
Pest Management for Food Security Shipments

Reducing risks to food and human health

Module Objective

Obtain familiarity with the structure, basic elements, principles & risks of stored grain pest management



Training Module Overview

- Most common pests in Middle East
- Integrated Pest Management
- Sanitation, Loading, Aeration, Monitoring
- Phosphine properties
- General Instructions for Fumigation
- The Future of Storage: Hermetic Sealing
- Rodents



The most common pests in the Middle East

- Indian meal moth
Plodia interpunctella



- Warehouse beetle
Trigoderma variabile



The most common pests in the Middle East

- Confused flour beetle
Tribolium confusum



- Cigarette beetle
Lasioderma serricorne



The most common pests in the Middle East

- Bean weevil
Acanthoscelides obtectus



- Drugstore beetle
Stegobium paniceum



Common vertebrate pests in the Middle East

- Common mouse
Mus musculus



- Norway Rat
Rattus norvegicus



Integrated Pest Management

- Sanitation/Cleaning *all* residues
- Good aeration of commodities
- Pest identification important
- Knowledge of pest biology & ecology
- Risk-benefit analysis
- Multiple management tactics
- Routine monitoring is first & foremost



Sanitation/Clean all leftovers

- Note this food security warehouse: most floors had been swept/rinsed and had very little residual commodity—that's good!

Note: Clean all surfaces well including window sills, ledges, and pallets



Complete Sanitation

- Clean all surfaces well including window sills, ledges, and pallets
- Note that wheat flour left on this pallet has tiny trails in it—what is this?



Trails in wheat flour may have been:

- Larvae or adults of the Indian meal moth, the most common stored grain pest in the Middle East

Note that we only found 2 of these moths—not enough to fumigate, but enough to indicate more thorough cleaning so they don't lay eggs in the next shipment



Good aeration

- Nablus-Qabalan warehouse front with screened windows visible above doors
- Nablus-Azmoot warehouse inside with screened windows present above doors

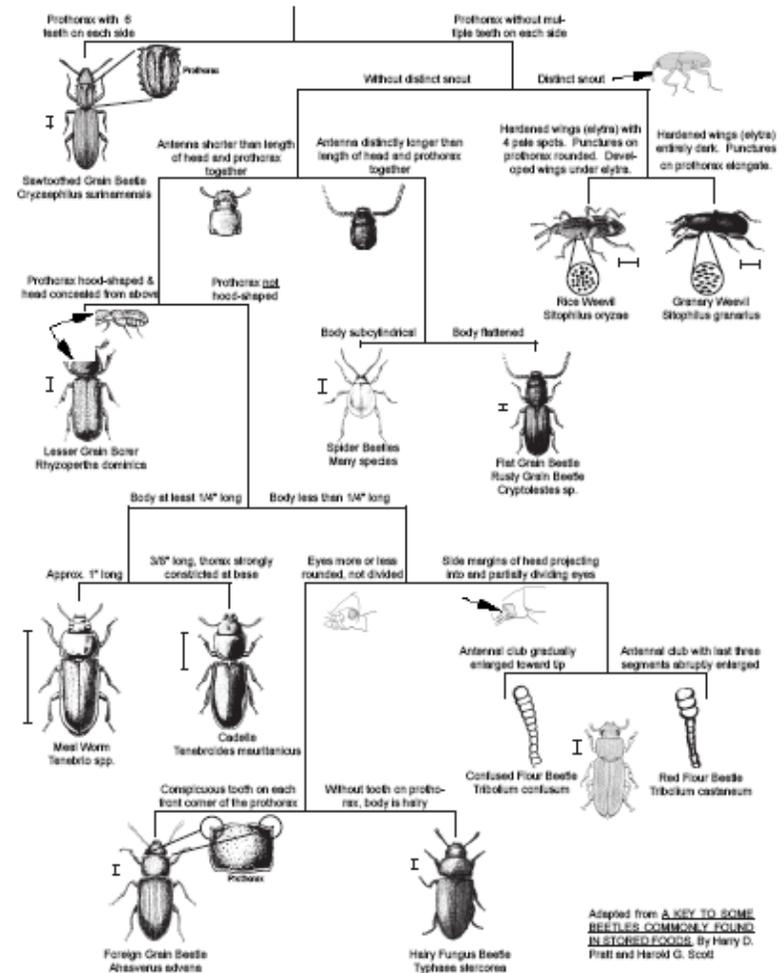


Pest Identification

- Keys are available to show differences between similar species and lead to positive identification

