CGAHR Update

Center for Grain and Animal Health Research
1515 College Ave.
Manhattan, Kansas 66502
Tel: 785-776-2700
www.ars.usda.gov/npa/cgahr

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To subscribe please email: cgahrinfo@ars.usda.gov

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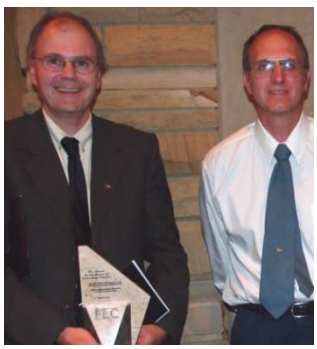
CGAHR
Center for Grain & Animal Health Research

Finally! Our new sign (below, left), correctly identifying us as the USDA-ARS **Center for Grain and Animal Health Research (CGAHR)**, has been installed along College Avenue in front of our main building. Not only does it look great, it's solar powered and utilizes high efficiency LED bulbs. Good for us and reduces our electrical power footprint.

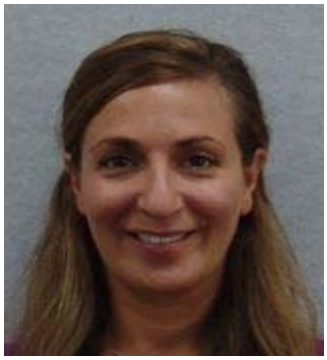
This summer we began construction on a new Wind Erosion Research Laboratory (see artist's rendition below, right). Construction began in August and should be completed by next summer. Once construction is complete, the wind tunnels and other research equipment will be moved into the new facility. The wind tunnels had previously been housed on the Kansas State University campus in a co-owned building. The tornado that hit Manhattan in June 2008 destroyed the building, prompting the need for this new facility.

We've had some special visitors at CGAHR over the past few months. The USDA Under Secretary for Research, Education and Economics, Dr, Catherine Woteki, visited in August. Two groups of USDA Cochran Fellows (8 from Tajikistan in May and 5 from Ecuador and Venzuela in August), and 8 members of a Nigerian wheat buying team also visited the Center. Other special visitors included Dr. Kurt Zoelke, Director of the USDA-Animal Disease Center in Ames, Iowa, and Dr. Hirotaku Kokubu, Professor at the University of Guadalajara, Mexico. Dr. Charlie Walthall, National Program Leader for Climate Change, Soils, and Air Emissions was at CGAHR as part of the Agricultural Air Quality Task Force meeting 21-22 Sept.

Recent Awards: **Drs. Tom Pearson** and **Dan Brabec** (EWERU, at right) won the Federal Laboratory Consortium Award for Excellence in Technology Transfer for an instrument they developed for rapid detection of insect infested grain. **Dr. Dick Beeman** (SPIRU) was selected for the Edminster Award for the best post-doctoral research proposal within ARS this year.



New Scientific Staff



Dr. Dana Nayduch (right) joined ABADRU in August 2011. Dr. Nayduch has been investigating dipteran-microbe interactions for 15 years. She was an NIH postdoctoral fellow at the Yale University Laboratory of Epidemiology and Public Health, and most recently was an Associate Professor of Biology at Georgia Southern University (GSU), where her research was funded by an NIH R15 AREA award. The two systems she has been working with are (1) house flies and bacterial pathogens, both as part of her doctoral research at Clemson University and as her primary research focus during tenure at GSU, and (2) tsetse flies and African trypanosomes, which she studied during her postdoctoral fellowship at Yale. In both of these systems, she has examined the interactions between microbes and their dipteran vectors on the microbiological and molecular level.

