Integrated Pest Management and Fumigation Safety Training

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Pesticide Technology

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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.
“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.
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...
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
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.
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.
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 might 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.
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.
Continuing with more of your immediate interests...

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

- Fundamentals of fumigation.
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.
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.
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.
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?
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.
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.
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.
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.
“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.
Future presentations will provide more specific phosphine fumigation information.
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