Nebraska Green Scene 2009

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Corn, soybeans, and... 
grapes? Research branches out

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The Best Learning Experience!

By Tri D. Setiyono

I began my Ph.D. program in the fall of 2003 focusing on the understanding of soybean growth at near optimum conditions and developing a soybean growth model. The project was funded by the Nebraska Soybean Board and was led by Dr. Achim Dobermann and Dr. James Specht. Even though I had a background in crop physiology, which helped in the agronomy aspect of the project, it was quite challenging overall because the modeling and software development aspects were new to me. Fortunately, I had the opportunity to develop the skills needed for the project. Excellent mentoring by my advisors, including Dr. Kenneth Cassman and Dr. Albert Weiss, combined with great programs and facilities offered by UNL, played an important role in my academic work. Support from fellow graduate students and postdoctoral associates was also very instrumental.

During my Ph.D. program, I developed a soybean phenology software called SoySim (Field Crop Research, 2007, 100:257-271). A complete soybean growth and yield model was developed later with the non-window version finalized by the end of my Ph.D. program in May 2007. Recently, the windows version of the model (SoySim) was validated against experimental data in the midwest, collaborating with researchers from Iowa State University and Purdue University. The results were quite promising and the software will be released soon. The software predicts developmental stages, growth, yield, and water use of soybeans as influenced by weather and agronomic management. It can facilitate growers and researchers to fine tune management for optimizing yield and is also useful as a learning tool to observe the complex interactions of abiotic factors influencing soybean growth and yield. The SoySim model was written in an object Pascal language using Delphi® 2007 for Win32.

Since January 2009, I have implemented the phenology and water use components of the SoySim model in the Water Agriculture and Energy Initiative (WEAI) project led by Dr. James Specht. The project aims in developing a Web site application for implementing a water-saving strategy in irrigated soybeans. Collaboration from colleagues at the Water Agriculture and Energy Initiative (WEAI) project at the University of Nebraska-Lincoln and Dr. Cassman. The project focuses on the application of crop modeling to understand the effect of climate, soil, and agronomic management in the sustainable rainfed cropping system in Leeward Kohala, Hawaii during the pre-European contact.

My experience at UNL indicates how valuable support of colleagues was in my professional development. As I continue to learn and develop computer programming skills...
Promotions & Tenure September 2009

Thomas Clemente

New Hires & Appointments

Dr. John Guretzky
Grassland Systems Ecologist
Lincoln
September 2009

Dr. Dipak Santra
Alternative Crops Breeding Specialist
PHREC
November 2008

Dr. Tom Haegemeyer
Plant Breeding, Professor of Practice
Lincoln
January 2009

Dr. Tim Shaver
Nutrient Management Specialist
WCREC
September 2009

Dr. David Holding
Horticultural Molecular Geneticist
Lincoln
January 2009

Dr. Brian Waters
Horticultural Molecular Geneticist
Lincoln
November 2008

Hello from South Dakota
By Sandy Smart

I was a research technologist in the Department of Agronomy from 1992 to 2001 and worked for Dr. Lowell Moser and Dr. Walt Schacht. During this period, I also worked on my Ph.D. part time under the guidance of Dr. Ken Vogel and Dr. Moser. I remember my stay in Lincoln with great fondness. I met my wife Elaine in Omaha, and we had our first daughter Rachel in 1999. Since then we've added Ian (7) and Livy (4) to our family. Upon graduation in the summer of 2001 with a Ph.D. in Range Management, I joined the faculty in the Department of Animal and Range Sciences at South Dakota State University with research and teaching responsibilities. The transition from a research technologist/graduate student to faculty member went smoothly because of the mentoring I received from Dr. Moser and Dr. Schacht. I was blessed to be a part of a strong research program at UNL where I helped 26 graduate students during my 9 year stay.

Currently, I am an associate professor of range science and my research and teaching focuses on how to manage grasslands to produce different ecosystem goods and services. South Dakota, like many of the Great Plains states, is a transition state with tallgrass prairie in the eastern quarter and mixedgrass prairie in the remaining portion. During the first 5 years at SDSU, I conducted research at the Cottonwood and Antelope research stations which were approximately 5 and 8 hours drive from Brookings, respectively. Traveling to these outlying stations was beneficial for me to get acquainted with the geography and plant communities of South Dakota. This also was helpful to connect with students in the classroom because I knew the locations of the various hometowns. My research is now focused in eastern South Dakota in the tallgrass prairies located in the Prairie Coteau (I-29 corridor) and mixed prairies of the James River valley. This has cut down the overnight travel immensely. I am studying grazing and burning strategies to enhance floristic diversity and increase structural heterogeneity across grazing landscapes.

