

NCCC-170
Research Advances in Agricultural Statistics
Annual meeting held at University of Puerto Rico Mayagüez
June 25-26, 2015

Members Present: Nora Bello (KS), Bruce Craig (IN, Admin.), Xin Dai (UT), Sara Duke (USDA-ARS), Ed Gbur (AR), Carla Goad (OK), Nick Keuler (WI), Matt Kramer (USDA-ARS), Alex Lipka (IL), Raul Macchiavelli (PR), Bahram Momen (MD), Dan Nettleton (IA), Gayla Olbricht (MOSci&Tech), Neil Paton (Cargill), Bahman Shafii (ID), Julia Sharp (SC), John Stevens (UT), Walt Stroup (NE), Rob Tempelman (MI), Mark West (USDA-ARS), Kathy Yeater (USDA-ARS)

Members Absent: John Aleong (VT), Jennifer Clark (NE), Susan Durham (UT), Mark Hinds (Pioneer Hi-Bred), Ken Koehler (IA), Larry Madden (OH), Kevin McCarter (LA), David Meek (USDA retired), Margaret Nemeth (Monsanto retired), Dan Schmoldt (USDA, Admin.), Linda Young (USDA), Jun Zhu (WI)

USSES and Others Present: Four official USSES members, Elizabeth Claassen (SAS), Ellen Paparozzi (NE), Perla Reyes (KS)

2015 Officers: Ed Gbur, Chair; Gayla Olbricht, Secretary; Bahman Shafii, Program Chair; Raul Macchiavelli, Local Arrangements

NCCC-170 Website: <http://www.uark.edu/misc/ncr170/>

Minutes:

Technical program: The meeting began at 9:00 a.m. on Thursday, June 25, 2015 with opening remarks by Raul Macchiavelli (Interim Dean and Interim Experiment Station Director as well as Local Arrangements Chair). Presentations ended at approximately 4:15 p.m. The technical program consisted of the following presentations.

Walt Stroup and Ellen Paparozzi	A glimpse of GLMMIX (with a peek at R) for use in horticultural research
Matt Kramer, Ellen Paparozzi, and Walt Stroup	Statistical issues in a horticultural journal: Misunderstanding and misapplication of fundamental concepts
Dan Nettleton	A glimpse inside the random forest black box
Gayla Olbricht	Investigating differences in sleep properties between Alzheimer's and normal fruit flies
Bruce Craig, Ningning Chen, and Sameera Wijayawardana	Assessing inter-observer agreement for multivariate IHC scoring data
Elizabeth Claassen	Mixed and generalized models in JMP
John Stevens	The bivariate null kernel method for LD-based QTL mapping
Ed Gbur	Inference issues related to the two sample test for means of beta distributions
Raul Macchiavelli	Application of non-linear mixed models to combine information from different sources to estimate site index curves in forestry studies

Business meeting: The business meeting began at 9:12 a.m. on Friday, June 26, 2015. Ed Gbur presided. The following items were discussed:

- (1) The organizers were thanked for a productive and enjoyable meeting: Raul Macchiavelli for local arrangements with assistance from Ms. Lucy Serrano and Bahman Shafii for the technical program. Ed Gbur was thanked for his work as chair and webmaster of the committee.
- (2) Presenters who wish to post their talk on the project website should send a pdf of the talk to Ed Gbur (egbur@uark.edu).
- (3) The annual report and impact statement are due shortly after the annual meeting. Participants need to send Ed Gbur (egbur@uark.edu) accountings of all activities (workshops, papers, presentations, grants, teaching related items, etc.) from October 1, 2014 to September 30, 2015 (or since last year's report) that are related to or inspired by their participation in NCCC-170 as soon as possible.
- (4) The 2016 meeting will be held in Maryland with Bahram Momen as the local host. Tentative dates are June 23-24, 2016. This will be a joint meet with USSES (SCC-013). Kathy Yeater will serve as program chair. The 2017 meeting is tentatively planned for Elk River, Minnesota at the Cargill Experiment Station with Neil Paton as the local host. The 2018 meeting is tentatively planned for Arkansas.
- (5) The current NCCC-170 project is scheduled to end on September 30, 2016. Ed Gbur announced that the initial deadline for the renewal proposal is September 15, 2015. His goal is to submit the proposal no later than September 1. More information and reminders along with deadlines for various steps in the process will be distributed shortly. It is important that all individuals sign up as official members. This includes current members because membership does **not** automatically roll over into the renewal. Organizations have the option of allowing multiple official members but only one member can be the voting member.
- (6) Kathy Yeater announced that on-line statistics trainings, facilitated by American Society of Agronomy's as part of their program "Statistics Workshops for Regional Meeting and Web-Based Platform," had three successful presentations over the last academic year that were taught by NCCC-170 members Julia Sharp and Carla Goad. Each course lasted 4 weeks, with 2 hours of contact time per week. Approximately 150 ASA members and industry partners enrolled in the courses. The society is very supportive of the online statistics courses and is open to facilitating more applied statistics courses.
- (7) Kathy Yeater also announced that at the upcoming Annual Meeting for ASA-CSSA-SSSA in November activities are scheduled for meta-analysis and data stewardship topics. There will be a symposium entitled "Meta-Analysis Applications in Agricultural Research" and a partnered workshop "Meta-Analysis for the Synthesis of Evidence in Agriculture." Larry Madden will be presenting the workshop. The Plenary special session is "Getting More from Data: Science for Sustainable Solutions."
- (8) Lastly, Kathy Yeater called for volunteer(s) or nomination(s) to present invited statistics workshop(s) for the Aquaculture America conference in February 2016. The topics of multiple comparison procedures, regression approaches, and categorical data analysis were requested.
- (9) Debbie Boykin announced an upcoming opening for an ARS Area Statistician to be located in Athens, Georgia. She encouraged interested individuals to apply as soon as possible after the announcement is posted.

