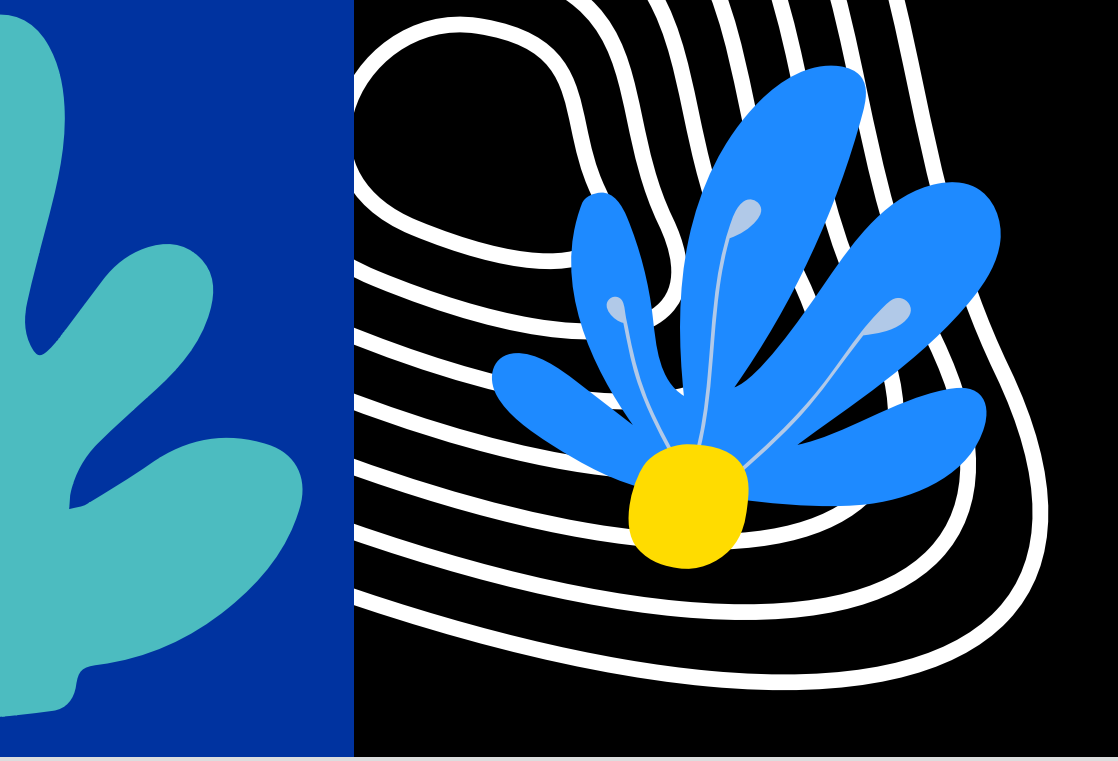

2024

PROFESSOR DONALD L. SPARKS & PROFESSOR BILL WITT GRADUATE STUDENT SYMPOSIUM

INTEGRATED PLANT AND SOIL SCIENCES GRADUATE PROGRAM

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PROFESSOR DONALD SPARKS

Current Position: S. Hallock du Pont Chair of Soil and Environmental Chemistry, Francis Alison Professor, and Chairperson, Department of Plant and Soil Sciences at the University of Delaware

Dr. Sparks researches the environmental soil chemistry of contaminants such as As, Zn and Ni, and nutrients such as S and P. He investigates their binding to soil under varied environmental and biological conditions. He is known for his use of synchrotron-based X-ray spectroscopy to understand the molecular basis of contaminant and nutrient interactions with soil and his emphasis on kinetics. His research helps to predict the leaching of contaminants and nutrients into water supplies and subsequent bioavailability and toxicity to plants, animals, and humans. He is a Fellow of the American Society of Agronomy, the Soil Science Society of America, and the American Association for the Advancement of Science. He has served as President of the Soil Science Society of America and the International Union of Soil Sciences. Prof. Sparks is also Recipient of the 2007 - UK Department of Plant and Soil Sciences Graduate Program Distinguished Alumni Award.

Degrees:

- Ph.D. - Soil Science - Virginia Polytechnic Institute and State University Dissertation: Potassium Adsorption and Desorption Kinetics in a Soil System and Its Relation to Plant Uptake
- M.S. - Soil Science - University of Kentucky Thesis: Physical, Mineralogical, and Chemical Properties, Including Ammonium Distribution, in the Shrouts Soils of Kentucky
- B.S. - Agronomy - University of Kentucky

PROFESSOR EMERITUS BILL WITT

Dr. Bill Witt received his Ph.D. in weed science from North Carolina State University. He was a faculty member in the Department of Plant and Soil Sciences at the University of Kentucky for 38 years, retiring in 2012. During those years, he dedicated much of his time to graduate student advising. He advised 40+ M.S. and Ph.D. graduate students, as well as serving on many other graduate student committees. He received the College's George Mitchell Award for Service to Graduate Education in 2002 and the Outstanding Teaching Award, the Distinguished Achievement Award in Education, and the Distinguished Service Award - Academia from the Weed Science Society of America, the North Central Weed Science Society, and the Southern Weed Science Society, respectively.

PROFESSOR MARK COYNE

Dr. Mark Coyne, Professor of Plant and Soil Sciences, retired in June. Dr. Coyne joined the faculty in 1991 as an assistant professor and became full professor in 2006. After earning his B.S. in Agronomy and International Agriculture from Iowa State University, he headed west to earn his M.S. in Soil and Environmental Science from the University of California, Riverside. Then he went on to earn his Ph.D. from Michigan State University in Crop and Soil Science (Soil Microbiology).

During his 30 year career at UK, Dr. Coyne taught numerous courses, advised undergraduate students, and trained 10 PhD and 13 MS students, while also serving on the committees of another 70(!) graduate students. Dr. Coyne lead the effort to create the Integrated Plant & Soil Science (IPSS) graduate degree program. The creation of this multi-departmental, interdisciplinary degree program took years of effort. Once created, Mark generously served as the Director of Graduate Studies for the program for the following decade. In this position, he shouldered the full weight of all new program administration. He created the necessary new courses, he created programmatic assessments and dealt with programmatic reviews, he taught the required courses, and he oversaw all student inquiries and applications. We estimate that Dr. Coyne helped >500 IPSS graduate students be successful over the course of his career. For these achievements, Dr. Coyne was the 2021 recipient of the College's George E. Mitchell Jr. Award for Outstanding Service to Graduate Students, and in 2020, he received the William B. Sturgill Award from the Grad School for outstanding contributions to graduate education.

ACKNOWLEDGEMENTS

01.

The IPSS program extends its deepest gratitude to Professor Donald L. Sparks, Professor Emeritus Bill Witt, the Department of Plant and Soil Sciences and University of Kentucky Graduate School Block Grant program for providing the funding for this symposium.

02.

We would also like to thank our faculty and postdoctoral judges for their time and consideration, as well as the program committee, which consists of the students of IPS 772-fall 2023 for organizing and moderating the sessions. We acknowledge Professor Mark Coyne for his years of service and dedication to the IPSS program and its students. The program committee has named a platform session in his honor.

03.

Finally, this symposium would not have been possible without the hard work of Zoë Womack and Suzette Walling as well as the entire staff at IPSS for everything they do.

SYMPOSIUM SUMMARY

SESSION I: 9:00-10:30

Kenneth Clayton - 9:00
Ashwini Shivakuma - 9:15
Aleksandar Grujic - 9:30
Paul Cöckson - 9:45
Bridget Bolt - 10:00
William Fleming - 10:15

Judges:
Travis Legleiter
Samuel Revolinski

Moderators:
Rob Nalley
Kiera Searcy
Alexis Gomez

SESSION II: 10:45-12:00

Lucca Madeo Cortarelli - 10:45
Maria Magdalena - 11:00
Rob Nalley - 11:15
Yan Zhou - 11:30
Hayden Love - 11:45

Judges:
Ray Smith
Rebecca McGraili

Moderators:
Jack Eaker
Leticia Pacheco Inoue
Hallie Sandeen

SESSION III: 1:00-2:15

Travis Banet - 1:00
Jack Eaker - 1:15
Vijyesh Sharma - 1:30
Mounica Talasila - 1:45
Alec Besinger - 2:00

Judges:
Erin Haramoto
Mark Coyne

Moderators:
Danielle Doering
Reilly Kaplan-Fardy
Maggie Gillum
Diala Abboud

SESSION IV: 2:30-4:00

Poster Judging
Awards

SCHEDULE

SESSION I

8:30 Coffee & Welcome

9:00 Kenneth Clayton

9:15 Ashwini Shivakumar

9:30 Aleksandar Grujic

9:45 Paul Cöckson

10:00 Bridget Bolt

10:15 William Fleming

Moderators: Rob Nalley, Kiera Searcy, Alexis Gomez
Judges: Travis Legleiter, Samuel Revolinski

