STUDENT RESEARCH DAY

APRIL 19, 2022

presented by

NDSU EXPLORE
GAMMA SIGMA DELTA
NDSU GRADUATE STUDENT COUNCIL

WELCOME

Message from RCA

Welcome to NDSU Student Research Day 2022, a collaborative event that combines our annual NDSU EXPLORE program with both the Graduate Student Council and Gamma Sigma Delta programs. We are excited to be a part of this day celebrating NDSU student researchers.

We have a long history at NDSU of both undergraduate and graduate students working side by side with faculty researchers and contributing to many amazing discoveries. Many of these students have then continued the path of discovery and found their own success in academics, laboratories and the private sector. But no matter where they end up, so many identify their student research experiences as important points in their development as scientists and scholars.

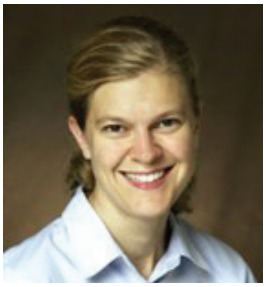
Today you can experience the smart and innovative work of these students early in their careers and you'll see firsthand what creativity, drive, focus and a healthy dose of curiosity can help a person accomplish. The research you'll hear about spans the many disciplines here at NDSU, but rest assured, tomorrow's discoveries are in good hands with these students.

Thank you for your support of Student Research Day and for your commitment to the success of the student presenters.

Colleen M. Fitzgerald, PhD

Vice President, Office of Research and Creative Activity

Message from Gamma Sigma Delta, NDSU Chapter



Research and Agriculture are pillars of NDSU's history; together, these endeavors have made tremendous contributions to the people of North Dakota and beyond. This event includes another pillar of success: our students. Gamma Sigma Delta, the Honor Society of Agriculture, is pleased to welcome you to this student research symposium. Thank you for joining us today.

Rebekah Oliver, PhD

Associate Professor of Practice, Plant Sciences
President, Gamma Sigma Delta, NDSU Chapter

Message from Graduate Student Council

Welcome to the Student Research Day 2022. The Graduate Student Council is thrilled to be a part of this collaboration with NDSU EXPLORE and Gamma Sigma Delta: The Honor Society of Agriculture. For GSC this year, we have seen a record number of registrations for both oral and poster presentations. This would not have been possible without the tremendous help we had from our partner organizations regarding the planning, advertising and execution of this event. A big thanks to them. Also, this indicates the level of dedication and hard work the graduate students have been giving for research at NDSU. We are elated to give them the platform to showcase their excellent work.

The GSC thanks the departments of plant sciences, mechanical engineering, and industrial and manufacturing engineering for their generous donations to help the finance this event. Thanks go to the GSC executives and co-chairs and other volunteers who helped make this event a success. Finally, we would like to thank the Graduate School for giving us the support and funding the GSC every year, which enables us to participate in such initiatives.

I sincerely hope that NDSU Student Research Day will be a milestone for NDSU and will continue to happen. From this event, both the academic and industry personnel of North Dakota will receive an idea about the research strength of NDSU, which I believe will open new doors for research funding and collaboration in near future.

Thank you.

Raihan Quader

President, Graduate Student Council

SCHEDULE

9:30-11:30 a.m.
Undergraduate Student Oral Presentations and Poster Session
NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity
Research Symposium of Gamma Sigma Delta: The Honor Society of Agriculture

1-3 p.m.
Graduate Student Oral Presentations and Poster Session
Research Symposium of Gamma Sigma Delta: The Honor Society of Agriculture
Research Symposium of the Graduate Student Council

3:30-4:30 p.m.
Presentation: Preparing to Apply to Graduate School
Neely Benton, NDSU Graduate School

4:30-5:30 p.m.
Awards Reception
NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity
Research Symposium of Gamma Sigma Delta: The Honor Society of Agriculture
Research Symposium of the Graduate Student Council

PARTICIPANTS

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

ORAL PRESENTATIONS:

Ryan Anderson, Civil Engineering
Yasser Ayeva, Electrical Engineering
Dalton Booth, Pharmacy
Mark Delisi, Psychology
Kaija Dockter, Hospitality and Tourism Management
Joseph Ekstrom, Pharmacy
Kira Eliason, Civil Engineering
Carly George, Biotechnology
Gavin Mallott, Electrical Engineering
Victor Martinez, Pharmacy
Madeliene Nichols, Animal Sciences
Xavier Pahl, Pharmacy
Rachel Voigt, Animal Sciences

POSTER PRESENTATIONS:

Floyd Althoff, Music
Mary Bailey, Geology
Paige Ballard, Human Development and Family Science
Catherine Bunker, Geology
Katie Gerold, Mechanical Engineering
Mia Haugan, Microbiology
Emily Jackson, Geology
Jake Jenson, Animal Sciences
Isabella Jurgens, Animal Sciences
Hannah Khan, Biological Sciences
Madison King, Health Services
Kyla Larson, Anthropology
Grace Loegering, Microbiology
Carl Ludewig, Geology
Brianna Maddock, Biotechnology
Shae Pfenning, Anthropology
Grace Rebel, Anthropology
Brooke Rothamer, Biological Sciences Education
Jakob Sailer, Mechanical Engineering
Ayden Schmidt, Electrical Engineering
Kathleen Schmidt, Microbiology
Tanner Smith, Mechanical Engineering
Samantha Stueber, Biological Sciences
Trevor Theurer, Microbiology
Natalie Visich, Biotechnology
Kirsten Warcup, Biological Sciences
Kaylee Weigel, Microbiology
Danielle Wright, Microbiology

Research Symposium of Gamma Sigma Delta: The Honor Society of Agriculture

UNDERGRADUATE STUDENT ORAL PRESENTATION:

Madeliene Nichols, Animal Sciences

GRADUATE STUDENT ORAL PRESENTATIONS:

Natalie Acosta Castellanos, Animal Sciences
Md Zahangir Alam, Plant Sciences
Ahmad Al-Amad, Microbiology
Samuel Bibby, Plant Sciences
Kerri Bochantin, Animal Sciences
Lennel Camuy-Vélez, Microbiology
Bethania Davila Ruiz, Animal Sciences
Brady Goettl, Soil Science
Maverick Guenther, Animal Sciences
Shivreet Kaur, Plant Pathology
Robin Malik, Range Science
Mika Mzumara, Horticulture

UNDERGRADUATE STUDENT POSTER PRESENTATIONS:

Mia Haugan, Microbiology
Isabella Jurgens, Animal Sciences

GRADUATE STUDENT POSTER PRESENTATIONS:

Lucas Alexandre Batista, Plant Sciences
Ibrahim Bello, Agricultural and Biosystems Engineering
Angela Johnson, Extension Education
Heymant Kaur, Cereal Science
Nirmala Subedi, Cereal Science
Aishwarya Suresh, Cereal Science
Mikayla Tabert, Plant Sciences
Runhao Wang, Plant Sciences

Research Symposium of the Graduate Student Council

ORAL PRESENTATIONS:

Natalie Acosta Castellanos, Animal Sciences
Md Zahangir Alam, Plant Sciences
Ahmad Al-Amad, Microbiology
Labiba Noshin Asha, Industrial and Manufacturing Engineering
Samuel Bibby, Plant Sciences
Kerri Bochantin, Animal Sciences
Lennel Camuy-Vélez, Microbiology
Emma Chandler, Environmental and Conservation Science
Prantik Roy Chowdhury, Mechanical Engineering
Autumn Clark, Environmental and Conservation Science
Justin Clarke, Range Science
Urmi Das, Microbiology
Bethania Davila Ruiz, Animal Sciences
Sunil GC, Agricultural and Biosystems Engineering
Anuj Ghimire, Biological Sciences
Bijaya Ghimire, Horticulture
Brady Goettl, Soil Science
Ryan Goke, Communication
Krystal Grieger, Chemistry
Maverick Guenther, Animal Sciences
Emma Hawley, Microbiology
Phat Huynh, Industrial and Manufacturing Engineering
Md Tariqul Islam, Cellular and Molecular Biology
Md Zahirul Islam, Mechanical Engineering
Ellysa Johnson, Natural Resources Management
Nathaniel "Thanny" Johnson, Dietetics
Shivreet Kaur, Plant Pathology
Esben Kjaer, Range Science
Richard Lamptey, Pharmaceutical Sciences
Magda Lopez Rodriguez, Anthropology
Robin Malik, Range Science
Mika Mzumara, Horticulture
Olugbemiga Olatoye, Construction Management
Md Ashif Islam Oni, Electrical and Computer Engineering
Md Atikur Rahman, Mechanical Engineering
Md Mirazur Rahman, Electrical and Computer Engineering
Nitin Rai, Agricultural and Biosystems Engineering
Jake Reinholz, Mechanical Engineering
Kazi Sarjana Safain, Cellular and Molecular Biology
Biraj Saha, Civil Engineering - Environmental
Ranjan Sapkota, Agricultural and Biosystems Engineering
Byron Ward, Music - Performance
Himani Yadav, Civil Engineering - Environmental

POSTER PRESENTATIONS:

Lucas Alexandre Batista, Plant Sciences
Kaitlynn Anderson, Anthropology
Juliana Antwi, Public Health
Valentina Asiedu, Public Health
Rebecca Aubart, Pharmacy
Anurag Banerjee, Pharmaceutical Sciences
Ibrahim Bello, Agricultural and Biosystems Engineering
Niyati Borkar, Pharmaceutical Sciences
Ashish Christopher, Plant Science
Amirreza Daghighi, Biomedical Engineering
Omolola Eniodunmo, Chemistry
Shrinwanti Ghosh, Biological Sciences
Jesmin Jahan, Cellular and Molecular Biology
Angela Johnson, Extension Education
Emily Johnson, Psychology
Anas Karuth, Coatings and Polymeric Materials
Achiya Khanam, Coatings and Polymeric Materials
Garrett Levin, Microbiology
Sekhar Mariappan Ajitha Kumari, Environmental and Conservation Science
Md Saimon Mia, Pharmaceutical Sciences
Tamanna Mim, Industrial Engineering and Management
Vimukthi Molligoda, Cereal Science
Taofeek Mukaila, Environmental and Conservation Science
Vikneshwari Natarajan, Cellular and Molecular Biology
Sierra Nguyen, Public Health
Tam Nguyen, Civil Engineering - Water Resources
Heather North, Biological Sciences
Kelly Parker, Health Nutrition and Exercise Science - Exercise/Nutrition Science
Jacob Pithan, Biological Sciences
Md Mahbubar Rahman, Industrial and Manufacturing Engineering
Bethany Roberton, Entomology
Prattasha Saha, Civil Engineering - Structural
Sajib Sarkar, Construction Management
Jake Schumacher, Microbiology
Thomas Stach, Chemistry
Nirmala Subedi, Cereal Science
Aishwarya Suresh, Cereal Science
Jessica Syring, Animal Sciences
Bryce Van Vleet, Developmental Science
Runhao Wang, Plant Sciences
Haley Woods, Chemistry
Aaron Yang, Software Engineering
Rose Yang, Pharmacy

ABSTRACTS

UNDERGRADUATE STUDENT ABSTRACTS

Floyd Althoff

MUSIC

Faculty mentor: Kyle Vanderburg, DMA – Challey School of Music

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

Implications of Rhythm, Meter, and Tempo in Samuel Barber's Hermit Songs

In 1953, Samuel Barber premiered his *Hermit Songs* with the iconic soprano Leontyne Price and himself at the piano. This set is a collection of ten charming songs with texts written one thousand years ago by an assemblage of anonymous Irish monks. Barber employs an intensely varied musical language throughout this work that encapsulates the distinct characters of each poem. Whether it be a tongue and cheek ode to one's cat or a depiction of the elements of Earth tearing us asunder, one thing arises as the underpinning of each expression: Barber's use of time. Time in music comprises three distinct aspects: rhythm, meter, and tempo. Tempo is the overarching speed of the music. It determines the quickness of each beat; whereas, meter determines the hierarchy of beats as well as each of their stresses and divisions. Lastly, rhythm is the organization of music by the duration of each sound on a smaller scale. To analyze the eccentric use of time in Samuel Barber's *Hermit Songs*, I used a reductive style of analysis to reduce the music into diagrams of rhythm, meter, and tempo as well as how these interacted with the musical character at that moment. Once the music is dissected in such a way, what seems like an almost nonsensical aspect of Barber's composition style reveals recognizable patterns in rhythm, meaningful changes in meter, and an artful use of tempo to heighten the expression of each song.

Ryan Anderson

CIVIL ENGINEERING

Faculty mentor: Syeed Md Iskander, PhD - Civil, Construction and Environmental Engineering

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

Nanoplastics in Landfill Leachate and Its Environmental Implications

Plastics pollution is a major problem facing humanity. Global annual production of plastics is predicted to reach 12 billion metric tons by 2050, and approximately 21 - 42% of generated plastic is stored in landfills. These landfilled plastics are broken down through biochemical reactions, having detrimental environmental and human health impacts. Plastic particles smaller than 100 nm are classified as nanoplastics, which end up in landfill leachate and proliferate in the environment. To understand leachate nanoplastics pollution and their environmental impact, we are investigating a landfill leachate sample from Virginia. We first filtered the leachate through a 100 nm filter and divided our leachate into 8 different samples. After that, we performed chemical oxidation on 4 samples to remove organics, reducing interference during nanoplastics identification and characterization. To remove the organics, we added 2 mL 30% hydrogen peroxide solution to 10 mL filtered leachate overnight at room temperature. The freeze and dry method was used to concentrate the other 4 samples. In addition, 0.1 mL of diluted polystyrene solution (100 nm size) was added to 2 digested, and 2 concentrated samples. Electron Microscopy was used to image these samples to understand the occurrence of leachate nanoplastics. We are in the process of performing Fourier transform infrared spectroscopy (FTIR) to understand the composition of leachate nanoplastics. With the growing concern on plastics pollution, our study will elucidate the potential of landfill leachate as carriers of nanoplastics and their potential environmental impacts.

Yasser Ayeva
ELECTRICAL AND COMPUTER ENGINEERING

Gavin Mallott
ELECTRICAL AND COMPUTER ENGINEERING

Faculty mentor: Dharmakeerthi Nawarathna, PhD - Electrical and Computer Engineering

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

Monitoring and Identification of Microalgae Strains Through Electrical Impedance Spectroscopy

Microalgae is a microscopic eukaryote which closely resembles a plant cell and can often be found in bodies of water. While microalgae contribute to the geochemical cycle, excessive growth can cause environmental issues such as eutrophication. Detection of algae in field conditions remains a pressing concern. This research is an attempt to develop a portable flow device for algal identification and monitoring in field conditions utilizing non-destructive electrical impedance spectroscopy (EIS). Electrical impedance can be measured by applying a harmless level of voltage across the cells to determine their unique impedance response. To do so with high accuracy and sensitivity we have used dielectrophoretic (DEP) force on microalgae cells and concentrated them on the electrodes. We then used EIS to quantify the microalgae. To produce a larger DEP force on microalgae cells, it requires a large electric field gradient. Several electrode configurations were modeled using finite element modeling and determine an ideal electrode configuration, ultimately resulting in an interdigitated microelectrode having an electric field gradient magnitude over $2x10^6$ V^2/m^3 across most of the active region. Samples of microalgae cultures *Chlorella vulgaris* and *Chlorella sorokiniana* were obtained and a stock concentration was set to $2x10^7$ cells per mL. The impedance response of a series of dilutions was recorded for each sample, alongside color intensity measurements through image analysis. The impedance response was used to create an equivalent circuit model for the sample. In the next step, we will design a portable device that can measure the microalgae quantity using EIS.

Keywords: Microalgae, chlorophyll, Chlorella vulgaris, Chlorella sorokiniana, Electrical impedance spectroscopy (EIS), growth monitoring, microelectrode, Cyanobacteria

Yasser Ayeva, Shashi Bhushan, and Gavin Mallott

Mary Bailey
GEOLOGY

Faculty mentor: Kenneth Lepper, PhD - Geosciences

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

A closer look at the depositional ages for the upper and lower Campbell shoreline of Glacial Lake Agassiz in northwestern Minnesota

Glacial Lake Agassiz (GLA), the largest freshwater lake in North America's history, existed for almost 4,000 years between the Pleistocene and Holocene geologic time periods. The formation of GLA was a result of the Red River Lobe of the Laurentide ice sheet retreating during deglaciation from the Big Stone Moraine. GLA water level changes have formed several shorelines which are named Herman, Norcross, Tintah, and Campbell. Early interpretations of the Campbell water level separated the deposition of the ridge into an Upper and Lower expression by the Moorhead Low water phase, however, recent research suggests that the Moorhead Low occurred during the deposition of the Tintah. The study of GLA shoreline complexes is important to understanding the end to the last ice age in mid-continent North America, specifically the retreat of the Laurentide Ice sheet, and the effects of abrupt climate change during the Quaternary. The goal of this study was to determine the age of the Campbell strandlines mapped along the southern basin in Northwestern and evaluate how the results correlate to the southern valley. Four samples were collected and dated via optically stimulated luminescence (OSL) processes from each of the Campbell shorelines along a 75 km transect, eight samples in total. The results allow a new interpretation that the Campbell shoreline elevation may have been occupied more than once.

Paige Ballard
HUMAN DEVELOPMENT
AND FAMILY SCIENCE

Faculty mentor: Christi McGeorge, PhD - Human Development and Family Science

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

Teachers and LGBQ Parents in the Classroom: Implications for an Inclusive Environment

Teachers in primary and secondary schools need to be prepared to work with parents with diverse identities. Little is known about how K-12 teachers are trained to work with lesbian, gay, bisexual, and queer (LGBQ) parents, and how teachers incorporate LGBQ parents or identities into their classrooms. The existing research suggests that teachers and schools struggle to create inclusive environments for LGBQ students, and teachers report that they have not received adequate training to work with students with a marginalized sexual orientation. Thus, it is quite possible that teachers are not well trained to work with LGBQ parents and may unintentionally engage in exclusory behaviors. This exploratory quantitative study sought to examine the type and level of training and education that K-12 teachers and undergraduate education students have received to work with LGBQ parents and their children, as well as the relationship between their training and how they address marginalized sexual orientations in their classrooms. The data for this study came from 182 K-12 teachers and undergraduate education students and was collected using an online survey comprised of Likert scale items. The results of this study suggest that teachers and undergraduate education students have received little training on working with LGBQ parents. The findings of this study provide implications for additional information that needs to be added to undergraduate education curriculums and topics for professional development sessions for teachers to create a more inclusive classroom environment for LGBQ parents and their children.

Catherine Bunker
GEOLOGY

Faculty mentor: Lydia Tackett, PhD - Geosciences

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

New Zealand Triassic Benthic Foraminifera

The driving force behind this research is to learn more about the marine paleoenvironments of New Zealand during the Triassic Period (250 to 200 million years ago), and how foraminifera interacted in those environments. The goal of this project is to study and identify the benthic foraminifera (a type of shelled amoeba) of the Upper Triassic from New Zealand. By identifying the foraminifera using their shell shape to classify them into a taxonomic family, we can then identify the possible environment the foraminifera inhabited, specifically whether the group lived on the seafloor or floating in the ocean. Despite the ancient age of these fossils (~220 million years old), we can determine their taxonomic lineage and interpret their lifemodes.

Mark Delisi
PSYCHOLOGY

Faculty mentor: Mark Nawrot, PhD – Psychology

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

Efficacy of the saccadic eye movement system in the perception of depth from motion parallax

The visual perception of objects' position and depth in an environment can readily be done using motion-based cues. To perceive depth, the visual motion of an object is combined with the observer's smooth slow-eye movements to disambiguate the depth and location of the object in the field. This information can typically be processed extraordinary quickly. Due to how fast this happens, we wondered whether the fast-eye movement system could serve the same role as the smooth slow-eye movement system for the accurate perception of depth. To test this, we used computer-generated virtual stimuli translating laterally with varying presentation durations. If the visual system receives the proper information, these virtual stimuli could be perceived as having depth. Decreasing the presentation duration allows us to determine whether the system is functioning correctly or not. Results show that with slow eye movements observers required only a brief presentation to accurately perceive depth. Presentation durations needed to be much longer with fast eye movements. We interpret these results to mean that fast-eye movements do not provide the necessary information to perceive the location and depth of an object as do smooth slow-eye movements. Thus, fast-eye movements do not play a role in the perception of depth using motion parallax. These results provide the basis of exploration for the brain regions involved in motion parallax since the brain regions for fast and slow eye movement are closely abutting in the human brain.

Kaija Dockter
HOSPITALITY AND TOURISM MANAGEMENT

Faculty mentors: Jeongdoo Park, PhD - Apparel, Merchandising, Interior Design and Hospitality Management; Kwangsoo Park, PhD - Apparel, Merchandising, Interior Design and Hospitality Management

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

Perceptions of and attitude toward the application of AI service robots

Artificial intelligent (AI) service robots have become an emerging trend in the lodging industry. This study compared managers' and consumers' thoughts on AI service robots' service capabilities, economic benefits, and security and safety concerns associated with the adoption of service robots in the lodging industry. An online survey was administered to 50 managerial employees working for two hotel management companies in the Midwest and an online survey using Amazon Mturk was completed by 213 consumers in the United States of America. Descriptive, frequency, and test of differences analyses were conducted to analyze the data. The results revealed that consumers overall view AI service robots in a more positive light than do the managers. Consumers believe they would enjoy being served by an AI robot while managers hold the perception that customers would rather be served by a service employee. Consumers believe AI robots will be able to provide prompt, reliable, personalized, empathetic, and correct service, while managers believe service robots will not be able to understand customers' specific needs and give personalized service. Consumers were positive about the potential economic impacts (increased revenue and reduced operating costs) while managers were neither positive nor negative. Both consumers and managers want to feel confident there will be minimal technology issues and safety risks associated with adoption. Overall, mean scores for attitude indicate that both consumers and managers have a favorable attitude toward the adoption of AI service robots, though only consumers have a high intent to actually adopt this technology.

Joseph Ekstrom
PHARMACY

Dalton Booth
PHARMACY

Victor Martinez
PHARMACY

Xavier Pahl
PHARMACY

Faculty mentor: Mark Dewey, PhD - Pharmacy Practice

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

Exploring Sublingual Tropicamide for Clozapine Induced Sialorrhea

Schizophrenia effects 1 in 300 people and is present in 50% of mental hospital patients worldwide. It is a debilitating disease associated with high rates of suicide, occupational dysfunction, social dysfunction, and reduced life expectancy. It's widely accepted that clozapine is the most effective medication for treatment resistant schizophrenia but has several side effects limiting use. One side effect is clozapine-induced sialorrhea (CIS). There are no approved treatments for CIS as the mechanism is currently unknown. Salivation is primarily controlled by the M_3 muscarinic receptor, but research suggests that several mechanisms contribute to CIS. Studies indicate that clozapine's metabolite, N-Desmethylclozapine, is an agonist of the M_3 and M_4 receptors. Scientists theorize that stimulation of the salivary glands and resulting sialorrhea is due to the agonism of these receptors. Tropicamide is a M_3 and M_4 receptor antagonist, but is not currently formulated for localized use in the mouth. It's been successfully used for off-label CIS treatment. We propose tropicamide sublingual tablets to promote localized absorption and antagonism of the M_4, and M_3 receptors in the salivary glands for the treatment of CIS.

Kira Eliason
CIVIL ENGINEERING

Faculty mentor: Syeed Md Iskander, PhD - Civil, Construction and Environmental Engineering

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

Long-Term Monitoring of Metal Concentration in Southern California Sea Beaches

Increased usage of metals in industries such as electronics, medical, and vehicles have made finding alternative sources of metals imperative. Over the course of two years, sand samples were collected from 11 Southern Californian beaches for metal analysis. The beaches are Laguna Beach, Newport Beach, Huntington Beach, Seal Beach, Hermosa Beach, Manhattan Beach, Dockweiler Beach, Venice Beach, Santa Monica Beach, Malibu Pier Beach, and Point Dume Beach. After separating the metals from the sand samples using a strong magnet, strong acids such as hydrochloric acid, nitric acid, and hydrogen peroxide were used to digest the metals. The digested solution was analyzed using the Inductively coupled plasma mass spectrometry (ICP-MS). Preliminary results showed high levels of iron, titanium, and manganese in the dissolved solution. These results indicate that sand may be a viable source of metals for recovery in the future.