- (10) Nora Bello announced that the mixed models workshop will be presented at the annual Animal Science meeting on July 15-16, 2015 in Orlando, Florida. The workshop has already reached the 100 participant limit. Since the Animal Science and Dairy Science annual meetings are being planned as separate meetings in the future, there was discussion about presenting the workshop for both societies, possibly alternating years between them.
- (11) The group reviewed progress toward the goals identified at the 2014 meeting. In addition, based on the discussion generated by the first two presentations of the technical program, the group agreed that incorporating ideas for providing statistical support to the scientific community in the review and editorial process of publications was important to include in the Goals, Impacts, and Outcomes sections of the annual report and renewal proposal. A few other changes regarding wording of application areas were also suggested.
- (12) The group discussed USSES (SCC-013) meeting jointly with NCCC-170 yearly. Previously the two groups met together every three years. For the immediate future, the administrative structure of the individual groups would not change. Meeting jointly would allow both groups to benefit from the presentations and experience of the combined group. Concern was expressed that the combined groups may eventually become too large.

The meeting adjourned at approximately 10:50 a.m. A group photograph for the project web site was taken during a break in the meeting.

Accomplishments: Statisticians who consult and do research in an Agricultural Experiment Station environment enable land grant institutions to perform their agricultural research missions more effectively and efficiently than would otherwise be possible. However, most stations have at most one or two professional statisticians who are not, and cannot be expected to be, experts in every area of statistics. This multi-state committee brings together statisticians to work cooperatively to determine the best current approaches to common statistical problems and to help guide future directions of sound statistical practice. In addition to producing group outputs such as workshops, the committee serves as a resource for its members and a sounding board for new ideas in their applied statistical research. As a result, all members are able to provide more effective assistance to agricultural researchers addressing national research priorities than they would without NCCC-170.

Outputs:

Workshops:

Walt Stroup and Ellen Paparozzi presented a workshop entitled “A glimpse of GLIMMIX (with a peek at R) for use in horticultural research” at the International Horticulture Congress in Brisbane, Australia in August 2014. The presentation has been accepted to appear in refereed proceedings that will be published in *ActaHorticultura*.

Ken Koehler and Kevin McCarter taught the mixed model workshop focusing on the application of general and generalized linear mixed models to research problems in the animal and food sciences at the Annual American Dairy Science Association and American Society of Animal Sciences National Meetings in Orlando, FL in July 2015.

Jennifer Clarke presented a workshop on statistics and “big data” at the Annual Meeting of the Snake River Chapter of the American Statistical Association in May 2015 in Meridian, ID. The workshop included invitees from universities in Idaho and Utah, as well as members of NCCC-170.

Presentations:

Larry Madden. Meta-analysis of 19 years of fungicide trials for the control of Fusarium head blight of wheat. Keynote presentation at the National Fusarium Head Blight Forum, December 2014. St. Louis, MO.

Bruce Craig. Consensus development for public health guidelines: a critical approach. Women's Global Health Institute High Tea Symposium. Purdue University, November 7, 2014.

Bruce Craig. Assessing inter-observer agreement for multivariate IHC scoring data. Department of Statistics, University of Georgia, September 4, 2014 and at the Department of Biostatistics, Indiana University, November 21, 2014.

Macchiavelli, R.; A. Calvo; P. Torres-Saavedra; J. Chavarría-Carvajal. Semiparametric Mixed Beta Regression with Penalized Splines for Disease Severity in Plants. XXVIIIth Annual Conference on Applied Statistics in Agriculture. 26-29 April, 2015, Manhattan, KS.

Calvo, A.; R. Macchiavelli. Regresión semi-paramétrica con Distribución Beta y efectos aleatorios. XXX Seminario Interuniversitario de Investigación Matemática (SIDIM). 27-28 Febrero 2015, Mayagüez, PR.

Torres-Saavedra, P.; R. Macchiavelli. Semiparametric Mixed Beta Regression with Penalized Splines for Disease Severity. XXX Seminario Interuniversitario de Investigación Matemática (SIDIM). 27-28 Febrero 2015, Mayagüez, PR.

Piccardi, M, R. Macchiavelli, M. Balzarini. Modelos no lineales mixtos para la producción de lechetería. XIX Reunión Científica del Grupo Argentino de Biometría. 10-12 September, 2014, Santiago del Estero, Argentina.

Willems, P., R. Macchiavelli, C. Robles. Comparación de formas de aplicación de la vacuna *Brucella abortus* cepa 19 en bovinos: Aplicación de modelos no lineales mixtos. XIX Reunión Científica del Grupo Argentino de Biometría. 10-12 September, 2014, Santiago del Estero, Argentina.

John Stevens, Mecham D, Isom SC, and Saunders G. mvGST: Multivariate and Directional Gene Set Testing. Kansas State University Conference on Applied Statistics in Agriculture in April 2015 and at the Joint Statistical Meetings in Seattle, WA in August 2015.

Yu M, Kearney M, Momen B, Riter, JCA. Correlating peak NDVIs of salt marshes with environmental conditions in Louisiana, USA, using principal component analysis. IGARSS, 2015.

Nora Bello. Experimental design basics. Kansas State University Honors Undergraduate Program on General Agriculture. February 2015.