Her work focuses on how the insect innate immune response impacts the survival and transmission of microbes. The application of her research has been to determine the interplay between insect defenses and microbial transmission in light of vector potential. Studies in tsetse-trypanosome interactions revealed a possible role in temporal antimicrobial responses and species-specific vector refractoriness. In house flies ,she and her students have been investigating bacterial dose- and species-specific effects on antimicrobial responses in the alimentary canal, and impact on survival and transmission of human pathogens. In addition to her experience in vector biology, Dr. Nayduch has a background and research experience in Animal Science and Parasitology,

Meetings/Conferences

Barbara Drolet was a speaker and participant at the American Society for Virology in Minneapolis, MN, 16-20 July. Her presentation was entitled “Susceptibility of North American white-tailed deer to the Netherlands strain of BTV serotype 8”.

Scott McVey attended the American Veterinary Medical Association, College of Veterinary Microbiologists, and American Association of Veterinary Parasitologists Meetings ,16-19 July, in St. Louis, MO.

Barbara Drolet, **William Wilson**, **Lee Cohnstaedt**, and **Scott McVey** travelled to Nairobi, Kenya, and Cairo, Egypt, from 5-15 September to participate in planning and progress meetings for the Department of State, Biosecurity Engagement Program on the Rift Valley fever.

Scott McVey, **Barbara Drolet**, **William Wilson**, and **Lee Cohnstaedt** travelled to Buffalo, NY, 29 September 29 to 5 October to present research at the United States Animal Health Association/American Association of Veterinary Laboratory Diagnosticians joint annual meeting.

Research Highlight

Incidence and Spread of Insects from Bucket Elevator Leg Boots

Research has shown that commercial grain elevator storage facilities can quickly become infested with stored-product insect pests. Data suggest that insect pest infestations are likely carried over from one year to the next in equipment or other areas that accumulate residual grain. Many locations can be identified where infested residual grain accumulates; the largest collection point within the handling equipment is usually the bucket elevator leg boot.

The elevator boot is the enclosed base of the bucket elevator leg casing where residual grain unavoidably accumulates during use (Figure 1). Residual grain often remains in the boot because manual clean-out of the elevator boot is not done on a regular basis in most grain elevators. Residual grain accumulation in the elevator boot likely contributes to commingling of insects with grain that moves through the elevator leg. No research was found in the literature on the spread of insect infestations from commingling of insects in the elevator boot. The objectives of this research were to survey stored-grain insect pest populations from the boot, pit, and load-out areas of commercial elevator and feed mill facilities over two years and to measure the commingling levels of stored-grain insect pest populations in wheat and corn from pilot-scale bucket elevator boots. The laboratory and field data will be used to identify the dynamics that lead to the spread of infestations from the elevator boot area to other sections of a facility and to develop best management practices to control the spread of insect infestations in the grain handling and storage facilities of commercial elevators and feed mills.

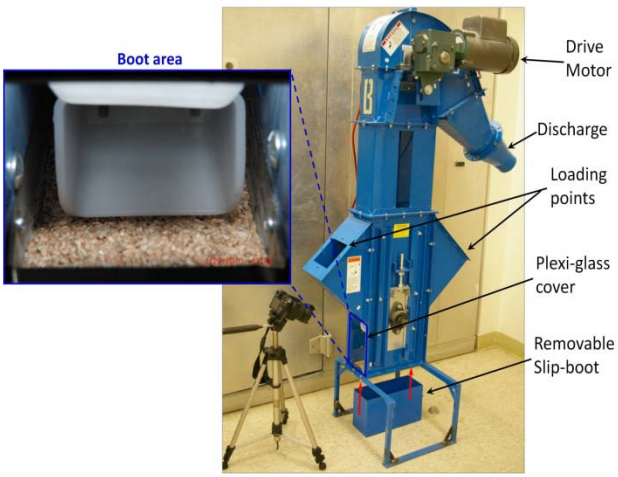


Figure 1. Pilot-scale bucket elevator leg boot arrangement.

