THE OHIO STATE UNIVERSITY

COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

Annual Research Forum
Poster Competition
2023

Graduate and Professional

Monday, March 27, 2:00-4:00pm
Tuesday, March 28, 10:00-12:00pm

Columbus Schedule

TUESDAY

Nationwide and Ohio Farm Bureau 4-H Center

Wooster Schedule

MONDAY

Shisler Ballroom

Table of Contents

Contents

Judges

A special thank you to all of the judges across all competition levels!

Sherifat Alabi, PhD Student, Agricultural Communication, Education, and Leadership
Sheryl Barringer, Faculty, Food Science and Technology
Patricia Boley, Staff, Animal Sciences
Stephen Boyles, Faculty, Animal Sciences
Chris Bruynis, Faculty, Other (type below)
Wanderson Bucker Moraes, Post Doc, Plant Pathology
Wanderson Bucker Moraes, Post Doc, Plant Pathology
Tyler Carr, Faculty, Horticulture and Crop Science
Kellie Claflin, Faculty, Agricultural Communication, Education, and Leadership
Kimberly Cole, Faculty, Animal Sciences
Priyadarsini Das, PhD Student, Agricultural Communication, Education, and Leadership
Cecilia de Freitas, Post Doc, Plant Pathology
Warren Dick, Faculty, School of Environment and Natural Resources
Benjamin Duran, PhD Student, Animal Sciences
Jeff Firkins, Faculty, Animal Sciences
Lyda Garcia, Faculty, Animal Sciences
Srishti Gaur, Post Doc, Food, Agricultural and Biological Engineering
Monica Giusti, Faculty, Food Science and Technology
Richard Gonzalez, Masters Student, Plant Pathology
Andrea Gschwend, Faculty, Horticulture and Crop Science
Demilade Ibiwoye, PhD Student, Animal Sciences
Shoshanah Inwood, Faculty, School of Environment and Natural Resources
Dee Jepsen, Faculty, Agricultural Communication, Education, and Leadership
Reed Johnson, Faculty, Entomology
Scott Kenney, Faculty, Animal Sciences
Jaelene Loor Suche, Masters Student, Agricultural Communication, Education, and Leadership
Ashish Manandhar, Staff, Food, Agricultural and Biological Engineering
Lily Mank, PhD Student, School of Environment and Natural Resources
Leah McHale, Faculty, Horticulture and Crop Science
Megan Meuti, Faculty, Entomology
Mackenzie Miller, Post Doc, School of Environment and Natural Resources
Sachin Naik, Post Doc, Horticulture and Crop Science

Ali Nazmi, Faculty, Animal Sciences
Ali Nazmi, Faculty, Animal Sciences
Sunny Park, Staff, Other (type below)
Ali Peart, Masters Student, Plant Pathology
Peter Piermarini, Faculty, Entomology
Krystal Pocock, Staff, School of Environment and Natural Resources
Brian Raison, Faculty, Agricultural Communication, Education, and Leadership
Heather Raymond, Staff, Research and Graduate Education
Luis Rodríguez-Saona, Faculty, Food Science and Technology
Tiffanna Ross, Post Doc, Plant Pathology
Mitchell Roth, Faculty, Plant Pathology
Branden Ritter, Staff, Research and Graduate Education
Elizabeth Share, Staff, Animal Sciences
Jonathon Van Gray, Faculty, Other (type below)
Brooklyn Wagner, Faculty, Animal Sciences
Macdonald Wick, Faculty, Animal Sciences
Roger Williams, Faculty, School of Environment and Natural Resources

Poster Authors

Masters

Valerie Anderson, MS, Entomology; Advised by Luis Canas

Dina Bugybayeva, MS, Animal Sciences; Advised by Gourapura Renukaradhya

James Cross, MS, Environmental Sciences Graduate Program, Food, Agricultural, and Biological Engineering; Advised by Darren Drewry

Ellen Danford, MS, Environmental Sciences Graduate Program, Entomology; Advised by Dr. Mary Gardiner

Sandeep Dhakal, MS, Food, Agricultural and Biological Engineering; Advised by Ajay Shah

Ziyu Dong, MS, School of Environment and Natural Resources; Advised by Roger Williams

Richard Gonzalez Aquino, MS, Plant Pathology; Advised by Horacio Lopez-Nicora

Camila Gutierrez, MS, Horticulture and Crop Science; Advised by Jonathan Fresnedo Ramirez

Daniela Gutierrez Yanez, MS, Plant Pathology; Advised by Francesca Hand

Daniel Hemphill, MS, Horticulture and Crop Science; Advised by Jonathan Fresnedo-Ramirez

Conner Johnson, MS, Plant Pathology; Advised by Horacio Lopez-Nicora

Neha Joshi, MS, Food, Agricultural and Biological Engineering; Advised by Dr. Sami Khanal

Jessica Laemont, MS, Food Science and Technology; Advised by Sheryl Barringer

Olivia Lang, MS, Entomology, Masters in Plant Health Management; Advised by Luis Canas, Andy Michel, and Ashley Leach

Forrest Lang, MS, Agricultural Communication, Education, and Leadership; Advised by Amanda Bowling

Lauren Ma, MS, Food Science and Technology; Advised by Sheryl Barringer

Erick Martinez Rodriguez, MS, Entomology; Advised by Peter Piermarini

Yamikani Ng'ona, MS, Entomology; Advised by Andrew Michel

Alison Peart, MS, Plant Pathology; Advised by Horacio Lopez-Nicora

Brandon Shannon, MS, Environmental Sciences Graduate Program, Entomology; Advised by Reed Johnson

Olaitan Shekoni, MS, Animal Sciences, Center of Food Animal Health; Advised by Aradhya Gourapura

Ambria Small, MS, Plant Pathology; Advised by Horacio Lopez-Nicora

Raksha Suresh, MS, Animal Sciences; Advised by Renukaradhya Gourapura

Lu Xun, MS, Food Science and Technology; Advised by Monica Giusti

Doctoral

Stephanie Almquist, PhD, Food Science and Technology; Advised by Devin Peterson

Rachel Combs-Giroir, PhD, Horticulture and Crop Science; Advised by Dr. Andrea Gschwend

Eric Devney, PhD, Food, Agricultural and Biological Engineering; Advised by Dr. Judit Puskas

Cullen Dixon, PhD, Horticulture and Crop Science, Translational Plant Science; Advised by Dr. Andrea Gschwend

Daniel Do, PhD, Food Science and Technology; Advised by Dr. Jessica Cooperstone

Ademola Duduyemi, PhD, Animal Sciences; Advised by Thaddeus Ezeji

Benjamin Duran, PhD, Animal Sciences; Advised by Alvaro Garcia Guerra

Xinyue Fan, PhD, Food Science and Technology; Advised by Monica Giusti

Xiaoyi Fang, PhD, Agricultural, Environmental and Development Economics; Advised by Ani L. Katchova

Jane Fu, PhD, Food Science and Technology; Advised by Hua Wang

Brianda Daniela Gonzalez Orozco, PhD, Food Science and Technology; Advised by Dr. Valente Alvarez

Ashley Herkins, PhD, Food, Agricultural and Biological Engineering; Advised by Katrina Cornish

Eric Hobson, PhD, Plant Pathology; Advised by Jonathan Jacobs

Hetian Hu, PhD, Food, Agricultural and Biological Engineering; Advised by V.M. Balasubramaniam

Veeramani Karuppuchamy, PhD, Food Science and Technology; Advised by Osvaldo Campanella

Sushma Katari, PhD, Food, Agricultural and Biological Engineering; Advised by Sami Khanal

Manpreet Kaur, PhD, Food, Science and Technology; Advised by Sheryl Barringer

Marziyeh Khavari, PhD, Horticulture and Crop Science; Advised by Jonathan Fresnedo Ramirez

Min (Kevin) Kim, PhD, Food Science and Technology; Advised by Christopher Simons

Nate King-Smith, PhD, Food, Agricultural and Biological Engineering; Advised by Katrina Cornish

Carolyn Lee, PhD, Animal Sciences, Center of Food Animal Health; Advised by Scott Kenney

Jonathan Lee-Rodriguez, PhD, Entomology; Advised by Luis Canas

Yutong Li, PhD, Food Science and Technology; Advised by Hua Wang

Jenna Moore, PhD, Plant Pathology; Advised by Horacio Lopez-Nicora

Hyeon Woo Park, PhD, Food Science and Technology; Advised by V. M. Balasubramaniam

Michelle Pham, PhD, Environmental Sciences Graduate Program, Entomology; Advised by Mary Gardiner

Carlos Alfredo Porras Guardado, PhD, Food Science and Technology; Advised by M. Monica Giusti

Annika Pratt, PhD, Plant Pathology; Advised by Mitchell Roth

Juan Quijia Pillajo, PhD, Horticulture and Crop Science; Advised by Michelle Jones

Thomas Reis, PhD, Food Science and Technology; Advised by Christopher T. Simons

Peter Renz, PhD, School of Environment and Natural Resources; Advised by Richard Dick

Silvette Ruiz-Ramirez, PhD, Food Science and Technology; Advised by Rafael Jimenez-Flores

Abigail Sommer, PhD, Food Science and Technology; Advised by Yael Vodovotz

Erica Summerfield, PhD, Agricultural Communication, Education, and Leadership; Advised by Annie Specht

Zhining Sun, PhD, Agricultural, Environmental and Development Economics; Advised by Ani Katchova

Grace Sward, PhD, Entomology; Advised by Luis Canas

Jaden Tatum, PhD, Food, Agricultural and Biological Engineering; Advised by Ajay Shah

Haotian Wu, PhD, Agricultural, Environmental and Development Economics; Advised by Allen H.Klaiber

Kush Yadav, PhD, Animal Sciences; Advised by Scott Kenney

Ming Yan, PhD, Animal Sciences; Advised by Dr. Zhongtang Yu

Hengkang Zhao, PhD, School of Environment and Natural Resources; Advised by Rattan Lal, Brian K Slater

Rui Zheng, PhD, Animal Sciences; Advised by Sheila Jacobi

Postdoctoral

Javier Campos, Post-doc, Food, Agricultural and Biological Engineering; Advised by Dr. Erdal Ozkan

Srishti Gaur, Post-doc, Food, Agricultural and Biological Engineering; Advised by Dr. Darren Drewry

Dong Hwan Kim, Post-doc, Animal Sciences; Advised by Kichoon Lee

Joonbum Lee, Post-doc, Animal Sciences; Advised by Kichoon Lee

Carla Roman, Post-doc, Food, Agricultural and Biological Engineering; Advised by Erdal Ozkan

Research Staff

Nuris Acosta, Staff, Entomology; Advised by Pete Piermarini

Daiyanera Kelsey, Staff, Entomology; Advised by Ashley Leach

Ashish Manandhar, Staff, Food, Agricultural and Biological Engineering; Advised by Ajay Shah

Jennifer Schrock, Staff, Animal Sciences, Center of Food Animal Health; Advised by Aradhya Gourapura

Presentation Schedule

Monday, March 27, 2023

Wooster Campus

Shisler Ballroom, 1680 Madison Avenue

Graduate and Professional poster presentations
Poster Set-up: 1:00 p.m.
Judging: 2:00-4:00 p.m.

Tuesday, March 28, 2023

Columbus Campus

Nationwide & Ohio Farm Bureau 4-H Center, 2201 Fred Taylor Drive

Graduate and Professional Poster Presentations
Poster Set-up: 9:00 a.m.
Judging: 10:00-12:00 noon

Undergraduate Research Poster Presentations
Poster Set-up: 12:00 noon
Judging: 1:00-3:00 p.m.

Thursday, March 30, 2023

Columbus Campus

Nationwide & Ohio Farm Bureau 4-H Center, 2201 Fred Taylor Drive

CFAES Research Forum Awards Ceremony & Desert Reception
1:00-3:00pm

Full Abstracts

Columbus Campus

Master's Level

Alison Peart, MS, Plant Pathology

*Presenting author

Early detection of soybean cyst nematode (SCN)-infected soybean plants using near-infrared (NIR) spectroscopy and machine learning

Alison Peart*, Zak Ralston, Carrie Fearer, Enrico Bonello, and Horacio Lopez-Nicora

The soybean cyst nematode (SCN) is one of the most damaging soybean pathogens in North America. SCN often causes significant yield reduction with no visible symptoms, which makes its early detection critical for effective disease management. Here, we show that asymptomatic leaves from soybean plants growing in soils infested with a high SCN population can be discriminated from leaves of healthy plants growing in SCN-free soils using near-infrared (NIR) spectroscopy combined with machine learning. The relationship between soybean yield and the initial SCN population at planting (Pi) was also evaluated. During the 2021 and 2022 growing seasons, we collected soil samples from an unevenly SCN-infested field divided into a grid of 100, 28 x 33 ft quadrats to determine SCN Pi. We then identified and collected NIR spectra from plants in the center of quadrats with high SCN populations (Pi > 1,000 eggs/100 cm3 soil) and compared them to spectra from plants centered on SCN-free quadrats (Pi = 0 eggs/100 cm3 soil). All plants were at the V9-V10 growth stage. While the foliage from the two groups of plants looked identical at V9-V10, we measured a 37% yield reduction in quadrats with high SCN ($P < 0.01$). Such difference in health status was correctly predicted by a support vector machine model, a form of machine learning, applied to the NIR spectra, with a testing accuracy of 73.1% (N = 100). These findings suggest that NIR spectroscopy may be a useful tool for early detection of SCN and a valuable component of more proactive management strategies for this deceptive disease.

James Cross, MS, Environmental Sciences Graduate Program, Food, Agricultural, and Biological Engineering

Ensemble machine learning for interpretable soil heat flux estimation

James Cross*, Darren Drewry

Soil heat flux is a key driver of water use, nutrient uptake, and plant photosynthetic capacity, among other physiochemical processes, but is often poorly quantified in existing semi-empirical model formulations. The soil's thermal response is influenced by factors of soil composition,

vegetation density, phenology, and environmental conditions. Soil heat flux process-based and data-driven prediction methods have typically focused evaluations on midday landscape scale estimates when satellite observations are available, despite the high variability that soil heat flux can display at diurnal scales and across plant morphologies.
Here we assess the performance of ensemble machine learning modeling for predicting soil heat flux at half-hourly resolution for multiple agro-ecosystems across the wide range of phenological and climatological variability spanning a complete growing season. We utilized the random forest ML approach to develop a wide range of models spanning predictor sets including both common meteorological conditions and remote sensing observations and compared ML model performance to a baseline set of six semi-empirical soil heat flux models. The random forest ML ensembles demonstrated a general ability to significantly outperform the six semi-empirical models in capturing diurnal variations across the growing season for each of the four crops examined here (soybean, corn, sorghum and miscanthus). We found ML models using the complete set of meteorological and remote sensing predictors captured over 90% of the variability in SHF across all crops. ML models using only canopy temperature and NDVI as predictors were able to capture over 82% of SHF variability across all crops.
Shapley additive explanations (SHAP) methods were examined to allow for model interpretability, providing insights into the typically opaque ML modeling process. Models trained with fewer input variables tended to display more linear and interpretable feature attribution, suggestive of physical consistency. Canopy temperature and air temperature were often the most crucial predictors when present due to high correlation with soil heat flux, with NDVI as the next most crucial feature due to its ability to quantify canopy density and phenological status. This work highlights the potential of machine learning to support the observation necessary for the development of more efficient and sustainable agricultural practices.

Ellen Danford, MS, Environmental Sciences Graduate Program, Entomology

Are there barriers to urban lady beetle conservation?
Ellen Danford*, Mary Gardiner

The Luxury Effect Hypothesis predicts that neighborhoods with a higher median income support a higher plant species richness than lower income areas. This hypothesis suggests that the habitat quality of neighborhoods might vary based on income. We propose that if the Luxury Effect Hypothesis is supported, neighborhoods may vary in habitat quality for insects of conservation concern. Across the US, several species of aphidophagous native lady beetles (Coccinellidae) have exhibited marked declines, yet we have found that populations of many native lady beetle species

can utilize residential gardens as habitat. Our goal was to determine if the Luxury Effect Hypothesis predicted the species richness and abundance of lady beetles within urban neighborhoods. We predicted that higher income neighborhoods would support a higher species richness and abundance of floral resources and prey, resulting in a greater abundance of lady beetles as compared to lower income neighborhoods. Our approach was to establish 15 greenspace plots across the city of Columbus, Ohio, USA that varied in median household income. Each plot was located at a municipal building such as a school, library, or fire station. At each location we collected lady beetles monthly from May-August using unbaited yellow sticky card traps. Each lady beetle collected was counted and identified to species. Vegetation data was collected at each site by randomly selecting two meter squared quadrats and identifying and counting all blooming vegetation in the quadrat. Following our hypothesis, we found total lady beetle abundance was positively associated with socioeconomic status. Native species had no association to socioeconomic status. Our findings illustrate that the Luxury Effect Hypothesis does extend beyond plant communities to predict the distribution of insects that rely on plants for prey and non-prey foods. In conclusion, our study suggests that wealth is a factor in the ability of insect communities to thrive in urban greenspaces and indicates socioeconomically based inequity in the conservation value of urban greenspaces. Our results suggest that greening investments to support the conservation of lady beetles and other flower feeding insects should focus on quality and connectedness in lower income neighborhoods within the Columbus, Ohio metropolitan area.

Ziyu Dong, MS, School of Environment and Natural Resources

Effects of Physiography and Fuel Characteristics on Fire Behavior
Ziyu Dong*, Roger Williams

Over the past two decades, the area burned by wildfires annually in the eastern U.S. has averaged 1.3 million acres, or 19% of the total area burned in the U.S. However, the eastern U.S. has averaged 44,246 wildfires annually during this same period, or 62.9% of all wildfires in the U.S. While the eastern U.S. has experienced 77% fewer acres burned compared to the western U.S., the east has experienced 75% more wildfires. Of the fires that occurred in the eastern U.S., 97.1% of these fires were human-caused, compared to 68.0% in the western U.S., and in 2019 76% of the U.S. population resided in the eastern U.S., a region that has experienced the greatest increase in the wildland-urban interface (WUI). Recent large wildfires in the east and the lengthening of fire seasons becomes more of a concern in the densely populated eastern U.S. Predicting the future trends of fire severity and intensity are difficult to determine owing to the complex and non-linear interactions between weather, vegetation, and people, and it becomes necessary to acquire improved fire data. Since future predictions show dramatic increases in fire probability in the

eastern U.S. where the greatest occurrence and expansion of the WUI exists, more attention needs to be given to understanding the factors of fire behavior and spread in eastern forests. The objectives of this study are to determine the impact of slopes, aspect, and fuel composition on fire intensity in temperate hardwood forests.