Carly George
BIOTECHNOLOGY

Faculty mentors: Gongjun Shi, PhD - Plant Pathology; Zhaohui Liu, PhD - Plant Pathology

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

Genetic Mapping for New Virulence Gene in Pyrenophora Tritici-Repentis

Problem Statement: To conduct genetic mapping of a virulence gene in tan spot pathogen, *Pyrenophora tritici-repentis*. *Ptr* is the causal agent to cause tan spot disease on wheat. Understanding the mechanism of how this pathogen causes disease will greatly benefit our control and management of this disease.

Research objective: This study will focus on genetic mapping of the virulence gene to cause disease in *Ptr*, which lay the foundation for further cloning and characterizing of the virulence gene.

Research methodology:

1.Pathogen and plant materials. Our lab has created a virulence segregating population between three races of *Ptr.* Differential lines (ARcrossB10, 86124, DW5).

2. Population genotyping: SSR and STARP markers will be designed according to the available genome sequence of *Ptr.* PCR will be conducted with the designed markers and each individual isolate will be amplified with polymorphic primers.

3. Linkage map construction: Software Mapdisto will be deployed.

4. Tan spot resistance evaluation: Condia spore collection and inoculation will be conducted according to reference. 2-week-old plants will be inoculated and reaction types will be scored 7 days post inoculation.

5. QTL analysis: Qgene programming will be used for QTL analysis.

Results: 480 TCAP durum, 280 T. dicocum, and 192 T. dicoccoides populations were screened for different reactions among the three pathogens. In the future, 120 progenies from each cross of the three pathogens will be screened on the above differential lines.

Implications: This study will discover more virulence alleles which will help manage this pathogen in the long run.

Katie Gerold
MECHANICAL ENGINEERING

Faculty mentors: Chad Ulven, PhD - Mechanical Engineering; Ali Amiri, PhD - Mechanical Engineering

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

UV Resistance and Weatherability of Biopolymers

Due to the advantages of natural fibers/fillers over synthetic or mineral counterparts, they have been the center of attention for the past couple of decades. Incorporating natural fillers into commonly used plastics such as polypropylene or polyethylene can increase materials sustainability and reduce their carbon footprint by increasing their bio content. However, there are challenges to overcome before these biopolymers become more widespread in the advanced structural applications. One of these challenges is degradation due to exposure to weather (UV, moisture and heat). In this study, a couple of different additives have been compounded into biopolymers, in order to explored their effect on improving weather and UV resistance of these bioplastics. Results of this study provided insight into treatment of bioplastics for improved properties to endure and withstand harsh weather conditions (moisture, heat and UV).

Katie Gerold, Abigail Henderson, Chad Ulven, and Ali Amiri

Mia Haugan
MICROBIOLOGY

Grace Loegering
MICROBIOLOGY

Natalie Visich
MICROBIOLOGY

Faculty mentor: Barney Geddes, PhD - Microbiological Sciences

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

Research Symposium of Gamma Sigma Delta: The Honor Society of Agriculture

Estimation of Genotypic Diversity for *Rhizobium leguminosarum* Isolates Throughout the State of North Dakota

Rhizobium leguminosarum is a nitrogen fixing symbiont that is important in providing nitrogen to pea plants. To harness this sustainable source of nitrogen, these bacteria are often applied as inoculants to pea crops as an alternative to fertilizers. Understanding the diversity of rhizobia in different environments is key to improving inoculants and finding elite strains. Here we isolated *R. leguminosarum* from 16 different soil types located around North Dakota. To isolate the rhizobia, a nodule trapping assay was performed in the greenhouse, where pea plants were planted in a small amount of soil that was collected from one of the 16 sites. The resulting nodules that formed were crushed and plated on tryptic yeast extract agar to culture the rhizobia from each nodule, and the resulting isolates were purified by streak plating. Using this method 950 rhizobia were isolated. In order to estimate the genotypic diversity in the North Dakota rhizobium collection, we performed ERIC PCR (Enterobacterial Repetitive Intergenic Consensus Polymerase Chain Reaction) and analyzed the resulting DNA fingerprint using agarose gel electrophoresis. Fingerprints from the 950 rhizobium strains were each other in order to group the strains based on similarities in band sizes and intensity. This resulted in approximately 40 unique groups of *R. leguminosarum* strains. We provide data comparing the distribution of these unique groups of *R. leguminosarum* in pulse fields across North Dakota and compare their distribution with chemical properties of the soils. We also highlight plans for further experiments to phenotype representatives from each group which could lead to the identification of elite strains for use in North Dakota agriculture.

Emily Jackson
GEOLOGY

Faculty mentor: Lydia Tackett, PhD - Geosciences

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

Mid to Late Triassic Foraminifera of Nevada: Using microfossils for paleoenvironmental interpretations and determining the ages of rocks

Foraminifera are widespread, predominantly marine, single-celled microorganisms with shells that are most commonly composed of calcareous minerals. Like many other organisms, foraminifera have preferred environments in which they live; and their shell shapes inform whether they lived on the seafloor or floating in the ocean. Different genera lived at different times in Earth's history, so they are also useful for determining the age of the rocks in which they are found. I was able to identify forams from at least three different genera dated from the Mid to Late Triassic from sediment samples of the Gabbs Formation in Nevada. Using these identifications, it is possible to make some basic environmental interpretations about the area from which the samples were taken, and to correlate these rocks with other localities.

Jake Jenson
ANIMAL SCIENCES

Faculty mentor: Carolyn Hammer, DVM, PhD – Animal Sciences

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

Effects of Maternal Vitamin and Mineral Supplementation on Neonatal Fc Receptor (FcRn) Abundance in Newborn Calf Intestine and Lung Tissue

The neonatal Fc receptor (FcRn) is responsible for antigen presentation, recycling of albumin, and bidirectional transportation of immunoglobulin G. This receptor has been identified in various species, but limited information is available regarding presence of FcRn in young calves. The objective of this study was to evaluate maternal vitamin and mineral supplementation on FcRn abundance in newborn calves. Starting 60 d before breeding, 14 Angus-based heifers were randomly assigned to either a basal diet (n=7) or the basal diet with vitamin and mineral supplementation (n=7). Immediately after parturition, calves were removed from their dams. Calves were fed commercial colostrum and managed similarly post-birth regardless of dam nutritional treatment. Tissues were harvested at 30h of age and fixed in 10% NBF fixative solution prior to paraffin embedding and sectioning. Cross sections (5 μm) were mounted onto glass slides, deparaffinized, stained for FcRn, and counterstained with DAPI. Areas of tissue cross-sections were captured with Plan-Apochromat 20x/0.8 NA lens using the tiling module of Zeiss software. Images were analyzed using ImagePro Premiere software. Data were presented as relative fluorescence units per tissue area to indicate FcRn abundance and were analyzed using the general linear model procedure of SAS. Results demonstrate FcRn presence in intestine and lung of the newborn calf. There was no effect of maternal vitamin and mineral supplementation on calf FcRn abundance in jejunum or lung tissue (p=0.84 and p=0.72; respectively). Future studies should focus on receptor function during the neonatal period and the impacts of maternal nutrition.

J.A. Jenson, C.J. Hammer, P.P Borowicz, J.L. Hurlburt, F. Baumgaertner, K.A. Bochantin, A.C. B. Menezes, S.R. Underdahl, J.D. Kirsch, K.K. Sedivec, C.R. Dahlen

Isabella Jurgens
ANIMAL SCIENCES

Faculty mentor: Carl Dahlen, PhD – Animal Sciences

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

Research Symposium of Gamma Sigma Delta: The Honor Society of Agriculture

Nutrition During Early Pregnancy Impacts Offspring Ovarian Characteristics

During early pregnancy offspring are directly exposed to nutrients consumed by their mother, and the development of their own reproductive tract is underway. The objective of this research was to determine how characteristics of offspring ovaries were affected by different maternal rates of gain during the first trimester of pregnancy. Beginning at breeding beef heifers were managed to achieve one of two rates of gain: low (0.20 kg/d, n = 8; LG) or moderate (0.75 kg/d, n = 8; MG) for the first trimester of pregnancy, after which time they were managed as a single group through calving. Calves remained with their dams until weaning and were managed as a single group through breeding. On the 84th day of gestation ovaries were removed from the reproductive tract, weighed, photographed, and visible antral follicles were counted. Though no differences (P = 0.45) were observed in number of visible follicles, the corpus luteum (CL) was heavier (P = 0.03) and average ovarian length was greater (P = 0.04) in offspring from LG dams compared with those from MG dams. Heavier CLs have a positive correlation with the amount of progesterone released, which is essential for pregnancy maintenance. Longer lengths of the ovaries suggest more area for follicles to develop, which is indicative of future reproductive success. Evaluation of microscopic follicles present in ovaries is forthcoming. These findings demonstrate that maternal nutrition during early pregnancy impacts offspring reproductive tract development and can be useful for producers when making early gestation feeding decisions.

Hannah Khan

BIOLOGICAL SCIENCES

Faculty mentor: Katie Reindl, PhD – Biological Sciences

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

Modeling Acquired Drug Resistance in Pancreatic Cancer Cell Lines

Pancreatic ductal adenocarcinoma (PDAC) is a lethal solid malignancy characterized by an 11% 5-year survival rate. Some reasons for this abysmal survival rate include late detection and acquisition of drug resistance. When pancreatic cancer cells become resistant to the treatments available, it decreases overall survival. The mechanisms of acquired drug resistance in pancreatic cancer are not fully understood. Therefore, modeling acquired drug resistance in a variety of pancreatic cancer cell lines allows for further investigation into mechanisms of drug resistance. Common drugs for pancreatic cancer treatment include oxaliplatin, 5-fluorouracil, irinotecan, and gemcitabine. Two human pancreatic cancer cell lines, PANC-1 and MIA PaCa-2, were treated with these drugs at increasing concentrations, to create resistant cell lines. By increasing the concentrations of drug added over months, and verifying the results by way of MTT assays, it was shown that these lines are drug resistant compared to their parental cell lines. We plan to use the resistant lines to identify the mechanisms of acquired drug resistance. Further, we will use the drug-resistant cell lines to investigate other therapeutic options for when pancreatic cancer cells become resistant to these commonly used drugs.

Madison King

HEALTH SERVICES

Faculty mentor: Estelle Leclerc, PhD - Pharmaceutical Sciences

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

Optimization of monoclonal antibody production in CHO cells

Monoclonal antibodies are becoming a more common adjunct to traditional cancer treatment because of improved outcomes. Therapeutic monoclonal antibodies can be generated from mammalian cells. The procedure used to express and purify monoclonal antibodies needs to be optimized for each antibody. In this study, we aimed to determine the optimal length of incubation following the transfection of Chinese Hamster Ovary (CHO) cells with the antibody coding plasmids. This experiment compares an eight-day collection time to two four-day collection times where the media was exchanged after four days. Potential outcomes of this study will be an optimal procedure based on collection time resulting in the highest yield of the desired monoclonal antibody.

Kyla Larson

ANTHROPOLOGY

Faculty mentor: Kristen Fellows, PhD - Sociology and Anthropology

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

How Communal Mitigation Efforts Have Changed Over the Course of Historic Floods in the Fargo-Moorhead Area

This research examines how communal response to flooding has changed over time in Fargo, ND. Three major local floods (1897, 1997, and 2009) will serve as case studies for this project. Primary sources including news articles, social media posts, and photographs will be analyzed. Photographs will provide evidence of material responses, such as sandbags and other barrier mechanisms, as well as individuals participating in mitigation efforts. Although not as ubiquitous over the three flood events, news accounts and social media sources will offer insight into the role of technology in organizing communal responses to natural disasters. Analysis will show that as technology has advanced since the 1897 flood, so has collaboration within the community. Additionally, state and national responses have increased to further support local communities. Modern technology brings both new forms and amounts of communication for organizing purposes in addition to materials and supplies to help communal mitigation efforts.

Carl Ludewig
GEOLOGY

Faculty mentor: Lydia Tackett, PhD - Geosciences

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

Petrology of New Zealand Sediments and its impact on environmental determination

Sedimentary rocks and processes can reveal a lot about the past. Not only do they preserve different types of organisms that lived when the sediments were deposited, but sedimentary rocks also record information about the environments in which these organisms lived. A way to determine these environments is to use the individual mineral grains and the matrix of the rocks to determine environment based on predictable sedimentary processes. The presence of a variety minerals, including feldspars, quartz and micas, were all seen throughout. X-ray diffraction was used to determine the mineral composition of the matrix between grains. This research demonstrates that environments through the Norian of New Zealand remained shallow-marine despite an atypical fossil assemblage. Slight changes in mineralogy going from larger amounts of quartz in the older and small to no feldspars in the oldest formations and in the latest Norian there is a larger presence of feldspar in whole grains and within lithics, and low presences of clay minerals, showing that the Warepan was a higher energy environment than that of the older formations.

Brianna Maddock
BIOTECHNOLOGY

Faculty mentor: Glenn Dorsam, PhD - Microbiological Sciences

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

Confirmation and Improved Taxonomic Resolution of the Altered Gut Microbiota Community Structures in VIP Deficient Mice by Quantitative PCR.

Vasoactive intestinal peptide (VIP) is a 28 amino acid, anti-inflammatory neurotransmitter that acts as a master circadian rhythm regulator, and gastrointestinal tract (GIT) homeostatic mediator. Previously, we showed that genetic deletion of VIP on a C57BL/6 murine background exhibited gut microbiota dysbiosis by 16S rRNA sequencing. These reported bacterial compositional changes consisted of elevated Gram-negative phyla, including *Bacteroidetes*. Unfortunately, this study did not confirm the veracity of 16S sequencing by a second technique, nor could the 16S DNA reads annotate to the taxonomic level of species. To this end, we used quantitative polymerase chain reaction (qPCR) to confirm the altered gut microbiota community structures and improve the taxonomic resolution from genera to species. In support of our previously reported 16S rRNA dataset, qPCR analyses of VIP KO fecal DNA samples revealed significant blooms in the abundance of Bacteroides genus compared to WT, and furthermore identified *vulgatus* and *ovatus* as contributing species within the Bacteroides genus. Although both species are commonly found in the human and murine gut microbiota, elevated levels can be considered risk factors for inflammatory disorders, including Celiac Disease (*vulgatus*) and Inflammatory Bowel Disease (IBD, *ovatus*). These data suggest that VIP signaling plays an important role in preventing blooms of potentially proinflammatory Gram-negative bacteria species link to inflammatory bowel disorders.

Brianna Maddock, Justin Daniels and Glenn P. Dorsam; Department of Microbiological Sciences

Madeliene Nichols
ANIMAL SCIENCES

Faculty mentor: Zachary Carlson, PhD - Animal Sciences

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

The influence of Megasphaera Elsdenni and Diet Adaptation Program on Feedlot Performance of Yearling Heifers Accelerated to a High-Concentrate Finishing Diet

Ruminal acidosis is a metabolic disorder that commonly occurs in ruminants consuming high concentrate diets, affecting both their growth performance and overall well-being. The objective of this trial is to determine the rumen pH-balancing capacity of the oral drench Lactipro, a probiotic containing Megasphaera elsdenni, by comparing feed intake, rate of gain, frequency of bloat, and quantifying microbial community populations between our two groups as they were stepped-up onto a high-concentrate finishing diet consisting of corn products/byproducts. The study consists of 32 two-year-old heifers (462±34 kg).16 heifers were allocated to the control group, receiving 0mL of the probiotic on day one and were stepped-up to the finishing diet over 21 days, and 16 heifers were allocated to the ME group, receiving 40mL of the probiotic on day one and were stepped-up onto the finishing diet over 11 days. The heifers are fed via Calan headgates (American Calan Inc., Northwood, NH) to measure individual feed intakes. The heifers are weighed on at the start of the trial and on days 15, 28, 56, and 84 to measure rate of gain, rumen fluid and fecal samples are collected on days 1, 15, 28, 56, and 84 to monitor microbial populations, and they are observed twice daily to monitor bloat and the amount of feed remaining in the bunk. We hypothesize the heifers orally drenched with Lactipro NXT will not experience severe cases of bloat from an accelerated diet adaptation phase, resulting in no differences in growth performance compared to the control treatment.

Shae Pfenning
ANTHROPOLOGY

Faculty mentor: Kristen Fellows, PhD – Sociology and Anthropology

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

Everyday Experiences of Prohibition in North Dakota

This preliminary research examines prohibition during the 1920's and its effects on the lives of people living in North Dakota. In particular, one family will serve as a case study and will be situated within the larger context of prohibition in the area. In doing so, this research hopes to explore the everyday lives of past families that may have been involved in bootlegging and other activities associated with prohibition. Analysis of oral histories, genealogical records, and other archival materials will provide insights from a variety of sources and enable an investigation of what life was actually like in prohibition-era North Dakota.

Brooke Rothamer
BIOLOGICAL SCIENCES EDUCATION

Faculty mentor: Ellen Rubinstein, PhD - Sociology and Anthropology

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

Caring relationships of older individuals in the era of COVID-19

Traditionally, caring relationships include the actions of a caregiver toward a recipient to provide for their needs. A broader definition of care includes reciprocity between the "caregiver" and the "recipient." The COVID-19 pandemic interrupted existing routines and traditions of care by introducing new policies for isolation and social distancing. To investigate the nature of care in the era of COVID-19, I investigated the nature of care among older individuals, who are often both caregivers and care receivers. Our class research team collected data in semi-structured interviews regarding care during COVID-19. My investigation included transcripts of interviews with seven subjects over age 50. Across the data, subjects described being cared for through their younger relatives not visiting them, the absence of an action rather than the performance of one. They also described not being able to provide care themselves, particularly toward younger members of their family who they could not see. Though subjects replaced typical visits to friends and family with virtual check-ins and events, they did not report the same quality of social interaction. COVID-19 introduced a new form of physical care, social distancing, but weakened the quality of social care traditionally provided. Virtual interactions will need to be continually improved to involve people who are physically at risk in everyday interactions with their friends and family.

Jakob Sailer

MECHANICAL ENGINEERING

Faculty mentors: Alan Kallmeyer, PhD - Mechanical Engineering; Chad Ulven, PhD - Mechanical Engineering

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

Mechanical Properties of Adhesive in Bolted Joints

The research that was conducted over the past couple of years was testing and comparing the mechanical properties of various adhesives on the structural integrity of bolted joints. PPG Industries wanted to evaluate the mechanical properties of one of their newer adhesives that was contracted by the US Army. The goal was to compare the new product to a simple mechanical connection in conjunction with existing adhesives that had similar projected strength values. The three tests that were conducted were Tensile, Impact, and Fatigue testing. The Tensile test utilized five specimens in two configurations for all adhesives along with a simple bolted connection set of samples. The results found showed that the addition of adhesive increased the max strength and extension of the connection before failure, with the PPG and bolted connection having the greatest addition to the overall increase in extension and strength before failure. The Impact test utilized samples with only the PPG adhesive and a bolted connection along with a set of simple bolted connection samples. The results of the impact showed the compressive strength of the adhesive and bolted connection. The third test conducted was a fatigue test that utilized only the PPG adhesive with the 2 bolt configuration similar to the one used in the tensile test. The results from these tests showed the number of cycles to failure for the adhesive, adhesive with bolts, and the simple bolted connections.

Ayden Schmidt

ELECTRICAL ENGINEERING

Faculty mentor: Dharmakeerthi Nawarathna, PhD - Electrical and Computer Engineering

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

Development of a 3-D Printed Column for Magnetic Activated Cell Separation using Novel Nickel Strips

Magnetic activated cell sorting is a well-established technique for separating cells. The method utilizes micron-sized iron beads, functionalized to relevant antibodies that bind to cells or other particles of interest. After beads are bound to cells, a magnetic field is applied attracting the beads and therefore cells to sides of the column and preventing them from eluting – that is until the magnetic field is removed. This method is often used to capture specific white blood cells from a population of others. Currently, magnetic activated cell sorting columns utilize large iron spheres that are magnetized to capture the smaller micron-sized iron beads and the cells of interest that are attached to the beads. A new approach using interdigitated nickel strips as opposed to iron spheres produces a greater magnetic field that may enhance recovery during magnetic activated cell sorting. However, a column to support using these devices with nickel strips has not been developed. In this project, we report on the development and production of a 3D-printed device that is capable of securing these novel nickel devices for future magnetic activated cell sorting experiments.

Tanner Smith

MECHANICAL ENGINEERING

Faculty mentor: Chad Ulven, PhD - Mechanical Engineering

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

Development of a Wireless CO2 Measurement Sensor for Soil

Soil respiration is the combined production of carbon dioxide by all soil organisms and plant matter. The rate at which soil respirates is an indicator of soil health as it sheds a light on the level of microbial activity. Along with this respiration rates have become even more important in recent years as scientists propose ways of sequestering carbon dioxide in the soil. Current methods of measuring soil respiration rates are short term and do not measure the rates at varying depths. This research was done to find a simple method of measuring carbon dioxide release rates at varying depths for both long and short-term study. The method proposed uses a battery powered carbon dioxide sensor that can wirelessly send the data to a phone or computer. This sensor is stored in a protective housing and attached to a wellpoint style spike that can be entered into the soil to get respiration rates at any depth. The proposed method gives a researcher the ability to do more in-depth long-term studies of soil respiration and collect data easily and quickly in many different places.

Samantha Stueber
BIOLOGICAL SCIENCES

Grace Rebel
ANTHROPOLOGY

Faculty mentor: Ellen Rubinstein, PhD – Sociology and Anthropology

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

The Impact of Covid-19 in Academia

The Coronavirus or Covid-19 is a very contagious virus that has swept through the world since the end of 2019. We have collected our data from interviews that were then transcribed from a collection of students in NDSU's Medical Anthropology class (2021). Upon analysis of the transcripts, there was a profound impact that masks alone had on the individuals that we collected data from. We then categorized these shared experiences into wearing masks at work, at school, and others not following mask wearing guidelines. The data collected from the analyzed transcripts support three themes of anthropology: global health, care, and barriers. These findings are important because they bring knowledge and insight as to how our educators and students have been affected by the dramatic changes they have experienced in the past years. This knowledge can be furthered used to improve upon the current state of our education system as well as preparing for another potential global crisis.

Trevor Theurer
MICROBIOLOGY

Faculty mentor: Danielle Condry, PhD - Microbiological Sciences

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

Creating public communications utilizing Survey data on CWD knowledge in North Dakota

This project will provide two examples of possible applications that can be used from collecting survey data, specifically based upon a 2021 study from North Dakota Game and Fish regarding chronic wasting disease (CWD) and public awareness within the state. Using information from this survey, knowledge gaps were identified in the survey population: hunters in North Dakota. Knowledge gaps include the differences between epizootic hemorrhagic disease (EHD) and CWD as well as what to do when a deer has tested positive. CWD is a relatively new disease in the state of North Dakota in the cervid population, however, it isn't to be taken lightly as it has a mortality rate of 100% and is highly transmissible. States near North Dakota such as Wisconsin, Iowa, and Wyoming have a much higher prevalence and provide a warning on what is to come within North Dakota if CWD is left unchecked. Identifying knowledge gaps by using the 2021 survey data has made it possible to educate hunters and potentially slow the spread of this disease in the state, a top priority for the North Dakota Game and Fish.