South Dakota State University has had a long, rich range management program. We are especially blessed by the support of the South Dakota Section for the Society for Range Management (SRM) which has a large endowment that provides scholarships for range science majors and financial support for Range Club to travel to the annual SRM meetings. Since my tenure at SDSU, I have found great joy in seeing my advisees working as professionals for various state and federal agencies. I always seem to reconnect with a few former students at field tours or professional meetings.

My plan is to stay at SDSU in Brookings. I enjoy the academic life and have even served on academic senate and various university committees. This past spring I was honored to receive the Early Career Teaching Award from the Range Science Education Council of SRM. I feel so blessed to be at SDSU, and I am extremely grateful for the people at UNL that played a role in mentoring me.

Sandy Smart, Ph.D. 2001
Associate Professor/Range Scientist
Department of Animal and Range Sciences
South Dakota State University
PO Box 2178
Brookings, SD 57007-0392

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Our students are the future of the green industry. We are relying on them to be problem solvers and forward thinkers. To meet our educational challenges, we are offering you the opportunity to contribute to the University of Nebraska Foundation in support of the Department of Agronomy and Horticulture and its students. Together we can make a difference in the life of each student. Please make gifts payable to the University of Nebraska Foundation, 1010 Lincoln Mall, Suite 300, P.O. Box 82555, Lincoln, NE 68501-2555.

If you have questions about giving opportunities, please contact Dr. Mark Lagrimini, Professor and Head, Department of Agronomy and Horticulture, at (402)472-1555 or mlagrimini2@unl.edu. You may also contact Ann Brunzt, Director of Development, IANR, University of Nebraska Foundation, at (402)458-1176 or abrunzt@unfoundation.org.
I was mid-way through my high school career in 1998 when the initial planning for a grazing system study began at UNL’s Barta Brother’s Ranch in north central Nebraska. Now, over 10 years later, I am working with Dr. Walt Schacht and Dr. Jerry Volesky as an M.S. graduate student to analyze the effects of different grazing systems on herbage production, botanical composition, and livestock performance in the Sandhills region of Nebraska.

Grazing systems have evolved since the early 20th century in an effort by land owners and managers to increase production while improving rangeland health. Several different systems have been utilized on ranches in the Sandhills, but little research has been done in this region to quantify the superiority, if any, of one grazing system over another. This study compared two grazing systems that are commonly recommended in Nebraska, an 8-pasture short duration grazing (SDG) and a 4-pasture deferred rotation (DR) grazing system.

The SDG system is characterized by rapid movements of cattle during the growing season through 8 or more pastures with multiple grazing and non-grazing periods. The basis of this grazing system is to graze pastures quickly while grass is growing to utilize the grass before it reaches maturity. Furthermore, 2 or more short grazing periods/seasons rather than one longer grazing period is proposed to keep a higher proportion of the grass stand in a vegetative, more nutritious state and allow grasses to replenish root reserves between defoliation. The DR grazing system is based on the movement of cattle through 3 to 5 pastures so that one pasture is deferred until key forage species have reached maturity in early fall. Each pasture is grazed only once during the growing season for 30 to 45 days. Because there are fewer pastures and movements of cattle, the DR system is less management intensive and less costly to implement and operate than SDG.

Herbage production data was gathered in June and August of each year by collecting plant material in 240 (120 for each system) 1-m² cattle exclosures that were moved every spring to capture the previous years’ grazing treatment effects. Plant material was clipped at ground level, separated into plant groups, dried, and weighed. Botanical composition was collected at the beginning, mid-point, and end of the study by collecting frequency of occurrence of all plant species on three hundred transects placed randomly throughout the ranch. Spayed heifers were used to evaluate the differences in livestock gains. Heifers were weighed at the beginning and end of each grazing season in the last 3 years of the study. Weight gains of the individual heifers were divided by the number of grazing days to determine the average daily gain.

Last year was the 10th and final year of the study, and we are in the process of analyzing the data. We are finding that the DR system produced slightly more herbage than the SDG system over the course study, but there was little difference in botanical composition and cattle weight gains between the grazing systems. The data is also allowing us to determine topographic effects on botanical composition and effect of timing of grazing on herbage production. While there are many variables that are associated with the success of a grazing system, this data initially suggests that the input of additional fence, water, and labor required of a SDG system does not provide a significant increase in benefits over a DR grazing system.
I've found myself moonlighting as an unofficial spokeswoman for the Nebraska grape and wine industry.