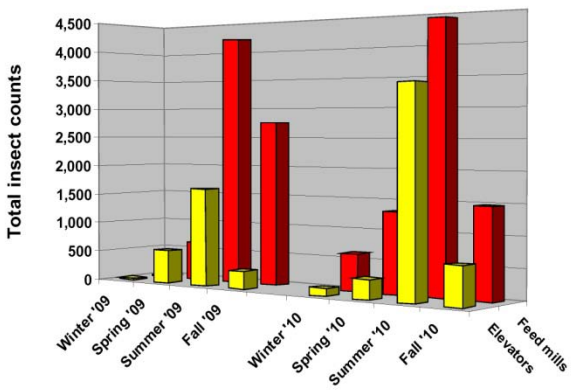


Figure 2. Total seasonal insect counts for elevator and feed mill facilities in Kansas.

Survey data from monthly residual grain samples taken from feed mills and elevators were combined by facility type . Total adult insect counts from feed mills and elevator facilities were significantly different between seasons of each year, except for the spring and winter of 2009 (Figure 2). Insect densities in feed mills were low during the winter and spring of 2009, but spiked during the warm summer months, followed by lower insect counts during the fall (2009). However, feed mill insect densities gradually increased during the winter, spring, and summer of 2010, followed by a typical reduction in the fall. Elevator facility insect densities were low during all seasons of both calendar years, except during the summer of 2010. Insect densities in the elevators spiked during the summer (2010), likely due to weather conditions and reduced cleaning (sanitation) practices.

In the pilot-scale tests, the insect density levels in infested bucket elevator leg boots affected the level of insects transferred through the elevator leg to other locations. Clean corn transferred over the infested boot was infested with increasing numbers of external insects as the initial rest period increased up to 24 weeks (Figure 3, initial count). The 8 to 24 week rest periods simulate the usual scenarios in the field where residual grain in the boot is not cleaned out on a regular basis. For both corn and wheat (wheat data not shown), external insect densities in originally clean grain transferred over infested boots was about 1 insect/kg when transferred immediately after the boot was infested, increasing to 2 insects/kg after the infested boot was incubated for an 8-week *grow-out* period after the external insects were removed. The 8-week grow-out allows the internal infesting insects (the *hidden infestation*) to emerge and be counted. The higher numbers after the grow-out indicated much larger numbers of internally infested kernels were picked up by clean grain flowing over the infested grain in the boot compared to the numbers of external infesting insects picked up by the grain.

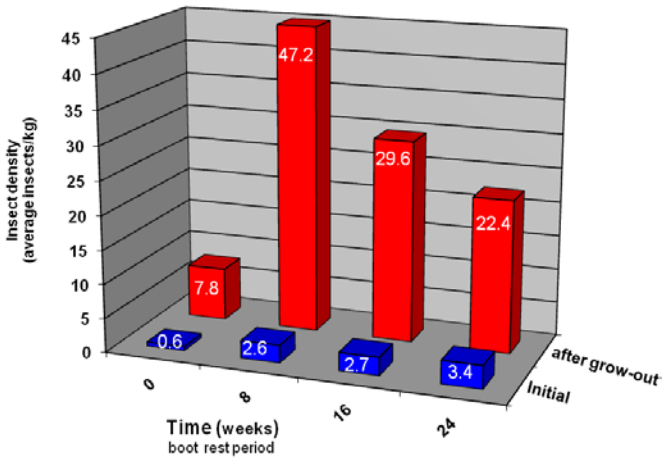


Figure 3. Average insect density in initially clean corn transferred over infested bucket elevator leg boots. Before the transfer, each infested boot was incubated for a 0, 8, 16, or 24 week rest period. After the transfer external insects were removed to obtain the initial count. After an 8-week grow-out period additional insects (emerged internal insects) were counted.

In the final phase of the project we will combine laboratory and field data with computer model simulations to determine best management practices to minimize the spread of insect infestations through the bucket elevator leg boot of commercial elevator and feed and flour mill facilities.