Rachel Voigt
ANIMAL SCIENCES

Faculty mentor: Carolyn Hammer, DVM, PhD – Animal Sciences

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

Maternal Supranutritional Selenium Supplementation Influences the Abundance of the Neonatal Fragment Crystallizable Receptor (FcRn) in Ewe Mammary Tissue

Immunoglobulin G (IgG) in livestock is transferred to offspring exclusively through colostrum. A highly selective mammary barrier allows only immunoglobulin G1 to enter colostrum in substantial amounts. The neonatal Fc receptor (FcRn) is responsible for bidirectional transport of IgG; however, its role in concentrating IgG into colostrum remains unknown. The objective of this study was to evaluate FcRn abundance in mammary tissue of ewes fed differing planes of nutrition and supplemented with supra-nutritional selenium (Se) during pregnancy. Pregnant ewes (n=80) were used in a 2x3 factorial treatment arrangement. Treatments included dietary Se level [adequate (9.5 µg/kg BW) vs. supra-nutritional (81.8 µg/kg BW)] and plane of nutrition [60%, 100% and 140% of requirements]. At parturition, mammary glands were collected. The samples were fixed in 10% NBF prior to paraffin embedding and sectioning. Cross-sections were mounted onto slides, deparaffinized, stained for FcRn, and counterstained with DAPI. Areas of interest (AOI) were captured using Zeiss software and analyzed using ImagePro Premier software. Relative fluorescence within the AOI was used as an indicator of FcRn receptor abundance with data presented as receptor abundance per glandular tissue area. Data were analyzed using the general linear model procedure of SAS. Supra-nutritional Se increased FcRn abundance per glandular area (P=0.01) and mammary FcRn was positively correlated (r^2=0.25; *P*=0.02) with IgG levels in colostrum. Results demonstrate the presence of FcRn in ewe mammary tissue and a positive correlation with colostrum IgG. Further investigation into the role of supra-nutritional Se and the FcRn is warranted.

Rachel A. Voigt, Carolyn J. Hammer, Maverick C. Guenther, Pawel P. Borowicz, Tammy L. Neville, Tara J. Swanson, Kimberly A. Vonnahme, Dale A. Redmer, Larry P. Reynolds, Joel S. Caton

Kirsten Warcup
BIOLOGICAL SCIENCES

Faculty mentor: Steven Travers, PhD - Biological Sciences

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

Conserved Stress Response: Identification of Novel HSP Genes in Solanum Carolinense

Heat shock proteins (HSPs) are the product of the highly conserved domain of stress response genes. Past research has confirmed the presence of HSPs in many species in the Solanaceae family. The purpose of this project is to identify HSP genes in *Solanum carolinense*, a weedy member of the Solanaceae family found across the United States. By using known HSP genes from *Solanum lypersicum, Solanum melongena,* and *Nicotiana tabacum* primers were designed for use in PCR with the intention of determining if those genes are shared with *S. carolinense*. We hope to find HSP genes in *S. carolinense* and use qPCR to determine how expression levels change in response to heat stress.

Kaylee Weigel
MICROBIOLOGY

Kathleen Schmidt
MICROBIOLOGY

Faculty mentor: Danielle Condry, PhD - Microbiological Sciences

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

Stress and Growth Response in Escherichia Coli Cells After Exposure to Short-Chain Fatty Acids Butyrate and Propionate

The human gut microbiota plays a vital role in overall human health and dysbiosis of the gut microbiome can lead to diseases such as inflammatory bowel disease, diabetes, and obesity. Short-chain fatty acids (SCFAs) produced via bacterial fermentation in the body, notably acetate, butyrate, and propionate, can confer many benefits to the host, such as inflammation reduction, dietary fiber digestion, and metabolizing nutrients for the colon. Although acetate has been shown to evoke a stress response in the proteome of *Escherichia coli* cells, there is little known about the effects that butyrate and propionate have on the same cells. Exploring the effects these SCFAs have on *E. coli* cells is vital in understanding the effects of using artificial concentrations in clinical interventions. *E. coli* strain W3110 with the pUCD615 plasmid containing the *Vibrio fischeri luxCDABE* operon served as our model organism to detect stress. Three different promoters were used to detect different types of stress response systems: *grpE'::lux* fusion detected heat shock response, *katG'::lux* fusion detected oxidative damage response, and *recA'::lux* fusion determined SOS response. We found that when these promoters were exposed to known stressors, SCFAs confer a protective effect in *E. coli* cells. Understanding the effects of SCFAs and their reductive effects on *E. coli* stress could explain their ability of SCFAs to combat responses such as inflammation in the gastrointestinal tract. Future research directed towards multiple bacteria species in the gut is necessary to understand the full scope of butyrate and propionate's effects on the human microbiota.

Danielle Wright
MICROBIOLOGY

Faculty mentor: Steven Travers, PhD - Biological Sciences

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

Impact of Mycorrhizal Colonization on Growth of Plants Infected with *Sclerotinia sclerotiorum*

Mycorrhizae have long been shown to help with plant nutrition, especially phosphorous uptake. However, there has been some indication that plant-mycorrhizae symbiosis also contributes to plant resistance to disease-causing organisms by improving the plant immune response. This aspect of the symbiotic relationship has not been explored as extensively and could have additional benefits for agricultural research. To investigate the relationship, *Nicotiana sylvestris* was grown in soil with and without mycorrhizae. Once the second true leaves appeared, half the plants from each treatment were infected with the plant pathogenic fungus *Sclerotinia sclerotiorum*, which causes white mold. At the same time, the other half were used as negative controls. Plant growth rate and spread of mold from the infection site were used to indicate the level of disease resistance. It is expected that plants that have a symbiotic relationship with mycorrhizae and are infected or damaged early in the developmental process will grow better than infected plants grown in non-mycorrhizae soil because the symbiotic relationship improves the plant immune response. Implications of these findings include further research into how the mycorrhiza-plant relationship helps in disease resistance, how the agricultural industry can manipulate this to reduce pesticide use, and how the relationship can be used for disease intervention practices.

GRADUATE STUDENT ABSTRACTS

Natalie Acosta Castellanos

ANIMAL SCIENCES

Faculty mentor: Eric Berg, PhD - Animal Sciences

Research Symposium of Gamma Sigma Delta: The Honor Society of Agriculture

Research Symposium of the Graduate Student Council

Supplementation of Sucrose and Beef during Sow Gestation: Effects on Fetal Muscle Growth

The myogenesis during fetal stage depends deeply on the maternal diet which will impact postnatal growth and development. The aim of this study was to compare the effects of beef or sucrose supplemented to a maternal diet on fetal myofiber growth and differentiation. 21 pregnant sows were randomly assigned to 1 of 4 isocaloric treatments: control (CON) 126g corn-soybean meal-based diet, 110g ground beef (BEEF), 85.5g sucrose (SUG), or the combination of 54.8g BEEF and 42.7g SUG (B+S). Dietary supplements were added from day 40 to 110 (±0.58) of gestation, sows were euthanized on d 111. Longissimus dorsi (LD) and semimembranosus (SM) samples were collected from 1 median weight male and female fetus of each sow. Immunofluorescence was used to determine the total number and proportion of slow (ST) and fast twitch (FT) muscle fibers. Data were analyzed using the MIXED model of SAS where differences were considered statistically significant at $P \leq 0.05$. Muscle type differed for total number ($P < 0.0001$) and myofiber percentage ($P < 0.0001$). Longissimus dorsi showed the largest percentage of ST and greatest total number of myofibers; in contrast, semimembranosus showed the largest percentage of FT and the smallest value total number. Female LD and SM had a numerically greater percentage of ST and smaller myofiber number than male. Results suggest that these levels beef or sucrose supplementation to a standard sow maternal diet have minimal effects on fetal muscle fiber type.

Key words: ground beef, maternal diet, myofiber, sucrose, swine

Md Zahangir Alam

PLANT SCIENCES

Faculty mentor: Md Mukhlesur Rahman, PhD - Plant Sciences

Research Symposium of Gamma Sigma Delta: The Honor Society of Agriculture

Research Symposium of the Graduate Student Council

Development and Advancement of MAGIC Population for Improved Sclerotinia Stem Rot Resistance in *Brassica napus* L.

The Sclerotinia Stem Rot (SSR) disease caused by *Sclerotinia sclerotiorum* is one of the most critical diseases in canola (*Brassica napus* L.). Canola is the second most important oil crop in the world after soybean. Multi-parent Advanced Generation Inter-Crosses (MAGIC) inter-mate multiple inbred founders (typically 4, 8, or 16 parents) for several generations and subsequently create recombinant inbred lines, whose genomes are fine-scale mixtures of contributions from all founder parents. MAGIC generates a genetic resource population with large phenotypic diversity, suitable for high-resolution mapping of complex quantitative traits. We have screened 350 globally distributed rapeseed/canola germplasm accessions against the SSR disease under greenhouse and field conditions from 2016 to 2020 and identified three accessions (g151, g127, and g339) with high levels of resistance/tolerance to the disease. In addition, we have used other available genetic resources of canola with partial resistance, high yielding potential, and good quality oil. Then we developed two 4-parents MAGIC plants to incorporate all the *S. sclerotiorum* resistant sources into one background. We also have developed an 8-parents MAGIC and a 16-parents MAGIC to incorporate multiple disease resistant sources, superior oil quality, and improved yield traits into a single background. The single-seed descent method is being applied to generate recombinant inbred lines. Since non-host crop rotation and fungicides application are not feasible, breeding for disease-resistant cultivars with the MAGIC populations would be an efficient, economically feasible, and environmentally friendly option.

Key Words: Brassica napus L., Sclerotinia sclerotiorum, MAGIC, Screening, and Disease Resistance

Md Zahangir Alam[1], Jayanta Roy[1], Luis DelRio Mendoza[2], and Md Mukhlesur Rahman[1]*
[1]Department of Plant Sciences; [2]Department of Plant Pathology

Ahmad Al-Amad
MICROBIOLOGY

Faculty mentor: Barney Geddes, PhD – Microbiological Sciences

Research Symposium of Gamma Sigma Delta: The Honor Society of Agriculture

Research Symposium of the Graduate Student Council

Experimental Engineering of a New-To-Nature Symbiosis between *Sinorhizobium meliloti* and *Vigna unguiculate*

Diazotrophic members of the *Sinorhizobium* genus are capable of nodulating the root systems of plants of the legume family. Both bacteria and legume are selective to which partner they recognize and associate with. Inside the nodule rhizobia differentiate into Bacteroides which fix atmospheric nitrogen into usable forms that are supplied to the host plant. In turn the plant provides photosynthetic products for bacterial consumption. *S. freddi* is the natural symbiont of the cowpea (*Vigna unguiculata*), while model rhizobium *S.meliloti*, which is the natural symbiont of alfalfa, is incapable of nodulating cowpeas. In this experiment, three genetically modified (GM) *S. meliloti* strains which have been engineered with elements from the *S. freddi* genome were used to experimentally engineer a new-to-nature symbiosis between *S meliloti* and cowpeas. The symbiotic performance of each of the novel cowpea symbionts was evaluated. These phenotypes will serve as the starting point for future efforts to determine the minimal genetic subset required to establish a functional symbiosis with a novel host.

Key Words: Nitrogen Fixation, Genetically Modified Organisms, Symbiosis, Cowpeas, Rhizobia

Ahmad al-Amad, Turlough M. Finan and Barney A. Geddes (Microbiological Sciences)

Lucas Alexandre Batista
PLANT SCIENCES

Faculty mentor: Andrew Green, PhD - Plant Sciences

Research Symposium of Gamma Sigma Delta: The Honor Society of Agriculture

Research Symposium of the Graduate Student Council

High Throughput Phenotyping in Hard Red Spring Wheat Breeding in Early Generations

Hard Red Spring Wheat (HRSW) is an important class of wheat grown all over the world. The rise of population requires increasing food production, especially wheat. A key solution is to improve breeding efficiency by reducing time and the number of genotypes to be tested. This could improve genetic gain in two ways, by both improving selection accuracy and decreasing the time required to develop new lines. Therefore, the objective of this work is to evaluate populations in early generations, and subsequently, inbred lines of HRSW for important agronomic trait such as Fusarium Head Blight, yield and protein. We used an Unmanned Aerial Vehicle (UAV) (DJI Inspire 2 Drone) and remote sensors (Sentera 6X Multispectral Sensor and Vibe QM3 Grain Analyzer) to understand differences among and between populations. Three breeding populations have been analyzed. Filial generation 1 (F1) were individually harvested and threshed separately. Each population was divided by four to test at two locations across two years at Prosper, ND and Casselton, ND. F2 head rows were evaluated by image analyses captured by UAV, aiming to identify desirable agronomic traits. Preliminary results showed that, head rows with broad sense heritability for protein of (0.86) and yield (0.64). There was low level of FHB in the two locations 2021. 5 spikes of each head row were harvested and threshed separately. Plants were planted in a growth chamber using Single-Seed Descendent (SSD) technique and advance to F2:6. Evaluation of lines F2:6 will be made in 2022.

Key Words: Plant Breeding, phenotyping, FHB

Lucas Alexandre Batista; Filipe Inácio Matias; Andrew J. Green
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Kaitlynn Anderson
ANTHROPOLOGY

Faculty mentor: Kristen Fellows, PhD - Sociology and Anthropology

Research Symposium of the Graduate Student Council

Greensboro's Immoral Madams and the Legal System: A Linguistic Analysis

Research on historical sex work suggests the existence of a prostitution hierarchy throughout various cities in the United States, though most work has focused on larger, urban locations. One smaller, southern city, Greensboro, North Carolina, represents a gap in the research area. In order to determine if a prostitution hierarchy existed in Greensboro, an analytical framework established by Munns (2017) in her work on Fargo, ND was applied to the analysis of city directories, judgement dockets, court minutes, and census records. These sources further proved valuable to conduct a linguistic analysis of individuals charged with prostitution-related crimes to determine how the legal system interacted with each tier in the prostitution hierarchy. Particular attention is paid to the upper tier, also known as the madam cohort. Based on preliminary findings, Greensboro's prostitution-related arrests and charge terminology altered after the city ordinances were enacted in 1912. These findings highlight public perceptions of sex work according to local and regional views. This research contributes to eliminating a gap within the southern brothel narrative, while testing the applicability of a pre-existing framework.

Key words: Prostitution, Legal System, Linguistic Analysis, Greensboro

Juliana Antwi
PUBLIC HEALTH

Faculty mentor: Ramona Danielson, PhD - Public Health

Research Symposium of the Graduate Student Council

A multi-state Perinatal Quality Collaborative (PQC) to improve outcomes for maternal and infant health

Statement of Problem: North Dakota and South Dakota were among a handful of states without a Perinatal Quality Collaborative (PQC) until 2018, when public health and health care professionals created the North and South Dakota Perinatal Quality Collaborative (NSDPQC) to improve outcomes for maternal and infant health. The states share similarities such as hospital systems and large portions of each state being rural coupled with a shortage of healthcare professionals.

Method: NSDPQC partners explored funding opportunities as the initial stages of the NSDPQC was volunteer-run. The leadership transition to the Health Equity Office of the North Dakota Department of Health and the Title V Maternal and Child Health programming provided an opportunity to contract with a program coordinator as well as graduate student interns working on their Master of Public Health degrees. A transition in leadership to the University of North Dakota is planned for spring 2022. Partners from both states include physicians (e.g., obstetricians, specialty pediatrics, family medicine), nurse practitioners, university faculty and graduate students, partners from tribal health care organizations, and state department of health staff.

Results: The NSDPQC selected severe hypertension in pregnancy as its first quality improvement project. This multi-state collaboration led to identification of congenital syphilis as an emerging issue, the need for health equity training, and increased cases of hypertension in pregnancies.

Conclusions: A multi-state PQC has been effective for leveraging costs of infrastructure, sharing resources, working with hospital systems that span state lines, engaging tribal partners, and early identification of emerging issues.

Key words: Multi-state Perinatal Quality Collaborative

Labiba Noshin Asha
INDUSTRIAL AND MANUFACTURING ENGINEERING

Faculty mentor: Nita Yodo, PhD - Industrial and Manufacturing Engineering

Research Symposium of the Graduate Student Council

A Review on Multi-Objective Optimization Approaches for Sustainable Green Supply Chain Management

Supply chain management has accumulated economic and environmental concerns, especially during the COVID-19 pandemic. Over the years, the global supply chain has evolved into a more extensive interconnected complex network from multiple suppliers and manufacturers to customers. Since environmental issues have become a burning question in recent years, the focus has shifted to attain sustainability in supply chain management. However, this green supply chain management is often challenged with additional operating costs and difficulty monitoring the impact within the complex network system. Additionally, many stakeholders are not aware of the importance of sustainability analysis which eventually complicates the adoption of the green cultures in actual applications. Therefore, multi-objective optimization has become the commonly used technique for optimizing various aspects of supply chain performance. This research provides an overview of multi-objective optimization techniques deployed to formulate a green supply chain. The result of the study evaluates the effectiveness of analyzing green supply chain network design using the multi-objective optimization approaches. Finally, a conclusion is drawn with the scope of the potential research opportunities of integrating the economic and environmental considerations simultaneously in sustainable supply chain management practice.

Key words: Green Supply Chain, Multi-objective Optimization, Mathematical Model, Literature Review

Valentina Asiedu
PUBLIC HEALTH

Faculty mentor: Ramona Danielson, PhD - Public Health

Research Symposium of the Graduate Student Council

Pilot Use of the Participatory Grantmaking: An Equitable Method for Allocating Funds to Community-Based Organizations

Statement of Problem: To address results from its 2019 Maternal Child Health (MCH) Needs Assessment, the North Dakota (ND) Department of Health (DoH) strategized to increase routine preventative health visits among economically/socially marginalized women of reproductive age.

Approach: The NDDoH piloted the use of participatory grantmaking, an equitable method for funds allocation, to community-based organizations that served this population to implement culturally-specific media campaigns. Eight organizations serving the population of focus submitted a 1-page application or short video detailing their proposal for a project year. All applicants joined together to make funding decisions. Following the session, contracts were issued by NDDoH for all eight organizations. Grantees met several times to discuss their projects' progress and opportunities for collaboration.

Results: The grantees implemented educational approaches including webinars, training sessions, distribution of fliers, etc., rather than media campaigns as initially proposed by NDDoH. Overall, grantees reported appreciating the opportunity to award funds to viable community-based projects. Challenges encountered included lack of expertise in navigating online registration platforms and little knowledge on grant processes.

Implications: Participatory grant-making better reflected the NDDoH's commitment to equity and empowerment principles and resulted in a more diverse group of grantees than the NDDoH had reached through traditional grant-making methods.

Next Steps: Process evaluation resulted in a revised participatory grant-making process for a new cohort in 2022, currently in progress: a structured application and registration process for grantees, extensive training for grantees on the grant-making process, and an in-person grant making session to improve communication and comprehension.

Key words: Participatory Grantmaking, Equity, Reproductive age, Preventive, Process Evaluation

Rebecca Aubart
PHARMACY

Faculty mentor: Jeanne Frenzel, PharmD, PhD, BCSCP - Pharmacy Practice

Research Symposium of the Graduate Student Council

Accidental Overdose Rates in Discharge Patients Prescribed Naloxone

Any patient with an opioid prescription is at risk of accidental overdose. An average of 38 people died in the United States each day from overdosing on prescription opioids in 2019. Strategies to mitigate opioid overdoses in our communities include granting more access to naloxone products and providing effective education to those at risk and their support network. In a retrospective cohort study with chart review, we looked at naloxone dispensing to hospital discharge patients with an opioid prescription and risk factors for accidental overdose. Our research focused on hospital encounters and readmission post discharge involving opioid overdose and broke down whether the patient was prescribed naloxone or not at discharge. We could not conclude that naloxone prescribing decreased the number of readmissions. However, this is a relevant time for pharmacists to intervene to improve patient outcomes. Although local overdose rates are low, pharmacists can contribute by identifying patients at risk, providing information on opioid safety, signs of overdose, and naloxone use.

Key words: Hospital Discharge, Naloxone, Readmission, Overdose

Anurag Banerjee
PHARMACEUTICAL SCIENCES

Faculty mentor: Buddhadev Layek, PhD - Pharmaceutical Sciences

Research Symposium of the Graduate Student Council

Combination Therapy for Pancreatic Cancer Management

Pancreatic cancer is the 3rd leading cause of cancer-related death in the USA. Even though significant improvement has been observed in the prognosis of most cancer types, pancreatic cancer still has high mortality with a 5-year survival rate of 9%. Lack of efficient strategies to achieve cytotoxic concentrations of chemotherapeutics in the tumor tissue and the tumor's innate resistance to chemotherapy are significant barriers in improving treatment outcomes for pancreatic cancer along with severe side effects of chemotherapeutics. Thus, to resolve this shortcoming, researchers are focusing on alternative ways to provide effective concentration on tumor sites while still minimizing the overall concentration of chemotherapeutics in the body. Combination therapy has gotten a lot of attention nowadays. Combination therapy, the combination of two or more therapeutic agents, is a cornerstone of cancer therapy. Incorporating anticancer drugs that target different key pathways can reduce drug resistance while simultaneously reducing tumor growth and metastatic potential at low concentrations. Histone deacetylase (HDAC) inhibitors are emerging therapeutic agents as HDAC plays an essential role in growth arrest, differentiation, and apoptosis of tumor cells, with minimal effects on normal tissue. However, the efficacy of HDAC inhibitor as a single-agent therapy remains limited. In addition, their application in cancer therapy is also plagued by dose-limiting toxicities, including hematological and neurological toxicities. Oxaliplatin is a part of the FOLFIRINOX regimen to treat PDAC. However, because of the severe toxicity of oxaliplatin itself, the approach is limited to a subset of patients. In the proposed studies, we will address a new approach for treating PDAC with a combination of a novel HDAC inhibitor (entinostat) and a leading chemotherapeutic agent (oxaliplatin), used at much lower concentrations. Therefore, the long-term goal of this research is to develop a clinically achievable combination therapy for the treatment of PDAC and other solid tumors.

Initially, we have determined the synergistic potential of oxaliplatin/entinostat combination in both mouse and human pancreatic cancer cells. KPC and PANC-1 cells were treated with different drug combinations and synergistic potential was evaluated using compusyn and combenefit software. We observed synergistic antitumor efficacy at multiple combinations. To further verify the synergistic combination of these drugs, colony formation assay was performed. As a comparison to control, colony numbers were reduced to 73.96%, 75.69%, and 29.34% in entinostat, oxaliplatin, and combination treatment respectively. The mechanistic approach of synergism was evaluated by western blot where acetylated H3, H4, and cleaved caspase 3 was observed higher in combination treatment than in individual treatment.

In the future, we will be further investing in the synergistic effect of combination therapy in vivo model, it's further other mechanistic approaches for synergism.

Key words: Pancreatic cancer, Combination Therapy, Nanoparticles, Synergy

Ibrahim Bello
AGRICULTURAL AND
BIOSYSTEMS ENGINEERING

Faculty mentor: Ademola Hammed, PhD - Agricultural and Biosystems Engineering

Research Symposium of Gamma Sigma Delta: The Honor Society of Agriculture

Research Symposium of the Graduate Student Council

Optimization of Soybean Protein Extraction with Ammonium Hydroxide (NH_4OH) Using Response Surface Methodology

Plants have been recognized as sustainable sources of proteins. However, plant protein separation is challenging due to the resistance posed by plant recalcitrant cell wall. The conventional extraction methods make use of non-reusable alkali chemicals, and severe extraction. In this study, soy protein was extracted using NH_4OH, a mild recoverable and reusable alkali. Extraction conditions were optimized using response surface methodology (RSM). A central composite design (CCD) with four independent variables: temperature (25,40, 55, 70, and 85°C); NH_4OH concentration (0.5, 1, and 1.5%); extraction time (6, 12, 18, and 24 h) and solvent ratio (1:5, 1:10, 1:15 and 1:20 w/v) were used to study the response variables (percentage protein yield and amine concentration). Amine concentration indicates the extent of protein hydrolysis. The RSM model equation for independent and response variables was computed and used to create the contour plot graphs. Predicted yield of 77% protein and 0.22mM amine revealed a multiple R-squared value of 0.83 and 0.69 respectively. Optimum conditions to obtain high protein while minimizing amine concentration were obtained with 0.5 % NH_4OH concentration, 12 h extraction time and 1:10 (w/v) solvent ratio at 52.5°C. The findings suggest that NH_4OH is suitable to extract soybean protein without causing degradation.

