# Summary of the Stored Product Insect Pest Biology, Ecology, and Monitoring Research Planning Meeting

July 17-18, 2000

This document is a summary of discussions among university, USDA, industry, and product developers on July 17 and 18, 2000, at Purdue University in West Lafayette, IN. This workshop was sponsored by Purdue's Industrial Affiliates Program in the Department of Entomology, and financially underwritten by Dow AgroSciences and Aventis Environmental Science. The Industrial Affiliates Program supports research and education efforts in Purdue's Center for Urban and Industrial Pest Management, including sponsorship of a workshop series designed to bring together parties sharing the common goal of urban and industrial pest management.

This summary is organized into two sections, which reflects the order of topics discussed during the meeting. The first section is a Priority List of data gaps/key research questions (biology, ecology, monitoring, and pest management principles) in mill, food/feed processing and warehouse pest control situations. The second section outlines an Action Plan for the first steps in conducting any significant research: educating potential supportive and impacted parties, garnering their support, and preparing research funding proposals.

The intent of this summary is two-fold: (1) it is to be used by the research community to focus efforts in stored product protection, and (2) it is meant to promote collaboration on high-priority areas of stored product pest management.

# Data Gaps in Stored Product Pest Research

The group brainstormed Data Gaps or key research questions in each of the four sub-sections. After combining similar points, the resulting general research questions were prioritized based on the value of answering these in advancing insect pest management in mills, processing plants, and warehouses. Each participant voted a 3 for the highest priority, 2 for the 2nd, and 1 for the 3rd priority. Highest total value any data gap could receive was 10 participants × 3 = 30.

## General

1. **Political Leadership** (Highest priority, 28 pts)
   - Industry needs to be the driving force to fund research to answer priority questions
   - If the post-harvest food industry is not the driving force, then determined leadership in government is needed
   - Building from this team's impetus, core group of Industry members define mission/vision for stored product pest management and research to achieve that vision.
   - Quantify need for research and prepare convincing for-public argument (position papers) for funding.

2. **Information Organization and Outreach Programs** (a.k.a. Technology Transfer) (17 pts)
   - A list of stored product pest management websites will be shared (e.g., Ceris, Purdue, USDA)
     KSU's website: www.ksu.edu/issa/speres Password: bugprop, INstar008
   - A mechanism for efficient, clear, comprehensive technology (information) transfer is needed. Advertise what's available to facilitate use of available information.
   - Information needs to be shared among USDA, University and Developers during working sessions to develop action plans.
   - A leader is needed to organize an Outreach Communication Plan.

3. **Cooperation: Sites/Manpower/Market Research** (10 pts)
   - Draft a 'Who's Who' list of information sources/researchers/developers
   - More field sites and cooperators need to be located
   - A plan for safeguarding cooperator information who participate in field research needs to be written to open up more testing sites and reach a critical mass of sites from which meaningful conclusions can be drawn.

4. **Research Program Coordination** (5 pts)
   - Effective alliances for garnering funds among USDA, university, industry, and developers are needed (e.g., of successful alliances include the cut flower alliance, strawberry growers alliance).
   - Develop a directive general research plan (list/explanation of influential industry groups) (no czar of research) from which specific research proposals can be drawn

- Note: this was voted low priority by some because it was assumed this activity would be accomplished regardless.

5. **Funding Source List/Description** (What are the funding sources and how to get funding?)
   - Identify funding sources.
   - What is the political tie-in that motivates funding? See above Political Leadership actions.
   - How can the need for stored product pest management research be effectively communicated? See above Political Leadership actions.

## Basic Biology Priorities

1. **Understanding Insect Pest Population Rebound Potential** (Highest priority, 26 pts)
   - Which factors cause rebounds to occur? What is the relative influence of these factors on rebound rate?
   - How fast do populations rebound after treatment (e.g., fumigation, heat, sanitation, etc.) occur?

2. **Demographics by Food Commodity** (foundational information for forecasting) (17 pts)
   - Determine life tables (e.g., survival, mortality factors from egg to adult stages), age grading, sex ratio, and growth rates for different commodities.
   - How do the different preservatives, nutrients, and additives for each commodity affect insect growth rates?
   - How does the potential reproductive capacity in the lab differ from what occurs in the field (e.g., mills, warehouses, etc.)?
   - Do insect populations overlap spatially and/or temporally?

3. **Life Stage-Specific Susceptibility** (10 pts)
   - How susceptible to different treatments (e.g., fumigants, heat, etc.) are eggs, larvae, pupae, and adults?
   - How does diapause affect treatment efficacy?
   - How can diapause be broken to increase insect movement and susceptibility?
   - How can mating disruption be used as a pest control tool?

4. **Forecasting Phenology** (Lowest priority, 7 pts)
   - How can the seasonal variations in insect population dynamics be predicted?

