

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

Winter 2012

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

Inside this issue:

Arthropod-Borne Animal Disease Research Unit

Research Highlight.....	2
Meetings/Conferences.....	2
Visitors.....	2

Engineering & Wind Erosion Research Unit

Research Highlight.....	3
Meetings/Conferences.....	4
Visitors.....	4

Grain Quality & Structure Research Unit

Research Highlight.....	5
Meetings/Conferences.....	5
Grants.....	5
Visitors.....	5

Hard Winter Wheat Genetics Research Unit

Research Highlight.....	6
Meetings/Conferences.....	7
Grants.....	7
Visitors.....	7

Stored Product Insect Research Unit

Research Highlight.....	8
Awards.....	8
Meetings/Conferences.....	9
Grants.....	9
Visitors.....	9

Center News

Personnel News.....	10
---------------------	----

USDA Sesquicentennial The United State Department of Agriculture (USDA) is 150 years old this year. In May 1862, President Lincoln created USDA, calling it the "People's Department." USDA agencies in Kansas will be celebrating this anniversary at 2 p.m. on April 10th at CGAHR. At this event, we will also dedicate our new Wind Erosion Laboratory and celebrate the 75th anniversary of the Hard Winter Wheat Quality Laboratory. A number of dignitaries have been invited and all of the USDA agencies in Kansas will participate in a Resource Fair with information explaining their programs and activities. These events are open to the public and media. **PLEASE join us on April 10th.**



Dr. Richard Beeman Retires Dick

Beeman (right), Research Entomologist in Stored Product Insect Research Unit (SPIRU), retired after 32 years of federal service. Dick was the driving force behind the Red Flour Beetle genome project and the wealth of biological and genetic information this project produced. Dick is holding one of several "balls" of adhesive tape labels that were painstakingly collected by laboratory personnel and presented to him at the retirement party. Dick won numerous awards and was recognized in 2007 as ARS's Outstanding Senior Research Scientist in the Northern Plains Area. Dick will continue to be a presence at CGAHR as a collaborator...presumably adding more tape labels to the ball!



Research Highlight

Development of diagnostic tests for Rift Valley fever virus

Rift Valley fever virus (RVFV) is a zoonotic insect transmitted virus endemic to Africa and the Arabian Peninsula. Spread of this virus from endemic areas to North America is a serious threat to livestock, wildlife, and people. Infection causes abortions and high mortality in newborn ruminants with an overall human infection rate of <1%. The potential of RVFV as a bioterrorism agent and/or being accidentally introduced into North America is widely recognized. Currently, regional diagnostic labs do not have the ability to diagnose RVFV because all diagnostics and reagents available must be used in high containment labs. We developed and evaluated two diagnostic assays to detect virus that can be safely run in typical veterinary diagnostic labs.



For RVFV nucleic acid detection, a one-step real-time RT-PCR (rRT-PCR) assay was developed where samples are quickly inactivated allowing the assay to be performed in BSL-2 laboratories. The sensitivity and specificity of the viral RNA detection assay was evaluated in experimentally infected calf and lamb blood and tissue samples.

For RVFV protein detection, a single gene from the virus was cloned, protein expressed, and antibody made and used to develop an immunohistochemical assay. The sensitivity and specificity of the viral protein detection assay was evaluated in experimentally infected calf and lamb tissue samples (red = virus; figure at lower right).

Once validated and approved by national regulatory agencies, these reagents and assays will be useful to national laboratories as initial diagnostic tests with confirmation by virus isolation. These assays can be safely produced and distributed, giving our regional diagnostic labs the capacity to diagnose RVFV in the event of an introduction.



For more information contact: Dr. Barbara Drolet (785) 537-5569, Barbara.Drolet@ars.usda.gov
(Collaborators were: H. Weingartl, J. Jiang, J. Neufeld, P. Marszal, R. Lindsay, M.M. Miller, M. Czub, and W.C. Wilson)

Meetings/Conferences

Lee Cohnstaedt attended, as one of the organizer, a workshop entitled, "Multiscale Computational Modeling for Zoonotic Epidemics." This workshop was sponsored by the National Agricultural Biosecurity Center at Kansas State University and held at the Embassy Suites Kansas City Plaza, 10-12 Oct. 2011.

William Wilson traveled to the National Centre for Foreign Animal Disease, Winnipeg, Canada, 11-13 Oct. 2011, to attend the Annual Review of the CRTI 06-0138RD Development of Canadian Diagnostic capability for Rift Valley fever virus (RVFV) project as a collaborator on the project.