Ou, Z., R.J. Tempelman, J.P. Steibel, C.W. Ernst, R.O. Bates and N.M. Bello. Breeding implications of heteroskedastic whole-genome prediction of genetic merit. Joint Annual Meetings of the American Dairy Science Association and the American Society of Animal Science. Orlando, FL. July 12-16, 2015.

Lu, Y., M.J. Vandehaar, D.M. Spurlock, K.A. Weigel, L.E. Armentano, C.R. Staples, E.E. Connor, Z. Wang, M. Coffey, R.F. Veerkamp, Y. deHass, N.M. Bello and R.J. Tempelman. Hierarchical Bayesian inference on genetic and non-genetic components of partial efficiencies determining feed efficiency in dairy cattle. Joint Annual Meetings of the American Dairy Science Association and the American Society of Animal Science. Orlando, FL. July 12-16, 2015.

Delph, K., E.G. Davis, N.M. Bello, K. Hankins, M.J. Wilkenson and C. Ewen. Comparison of immunologic responses following intranasal and oral vaccination with a USDA-approved, live-attenuated *Streptococcus equi* vaccine. 2015 American College of Veterinary Internal Medicine Forum. Indianapolis, IN. June 4-6, 2015.

Johnson, L., M.M. Gray, P. St. Amand, M. Galliard, S. Brown, J. Poland, K. Garret, E. Ekhunov, N.M. Bello, T. Morgan, S.G. Baer and B. Maricle. Genetic differentiation, transcriptome variation, and local adaptation of dominant prairie grass *Andropogon gerardii* along the climate gradient of the US Midwest: Implications for climate change. Society for Molecular Biology and Evolution Satellite Meeting. Montpellier, France. May 26-29, 2015.

Galliard, M., P. St. Amand, J. Pollard, N.M. Bello, S. Sabates, H. Tetreault, A. DeLaCruz, J. Bryant, T.J. Morgan, M. Knapp, S.G. Baer, D. Gibson, L. Wilson, B.R. Maricle and L. Johnson. Trait variation and genetic divergence of a widespread grass *Andropogon gerardii* across a Great Plains climate gradient. American Society of Plant Biologists Midwestern Section Meeting. Lincoln, NE. March 24-25, 2015.

Goncalves, M.A D., S.S. Dritz, M.D. Tokach, N.M. Bello, J.M. DeRouchey, R.D. Goodband and J.C. Woodworth. Effect of lysing and energy intake during late gestation on weight gain and reproductive performance of gilts and sows under commercial conditions. Joint Midwest Meeting of the American Dairy Science Association and American Society of Animal Science. Des Moines, IA. March 15-18, 2015.

Cull, C., D. Renter, N.M. Bello, A. Babcock, S. Ives and T.G. Nagaraja. Efficacy of a vaccine and a direct-fed microbial against fecal shedding of *Escherichia coli* O157:H7 and corresponding impacts on cattle performance in a commercial feedlot. Kansas State University Cattlemen's Day. Manhattan, KS. March 6, 2015.

Johnson, L., J. Shelton, N.M. Bello, S. Raithel, M. Galliard, S.J. Brown, N. Herndon, R. Welte, B. Nikolau, T. Samarakoon, Z. Song and R. Jeannotte. Divergent epicuticular wax and transcriptome of edaphically differentiated *Andropogon* grasses in the US Midwest prairies. XXIII International Plant & Animal Genome Conference. San Diego, CA. January 10-14, 2015.

Galliard, M., P. St. Amand, J. Pollard, N.M. Bello, S. Sabates, H. Tetreault, A. DeLaCruz, J. Bryant, T. J. Morgan, M. Knapp, S.G. Baer, D. Gibson, L. Wilson, B.R. Maricle and L. Johnson. Trait variation and genetic divergence of a widespread grass *Andropogon gerardii* across a Great Plains climate gradient. XXIII International Plant & Animal Genome Conference. San Diego, CA. January 10-14, 2015.

Kivett, J., N.M. Bello and R. Cloyd. Efficacy of rotation programs against the western flower thrips, *Frankliniella occidentalis* that include entomopathogenic fungi. Entomological Society of America Annual Meeting. Portland, OR. November 16-19, 2014.

Raithel, S., L. Johnson, M. Galliard, S. Brown, J. Shelton, N. Herndon and N.M. Bello. Assessing gene filtering strategies in RNA-Seq differential expression analysis of an edaphic subspecies of dominant prairie grass *Andropogon gerardii*. 10th Annual Ecological Genomics Symposium. Kansas City, MO. October 31 - November 2, 2014.

Cull, C.A., D.G. Renter, N.M. Bello, A.H. Babcock and T.G. Nagaraja. Efficacy of a vaccine and a direct-fed microbial against fecal shedding of *Escherichia coli* O157:H7 and corresponding impacts on cattle performance in a commercial feedlot. 10th Annual Applied Animal and Public Health Research and Extension Symposium. Kansas, City, MO. October 18, 2014.

Gardhouse, S., D. Eshar, N.M. Bello and D. Mason. Evaluation of changes in critical care blood analytes during isoflurane anesthesia in zoo-kept black-tailed prairie dogs (*Cynomys ludovicianus*). American Association of Zoo Veterinarians Annual Conference. Orlando, FL. October 18-24, 2014.

Gerard, P., Wrenn, J., and Sharp, J.L. Identifying the perceived value of statistical consulting in a university setting. Joint Statistics Meetings, Boston, MA. August 2-7, 2014.