- Needed for IPM

A PICTORIAL KEY TO BEETLE PESTS OF STORED GRAIN COMMONLY FOUND IN INDIANA



Adapted from A KEY TO SOME BEETLES COMMONLY FOUND IN STORED FOODS, by Henry D. Pratt and Harold G. Scott



Monitoring-Detection

- Perforated grain probe
- Plastic probe/pitfall trap
- Traps with pheromones for sex-attraction, aggregation & food attractants



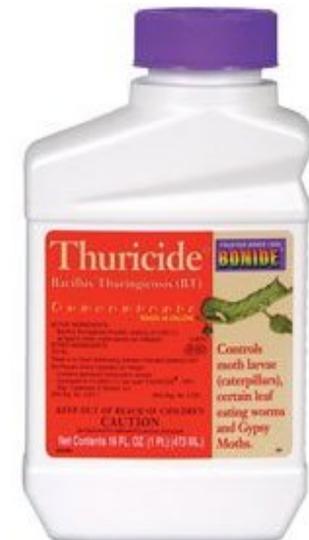
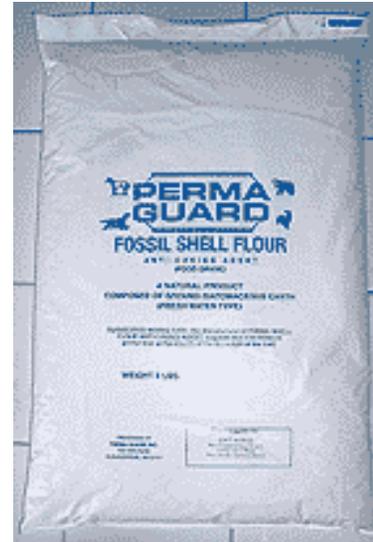
IPM Methods for Stored Grain Pests

- Prevention: Treating storage walls, shelves, windowsills with a protectant
- Destroy small quantities of infested grain = more economic than spraying



Alternative Controls

- Diatomaceous earth: microscopic razor-sharp edges cut insect cuticle
- BT, *Bacillus thuringiensis*: bacteria that have a crystal of moth-killing toxin inside them



Fumigation: Common Metal Phosphides

- zinc phosphide (Zn_3P_2)—used as rat poison in some places, but not highly recommended
- aluminum phosphide (Al-P)—which we use
- magnesium phosphide (Mg_3P_2)—which releases phosphine gas much faster than aluminum phosphide—endangers applicator, may hinder even gas penetration through grain



Phosphine structure

- Aluminum phosphide is: Al-P
- When reacting with water (H₂O) in air, oxygen is released and hydrogens (H) attach to the phosphorous, producing:
- P-H₃ = tri-hydrogen phosphide (phosphine)



Phosphine



- Colorless/Odorless gas with ingredient added to make it smell like garlic or fish
- **It is Explosive!**
- Phosphine is flammable and explosive in air
- It can auto-ignite at ambient temperatures



Phosphine route of entry to body

- The skin and eyes are not common routes of absorption of phosphine
- Oral ingestion is rare, but also deadly
- **Inhalation** is the commonest route of phosphine poisoning



Phosphine

- **Mild phosphine inhalation** mimics an upper respiratory tract infection (sore throat)
- Other symptoms may include nausea, vomiting, diarrhoea, headache, fatigue and dizziness



Phosphine Exposure & Death

- **High concentration inhalation** of phosphine may cause **severe** pulmonary irritation...
- ...leading to acute fluid in lungs, shut down of heart & vein functions, over-excitation of central nervous system, coma and death
- Exposure to 1400 mg/m³ (1000 ppm) for 30 minutes may be fatal



Phosphine Diagnosis

- A silver nitrate-impregnated paper test can be used for the breath and gastric fluid of the patients exposed to phosphine
- Cell blood counts, haemoglobin, haematocrit, arterial blood gas analyses, renal and liver function tests and cardiopulmonary monitoring and investigations (ECG and chest X-ray) are essential for the assessment of organ effects and the management of phosphine poisoning