For more information contact Dr. Mark Casada (785) 776-2758, Email: Mark.Casada@ars.usda.gov

Grants

Larry Wagner received funding from the Strategic Environmental R&D Program to continue with the second year of his grant titled “Measurement and Modeling of Fugitive Dust from Off-Road DOD Activities.” ($212,517)

Tom Pearson received funding for a CRADA. He will be working with a company to develop a high-throughput sorting device. ($37,500)

Meeting/Conferences

Tom Pearson and **Dan Brabec** traveled to Nashville, TN, on 5 May to receive the 2011 Federal Laboratory Consortium for Technology Transfer (FLC) Award for Excellence in Technology Transfer.

Mark Casada attended the American Society of Agricultural and Biological Engineers (ASABE) Annual International Meeting and Expo, 7-10 Aug., in Louisville, KY.

Mark Casada, **Larry Wagner**, and **John Tatarko** presented papers at the International Symposium on Erosion and Landscape Evolution held 18-22 Sept. in Anchorage, AK.

Visitors

Thomas Soerensen and John Thomas from Vestergaard Frandsen, Switzerland, visited EWERU to discuss technologies to prevent post harvest losses to grain and rodents in developing countries. Dr. Bob Wirtz, Chief Entomologist, CDC, Atlanta, GA, visited with scientists to discuss collaborative research to adapt near-infrared spectroscopy technology to measuring traits of infectious disease vectors.

Research Highlight

Development of a High-Throughput Micro Platform Assay for Determining the Phenolic Compounds in Sorghum

Sorghum, a major cereal food crop used in many parts of the world, contains high levels of diverse and unique phenolic compounds (phenolic acids, flavonoids) that may be a good source of natural antioxidants. Globally, there are 40,000 sorghum accessions, most of which have not been characterized for these unique phenolic compounds. Because the 40,000 lines are a bit overwhelming to evaluate all at once; a diverse subset of approximately 300 sorghum lines that span the genetic diversity was assembled. Researchers typically report total phenolic content, flavonoid content, and antioxidant capacity as a means of profiling and assessing the human health benefits. The conventional methods for measuring total phenolic content, flavonoid content, and free radical scavenging capacity require manual sample preparation, which is time-consuming and labor-intensive and results in low overall throughput. Conventional methods often consume most of a day, resulting in low efficiency of sample throughput.

Faced with the prospect of screening thousands of sorghum lines, simpler and less time-consuming methods would be advantageous. The 96-well microtiter assay has been used for decades in the pharmaceutical industry for screening drugs. Additionally, the 96-well microtiter assay was adapted with success for estimating total phenolic content in fruits, wheat, purple corn and black rice. The evaluation of sorghum accessions have not progressed as quickly as the other aforementioned crops with respect to characterization for health promoting compounds and lagged behind in assay development. Therefore, a high-throughput micro platform 96-well plate assay to determine the total phenolic content, flavonoid content, and free radical scavenging capacity in large sample sets of sorghum was developed.

The accuracy and precision of the high-throughput assay was comparable to the conventional test tube method. The high-throughput 96-well platform method proved to be as efficient, accurate, precise, and reproducible (%CV < 10%) as the conventional method for determining total phenolics, flavonoids, and free radical scavenging. The research concluded that the high through put 96-well microplate assay can serve as a credible method for screening large sample sets of sorghum. In addition to the assays described above, the antioxidant capacity of the diversity panel is being measured by the Oxygen Radical Absorbance Capacity assay. Currently, about half of the sorghum samples in the diversity panel have been analyzed and are being grouped in to high, medium and low antioxidant capacity hybrids. Hence, assisting breeders in health related trait selection for future inclusion into their programs.

For more information contact: Dr Tom Herald, 785-776-2703, Tom.Herald@ars.usda.gov

Grants

Jeff Wilson and **Scott Bean** received funding ($12,000) from the Kansas Grain Sorghum to pursue research on the effect of starch content on the functional quality of sorghum.

Scott Bean is a co-PI on a funded project ($27,000) from the United Sorghum Checkoff Program to study the effect of heating on the quality of sorghum DDGS.

GQSRU News

Meeting/Conferences

Richard Chen and **Mike Tilley** attended the Tortilla Industry Association Annual meeting in Las Vegas, NV, 9-13 Sept.

