



# GROWING SOUTH DAKOTA

A MAGAZINE BY SOUTH DAKOTA STATE UNIVERSITY | SPRING/SUMMER 2020  
COLLEGE OF AGRICULTURE, FOOD AND ENVIRONMENTAL SCIENCES



**SOUTH DAKOTA  
STATE UNIVERSITY**  
South Dakota Agricultural  
Experiment Station

2019 ANNUAL REPORT



*"Opportunity is missed by most people because it is dressed in overalls and looks like work" - Thomas Edison*

South Dakota State University and the College of Agriculture, Food and Environmental Sciences are educating the workforce and leaders of tomorrow, and supporting the growth of existing and developing industries in South Dakota. Our educational programs are centered around a philosophy of learning by doing, and students in CAFES are getting outstanding opportunities to put their classroom knowledge into practice.

These high impact learning approaches help us to prepare career-ready graduates that will become the industry leaders of the future.

The research conducted in the college and through the South Dakota Agricultural Experiment Station not only make new discoveries that extend the boundaries of scientific knowledge, but also take the knowledge of today and apply it to the current challenges facing our farmers, ranchers, conservationists, and other stakeholders. We are addressing some of the most pressing challenges facing our producers, natural resource managers, and health care practitioners, in addition to exploring opportunities to expand existing industries and the creation of new sectors to drive economic development for our state. The College of Agriculture, Food and Environmental Sciences is proud to serve South Dakota today and in the future!

South Dakota Corn Endowed Dean of the College  
of Agriculture, Food and Environmental Sciences

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# GROWING

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Wildlife and fisheries student Madison Posusta examines fish used for feeding trials at Prairie Aquatech, a company started by SDSU researchers. Photo courtesy of Greg Latza.

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# BILL GIBBONS

## NAMED DIRECTOR OF SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION AND ASSOCIATE DEAN OF RESEARCH

BY SYDNEY MEYER

**B**ill Gibbons has been named the new director of the South Dakota Agricultural Experiment Station at South Dakota State University and the associate dean of research for the College of Agriculture, Food and Environmental Sciences.

Gibbons has been serving as the interim for both positions since 2016. He began as the director and associate dean on Dec. 22, 2019. In these roles, Gibbons coordinates and facilitates research in the College of Agriculture, Food and Environmental Sciences and the college's statewide network of research farms and stations that make up the South Dakota Agricultural Experiment Station.

"This is a very exciting time for agricultural and environmental research at SDSU, and recent upgrades to several of our research facilities provide the infrastructure to create innovative solutions to the issues and opportunities that lie ahead of us," says Gibbons. "Together with our partners in SDSU Extension, we will continue to deliver effective and efficient solutions to South Dakota producers and residents."

With six field stations and more than 17,000 acres of land across the state devoted to scientific exploration, the South Dakota Agricultural Experiment Station is the largest public and privately funded research organization in the state.

"Dr. Gibbons brings a tremendous level of expertise in research, intellectual property management, administrative experience and an entrepreneurial spirit," says John Killefer, South Dakota Corn Endowed Dean of SDSU's College of Agriculture, Food and Environmental Sciences. "He has done an outstanding job serving in the interim role and I look forward to his continued leadership in the permanent roles as director of the South Dakota Agricultural Experiment Station and associate dean for research."

Gibbons has a highly accomplished research career at SDSU. His work focuses on applied microbiology and biotechnology, specifically in value addition to agricultural products through

bioprocessing. He helped develop a high-protein aqua feed ingredient from soybean meal that is now being commercially manufactured and providing aquaculture farmers and feed manufacturers around the world with the power needed to boost the rapidly growing industry's performance. As a graduate student, Gibbons participated in one of the most impactful projects ever conducted at SDSU, the groundbreaking ethanol fuel research and development project that began in 1977. Since then, the ethanol technology developed at SDSU has grown and spread across the country.

Gibbons has practiced and promoted interdisciplinary research for many years and has a strong network of collaborators from process and chemical engineers to biochemists and molecular biologists. His research has exceeded more than \$5 million over the past four years.

Gibbons earned multiple degrees at South Dakota State University - bachelor's degrees in biology, microbiology and chemistry; a master's degree in microbiology; and doctoral degrees in agronomy and microbiology. Gibbons joined the Department of Biology and Microbiology as an assistant professor in 1987 and attained the rank of professor in 1997. He was named a distinguished professor in 2018.

In his role as a professor, Gibbons taught a biotechnology course and advises graduate students and undergraduate researchers. He has trained over 20 master's students, three doctoral students and countless undergraduate students, most of which have gone on to work in the biotechnology industry.

His honors include being named a Distinguished Professor by SDSU in 2018, a National Wetlands Award winner by the Environmental Law Institute in 2018, an F.O. Butler Award for Excellence in Research by SDSU in 2014, the Pat and Jo Cannon Intellectual Property Commercialization Award in 2011, Gamma Sigma Delta Researcher of the Year in 2011, College of Agriculture and Biological Sciences Distinguished Researcher of the Year in 2007 and SDSU Microbiology Club Teacher of the Year in 1990.



## BRING US THE PROBLEMS AND WE WILL SEEK SOLUTIONS

I wrote this article in February 2020, well before any of us had ever heard of COVID-19, let alone understood how this virus would turn our world upside down. Just as this pandemic has affected your lives, it also affected research and outreach activities at land grant universities across the nation. In early March, research activities at SDSU were largely paused with the exception of essential activities that involved protecting human and animal health, or that were necessary to maintain very high-value research equipment and assets. We were also able to continue certain long-term studies that would have otherwise been ruined by a disruption in activities. Our faculty, staff, and students were quite innovative in making the best of this situation, maintaining as much productivity as possible while limiting contact with others.

As of June 1, SDSU and many other land grant universities began to relax restrictions. Re-starting the research enterprise will be a gradual process, as our chief priority continues to be human safety. We are making use of CDC guidelines to maintain distancing in time and space, while also incorporating appropriate personal protective equipment. Researchers will be working to elevate activities in a sequential manner throughout the summer. While we won't be able to have many direct interactions with our stakeholders until this pandemic is over, you can rest assured that SDSU researchers and extension specialists remain committed to working with you to address the challenges we face.

There is a very old saying used by optimistic people when they are asked about how they overcame a problem. "If life hands you lemons, make lemonade!"

As a group, I think South Dakotans, and Midwesterners in general, exemplify this mindset more than any other region in the country – and perhaps the world.

Maybe this is due to the more rural nature of our communities and upbringing, where we have learned to be more self-reliant and creative in addressing obstacles we encounter.

I know our agricultural producers are especially proficient at solving the multitude of challenges they face each day. After all, that's where the joke about being able to fix anything with baling wire and a pair of pliers came from. Of course, now the baling wire and pliers have been replaced by duct tape.

While this "I can fix anything" confidence is an admirable trait, the land grant system was developed to provide United States citizens with additional assistance in overcoming a broad range of challenges. Our academic programs provide the foundational basis of knowledge needed to understand how complex systems function and interact. Our research activities seek to develop

new knowledge in basic and applied fields of study. Our extension programs extend the research discoveries into practical applications, and also serve to communicate stakeholder problems and challenges back to our researchers.

This latter role of extension is an often overlooked, but critically important, element of the land grant system. While we tend to focus on the successful outcomes of transferring technology solutions from researchers through extension personnel to stakeholders, the first critical step is identifying the key problems in the first place.

In some cases the problems are quite apparent. For example, over the past decade, who hasn't noticed areas of bare, whitish soil in fields of otherwise healthy crops? Producers quickly relayed this problem back to our scientists, who discovered the issue to be caused by a build-up of salts at and near the soil surface. Our researchers discovered that traditional remedies didn't work in South Dakota soils. Instead, they are now assessing salt-tolerant plants and microorganisms as a means of gradually remediating these soils.

Other problems may be more subtle, or the cause and effect relationships might be much more complex than first assumed. For example, we used to think that animal performance was simply due to the genetics of the parents, along with quality of the feed and conditions under which the animal was raised. However, now we know that differences in performance between individual animals can be significantly affected by the gut microbiota of that animal, and even the nutritional status of the mother during gestation.

A key point is that success of the land grant mission relies heavily on stakeholders and the public bringing us their concerns, problems and opportunities so that we can conduct effective and impactful research. The problems and solutions might be relatively direct, or they may be complex and lead us to investigate other inter-related issues. Therefore, keep in mind that the doorways from research to extension to the stakeholder open in both directions, and we all benefit from these interactions.

Director of the South Dakota  
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# FISH FEED FROM SOYBEAN MAKING FISH FARMING MORE ECONOMICAL AND SUSTAINABLE

BY SYDNEY MEYER



Dr. Mike Brown and Madison Posusta, a Wildlife & Fisheries student, examine a tank of rainbow trout fingerlings that are being prepared for a growth performance trial.



Worldwide, people are consuming more fish and shellfish than ever before. According to the United Nations Food and Agriculture Organization (FAO), since 1961 the annual global growth in fish consumption has been twice as high as global population growth. This has increased pressure on wild fish populations across the world. Globally, overfishing of wild fish stocks has increased significantly since the 1980s, with about one-third now being overfished.

As a result, aquaculture (fish farming) has begun to fill the gap. The aquaculture industry was the world's fastest-growing food-producing sector in 2016 according to the FAO. In 2016, aquaculture provided 53% of fish and shellfish products for human consumption, an all-time high. This has played a key role in alleviating pressure on wild fish populations.

A consequence of the rapid growth in aquaculture has been the increased demand for fish meal, which is the primary protein source in aquaculture diets, particularly carnivorous fishes commonly preferred by consumers. Fish meal is produced from a range of small marine fishes such as herring, anchoveta, and menhaden, and these species are also now fully exploited on a global basis.

To help meet the needs of the expanding global aquaculture industry, and consequently the growing human population, in 2011 researchers at South Dakota State University developed a proprietary soybean-based, high-performance protein ingredient for fish feed that is both economical and sustainable.

Through an interdisciplinary, collaborative effort, professors Michael Brown of the Department of Natural Resource Management and William Gibbons of the Department of Biology and Microbiology, discovered that a microbial fermentation process could convert soybean into a highly digestible, concentrated protein ingredient yielding performance characteristics equivalent or better than marine-derived fish meal used in commercial fish feeds.

“Fish and shellfish culture is really at the research forefront compared to other areas of food animal production, like poultry, beef and pork, that have been tweaked and fine-tuned for decades,” Brown explains. “Globally, there are hundreds of freshwater and marine species produced for the food markets, presenting unique challenges in understanding their specific nutritional requirements. Developing this high-performance protein ingredient was a matter of thinking globally - the aquaculture industry is growing rapidly and there is a significant need for better and sustainably based aquafeeds.”

Due to its high digestibility, the ingredient decreases net feed costs and helps make commercial fish production more profitable. “We also wanted to create a more stable, sustainable protein feedstuff to decrease the aquaculture industry's use of fish meal. Doing so lowers cost and reduces market volatility,” Brown said.

Additionally, the ingredient also expands opportunities and markets for South Dakota soybean growers and processors.

The collaborative work began in 2011 with a grant from the South Dakota Soybean Research and Promotion Council and the United Soybean Board. Additional support came from the South Dakota Agricultural Experiment Station at SDSU, the North Central Sun Grant Initiative, the South Dakota Board of Regents and the South Dakota Governor's Office of Economic Development.

Development of the fish feed ingredient was a team effort. Brown initially found that appropriately treated soybean itself could replace up to 25% to 35% of fish meal in a feed, depending on species. However above that range, fish performance suffered greatly because of anti-nutritional factors present in soybeans. Gibbons postulated that certain microbes being used in his lab might consume and/or degrade the anti-nutritional factors, resulting in a product that would be usable by fish.



**Above:** Drs. Bill Gibbons (left) and Mike Brown (right) standing in the feed manufacturing area of the aquaculture pilot facility.

Gibbons selected a specific food-grade microbe and found that it provided the necessary bio-activities to drastically reduce the levels of anti-nutritional factors, while producing a product with more than 70% protein. An added benefit was the microbe increased the digestibility of the protein from 80% to practically 100%. Better digestibility means that almost all of protein is converted into fish tissues. The process also improved the digestibility of phosphorous, reducing the amount of nutrients expelled from fish and thereby improving environmental water quality.

Brown then evaluated the performance of this product, called ME-PRO® (for microbially enhanced protein) in a range of fish species. He formulated a series of diets using varying levels of ME-PRO® to meet nutritional requirements in terms of protein, amino acids, vitamins and minerals. Diets were manufactured and applied to palatability, digestibility and grow-out trials to determine acceptability, conversion efficiency and growth performance. Overall, these experiments revealed that the ingredient resulted in performance that meets or exceeds that of marine fish meal.

Based on these very positive findings, SDSU was able to patent this discovery in the U.S. and internationally. New domestic and international applications are also being pursued. SDSU licensed the technology to Prairie AquaTech, a company formed by the two researchers and a regional venture capital firm called South Dakota Innovation Partners.

Prairie AquaTech has worked to optimize and commercialize the ME-PRO® production process. The company started out in various incubator labs in Brookings, South Dakota, and in 2014

*"Developing this high-performance protein ingredient was a matter of thinking globally - the aquaculture industry is growing rapidly and there is a significant need for better and sustainably based aquafeeds."*



moved into a 30,000-square-foot pilot-scale facility built and owned by the Brookings Economic Development Corporation. This facility allowed the company to scale up the conversion process to a larger scale and test the system under continuous or semi-continuous operating conditions that simulate commercial-scale production, as well as expanded fish nutrition trials. According to Gibbons, conversion processes often need to be modified as the scale increases due to mass transfer issues and energy requirements.

The pilot-scale facility served as a transition stage to allow them to move to a 45,000 square-foot, commercial production plant in Volga, South Dakota, during 2019 that can produce 30,000 tons of ME-PRO® annually from South Dakota-grown soybeans.

The product has also been extensively tested in other university research facilities and numerous commercial aquaculture facilities, with outstanding results in a wide variety of marine and freshwater species of fish and shellfish. "ME-PRO® provides aquaculture farmers with improved feed-conversion ratios for fish and shrimp, as well as better water quality due to lower phosphorus discharge, leading to greater profitability and environmental stewardship of farm effluents," Brown said.

Though the company is especially proud of its South Dakota roots, the Prairie AquaTech team, many of whom are SDSU graduates, see the world as its marketplace. ME-PRO® is not only widely used by aquaculture farmers and feed manufacturers in the United States, but also in Latin America and as of October 2019, the European Union. This reach helps bolster the ME-PRO® slogan, "For Powerful Aqua Feed."



# NEW FACES

## NEW RESEARCH



### **WOOKJAE HEO: DEPARTMENT OF CONSUMER SCIENCES**

"My research focuses broadly on financial consumer welfare including financial behavioral intervention, financial stress on consumer behavior, data mining and data analysis in consumer research. A main focus of my research is annual tracking of familial financial stress and developing the behavioral intervention specifically in farmland workers."



### **GRETA KRAFSUR: DEPARTMENT OF VETERINARY AND BIOMEDICAL SCIENCES**

"My research focuses on pulmonary vascular biology and cardiovascular pathology as they apply to the development of a translationally relevant pre-clinical large animal model of pulmonary hypertension (PH) on left heart disease (LHD). Through my research, I hope to bridge the gap between basic science and clinical trials in Group 2 PH-LHD patients with the added benefit of developing a mechanistic understanding of bovine congestive heart failure (CHF), informing the industry on how best to mitigate the impact of bovine CHF, enhance cattle health and welfare and improve sustainability of beef production."



### **ISAAC SALFER: DEPARTMENT OF DAIRY & FOOD SCIENCE**

"My research is focused on dairy herd management with a specific interest in how biological rhythms (circadian rhythms and circannual rhythms) affect cow behavior and milk production. I am interested in developing feeding, lighting and management strategies that can improve animal efficiency by matching these processes with the cow's internal biological clock. I also have focused on developing strategies to modify rumen fermentation to improve the efficiency of digestion within the rumen of dairy cows."



### **ONJA RAZAFINDRATSIMA: DEPARTMENT OF NATURAL RESOURCE MANAGEMENT**

"I am interested in the mutualistic interactions between fruit-eating animals and their food plants, specifically the roles of such interactions in influencing the ecology of both partners and their responses to environmental changes as well as for sustaining a healthy ecosystem."



### **CLIFFORD HALL: DEPARTMENT OF DAIRY & FOOD SCIENCE**

"The focus of my research program is the utilization of traditional and non-traditional crops in food products. Examples include omega-3 fortification, from flaxseed, in extruded bean snacks, use of pulse proteins (pea, chickpea) as egg replacers, fortification of meat products with texturized pulse proteins, effects of extrusion processing on pulse components and sensory and stability characteristics of pulses, pulse flours and pulse fortified products (e.g. cookies and crackers). In addition, methods for de-flavoring of pulse flours has been an area of research."



### **LEE WEIDAUER: DEPARTMENT OF HEALTH AND NUTRITIONAL SCIENCES**

"The overall goal of my work with the South Dakota Agricultural Experiment Station is to determine the role of diet and physical activity in the health of muscle, bone and cartilage. In doing so, my hope is to use this information to develop interventions to reduce the burden of musculoskeletal diseases that result in loss of independence later in life. In the long term, my hope is that my research can play a part in improving longevity and quality of life for older adults."

A photograph of Anne Fennell, a woman with short grey hair and glasses, smiling and working in a vineyard. She is wearing a light-colored, long-sleeved, vertically striped shirt. She is holding onto a wooden support post of a grapevine. The background is filled with green grape leaves and other support posts.

# ANNE FENNELL

RECOGNIZED FOR GRAPEVINE  
GENOMICS RESEARCH

BY CHRISTIE DELFANIAN

Growing grapes, a woody perennial, requires long-term planning and careful selection of the best cultivars. “As this year’s crop emerges, next year’s is forming in the bud,” according to professor Anne Fennell of the South Dakota State University Department of Agronomy, Horticulture and Plant Science.

Fennell has developed a nationally and internationally recognized grapevine systems biology and genomics research program. More specifically, the bioinformatics expert uses genomic data and advanced computing capabilities to identify biomarkers that help breeders develop better cold-hardy grape varieties.

Last year, Fennell received the university’s award for international engagement and this spring, she became a distinguished professor, the highest level of scholarly distinction granted to a faculty member.

### Mapping grape genome

She has provided team leadership as principal investigator or co-principal investigator for more than \$44 million in research funded through the U.S. Department of Agriculture and the National Science Foundation, including the South Dakota Biosystems Networks and Translational Research Center, BioSNTR. In addition, she is a member of the National Grape Research Alliance.

“We are in a phase of rapid genome assembly,” explains Fennell, who also serves on the international science team developing standards for genomic data through the European Cooperation in Science and Technology program, known as INTEGRAPE. “There are more than 40,000 genes in a grapevine and researchers are identifying the function of each of these genes,” notes Fennell, whose team assembled the cold-hardy native grape *Vitis riparia* genome.

