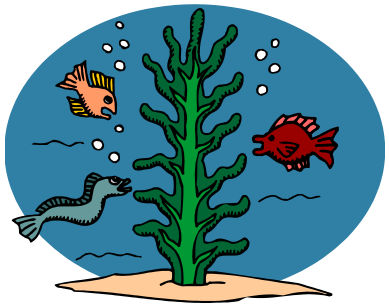
Minerals: Sulfur

- Oldest known pesticide
- Possibly phytotoxic
- DO NOT mix with oils

} CAUTION!!

- Target pests: spider mites, psyllids, thrips
- Crop: vegetables, fruit crops

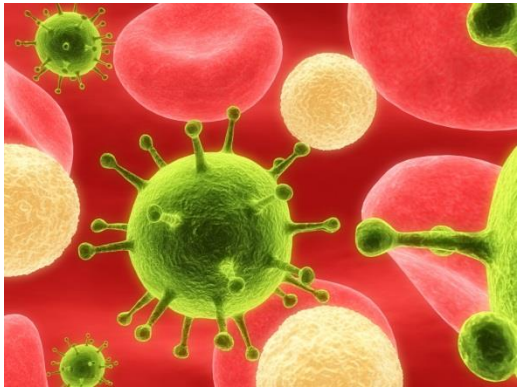
Diatomaceous Earth



- Mined from fossilized silica shell of diatoms (algae)
- Abrades and dries out insect cuticle
- May be mixed with pyrethrins
- Target pests: slugs, grasshoppers, millipedes, sowbugs

4. Microbial Insecticides

- Commercial products that contain pathogens or microbially-derived toxins / by-products that kill insects
  - Fungi
  - Bacteria
  - Viruses
  - Protozoa
  - Nematodes (not really a microbe…)



Microbial Insecticides: Benefits

- Specific to their target pest(s);
  - No non-target effects
- Considered non-toxic to humans
  - PPE may not be needed
- Can be applied with standard pesticide equipment
  - Applications should be done to minimize factors that could decrease efficacy
- Can be important rotation products

1) Insect Pathogenic Fungi

- Spores grow on the insect cuticle, then hyphae penetrate the cuticle and grow inside the body, soon killing the insect

Fungus-infected chinch bug (left) & whiteflies (right)

Green Muscardine Disease
Metarhizium anisopliae

- Fungus is naturally in soil & infects insects
- Infects ~200 arthropod species (used for ticks, beetles, flies, gnats, thrips), but is safe for use around mammals
  - Spores grow on insect cuticle, then hyphae penetrate the cuticle and grow inside the body, soon killing the insect. The cadaver's cuticle becomes **red**. In high humidity, a white mold grows on the cadaver, which turns **green** as spores are produced.

Green June beetle grubs killed by *Metarhizium anisopliae*

Japanese beetle grub infected with *Metarhizium*

White Muscardine Disease *Beauveria bassiana*

- Fungi do not need to be ingested to work
- Infected insects die within a few days to a week
- Greatest mortality in hot and humid conditions
- Used for aphids, whiteflies, mealybugs, thrips, beetles, flies, gnats and ticks.
- Some trade names: Naturalis T, Botanigard
- Avoid tank-mixing with fungicides

A bluegrass billbug adult (above) and Japanese beetle larva (right) infected with *Beauveria*.

A gypsy moth larva infected with a fungus, *Entomophaga maimaiga*

2) Bacterial Insecticides

- Spore-forming, rod-shaped bacteria in the genus *Bacillus*
- Produced commercially by fermentation
- Commonly occur in soils
- Must be eaten to be effective
- Apply with standard pesticide equipment

Bacillus thuringiensis (Bt)

- Bt var. kurstaki - used since 1950's to control leaf-eating caterpillars
- Very low vertebrate toxicity
- Short residual in sunlight
- Works better against small larvae than vs. larger ones

Milky Spore Disease
(*Paenibacillus popilliae*)

Diseased (left) and normal (right) grubs.

Note the color of the hemolymph where the leg was cut off.

3) Viruses

- Highly specific to plant pests (e.g., moths, beetles, sawflies)
- Must be ingested, act on the gut, go into the blood, multiply, and cause death
- Not usually commercially available
- Example: nuclear polyhedrosis virus (NPV)

A gypsy moth larva killed by a viral disease.

4) Protozoa

- *Nosema locustae*
- Grasshopper control

5) Entomopathogenic Nematodes

- Microscopic, unsegmented worms
- Attack various insects (e.g., soil insects, wood borers)
- Enter host's body through mouth & spiracles, release and feed on bacteria, reproduce inside insect body, bacteria kill the host
- Don't damage plants – have different mouthparts

Nematode Species

- Several species (*Steinernema* spp., *Heterorhabditis* spp.) occur naturally in the soil, but some can be purchased
- Some insecticides, like imidacloprid (Merit), may slow grub behavior down and make them more susceptible to nematode infection

Insects infected with *Steinernema* nematodes are usually light tan in color.

Note the adults (larger nematodes) and the infective juveniles (the tiny nematodes forming a cloud around the grub.

Insects infected with *Heterorhabditis* nematodes are usually a reddish color.

B. Other Terminology

- Organic
- Minimum risk
- Reduced risk

USDA National Organic Program

- **What is organic?**
- Organic production is a system that is managed in accordance with the **Organic Foods Production Act (OFPA) of 1990** and regulations in Title 7, Part 205 of the Code of Federal Regulations to respond to site-specific conditions by integrating cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biodiversity. The National Organic Program (NOP) develops, implements, and administers national production, handling, and labeling standards.

Minimum Risk Pesticides

- Exempt from EPA registration
- Contain active ingredients listed in “the 25b list” and inert ingredients in “the 4A list”
- Must display pesticide use directions, all ingredients and their percent concentrations

Garlic Barrier®

"Keeps Your Plants From Being Eaten Alive"

Reduced-Risk Pesticides

- Reduced risk to human health
- Reduced risk to non-target organisms including fish, birds and natural enemies
- Reduced ground and surface water pollution
- Low use rate, low pesticide resistance potential
- Compatible with IPM