Lee Cohnstaedt and **Dana Nayduch** attended the Entomological Society of America annual meeting in Reno, NV on 16 Nov. 2011.

Scott McVey attended the Conference of Research Workers in Animal Diseases (CRWAD) Meeting, 2-4 Dec. 2011 in Chicago, IL.

Dana Nayduch attended the S1030 Multistate project meeting "Flies Impacting Livestock, Poultry and Food Safety" in Orlando, FL, 10-12 Jan. 2012 and presented a talk on "Species-specific fate of bacteria in house flies and impact on vector potential for pathogens".

Lee Cohnstaedt was invited to attend the Vector-Borne Diseases Modeling Workshop in Ottawa, Ontario, Canada, 18-21 Jan. 2012, to contribute modeling and disease surveillance expertise towards the development of disease vector prediction and management plans.

Visitors

On 1 Dec. 2011, Dr. Xuepeng Cai (Director General of the Chinese Animal Control Center) and Dr. Wang Qingbo (Vice Secretary General of the Chinese Veterinary Medical Association) visited and toured laboratories at the Center for Grain and Animal Health Research. Dr. Scott McVey, Research Leader, gave the visitors an overview of the Unit's research activities. Drs. Cai and Qingbo were visiting Manhattan to develop continuing education programs with Kansas State University for Chinese veterinarians.

Research Highlight

High speed sorting of grains

New technologies have been developed for automated separation of seeds that are discolored, blemished, infected by fungi, or from different species - such as wild grass seed from noxious weeds. This technology uses a newly developed "smart" camera developed in our lab that enables high speed image capture and digital processing of images from each individual seed as they drop off the end of a chute. This camera has been integrated into a complete sorting system as shown in Figures 1 and 2. Seeds are separated by a short burst of air from an air nozzle placed near the falling stream of seeds (Figure 2). For wheat, the system has a throughput of approximately 20Kg/hr and has been used extensively by plant breeders and seed foundation organizations for separating red and white wheat classes, scab damaged wheat, and removal of other crop seeds, such as barley, from wheat seed. The system has also been used extensively for removing noxious weeds from wild grass seed, separating yellow from brown flax seed, alfalfa seeds, pulses, and separating corn seed by size. It is also being used to separate industrial diamonds by color.



Figure 1. Complete image based color sorting system.

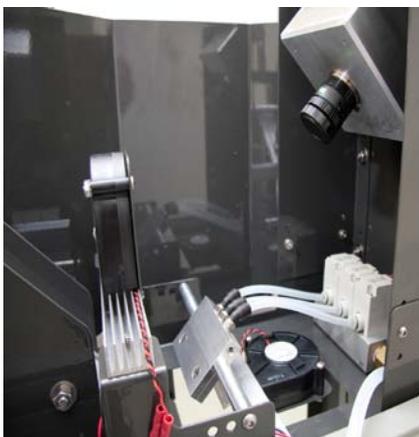


Figure 2. Close up of the camera (upper right) and air nozzle (lower middle) for diverting seeds.

All of the red, green, and blue pixels of the color images are used by the new "smart" camera to classify each seed using modern pattern recognition technologies. In contrast, traditional color sorters only use one or two colors and divert seeds if one or both of the colors exceed a level that is manually set by the operators. As such, the new image based system is able separate seeds having low color contrast at much higher accuracies than traditional sorting machines. The system is able to separate seeds by such minor color differences that are hard to distinguish by the human eye. Furthermore, the image can be used to identify small blemishes on seeds that are not large enough to be detected by traditional color sorters. Examples of seeds having minor blemishes are fungal infected popcorn and sorghum as shown in Figure 3. While the throughput of the image based system is not as large as commercial color sorting machines, the cost is also much lower, making the technology accessible to most seed breeders and seed foundation organizations.

This technology will improve quality of many crops by ensuring better seed that is free from weeds or other contamination and the technology will help deliver safer foods by reducing fungal contaminated products. Currently, we are working on adding near infrared capabilities to the sorting system to improve separation of fungal infected seeds as well as enabling separations based on wheat hardness and protein content.