SCHEDULE

SESSION II

10:45 Lucca Madeo Cortarelli

11:00 Maria Magdalena

11:15 Rob Nalley

11:30 Yan Zhou

11:45 Hayden Love

Moderators: Jack Eaker, Leticia Pacheco Inoue, Hallie Sandeen

Judges: Ray Smith, Jason Unrine

12:00 - 1:00 LUNCH

SCHEDULE

SESSION III

1:00 Travis Banet

1:15 Jack Eaker

1:30 Vijyesh Sharma

1:45 Mounica Talasila

2:00 Alec Besinger

Moderators: Danielle Doering, Reilly Kaplan-Fardy, Maggie Gillum, Diala Abboud

Judges: Erin Haramoto, Mark Coyne

SCHEDULE

SESSION IV

2:30 Poster Session

4:00 Awards Presentation

POSTER ASSIGNMNENTS

Poster #	Presenter	Judges
1	Alexis Gomez	Phillips & Van Sanford
2	Brian Rinehart	Pearce & Lopes Dos Santos
3	Cora Spohn	Lopes Dos Santos & Shepard
4	Danielle Doering	McCulley & Haramoto
5	Diala Abboud	Revolinski & Gauthier
6	Easton Sarver	Gauthier & Rudolph
7	Eric Luteyn	Brzozowski & Van Sanford
8	Hallie Sandeen	McCulley & McGrail
9	Hanna Lefevers	Gauthier & Jacobsen
10	Isabel Delamater	Pearce & Haramoto
11	Jenni Fridgen	Matocha & Monteiro
12	Joshua James Singleton	Hildebrand & Brzozowski
13	Joyce Robinson	Brzozowski & Phillips
14	Kent Pham	Revolinski & Kawashima

POSTER ASSIGNMNENTS

Poster #	Presenter	Judges
15	Kiera Searcy	Rudolph & McGrail
16	Leticia Pacheco Inoue	Van Sanford & Haramoto
17	Maggie Gillum	McGrail & Revolinski
18	Mustafa Atilla Ilgun	Shepard & Monteiro
19	P. Luize Lessman	Jacobsen & Corbin
20	Reilly Kaplan-Fardy	McCulley & Phillips
21	Sapana Pandey	Rudolph & Corbin
22	Sara Qian	Brzozowski & Lopes Dos Santos
23	Shelby Watkins	Jacobsen & McGrail
24	Stacy Antle	Matocha & Pearce
25	Sumeet Sharma	Matocha & Shepard
26	Upama Dev	Kawashima & Corbin
27	Xia Wu	Hildebrand & Kawashima
28	Yifei Wang	Hildebrand & Monteiro

ORAL PRESENTATIONS: ABSTRACTS

TITLE:

IMPROVING ZOYSIAGRASS ESTABLISHMENT WITH THE USE OF COMMON BERMUDAGRASS AS A NURSE CROP IN THE TRANSITION ZONE

PRESENTER:

KENNETH CLAYTON

ADVISORS:

RAY SMITH

ABSTRACT:

Turfgrass covers an estimated 50 million acres in the United States. Golf Courses cover 2.3 million acres with 60 percent of those acres in maintained turfgrasses. Outranking corn, turfgrass is the largest irrigated crop in the United States. The inputs needed to maintain turfgrass can drastically change depending on the species grown. Zoysiagrass [Z. japonica Steud. x Z. matrella (L.) Merr.]) is a species that has long been recognized as a slow growing, low input turfgrass that shows excellent shade, drought, and cold tolerance. Zoysiagrass also demonstrates a low susceptibility to insect damage, weed encroachment, and disease damage. It is considered an attractive grass for lawns and golf courses and provides a superior playing surface for the sport of golf. While this turfgrass has many wonderful qualities, adoption has been limited for lawns and golf courses due to a slow growth rate which requires two or more years to reach 100% coverage. This research will evaluate the use of common bermudagrass [Cynodon dactylon (L.) Pers.] as a nurse crop for vegetatively propagated zoysiagrass. Seeding the bermudagrass and sprigging the zoysiagrass will provide full coverage of a golf course fairway in the first year of establishment. During the second year Fluazifop with the chemical safener metcamifen will be applied in an attempt to slowly remove the less desirable bermudgrass while allowing the zoysiagrass to fill in the voids. Greenhouse dose response trials will be performed to determine the appropriate rate of herbicides needed before year two of the study. To determine the suitability of this establishment plan species composition will be measured by a point quadrat method and percent green coverage by digital image analysis with Canopeo.

TITLE:
COMPARATIVE ANALYSIS OF RNA-SEQ DATA FOR EARLY SEED DEVELOPMENT

PRESENTER:
ASHWINI SHIVAKUMAR

ADVISORS:
TOMO KAWASHIMA

ABSTRACT:

In Angiosperms, double fertilization leads to the formation of a seed with a diploid embryo and a triploid endosperm. Seed formation is crucial to the life cycle of plants for food security and economic yield. Early seed development is short, vital, and sensitive to environmental changes, and pre-determines the potential final seed size. However, molecular insights into early seed development, especially at the cellular and seed compartment levels (e.g., the embryo and endosperm), remain limited. To address this gap, we leveraged publicly available RNA-seq data for major cereal crops, such as maize and rice, along with dicots, such as soybean and Brassica. Our study focused on unraveling molecular distinctions in early seed development among these major crops and identifying conserved gene players, if any. By examining gene transcript expression through ortholog IDs within the seed compartments, we elucidated the distribution of conserved and crop-specific gene transcripts across the four species. Notably, we highlight a case where endosperm-enriched gene transcripts in soybean exhibit orthologous counterparts distributed across different compartments in the seeds of Brassica, rice, and maize. The exploration of conserved ortholog patterns across crops offers valuable insights into the evolutionary perspectives and functions of various seed compartments during early seed development. Our results provide a comprehensive framework for understanding the molecular intricacies of early seed development among major crops, offering potential avenues for enhancing economic yields in agriculture.

TITLE:

SOIL RESIDUAL HERBICIDES INTERACTION WITH CEREAL RYE COVER CROP PLANTING AND TERMINATION TIMING TO SUPPRESS WEEDS IN SOYBEAN

PRESENTER:

ALEKSANDAR GRUJIC

ADVISORS:

ERIN HARAMOTO

ABSTRACT:

Cereal rye (Secale cereale L.) is considered as a valuable cover crop species preceding summer cash crops. Fall-planted cereal rye complements no-till soybean production system by improving soil structure and health, reducing erosion, decreasing nutrient loss and water runoff. Furthermore, living and terminated cereal rye exhibit significant potential for weed suppression in integrated weed management programs. Upon termination, rolled cereal rye residues serve as a physical barrier creating unfavorable environmental conditions that hinder weed seed germination and seedling emergence. This study's objective is to evaluate (1) the impact of varying levels of residue biomass and (2) interaction with soil residual herbicide on weed suppression in subsequent soybean crop. Two sites were established a month apart to simulate different cereal rye planting dates that could affect its development and biomass production. Additionally, the experiment will include applied soil residual herbicide further investigating its (1) interaction with cover crop residues and (2) effectiveness on weed control in initial stages of soybean development. Prior to termination, cereal rye growth and development will be measured and assessed by biomass and vegetation stage, respectively. Weed density and biomass will be quantified after the cover crop termination, before each post-emergence herbicide application in soybean. The anticipated results will help understand the interaction between delayed cover crop termination and soil residual herbicide, providing potential benefits and efficiency for weed control and herbicide resistance management in no-till soybean crop.

TITLE:
EARLY GROWTH ROOT MORPHOLOGY OF INDUSTRIAL HEMP CULTIVARS

PRESENTER:
PAUL COCKSON

ADVISORS:
BOB PEARCE

ABSTRACT:

Establishment of direct seeded industrial hemp (IH) (Cannabis sativa L.) under field conditions has been challenging with live seed establishment of only 80 – 20%. Early plant growth parameters may be key indicators for stand success and thus, this study sought to identify and describe key early season root morphological parameters within a selected population of IH. Twelve commercially available IH cultivars were selected based on the availability of seed and later grouped based on their phylogeny and morphologic descriptions as either Chinese, Fiber/Feral, and Grain/Dual morphotypes. Seeds were sown in sand substrate and grown for 24 days in a greenhouse. RhizoVision Explorer was utilized to measure 24 root characteristics. Data was analyzed using canonical discriminate analysis and Linear Discriminate Analysis to identify which rooting characteristics were most important in differentiating each aforementioned type. Seven key rooting characteristics were selected in our model to aid in discriminating root morphotypes. After validating our model, a standard MANOVA followed by adjusted ANOVAs and Tukey multiple comparisons found that maximum number of roots, network depth, and rooting volume were not significantly different among the three groups ($\alpha \leqslant 0.007 = 0.05/7$). The other variables were statistically significant with Tukey comparisons suggesting ($\alpha \leqslant 0.007$) Chinese types were different from grain/dual in all cases. Chinese types were also different from fiber/feral on number of root tips. From these data we can start correlating field trial germination and establishment rates with key rooting characteristics to inform breeders and stakeholders.