Key words: Soybean proteins; Extraction; Ammonium hydroxide; Optimization; Response surface methodology

Samuel Bibby
PLANT SCIENCES

Faculty mentor: Marisol Berti, PhD - Plant Sciences

Research Symposium of Gamma Sigma Delta: The Honor Society of Agriculture

Research Symposium of the Graduate Student Council

Wider corn row spacing reduces corn yield but improves intercropped alfalfa yield in the following year

Alfalfa (*Medicago sativa L.*) is a staple crop grown by many dairy and beef farmers and some crop farmers in the northern Great Plains. The seeding year for alfalfa is almost always the least productive and often only provides one to two cuttings in the northern Great Plains. To determine if seeding alfalfa with corn (*Zea mays L.*) could increase alfalfa yield in the second year, and provide a corn crop during the first year, an experiment was conducted in Prosper and Hickson, ND during the years of 2020 and 2021. The experimental design was a randomized complete block with four replicates at each location. Treatments included alfalfa alone, corn alone at 76- and 152-cm row spacings and corn intercropped with alfalfa at 76- and 152-cm row spacings. The overall scale of success of these treatments is measured in corn grain yield in the first year and alfalfa establishment and forage yield in the second year. When years and locations were combined, corn alone with 152-cm row spacing yielded 17% less than corn alone with 76-cm row spacing, however, when comparing intercropped treatments, corn with 152-cm rows yielded 23% less than corn with 76-cm rows. The presence of alfalfa did not significantly affect corn yield with either corn row spacing. Data collected on each experimental unit also includes measurements of soil gravimetric water content, intercepted photosynthetically active radiation by the crop canopy, and multispectral indices recorded with an unmanned aerial vehicle. The data sets collected over this two-year study will allow for more specific recommendations regarding alfalfa-corn intercropping. Optimizing this specific cropping system for growers in the northern Great Plains could increase profitability as well as forage nutritive value and crop efficiency.

Key words: Corn, Alfalfa, Intercropping, Interseeding, Row-Spacing

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Kerri Bochantin
ANIMAL SCIENCES

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Research Symposium of Gamma Sigma Delta: The Honor Society of Agriculture

Research Symposium of the Graduate Student Council

Divergent planes of nutrition altered concentrations of hormones and metabolites but not semen characteristics in mature rams

Objectives were to evaluate impacts of divergent planes of nutrition on body weight, hormone and metabolite concentrations, and semen characteristics in rams. Mature rams (n=24; BW=83.1±2.64 kg) were individually housed and randomly assigned to positive (POS), maintenance (MAINT), or negative (NEG) planes of nutrition for 84 days. Rams were fed a common diet with feed allocations adjusted weekly based on body weight (BW) to achieve targeted weight change (approximately 12% initial BW). On days 0, 28, 56, and 84, body condition scores (BCS) and scrotal circumference (SC) were recorded, and blood and semen were collected. Blood was analyzed for triiodothyronine (T3), thyroxine (T4), testosterone, insulin-like growth factor-1 (IGF-1), glucose, and non-esterified fatty acids (NEFA). Semen was collected via electroejaculation and analyzed by Computer Assisted Semen Analysis. Data were analyzed with the MIXED procedure of SAS, with ram as experimental unit and significance determined at $P<0.05$. By design, BW was influenced by a treatment × day interaction ($P<0.0001$), and daily weight change was greater ($P<0.0001$) for POS (0.11±0.011kg) than MAINT (0.01 ±0.011kg), which was greater ($P<0.0001$) than NEG (-0.12±0.011kg). BCS and SC were greater for POS than NEG, indicated by a treatment × day interaction ($P<0.0001$). Concentrations of T3, IGF-1, and NEFA were increased in POS compared with NEG and MAINT by day 84 ($P\leq0.03$), whereas T4, testosterone, and glucose remained unaffected ($P\leq0.39$). No differences were observed among treatments for semen volume/concentration, motility, or morphology ($P\leq0.49$). Collectively, these results indicate a potential for epigenetic alterations which could influence offspring outcomes.

Key words: sire fertility, nutrition, hormones, metabolites

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Niyati Borkar
PHARMACEUTICAL SCIENCES

Faculty mentor: Sathish Venkatachalem, PhD - Pharmaceutical Sciences

Research Symposium of the Graduate Student Council

Kisspeptin Reduces Airway Hyperreactivity and Remodeling in Asthmatic Ovariectomized Mice

Motivation: After puberty, increased severity in women shows sex-skewed occurrence of asthma. Greater asthma in women may represent detrimental mechanisms upstream to or independent of estrogen. Moreover, CNS studies show kisspeptin (Kp) signaling is modulated by estrogen. However, the relevance and effect of endogenous estrogen on Kp signaling in regulating airway hyperresponsiveness (AHR) and remodeling is not yet explored. In this study, we utilized intact female vs. ovariectomized (OVX) mice to isolate estrogen influence from Kp effect in regulating AHR and remodeling in a murine model of allergic asthma.

Methods: Wild Type C57BL/6J female and OVX mice procured from Jackson Laboratory were challenged intranasally with mixed-allergen (MA)/PBS (vehicle) for 28 days, while animals from the treatment group received Kp-10 on alternate days. On day 29, mice were subjected to SCIREQ flexiVent to measure lung mechanics parameters. Bronchoalveolar lavage (BAL) was performed for differential leukocyte count (DLC) and lung tissues were processed for histology staining.

Results: MA-challenged female and OVX mice showed significant increase in airway resistance as compared to PBS, more pronounced effects observed in intact females. Kp-10 treatment significantly reversed the MA-induced changes. Interestingly, OVX mice showed significant effects of Kp-10 to improve lung mechanics compared to intact females. DLC and histology studies showed Kp-10 reduced MA-induced inflammatory cell infiltration and smooth muscle mass deposition in the airways respectively.

Conclusion: Overall, this study proves the modulatory role of estrogen in regulating kisspeptin signaling, thereby AHR and remodeling. Thus, providing relevance to higher asthma incidence and severity in women.

Key words: Asthma, sex steroids, animal studies, estrogen, kisspeptin receptor

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Lennel Camuy-Vélez
MICROBIOLOGY

Faculty mentors: Samiran Banerjee, PhD - Microbiological Sciences; Kevin Sedivec, PhD – School of Natural Resource Sciences

Research Symposium of Gamma Sigma Delta: The Honor Society of Agriculture

Research Symposium of the Graduate Student Council

Impact of grazing intensity on soil microbiome dynamics

Grasslands constitute one of the largest biomes on earth. Various management practices are used to prevent the homogenization of plant communities in grasslands and one of the most commonly used practices is cattle grazing. Soil microbial communities play an indispensable role in grasslands by performing numerous ecosystem services. However, our knowledge of the effect of grazing on soil microbiomes remains limited. To unravel the effect of grazing intensity, we assessed soil bacterial, fungal and protist communities under four levels of grazing: no grazing (0 days), low grazing (27 days), moderate grazing (54 days), and heavy grazing (74 days). Our results showed that while there were no major changes in bacterial and fungal diversity, intensive grazing significantly ($P<0.05$) increased the diversity of protists. Grazing intensity also significantly ($P<0.001$) changed the community structure of all three microbial groups. Interestingly, the decline in the relative abundance of some soil bacterial (e.g., Actinobacteria) and fungal (e.g., Agaricales, Helotiales, and Mortierallales) groups coincided with the increase of some protist groups (e.g., Discoba and Ochrophyta). Indeed, intensive grazing facilitated putative predator-prey relationships with a strong effect on protist:bacteria+fungi ratio ($R2=0.69$; $P<0.001$). This negative association between protists and bacterial and fungal groups were also clear in the soil microbiome network. Overall, our study reveals differential effects of intensive grazing on soil microbiomes with a negative effect on soil bacteria and fungi but a facilitative effect on protists.

Key words: microbiome, grasslands, grazing, soil, protist

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Emma Chandler
ENVIRONMENTAL AND CONSERVATION SCIENCE

Faculty mentor: Steven Travers, PhD - Biological Sciences

Research Symposium of the Graduate Student Council

Minnesota chill to Texas heat: The intraspecific variation of temperature tolerance in the sporophytic and gametophytic life stages of *Solanum carolinense*

Climate change is rapidly altering the environment and threatening plant species sensitive to environmental change. To persist in a changing environment, plants must adapt through natural selection, have the phenotypic plasticity to match the environment, or shift ranges to conditions that are more suitable for the species. In this study, we compared temperature tolerance in populations of *Solanum carolinense* from Texas and Minnesota to determine the intraspecific variation between populations of different climates. We examined traits in both the sporophytic (diploid) and gametophytic (haploid) life stages as selection occurs in both stages independently and each could contribute to evolutionary change. Evidence of overlap in gene expression between the sporophyte and gametophyte suggests a correlation between the two. Because monthly temperatures in Texas and Minnesota differ, we hypothesized that local adaptation of traits related to thermotolerance has resulted in a divergence between northern and southern populations. We also hypothesized that selection in both stages was correlated and involved in local adaptation of the populations. We found mixed results that were lacking a clear pattern for temperature tolerance between plants of MN and TX. These results indicate that there has been less divergence in the populations than we anticipated. There was no significant correlation between the sporophytic and gametophytic stages, suggesting that pathways involved in thermal tolerance in pollen and leaves may differ.

Key words: plants, temperature tolerance, adaptation, ecology, biology

Prantik Roy Chowdhury
MECHANICAL ENGINEERING

Faculty mentor: Adam Gladen, PhD - Mechanical Engineering

Research Symposium of the Graduate Student Council

Experimental analysis of the effect of fuel cell shutdown and assemble-disassemble on its performance

High temperature-based proton exchange membrane (PEM) fuel has grown attention because of its elevated reaction kinetics, high carbon-monoxide (CO) tolerance and simplified water management process. Prior research mainly focused on the performance degradation and durability of membrane electrode assembly (MEA) for continuous operation over a long period of time. However, there is limited data regarding the effect of shutdown and assemble-disassemble on fuel cell performance. The purpose of this study is to investigate the effect of these processes on the fuel cell performance at different combinations of operating conditions for serpentine-serpentine and serpentine-interdigitated flow field designs. The results show that the cell electric potential drop was less after second time shutdown compared to first time shutdown. The cell potential drop was also less due to dis-assemble and assemble of fuel cell for serpentine-serpentine combination. However, there was no cell potential drop noticed when the cell was dis-assembled and replaced by interdigitated flow field, and shutdown effect on cell potential drop was also negligible for serpentine-interdigitated combination. The cell potential drop was prominent after third times of dis-assemble and assemble of fuel cell. Thus, the fuel cell performance become stable after multiple times shutdown whereas performance drop become prominent after multiple times disassembling and assembling of fuel cell if same MEA is used.

Key words: PEM fuel cell, High temperature, Shutdown, Assemble-disassemble, Performance

Ashish Christopher
PLANT SCIENCES

Faculty mentor: Kalidas Shetty, PhD - Plant Sciences

Research Symposium of the Graduate Student Council

Phenolic Phytochemical-Linked Human Health and Food Safety Benefits of Select Botanicals

Edible plants are rich sources of phenolic phytochemicals with dual benefits of human health and food safety relevant functional qualities. These phenolic enriched edible plants are good dietary and therapeutic targets to address diet-linked chronic diseases such as type 2 diabetes, while also countering microbial spoilage and contamination of human food and animal feeds. Therefore, screening of botanicals for their phenolic phytochemical-linked antidiabetic and antimicrobial functional qualities has wider food and ingredient application relevance. Based on this above rationale, hot water extracts of select botanicals, amla (*Phyllanthus emblica*), clove (*Syzygium aromaticum*), kokum (*Garcinia indica*), and garlic (*Allium sativum*) were screened for their total soluble phenolic (TSP) content, phenolic profile, antioxidant activity, and anti-hyperglycemic property through *in vitro* inhibition of carbohydrate digestive enzymes such as *α-amylase* and *α-glucosidase*. Additionally, antimicrobial property of the botanical extracts against strains of *Salmonella Enteritidis*, *Listeria monocytogenes*, and *Escherichia coli* that are commonly associated with food-borne illnesses were also determined. High baseline TSP content, antioxidant and anti-hyperglycemic properties were observed among all botanical extracts. The major phenolic phytochemicals detected in the extracts were gallic, cinnamic, ellagic, benzoic, dihydroxybenzoic, protocatechuic, and *p-coumaric* acid along with catechin and rutin. All botanical extracts displayed significant antimicrobial activity against most of the bacterial strains that were tested, and the antimicrobial activity was specific for each strain. The results of this study indicate that select botanicals with rich phenolic profile can be integrated in human food and animal feed synergies to improve dual functional benefits of health and food safety.

Key words: Antioxidant, antihyperglycemic, antimicrobial, botanicals, phenolics

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Autumn Clark
ENVIRONMENTAL AND
CONSERVATION SCIENCE

Faculty mentor: Devan McGranahan, PhD - USDA-ARS

Research Symposium of the Graduate Student Council

Perceptions of Prescribed Fire for Wildlife management by Dakotan Stakeholders

In the Northern Great Plains, Federal, State, and NGO entities have been the primary users of prescribed fire, with an emphasis on wildlife habitat management and rangeland grazing resources. With but a small area of the Northern Great Plains publicly owned and managed, and initiatives aimed at enhancing the value of private land for game and non-game habitat, there is a growing need for broader use of prescribed burning on privately-owned land. Imperative to promoting safe and effective prescribed fire is a better understanding of the perceptions and attitudes of prescribed fire among the diversity of practitioner groups. In spring of 2021, we conducted semi structured interviews with private land managers, state and federal land management professionals, and fire management professionals across North Dakota and northwestern South Dakota. The interviews focused on assessing: individual familiarity with prescribed fire, use of prescribed fire by land managers, knowledge land management professionals have of the landowners in their community, and the training that fire management professionals undergo. We also asked about barriers to fire adoption specific to the region. Landowners interested in burning reported burn bans and insufficient help were barriers to application. Landowners who did not burn emphasized prior escapes, liability concerns, and lack of fire use in the area. The results suggested that increased prescribed fire knowledge for land management professionals and local examples of fire use could provide landowners with more decision-making information. These interviews lay the groundwork for a quantitative analysis about prescribed fire in stakeholder communities. Additionally, the results provide meaningful bounds within which land managers are supported and informed in their communities. The results of this work will help to work across fences and jurisdictional boundaries to restore and maintain fire dependent landscapes in the Northern Great Plains that local wildlife relies on.

Key words: social perceptions, prescribed fire, wildlife

Autumn Clark, Devan McGranahan, Benjamin Geaumont, Carissa Wonkka

Justin Clarke
RANGE SCIENCE

Faculty mentor: Torre Hovick, PhD - School of Natural Resource Sciences

Research Symposium of the Graduate Student Council

Breeding Bird Nesting Abundance and Success in a Modified Twice-over Rest-rotation Grazing System

Grassland birds are one of the most threatened avian guilds, largely due to loss and mismanagement of grasslands. Current management negatively influences avian biodiversity by creating homogenous pastures through uniform grazing practices and altered or suppressed fire regimes. Restoring disturbance regimes including fire can be an effective way to create heterogeneity but, in many regions, a cultural aversion to fire requires creative management practices to restore heterogeneity. In 2018, we implemented a modified twice-over rest-rotation grazing system with varying grazing intensities to create heterogeneity in vegetation structure. This system has four replicates that are split into quarters, based on percent utilization: heavy (60+ %), full (40-60%), moderate (20-40%), and rested (0%). We assessed paddock scale vegetation structure using three 25 meter transects within each paddock. We used nest dragging to locate nests and monitored nests every 2-4 days until the nest fledged or failed. We used the RMark interface to assess nest survival rates and used hierarchical modeling steps to assess the drivers of nest success. We found that the MTORG system achieved structural heterogeneity between paddocks. We found 437 nests belonging to 18 facultative and 6 obligate grassland birds. Nesting species richness and nesting abundance was highest in the full and light treatments and lowest in the heavy and rested treatments. Overall apparent nest survival was 29% for all species combined. Our preliminary results support that variation in grazing intensity influences diversity in breeding bird nesting abundances by altering vegetation structure.

Key words: avian; grazing; survival; nest

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Amirreza Daghighi
BIOMEDICAL ENGINEERING

Faculty mentor: Bakhtiyor Rasulev, PhD - Coatings and Polymeric Materials

Research Symposium of the Graduate Student Council

In Silico Prediction of the Toxicity of Nitroaromatic Compounds: Application of Super Learner QSAR Approach

To produce functional materials with desired qualities, in silico prediction of physio-chemical characteristics of materials' components has become an essential tool in modern chemists' toolbox. In this work, we propose a Quantitative Structure-Activity Relationship (QSAR) model that estimates toxicity for a large set of nitroaromatic compounds. The model's theoretical descriptors were derived from the structure of the compounds, and selected from initially generated set of 4500 descriptors. A super learner model was created with the greatest predictive performance coming from two Support Vector Regression (SVR) base models followed by linear regression to fine-tune the out-of-SVR predictions. Various methods were used to validate the predictability and robustness of the super learner, including squared correlation coefficient (R^2), Root Means Square Error (RMSE), mean absolute error (MAE) on the training set, test set, and true external test set. Finally, this research addresses the contribution of each descriptor to the toxicity using the Accumulated Local Effect (ALE) approach.

Key words: QSAR, Artificial Intelligence, toxicity, nitroaromatic compounds, interpretation

Urmi Das
MICROBIOLOGY

Faculty mentors: Barney Geddes, PhD - Microbiological Sciences; Carrie Miranda, PhD - Plant Sciences

Research Symposium of the Graduate Student Council

Harnessing the microbiome to combat iron deficiency chlorosis in soybean

Iron deficiency chlorosis (IDC) is a significant yield constraint in agriculture, particularly for soybean, a major crop in North Dakota. However, farmers are yet to find an eco-friendly solution to this problem. Therefore, we expect to explore the untapped reservoir of microbiome that would offer a practical solution to iron deficiency chlorosis. We hypothesize that, under IDC stress, soybean plants may recruit beneficial microbes that might help to alleviate iron deficiency. To address this hypothesis, we are using 16S amplicon sequencing to evaluate the restructuring of the microbial community in the soybean rhizosphere under IDC or non-IDC conditions. We sampled four different soybean genotypes having differential sensitivity or tolerance to IDC from four different field locations in North Dakota that had variant degrees of iron deficiency. We also used high-IDC soils in combination with various doses of nutrients and Soygreen (EDDHA), a Fe chelator, to induce different levels of IDC in tolerant and sensitive genotypes in a greenhouse. Preliminary data using field samples indicate distinct microbial community structures in the rhizosphere of soybeans with varying levels of IDC. Visual chlorophyll scoring system, ranging from 0 to 5, revealed consistent IDC in leaves of sensitive varieties under all IDC conditions tested; these data indicate visual scoring with soygreen supplementation may be useful tools not only for managing and screening IDC resistance, but also for reductionist approaches to study the effect of IDC on the plant microbiome. These findings encourage more efforts into investigating how IDC affects microbial communities and how we may harness beneficial microbiome as a tool for stress-resilient crops for sustainable agriculture in North Dakota.

Key words: soybean microbiome to withstand iron deficiency

Bethania Dávila Ruiz
ANIMAL SCIENCES

Faculty mentor: Lawrence Reynolds, PhD - Animal Sciences

Research Symposium of Gamma Sigma Delta: The Honor Society of Agriculture

Research Symposium of the Graduate Student Council

Effect of dietary supplementation with vitamins/minerals and/or energy on fetoplacental vascularity in crossbred Angus heifers

The placenta establishes a vascular interface between mother/embryo supplying the bioenergetic needs for successful development. In these studies, we evaluated if vascularity of the fetal part of the placenta termed cotyledon (COT), of crossbreed Angus heifers, is affected by vitamin and mineral (VTM) and/or energy (NRG) supplementation during pregnancy. Two experiments were conducted: In Exp.1, 34 heifers were randomly assigned to VTM/NoVTM supplementation 71 days before artificial insemination. At breeding, heifers were also randomly assigned to receive NRG, resulting in the following treatments combinations: NoVTM-NoNRG (n=8), NoVTM-NRG (n=8), VTM-NoNRG (n=9), and VTM-NRG (n=9). Supplementation was maintained until d 83 when heifers were ovariohysterectomized and COT was collected. On Exp.2, 72 heifers were randomly assigned to VTM (n=36) or control (CON) (n=36) supplementation at breeding and continuing until parturition when COT from 28 heifers was collected. COT from both experiments were evaluated by immunohistochemistry using rabbit anti-CD34/CD31 antibodies as markers for vascularity and DAPI for background nuclear staining. In Exp.1, BS1 lectin was used as a marker of fetal placental tissue. Three images per animal were captured and the percentage/number of blood vessels within the tissue area was analyzed with the SAS GLM procedure. Results indicated COT vascularity is not affected by VTM, NRG, or their interaction on Exp.1, whereas there was a tendency in Exp.2 for COT vascularity to be greater on VTM supplementation (P- value=0.0723). These results suggest that dietary VTM supplementation from breeding until parturition potentially has a beneficial effect on placental vascular development in crossbred Angus heifers.

Key words: placenta; cotyledon; vascularity; vitamin; mineral; supplementation

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Omolola Eniodunmo
CHEMISTRY

Faculty mentor: Svetlana Kilina, PhD - Chemistry and Biochemistry

Research Symposium of the Graduate Student Council

Fine-Tuning the Photophysical properties of Cu (I) Dipyrrin Complexes via Substituting groups and Conjugation

Most photo-active transition metal complexes (TMCs) are made from precious metals with very low natural abundance in Earth's crust. Additionally, development of highly efficient near infrared (NIR) emitting TMCs has been under-pursued to date due to our limited understanding of the interplay between radiative and non-radiative relaxation processes leading to extreme variations in photoluminescence quantum yield (PLQY). We use density functional theory (DFT) and time-dependent DFT (TDDFT) to investigate the photo-physics of Cu (I) dipyrrin complexes and Redfield-based non-adiabatic molecular dynamics (NAMD) to compute PLQY. Calculations show a low-energy absorption peak appearing in the red-to-near infrared (NIR) regions (~700 nm) tunable by substituting electron withdrawing (CN, NO_2) and electron donating groups (OCH_3, NPh_2), as well as changing the π-conjugation via side linking groups (H, -CH_2CH_2-, -CH=CH-). The substituent groups change the charge transfer character of the low-energy excitons which is expected to have a large influence on the resulting PQLY, while the side linkages (conjugated connectors) increase the degree of delocalization of the excitons. When non-adiabatic couplings are computed with PBE functional, the splitting between energy levels, including the HOMO-LUMO gap, is smaller, compared to hybrid PBE0 functional. Therefore, PBE likely overestimates non-radiative recombination rates. However, systematic comparison across all models shows that the PLQY increases with the strongest electron-withdrawing group, as well as with enhancement of structural rigidity caused by π-conjugated side linking. Further work will involve computing non-adiabatic couplings with a hybrid functional to improve accuracy of NAMD calculations.

Key words: Near Infra-red, Quantum Yield, Photo-physics, excitons, Dynamics

Sunil GC
AGRICULTURAL AND BIOSYSTEMS ENGINEERING

Faculty mentor: Xin Sun, PhD - Agricultural and Biosystems Engineering

Research Symposium of the Graduate Student Council

Weed Species Classification using Computer Vision Based Texture Features and Support Vector Machine Classifier

Post-emergence weed control requires high precision when controlling weeds that are side-by-side with crops due to potential damage to the crop. Precision weed control depends on the accuracy of image-based classification of weeds and crops. The variety of weeds and crops and their close proximity pose challenges for weed identification in field conditions. The objective of this study was to classify the species of weeds and crops using RGB image texture features with Support Vector Machine (SVM) classification algorithm and compare the classification of six crops species (black bean, canola, corn, flax, soybean, and sugar beet) individually in the presence of four species of weeds (horseweed, kochia, waterhemp, and ragweed). These species were selected because production of these crops is very prominent in the Mid-West region of the USA and selected weed species have negative impact on crop yield. A total of 3792 images were captured using a google Pixel 5 mobile (Google Inc, Melon Park, CA) under the greenhouse environment condition, including 2271 weed images and 1521 crop images. The excess green component was used to extract the green vegetative part of the images, from which local binary pattern (LBP) and gray-level co-occurrence matrix (GLCM) texture features were extracted. ReliefF feature selection algorithm was applied to select the most important features which were used for SVM model training. The images were divided into 80% and 20% ratio to construct the training and testing data sets, respectively. One model was trained using only four weed species and six models were constructed each with one of the six crops together with the weeds (seven models total). Accuracy percentage, f1-score, and kappa score were used to evaluate model performance and data reliability. Accuracy and f1-score percentage was obtained between 87% and 90%, whereas kappa score was 0.84 to 0.87. For individual crop species, f1-score was obtained between 85% and 99%. These results demonstrated promising application of SVM and texture features for weed identification in precision agriculture.

