Dr. Dennis Shuman, a former scientist (now retired) with the USDA's Center for Medical, Agricultural, and Veterinary Entomology in Gainesville, FL, has developed Insector, a system for automatically counting insects associated with stored grain. What follows is an interview with Dr. Shuman regarding this system, which is now commercially available for use by grain managers.

Subramanyam: What is the importance of automated monitoring for insects in stored grain?

Shuman: Each year in the United States, post-harvest grain losses exceed $1 billion, and the worldwide annual cost of protecting bulk-stored agricultural commodities from infestations and direct losses caused by insects is far greater. To address the shortcomings of traditional monitoring practices, Insector, the world's first commercially available automated stored-grain monitoring system (see Figure 1), continuously provides time-stamped insect counts on a handheld monitor or office computer without entering the bins or storage facilities.

Graphical analyses of these real-time infestation data then can be used to reduce fumigations by performing them only when and where they are needed. This targeting of control measures can also enhance the viability of pesticide alternatives such as fumigation, modified atmospheres, and biological control.

Since the probes can remain operational during and after pest management, the system can provide real-time evaluation of pest management intervention. The Insector technology is presently available from OPisystems, Inc., Calgary, AB (800-661-1055/www.opisystems.com/ipn3001.htm), a manufacturer and worldwide distributor of stored-product management systems for grain quality optimization.

Subramanyam: Describe how the system operates.

Shuman: The system consists of a network of thallium-tipped probes that are placed in the grain bins. The probes emit a low-intensity light that is scattered by insects. The scattered light is detected by photodetectors, and the number of insects present is calculated based on the intensity of the scattered light.

Subramanyam: How does the system process the data?

Shuman: The data are processed in real-time by a computer, which continuously monitors the insect population. The system provides time-stamped insect counts, which can be accessed by a handheld monitor or computer.

Subramanyam: What are the benefits of using Insector for pest management?

Shuman: Using Insector for pest management offers several benefits. It allows for targeted control measures, reducing the need for excessive fumigations. It also enhances the viability of pesticide alternatives, such as fumigation and modified atmospheres. Additionally, it provides real-time evaluation of pest management intervention, which is crucial for optimizing pest control strategies.

Subramanyam: How is the system maintained?

Shuman: The system is designed to be maintenance-free, with the probes requiring only occasional cleaning. Regular calibration checks are also conducted to ensure accurate data collection.

Subramanyam: What is the future of Insector technology?

Shuman: The future of Insector technology is promising. With ongoing research and development, the system is expected to become even more efficient and effective in managing pest populations in stored grain.
commercial system works.

Shuman: Insect electronic grain probe traps are deployed in bins and elevators after the grain is loaded. Dual infrared-beam sensors in probes detect each insect that falls into a probe’s recep-

Figure 1. Insect monitoring system probe.

torch and relays each time-stamped electronic insect count back to a central display. Sophisticated algorithms applied to the sensor data in the probe and computer level result in real-time counts for each insect captured despite unpredictable insect behaviors and the harsh environmental conditions encountered in the field.

Subrahmanyam: Briefly comment on the performance of the commercial system in stored wheat.

Shuman: A field test was conducted at the Central Agricultural Research Center of Montana State University, Moccasin, MT, in two concrete-floor, 3,000-bushel steel bins during the 2003–04 storage seasons. In each bin, five probes were checked weekly for captured insects.


Subrahmanyam: Does the commercial system have the ability to capture and count major stored grain insect species?

Shuman: The commercial system is designed to detect and count the full range of stored grain insect species of various sizes, from flat grain beetles to rice weevils. In fact, based on how much of the infrared beams are blocked by each insect dropping through a probe, the system gives a probabilistic indication of the species. Another advantage of the system is that it’s small percentage of counts caused by incidental species such as pests, mites, as well as by grain or dust particles, can be screened out so as not to confuse the system.

Subrahmanyam: How is the commercial system installed in commercial storage facilities?

Shuman: After grain is loaded into a bin, a number of probes (based on the cross-sectional area of the grain) are inserted vertically just below the surface of the grain. The probes are daisy-chained together or joined to a central collecting station using cables with snap connectors so that a single cable emerges from the bin.

Each probe has its own unique address, which is automatically transmitted back to the central computer or hand-held monitor when the system is turned on for the first time. The link from the bin back to a central computer can be accomplished by cable, radio links, or a combination thereof.

Subrahmanyam: How user-friendly is the automated system?

Shuman: The Insect system is plug-and-play with graphical charts and color-coded data display for individual probes. One bar chart shows the number of

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counts as a function of time (with a user-selectable time axis), while another bar chart shows the distribution of insect sizes captured over the selected time interval. The system is extremely user-friendly.

Subramanyam: What environmental variables influence the performance of the system?

Shuman: All probes are calibrated at the time of manufacture so that they have identical performance. While the probes are operational in the grain, they are automatically recalibrated at regular intervals to maintain identical performance over varying environmental conditions.

Anything that might disrupt the grain during monitoring such as walking on the grain or aerating could result in false readings due to grain debris entering probes, and therefore, the time of occurrence of such events should be noted, so that data acquired during those times can be deleted. This process can be automated when aeration is controlled by OPISystems software.

Subramanyam: Is this, a standalone system, or can it be integrated with existing OPISystems for grain quality management?

Shuman: As an insect system can be a standalone system or part of a larger OPISystems grain management system including temperaturic cables, environmental monitors, and automated aeration controllers.

"To address shortcomings of traditional monitoring practices, Inceptor continuously provides time-stamped insect counts on a hand-held monitor or office computer, without entering bins or storage facilities."

Dr. Dennis Shuman, Inceptor developer

Subramanyam: What is your vision for the future, as this technology is embraced by the grain industry?

Shuman: First, this technology can be used across the full spectrum of on-farm through commercial storage facilities. Second, we envision Inceptor as an integral component of professional pest management providers delivering grain-care services. Third, we see Inceptor partnered up with existing practices such as fumigation or new technologies such as automation to evaluate efficacy of these technologies.

Fourth, we see Inceptor fitting into value-added processes such as traceability, whereby insect/temperature gauging is utilized at numerous points along the producer-consumer continuum, from on-farm storage through to commercial facilities and in-transit rail, barge, and ship movements, then ultimately on through processing and food warehousing.

And finally, we see Inceptor opening the door to a whole new field of real-time measurement, data collection, and transmission technologies from various forms of bulk commodity management to field crops, orchards, and forestry, as well as food warehousing and retail.

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