Richard Gonzalez Aquino, MS, Plant Pathology

Evaluate the efficacy of an automated machine sampler and traditional soil sampling for Soybean Cyst Nematode (Heterodera glycines)
Richard S. González, Horacio Lopez-Nicora

Daniela Gutierrez Yanez, MS, Plant Pathology

Evaluating the effect of gerbera daisy plant age and Phytophthora drechsleri inoculum rate on incidence and severity of crown rot in ASD-treated substrate
Daniela Gutierrez Yanez*, Anna Testen, Francesca Peduto Hand

Anaerobic soil disinfestation (ASD) is a non-chemical soil treatment where an easily decomposable carbon source is incorporated into the soil and incubated in anaerobic conditions. The antagonistic effects of anaerobic organisms and the release of toxins during incubation can be effective at reducing soilborne pathogen survival. ASD efficacy in controlling Phytophthora crown rot of gerbera daisy has been previously tested unsuccessfully. This study aimed to simultaneously evaluate the effect of Phytophthora drechsleri's inoculum rate on the efficacy of the ASD treatment, and of plant age on disease development. Sterile vermiculite infested with P. dreschleri was incorporated to a soil-based substrate at the rate of 3.4, 6.8, 10.2, 13.6, and 17 kg/m3 along with wheat bran as the carbon amendment (9 t/A). Treatments were placed inside bags, water saturated, and incubated in anaerobic conditions at 25°C for 4 weeks. Non-amended aerobic and anaerobic treatments were included as controls. Treatments were arranged in a split plot design with 4 blocks, with ASD treatment as the main plot factor and inoculum rate and plant age as the sub-plot factors. After incubation, treatments were transferred to pots and 10-, 8-, 6- and 4-weeks-old Gerbera jamesonii 'Cartwheel Strawberry Twist' plugs were transplanted in each pot with plant age as the main plot factor. Pots were maintained for 4 weeks in a greenhouse and evaluated weekly for disease incidence and severity. The experiment was conducted twice. Treatment effects on response variables were analyzed by ANOVA. Six- and 8-weeks old plants displayed significantly less disease incidence and severity compared to 4-weeks old plants. There was a significant interaction between inoculum rate and ASD treatment as the anaerobic control,

when incorporated to the two lowest inoculum rates, resulted in significantly lower disease incidence and severity compared to higher rates. Carbon amendment increased disease incidence and severity compared to both controls. These results indicate that ASD could be effective at reducing Phytophthora crown rot when inoculum levels in the substrate are low, and that plants should be transplanted into ASD-treated substrates not earlier than 6-weeks after sowing. However, different carbon sources should be further investigated as more suitable amendments.

Conner Johnson, MS, Plant Pathology

Screening Commercial Soybean Cultivars for Resistance to Soybean Cyst Nematode Type 2
Conner Johnson*, Laura Lindsey, Horacio Lopez-Nicora

Soybean cyst nematode (SCN) is the leading cause of yield loss for soybeans in North America. Most commercial varieties derive resistance from cultivar PI 88788. These varieties have been grown continuously throughout the Midwest, putting massive pressure on SCN populations to adapt. In Ohio, more than 60% of fields with high SCN levels have Type 2 SCN populations, which is defined by its ability to reproduce on PI 88788 at least 10% as effectively as it reproduces on susceptible cultivars. While most commercial varieties are labeled resistant to SCN, this evolving situation requires study of how available varieties fare against adapted SCN populations now found throughout the state. This study screened 128 commercial soybean cultivars against SCN populations isolated from Ohio fields. Three replicates of each cultivar were inoculated with a Type 2 SCN population, Lee-74 and Williams-82. Plants were grown for 30 days in the greenhouse, then females (or cysts) were extracted from the roots. The average number of females extracted from each variety was divided by the average number extracted from the susceptible cultivars planted in the same test. This percentage is known as the Female Index (FI). Varieties with less than 10% FI were categorized as highly resistant, 10%-25% as resistant, 25%-40% as moderately resistant, 40%-60% as low resistance and greater than 60% as no resistance. Of 128 varieties screened, more than 40 were classified as no resistance, 18 as low resistance, and only 10 as highly resistant. This specific SCN isolate is highly virulent to PI 88788, so farmers planting in fields with this pathotype can expect significant yield loss. Based on these results, recommendations to farmers include: rotating with different resistance sources and non-host crops and routinely monitoring SCN levels and population types. For breeders, this highlights the urgent need for new varieties with different resistance genes.

Neha Joshi, MS, Food, Agricultural and Biological Engineering

Monitoring the proxies of harmful algal blooms using Sentinel-3: A case study of Western Lake

Erie Basin
Neha Joshi*, Jongmin Park, Kaiguang Zhao, Sami Khanal, and Alexis Londo

Cyanobacterial harmful algal blooms release toxins on the water surface causing widespread problems, including serious threats to human health and the water ecosystem. To identify the potential drivers for the bloom, there is a need for extensive observations of the water sources with bloom occurrences. However, historical protocols for monitoring water sources such as ground sample collection have proven limited due to economic costs, and spatial and temporal heterogeneity of water resources. These limitations can be addressed through the use of high-frequency satellite data. In this study, we explored the use of Random Forest (RF), a widely used machine learning architecture, to evaluate the performance of Sentinel-3 OLCI (Ocean and Land Colour Imager) L2 images in predicting bloom proxies in the western region of Lake Erie. Sixteen available bands from images were used as the predictors while four proxies of algal bloom, including Chlorophyll-a, Microcystin, Phycocyanin, and Secchidepth, were considered as response variables in the RF models, with one RF model per proxy. Each of the proxies comes with a unique set of traits that can help with bloom detection. Among the four RF models, the model for Chlorophyll-a performed the best with R2 = 0.55 and RMSE = 20.84 ±µg/L, while R2 performance for the rest of the other proxies was less than 0.5. This is because Chlorophyll-a is the most dominant and optically active pigment in water, while Phycocyanin, which is a strong indicator of harmful bloom, is present in low concentrations. Additionally, Microcystin, responsible for bloom toxicity, has limited spectral sensitivity, and Secchidepth could be influenced by various factors besides blooms, such as coloured dissolved organic and inorganic matter. We further examined the relationships between the proxies to see how they relate to one another. The association of Chlorophyll-a with the corresponding proxies elucidates the possibility of Chlorophyll-a being utilized as a complement for other proxies in case the measurements of those proxies are limited.

Jessica Laemont, MS, Food Science and Technology

Effect of pH and Reducing Sugar Content on Roasted Sunflower Seed Aroma Volatiles
Jessica Laemont*, Sheryl Barringer

Introduction
Sunflower seeds are a popular snack in baseball, China, and Spain. Roasting sunflower seeds is necessary to create desirable aromas from the Maillard and lipid oxidation reactions. Pyrazines are major aroma compounds formed from the Maillard reaction, and are affected by pH, type and concentration of reducing sugar. The objective of this study was to improve roasting conditions to maximize positive volatile aroma compounds for sunflower seeds by modifying reducing sugar

content, type and pH.

Method

A 30g portion of sunflower kernels were soaked overnight in 70mL solutions at pH 4, 7, or 9, 20% glucose, or 20% fructose, dried for 24hr at 25±°C, then oven roasted at 165±°C for 8 minutes. Seeds were ground, and 10g were used for volatile analysis. Selective-ion flow tube mass spectrometry (SIFT-MS) was used to measure the volatiles in the seeds. ±°Brix was measured by refractometer and color by colorimeter. All samples were in triplicate. ANOVA with Tukey's test was conducted for statistical analysis.

Results

During roasting, the lipid oxidation volatiles were at higher concentrations than the Maillard reaction volatiles. Pentanal is the most abundant volatile due to the lipid oxidation of linoleic acid, contributing an increase in a fruity or nutty odor. Increasing pH and reducing sugar content, the limiting reagent, increased the Maillard reaction volatiles. Increasing the pH increased 2-methylpyrazine, dimethylpyrazines, trimethylpyrazine, and tetramethylpyrazine because the nucleophilic attack of the amino group during the initial stage of the Maillard reaction favors a basic pH. Fructose increased dimethylpyrazines, 2-methylpyrazine, and trimethylpyrazine formation more than glucose, while pyrazine increased more with glucose than fructose. Tetramethylpyrazine had no difference based on type of reducing sugar and increased with both treatments. The pyrazine compounds contribute to a nutty aroma. Furfural increased exponentially with fructose and glucose contributing a caramelic aroma. The L value decreased as the pH increased and with glucose and fructose. Optimizing roasting conditions by increasing the reducing sugar content and increasing the pH can favor the Maillard reaction conditions increasing the positive aromas associated with roasted sunflower seeds.

Lauren Ma, MS, Food Science and Technology

Effect of sucrose, pH and pectin methoxyl levels on concord grape (Vitis labrusca) jelly volatiles

Lauren Ma*, Sheryl Barringer

Sugar-free and low sugar jellies have become increasingly popular as consumers became more conscious of how much sugar is in their diets. With the abrupt departure from traditional jelly, it is necessary to maximize the fruit flavor using existing ingredients. Grape flavor is the second most popular jelly in America and concord grape is a popular cultivar used in jellies. Therefore, it is important to determine how different ingredients in jelly affect the final volatile profile.

Control jelly was created with 3.75 g of grape juice concentrate, 2 g dH2O, 15 g of 5% high methoxyl pectin slurry (72 DM), 40 g sucrose, and 2 g 10% citric acid solution. Variables, including amount of sucrose (55±° Brix and 81±° Brix), amount of acid (pH 2.7 and 3.3), and type of pectin

(Low Methoxyl 40 DM). Ingredients were mixed in a 500 mL bottle with septum, heated for 4 minutes in a 100 ±°C water bath then immediately incubated at 60 ±°C for 60 min. '‹The volatiles were measured with SIFT-MS and analyzed with ANOVA and Tukey's HSD. There were three replicates for each condition
In low methoxyl pectin concentrations of acetoin, butanoic acid, ethyl acetate, and isobutanoic acid were significantly higher (p=0.01) than high methoxyl pectin concentrations, making the pectin matrix the most important factor influencing volatile concentrations. High methoxyl pectin creates hydrophobic micelles that trap volatiles The different levels of pH and amount of sucrose did not create significantly different volatile concentrations in high methoxyl pectin jellies but did show a positive trend with increased pH and sucrose amounts. '‹These differences can be attributed to the increase in pH and sucrose making the environment more hydrophilic and driving hydrophobic volatiles out of the jelly.
The flavor of grape jelly can be improved by changing pectin type and increasing pH and sucrose to boost its volatile levels, helping brands to produce more flavorful products with minimal changes to their jelly processing.

Ambria Small, MS, Plant Pathology

Relationship between Soybean Cyst Nematode and Soil Texture in Ohio
Ambria Small*, Horacio Lopez-Nicora

The Ohio State University's Soybean Pathology & Nematology laboratory joined a coalition in 2018 to support Ohio extension agent and grower need for Heterodera glycines, or Soybean Cyst Nematode (SCN), testing and evaluation of SCN population trends. SCN is the most economically important pathogen on soybean in North America, resulting in 30% yield losses without observable symptoms in plants. Currently, soybean growers are motivated to submit samples to the program with the understanding that SCN thrive only in sandy soils. Much of Ohio soil types that support soybean crops are medium-textured, silty to clayey soils due to historical glacial movement and the pre-existing parent materials. SCN are surviving and thriving in soils not commonly associated with nematodes. The objective of this study is to evaluate Ohio county soils for SCN populations across growing seasons of all field crops and determine whether soil texture influences the success of SCN populations in agricultural fields.

Lu Xun, MS, Food Science and Technology

Adding Value to Purple Corn Cob: Anthocyanin-Derived Food Colorants with Improved pH Stability

Lu Xun*, Danielle M. Voss, Gonzalo Miyagusuku-Cruzado, M. Monica Giusti

Consumer demands for naturally sourced, environmentally sustainable food colorants position pyranoanthocyanins as promising options. Associated with red wine, pyranoanthocyanins show excellent heat stability and could be formed from pigment-rich byproducts from the agro-industry. However, more information is needed on their production and application potential. Our objectives were to optimize the formation parameters for 10-p-hydroxyphenyl-pyranoanthocyanin from purple corn cob (PCC) anthocyanins and 4-vinylphenol and to characterize the color stability across pH for 10-p-hydroxyphenyl-pyranocyanidin-3-glucoside.
Semi-purified PCC anthocyanins (cyanidin-, peonidin-, and pelargonidin-3-glucoside, 80 ±µM) were mixed with 4-vinylphenol and incubated in the dark for 96h. Box-Behnken design was used to evaluate pH (2.0, 2.7, and 3.4), temperature (40, 50, and 60±°C), and cofactor:pigment ratio (2:1, 10:1, and 18:1). Pyranoanthocyanin formation was monitored by uHPLC-PDA-ESI-MS/MS and color changes were measured with spectrophotometry and ColorBySpectra±®. Optimal incubation conditions were determined using response surface analysis. Color stability was assessed for isolated 10-p-hydroxyphenyl-pyranocyanidin-3-glucoside or cyanidin-3-glucoside (40 ±µM) in pH 3-10 water (adjusted with HCl or NaOH), pH 1 and 3 KCl buffer, and 0.1% HCl MeOH. Spectra were recorded after equilibration for up to 2h and used to calculate color (CIELAB) and molar absorptivity (Beer's Law).
10-p-Hydroxyphenyl-pyranoanthocyanins formed from PCC following pseudo-first-order kinetics (R2 > 0.99). PACN yield fit a second-order polynomial model (R2 = 0.9840, CV = 6.18%). The optimal conditions for PACN yield (predicted at 97.3%) were pH 2.7, 42.6±°C, and 12.6:1 cofactor:pigment ratio. The solution became more orange over time, noted by a hypsochromic Î»vis-max shift. In pH 1-3 buffers, 10-p-Hydroxyphenyl-pyranocyanidin-3-glucoside was yellow orange (hab ~65) with up to 3.6x greater absorptivity than the red-pink cyanidin-3-glucoside (hab 30 at pH1, 13.2 at pH3, respectively). In water, the pyranoanthocyanin's color transitioned from yellow orange (Î»vis-max = 492-493) at pH ~3-5 to fuchsia (Î»vis-max = 529'“530) at pH ~8-10. At neutral pH, 10-p-Hydroxyphenyl-pyranocyanidin-3-glucoside lost some color, while cyanidin-3-glucoside completely faded. No precipitation was observed for 10-p-hydroxyphenyl-pyranocyanidin-3-glucoside, yet the color changed over time at basic pH.
Optimization of PCC pyranoanthocyanin production and their improved color stability across pH increase their potential as sustainable colorant options for a variety of products.

Doctoral Level

Stephanie Almquist, PhD, Food Science and Technology

Characterizing Interactions of Volatile Flavor Compounds and Pea Protein Using Gas Chromatography/Mass Spectrometry

Stephanie Almquist*, Paulina Ongkowijoyo, Edisson Tello, Devin Peterson

Changing consumer behavior due to health and environmental concerns has led to growth in the global alternative protein market. Total US sales of plant-based proteins are predicted to more than double by 2025 to over 3 billion dollars (Formanski 2019). One of the major challenges facing consumer acceptability of plant protein meat alternative products is inferior flavor quality. Proteins, being macromolecules with multiple binding sites are capable of absorbing flavor compounds with different functional groups often resulting in an unbalanced flavor profile in the finished food product. An improved mechanistic understanding of the protein-flavor binding is needed to control and predict binding within protein food products. This is a challenging task due to the complexity of binding interactions, as specific mechanisms depend on the type of protein, protein concentration, protein structure, the chemical composition of the flavor molecule, and even external conditions such as processing and storage (e.g., temperature, pH). The objective of this research study was to parameterize several factors influencing flavor-protein binding: the impact of flavor composition (i.e., flavor compounds in a mixture), protein concentration, and protein solubility (i.e., soluble vs. precipitate peptides). A gas chromatography/mass spectrometry (GC/MS) analytical protocol was developed and optimized for different flavor compounds to calculate of the percentage of flavor bound to the protein, by comparison of the ratio of the peak area of the flavor in the protein solution to the peak area of the flavor in a control aqueous solution. In summary, all factors (flavor concentration, flavor composition, protein concentration, and protein solubility) demonstrated impact on flavor-protein binding interactions, which might assist in possible strategies to reduce binding of desirable flavors in products, such as manipulating protein: protein interactions themselves. Ultimately, these results provided novel understanding of flavor-plant protein interactions and can assist in improving flavor quality and stability within protein food products.

References:

Formanski K (2019) Plant-based proteins - US, May 2019.

Rachel Combs-Giroir, PhD, Horticulture and Crop Science

Morphological and transcriptomic responses of pennycress to waterlogging

Rachel Combs-Giroir* and Andrea R. Gschwend

Field pennycress (Thlaspi arvense) is a new biofuel cover crop with extreme cold hardiness and a short life cycle, enabling off-season integration into corn and soybean rotations across the Midwest. Pennycress fields are susceptible to winter snow melt and spring rainfall, leading to waterlogged soils. The objective of this research was to determine if waterlogging has a significant effect on morphology, yield, and gene expression of two pennycress lines (SP32-10 and MN106) waterlogged for 1 week during the reproductive stage in a controlled environment. Total pod number, shoot/root dry weight, and total seed count/weight were significantly reduced in SP32-10 in response to waterlogging, whereas primary branch number, shoot dry weight, and single seed weight were significantly reduced in MN106. This indicates waterlogging has a negative impact on growth and a different significant effect on yield across accessions. Differentially expressed genes (DEGs) between waterlogged and control roots accounted for 27% and 21% of all genes in MN106 and SP32-10 respectively. Functional enrichment analysis of upregulated DEGs revealed Gene Ontology (GO) terms associated with hypoxia and decreased oxygen, with genes in these categories involved in alcoholic fermentation and glycolysis. Downregulated DEGs revealed GO terms associated with cell wall biogenesis and secondary metabolite biogenesis, indicating suppressed growth and energy conservation. Together, these results imply significant inhibition of pennycress plant growth and the reconfiguration of cellular and metabolic processes in response to the severe energy crisis induced by waterlogging. Candidate genes and pathways involved in the response of pennycress to waterlogging can be further utilized for the development of elite lines with enhanced tolerance to waterlogging.

Cullen Dixon, PhD, Horticulture and Crop Science, Translational Plant Science

Investigation of Insect-Herbivory Resistance in Wild Vitis labrusca and Cultivated Vitis vinifera Grapevine

Cullen W. Dixon* and Andrea R. Gschwend

Grapevine is one of the world's most important fruit crops, valued at over $220B in the United States, but insect herbivory leads to 20-40% of global crop production loss annually. Discovery of insect-herbivory resistance genes and subsequent introduction into cultivated grapevine could curtail these losses. Vitis labrusca, a North American grapevine species, possesses adaptations that impart fitness advantages over European grapevine, Vitis vinifera. We hypothesize V. labrusca is more resistant to insect herbivory than V. vinifera grapevine. To address this hypothesis, three insect herbivory studies were conducted. An insect herbivory choice assay revealed seven times less defoliation of V. labrusca; acc. 'GREM4' leaves than V. vinifera; cv. 'Pinot

Noir' ('PN') while timecourse feeding studies report significantly less defoliation (4.6-35x decrease) in 'GREM4' than 'PN' after 30min, 1h, and 4h of feeding. Under conditions where leaf trichome densities were equal between species, three times less defoliation was still observed in 'GREM4' than 'PN', suggesting trichomes are not the only factor deterring 'GREM4' insect herbivory. Overall, these results suggest an aversion to feeding upon 'GREM4'. We hypothesize that novel expression of defense gene or differences in defense gene copy number contribute to the increase in 'GREM4's insect herbivory deterrence. Comparative transcriptomic analysis of 'GREM4' and 'PN' insect-defoliated leaves revealed increased expression of genes implicated in insect-herbivory defense in 'GREM4' compared to 'PN', with further analysis still ongoing. These findings will provide geneticists and breeders with candidate genes to introgress or engineer into cultivated crops to increase insect-herbivory resistance and yields.