Drennan, K., Wiesinghe, D., White, S., White, D., Menchyk, N., Sharp, J., Vincent, E. and Park, D.M. Soil Temperature and Moisture Differentials from Concrete Sidewalks. 14th American Ecological Engineering Society Meeting. Charleston, SC. June 10, 2014.

Lund, R.L., Bowman, D.D., Brown, H., Malone, J.B., McMahan, C., Sharp, J.L. Wang, D. Identifying relevant canine heartworm factors. American Association of Veterinarian Parasitologists. Denver, CO. July 26-29, 2014.

Solomons, A.G., Mikhailova, E.A., Post, C.J., and Sharp, J. L. Using low-cost thermal cameras to validate LiDAR-based predictions. Clemson Biological Sciences 7th Annual Student Symposium. Clemson, SC. February 28, 2015.

Sharp, J.L., Smith, J., Park, D. Exploring Challenges Encountered With Streaming Data Analyses. Kansas State University Conference on Applied Statistics in Agriculture. Manhattan, KS April 27-28, 2015.

West, Mark. Three presentations entitled Introduction to R with RStudio; Experiments, designs and models; Introduction to mixed model analysis. Natural Resource Management Research Center, Mandan, ND. March 11, 2014.

West, Mark. How to mess up experiments, designs and models. Red River Valley Agricultural Research Center, Fargo, ND. September 24, 2014.

Thompson, K.T. and Gbur, E.E. Small sample properties of the two independent sample test for means from beta distributions. Conference on Applied Statistics in Agriculture. Manhattan, KS April 27-28, 2015.

Olbricht G.R. Analyzing DNA Methylation Data in Plants: The Importance of Sequence Context. University of Missouri – Kansas City, Mathematics and Statistics Department Colloquia. Kansas City, MO, April 24, 2015.

Baumann D. and Olbricht G.R. Statistical Analysis of DNA Methylation in Plants. Conference on Applied Statistics in Agriculture. Manhattan, KS, April 27-28, 2015.

Goad, Carla. Experimental design basics. Oklahoma State University Department of Horticulture and Landscape Architecture seminar (*Invited*). January 2015.

Clarke, J. The Challenge of Big Data. USDA-ARS Big Data Workshop. George Washington Carver Center, Beltsville, MD. July 15-16, 2015.

Snelling, W.M., Kuehn, L.A., Sinha, R., Wells J.E., Bono, J.L., Berry, E.D., Kim, M.S., Clarke, J., Kachman, S.D., Moriyama, E., Wilson, D., Benson, A. Geneomic heritabilities and SNP associated with lower gastrointestinal tract microflora taxonomic groups and E. coli O157:H7 shedding. Joint Midwest Meeting of the American Dairy Science Association and American Society of Animal Science. Des Moines, IA. March 15-18, 2015.

Kuehn, L.A., Snelling, W.M., Sinha, R., Wells J.E., Bono, J.L., Freetly, H.C., Kim, M.S., Clarke, J., Kachman, S.D., Moriyama, E., Wilson, D. and Benson, A. Genetic correlations of lower gastrointestinal tract microflora taxonomic groups with animal intake and gain. Joint Midwest Meeting of the American Dairy Science Association and American Society of Animal Science. Des Moines, IA. March 15-18, 2015.

Clarke, B., Valdes, C., Dobra, A. and Clarke, J. A Bayes testing approach to metagenomic profiling in bacteria. ICASA Annual Meeting, Colorado State University, Ft. Collins, CO, June 17-18, 2015. (*Invited*)

Other project related activities:

As part of the American Society of Agronomy's on-line statistics training initiative Julia Sharp taught "Introduction to Statistics for Agricultural Researchers" in Fall 2014 and Carla Goad taught the follow-up "Introduction to Experimental Design and Analysis." Carla Goad's course included 24 Pakistani participants from partner organizations United States Agency for International Development (USAID) and International Maize and Wheat Improvement Center (CIMMYT). In Spring 2015 Julia Sharp taught "Introduction to Statistics Using R."

Walt Stroup's invited paper "Rethinking the Analysis of Non-Normal Data in Plant and Soil Science" in *Agronomy Journal* has been the tenth mostread paper of 2015 for that journal. Four of the top ten papers were invited statistics manuscripts. The invited Statistics Series manuscripts for *Agronomy Journal* have elicited an out-growth to a textbook being prepared for ASA-CSSA-SSSA Publications.

Nora Bello is a co-PI on a USDA-AFRI Foundational Program A1221 grant proposal entitled "Risk Management Strategies to Reduce the Impacts of Bovine Respiratory Disease Complex in Commercial Feeder Cattle." Principal Investigator is David Renter, College of Veterinary Medicine, Kansas State University. The proposal was funded for 2014-2018 at \$498,500. It was ranked as Outstanding and the #1 ranked grant for this review panel.

John Stevens has maintained the R package mvGST on Bioconductor since its acceptance there in October 2014. This package facilitates multivariate and directional gene set testing, was primarily motivated by collaboration with animal science reproduction researchers, and was co-authored with former students Dennis Mecham and Garrett Saunders.

NCCC-170 has helped Bahram Momen improve the content of his graduate course in experimental design and advanced statistical analysis (BIOM602) course at the University of Maryland. It has also helped him substantially in consulting and mentoring many graduate students and faculty members in designing their research and analyzing the data.