“Sequence data is very structured and readily stored in national and international databases,” she explains. However, data regarding other observable characteristics, known as the phenotype, the proteins and their metabolites are not as straightforward. Because of the enormity and varied nature of the datasets, “no institution or country is able to house everything, but we in the scientific community need make sure the data are findable, accessible, interoperable and reusable.”

### Improving cold-hardy grape varieties

The cultivars a producer plants affect the operation long-term, because the vines take up to three years to produce fruit and 10 years to reach mature production. While grapes in Europe have been cultivated for more than three centuries, cold-climate grape varieties have only two decades of growing history.

“Cold-hardy cultivars are complex hybrids of *Vitis vinifera* and native American species including *Vitis riparia*, which is native to this region,” says Fennell, noting that the cultivars can contain traits from three to seven species. To study traits related to cold hardiness, disease resistance, fruit quality and fruitfulness, Fennell and her graduate students extract DNA and RNA from stems, leaves, flowers, fruit and roots.

Graduate student Seyma Bolzkus, a Turkish native whose parents raise grapes, is working to increase the amount of fruit each vine produces. The wild varieties from which these cold-hardy cultivars are descended typically bear fruit at node five or six, but the goal is to develop varieties that bear fruit at node one

or two, Fennell explains. “That affects the way in which grapevines are pruned.”

Doctoral student Dilmini Alahakoon of Sri Lanka is examining root architecture and seasonal cycling. “The timing of the plant going into and coming out of dormancy are critical in terms of sustainability,” Fennell says understanding these genetic mechanisms will help breeders select grapevines for sustained winter survival and will help producers adapt their cultivation techniques to support production.



Right: About two-thirds of these grapevines are now in Fennell’s newly established vineyard.

For instance, a wet fall increases the amount of water in the grapevine during the cold period, which can lead to trunk splitting. Producers can plant early crops, such as oats, in the vineyard that will pull the water from the soil and help prevent damage to the vines, Fennell explains. “Everything is about timing—it’s huge.”

### Combining computational skills with biology

Fennell, who is an adjunct faculty member of the Department of Mathematics and Statistics, emphasizes the importance of having someone with a strong computational sciences background in her research group.

Doctoral student Roberto Villegas-Diaz of Costa Rica, who works with SDSU’s high-performance computing clusters, uses his computational expertise to help the group analyze large biological datasets. “Roberto is a transdisciplinary person because he speaks both languages,” Fennell said.

For an analysis of stem tissues aimed at identifying metabolites involved in disease resistance, the researchers had a 1,400-feature dataset in which they analyzed 14,000 data points. Villegas-Diaz used parallel processing to cull the data for outliers and make sure the data have a normal distribution. “Doing this manually takes a fair amount of time, so we are improving our efficiency,” Fennell explains.

As producers adopt precision agriculture technologies, the demand for people with computational and biological skills will increase, she says. “We are training the next generation of students who will help shape the future of agriculture.”



# DAVID CLAY

## SEEKS PRECISION AGRICULTURE SOLUTIONS

BY CONNIE SIEH GROOP

**S**outh Dakota State University Professor David Clay has dedicated his life work to soil science and has been at the forefront in designing cutting-edge tools for soil health and precision agriculture.

Named as a 2019 Distinguished Professor at the SDSU Celebration of Faculty Excellence at South Dakota State University last spring, Clay is a professor in the Department of Agronomy, Horticulture and Plant Science.

“This is the university’s ultimate academic recognition presented to those who have reached the pinnacle of their careers through distinguished performance and national or international recognition,” SDSU President Barry Dunn stated when he presented the award to Clay.

One of Clay’s main goals is to convert

agricultural research into tools that producers can use to increase their profitability. “When I do on-farm research, we attempt to transfer and test new ideas from the laboratory to the field,” Clay explains. “To expand the results from one farm to the next, we use mathematics to help identify where the treatments will be best suited.”

Several years ago Clay obtained funding from USDA to create a national team focused on workforce development in precision agriculture. This resulted in two books. One was called ‘Precision Agriculture Basics’ and the second one was called ‘Practical Mathematics for Precision Farming.’ The American Society of Agronomy and the Soil Science Society of America published both books. These books present practical precision farming

information targeted to agronomists, soil scientists and producers with a goal of helping them reduce production cost and reduce environmental impact. Clay also worked with the American Society of Agronomy Certified Crop Advisor (CCA) program to create a precision farming specialty for professional Certified Crop Advisors. The first exam for this program occurred during the summer of 2019.

Recently, Clay was elected as the incoming president elect of the American Society of Agronomy in 2020.

### **In the lab and in the field**

Clay works in the field and in the lab to tackle research challenges. “One challenge that we are working on is soil health, and how to integrate soil health improvements into our fertilizer recommendations,” he

says. “Over the last 30 years, many farms have seen a continuous improvement in soil organic matter, which increases net productivity and the ability of the soil to withstand adverse climatic conditions. The soil health improvements reduce risk to adverse environmental conditions and wind and water erosions. Our research attempts to determine how to integrate soil health measurements into fertilizer guidelines. We are also looking at how to create market-based incentives for adoption of agronomic best management practices based on measurable improvements in soil health.”

While most of the research takes place in the field, the laboratory work helps to define how soil and plants respond to stress. “If we only look at the yield, we might confuse water stress with nitrogen stress. But by looking at how the plant responds to stress at the molecular level, we can better match potential solutions to problems,” Clay states. To integrate research findings into production systems Clay works with a team that includes molecular biologists, economists, modelers, soil scientists, social scientists, range scientists, animal scientists, statisticians, engineers, farmers, ranchers, microbiologists, and agronomists who are looking at soil and plant responses to stress at both the landscape and molecular levels, simultaneously.

“Our approach is pretty unique across the nation and is at the cutting edge of soil health and precision agriculture research. Based on our work, we have received awards from multiple professional societies,” Clay states.

### **Becoming precise**

Clay notes that technology is always changing. To minimize production costs, he and his team test new products prior to wide-scale implementation. “For example, we’ve always been able to see how much phosphorous or nitrate is in the soil prior to the growing season. Based on this information, recommendations are developed and implemented. However, soil sampling collected prior to planting the crop provides little information about the growing crop. New sensors mounted on unmanned aerial vehicles (drones) can provide information that can target corrective treatments. This data gives us

the ability to look at individual plants instead of large swaths in fields.”

According to Clay, three technologies have made a significant contribution to precision agricultural practices. “Computer miniaturization has provided us with smart phones, yield monitors, and the ability to analyze very large data sets. The second technology is our ability to analyze genetic responses to stress and the third technology is our ability to almost instantly get information and communicate with experts. Using these technologies, we can answer questions we did not even think were possible. It’s an exciting time to be a scientist,” he says.

“*Students bring new perspectives to not only solve today’s problems but also to resolve tomorrow’s problems.*”

### **New perspectives**

Clay has been a professor of plant sciences since 2001. He provided soils training to over 1,500 undergraduate students and 50 graduate students.

Being acknowledged and making a difference by working with the people is the most rewarding part of Clay’s work. He says seeing the difference his work makes in the lives of producers and students is the best reward.

“Students are always pushing us,” Clay says. “When they question our assumptions, that changes what we do and our understanding and interpretation of past experiments. Students bring new perspectives to not only solve today’s problems but also to resolve tomorrow’s problems.”

### **Editor of Agronomy Journal**

Clay was selected as a Fellow of the American Society of Agronomy in 2007 and has served as the editor of the *Agronomy Journal* since 2018. The *Agronomy Journal* is the premier journal for the American Society of Agronomy and it has been publishing papers for the last 110 years. Clay is the first editor from

South Dakota and last year, 1,000 papers were submitted for publication. Of those papers, they accepted 40% for publication. He works with a team of eight technical editors and 125 associate editors.

Besides his work as editor, Clay is the author of 16 books and has published over 265 referred papers in books and professional journals.

### **Tough year for farming**

Clay grew up as a regular kid playing baseball and football. He learned to love science from his father who was a geophysicist in the geology department at the University of Wisconsin. On family trips, they would travel across the country and his father would explain the science behind what they saw. His father’s interests in the natural sciences rubbed off and Clay majored in soil science and received degrees from the University of Wisconsin-Madison, University of Idaho, and the University of Minnesota. His interest in soil science and agronomy grew and eventually led him to SDSU.

Like many area farmers, the research work Clay planned to do in the field during the summer of 2019 was altered. Experiments designed to investigate seeding and planting rates changed to investigate the strength and weakness of cover crops and responses to prevent plant. He notes, “As hard as it was for us, it was much more difficult on our farmers and ranchers.” To reduce these economic hardships, Clay continues to explore options for creating market-based incentives for adopting best management practices. For example, if no-till practices reduce erosion and sequesters carbon, this creates services that farmers could be compensated for. It takes time to figure it out, and Clay is looking at ways to reduce the transition barriers.

Reflecting on the changes he has seen during his career, Clay says, “It is amazing where science is now. A couple of years ago we didn’t think we could do much more that was new. Technologies have changed that. Being an agronomist or soil scientist and doing the work we are doing is really fascinating with our ability to measure things better and more accurately. We are finding out that some old ways of thinking are no longer true. It’s an exciting time to be in agronomy and soil science.”

# S H A R O N C L A Y

## PURSUES PURPOSEFUL WEED MANAGEMENT

BY CONNIE SIEH GROOP

**S**haron Clay, distinguished professor in the Department of Agronomy, Horticulture and Plant Science, focuses on weeds and their interaction with crops through herbicides and soils. She has played pivotal roles in examining how weed management will fit into precision agriculture and what is needed for workforce development in the future. In addition, she has worked with plant physiologists and geneticists to better understand weed/crop interactions during early stages of crop growth.

Clay received the honor of South Dakota State University College of Agriculture, Food and Environmental Sciences Outstanding Researcher during the 2019 SDSU Celebration of Faculty Excellence.

“Being named as Outstanding Researcher is a validation of the research accomplishments of the teams I’ve been involved with at SDSU, as well as across the region and country,” Clay said. “The research is of importance to South Dakota and beyond.”

*“I would like to see how we can use these weeds to our advantage. We need to learn to use them purposefully instead of taking them out of the fields.”*

Understanding the relationship between weeds and crops helps design a better plant for the future. One thing the team did was look at how weeds interfere with crops to determine what genes are influenced during early crop stages, when most of the yield loss is determined.

“When crops are small, there is plenty of fertilizer and water in the spring. However, if even small weeds are present

and removed, yield losses can occur before fertilizer or water is limiting,” she explains. “We found that photosynthesis genes and other important pathways in crops are compromised when weeds are present and even if removed these genes never fully recovered. This means that even if more water and fertilizer is added, the affected plants may never have the same yield as those that never were exposed to weed pressure. This information puts a different outlook on how weeds and crops interact and could not have been accomplished without the foundational work on plant genomes.”

Eighty percent of Clay’s work is directed to research. Over the course of her career, she has secured over \$10 million as a principal investigator (PI) and close to \$50 million as a co-PI.

Clay says she has always been curious. While growing up in Milwaukee, Wisconsin, she remembers, “I was always looking under rocks, climbing trees and bringing home snakes.”

She pursued an undergraduate degree in horticulture at the University of Wisconsin–Madison. After finishing her bachelor’s degree, she married David Clay, and moved to Idaho. She worked with ranchers as a county weed supervisor, and says she learned to deal with weeds such as yellow star thistle, leafy spurge, and Canada thistle. Her interest

in weed science caused her to pursue a master’s degree working with weed control in barley, followed by a Ph.D. earned while working with weed control in the northern Minnesota bogs of wild rice.

“My post-doctoral research involved working with herbicide/soil interactions and examining water quality. I have always been fascinated by research and science. I want to know what has and hasn’t been

done and how what we learn fits in other environments,” she says.

Her career in weed science has fueled Clay’s passion for battling herbicide resistance issues in weeds. Clay has studied how weeds react to alternative management. She’s looked at alternatives such as mob grazing’s effects on weed management in range conditions, the effects of prescribed burning on range weed management, biological weed control, organic weed control using cover crops and grit application, and saline/sodic soil remediation using different plants.

“Herbicide control is still the gold-standard,” Clay says. “Other methods can decrease populations, but most do not equal what a single herbicide application can do. However, producers should continue to use diverse integrated methods including prevention, and cultural management to reduce weed impacts.”

### Teamwork

Clay emphasizes the importance of teamwork when it comes to solving complex research questions. She points out in today’s interdisciplinary research climate, some projects may need three to five experts such as a weed scientist, an ag engineer, and an economist. Each has their own piece of the puzzle and knowledge they bring to the table. Clay says she relies on research associates in the day-to-day operation as she is involved in writing, teaching and overseeing students. As they analyze the data, grad students craft their thesis. She goes through their work, challenging statements to make sure the research is sound.

### Answers raise more questions

She shares, “It’s hard when you’ve written the grant and you found answers to the questions posed, but you may end up with new questions more important than the original question. Once you get done you always think, ‘What could I have done

differently? What should I have done? I would like to do more but the grant is completed.' Every project brings unanswered questions. These may be the catalyst for the next grant idea.”

As a weed scientist Clay would really like to find a use for weeds. “I would like to see how we can use these weeds to our advantage. We need to learn to use them purposefully instead of taking them out of the fields.”

Clay notes that when she wants to grow weeds for research, they often don't cooperate. “If we try to grow weeds, then they don't grow. Crops have been bred to have 99% germination in the growing season and grow in rows when you want. Weeds, however, have not been selected for this and unlike crops, they often have specific requirements to break dormancy.” Clay says when planting in a field, only 1% to 2% of the weed seeds may germinate and even fewer will establish. The rest are sitting dormant or dead in the seed bank in the soil. Dormancy can cause weed “flushes” five or 10 years after the original seeds are shed. “So, weeds you are observing this year may have been from last year's plants or from the distant past. A single plant can shed hundreds to hundreds of thousands of seeds per year, making weeds with even a 1% germination rate per year a large infestation,” she states.

Clay teaches a weed science class that started out with 18 people. Interest has grown with 80 people in the fall class which includes a two-hour lab once weekly. Most of her students are agronomy or precision agriculture majors or minors.

## Leadership

Her dedication to her profession led Clay to become the first female president of the American Society of Agronomy in 2013. “Being president was a wonderful experience,” she said. “I traveled to represent the Society in India and Mexico. It was a very worthwhile experience, seeing agriculture from a different perspective. In addition, during my term, I set up two programs within ASA to enhance our connection with students.”

Clay said graduate students rarely met with members of ASA governing board when they attended the group's meetings. She conceptualized “Pop with the Presidents” and invited those starting in their careers to meet with officers of the society to talk about their goals, where they want to go with their career, and how to develop a plan to succeed.

She also set up the “Greenfield Scholars” program which paired students with a certified crop advisor. This provides a CCA mentor for a student for a year to help them understand what is expected in the workforce.

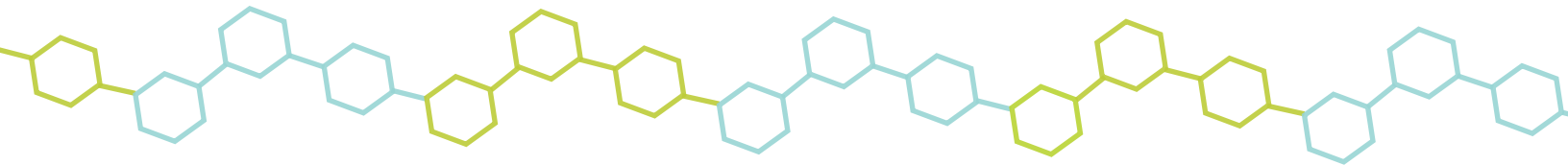
Clay's work has led her to author six books and over 160 referred publications. The Weed Science Society of America awarded her the Weed Science Paper of the Year for papers in the journal “Weed Science” in 2007, 2012 and 2013. Her expertise was tapped when working on both the precision agriculture and resistance management specialty certifications of the CCA program, which is run through the American Society of Agronomy.

“I have had the opportunity to work on a lot of different projects and collaborate with amazing scientists, graduate students, undergraduates, and producers. I have been extremely fortunate in my career at SDSU,” she says.



**From left to right:** Students Maggie Steinkamp, Shannen Mahal and Morgan Erickson with Sharon Clay at the city wall of Xi'an in China during a study abroad trip in 2019.

# RESE



SDSU offers students endless opportunities to gain firsthand experience from our knowledgeable faculty and staff both on and off campus.

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Examples include:

- Conducting research in a lab
- Working at a livestock unit
- Serving as a teaching assistant
- Tutoring other students
- Competing on a collegiate judging team
- Providing community service

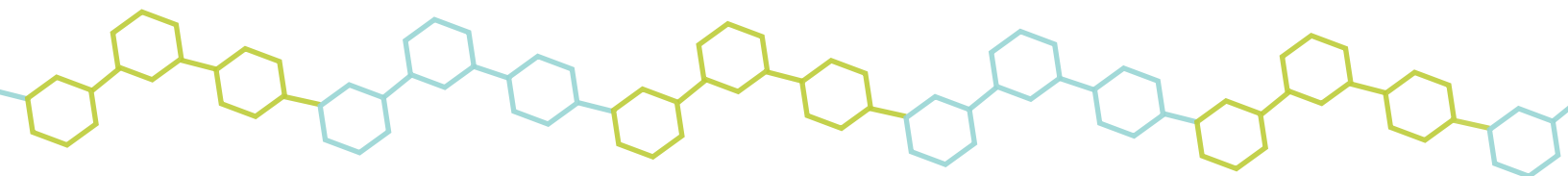
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Hear from five students about how the opportunity to conduct in-depth research in their respective fields of study has enhanced their education.



# ARCH

IN OUR OWN WORDS...