Daniel Do, PhD, Food Science and Technology

Pharmacokinetics of tomato steroidal alkaloids in healthy adults following consumption of two doses of tomato juice

Daniel Do*, Maria Sholola, Jessica Cooperstone

Tomato steroidal alkaloids (TSAs) are gaining traction for their potential health benefit based on a growing number of in vitro and in vivo studies, but little is known about their behavior in the human body making it difficult to define their relevance. The objective of this study is to elucidate the pharmacokinetics, that is to define the bioavailability and metabolism, of TSAs following a single tomato juice containing meal. We hypothesize that TSAs will be absorbed and undergo extensive phase I and phase II metabolism. Healthy subjects (n = 11, 6M/5F) participated in a randomized crossover trial where each person consumed 94 g juice (low dose) and 505 g juice (high dose) with a two-week washout period in between doses. Blood samples were collected at 11 time points over 12-hours following test meal consumption, and plasma was isolated to be analyzed using UHPLC-QTOF-MS. Fragmentation patterns and comparison to authentic standards (where available) were used for compound identification and quantification. Baseline-corrected area under the absorption curve (AUC) was calculated using the trapezoidal rule to estimate the relative exposure of each metabolite in plasma. TSAs in juice were quantified using UHPLC-MS/MS. Relative absorption of TSAs from diet were determined by taking the ratio of the aggregate TSAs in plasma to juice. A significant difference ($p < 0.05$) was observed in fractional absorption (mean ± SD) between the high (9% ± 5%) and low (5% ± 2%) dose of tomato juice. More than 90% of the quantified TSAs found in plasma have undergone either a phase I or phase II biotransformation in both interventions. It was found that dihydroxytomatidine, a phase I metabolite, was most abundant with an AUC value of 812.20 ± 157.44 nmol*h/L for the high dose and 60.97 ± 7.87 nmol*h/L for the low dose. This study demonstrates moderate absorption and

extensive metabolism of TSAs and reports the first pharmacokinetic data for these phytochemicals. These data provide context for future studies investigating the potential role that these compounds may play in human health.

Benjamin Duran, PhD, Animal Sciences

Initiation of corpus luteum regression after pregnancy loss: role of prostaglandin F2α
Benjamin Duran*, Alexandria Crist, Jessica Motta, Caleb Rykaczewski, Cameron Hayden, Muhammad Saad, Ana Carranza-Martin, Martin Mussard, Alvaro Garcia-Guerra

During the second month of gestation basal prostaglandin F2α (PGF2α) is greater whereas pulse frequency/amplitude are similar to that at the expected time of luteolysis during the estrous cycle. It is unclear whether PGF2α is responsible for corpus luteum regression (luteolysis) after induced pregnancy loss. The aim was to test the hypothesis that inhibition of PGF2α secretion, using flunixin meglumine, will prevent luteolysis after induced pregnancy loss. Pregnant nonlactating beef cows had pregnancy loss induced at day 35 of gestation (d0) and were randomly assigned to: Control (n=9), flunixin meglumine (FM;n=12), FM+Early PGF2α (FME;n=8), or FM+Late PGF2α (FML;n=8) treatments. Pregnancy loss was induced by intrauterine administration of hypertonic saline. Flunixin meglumine was administered intravenously every 8- hours at a dose of 1.65mg/kg from day 4 to 14. Four intrauterine PGF2α pulses (0.5mg/pulse) were administered every 6-hours on day 5 or 12 in FME and FML groups, respectively. Blood samples were collected twice daily for P4 quantification. Onset of luteolysis was defined as the day before serum P4 decreased to less than 50% of the average for the previous three samples. Data were analyzed using ANOVA and logistic regression using SAS. Luteolysis was identified in all animals. Luteolysis tended (P=0.06) to occur later (10.2±1.1d) in cows of FM than the Control group (7.4±0.8d). Conversely, luteolysis in cows of the FML (11.6±0.8d) group occurred later (P<0.05) than in those of Control and FME (8.0±1.2d) groups. Percentage of cows with luteolysis between day 4 to 14 was not different (P=0.52) among cows of Control (100%); FM (75%); FME (87.5%); and FML (100%) groups. Similarly, percentage of cows initiating luteolysis as a result of intrauterine PGF2α, defined as onset of luteolysis within 24 h of administering the first PGF2α pulse, was not different (P=0.17) between FME (50%) and FML (100%) cows. Furthermore, interval between first PGF2α pulse and luteolysis was not different (P=0.9) between FME (0.6±0.2d) and FML (0.6±0.1d) cows. In conclusion, inhibition of PGF2α secretion did not prevent but rather delayed luteolysis after induced pregnancy loss, thus, providing partial support for the hypothesis that PGF2α is responsible for initiation of luteolysis after pregnancy loss.

Xinyue Fan, PhD, Food Science and Technology

Extraction of hydroxycinnamic acids by alkaline hydrolysis of grape pomace
Xinyue Fan*, Gonzalo Miyagusuku-Cruzado, M. Monica Giusti

Grape pomace is the solid residue produced from winemaking and contains grape stems, skins and seeds. It is a rich source of cellulose, hemicelluloses and lignin. Alkaline hydrolysis can dissolve lignin, allowing utilization of hemicelluloses, which in turn can release phenolic acids. Hydroxycinnamic acids (HCA) including ferulic acid (FA), caffeic acid (CA), p-coumaric acid (pA) and sinapic acid (SA) are valuable phenolics due to their potential applications in the food, health, cosmetic and pharmaceutical industries. In addition, hydroxycinnamic acids can react with anthocyanin pigments to produce the more stable pyranoanthocyanins.
In this study, we compare HCA profiles and content that could be released by alkaline hydrolysis from CS and MT. We also determined the treatment time that maximized the recovery of HCA from pomace.
Cabernet Sauvignon (CS) or Merlot (MT) (0.1g) grape pomace was mixed with 10 ml 10% KOH solution and sonicated for 15, 30, 45, and 60 min with 3 replicates. The release of HCA was monitored by high-performance liquid chromatography coupled to photodiode array detector.
The release of HCA from grape pomace over time followed a quadratic model. The highest total HCA concentration was obtained at 60 min with MT releasing more HCA than CS (28.8 ± 0.19 ppm vs 21.1 ± 0.7 ppm, respectively). pA contributed 71% and 61% of the total HCA in MT and CS, respectively. This high concentration of pA might be the result of delignification with KOH combined with the saponification of acylated anthocyanins in grape pomace since CA and MT grape skin typically contain ~15-25% coumaroyl anthocyanin derivatives. CA was the second most abundant HCA, with CS (6.0 ± 0.2 ppm) releasing more CA than MT (5.0 ± 0.1 ppm). Only a small amount of FA was obtained from the alkaline treatment of grape pomace and SA was not detected throughout the treatment. This study showed that grape pomace subjected to 60 min alkaline hydrolysis could be used as a source of pA to be used for other applications, adding value to a by-product from winemaking and providing a starting material for pyranoanthocyanin formation.

Xiaoyi Fang, PhD, Agricultural, Environmental and Development Economics

Does Price Asymmetry Exist in Agricultural Commodity and Energy Markets?
Xiaoyi Fang* and Ani Katchova

This study investigates the price transmission mechanism of agricultural products and empirically

analyzes the fluctuation characteristics of energy prices and crop prices under the current special environment. The research questions are: what kind of transmission effects do crude oil and ethanol prices exhibit with each commodity price, and does price asymmetry exist in the commodity and energy markets?

The study uses monthly price data from January 1995 through December 2022 for five variables: corn, soybeans, wheat, crude oil, and ethanol. Due to the use of time series data, the Dickey-Fuller and Rolling Mean tests were used to test whether the data were stationary. We apply the Engel-Granger two-step cointegration test, which is used to determine whether a set of variables has a cointegrating relationship. The Granger causality test is then used to determine the agricultural price transmission pathway, which can test the causality between variables in a statistical sense. Finally, to investigate the symmetric or asymmetric characteristics of agricultural price transmission, we use an error correction model (ECM).

The preliminary findings show that the transmission mechanisms of energy prices to the three commodities of wheat, soybeans, and corn during the rising and falling phases are different. The transmission effects of corn and crude oil/soybean and ethanol are the strongest, especially when energy prices are high. Corn, the primary raw material used to make fuel ethanol, is most affected by rising crude oil prices. Wheat prices are not sensitive to changes in crude oil prices, but when corn prices rise with crude oil prices over wheat prices, the substitution effect of corn and wheat drives up wheat prices, which in turn leads to an increase in the wheat crude oil transmission effect.

The research is significant in terms of understanding the impact of energy prices on agricultural commodity prices and exploring the transmission mechanism. It is also relevant to stabilizing food prices and ensuring economic stability.

Jane Fu, PhD, Food Science and Technology

An OSU new generation of probiotic effectively improved poultry production and mitigated gut antibiotic resistome

Siying Fu*, Yang Zhou, Lu Zhang, Yutong Li, David Sun, Xiaolin Wu, Michael Cressman, Osvaldo Campanella, Hua H Wang

Penicillin and derivatives (beta-lactam antibiotics) used to be the most powerful drugs saved countless lives. But rapid spread of antibiotic resistance (AR) genes has negated effective therapy and shaken the foundation of modern medicine. Even without exposure to antibiotics, bacteria with genes resistant to broad spectrum of beta-lactam antibiotics, such as ESBL/pAmpC+ E. coli responsible to deadly infections, are now abundant in hosts. For instance, blaCMY-2+ (pAmpC) E. coli isolates were prevalent and persistent in gut microbiota of newly hatched chickens, and there

are no productive solutions. The objective of this study was to assess the efficacy of an OSU patented new generation of probiotic to combat persistent AR in poultry production.

Our new probiotic successfully inhibited persist pAmpC E. coli by in vitro screening. In the animal study at the CFAES poultry facility using newly hatched chickens, the packaged probiotic was supplemented to regular feed in the first 2 weeks for the experimental but not the control chickens. The fecal samples were assessed by shotgun sequencing assessments during the experimental period, and the body weights of all chickens were also documented for 4 weeks.

At the end of the study, the body weight of probiotic-treated experimental Cornish and Leghorn chickens improved 3.7% and 10.6%, respectively, comparing to the non-treated, same types of control chickens. Besides, probiotic supplementation led to effective mitigation of resistant genes against beta-lactams and multidrugs in gut microbiota of all treated chickens assessed by metagenomic analysis, representing 67% of the subpopulation. Resistant genes decreased up to 3 logs, with average reduction of 90% and more than 90% for beta-lactams and multidrugs, respectively, in probiotic-treated chickens. Meanwhile, in control chickens without probiotic supplement, resistant genes for beta-lactams and multidrugs increased 328% (S.D.122%), and 291% (S.D.76%), respectively.

This is the first report on effective mitigation of the most impactful AR gene pools in host gut microbiota. The finding represents a major scientific breakthrough with productive impact on public health, food animal production and environmental protection. The improved poultry production and animal health alone by our probiotic is expected to generate multibillion-dollar profit for the poultry industry.

Brianda Daniela Gonzalez Orozco, PhD, Food Science and Technology

Enhanced probiotic traits of Lactobacillus kefiranofaciens bdgo-ANA1 in co-culture with Kluyveromyces marxianus bdgo-ym6

Brianda D. Gonzalez-Orozco*, Erica Kosmerl, Rafael Jimenez-Flores, Valente B. Alvarez

L. kefiranofaciens bdgo-ANA1 is a microorganism isolated from kefir grains that has shown probiotic properties like adhesion to intestinal cells and production of antibacterial proteins. Additionally, this species is the principal responsible of the production of the exopolysaccharide (EPS) known as kefiran, that has potential for industrial applications as a thickener and stabilizer food ingredient with additional bioactive properties. In nature, interkingdom interactions can be

observed on products like kefir grains and kombucha SCOBY. According to previous research, co-cultures of lactic acid bacteria (LAB) and yeast may increase resistance to environmental challenges like those encountered in the gastrointestinal tract and enhance metabolic activities, including the production of EPS, by combining metabolic capacities. The main hypothesis of the study is that the co-culture of L. kefiranofaciens bdgo-ANA1 with yeast Kluyveromyces marxianus bdgo-ym6 enhance survival during digestion, exopolysaccharide production, and adhesion to intestinal cells.
Survival during digestion of mono and co-culture was determined by the INFOGEST static in vitro simulation of gastrointestinal food digestion. Adhesion to ontestinal cells was performed in Caco-2 cell model. A modified Casein Glucose Broth (CGBm) was developed to avoid extraction of sugars from the media during EPS quantification. Fresh CGBm was inoculated with ï‚»108 CFU/mL of microbial cultures and incubated for 36 h. Samples of mono and co-culture were taken every 8 h and OD600 values were also determined. Total EPS concentration was determined by total sugar content by phenol-sulfuric acid method minus reducing sugar content by 3,5-dinitrosalicylic acid assay at each time point.
The co-culture of L. kefiranofaciens with K. marxianus significantly increased survival during simulated digestion by 2-fold and adhesion to epithelial cells by 1.3-fold. The latter may be attributed to the observed increase in EPS production in co-culture at the late exponential phase which could play a role in protecting the microorganisms from the severe gastric tract conditions. CFS of L. kefiranofaciens bdgo-ANA1 in mono and co-culture portray antibacterial activity against indicator microorganisms. The results of the study warrant further research into the application of co-cultures of L. kefiranofaciens bdgo-1 and EPS in functional/symbiotic dairy products.

Ashley Herkins, PhD, Food, Agricultural and Biological Engineering

Durability Variation amongst Medical Gloves Made from Different Elastomers
Ashley Herkins*

Glove durability is of critical importance in healthcare settings where gloves act as barriers against bacteria, viruses, and bodily fluids, preventing the spread of deadly diseases. However, ASTM International does not provide specific standards for glove durability once the gloves are removed from their package and worn by the consumer. This has resulted in many glove manufacturers 'cutting corners'☒ and saturating the market with flimsy, low-quality gloves.
A device developed to assess the durability of medical gloves without the need for manual inspection was used to objectively compare the durability of examination and surgeon's gloves made from a variety of elastomeric materials, both natural and synthetic, and by different manufacturers.

Despite the shift to synthetic latex gloves in the 1990's due to widespread Type I latex allergies caused by high levels of soluble proteins in gloves not properly washed during manufacture, natural latex gloves are still softer, more elastic and tear resistant, and more comfortable for the wearer. Their higher mechanical performance and durability provides better protection against pathogens than synthetic versions. Additionally, thicker gloves of all varieties are more durable than thinner gloves of the same material.
Properly washed, polymer coated, unpowdered natural latex gloves, made from latex tapped from tropical rubber trees, can be used safely by people who do not already have Type I latex allergy. Gloves made from domestically produced guayule latex outperformed all other gloves tested, including those made from Hevea latex, without posing allergy risks. Mechanical analysis demonstrated that the guayule gloves were as strong as the best alternatives while also being softer and more elastic. Guayule latex can address the need for domestic production of gloves to resolve supply chain and quality issues and encourage a shift back to natural latex gloves, which would reduce the carbon footprint of the glove manufacturing industry as a whole and biologically and geographically diversify the critical natural rubber supply.

Eric Hobson, PhD, Plant Pathology

Examining the Role of Plant Immunity on the Bacterial Colonization of the Inner Leaf
Eric Hobson*, Nathaniel Heiden, Eduardo Bernal, Jonathan Jacobs

Xanthomonas± is a widespread plant-associated pathogenic bacterial genus that infects over 400 host species. The molecular mechanisms of individual bacterial virulence factors and plant immune responses have been heavily studied, but little is known about the molecular aspects of inner leaf colonization over space and time. Here we examined the impact of immunity of bacterial leaf colonization in the inner leaf landscape of Barley. Plants maintain a robust plant defense system to combat early and latent pathogen infection. The plant immunity pathways such as patterned triggered immunity (PTI) and effector triggered immunity (ETI) work in concert to recognize conserved bacterial structures and antagonistic effectors to respond with a multifaceted riposte. Pathogens are able to circumvent plant defensive strategies through suppression or elusion of the PTI pathway. We showcase that the engagement of plant immunity preceding pathogen infection influences reduced bacterial proliferation through the leaf tissue utilizing in planta assays through fluorescence microscopy and bacterial content quantification. In order to elicit a defense response prior to pathogen infection, the PTI elicitor Flg22 was. The priming treatment not only reduced bacterial spread but localized bacteria at the infection site± . Furthermore, we examine how plant immunity changes the nutrient environment of the plant leaf utilizing extracted leaf mesophyll fluid. Ex-vivo assays examining bacterial growth in untreated and Flg22 treated Barley leaf

mesophyll fluid showcase reduced bacterial growth in Flg22 treated leaf fluid Taken together, these results support the hypothesis that plant immunity changes the nutrient environment of the inner leaf.

Hetian Hu, PhD, Food, Agricultural and Biological Engineering

Effects of pressure, shear, temperature, and their interaction on the inactivation of Clostridium sporogenes PA3679 spores during ultra-shear processing
Hetian Hu*, V. M. Balasubramaniam, Ahmed Yousef, Edmund Ting

Ultra-shear Technology (UST) is a novel semi-continuous high-pressure food processing. By pressurizing liquid foods up to 400MPa and decompressing the foods through a small gap, the process was designed to sterilize liquid foods and modify their structure and rheological characteristics. This study aims to evaluate the effects of pressure, temperature, shear, and the combination of these lethal factors on the inactivation of the endospores of Clostridium sporogenes PA3679, a non-pathogenic surrogate for proteolytic Clostridium botulinum strains. C. sporogenes PA3679 spores (6.26 ± 0.02 log CFU/ml) suspended in pressure-stable HEPES buffer (pH 7.0) were used for all the experiments. UST experiments were conducted using a bench scale UST equipment at 200 or 400MPa with shear valve exit temperatures of 30, 105, and 125oC to evaluate the lethal effects of (a) pressure + shear and (b) pressure + temperature + shear on the spore population. Additional experiments were conducted to investigate the lethal effects of pressure-holding prior to shear discharge. A batch high-pressure processor was used to evaluate the lethal effects of (c) pressure-only and (d) pressure + temperature by processing the samples at 400MPa, 30 and 105oC with 0s and 5 min holding. The (e) thermal-only lethal effect was determined using an oil bath set at 105oC with 0s and 5 min holding. The survivor spores were enumerated by pour-plating into TPGY agar plates and incubating anaerobically at 32oC for 3 days.
Results indicated pressure, temperature, shear (above certain threshold values), and pressure holding time had synergistic effects on spore lethality. Within the experimental conditions of the study, thermal-only and pressure-only treatments did not inactivate spores significantly ($p > 0.05$). 400MPa-105oC treatment resulted in a 3.27-log reduction when the spores were subjected to 5 min pressure holding time, compared to 0.35-log reduction at 0 s holding time. On the other hand, 400MPa pressure pre-treatment at 75oC for 5 min, followed by shear discharge at 105oC, resulted in only 1.24-log spore inactivation. Overall, this study highlighted the relative importance of pressure, temperature, shear intensity, and pressure-thermal history on spore lethality, and will help identify safe harbor processing conditions for high-pressure-based sterilization technologies.