For more information contact: Dr. Tom Pearson
(785) 776-2729, Thomas.Pearson@ars.usda.gov



Figure 3. Examples of seeds having small blemishes that are nearly impossible to detect using traditional color sorters but can be detected using image processing built into the new camera. The popcorn kernel (left) has a blue colored discoloration on the germ caused by a post-harvest fungus while the sorghum kernel (right) has minor fungal damage that created the small spots. Both of the fungal infestations can cause off tastes when used in foods.

Meeting/Conferences

Floyd Dowell was invited by the Organizing Committee of the ICC India Grains Conference, 16-18 Jan. 2012, where he chaired a session on food security, presented a paper on developing country storage technology, and represented the US at the ICC Governing Committee meeting.

Visitors

EWERU scientists held a workshop on WEPS/SWEEP (Wind Erosion Prediction System/Single-event Wind Erosion Evaluation Program) on 11-12 Jan. 2012 at CGAHR. Participants included 3 visitors from China, and 2 current PhD students from China, as well as interested students and colleagues from Kansas State University. The Chinese visitors were Yaqin Ji, College of Environmental Science and Engineering, Nankai University; Li Chen, College of Urban and Environmental Science, Tianjin Normal University; and Tao Li, College of Information Technical Science, Nankai University. The PhD students are Benli Liu, Cold and Arid Regions Environmental and Engineering Research Institute, Lanzhou; and Jiaqiong Zhang, Academy of Disaster Reduction & Emergency Management, Beijing Normal University. See photos below.



**WEPS/SWEEP Workshop
January 11-12, 2012**

**Special guests visiting from Tianjin, China included
Yaqin Ji, Li Chen, and Tingting Han**

Research Highlight

The Hard Winter Wheat Quality Laboratory: 75 Years and Going Strong

In 1937, the U.S. Congress established the Hard Winter Wheat Quality Laboratory (HWWQL) to develop reliable small scale testing for evaluating and predicting the quality of commercial cultivars and early generation breeding lines. The HWWQL initially interacted with plant breeders of the Great Plains. HWWQL research personnel were originally located in the Department of Milling Industry (later renamed Department of Grain Science and Industry) on the Kansas State University campus. The early employees of the HWWQL commenced their research early in 1938 and the personnel included Mark Barmore, Karl Finney, and Max McCluggage.



In 1937, a significant percentage of commercial HWW cultivars exhibited poor mixing and baking properties. The HWWQL was tasked to develop a bread making method that would give a full expression of the potential quality of commercial cultivars and breeding lines. Furthermore, the HWWQL were asked to develop methods that would reveal the impact of protein content, genetics, environment, and agronomic practices on bread making. In essence, the HWWQL developed micro tests that determine why good cultivars are good and poor ones are poor before wheat cultivars reached the consumer. In the 75 years since the four ARS wheat quality laboratories were established, there has been a profound improvement in the functional properties of cultivars representing all classes of wheat. Today, USDA-ARS and the Wheat Quality Laboratories continue to provide unbiased results to breeders, millers and the food industry to ensure a stable and high quality grain source to the domestic and export markets



For more information contact: Dr Brad Seabourn (785) 776-2751,
Brad.Seabourn@ars.usda.gov

The members of the GQSRU take great pride in being the home of the HWWQL that has served the growing region since 1937. This 75th Anniversary Celebration serves to recognize the contributions of the members of the HWWQL current and past. These diligent and dedicated ARS employees take great pride to maintain the quality standards expected by our stakeholders since 1937. The dreamers and doers that have passed through the research unit have paved the way for developing and evaluating new technologies to assess vibrant wheat lines that have fought off disease resistance and provide higher yields to feed Americans and beyond. The HWWQL for 75 years has been recognized to help our much valued public wheat breeder and to be the go-to place for unbiased and professional evaluation of hard winter wheat quality. The HWWQL will continue to work with the breeders, producers, millers, and bakers to evaluate new and existing wheat lines to meet the challenges of today and into the future.

Meeting/Conferences

Jeff Wilson, Richard Chen and Mike Tilley attended the AACCI Annual meeting in Palm Springs, CA on 15-20 Oct. 2011.

Grants

Scott Bean was awarded an NC-213 Anderson Grant (total amount \$49,725 over 2 years) to work on "Identification of factors related to sorghum protein quality."