## ELISE SCHWEER – UNDERGRADUATE RESEARCHER

**Department:** Biology and Microbiology

**Project Focus:** Antibiotic Tolerance

**Major(s):** Biology and Microbiology

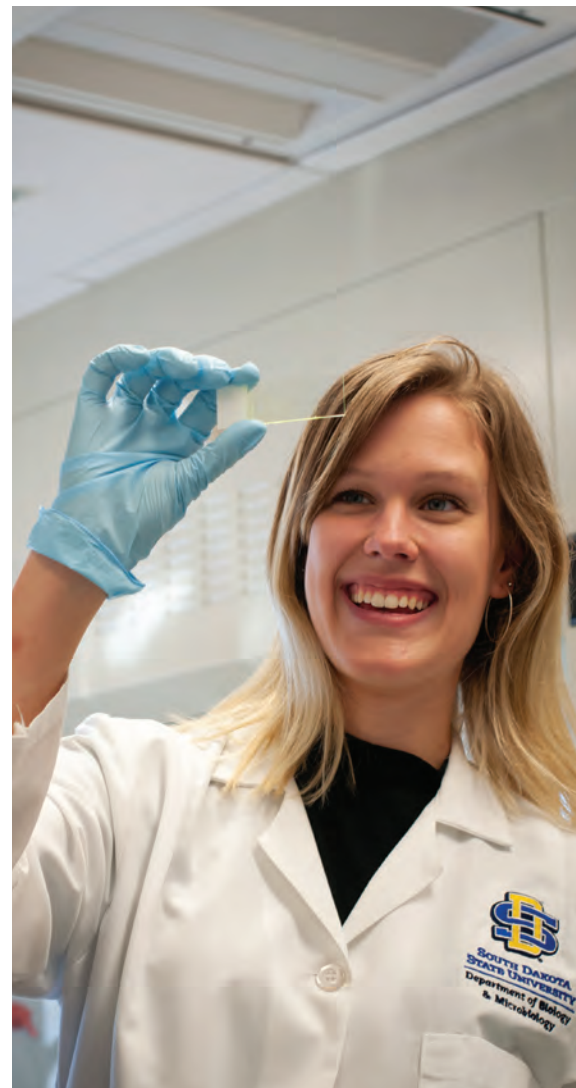
**Hometown:** Watertown, South Dakota

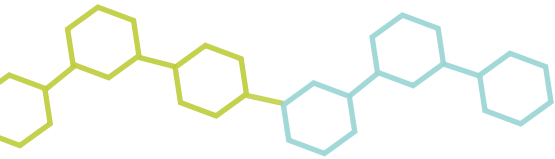
**Faculty Mentor:** Dr. Nicholas Butzin

"The use of therapeutic antibiotics has saved countless lives since the discovery of penicillin. Antibiotics advanced the treatment of infectious diseases worldwide, but the usage of antibiotics has come with significant consequences. The current challenges of antibiotic resistance are estimated to continue harming thousands of lives due to multidrug-resistant crises. Antibiotic resistance is the ability of a bacterial cell to survive in the presence of an antibiotic due to genetic mutations. Underlining antibiotic resistant cells are tolerant cells, which are a short-term population of cells that play a significant role in rendering antibiotic treatments ineffective and facilitating antibiotic resistance. Tolerant cells can withstand antibiotic treatments because their metabolic activities are reduced, but the underlying cellular mechanism of tolerance is not well understood.

Our team in Dr. Nicholas Butzin's lab has developed a queuing theory model of tolerance, which describes that when proteases are overloaded with proteins to break down, a queue assembles and then slows the degradation process. Using two different antibiotics, we showed that the proteolytic queue results in a higher tolerance frequency. However, when we use an antibiotic that prevents queue formation, there is no observed change in tolerance. Our next objective is to discover which component of the protease complex is limited and thus causing the queue. We propose to alter the levels of specific components of a protease complex and measure the effect on the queue. Our long-term goal is to understand the mechanics of proteolytic queuing and apply that knowledge to further study antibiotic tolerance."

**Future Plans:** "My future plans are to take one year off from school to prepare for graduate school. I would like to begin with a master's degree related to microbiology. From there, I am open to earning a Ph.D. or finding a job with a biotechnology company."





### **MOLLY KROEGER – UNDERGRADUATE RESEARCHER**

**Department:** Veterinary and Biomedical Sciences, Biology and Microbiology

**Project Focus:** Emerging Swine Pathogens

**Major(s):** Biotechnology and Microbiology

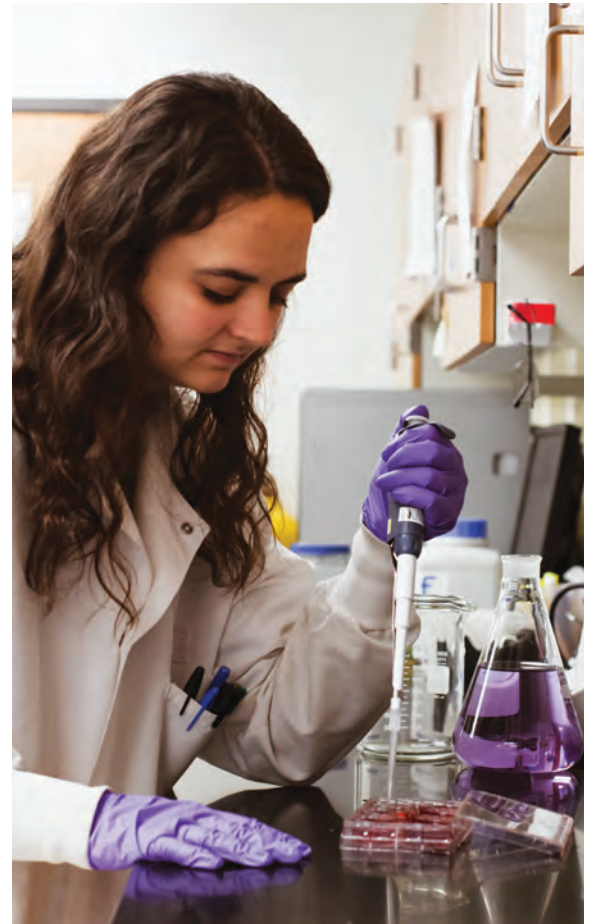
**Hometown:** Lennox, South Dakota

**Faculty Mentor:** Dr. Steve Lawson

"Dr. Lawson and I work together as a team in the laboratory to develop new diagnostic tests and reagents for emerging swine pathogens including Porcine Reproductive and Respiratory Syndrome (PRRS), Swine Acute Diarrhea Syndrome Coronavirus (SADS-CoV), and Influenza C and D. Our projects focus around monoclonal antibody production through hybridoma clones. We commonly do virus titrations, protein extraction and purification, virus gene cloning, and restriction enzyme digests. Dr. Lawson challenges us to be leaders in the laboratory by giving us managerial responsibilities like maintaining cell cultures, ordering supplies, and calibrating equipment.

Dr. Lawson has greatly helped me reach my educational goals at SDSU. By working in his lab, I have gained the necessary skills to take competitive internships and opportunities. I was a Swine Research and Development Intern with Merck Animal Health in Kansas City, Missouri, this past summer. This was an amazing opportunity to learn about vaccine formulation and to enhance my laboratory skills."

**Future Plans:** "I will attend graduate school with the hopes of starting an Infectious Disease and Immunology Ph.D. in the fall of 2020. I want to pursue a professional research career in animal health and vaccine development. I believe these goals are attainable due to the quality undergraduate research opportunities, coursework standards, and influential professors here at SDSU."



***"I BELIEVE THESE GOALS ARE ATTAINABLE DUE TO THE QUALITY UNDERGRADUATE RESEARCH OPPORTUNITIES, COURSEWORK STANDARDS, AND INFLUENTIAL PROFESSORS HERE AT SDSU."***

**– MOLLY KROEGER**

"PLAYING ON FARMS AND IN RURAL VILLAGES INSPIRED ME TO PURSUE HIGHER STUDIES IN PLANT SCIENCES."

– DEVA RAJ KHANAL

#### DEVA RAJ KHANAL – GRADUATE RESEARCHER

**Department:** Natural Resource Management

**Project Focus:** Complexity of Russian Thistle & Invasion Potential

**Master's Program:** Biological Sciences

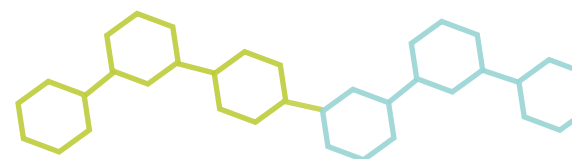
**Hometown:** Uurlabari Morang, Nepal

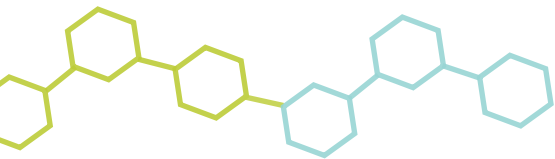
**Faculty Mentor:** Dr. Maribeth Latvis

"I grew up in a family attached to farming in eastern Nepal. Playing on farms and in rural villages inspired me to pursue higher studies in plant sciences. As a student in high school and at the university level, I involved myself in learning about agricultural crop production, invasive species, and biodiversity. After completion of a bachelor's degree in horticulture from Tribhuvan University in Nepal, I joined South Dakota State University as a master's student under Dr. Maribeth Latvis, studying biological sciences in the Department of Natural Resource Management in fall 2019.

At present, my research focuses on the complexity of Russian thistle (*Salsola tragus*), a major agricultural weed introduced in 1873 in South Dakota. Russian thistle is a polyploid species and a few different levels of chromosome numbers, i.e., diploids ( $2n=18$ ), tetraploids ( $2n=36$ ), and hexaploids ( $2n=54$ ) have been documented in California. I am gathering molecular data to understand phylogenetic relationships within the genus *Salsola* as a whole, with a focus on how the cytotypes variation of Russian thistle might influence the invasive potential within this species. I love working with old historical herbaria collections from across the world and fresh plant samples collected from different regions of the United States."

**Future Plans:** "After completion of my master's degree, I plan to pursue a Ph.D. and would like to work in the field of invasive plants management in the near future."





### **KARL VALLIN – UNDERGRADUATE RESEARCHER**

**Department:** Dairy and Food Science

**Project Focus:** Curcumin Load in Starch Granules

**Major(s):** Food Science

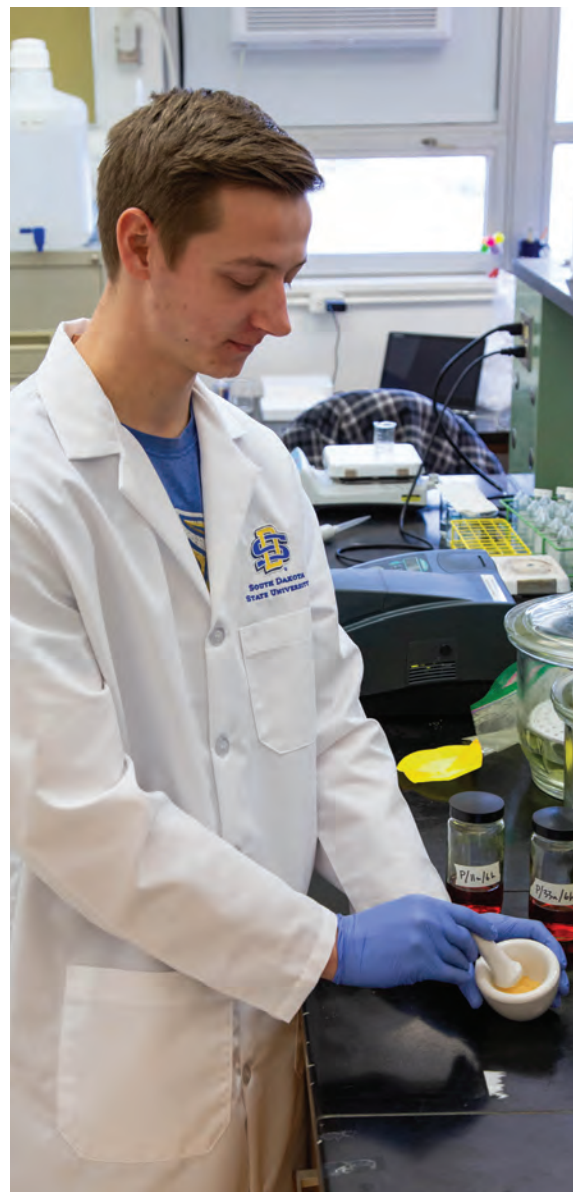
**Hometown:** Eagan, Minnesota

**Faculty Mentor:** Dr. Srinivas Janaswamy

"The modern lifestyles and dietary habits along with low consumption of bioactive compounds are some of the contributing factors for the proliferation of diabetes, obesity, cardio-vascular disease, and cancer. Foods enriched with bioactive compounds would aid to address these health risks and improve human health. Bioactive compounds are difficult to implement into food formulations, however, because of their poor water solubility and instability during processing and storage conditions. Corn starch and potato starch have been chosen as a suitable matrix to encapsulate curcumin– a plant-based compound with anti-diabetic, anti-cancer, anti-inflammatory and anti-obese properties. In order to increase the curcumin load in starches, pores have been created on starch granules through enzymatic modification. Encapsulation of bioactive compounds in porous starch granules, indeed, stands out to be the best scientific and industrial approach to not only enhance water solubility of bioactive compounds, but also to mask bitter taste and to protect their functionality from external stresses.

At this time, I have created porous starch granules and curcumin has been encapsulated. The current focus is to measure curcumin load in starch granules and to establish the release nature. Later, rate of starch digestion will be established along with the influence of curcumin's presence on starch digestion. Upon completion of the planned research, new insights of how porous starches, with modulated starch digestion, could serve as useful carrier templates to bioactive compounds would be revealed. The outcome sets the stage to design and develop novel health promoting and disease preventing functional foods and medicinal foods."

**Future Plans:** "After graduation I plan to attend the University of Minnesota to complete my master's degree in food science. My ultimate goal is to work for a food company and be a part of product development or research and development in that company to improve and create new foods. "



***"THE OUTCOME SETS THE STAGE TO DESIGN AND DEVELOP NOVEL HEALTH PROMOTING AND DISEASE PREVENTING FUNCTIONAL FOODS AND MEDICINAL FOODS."***

**– KARL VALLIN**

*"EVENTUALLY, I WANT TO ATTAIN A CAREER  
PRESERVING PRAIRIE GRASSLAND  
HABITATS IN THE MIDWEST."*

– PAMELA FEHR



#### **PAMELA FEHR – UNDERGRADUATE RESEARCHER**

**Department:** Natural Resource Management

**Project Focus:** Impacts of Reindeer Grazing in Finland

**Major(s):** Ecology and Environmental Science

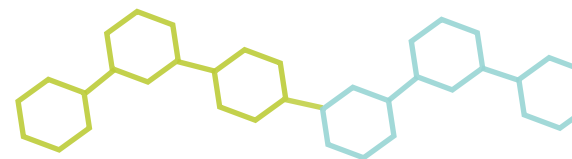
**Hometown:** Wimbledon, North Dakota

**Faculty Mentor:** Dr. Joshua Leffler

"Due to a long historical culture of nomadic reindeer herding by natives in Finland, reindeer across this country are semi-domesticated. Reindeer are culturally important in Finland. They are raised for their hides and milk, but they are primarily raised as a food source. Over the past ten years, the number of reindeer grazing the landscape has increased dramatically, increasing grazing pressure on ecosystems. Reindeer are selective grazers, and primarily select for lichen during grazing. These selective grazing habits have significantly decreased lichen ground cover across the landscape, and allowed shrubby, woody species to encroach into areas where lichen has been removed.

The objectives of our study were to determine the effects grazing would have on soil temperature, soil moisture, and carbon cycling in a boreal forest due to the altered ground cover. First, we established a grazed and ungrazed plot. Within each plot, we recorded moisture, temperature, and respiration values for two lichen communities in each grazed and ungrazed plot, and two *Vaccinium* (blueberry) communities in each plot from June through August. Our results concluded that there wasn't a significant difference in soil temperature or soil moisture between the two different plots. Respiration increased in both plant communities in the grazed plot. Photosynthesis decreased by nearly half in the *Vaccinium* plant community within the grazed plot. Overtime, as lichens decrease across the landscape and grazing continues, this data implies that carbon storage may decrease within these systems. The increases in respiration and decrease in photosynthesis could potentially turn these boreal forest systems from a carbon sink to a carbon source."

**Future Plans:** "I plan to pursue a master's degree in ecology. Eventually, I want to attain a career preserving prairie grassland habitats in the Midwest."



# FIGHTING CORN ROOT ROT

BY CHRISTIE DELFANIAN

**A**n invisible enemy is attacking South Dakota corn. The corn crop may look fine above ground, but as many as eight species of a common soil fungus may be infecting the roots—and compromising yields, according to South Dakota State University plant disease experts.

Research associate Paul Okello of the Department of Agronomy, Horticulture and Plant Science recently identified eight *Fusarium* species that cause root rot in South Dakota cornfields as part of his doctoral research. Furthermore, seven *Fusarium* species isolated from corn also cause disease in soybeans.

This is the first time South Dakota researchers have identified the pathogens causing root rot of corn in the state, according to Field Crops Pathologist Febina Mathew, an assistant professor in the Department of Agronomy, Horticulture and Plant Science. “The number of species can vary from region to region, but eight species have been identified in South Dakota,” Okello said.

*Fusarium* species have a broad host range, which includes soybean, sunflowers and small grains, such as wheat, consequently the pathogen can affect crops that are commonly rotated with corn,” said Mathew, who was Okello’s research adviser. “Our research on *Fusarium* root rot of corn will help us work with breeders to develop resistant varieties and with chemical companies to test the efficacy of seed treatments that target these specific pathogens.”

The May 2019 issue of *Plant Health Progress*, a journal published by the American Phytopathological Society, featured two articles on the research. The article identifying the *Fusarium* species causing corn root rot received the Editor’s Pick Award. Okello was first author on both papers.

The corn research was supported by U.S. Department of Agriculture Hatch Act funding through the South Dakota Agricultural Experiment Station. The soybean work was funded by the South Dakota Soybean Research and Promotion Council and the North Central Soybean Research Program.

## Analyzing corn root rot

While identifying species of *Fusarium* causing root rot of soybean in 2014, Okello noticed previous crops in some of the fields were corn or wheat. That piqued his interest in finding out which *Fusarium* species affected corn.

In 2015, SDSU researchers collected discolored roots from 50 cornfields across a 24-county area in eastern South Dakota, which produces 50% of the state’s corn.

Estimated yield losses due to corn root rot, seedling blight and plant-parasitic nematodes during the last six years varied from average of 225,000 bushels per year beginning in 2012 to approximately 75,000 bushels in 2017 and 2018 in South Dakota, according to surveys conducted

by the Corn Disease Working Group. A greater awareness of the disease, unfavorable environmental conditions and changes in management strategies may have helped reduce losses recently, Mathew explained.

“*Fusarium* is always in the soil, but environment plays a big role in disease development,” Okello said. Cool, wet soil conditions favor disease development. During the 2019 growing season, Mathew noted excessively wet fields meant the researchers were seeing more of the disease.

Lisa Richardson, executive director of the South Dakota Corn Utilization Council and the South Dakota Corn Growers Association, said, “Though these losses are small relative to the nearly 800 million bushels of corn produced annually in the state, we are thankful that this research helps producers have an awareness and understanding of this fungus and how it moves and how they can address it should a significant outbreak occur.”

## Identifying fungal species

Okello isolated the eight species of *Fusarium* from the root specimens and then verified in the greenhouse that these pathogens caused root disease in corn. One of the species, *Fusarium boothii*, had never been reported as affecting corn in the United States. However, *Fusarium boothii* was previously identified as causing disease on wheat in Nebraska.