TITLE:
A MOBILE GENOME EDITING SYSTEM FOR PERENNIAL CROPS: REVOLUTIONIZING GRAPEVINE RESILIENCE

PRESENTER:
BRIDGET BOLT

ADVISORS:
CARLOS RODRIEGUEZ-LOPEZ

ABSTRACT:

It is predicted that 50-81% of the growing acreage for perennial crops such as grapevine will fall out of production due to weather changes in the USA by 2040. This urgently demands the breeding of varieties more resilient to periods of environmental stress. Perennialism imposes protracted and costly breeding programs (25-30 years) due to lengthy evaluation periods in each breeding step. Genome Editing (GE), particularly the use of CRISPR/Cas9 transgenic constructs, has revolutionized our ability to modify the genome in a targeted manner. However, the implementation of GE in grapevine and other perennial crops faces multiple bottlenecks, including In vitro culture induced somaclonal variation; Lack of efficient transformation methods; Need for back-crosses for transgene removal; Industry Reluctance to Genetic Modification. We propose the development of and an efficient GE method for grapevine based on the intrinsic characteristics of dicistronic mRNA:tRNa molecules, which will fulfill the following requirements: 1. Allow genome editing without permanent integration of transgenes to eliminate the need for backcrosses and undesirable genetic alterations, and 2. By-pass the need for in-vitro culture to allow GE of recalcitrant varieties/species, to eliminate somaclonal variation occurrence and avoid the loss of preexisting chimerism. 3. Determine if wine consumers' perception on labeling match their purchasing habits.

TITLE:
DETERMINING SOIL FERTILITY'S ROLE IN THE ALFALFA YIELD PLATEAU

PRESENTER:
WILL FLEMING

ADVISORS:
EDWIN RITCHEY

ABSTRACT:

Alfalfa is a perennial forage legume known as the "Queen of Forages" for its ability to produce high quality hay. In the United States it is commonly produced for feed in the dairy, beef, and equine industries. During the 1950s alfalfa yields grew exponentially nationwide due to technological advances in novel varieties, synthetic fertilizers, and pesticides. However, yields plateaued in the 1980s at approximately 7.5 megagrams per hectare and remain there today for reasons not fully understood. This study is part of a much larger study funded by the USDA-ARS that also includes Oregon and Washington with the overarching objective to determine soil fertility's role in the observed alfalfa yield plateau. In 2022 and 2023, 53 and 61 alfalfa stands were sampled in Kentucky and surrounding states. Soil samples were collected at 10, 15, and 30 cm and analyzed for plant-available macro and micronutrient levels. In addition, the top 15 cm of 30 stems were collected to be analyzed for tissue nutrient content. Preliminary data from 2022 samples revealed that approximately 40% of stands were below the ideal pH range. Soil analysis also indicated that approximately 5% and 35% of samples were low in phosphorus and potassium. However, tissue analysis reported that no stands were low in phosphorus and only 25% were low in potassium. Tissue analysis also reflected that 25%, 15%, and 5% of stands were below sufficiency ranges for magnesium, sulfur, and boron, respectively. In conclusion, soil fertility is likely a contributor but not the sole cause of the observed alfalfa yield plateau.

TITLE:

EXAMINING TOXICITY OF 2D NANOMATERIALS, NANOCOMPOSITE MEMBRANES AND THEIR POTENTIAL FOR REMOVAL OF PER-AND POLYFLUOROALKYL SUBSTANCES.

PRESENTER:

LUCCA MADEO CORTATELLI

ADVISORS:

OLGA TSYUSKO

ABSTRACT:

The aim of this research is to apply toxicity evaluations to govern development of safe nanocomposite membranes for Per- and polyfluoroalkyl substances (PFAS) removal from contaminated water. PFAS are widely used persistent and ubiquitous environmental contaminants of global concern with significant risk to human health. The toxicity evaluations will rely on usage of Caenorhabditis elegans, a nematode, which serves as a powerful toxicity model of various contaminants, including nanomaterials. The objectives include toxicity evaluation of the polymeric membranes when synthesized with two different solvents, commonly used N-methyl-2-pyrrolidone and less toxic gamma-valerolactone), and under different pH. The nematodes will also be used to measure the toxicity of 2D nanomaterials (Phosphorene and Hexagonal Boron Nitride) in free-standing form and after being embedded onto the membranes. The third objective will consist of toxicity analysis of two representative PFAS (PFOA and GenX) with and without free-standing 2D nanomaterials and after filtration of the PFAS-spiked water through the nanocomposite membranes. The specific endpoints utilized will be C. elegans mortality, reproduction, growth, and lipid accumulation. Using RNA-seq we will also examine biological pathways affected by the exposure to the 2D nanomaterials in the presence of PFAS and without PFAS. SEM images, atomic profile scans of the membrane's surface via X-ray photoelectron spectroscopy (XPS) and LC-MS-MS analysis will be used to verify breakdown of PFAS into shorter-chain fluorine compounds. These results have the potential to be utilized in application of Phosphorene and Hexagonal Boron Nitride composite membranes in removal and breakdown of PFAS from water.

TITLE:

ON THE RACE: DEVELOPING TOOLS TO CONTROL CORN EARWORM IN INDUSTRIAL HEMP

PRESENTER:

MARIA MAGDALENA RICCIARDI

ADVISORS:

BOB PEARCE

ABSTRACT:

Corn earworm (Helicoverpa Zea, CEW) is considered a primary insect pest affecting hemp (Cannabis sativa L.) production according to survey information collected during 2021-2023 at University of Kentucky research trials (Fayette and Breathitt Counties). This project aimed to improve the understanding of the CEW infestation cycle in hemp, assess crop damage, and evaluate potential management strategies. In 2023 a field trial was conducted using transplanted plants of a CBG dominant cultivar ("White CBG", Oregon CBD). Nine treatments were arranged in a randomized complete block design with four replications. Treatments included 3 biological insecticides applied weekly or every 15 days, an alternate treatment (weekly alternation between two biological insecticides); a positive control (water-only), and a negative control (conventional insecticide), both every 15 days. Treatment applications started when the CEW population was considered significant (7 larvae/plot, average). Five plants per plot were evaluated for the total number of CEW (weekly), the CEW damage (once, pre-harvest), and the yield (dry flower material, lbs./acre). Initial results indicate no statistical differences in the CEW number or damage between treatments. The yield of the conventional insecticide treatment was significantly higher than the water-only control. Biological insecticide treatments' yields were intermediate and not different from both controls. Additional trials with higher CEW pressures are needed to better assess the potential efficacy of CEW management treatments.

TITLE:

COMPARISON OF WHEAT AND BARLEY TO RYE AS A COVER CROP BEFORE CORN

PRESENTER:

ROB NALLEY

ADVISORS:

CHAD LEE

ABSTRACT:

Winter cereal cover crops have become an essential management practice for sustainable corn production. Rye (Secale cereale L.) is the most popular winter cereal cover crop, but wheat (Triticum aestivum L.) and barley (Hordeum vulgare L.) may provide a comparable value due to their similar fibrous root systems. Winter cereals provide organic matter, scavenge residual nutrients, and protect the soil from erosion. Winter cereals can immobilize nutrients for the corn crop and can reduce corn stands in some situations, reducing corn yield. This study's main objective was to determine if wheat and barley cover crops have fewer corn yield penalties than rye. Three site-years included Lexington, KY, 2022, Lexington 2023, and Glendale, KY, 2023. The study consisted of four cover crop treatments, five nitrogen rates, and two nitrogen timings. The cover crop treatments were 'Somerset' barley, 'Pembroke' wheat, 'Aventino' rye, and a no cover crop control. Five nitrogen rates were 40, 110, 210, 310, and 410 lb N/acre. Liquid UAN (32-0-0) was surface applied at 40 lb N/acre to all plots at planting; the remaining nitrogen was applied at planting or side dress (V3 growth stage) as Urea (46-0-0). Wheat significantly produced the highest biomass in all site-years and was significantly in Lexington 2023. No significant effect of cover crop on corn grain yield in Lexington 2022 or Glendale 2023. No benefit of sidedress nitrogen at the same N rates in any site-year. Sidedress N at 310 lb N/acre yielded significantly higher than 210 lb N/acre applied all at-planting.