Visitors

Dr. Larisa Cato, Australian Wheat Board, visited 21-24 Oct. 2011. Dr. Tom Clemente, Dept. of Agronomy & Horticulture, University of Nebraska, visited Oct. 26 and discussed sorghum research projects. The United Sorghum Checkoff Program brought a Japanese film crew to the U.S. to film a 30 minute show on sorghum (this is a part of U.S. Grains Council marketing effort for sorghum in the Japanese market). The crew visited GQSRU on Nov. 7. Dr. Tetsuo Hamamoto, U.S. Grains Council and Kazuki Fukano, President and Director, WinWin LLC led the group.

Research Highlight

Dramatic Expansion of Secreted Salivary Gland Protein Gene Families in the Hessian Fly Genome

Hessian fly (see photo) is a major destructive pest of wheat and typically overcomes new host resistance genes within three to eight years of release of new cultivars. Researchers are constantly looking for new sources of genetic resistance to incorporate into new varieties. In addition, we are seeking a deeper understanding of how Hessian flies attack wheat plants with the goal of finding an Achilles' heel that could be exploited to achieve more durable resistance.

USDA-ARS Research Entomologist Ming-Shun Chen, in collaboration with Kansas State University researchers Hang Chen, and Xuming Liu, and Purdue researcher Jeffrey J. Stuart have been studying how Hessian fly larvae establish feeding sites at the base of wheat seedlings (see photo). Larvae inject secreted salivary gland proteins (SSGPs) into the wheat seedlings that are thought to change the physiology of the plant to favor growth of the insect. Specifically, Hessian fly larvae induce specialized nutritive cell formation and reprogram metabolic pathways at the feeding site to access and enrich nutrients, inhibit wheat growth to create a stable environment, and suppress basal host defenses.

Analysis of the Hessian fly genome revealed the dramatic expansion of gene families encoding SSGPs compared to related insects. A total of 1,687 genes or gene fragments (incomplete genes) were found to encode SSGPs. The SSGP genes/gene fragments can be classified into 67 families. The largest gene family, SSGP-L, contains at least 477 genes. This gene family is by far the largest gene family of any type from any known organism so far identified. It is so huge, that it should be in the Guinness Book of World Records! The other gene families comprise a total of at least 195 genes, each with its own unique gene structure. Unconventional conservation patterns were found in the SSGP-encoding genes in Hessian fly. These strange patterns are also found in the related Asian rice gall midge, which shares the same feeding mechanism.

Comparative analyses indicate that the SSGP-encoding genes are constantly duplicating and diversifying. The large number of SSGP-encoding genes and the dynamic process of duplication and diversification for these genes are likely the molecular mechanism for the two extraordinary capacities that allow Hessian fly larvae to 1) rapidly defeat host resistance and 2) to take control of host plant physiology. Further work is needed to identify weaknesses in this insect's formidable arsenal of injected proteins.



Figure 1. A: An adult Hessian fly female depositing eggs on a wheat leaf. B: Hessian fly larvae feeding between wheat leaf-sheaths.

For more information contact: Dr. Ming-Shun Chen (785) 532-4719, [.Ming-Shun.Chen@ars.usda.gov](mailto:Ming-Shun.Chen@ars.usda.gov)

Meeting/Conferences

Guihua Bai attended the American Society of Agronomy * Crop Science of America * Soil Science Society of America International annual meeting in San Antonio, TX on 16-20 October 2011.

Guihua Bai attended the U.S. Wheat and Barley Scab Initiative meeting in St. Louis, MO, 3-7 Dec. 2011.

Robert Bowden attended the 2011 Field Crops Rust Symposium in San Antonio, TX, 14-16 Dec. 2011.

Ming-Shun Chen attended the Entomological Society Annual Meeting in Reno, NV, November 12 – 17, 2011.

Jaime Mitchell attended the Northern Plains Area Council of Office Professionals Annual Meeting in Fort Collins, CO, 18-21 Oct. 2011.

Jesse Poland was invited by Colorado State University to present a departmental lecture for the Soils and Crop Science Department as well as present his research. He gave a presentation entitled “Next – generation Plant Breeding”. Fort Collins, CO, 26-28 Oct. 2011.

Jesse Poland was invited to give a departmental lecture for the Crop Science Department at the University of Illinois. His presentation was titled “Genotyping-by-sequencing for genomic selection in wheat.” Champaign, IL, 8-9 Nov. 2011.

Robert Bowden, Guihua Bai, John Fellers and Jesse Poland attended the Plant and Animal Genome meeting in San Diego, CA, 13-19 Jan. 2012.



Grants

Guihua Bai, Jesse Poland, and Robert Bowden were approved for a second year of funding from the USDA-NIFA Triticeae Coordinated Agricultural Project entitled, “Improving Barley and Wheat Germplasm for Changing Environments.”

