GMPRC
GRAIN MARKETING AND PRODUCTION RESEARCH CENTER

Research Kernels

Our Latest Research Results • July 2007

Efficacy of chlorfenapyr against *Tribolium castaneum* and *Tribolium confusum* (Coleoptera: Tenebrionidae) adults exposed on concrete, vinyl tile, and plywood surfaces

Phantom® is a new insecticide that specifically targets insect metabolism, and is registered to control termites, cockroaches, and ants. If this chemical could be registered to control stored-product insects inside facilities where processed food is stored, it would enable the use of an insecticide that would be of limited danger to humans. Since there are no published data for stored-product insects, adult red flour beetles and confused flour beetles were exposed on concrete, tile, and plywood surfaces treated with Phantom®. The insecticide was more effective on concrete compared to tile and plywood, and the red flour beetle was more susceptible than the confused flour beetle. Most beetles died within 1-7 days after they were exposed on the treated surfaces. Results show that this insecticide can be incorporated into management plans for stored-product insects in food processing facilities, and the insecticide label is being amended to include control of these insects.

Contact: Frank Arthur, Telephone: 785-776-2783, Email: frank.arthur@gmprc.ksu.edu

Resistance to Bacillus thuringiensis Cry1Ab in *Ostrinia nubilalis* (Hubner) (Lepidoptera: Crambidae) is ineffective against transgenic corn

Bacillus thuringiensis is a bacterium used to control insect pests, and it acts through toxins (one of which is cry1Ab) which is activated in the insect gut. Resistant European corn borer larvae can survive Bacillus thuringiensis Cry1Ab protoxin in bioassays, but not Cry1Ab-transgenic plants or plant extracts in bioassays. To examine the paradox, Cry1Ab protoxin was incubated with enzymes in corn extracts, and the protoxin was hydrolyzed to a 58 kDa protein, similar to the product obtained from incubating Cry1Ab protoxin with either corn borer gut enzymes or mammalian trypsin. Therefore, although the purported form of Cry1Ab in transgenic hybrids is not fully activated, the insect ingests a functionally active form of the toxin, either as a result of corn and/or insect gut enzymes. These data explain why Bt-resistant corn borer larvae cannot survive on Bt-transgenic corn and provide assurance that proteinase-mediated resistance in field corn borer populations poses no threat to the success of Bt transgenic technology.

Contact: Brenda Oppert, Telephone: 785-776-2780, Email: brenda.oppert@gmprc.ksu.edu

Analysis of Transcripts and Proteins Expressed in the Salivary Glands of Hessian Fly (*Mayetiola destructor*) Larvae

The Hessian fly (Mayetiola destructor) is one of the most destructive insects of wheat. The insect is currently controlled almost exclusively by host plant resistance. The challenge for host plant resistance is that Hessian fly constantly develops new biotypes that overcome resistance of deployed cultivars. To generate durable resistant wheat plants, we need to understand how new biotypes are being developed. The objective of this research is to analyze the genes expressed in the salivary glands of Hessian fly larvae, and the proteins that are likely injected into host plants. The proteins injected into host plants are likely important for insect biotype development. This research identified a large number of genes encoding proteins that are likely injected into wheat tissues. The super-diversity and fast evolution of these genes are consistent with rapid biotype development of the insect. This research provides a foundation for future research to reveal the mechanism of biotype development.

Contact: Ming-Shun Chen, Telephone: 785-776-4719, Email: ming-shun.chen@gmprc.ksu.edu

Relationship of Bread Quality to Kernel, Flour, and Dough Properties

It is difficult to examine wheat kernels, or the flour or dough from those kernels, and determine if they can be used to make a good loaf of bread. However, breeders need to know if their breeding lines will bake well, and millers and bakers need to know if grain or flour they buy will result in good quality bread. We worked with the Federal Grain Inspection Service to select commercial samples on which we measured about 50 different grain, flour, and dough attributes. We then developed models to predict bread quality including loaf volume, bake mix time, and water absorption. Resulting models showed that these quality indicators could be predicted with accuracies sufficient for screening samples. These results will help breeders develop lines with good bread quality, and help millers and bakers adjust their processes to maximize profits and give domestic and international consumers a consistently high-quality product.

Contact: Floyd Dowell, Telephone: 785-776-2753, Email: floyd.dowell@gmprc.ksu.edu

Effect on diet on population growth of the psocids *Lepinotus reticulatus* Enderlein and *Liposcelis entomophila* (Enderlein)

Psocids, which are also referred to as booklice or barklice, are minute, soft-bodied insects that are emerging as a problem in grain storages, grain processing facilities, and product warehouses in the United States and many other countries. Knowledge of the suitability of different cereal grains for psocid pests is important for their management. We found that wheat and barley are the most suitable diets for Liposcelis entomophila, followed by milo, rice, oats, and corn. In the case of Lepinotus reticulatus, we found oats to be the most suitable, followed by rice, barley, milo, and wheat; corn is the least suitable. Knowledge of relative suitability of these cereals to L. reticulatus or L. entomophila can aid in improving pest management. For example, the frequency of monitoring for these pests in storages may be adjusted based on relative rates of population growth.

Contact: James Throne, Telephone: 785-776-2796, Email: james.throne@gmprc.ksu.edu

Purification of a cysteine protease inhibitor from larval hemolymph of the Tobacco Hornworm (*Manduca sexta*) and functional expression of the recombinant protein

The role of many enzyme inhibitors in insect growth and development is poorly understood. Together with collaborators at Ibaraki University in Japan and at Kansas State University, we purified a novel enzyme inhibitor from insect blood and several of its properties were determined. One very unique property of this inhibitor is that it is initially synthesized as a very large and complex precursor protein containing multiple inhibitory and other subunits that are processed into single inhibitory and other types of molecules. The results contribute to our basic understanding of insect biochemistry and physiology, and identify a new type of insect metabolism that is a potential target of insect growth regulators.

Contact: Richard Beeman, Telephone: 785-776-2710, Email: richard.beeman@gmprc.ksu.edu

Design and Testing of an Instrument to Measure Equilibrium Moisture Content of Grain

An instrument probe was developed to measure the equilibrium moisture content (EMC) of grain using a relative humidity (RH) and temperature (T) sensor. The probe was designed for insertion into the top of grain bulks. Advantages of this method of moisture measurement are that the sensor is inexpensive and is interchangeable. Disadvantages are that moisture measurements rely on the accuracy of ERH and T predictions of moisture and the response time of the sensors are slow to equilibrate to the grain environment. Instrument response time was substantially improved by forcing airflow over the sensor and using prediction models to determine the equilibrium value of the sensor. Measurements time was reduced to approximately five minutes or less.

Contact: Paul Armstrong, Telephone: 785-776-2728, Email: paul.armstrong@gmprc.ksu.edu

USDA-ARS
GRAIN MARKETING
AND PRODUCTION
RESEARCH CENTER

1515 College Ave.
Manhattan, KS 66502

1-800-627-0388
gmprcinfo@gmprc.ksu.edu
ars.usda.gov/npa/gmprc

United States Department of Agriculture
Agricultural Research Service