A 1973 study done by University of Minnesota and Purdue University researchers found six *Fusarium* species in corn. However, the Okello study identified eight species in corn. “This suggests that the *Fusarium* species diversity affecting corn may have changed and additional research is required,” he said.

Next, the researchers did a cross-pathogenicity study, putting the *Fusarium* isolates from corn on soybeans and the ones from soybeans on corn in the greenhouse. “We found that seven species of the South Dakota isolates from either soybean or corn cause disease in both crops,” Okello said. “This means if you are going to plant soybeans after corn or vice-versa, you are increasing the inoculum level of these soil pathogens, amplifying what’s already there.”

Mathew’s lab is now testing fungicide seed treatment to determine if the current chemistries can help manage *Fusarium* root rot.

The use of partially resistant hybrids can also decrease losses, Mathew pointed out. “However, these are hybrids that can provide resistance to *Fusarium* ear rot, which growers can verify with the commercial seed companies. At this time, we are not sure if the genes conferring resistance to *Fusarium* root rot are also responsible for resistance to *Fusarium* ear rot and/or stalk rot. This warrants further study.”

Though knowing what specific *Fusarium* species infect corn will help breeders screen germplasm, Mathew said, “the breeding process can be challenging because resistance to *Fusarium* is controlled by multiple genes.”

▲ **Top:** The yellowing wilted leaves on these plants are one of the signs of root rot caused by one of eight species of *Fusarium* in South Dakota corn fields.

# "THE LESS PEOPLE KNOW ABOUT US"

SDSU RESEARCHER AXTON BETZ-HAMILTON USES HER OWN EXPERIENCE TO HELP VICTIMS OF FINANCIAL EXPLOITATION AND IDENTITY THEFT



BY NICOLE HUDSON

**F**inancial exploitation by family members is one of the most under-researched areas of financial exploitation. This has resulted in a lack of resources for those who have experienced this kind of financial abuse.

Dr. Axton Betz-Hamilton, assistant professor and researcher at South Dakota State University, is focusing her research on family financial abuse. Betz-Hamilton is working to fill the need for information on family financial exploitation by creating content and programming for those who experience this kind of exploitation. Her research focuses on several family financial abuse topics including child identity theft and elder family financial exploitation, specifically investigating what motivates a perpetrator and the behaviors that lead to familial financial abuse.

Betz-Hamilton is currently chair of a U.S. Department of Agriculture multi-state research project entitled "Elder Financial Exploitation: Family Risk and Protective Factors." She is working alongside researchers from Minnesota, Virginia, Washington, Wisconsin and Wyoming. Betz-Hamilton and a researcher from Minnesota are analyzing interview data collected from family members of victims to understand what motivates a perpetrator, the family dynamics, behaviors of the perpetrator and the emotional health of the perpetrator.

"Often times with elder family financial exploitation, dementia opens the door for the exploitation. So, we have to speak to family members close to the perpetrator and the victim to understand how and why the exploitation began," shared Betz-Hamilton.

The group of researchers are hoping to discover commonalities in interaction patterns between perpetrators' and victims' social and environmental influences that contribute to elder family financial exploitation so that others will be able to identify behaviors and prevent this problem.

Betz-Hamilton attended Purdue University where she received a bachelor's degree in agricultural economics and a master's degree in consumer sciences and retailing. Betz-Hamilton later received a Ph.D. from Iowa State University in Human

Development and Family Studies. Before coming to SDSU, Betz-Hamilton held faculty appointments at Eastern Illinois University, University of Wyoming and Iowa Central Community College. She has devoted herself to researching and helping those who experience financial exploitation like she has.

Betz-Hamilton has published many peer-reviewed research articles about family financial abuse, but her most notable work is a book she published in October 2019, "The Less People Know About Us: A Mystery of Betrayal, Family Secrets, and Stolen Identity." Betz-Hamilton's book shares the story of her own identity theft.

Betz-Hamilton's book details how she discovered the theft when she was renting her first apartment during her time at Purdue. She learned that her identity had first been stolen when she was 11 years old. Betz-Hamilton spent years investigating her identity theft and eventually decided to pursue

a career researching the topic of identity theft. Twenty years later, Betz-Hamilton uncovered that her mother had been the perpetrator all along. Betz-Hamilton and her father uncovered years and years of exploitation by her mother including credit card bills and notices from collection agencies.

Since the release of her book, Betz-Hamilton has been invited to speak across the nation about her experience. Betz-Hamilton has done interviews for local and national news sources, including an appearance on The Dr.Oz show. She has been invited to speak at conferences in states across the nation including Florida, Washington D.C., Nebraska and Colorado.

Betz-Hamilton's book was announced as the winner of an Edgar Award on April 30, 2020 for Best Fact Crime. The Edgar awards recognizes the best in mystery fiction, non-fiction and television produced in 2019.

"I never knew anyone else who had gone through this," said Betz-Hamilton. "By sharing my story, I hope to give other victims something so they don't feel so alone."

*"BY SHARING MY STORY, I HOPE TO GIVE OTHER VICTIMS SOMETHING SO THEY DON'T FEEL SO ALONE."*

# SUSTAINABLE AGRICULTURE:

## RESEARCHING THE ECONOMICS OF CONSERVATION



BY MADDIE HOKANSON

**A**s agriculture evolves, so does the knowledge farmers have about best practices to be both sustainable and profitable.

Dr. Tong Wang, SDSU Extension Advanced Production Specialist and part of the Ness School of Management and Economics, has been researching economics of conservation in agriculture since she joined the faculty in 2015.

“I hope my work can allow people to have an accurate perspective about production practices when they are looking at things to adopt on their farms and ranches,” said Wang. “We also work to inform farmers and ranchers about the outcomes of conservation practices in South Dakota and throughout the Great Plains.”

Wang is currently working as the principle investigator (PI) of two research projects. The first is with the U.S. Department of Agriculture and focuses on the grassland of the Great Plains to determine whether management intensive grazing is both a socially and economically viable option for agricultural producers.

Around 4,500 surveys were sent to producers in South Dakota, North Dakota and Texas to get an understanding of technical and economic challenges faced by grass-based agriculture. Based on the results from 900 respondents, the conclusion was drawn that non-adopters of management intensive grazing had several common challenges that kept them from doing it.

The largest challenge was a lack of labor in order to execute rotational grazing, and the other major factor was a lack of water resources. Some also shared challenges such as the burden of the initial start up costs, while others said they simply didn’t have the technical support needed for it to be successful.

Beyond the agriculturist point of view, Wang and her Co-PI have also worked to look at how management intensive grazing affects watershed functions, such as downstream flood risk and other environmental effects.

This study is not yet complete, and they are working to continue toward more definite answers and solutions for farmers and ranchers.

Wang’s other main project is with the South Dakota Natural Resource Conservation Service (NRCS) and looks at soil health economics in South Dakota. The goal is to find out if agricultural producers who continue to implement soil conservation practices, namely no-till, cover crops, diversified crop rotation and integrated cropping and livestock systems will be more profitable than those who are using conventional farming practices.

In one phase of the study, agricultural operations in the same neighborhood, one that adopted conservation practices such as no-till and cover crops and one that used conventional practices with tillage and a two-crop rotation, were compared by their yields and net profit over a few growing seasons.

“Our biggest takeaway was that conservation practices make the land more resilient to harsh growing conditions with less yield loss realized,” said Wang.

A survey was also sent out to 3,500 South Dakota producers to see how many utilize some kind of conservation practice and their viewpoints on it.

“With practices such as cover crops and no-till, the producers who had been implementing them for more than 10 years had achieved significantly more positive outcomes in yield and profit than those who had been utilizing them for three years or less,” she shared. “The benefits usually take time to be fully realized, so producers must be willing to try it over several years.”

Wang shared that her research not only impacts people in agriculture but also everyone in society.

“These practices have the potential to continually improve our environment,” said Wang. “So whether people realize it or not, these studies can positively impact everyone in one way or another.”



**Below:** Daniel Mbogo (right) of the International Potato Center in Kenya, Srinivas Janaswamy (left).



## COMBATTING **VITAMIN A** DEFICIENCY

BY LORA BERG

**S**rinivas Janaswamy, assistant professor in the Department of Dairy and Food Science, has established an impactful research program focused on functional carbohydrates for promoting human health. Janaswamy is working with researchers from around the globe to develop economical and sustainable solutions to deliver health-promoting and disease-preventing compounds by employing staple carbohydrates – starches and polysaccharides – as suitable delivery systems. Janaswamy is well-known in the international scientific community due to his scientific contributions.

Focused on healthier diets, his research emphases are on functional breads made from orange-fleshed sweet potatoes to combat Vitamin A deficiency. This is an outcome of his collaboration with the International Potato Center in Nairobi, Kenya supported through the Borlaug International Agricultural Science and Technology Fellowship Program, USDA- Foreign Agricultural Service. His research led to a new realization about reduced starch digestion of sweet potato breads, which has the

potential to aid individuals with glycemic issues. Janaswamy is currently expanding research on sweet potato products that could address both Vitamin A deficiency and diabetic concerns.

Janaswamy is also teaming up with several Chinese universities including Dalian Polytechnic University, Dalian; Jiangnan University, Wuxi; South China University of Technology, Guangzhou and Qilu University of Technology, Jinan in addition to Indian universities including Amity University, Noida and Vellore Institute of Technology, Vellore.

His goal is to establish strong research collaborations that could result in the development of new food products. His efforts also extend to byproducts from agricultural biomass to develop biodegradable materials that could both help to replace plastics and improve water quality. These well-coordinated activities will further Janaswamy's research in fostering novel contributions to the field of food science and, in-turn, will be valuable to both SDSU and his collaborators.

# BOOMING

# BEARS

BY CHRISTIE DELFANIAN

Pennsylvania's black bear population is booming. The population has increased from around 4,000 in the 1970s to about 18,000, according to the Pennsylvania Game Commission. "With that rising population comes human-wildlife conflict," said Rob Lonsinger, an assistant professor in the South Dakota State University Department of Natural Resource Management and a Pennsylvania native.

In 2002, Pennsylvania held its first bear hunting season in more than 50 years. Despite a record-setting harvest of 4,350 bears in 2011, wildlife officials have "not seen the dramatic declines in the population they expected," said Lonsinger, noting "females are the limiting factor in terms of growth rate."

Through a more than \$140,000 grant from the Pennsylvania Game Commission, Lonsinger will assess factors affecting female bear harvest rates in north central Pennsylvania. He is collaborating with Pennsylvania game mammals section supervisor Matt Lovallo for the three-year project, which began in December 2019. The approximately 100-square-mile study area is in the Appalachian Mountains in north-central Pennsylvania.

Last fall, the statewide bear hunting season was extended from approximately two weeks to 32 days. The muzzleloader season began in October, with an early November archery season and then in late November, a rifle season. "The idea behind this is by late November females are already starting to den. Starting the season sooner might increase the female harvest," Lonsinger explained.

With 4,577 bears harvested by Dec. 9, 2019, this may be the largest bear harvest in state history. However, he pointed out, "We have not yet figured out if the increase is in males or females harvested."

Brandon Snavelly, a wildlife biologist aide at the Pennsylvania Game Commission, has already begun collecting data and will work on the project as a master's student in the SDSU Department of Natural Resource Management. The researchers will deploy GPS collars on at least 40 female black bears. "This will give us a lot of location and movement data," Lonsinger said. This spring they will begin handling bears in the dens.

"We have a tremendous amount of in-kind support from the game commission," he said. The commission is purchasing the GPS collars and covering field expenses, including collaring and tracking the bears, and is also quantifying the food supply through vegetation and forage surveys. Acorns are an important source of energy for bears, he noted.

In addition, Pennsylvania wildlife officials capture and tag upward of 800 black bears annually and have been doing so for 17 years. "We have a pretty lush dataset with which to look at how many of the harvested bears are tagged and use that to estimate abundance," Lonsinger said. "The information on hunter activity will help us understand how these different factors affect female space use and ultimately harvest rates."



# GROWING STRONG:

## SOUTH DAKOTA WHEAT COMMISSION COLLABORATES WITH SDSU RESEARCH



BY SADIE VANDER WAL

Over the last 20 years, the South Dakota Wheat Commission has provided more than \$10 million to South Dakota State University for the purpose of advancing wheat-related research in the state. The organization's checkoff program provides significant funding to the College of Agriculture, Food and Environmental Sciences for research projects, scholarships, equipment and buildings, all of which generate an impact on South Dakota's wheat industry and its producers.

"This research helps produce new varieties and new agronomic practices that provide direct benefit to our wheat producers in South Dakota and for the future," said Reid Christopherson, executive director of the South Dakota Wheat Commission. "It's all about returning their investment back to measurable impact on their production."

The South Dakota Wheat Commission was established in 1961 after the South Dakota Wheat Resources Act was passed. The act aimed to protect the future of wheat production and its producers, which is now carried out through the group's mission of improving the state's wheat industry through research, market development and education.

Through its partnership with SDSU, the commission serves as the link between wheat producers and university research. Commodity groups such as the South Dakota Wheat Commission gather information regarding current crop production concerns, which helps researchers define areas of focus for their projects. From there, research findings are brought back to the producers through annual reports, extension publications and presentations, and group and individual consultations.

"The commodity groups not only provide funding, but as importantly help provide direction for research priorities and then implement the research discoveries in the field," said Bill Gibbons, director of the South Dakota Agricultural Experiment Station and the associate dean of research for the College of

Agriculture, Food and Environmental Sciences.

From a federal standpoint, the United States Department of Agriculture provides limited funding for wheat research and does not allow for its funding to be invested into research infrastructure. The South Dakota Wheat Commission serves as a stable source of funding for both infrastructure and longer-term projects that directly support South Dakota producers.

Recent contributions from the commission have helped fund projects on the SDSU campus including the Young Brothers Seed Technology Laboratory, the new greenhouse complex, scholarships and several types of major equipment items for both laboratory and field research, one of which has included a test plot combine. A significant amount of funding also goes to annual research projects, many of which involve wheat breeding, variety evaluations, pest management, agronomic practices and new uses for the crop.

Due to the variability in agronomic factors from state to state, producers depend on research and breed varieties that are developed within state lines.

"It's very critical that we are developing wheat varieties that are specific to the conditions in South Dakota," Christopherson explained. "We are very fortunate to have that talent here in South Dakota."

In the future, SDSU will continue its efforts in wheat research with both spring and winter wheat breeding programs. In addition, developing new and higher-value uses for wheat and investigating the various benefits of using it in crop rotations are of high interest.

"Without the South Dakota Wheat Commission's support of our research efforts, we wouldn't be able to generate the discoveries and yield improvement needed to keep wheat as a major crop in South Dakota and the region," Gibbons said. "We are extremely appreciative of this strong partnership."

# CROP IMPROVEMENT

## PLANT BREEDING PROGRAMS RELEASE FOUR NEW VARIETIES IN 2019

BY MADDIE HOKANSON

South Dakota State University's plant breeding programs announced the release of four new crop varieties in 2019.

Winner and Draper were the two hard red winter wheat varieties released, Driver was the hard red spring wheat variety and Rushmore was the oat variety released.

### WINNER AND DRAPER – HARD RED WINTER WHEAT

For Dr. Sunish Sehgal, SDSU's winter wheat breeder since 2014, working in a field that applies directly to farmers and their success is exactly what he enjoys doing. At any given point, the winter wheat breeding program has around 3,000 experiments going, and this year they were able to produce two new varieties from it. Both Winner and Draper were available to Certified Seed growers in the fall of 2019.

According to Sehgal, the Winner variety has excellent yield potential with above average baking quality, good disease resistance and straw strength and is better suited for good-moisture environments. During trials, it performed well in central and eastern South Dakota and the northern Great Plains, and it topped several trials over the past three years.

The Draper variety has similar characteristics to Winner with high yield potential while maintaining good protein content, but it is better suited in dry conditions having strong drought tolerance. Therefore, it is likely well-adapted for western South Dakota.

"I want farmers to understand that it's a very slow process developing new varieties," said Sehgal. "Changes happen over time with a long-term impact instead of quick results, so continue to believe in us and what we are working to improve."

### DRIVER – HARD RED SPRING WHEAT

Dr. Karl Glover, spring wheat breeder at SDSU, and his team began the production of Driver in 2011 with the initial cross that took place in the greenhouse. After years of testing and trials, it was presented to and approved by the Agronomy, Horticulture and Plant Science release committee, and it was then released to Certified Seed growers for the spring of 2020. According to the SDSU Foundation Seed Stocks Division, Driver has already sold out for the season.

"I chose the name 'Driver' for this variety because my dad was a truck driver," said Glover about his name choice for the variety. "He pushed me to continue my education and use my brain, and he actually passed away two years ago in February. I figured if I was ever going to be able to thank him for what he did, this would be a good way to do so."

Any new variety approved for release must at least meet, if not exceed, the yield potential and protein content of what's already available. Driver is competitive in both areas, along with having good scab resistance, but where it excels is in its straw strength.

The Red River Valley, including northeastern South Dakota, eastern North Dakota and northwestern Minnesota is likely the optimal location for Driver because of its excellent straw strength and ability to stand in the field, Glover notes.





## RUSHMORE – OAT

The Rushmore oat variety was also released in 2019 and made available to Certified Seed growers for spring of 2020, although it has already sold out as well.

Dr. Melanie Caffé has been the oat breeder at SDSU since 2014. The process to create a new oat variety typically takes 8-10 years, so development of Rushmore began before she was in the position.

Through performance testing over the past several years, Rushmore has proven to have a very high test weight, good milling and nutritional quality and have moderate resistance to crown rust. Because of these qualities, it is likely better suited for the eastern parts of South Dakota where greater precipitation is typical.

When compared to the Hayden oat variety in East River test plots, Rushmore showed a 23 bushel/acre potential advantage. However, Caffé points out that can change significantly depending on weather, disease pressure, soil type and many other factors.

Some of SDSU's plant breeding programs have been going since the 1940s, and their success can be attributed to great collaboration between the university and multiple organizations in South Dakota and the surrounding states.

### RECENT SDSU CROP VARIETY INTRODUCTIONS:

#### Oats:

*Rushmore (2019)*  
*Warrior (2018)*  
*Saddle (2017)*  
*Sumo (2016)*  
*Natty (2014)*  
*Hayden (2014)*  
*Goliath (2012)*  
*Horsepower (2011)*  
*Shelby 427 (2009)*  
*Streaker (2009)*

#### Spring Wheat:

*Driver (2019)*  
*Boost (2015)*  
*Surpass (2015)*  
*Focus (2014)*  
*Prevail (2013)*  
*Advance (2011)*  
*Forefront (2011)*  
*Select (2010)*  
*Brick (2008)*

#### Winter Wheat:

*Winner (2019)*  
*Draper (2019)*  
*Thompson (2017)*  
*Oahe (2016)*  
*Redfield (2013)*  
*Ideal (2011)*  
*Lyman (2008)*





# DEVELOPING A NEW METHOD OF PRODUCING LOW-CALORIE SWEETENERS FROM LACTOSE

BY SYDNEY MEYER

To help combat the obesity epidemic in the United States, one researcher at South Dakota State University is developing a new method of deriving low-calorie sweeteners from milk as healthier alternatives to common sweeteners found in food and drinks.