Visitors

Dr. James Kolmer, Plant Pathologist with the ARS-Cereal Disease Laboratory in St. Paul MN, visited 5-7 Oct. 2011 and presented a seminar to the Kansas State University Plant Pathology Department in Throckmorton Hall. The seminar was titled “Wheat Leaf Rust & Beyond.”



Research Highlight

New Insights into the Mechanisms of Action of a Chitin Inhibitor

A characteristic feature of insects is their hard exoskeleton. The exoskeleton is composed of chitin, a long polymer that provides strength and support, in a matrix of proteins. The insect exoskeleton has many unique functions vital for insect survival, and is therefore an attractive target for new biopesticide design. One of the older pesticides, diflubenzuron, disrupts the insect exoskeleton, but exactly how this occurs has never been fully understood. We used modern genomic techniques to assess the effects of diflubenzuron toxicity on the expression of 11,000 of the 16,000 total genes in the red flour beetle genome. The red flour beetle was the first agricultural pest, and first beetle, to have its genome sequenced. This makes the red flour beetle an ideal organism for studying the function of specific genes. Interestingly, genes for chitin metabolism were not affected, but exoskeleton proteins did show abnormal expression. Genes for diflubenzuron detoxification also showed increased activity. Our work demonstrates the complexity of diflubenzuron's mechanism of toxicity, which could explain why this mechanism has remained elusive for decades. Modern genomic technology should enable this mystery to be solved, opening the door for better design of biopesticides that target the insect exoskeleton. These biopesticides hold the promise of being more specific for the target pest, and being less toxic to non-target organisms.

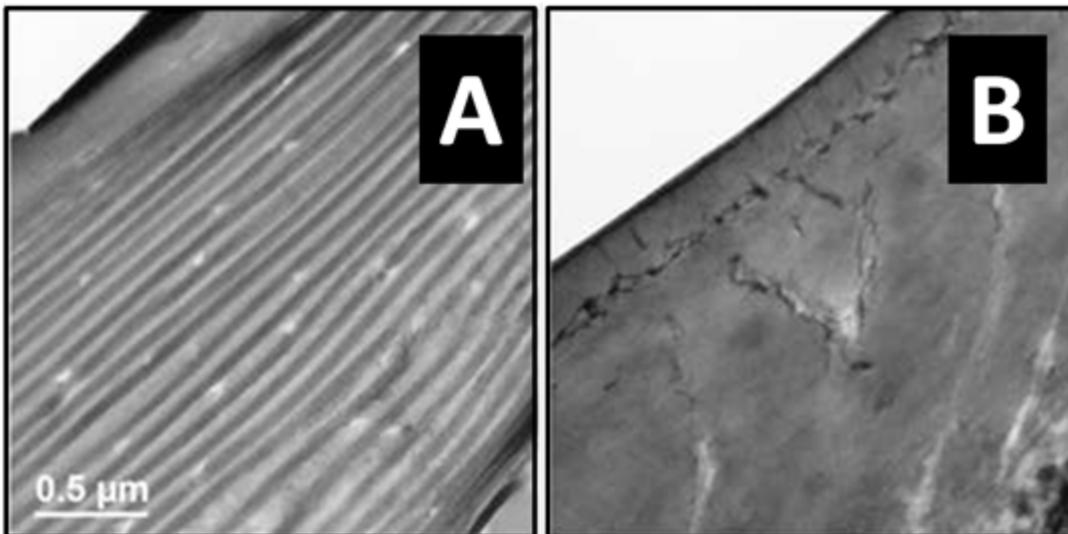
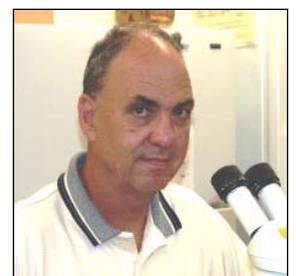


Fig. 1. Diflubenzuron disrupts ordered layering of insect cuticle. Shown are transmission electron micrographs of cross-sections of *Tribolium* larval abdominal cuticle. A: control. B: after treatment with 100 ppm diflubenzuron.