I met Kelly Brink

As an undergraduate student in the Grazing Livestock Systems major, I focused primarily on production-oriented courses. I coupled my major with the Feedlot Management Internship Program through the Animal Science Department, desiring my education to cover all phases of beef cattle production. Also during this formative time, I engaged in applied internships and work experiences during the academic year in both grazing- and finishing-beef cattle production systems. After graduating with my B.S. degree, I entered the labor force in a position with a cattle-feeding operation. Experiences in those first few years of my professional career quickly put doubts in my mind of a career focused primarily on cattle feeding. I came to the full realization that I wanted a career in ranch management focusing on sustainable livestock production systems on native rangelands. After learning of my interest in an M.S. degree, Dr. Walter Schacht offered me an opening to interview for a research technician position with him and Dr. Bruce Anderson. Through the past three years, I have been exposed to projects involving nitrogen cycling within grazed pastures, interseeded-legume studies, roadside vegetation, forage variety trials, and grazing systems studies in the Sandhills mixed prairie. My M.S. study involves prediction of leadplant utilization in the eastern Sandhills given time of year and amount/quality of total herbage.

The practices which I have applied in managing Dr. Schacht’s projects will prove useful post-graduation as I still desire to pursue a career in ranch management, or a closely related field. The application of science-based principles coupled with artful practical management is what makes ranch management very interesting to me.

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**Grape System**

Graduate student Christina Huck does non-traditional work with her hands-on research in viticulture. Her study was conducted at Czechland Vineyard, a commercial vineyard between Crete and Wilber. The site was ready and waiting for a trellis comparison study, with established ‘Frontenac’ grapevines already trained to 5 different trellis styles, canopy light environment, and fruit quality. I conducted my project I investigated the effects of light on wine grape quality.

I also tested a canopy analysis method called point quadrat, which did not have significant differences between the trellises were that was available in the fruit zone. The only parameters I measured were the solar radiation in the fruit zones (within the canopies) of the vines at my test plot; and compared those values to the amount of total radiation that the vineyard was receiving. The light measurements had to be taken on clear sunny days, at several intervals throughout the growing season. At the end of the season, I analyzed fruit samples from the different trellises and found that the grapes’ sugar content, pH, and acidity were all positively correlated with the amount of light that was available in the fruit zone. The only parameters I measured which did not have significant differences between the trellises were the concentrations of phenolic and flavonoid compounds. As well as providing many health benefits, these are important flavor and aroma constituents of grapes and wine.

I also tested a canopy analysis method called point quadrat, which is a quick, easy way to map the density of vines in a canopy. To perform point quadrat analysis, simply insert a long stick through the canopy; record the number of times the stick touches a leaf or cluster, and repeat throughout the vineyard. The point quadrat results corroborated the findings of my light study, which is good news for growers: they can use point quadrat to quickly and accurately characterize the canopy density of their vines.

One trellis style in particular, Geneva Double Curtain (GDC), stood out in almost every category that we measured. Geneva Double Curtain is a horizontally divided training system; each row of vines actually has two separate, parallel canopies about five feet high. In my study, the ‘Frontenac’ vines grown on GDC had among the best light levels, sugar content, pH, and acidity, and they had the highest yield. I had the opportunity to give a presentation at a growers’ conference in March, and it was both exciting and rewarding to be able to give recommendations based on the results of my research.

When I started my master’s program in 2007, I had no idea my research area would be such a conversation-starter. I thought I would be spending all my time learning about the biology of grapevines, but I’ve found myself moonlighting as an unofficial spokeswoman for the Nebraska grape and wine industry.

**Grapes in the Cornhusker State**

By Christina Huck

As an M.S. candidate in horticulture, I have worked for the past two years under the supervision of Dr. Paul Read who heads the University of Nebraska–Lincoln Viticulture Program. With a B.S. from the University of Illinois in Urban-Champaign in Natural Resources and Environmental Science, I had anticipated studying native prairie plants until Dr. Read asked: “Have you ever considered working with grapes?” My fascination with wine and grapevines began. For my master’s project I investigated the effects of light on wine grape quality.

My research objective was to explore the relationships between trellis style, canopy light environment, and fruit quality. I conducted my study at Czechland Vineyard, a commercial vineyard between Crete and Wilber. The site was ready and waiting for a trellis comparison study, with established ‘Frontenac’ grapevines already trained to 5 different trellis styles, canopy light environment, and fruit quality.

