MPRINT Research Thrusts

The Purdue Insect Feeding Monitor: A Useful Tool for Resistance Gene Discovery

Basic research can have surprising consequences, though they may be reached by a labyrinthine path. For example, in the mid-1980's, Larry Murdock was studying the digestive proteinases in larvae of the cowpea weevil, a major pest of stored cowpea grain. He found great variability in the level of proteinases in the midguts of the larvae, despite the fact that the larvae were all of the same size and age. While some insects had as much as 20 units of proteolytic activity, others had as little as one unit.

Why the large variation from insect to insect? Cowpea weevil larvae grow and develop hidden inside cowpea seeds. Murdock and his colleagues discussed the cause of the variability and speculated that maybe the larvae feed in episodes and that their gut digestive proteinase level rises and falls according to whether the insect has been feeding or not.

To test this "episodic feeding" hypothesis, it was necessary to figure out a way to determine when the insects inside the seeds were feeding. He tried different tests, such as holding infested seeds on a supersensitive microbalance, hoping the balance would jiggle during feeding. Nothing worked.

Enter another Purdue entomologist and later MPRINT colleague Dick Shade. He pondered the problem and eventually took infested seeds to Eric Furgason, a professor of Electrical Engineering at Purdue. At that time Furgason was studying ultrasonic signals generated in cracking ceramic insulators, using a piezoelectric signal transducer that detected ultrasonic emissions at 40,000 Hertz. Putting infested seeds on his transducer, Furgason was soon able to report that the feeding activity was easily detectable, indeed, the feeding of the larvae sounded like popcorn popping!

This research led to a U.S. patent and many useful new applications, including the following.

1. Life history information. From the time the larvae hatch and bore into the seeds, all feeding can be detected for virtually any stored grain insect pest. It's now far easier to know about the feeding activities of insects hidden within seeds.

2. Ways to detect hidden insect pest. Wood-feeding insects, termites, and beetles can be detected easily, as well as stored grain pests. Possible applications include early detection of termite infestations by pest control operators. Currently the Purdue-developed technology is being licensed to a major corporation.

3. Tool for plant breeders. Screening of grain germ plasm for types with high resistance of grain pests can now be conducted very early. This can result—through plant breeding—in grain types not requiring fumigants during storage.

4. Methods for discovering new resistance genes. These genes can be used to create new types of resistance for important stored grain pests, through genetic engineering. This is currently an active program at Purdue.

One thing does lead to another—and sometimes the other thing can be both unexpected and very useful, indeed.

Shade, R. E., E. Furgason, and L. L. Murdock. (1990) Detection of hidden insect infestations by feeding-generated ultrasonic signals. American Entomologist, Fall, 231-234.