Integrated Pest Management and Fumigation Safety Training

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Pesticide Technology

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Pesticide "Modes of Action" (MOA) are at very specific physiological sites

- Many poisons have MOA in animal nervous systems, but there are lots of different sites, and MOA's in other systems.
- Structurally similar pesticides = classes of chemistry usually share the same MOA.

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“Pesticide” is a legal designation

- US Federal Insecticide Fungicide Rodenticide Act (FIFRA): compounds intended to control, repel, mitigate a pest… “Pest” can be almost any organism out of place or undesirable.
- Registration requirements: rules and regulations lay out a pathway of data requirements to qualify for registration, and demonstrate thorough understanding of a compound’s characteristics.
- The Label is the legally-binding summary.

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Pesticide toxicity determinations and basic safety

- Two kinds of toxicity:
  - Acute (immediate, short term)
  - Chronic (resulting from long term exposures)
- Three routes of exposure:
  - Oral (eating or drinking)
  - Dermal (skin absorption)
  - Inhalation (breathing)
- Acute toxicity determined with animal exposure tests.

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Basic toxicology and safety, cont.

- Worst case toxicity from test animals determines "signal word" on label: Danger, Warning, or Caution – a quick and easy reference to a product's hazard potential.
- Exposure hazards:

- Dermal exposure most serious for most applicators.
- Inhalation exposure hazards mostly space treatments.
- Oral exposure accidental or intentional…

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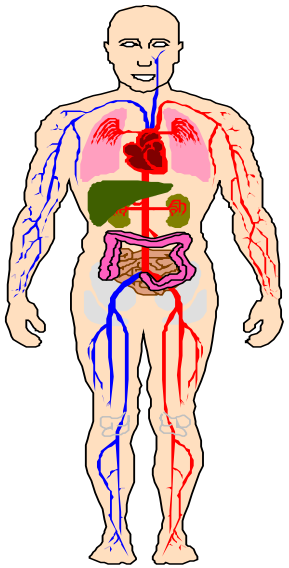
Classic exposure study on absorption efficiency of different body parts has taught us about selection and care of dermal exposure protective equipment!

- If absorption on forearm is “1”…
- Palm of hand 1.3
- Ball of foot 1.8
- Abdomen 2.1
- Forehead 4.2
- Genitals 11.8



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Lessons

- Applicators should protect themselves appropriately for exposure they will experience: Head protection from downward drift, shirts, pants, aprons for certain workers. Also, care and cleaning of equipment, face pieces, cleanable glove interiors, hat headbands, etc.
- About 85% of pesticide poisonings begin with exposure to hands, especially when mixing and loading equipment.
- Gloves are prime protection for most applicators.

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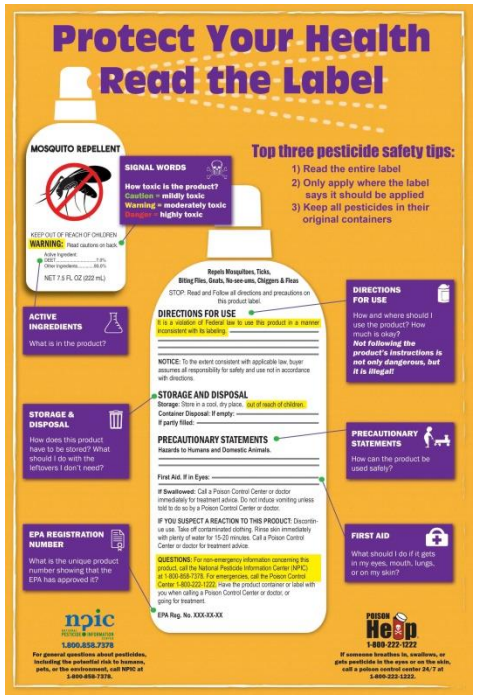
Pesticide Formulation Technology

- Active ingredients are formulated with “inert ingredients” to make useful products:

- Able to package, dilute, mix, measure and apply.
- Able to be absorbed by target pest.
- Able to resist environmental breakdown long enough.
- Many performance and safety attributes.

- Wide variety of formulations: Liquids, solids, powders, baits, aerosols, vaporizing devices… Fumigant gases.

Product information, precautions, and legal uses are all summarized in useful terms on the Label



- About 19 sections.
- Very brief or very long.
- 3 different names: Trade, a.i. common name and full name.
- Signal word
- Manufacturer ID, etc.

Label contents, cont.

- Numerous precautions and hazards identified.
- Specific safety precautions, notification requirements, personal protective equipment.
- Directions for use and specifications on legal sites.

Pesticide product technology does not export easily!

- US has markets to support a pesticide industry, large toolbox of products, wealth to afford environmental and safety precautions, and regulatory enforcement.
- Certain other developed countries have their own robust pesticide regulation, different than the US.
- Many countries lack markets, lack an honest regulatory system, and have extremely limited product availability, or variable product availability from time to time.

