New Research on Stored Product Pest Pheromones
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Summary Handout

Stored product species for which pheromones have been identified and available as formulated lures

1. Cigarette beetle and drugstore beetle
2. Lesser grain borer and larger grain borer
3. Rice weevil and maize weevil
4. Carpet beetle, khapra beetle and warehouse beetle
5. Red flour beetle and confused flour beetle
6. Indianmeal moth, almond moth, tobacco moth, raisin moth, Mediterranean flour moth, webbing cloth moth and Angoumois grain moth

Different pheromone systems

1. Sex pheromones produced by females and males respond (short-lived adults)
   Pyralid moths
   Geliciid moths
   Anobiidae
   Bruchidae
   Dermestidae
2. Aggregation pheromone both males and females respond (long-lived adults)
   Bostrichidae
   Silvanidae
   Curculionidae
   Tenebrionidae

Requirements for synthetically produced pheromones

- To produce pheromones that release structurally correct compound
- Has proper component ratio and concentration
- Release pheromone long enough time period
- Release sufficient levels

Pheromone-based approaches for pest management: Recent developments

1. Insect monitoring using pheromone traps

- Most widely used method for monitoring stored-product pests
- Use an attractant (sex pheromone, aggregation pheromone, food odor)
- Species specific response
- Wide range of trap and lure types commercially available

Advantages of using pheromone traps

- Sample continuously
- Large active space for some attractants
- Early detection
- Species specific
- Relatively easy to use
- Quick results
- Can be used to target monitoring and management

Disadvantages of using pheromone traps

- Only capture receptive insects
- Pheromones not available for all species
- Small active space for some species
- Multiple lures/traps to monitor multiple species
- Expense
- Visibility
- How to use results?

Components of a monitoring program

1. Trap and pheromone type
2. Need to match trap and pheromone type with environment and target pest(s)
3. Some of the critical issues are: *target species, floor or hanging trap, amount of dust, interaction between food odor and pheromone*
4. Trap placement
5. A balance of practical and scientific considerations on trap number and placement
6. Grid pattern is generally best
7. Traps placed outside are useful
8. Checking traps: Servicing and replacing traps, observations and recording
9. Visualization and interpretation of results: Graph averages over time to look at population trends and also can look at the spatial distribution

2. **Mass trapping: Pheromone-based suppression**

- Only have significant effect if substantial adults are removed
- For aggregation pheromone-females can be removed
- For sex pheromones- critical number of males must be removed. Females are not trapped
- Need to deploy high density of traps
- Expensive
- New direction is to Incorporate host odor-borne attractant along with sex pheromone to reinforce trap attractiveness for both sexes

3. **Attract and kill: Pheromone-based suppression**

- Males are killed rather than "confused"
- Traps do not have to be deployed and serviced
- Many "killing stations" can be set up
- Only a very low dose of pheromone combined with pesticide
- Toxicologically benign (extremely low pesticide residue and need reduced-risk or bio-rational pesticide)

- Lure-and-kill technology has had limited development in stored products pest management

4. **Pheromone-based mating disruption**

Mechanism of mating disruption

- Pheromone dispensers generate a "fog" of synthetic pheromone
- False trail-following to artificial sources
- Masking of natural female pheromone by overwhelming unfocused "cloud" Habituation of olfactory receptors to higher levels
- Males can no longer distinguish the pheromone emitted by a female
- Males spend time and energy locating "false females"
- *Male elimination* method
- Some of the advantages of using mating disruption are no detectable residues in many dispensing systems and the method is highly selective for primary target species. However there is a need to supplement the pheromone program in high pest-pressure situations. It may require EPA registration and government approval in many countries for new mating disruption systems.

Cost of using mating disruption/pheromones

- Pest monitoring with pheromone traps is a *necessary expenditure*
- Monitoring devices purchased in bulk is reasonably priced
- Mating disruption treatments are no more expensive than fogging every 3-months
- Substantial cost associated with
- Cost of labor (deploy & service traps)
- Effort to interpret and act on trap data

Future approaches for stored product pest management

- Antagonist semiochemicals to prevent infestations
- Repellents/anti-feedants
- Packaging/apply to structures
- Host odor-borne
- Insect-borne
- "Push-Pull" system
- Commodity protected with antagonist semiochemicals
- Diverted insects are eliminated by attracting to traps
- Trap commodities, bait bags, poison bait stations release attractants
- Mating disruption for Dermestidae and Bruchidae