Sergio Martinez-Monteaquedo, assistant professor and researcher in the Dairy and Food Science Department, is developing a chemical process to produce low-calorie sweeteners from lactose, the sugar in dairy products, in larger quantities and at a more affordable rate than traditional manufacturing techniques. This has the potential to make the sweeteners cost-effective alternatives to sugar or high-fructose corn syrup.

“Lactose is the most underutilized dairy ingredient - current applications of lactose are insufficient to use the left-over lactose from the manufacturing of dairy products such as cheese, Greek yogurt and protein concentrate,” he says. “Additionally, as an ingredient lactose offers technological challenges like poor solubility and low sweetness strength. It is critical to develop technological approaches that can help to expand lactose utilization, which will also provide more opportunities for dairy producers.”

Strategies leading to expanding lactose utilization include enzymatic and catalytic conversion into nutritive sweeteners, prebiotics and nutraceuticals. However, both conversions require concentrated and purified lactose, which involves multiple steps and strict control of the reaction.

Martinez-Monteaquedo’s research explores the potential of using lactose permeate, a dairy byproduct that can be used without further purification, as a source for producing natural sweeteners, which would abolish the need to use purified lactose.

He is also developing a new class of catalysts that consist of an active metal site embedded in an insoluble framework to perform

the chemical process of deriving natural sweeteners from lactose. The catalysts offer the advantage of performing the chemical process in aqueous environments, where traditional chemical and enzymatic synthesis cannot occur. He is utilizing a two-step process consisting of hydrolysis followed by isomerization.

“The anticipated outcome is a scalable process capable of converting lactose permeate to sweetening syrup made primarily of tagatose, which is a low-calorie, rare and natural carbohydrate found in dairy products and some fruits (apples, oranges and pineapple),” he says.

Tagatose exhibits almost identical tastes and textures as sucrose, with sweetness being 94% compatible to sucrose. However, tagatose has much fewer calories - about 40% of sucrose. Additionally, it does not increase blood glucose levels as much as sucrose or fructose.

“Tagatose is a healthier alternative to sucrose without having to compromise on flavor,” he says. “But in spite of its benefits, tagatose has a high manufacturing cost that has kept it from wide commercial use.”

Although tagatose is naturally present in small amounts, the concentrations are too low to isolate it effectively. Tagatose is exclusively produced via enzymatic conversion and an alternative chemical process has not yet been developed. All enzymatic processes present some drawbacks such as prolonged reaction time, limitations in the reuse of enzymes, use of buffers to control pH, low stability of the enzymes and the use of highly pure feedstock (galactose). The traditional manufacturing method involves a multi-step enzymatic process that turns galactose, which is a component of lactose, into tagatose. However, only 30% of galactose is converted into tagatose as a result of the enzymatic reaction, forcing manufacturers to use an expensive process to remove the tagatose from the galactose mixture.

According to Martinez-Monteagudo, tagatose can also be produced through chemical process known as base-catalyzed isomerization, where the reaction is operated at high pH values using soluble alkalis (sodium hydroxide, potassium hydroxide, or calcium hydroxide). The reaction is neutralized with acids once the desired level of conversion has been achieved. However, this process results in low yields of tagatose due to the formation of numerous by-products.

“The chemical process I am developing with a new class of catalysts has potential to allow the production of tagatose in larger quantities and at a lower cost, which could make it a cost-effective alternative to sucrose,” Martinez-Monteagudo says. “This will also create a value-added dairy product that will provide more opportunities and new markets for dairy farmers.”

Martinez-Monteagudo is in the beginning phases of working with a company to prove the concept in commercial scale.

### Beginning work on a new sweetener

Martinez-Monteagudo also recently started working on developing a more effective means of manufacturing another natural sweetener similar to tagatose, called allulose, from lactose permeate.

Like tagatose, allulose is also a low-calorie, rare carbohydrate naturally occurring in small amounts in nature. It exhibits similar tastes and textures as sucrose, with sweetness being 80% compared to sucrose, while its caloric value is only about 10% that of sucrose. It also has no impact on blood sugar levels.

Allulose is traditionally manufactured through epimerization, meaning the orientation of the chemical formula, of fructose by an enzymatic process (epimerase) under restricted levels of pH and temperature. Martinez-Monteagudo is exploring the production of allulose from streams rich in lactose such as milk, acid and sweet permeate, using a chemical process with the same

*“This will also create a value-added dairy product that will provide more opportunities and new markets for dairy farmers.”*



class of catalysts as in the production of tagatose.

“Prior results in the study have shown that this process of using catalysts to produce allulose has production yields comparable with the enzymatic process and can perform epimerization over fructose,” he says.

He produces allulose from the lactose using one-pot synthesis, which is a strategy to improve the efficiency of a chemical reaction by a reactant being subjected to successive chemical reactions in just one reactor. The lactose permeate will first be hydrolyzed, meaning broken down by a chemical reaction with water; isomerized, which changes it from one isomer to another; and then epimerized, which converts it from one epimeric form

into another. As a result, inorganic catalysts are then easy to separate after the reaction and can be regenerated, making this a sustainable option for production.

He expects that the obtained products will consist of mixtures of different sweeteners such as tagatose, allulose, fructose, glucose, and galactose depending on the reaction conditions. These mixtures may require minimum purification and can be used as sweetening syrup.

The project is supported by the South Dakota Agricultural Experiment Station and Dairy Management Inc., through checkoff dollars.

# LEGISLATION COULD IMPACT SOUTH DAKOTA AGRICULTURAL LAND VALUES



BY MADDIE HOKANSON

South Dakota State University faculty members completed a study on Ag Land Highest and Best Use (HBU) funded by a special appropriation in the 2016 legislative session (HB1007).

The study looked at three different approaches to determine HBU as either cropland or noncropland for agricultural land in South Dakota, including the current method used, an actual use method (AU) and most probable use (MPU) method. HBU is defined as the reasonably probable use of property that results in the highest value.

The current method used by the South Dakota Department of Revenue is largely based on the Land Capability Classification for each soil map unit. The HBU determination is used along with the productivity formula to value agricultural land in South Dakota for property tax purposes.

An alternative method is to base HBU of each soil on the current use, more often referred to as actual use (AU). If South Dakota were to implement an AU policy, it's estimated there would have been a 19% decline in agricultural land values in 2017.

Another alternative method would use an economic model to determine the probable use of a soil, commonly referred to as most probable use (MPU). This method looks at the probability of a particular use for agricultural land. If South Dakota

implemented an MPU policy, it's estimated there would have been a 12% drop in agricultural land values in 2017.

Both new methods cause a decrease in agricultural land values, meaning some counties would see an increased tax burden toward nonagricultural properties.

As of Feb. 25, South Dakota Legislature House Bill (HB) 1007 had been delivered to the Governor, which modifies the language in current state statutes regarding HBU determinations and adjustments.

HB 1007 would allow property owners to request an examination of their property by the Director of Equalization for their county if the actual use of the property is different than the use that the property is being assessed as. Public testimony is also welcome at the Ag Land Assessment Oversight Committee meetings during the interim sessions.

SDSU Extension Agribusiness Specialist Dr. Matthew Elliott shared, "South Dakota agricultural landowners have an advantage over agricultural landowners in other states because the assessment allows legislature to be more directly involved through the oversight committee. This allows for greater transparency in understanding assessments."





# AMINO ACID SUPPLEMENTATION IMPROVES COW HEALTH AND MILK COMPOSITION

BY CHRISTIE DELFANIAN

**W**ithin the first week of giving birth, a high-yield dairy cow can increase milk production to as much as 100 pounds per day, according to assistant professor Johan Osorio of South Dakota State University's Department of Dairy and Food Science. "This dramatic change causes stress—we are walking a thin line between healthy and unhealthy, particularly in cows that can deliver a high milk production."

His research focuses on how methionine, an essential amino acid, can improve the health of cows making the transition into lactation. "Providing a good amount of methionine during that transition period can minimize stress," said Osorio, who came to SDSU in 2016 after doing postdoctoral research at Oregon State University. However, his research goes deeper than that.

"We are breaking it down to the molecular level," Osorio said. His dissertation research showed that the methionine supplement interacts with the genome, affecting more than 2,600 genes. At SDSU, he is exploring these nutrigenomic interactions through U.S. Department of Agriculture Hatch Act funding from the South Dakota Agricultural Experiment Station.

What he discovers may make it possible to customize the fat and protein makeup of milk to meet consumers' needs.

## Easing stress of transition

"A lot of metabolic adaptations occur in dairy cows during the days leading to calving and during the start of the lactation," Osorio said. During this stressful time, cows are likely to eat less, which negatively affects their metabolism and immune system and can leave them vulnerable to disease.

His work showed that feed intake and milk quality improved in cows receiving a methionine supplement during the 30 days after calving. "The milk had more fat and protein," he said. "There was also some indication of better resistance to mastitis."

When Osorio examined gene markers in the cows' liver, he found the methionine supplement changes the way in which 2,633 genes in the liver are expressed, either increasing or decreasing

the production of specific proteins. Those changes improve liver function, thereby reducing inflammation and stress.

## Analyzing protein changes

Osorio and his two doctoral students are using bovine mammary epithelial cells as a model to examine the molecular changes that methionine triggers which, in turn, affect milk production and improve the animal's overall health. The researchers examine RNA, a single-stranded molecule that transcribes or codes, the information for amino acids that are the building blocks to produce a protein. When animals consume a methionine supplement, the production of specific types of proteins can be turned on or off.

To track those changes, Osorio uses a system developed at the Massachusetts Institute of Technology in which two key proteins are tagged with different fluorescent colors. That then allows the researchers to microscopically track what's happening when varying levels of methionine are added to the cell cultures.

"If we increase the methionine in the media, the cells respond," he explained. "We are building a model in the lab that we can then test on the farm." Initial testing confirmed that increasing the levels of methionine can impact the signaling of the proteins, but since the effect is not dose-dependent, other factors are likely at work.

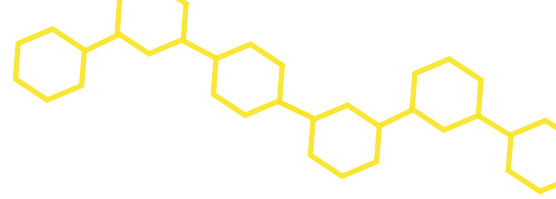
"We are able to control the carbon dioxide, temperature and humidity of the cell during our experiment and can take photos at regular intervals to track protein activity in real-time in the cells," he explained. Now the researchers are using software to gather quantitative data from each cell based on the fluorescent intensity. The next step will be to analyze blood samples from an animal study in which cows were given varying levels of methionine.

"If you go deep down, you might find key regulatory mechanisms that can be enhanced," he said. "That is part of the excitement, not knowing what you are going to find."

# RESEARCH IN PRO



**Above:** Péter Kovács, assistant professor in the South Dakota State University Department of Agronomy, Horticulture and Plant Sciences.



# GRES S

BY ADDISON MAGILL

## Improving South Dakota's Crop Production Systems

Péter Kovács, assistant professor in the South Dakota State University Department of Agronomy, Horticulture and Plant Science, is researching how to enhance agronomic efficiency and stress resilience of South Dakota crops while reducing environmental impacts.

Climatic conditions in crop production areas have changed significantly over the past decades. Some changes have been beneficial, including longer growing seasons with an increasing number of frost-free days. However, other changes such as amount of precipitation have had negative impacts. There is a demand in developed countries, including the United States, for farmers to minimize environmental effects while increasing crop yields to meet the needs of a growing population. Consumers are calling for more sustainable production practices in order to achieve this goal. Due to rapid advancements in technology, equipment and production practices, further research is needed to understand crop responses to interactions between genotype, environment and management. Seed and fertilizer are the two largest variables that affect cost and yield. Adjusting current fertilizer application strategies to be more closely synchronized to crop demand can lead to greater certainty about the amount to apply and, in turn, reduce fertilizer loss to the environment. Kovács hopes that his research will assess alternative crop production systems to improve input efficiency and crop stress resilience. He is also working to identify site-specific strategies to help improve or maximize the interactions between genotype, environment and management. Kovács is also assessing and incorporating in-season and remotely sensed information into best management practices to improve crop condition.

In order to achieve these goals, Kovács is following the 4R Nutrient Stewardship Program guidelines in order to investigate better ways to match nutrient availability with crop demands in various tillage systems and growing environments. He is collecting in-season field (plant and soil) observations and complementing them with proximal sensed data throughout the trials.

As a result of his research, Kovács expects to identify cropping systems and management strategies that producers can implement to maintain or increase their yields and profits while lowering the environmental risk associated with their operations.

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## Exploring the Impacts and Values of Natural-Based Recreation and Tourism in Rural Communities

Nature-based recreation and tourism offers the potential to provide rural communities with opportunities for economic gain, environmental protection and historic preservation. Stella Liu, assistant professor in the South Dakota State University Department of Health and Nutritional Sciences, plans to increase the understanding of the values and impacts of nature-based recreation and tourism for both personal and community well-being.

Liu notes that natural resources can provide residents access to close-to-home, low-cost outdoor recreation that can promote physical activity and improve health and mental well-being. Through her research, Liu hopes to gain a better understanding of the personal experience, perceived values and behavior of using public lands and resources for recreation. Liu is evaluating the relationship between individuals' attitudes and behavior when participating in outdoor recreation and their overall personal health, life quality and well-being. She will also investigate the effects on children and youth who are participating in outdoor recreation as well as the impact of nature-based tourism in rural communities.

Liu expects to gain an increased understanding about the connection between personal health and quality of life in rural communities, which could increase the public's awareness about the benefits of being outdoors. Additionally, Liu projects her research to have a positive impact on the development of rural, nature-based tourism. Liu's findings could help rural communities more effectively promote their nature-based recreation opportunities by providing a better understanding of the benefits associated with participating in outdoor recreation.

# RESEARCH IN PROGRESS



## Investigating Plant Partnerships

Heike Bücking, head of the Department of Biology and Microbiology, along with Sen Subramanian, associate professor and graduate coordinator in the Department of Agronomy, Horticulture and Plant Science, are looking to gain a better understanding of a three-partner interaction among legume plants, mycorrhizal fungi and nitrogen-fixing bacteria in order to maximize the symbiotic benefits of these interactions.

By the year 2040, the demands of a growing human population are projected to require 40 and 20 million metric tons of additional nitrogen and phosphate fertilizers, respectively, to meet global food production needs on declining arable land resources. However, the increasing application of nitrogen and phosphate fertilizers leads to substantial environmental costs, such as the pollution of aquifers and water streams, and greenhouse gas emissions. This unsustainable trend can be reversed by harnessing microbes that increase nutrient availability and enhance growth of agronomically important crops. Nitrogen-fixing bacteria and arbuscular mycorrhizal fungi both have the capability to increase the nutrient efficiency of their associated hosts and have the potential to serve as biofertilizers in environmentally sustainable agriculture. Under natural conditions, legumes are simultaneously colonized with nitrogen-fixing bacteria and arbuscular mycorrhizal fungi leading to a three-partner interaction. While nitrogen-fixing bacteria convert atmospheric nitrogen into plant usable forms, arbuscular mycorrhizal fungi act as an extended root system that can obtain additional nitrogen and phosphorus resources that are inaccessible to the plant. However, these interactions are quite costly for the host plant, and the plant transfers substantial amounts of carbohydrates to both symbionts. In order to be beneficial for the host plants, the benefits of these interactions must outweigh their costs, but our current knowledge about the carbohydrate allocation to specific partners, and the cost-to-benefit ratio of these interactions is limited. A better understanding of these processes can help devise strategies to maximize plant nutritional gains from these root symbionts.

The goal in this project is to test if and how the host plant changes its carbon allocation strategy to each root symbiont dependent on its nutrient demand to maximize plant growth very similar to a market where prices are determined by demand and supply. The carbon provided by the host plant acts as an important driver for symbiotic benefit and therefore determines the effectiveness with which symbiotic partners are able to provide nutritional benefits. Both root symbionts compete for carbon resources and this competition increases the bargaining power of the host plant and allows the host to increase its symbiotic benefit. To achieve a greater understanding of these tripartite interactions, Bücking and Subramanian will employ a range of innovative tools to manipulate the interactions between legumes and their beneficial root symbionts.

As a result of their research, Bücking and Subramanian expect the project to directly impact the understanding of how host plants are able to control their symbiotic partners and how these processes evolved. Having a better understanding of these processes is critical to maximize the symbiotic benefits for agricultural legumes, reduce the use of synthetic fertilizers, and enhance sustainable crop production.

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## Manufacturing Dairy-Based Ingredients

Lloyd Metzger, professor and Alfred Chair in the Department of Dairy and Food Science, is looking to develop and improve manufacturing processes to produce dairy-based ingredients that have an extended shelf life and can be utilized in domestic and international markets.

In the U.S., milk production has steadily climbed from 115 billion pounds in 1975 to over 208 billion pounds today, all while cow numbers have remained fairly constant. Dairy-based ingredients targeted for export markets can offer a potential new market for U.S. dairy producers.

In order to capitalize on the trend of a rapidly expanding export market, the U.S. dairy industry needs to identify the components of milk that are most valuable and determine how these components can be economically isolated and converted into shelf-stable products. Through Metzger's research, he plans to model the drying characteristics of dairy-based ingredients to maximize the efficiency of the drying process and accelerate the development of new dairy-based ingredients and develop a lab-scale crystallization system and analysis protocols that will be utilized to evaluate modified manufacturing processes. Metzger is seeking methods to improve the efficiency of lactose and permeate manufacturing and develop and evaluate membrane-based manufacturing processes that can be used to isolate or concentrate components in various dairy products including milk, whey, permeate and delactosed permeate.

Metzger is using a technique called single droplet drying. During this process, a droplet of a liquid such as milk is suspended on the tip of a glass filament in order to measure the droplet diameter, mass and temperature as the droplet is dried under controlled conditions. Metzger will also utilize a laboratory scale crystallization set-up along with a lab-scale filtration system to achieve additional research objectives.

Metzger plans to present and publish his findings at the American Dairy Science Association and Institute of Food Technology Annual Meetings. Metzger believes his research could help allow for continued growth of the U.S. dairy export market, which plays an important economic role in the industry.



**Above:** Heike Bücking, Associate Dean for Research and Scholarly Activities in the Department of Biology and Microbiology.