TITLE:
POST-TRANSLATIONAL REGULATION OF NICOTINE BIOSYNTHESIS BY MAP KINASE CASCADE

PRESENTER:
YAN ZHOU

ADVISORS:
LING YUAN

ABSTRACT:

Nicotine is an essential specialized metabolite that tobacco produces mainly for resisting biotic stresses. The transcriptional regulation of nicotine biosynthesis has been extensively studied; however, the post-translational regulation mechanisms involved in the pathway remain unclear. The mitogen-activated protein kinase (MAPK) cascades comprise at least 3 kinases, including MAP3K, MAP2K, and MAPK. MAPK cascades are well-known stress-responsive regulators; however, how they are involved in specialized metabolism is poorly understood. Our previous work has demonstrated that the tobacco MAPK, NtMPK4, is a positive regulator of nicotine biosynthesis. However, the upstream MAP3K and MAP2K in the signaling cascade have not been identified. Here, we identified NtMEKK1b and NtMKK2s as the upstream kinases of NtMPK4 in the cascade. Protein-protein interaction assays demonstrated that NtMKK2a and NtMKK2b interact with NtMPK4 and that the NtMEKK1b interacts with NtMKK2a in yeast and plant cells. NtMKK2a phosphorylates NtMPK4 in vivo. Promoter transactivation assays demonstrated that NtMEKK1b and NtMKK2s enhance the activity of a nicotine biosynthesis-related transcription factor, NtERF221. The overexpression of NtMEKK1b or NtMKK2a in tobacco hairy roots increased the expression of nicotine biosynthetic genes and nicotine contents. Knocking down NtMEKK1b in transgenic plants resulted in reduced expression of nicotine biosynthetic genes and nicotine contents. Knocking down NtMKK2s in tobacco hairy roots decreased the nicotine content and pathway gene expression. In summary, our findings indicated that the NtMEKK1b-NtMKK2-NtMPK4 cascade plays a positive role in the post-translational regulation of nicotine biosynthesis. This work helps decipher the post-translational regulatory mechanisms of specialized metabolism in plants.

TITLE:

ASSESSING THE CONTROL OF ITALIAN RYEGRASS (LOLIUM PERENNE SSP. MULTIFLORUMIN) WITH A SEED CONTROL UNIT IN WINTER WHEAT IN KENTUCKY

PRESENTER:

HAYDEN LOVE

ADVISORS:

TRAVIS LEGLEITER

ABSTRACT:

The reliance of herbicides to control Italian ryegrass (Lolium perenne spp. multiflorum) has increased herbicide resistant populations in Kentucky. Harvest weed seed control could be an option for control of Italian ryegrass in winter wheat at harvest. At wheat harvest, ryegrass seed shattered at the head of the combine, within the thresher chaff, and in the grain tank was collected to determine seed distribution. Additionally, chaff samples were caught directly from the straw chopper and seed control unit to determine the effectiveness of the seed control unit and loss of seed in the straw portion of the chaff. In both years there was no difference in ryegrass seed lost at the combine header, within the thresher chaff, and in the grain tank. Although, when combining seed found in the grain tank and chaff, there was a difference in the number of seed entering the combine verses seed shattering at the header. In 2022, there was a reduction in ryegrass seed contained within the thresher chaff when the unit was engaged, but in 2023 there was no difference between unit engagement. When header shatter is considered, there was not a difference in ryegrass seed being contributed to the seed bank in both years. In 2022, there was a reduction in ryegrass seed contained in the composite chaff caught directly from the combine when the unit was engaged. Additionally, there was not a difference of the number of seed that was leaving through the straw chopper or seed control unit.

TITLE:

TOWARD IMPROVED IMAGE-BASED ROOT PHENOTYPING: TEMPORAL AND CROSS-SITE DOMAIN SHIFTS IN CROP ROOT SEGMENTATION MODELS

PRESENTER:

TRAVIS BANET

ADVISORS:

HANNA POFFENBARGER

ABSTRACT:

Deep learning techniques have improved crop root phenotyping platform throughput. Yet, models that are trained on one dataset of root images may not accurately identify roots in another image dataset. Model accuracy could especially decline when the image datasets contain known differences called domain shifts. Our aim was to quantify how model performance is impacted by domain shifts and to evaluate model development strategies to mitigate domain shift related error. We collected maize root images at two growth stages (V7 and R2) in a field experiment and manually annotated images to quantify total root length (TRL) and developed five unique segmentation models and quantified each model's ability to handle a temporal (growth-stage) domain shift. At the V7 growth stage, a growth stage-specific model trained only on those images resulted in the most accurate TRL estimates. At the R2 growth stage, combining images from both growth stages to create a multi-growth stage model led to the most accurate TRL estimates. We also applied two of the field models to maize root images collected in a greenhouse study to measure how the field image-based models could handle a cross-site domain shift. Compared to models that were trained only on images collected in the greenhouse experiment, the field models were less accurate than greenhouse models. Despite highly similar features in images (e.g., crop species, growth stage, soil type), we find that using a model trained on images from one site inflate model error when used to segment images collected in a separate experiment.

TITLE:
SOIL HEALTH AFFECTED BY INCORPORATION OF INDUSTRIAL HEMP INTO KENTUCKY CROPPING SYSTEMS

PRESENTER:
JACK EAKER

ADVISORS:
LUKE MOE & REBECCA MCCULLEY

ABSTRACT:

Intensification of industrial hemp (Cannabis sativa L.) cultivation in Kentucky has grown since the 2018 Farm Bill legalized commercial production. Although many approved producers have begun cultivating the crop, little is known of its effects on yield potential of other KY cash crops and agroecosystem services. Particularly, there is a knowledge gap within the incorporation of both fiber and grain hemp into a generalized conventional Kentucky crop rotation (corn-soybean). Therefore, the objective of this study is to analyze various soil physical, chemical, and biological parameters used in soil health assessments. This study was conducted over three years at the University of Kentucky Spindletop Farm and Kentucky State University Harold R. Benson Research and Demonstration Farm. Soil health indicators were measured prior to planting at both sites and will be compared with measurements taken at year three post-establishment. Soil health indicators were selected from the Cornell Soil Health Lab and Haney Tests, the two currently offered soil health tests available for producers. These selected indicators include: particulate organic matter, soil respiration, aggregate stability, water extractable organic carbon, water extractable organic nitrogen, organic carbon to organic nitrogen ratio, and standard agronomic nutrient availability. The overall hypothesis is that hemp will have positive effects on soil health. Overall, this project evaluates the claim that hemp improves soil health and will improve understanding on the effects of hemp inclusion in the conventional KY rotations.

Keywords: crop rotation, industrial hemp, soil health

TITLE:

F-ACTIN CONTROLS THE TURGOR PRESSURE IN THE COENOCYTIC ENDOSPERM AND IS ASSOCIATED WITH THE FINAL SEED SIZE IN ARABIDOPSIS THALIANA

PRESENTER:

VIJYESH SHARMA

ADVISORS:

TOMO KAWASHIMA

ABSTRACT:

In Arabidopsis thaliana, the early-stage endosperm undergoes unique coenocytic development and rapidly expands, which drives seed growth. This coenocyte or the liquid endosperm generates turgor pressure which is the guiding force for expansion just like other plant cells. However, the question remains, what is the molecular mechanism that regulates turgor pressure inside the coenocytic endosperm. Here, we combine molecular and biophysics studies to answer the question. We show that changing the F-actin dynamics of the coenocytic endosperm can cause differences in growth and development and ultimately affecting the final seed size. The overexpression of the actin gene specifically during coenocytic endosperm development (OX-ACTIN) makes larger seeds, whereas the overexpression of the dominant negative form of the actin gene (DN-ACTIN) makes smaller seeds. We measured seed stiffness of these lines and found differences among the control, OX-ACTIN, and DN-ACTIN lines. Our results indicate that F-actin dynamics in coenocytic endosperm not only help in the nuclear organization in the multinuclear endosperm, but they also regulate the seed stiffness which is linked with the turgor pressure of the endosperm. The relationship between F-actin dynamics and turgor pressure provides us with insights into the unique developmental mechanism of endosperm and new opportunities for increasing seed size which is important for food security.