Key words: weed and crop classification, feature selection, texture features, machine learning, support vector machine

Sunil GC, Yu Zhang, Cengiz Koparan, Mohammed Raju Ahmed, Kirk Howatt, Xin Sun

Anuj Ghimire
BIOLOGICAL SCIENCES

Faculty mentor: Britt Heidinger, PhD - Biological Sciences

Research Symposium of the Graduate Student Council

Periodic cooling induced compensatory growth in house sparrow (*Passer domesticus*) nestlings

Organisms are subjected to allocation of a finite amount of resources to different competing life history traits. This difference in resource allocation results in varying amounts of investment in each life history trait. This varying amount of investment creates a trade-off between different traits. Among various traits that could be involved in these trade-offs that shape organisms' phenotype and overall fitness, one of the important trade-offs exists between growth and longevity. Though growth and longevity have been found to be negatively related, the results are varying from negative, positive, and even no relationship at all. Depending upon the individuals and environmental quality these trade-offs might be obscured. However, this trade-off might be exacerbated during stressful conditions during prenatal and postnatal growth. Here, we manipulated stress exposure during prenatal growth in house sparrow eggs. Eggs were periodically cooled for 3 hours every day during the incubation period. Chicks were blood sampled on days 2 and 10 post-hatching and measured on days 2, 6, and 10 post-hatching to examine the effects of treatment on growth, changes in telomere length, and body size. Results will be discussed within the context of life-history theory.

Key words: Life History Trade-offs, Telomeres, Growth, Evolutionary Ecology, Evolutionary Biology, Avian Ecology

Bijaya Ghimire
HORTICULTURE

Faculty mentor: Harlene Hatterman-Valenti, PhD - Plant Sciences

Research Symposium of the Graduate Student Council

Yield Response of Bell Pepper *(Capsicum annum)* Cultivars to Different Sources of Nitrogen

Six bell pepper cultivars and three nitrogen sources were evaluated during the 2021 growing season at the NDSU Horticulture Research Station near Absaraka, ND. The goal was to analyze the yield responses for sweet pepper cultivars with different nitrogen sources. SUPERU and ESN were applied pre-plant at 54.43 kg N ha^{-1}, while urea was planned as a split application (50% pre-plant and 50% mid-season). Since plants took more time to establish (covering to prevent freezing temperature and cool late spring temperatures), additional 9.07 kg N ha^{-1} (10-10-10) was applied on June 8 and July 1. The remaining 50% of urea was not applied since plants were not chlorotic during the mid-season. 'King Arthur' was a superior cultivar in terms of fruit number per plant and fruit weight per plant. 'Olympus' had the greatest average fruit weight per plant, but this was not significantly different from 'King Arthur'. Plants receiving ESN and SUPERU had a greater number of fruits and greater fruit weight per plant. The interaction between cultivar and nitrogen sources showed a significant effect on average fruit weight. The Greatest average fruit weight occurred with 'Olympus' and the urea application, which was similar to 'King Arthur' and the ESN application. For growers, 'King Arthur' should be recommended because it had the greatest yield regardless of the N source. Future research will examine if a combination of urea plus ESN or SUPERU at plant would reduce labor costs, provide season-long N and a more environmentally sustainable fertilizer application.

Key words: Bell Pepper, Urea, ESN, Super Urea

Shrinwanti Ghosh
BIOLOGICAL SCIENCES

Faculty mentor: Jiha Kim, PhD - Biological Sciences

Research Symposium of the Graduate Student Council

3D In Vitro Model of Patient-derived Breast Cancer Cell line Mimic In Vivo Features

Cell culture is essential and required step in cancer research. Most cells are cultured using traditional two-dimensional (2D) methods. However, 2D cultures have many drawbacks, such as variations in cell morphology, method of cell division, stages of cell cycle, and cell-cell interaction. These limitations led to the design of improved three-dimensional (3D) cell culture model, which have been applied as a transitional model between in vitro cancer cell cultures and in vivo tumors. The aim of this study was to create reliable in vitro 3-D models with characteristics close to in vivo tumors. We explore a 3D "hanging drop" model to evaluate the proliferation capacity of patient derived breast cancer cells. We revealed 3D is a promising model to evaluate essential tumor stages, including epithelial-mesenchymal transition (EMT), programmed cell death apoptosis. In our experiments, among the five different cell lines 3D model was tracking intermediate stages of cancer associated EMT. Our findings revealed the apoptotic marker expression, and the necrotic region will arise in the spheroids during prolonged spheroidization time. Herein, we used image analysis to establish a link between human breast cancer spheroid morphology and spheroidization time. Considering the results, 3D cell culture model has potential to provide alternative ways to study cancer cell behavior and is anticipated to ultimately bridge the gap between 2D cell culture and patient derived cell lines. Our study indicates tumor cells in 3D models appears to better represent physiological properties like those in vivo.

Key words: 3D cell culture methods, Proliferation rate, EMT, Apoptosis, Necrotic Core

Brady Goettl
SOIL SCIENCE

Faculty mentor: David Franzen, PhD - School of Natural Resource Sciences

Research Symposium of Gamma Sigma Delta: The Honor Society of Agriculture

Research Symposium of the Graduate Student Council

Economically Optimum Nitrogen Rates for North Dakota Two-Row Malting Barley

As the demand of two-row malting barley (*Hordeum vulgare L.*) increases, having sound nitrogen (N) recommendations is increasingly necessary. Not only does N play a role in grain yield, but also significantly impacts grain malting characteristics including protein and plump. To determine the impacts N rate and N availability have on two-row malting barley, two experimental sites were established in Spring 2020 and 2021. The experiments were organized as a randomized complete block design with a split-plot arrangement; each site consisted of 100 experimental units in 2020 and 50 experimental units in 2021. Treatments consisted of five fertilizer rates from 0 to 190 kg N ha^{-1} and two malting barley cultivars. Soil nitrate-N samples were taken prior to planting and N credits from the previous crop were considered to determine the total known available soil N (TKAN). It was determined there was a strong relationship between N rate and grain yield. There was also a strong positive correlation between N rate and grain protein. When the relationship between grain yield and TKAN was modeled using a best-fit regression, it was determined maximum yield can be reached at 210 kg TKAN ha^{-1} with a grain protein of 128 g kg^{-1}, meeting malting quality requirements. When factoring in economic information, the TKAN range needed to produce the barley crop at the highest profitability is lower than TKAN of maximum yield; ranging from 106 to 189 kg TKAN ha^{-1}. No significant interactions between N rate and kernel plump were noted.

Key words: Malting, Barley, Nitrogen, Fertility

Brady Goettl, Honggang Bu, Abbey Wick, David Franzen

Ryan Goke
COMMUNICATION

Faculty mentor: Catherine Kingsley-Westerman, PhD - Communication

Research Symposium of the Graduate Student Council

Organizational support, climate of creativity, and safety culture as antecedents to promotive and prohibitive voice

The key to encouraging employee voice is signaling support for change and helping employees overcome obstacles that discourage them from speaking up. Because behaviors and norms that enable or discourage employee voice are manifested in organizational features, this report examines how organizational support for creativity and a culture of safety influence promotive and prohibitive voice behaviors. Results indicate a significant improvement to the regression models for both promotive and prohibitive voice with the addition of safety culture and climate of creativity, demonstrating the importance of these organizational features for enhancing employee voice.

Key words: Employee voice, Climate of creativity, Safety culture, Organizational Support

Krystal Grieger
CHEMISTRY

Faculty mentor: Alexey Leontyev, PhD - Chemistry and Biochemistry

Research Symposium of the Graduate Student Council

Development of the *Assessment of Student Knowledge of Green Chemistry Principles* (ASK-GCP)

There has been increased attention on the need to integrate green chemistry into the curriculum, which has promoted a flurry of literature articles on methods for its incorporation. However, most reports of green chemistry instruction include only student perceptions instead of learning gains from the activity. The development of an instrument which can rapidly measure student knowledge of green chemistry would allow cognitive gains from the instructional activity to be measured and compared across studies. Therefore, this presentation will address our research on the development of the *Assessment of Student Knowledge of Green Chemistry Principles* (ASK-GCP) and evaluation of its sensitivity and effectiveness for measuring student knowledge of green chemistry principles. This 24-item true–false instrument was administered to 448 students enrolled in general and organic chemistry courses. The instrument was shown to be sensitive for distinguishing known groups with various levels of green chemistry knowledge and instructional exposure. It was also shown to be effective for detecting gains in green chemistry knowledge when used to assess student knowledge before and after instruction. Furthermore, the item difficulty range was found to match the student ability range. Thus, the findings verified that the ASK-GCP instrument would provide an accurate measure of student knowledge of green chemistry principles and can fulfill the need for a rapid uniform assessment.

Key words: assessment, instrument development, green chemistry, chemistry education, discipline-based educational research

Maverick C. Guenther
ANIMAL SCIENCES

Faculty mentor: Carolyn Hammer, DVM, PhD - Animal Sciences

Research Symposium of Gamma Sigma Delta: The Honor Society of Agriculture

Research Symposium of the Graduate Student Council

Evaluation of neonatal Fc receptor (FcRn) in lamb intestinal tissues

The neonatal Fc receptor (FcRn) transports IgG across mucosal surfaces and is important for intestinal immune protection; however, its role in the lamb is unknown. Additionally, the effects of maternal nutrition on offspring FcRn abundance have not been reported. Maternal selenium (Se) supply and plane of nutrition alter morbidity and mortality in lambs as well as absorption of IgG. The objective of this study was to evaluate intestinal FcRn abundance in lambs born from ewes fed differing levels of nutrition and Se. Intestinal tissues from two experiments (EXP1 n=71; EXP2 n=80) were used. Both experiments utilized a 2x3 factorial design. Main effects included Se supplementation [adequate or high] and plane of nutrition [60% (RES), 100% (CON), or 140% (HIGH) of requirements]. Lambs were raised to 57 d or 21 d (EXP1 and EXP2; respectively). Intestinal tissues were collected and fixed prior to paraffin embedding. Cross-sections were stained for FcRn. Tissue area of interest was captured using the tiling module of Zeiss and images were analyzed using ImagePro Premiere software. Relative fluorescence per area was used as an indicator of FcRn abundance. Maternal nutrition tended ($P \leq 0.07$) to affect lamb intestinal FcRn abundance with CON having higher abundance compared to HIGH or RES (EXP1). There was no effect of maternal nutrition in EXP2 or maternal Se supplementation on intestinal FcRn abundance in lambs from either experiment ($P \geq 0.56$). These data show that maternal nutrition may influence offspring FcRn abundance and that further studies examining the contribution of lamb age are needed.

Key words: FcRn, IgG, Lamb, Nutrition, Selenium

Emma Hawley
MICROBIOLOGY

Faculty mentor: Glenn Dorsam, PhD - Microbiological Sciences

Research Symposium of the Graduate Student Council

Sexual Dimorphisms in the Function of a Gut Neuropeptide on Adipose Biology

Obesity is associated with the leading causes of mortality in the US, resulting in healthcare costs equaling $179 billion annually. Therefore, there is a critical need to improve therapeutic strategies to combat this 21st century epidemic. White fat consists of at least two types of adipocyte cell lineages, called white and beige adipocytes. White adipocytes store fat, while TMEM26+ beige adipocytes "burn" fat and are clinically relevant due to their anti-obesogenic actions. Vasoactive intestinal peptide (VIP) is a metabolic hormone that regulates insulin and glucagon secretion and is secreted by, and acts on, white adipocytes. VIP deficient mice are leaner than wild type littermates yet consume similar amounts of food. We hypothesized that loss in VIP signaling skews towards beige adipocyte differentiation resulting in leaner body weights. To this end, we investigated various parameters of adipose biology using male and female VIP deficient mice. Surprisingly, our results showed that male, but not female, VIP deficient mice exhibited lower mRNA levels for the beige adipose marker, TMEM26, hypertrophic remodeling of their subcutaneous white adipocyte depots and decreased serum non-esterified fatty acids compared to wild type littermates. These observations suggest a sexual dimorphism in which VIP signaling in male mice regulate beige adipocyte differentiation and fatty acid homeostasis. Importantly, we propose that VIP agonists, rather than antagonists, might serve as a translational remedy for treating human obesity in males.

Key words: Adipogenesis, lipids, thermogenesis and gut peptide

Phat Kim Huynh
INDUSTRIAL AND MANUFACTURING ENGINEERING

Faculty mentor: Trung Quoc Le, PhD - Industrial and Manufacturing Engineering

Research Symposium of the Graduate Student Council

Optimal Sampling Strategy for Multi-scale Complex Dynamical Systems using Deep Reinforcement Learning

Background and motivation: Multi-scale modeling of complex system dynamics is modeling the system behaviors at multiple time and/or spatial scale, where the macro-scale phenomena are driven by micro-scale dynamics. However, the coupling dynamics across scales has caused the system modeling problem to become more difficult unless the scales are disambiguated in a systematical way. Therefore, it motivates the development of efficient data-driven algorithms for multi-scale dynamics discovery and optimal sampling strategy.

Methods: We propose a reinforcement learning framework using deep Q-learning agent that integrates multi-scale complex dynamics to define the reward signals for the agent, which aims to optimally sample the data that capture multi-scale system dynamics and therefrom use these data points to control complex systems. Two algorithms for systems dynamics discovery and prediction are used: (1) sparse identification of nonlinear dynamical systems (SINDy) and (2) Hankel alternative view of Koopman (HAVOK). The proposed methods are validated using 3 case studies: (1) noisy Lorenz system, (2) fast and slow Van der Pol oscillator, and (3) real-life complex system — cardiovascular and respiratory systems.

Results: The multi-scale deep reinforcement learning model which can automatically determine the optimal data sampling strategy for sufficiently capturing multi-scale and/or multi-physics dynamics in all three case studies. The learnt optimal policy was relatively complex to resist the non-convergence problem, minimize the sample size, and sample the data points in the region of disagreement.

Conclusions: The work can facilitate the advancement of data-efficient reinforcement learning methods for multi-scale complex systems, and therefrom understand, predict, and control them.

Key words: Optimal sampling strategy, multi-scale dynamics, multi-scale modeling, complex systems, deep reinforcement learning

Md- Tariqul Islam
CELLULAR AND MOLECULAR BIOLOGY

Faculty mentor: Sheela Ramamoorthy, DVM, PhD - Microbiological Sciences

Research Symposium of the Graduate Student Council

In-vivo models for Torque Teno Sus Virus (TTSuV)

Motivation / Statement of Problem: Torque Teno Viruses (TTVs) are small, ubiquitous DNA viruses in host virome and TTVs role as primary pathogen is not clear. Co-infection of TTVs with porcine circovirus type 2 (PCV2) and swine influenza (SIV) results in exacerbation of clinical manifestations. Since TTVs do not grow well in cell cultures, the primary objectives of this study are to determine whether recombinant TTV derived from infectious clone will infect and replicate in pigs and mice.

Methods: Recombinant TTSuV1 obtained by transfection of HEK21 cells with the dimerized infectious clone was used to infect 2-3 days old colostrum-deprived piglets and 2 weeks old C57BL/6J mice. Study animals were superinfected with SIV at 12- and 24-days post TTSuV1 infection. Viral loads in serum, lungs and nasal swabs were assessed by TTSuV1-specific qPCR. Blood cell associated virus was detected by flow cytometry using virus and cell type-specific markers. Tissue pathology due to viral infection was assessed by histopathology.

Results: A higher viral load was observed in both single and co-infected group between 2-4 weeks compared to uninfected animals. Flow cytometry data establishes the notations of blood cells permissiveness to TTV infection, preferentially targeting lymphocytes. Mild to moderate tissue lesions were detected in both single and co-infected group.

Conclusions / Impact: Recombinant TTSuV1 derived from the infectious clone behaved in a manner like natural variant in pigs and mice. In-vivo models developed in this study helped to establish baseline parameters for understanding TTVs role as primary or co-infecting agents.

Key words: Torque Teno Virus, Infectious clone, Recombinant TTSuV1, In-vivo model, Co-infection

Md Zahirul Islam
MECHANICAL ENGINEERING

Faculty mentor: Chad Ulven, PhD - Mechanical Engineering

Research Symposium of the Graduate Student Council

Continuous Carbon Fiber Reinforced Custom Object Printing using UV Curable Thermoset Resin and their Mechanical Characterization

Due to design flexibility 3D printing has become an emerging manufacturing technique, however its application as a structural material is still limited due to the poor mechanical strength and low thermal stability of 3D printed parts. Because of the superior mechanical strength of carbon fiber, 3D printing of continuous carbon fiber reinforced thermoset composites could overcome this barrier of mechanical strength and thermal stability. UV curing based 3D printing of continuous carbon fiber shows potential, however this process is also limited in making custom object due to fiber loop creation by turning of the nozzle at the corner of the object. A laser cutter incorporated 3D printing of continuous carbon fiber reinforced thermoset composites is proposed and demonstrated over this current study. This proposed 3D printing technologies successfully demonstrated the manufacturing of custom object having comparable mechanical and thermal strength with similar composites manufactured by conventional manufacturing process. Proper tuning of the process parameter of this proposed 3D printing technique has great potential to replace conventional manufacturing process of composites by 3D printing.

Key words: 3D printing, Carbon fiber, UV curing, continuous fiber reinforcement, thermoset composites

Jesmin Jahan
CELLULAR AND MOLECULAR BIOLOGY

Faculty mentor: Yagna Jarajapu, MPharm, PhD, FAHA - Pharmaceutical Sciences

Research Symposium of the Graduate Student Council

Transient Silencing of TGF-**β1** Reverses Myelopoietic Bias in Older Diabetic CD34⁺ Cells

Background: CD34⁺ stem progenitor cells participate in vascular repair by stimulating angiogenic functions of the endothelium. Aging and diabetes are associated with the impaired vasculogenic potential of CD34⁺ cells. Previous studies showed that diabetic dysfunction was largely due to paracrine pro-inflammatory and anti-angiogenic switch in the phenotype of CD34⁺ cells. We recently showed that older-diabetic (DB) cells had increased expression of transforming growth factor β1 (TGFβ1).

The current study tested the hypothesis that TGFβ1-silencing reverses myelopoietic bias in diabetic CD34⁺ cells by downregulation of alarmin/RAGE axis.

Methods: CD34⁺ cells were isolated from nondiabetic (ND) and DB subjects. Phosphorodiamidate morpholino oligomers (PMO) were used for TGFβ1-silencing. Circulating CD34⁺ cells and monocyte -macrophages were enumerated. For gene expression qPCR and for myelopoiesis, CFU-GM assays were carried out.

Results: Classical monocyte (anti-inflammatory) was lower ($p<0.05$), whereas non-classical (pro-inflammatory) monocyte ($P<0.05$) was higher in DB than ND. DB-CD34⁺ cells generated more colonies in the CFU-GM assay than ND cells. Non-classical monocyte was higher in DB-CFUs ($p<0.05$). A higher number of pro-inflammatory ($p<0.05$) and a lower number of anti-inflammatory macrophages ($p<0.05$) were detected in CFUs derived from DB cells. This imbalance was not observed in cells modified with TGF β1-PMO. Gene expression of S100A8/A9, A10, A14, S100P, HMGb1, and RAGE were higher ($p<0.05$) in DB CD34⁺ cells than ND and reversed by TGFβ1 silencing.

Conclusions: Silencing of TGF-β1 is a promising approach for enhancing the revascularization potential of CD34⁺ cells from diabetic older adults by reversing the paracrine pro-inflammatory functions that would negatively impact vascular repair.

Key words: Stem cells, Diabetes, Myelopoiesis, TGF-beta1

Angela B. Johnson
EXTENSION EDUCATION

Faculty mentor: Elizabeth A. Gilblom, PhD - School of Education

Research Symposium of Gamma Sigma Delta: The Honor Society of Agriculture

Research Symposium of the Graduate Student Council

Farm Machinery Injuries: A Retrospective Analysis of Admissions at a Level 1 Trauma Center in North Dakota

Purpose: Farm machinery is consistently identified as the principal cause of fatal and nonfatal agricultural injury (AI). However, few studies examine the incidence and magnitude of farm machinery injuries (FMIs) sustained from a variety of farm machinery. Additionally, AI rates are underrepresented in the upper Midwest due to a lack of a national reporting system. The purpose of this study was to characterize the incidence and severity of FMI patients presented to a Level I adult trauma center in Fargo, North Dakota.

Methods: A retrospective review of the trauma registry of Sanford Medical Center Fargo (SMCF) was performed between January 2010 and December 2020. FMI were identified through ICD-9 and ICD-10 codes. We compiled a final list of 106 patients with FMI, and manually categorized each injury by the type of machinery associated with the injury. Falls, ATVs, and animal handling were excluded from the analysis.

Results: The age range for FMI patients was 10 to 86 years with a mean of 48 years. Males experience 91.2% of tractor injuries and males 65 and over account for nearly 53% of all tractor injuries (n=18), including five deaths. The 'other machinery' category was the second most common FMI (n=26) and auger injuries (n=24) are third.

Conclusion: FMI represent a significant problem in the upper Midwest. While the leading cause of fatal and non-fatal FMI are tractors, most tractor injuries are preventable. Safety education for older adult machine operators should include the relearning of the safe operation and maintenance of tractors.

Key words: agriculture, injury, farm machinery, farm safety, tractor

Ellysa Johnson
NATURAL RESOURCES MANAGEMENT

Faculty mentors: Torre Hovick, PhD - School of Natural Resource Sciences; Jason Harmon, PhD - School of Natural Resource Sciences

Research Symposium of the Graduate Student Council

Monarch (*Danaus plexippus L.*), milkweed (*Asclepias spp.*), and forb responses to reintroducing grazing and fire disturbance regimes in managed rangelands

Biodiversity continues to decline both globally and locally. A large contributor to this decline is land-use change towards agriculture. North American rangelands present a unique opportunity for meeting human food demands in the form of livestock production while supporting conservation practices that enhance biodiversity. Eastern migratory monarchs (*Danaus plexippus L.*) are a suitable candidate to investigate methods of enhancing biodiversity in these working landscapes due to their candidacy under the Endangered Species Act and cultural importance. In the last two decades, this population has declined by 80%, primarily due to land conversion to agriculture and the subsequent use of herbicides that reduce their milkweed (*Asclepias spp.*) host plants. Rangelands can potentially provide milkweed and forbs for nectar; however, it is unclear whether current management goals to maximize cattle production on such rangelands are compatible with monarch conservation. To determine the compatibility between these goals of production and conservation, we monitored adult and juvenile monarchs, milkweeds, and flowering forbs in North Dakota mixed-grass prairie rangelands and assessed their responses to three grazing management strategies: (1) modified twice-over rest-rotation grazing (MTORG), (2) patch-burn grazing, and (3) season-long grazing. During the monitoring period (Summer 2021), a substantial drought (classified as D3 and D4 by the U.S. Drought Monitor) occurred, which influenced vegetation in each management strategy. In these conditions, we found that the MTORG management strategy had the highest abundances of all four response variables. Out of a total of 96 adults, 77 juveniles, 17,099 milkweed stems, and 69,778 flowering forbs, about 60% of all observations were found in MTORG (53, 44, 11,044, and 39,173, respectively). Within MTORG, some areas were rested (0% utilization). These areas seemed to act as a refuge for vegetation during the drought. Our results will continue in the summer of 2022 to compare monarch, milkweed, and forb responses under different growing season weather conditions. These findings could inform future monarch conservation and rangeland management, particularly under predicted climate change, by helping align human demands with those of wildlife.

Key words: monarch butterfly, milkweed, working landscapes, rangeland management, conservation

Emily Johnson
PSYCHOLOGY

Faculty mentor: Mark Nawrot, PhD - Psychology

Research Symposium of the Graduate Student Council

Understanding the limits for the visual perception of depth from motion in virtual displays

Visual cues allow people to perceive the location of specific objects and their relationship with other objects in a complex environment. We investigate how the visual system processes motion-based information to perceive depth and how failures to accurately perceive depth in virtual environments can be traced to specific violations of the stimulus parameters for motion parallax as outlined in a new mathematical model of the visual processing. This violation of the model, which is easily done virtually, employs stimulus parameters impossible in the physical world and is often perceived as "backwards".

