ENTOM 490
Grape Pest Management

Lecture 4 (by Felsot)
Specific Mode of Action
Pesticide Label
Sprayer Technology
Mode of Action

• Characteristic symptomology exhibited by pest species
• How a pesticide protects the plant
• How a pesticide interacts with the function of specific biochemical components (macromolecules)
Characteristic Symptomology

• Applicable to situations where the crop plant has been “poisoned” by use of a pesticide
  – For example, it is possible for crop to experience some phytotoxicity from use of herbicides that are actually registered for the crop
  – Under certain weather conditions, some fungicides or plant growth regulators may cause phytotoxicity
  – Drift from crop to crop

• Applicable to understanding types of symptoms exhibited by weeds or insects after use of herbicide
  – For example, how long does it take for the weeds and/or insects to die
  – Can insects feed until death?
How Does the Pesticide Protect the Plant (or Control the Weed)

• Two basic types of pesticides
  – Non-systemic
  – Systemic

• Non-systemic (Contact Pesticides)
  – Little or no ability to penetrate plant tissues (leaves or roots) and translocate from site of contact to distal parts of the plant
  – Thus, pest must either feed directly on residue deposit following spraying, or
  – Spray must contact pest directly
How Does the Pesticide Protect the Plant (or Control the Weed)

• **Systemics**
  – Pesticide can penetrate plant tissue and be translocated to other parts of plant
  – Chemical diffuses through the cuticle of leaves (sprays) or through the outer layer of roots (soil applications) into the epidermal cells
  – Chemical crosses into either the xylem or phloem
    • Some chemicals are only xylem mobile and thus can only move upward in the transpiration stream from the site of first contact
    • Phloem mobile chemicals can move either up or down from the site of first contact (the “true” systemics)
How Does the Pesticide Protect the Plant (or Control the Weed)

• Some chemicals are transported translaminarly from one side of leaf to the other
• Some chemicals move only locally (i.e., a short distance from the site of contact)
Biochemical Mode of Action

• How toxicity is manifested
  – Specific interactions with macromolecules like enzymes or cytochromes to cause inhibition of function
• Example: some fungicides and insecticides function by inhibiting the function of cytochromes important for electron transfers and thus energy production during normal respiratory metabolism located in the cell mitochondria
  – Strobilurin fungicides
Biochemical Mode of Action

– In some cases, normal function of macromolecule is mimicked, thereby enhancing its effect to the detriment of the pest
  • Example: mimicking of plant growth hormones like auxin (2,4-D; triclopyr; clopyralid; dicamba)
Herbicide Mode of Action

• Pre-emergence vs. Post-emergence Use
  – Some herbicides, for example simazine and oryzalin, are applied directly to the soil before weeds emerge
  – Some herbicides are sprayed directly on germinated weed
    • Glyphosate (Roundup) is a true phloem mobile systemic
    • Paraquat (Gramoxone) is a non-systemic contact herbicide
Herbicide Mode of Action

• Specificity (Selectivity)
  – Some herbicides are broad spectrum and will kill both monocots (grasses) and dicots (broadleaf plants)
    • Glyphosate
      – Inhibits aromatic amino acid synthesis
    • Paraquat
      – Causes extensive oxidation of cell macromolecules
    • Oryzalin
      – Inhibits root elongation by inhibiting cell division and elongation
Some herbicides are specific for grasses or for broadleaf plants

- Simazine is used as a pre-emergent herbicide to control broadleaf plants although it has some activity on grasses
  - Inhibits photosynthesis
- 2,4-D is used as a post-emergent herbicide to control broadleaf plants
  - Mimics the action of the auxin hormone
Insecticide Mode of Action

- Insecticides tend to have limited mobility within the plant
  - “Systemics” are xylem mobile only
    - Can often be soil applied, although they may also be sprayed
      - Example: imidacloprid (Provado) for aphid control
    - Some insecticides have translaminar activity
      - Characteristic of the neonicotinoids (includes imidacloprid and acetamiprid)
Many insecticides are neurotoxins and kill insects rapidly