Walt Stroup developed and taught a course on non-normal data for entomology and ecology graduate students at the University of Nebraska in the Fall 2014 semester. In addition, his graduate level Design of experiments and Statistical modeling courses have been influenced by his participation in NCCC-170. The audiences for both courses include agriculture graduate students. Approximately half of the students in the Design class were from agricultural disciplines.

Jennifer Clarke developed and is co-director of a new doctoral program in Complex Biosystems at the University of Nebraska. She is director of the program specialization in Systems Analysis. The program has accepted its inaugural class of students and will begin teaching courses in Fall 2015. Entering students have undergraduate degrees in analytical as well as agricultural areas of study. The program design was

influenced by the NCCC-170 and includes required courses in statistics and specializations in integrated plant biology, microbial interactions, and computational ecology, evolution, and organismal biology.

Specific goals for the next three years:

- (1) Educate project members in statistical issues and methodology related to statistical problems related to new complex data types collected on relatively few experimental units. Application areas include agricultural analytics, informatics, -omics, and -metrics.
- (2) Continue to offer updated and expanded mixed model and generalized linear mixed model workshops upon request from subject matter groups.
- (3) Develop web-based educational materials and workshops for agricultural scientists including statistical assistance in the review and editorial process of agricultural publications.

Impacts:

- (1) NCCC-170 fosters research to identify and develop statistical methodology applicable to agricultural research and provides a forum for sharing and educating both statisticians and subject-matter scientists in the agricultural, environmental and natural sciences. As a result, all members are able to provide more effective assistance to agricultural researchers addressing national research priorities than they would be without NCCC-170.
- (2) Project members provide continuing education for scientists in agriculturally related disciplines in modern statistical analyses of designed experiments in general and specifically in the areas of generalized linear mixed models, statistical techniques in genomics applications, and meta-analysis. Examples of such activities and their immediate impacts for the current reporting period are listed in the Accomplishments section of this report.
- (3) Project members collaborate in research projects with scientists in agricultural related disciplines to develop and use proper statistical design and analysis methodology well beyond standard textbook applications. These efforts often result in competitive grant participation and refereed publications. Each of these impacts is listed in the Accomplishments and Publications sections of this report.

Publications:

Easson, M.W., S.A. Wojkowski, B.D. Condon, K.M. Yeater, R.P. Slopek, and C.A. Fortier (2015). Ultrasound-enhanced bioscouring of greige cotton: regression analysis of process factors. *American Association of Textile Chemists and Colorists Journal of Research* 2(1):16-23.

Gealy, D., N.R. Burgos, K.M. Yeater, A.K. Jackson (2015). Outcrossing Potential between U.S. Blackhull Red Rice and Indica Rice Cultivars. *Weed Science* (in press, Accepted February 12, 2015). doi: <http://dx.doi.org/10.1614/WS-D-14-00150.1>.

Guerrero, F.D., R. Andreotti, K.G. Bendele, R.C. Cunha, R.J. Miller, K. Yeater, and A.A. Perez de Leon (2014). *Rhipicephalus (Boophilus) microplus* aquaporin as an effective vaccine antigen to protect against cattle tick infestations. *Parasite Vectors* 7:475. Published online 2014 Oct. 12. Doi: 10.1186/s13071-014-0475-9.

Kim, H.J., D.J. Hinchliffe, B.A. Triplett, K.M. Yeater, H.S. Moon, M.K. Gilbert, G.N. Thyssen, R.B. Turley, and D.D. Fang (2015). Phytohormonal networks promote differentiation of fiber initials on pre-anthesis cotton ovules grown in vitro and in planta. *PLoS One* 10(4):e0125046.

Sheffield, C.L., T.L. Crippen, J.A. Byrd, R.C. Beier, and K.M. Yeater (2015). Canonical discrimination of the effect of a new broiler production facility on soil chemical profiles as related to current management practices. *PLoS One* 10:1-13.

Neuman-Lee, L.A., H.B. Fokidis, A.R. Spence, M. Van der Walt, G.D. Smith, S. Durham, and S.S. French (2015). Food restriction and chronic stress alter energy use and affect immunity in an infrequent feeder. *Functional Ecology* (in press).

Ranglack, D.H., S. Durham, and J.T. du Toit (2015). Competition on the range: science vs. perception in a bison-cattle conflict in the western USA. *Journal of Applied Ecology* 52: 467-474.

Tepedino, V.J., S. Durham, S.A. Cameron, and K. Goodell (2015). Documenting bee decline or squandering scarce resources. *Conservation Biology* 29: 280-282.

Ramos-Santana, R., Y. Quijano-Cabrera, R. Macchiavelli (2014). Evaluación del rendimiento y la calidad del forraje Maralfalfa en tres vaquerías del norte de Puerto Rico en la época de días cortos. *Journal of Agriculture of the University of Puerto Rico* 98: 49-56.

Ramos-Santana, R., E. Valencia-Chin, R. Macchiavelli (2014). Potencial de *Morus alba* (Morera) en la alimentación de cabras de reemplazo en Puerto Rico. *Journal of Agriculture of the University of Puerto Rico* 98: 79-82.

Anaya, A.; I. Padilla; R. Macchiavelli; D. Vesper; J. Meeker; A. Alshawabkeh (2014). Estimating preferential flow in karstic aquifers using statistical mixed models. *Groundwater* 52:584-596 (doi: 10.1111/gwat.12084).

Klun, JA and Kramer, M. (2014). Klun & Debboun modules: uses and data analysis. *In* Insect Repellents Handbook, 2nd ed. Eds: Debboun, M; Frances, SP; Strickman, DA. CRC Press, Boca Raton, FL. pp. 267-281.