TITLE:
INCREASING NET RETURNS AND SUSTAINABILITY OF SOYBEAN PRODUCTION IN KENTUCKY

PRESENTER:
MOUNICA TALASILA

ADVISORS:
MONTSE SALMERON

ABSTRACT:

Previous research conducted in Lexington (2017 -2020) revealed that irrigation increased soybean yields by 8-53% depending on the year, relative to rainfed treatments. These results substantiate the idea that there is prevailing yield loss due to water stress in this region. In addition to irrigation, producers are interested to know if advancing planting date can increase their economic returns. Therefore, I utilized a calibrated process-based crop model to: (i) quantify the yield gap due to water stress across regions and soil types in Kentucky, and the associated change in net returns if producers adopt irrigation; (ii) identify optimum planting windows that maximize net returns, and how they interact with irrigation management and cultivar maturity. I hypothesized that planting date and cultivar maturity recommendations that maximize net returns will differ under rainfed and irrigated conditions. Results from 30-yr simulations in Lexington revealed that irrigation increased yield by 24%, and net returns by $279/ac (16.8%) on average, relative to rainfed treatments. The optimum planting window to maximize yield was in April, with relatively wider planting windows depending on the cultivar maturity and under rainfed conditions. Early planting dates and irrigation had a synergistic effect on net returns, and advancing planting from mid-May to mid-April would benefit producers more under irrigation ($215/ac increase) than under rainfed conditions ($162/ac increase). Across the range of management options that maximize net returns, the simulation results reveal an opportunity to increase water use efficiency and soil carbon inputs in soybean production systems.

TITLE:
NITROGEN BEHAVIOR IN A NO-TILLAGE AGRO-ECOSYSTEM LOCATED IN THE INNER-BLUEGRASS

PRESENTER:
ALEC BESINGER

ADVISORS:
CHRIS MATOCHA

ABSTRACT:

Nitrogen (N) is a crucial element, often limiting productivity in ecosystems. This limitation is relieved N fertilizer additions. No-tillage (NT) agroecosystems are prone to lower N availability translating to lower crop yields. The default explanation for lower N availability in NT is microbial immobilization of added N fertilizer. Historically, N availability is often assessed using chemical extractions such as KCl to evaluate levels of inorganic N in the soil. The possibility of this abiotic clay mineral fixation as mechanism in well-drained NT soils has been overlooked. The objectives of this study are to quantify N availability using KCl, NaCl, and water extractions. To tease out the contributions of biotic pathways from abiotic immobilization, the selective inhibitor methionine sulfoximine (MSX) was employed to inhibit glutamine synthetase. Extractable ammonium decreased suggesting that the KCl might be trapping native ammonium. Ammonium removal from solution was rapid under all conditions. In all treatments, ammonium removal was greater in the presence of MSX when compared with control samples. X-ray diffraction analysis of the clay fraction revealed layers of chlorite, vermiculite, mixed-layer vermiculite-illite, illite, kaolinite, and quartz in the 0 kg N/ha treatment. The implications of these results for NT systems will be discussed.

POSTER PRESENTATIONS: ABSTRACTS

TITLE:
BREEDING WINTER OATS (AVENA SATIVA L.) FOR STRESS RESILIENCE AND NUTRITION FOR KENTUCKY

PRESENTER:
ALEXIS GOMEZ

ADVISORS:
LAUREN BRZOZOWSKI

ABSTRACT:
Oats (Avena sativa L.) have been gaining popularity across the United States for their nutritional benefits as both whole grains and in oat products. Oats are rich in fiber, including β-glucans and arabinoxylans, which contributes to the reduction of cardiovascular diseases and other health benefits. Oats are categorized by vernalization requirements as either- spring, winter, or facultative types. Of these, most oats for human consumption are spring oats largely due to their test weights. Nonetheless, winter oats are a sustainable alternative due to enabling a shorter fallow period and suitability to crop rotations in Kentucky. A key question, however, is the degree to which winter oats meet or exceed nutritional density of spring oats, especially after winter (cold) stress. In this study, 455 lines of spring, winter, and facultative oats will be assessed for winter survival and β-glucan and arabinoxylan content. Historical data suggest that environmental conditions modulate the effect of genetic loci and grain composition of oats. This study hypothesizes that a select amount of oat genotypes will have the potential to exhibit resilience to severe frosts without a tradeoff with β-glucan and arabinoxylan levels. Broadly, this study will lead to the development of winter oat varieties that can withstand winter climates in Kentucky as well as to provide optimal nutritional profiles for human consumption.

#1

TITLE:
HIGH ROOT SUBERIN CONTENT INHIBITS TISSUE DECOMPOSITION IN THE SHORT TERM

PRESENTER:
BRIAN RINEHART

ADVISORS:
HANNA POFFENBARGER

ABSTRACT:

In recent frameworks of soil organic matter dynamics, the role of plant litter chemistry remains contentious. In particular, it is uncertain whether stable organic matter is predominantly plant or microbially derived, and to what extent complex biopolymers such as suberin promote the build-up of organic matter. With increasing interest in breeding plant roots for carbon storage it is important to further develop our understanding of the role of tissue composition in organic matter formation and partitioning. To further this aim, we conducted a carbon-13 natural abundance study, incubating the roots of seven plant species with a gradient of suberin content in two contrasting soils for six months to track the movement of root carbon into particulate and mineral-associated organic matter fractions. Soil respiration was measured regularly throughout the incubation, and multiple deconstructive samples were taken over the course of the incubation to measure exoenzyme activity, microbial community composition, and soil carbon fractions. Preliminary results indicate that for both soils, soil respiration and enzyme potential activities decreased with increasing suberin content in the root litters, while other factors such as root C:N or lignin content were poor predictors. Furthermore, microbial communities showed a limited response to high suberin treatments. In addition to quantifying the changes in organic matter fractions, fractions will be analyzed with FTIR spectroscopy to evaluate the chemical changes that occurred during the incubation and relate them back to the litter chemical composition.

#2

TITLE:
NUTRIENT CONTENT IN WETLAND CHRONOSEQUENCE: UPPER MISSISSIPPI EMBAYMENT

PRESENTER:
CORA SPOHN

ADVISORS:
BRAD LEE

ABSTRACT:

The NCRS Wetland Reserve Easements (WRE) of the Agricultural Conservation Easement Program (ACEP) is focused on converting marginal agricultural land to wetlands to preserve and enhance wetland habitat. As these wetlands are converted from row crops to wetland vegetation, the soil phosphorus (P) dynamics are changing. There is a gap in knowledge in how these P dynamics develop over time, especially within the upper Mississippi Embayment. In this study, we will use a chronosequence of former farmlands now protected in the ACEP WRE that have developed into palustrine wetlands in the upper Mississippi Embayment to evaluate the state of P over time and depth. To determine P dynamics in the wetland soil, five nutrient extractions will be performed to determine the soil P concentrations in the nonlabile and labile P pools at three soil depths (0-10, 10-30, and 30-60 cm). These extractions will be performed on a chronosequence of wetlands at three distinct ages (0, 7 and 33 years) thus exemplifying wetland conversion from row crops. The results from this study will demonstrate changing P dynamics from managed fields to natural wetlands. It is hypothesized that the established wetlands will contain the highest amount of labile P near the soil surface and decrease with depth, while the new wetlands will have a more uniform distribution of labile P throughout soil depth. These results have the potential to further the knowledge base of how P dynamics change over time at the ACEP WRE within the upper Mississippi Embayment.

#3

TITLE:
THE INFLUENCE OF WINTER-KILLED AND SPRING-KILLED COVER CROPS ON SOIL PHYSICAL PROPERTIES AND SOIL ORGANIC CARBON

PRESENTER:
DANIELLE DOERING

ADVISORS:
HANNA POFFENBARGER

ABSTRACT:

Cover crops can alter soil water dynamics in cropping systems by transpiring water as they grow and by changing the physical properties that influence water movement into and through soils as cover crops decompose. Both root and shoot inputs may also increase soil organic matter, leading to improvements in water-holding capacity and aggregate stability. Our objective was to determine how changes in soil physical health respond to timing of cover crop killing. We hypothesized that eight years of cover crop use would increase soil unsaturated hydraulic conductivity, water content at both field capacity and saturation, aggregation, and the percentage of large pores and decrease bulk density relative to no cover crop use. Moreover, we hypothesized that improvements in physical properties and soil organic C would be positively related to cover crop root and shoot inputs across varying levels of winter cover. We tested these hypotheses in an eight-year study that included bare fallow, weedy fallow, winter-killed, and spring-killed cover crop treatments in a corn-soybean rotation in Lexington, KY. Preliminary data suggests that spring-killed cover crops have significantly lowered bulk density and increased mean weight diameter of water stable aggregates compared to weedy fallow ($p<0.10$). However, cover crops have not affected field unsaturated hydraulic conductivity or the carbon held within aggregates. With additional data collection, this study will demonstrate how medium-term winter cover management affects soil hydrology through physical soil properties and soil organic matter.