Our laterally translating visual stimuli included both physical and virtual dihedral angles, varying in depth and slant angle. To psychophysically "measure" perceived depth of both stimuli, participants indicated slant orientation through palm position measured electronically with a potentiometer.

Results for physical stimuli indicate that observers have a systematic underestimation of slant, which in the virtual environment would be interpreted as an increase in perceived depth. The physical data allows for an applied correction to virtual stimuli data. Correction found that although participants underestimated the slant they were quite accurate in perceiving the depth portrayed by the motion of the virtual displays. However, when virtual stimuli with physically impossible parameters were presented to participants, they accurately interpreted the depth in the backwards but physically possible manner.

This model of depth from motion parallax accurately predicts the precise condition for perceptual failures and helps us to understand how the visual system perceives depth from motion.

Key words: Vision, depth, perception

Nathaniel "Thanny" Johnson
DIETETICS

Faculty mentor: Sherri Stastny, PhD - Health, Nutrition and Exercise Sciences

NDSU EXPLORE Showcase of Undergraduate Research and Creative Activity

Way More Than Baking Cookies: Network Analysis Highlights the Complexity of Analyzing Dietary Intake Data

Nutrition is often misunderstood by other scientists and the public as a straightforward, simple, and "easy" field of scientific inquiry. However, beyond the complexities of the genetic, socio-economic, and psychological factors that motivate food choice, food itself is multidimensional containing various nutrients or other chemicals that affect individuals' health. For instance, two foods that provide the same amount of energy but have different macronutrient contents will have different effects. A food high in carbohydrates results in hyperglycemia and insulin release, whereas a food high in protein results in hyperaminoacidemia and muscle protein synthesis. To further complicate things, largely due to lack of funding, controlled feeding studies where participants' dietary intake is truly objectively measured and controlled are rarely performed. Thus, most Nutrition research is done under free-living conditions where self-report tools are used, and dietary intake is not objectively measured. Unfortunately, dietary intakes assessed from these tools, are associated with one another. One cannot simply enter a dietary variable like protein intake into a statistical model, as protein intake is ipso facto related to energy intake and is also related to intake of the other macronutrients. As a result, complicated statistical models are needed in the analysis of free-living dietary intake data to control for things like energy and macronutrient intakes. In this work, network analysis is used to show why it is important to control for things like energy and macronutrient intakes and how this was done in various statistical models investigating protein intake and muscle strength.

Anas Karuth
COATINGS AND POLYMERIC MATERIALS

Faculty mentor: Bakhtiyor Rasulev, PhD - Coatings and Polymeric Materials

Research Symposium of the Graduate Student Council

Application of Machine Learning Driven Molecular Dynamics Simulation for Predicting the Glass Transition and Simulating Degradation Behavior in Polymers

Data-driven Machine Learning (ML) techniques are gaining popularity in chemical science due to their ability to predict the properties of chemical compounds with unprecedented efficiency and high accuracy. We utilize machine learning methods to build a quantitative relationship between the chemical and functional descriptors and properties of the polymeric systems, including glass transition temperature. The ML model is coupled with molecular dynamics to further delineate the mechanistic interpretation and systematic dependence of this ML identified influential structural features in the polymeric system. Another promising application of the Machine Learning technique is ML-driven force felids in Molecular Dynamics (MD) simulation. The ML trained empirical force field (FF) is utilized to provides new insights into the reversible and irreversible hygrothermal aging process in the epoxy network and inform us about the new design criteria for broadening the application of epoxy materials, including in humid environments.

Key words: Machine learning, molecular dynamics, glass transition, degradation, polymers

Heymant Kaur
CEREAL SCIENCE

Faculty mentor: Frank Manthey, PhD - Plant Sciences

Research Symposium of Gamma Sigma Delta: The Honor Society of Agriculture

Hydration Level During Extrusion Affects Fresh Pasta Quality

Fresh pasta can be part of a convenient nutritious meal. Flour hydration is known to affect dough strength which in turn can affect extrusion properties during pasta processing. The objective of this research was to determine the effect of hydration level on the physical and cooking quality of fresh pasta made with different wheat flours. Flours evaluated were bread wheat flour, durum flour, semolina, and whole-wheat durum flour. Five different hydration levels were evaluated for each flour. The results indicated that regardless of flour tested, spaghetti strand diameter increased with cooking and that cooked firmness and cooking loss were lower for spaghetti made with high than with low hydrated flours.

Shivreet Kaur
PLANT PATHOLOGY

Faculty mentor: Upinder Gill, PhD - Plant Pathology

Research Symposium of Gamma Sigma Delta: The Honor Society of Agriculture

Research Symposium of the Graduate Student Council

Tapping Global Wheat Diversity for Identifying Novel Sources of Genetic Resistance against the Cereal Killer, Wheat Rust

Leaf rust (Lr), caused by *Puccinia triticina* (Pt) is among the most devastating diseases posing a significant threat to wheat production globally, accounting for 3.25% yield losses annually worldwide. Genetic resistance is the most efficient and cost-effective management strategy to control Lr. The race-specific seedling resistance genes provide all stage resistance but can be overcome by evolving virulent pathogens. In contrast, non-race specific, adult-plant resistance (APR) is partial resistance at the adult plant stage and more durable due to non-specificity to the pathogen races. In this study, a diversity panel of 365 wheat accessions selected from a worldwide population of landraces and cultivars was evaluated for Lr resistance at the seedling and adult plant stage. The seedling screening was conducted using prevalent Pt races in ND namely, TDBJQ, TBBGS, MNPSD and, TNBJS in the greenhouse facility. A wide distribution of seedling responses against the four Pt races was observed. Further, the spring wheat lines from the panel were screened for APR to Lr (race mix) at Prosper and Langdon, ND in 2021. 67.8% and 69.6% lines were susceptible whereas 32.2% and 30.5% lines ranged from resistant to moderately resistant at Prosper and Langdon respectively. Genome-wide association study (GWAS) is the method of choice for dissecting the genetic loci associated with a trait. A filtered set of 302,524 SNPs was used for conducting the preliminary GWAS analysis which yielded significant QTLs associated with Lr. Exploring novel sources of resistance will broaden and improve the existing resistance gene pool for germplasm development.

Key words: Wheat, leaf rust, Puccinia triticina, genetic resistance, GWAS

Achiya Khanam
COATINGS AND POLYMERIC MATERIALS

Faculty mentor: Bakhtiyor Rasulev, PhD - Coatings and Polymeric Materials

Research Symposium of the Graduate Student Council

A QSAR Study on the Fouling Release Performance of Silicone Oil-Modified Siloxane Polyurethane Coatings

Anti-fouling coatings are largely used to prevent marine biofouling that involves over 4000 marine organisms and causes significant economic and environmental loss to the marine industry. A novel cheminformatics-based approach has been employed to investigate the fouling-release performance of siloxane-PU coating system. In this particular study we investigate the improvement of fouling release performance of siloxane PU coatings by incorporating the phenylmethyl silicones oils. The results showed that the performance was highly dependent on the composition of silicon oil used. Silicone oils with a range of phenylmethyl compositions (PMM-1025, PMM-1043, PMM-5021, PMM-6025, PMM-0021, PMM-0025) were incorporated into a SiPU coating system at 1, 2 and 5 wt% based on PDMS with the intention of obtaining improved fouling release performance relative to the 1st generation SiPU (A4-20) system without oil. By applying quantitative structure activity relationship several unique models were developed that were able to predict improved fouling release performance of modified siloxane PU coating with a small amount of phenylmethyl silicone oil formulations for microalgae, barnacles, and mussels with higher correlation coefficient (R_{test}^2= 0.71 to 0.88). This computational machine learning-based model may be used as a powerful tool to predict coating formulations with effective fouling performance.

Key words: Cheminformatics, QSAR, Anti-fouling coatings, Silicone oil, Biofouling

Esben L. Kjaer
RANGE SCIENCE

Faculty mentor: Ryan Limb, PhD - School of Natural Resource Sciences

Research Symposium of the Graduate Student Council

Reducing Invasive Grass Thatch Using Different Rangeland Management Strategies

Kentucky bluegrass (hereafter bluegrass), one of the most influential exotic grasses in the northern Great Plains, invades native plant communities and suppresses native species. This process is primarily achieved through the build-up of a thatch layer that alters water infiltration and prevents seed recruitment and germination of native plants. We examined alternatives to manual thatch removal in the form of conventional rangeland management techniques, such as patch-burn, rotational, and season-long grazing. To test these different strategies, we measured thatch depth at multiple points across different pastures invaded by bluegrass in southcentral North Dakota. Each pasture was managed with either patch-burn grazing (PBG), modified twice-over rest-rotational grazing (MTORG), or season-long grazing (SLG). Both the PBG and MTORG pastures were designed to increase landscape-level heterogeneity. However, the MTORG was designed to create heterogeneity through differential grazing intensities versus fire. We found no difference in thatch depth between the MTORG and SLG (2.59 and 2.60cm; respectively, $p>0.05$). However, pastures managed with PBG had a thinner thatch layer (1.79cm) than those managed with either MTORG or SLG ($p<0.05$). These findings suggest grazing alone did not affect bluegrass thatch, irrelevant of grazing strategy, and fire plus grazing reduced thatch accumulation. These results suggest that PBG is an effective tool in reducing thatch accumulation and may lessen the impact of bluegrass on prairies. To reduce the impact of bluegrass on native plant communities, future management plans should utilize practices that reduce thatch accumulation by removing bluegrass litter.

Key words: Rangelands, Invasive Species, Kentucky Bluegrass, Plant Ecology, Restoration

Esben L. Kjaer[1], Ryan F. Limb[1], Benjamin Geaumont[2], Jason P. Harmon[1], Torre J. Hovick[1], Kevin Sedivec[1,3]
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Richard Lamptey
PHARMACEUTICAL SCIENCES

Faculty mentors: Jagdish Singh, PhD - Pharmaceutical Sciences; Chengwen Sun, MD, PhD - Pharmaceutical Sciences

Research Symposium of the Graduate Student Council

Brain targeted drug delivery for the management of neurogenic hypertension

Greater than 40% of all hypertensive cases are resistant to current therapy, and this is because the underlying condition originates from the brain. Existing techniques that counter brain associated hypertension include surgical procedures requiring nerve removal or an external pulse generator. These techniques are highly invasive and not clinically translatable, creating a need for a method that can deliver drug targets to the brain in safe and less invasive ways. Herein, we formulate and characterize penetratin and transferrin dual functionalized liposomes as a therapeutic tool to deliver the model antihypertensive drug losartan into the brain of rats.

Initially, we investigated the ability of losartan potassium solution to cross the blood-brain barrier when intravenously administered to rats. We did not detect any quantifiable amount of losartan in the brain tissue of the rats after injecting at a dose of 10 mg/kg. However, losartan was present in the injected rats' spleen, kidney, heart, and blood. Using the post-insertion technique, we synthesized dual functionalized losartan liposomes of average hydrodynamic diameter 143 nm (PDI ~ 0.285) and surface charge ~40.4 mV. In a drug release study, the liposome formulation released ~60% of the encapsulated drug within 2 hours at 37C. Formulations were found to be hemocompatible using rat erythrocytes, and also cytocompatible in primary astrocytes, primary neurons, brain endothelial and hCMEC cell lines. Although all formulations were internalized by primary and cultured cells in 4 hours, dual functionalized liposomes showed a significantly ($p < 0.05$) higher uptake profile than all other formulations, including free losartan. Also, dual functionalized liposome formulations were capable of delivering losartan to the brain of WKY rats, even at a dose of 3mg/kg following intravenous administration.

Our findings suggest that it is possible to safely deliver losartan potassium to the brain using our functionalized liposomes.

This research was supported by National Institutes of Health Grants R01 AG051574 and RF1 AG068034.

Key words: Neurogenic hypertension, Blood brain barrier, functionalized liposome, losartan, brain targeted drug delivery

Richard N. L. Lamptey, Chengwen Sun and Jagdish Singh

Garrett Levin
MICROBIOLOGY

Faculty mentor: Barney Geddes, PhD - Microbiological Sciences

Research Symposium of the Graduate Student Council

Characterizing Gene Complements from the *S. meliloti* Minimal Symbiotic Genome Required for Optimal Symbiosis with Alfalfa

Nitrogen fixation converts atmospheric nitrogen into ammonia, a form useable by plants. Plants alone are not capable of performing nitrogen fixation. In the case of legume crops, a symbiotic relationship is formed with nitrogen fixing bacteria called rhizobia. The agriculturally important crop alfalfa, and the model legume *Medicago truncatula* form symbiotic relationships with rhizobia from the genus *Sinorhizobium (Ensifer)*, including the model rhizobium *Sinorhizobium meliloti. S. meliloti* has a tripartite genome structure that includes the symbiotic megaplasmid pSymA. pSymA contains the genes necessary for establishing a symbiotic relationship with an appropriate legume host. We previously established a minimal gene set of 162 Kb sufficient for optimal symbiosis between *S. meliloti* and alfalfa. Further reduced gene complements continued to confer functional, but not optimal, *symbioses*[1]. Using dry-weight, nodule size and abundance, and nitrogenase activity to evaluate symbiotic capability we are investigating gene clusters from the "minimal symbiotic genome" that are required for optimal symbiosis between *S. meliloti* and its legume hosts.

1. Geddes, Barney A., et al. "Minimal gene set from Sinorhizobium (Ensifer) meliloti pSymA required for efficient symbiosis with Medicago." Proceedings of the National Academy of Sciences 118.2 (2021).

Key words: Rhizobia, Legume, Symbiosis

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Magda Lopez Rodriguez
ANTHROPOLOGY

Faculty mentor: Ellen Rubinstein, PhD - Sociology and Anthropology

Research Symposium of the Graduate Student Council

Beyond Better: Undocumented during COVID-19

Beyond Better is a public humanities project that seeks to destabilize ableist narratives in U.S. health care through oral history, storytelling, and art through the social media platform, Instagram. As a summer intern in their "Afterlives of Pandemics" initiative, I analyzed the impact of Covid-19 on undocumented Latinx immigrants in the U.S. through two oral history interviews. These interviews revealed the inequalities undocumented immigrants face in accessing employment and health care because of structural barriers like language, law enforcement, and poor working conditions. Such stories demonstrate the massive gaps in the American public health system, especially during a crisis.

Key words: Oral History, Undocumented, Covid-19, Disability

Robin Malik
RANGE SCIENCE

Faculty mentor: Kevin Sedivec, PhD - School of Natural Resource Sciences

Research Symposium of Gamma Sigma Delta: The Honor Society of Agriculture

Research Symposium of the Graduate Student Council

Cattle or Goats for Control of Problem Plants

Targeted grazing by livestock can effectively address vegetation management challenges, such as controlling invasive weeds, and has become an increasingly popular management strategy. Our objective was to determine if cattle and/or goats are effective targeted grazers when fed an ad libitum ration of high-quality hay and high-energy grain along with the targeted plants, as high-quality diets may help detoxify chemicals in invasive weeds leading to increased consumption. We explored the intake behavior of goats and cattle with wormwood sage (*Artemisia absinthium*), Canada thistle (*Cirsium arvense*), and western snowberry (*Symphoricarpos occidentalis*). In addition, we evaluated if their intake changed when the plants were offered both individually and simultaneously, potentially indicating preference. Cattle (n=10) and goats (n=10) were each fed 100g of each plant species individually for 3 days (per species) and then fed all species collectively for 3 days. Cattle consumed more Canada thistle than Western snowberry and Wormwood sage, which they rarely tasted on all three days of the trial. However, there was significant variation in intake behavior amongst the cattle group. The goats generally consumed at similar levels and large amounts of all plant species. Pre-exposing cattle to the plant species with high-quality hay and high-energy grain did not lead to greater consumption of those plant species; whereas the goats' consumption was higher indicating they will likely control these weeds better.

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Sekhar Mariappan
Ajitha Kumari
ENVIRONMENTAL AND CONSERVATION SCIENCE

Faculty mentor: Ned Dochtermann, PhD - Biological Sciences

Research Symposium of the Graduate Student Council

Direct and indirect effects on agonistic behaviors of house crickets (*Acheta domesticus*)

Individuals alter their behavior in response to both the same behavior or different behaviors of conspecifics. These direct and indirect genetic effects play a major role in shaping social interactions, especially during conspecific aggression. In this study, we used house crickets, *Acheta domesticus*, to investigate whether there are any direct or indirect genetic effects of opponents on aggressive behavior during agonistic interactions. We predicted that the focal individuals' characteristics may vary according to opponent identity. Crickets were paired randomly in groups and had their interactions recorded during agonistic interactions. Three interactions namely approach, first aggression and victory were estimated during each agonistic interaction. Indirect genetic effects were quantified using both trait and performance-based approach. We found that the probability of initiating approach was influenced by direct effect of mass and indirect effects independent of mass. Whereas for first aggression it was direct and indirect effects independent of mass, while for victory it was indirect effects. Understanding these social interactions are necessary for maintaining behavioral variation at both within and among individual level. Which also contributes to selection.

Key words: Behavioral Ecology, Evolution, Indirect genetic effects, Social behavior, Agonistic behavior

Md Saimon Mia
PHARMACEUTICAL SCIENCES

Faculty mentor: Sijo Mathew, PhD - Pharmaceutical Sciences

Research Symposium of the Graduate Student Council

Integrin α2 mediated cellular functions are cell type specific in pancreatic cancer.

Desmoplasia is a characteristic of pancreatic tumors, where deposition of ECM and interaction with cell surface receptors play a pivotal role in tumor progression. Integrin's are the main cell surface receptors for the adherence of cells to the ECM. Integrin β1 is known as pro tumorigenic, whereas integrin α2 shows both pro and anti-tumorigenic properties. The objective of this study is to understand the role of integrin β1 on the cellular function of integrin α2 in pancreatic cancer.

Two of the major pancreatic cancer types, Mia Paca-2 and Panc-1 cell lines were used in this study. The protein level of integrin β1 was downregulated using genetic approaches. One-way ANOVA was performed to check the statistical significance.

Downregulation of integrin β1 in both Mia Paca-2 and Panc-1 cells decreased tumor growth in the 3D matrix ($n=10$, $p<0.0001$) as well as a significant decrease in integrin α5 resulted a significant reduction of cell adhesion and spreading in ECM ($n=40$; $p<0.05$). However, a contrasting result is observed in integrin α2 expression with the downregulation. We found an increase in integrin α2 expression with the knock-out of integrin β1 in Miapaca-2 cells ($n=3$, $p<0.05$) resulting in increased cell adhesion and spreading ($n=3$; $p<0.05$) in collagen-1. Whereas in Panc-1, there is reduced expression of integrin α2 with the knock-down of integrin β1, resulting in decreased cell adhesion ($n=3$; $p<0.05$) and spreading ($n=30$; $p<0.05$).

The results indicate that the tumor suppressor property of integrin α2 varies from cell line to cell line in pancreatic tumors.

Key words: Pancreatic Cancer, Integrin, Extracellular matrix, CRISPR-Cas9, tumor growth

Tamanna Mim
INDUSTRIAL ENGINEERING AND MANAGEMENT

Faculty mentor: Nita Yodo, PhD - Industrial and Manufacturing Engineering

Research Symposium of the Graduate Student Council

Supply chain risk assessment with Dynamic Fault Tree and Bayesian Network

The COVID-19 pandemic has proven that uninterrupted operations within the supply chain networks are crucial. A supply chain network continuously deals with moving materials and information within different entities, including suppliers, manufacturers, distributors, retailers, and customers. Managing relationships and activities among these entities has been a big challenge as their interactions are very dynamic, complex, and often hard to quantify. To overcome the challenge, this research proposed an assessment of risk in the supply chain network with Dynamic Fault Tree (DFT) and Bayesian Network approach to capture the complex dynamic relationships. The objective of the proposed method is to demonstrate that DFT can capture dependency and dynamic interaction among multiple stakeholders of a supply chain network which leads to a more desirable and accurate risk assessment. Bayesian Network approach can quantify the marginal probability tables for the root nodes and conditional probability tables for other intermediate nodes over time. Further, the joint probability distribution can estimate the risk in supply chain networks. A scenario focusing on risks of inventory stockout, considering different states of events over time within supply chain networks, will be presented. The broader impacts of this research aim to improve supply chain risk assessment during the COVID-19 pandemic and can be applied to any future pandemics.

Vimukthi Molligoda
CEREAL SCIENCE

Faculty mentor: Frank Manthey, PhD - Plant Sciences

Research Symposium of the Graduate Student Council

Impact of Tempering on the Physical Properties of Stone-Milled Hard Red Spring Whole Wheat Flour

Stone milling represents a direct, single-pass milling system that can be used to produce whole wheat flour. Before milling, wheat grain is often tempered. Tempering increases the moisture content of the grain which results in reduced kernel hardness. This research was conducted to determine the effects of tempering level, the time between tempering and milling, motor speed, and feed rate on the quality of whole wheat flour produced during stone milling. Flour quality was evaluated by determining its particle size distribution, color, moisture, and bulk density. According to the data, there was no significant difference in the particle size of the flour due to the change in the tempering level, tempering time, or stone speed. A significant difference was observed in the particle size due to the change in feed rate. Particle size was smaller with high compared to low feed rate. Neither tempering level, tempering time, motor speed, or feed rate affected flour color. There was a significant effect on bulk density by tempering level. The bulk density was reduced with the increased tempering moisture. No significant differences were observed for bulk density by the tempering time, feed rate, or motor speed. These findings can be used in establishing a protocol for milling wheat into whole wheat flour using a stone mill.

Key words: Milling, Flour, particle size, bulk density

Taofeek Mukaila
ENVIRONMENTAL AND CONSERVATION SCIENCE

Faculty mentor: Ademola Hammed, PhD - Agricultural and Biosystems Engineering

Research Symposium of the Graduate Student Council

Environmental Data Acquisition: A review of Remote Sensing Platforms and Sensors

Environmental issues such as flooding, land and soil deterioration, drought, and pollution are not new, but they have been exacerbated by numerous human actions, either intentionally or unintentionally. Several remote sensing devices have been developed and used to capture environmental data for use in modeling environmental phenomena in an attempt to understand and make informed decisions. Remote sensing systems capitalize on the interaction of light signals (electromagnetic radiation) amidst phenomena that are further processed to meaningful information using various statistical and geospatial techniques. The choice of remote sensing data acquisition device for environmental data acquisition is central to environmental research goals. The various remote sensing data acquisition platforms, sensors, and their products for environmental data acquisition are the highlights of this review paper.

Key words: remote sensing, sensors, platform, environment data, environmental phenomena

Mika Mzumara
HORTICULTURE

Faculty mentor: Harlene Hatterman-Valenti, PhD - Plant Sciences

Research Symposium of Gamma Sigma Delta: The Honor Society of Agriculture

Research Symposium of the Graduate Student Council

Potentiate strawberry production with tunnel technology in North Dakota

Strawberry (*Fragaria x ananassa*) production can be done in a wide range of environments, but in cold climates, there are some constraints in terms of frost damage and winter injury. North Dakota is one of the states known for its cold winters that influence the planting dates for crops prone to cold damage and, in some cases, short growing periods. The research aimed to use tunnel technologies to investigate the production potential of newly released day-neutral strawberries under North Dakota conditions. The research used six day-neutral cultivars grown under three production methods; high tunnel, low tunnel, and field. In 2021, each culture practice's total and marketable fruit yield was collected and analyzed weekly. Total soluble solids (°Brix) were measured for the quality of the fruits from each cultivar. The yields and total soluble solids did not significantly differ in all production methods and among cultivars, which was attributed to an unforeseen delay in transplanting and the need to retransplant due to poor transplanting success. However, based on 2021 results, the growing period increased with the high tunnel from May through November, allowing growers to produce strawberry fruits for an extended period to meet the local demand. Generally, the first-year data results are consistent with other regions which claim season extension with the use of the high tunnel technology, but because transplanting occurred on the same day for all three production methods, the season extension advantage of tunnel production was not fully utilized. The expected impact of this research is to increase the competitiveness of strawberry production in North Dakota.