Deidre Blackwell, **Prini Gadgil**, **Rhett Kaufman** and **Jeff Wilson** attended the Sorghum Improvement Committee of North American conference in Stillwater, OK, 12-14 Sept.

Richard Chen, **Margo Caley**, **Tom Herald**, **Lucy Lu**, **Laura McLaughlin**, **Alicsa Mayer**, **Brad Seabourn**, **Theresa Sutton**, and **Sue Xiao** attended the Wheat Breeder's Field Day in Manhattan, KS, 2-3 June.

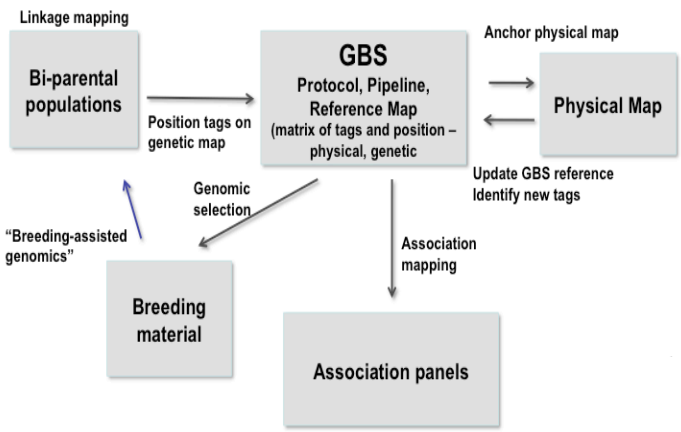
Visitors

Recent visitors included Joseph Shapiro, Wheat Breeder, and 29 other Monsanto scientists; Shu Ping Yan, Brabender Inc. toured our facility, and discussed instrumentation and collaborative research; Earl Roemer, President, Nulife Foods; Roger Vanderkolk and Ronald Steffen, DICKEY-john Corp.; Gunter Welz and Maqbool Ahmad, Bayer Crop Science; Kurt Weller and graduate students from University Nebraska-Lincoln discussed potential sorghum research collaboration. Several US Wheat Associates staff members visited including Marcelo Mitre Dieste, from the Mexico City office, and Edward Wiese, from the Sub-Saharan office, along with Arie Wessels, Grain Research Manager, Sasko, Republic of South Africa.

HWWGRU News

Research Highlight

A New Genotyping Approach for Wheat.
The wheat genome is extremely large at 16 GigaBases (by comparison the rice genome is 0.46 GB and the human genome is 3 GB) and is hexaploid (two copies of three different ancestral genomes). This large and complex genome has limited the pace of developing molecular markers for use in wheat genetics and marker-assisted breeding. A new approach for genotyping using next-generation DNA sequencing has recently emerged and is now being applied to wheat genotyping in the lab of Dr. Jesse Poland. This new approach termed "Genotyping-by-Sequencing" (GBS) utilizes the capacity of new sequencing machines such as the Illumina HiSeq2000, which can generate sequence data for hundreds of millions of short pieces of DNA in a single run. By combining this sequencing capacity with "DNA barcodes", many samples can be sequenced at the same time, greatly increasing the throughput and decreasing the per-sample cost.



Integration of new GBS approach with genetic mapping and breeding objectives for wheat germplasm improvement.

Research Highlight **(continued)**

The first results from wheat indicated that GBS is a very useful approach even in this large complex genome. Dr. Poland has been able to identify tens of thousands of useful molecular markers from the wheat data. This method for wheat genotyping, along with the discovered markers, can now be put to use in wheat breeding programs for marker-assisted selection of superior wheat breeding lines. With funding from the Kansas Wheat Alliance, Dr. Poland along with Kansas State University (KSU) wheat breeder, Dr. Allan Fritz, will be genotyping all of the elite breeding material in the KSU Manhattan and Hays breeding programs. By combining phenotypic data collected on these lines with the new molecular data from GBS, Drs. Poland and Fritz will develop genomic selection models to predict the yield and agronomic performance of new breeding lines. The ability to predict performance based on markers will assist in making selections of superior experimental wheat lines earlier in the breeding process. The diagram below shows the integration of the GBS approach with genetic mapping and breeding objectives for wheat germplasm improvement.