For more information contact: Dr. Richard W. Beeman (785) 776-2710, richard.beeman@ars.usda.gov (Collaborators were: Drs. H. Merzendorf, H.S. Kim, S.S. Chaudhari, M. Kumari, C.A. Specht, S. Butcher, S.J. Brown, J.R. Manak, K.J. Kramer and S. Muthukrishnan)

Awards

Dr. Frank Arthur (right) was selected to receive the Recognition Award in Entomology from the Entomological Society of America's North Central Branch. This award recognizes entomologists who have made significant contributions to agriculture through the field of entomology. Dr. Arthur will receive the award at the Society's Branch Meeting to be held in Lincoln, NE, 3-6 Jun. 2012.



Meeting/Conferences

Jim Campbell attended the National Pest Management Association's PestWorld 2011 in New Orleans, LA, on 20-22 Oct. 2011, and presented the invited talk "Using Pheromones for Pest Management".

Frank Arthur attended the International Research Conference on Methyl Bromide Alternatives and Emissions Reductions in San Diego, CA, on 30 Oct.-2 Nov. 2011, and presented the talks "Insect Pest Management in Rice Mills" and "Efficacy of Insecticide Treatments on Resident Populations of the Red Flour Beetle."



Jim Throne attended the Fall Grain Handlers Programs in Wichita and Garden City, KS, on 3-4 Nov. 2011, and presented the invited talk "Recent Research on Controlling Insects in Stored Grain" at both locations.

Frank Arthur, Karrie Buckman, Jim Campbell, Paul Flinn, and Jeff Lord attended the Annual Meeting of the Entomological Society of America in Reno, NV, on 12-17 Nov. 2011. Frank Arthur presented the talk "Impact of Lesser Grain Borer, *Rhyzopertha dominica*, Infestation on Rice Milling Quality: Challenges and Pitfalls in Data Interpretation." Karrie Buckman presented the talk "Effect of Combining Host Plant Resistance and Soybean Seed Treatment on a Soybean Aphid Fungal Pathogen." Jim Campbell presented the talk "What Generates Spatial Pattern in *Tribolium castaneum* Trap Captures in Flour Mills?" Paul Flinn presented the poster "Effects of Flour Conditioning on Cannibalism of *Tribolium Castaneum* Eggs and Pupae." Jeff Lord presented the poster "Heat Curing of Microsporidian, Neogregarine, and Eugregarine Infections in *Tribolium castaneum*."

Grants

Frank Arthur and Jim Campbell were awarded \$83,000 as part of a \$450,502 USDA-NIFA Methyl Bromide Transitions Program grant with Arkansas State, Oklahoma State, Texas A&M, and Louisiana State Universities entitled "Integrated Pest Management Programs to Reduce Reliance on Methyl Bromide Fumigation in Rice Mills."

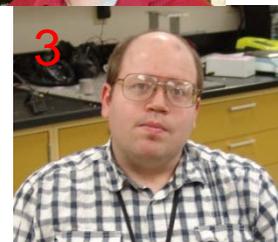
Visitors

Dr. Jarrad Prasifka, a Research Entomologist with the USDA-ARS Sunflower Research Unit in Fargo, ND, visited CGAHR on 7-8 Feb. 2012. He met with Jim Campbell and Frank Arthur of SPIRU, and Tom Pearson from EWERU, to discuss potential research projects. Ann Redmon assisted Dr. Prasifka with an evaluation of the SPIRU digital x-ray unit to determine whether it could accurately detect stem-boring insects in sunflower stalks. Use of the X-ray unit could simplify the process of evaluating resistance to insects of new sunflower varieties developed as part of the ARS breeding program.



Personnel News

1. **John Diaz** joined SPIRU as a Postdoctoral Research Associate.
2. **Myron Bruce** joined HWWGRU as a Postdoctoral Research Associate.
3. **Joe Beauchamp** joined the EWERU as an Engineering Technician
4. **Bethany Vosburgh** joined GQSRU as a Biological Science Technician.
5. **Benli Lui** and **Jiaqinong Zhang** (L and R), from Lanzhou and Beijing, China, joined EWERU as a Ph.D. students.
6. **Kyle Schweisthal** joined ABADRU as a Biological Science Technician.
7. **Jacob Schmidt** joined, and **Evan Mesh** and **Pat Gregg** left, the CGAHR as a Student Interns (Facilities)



8. **Dick Beeman Retirement** SPIRU staff Ken Friesen, Rich Hammel, Jeff Lord, Dick Beeman and Paul Flinn (L to R) enjoy Dick's retirement party.



EEO/Non-Discrimination Statement

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410, or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.