Baldos, OC; DeFrank, J; Kramer, M; Sakamoto, GS. (2014). Storage humidity and temperature affect dormancy loss and viability of tanglehead (*Heteropogoncontortus*) seeds. *HortScience* 49: 1328-1334.

Ulrich, KR; Feldlaufer, MF; Kramer, M; St. Leger, RJ. (2014). Exposure of bed bugs to *Metarhiziumanisopliae* at different humidities. *J. Economic Entomology* 107: 2190-2195.

Ulrich, KR; Feldlaufer, MF; Kramer, M; St. Leger, RJ. (2015). Inhibition of the entomopathogenic fungus *Metarhiziumanisopliae* ensulato in vitro by the bed bug defensive secretions (E)-2-hexenal and (E)-2-octenal. *BioControl* 60: 517-526

Apps, PJ, Weldon, PJ, Kramer, M. (2015). Chemical signals in terrestrial vertebrates: search for design features. *Nat. Prod. Rep.* 32: 1131-1153.

Saunders G., Fu G., and Stevens J.R. (2014). A graphical weighted power improving multiplicity correction approach for SNP selections. *Current Genomics* 15(5):380-389.

Saunders G., Stevens J.R., and Isom S.C. (2014). A shortcut for multiple testing on the directed acyclic graph of gene ontology. *BMC Bioinformatics* 15:349.

Walsh, S.W., F. Mossa, S.T. Butler, D.P. Berry, D. Scheetz, F. Jimenez-Krassel, R.J. Tempelman, F. Carter, P. Longergan, A.C.O. Evans, and J.J. Ireland (2014). Heritability and impact of environmental effects during pregnancy on antral follicle count in cattle. *Journal of Dairy Science* 97:4503-4511.

Tempelman, R.J., D.M. Spurlock, M. Coffey, R.F. Veerkamp, L.E. Armentano, K.A. Weigel, Y. de Haas, C.R. Staples, E.E. Connor, Y. Lu, and M.J. Vandehaar (2015). Heterogeneity in genetic and non-genetic variation and energy sink relationships for residual feed intake across research stations and countries. *Journal of Dairy Science* 98:2013-2026.

Yang, W., C. Chen, and R.J. Tempelman (2015). Improving the computational efficiency of fully Bayes inference and assessing the effect of misspecification of hyperparameters in whole genome prediction models. *Genetics, Selection, Evolution* 47(1):13.

Jimenez-Krassel, F., D. Scheetz, L. Neuder, J. Ireland, J.R. Pursley, G. Smith, R.J. Tempelman, T. Ferris, W. Roudehush, W. F. Mossa, and P. Lonergan (2015). Anti-Müllerian hormone concentration in dairy heifers is positively associated with productive herd life. *Journal of Dairy Science* 98:3036-3045.

Yang, W., C. Chen, J.P. Steibel, C.W. Ernst, R.O. Bates, L. Zhou, and R.J. Tempelman (2015). A comparison of alternative random regression and reaction norm models for whole genome predictions. *Journal of Animal Science* 93: 2678-2692.

Chen C., H. Wang, W. Yang and R.J. Tempelman (2014). Exploring extensions and properties of expectation-maximization methods for whole genome prediction. *Proceedings of the 10th World Congress on Genetics Applied to Livestock Production*. August 17-22, 2014, Vancouver, Canada, ASAS, Champaign, IL.

Spurlock, D. M., Tempelman, R. J., Weigel, K. A., Armentano, L. E., Wiggans, G. R., Veerkamp, R. F., deHaas, Y., Coffee, M. P., Connor, E. E., Hanigan, M. D., Staples, C., and Vandehaar, M. (2014). Genetic architecture and biological basis of feed efficiency in dairy cattle. *Proceedings of the 10th World Congress on Genetics Applied to Livestock Production*. August 17-22, 2014, Vancouver, Canada, ASAS, Champaign, IL.

Lu, Y., Vandehaar, M., Weigel, K., Armentano, L., Spurlock, D., Staples, C., Connor, E., and Tempelman, R. J. (2014). An alternative approach to modeling genetic merit of feed efficiency in dairy cattle. 2014. *Proceedings of the 10th World Congress on Genetics Applied to Livestock Production*. August 17-22, 2014, Vancouver, Canada, ASAS, Champaign, IL.

Weigel, K. A., Yao, C., Hoffman, P. C., Armentano, L. E., Spurlock, D. M., Tempelman, R. J., and Vandehaar, M. (2014) Improving biological and economic aspects of production efficiency through genetic selection and genome-guided replacement management. *Proceedings of the 10th World Congress on Genetics Applied to Livestock Production*. August 17-22, 2014, Vancouver, Canada, ASAS, Champaign, IL.

Mota, R., Tempelman, R. J., Cardoso, F., Aguilar, I., & Lopes, P. (2014). Genomic Wide-Selection for Tick Resistance in Hereford and Braford Cattle via Reaction Norm Models. 2014. *Proceedings of the 10th World Congress on Genetics Applied to Livestock Production*. August 17-22, 2014, Vancouver, Canada, ASAS, Champaign, IL.

Cladis, DP, Zhang, R, Tan, Xi, Craig, BA, and Santerre, CR. (2015). Postharvest Correlation between Swordfish (*Xiphias gladius*) Size and Mercury Concentration in Edible Tissues. *Journal of Food Protection* 78(2), 396--401.

Janle, E, Freiser, H, Mangnais, C, Chen, T-Y, Craig BA, and Santerre, C. (2014). Green tea increase the concentration of total mercury in the blood of rats following an oral fish tissue bolus. *BioMed Research International*, Article ID 320936.