#4

TITLE:
A META-ANALYSIS OF THE USE OF MID-INFRARED SPECTROSCOPY FOR EVALUATING SOIL HEALTH PROPERTIES

PRESENTER:
DIALA ABBOUD

ADVISORS:
CHRIS SHEPARD

ABSTRACT:

With the changing climate and increasing land use globally, our understanding of soil health and conservation is imperative as it impacts ecosystem services, food production, plant and animal productivity, water quality, and more. In recent years, the application of mid-infrared (MIR) and diffuse reflectance infrared Fourier transform spectroscopy (DRIFTS) coupled with statistical modeling analyses, such as partial least square regression (PLSR), random forest (RF), and Cubist and memory-based learner (MBL), has provided quick and cost-effective predictions of soil health parameters. These methods have predicted different soil health properties such as water retention (WT), bulk density (BD), cation exchange capacity (CEC), base saturation (BS), electrical conductivity (EC), and total nitrogen, with varying degrees of success. Through the use of meta-analysis, comparison of the different statistical models will provide insight on how poorly or how well different soil health properties are modeled and predicted. Additionally, we can determine where data is lacking and how much data is sufficient to make informed predictions.

#5

TITLE:
EFFECT OF DOMESTICATION ON THE BRASSICA OLERACEA HOST MICROBIOME COMPOSITION

PRESENTER:
EASTON SARVER

ADVISORS:
KENDALL CORBIN & KRISTA JACOBSEN

ABSTRACT:
The domestication of Brassica oleracea has led to significant morphological diversity in edible organs, making it a globally significant horticultural crop. In addition to changes in edibility, plant microbe relationships also shifted during the process of domestication. While it is well-documented that domestication has altered plant-pathogen interactions, more recent research has also shed light on the beneficial microbial interactions but has presented a knowledge gap for how domestication has affected the beneficial microbial communities in edible tissues of B. oleracea. This study investigates the effects of domestication on B. oleracea's microbiome, comparing domesticated varieties to its closest wild relative, B. cretica, through a comprehensive analysis of rhizosphere and phyllosphere microbial communities. Through sequencing, our pilot study explores microbial diversity at key growth stages, revealing potential reductions in host-associated diversity, altered ecological functions, and stage-dependent shifts in microbial composition. Notably, our research anticipates unique microbial patterns within the edible portions, shedding light on domestication's influence on human-consumed plant components. These findings hold significant implications for understanding the complex interplay between domestication and plant-microbe interactions. By uncovering the nuances of domestication's impact, this study contributes vital insights into preserving plant diversity and ensuring sustainable agricultural practices in the face of evolving global demands.

#6

TITLE:
EVALUATING THE GROWTH AND PERFORMANCE OF NEWLY DEVELOPED TEXAS BLUEGRASS X KENTUCKY BLUEGRASS INTERSPECIFIC HYBRIDS

PRESENTER:
ERIC LUTEYN

ADVISORS:
TIM PHILLIPS

ABSTRACT:
Kentucky bluegrass (Poa pratensis L.) is a high-quality cool season forage grass commonly found in Kentucky pastures. This species has the capacity to tolerate close and frequent grazing but often becomes brown and dormant during the hot and dry summer months. Texas bluegrass (Poa arachnifera Torr.) has shown to be a heat and drought tolerant species that provides useful forage for grazing animals in the southern plains. Developing interspecific hybrids of P. arachnifera × P. pratensis could produce a new source of Poa germplasm with a wide variety of traits from both species. The goals of this research are to develop new interspecific hybrid bluegrass, use flow cytometry to aid in the identification and characterization of the hybrid progeny, and to evaluate the growth and performance of these hybrids in a multi-year field study. If successful, these new bluegrass hybrids could be used to improve pastures and provide a highly palatable, persistent, and drought tolerant forage that maintains production throughout the hot and dry months.

#7

TITLE:
PERENNIAL GROUNDCOVER: EVALUATING POACEAE SPECIES' ESTABLISHMENT AND WEED SUPPRESSION POTENTIAL

PRESENTER:
HALLIE SANDEEN

ADVISORS:
ERIN HARAMOTO

ABSTRACT:
Perennial groundcover (PGC) can provide ecosystem services in regions with intensive annual crop production. In this system, a perennial groundcover is drilled, and the rows are stripped-tilled and suppressed prior to corn (Zea mays L.) planting. As PGC systems are in the preliminary stages of development, the most functional Poaceae species, when grown in continuous corn rotation, remains unclear. We are evaluating Poaceae species as a potential candidate for this system: tall fescue (Festuca arundinacea), Kentucky bluegrass (Poa pratensis), and perennial ryegrass (Lolium perenne). These species were selected based on their contradistinctive characteristics, such as the amount of biomass produced, varying shades of green, establishment, and response to herbicide treatments. Comparison of the species will be based on weed suppression, establishment, and ability to be suppressed prior to corn emergence, which will be evaluated visually and through imagery. The main plot treatments will be organized in a randomized, split-plot design. The split-plot design will include a herbicide treatment and control to determine perennial groundcover growth potential with and without suppression and weed competition. Evaluations of the selected Poaceae species will help progress the goal of developing a functional and operable PGC system. Integrating PGC systems into intensive cropping systems is a potential sustainable solution for improving soil structure and biodiversity, promoting long-term food security for future generations.

#8

TITLE:
INVESTIGATING THE ROLE OF "DIET" ON THE GUT MICROBIOME OF FALL ARMYWORMS (SPODOPTERA FRUGIPERDA)

PRESENTER:
HANNA LEFEVERS

ADVISORS:
KENDALL CORBIN

ABSTRACT:
It is well known that differing food sources and diets will alter the gut microbiome for any organism. However, there is little research behind what specific factors of different foods are responsible for the alteration of the gut microbiome: for example, the microbes on the surface of foods, exRNAs excreted from foods, a combination of both, etc. We will be conducting an experiment using Fall Armyworms (FAW) as a model organism to see what factor of food is responsible for the alteration of the gut microbiome. We hypothesize that microbes found on the leaf surface of corn is responsible for altering the gut microbiome. Another goal of this research is to create a mock microbe community of the FAW gut. This way, the FAW gut microbiome can be tested in months with cold temperatures. The findings from this project would be insightful for furthering the understanding of the FAW gut microbiome and ultimately advance the knowledge behind successful insecticides. Upon future work, researchers could create insecticides that target the factor identified in the study to help reduce crop damage from FAW.

#9

TITLE:
THE IMPACT OF CLAY MINEROLOGY ON NITROGEN FIXATION IN SOILS ACROSS A CLIMATE GRADIENT

PRESENTER:
ISABEL DELAMATER

ADVISORS:
CHRIS MATOCHA

ABSTRACT:

Nitrogen fixation affects the efficacy of fertilizer applications. Both microbial and clay mineralogical fixation may play important roles in this interaction. Previous research has focused on the importance of biological components in nitrogen fixation. However, more research is beginning to show the importance of abiotic factors, like clay minerals, on nitrogen fixation in soils. Despite recent progress in clay mineralogical research, any attempt at quantifying abiotic factors has been contradictory. This study examines the difference in soil nitrogen fixation with and without microbial interference. Baseline fixation data are taken for each of the soil sites then methionine sulfoximine (MSX) is used as a microbial blocker. MSX was chosen as it will not damage the integrity of the clay minerals. This research is performed on soils with a range of clay minerals including vermiculite, montmorillonite, and kaolinite. The soils also represent a climate gradient. Results from this study can be used to ensure fertilizer applications are providing enough nitrogen for plants while limiting off-target movement of nitrogen. This maximizes yield while minimizing the negative impact on both the environment and human health.

#10

TITLE:
DISCRIMINATING VARIABLE RESPONSE TO APPLIED PHOSPHORUS IN CORN FOR IMPROVED PRECISION PHOSPHORUS MANAGEMENT

PRESENTER:
JENNI FRIDGEN

ADVISORS:
EDWIN RITCHEY

ABSTRACT:
Historically, soil scientists did not develop soil test-based fertilizer recommendations to support precision phosphorus (P) applications. Improved understanding of spatial variability in crop responses to applied P would likely improve environmental, economic, and production outcomes associated with P fertilizer management. This research was conducted at two sites in Kentucky from 2016 to 2021 to evaluate the performance of corn to applied P fertilizer in low soil test P levels at a high spatial resolution. Results showed that on average, soil test P accurately predicted maize yield response at the field level but failed at the plot scale (1/100th ha), with yield increasing in only 41% of plots. These initial results demonstrate, on average current P recommendations are accurate but not precise. This suggests that precise predictions of crop fertilizer P response might require other explanatory factors, such as additional chemical, physical (soil texture, ECa, penetrometer resistance), and landscape (elevation, slope, TWI) properties to support precision P management. Three methods (partial-least squares-discriminant analysis (PLS-DA), principal component analysis (PCA), and random forest(RF)) were investigated to identify important explanatory factors to help better explain spatially variable yield response to applied P. We hypothesize that integrating soil P with soil chemical, physical and landscape properties can improve yield response predictions of applied P fertilizer.