Veeramani Karuppuchamy, PhD, Food Science and Technology

Estimation of brewers' spent grain (BSG) composition by mid-infrared spectroscopy
Veeramani Karuppuchamy*; Shreya Nuguri; Osvaldo Campanella; Luis Rodriguez-Saona

Brewers' spent grain (BSG), a major by-product that accounts for 85% breweries waste, is an excellent source of dietary fibers and proteins. There is a growing interest in exploring BSG as a food ingredient, especially in extruded snack applications. Thus, it is essential to determine the composition of BSG to get desired nutritional profile. However, the conventional wet chemistry methods like convection oven or Soxhlet extraction are time consuming, labor intensive, and costly. In this study, we investigated the application of mid-infrared spectroscopy for quantifying composition of BSG.
The proteins, carbohydrates, and lipids in BSG samples were determined using AOAC-approved reference wet chemistry methods. Fourier Transform Infrared (FTIR) spectrometer (Agilent, Santa Clara, CA) was used to scan the BSG samples at a wavenumber range of 4000 to 700 cm-1. The absorbance spectra from the scans were analyzed using supervised classification technique like soft independent modeling of class analogy (SIMCA) followed by partial least squares regression (PLSR) for developing the calibration models. The data preprocessing and transformation was done in chemometrics.
The amount of components in BSG samples obtained from reference methods agreed with previously reported values. The fingerprint region (1500 to 700 cm-1) was used for classification in SIMCA. The calibration models were developed for carbohydrates, proteins, and lipids. The developed models had a standard error of validation less than 0.5%. The correlation coefficients of validation (rval) and calibration (rcal) were above 0.90. These findings suggest that the spectroscopy can provide fast and accurate results for estimating BSG composition within a few seconds.
An accurate measurement of composition is essential for nutrition label claims. The studied FTIR spectroscopic method was easy to use for rapid quantification of nutrients without any need of sample preparation or training. This can be also considered as a 'green technology' due to an elimination of hazardous chemicals. The quality of developed prediction models needs to be periodically validated to check the accuracy of values. A cost economics also need to be considered for application of FTIR spectrometers in the analytical labs due to a high initial cost involved.

Sushma Katari, PhD, Food, Agricultural and Biological Engineering

An automated framework for counting corn plants using UAV images
Sushma Katari* and Sami Khanal

Plant counting is a critical task in crop management, providing farmers with information about the success rate of seed germination and within-field variation in crop population density, which are critical traits to crop yield and quality. The traditional approach to plant counting involves manual scouting, which is time-intensive, laborious, and costly. Recent advancements in Unmanned Aerial Vehicles (UAV) technology and machine-learning techniques can help develop automatic plant counting methods. Various computer vision models based on UAV images are available for detecting and classifying crop plants. However, the accuracy of those models is dependent on a large amount of manually labeled training datasets. In this study, our goal is to develop a robust plant-counting model by integrating automatically labeled images into training the plant-counting model. The plant counting framework was developed using the 1.5cm spatial resolution images collected by DJI Matrice 200 at the V2-V3 growth stage of corn plants located in Wooster, Ohio. The implemented automated labeling system depends on the extraction of corn plants' locations in high-resolution UAV images based on the percentage of crop green areas and crop rows in a field. These labeled datasets are then used to train and validate the VGG16 model for identifying the corn plants. The performance of the VGG16 is tested on the data from the untrained region of a field and the accuracy was found to be 80%, suggesting the potential for developing a plant counting system without manual labeling.
Min (Kevin) Kim, PhD, Food Science and Technology, Advised by Christopher Simons

Manpreet Kaur, PhD, Food, Science and Technology

Effect of yoghurt and its components on the deodorization of fried garlic volatiles
Manpreet Kaur*, Sheryl Barringer

Garlic is used for culinary purposes worldwide despite causing bad odor that may persist in the breath and body for as long as 24 hours after consumption. The sulfur volatiles allyl mercaptan, allyl methyl sulfide, allyl methyl disulfide, and diallyl disulfide are the cause of the bad odor. These volatiles are formed when garlic is crushed or chopped. Therefore, the purpose is to study the effect of yoghurt components on the deodorization of garlic volatiles.

Garlic was fried at 120±°C for 12 minutes. Different treatments (100g) such as water at pH 4 or 7, yoghurt at pH 4 or 7, butter (3, 10, 20, 40, or 80%), 50:50 mixture of non-fat milk-powder and water, or a 9% protein solution (whey protein isolate, whey protein concentrate, micellar casein, calcium caseinate, milk protein isolate and milk protein concentrate) were mixed with 6g of fried garlic. Fried garlic is used as control. The samples were mixed and held for 30 minutes at 25±°C. Three replicates were conducted for each treatment. Measurements of volatiles were done using a selected-ion flow-tube mass spectrometer. Statistical analysis was conducted using ANOVA with

Tukey HSD post-hoc analysis.

The concentration of all sulfur-based volatiles was reduced significantly after treatment with yoghurt. Fat and protein were responsible for the reduction of volatiles. The more hydrophobic environment created by the fat results in reduction of volatility leading to deodorization. As the amount of fat increases the deodorization of volatiles increases. Proteins react with the volatiles by forming irreversible covalent linkages or through reversible hydrogen and hydrophobic bonds. Whey protein and casein both caused deodorization of all volatiles but the combination of whey and casein i.e., milk protein concentrate created the highest deodorization. At the same concentration, fat produces a higher percent deodorization than protein for most sulfur volatiles. Water, pH and heating produced no deodorization effect. Foods with higher fat or protein content such as yoghurt can be formulated to maximize deodorization of garlic.

Min (Kevin) Kim, PhD, Food Science and Technology

Characterization of textural properties of plant and animal-based beverages

Min (Kevin) Kim*, Laura Nattress, Christopher Simons

With the rise in popularity of plant-based beverages in the past decade, these products have amassed to having the largest market value in the plant-based food sector with $2.6B in sales in the US in 2021. In accordance with this recent trend, emphasis has been placed on optimizing the sensory properties of these products to mimic their animal-based counterparts. However, there is a lack of research that extensively investigates the difference in textural properties of plant-based beverages compared to animal-based counterparts. Therefore, the purpose of this study was to develop a comprehensive texture lexicon (i.e., a list of terms) for characterizing and differentiating various plant and animal-based beverages. A group of 16 trained participants were selected to develop and refine a texture lexicon (n = 20 attributes) to describe textural characteristics of animal and plant-based beverages. Using descriptive analysis, a subset of those individuals (n=12) then utilized the final lexicon to evaluate and characterize 14 different animal and plant-based liquids (7 low protein and 7 high protein). Participants evaluated products in semi-isolated individual sensory booths under red light in duplicate. During evaluation, participants tasted beverages in these booths and rated the perceived intensity of 20 texture attributes on a continuous 10-point line scale. Study results showed significant differences in perceived intensity for each texture attribute among the different products. For the low protein beverages, the powdery, smooth, and viscosity attributes had the most variation among the product set and were key factors in differentiating between plant and animal-based products. For the high protein beverages, adhesiveness, mouth coating, powdery, residual coating, sliminess, smooth, and

viscosity were highly variable and were key factors in discriminating between plant and animal-based beverages. Furthermore, post-hoc analysis showed that soy protein concentrates significantly differed from other beverages in terms of viscosity and powdery attributes, regardless of protein concentration. Therefore, protein source and content have a significant impact on the textural properties of plant-based and animal-based liquids. Determining what textural aspects differ between plant and animal-based beverages can give guidance to product developer to help increase the success of the next generation of plant-based beverages.

Yutong Li, PhD, Food Science and Technology

Traditionally fermented foods still a critical avenue impacting host gut antibiotic resistome
Yutong Li*, David Sun, Xiaolin Wu, Siying Fu, Matthias S Klein, Hua Wang

Background: Disrupted gut microbiota (GM) is recognized as a critical risk factor for many diseases ranging from diabetes to brain and immune function disorders. Fermented foods as a source of "living beneficial bacteria", have been promoted for GM replenishment in recent years. However, viable bacteria of fermented foods are still prone to food safety challenges. For instance, fermented foods, especially traditionally fermented products, are still susceptible to antibiotic resistance (AR). The rapid spread of AR genes is life threatening. According to WHO, AR is among the top 10 global public health challenges. The impact of fermented food consumption on host gut resistome (AR gene pool) still remains largely unknown. The objectives of this study were 1) to investigate the impact of fermented food consumption on the prevalence of AR genes (ARGs) in the host GM; and 2) to assess AR resistome in representative traditionally fermented foods.

Methods: fecal metagenomic sequencing data from a published human dietary intervention study were re-assessed for the trend of ARG abundance in the participants' GM throughout the 10-week intervention by diets high in fermented foods or dietary fibers. Representative kimchi and artisan cheeses were purchased from retail stores and assessed for resistome and AR bacterial isolates.

Results: Dietary intervention by fermented foods led to significant increase of gut antibiotic resistome in human subjects ($p = 0.03$), while this trend was not observed in the fiber intervention group ($p = 0.94$). Bacteria highly resistant to clinically important antibiotics were found prevalent in about 90% of the kimchi and all artisan cheese samples assessed so far.

Conclusion: There is an underlying risk of introducing AR bacteria and ARGs into the consumer's gut microbiota by fermented food consumption. In addition, the potential entering of AR bacteria into the host circulation system through "leaky" gut could potentially cause serious health consequences, including but not limited to bacteremia and sepsis, untreatable by antibiotics, especially in patients with compromised immune functions. Data from this study thus call for more

extensive studies to comprehensively assess the benefits along with underestimated safety challenges associated with fermented foods, and strategic mitigation.

Jenna Moore, PhD, Plant Pathology

A survey of soybean Sudden Death Syndrome in Ohio
Jenna Moore*, Mesfin Bogale & Horacio Lopez-Nicora

Soybean is one of the most economically important crops in the USA. Its production is under threat from sudden death syndrome (SDS), a fungal disease that incurs an economic loss accounting to ~245 million per year. While many species of Fusarium (F. virguliforme, F. tucumaniae, F. brasiliense, F. crassistipitatum, and F. cuneirostrum) can cause SDS, only F. virguliforme was thought to be present in the USA until F. brasiliense was discovered to cause SDS in Michigan in 2019. Other Fusarium species, including F. cuneirostrum, and F. phaseoli, were also found in association with this disease in Michigan through greenhouse experiments, though these species did not result in foliar symptoms typical of SDS. One of the most effective SDS management strategies available today is the use of fungicide-treated seeds. However, there are few effective chemical agents available for this purpose; ILEVO (fluopyram) and Saltro (pydiflumetofen) have the same succinate dehydrogenase target, rendering a high risk of developing fungicide resistance. Though SDS was first discovered in Ohio about 30 years ago, to our knowledge, there has not been a comprehensive survey to determine the status of SDS agents in this state. Our study aims to address this gap by assessing the species and genetic diversity of SDS agents, determining their sensitivity to commercially available fungicides and identifying development of potential pathogen resistance in Ohio. The species and genetic diversity of Fusarium isolates will be determined using analyses of nucleotide sequence information from translation elongation factor 1α (TEF) and RNA Polymerase II (RPBI and RPBII) genes. Isolate sensitivity to fungicides will be determined from growth-rate on media containing various fungicide concentrations. It is common for SDS to occur simultaneously with Heterodera glycines, soybean cyst nematode (SCN), another pathogen of soybean. However, past research on the effects of SDS and SCN interaction on plant infection has been inconclusive. This study will attempt to evaluate changes in soybean gene expression during single and mixed infections with SDS and SCN using RNA sequencing and transcriptome analysis. The findings from this study will contribute to the development of new management strategies for SDS in Ohio.

Hyeon Woo Park, PhD, Food Science and Technology

Image processing technique for evaluating thermal uniformity during superheated steam

impingement of dry food processing surfaces
Hyeon Woo Park* and V. M. Balasubramaniama

Superheated steam is an emerging technology for the sanitation of dry food processing environments. Limited studies investigated treatment uniformity during superheated steam sanitation. The objective of the study was to quantitatively evaluate the thermal distribution on stainless steel surface during superheated steam sanitation using thermal image processing. The knowledge would aid in the validation of the sanitation efficiency of superheated steam.

A thermal camera, calibrated using a small stainless steel coupon (5cm×5cm×1cm) at temperatures ranging from 25°C-250°C, was employed for thermal imaging studies. Superheated steam experiments were conducted using a pilot-scale superheated steam generator (SaniZap-600-40240, Bayzi, Cincinnati, OH) on a stainless-steel coupon (30cm×30cm×1cm) at nozzle-to-surface distances ranging from 2-5 cm. The thermal camera recorded the surface temperature distribution during treatment. The successive thermal images were processed through image acquisition, perspective control, segmentation, and analysis. All experiments were triplicated.

The thermal camera was calibrated to monitor the surface temperature of stainless steel (R2=0.99 at 0.23 emissivity). The surface temperatures at the impingement point were 245.6±3.9°C, 218.5±7.9°C, 179.0±4.4°C, and 157.6±1.7°C when the nozzle was placed at 2, 3, 4, and 5 cm distances from the impingement surface, respectively. Subsequently, the surface temperature of the surface increased radially from the impingement point. Surface heat transfer coefficient decreased from 2541.7 W/m2K to 917.6 W/m2K at 0 cm and 5 cm radial distance, respectively. The developed quantitative analysis of surface thermal uniformity can be used to validate the sanitation efficacy of superheated steam.

Michelle Pham, PhD, Environmental Sciences Graduate Program, Entomology

Does establishing native wildflowers on vacant land aid bee conservation in a legacy city?
Michelle Pham*, Katherine Turo, Carlee Shepard, Kayla Perry , Jena Copley, Mary Gardiner

Legacy cities are afflicted with economic disinvestment, decreasing populations, and numerous social and political challenges. As people leave legacy cities, abandoned homes are eventually demolished and transformed into vacant lots. Although there are many challenges associated with vacancy, these greenspaces have been demonstrated to provide habitat for urban wildlife and provide some ecosystem services for local communities. Vacant land is managed with monthly mowing and supports abundant bee forage in the form of urban spontaneous vegetation. In the

legacy city of Cleveland, Ohio, 20% of the state's bee fauna has been collected within vacant lots. Our goal was to determine if transforming vacant land into small native wildflower plantings would result in a higher abundance and richness of wild bees using these sites compared to vacant lots. Our approach was to establish the Cleveland Pocket Prairie Project which incorporated a network of vacant lots and pocket prairies in this legacy city. We compared bee communities in these habitats with peri-urban grasslands maintained by the Cleveland Metroparks system within surrounding suburban landscapes. Our hypothesis was that urbanization would strongly filter the bee community able to colonize pocket prairies and vacant lots. However, we predicted that establishing plantings of native wildflowers would attract and retain a higher abundance and richness of wild bees. Using pan traps and hand vacuums, we sampled bees within each treatment from June to September 2019. We found 1,087 bees representing 24 genera and 83 species. Here, we show that bees visited over 30 floral species, ranging from native wildflowers to urban spontaneous vegetation. PERMANOVA analysis revealed that peri-urban grasslands supported bee communities that were distinct from those collected from pocket prairies and vacant lots, indicating that urbanization was an environmental filter. Interestingly, grasslands and pocket prairies generally supported a higher bee abundance and richness compared to vacant lots. While analyses are ongoing, our preliminary results demonstrate the importance of vacant land as bee habitat and suggest that establishing native wildflower plantings can be a useful component of an urban conservation strategy for legacy cities.

Annika Pratt, PhD, Plant Pathology

Genetic Characterizations in the broad host-range pathogen, Macrophomina phaseolina
Annika Pratt*, Maeve Florence-Smith, Tiffanna J. Ross, Horacio Lopez-Nicora, and Mitchell Roth

Macrophomina phaseolina is a globally distributed fungal pathogen capable of infecting over 500 different plant hosts, including economically important crops. In soybean, M. phaseolina causes the disease known as charcoal rot, which frequently ranks in the top 5 yield-reducing diseases of soybean. While other major soybean pathogens have received significant research attention to understand the genetic and molecular mechanisms of pathogenicity and virulence, these types of studies in M. phaseolina are lacking. To gain a better understanding of this pathogen, we screened twenty soybean varieties against three M. phaseolina isolates to see which combination resulted in the most severe disease symptoms. Results indicated extreme variability in disease severity with little correlation between M. phaseolina isolate and soybean variety. Understanding how M. phaseolina causes disease on a broad range of soybean varieties is important for improving genetic resistance. To identify genes important in virulence against soybean, we are using genetic modification to knock out genes in M. phaseolina. A major hurdle in genetic modification of

filamentous fungi is the cell wall. For a fungal cell to uptake foreign DNA, the cell wall must first be removed in a process called protoplasting. To date, there are no published efforts to create protoplasts of M. phaseolina. We are developing a protoplasting protocol for M. phaseolina, have successfully created M. phaseolina protoplasts, and are refining the protocol to generate knockout mutants.

Carlos Alfredo Porras Guardado, PhD, Food Science and Technology

Bioreactor production of more stable naturally derived colorants: Efficient pyranoanthocyanin formation using 4-vinylphenol

Carlos Porras-Guardado*, Danielle M. Voss, M. Monica Giusti

Anthocyanins (ACNs) are polyphenolic pigments responsible for the orange-red to blue-violet colors in fruits, vegetables, flowers, and leaves. Besides color, ACN are believed to impart health benefits associated with their antioxidant capacity and anti-inflammatory properties. ACNs types are defined by the number of hydroxylations and methoxylations in their structure. Additionally, different ACNs found in nature present glycosyl moieties that can be further modified by aromatic and/or aliphatic acyl substitutions. Pyranoanthocyanins (PACNs) are ACN derived pigments formed by the interaction of an ACN with a cofactor, adding a fourth ring to their structure. PACNs are more stable to long-term storage, and more resistant to bleaching and heat-induced degradation, as compared to their precursor ACNs. However, PACN formation is typically time-consuming, taking months for PACN to be produced in wine. Nevertheless, PACN formation efficiency has been increased by selecting ACN types and substitutions, cofactor concentrations, and by modulating the conditions for the reaction. The purpose of this study was to evaluate PACN formation in a bioreactor set up, and to determine the best conditions to produce these pigments at large scale to facilitate industrial applications. We hypothesized that PACN formation efficiency can be increased by facilitating the interaction between the reactants during the process. PACNs were produced using saponified black carrot ACNs and 4-vinylphenol, as a cofactor, in a 1:5 molar ratio. Bioreactor incubation temperatures between 45 and 60±°C were evaluated with or without agitation (250 rpm, reverse spin each 10 seconds). Pigments were identified using UHPLC-PDA- MS/MS and PACN formation was monitored at 48 hours. After 48hr, most of the initial ACN were converted to PACN (~50% yield) with no significant difference among the tested conditions ($p>0.10$), yielding ~1.5x more PACN than previously reported using similar conditions in an incubator. When evaluating PACN content as percent of total pigment, incubation at 60±°C with agitation (~88%) was significantly higher than 45±°C with agitation (~71%), but no significance difference was reported when compared with the other tested conditions ($p>0.10$). This study demonstrated that PACN formation could be achieved in a bioreactor with less energy,

facilitating the application by the food industry.