For more information contact Dr. Jesse Poland (785) 532-2709, Email: Jesse.Poland@ars.usda.gov

Meeting/Conferences

Robert Bowden and **John Fellers** attended the North American Rust Workers Meeting and 2011 Borlaug Global Rust Initiative Technical Workshop in St. Paul, MN, 11-16 June 2011.

Ming-Shun Chen participated in the Metabolomics Workshop on 6 May 2011, in St. Louis, MO.

Ming-Shun Chen attended a meeting on 'Wheat Insect Pest Management in the Great Plains' in Stillwater, OK, on 25 August.

Jesse Poland participated in the International Triticeae Mapping Initiative, Mexico City, 2-10 Sept.

Visitors

Jarislav von Zitzewitz, from Uruguay visited Jesse Poland May 31 - Jun 2.

Grants

Jesse Poland is the PI for a recently funded project "Genome-wide characterization and capture of exotic alleles for increased yield from primary synthetic bread wheat" with Monsanto Beachell-Bourlaug International Scholar, Sandra Dunckel.

Jesse Poland and Alan Fritz (Kansas State University) recently received funding for "Development of a Genomic Selection Training Population for KSU Wheat Germplasm", from the Kansas Wheat Alliance.

Research Highlight

Aerosol Insecticides Can Reduce the Need for Fumigation

Aerosol insecticides can be used to kill insects inside structural facilities. They are usually liquid formulations atomized through nozzles to create a fog or a mist spray. Ultra low volume (ULV) sprays often require specialized equipment to dispense insecticides without an inert carrier to create specific particle sizes, but are analogous to aerosols in that they kill only exposed insects and do not penetrate bagged or packaged produce. Therefore, they should not be confused with fumigants. Aerosols, including ULV sprays, can be included in insect management plans for food storage and milling facilities.

As part of our research program, we are evaluating dispersion and efficacy of aerosols in commercial milling and warehouse facilities, and also conducting small-scale studies in experimental sheds. Many commercial sites are applying pyrethrin insecticide alone or combined with an insect growth regulator (IGR), either methoprene (Diacon II®) or pyriproxyfen (NyGuard®). These IGRs do not kill adults but instead affect molting and development of the immature stages. Aerosols can be dispensed from a nozzle mounted high on a wall or on a ceiling or through a portable application system. The pyrethrin component generally gives immediate kill of exposed immature and adult stages of insects, while the IGR offers residual control of the immature stages because it is persistent and breaks down slowly after the aerosol particles drift downward and are deposited on a flooring surface.

Aerosol fogging in a stored product warehouse

The Red Flour Beetle (L) and the Confused Flour Beetle

When pyrethrin aerosols are applied to control adult flour beetles, the presence of food material such as flour can lead to increased survival of exposed insects, and therefore sanitation and cleaning are important components of pest management programs. When IGRs are applied with the pyrethrin, evaluation studies are done by exposing Petri dishes containing concrete to the aerosol, and then placing larval flour beetles along with flour on the surface that had been exposed to the aerosol. Residual persistence of the aerosol deposit is then measured by the number of adults that can successfully emerge from the larvae placed on the treated surface. Our studies show that applications of pyrethrin with either Diacon II or NyGuard have residual persistence for some weeks after the initial application.

Future research will focus on long-term effects of aerosols on insect populations in simulated studies and in field sites. We will also examine how well aerosols are dispersed into hidden and obstructed areas inside flour mills and food warehouses.

For more information contact Dr. Frank Arthur (785) 776-2783, Email: Frank.Arthur@ars.usda.gov (Collaborators were: Drs. James Campbell, CGAHR; Kun Yan Zhu, Kansas State University, Manhattan, KS; and flour mill managers at various field sites)

Meeting/Conferences

Jim Campbell attended the International Association of Operative Millers Food Protection Committee meeting in San Antonio, TX, 1-4 May.