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International Challenges

- US labeled products with information we take for granted are not necessarily international.
- Developing countries often have lower standards of safety. Some countries have higher safety stds than US
- Your expectations for pest mgmt. and fumigation contractors may be completely foreign to their normal practices.
- You can be agents for positive change, but it will be a process.

Suggestions for selecting a pest mgmt or fumigation contractor

- Fumigators are among the rarest pesticide applicators.
- Does the host country have a tobacco industry? The tobacco industry has fumigation standards that include efficacy monitoring. Tobacco fumigators <u>might</u> have monitoring equipment and experience.
- Multi-national food processors, or suppliers to those processors? Contractors in these product chains may be accustomed to meeting certain audit requirements.

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When you have located potential contractors…

- Sample contract is among your references.
- Be forthright that your expectations may include some unfamiliar safety precautions and procedures. Position in a positive light.
- Review Fumigation Mgmt Plan (FMP) and other documents/expectations.
- Expect to pay for higher standards of service.

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Continuing with more of your immediate interests…

- Overview of pesticide types and applications likely at your facilities.
- Fundamentals of fumigation.

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Residual insecticides applied with sprayers or mist blowers

- Popular products internationally seem to include:
  - Actellic (pirimiphos-methyl)
  - Multiple brands (cypermethrin)
- Others you are aware of? Others seem likely…
- Residuals generally:

  3-4 weeks residual performance. Discourage invaders.

  Sanitation value. Used indoors and out.

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Actellic (pirimiphos-methyl)

- Best known as a grain protectant in the US. Direct application to corn and sorghum to protect in storage.
- Organophosphate class
- Signal word “Warning”
- Liquid emulsifiable concentrate and dustable powder formulations.
- Expect strong odor, somewhat worse with mist blower applications.

cypermethrin

- Multiple brands, formulations, mixtures with other active ingredients.
- May be designated (Greek letter-)cypermethrin further identifying molecular structure.
- Synthetic pyrethroid class.
- Signal word “Caution” or “Warning”
- Dermal sunburn type exposure symptom.

Aerosol space treatments, "foggings": dichlorvos

- Vaporizing aerosol, "weak fumigant" behaves like a gas but does not penetrate significantly.
- Strong performance against stored product insects. Alternative to real fumigations.
- Organophosphate class, "Warning" signal word.
- Requires respiratory protection and longer evacuation than other aerosols
- Liquid formulations applied with mechanical aerosol generators.
- Long association with hazardous solvents, and fears of carcinogenicity, but has cleared regulatory reviews.

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Rodenticide Baits

- Most are anticoagulants in grain mixtures formed into paraffin blocks.
- Variable use around the world: Very standard to no use.
- Growing concern about non-target impacts.
- Best to secure baits in stations.
- Monitor feeding and keep baits fresh.
- Wear gloves for rodent equipment service.

Any other non-fumigant pesticides of interest?

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Fundamentals of Fumigation

- Fumigants are pesticides active in the gas state.
- Fumigants generally have penetrating capability – through packaging, deep into stacks and commodities.
- Penetration is not as quick or thorough as people think!
- Fumigants generally dissipate fairly quickly to degrade in the atmosphere, leaving behind no meaningful residue.
- Pests can re-infest immediately, but hopefully population has been reset to nearly zero.
- Fumigations mostly target insects, sometimes rodents. Rodent burrow fumigations are extremely hazardous.

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Three important fumigant gases

- Phosphine:

- Most commonly applied as solid aluminum phosphide which reacts with humidity to produce phosphine gas (hydrogen phosphide, PH3).
- Most popular commodity fumigant.

- Methyl bromide:

- Mostly phased out of use except for certain quarantine fumigations.

- Sulfuryl fluoride: Likely future PH3 replacement.

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For success all fumigations require:

- Adequate temperature. Specifications vary.
- Concentration and exposure time (CT value).
  - Specifications vary with fumigant, pest, temperature.
  - Concentration needs to be achieved throughout space/mass.
  - Concentration will be a function of dosage.
  - Exposure time will be a function of gas tightness of space.
- Some kinds of (non-phosphine) fumigations routinely feature high concentration monitoring and ability to add fumigant.

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Sealing to hold gas gets lots of attention

- Leakage is inevitable. Compensate with dosage or monitor and add gas if necessary.
- Aeration becomes a challenge under some circumstances and needs to be considered when planning.

Commodity fumigations are challenged to meet fundamental requirements!

- Will CT requirements be met in the interior of this stack in the time allocated?
- Efficacy monitoring is not practical. Could have been built in when stacked
- There is no practical way to assist penetration and circulation.
- There is no practical way to add fumigant. Dosing high at beginning to compensate would be guesswork.

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"Fumigation Management Plans"

- Became requirements of US phosphine labels about 12 years ago. Other countries?
- Requirement for written planning documents covering all aspects of an upcoming fumigation, and record keeping afterwards. Often checklist formats, static information plus current event.
- Always a sensible business practice at a certain level.
- Now extends to other fumigants in the US.

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Future presentations will provide more specific phosphine fumigation information.

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Thanks for your attention.

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