**Above right:** Sanjeev Anand, Professor in the Department of Dairy and Food Science.

# RESEARCH IN PROGRESS



## Process Interventions for Enhancing Microbial Quality, Safety, and Nutrition of Dairy Foods

Enhancing microbial quality and safety of milk and dairy products is an ongoing challenge that Sanjeev Anand, professor in the Department of Dairy and Food Science, is addressing through his research.

Anand's projects are intended to help dairy producers, processors and industries that provide equipment and supplies to the dairy processing industry. As a result of his research, Anand hopes to gain a better understanding of sporulation and spore germination behavior of common dairy sporeformers and develop risk analysis models in order to reduce the overall risk of food pathogens.

In another group of projects, Anand is working to develop novel dairy products containing probiotics. Adding probiotics to improve the nutritional value of dairy ingredients could increase consumer acceptance of fermented dairy products. Anand plans to develop an encapsulated probiotic product using whey protein hydrolysates as encapsulants. This novel health formulation incorporating common probiotic bacteria and whey protein hydrolysates would provide an alternative health-based dairy product line to consumers.

Anand's projects are intended to help dairy producers, processors and industries that provide equipment and supplies to the dairy processing industry. As a result of his research, Anand hopes to gain a better understanding of sporulation and spore germination behavior of common dairy sporeformers, learn methods for control of bacterial biofilms, develop risk analysis models for environmental bacterial contaminants in order to reduce the overall risk of food pathogens and create wholesome products.

Effective and efficient control of bacteria in dairy processes and the development of novel products is crucial for consumers as well as for the sustenance of the dairy industry.

Anand's research involves a post-doctoral research associate, graduate students and undergraduate researchers.

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## Imaging and Informatics for Crop-Microbial Interactions

Understanding how plants recruit beneficial microbes could enable the development of new technologies to increase plant productivity. Sen Subramanian, associate professor and graduate coordinator in the Department of Agronomy, Horticulture and Plant Science, hopes to gain a better understanding of these processes through his research project investigating soybeans and grain sorghum, two important crops in South Dakota.

Imaging and informatics methods will be utilized to evaluate soybean nodule vascular development. Subramanian plans to evaluate root nodule development by using microCT-based imaging methods. He will also investigate cell type-level hormone balance during nodule development using quantitative fluorescence imaging while also monitoring early stage chilling tolerance in sorghum using aerial imaging. Leaf microbial communities will be evaluated to identify microbes that contribute to chilling tolerance.

The results from this project will provide a better understanding of how different cell types are specified during soybean nodule development and should aid understanding regarding specific microbes that are frequently associated with chilling tolerance in sorghum. In turn, Subramanian's findings from this collaborative research effort could be used to develop microbial solutions to increase productivity of soybeans and sorghum in South Dakota. Subramanian acquired the microCT instrument through a National Science Foundation-MRI award in collaboration with the University of South Dakota. The quantitative fluorescence imaging is being done through a collaboration with the South Dakota School of Mines and Technology and is enabled by a National Science Foundation Established Program to Stimulate Competitive Research (EPSCoR) award.

## Mechanisms Dictating Precise Spatio-temporal Auxin-cytokinin Balance During Soybean Nodule Development

Sen Subramanian, associate professor and graduate coordinator in the Department of Agronomy, Horticulture and Plant Science, plans to determine how to increase biological nitrogen fixation in soybeans in order to decrease dependence on chemical fertilizers. He notes that one-third of agricultural nitrogen needs are currently met by biological nitrogen fixation in symbiotic legume nodules, with the rest of the needs met by chemical fertilizers.

Existing knowledge indicates that a balance between auxin and cytokinin, two key plant hormones, is crucial for proper nodule development in soybeans. However, how plants achieve the balance between these hormones is not yet known. Subramanian hopes to fill this gap in knowledge by identifying molecular and cellular mechanisms by which the balance between auxin and cytokinin is regulated. This knowledge can help play a role in sustainably meeting agricultural nitrogen needs. U.S. Farmers used roughly 13 million tons of nitrogen in 2011, costing them on average \$10 billion, according to USDA-ERS data. Not only could reduced use of synthetic fertilizer have a positive impact on the environment, but it could also help reduce input costs for farmers.

Subramanian believes that identifying plant mechanisms that regulate symbiotic nodule development in legumes will enable strategies to optimize biological nitrogen fixation.

# CAFES UPDATES

## ENDOWED FACULTY POSITION IN SWINE PRODUCTION

Farm Credit Services of America has committed to establishing an endowed faculty position in swine production in the South Dakota State University College of Agriculture, Food and Environmental Sciences.

The \$1.5 million gift will support the first endowed position in swine production in the nation. The endowment was announced at South Dakota's 51st Annual Pork Congress on Jan. 15 in Sioux Falls, South Dakota.

"Pork production provides an excellent opportunity for young people to be able to return to the family farm. We have an impressive number of our SDSU graduates making a positive difference in an industry that offers them fulfilling career opportunities. A gift such as the Farm Credit Services of America endowment helps us support the growing, dynamic pork industry in South Dakota into the future and continue making an impact on both our current and future students," said John Killefer, South Dakota Corn Endowed Dean of the College of Agriculture, Food and Environmental Sciences.

The endowment will support faculty conducting research and SDSU Extension programs as well. The gift is a continuation of the legacy of the Swine Education and Research Facility built by producers and allied industry partners.

South Dakota has seen recent significant growth in both sow and finishing pig numbers. As of December 2019, South Dakota now ranks eighth in the nation for number of finishing pigs.



**Above:** John Killefer, South Dakota Corn Endowed Dean of the College of Agriculture, Food and Environmental Sciences (left), is pictured with Craig McManus representing Farm Credit Services of America.

## WEST RIVER RESEARCH FARM

Research at South Dakota State University's West River Research Farm near Sturgis, South Dakota, is examining how the integration of livestock back into annual cropping systems alters both soil health and economics.

Currently, SDSU Extension Agronomist Christopher Graham is working on two ongoing research projects involving integrated livestock cropping systems. The first is meant to be a long-term rotation study examining a rotation of winter wheat, spring wheat, field peas, corn, soybeans and millet with cover crops following harvest, then grazing cattle on the cover crops in late fall.

The second project is a four-year study examining the effects of alternative grazing strategies on soil health. The project entails grazing livestock on hay swathed in the field rather than baled and removed. Graham is looking at how the livestock integration changes soil properties such as the microbial community and soil carbon.

Construction of a new research facility on the property began in fall of 2019 and is expected to be finished in mid-June. Once the facility is finished, SDSU Extension hopes to expand the use of the site to other SDSU faculty and researchers across the state.







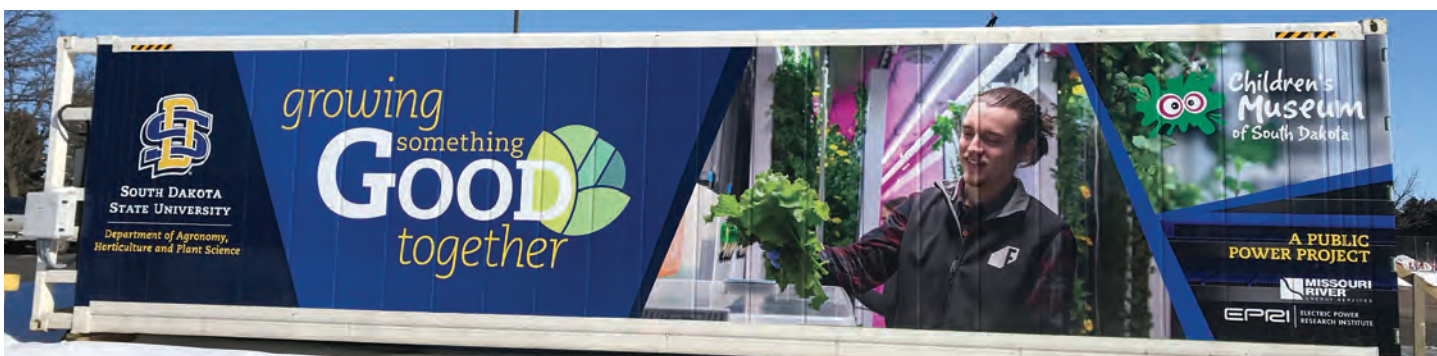
**Above:** Construction progress of the Raven Precision Agriculture Center on the SDSU campus as of June 5.

## RAVEN PRECISION AGRICULTURE CENTER

Construction continues on the Raven Precision Agriculture Center on the SDSU campus in Brookings, South Dakota. Most of the outside structure of the building was completed as of the end of May 2020. Building construction has progressed by quadrants.

Colin Gaalswyk, senior mechanical engineer with the SDSU Facilities and Services Department, reported that interior framing has been in progress on the second floor of the building in early June. Electrical rough-in has been progressing on the second floor as well. Gaalswyk anticipates the building should be totally enclosed as of the end of August, 2020.

The Raven Precision Agriculture Center is slated for completion as of June 30, 2021. Watch the construction progress via the Raven Precision Agriculture Center Construction Cam link at the [sdstate.edu/cafes](http://sdstate.edu/cafes) website.



## HIGH-TECH FOOD POD

South Dakota State University, Missouri River Energy Services, the Electric Power Research Institute, and Children's Museum of South Dakota are collaborating on a high-tech food pod built entirely inside a specialized 40-foot container.

The pod is designed to grow vegetables hydroponically using a closed container and LED lighting. This specially designed food production system is part of a multi-state research project to help determine the electric energy cost of producing food in a controlled environment chamber.

The food pod was delivered and installed Jan. 10 on the SDSU campus in Brookings, South Dakota. It will be operated by graduate students from the SDSU Department of Agronomy, Horticulture & Plant Science, with production anticipated to start in the spring.

"The inclusion of the food pod on our campus and our collaboration with the research partners means the SDSU College of Agriculture, Food and Environmental Sciences now has the ability to share agriculture in a learning environment all the way from a highly integrated production system represented by this food pod, to our Local Foods Education Center which utilizes high tunnels, to multi-thousand-acre food production systems that utilize no-till and conventional tillage systems in all areas of the land-grant system from teaching, to research, to outreach," said John Killefer, South Dakota Corn Endowed Dean of the

SDSU College of Agriculture, Food and Environmental Sciences.

Weekly, the container is expected to produce 110 pounds of Red Rosie Romaine lettuce, a disease-resistant and palatable crop. Unlike traditional farms, the lettuce will be vertically grown without soil, receiving nutrition hydroponically from water and light energy from powerful LED bulbs. The system will operate independently from land, climate and season, resulting in fresh greens that can be produced locally year-round.

Food produced in the container will be donated to Café Coteau located in the Children's Museum of South Dakota, which focuses on serving healthy, locally-sourced foods. Produce that exceeds the capacity of Café Coteau will be donated to local organizations with missions to reduce food insecurity in the region.

"This project aligns well with our museum values to promote sustainability and to give back to the community," said Kate Treiber, executive director of the Children's Museum of South Dakota. "The research could potentially provide some unique opportunities for us to share information related to sustainable agriculture to our guests as well."

The project is co-funded by MRES and a grant from the American Public Power Association's Demonstration of Energy & Efficiency Development program. It is part of a larger, collaborative EPRI effort involving several other indoor agriculture facilities across the country.



# 2020 OUTSTANDING RESEARCHER JOY SCARIA

BY SYDNEY MEYER

*"Dr. Scaria's research in finding and cultivating novel bacterial communities (microbiome) has great potential for combating infectious diseases across multiple species. In addition, Dr. Scaria has also 'cultivated' wonderful graduate and post doctoral students who are as driven as he is in doing the best research possible."*

*- Jane Christopher-Hennings, Head of the Department of Veterinary and Biomedical Sciences*



**Above:** Dean John Killefer (left) presents Scaria (right) with the 2020 College of Agriculture, Food and Environmental Sciences Outstanding Researcher award.

**H**onored as the 2020 College of Agriculture, Food and Environmental Sciences Outstanding Researcher is Dr. Joy Scaria, assistant professor and researcher in the Department of Veterinary and Biomedical Sciences.

The primary goal of Scaria's research program is to understand how the composition of gut microbiota determines health or disease. Using this knowledge, his laboratory seeks to develop gut commensals as an alternative to treat drug-resistant infections. He is also an expert in bacterial genomics and helped develop genome sequencing as a new generation diagnostic tool to track multi-state foodborne outbreaks. Additionally, he serves as a resource person for the U.S. Food and Drug Administration's efforts to use genome sequencing as a tool for pathogen detection and tracking.

Scaria also delivered the David Fee Memorial Lecture during the Celebration of Faculty Excellence. Fee taught philosophy and religion at SDSU for more than 20 years. Annual presenters of the named lecture are selected based on their topics and contributions to Fee's example of cross disciplinary learning, inquiry and collegiality.

Scaria's lecture titled, "Transforming Animal Agriculture to Improve Planetary Health," focused on the need for innovations in agriculture and medicine to feed the people of the world sustainably and keep them healthy. His lab has developed beneficial bacterial blends to treat human and animal gut bacterial infection. Development of such non-antibiotic alternatives and improved diagnostic methods are important to keep the food production system efficient without compromising human and animal health.

Right: Patricia Johnson harvesting microplots for evaluating plant responses to grazing at the Cottonwood Research Station near Philip in 2003.



## PATRICIA JOHNSON RETIRES AFTER 33 YEARS OF DEDICATED WORK IN RANGE SCIENCE

BY SYDNEY MEYER

The second woman in the world to be hired into a range science faculty position, Patricia Johnson served as an essential educator and impactful researcher at South Dakota State University for 33 years.

“Pat has been a trailblazer and a role model for women in her discipline throughout her career,” said Dr. Michele Dudash, head of the Natural Resource Management Department.

As a professor, Johnson taught 14 different undergraduate and graduate range science courses, influencing hundreds of students at SDSU. She also served as a mentor for 15 doctoral and master’s students and served on the committees for over 40 students.

“Working with and teaching students, both in the class and in the field, was definitely a highlight of my career,” Johnson said. “Not only did I get to see them learn, but I loved their excitement. Seeing my former students succeed, making significant impacts on rangeland management and enjoying their careers, is one of my greatest joys.”

Johnson conducted research focused on grazing management, plant and animal interactions, ecology of prairie dog towns, and plant responses to herbivory and livestock and wildlife interactions. She was based on campus in Brookings, South Dakota, until 1998 and then transferred to the SDSU West River Research and Extension center in Rapid City, South Dakota, where she worked until her retirement.

“I had the privilege of participating in one of the longest grazing studies in the world at SDSU’s Cottonwood Research Station located near Philip,” she said. “The data from that study, which continues to this day, is a rich resource for evaluating not only the effects of stocking rate on rangelands, but also for evaluating changes in climatic factors on mixed grass prairie ecosystems.”

Throughout her career, Johnson collaborated with faculty at SDSU and other universities, state and federal agencies, and non-profits, resulting in \$9.92 million in grant awards during her time at SDSU. She has published 72 peer-reviewed papers, a book

chapter and three monitoring videos.

“The times I spent with other scientists developing research questions, understanding underlying concepts and developing experimental strategies are some great highlights for me,” Johnson explained.

She applied her research to support citizens of western South Dakota by working with SDSU Extension to help ranchers implement grazing strategies, provided information on new management strategies and research results both one-on-one and through programs, worked with youth at Rangeland Days, provided information on plant toxicity, and much more.

Johnson also provided service and leadership to the Society for Range Management (SRM) by serving as director on the International Board of Directors, as the SRM South Dakota section president and on a variety of committees.

Johnson said she “pretty much fell into a career in range science.” After graduating with bachelor’s degrees in mathematics and biology from Ft. Lewis College in Durango, Colorado, she was hired as a research technician for a scientist from Australia who was on sabbatical at Utah State University.

“His work on patterns of defoliation by sheep on meadows in mountainous country and water use by a salt desert shrub (shadscale) really ignited my interest in range science and ecology. I went directly from that to working on a master’s degree in range ecology and was one of the first five women in the world to achieve a doctorate in range science/ecology.”

As a result of her dedicated work, Johnson was awarded the SDSU College of Agriculture and Biological Sciences Dean’s Award for Excellence, the SDSU Woman of Distinction Award, and she was the fourth woman to be awarded the Society for Range Management Fellow Award, which has been awarded to only eight women out of nearly 300 total recipients.

Her impactful career as an educator and researcher has earned Johnson the new title of Professor Emeritus of Range Science, effective as of Oct. 21, 2019.

# GARY GACKSTETTER

## Director of the New Professional Program in Veterinary Medicine

BY SYDNEY MEYER

**D**r. Gary Gackstetter has been named the director of South Dakota State University's new Professional (DVM) Program in Veterinary Medicine.

Enrollment applications are now open for the first class of students who will be part of the new, collaborative program between SDSU and the University of Minnesota. The application deadline is September 15, 2020, with a program start date of fall 2021. Once students have completed their pre-veterinary requirements, the program will allow admitted students to complete the first two years of their veterinary medicine education at South Dakota State University and the final two years at the University of Minnesota's College of Veterinary Medicine in St. Paul.

Gackstetter is a professor, veterinarian, epidemiologist and public health practitioner with over 40 years of experience across a broad range of veterinary clinical practice, teaching, research and operational public health activities. He began his duties at SDSU in November 2019.

"I am very excited for Dr. Gary Gackstetter to join us in the role of director of the Professional Program in Veterinary Medicine at SDSU," said John Killefer, South Dakota Corn Endowed Dean of the College of Agriculture, Food and Environmental Sciences. "Dr. Gackstetter brings with him a tremendous pedigree of veterinary and scientific education along with exceptional leadership experience in professional medical programming. Our program and students are fortunate to have Dr. Gary Gackstetter provide guidance and mentoring as we begin this exciting new professional program."

As a result of an Air Force ROTC scholarship, Gackstetter attended SDSU and graduated with a bachelor's degree in animal science and completed the pre-veterinary medicine requirements. He then attended Iowa State University's College of Veterinary Medicine and earned a Doctor of Veterinary Medicine (DVM) degree, and after graduating entered active duty as a veterinarian. While employed by the United States Air Force,



he was provided the opportunity to complete a Master of Public Health degree from Boston University and a doctoral degree in epidemiology from the University of Minnesota.

"I'm thrilled to be back at SDSU and am excited by the opportunity to provide the next generation of South Dakota veterinarians with a science-based professional education that will prepare them to contribute to South Dakota's agricultural and public health systems," Gackstetter said. "While our program will focus on farm animal medicine, it is our responsibility to ensure our graduates are well-prepared to contribute across the whole spectrum of veterinary medicine."

Gackstetter is board certified in veterinary preventive medicine and a Fellow of the American College of Epidemiology. He has had a distinguished academic and research career, including 67 peer-reviewed publications and two book chapters.

He spent the past four years as professor, vice chair of research and co-director of graduate research and practicum programs at the Uniformed Services University of the Health Sciences' F. Edward Hébert School of Medicine in the Department of Preventive Medicine in Bethesda, Maryland. In addition to his research and executive administrative duties, he taught epidemiology and research methods to both graduate and medical students.