Thomas Reis, PhD, Food Science and Technology

Improving ecological validity of sensory tests through the addition of virtual social elements
Thomas Reis* & Christopher Simons

This study focuses on the addition of a social context to food evaluations, as humans often consume food with other humans. We look to see if by adding a social element we can elicit certain social eating phenomena, such as the social facilitation of eating and food intake modeling. 29 participants evaluated 3 popcorn samples in 3 environments depicting different virtual social interactions. In the ±€˜Solo' condition, panelists ate in front of a video of a library interior. In the ±€˜Low Consumption' (LC) and ±€˜High Consumption' (HC) conditions, videos of an actor consuming popcorn in a library were shown, emulating the experience of snacking with someone while working. These two conditions varied in the rate at which the actor consumed popcorn. At the end of each session, the mass of popcorn consumed from each sample was measured. When consumption was combined for all 3 samples across panelists, consumption was significantly higher in the HC and LC conditions than the ±€˜Solo' condition. When looking at consumption for each panelist's most liked sample, we saw significantly higher consumption in the HC condition than the ±€˜Solo,' and marginally higher consumption in the LC condition than the ±€˜Solo.' As expected, we were able to socially facilitate higher consumption of popcorn through the social context applied to the HC condition virtually. Consumption in the LC condition was higher than expected, due to the baseline consumption in the Solo' condition being so low that the LC rate was higher, leading to up-regulated consumption. Ultimately, this study shows that social context in the way it was implemented is another layer of context that can be added to improve the ecological validity of sensory tests. This can be particularly useful when running consumer tests of foods typically eaten in the presence of others such as party snacks or restaurant menu items.

Peter Renz, PhD, School of Environment and Natural Resources

Development of a Novel Soil Health Model that Incorporates Soil Biology Properties, Land Management Practices, and other Factors
Peter Renz*, Richard Dick

In 2017, a published paper by Roper et al. determined that the existing Soil Health tests (CASH, Haney) had a limited ability for differentiating agronomic land management practices and that they poorly correlated with yield outcomes. Furthermore, this and other research has shown that Soil

Health (SH) indicator measurements are confounded by soil type which makes calibration and interpretation nearly impossible.

Thus, the objective of this project was to develop a model that correlates with soybean yield outcomes while including soil type information. To create such a model, we measured a variety of soil properties, recorded land management practice information, and determined the true localized soybean yield.

We collected soil samples on participating farm field sites in Ohio for a period of 3 years, and we included the Wooster, Hoytville, Lal, and Kellogg long-term field sites in the final year. The recorded data set of soil properties, land management survey information and other factors allowed us to compute a Multi Linear Cross-Validation model with an R2 value of 0.821. Five randomized test runs with a training and test data cluster revealed that our model would be trustworthy and would allow us to predict soybean yield outcomes. The outcome of this work revealed that Enzyme and Land Management information are crucial in the model development.

The outcome of this work will allow us to understand what soil properties are significant under different land management practices. The information from this concept will help us to develop a biological Soil Health Index. If successful it would allow us to identify beneficial land management practices and develop a novel tool that farmers could use to determine the health of their soil while increasing their yields.

Silvette Ruiz-Ramirez, PhD, Food Science and Technology

Purification and characterization of B-galactosidase from Lactobacillus helveticus OSU-PECh-4A with improved potential for industrial processing
Silvette Ruiz-Ramirez*

B-galactosidase is a hydrolytic enzyme of great importance in the dairy industry due to several applications where products such as lactose-free milk are produced. It has also been demonstrated that B-galactosidase can produce a highly valued prebiotic derived from lactose through a second reaction. Since this reaction is driven by high temperature, using a thermophilic B-galactosidase would provide an excellent advantage for its industrial applications. In 2021, our laboratory reported that out of 24 Lactobacillus strains, the thermophilic Lactobacillus helveticus OSU-PECh-4A had the highest B-galactosidase activity when grown on acid whey, a dairy industry's rich-lactose by-product. Therefore, the present study aims to purify and characterize the B-galactosidase from L. helveticus for the future synthesis of lactose-derived prebiotics. To achieve that, L. helveticus was isolated and characterized using a two-step purification, steady-state kinetics, and thermal stability assay. The Km and Kcat values for the colorimetric substrate oNPG

(O-nitrophenyl-B-D-galactopyranoside) and natural substrate lactose were 0.067mM and 103.5s-1, and 29.87mM and 138.7s-1, respectively. The end product, D-galactose, inhibited the enzymatic activity. However, the end product, D-glucose, had a positive allosteric effect. Ions such as MgCl2 significantly increased the enzyme's activity, while NaCl and other ions found in dairy products did not have any effects. The B-galactosidase from L. helveticus showed an optimum pH of 6.5-7.0 and possessed activity at temperatures as high as 70±°C. With these results, this study presents a well-characterized and highly functional B-galactosidase from a food-grade source with the industrial potential to valorize acid whey by producing lactose-derived prebiotics.

Abigail Sommer, PhD, Food Science and Technology

Consumer Rejection Threshold of Fish Oil and Algae Oil in Plant Based Milk Analogs
Abigail Sommer* and Yael Vodovotz

Fish and algae oils and their component fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) have demonstrated health benefits such as reducing cardiac death risk and lowering inflammation. However, a large portion of the US and global population is not consuming the recommended amount of fish or EPA and DHA, partially due to low accessibility, dietary restrictions, contamination concerns, or general dislike. To combat this low consumption, fish and algae oil fortified plant milk beverages made from soy, oats, and almonds were developed and optimized for stability. Fortifying these beverages with fish and algae oil was expected to impact their consumer liking due to expected off flavors. The goal of this study was the determine the maximum concentrations of fish and algae oil in each beverage which were acceptable to consumers and select the optimal combination of beverage, oil, and oil concentration. It was hypothesized that beverage base would impact the consumer acceptability of fortified samples due to differences in background flavor and texture. Soy, oat, and almond milk beverages with five concentrations between 0 and 1% fish or algae oil were produced. 123 regular consumers of plant milk beverages aged 18 or older were recruited for a sensory evaluation study. Each fortified beverage was compared against a control containing sunflower oil, with panelists indicating their preference between the two and overall liking of each sample. The consumer rejection threshold (CRT) was defined as the maximum concentration of fish or algae oil that could be added to each beverage before consumers began to prefer the control and overall liking of the fortified beverage dropped. The CRT was found to be 0.2 or 0.4% fish oil and algae oil, respectively, and varied by beverage and oil type. Oat- and soy-based beverages were preferred over almond, and algae oil was minimally preferred over fish oil. A 12 oz serving of a beverage with 0.4% fish or algae oil would contain approximately 720-890 mg of combined EPA and DHA, almost 3 times the recommended daily amount. This study shows that planFish and algae oils and their component

fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) have demonstrated health benefits such as reducing cardiac death risk and lowering inflammation. However, a large portion of the US and global population is not consuming the recommended amount of fish or EPA and DHA, partially due to low accessibility, dietary restrictions, contamination concerns, or general dislike. To combat this low consumption, fish and algae oil fortified plant milk beverages made from soy, oats, and almonds were developed and optimized for stability. Fortifying these beverages with fish and algae oil was expected to impact their consumer liking due to expected off flavors. The goal of this study was the determine the maximum concentrations of fish and algae oil in each beverage which were acceptable to consumers and select the optimal combination of beverage, oil, and oil concentration. It was hypothesized that beverage base would impact the consumer acceptability of fortified samples due to differences in background flavor and texture. Soy, oat, and almond milk beverages with five concentrations between 0 and 1% fish or algae oil were produced. 123 regular consumers of plant milk beverages aged 18 or older were recruited for a sensory evaluation study. Each fortified beverage was compared against a control containing sunflower oil, with panelists indicating their preference between the two and overall liking of each sample. The consumer rejection threshold (CRT) was defined as the maximum concentration of fish or algae oil that could be added to each beverage before consumers began to prefer the control and overall liking of the fortified beverage dropped. The CRT was found to be 0.2 or 0.4% fish oil and algae oil, respectively, and varied by beverage and oil type. Oat- and soy-based beverages were preferred over almond, and algae oil was minimally preferred over fish oil. A 12 oz serving of a beverage with 0.4% fish or algae oil would contain approximately 720-890 mg of combined EPA and DHA, almost 3 times the recommended daily amount. This study shows that plant milk beverages can be an effective vehicle for EPA and DHA.t milk beverages can be an effective vehicle for EPA and DHA.

Erica Summerfield, PhD, Agricultural Communication, Education, and Leadership

Prime' Time Farming: Analyzing Frames in Clarkson's Farm
Erica Summerfield*, Nicole Volk, Annie Specht, Kellie Claflin

The Amazon Prime documentary series Clarkson's Farm depicts first-time farmer and TV presenter Jeremy Clarkson as he attempts new tasks on his farm in the rural Cotswolds' region of England. In a previous study evaluating agricultural and non-agricultural audience reactions to Clarkson's Farm, researchers found that students were drawn to scenes in the first two episodes that influenced their perception of agriculture and the information they learned. This study utilizes schema theory and media framing to interpret the content of Clarkson's Farm. Researchers

analyzed the first two episodes, 'Tractoring,'☒ and 'Sheeping,'☒ using a summative content analysis to quantify visual content to understand representation of student-identified topics in the program. Thirteen topics were identified and used for this analysis: animal management, animal injury/complications, animal breeding, crop production, equipment, seed and fertilizer, finances, advising, weather, regulations, pests, water sources, and landscape. Researchers watched the first two episodes of Clarkson's Farm, noting time stamps and number of scenes in which each identified topics was present. Time stamps were calculated into total amount of time spent on each topic throughout the two episodes. Students identified topics like advising and equipment due to the episodes' focus on these topics, quantified by the number of scenes and amount of time they were featured on screen. Topics like pests, seed and fertilizer, and regulations were identified even though the episodes offered few scenes and little time on screen. Students also noted finances, which had little time on screen but was represented in a larger number of scenes, as a key topic. Schematic influences may have had an impact on student identification of these topics.

Zhining Sun, PhD, Agricultural, Environmental and Development Economics

Impact of Interest Rates on Agricultural Commodity Price Dynamics
Zhining Sun* and Ani Katchova

Recent dramatic changes in monetary policy have led to a renewed interest in how interest rates affect agricultural commodity prices. Over the past decade, the U.S. Federal Reserve System has undertaken unusually aggressive interest rate interventions to stabilize and stimulate the economy in response to recessionary pressures, high inflation, international supply chain disruptions, and other macroeconomic shocks.

In this study, we examine how agricultural commodity prices respond to changes in the interest rates, both in the short- and long-run in three aspects—the existence of overshooting, short-term asymmetry, and long-term symmetry, with a particular focus on corn, wheat, and soybean. Specifically, we aim to show that in the short(long) run, the magnitude of the change in commodity prices is different for an interest rate decrease from an interest rate increase of equal magnitude. Moreover, we attempt to show the overshooting process of commodity prices in response to positive and negative interest rate changes, separately. We estimate a nonlinear autoregressive distributed lag model to uncover the short-run and long-run impact of interest rates on corn, soybean, and wheat prices. To study the asymmetric short- and long-term impact of real interest rates on agricultural commodity prices, the first differences of interest rates and lags are decomposed into positive and negative partial sums in the model.

Our estimates indicate that wheat and soybean prices have short and long-run asymmetry, but corn has short-run asymmetry and long-run symmetry, in response to interest rate change. We also find there exists overshooting in soybean and corn prices. Our research will contribute to the literature on the impact of interest rates on commodity prices by employing updated data that spans the recent period of highly volatile Fed monetary policy. Our research will help farmers to better understand how interest rates affect agricultural commodity prices, allowing them to make better-informed production and risk management decisions. It will also help inform agricultural processors, commodity traders, brokers, and agricultural policymakers to account for the impacts of monetary policy in their decision-making.

Jaden Tatum, PhD, Food, Agricultural and Biological Engineering

Design and Pilot Testing of a Shallow Geothermal Heat Exchanger for Low-Cost Season Extension
Jaden Tatum* and Ajay Shah

Season extension practices of cooling and heating high tunnels will be necessary to achieve year-round availability of fresh, local produce in Ohio. The Ohio State University has a goal to source 40% of its food from sustainable and local sources by 2050, but currently there are only 2 farmer's markets open in winter in the Columbus area, suggesting there is not high capacity to provide year-round produce. This is partly due to the prohibitive costs of heating greenhouses and high tunnels through the winter. To address the high costs and fossil fuel consumption of heating greenhouses, we investigated the capacity of shallow geothermal earth-to-air heat exchange (EAHX) systems in Ohio and installed and monitored a pilot EAHX system on a commercial farm in Urbana, Ohio. The system was designed to prioritize off-the-shelf and low-cost components. Using heat transfer equations and pressure loss calculations, the system was designed to balance thermal efficiency of the system with fan size and cost.
The pilot system was installed in December 2022 using materials purchased from Menard's and Grainger for a total cost of $1,350. Initial monitoring has demonstrated the airflow through the system aligns with the model-estimated flow rate of 0.5 air changes per hour for the 30x96' commercial high tunnel. The air flowing through the system at initial spin-up was able to gain 11°F, tempering external air at 26°F to 37°F as it moved through the 60 ft of underground tubing. Ongoing monitoring will allow validation of thermal modeling and economic analysis of the cost savings of this system, but the preliminary findings of the piloted system indicate EAHX could be a sustainable season extension tool for Ohio farmers to minimize costs of year-round growing.

Haotian Wu, PhD, Agricultural, Environmental and Development

Economics

Impacts of Oil and Natural Gas Exploration, Drilling, and Extraction on U.S. Farm Loan Delinquencies
Haotian Wu*

At the beginning of the 2000s, surging oil and gas prices and reductions in the costs of horizontal drilling and hydraulic fracturing (“fracking") made the extraction of shale oil and shale gas economically profitable. As a result, U.S. oil and gas production increased rapidly “the shale boom"), resulting in the U.S. becoming the largest natural gas and crude oil producer and a net exporter of both products in recent years (EIA, 2022).
Because building new oil and gas wells requires placing well pads and other necessary infrastructure on land, new drilling has been conducted primarily in rural agricultural areas. Potential benefits of oil and gas development activities to agriculture include income from initial oil and gas lease payments as well as ongoing royalty payments to farmland owners who possess mineral rights (Harleman & Weber, 2017; Weidner, 2013).
The impact of oil and gas development on agriculture remains an understudied question, particularly regarding the impact on farm financial viability and resilience. Research on the topic has been impeded for a variety of reasons. Our research aims to investigate the impact of oil and gas drilling and extraction on U.S. farm financial viability and resiliency using agricultural loan delinquency rates for financial institutions to provide a window into the health of agricultural producers. This financial data is available from the Federal Deposit Insurance Corporation (FDIC) and reflects farm financial viability within the regions covered. This data is overlaid with detailed information on oil and gas well activity, including drilling and extraction data used to measure annual oil and gas activities and leasing. Combining these data sources, we estimate a model using delinquency rates as the dependent variable and oil and gas activities variables, joined with other control variables, as regressors.
In addition to providing new insights into the role of oil and gas development on agricultural activity, this research will also inform financial institutions on the potential changes in liability associated with agricultural lending in areas experiencing oil and gas development.

Ming Yan, PhD, Animal Sciences

Unraveling the viral dark matter of the rumen microbiome with a new global virome database
Ming Yan*, Akbar Adjie Pratama, Zongjun Li, Yu Jiang, Matthew B. Sullivan, and Zhongtang Yu

Like in the human gut and other environments, viruses are probably also diverse and modulate the microbiome (both population and function) in the rumen of ruminants, but it remains largely

unknown. Here we mined 975 published rumen metagenomes for viral sequences, created the first rumen virome database (RVD), and perform ecogenomic meta-analyses of these data. This identified 397,180 species-level viral operational taxonomic units (vOTUs) and allowed for a 10-fold increase in classification rate of rumen viral sequences compared with other databases. Most of the classified vOTUs belong to the order Caudovirales, but distinct from those in the human gut. Rumen viruses likely have ecosystem impacts as they were predicted to infect dominant fiber degraders and methane producers, and they carry diverse auxiliary metabolic genes and antibiotic resistance genes. Together, the RVD database and these findings provide a baseline framework for future research on how viruses may impact the rumen ecosystem.

Hengkang Zhao, PhD, School of Environment and Natural Resources

Temporal Changes of Soil Aggregates in Relation to Tillage and Drainage
Hengkang Zhao*, Rattan Lal, Brian Slater

Well aggregated soils can create favorable soil air and water conditions for the plant roots and reduce erosion. Understanding temporal dynamics of soil aggregates is important because of the effects over time on soil functions and crop production. The objectives of this report is to focus on a) How soil aggregates change over time in different crop growth stages; b) How tillage and drainage affect soil aggregates; and c) How soil aggregates interact with crop growth and production.
Bulk soil samples were collected with 3 replicates through 2019/5-2019/9 at depths of 0-15cm, 15-30cm, 30-45cm. Managements treatments were no-till (NT) vs chisel-till (T) and no drainage (ND) vs tile drainage (D). Water stable aggregates (WSA, >0.25mm) and mean weight diameter (MWD) were determined by the wet sieving method.
The results revealed that:
a) NT significantly increased WSA and MWD in 0-45cm depth over time. WSA and MWD in NT at 0-15cm depth increased from 84.9% to 92.3% and 2.55mm to 3.31mmover time). WSA and MWD in ND (73.1% and 1.34mm), D (73.2% and 1.46mm) treatments in 15-45cm and WSA for T (69.1 %) in 30-45cm depth were generally higher in 2019/8, and had lower value (66.1% and 0.38mm for T, 56.9% and 0.61mm for ND) in 2019/6.
b) In 0-15cm depth, NT had significantly higher WSA and MWD than T treatment (88.5% and 3.00mm vs 71.3% and 1.81mm). ND had higher better WSA than D through 2019/5-2019/7 (80.5-83.3% vs 72.9-77.6%) but became lower than D in 2019/8-9 (78.2-81.9% vs 82.4-82.5%). In 15-30cm depth, NT had higher WSA than T through 2019/7-2019/9 (78.7-82.8% vs 73.4-65.1%) and higher MWD through 2019/8-2019/9(1.74-2.21mm vs 0.92-1.70mm). ND tiles had lower WSA than D in 2019/5-2019/6 (68.0-61% vs 75.7-67.6%), and lower MWD in

2019/6(1.31-0.85mm vs 1.64-1.15mm). In 30-45cm, NT had lower WSA than T in 2019/5-6 (60.7-72% vs 68.9-69.1%) but became higher in WSA and MWD in 2019/8-2019/9 (77.5-72.1% and 1.72-1.25mm vs 68.8-62.7% and 0.54 vs 0.50mm). D tiles had higher WSA and MWD through 2019/5-2019/6 .
c) Comparing to T, NT significantly increased crop growth and crop yield (4.21 Mg/ha vs 3.80 Mg/ha). Effect In 0-15cm effect of tillage and yield were strong in 2019/6-8 (Pearson correlation 0.337-0.546), and effect of drainage was prominent in 2019/7-9 (Pearson correlation 0.397-0.512). Higher yield in NT treatment was related to larger MWD in 0-15 cm depth. Therefore NT system used in conjunctrion with tile drainage would benefit crop production. Better crop growth in drained treatment may result in higher WSA and MWD in 0-15cm.
It can be concluded that the temporal variation of soil aggregates is related to depth and crop growth. Maintaining aggregation in surface soil is important. Proper drainage management implemented along with NT strategy is crucial to improving soil quality and crop production.