## Ecology

1. **Movement/Dispersal Inside and Outside of Facilities** (Highest priority, 30 pts)
   - Where do the insects originate: do outdoor insects go inside, and do interior insects go outside? (Immigration and Emigration rates by insect, facility, commodity, etc.)
   - Do insects avoid previously treated areas?
   - Do insects avoid current treatments by dispersing to untreated areas?

2. **Importance of Refugia** (20 pts)
   - Characterize types of refugia.
   - What are the microclimate preferences of insect species?
   - Why do insects move out of refugia; what would make insects move out?
   - What is the impact of refugia on population rebound?

3. **Environmental Impacts on Sampling** (Lowest priority, 8 pts)
   - What is the impact of temperature, humidity, air currents, light, various disturbance factors, amount or type of oviposition substrate, etc., on sampling?
   - What is the relative impact of the factors in the first question on sampling with food vs. pheromone traps?

## Monitoring

1. **Sampling incoming and outgoing (ingredients) commodity** (Highest priority, 17 pts)
   - What is the optimal number of traps or samples (sample size)?
   - How do we/how should we detect insects in equipment?
   - What is the most accurate and informative means of assessing insect numbers inside traps and equipment?
   - Of those insects caught in traps, how many were naturally dispersing or drawn out from refugia?
   - What are the 'average' sampling counts pre-treatment, immediately post-treatment, and long term post treatment for various types of facilities/equipment (e.g., flour mill sifter) and treatments (e.g., fumigation)? Are these three counts correlated in a consistent and predictable manner?
   - Are visual, trap, and absolute sampling counts correlated in a consistent and predictable manner?
   - How can product entering the facility be accurately and efficiently sampled?
   - What is the predictive capacity (of insects being in finished product) of Tailings Counts vs. other sampling techniques?
   - What is the most efficient sampling procedure for finding and measuring non-randomly distributed populations?

2. **Better Traps (Lures, Multi-Species, New species)** (15 pts)
   - In general, a better understanding of stored product pest chemical ecology is needed.

- How effective are current food and pheromone traps?
- Better attractants, Food, Pheromone, Food + Pheromone lures are needed.
- How can light traps be more effectively used?
- Can light traps be used concurrently with pheromone traps without reducing the effectiveness of either? Is the combination synergistic?
- How/where would they be placed to optimize the sampling power of this combination?
- What is the relative impact of all the factors that interfere with trap catch?
- Traps for merchant & sawthoothed grain beetle, *Tribolium*, rice weevil, female moths (egg traps) are needed.

3. **Optimal trap placement** (14 pts)
   - What is the optimal number to use by species? How far apart should traps be placed? Where (specifically) should traps be placed place them.
   - What is the influence on catch of commodity in proximity to traps?

4. **Trap Catch Data Interpretation** (14 pts)
   - What are the trap catch data analysis program options?
   - How is trap catch data interpreted? (field vs. lab results)
   - Is the number of adults correlated to the number of other life stages? IF not, what value is there in catching only adults?
   - What should be the minimum data fields for which data should be collected when sampling in mills/processing plants/warehouses? (some previous data are not interpretable due to unreported data)

## Pest Management Principles

1. **How Cost Effective/Practical Are Pest Control Options** (Highest priority, 24 pts)
   - How effective/expensive are monitoring/sampling, mating disruption, sanitation, and other treatment alternatives to methyl bromide fumigation?
   - What are the available economic models comparing the cost-effectiveness of pest management treatments (fumigation, heating, no-pesticide sanitation, etc.)?
   - Are prescribed treatments (monitoring, then treatment) cost effective vs. no treatment at all?
   - Are prophylactic or scheduled treatments "better" than curative treatments? How (lower pest control costs, fewer rejected shipments, etc.)?
   - Do chemical treatments provide 100% control? If any, which ones? Why do millers assume they generally do? If they do not, why are millers/processors satisfied with present control levels?

2. **Action thresholds** (22 pts)
   - Are action threshold really necessary? (when industry is generally satisfied with scheduled treatments)
   - If action thresholds were developed, would pest control operators and millers use them?

- What are the variables used to determine action thresholds?
- Where/when are insects an actionable problem?
- What is the relationship between an action threshold and economic threshold, and how do these vary by facility?
- Are there any guidelines (for action thresholds) from the USDA or universities?

3. **Satisfactory Level of Control** (Lowest priority, 14 pts)
   - What is a satisfactory level of control for each major insect pest species and life stage? (The answer to this question is critical in directing the development of Methyl Bromide alternatives.)
   - How can alternatives be assessed if the level of satisfactory control is not known and the level of control MB provided is only vaguely defined in reports?
   - Critical question for Who really knows the answer to the previous question? (are we all just guessing?).
   - See Pest Management Principles #1 above for further questions on Satisfactory Level of Control.

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