Jim Campbell and **Frank Arthur** traveled to Crowley, LA, Beaumont, TX, and Jonesboro, AR, as part of the USDA-CSREES-RAMP workshops on Stored Grain Pest Management: Optimizing Insect Control and Grain Quality. **Frank Arthur** presented talks at all locations titled “Insect Pest Management for Rice Mills: Residual Efficacy of Aerosols,” and “Impact of Lesser Grain Borer Infestations on Milled Paddy Rice”. **Jim Campbell** presented a talk at all locations titled "Monitoring Programs for Stored-Product Insects Inside and Outside Rice Mills,” 9-14 May.

Jim Campbell went to Sturgis, MI, 19-20 May, to meet with Abbott Nutrition to discuss potential collaboration.

Dick Beeman attended the Arthropod Genomics Symposium held in Kansas City, MO, 7-12 June. He co-authored a poster “*Tribolium castaneum* Knickkopf is a chitin-binding protein that protects procuticular chitin from chitinases” and a talk “Annotation and functional analysis of bacteria-like genes in the red flour beetle”.

Jeff Lord attended the annual meeting of the Society for Invertebrate Pathology at St. Mary’s University in Halifax, Nova Scotia, 5-12 Aug., and presented the talk “A novel nuptially-transmitted DRIP symbiont of *Tenebrio molitor*.”

Jim Campbell attended the Royal Entomological Society Annual Meeting at the University of Greenwich, UK, 4-10 Sept., and presented the keynote address “Stored-Product Insect special Distribution in Food Processing Facility Landscapes: Implications for Pest Management.”

Jim Throne attended the International Association of Operative Millers Food Protection Committee meeting, 6-8 Sept., held at the ARS San Joaquin Valley Agricultural Sciences Center in Parlier, CA.

Visitors

Dr. David Schlipalius, (at right with Dr. Jim Throne, SPIRU Research Leader) with the Plant Science Division of the Department of Employment, Economic Development, and Innovation (DEEDI) and the Cooperative Research Centre for National Plant Biosecurity in Queensland, Australia, visited CGAHR to discuss collaborative research on sequencing the lesser grain borer genome/transcriptome. Dr. Schlipalius gave a seminar titled “Mechanisms of phosphine toxicity and resistance”.

Dr. David Claborn, Professor of Public Health at Missouri State University in Springfield, MO, visited Dr. Frank Arthur to obtain a colony of red flour beetles and to discuss potential collaborative projects.

Dr. Christian Nansen, Assistant Professor of Small Grains Entomology at Texas Tech University in Lubbock, TX, visited with scientists in SPIRU. Dr. Nansen conducts research on ecology of stored-product insects, and he has collaborated with SPIRU scientists on various research projects.

Community Service

Adopt-a-Highway CGAHR staff picked up litter along a 2.1 mile section of highway in Manhattan this spring/summer. Two of the three scheduled collections for 2011 were completed along Highway 113. This is the 4th year that CGAHR staff have helped to keep our community's road clean and litter-free.

Feds Feed Families Food Drive CGAHR employees collected more than 1 ton of food and other items for the Flint Hills Breadbasket foodbank in Manhattan and Eden Children's Village orphanage in Zimbabwe. This was approximately 45% more than was collected last year in this annual USDA food drive. Staff enjoy pie and coffee (left) after donating canned goods during the food drive.

Personnel News

Brad Bandy (right) joined the CGAHR as the Administrative Officer.

Natasha Gaudreault joined ABADRU as a Postdoctoral Research Associate.

Dana Nayduch joined the ABADRU as a Research Entomologist.

Elin Maki joined ABADRU as a Biological Science Technician.

Kyle Schweisthal joined ABADRU as a Biological Science Technician.

S. Grant Thompson, joined the CGAHR as a Student Intern (Facilities)

EEO/Non-Discrimination Statement