The majority of Gackstetter's career was spent in the United States Air Force where he served in a wide variety of leadership roles with veterinary clinical and public health responsibilities. Some of his various duties included military working dog and companion animal care; food inspection; food facility sanitation; animal bite and rabies control; vector-borne, waterborne and

foodborne disease prevention programs; occupational health programs; hospital infection control; and infectious disease prevention programs.

While in the Air Force, he was assigned to the Pentagon in the Office of the Secretary of Defense as the deputy director of the Military Public Health Section. Some of his other Air Force roles included the chief of Veterinary Public Health Services at the U.S. Air Force Hospital George in Victorville, California; chief of Environmental Health Services at the U.S. Air Force Clinic Hanscom in Boston, Massachusetts; chief of the Epidemiology Department at the U.S. Air Force Wilford Hall Medical Center in San Antonio, Texas; associate professor and director of advanced courses at the U.S. Air Force Academy; and director of graduate programs and acting chair of the Department of Preventive Medicine in the Uniformed Services University of the Health Sciences' F. Edward Hébert School of Medicine in Bethesda, Maryland.

While serving in the Air Force, Gackstetter also continued to work off-duty in local veterinary practices wherever he was stationed. Since he was relocated by the Air Force every three years, he became licensed to practice veterinary medicine in each new state and was able to practice in eight different states from California to Massachusetts.

"I have been very fortunate to see many different practices, treat thousands of animals and help owners from coast to coast," he said.

After the Air Force, he worked for Analytic Services, Inc., involved in chemical and biological defense issues. He returned to the Pentagon, and later was asked to aid in the enhancement of the National Biosurveillance Integration Center inside the U.S. Department of Homeland Security. He also helped to identify, fund and manage chemical and biological defense-related research at the Defense Threat Reduction Agency in the U.S. Department of Defense.

Gackstetter's leadership roles in veterinary medicine have included serving on the executive committee for the American College of Veterinary Preventive Medicine, chairman of the board of directors for the International Council for Veterinary Assessment, a member of the board of directors for the District of Columbia Academy of Veterinary Medicine and a member of the examination development advisory board for the National Board of Veterinary Medical Examiners.

His honors include the Uniformed Services University of the Health Sciences' Distinguished Service Award, the Uniformed Services University School of Medicine Dean's Impact Award, the Dr. Charles Stange Distinguished Alumni Award from Iowa State University, selection as a Corporate Fellow of Analytic Services, Inc., the James A. McCallam National Award for outstanding accomplishments as an epidemiologist in the field of Medicine and Public Health, the U.S. Air Force Academy Outstanding Military Educator Award in Biology, and the Presidential Leadership and Service Award from the University of Minnesota.

For more information about SDSU's Professional DVM Program in Veterinary Medicine, contact Dr. Gary Gackstetter, Director of the Professional DVM Program in Veterinary Medicine, at [gary.gackstetter@sdstate.edu](mailto:gary.gackstetter@sdstate.edu).

# FAQ'S ABOUT: the Professional Program in Veterinary Medicine

## 1. What is the Professional Program in Veterinary Medicine?

The Professional Program in Veterinary Medicine leading to a Doctor of Veterinary Medicine degree (DVM) is a new, collaborative program between SDSU and the University of Minnesota.

## 2. When are students eligible for the program?

Once students have completed their pre-veterinary requirements, the program will allow admitted students to complete the first two years of their veterinary medicine education at South Dakota State University and the final two years at the University of Minnesota's College of Veterinary Medicine in St. Paul.

## 3. When will the program begin?

The first 20-student cohort is expected to begin classes on the SDSU campus in Brookings within the Veterinary and Biomedical Sciences Department in August 2021.

## 4. Where can I learn more and/or apply?

Learn more about the application process for the Professional Program in Veterinary Medicine by visiting [www.sdstate.edu/professional-dvm-program-veterinary-medicine/how-apply](http://www.sdstate.edu/professional-dvm-program-veterinary-medicine/how-apply).



**Above:** (From left to right) Katelyn Zeamer, Molly Kroeger, Logan Tesch and Morgan Busack provide virtual tours of SDSU's Swine Education and Research Facility as part of the National Pork Checkoff's Operation Mainstreet program.

# NATIONAL PORK CHECKOFF PROGRAM DEVELOPS



## INDUSTRY ADVOCATES AT SDSU

BY ADDISON MAGILL

Originally started by the National Pork Checkoff in partnership with Eidson & Partners in 2004, Operation Main Street is a program that trains volunteers across the country to be the voice of the pork industry. Through Operation Main Street, South Dakota State University students have been trained to conduct live-streamed virtual tours of the SDSU Swine Education and Research Facility in order to shed light on modern day swine production practices for audiences such as FFA students, livestock associations, medical professionals, culinary students, food service industry professionals and community leaders.

The virtual tours give a real-time look into what happens in a hog barn regarding animal care, nutrition and production practices. A common topic discussed by tour guides is the purpose of raising pigs indoors. Tour guides explain how raising hogs in a barn allows producers to control temperature and biosecurity practices and better monitor animal health. The guides give an introduction of themselves and their backgrounds before explaining the purpose of farrowing stalls and the care given to newborn piglets. Their message also covers the use of automatic feeders

to ensure proper nutrition as well as discussing SDSU's sustainability practices, including educating farmers about best practices and leading research projects to improve production practices and air quality. A majority of the virtual tour is left open for questions where participants often ask about production practices, the differences between gilts and sows, the length of time sows spend in gestation and average litter size. Other common questions often refer to animal welfare and why farrowing stalls are used.

Former SDSU graduate student Katelyn Zeamer says Operation Main Street is an important program to South Dakota pork producers because, "it showcases our state as a growing pork producing state and showcases our university's high-class research."

According to virtual tour guide Morgan Busack, before being able to conduct virtual tours, students are required to attend a training in Kansas City, Missouri, where they learn the ins and outs of conducting tours and answering difficult questions. Once students have returned to SDSU, they go through hands-on training in the barn to prepare them for their first tour. The training equips students with

skills to be educated advocates, whether they are giving tours or engaging in conversations about the future of the pork industry.

Busack believes Operation Main Street is pertinent to the pork industry. "By having this program, it gives us a chance to educate on what goes on in a hog barn and why we do what we do," she said.

The five students that served as virtual tour guides throughout the past year at SDSU include Alison Eibs, agricultural communications and animal science student of Henderson, Minnesota; Molly Kroeger, microbiology student of Lennox, South Dakota; Morgan Busack, agricultural leadership student of Echo, Minnesota; Logan Tesch, animal science and agricultural business student of Henderson, Minnesota and Katelyn Zeamer, former graduate research assistant in the Department of Animal Science of De Pere, Wisconsin.

When asked why they chose to get involved with the program, a common response among the five students was to share their passion and knowledge about the pork industry with others.

# CAFES WELCOMES MARK SANDAGER AS NEW DEVELOPMENT DIRECTOR

BY ANDREA SCHUBLOOM



After graduating from South Dakota State University in 2011, Mark Sandager moved back to Minnesota to begin his career in agriculture. After working in the agricultural industry for eight years, Mark has returned “home” to Brookings with his wife, Ellen, and their two daughters to work at his alma mater providing educational experiences for students in the College of Agriculture, Food and Environmental Sciences.

**Above:** Mark Sandager (left) with his wife, Ellen, and their two daughters. Photo courtesy of Makayla Rae Photography.



**WHAT EXTRA-CURRICULAR ACTIVITIES WERE YOU INVOLVED IN WHEN YOU WERE A STUDENT AT SDSU?**

“I swam for three years with the men’s swim team and helped coach the team during my senior year. I was also a member of FarmHouse Fraternity, served as a Students’ Association senator and studied abroad in West Africa with the College of Agriculture and Biological Sciences. Additionally, I spent a summer in New Zealand completing an internship with a nursery that grew trees for a forestry division and competed for a club swim team while I was there as well.”

**PRIOR TO JOINING THE SDSU FOUNDATION, WHAT OTHER JOB EXPERIENCES DID YOU HAVE?**

“After completing my degree, I took a job with Cargill as a grain buyer at an elevator in Pipestone, Minnesota and worked there through March of 2016. I then took a job with the National Pork Producers Council in Waseca, Minnesota as a regional director of development where I worked on legislative issues, met with producers to develop grass roots objectives and communicated information between the board of directors and members of the council.”

**HOW HAS YOUR SDSU EDUCATION INFLUENCED YOUR CAREER THUS FAR?**

“I’d say ag education was the perfect major for me because it gave me a diverse background in agriculture and it gave me the planning and communication skills necessary for the type of work that I’m doing now.”

**WHAT INTERESTED YOU IN COMING BACK TO SDSU TO PURSUE YOUR CAREER?**

“Brookings and the SDSU community really became home to my wife and I, so it was really exciting to have the opportunity to come back and support the university again. It was the people that brought me to SDSU as a student and the people are the same reason that I wanted to come back. I’m super *jacked* to be here!”

**FOR THOSE WHO ARE UNFAMILIAR, HOW WOULD YOU EXPLAIN WHAT THE SDSU FOUNDATION DOES?**

“We take in assets of value such as stock, livestock, money, vehicles and land and we use those assets to provide educational experiences for students. With those assets, we are able to build facilities, provide research opportunities through endowments and, most importantly, scholarships.”

**EXPLAIN WHAT YOU DO IN YOUR NEW ROLE AS DEVELOPMENT DIRECTOR.**

“My job is to work directly with the dean to fulfill the needs of the college. We focus on our people, our places, our traditions and our innovations and prioritize what will attract students and fulfill our mission.”

**WHAT DOES A TYPICAL DAY AT WORK LOOK LIKE FOR YOU?**

“I don’t really have a typical day. I would say that I can separate my responsibilities into three buckets; the first being strategic planning with the college, the second being internal and administrative planning and the third being donor relations, which is a majority of what I do.”

**HOW DO YOU SHOW YOUR JACKRABBIT PRIDE?**

“My favorite thing ever is walking through airports with Jackrabbit gear on. You can be on the other side of the world and meet people that know of SDSU – you get stopped everywhere!”

**WHAT ARE THE DIFFERENT WAYS PEOPLE CAN GIVE TO CAFES AND/OR SDSU?**

“People can give in almost any way they can imagine. We can help students through scholarships, travel, equipment, facilities and so much more. Whether it is a gift of \$10 or \$10 million, there will always be students who benefit from those gifts.”

**FOR THOSE WHO ARE WANTING TO GIVE BUT DON’T KNOW WHERE TO START, WHAT IS YOUR ADVICE?**

“We have a team here at the university that works in all ways. There are options to give on our website through a credit card donation or you can donate during SDSU’s One Day for State and unlock large matching gifts. If you are planning an estate, we have a team that will assist you with estate planning. If you are a business owner and want your name on a wall, we can do that, too. Just reach out and ask us!”

**QUESTIONS? CONTACT MARK:**

MARK.SANDAGER@SDSTATEFOUNDATION.ORG | (605) 697-7475

# JEFF HELD

## RETIRES AFTER 30 DEVOTED YEARS SERVING THE SHEEP INDUSTRY

BY ANDREA SCHUBLOOM

For more than 30 years, SDSU Extension Sheep Specialist and animal science professor Jeffrey Held has served as a dedicated advocate for the lamb and wool industry and an essential educator in the College of Agriculture, Food and Environmental Sciences at South Dakota State University.

“Jeff has been an incredible land grant ambassador to the university, the state of South Dakota, the region and our nation,” said SDSU President Barry H. Dunn.

Throughout his career, Held has mentored countless students, producers and industry associates as a colleague, teacher, scholar, advisor and friend. For the past 15 years, he has taught sheep and wool production courses in the Department of Animal Science. Additionally, for the past eight years, he supervised the SDSU Sheep Research and Teaching Unit which maintains a closed ewe flock of 250 commercial Polypay and 125 purebred Hampshire ewes. At the unit, Held has hosted a variety of outreach programs including a field day in conjunction with the South Dakota Sheep Growers convention education program in fall 2018 and an open house during lambing season in February 2019.

“Dr. Held is recognized as a national leader in lamb and wool production and has provided me with a wealth of knowledge regarding South Dakota agriculture and producers,” said Joe Cassidy, Head of the Department of Animal Science at SDSU. “He has served as a teacher and mentor to many faculty and staff members within the Department of Animal Science.”

In his role as an SDSU Extension Sheep Specialist, Held’s main responsibilities included providing industry support, assisting producers across South Dakota, making flock management recommendations and hosting a variety of county and state meetings and outreach programs. Additionally, he started the South Dakota Sheep Shearing Program that trains and educates producers on the proper techniques for harvesting, packaging and grading wool. Since the program’s start in 1990, Held has hosted more than 34 trainings.

Alongside his fellow SDSU Extension colleagues, Held helped create the All American Sheep Day Program held at the Black Hills Stock Show where farmers and ranchers can learn about and discuss topics related to flock health, wool and lamb products and observe and interact in a series of demonstrations and activities.

Held’s primary research focus was on ruminant nutrition and developing innovative diet formulation strategies using co-product feed ingredients including soybean hulls, dried distillers grains with solubles and corn stover. As a result, he quickly became a well-known resource for producers and has since trained many graduate students in the area of sheep nutrition.

With his extensive expertise, Held was invited to be an author



**Above:** Jeff Held (center) is recognized at the 2020 SDSU Lamb Bonanza for his continued support of the event by SDSU President Barry H. Dunn (left), College of Agriculture, Food and Environmental Sciences Dean John Killefer (right), and Jack the Jackrabbit.

and reviewer for the American Sheep Industry Association’s Sheep Production Handbook. Held’s additional recognition and awards include: several nominations for the College of Agriculture, Food and Environmental Sciences Teacher of the Year, an induction into the Pipestone Lamb and Wool Hall of Fame, the South Dakota Sheep Growers Association Shepherd Award and the South Dakota Extension Specialists Association Distinguished Service Award.

Furthermore, Held hosted the South Dakota Sheep Shearing Training Program, coordinated the Dakota Performance Ram Test, initiated the SDSU Registered Hampshire Sale, served as the AKSARBEN Lamb Carcass Superintendent, worked with the South Dakota State 4-H Sheep Show for 30 years and initiated and organized the SDSU Lamb Bonanza for 28 years.

Lamb Bonanza is a collaborative event hosted at a SDSU basketball game by SDSU Athletics, the South Dakota Sheep Growers Association and the Department of Animal Science. Each year, the South Dakota Sheep Growers Association serves leg of lamb sandwiches and lamb meatballs prior to the game and six custom yellow and blue lamb pelts featuring the SDSU letters are auctioned during halftime. Funds raised from the pelt auction have been used to provide student scholarships and support educational programs.

“Many of the individuals I have worked with have been working together for a long time and we all have a strong desire to serve the producers throughout the state,” said Held. “We worked hard to provide resources to help producers make better production decisions.”

His time spent educating students and producers have earned him the new title of Professor Emeritus of Animal Science, effective as of Jan. 21. Upon his retirement, Held plans to continue his involvement with the South Dakota Sheep Growers Association, take advantage of local, regional and national opportunities and spend more time with his wife and family.



# 2019 LIVESTOCK JUDGING TEAM COMPLETES COMPETITIVE SEASON

BY ADDISON MAGILL

The 2019 South Dakota State Livestock Judging Team competed in 12 contests over the course of the year, finishing in the top ten at every national contest attended. The team members include: Miles Stagemeyer of Paige, Nebraska, Riley Donkers of Faribault, Minnesota, Jackson Neil of Northfield, Minnesota, John Eilertson of Wentworth, South Dakota, Calah Covey of Hamill, South Dakota, Wesly Johnson of Pipestone, Minnesota, Justin Ringkob of Lake City, South Dakota, and Addison Magill of Verona, North Dakota. Brady Jensen serves as the team's head coach and an instructor in the Department of Animal Science.

Throughout the season, the team competed at the National Western Stock Show, Sioux Empire Livestock Show, Iowa Beef Expo, Nebraska Cattleman's Classic, Houston Livestock Show and Rodeo, National Meat Animal Evaluation Contest, National Barrow Show, AKSARBEN, Flint Hills Mid-American Classic, Tulsa State Fair, American Royal and the North American International Livestock Exposition.

Additionally, the team also helped host 4-H and FFA judging contests throughout the year. In June 2019, judging team members helped host two livestock judging camps on the SDSU campus, teaching youth from South Dakota, Minnesota, Iowa, Wisconsin, North Dakota and Nebraska to develop and expand their judging skills.

Competing on a collegiate livestock judging team develops skills far beyond livestock evaluation. "Being a part of the livestock judging team at SDSU has given me the opportunity to visit prominent seedstock operations of every species around the country and learn from great minds," said team member John Eilertson. "While being a part of the judging team, I was

able to develop concise and persuasive communication skills that have strengthened my ability to make connections with industry professionals."

## National Barrow Show

**Team Results:** 7th Overall

**Individual Results:** John Eilertson – 10th Overall, Addison Magill – 10th Reasons

## AKSARBEN

**Team Results:** 7th Overall

**Individual Results:** Miles Stagemeyer – 2nd Beef, 11th Overall, Justin Ringkob – 12th Beef, Addison Magill – 15th Hogs

## Flint Hills Mid-American Classic

**Individual Results:** Miles Stagemeyer – 18th Overall, 4th Sheep and Goats, Riley Donkers – 4th Hogs

## Tulsa State Fair

**Team Results:** 9th Overall

**Individual Results:** Miles Stagemeyer – 20th Overall

## American Royal

**Team Results:** 10th Overall, 6th Hogs, 10th Cattle, 10th Reasons

**Individual Results:** Miles Stagemeyer – 10th Cattle

## NAILE

**Team Results:** 9th Overall, Tied for 1st Performance Sheep, 7th Beef Cattle, 7th in All Performance Classes

**Individual Results:** Jackson Neil – 9th Cattle, Riley Donkers – 10th Cattle and 18th Overall



# SOUTH DAKOTA 4-H

## Hosts Inaugural Capitol Day Event

BY SYDNEY MEYER

**M**ore than 160 4-H members and supporters from across South Dakota joined together for the inaugural South Dakota 4-H Capitol Day in Pierre on Jan. 15. The civic engagement event provided a unique experiential learning opportunity for 4-H members to build skills as young leaders, as well as learn about the state government.

“South Dakota 4-H Capitol Day allowed youth to learn about civic engagement and governmental processes by giving them an inside look,” said Hannah Frost, State 4-H Leadership Ambassador from Minnehaha County. “I truly believe that most people do not understand what goes on in the Capitol until they see it for themselves. 4-H experiences like these teach youth about how our state government functions and what it can do for the people of South Dakota.”



**Above:** 4-H members and supporters, South Dakota State University administration and State Legislators at the Capitol building rotunda during the inaugural South Dakota 4-H Capitol Day on Jan. 15.