Running CA, Craig BA, and Mattes RD (2015). Oleogustus: The Unique Taste of Fat. *Chemical Senses*, 2015, 1–10 doi:10.1093/chemse/bjv036.

Haas, Z and Craig, BA (2014). Developing prediction equations for carcass lean mass in the presence of proportional measurement error. *Proceedings of the Conference on Applied Statistics in Agriculture Conference*. Ed. W. Song.

K.M. Webb, R.M. Harveson, M.S. West (2015). Evaluation of Rhizoctoniae as a potential biological control option for fungal root diseases of sugar beet. *Annals of Applied Biology* 167: 75–89.

Rebecca L. Phillips, Mikki R. Eken, Mark S. West (2015). Soil Organic Carbon Beneath Croplands and Re-established Grasslands in the North Dakota Prairie Pothole Region. *Environmental Management* 55(4).

Rao S, Stolle EC, Sher S, Lin CW, Momen B, Nahabedian MY (2014). A multiple logistic regression of complications following microsurgical breast reconstruction. *Gland Surgery* 3:226-31. DOI: 10.3978/j.issn.2227-684X.2014.10.03.

Yu M, Momen B, Kearney M. (2015). Quantifying moderate resolution remote sensing phenology of Louisiana coastal marshes. *Ecological Modeling* 312: 191-199.

Johnson, L., J.T. Olsen, H. Tetreault, R.K. Goad, M.M. Mendola, A. DeLaCruz, H. Bryant, T. Morgan, M. Knapp, N.M. Bello, S. Baer and B. Maricle (2015). Intraspecific variation of a dominant grass and local adaptation in reciprocal garden communities along a US Great Plains' precipitation gradient: Implications for grassland restoration with climate change. *Evolutionary Applications*. DOI: 10.1111/eva.12281

Higbie, C.T., D. Eshar and N.M. Bello (2015). Evaluation of three point-of-care meters and a portable chemistry analyzer for measurement of blood glucose concentrations in black-tailed prairie dogs (*Cynomys ludovicianus*). *American Journal of Veterinary Research* 76(6): 532-539.

Horne, E.A., S. Foulks, N. M. Bello (2015). Visual display in Blanchard's cricket frogs (*Acris blanchardi*). *The Southwestern Naturalist* 59(3): 409-413.

Gray, M., P. St. Amand, N.M. Bello, M.B. Galliard, M. Knapp, K. Garrett, T.J. Morgan, S.G. Baer, B.R. Maricle, E. Akhunov and L. Johnson (2014). Ecotypes of an ecologically dominant prairie grass (*Andropogon gerardii*) exhibit genetic divergence across the U.S. Midwest grasslands environmental gradient. *Molecular Ecology* 23(24): 6011-28. DOI: 10.1111/mec.12993.

Miller, C., J.K. Craver, K.A. Williams and N.M. Bello (2014). UVB radiation affects intumescence development in ornamental sweet potato (*Ipomoea batatas*). *HortScience* 49(10):1277-1283.

Davis, E.G., N.M. Bello, A.J. Bryan, K. Hankins, M. Wilkerson (2014). Characterization of immune responses in healthy foals when a multivalent vaccine protocol was initiated at 90 and 180 days of age. *Equine Veterinary Journal*. doi: 10.1111/evj.12350.

Wesselowski, S., M. Borgarelli, N. M. Bello and J. Abbott (2014). Discrepancies in identification of left atrial enlargement in dogs using left atrial volume versus left atrial to aortic root ratio. *Journal of Veterinary Internal Medicine* 28(5): 1527-33. DOI: 10.1111/jvim.12410.

Douhit, T.L., J.M. Bormann, N.M. Bello (2014). Assessing the association between hoof thermography and hoof doppler ultrasonography for the diagnosis of lameness in horses. *Journal of Equine Veterinary Science* 34: 275-280.

Xu, X., and Madden, L.V. 2014. The limits of the binary power law describing spatial variability for incidence data. *Plant Pathology* 63: 973-982.

Salgado, J. D., Madden, L. V., and Paul, P. A. 2014. Efficacy and economics of integrating in-field and harvesting strategies to manage Fusarium head blight of wheat. *Plant Disease* 98: 1407-1421.

Anderson, K.F., Madden, L.V., and Paul, P.A. 2015. Fusarium head blight development and deoxynivalenol accumulation in wheat as influenced by post-anthesis moisture patterns. *Phytopathology* 105: 210-219.

Salgado, J. D., Madden, L. V., and Paul, P. A. 2015. Quantifying the effects of Fusarium head blight on grain yield and test weight in soft red winter wheat. *Phytopathology* 105: 295-306.

Piepho, H.-P., Madden, L.V., and Williams, E.R. 2015. Multiplicative interaction in network meta-analysis. *Statistics in Medicine* 34: 582-594.

Wang, D., Bowman, D.D., Brown, H., Harrington, L.C., Kaufman, P.E., McKay, T, Nelson, C.T., Sharp, J.L. and Lund, R. (2014). Factors influencing U.S. canine heartworm (*Dirofilaria immitis*) prevalence. *Parasites and Vectors* 7:264.

Stroup, W.W. 2015. Rethinking the Analysis of Non-Normal Data in Plant and Soil Science. *Agronomy Journal* 107: 811-827.

