GMPRC
Grain Marketing and Production Research Center

Research Kernels

Our Latest Research Results • June 2008

New Research Leader for Grain Quality and Structure Research Unit (GQSRU)

Dr. Thomas J. Herald has been appointed the Research Leader for GQSRU at the Grain Marketing and Production Research Center in Manhattan, Kansas. Tom was raised in Michigan and earned BS, MS and PhD degrees in Food Science from Michigan State University. He served as a Peace Corps Volunteer in Swaziland, Southern Africa, and has also worked for Yoplait USA and Kellogg's. He comes to the GQSRU after more than 16 years as a professor at Kansas State University. Please feel free to contact Tom at 785-776-2703 or tom.herald@ars.usda.gov.

Inducible direct plant defense against insect herbivores - a review

Research in direct plant defenses against insect pests has been advancing rapidly. Numerous papers have been published in a broad range of journals. This article provides a brief review of recent research advances in direct plant defenses against insect herbivores, including overall defense categories, specific defense chemicals, and future research directions. The article provides valuable information for a broad audience including scientists, graduate students, and pest managers.
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New FHB-resistant sources from Asian wheat germplasm

Fusarium head blight (FHB), also called scab, is an important disease of wheat worldwide. Severe disease epidemics can dramatically reduce grain yield and quality. Currently, only a limited number of germplasms are used as the FHB-resistant parents in breeding programs. New FHB-resistant germplasm linesare desired for breeding wheat cultivars with better FHB resistance. Ninety-four wheat landraces and cultivars were selected mainly from China and Japan. These wheat lines were evaluated for FHB resistance and accumulation of deoxnivalenol (DON), a toxic compound produced by the pathogen during disease development, in diseased grains. Two-thirds of the accessions were either resistant or moderately resistant to FHB. Among them, 26 highly resistant accessions were mainly from China and Japan, 15 had low DON content (<2 ppm) in harvested grain and 6 had three different types FHB resistance. Some resistant lines may carry genes for resistance to FHB and DON accumulation different from those in Sumai 3, a commonly used resistant parent in breeding programs worldwide. The new germplasm lines identified in this study have potential to provide new source of FHB resistance genes for improving FHB resistance in US wheat cultivars.
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Altered expression of trypsin- and chymotrypsin-like genes in midguts of Tobacco Budworm induced by feeding on Cry toxins from *Bacillus thuringiensis*

Tobacco budworm is a key target pest of transgenic cotton incorporating insecticidal toxins from *Bacillus thuringiensis* (Bt). However, in the laboratory, budworm larvae have demonstrated enormous capacity for resistance to Bt toxins, with some strains over 70,000-fold resistant to the transgenic toxin. Previously we demonstrated that Bt-resistant strains of budworms had differences in gut proteolytic activity. These differences are due to differential expression of specific trypsin and chymotrypsin proteinase genes in some of the Bt-resistant budworms. The information in this study provides critical understanding of budworm gut proteinases and expression levels in response to Bt toxins. With this data, transgenic toxins may be engineered to overcome budworm adaptations that promote resistance.
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Acute lethal and behavioral sublethal responses of two stored-product psocids to surface insecticides

Psocids, or booklice, are emerging pests of stored products, such as in grain storages and flour mills. Previous studies have shown low to moderate efficacy of insecticides used for controlling psocids on concrete surfaces in flour mills. We tested susceptibility of two species of psocids, *Liposcelis bostrychophila* and *L. entomophila*, to three

insecticides applied to experimental concrete surfaces, and also the sublethal effect of these insecticides on the mobility of these species. The insecticides beta-cyfluthrin and chlorfenapyr showed high short-term efficacy against both psocid species, unlike pyrethrins. *Liposcelis bostrychophila* was slightly more tolerant than *L. entomophila* to all three insecticides. Behavioral assays indicated that the insecticides reduced the mobility of both species and that pyrethrins elicited weak repellence in *L. bostrychophila*. Lower mobility observed in *L. bostrychophila* may be a contributing factor to its higher insecticide tolerance. Beta-cyfluthrin and chlorfenapyr, unlike pyrethrins, were effective against both psocid species and should be useful tools for management of these pests.

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Functional specialization among insect chitinase family genes revealed by RNA interference

The red flour beetle recently became the first agricultural pest insect to have all 16,000 of its genes identified. This achievement creates a valuable resource for pest biology, namely a large number of new genes that could be studied to understand pest survival strategies, and that could be exploited as biopesticide targets. We examined the functions of a set of "chitinase-like" genes thought to be involved in recycling of the exoskeleton. Each gene was inactivated by a technique called "RNA interference", and the effect on the insect was observed. We found that many of the chitinase genes are essential for life, but that each one has a different function. For example, some are required only for the adult exoskeleton while others are needed for the larval exoskeleton. These findings add to the list of vital insect genes that might be targeted for disruption for pest control purposes.

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Temporospatial distribution of the psocids *Liposcelis entomophila* and *L. decolor* in steel bins containing wheat

Psocids are an emerging problem in stored grain and in grain processing facilities in the U.S. We investigated seasonal distribution of psocids in wheat stored in steel bins and compared several methods for sampling psocids in the wheat – cardboard refuges on the surface of the grain and on the underside of the bin hatch, grain samples, and automated sampling using the StorMax Insector™ system. Two species of psocids were found - *Liposcelis entomophila* in 2005 and *L. decolor* in 2006. Numbers of psocids in cardboard refuges on the wheat surface were low immediately after bins were filled in July 2005, peaked in October, dropped to almost zero in December, and then remained at low levels until the study was ended in April. The results indicate that cardboard refuges or Insectors™ may provide an efficient method for sampling psocids in bins of wheat, and the results could be used to time pest management during the peak infestation period.

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Efficacy of chlorfenapyr (Phantom®) against adult red flour beetles exposed on concrete

Phantom® is a new insecticide that was labeled in 2007 to control stored-product insects inside mills, warehouses, and processing plants, but there is no information concerning the effects of the presence of food on survival after insects are exposed on a surface treated with Phantom®. We exposed adult red flour beetles, a major pest of flour mills, for different times on concrete treated with a range of concentrations of Phantom®, removed the beetles from the treated surface, and held them for 7 days either with or without whole-wheat flour. In the absence of flour, beetle survival steadily decreased during the 7-day holding period, at all time periods for which they were exposed on all concentrations of Phantom®. When beetles were given flour, they were able to survive exposure to the insecticide, regardless of concentration and exposure period. This level of survival was generally much greater compared to beetles that were not given flour after exposure. Results show that Phantom® can be used to control the red flour beetle inside flour mills, but sanitation and cleaning to remove available flour food sources should be done as well to ensure that the insecticide application will be effective.

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