Rui Zheng, PhD, Animal Sciences

Dietary milk fat globule membrane improves neonatal piglet intestinal architecture and enhances mucosal diamine oxidase activity following lipopolysaccharide challenge
Rui Zheng*, Rebecca Brown, Rafael Jimenez-Flores, and Sheila K. Jacobi

Background: Early life stressors alter the trajectory of gut development and impair nutrient utilization, barrier function, and animal performance throughout life. Gastrointestinal (GI) maladies increase morbidity and mortality in neonates, and dietary nutrients are essential in supporting GI function. Dietary milk fat globule membrane (MFGM) has beneficial effects on promoting gut health. However, mechanisms of actions are still being defined.

Objective/Hypothesis: The objective is to define the effect of MFGM supplementation on neonatal piglet intestinal health. We hypothesize dietary MFGM will enhance piglet intestinal architecture and tight junction (TJ) protein abundance, attenuating systemic lipopolysaccharide (LPS)-induced intestinal barrier disruption.

Methods: Thirty-two one-day-old piglets were assigned to soy (CON) or MFGM phospholipid supplemented diet (0.75% w/w) ± LPS (100 μg/kg body weight) challenge in a 2×2 factorial design (n=8/diet/challenge). Piglets were fed for 21 d and 8 animals/diet received saline or LPS injections 4 h prior to euthanasia. Piglet weights and feed intake were recorded daily to calculate performance. Intestinal tissues were collected to assess villus height (VH) and crypt depth (CD) by hematoxylin and eosin staining. Two biomarkers of intestinal integrity, intestinal fatty acid-binding protein (I-FABP) and diamine oxidase (DAO), were measured in serum or tissue. Protein abundance of claudin-1 and occludin in ileal and colonic mucosa were detected by Western blot.

Data were analyzed by 2×2 factorial design using the PROC MIXED procedure of SAS.
Results: Dietary MFGM had no adverse impact on growth performance or TJ proteins (P>0.05). Dietary MFGM increased VH (CON: 348.8 and MFGM: 427.0 ± 26.79 μm) and decreased CD (CON: 166.3 and MFGM: 147.4 ± 8.42 μm) in ileum, thereby increasing the VH:CD ratio (CON: 2.2; MFGM: 3.1 ± 0.13) (P<0.05). Further, LPS treatment increased serum I-FABP by 4.4-fold and decreased jejunal mucosal DAO by 0.5-fold compared to saline treatment (P<0.05). Additionally, there was a 93.1% increase in colon DAO activity with MFGM diet compared to soy-fed pigs, regardless of LPS challenge (P<0.05).

Conclusions: Dietary MFGM improved neonatal piglet ileum architecture and increased colon DAO activity, potentially attenuating the intestinal barrier disruption following LPS challenge.
Acknowledgments: Foods For Health SEEDS Grant.

Postdoctoral Level

Srishti Gaur, Post-doc, Food, Agricultural and Biological Engineering

Utility of Explainable Machine Learning (eXML) for the Prediction of Stomatal Conductance
Srishti Gaur* and Darren Drewry

Stomatal conductance (gs) is a key leaf-level function controlling water, carbon, and energy exchange between vegetation and the surrounding environment. Conventionally, semi-empirical models have been used to model gs. However, these models are difficult to parameterize and require re-parameterization as ecosystems undergo phenological changes throughout the growing season. Machine learning (ML) models in contrast offer a potential path to overcome this problem but lack transparency and interpretability and are often plagued by over-fitting to limited data. To overcome these problems, we have utilized an explainable machine learning (eXML) approach to interpret the outcomes of the ML models using a popular eXML algorithm SHapley Additive exPlanations (SHAP). Here, we contrasted the performance of three ML models, i.e., extreme gradient boosting (XGBoost), random forest (RF), and neural network (NN)in predicting the gs across C3 crops, C3 grasses, shrubs, and tree species. The different combinations of ML models utilized for gs prediction, which include Model-1 (Ball-Berry proxy), Model-2 (Leuning proxy), Model-3 (combinations of two environmental variables), Model-4 (combinations of three environmental variables), Model-5 (combination of all environmental variables), and Model-6 (combination of environmental and physiological variables). Results suggested that ML proxies for Ball-Berry and Leuning models performed better than the semi-empirical Ball-Berry and Leuning models. The study also come up with a non-invasive solution for gs prediction. Overall, Model-6 outperformed the other set of models in predicting the gs responses. Also, the XGBoost model performed the best among all ML models across all plant function types. The global interpretations from SHAP highlighted the utility of individual variables in predicting the gs responses, i.e., whether a particular variable has a positive or negative impact on model outcomes, and thus, explained the outcomes of the black-box ML models. ML models allow the opportunity to bring multiple environmental conditions together with physiological plant characteristics to model stomatal responses. The findings of the study highlighted the utility of eXML in understanding ML model performance in the context of terrestrial ecohydrology.

Dong Hwan Kim, Post-doc, Animal Sciences

Retinol Binding Protein 7 Promotes Adipogenesis in vitro and Regulates Cellular Retinol Metabolism
Dong-Hwan Kim*, Jinsoo Ahn, Ouliana Ziouzenkova, Kichoon Lee

Retinol is an essential nutrient in animals. Its metabolites, specifically retinoic acid (RA), are crucial for cell differentiation, including adipogenesis. Retinol binding protein 7 (Rbp7) is under the control of PPARg the master regulator of adipogenesis. However, the role of RBP7 in adipogenesis is unclear. Our study showed that Rbp7 was abundantly expressed in white and brown mouse adipose tissues and had a higher expression in adipocytes than in stromal vascular fraction. Rbp7 overexpression promoted 3T3-L1 preadipocyte differentiation with increased triglyceride accumulation and up-regulation of Pparg, Fabp4, C/ebpa, and AdipoQ. Rbp7 deficient adipocytes had opposite effects of the overexpression, which were rescued by RA supplementation. Indirect assessment of relative nuclear RA levels using RAR response element (RARE)-Luc reporter assay demonstrated that Rbp7 overexpression significantly increased RARE-Luc reporter activity. Rbp7 overexpression significantly increased expression of Raldh1, responsible for RA production, and up-regulation of Lrat and Cyp26a1, involved in retinol storage and RA catabolism, respectively, in 3T3-L1 adipocytes. Rbp7 deficient adipocytes had opposite effects of the overexpression of those genes involved in retinol metabolism. These data suggest that RBP7 increases nuclear RA concentration that may induce negative feedback responses via regulation of the gene expression for retinol homeostasis. Our data indicate critical RBP7 functions in adipocytes: regulation of nuclear RA concentrations and adipocytes differentiation, potentially providing a new target for obesity therapy.

Joonbum Lee, Post-doc, Animal Sciences

The Effects of Myostatin Mutation on the Tibia Bone Quality in Male and Female Japanese Quail
Joonbum Lee*, Yuguo Tompkins, Dong-Hwan Kim, Woo Kyun Kim, Kichoon Lee

Although modern broilers and layers successfully provide larger amounts of meats and eggs, abnormal leg bone development and poor bone quality are considered as major issues in the broiler and layer industries. In addition to nutritional and environmental factors, genetic factors have been considered major factors regulating bone quality in poultry species but are yet to be fully investigated due to limitations on available animal models. After the discovery of the function of the Myostatin (MSTN) gene as an anti-myogenic regulator in mice, our group generated MSTN mutant quail for the first time using our novel CRISPR/Cas9-mediated avian genome editing method and demonstrated conserved function of the MSTN gene on regulation of muscle development between mammals and birds. Although the positive effect of MSTN mutation on bone quality was reported in mouse model, however, such effect has not been investigated in avian model. In the current study, the effect of MSTN mutation on avian bone quality was investigate by collecting tibia bones from MSTN mutant and WT male quail at 4 months old, and

females at 5 weeks and 4 months old. Material and structural properties and breaking strength of tibia bones were analyzed by micro-Computed Tomography scanning and a three-point bending test, respectively. Tibia bone sizes and qualities of male quail at 4 months old and female quail at 5 weeks old were significantly improved by MSTN mutation, indicating conserved function of the MSTN gene on bone development and quality between mammalian and avian species. However, similar tibia bone quality and strength between the two female groups at 4 months old, suggested that the effect of egg production overrides the effect of MSTN mutation on bone quality. In conclusion, the MSTN mutant quail model has provided new insights into regulation of bone quality not only by a genetic factor, the MSTN gene, but also by physiological factors, sex and ages. More importantly, the current study provides scientific evidence for potential application of the MSTN gene as a genetic marker to alleviate leg bone problems in meat producing male poultry species

Wooster Campus

Master's Level

Valerie Anderson, MS, Entomology

Attraction of Female Fungus Gnats (Lycoriella spp.) to Oyster Mushrooms (P. ostreatus) and Oyster Mushroom Growing Media
Valerie Anderson*, Grace Sward, Christopher Ranger, and Luis Canas

Fungus gnats have a rapid life cycle, and their infestations can be a nuisance for farmers of many crop commodities. In the production of oyster mushrooms (Pleurotus spp.), fungus gnat larvae feed on developing mycelium damaging mushroom fruit and reducing its economic value. Conventional synthetic insecticides are not helpful for oyster mushroom producers as they have been shown to impair mushroom primordia growth and pose environmental health concerns. In prior work, we developed a bioassay method to grow oyster mushrooms and assess the effectiveness of biological control agents for control of fungus gnats (Anderson et al. 2021). To broaden the management strategy for this pest on oyster mushrooms, behavioral work to understand attraction must be performed. Our objective was to evaluate the attractiveness of oyster mushroom substrate using a simple two-choice static-flow olfactometer. These tests determined attractive substrates for female fungus gnats including inoculated straw, oyster mushroom mycelium, and oyster mushroom fruit. Pasteurized straw alone was not attractive to the gravid female fungus gnats, while all mushroom components were attractive. Results will aid in future behavioral work including repellency bioassays with the established olfactometer design. Upcoming studies will incorporate pest control methods in gourmet mushroom production, leading to more effective management strategies.

Dina Bugybayeva, MS, Animal Sciences

Surface conjugated influenza antigen and STING adjuvant on mannose-chitosan nanoparticle is beneficial for intranasal vaccination to potentiate the cross-protective cellular immunity in pigs
D. Bugybayeva*, E. Dumkliang, V. Patil, G. Yadagiri, R. Suresh, S. Dolatyabi, J. Schrock, J. F. Hernandez-Franco, H. HogenEsch, R.J. Gourapura.

Introduction
Swine influenza A virus (SwIV) is a major threat to the swine industry, and vaccination is the most viable strategy to control SwIV infections. Poor induction of mucosal and cellular immunity in the respiratory tract by current intramuscular SwIV vaccines is responsible for limited cross protection. Our objective is to improve the mucosal and cellular immunity induced by whole inactivated SwIV

entrapped mannose-chitosan nanoparticle (mChit-SwIV-NP) vaccine by including a STING (stimulator of interferon gene) adjuvant administered by intranasal (IN) route.
Materials and Methods
We developed mChit-SwIV-NP vaccine containing whole inactivated SwIV H1N2 and STING adjuvant ADU-S100, either encapsulated (mChit-SwIV+S100-eNP) or surface adsorbed (mChit-SwIV+S100-sNP). Influenza free nursery pigs were vaccinated intranasally twice at 3-week intervals and challenged with the pandemic 2009 H1N1 virus. Nasal swabs collected at day post challenge (DPC) 2, 4 and 6 (necropsy day) were analyzed for infectious virus load. Peripheral blood mononuclear cells (PBMCs), bronchoalveolar lavage fluid (BAL) cells, and tracheobronchial lymph nodes mononuclear cells (TBLN MNCs) isolated at DPC 6 were evaluated for virus specific activated lymphocyte subsets by flow cytometry and T-cell proliferation.
Results
The infectious virus load was reduced by around one log10 in the nasal passage of both mChitSwIV+S100-encapsulated NP and mChit-SwIV+S100-surface adsorbed NP vaccinates, with the latter performed relatively better. Immunologically, the frequency of activated IFNγ+ CTLs and IL-17A+ cytotoxic T lymphocytes and Thelper/memory cells in PBMCs and TBLN MNCs were increased in mChit-SwIV+S100-sNP vaccinates better than mChit-SwIV+S100-eNP group. While in TBLN MNCs, virus specific increase in lymphocytes stimulation index was observed in mChit-SwIV-eNP vaccinates.
Conclusion and Discussion
In summary, the electrostatic surface conjugation of preformed mannose-chitosan nanoparticles with SwIV antigen and STING adjuvant stimulated the cross-protective specific mucosal and cellular immune responses in intranasal vaccinated pigs better than their cohort, a potential vaccine candidate to mitigate swine influenza in pigs.

Sandeep Dhakal, MS, Food, Agricultural and Biological Engineering

Monitoring Surface Coal Mine Areas using Remote Sensing
Sandeep Dhakal*, Sami Khanal, Ashish Manandhar, Ajay Shah

Surface coal mining operations have been associated with several environmental issues, including eradication of native ecosystems, soil erosion, landslides, methane, and other greenhouse gases emission. All these issues release harmful toxins which possess serious health hazards, including cardiovascular and respiratory illnesses and cancer. The intensive monitoring of mining areas is important for addressing these concerns. However, monitoring a larger geographic region is a challenging task and remote sensing is the one of the cost-effective solutions. Therefore, the objective of the study is to identify surface coal mine areas and detect their land use change using

multispectral and multi-temporal satellite imagery. A site-scale study was conducted using satellite images available from the Google Earth Engine (GEE) and processed in ArcGIS. Two different machine-learning models, Support Vector Machine and Random Forest, were explored for supervised object based image classification in this study. It is observed that the object-based Support Vector Machine model performed better than Random Forest with an overall accuracy of 86.5%, precision of 96.8%, and recall of 100%. The multi-temporal study revealed that the coal mine area increased by 24% from 2019 to 2022. The coal mine area primarily expanded to the surrounding forest and shrubland areas. This suggests that remote sensing can be effectively employed to monitor mining activities (exploration, extraction, and reclamation) or environmental conditions for safety, environmental concerns, and regulatory compliance.

Camila Gutierrez, MS, Horticulture and Crop Science

Genetic mapping of self-compatibility and herbicide-tolerance in rubber dandelion Taraxacum kok-saghyz (TK)

Camila Gutierrez Manriquez*, Jonathan Fresnedo Rami-rez

Taraxacum kok-saghyz, a.k.a. TK, has been identified as a promising alternative source of natural rubber. However, it is in the process of (neo)domestication and yet exhibits undesirable traits, such as obligated outcrossing and poor competitive ability in field settings. This project seeks to query the TK genome on two advantageous agronomic features already identified and developed in TK's germplasm, self-compatibility (SC) and herbicide tolerance (HT). One approach consists of genome homology using the TK genome assembly available in our lab (pending publication). I performed 'best local alignment protein to nucleotide' (tBLASTn) by using protein sequences associated with SC from A. thaliana and HT from T. officinale to identify homologous sequences on the TK genome. This approach will enable the design of primers for gene expression using qPCR. The second approach consists of genetic mapping based on segregating populations. I crossed self-compatible lines with herbicide-tolerance accessions to generate an F1, and from their expected self-seeding, create a segregating F2. The progenies will be screened for herbicide tolerance with sulfentrazone. Furthermore, germplasm from divergent phenotypes will be genotyped to identify single nucleotide polymorphism markers using TASSEL 5 genotyping pipeline and VCF tools. Afterward, create a linkage map using R/QTL (or Join Map). Finally, merging genetic with phenotypic data, using R/QTL, will produce a genetic map to allow the identification of genetic components involved in SC and HT. Results for the first approach show homology for candidate genes associated with SC from A. thaliana's in the TK genome with over 50% of homology. On the other hand, using T. officinale's genes, sequences associated with HT were found in the TK genome with over 90% of homology. For the second approach, after two weeks of herbicide

spraying the F1, sixty-one individuals germinated (out of 400 tested), and forty have survived and grown until today. Some individuals exhibited self-compatibility. Both approaches' outcomes are expected to pseudo-validate each other. This study will develop valuable germplasm and identify the TK's genome regions that govern SC and HT. These outcomes will help to enable the marker-assisted selection of germplasm homogenous and competitive in field establishments.

Daniel Hemphill, MS, Horticulture and Crop Science

Establishing accelerated pre-breeding pipeline for apple with transgenic technology
Daniel Hemphill*, Diane Miller, Jonathan Fresnedo-Ramirez

Apples are the most consumed fruit in the United States yet there remain great obstacles for breeders, regarding their physiology, to overcome. Particularly notable of the obstacles to apple breeding is that of the large duration of apples' juvenility period. The juvenility period is the initial phase in the life cycle of apple lasting between four and ten years throughout which the trees produce no fruit. The creation of new cultivars to assuage; the demands of consumers, the nutritional needs of the population, and the constant threats posed by apple diseases, are stymied by the juvenility period exhibited by young apple trees. I am creating a breeding pipeline with the aim of circumventing the juvenility period of apple through the use of transgenic progeny I have acquired named the G19108s. The transgene, named BpMADs4, in the G19108s allows them to flower in as early as six weeks. In addition, I have 20 types of apples from central Asia and 14 commercial varieties that are adding and maintaining variation within my breeding populations through crosses with my G19108s. Through crossing the G19108s with my diverse germplasm, I will create an elite pre-bred stock that can be rapidly mobilized to establish a breeding pipeline for any specific purpose. I have narrowed down my initial 6,000 crosses to 69 elite individuals that demonstrate more desirable architecture in the form of columnar growth and height as well as a propensity to flower consistently. I am currently growing 2200 more crosses to evaluate and select similarly. My research has resulted in a nascent breeding pipeline for apple which has produced 69 viable apple trees more desirable than the G19108s that can bear fruit with seeds in a year's time. With the acceleration of the breeding cycle of apple from between four and ten years to one year, there are leaps of progress to be made in aspects for apple nutrition, production, fortification against climate change, and cost reduction.