- **Carbamates & organophosphates** (OPs) inhibit the neuromodulatory enzyme acetylcholinesterase, resulting in excessive nerve signal transmission in the central nervous system and ultimately death by respiratory failure

- Tend to be broad spectrum in activity
  - Thus, not selective for pests and natural enemies

- However, selectivity has been achieved when the chemical is more quickly metabolized in the pest vs. the nontarget organism
  - Carbamate examples: carbaryl, methomyl
  - OP examples: dimethoate, chlorpyrifos, malathion
Insecticide Mode of Action

• **Neonicotinoids** (a.k.a. chloronicotinyls)
  – This comparatively new group is also neurotoxic but they function as mimics of the neurotransmitter acetylcholine by binding to its receptor at nerve endings
    • Selective for pests (including aphids and some moths)
    • May show lower bioactivity against natural enemies
    • The acetylcholine receptor of vertebrates is insensitive to binding
  – Examples: imidaclorpid, acetamiprid
• **Avermectins**
  – Represented by abamectin, these compounds are also neurotoxins and are used as acaricides
    • Block the action of the inhibitory neurotransmitter GABA (gamma aminobutyric acid)
    – They can be “harsh” on predatory mites
• **Propargite**
  – Strictly used as an acaricide
  – May not be “safe” for predatory mites
  – Adversely affects cellular energy production by inhibiting the enzyme ATPase
Insecticide Mode of Action

• **Diacylhydrazines (“Fenozides”)**
  – Represented by methoxyfenozide, these compounds mimic the action of the insect molting hormone ecdysone and cause premature molt
  – Take longer to kill than neurotoxins but can make insects lethargic and stop feedings
  – Soft on natural enemies

• **Spinosad** (spinosyns)
  – These also function as neurotoxins but they are naturally derived and produced by fermentation
  – One formulation is registered as “certified organic”
  – Very low hazard to natural enemies and other nontarget organisms
# Fungicides Mode of Action

## How to Manage Pests
### UC Pest Management Guidelines

| More pests | More crops | About guidelines |

## GRAPE
### GENERAL PROPERTIES OF FUNGICIDES USED IN GRAPES

(Reviewed: 12/02, updated: 12/02)

**IN THIS GUIDELINE:**
- [Publication](#)
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Fungicide Mode of Action

• Nonsystemic fungicides act as protectants and are applied to prevent establishment of disease organisms
  – Inorganics
    • Sulfur
      – Soaks up electrons that would be used for energy production in the electron transport chain located in the mitochondria
    • Copper compounds
      – Nonspecific denaturation of proteins
      – Binding amino acid in enzymes, thus inhibiting activity
Fungicide Mode of Action

– Nonsystemic Organics
  • Chlorothioalkyl heterocyclics (captan)
    – Nonspecific mode of action (probably affects multiple biochemical targets)
  • Dicarboximides (iprodione)
    – Disrupts mitochondrial membranes and thus affects energy production; can also affect DNA/RNA synthesis
  • Strobilurins (trifloxystrobin and Kresoxim-methyl)
    – Inhibit electron transfers and thus energy production in the electron transport chain of the mitochondria
  • Hydroxyanilide (fenhexamid)
    – Inhibits sterol biosynthesis
Fungicides Mode of Action

• Systemics
  – Can be applied after an infection is detected because they can diffuse into leaf and they are at least xylem mobile
  – All organic compounds
    • Strobilurins (axoxystrobin [Abound])
      – Inhibit energy production in electron transport chain of mitochondria
    • Triazoles (triflumizole; tebuconazole)
      – Inhibit sterol biosynthesis
    • Pyrimidines (cyprodinil)
      – Inhibit amino acid methionine biosynthesis
Formulations

• Formulations are actually registered but the risk assessment necessary for registration is conducted on the active ingredient

• Formulations will contain solvents and adjuvants that help dissolve the pesticide but also contribute to its activity
  - Adjuvants are formulant ingredients that enhance the properties and bioactivity of active ingredients
  - Adjuvants such as surfactants may also be added to a tank mix containing the formulation
Formulation Adjuvants

• Solvents and adjuvants having no pesticidal activity are called inert ingredients

• Adjuvants serve basically two purposes
  – Help reduce the surface tension of water so that the spray droplets are spread out over a greater leaf surface area
  – Help the active ingredient to stick on the leaf surface after spraying
No Surfactants (water droplets bead up)

With Surfactants (water droplets spread out)
The Pesticide Label

• The label is the law
• Learn how to read it
http://fruit.wsu.edu/labels/

Fungicide Index by Product Name

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Acrobat Reader may be required. For free software download, click the Icon above.
Each product listed below is labeled for disease control on some but not all fruit crops. As always, read the label carefully.