#11

TITLE:
THE FUNCTIONAL ROLE OF MED25 IN THE MIA BIOSYNTHESIS PATHWAY IN CATHARANTHUS ROSEUS

PRESENTER:
JOSHUA JAMES SINGLETON

ADVISORS:
LING YUAN

ABSTRACT:

A widely known treatment for leukemia, chemotherapy, utilizes two compounds vinblastine and vincristine. Vinblastine and vincristine are specialized metabolites synthesized for defense via the Monoterpene Indole Alkaloid (MIA) biosynthesis pathway in the subtropical plant Catharanthus roseus, more commonly known as Madagascar Periwinkle. There are two problems, these compounds are produced in low yield and due to structural complexity of these compounds prevents manufacturing as a viable option. What researchers have found was that the pathway is a complex network of enzymatic genes and transcription factors forming a regulation network of feedback loops controlling production. Mediators serve as a bridge between TFs and Pol II to activate transcription on promoters of target genes. One such mediator is MED25, which is involved in JA-signaling. The MIA biosynthesis pathway that produces vincristine and vinblastine, is induced via the JA-signaling pathway. Therefore, due to sequence and domain structure similarity we hypothesize that MED25 serves a functional role in a novel biosynthesis pathway exclusive to Catharanthus roseus. Through our experimental approach we were able to demonstrate protein-protein interactions between MED25 and key MIA pathway genes using Yeast-Two Hybrid. We found that when we overexpressed or repressed MED25 in hairy roots, dynamic variations in expression of key MIA pathway genes occurred, and that when MED25 is repressed the plant becomes desensitized to MeJA. Identifying a novel function of MED25 in the MIA biosynthesis pathway will help fill in informational gaps, leading us closer to improving the production efficiency of these vital chemotherapants.

#12

TITLE:
EFFECTS OF FHB RESISTANCE GENES ON FLAVOR AND YIELD IN SOFT RED WINTER WHEAT

PRESENTER:
JOYCE ROBINSON

ADVISORS:
DAVID VAN SANFORD

ABSTRACT:

Fusarium Head Blight (FHB) is an economically devastating disease of wheat (Triticum aestivum L.) causing low yields and poor quality. The causal agent, Fusarium graminearum, thrives in Kentucky's climate and disrupts the grain filling phase resulting in bleached spikes and shriveled seeds. Deoxynivalenol, produced by the fungal pathogen, is a harmful mycotoxin that threatens food and feed safety. FHB resistant varieties and timely fungicide applications is the optimum strategy for management of this disease. However, there has been little research focusing on the impact that FHB resistance genes may have on wheat yield, flavor, and baking quality. The objective of this study is to evaluate the impacts of different combinations of resistance genes on yield and flavor. Knowing these impacts will better focus breeding efforts on ways to achieve the highest FHB resistance and minimize negative effects on important agronomic and end-use characteristics of wheat. Two populations were created from three-way crosses between parents with multiple FHB resistance genes and desirable characteristics (strong gluten, high yield, etc.). From each of these two populations, 150 F2:3 lines were derived and are being evaluated for presence of FHB resistance genes. Yield data has been acquired and quality analysis is ongoing. Determining the resistance genes present in each line and obtaining yield and quality data from the lines will provide a correlation between specific resistance genes (or combinations of resistance genes) and the impact they have on yield and quality. The lines were genotyped with genome wide markers which will facilitate genomic predictions.

#13

TITLE:
METAGENOMIC ANALYSIS OF RETTING HEMP MICROBIAL COMMUNITIES THROUGHOUT THE RETTING PROCESS

PRESENTER:
KENT PHAM

ADVISORS:
LUKE MOE

ABSTRACT:

Hemp grown for fiber contains two main types of fibers, the long bast fibers found on the outside of the stem and the shorter, woody core hurd fibers. The more economically valuable bast fibers are bound to the hurd fibers by a network of sugars like pectin and hemicellulose. These fibers can be separated from one another through a microbially mediated degradation of the sugar network in a process called retting. In this study, we sampled hemp throughout the retting process to track how the microbial community composition and the functional gene profile changed at each time point. We predicted that as the hemp stalks retted, the abundance of genes associated with carbohydrate degradation would increase. Fiber hemp was field-retted and sampled weekly for 7 weeks, with 0 weeks being unretted (T0) 4 weeks being fully-retted (T4) and 7 weeks being over-retted (T7). At each time point, stalks were collected, and the microbial communities extracted for metagenome DNA sequencing. DNA sequencing data was assembled with Megahit 1.2.9 and annotated using the PFams enzyme database through the online tool IMG/MER's pipeline. After assembly, each time point returned between 300,000 and 1.2 million gene counts with a 60% annotation rate. GC% content increased from 50% (T0) to 60%(T4). Fungal reads increased throughout the retting process from 0.5% (T0), to 1.6% (T4), to 2.3% (T7). Gene annotations returned hits for enzymes linked to carbohydrate degradation like pectate lyase, pectinesterase, arabinofuranosidase, and galactosidase.

#14

TITLE:

WEED MANAGEMENT STRATEGIES FOR ESTABLISHING KENTUCKY BLUEGRASS (POA PRATENSIS) AS A PERENNIAL COVER CROP

PRESENTER:

KIERA SEARCY

ADVISORS:

ERIN HARAMOTO

ABSTRACT:

Perennial cover cropping systems have sparked interest because of limited maintenance requirements, lower establishment cost compared to annual cover cropping systems, and the potential to counteract some of the environmental effects of crop production systems. Implementing this system can limit soil erosion, increase nutrient availability, maintain soil moisture, and contribute to managing herbicide resistant weeds. There is limited knowledge about herbicides that are compatible with Kentucky bluegrass and how it functions as a perennial cover crop. Establishing slow-growing Kentucky bluegrass as a perennial cover crop can be challenging due to weed competition. To prevent this, we are employing various weed management strategies. Our goal is to determine timing and treatments to allow the cover crop to establish with minimal weed competition. To address this, we are testing four pre-emergent soil residual herbicides (pendimethalin, clopyralid, mesotrione, and s-metolachlor) and a post-emergent herbicide (dicamba). By investigating the establishment of Kentucky bluegrass as a perennial cover crop, we are seeing to increase the reliability of the system with low maintenance requirements.

#15

TITLE:

WHEAT RESPONSE TO FOLIAR AND SOIL NITROGEN FERTILIZATION WITH AND WITHOUT THE USE OF ZINC HYDROXYAPATITE NANOCARRIERS

PRESENTER:

LETICIA PACHECO INOUE

ADVISORS:

HANNA POFFENBARGER

ABSTRACT:

It is known that N fertilization can have adverse impacts on the environment. Crops typically utilize only around 40-60% of the applied N fertilizer, and residual N can be lost, contributing to eutrophication, climate change, and others. Foliar urea application may reduce N losses from the soil as compared to soil application but can have phytotoxic effects. Nanoparticle carriers are envisioned as a controlled release of N, which may increase N use efficiency and reduce damage to leaves. Our objectives were to determine how foliar application affects the optimum N rate as compared to soil application and assess wheat yield and N uptake following urea applied with and without a zinc hydroxyapatite (ZnHAP) nanocarriers. We conducted a greenhouse study that included 25 treatments – five N rates at five proportions of foliar to soil delivery, with four replicates per treatment. Also, we conducted a second greenhouse study consisting of three N rates that were applied to the soil or foliage with the different forms (urea or ZnHAP-urea) with three replicates per treatment. Controls consisting of ZnHAP without urea were included. As our results, on average the optimum N rates were 700 to 800 mg N pot-1, with no effect of foliar proportion on wheat response to N, even though there was a significant difference between the areas burned due to N toxicity. For the second study, preliminary plant evaluations from the second study showed better responses to ZnHAP-urea compared with urea, but no difference between foliar and soil application.

#16

TITLE:
THE EFFECT OF FUSARIUM HEAD BLIGHT RESISTANCE ON AGRONOMIC AND POST-HARVEST QUALITIES OF WINTER WHEAT

PRESENTER:
MAGGIE GILLUM

ADVISORS:
DAVE VAN SANFORD & LAUREN BRZOZOWSKI

ABSTRACT:
Wheat (Triticum aestivum L.) is one of the three most important crops produced worldwide and accounts for 50 percent of the world's diet. In Kentucky, soft red winter wheat (SRWW) is an important part of the grain crops rotation. Wheat crops are devastated annually by fungal diseases, with a major one being Fusarium head blight (FHB). Caused by Fusarium graminearum, FHB affects wheat, barley, oats, and other cereal grains. Breeding efforts for FHB resistance have resulted in the identification of multiple FHB resistance quantitative trait loci (QTL). While individual QTL have been studied, the effect of multiple pyramided QTL is unknown. The goal of this research is to identify any linkage drag associated with multiple combinations of pyramided FHB resistance QTL and post-harvest quality of soft red winter wheat (SRWW). In this study, 120 F2:3 lines of SRWW were planted in an augmented design with replicated parental lines. Each line has a different variation of FHB resistance QTLs. Post-harvest grain quality of these lines will be assessed by measuring grain protein, sedimentation volume, and standard milling and baking quality assays. This research will provide valuable information for breeding decisions regarding disease resistance and maintaining grain quality. A better understanding of FHB resistance in wheat will further development of resistant cultivars while maintaining high quality grain.