Olivia Lang, MS, Entomology, Masters in Plant Health Management

3D Printing: Engaging Stakeholders and Enhancing Extension
Olivia Lang*, Suranga Basnagala, Ashley Leach, Kelley Tilmon, Luis Canas, Andy Michel

The mission of Extension at Ohio State is “Engaging people to strengthen their lives and communities through research-based educational programming”. Since this educational programming traditionally takes on a lecture-like format, the question that must be asked is “how do we actively engage stakeholders in our programming?” Our objective is to showcase how 3D-printed hands-on tools can be paired with traditional extension methods to engage target audiences and enhance educational programming. Our research involves two case studies based on pest management topics. The first study we did was invasive species training with 3D printed models. The question that we sought to answer in this study was, “how do we train individuals to scout for a pest that is not yet in the area?” The pest that we focused on was Ohio’s newest invasive species, the Spotted Lanternfly. To do this we gave a traditional presentation with a mock scouting “scavenger hunt”. We found that our designs helped engage our target audiences and provided an acceptable replacement for actual pest specimens for mock scouting purposes. Our second study involved estimating percent defoliation of soybean leaves, and the question we sought to answer was “how do we increase accuracy when estimating percent defoliation?” Soybean insecticide sprays are based on defoliation thresholds, which are very hard to judge accurately with the naked eye. To solve this problem, we created 3D printed percent defoliation leaves that help stakeholders better estimate the true level of defoliation. We did a pre and post test with this tool, coupled with a traditional presentation on the benefits of spraying based on thresholds. We found that when using our 3D printed tool, stakeholder estimates increased in accuracy by 35%. In conclusion, through both case studies we saw positive results in engagement by adding a hands-on portion to our programming using 3D printed materials.

Forrest Lang, MS, Agricultural Communication, Education, and Leadership

Development of a Lawnmower 4-H Project Book

Forrest Lang*, Dee Jepsen

A review of youth injuries and available educational resources was conducted to determine the need for a 4-H project book focused on lawnmowers. Between 1990 and 2014, a reported 212,258 children under the age of 18 received emergency treatment for lawn mower-related injuries, which yields an annual average rate of 11.9 injuries per 100,000 U.S. children. Reviewing educational materials available to youth on lawnmower operation and safety yielded very limited results. Based on these findings, five objectives were identified for this project (1) describe the characteristics of lawnmower safety, operation, and maintenance that will educate youth; (2) develop activities based on the 4-H experiential learning model; (3) develop a training and practice

guide based on the 4-H lawn mower competition; (4) provide a draft project book for evaluation in the 2022 4-H year; and (5) publish the project book for use in the 2023 4-H year. To meet these objectives a panel of experts consisting of Purdue University Extension professionals, the Ohio 4-H Curriculum Manager, and the Ohio State Agricultural Safety and Health Leader convened to develop the content of the book. It was decided to focus the content on three areas including (1) lawnmower safety, (2) operation of lawnmowers, and (3) lawnmower maintenance. Activities for each area were developed by referencing the 4-H experiential learning model and through panel's knowledge and experiences. A draft version of the book was sent to 31 Ohio and Indiana 4-H Extension professionals and volunteers for evaluation. Quantitative responses (n = 2) and qualitative responses (n = 15) were collected and incorporated into the final version of the book. The result is a 52-page project book that is available in Ohio and Indiana for the 2023 4-H program year and will be submitted to the national 4-H review board for their jury review.

Erick Martinez Rodriguez, MS, Entomology

Bud vs Skeeters! Evaluating the toxic and repellent effect of hemp extract against yellow fever mosquitoes

Erick Martinez Rodriguez*, Luis Canas, Liva Rakotondraibe, Peter Piermarini

The goal of my research is to generate insight into the use of hemp extracts as a novel tool to control the yellow fever mosquito, Aedes aegypti. The yellow fever mosquito is vector of numerous pathogens that cause deadly and debilitating diseases in humans, making it the most dangerous animal in the world against humankind. Humans have heavily relied on the use of chemical insecticides to control mosquito populations, however, the overuse of these chemicals has led to resistance concerns worldwide leading to pesticide applications having little to no effect on mosquitoes. In addition, chemical applications also have a major impact on human and environmental health, which is why new and safe alternatives are needed for mosquito control. My research focuses on using hemp (Cannabis sativa) extracts as a biopesticide and repellent against adult female mosquitoes. I hypothesized that hemp plants, particularly the hemp leaf and inflorescence (flower) extracts, will cause toxic and repellent activity against mosquitoes. To test toxic and repellent effects, I performed several bioassays exposing A. aegypti to several concentrations of hemp extracts. Our results suggest that hemp extracts have concentration-dependent effects on mortality of adults and deter adult females from feeding on blood. The results of this study suggest hemp is a potential source for novel biopesticides to control yellow fever mosquito

Yamikani Ng'ona, MS, Entomology

Surveying Cry1F resistance in European Corn Borer
Yamikani Ngona*, Yasmine Farhan, Jocelyn Smith PhD, and Andrew Michel

Bacillus thuringiensis (Bt) corn is genetically engineered to produce proteins that have toxic and insecticidal characteristics towards specific insects. However, insects are rapidly evolving resistance to Bt crops. One of the insects with resistance is Ostrinia nubilalis (European corn borer, or ECB). ECB is an important corn pest that attacks the tassels, ears, and stalks. They create nesting cavities that obstruct the circulation of water and nutrients through the plant. The first case of practical resistance to Bt maize by ECB was documented in 2018 in Nova Scotia, Eastern Canada. In other species, DNA mutations in ABC transporter genes have been linked to Bt resistance. In ECB, we have identified molecular markers within the ABCC2 gene that are tightly linked to resistance. Using these molecular markers, we plan to survey Cry1F resistance from ECB collected in New Hampshire, and New York. Collaborators sent larvae and adults collected from sweet corn or pheromone traps. We extracted DNA and will genotype all samples with Cry1F molecular markers to estimate the frequency of putative resistant alleles. Given the proximity of these locations to Eastern Canada, we expect to find low frequencies of resistant alleles. Understanding how quickly resistance in ECB is spreading will help develop better monitoring techniques and find ways to extend the durability of Bt corn.

Brandon Shannon, MS, Environmental Sciences Graduate Program, Entomology

Toxicity of the not so 'Inert Ingredients' Used in Pesticides to Adult Worker Honey Bees
Brandon Shannon*, Reed Johnson

Commercial beekeepers have reported colony losses while providing pollination services for almonds and other bee-pollinated crops, possibly due to pesticide applications made during crop bloom. Pesticides are often applied as tank mixes, or mixtures of fungicides and insecticides combined into a single application that often contain spray adjuvants, which are added to improve the handling or application characteristics of a pesticide and may include spreaders, stickers, or surfactants. Adjuvants and their ‘principal functioning agent’ constituents, which also serve as ‘inert ingredients’ in formulated pesticides, are not subject to much of the regulatory toxicity testing that is required of pesticides. This study established the honey bee acute toxicity, expressed as the LC50¬, of formulated adjuvants alone, combinations of formulated adjuvants with pesticides, and individual adjuvant ‘principal functioning agent’ constituents. Treatments were applied to three-day-old adult worker honey bees using a Potter Spray Tower and mortality was assessed 48 hours following exposure. Twelve formulated adjuvants, field relevant adjuvant-

pesticide tank-mix combinations of seven formulated adjuvants with six formulated pesticides, and sixteen individual adjuvant 'principal functioning agent' constituents were tested. Results demonstrate that some formulated adjuvants have the potential to cause acute honey bee mortality at near field application rates, both when applied alone and in combination with pesticides. The adjuvant products Kinetic, Induce, Surf-90, and LI 700 demonstrated increased toxicity when combined with pesticides compared to the adjuvant alone, while some combinations, including the adjuvants Cohere, Dyne-Amic, and LI 700, showed decreased toxicity compared to the adjuvant alone. Individual adjuvant 'principal functioning agents' from the polyethoxylate, organo-silicone, and other non-ionic polymer chemical groups demonstrated toxicities at near application rates. A better understanding of adjuvant and adjuvant-pesticide tank mixture toxicity to honey bees will play a key role in informing 'Best Management Practices' for pesticide applicators using spray adjuvants during bloom when honey bee exposure is likely and will guide safer formulation chemistries for pesticide and adjuvant manufacturers.

Olaitan Shekoni, MS, Animal Sciences, Center of Food Animal Health

Development of Bird Mucosal-Deliverable Nanovaccine
Olaitan Shekoni*, Schrock J., Suresh R., Bugybayeva D., Akter F., Renukaradhya G.J.

Avian influenza virus (AIV) is a significant threat to the poultry industry. The AIV infection causes massive influenza outbreaks and high mortality leading to devastating economic loss to the poultry industry globally. AIV is divided into two groups, highly pathogenic AIV (HPAI) and low pathogenic AIV (LPAIV). The aim of this study was to design a bird-flu mucosal-deliverable nanovaccine, which is expected to reduce morbidity, mortality and spread of the virus. In this study, we have selected the H5N3 strain of LPAI to prepare mannose-conjugated chitosan nanoparticle encapsulated inactivated AIV, which is surface coated with Salmonella flagella protein (mCSf-AIV-NP). In addition, a potent mucosal adjuvant c-di-GMP was also entrapped separately (mCSf-GMP-NP). The formulations were characterized for particle size, shape and charge using Malveren zetasizer and scanning electron microscopy. Our data indicated that the particles were spherical, 100-400nm in size, Polydispersity Index (PDI) <0.4 and zeta potential +25mV, suggesting the formulated vaccine was monodisperse with a high positive charge, ideal for a mucosal nanovaccine. For in vivo study, 78-layer chicks (13 groups, n=6/group) were administered twice at 3-week interval with the vaccine via mucosal route (oral/conjunctival/nasal). The samples collected for immunological study include cloacal swab, oropharyngeal swab, and serum samples at day post vaccination (DPV) 0 and 21. Virus specific mucosal IgA and systemic IgG antibodies in serum and mucosal samples were analyzed by ELISA.

Raksha Suresh, MS, Animal Sciences

Characterization of anti-porcine CXCL10 monoclonal antibodies
Raksha Suresh*, JK Lunney, T Hailstock, C Dal, J Aquino, S. Chick, K Walker, JN Manirarora, Y Sullivan, J LaBresh, and GJ Renukaradhya

CX-C motif chemokine ligand 10 (CXCL10) facilitates chemoattraction of important immune cells to tissues. As part of the USDA-NIFA Swine Immune Toolkit Initiative, our goal is to provide the veterinary community with new commercial immune reagents and standardized assays for future research efforts. For the chemokine target CXCL10, we used yeast expressed, recombinant porcine CXCL10 (rPoCXCL10) to generate a panel of anti-CXCL10 monoclonal antibodies (mAbs). Subsequently, we screened AF647-tagged a-CXCL10 mAbs for intracellular staining of pig immune cells using different stimulation conditions. Of the 9 mAbs only one (a-CXCL10-1.4) detected intracellular CXCL10 expression in PMA/ionomycin or rPoIFNg-stimulated porcine cells. Further, cell characterization assays verified CXCL10+ cells as CD3-CD4-CD172+, with occasional CD4+ subsets. Overall, we recommend a-CXCL10-1.4 for use in analysis of intracellular signaling to detect interactions that may regulate cell migration. A sandwich ELISA was also developed to quantitate CXCL10 protein expression; it verified reactivity with native porcine CXCL10 using a-CXCL10-1.6/-1.9 mAbs. Immunohistochemistry analysis for binding of anti-CXCL10 mAbs to CXCL10 on pig lymph node and spleen tissues indicated positive reactivity with a-CXCL10-1.1 and -1.2 mAbs, and will be useful for evaluating immunity and vaccine responses. Thus a diversity of a-CXCL10 mAbs will be needed to assure best evaluation of the role of this chemokine on pig immune responses. New reagents identified by the Swine Immune Toolkit Initiative will undoubtedly advance future swine research efforts.

Eric Devney, PhD, Food, Agricultural and Biological Engineering

Eric Devney*

Advances in technology make natural rubber created from the Parthenium argentatum guayule shrub an increasingly viable option for an alternative supply in the natural rubber industry. The current standard, Hevea natural rubber, is currently grown nearly exclusively as clones in Southeast Asia, which makes it prone to disease and blight in the long run. The purpose of this experiment was to extract the latex from guayule shrubs to be used in size exclusion chromatography and tensile testing to find the optimal rubber out of ten transgenic variants of the shrub. The goal of the experimentation was to find the natural rubber sample with the most favorable physical properties, with the goal of eventual mass production. There were five different genetic changes and two age groups tested in the study: older and younger shrubs. After the latex

was extracted and coagulated into rubber, a new procedure was developed to microcompound the rubber samples on a laboratory scale of five grams. Conventional milling methods would be impossible with such small quantities, so a coagulation method was developed to mix the additives into the natural rubber samples. From the results of the experiment, it was found that the different transgenic rubber samples had no statistically significant effect on molecular weight when taken the average of old and young samples, but the age of the sample did have a significant effect. Additionally, statistical analysis of the tensile testing data showed that one rubber combination created the most resilient rubber sample. The AOO Old sample had both the highest tensile stress at break and the lowest Modulus at 100% strain, which makes it the optimal sample out of the six compounds tested. The other samples could still find niche uses in industry, as lower molecular weight compounds can still be used for a variety of goods.

Doctoral Level

Ademola Duduyemi, PhD, Animal Sciences

In-situ recovery of C5 - C8 alcohols from bioreactor by vacuum-assisted gas stripping
Ademola Duduyemi*, Christopher Okonkwo, Victor Ujor, and Thaddeus Ezeji

Bioproduction of high-molecular-weight C4-C8 alcohols has been limited by product toxicity to fermenting microorganisms. Although research on in-situ recovery of biobutanol during fermentation is ongoing, no work has been performed on simultaneous fermentation and in-situ recovery of C5-C8 alcohols such as pentanol, hexanol, heptanol, and octanol. In this investigation, the feasibility of using vacuum-assisted gas stripping (VAGS), a novel technique for in-situ recovery of biobutanol, to recover C5-C8 alcohols was evaluated. The VAGS process relies on thermodynamic principles of vapor-liquid equilibrium (VLE) and behavior of liquid mixtures under pressure. Using the UNIFAC activity coefficient model of DWSIM™, VLE of the C5-C8 alcohols was simulated to study the behavior of these alcohols before validation by laboratory experiments. The simulation results revealed that the mass compositions at the vapor phase at 50 mbar are 9.1-9.5 and 7.4-8.0 times richer in pentanol and hexanol, respectively than in aqueous solution containing 0.2-1.0 g/L of the C5 and C6 alcohols, while there was no heptanol and octanol in the vapor phase at 50 mbar. To validate simulated data, model solutions of C5-C8 alcohols (0.2-1.0 g/L) were prepared to mimic concentrations typically obtained during batch C5-C8 alcohols fermentation and used in batch VAGS process. Samples were collected at 0.33 h intervals for a total cycle of 1.5 h. Gas chromatograph was used to analyze C5-C8 alcohols in model solutions and recovered condensates following each VAGS cycle. Similar to the simulated VLE data, recovered condensates from the model solution containing only C5-C8 alcohols during the VAGS

process were 7-11, 5-9, and 0.9-2 times richer in pentanol, hexanol and heptanol, respectively, than the model solution while no octanol was recovered. Subsequently, model solutions of C5-C8 alcohols were supplemented with butanol, ethanol, acetic and butyric acids which increased recovery of the C5-C8 alcohols to about 40-79% pentanol, 30-74% hexanol, 5-71% heptanol, and 3-21% octanol from the bioreactor, depending on initial feed concentrations. Overall, these results establish the suitability of the VAGS process for the recovery of C5-C8 alcohols and demonstrate a new effort towards alleviating product toxicity to fermenting microorganisms during the bioproduction of high-molecular-weight biofuels and platform chemicals.

Marziyeh Khavari, PhD, Horticulture and Crop Science

Understanding almond non-infectious bud failure using phenotyping and epigenetics approaches
Marziyeh Khavari*, Jonathan Fresnedo Ramirez

The almond industry has struggled with non-infectious bud failure (NBF) disorder for a century which caused the death of terminal buds and continuously results in reduced flowering buds afterward. NBF has been considered a latent risk for the almond industry in commercial production, breeding stock, and nurseries. This disorder caused the rapid abandonment of commercial cultivars such as Carmel in 2000 and affected other commercial cultivars, including Nonpareil, Bennett-Hickman, and Mission. Despite the severity of NBF in the almond industry, there is no clear underlying NBF onset mechanism and diagnostics marker for tracking, screening, and controlling. Since 2012, our team has approached NBF using contrasting germplasm from commercial cultivars, breeding selections, and interspecific hybrids. High-throughput sequencing of DNA methylation has enabled the identification of altered gene expression patterns and genomic signatures that may help monitor NBF. In my doctoral program, Characterize epigenetic covariation among almond clonal cultivars through single nucleotide polymorphisms (SNPs) approach for the identification of differentially methylated cytosines (DMCs). Identification of DMCs epigenetic variation which is associated with NBF and overlapping with differentially methylated regions (DMRs), genes mobile transposable elements, small RNA, and non-coding RNA. Ultimately, identification of the putative genomic biomarker to determine the most cost-effective, replicable, and accurate diagnostic test design screen and track the onset of NBF in the almond seedlings.

Nate King-Smith, PhD, Food, Agricultural and Biological Engineering

Ebb and Flood Hydroponic Dandelion Rubber Production
Nathaniel King-Smith* and Katrina Cornish

Rubber dandelion (Taraxacum kok-saghyz) produces natural rubber (NR) (cis-1,4, polyisoprene) in its roots. This NR is similar to that of the Brazilian rubber tree (Hevea brasiliensis), the sole commercial source. Rubber use is increasing globally and Hevea will be unable to supply enough NR to meet this demand. Temperate regions of the world, including the United States, are unable to produce Hevea trees due to their tropical requirement. Diversification of rubber sources is essential, and rubber dandelion offers a production option for temperate regions. Furthermore, hydroponic agriculture avoids field issues such as weed pressure, dirt contamination, and short growing seasons. Hydroponic production of rubber dandelion was explored with a focus on root production. Two Ohio State populations were tested as well as two nutrient solutions and different cut heights below the net cups before root regrowth. A population bred for large field root size grew well hydroponically, but a highly inbred line did not. Cut height had no effect on root weights at subsequent root harvest, but root weights were significantly greater in a medium designed to support growth of roots rather than leaves. The system can produce 10 harvests/year of roots much larger than possible in Wooster soils, and so is much more productive than one field harvest.