Fungicide by Company | Insecticide Info | Greenbook Label & MSDS | Reentry Interval
RESTRICTED USE PESTicide

Due to Acute Toxicity
For retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicator's certification.

Guthion® Solupak

50% WETTABLE POWDER CROP INSECTICIDE IN WATER SOLUBLE PACKETS

For effective economical insect control.

ACTIVE INGREDIENT:

O,O-Dimethyl S-[4-oxo-1,2,3-benzotriazin-3(4H)-yl]methyl]phosphorodithioate .................. 50%

INERT INGREDIENTS: ........................................ 50%

100%

Keep water soluble packets in this container and store in a cool dry place, but not below freezing (32°F). Protect from heat. Keep away from open flame. Do not heat. Entire inner packets dissolve in water. After opening outer bag, drop the required unopened inner packets into spray tank as directed. Do not excessively handle water soluble packet or expose it to moisture, since this may cause breakage.

DEALERS SHOULD SELL IN ORIGINAL PACKETS ONLY

CONTAINS 5 ONE-POUND WATER SOLUBLE PACKETS

EPA Reg. No. 3125-301 Five 1-Pound Packets Per Pouch, Four Pouches Per Case

STATEMENTS OF PRACTICAL TREATMENT

Organophosphate

In case of poisoning, call a physician immediately. Have patient lie down and keep quiet. If swallowed, vomiting should be induced. Administer water freely and induce vomiting by giving one dose (1/2 oz. or 15 mL) of syrup of ipecac. If vomiting does not occur within 10 to 20 minutes, administer second dose. If syrup of ipecac is not available, induce vomiting by sticking finger down throat. Repeat until vomit fluid is clear. Never give anything by mouth to an unconscious person. Professional medical assistance should be secured immediately. If on skin, remove contaminated clothing and wash skin immediately with soap and warm water. If inhaled, remove victim to fresh air. If not breathing, give artificial respiration, preferably mouth to mouth. Get medical attention. If in eyes, flush with plenty of water. Call physician if irritation persists.

Note To Physician: ANTIDOTE - Administer atropine sulfate in large therapeutic doses. Repeat as necessary to the point of tolerance. 2-PAM is also antidotal and may be administered in conjunction with atropine.

Compound inhibits cholinesterase resulting in stimulation of the central nervous system, the parasympathetic nervous system, and the somatic motor nerves. Do not give morphine. Watch for pulmonary edema, which may develop in serious cases of poisoning even after 12 hours. At first sign of pulmonary edema, the patient should be placed in an oxygen tent and treated symptomatically.


STOP - Read the label before use.
Keep out of reach of children.

POISON

DANGER ⌛️ PELIGRO
Sprayer Technology

• For insect and disease management, basically two types of sprayers are used
  – Air-blast
  – Proptec
Vineyard Airblast Sprayer Calibration Worksheet

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Sprayer calibration should be done at least once per season, but preferably every time there is a significant difference in the desired spray volume (gal/acre). For example, early-season applications cover a small canopy and therefore require a lower spray volume for thorough coverage compared to later applications to a full canopy. This worksheet is intended to take you stepwise through the calibration process.

1. **Determine tractor speed.**
   Establish a preferred operating speed in a pre-set gear. Note gear and throttle settings. Fill the spray tank half full with water for a speed test. Insert numbers
Atomized Spray from Proptec Head
Proptec Mounted on a T-Boom
Horizontal Boom on Proptec Orchard Sprayer
Proptec Sprayer--Deposition Pattern

Dark Areas Did Not Intercept Spray

Yellow Green Area Intercepted Fluorescent Dye in Spray