Phosphine First Aid

- Remove the patient from exposure site, and keep at rest
- If the patient is unconscious and breathing stops, immediately provide mouth-to-mouth resuscitation and if the heart stops, begin cardiopulmonary resuscitation
- There is **No antidote** for phosphine poisoning (early recognition & management are essential)



Fumigation

- In the USA, “persons who are not trained for the use of grain fumigants should not attempt to fumigate stored grain”
- Follow the aluminum phosphide label to determine correct amount of chemical to use per cubic meter
- Use only on a calm warm day with no wind and temperature above 16 degrees C



Fumigation continued

- Learn & follow all safety regulations
- Have **two** trained people present for safety
- Plan to finish fumigation in 15-20 minutes maximum
- Post warning signs on all doors



Fumigation continued

- Use tape and 4 ml polyethylene sheeting
- Leave only necessary holes for putting phosphide and quickly sealing them
- Use probes to put tablets inside
- Remove webbing if Indian meal moth larvae are present
- Use proper respiratory protection equipment for both fumigators & use phosphine gas detection devices



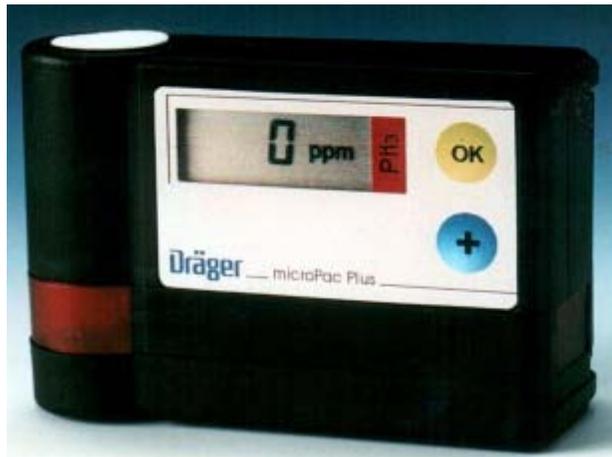
Fumigation continued

- Canister gas masks for phosphene concentration 0.3-15 ppm
- Self-contained breathing apparatus (SCBA) for phosphene concentration above 15 ppm



So:

- We need to have both canister and SCBA available to be ready for any concentration
- We need to have phosphine meters present



And,

- Fumigators must measure concentration of phosphine to determine proper protective equipment
- One fumigator puts the tablets or gas, and the other seals the plastic & monitors phosphine level **continuously**
- Passive phosphine detection devices can also be worn by applicators



Factors that contribute to less than 100% control

- Poor gas distribution
- Unfavorable treatment conditions
- Leaks
- Fines (grain dust)
- Type of pest (resistance is present)
- Grain temperature
- Presence of high amounts of insect eggs—a difficult stage to manage



Storage of rich temporary structures units



Separate units of 40
tonne stored in 60
m³ each



Storage under phosphine as a pest control treatment (optional)

Calculated phosphine concentration was 708 ppm using 60 phosphine tablets



After 9 days the phosphine concentration reduced to 500 ppm

After 14 days the phosphine concentration reduced to 412 ppm



Rats & Mice

- Rat & mouse bait box
- Open waiting for anti-coagulant bait to be added
- And closed with bait inside, away from domestic animals



Rat/Mouse Traps used at Houлда Warehouse

- Note trap with red warning sticker on top and metal cable attaching it to pole
- Note red warning sticker on wall above trap for added safety



Anticoagulant in Rat/Mouse Traps

- Fatal internal bleeding is caused by lethal dose of anticoagulants such as **brodifacoum**, **coumatetralyl**, or **warfarin**
- These substances are anti-vitamins K
- Resulting in inability of production of essential blood-clotting factors
- And, cause damage to tiny blood vessels, increasing their permeability, causing diffuse internal bleedings which do not stop
- Leading to rodent death in 1-2 weeks



Take-Away Messages

- Best Bug Prevention: Sanitation, Aeration & Monitoring
- Fumigation must be performed by **only** highly-trained personnel
- Fumigation is very dangerous and requires complex respirators & phosphine monitors
- Hermetic sealing is the Future of storage
- Rats & mice can be treated with anticoagulant baits in protective boxes



Small Group Exercise

- Describe the most significant benefits of sanitation, aeration & monitoring
- Based on case study identify the riskiest parts of fumigation & why?
- Suggest methods for partners to report to CTO's successful conformity with pesticide risk reduction