Attendees participated in round-table discussions with legislators, allowing them to gain a better understanding of the work done by elected officials. Other experiences included Capitol building tours, House and Senate floor observations, scavenger hunts, 4-H promotion and more.

The State 4-H Ambassadors were also provided the opportunity to shadow State Legislators for the day, allowing them to gain additional context about the important role that state government officials fulfill.

“The generosity shown by our legislative officials was incredible,” said Timothy Tanner, State 4-H Program Director. “By embodying a servant leadership ethic, they connected the dots between citizenship and leadership for our aspiring 4-H leaders.”

According to a 2019 National 4-H Alumni Survey conducted

by Edge Research, 4-H alumni are 20% more comfortable in a leadership role and 25% more active in their communities than their non-4-H peers.

“Events like the 4-H Capitol Day play a large role in developing these life-long attributes among 4-H members,” Tanner said.

Coordinators of the 4-H Capitol Day were: Caroline Hansen, SDSU Extension 4-H Youth Program Advisor in Hanson and Davison Counties; Jenae Hansen, SDSU Extension 4-H Volunteer Field Specialist; Amber Erickson, SDSU Extension 4-H Youth Development Field Operations Coordinator; and Hilary Risner, SDSU Extension Regional 4-H Youth Program Advisor.

To learn more about this event or if interested in participating in the future, contact Amber Erickson at (605) 688-4167 or [amber.erickson@sdstate.edu](mailto:amber.erickson@sdstate.edu).

# DAVE OLLILA

## RETIRES FROM SDSU EXTENSION

BY SADIE VANDER WAL

With a focus on education and communication throughout his career, Dave Ollila has left his mark on South Dakota agriculture in more ways than one.

Over the past eight years, Ollila has provided support and education to sheep producers in South Dakota and surrounding states as an SDSU Extension Sheep Field Specialist based out of Rapid City, South Dakota. From coordinating educational programming to providing information on the sheep industry's regional impact to lawmaking bodies, Ollila has developed communication pathways between sheep producers and industry stakeholders and promoted the value of lamb, wool and sheep as a credible and valued enterprise to South Dakota farms and ranches.

"Dave strived to provide Extension education by building engaging personal relationships with his constituent audiences and then empowering them in the learning process," said Director of SDSU Extension Karla Trautman. "There is no doubt that he will be missed, but his efforts have laid a foundation of best practice for years to come."

Proven by his coordination of several programs and activities to grow sheep producers' knowledge of the industry, education has always been at the forefront of Ollila's career. Furthermore, his programs have offered valuable information to consumers on the value of lamb and wool to their everyday lives. He applies his knowledge of the land and natural resources to the sheep industry through teaching others how to use sheep as a tool to manage natural resources both on private and public land through target grazing, multi-species grazing and cycling nutrients in soil health applications.

Another program Ollila has coordinated includes sheepSD, a program modeled after beefSD that educates sheep producers on skills and practices needed to facilitate success. He has also enabled producers to gain a better understanding of genetics and feeding programs through a lamb feedlot performance program, one that he played a part in for several years. The Black Hills Stock Show All American Sheep Day was another effort Ollila has helped organize and host, an event that features the National Sheep Shearing and Wool Handlers Championships, North American Sheep Dog Trials and educational demonstrations and activities to promote lamb and wool to the public.

In addition, Ollila's efforts within the wool side of the industry have included collaborating with sheep shearers to educate and recruit new shearers to support producers, in addition to programming geared to help producers improve the quality of wool coming off their ewes.

With such passion for and knowledge of the sheep industry, Ollila's efforts to provide resources and education to others runs deep through organizations such as the South Dakota Sheep Growers Association. His involvement with the organization's Premium Yearling Ewe Sale, along with the Newell Ram Show and Sale, has enabled him to ensure quality sheep genetics are available to producers in the state.



Above: Dave Ollila (right) skirting wool fleeces.

"It's God's calling to help our fellow man be successful, and in this lifestyle, we know how challenging it can be," Ollila said. "One of the character traits of farmers and ranchers that is highly valued is helping your neighbor, and I've had that instilled in me."

His efforts in supporting producers are not limited to South Dakota residents. Ollila has also worked closely with sheep researchers and outreach staff from surrounding states in order to support the sheep industry for the entire region. Additionally, his involvement with national boards and committees through the American Sheep Industry Association, American Lamb Board and Society for Range Management have provided him an outlet to provide educational material to producers across the nation.

As a part of the South Dakota Section for the Society for Range Management, Ollila has served as the youth activities coordinator, in which he has collaborated with the Natural Resources Conservation Service, 4-H and FFA leaders to provide education and competitions for youth in range and soils evaluation, a role that has enabled him to serve over 800 students each year. Through cooperative efforts with South Dakota Grassland Coalition and South Dakota Soil Health Coalition, Ollila has also had the chance to provide support and promote improvement of rangelands and livestock integration.

After serving 25 years as an agriculture educator and FFA advisor at Newell High School, Ollila continues to pursue youth education and provide support where he can to students. Even after his time in the classroom, he continues to keep youth education a priority in his life by supporting 4-H and FFA teams competing in land and range judging where he has helped coach national youth range judging teams to win national accolades.

Ollila's impact on South Dakota and the agriculture industry will not discontinue with his retirement. In fact, his commitment to serving agricultural producers in any capacity will continue with his part-time role as a soil health specialist for South Dakota Soil Health Coalition, in which he will serve producers in western South Dakota by providing them with insight and guidance on integrating rangeland and soil health practices into their own operations. As for the rest of his retirement, Ollila will focus on his family's ranch east of Newell where they raise cattle, sheep and crops.



## SDSU WOOL JUDGING TEAM MAKES A RETURN TO THE NATIONAL WESTERN STOCK SHOW

BY ADDISON MAGILL

After three years without a wool judging team, South Dakota State University made a competitive outing at the National Western Stock Show on Jan. 17. The two SDSU teams placed eighth and 11th overall as well as sixth and seventh in reasons. Individual highlights include: Jen Hurlbert – third in reasons, Ryeleigh Laib – third in value-based, Ty Schoelerman and Joslyn Hurlbert – tied for 10th in reasons, Malorie Schmoll – tied for 14th in placings, Dani Houghtaling – 20th in grading. This year’s team was coached by Addison Magill.

The team dedicated many hours to practice throughout the fall semester and the week prior to the NWSS contest. The contest consists of six placing classes with three sets of oral reasons, a grading rail of 15 fleeces, four handspinning placing classes, and a value-based class. Team members were able to participate in the new value based class in which participants rank four fleeces according to their value determined by weight, staple length, purity and grade.

This year’s members of the SDSU Wool Judging Team include: Danielle Houghtaling of Doland, South Dakota, Jennifer Hurlbert of Raymond, South Dakota, Joslyn Hurlbert of Raymond, South Dakota, Ryeleigh Laib of Mercer, North Dakota, Ty Schoelerman of Everly, Iowa, Anastasia Poull of Port Washington, Wisconsin, Grady Gullickson of Flandreau, South Dakota, and Malorie Schmoll of Wausau, Wisconsin.

Through competing on the wool judging team, team members had the opportunity to gain knowledge about wool production and build industry connections.

"Joining the team was the most rewarding decision of my college career thus far," said team member Jennifer Hurlbert.



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# SDSU PROFESSOR RECEIVES SUPPORT FOR CORN-BASED RESIN RESEARCH

BY CHRISTIE DELFANIAN

Chemicals extracted from corn may one day be used to produce durable, heat-resistant plastic parts, according to Distinguished Professor Kasiviswanathan Muthukumarappan of South Dakota State University's Department of Agricultural and Biosystems Engineering.

The bioprocessing engineer, who is commonly known as Muthu, formulated star-shaped resins using chemicals from the ethanol fermentation process. These resins, commonly produced from petroleum, are the substances that bond fibers in plastic composite materials.

His resins are unique because they can be used to create composite parts that can withstand harsh conditions and high temperatures. "The resins we developed are belong to the thermoset class," Muthu said.

Other researchers have developed corn-based resins which produce thermoplastic materials that can be heated and reformed, he explained. However, these materials can expand and contract, which causes problems for some applications.

Thermoset resin hardens when it cures and cannot then be reheated and reused. That creates composite materials that are more durable and stable in a variety of environments for applications, such as equipment panels in automobiles and agricultural machinery components, including gaskets. "When thermosets are required for an application, no thermoplast can do the job," Muthu pointed out.

The research was funded through a nearly \$100,000 grant from the North Central Regional Sun Grant Center. One doctoral student and one master's student also worked on the project.

"Through advanced processing, we are developing high-value uses for agricultural products that can help producers and boost the agricultural economy in the state and the nation," said professor Vance Owens, director of the North Central Regional Sun Grant Center.

In 2018, Muthu received \$25,000 to support his resin research through the first National Corn Growers Association Consider Corn Challenge. SDSU's project was one of six finalists among 38 entries in the worldwide competition. "This is an indication of the potential value of this research," said Muthu, who also sees the potential to produce resins using chemicals from soybean oil.

## Utilizing chemicals from ethanol processing

To formulate the corn-based thermoset resins, the SDSU researchers used three chemicals—itaconic acid, ethyl alcohol



**Above:** Jim Bauman, vice president of market development for the National Corn Growers Association, left, and Bruce Peterson, then chairman of the NCGA's feed, food and industrial action team, present South Dakota State University Distinguished Professor Kasiviswanathan Muthukumarappan with \$25,000 to support his corn-based resin research. The project, which was funded through the North Central Regional Sun Grant Center, was one of six finalists among 38 entries in the NDGA's first worldwide Consider Corn Challenge

and lactic acid—produced from what is known as the wet milling process. "Cargill produces these chemicals as part of its ethanol fermentation process," Muthu said. "The wet milling process can produce a lot of chemicals in addition to the ethanol."

However, he noted, many ethanol plants now use dry processing, which produces ethanol, dried distillers grain and carbon dioxide.

Approximately 90 bushels of corn produces slightly more than 1.1 tons of corn-based resin. The automotive industry alone uses an estimated 90,000 tons of unsaturated polyester, a specific type of thermoset resin, each year. If corn-based bioresins can capture even 1% of this market, Muthu estimated the revenue share could be about \$1.6 million annually.

Based on raw material costs, Muthu anticipates these corn-based resins may be less than half the price of petroleum-based resins.

## Further developing corn-based resins

Although the lab testing produced promising results, Muthu said, "there is still a long way to go."

For the Sun Grant project, the researchers used methacrylic anhydride, which is toxic, to functionalize the chemicals and produce high-viscosity resins. "We want to look for renewable functionalizing agents as well as develop formulations for low-viscosity resins," he said. The goal is to develop a product that is 100% biobased, nontoxic and biodegradable.

"Resins are a higher value product," said Muthu, who is applying for further funding to continue the research. "Anything that adds value to agricultural products is beneficial," Owens concluded.



# R

## RESEARCH AND EXTENSION EXPERIENCES FOR UNDERGRADUATES

BY NICOLE HUDSON

The Research and Extension Experiences for Undergraduates (REEU) program completed its third year at South Dakota State University during the summer of 2019.

The National Institute of Food and Agriculture (NIFA) funded REEU Fellowship Program is a two-year program available to students of freshmen and sophomore year status. Participating students are pursuing college degrees and are members of an ethnic minority group and/or are economically challenged and qualify for Pell Grant funding.

This past summer's students come from all across the nation with attendees from Wisconsin, Alabama, Oklahoma and South Dakota. Nine of the students attend Tuskegee University, one attends the University of Wisconsin-River Falls, two attend Oklahoma State University and several attend South Dakota State University and the University of South Dakota.

Dani Rinehart, participant in the REEU program from Oklahoma State University, worked under Sanjeev Anand, professor in the Dairy and Food Science Department and Joy Scaria, assistant professor in the Veterinary and Biomedical Sciences Department. Rinehart conducted research regarding genome sequencing of bacteria under the Food and Drug Administration (FDA). The hope is that the research will prevent foodborne illnesses.

"The experience in the lab pointed me in a new direction and is forming the beginning of what could be my career," said Rinehart.

During the first summer, students live and work on SDSU's campus in Brookings, South Dakota, for 10 weeks. All students are paired with two faculty members who serve as their mentors throughout the program and work with them on active research and SDSU Extension projects.

Over the course of the summer, the students learned cutting-edge research skills, developed scientific communication skills and prepared themselves for pursuing graduate studies and/or a career that will help feed a growing worldwide population in an environmentally sustainable manner.

Rachel Geary of Elk Point, S.D., worked under Melanie Caffé, assistant professor and oat breeder, on using genome studies to discover what gene causes leaf spot resistance in oats. Geary says, "It is nice seeing that the experiments I worked on this summer will impact the farmers around me."

During the second year of the program, students are given a stipend for living expenses at an off-campus site where they will complete another 10 weeks of work in their respective fields.

"This program is important because students are important," Michael Gonda said, REEU program coordinator and associate professor of Animal Science. "That's number one. They're our future."



*"THE EXPERIENCE IN THE LAB POINTED ME IN A NEW DIRECTION AND IS FORMING THE BEGINNING OF WHAT COULD BE MY CAREER."*

- DANI RINEHART

*"IT IS NICE SEEING THAT THE EXPERIMENTS I WORKED ON THIS SUMMER WILL IMPACT THE FARMERS AROUND ME."*

- RACHEL GEARY

# JACK RABBITS NOW & THEN



## Sanne de Bruijn

**Majors:** Dairy Production and Dairy Manufacturing

**Minor:** Food Safety

**Hometown:** Vicksburg, Michigan

**Graduation Year:** May 2020

**Q. What brought you to SDSU?**

**A.** "The Dairy and Food Science program. Growing up on a dairy farm my whole life, I learned how to produce a high-quality milk product up until it was in the bulk tank. This passion for producing a quality product sparked my interest in the further processing of milk after it leaves the farm. SDSU presented me with the opportunity to pursue both the farm and processing side of dairy."

**Q. What is your favorite flavor of SDSU ice cream?**

**A.** "Caramel Cookies 'n' Cream"

**Q. What are your plans after graduation?**

**A.** "I will be moving to France to complete a master's project on behalf of Lactalis. I will study and complete a project for my chosen U.S. based dairy processing company and graduate with a master's degree in engineering. Upon successful completion of my project, I will return to the U.S. and hopefully implement my project into the plant where I will be working. I am looking forward to a challenging opportunity to learn French and further my professional skills in the field of dairy manufacturing!"

**Q. Describe yourself in one word.**

**A.** "Curious – I love learning, trying new things, and exploring. My curiosity leads me to many exciting places and new adventures."

**Q. What is the best part about being an SDSU student?**

**A.** "I will rephrase the question. What is the best part about being an SDSU *dairy* student? My fridge is never cheese-less, and my sweet tooth is always satisfied with the amount of ice cream in my diet. In all seriousness, SDSU is always thinking about their students. There are endless opportunities available for any major and if there is something you want to do, you can find the people and resources to make it happen. There is so much help and support throughout this university!"

**Q. How would you spend a million dollars?**

**A.** "I will invest it in the dairy farm and good cow families."

## Dusty Oedekoven, DVM

**Degrees:** Agricultural Science, B.S.  
Doctor of Veterinary Medicine

**Years at SDSU:** 1995-1998

**Additional Education:** Iowa State  
University College of  
Veterinary Medicine

**Hometown:** Sturgis, South Dakota

**Current City:** Pierre, South Dakota



**Q. What is your current job title and place of employment?**

**A.** "I have served as the State Veterinarian for South Dakota and the Executive Secretary of the Animal Industry Board since 2009."

**Q. Describe your typical day at work.**

**A.** "One of the best aspects of my job is that there isn't a "typical day!" I'm not a clinical veterinarian – I don't see patients, but rather focus on industry-driven animal health programs, foreign and emerging disease response and emergency preparedness, epidemiology, public health and food safety. Sometimes this work is from my office on a conference call or in a small meeting with my staff, and sometimes it's a visit to a meat locker, an auction market or speaking at an ag organization's annual meeting."

**Q. What is your favorite memory from your time at SDSU?**

**A.** "I have so many great memories of people, organizations, and events while I was at SDSU. One special memory is of when I served as a state FFA officer during my freshman year. The team was very close, and we were committed to leadership development and the future of agriculture."

**Q. What is the best piece of advice you have ever received?**

**A.** "Dr. David Zeman was my advisor at SDSU. Having been in my shoes once as a driven student seeking admission to veterinary school, he wisely advised me to keep my priorities straight. Faith and family first, then academics and career goals. I'm grateful to him for that advice, which has guided me well through some challenging times."

**Q. What do you like to do in your spare time?**

**A.** "I enjoy serving in ministry activities with my local church, reading, and chasing our five children who are busy with church activities, sports and school. In the summer we spend time out on the river near Pierre with friends. When I get time, I ride road, gravel, and mountain bikes."

## SDSU: THE BEST DECISION I'VE MADE

When reflecting on the most meaningful moments in my life, I like to think about the paths that have led me to those points in time. The paths are filled with significant, milestone moments and all have a common thread centered around a place I hold near to my heart – South Dakota State University.

During my junior year of high school, I found myself in a small classroom listening to Tim Nichols, serving as assistant to the Dean of the College of Agriculture and Biological Sciences at the time, promote SDSU to my high school class. I became interested enough to do an on-campus tour two months later that spring. While on tour, we ran into Tim again in front of Brigg's Library and he remembered not only the high school I attended, but my name as well. That small interaction on the sidewalk solidified my decision to come to SDSU. I had visited several different campuses at this point and was always treated like a number, but not at SDSU.

Fast forward to the spring semester of my freshman year at SDSU – one of my professors kept me after class to encourage me to join him on a study abroad trip to Africa. Later on, that same professor encouraged me to complete an internship in New Zealand, run for a senator position with Students' Association and apply for my first job after graduation. That professor has been and will continue to be an instrumental mentor to me.

During my Sophomore year at SDSU, my younger brother came to join me on campus and subsequently moved in two doors down from my third floor Young Hall dorm room. It was then our friendship stretched beyond only being brothers and grew into an inseparable bond.

On an unseasonably warm day in November of 2010, while underneath the Campanile I asked my now Wife to marry me. Previously that day I went to Winks Jewelry to pick up an engagement ring with borrowed money. My now wife, Ellen, had spent the evening at the Collegian office, in the basement of the Union helping edit the student-run newspaper before it went to print. By the time she finished her work it was close to midnight. We went for a walk and stopped under the Campanile where I proposed. I was too excited to wait and give her a planned-out proposal. Looking back, we were just kids not knowing what we were going to do after graduation other than to be together.

SDSU didn't individually make these moments happen but it did provide the framework to shape the person I am today. Without the friendships, relationships and education, I received here in Brookings I would not be the person I am today. I am excited about opportunities SDSU provides to its students and the lifelong impacts it has. I can only imagine where we're headed next!

*Mark Sandager, '11*



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