Carolyn Lee, PhD, Animal Sciences, Center of Food Animal Health

Engineering an African Swine Fever Virus Multiepitope Protein for Use in an ASF Nanoparticle-based Subunit Vaccine

Carolyn Lee*, Daryl Jackwood, Renukaradhya Gourapura, Scott Kenney

African swine fever virus (ASFV), the virus that causes African swine fever (ASF), is a highly contagious and deadly virus affecting both domestic and feral pig populations with mortality rates approaching one hundred percent within seven days of infection. To date, there is no treatment or vaccine available for this disease. Although endemic in sub-Saharan Africa, ASF has also spread to parts of the European Union, Russia, China, southeastern Asia, the Dominican Republic, Haiti, and, most recently, Nepal. Although ASF has not been detected in the United States (U.S.), if ASF were arrive, it has the potential to result in dire consequences to U.S. pork producers, as well as the U.S. pork economy. Therefore, there is an increasing need for the development of vaccine interventions to treat ongoing ASF outbreaks abroad and work proactively should the disease make its way to the U.S. Recently, epitopes of ASFV have been identified and used in vaccine trials but have provided only limited protective immune responses, and cross-protection has not been reported. Therefore, the aim of this study was to engineer an ASF multiepitope nanoparticle vaccine, which will be evaluated for induction of robust, protective immune responses. Here, we used in-silico modeling and prediction tools to engineer an ASFV multiepitope protein, combining key immunogenic epitopes from multiple ASFV proteins into one synthetic protein. The multiepitope

protein was subsequently expressed using bacterial and mammalian cell expression systems and purified for combination with mannose-conjugated chitosan nanoparticles. Utilizing existing nanoparticle vaccine technology, coupled with established epitopes from critical ASFV proteins, should prove effective at eliciting a protective immune response against circulating and emerging ASFV strains.

Jonathan Lee-Rodriguez, PhD, Entomology

Seeing Without Eyes: Detection and Identification of Exotic Insects in Greenhouses and Urban Landscapes using Environmental DNA
Jonathan Lee-Rodriguez*, Chris Ranger, Andrew Michel, Luis Canas, Ashley Leach

Environmental DNA (eDNA) is the genetic material left behind by organisms that can be collected to detect the presence of species without the need for visual identification. eDNA is a relatively novel technique that is beginning to be used in the field of agriculture, with most studies conducted to date focused on non-agricultural aquatic environments. We hypothesized that eDNA could be used in two types of environmental settings: 1- control environment agriculture (greenhouses) and 2- urban landscapes. Our objective was to use eDNA to detect two exotic insect pests in two distinct settings, namely, the sweetpotato whitefly, Bemisia tabaci (Hemiptera: Aleyrodidae), in greenhouses and the spotted lanternfly, Lycorma delicatula (Hemiptera: Fulgoridae), in urban landscapes. Aqueous rinses of tomato plants growing within greenhouses were used to collect eDNA from whiteflies and rinses of plants within urban landscapes were used to collect eDNA from spotted lanternflies. Rinses were passed through a membrane filter from which eDNA was then extracted. Samples were processed using polymerase chain reaction (PCR) followed by gel electrophoresis to detect whitefly eDNA while real-time PCR was used for spotted lanternfly eDNA. We were able to detect both whitefly and spotted lanternfly eDNA using these methods. Whitefly eDNA was detectable on the surface of the leaves of tomato plants and we were also able to detect the presence of spotted lanternfly in various urban locations of Cleveland, Ohio. These results highlight the utility of using eDNA as a tool for detection and identification of terrestrial insect pests.

Juan Quijia Pillajo, PhD, Horticulture and Crop Science

Greenhouse evaluation of phosphorus solubilizing microorganisms using the TraitFinder digital phenotyping system.
Juan Quijia Pillajo* and Michelle Jones

Phosphorus solubilizing microorganisms (PSM) benefit plants by producing organic acids to release P from insoluble compounds like Ca2(PO4)3. Most PSM evaluations have been conducted in soil, but less is known about PSM efficacy in soilless substrates. PSM identification requires in-vitro and in-planta evaluations. Although in-vitro screenings can be adapted for large microorganism collections, the amount of labor and resources needed for greenhouse evaluations limits the number of bacterial strains that can be tested. The TraitFinder digital phenotyping system allows plant researchers to improve experimental throughput and accuracy. We aimed to evaluate five PSM capitalizing on the TraitFinder data acquisition capacity. We included three in-vitro-identified PSM (OSU1, OSU2, and OSU3) and two microbial-based products (Lalrise Vita and MycoApply Endo). Marigold (Tagetes patula) 'Durango Orange,' radish (Raphanus sativus) 'Cherry Belle,' and tomato (Solanum lycopersicum) 'Bush Beef Steak' were grown in a peat-based substrate for six weeks. Plants were irrigated with 100 mgÂ·L-1 N from a 15-0-15 fertilizer. P was supplemented weekly as insoluble Ca2(PO4)3 via drench. The growth index and shoot dry weight measurements were consistent with the digital biomass data calculated by TraitFinder. Lalrise Vita promoted growth in all plant species evaluated and improved marigold health. Plant health was assessed using the spectral indexes and information measured by TraitFinder. The active ingredient in Lalrise Vita is Bacillus velezensis. We tested the effect of pure B. velezensis inoculum on marigold plants grown in a peat-based substrate and fertilized with Ca2(PO4)3 as the only P source. B. velezensis pure culture did not have the same effect as Lalrise Vita on marigold growth and health. The TraitFinder allows rapid and accurate assessment of plants inoculated with PSM. Digital plant phenotyping is suitable for scaling up greenhouse evaluations of phosphorus-solubilizing microorganisms.

Grace Sward, PhD, Entomology

A peek at how different oyster mushroom (Pleurotus spp.) hunting strategies impact fungus gnat (Lycoriella spp.) management.

Grace Sward*, Valerie Anderson, Chris Ranger, and Luis Canas

Fungs gnats (Lycoriella spp.) are major pests of mushroom production. Oyster mushrooms (Pleurotus spp.) are a nutritious gourmet mushroom and the second most widely produced mushroom worldwide. At present, pest management strategies on oyster mushroom farms have been informed by research done in button mushroom systems (Agaricus spp). However, oyster mushrooms display carnivory towards nematodes, a biological control agent used against fungus gnats, while button mushrooms do not. This led us to our main question. Are fungus gnat loads impacted by different species of oyster mushrooms? We evaluated three species of oyster mushrooms (P. ostreatus, P. columbinus, and P. djamor). Mushrooms bioassay containers were

infested with six gravid female fungus gnats that were allowed to lay eggs for 72 hours. Separate containers were used to evaluate larvae and adults. The containers were held for 4 weeks at 21 C and 80% RH in Martha fruiting chambers. The containers were destructively sampled weekly to analyze larval populations. At week three, daily numbers of adult emergence were recorded. Significant differences were found between the mushroom species, leading to our second question. Are oyster mushrooms displaying carnivory upon fungus gnat larvae? Petri dishes with PDA agar were inoculated with the three species of oyster mushroom, then infested with 5 first instar larvae. These petri plates were held for three days, then number of traps were recorded. Significant differences were noted which matched the results from our first experiment. This is the first instance in which mushroom carnivory towards fungus gnats has been reported.

Kush Yadav, PhD, Animal Sciences

Chicken Model for Fatty Liver Disease
Kush Kumar Yadav*, Patricia A. Boley, Carolyn Lee, Saroj Khatiwada, Scott P. Kenney

The most common chronic liver disease in the US is nonalcoholic fatty liver disease (NAFLD). NAFLD causes liver disease and cancer. Hepatitis E virus (HEV) is a virus causing liver disease in humans transmitted by contaminated meat. NAFLD is worsened by HEV infection and vice versa, leading to severe liver disorders. This necessitates a model that can be used to study the role of NAFLD during HEV infection. The purpose of this study is to develop a fatty liver disease chicken model because chickens are the only animal model mimicking human HEV-induced liver lesions. We hypothesized that a high cholesterol and choline deficient diet in chickens would develop fatty liver disease which would recapitulate human NAFLD. In general, high cholesterol enhances fatty deposition in blood vessels and low choline enhances fat deposition in and around the liver. A randomized clinical trial design was used to allocate 16 chickens, 3-week-old specific pathogen free white leghorn, including both male and female chickens into two experimental groups. Group 1 (n = 8) was fed control diet (17% protein, 5.3% fat, and 1,300 mg/kg choline) and group 2 (n = 8) was fed high cholesterol with low choline diet (HCLC) (17% protein, 7.6% fat with additional 2% cholesterol and 800 mg/kg choline) for 5 weeks. Weekly weight and blood samples were collected for the measurement of triglyceride and cholesterol between groups. Half of the birds were sacrificed on day 17 and the other half at the end of the study. Liver was weighed and liver samples were snap frozen for the measurement of triglyceride, cholesterol, and free fatty acid between groups. StudentÃ¢±,¬±„¢s t-test was used to analyze the data. Increase in the liver organ index suggested fat accumulation in the liver of HCLC fed chickens. HCLC diets induced hyperlipidemia (high amounts blood lipids) evidenced by enhanced serum triglyceride and serum cholesterol in HCLC fed chickens. Our results indicate fatty liver disease in chickens fed with HCLC

diets mimics human NAFLD. Next steps are to use this chicken model to differentiate the role of fats and fatty acids in the replication enhancement of HEV.

Postdoctoral Level

Javier Campos, Post-doc, Food, Agricultural and Biological Engineering

Air-pinch PWM valve: An alternative to implement variable rate pesticide spray applications
Javier Campos*, Heping Zhu, Hongyoung Jeon, Erdal Ozkan

Electric pulse width modulation (PWM) solenoid valves are commonly used to regulate nozzle flow rates to achieve precision variable-rate spray applications. However, residuals of some pesticide compositions such as wettable powders and adhesive additives can be potentially stuck inside the internal valve chamber, causing malfunctions of the flow modulation. An air-piloted PWM pinch valve was evaluated to modulate flow rates of hollow-cone nozzles. With this valve, spray solutions only passed through a flexible tube to avoid chemicals directly contacting the action components inside the valve chamber. The flow rate modulation was performed by pinching the tube with air-piloted PWM actions so that the internal moving components were isolated from pesticides. Tests were conducted to evaluate the flow rate modulation capability along with droplet size distributions from three disc-core hollow-cone nozzles coupled with the PWM pinch valve and compared with a conventional electric PWM valve. Nozzles were Teejet D2-DC25, D4-DC25, and D5-DC25, operated at 414 and 827 kPa pressures and duty cycles ranging from 10% to 100% with 10% intervals. Flow rates were measured with the instantaneous mass of water discharged for 60 seconds, and the droplet size spectra were determined with a laser particle/droplet imaging analysis system and were classified following the ASABE S-572.3 standard. In general, both air-pinch and electric PWM valves performed similar flow rate modulations and droplet size distributions and classifications for all three nozzles at two pressures. However, at 10% DUC, the air valve was not able to control the nozzle flow rate, and at 90% DUC both PWM valves had the flow rates very close to those at 100% DUC. Droplet size classifications based on the ASABE Standard S-572.3 were generally consistent across DUCs ranging from 20% to 100% for the same nozzle and pressure with the two valves. Thus, the air-pinch PWM valve could be potentially used as an alternative to precisely apply variable-rate pesticides with specific formulations such as wettable powders and sticky agents.

Carla Roman, Post-doc, Food, Agricultural and Biological Engineering

New Sprayer with Eyesight to Reduce Pesticide Use
Carla Romain*, Hongyoung Jeon, Heping Zhu, Javier Campos, Erdal Ozkan

Current sprayers used for applying pesticides on specialty crops waste pesticides because

spraying is done continuously without considering the gaps between trees and tree canopy characteristics such as size and density. As part of the research presented, a sprayer equipped with a stereo vision control system was developed to spray only when there is a target and spray at variable rates depending on canopy volume detected from depth images. The purpose of this study was to evaluate the performance and pesticide reduction of this variable-rate sprayer compared to the performance of a conventional orchard sprayer used by growers currently that sprays at a constant rate regardless of the canopy characteristics and presence of a tree in an apple orchard. Results showed that the variable-rate mode reduced spray by 73% compared to the constant rate. In addition, the proportion of the sprayed liquid recovered on the canopy increased by 25.6% with the variable rate application, increasing the sprayer efficiency. Finally, spray ground losses were reduced by 23.6% because the new sprayer only applied where the canopy was detected. One obstacle to the adoption of variable-rate sprayers has been the high cost associated with converting a conventional sprayer into a variable-rate sprayer. The stereo vision-controlled variable-rate sprayer requires only one-tenth of the investment required by some commercially available variable-rate spraying systems making it a more economically viable option for growers while reducing pollution of the soil and air with pestic

Research Scientist

Nuris Acosta, Staff, Entomology

Evaluation of insecticidal activity of hemp extracts on Myzus persicae (Aphididae: Hemiptera)
Nuris M. Acosta; Erick Martinez; Danna Vera; Karine Bolson; Liva Rakotondraibe; Peter M. Piermarini and Luis A. Canas

Green peach aphid (Myzus persicae) is a polyphagous insect pest that affects multiple crops throughout the world. However, its control has been difficult due to its resistance to many insecticides. The objective of this study was to generate preliminary data on the insecticidal effect of hemp (Cannabis sativa) extracts (leaf and inflorescence) on green peach aphid mortality. Raw extracts of hemp were diluted with acetone and 3-fold concentrations were used (100, 30, 11, 3.6 and 1.2 mg/mL), plus an untreated control (100% acetone). Ten third instar aphid nymphs were placed in a piece of zinnia leaf in a petri dish arena and a 100 nL of treatment solution was applied on each insect using a micro-applicator. Each treatment was repeated four times and aphid mortality was assessed 24h after. Leaf and inflorescence extracts of hemp at various topical concentrations had a toxic impact on green peach aphids, resulting in more than 50% mortality across all treatments. Control values did not surpass 15% mortality. Based on these preliminary results, in the future we will continue with topical evaluations to generate response curves and LC50 values of both leaf and inflorescence hemp extracts. We will also conduct greenhouse evaluation on zinnias plants previously infested with aphids, and non-target effects of hemp extracts on beneficial organisms.

Daiyanera Kelsey, Staff, Entomology

The use of environmental DNA detection to monitor the Spotted Lantern Fly, Lycorma delicatula
Daiyanera Kelsey*, Ashley Leach

Spotted lantern flies Lycorma delicatula (Hemiptera: Fulgoridae), also known as SLF, are an invasive insect from Asia that has become a concern in the United States of America. As of 2020, SLF have made their way to Ohio. As SLF spreads across the USA, monitoring this species is crucial in attempts to control the increasing population. As we monitor the spread of SLF, environmental DNA (eDNA) detection, a technique only recently used in terrestrial settings, can give us an idea of where SLF are spreading and how early we can detect SLF. We hypothesize eDNA can be collected and used as an effective tool in monitoring early populations of SLF. From late May to early November in 2022, we collected eDNA samples from the Cleveland area. To collect eDNA, we used paint rollers that were sprayed with water and were rolled on randomly selected surrounding trees and grape vines. The water was filtered using membrane filters and

later extracted using DNA extraction solutions. The samples were analyzed using real time polymerase chain reaction. Our results showed sites with low, establishing populations were positive with SLF eDNA with expected results for active and nonactive sites. The use of the eDNA detection method was shown to be effective in detecting early populations and demonstrated the collection of eDNA as an efficient method in the detection of SLF. eDNA outperforms visual scouting and eDNA can be used as a tool to monitor at risk areas before SLF is detected.

Ashish Manandhar, Staff, Food, Agricultural and Biological Engineering

Techno-economic analysis of using biomass mulches for winter protection of vineyards in Ohio
Ashish Manandhar*, Imed Dami, Ajay Shah

Establishing a vineyard can be costly, with expenses exceeding $20,000 per acre. Cold temperatures can cause significant damage to grapevine tissue, resulting in a loss of up to 15% of the world's grape crop annually. Current methods for protecting grapevines from winter injury include insulating the base of the vines using soil. Biomass mulches can be used as an alternative to insulate the vines and prevent winter injury. However, biomass needs to be procured and applied using specialized equipment which can add to the vine protection costs. Thus, the objective of this study is to evaluate the use of biomass mulches as an alternative for protecting grapevines from winter injury. The study compared the conventional practice of soil hilling with mulching using different biomass types, including corn stover, wheat straw, and miscanthus. A techno-economic analysis model was developed to evaluate the use of biomass for winter protection of grapevines. The model incorporated different components such as the type of biomass, mulch application frequency and quantity, costs of biomass and equipment, and logistics for soil hilling/takeout and biomass mulch application. The input data was based on field tests performed in commercial and research vineyards in Ohio in 2020 and 2021, and supplemented with grape production guides and literature data. The study estimated the resource requirements such as the amount of biomass mulch, labor time, number of tractor and mulcher units, and fuel requirements for the tractor and mulcher. Further, the total costs of biomass, tractor and mulcher were estimated to determine the total annual cost for vineyard winter protection. The results showed that biomass mulching reduced the time required for winter vine protection by 71-73% compared to soil hilling and resulted in a 19-21% reduction in costs. Additionally, the use of biomass mulches resulted in a significant reduction in weed cover. The study suggests that using locally sourced biomass and optimizing application rates can further reduce costs. The study aimed to provide vineyard managers with an understanding of the potential advantages of using biomass mulches as a means of winter vineyard protection.

Jennifer Schrock, Staff, Animal Sciences, Center of Food Animal Health

Survivability of low pathogenic avian influenza (H5N2) in aqueous composted fertilizer
Authors: Jennifer Schrock*, Raksha Suresh, Olaitan Shekoni, Dina Bugybayeva, Juliette Hanson, Frederick Michel, Renukaradhya Gourapura

Avian influenza has been a growing problem in the United States for decades. Low pathogenic avian influenza has a high morbidity rate causing significant decreases in production and growth. In 2022, high pathogenic H5N1 clade 2.3.4.4 spread into the United States by wild birds. Over 58 million birds were infected or exposed to the H5N1 virus and euthanized.

Poultry manure is a valuable fertilizer, but research is ongoing to find ways to make it more beneficial to crops. Aqueous composting technology takes poultry manure and extracts the nutrients and microbes from the manure. The product is liquid that can be applied to fields or used in hydroponic operations, and the nutrients are more bioavailable to the plant. The by-product of this process is litter solids which still need to be spread on fields.

Many studies have previously shown that proper composting of poultry manure is effective at killing both low and high pathogenic avian influenza. However, no research can be found to date about the aqueous composting processes ability to kill avian influenza.

In this study, poultry litter was inoculated with low pathogenic avian influenza virus (H5N2). Then we processed this poultry litter using aqueous composting, where the water was added to the poultry litter, agitated to make a slurry, adjusted the pH and then heated and mixed for 1 hour. After 1 hour of incubation, we tested the pellet and supernatant for avian influenza virus and centrifuged the supernatant to pellet any virus in the sample. These samples were tested using real time PCR, live virus by infecting eggs, and hemagglutination assay to determine the complete virus degradation.

During the study we found the best way to mimic the industry method of aqueous composting was to heat the flasks containing the slurry in a water bath with shaking. This produced the most consistent temperature during the incubation time. This study optimized the procedure using the low pathogenic avian influenza virus and found the virus could be killed when heated at 55±°C for 1 hour. In future we will perform a similar study for high pathogenic avian influenza virus in our BSL3 facility.