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Dr. Gilles Basset joined the Department of Agronomy & Horticulture at UNL in October 2006. His research focuses on the biosynthesis of plant vitamins and coenzymes. These compounds, which often exist only in trace quantities in plant tissues, play a cardinal role for human and animal health. Plants, for instance, synthesize 11 of the 13 vitamins that humans require from their diet. In the US, plant-based foods represent the main dietary sources of several vitamins, including vitamin B9 (folic acid), vitamin C (ascorbic acid), vitamin K1 (phyloquinone) and vitamin E (tocopherols).

Historically, the study of plant vitamins and of their cognate biosynthetic enzymes has been difficult, owing to their low abundance and high instability. As a result, and despite the importance of plant vitamins in human nutrition and for the plants themselves, our understanding of vitamin metabolism in plants is fragmentary. In order to fill these gaps in our knowledge, the Basset laboratory uses novel bioinformatics tools based on phylogenomics (also called comparative genomics). The basic premise of such an approach is that genes that are involved in the same cellular function tend to physically associate in genomes. For instance, genes that are required for the biosynthesis of the same molecule are often found in clusters in certain organisms. Sometimes—as is often the case in plants—they fuse together. They are also either present together in the organisms that synthesize a particular compound, or by contrast, are all absent in the organisms that cannot synthesize it. By detecting the existence of such conserved genomic associations and occurrences across lineages, phylogenomics permit the inference of novel enzymatic functions providing that the role of at least one of the corresponding genes is known. In other words, if gene a, b, c, and d are physically associated, and that gene a is known to be important for the synthesis of molecule X, it is very likely that gene b, c, and d are required in the making of X as well. Basically, it is ‘guilt-by-association’ reasoning. In combination with the more traditional tools of reverse genetics, enzymology, and analytical chemistry, phylogenomics is extremely powerful at dissecting metabolic pathways. Using this integrative strategy, the Basset group identified and characterized a novel vitamin K1 biosynthetic enzyme in cyanobacteria, which are the evolutionary progenitors of plant chloroplasts. The results have been recently published in the Proceedings of the National Academy of Sciences of the USA (http://www.pnas.org/content/106/14/5399.long). The study is part of the research project of Joshua R. Widhalm, a graduate student in the Basset laboratory. The Basset group is now implementing this knowledge to improve the nutritional quality of certain staple crops that are naturally poor in vitamin K.

Research in the Basset laboratory is funded by the National Science Foundation, the Center for Plant Science Innovation and the Nebraska Tobacco Settlement Biomedical Research Development Funds. Joshua R. Widhalm is a recipient of Ph.D. fellowship from the Department of Agronomy and Horticulture.

Contact: gbasset2@unl.edu

www.nebraskasoybeans.org

By Dr. Gilles Basset

Plant Vitamins in the Basset Laboratory

Dr. Gilles J. Basset (left), Dr. Fabienne Furt, and Joshua R. Widhalm recently discovered a novel enzyme involved in the biosynthesis of vitamin K.

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Searching the Soil

The UNL Carbon Sequestration Field Research Facility

By Tim Arkebauer

Throughout the Great Plains the rich soils that developed under grasslands have been exposed to conditions resulting in the loss of organic matter. Much of the carbon (C) contained in this organic matter has entered the atmosphere in the form of carbon dioxide (CO2). Recently, there is growing concern over increasing atmospheric CO2 concentration and its potential effect on climate. Several faculty members in the Department of Agronomy and Horticulture are currently studying carbon fluxes and pools in agricultural systems in order to discern their role in the global carbon cycle and investigate how agricultural management decisions might mitigate further increases in atmospheric CO2 concentrations. Because the soil is the long-term pool of carbon in annual crop production systems this topic is often referred to as “soil carbon sequestration” research.

In 2001 researchers from UNL established the Carbon Sequestration Field Research Facility at the Nebraska Agricultural Research and Development Center near Ithaca, Nebraska. Funding to establish and maintain the facility and support the field research came primarily from the United States Department of Energy. Researchers include Drs. Shashi Verma, Ken Cavers, Dan Walters, Achim Dobermann, Jean Knops, Elizabeth Walter-Shea, Anatoly Gitelson and Tim Arkebauer. The facility consists of three study sites of about 160 acres each. Two sites are equipped with center-pivot irrigation systems. We are currently studying three cropping systems; namely, an irrigated continuous maize system, an irrigated maize-soybean rotation and a rainfed maize-soybean rotation. Since initiation in 2001, all sites have been under no-till (except continuous maize, further details below) Crop management practices have been employed in accordance with the best management practices prescribed for production-scale maize systems. Results indicate that the systems become a net sink for CO2 (i.e., CO2 is moving from the atmosphere to the agricultural system) in the second or third week of June (about 30 to 35 days after planting for maize and 25 to 30 days after planting for soybean). The maize fields remain a CO2 sink for about 100 to 110 days and have a maximum net ecosystem productivity (NEP)—the total quantity of carbon moving from the atmosphere to the system—of about 15-20 g C m⁻² d⁻¹. The soybean fields are a CO2 sink for about 80 days before returning to a source of CO2 in September due to the heavy litter layer resulting from their fall harvest. To address these constraints in our irrigated continuous maize system, starting in the fall of 2005, we began to utilize a conservation plow that does not completely invert the topsoil layer as happens with conventional plowing. The conservation-plow minimizes soil disturbance by vertically distributing about 0.20 – 0.25 m depth, while 1/3 remains on the soil surface. A small dose of N fertilizer is applied to the maize residue before the post-harvest conservation-plow operation. We hypothesize that the N application to maize stover and its incorporation with a conservation-plow will result in a net soil carbon sequestration. Our most recent results support this hypothesis.