Key words: Day-neutral, Strawberry, High tunnel, production, low tunnel

Vikneshwari Natarajan
CELLULAR AND MOLECULAR BIOLOGY

Faculty mentor: Jiha Kim, PhD - Biological Sciences

Research Symposium of the Graduate Student Council

PDAC derived exosomes manipulate tumor pericyte phenotype

Pancreatic ductal adenocarcinoma (PDAC) tumor microenvironment shows morphologically aberrant leaky vessels responsible for hypoxia and impaired immune response, which likely reduces the efficacy of cancer therapies. It is shown that pericyte coverage significantly correlates with vascular integrity/function and intratumoral hypoxia. Our study reveals that tumor-associated pericytes across all PDAC tumor tissues exhibit 10X higher ectopic αSMA expression than normal pericytes.

Our attempt to elucidate the underlying mechanism of pericyte phenotype switching using in vitro culture system shows that pancreatic cancer cell-derived extracellular vesicles-exosomes (PC-Exo) is a potent inducer of αSMA expression in pericyte contributing to changes in pericyte morphology, biomechanical properties, and immunomodulatory phenotype. Our foundational work will help understand the importance of pericyte phenotype and develop innovative ways to re-functionalize abnormal vessels.

Key words: PDAC (Pancreatic ductal adenocarcinoma), Pericytes, exosomes, vasculature, aSMA-(alpha smooth muscle actin)

Sierra Nguyen
PUBLIC HEALTH

Faculty mentor: Rick Jansen, PhD - Public Health

Research Symposium of the Graduate Student Council

Polycyclic Aromatic Hydrocarbons and Pancreatic Cancer: An analysis of Blood Biomarker PheT as an Exposure Identifier

Exposure to polycyclic aromatic hydrocarbons (PAHs), a byproduct of incomplete combustion, and its effects on the development of cancer is still being evaluated. Recent studies have analyzed the relationship between PAHs and tobacco or dietary intake in the form of processed foods and smoked /well-done meats. This study aims to assess the association of a blood biomarker and metabolite of PAHs, r-1-,t-2,3,c-4-tetra-hydroxy-1,2,3,4-tetrahydrophenanthrene (PheT), selected metabolism SNPs, and pancreatic cancer. Demographics, food-frequency data, SNPs, treatment history and levels of PheT in plasma were collected from 400 participants (202 cases and 198 control) and evaluated based on pancreatic adenocarcinoma diagnosis. A univariate analysis for all variables with OR>1 and p-value < 0.05 suggests significant relationship to pancreatic cancer and were carried forward to a multiple regression model for either food items or SNPs. Backward stepwise selection was used to eliminate non-significant variables. A final multiple regression model combined the significant food items and SNPs. Final significant factors associated with pancreatic cancer after backward selection included: Type 2 Diabetes [7.81 (3.43, 18.76)], red meat [1.02 (1.01, 1.03)], very well red meat [0.93 (0.89, 0.96)], Total Nitrite [0.05 (0.00, 0.49)], recessive(rs12203582) [4.63 (1.96, 11.36)], recessive(rs56679) [0.22 (0.04, 0.77)], overdominant (rs3784605) [2.97 (1.58, 5.76)], overdominant (rs721430) [0.41 (0.20, 0.82)]. Of note by design, the level of smoking did not differ between our cases and controls. This study does not provide evidence that blood PheT [0.83 (0.51, 1.37)] is a biomarker of pancreatic cancer independent of dietary intake and smoking.

Key words: PAH, PheT, urinary biomarker, dietary intake, pancreatic cancer

Sierra Nguyen[1], Heather Carlson[2], Andrea Yoder[3], William R. Bamlet[4], Ann L. Oberg[4], Gloria M. Petersen[4], Steven Hecht[5], Rick J. Jansen[1,5,6,7].
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Tam Nguyen
CIVIL ENGINEERING – WATER RESOURCES

Faculty mentor: Trung Bao Le, PhD - Civil, Construction and Environmental Engineering

Research Symposium of the Graduate Student Council

Investigation of Blood Flow Dynamics in Intracranial Aneurysms using High-Resolution CFD Simulation

We use High-resolution CFD simulation to investigate the dynamics of blood flow in brain aneurysms. We also implement a state-of-the-art code for solving the flow equations. In addition, patient-specific MRA data are processed to generate 3D geometries of aneurysms. The results allow us to investigate the dependence of the degradation of the aneurysm walls with the flow instabilities. High-resolution CFD simulation is robust for the variety of shapes, sizes, and complexity of intracranial aneurysms.

Key words: Computational Fluid Dynamics, Intracranial Aneurysm, Hemodynamics

Tam Thien Nguyen, Davina Kasperski, Trung Bao Le

Heather North
BIOLOGICAL SCIENCES

Faculty mentor: Julia Bowsher, PhD - Biological Sciences

Research Symposium of the Graduate Student Council

Does thiamethoxam reduce circadian rhythmicity and lower activity in Bombus impatiens?

Bumblebees (*Bombus*) are significant wild pollinators in temperate regions of North America. Pesticides of known toxicity to bees are in the nectar source of pollinator preferred crops, and their effect on many bumblebee behaviors is still poorly understood. Neonicotinoids are a concern because of their use on commercial crops bumblebees are known to visit. Neonicotinoid pesticides act as agonists of insect nicotinic acetylcholine receptors (nAChR) in the central nervous system that mediate neurotransmission within the insect brain. Circadian clock neurons use light to correspond with the clock through nAChR signaling. A locomotor activity monitor was used to record activity. Individual bees collected from hives kept in a 25 x 95 mm tube with a glass vial and a cotton wick inserted for feeding and bees were placed in the activity monitor. Bees were given 12L:12D cycle beginning at 07:00 h and ending at 19:00 h at a constant 21°C and 55%RH continuing for 8 consecutive days. Thiamethoxam treatments included 0nM, 1nM, 10nM, 100nM. The mean active time of day by treatment was Control (18:29:37), 1nM(20:16:53), 10nM (20:21:51), 100nM (1:24:23) p=2.2e-16.

Key words: Toxicity, Bumblebees, Thiamethoxam, Circadian Rhythm

Olugbemiga Olatoye
CONSTRUCTION MANAGEMENT

Faculty mentor: Youjin Jang, PhD - Civil, Construction, and Environmental Engineering

Research Symposium of the Graduate Student Council

COVID-19 pandemic impact on the performance of construction projects in terms of social/ psychological status of workers

COVID-19's impact on the construction world cannot be overestimated as it brought about several changes to the work environment, introducing new ways to perform works including the use of technology, social distancing, and eventually a lockdown at some point leading to several closures of projects or withdrawal of existing contracts. The social and psychological well-being of workers were tested during the pandemic period from social distancing to fear for one's health to eventual lack of human interaction. The adverse effects of all these cannot be overstated on the performance of construction projects post-pandemic period. The study aims to explore the COVID-19 pandemic impacts on performances of construction projects in terms of the social/ psychological status of workers. Thirteen social/psychological variables and three performance variables were selected. Then, the survey was carried out by construction professionals including managers, superintendents, and workers. Using statistical techniques, this study analyzed social/psychological variables affecting the performance before and after the COVID-19 pandemic and compared them between manager and worker levels. The results showed Financial Status, Social Support, and Motivation as the most impactful factors influencing workers' performances on construction projects thus suggesting to managers to include their workers more in the construction process which makes them feel more like a part of the entire team when making decisions. This study contributes to providing the managerial implications and guidance for improving performance post-pandemic.

Key words: Performance, COVID-19 pandemic, Social and Psychological Impact, Productivity

Md Ashif Islam Oni
ELECTRICAL AND
COMPUTER ENGINEERING

Faculty mentor: Shuvashis Dey, PhD -
Electrical and Computer Engineering

Research Symposium of the
Graduate Student Council

On the Performance Analysis of Super Wide Band MIMO Antenna for Wireless Body Area Network (WBAN) Applications

This project presents the performance analysis of a Super Wide Band MIMO antenna for WBAN applications. The proposed antenna has the advantages of both MIMO and Super Wide Band configurations which has a dominant influence for WBAN applications in Ultra-Wide Band (UWB) frequency range. FCC allocated UWB (3.1-10.6 GHz) band has shown greater promise to be used for WBAN applications. The antenna is excited via two separate ports and radiating in two opposite directions, demonstrating it can avoid signal fading by utilizing the multipath feature of MIMO system which provide larger data throughput with higher credibility and range. The proposed MIMO antenna has two planar-elliptical patch elements that are microstrip fed. The ratio bandwidth of the antenna is 12.5:1 (2.4 GHz - 30 GHz) which includes frequency bands of all UWB applications as well as parts of S and Ka-bands. For the purpose of easier analysis, the performance of the designed antenna has been analyzed at 6, 7 and 8 GHz in proximity of a human body phantom with respect to some performance metrics such as: reflection coefficient, 3D radiation pattern and directivity, voltage standing wave ratio (VSWR), and radiation efficiency. A significant novelty of this project lies in the fact that the designed antenna is a preferable option for WBAN applications with respect to the standardized performance metrics since it satisfies the requirements of WBAN described in IEEE 802.15.6 standard. CST Microwave Studio Suite Software has been used for the purpose of all designs and simulations.

Key words: Super-Wide Band, MIMO, Wireless Body Area Network (WBAN), Human body model, Performance metrics

Kelly Parker
HEALTH NUTRITION
AND EXERCISE SCIENCE -
EXERCISE/NUTRITION SCIENCE

Faculty mentor: Yeong Rhee, PhD -
Health, Nutrition and Exercise Sciences

Research Symposium of the
Graduate Student Council

Fruit and vegetable intake differences between body mass index (BMI) classes among college-aged young adults

Background: Obesity continues to be a concern in the United States. A high-fiber diet, rich in fruits and vegetables, can reduce the risk of obesity and many chronic conditions. However, most Americans consume fewer than the 5-9 servings of fruits and vegetables recommended per day by the Dietary Guidelines for Americans. Health interventions in young adults are likely to produce healthful habits that last a lifetime. This study examined whether fruit and vegetable intake differed between healthy weight and overweight participants in a sample of college-aged young adults.

Methods: A survey, including a food frequency questionnaire and self-reported height and weight, measured average daily fruit and vegetable intake in a sample of college-aged young adults (N = 274). Body mass index (BMI) was calculated, and independent t-test was used to measure differences in fruit and vegetable intake based on BMI classification (healthy weight: BMI 18.5-24.9 kg/m^2 [n = 152] vs overweight: BMI ≥25 kg/m^2 [n = 109]). Underweight participants (BMI < 18.5 kg/m^2 [n = 13]) were excluded from analysis.

Results: Fruit intake differed based on BMI classification (p = 0.01). Participants with a healthy weight reported consuming slightly more fruit than overweight participants (1.44 ± 1.66 vs 1.01 ± 1.04 servings/day). However, there was no significant difference in vegetable intake between healthy weight and overweight participants (p = 0.60, 1.85 ± 1.52 vs 1.76 ± 1.27 servings/day).

Conclusion: Fiber and water in fruits may contribute to feelings of fullness, decreased overeating, and a healthier weight. While fruit and vegetable consumption can contribute to a healthy weight and other benefits, this study shows that fruit and vegetable consumption are not the sole drivers of a healthy weight. It also suggests the need for education about caloric balance, portion control, and physical activity, which are contributors to weight and BMI status.

Key words: body mass index, fruit and vegetable intake, body mass determinants

Jacob Pithan
BIOLOGICAL SCIENCES

Faculty mentors: Kendra Greenlee, PhD - Biological Sciences; Giancarlo López-Martinez, PhD - Biological Sciences

Research Symposium of the Graduate Student Council

Effects of Aging on Performance and Accumulation of Oxidative Damage in the Solitary Bee, *Megachile rotundata*

The damage done by the imbalance between reactive oxygen species (ROS) and antioxidant defense has been theorized to be one of the primary causes of aging. ROS have the potential to interact with carbohydrates, lipids, and proteins causing oxidative damage leading to cell degradation and senescence. Additionally, it has been suggested that age-dependent declines in performance may be explained by the accumulation of oxidative damage, however, this needs to be explored further. Most aging studies in insects have been limited to *Drosophila melanogaster*. However, only focusing on a few organisms ignores the diversity of longevity and mechanisms involved in aging plasticity. In this study, we examine the effects of aging on the walking and flight performance in the solitary bee, *Megachile rotundata*. We hypothesized that *M. rotundata* experience age-related performance declines and increased oxidative damage. Adult *M. rotundata* were reared from emergence, and tested at day 0, 7, 14, or 21. For each age group, walking performance was measured using a locomotion activity monitor (LAM), and flight performance was assessed using a cylinder drop assay. Levels of lipid peroxidation were quantified using a thiobarbituric acid reactive substance (TBARS) assay. Contrary to our prediction, walking activity increased two-fold from day 0 to day 7 and was sustained till senescence. Similar to other aging studies, *M. rotundata* experienced continual declines in flight performance. Lipid peroxidation levels increased with age, however after day 7, peroxidation levels were sustained potentially indicating that antioxidant activity is reducing peroxidation of membranes in *M. rotundata*.

Key words: Aging, Oxidative Damage, Performance

Md Atikur Rahman
MECHANICAL ENGINEERING

Faculty mentor: Chad Ulven, PhD - Mechanical Engineering

Research Symposium of the Graduate Student Council

Process development, optimization and characterization of continuous fiber reinforced thermoset composite 3D printing

3D printing is one of the most rapidly growing fields of manufacturing process development in recent times. The application of polymer-based 3D printed parts as a structural component is mostly being limited due to the limitation of printable material properties. To improve the mechanical properties of polymer-based 3D printed parts research focus is being concentrated on the development of fiber reinforced polymer composite printing process. To generate maximum mechanical strength from the 3D printed parts, continuous fiber reinforced composite printing process is developed in this study. This study utilizes thermoset UV curable resin system as the composite matrix to produce higher thermal stability of the printed composite. This being a new printing process, the printing parameters such as printing speed, resin flow rate, line spacing, and nozzle sizes are not well investigated. This study investigates the variation of mechanical properties of the continuous fiber reinforced thermoset composite printed parts with the variation of process parameters. Different nozzle geometry was experimented with for this printing process and resin flow rate and line spacing was changed for each nozzle size. The resulting printed parts' mechanical properties were characterized and correlated with the printing parameters.

Key words: Composite 3D printing, UV curable thermoset, Continuous fiber reinforcement, process development, Optimization, Characterization

Md Mahbubar Rahman
INDUSTRIAL AND MANUFACTURING ENGINEERING

Faculty Mentor: Nita Yodo, PhD - Industrial and Manufacturing Engineering

Research Symposium of the Graduate Student Council

Two-Echelon Cooperative Ground Vehicle and UAV Routing for Last Mile Humanitarian Relief Operations

In the aftermath of a disaster, the timely delivery of emergency supplies is critical to reducing human suffering and other casualties. However, post-disaster humanitarian operations often fail to make the last-mile emergency deliveries because of physical transportation infrastructure failures. In this study, a low-cost last-mile delivery problem is proposed and solved. The proposed last-mile delivery problem is defined as the two-echelon cooperative ground vehicle and unmanned aerial vehicle (UAV) routing problem. With this setting, a person may receive delivery from a ground vehicle or a UAV based on one of the three conditions: the location in the disrupted network, the demand, or the optimized route of a ground vehicle or a UAV. A novel mixed-integer linear programming mathematical model is formulated for this scenario. The delivery problem of up to thirty-five people can typically be solved optimally using exact solvers. However, large-size problems containing fifty or more people require exponentially more computational time and memory requirements with the increased number of people in the problem. This research solves the large-size problem using the greedy randomized adaptive search procedure (GRASP) with a path relinking metaheuristic framework to overcome the computational challenge. The proposed framework is implemented in the C++ language. The results show that GRASP with path relinking implementation provides a good local optimal solution for the large-size problem in a timely manner. Promptly obtaining a good solution is crucial in reducing human suffering and causalities instead of waiting for hours or days for the optimal solution.

Key words: Humanitarian Relief Operation, Two-Echelon Cooperative Vehicle Routing, Unmanned Aerial Vehicle, Greedy Randomized Adaptive Search Procedure (GRASP) with Path Relinking

Md Mirazur Rahman
ELECTRICAL AND COMPUTER ENGINEERING

Faculty mentor: Shuvashis Dey, PhD - Electrical and Computer Engineering

Research Symposium of the Graduate Student Council

Towards Non-Invasive Monitoring of Human Bio-physiological Parameters Using an RF-Panel

This paper presents a novel RF-panel to monitor multiple human physiological parameters non-invasively and accurately without requiring any complex arrangements. The proposed panel consists of three resonators coupled with a transmission line. A finger model was placed on and in between the resonators and the responses of the resonators were observed. The results indicate that there will be a clear correlation between the responses received and different physiological aspects intended to be measured. This outcome also helps envision that the incorporation of smart sensing materials and machine learning based analysis will make this RF panel capable of sensing physiological parameters by just placing a finger on any position of the panel.

Key words: physiological, parameters, monitoring, RF-panel, resonators

Nitin Rai
AGRICULTURAL AND
BIOSYSTEMS ENGINEERING

Faculty mentor: Xin Sun, PhD - Agricultural and Biosystems Engineering

Research Symposium of the Graduate Student Council

Aerial-based spot spraying for site-specific weed management

Weeds are unwanted plants that compete with crops for sunlight, water, and nutrients. Because their growth is spatially heterogenous in nature (spot or patch-based), an unmanned aerial system (UAS) equipped with a spraying mechanism is flown over the entire field to spot spray weeds. But, according to current technological advancements, automation in recognizing these weeds at 10 ft altitude is still in its inchoative stage. Therefore, to automate weed recognition on UASs, we have integrated deep learning (DL) techniques on an edge-based platform to recognize and differentiate weeds from crop plants. Our data processing pipeline is solely based on a framework that includes, data collection, data curation, training and validation on the test plots. As of now, we have collected a year data and optimizing the algorithms to recognize weeds with high frame-rates and low latency is still worked upon. According to the results based on the previous year's data, we have been able to achieve success in recognizing 3 out of 4 weed species under dynamic field conditions at 8ft altitude. Our objective focus is to develop and establish a reliable pipeline and algorithm to automate weed recognition using UASs.

Key words: Aerial spraying, weeds, deep learning, recognition, UASs

Jake Reinholz
MECHANICAL ENGINEERING

Faculty mentor: Chad Ulven, PhD - Mechanical Engineering

Research Symposium of the Graduate Student Council

Effects of Processing Parameters and Thickness on Compression-Molded Thermoplastic Composites

Glass fiber-reinforced thermoplastic composites have become an integral material in the automotive industry due to excellent strength-to-weight ratio and low cost. These composites can be manufactured into parts such as vehicle hoods and body panels using a common processing technique called compression molding. When semicrystalline thermoplastics, such as polyethylene terephthalate (PET), are heated past their melt temperature during this process, the long polymer chains in the amorphous regions unravel and align to form crystalline regions with improved strength and stiffness. The ratio of crystalline regions to overall material is a composite's crystallinity, which is largely dependent on processing parameters and part thickness. Despite manufacturer's recommended parameters, adjustments in peak processing temperature, pressure, holding time, cooling rate, and thickness can significantly affect composite properties. This research aims to understand the effect of compression molding processing parameters and thickness on glass fiber-reinforced PET. Compression molds have been designed to allow the collection of temperature and pressure readings during processing while post-cure testing will determine mechanical properties and crystallinity. Using obtained data, optimal processing parameters will be prescribed and implemented into thick-section composite research.

Key words: Composites, Thermoplastics, Fiber-Reinforced, Compression-Molded

Bethany Roberton
ENTOMOLOGY

Faculty mentor: Jason Harmon, PhD - School of Natural Resource Sciences

Research Symposium of the Graduate Student Council

Bee community abundance, diversity, and resource use under various grazing regimes

As the human population increasingly depends on rangelands to support agricultural and livestock production, there is a need to study bee community responses and resource use across rangeland management regimes. Approximately 35% of crops and 87% of flowering plants are pollinated by animals which includes honeybees and native bees. Therefore, these pollinators need to be protected, especially considering that many bee species are facing worldwide declines. In grasslands, including working rangelands, this decline may be mitigated with disturbance regimes such as burning and grazing that may potentially promote floral resources for bees. Our research objectives are to examine the abundances and diversity of bee species, as well as their floral use, in three grazing regimes: patch-burn grazing (PBG), season-long grazing (SLG), and a modified twice-over rest rotational grazing (MTORG). We carried out surveys in all three treatments, recorded bee species observed, and noted the plants they were found visiting. Preliminary results for 2021 suggest that 1) the greatest number of bees were found in MTORG regime (and then within the rested treatment of the MTORG regime) while the PBG regime had the fewest bees, 2) bee genera richness amongst the three treatments were similar despite differing abundances, and 3) a wide variety of floral resources were visited by bees even in genera with low abundances. This research should give us insight into how different grazing management techniques may be used on rangelands to promote bee communities which, in turn, can benefit agricultural and livestock production.

Key words: Bees, rangelands, grazing, floral resources, conservation

Bethany Roberton, Jason Harmon, Torre Hovick, Kevin Sedivec, and Ryan Limb, School of Natural Resource Sciences; Ben Geaumont, Hettinger Research Extension Center, Hettinger, ND

Kazi Sarjana Safain
CELLULAR AND MOLECULAR BIOLOGY

Faculty mentor: Sheela Ramamoorthy, DVM, PhD - Microbiological Sciences

Research Symposium of the Graduate Student Council

Friends in Need: Torque-teno viruses and Circoviruses

Torque teno sus virus 1 (TTSuV1) is a non-enveloped, single-stranded DNA virus that is widely prevalent in both healthy and unhealthy production pigs. In coinfections, it is known to exacerbate clinical signs associated with other viruses such as porcine circovirus type 2 (PCV2) and influenza. However, TTSuV1 is co-detected much more frequently in unhealthy pigs (85%) manifesting the clinical signs of PCV2 than in healthy pigs (50%). The molecular mechanisms underlying these inter-viral interactions are unclear. Based on the observation that TTSuVs and PCVs share a very similar genome organization, the hypothesis that the TTSuV1 replicase protein can support PCV replication, and vice versa, was investigated. A PCV2 infectious clone was constructed in which the start codon of the replicase protein (ORF1) was deleted using site-directed mutagenesis. When co-transfected with TTSuV1 replicase, possible complementation of the PCV2 replicase protein resulted in the rescue of PCV2, as detected by a PCV2 specific monoclonal antibody. The findings of this study add to our understanding of the molecular processes underlying the pathogenesis of small DNA viral coinfections and suggest that TTSuV1 and PCVs could be using their replicase proteins interchangeably, thus providing a possible explanation for enhanced viral replication and morbidity in coinfections.

Key words: Torque teno virus, Circovirus, Porcine, Coinfections, Replicase protein

Biraj Saha
CIVIL ENGINEERING - ENVIRONMENTAL

Faculty mentor: Syeed Md Iskander, PhD - Civil, Construction, and Environmental Engineering

Research Symposium of the Graduate Student Council

Microplastics in Organic Waste Compost: Occurrence and Degradation

Microplastic pollution is a major environmental problem of the 21st century. Of the different dissemination pathways of microplastics to the environment, composting is dominant. To understand microplastic degradation in compost, we conducted food waste composting with polyethylene and polymethyl methacrylate microplastics of 1 mm size. We performed ultraviolet and sunlight weathering treatment of the microbeads for 30 days before composting according to ASTM G151 and G154 methods. After aerobic and hyperthermophilic composting, microplastics were separated using density separation and characterized by X-ray photoelectron spectroscopy and Fourier transform infrared spectroscopy analysis. This analysis demonstrated that the unoxidized to oxidized carbon ratio decreased from 24.8 to 12.4 (C/O ratio decreased from 38.6 to 11.1) after aerobic composting of the ultraviolet treated polyethylene beads compared to the virgin polyethylene beads. The molecular weight (MW) of the polymers decreased significantly (30-70%, $p<0.05$) after weathering treatments and hyperthermophilic composting, which indicates the breakdown of polymer chains. To elucidate the co-occurrence of other contaminants in compost, we investigated real-world yard waste compost for 40 different per- and polyfluoroalkyl substances (PFAS). We identified 21 different PFAS species with the predominance of Perfluorocarboxylic acids (26,770 ng kg^{-1}), Perfluorosulfonic acids (3,443 ng kg^{-1}), and Fluorotelomer sulfonates (334 ng kg^{-1}) in yard waste compost. This work improved our understanding of the degradation of microplastics and the occurrence of other contaminants in compost. The understanding will help to develop remediation measures to mitigate microplastics proliferation in the environment.