Salmeron, M., E.E. Gbur, F.M. Bourland, N.W. Buehring, L.Ernest, F.B. Fritsch, B.R. Golden, D. Hathcoat, J. Lofton, T.D. Miller, C.Nelly, G. Shannon, T.K. Udeigwe, D.A. Verbree, E.D. Vories, W.J. Wiebold, and L.C. Purcell (2014). Soybean maturity group choices for early and late plantings in the U.S. Midsouth. *Agronomy Journal*, 106, 1893-1901.

Smith, F., K.R. Brye, P. Chen, E.E. Gbur and K. Korth (2014). Residue and water management effects on aggregate stability and aggregate associated carbon and nitrogen in a wheat-soybean double crop system. *Soil Science Society of America Journal*, 78: 1378-1391.

Smith, A., M. Popp, D. Philipp, K. Coffey and E.E. Gbur (2014). Overseeding bermudagrass pastures with ryegrass and clovers: Estimating partial returns. *Journal of the American Society of Farm Managers and Rural Appraisers*. 108-123.

McMullen, R.L., K.R. Brye, A.L. Daigh, B.C. Menjoulet, A.L. Pirani, E.E. Gbur, D.M. Miller, M.A. Evans-White and R.E. Mason (2014). Long term runoff water quality as affected by broiler litter application to a Uduft in the Ozark Highlands. *Soil Science Society of America Journal*, 78, 2017-2031.

Ballesteros, D.C., R.E. Mason, C.K. Addison, A.A. Acuña, N.A. Arguello, N. Subramanian, R.G. Miller, H. Slater, E.E. Gbur, D. Miller, C.A. Griffey, M.D. Barnett and D. Tucker (2015). Tolerance of wheat to

vegetative stage soil waterlogging is conditioned by both constitutive and adaptive QTL. *Euphytica* 201(3), 329-343. DOI 10.1007/s10681-014-1184-3.

Motschenbacher, J.M., K.R. Brye, M.M. Anders and E.E. Gbur (2014). Long term rice rotation, tillage, and fertility effects on near-surface chemical properties in a silt-loam soil. *Nutrient Cycling in Agroecosystems*. DOI 10.1007/s10705-014-9628-7.

Nam, S., R. Slopek, D. Wolf, M. Warnock, B.D. Condon, P. Sawhney, E. Gbur, M. Reynolds and C. Allen (2015). Comparison of biodegradation of low-weight hydroentangled raw cotton nonwoven fabric and that of commonly used disposable nonwoven fabrics in aerobic Captina silt loam soil. *Textile Research Journal*. DOI 10.1177/0040517514551468.

Motschenbacher, J.M., K.R. Brye, M.M. Anders, E.E. Gbur, N.A. Slaton and M.A. Evans-White (2015). Daily soil surface CO₂ flux during non-flooded periods in flood irrigated rice rotations. *Agronomy for Sustainable Development*, 35, 771-782.

McMullen, R.L., K.R. Brye, A.L. Daigh, D.M. Miller, E.E. Gbur, A.L. Pirain, M.A. Evans-White and R.E. Mason (2014). Long term leachate water quality trends from a broiler litter amended Udult in the Ozark Highlands. *Vadose Zone*. DOI 10.2136/vzj2014.06.0064.

Barriga, P.A., C.F. Dormann, E.E. Gbur and C.L. Sagers (2015). Community structure and ecological specialization in plant-ant interactions. *Journal of Tropical Ecology*. DOI 10.1017/S0266467415000139.

Luján-Rhenals, D.E., R. Morawicki, E. Gbur and S.C. Ricke (2015). Fermentation of soybean meal hydrolyzates with *Saccharomyces cerevisiae* and *Zymomonas mobilis* for ethanol production. *Journal of Food Science*, 80, E1512-E1518.

Olbricht G.R., Samaranayake V.A., Injamuri S., Wang L., Fiebelman C., and Thimgan M.S. (2014). Modeling Sleep and Wake Bouts in *Drosophila melanogaster*. *Proceedings of the Conference on Annual Applied Statistics in Agriculture*. ed. W. Song. Manhattan, KS: Kansas State University. 58-70.

Dunn, Bruce L., Carla Goad (2015) Effect of Foliar Nitrogen and Optical Sensor Sampling Method and Location for Determining Ornamental Cabbage Fertility Status. 74 *HortScience*, 50(1), 74-77.

Dunn, B.L., A. Shrestha, and C. Goad (2015). Use of Non-Destructive Sensors to Quantify Ornamental Kale Nitrogen Status. *Journal of Plant Nutrition*. DOI: 10.1080/01904167.2015.1069342.

Al Sharqi, S., N.T. Dunford, C. Goad (2014). Evaluation of Water Degumming for Wheat Germ Oil. *Transactions of the ASABE*, 57(6): 1707-1715. DOI 10.13031/trans.57.10617.

Gifford, C.A., K.A. Branham, J.O. Ellison, B.I. Gomez, C.O. Lemley, G.G. Hart, C.R. Krehbiel, B.C. Bernhard, C.L. Maxwell, C.L. Goad, D.M. Hallford, J.A. Hernandez Gifford (2014). Effect of anabolic implants on adrenal cortisol synthesis in feedlot beef cattle implanted early or late in the finishing phase. *Physiology & Behavior*, DOI: 10.1016/j.physbeh.2014.10.025.

Clarke, J. and Clarke, B. (2014). Deconvolution of gene expression from mixed samples. *STAT*, 3 (1), 313-325.

Clarke, B., Valdes, C., Dobra, A. and Clarke, J. (2015) A Bayes testing approach to metagenomic profiling in bacteria. *Statistics and Its Interface*, 8 (2): 173-185.