Efficiency in the Field

By Darrin Roberts

In recent years there has been a growing concern about the potential environmental hazards of large uniform areas of fertilizer applications across agricultural fields. Current nitrogen management practices have resulted in much of this nitrogen fertilizer being left in the soil, ultimately leading to surface and groundwater contamination. With rising energy and other input costs, it is essential for today’s agriculture producers to efficiently manage fertilizer application. Additionally, increased biofuels production requires efficient management of crop inputs. Precision agriculture tools and technologies can potentially provide increased efficiency in crop production.

For the past three years, I have worked under the direction of Drs. Richard Ferguson and John Shanahan on a collaborative project between UNL and USDA-ARS Agroecosystem Management Research Unit as part of my Ph.D. in agronomy. My research has focused on how to combat the potential environmental hazards of large amounts of nitrogen fertilizer applied to croplands. Specifically, I studied active canopy reflectance sensors as a tool to accurately assess corn nitrogen stress during the growing season, and apply additional nitrogen where it was needed in the field. I evaluated an algorithm that converts sensor output data into a nitrogen application rate, and the possible incorporation of soils information to help fine tune the algorithm. In 2007 and 2008, I conducted on-farm research in test fields in central Nebraska representing a variety of spatial patterns in soil characteristics. In each of these fields I tested the current algorithm against a uniform nitrogen application strategy, and I also collected various soil data layers and remotely sensed images. Using soil variables to establish nitrogen management zones within each field, I found that the delineated zones appropriately characterized spatial patterns in both in-season crop response and yield. Compared to uniform nitrogen application, integrating management zones, and sensor-based nitrogen application resulted in substantial nitrogen savings for silt loam soils with eroded slopes. However, for coarser textured soils I found that the current sensor-based nitrogen application algorithm may require further calibration and for fields with no spatial variability there appears to be no benefit to using the algorithm. Collectively, my research results from these studies show promise for integrating active sensor-based nitrogen application and static soil-based management zones to increase nitrogen use efficiency and economic return for producers over current nitrogen management strategies. I am grateful to have had the opportunity to work with such great people and study at this fine school. I recently defended my Ph.D. dissertation and accepted a position as an assistant professor at Mississippi State University with a research focus in corn agromonics. Even though I will be trading in the Big 12 and Big Red for the SEC, I am very thankful for all the experience and friendship I have received at UNL. Thanks to all for the time and effort you have contributed to the growth of our program.

From Argentina to America

By Federico Vartorelli

It was a warm and dry afternoon of May 2000 when I arrived in Lincoln. My wife Mariana and my one-year old daughter Camila came along with me, carrying a suitcase full of Illinois clothes to increase my knowledge.

In a cold and snowy December four years later, we moved back to our home country, Argentina. By then, we had already a second child named Joaquin - a little Husker. This time, we returned to Argentina with a suitcase full of great memories about our life in Lincoln. We left good friends in Lincoln, in Keim Hall, and in the Seed Lab. I have visited several countries since graduating.

I got a Ph.D. in Plant Breeding and Genetics with experience in a soybean breeding program. The knowledge and experience gathered showed me new paths in my career and opened doors in Argentina. My first position after graduating was as Technical Manager of Renes.

I feel a lot of appreciation for Dr. George Graef, UNL graduates, the seed lab people, all of UNL, and our friends that gave us four beautiful years in Lincoln. My appreciation and regards to all of them. To all those Agronomy graduate students, I hope you enjoy the combination of the high education level with the diversity in nationalities of the students which make UNL an excellent University with a research focus in corn agromonics. Even though I will be trading in the Big 12 and Big Red for the SEC, I am very thankful for all the experience and friendship I have received at UNL. Thanks to all for the time and effort you have contributed to the growth of our program.
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