Key words: microplastics, compost, occurrence, degradation

Prattasha Saha
CIVIL ENGINEERING – STRUCTURAL

Faculty mentor: Mijia Yang, PhD - Civil, Construction, and Environmental Engineering

Research Symposium of the Graduate Student Council

Two-dimensional snowdrift simulation around a porous snow fence

Snowdrift is defined as the process of snow mass movement driven by wind. Snowdrift is affected by many factors like wind, snowfall, terrain, and their interactions. The purpose of this research is to model snowdrifts using ANSYS fluent (an available fluid simulation program) and help optimization of snow fence to contain snowdrifts through analyzing the maximum snowdrift height and the extension of snow accumulation from the snow fence due to different parameters. A 43% porosity is maintained in the snow fence. A series of numerical simulations are performed at different snow velocities (20ms^{-1}, 15 ms^{-1}, and 10 ms^{-1}) and snow volume fractions present in the air (50%, 40%, and 30%). The result shows that snow accumulates mostly near the snow fence when the air velocity is comparatively low (10 ms^{-1}). The same trend also follows for the lower snow volume fraction (30%). It has been noticed that the peak location with the highest snow volume accumulation increases with the decrease of snow volume fraction. For 50% snow concentration in the air, the decrease of air velocity from 20ms^{-1} to 10 ms^{-1} reduces the distance of the maximum drift height from the snow fence from 171.67ft to 33.26ft whereas the distance further reduces to 19.83ft for 30% snow volume fraction.

Key words: Snow-drift, snow-fence, air velocity, snow accumulation, drift height

Ranjan Sapkota
AGRICULTURAL AND
BIOSYSTEMS ENGINEERING

Faculty mentor: Paulo Flores, PhD - Agricultural and Biosystems Engineering

Research Symposium of the Graduate Student Council

Site-Specific Weed Control in Corn using UAS Imagery and Computer Vision

Currently, the most-used method to control weeds post-emergence in corn is a blanket application of herbicides across the field without considering the spatial distribution of weeds. Unmanned aerial systems (UASs) can provide high spatial resolution imagery, which can be used to map weeds across a field with high spatial and temporal resolution during early growing season to support site-specific weed control (SSWC). The proposed approach assumes that plants growing outside the corn rows are weeds that need to be sprayed. The first step to implement such an approach was identifying the corn rows. For that, we are proposing the use of "Pixel Intensity Projection" (PIP) algorithm for a pixel-classification and line detection over the corn rows on UAS imagery. After being identified, corn rows were then removed from the imagery and the remaining vegetation fraction was assumed to be weeds. That weed map served as the basis for a weed control prescription map, which was then uploaded to a commercial sprayer field weed control. The effectiveness of this SSWC approach was evaluated by comparing the spatial distribution information of weeds over the SSWC plots with the no-SSWC (blanket application) plots in a post-harvest imagery.

Key words: precision agriculture, computer vision, GIS, Remote sensing, drone

Sajib Sarkar
CONSTRUCTION MANAGEMENT

Faculty mentors: Youjin Jang, PhD - Civil, Construction, and Environmental Engineering; Inbae Jeong, PhD - Mechanical Engineering

Research Symposium of the Graduate Student Council

Multi-camera-based 3D human pose estimation for close-proximity human-robot collaboration in construction environment

Construction robots supporting construction workers have been increasingly adopted on construction sites to improve safety, efficiency, and overall productivity. To avoid collision with human workers in close-proximity human-robot collaboration on construction sites, robots must be aware of the context, particularly construction worker behavior, in real time. Most prior studies collected 3D human pose utilizing a single camera or an RGB-depth (RGB-D) camera to recognize human behavior. Single camera detection has some limitations such as occlusions, detection failure, and sensor malfunction, and an RGB-D camera may be hampered by lighting and surface material interference. To overcome these challenges, this study provides a unique approach for estimating 3D human pose by combining 2D joint locations retrieved from multiple images collected at the same time from different viewpoints. The probabilistic model is employed to extract the 2D location of the joints for greater precision, with each joint location derived from images being considered a noisy partial observation. The 3D human pose is then estimated by combining the probabilistic 2D joint locations to maximize the likelihood. The feasibility, efficiency, and accuracy of the suggested model were validated in both simulation and laboratory environments. By presenting a novel approach of 3D human pose estimation, this study contributes to assuring human safety in close-proximity human-robot collaboration.

Key words: human construction worker, construction robots, close-proximity human-robot collaboration, human pose estimation

Jake Schumacher
MICROBIOLOGY

Faculty mentor: Barney Geddes, PhD - Microbiological Sciences

Research Symposium of the Graduate Student Council

Towards high-throughput evaluation of rhizobial competitiveness and nitrogen-fixing efficiency in *Sinorhizobium meliloti*.

Improved incorporation of biological nitrogen fixation into agricultural systems via the development of the legume-rhizobia symbiosis would greatly aid efforts to minimize pollution from the overuse of nitrogen fertilizers. Highly competitive rhizobia fix nitrogen for legumes within symbiotically formed root nodules. However, the most effective rhizobia are not necessarily the most competitive[1]. The genetic basis for rhizobial competitiveness for root nodulation is insufficiently understood. *Sinorhizobium meliloti* is a model rhizobium that forms a symbiotic relationship with both alfalfa and the model legume *Medicago truncatula*. Measuring rhizobial competitiveness traditionally involves methods capable of comparing only a few strains at a time, but a high-throughput technique was recently developed to simultaneously measure competitiveness and effectiveness using a Plasmid ID system, fluorescent tags, and Next-Generation Sequencing[2]. Adapting this method to operate in *Sinorhizobium meliloti* is foundational to future research in pursuit of demystifying the esoteric legume-rhizobia symbiosis.

1. Dowling, D. N., and W. J. Broughton. "Competition for nodulation of legumes." Annual Reviews in Microbiology 40.1 (1986): 131-157.
2. Mendoza-Suárez, Marcela A., et al. "Optimizing Rhizobium-Legume Symbioses by Simultaneous Measurement of Rhizobial Competitiveness and N2-Fixation in Nodules." Proceedings of the National Academy of Sciences, vol. 117, no. 18, 21 Apr. 2020, pp. 9822–9831.

Key words: Rhizobia, legumes, competitiveness, fixation, methods

Thomas Stach
CHEMISTRY

Faculty mentor: Uwe Burghaus, PhD - Chemistry and Biochemistry

Research Symposium of the Graduate Student Council

Novel Sensor Materials for In-situ Resource Utilization in NASA Explorations - Adsorption of Small Molecules on Graphene and Pt/Graphene

Small-molecule gas sensors are a vital component of NASA probes and instrumental to the future of space exploration. Research continues to make these sensors smaller, cheaper, and more sensitive, and to support the development of next-generation gas sensors, this study sought to characterize the chemical activity of graphene and graphene-supported Pt clusters and assess their viability in sensing H_2S, SO_2 and CO molecules. The adsorption of SO_2 and H_2S at ultra-high vacuum conditions were studied on graphene epitaxially grown on Ru(0001) using thermal desorption spectroscopy (TDS) and Auger electron spectroscopy (AES). For both probe molecules, the parent masses were detected in TDS, i.e., a molecular adsorption/desorption pathway is present. However, multi-mass TDS deviates from the gas phase fragmentation pattern. Thus, the molecules undergo a chemical transformation. Whereas, H_2 desorbs in H_2S TDS, SO and O_2 desorb in SO_2 TDS experiments. In addition, AES does reveal adsorbed sulfur on the surface after the TDS experiments for both probe molecules. The data suggest that the reactivity is not caused by surface defects. Adsorption experiments of CO are underway for platinum clusters grown on graphene/ruthenium.

Key words: Sensors, Graphene, Sulfur, CO, Platinum

Nirmala Subedi
CEREAL SCIENCE

Faculty mentor: Frank Manthey, PhD - Plant Sciences

Research Symposium of Gamma Sigma Delta: The Honor Society of Agriculture

Research Symposium of the Graduate Student Council

Pasta quality varies with durum cultivar

Durum cultivars differ in quality parameters that are important to end-product quality. Quality and content of protein found in semolina have been associated with pasta quality, particularly cooking quality. Pasta quality was evaluated by measuring key physical characteristics like mechanical (breaking) strength and color. Cooking quality was evaluated by determining cooking loss and cooked firmness. The main objective was to determine the quality of pasta made from semolina derived from durum cultivars commonly grown in North Dakota. In this research, nine durum cultivars (Alkabo, Carpio, Divide, Joppa, Maier, Mountrail, NDGrano, Strongfield, and Tioga) were grown at six locations in North Dakota in 2019 and 2020. Significant differences were observed among cultivars for all quality characteristics investigated. Protein content was highest for Strongfield and lowest for Alkabo. Gluten index, a measure of protein quality was greatest with Carpio and least with Mountrail. Pasta made with Alkabo had the most cooking loss. Cooked firmness was greatest with pasta made with Strongfield and least when made with Mountrail. Pasta made with Carpio had the greatest breaking strength. Gluten index was positively correlated with pasta breaking strength and with cooked firmness. The results of this study suggest that cultivars differ in protein content and quality and that differences in these quality parameters are reflected in differences in pasta quality. These results will help producers in selecting the cultivars for planting that can produce high-quality pasta.

Aishwarya Suresh
CEREAL SCIENCE

Faculty mentor: Frank Manthey, PhD - Plant Sciences

Research Symposium of Gamma Sigma Delta: The Honor Society of Agriculture

Research Symposium of the Graduate Student Council

Particle size of stone-milled durum wheat flour

Whole grain wheat flour is in demand from consumers worldwide as it is considered healthier than refined flour. Particle size is an important quality parameter in the milling of durum wheat (*Triticum turgidum* L. var. durum). The goal of this research was to study the effect of the stone milling method on the particle size distribution of the durum whole-wheat flour. Durum wheat was milled using a New American stone mill which had a stone diameter of 0.66 m. The durum wheat was tempered to three different moisture levels (12%, 14%, and 16%). The gap between stones was adjusted to different levels depending on grain moisture. The gap settings for 12% moisture level ranged from 0.17 to 0.8 mm; for 14% moisture level ranged from 0.17 to 0.96 mm, and for 16% moisture level ranged from 0.17 to 1.28 mm. The feed rate was kept constant at 13.6 kg/h. The variation in tempering and gap setting produced flour with a significant difference in particle size. The particle size increased with an increase in tempering and as the gap setting increased. This finding will help food manufacturers to produce durum milled wheat using different mill settings to achieve different particle sizes and functionality using the stone mill.

Key words: Durum wheat, Stone milling, Particle Size

Jessica Syring
ANIMAL SCIENCE

Faculty mentor: Joel Caton, PhD - Animal Sciences

Research Symposium of the Graduate Student Council

Differential Gene Expression of Methionine-Folate Cycle Enzymes in Heifers Supplemented with One-Carbon Metabolites

The objectives of this study were to investigate the impacts of varying levels of one-carbon metabolite [OCM: folate (FA), vitamin B_{12} (B_{12}), methionine (Met), and choline (Chol)] supplementation on the expression of hepatic methionine-folate cycle enzymes at d 14 of the estrous cycle in beef heifers. In this study, 30 Angus beef heifers were fed a standard diet (SHD: 75% alfalfa/grass hay mix, 21% corn silage, and 4% mineral pellet without rumensin) and assigned one of five different treatments (0XNEG = SHD + 0.9% saline injection; 0XPOS = SHD + rumen protected Met fed at 0.08% on a DM basis + 60 g/d rumen protected Chol + 0.9% saline injection; 0.5X = SHD + same Met and Chol + 5 mg B_{12} + 80 mg FA; 1X = SHD + same Met and Chol + 10 mg B_{12} + 160 FA; and 2X = SHD + same Met and Chol + 20 mg B_{12} + 320 mg FA) with injections given at d 0 and 7 of the estrous cycle. Heifers were harvested on d 14 of the estrous cycle. Real-time PCR analysis followed by statistical contrasts revealed that combined B_{12} and FA treatments had greater ($P < 0.05$) methionine adenosyltransferase 2A (*MAT2A*) and methionine adenosyltransferase 2B (*MAT2B*) expression compared with 0XPOS. The FA treatments yielded a cubic increase ($P = 0.03$) in *MAT2A* and linear increase ($P < 0.0001$) in *MAT2B*. It can be concluded that strategic supplementation of OCM can increase expression of genes in the one-carbon metabolic pathways found in the liver of beef heifers

Key words: beef cattle, gene expression, methionine-folate cycle, one-carbon metabolites

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Mikayla Tabert
PLANT SCIENCES

Faculty mentor: Marisol Berti, PhD - Plant Sciences

Research Symposium of Gamma Sigma Delta: The Honor Society of Agriculture

Establishing alfalfa through sunflower intercropping

Intercropping is a way to better utilize the growing season and available resources more profitably. The integration of alfalfa (*Medicago sativa* L.) into crop rotations may also lead to a reduction of synthetic nitrogen use and losses by leaching or run-off. This research evaluated the possibility of intercropping alfalfa with sunflower (*Helianthus annuus* L.) in the northern Great Plains using a randomized complete block design to establish alfalfa for the subsequent crop year. This approach could increase alfalfa forage yield and nutritive value in the second year while providing a sunflower crop during the normally low-producing alfalfa establishment year. Treatments were alfalfa alone, sunflower alone at 76.2- and 152.4-cm row spacing, and sunflower intercropped with alfalfa at 76.2- and 152.4-cm row spacing. Sunflower achene yield in the first year was measured and no significant differences among treatments were determined in 2021. Alfalfa forage yield and nutritive value was also measured and calculated in 2021, along with measurements of soil gravimetric water and light interception. There was an interaction between treatments and date for light interception. This was mainly because alfalfa alone had much lower light interception than all treatments with sunflower. Gravimetric water was lower in soil where alfalfa and sunflower were intercropped. In-row alfalfa dry biomass and quality were not significantly different for the 76.2- or 152.4-cm sunflower row spacings. This study will continue in 2022 to evaluate alfalfa forage yield and quality in comparison to spring-seeded alfalfa alone, and the experiment will be repeated for 2022 and 2023.

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Bryce Van Vleet
DEVELOPMENTAL SCIENCE

Faculty mentor: Heather Fuller, PhD - Human Development and Family Science

Research Symposium of the Graduate Student Council

"I don't know:" Indirect indications of how older adults perceive their own advice

Older adults may be perceived as wise sources of advice, yet little is known about their own perceptions of giving advice. A Midwestern sample of older adults were asked what advice they would provide to others at two timepoints (June 2020 and Spring 2021). Using a grounded theory approach, a thematic content analysis revealed a subset of participants (n = 39) that indicated perspectives on their approach to advice provision. Transcripts were then value-coded. The first value, *ability to give advice*, indicated an overall belief that *advice-provision is difficult*. The second value, *audience characteristics*, suggested that *audience context matters*. Older adults thought about the circumstances of their audience and whether they could give sufficient advice for a general audience. The last value, *reception of advice*, indicated an overall belief that *advice may not be received well*. Future research should investigate possible challenges to advice-provision such as ageism or social dynamics.

Key words: Grounded theory, advice provision, gerontology, COVID-19

Runhao Wang
PLANT SCIENCE

Faculty mentor: Xuehui Li, PhD - Plant Sciences

Research Symposium of Gamma Sigma Delta: The Honor Society of Agriculture

Research Symposium of the Graduate Student Council

Recurrent Selection to Develop Hard Red Spring Wheat FHB resistant Germplasm

Fusarium Head Blight (FHB), caused by the pathogen of *Fusarium graminearum*, frequently threatens the production of hard red spring wheat (HRSW) in the northern Great Plains of US. FHB resistance in wheat is a complex trait controlling by many genes. Recurrent selection is an effective way to increase frequencies of favorable alleles and to develop improved germplasm. In this study, three cycles of recurrent phenotypic selection were conducted for FHB severity from 2019 to 2021 in a HRSW population derived from intercrossing of 18 elite cultivars and breeding lines. The FHB severity was reduced 31% from Cycle 0 to Cycle 1 population, and 15% from Cycle 1 to Cycle 2 population. No significant changes of plant height and days to flowering were observed during the selection. Implementing genomic selection (GS) can speed up selection and increase genetic gain in term of time and cost. We genotyped the Cycle 1 population of 183 lines using 90K SNP array and obtained 5,326 SNP markers. Using ridge regression best linear unbiased prediction (rrBLUP) model, the prediction accuracy for FHB severity is 0.26 using cross-validation. Our results indicate that recurrent phenotypic selection can improve FHB resistance in HRSW. Implementing GS in the recurrent selection is possible to further enhance genetic gain.

Key words: FHB, recurrent selection, spring wheat

Byron Ward
MUSIC - PERFORMANCE

Faculty mentor: Jeremy Brekke, DA - Challey School of Music

Research Symposium of the Graduate Student Council

Cornets, Creativity, and Celebration: The Life and Works of Virtuoso Cornetist Alessandro Liberati (1847-1927)

Alessandro Liberati (1847–1927) lived during the late nineteenth and early twentieth centuries, when music for solo cornet was one of the most popular musical outlets in America. He and many performers of this instrument were virtuosos and traveled the world performing beautiful melodies and stylistic acrobatics on the horn. They were the stars of their day and were often also conductors who led their own bands. Scholarly literature has only been written about a select few of these cornet soloists and band leaders. This leads to trumpet players overlooking significant cornet music and only performing works by a handful of composers.

In this study, I address the life and works of virtuoso cornetist Alessandro Liberati to bring forth new evidence that Liberati deserves greater attention as an important cornetist and band leader, a musician on par with his contemporaries. Liberati was an active soloist, band leader, and notable composer with a generous output of compositions. I rely on biographies, encyclopedias, dictionaries, method books, historical band books, newspaper articles, scholarly articles, and recordings of Liberati from Gold Moulded Records (1902). In addition, I consulted Liberati's musical scores and other archival documents housed in his collection at the Library of Congress. These sources show his wide influence as a cornetist, band leader, and composer. To this end, I suggest that Alessandro Liberati was just as successful as his contemporaries, well-liked by the public, sought after in his time, and deserves the same attention and performance today as his more well-known contemporaries.

Key words: Liberati, Cornetist, Band Leader, Composer, Virtuoso

Haley Woods
CHEMISTRY

Faculty mentor: Svetlana Kilina, PhD - Chemistry and Biochemistry

Research Symposium of the Graduate Student Council

The Fine-Tuning of Photophysical Properties of Organometallic Complexes for Application in Photodynamic Therapy

Photodynamic therapy (PDT) is a promising tool for cancer treatment and diagnosis. PDT works through a mechanism of photoexcitation of an organic or metal-organic dye, a photosensitizer (PS), followed by the intersystem crossing from singlet to triplet state and finalized by a triplet exciton transferring to molecular oxygen to produce a reactive oxygen species that can promote malignant cell death. Development of new PSs with absorption at the near IR range that can deeply penetrate through skin and long-time triplet lifetime for energy/charge transfer is crucial for improvement of the therapeutic outcome.

To establish the relationship between photophysical properties and molecular structures that enables a systematic design procedure for novel PS with improved PDT performances, time-dependent density functional theory (TD-DFT) calculations are performed on several PS candidates. Our calculations show red-shifted absorption for PS complexes with Ir(III) centers, relative to Ru(II) and Os(II) centers. Increase in the pi-conjugation length of thiophene ligands also facilitates absorption redshift. Changing the electron donating/withdrawing abilities of substituting groups (NO_2, H, and NH_2) shows no dramatic effect on major absorption peaks. However, NO_2 substituents result in an optically dark S_1 exciton compared to H, and NH_2 substituents. Mixing of the lowest triplet state, T1, with optically dark S_1 is expected to increase the lifetime of T1 state. Thus, our calculations predict that complexes with Ir(III) centers and NO_2 substituents are likely to provide better PS candidates for the generation of reactive oxygen species needed for treatment of a broader scope of cancer types.

Key words: Cancer, Chemistry, Physics

Himani Yadav
CIVIL ENGINEERING - ENVIRONMENTAL

Faculty mentor: Syeed Md Iskander, PhD - Civil, Construction, and Environmental Engineering

Research Symposium of the Graduate Student Council

Microplastics Release from Plastic Chopping Boards during Food Preparation

Microplastics (MPs) are ubiquitous in the environment and have been found throughout the food chain. Physical stress and injury could all be triggered by the accumulation of MPs in bodily tissues. Plastics, particularly those used in food contact materials, expose humans directly to microplastics and toxic chemicals. So, the purpose of our study is to understand the contamination of our food with microplastics through widely used plastic chopping boards. The experiment was designed to determine the effect of chopping board materials (Polyethene, Polypropylene, and Wood) and chopping patterns on microplastics release. We have recorded that striking a knife to prepare a meal per day in the first week of buying a plastic chopping board can release up to 1155 ± 744 microplastics. The composition of microplastics obtained is further confirmed by Fourier transform infrared spectroscopy, which matches manufacturer information. We have identified microplastics as small as 8 μm. We are replicating real-life scenarios by cutting a commonly consumed vegetable (i.e., carrot) on the plastic chopping board. This research would go much farther, identifying nanoplastics in the filtrate before and after cooking. We will quantify additives released by microplastics during high-temperature cooking to better understand the influence of microplastics on food contamination. A toxicity assessment using human cell lines exposed to after-cooking filtrate will help us in understanding dose-dependent effects on cells and, as a result, on humans.

Key words: Microplastics, Chopping boards, Toxicity, Additives, Human health

Aaron Yang
SOFTWARE ENGINEERING

Faculty mentor: Jun Kong, PhD - Computer Science

Research Symposium of the Graduate Student Council

Three-level Pressure-based Authentication on Touch Screens

Since pressure is invisible in nature, it has been applied to enhance the authentication security. However, previous work focused on only two-level pressure-based authentication, which makes it feasible for an attacker to guess a pressure level from a user's pressing behavior in the shoulder surfing attack. To mitigate the above risk, this paper extends pressure-based authentication from two levels to three levels and evaluates its usability and security through a serial of user studies. The first study showed that a three-level pressure-based password is as hard to memorize as a two-level pressure-based password, and it is more resistant to the shoulder surfing attack. However, three-level passwords have a higher false negative rate than two-level passwords, which implies that users lack a consistent pattern when pressing the medium level. To address the above issue, we designed an adaptive training process that assists users on forming a consistent pressing pattern. The training process is featured with an automatic termination when a consistent pressing pattern is detected, which potentially reduces the training length. The second user study indicated that the false negative rate in three-level passwords is significantly reduced after the training.

Key words: Pressure-based Authentication, Human-Computer Interaction, Usable Security, Mobile Authentication

Rose Yang
PHARMACY

Faculty mentor: Amy Werremeyer, PharmD, BCPP - Pharmacy Practice

Research Symposium of the Graduate Student Council

SNAP the Stigma

SNAP the Stigma (SNAP) is an engagement and mental health awareness program developed to de-stigmatize and humanize issues related to mental illness. The SNAP website encourages photovoice, a participatory-action method in which participants capture and reflect upon photos of their lived experiences. This mixed-methods research study investigates the research question: Does interaction with the SNAP website impact NDSU pharmacy and nursing students' perceptions towards individuals with mood and anxiety disorders? We will be focusing on NDSU pharmacy students for this poster. A pre-survey was sent to the students, which included demographic, perception, and social distance scale (SDS) questions. The SDS will measure a vignette with an individual named "Alex" who demonstrated symptoms of major depressive and generalized anxiety disorders. SDS was used to quantify the level of stigmatization participants had toward Alex, and a decrease in SDS score indicates a reduction in stigma. A post-survey was then emailed with the same questions, but participants had to interact with four posts on the SNAP website and reflect on one that impacted them. 36 responses were obtained. Using a paired t-test, a statistically significant decrease in SDS score was seen in three of the seven SDS questions. The mean for the total SDS score decreased following website interaction. The results indicate decreased stigma related to mental illnesses with the use of the SNAP website. The overall findings will allow us to further investigate and better understand health professional students' stigma towards mental illness by the use of a future focus group.

Key words: Mental-health, health-professionals, stigma, website, story

Rose Yang, Audrey Long, and Amy Werremeyer

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