#17

TITLE:
ASSESSING PRECISION FARMING FOR CROP PRODUCTION IN A SOIL CATENA USING RZWQM2

PRESENTER:
MUSTAFA ATILLA ILGUN

ADVISORS:
OLE WENDROTH

ABSTRACT:

Mustafa Atilla Ilgun, Liwang Ma, Montse Salmeron Cortasa, Hanna Poffenbarger, R.J. Walton, F. Sheikhi Shehrivar, Ole Wendroth

Agro-Ecosystem Models allow describing soil water, nutrient and crop growth dynamics and elucidate their relationship to weather, and nutrient and water management in farmlands. The Root Zone Water Quality model (RZWQM2) has been used extensively for farm management strategies. Rolling croplands imply a challenge for in-situ management of nitrogen and irrigation due to soil spatial variability and landscape topography and their impact on wetness index, erosion, and surface relief. An on-farm study was conducted with maize grown in a farmer's field in Princeton, Kentucky in 2022. Different rates of nitrogen and irrigation were applied along the soil catena. Topographic Wetness Index (TWI), Sediment Transport Index (STI) and Curvature were calculated based on a Digital Elevation Model (DEM). The RZWQM2 was used to assess its sensitivity for capturing the soil and landscape variability for precision farming in this soil catena. The spatial variability of soil texture and landscape topography revealed a stronger correlation with corn yield than nitrogen and irrigation management. The RZWQM2 showed high sensitivity to landscape and management variability and therefore implies a high potential for precision agriculture.

#18

TITLE:
SOIL SOLARIZATION FOR SUSTAINABLE MANAGEMENT OF PESTS, PATHOGENS, AND WEEDS IN SOUTHEASTERN HIGH TUNNELS

PRESENTER:
P. LUIZE LESSMAN

ADVISORS:
RACHEL RUDOLPH

ABSTRACT:
Kentucky and Tennessee combined have more than 2,000 high tunnels (HTs) which are primarily used by small-scale specialty crop growers. Growers have been using HTs to improve production by extending the growing season and protecting crops from harsh weather. Soilborne diseases, arthropod pests, and weeds can build up over time in HTs, causing damage to crops and decreasing yield and quality. Soil solarization is a technique that heats moist soil to high temperatures by trapping solar radiation under transparent plastic sheets. This method has been shown to help manage soilborne pathogens and weeds in previous work, but has had mixed results with management of arthropod pests and improvement of crop yield and quality. Our soil solarization study will be conducted in HTs in Kentucky and Tennessee over two years to evaluate the effects on soilborne fungal and oomycete pathogens, various weed species, arthropod pests, and lettuce yield and quality. We will implement soil solarization and a nonsolarized control in April, July, and September in open and closed HTs for 2- and 4-week durations. Soil temperature data will be collected at 5, 10, and 15 cm depths. We hypothesize that the soil will reach higher temperatures in July and at shallow depths. We expect a decrease in soilborne pathogen viability and weed and arthropod pest populations. Consequently, the lettuce grown following soil solarization will have higher yield compared to that grown in control plots.

#19

TITLE:
EVALUATING PASTURE IMPROVEMENTS ON HORSE FARMS IN KENTUCKY

PRESENTER:
REILLY KAPLAN-FARDY

ADVISORS:
RAY SMITH

ABSTRACT:

Pasture management is a vital part of proper livestock husbandry and forage is the most cost-effective food source for most livestock. To maintain healthy pastures, proper management practices need to be followed. Improvements like installing fencing for rotational grazing can be made to pastures to increase forage productivity and overall pasture health. The objective of this study was to monitor and compare one improved pasture on each of six Kentucky horse farms with a paired pasture where no improvements were made. The improved and unimproved pastures on each farm were monitored and evaluated for four years. Pasture health was measured based on botanical composition, a modified version of the NRCS pasture health scorecard, and productivity as measured with a rising plate meter. The results of this study showed that there was an increase in desirable grasses in the improved pastures and the percent of desirable grasses was significantly higher in the improved pastures compared to the unimproved pastures. The percent of warm season annual weedy grasses was significantly lower in the improved compared to the unimproved pastures. In conclusion, making improvements to pastures increases the amount of desirables forages which increases overall productivity and pasture health. Utilizing healthy, productive pastures allows livestock to meet their dietary needs almost completely from fresh forage forages and reduces the requirements for stored feed.

#20

TITLE:

THE EFFECTS OF POTASSIUM FERTILIZATION REGIMES ON FRUIT RIPENING QUALITY IN HIGH TUNNEL TOMATO PRODUCTION SYSTEMS

PRESENTER:

SAPANA PANDEY

ADVISORS:

KRISTA JACOBSEN

ABSTRACT:

A two-year field experiment was conducted at the University of Kentucky Horticulture Research Farm in Lexington, KY from 2022 to 2023 to investigate the effects of potassium (K) fertilization rates and the effects on tomato yield and ripening disorders in determinate and indeterminate tomato varieties (BHN-589 and Big Beef, respectively). The experiments were conducted within high tunnels (HTs) in the UK Organic Farming Unit, using a randomized complete block design each year with four replicate blocks located within one HT. The main plots within each block were assigned to K fertilization rates, based on existing Kentucky's commercial tomato fertilizer recommendations, and additional treatments informed by relatively high K rate recommendations from previous research in leading-edge HT production regions in the US (e.g. Northeast and New England). Tomato cultivars were assigned to subplots within each K treatment plot. In the first year, K rates representing the current commercial recommendation (0 kg/ha) and sequentially greater rates (68, 136, and 204 kg/ha) were applied. In the second year, K rates were increased based on lack of fruit quality response and were 0, 136, 204, and 408 kg/ha. Leaf tissue nutrients, tomato yield, tomato grade, and soil data were collected throughout each growing season. Soil analyses indicated a significant K fertilizer treatment effect on soil available K content, with the greatest soil K levels associated with the greatest K fertilizer rate treatment for that year (204 kg/ha) as compared to the control. However, marketable yield and fruit count were not affected by K fertilizer treatments or tomato variety, although unmarketable yield and fruit count were greater in the indeterminate (Big Beef) variety. To date, we conclude that standard commercial tomato fertilizer recommendations are insufficient for reducing fruit ripening disorders. However, high K fertilizer rates alone may not be sufficient to reduce the risk of ripening disorders, and further research is warranted.

#21

TITLE:

COMPARISON OF ROOT AND FOLIAR SILICON APPLICATION ON GROWTH AND SILICONACCUMULATION TALL FESCUE (FESTUCA ARUNDINACEA)

PRESENTER:

SARA QIAN

ADVISORS:

JASON UNRINE

ABSTRACT:

Silicon (Si), although not essential, is an important micronutrient for someplants, particularly grasses. Since the early 1990 s , Si has been applied as a foliarspray to promote growth and reduce biotic and abiotic stresses in turfgrass .However, there are few studies that compare the root and foliar Si application in turfgrasses . In this study, we assessed the different application methods on growth , SPAD value , and Si accumulation of tall fescue (Festuca arundinacea).Plants were grown in potting soil in which two Si concentrations (0, 7 mM Si)were supplied through root or foliar application as Na SiO . The treatmentswere soil control (SC), soil + 7mM Si (SS), foliar control (FC) and foliar + 7mM Si(FS). After five Si applications, we analyzed tissue for silicon content usinginductively-coupled plasma optical emission spectrometry. The Si concentrationof the above- or under- ground tissue was affected by application method . Inshoots, both Si treatments resulted in significantly higher Si concentrationcompared to the controls. However, Si treated plants tended to have lower rootSi concentration compared to the controls. We also analyzed the silica bod yareal coverage in ashed leaf tissue using epifluorescence microscopy. Plantswith foliar Si spray (FS) had the most silica body area but only significantlyhigher than the soil control treatment (SC). SPAD value showed no differencesacross treatments. These findings clearly indicate that supplying dissolved Siincreases shoot Si concentration but decreases root Si concentration. Ourresults also showed that foliar app lication of Si to tall fescue increases silicabodies in leaf tissues. The findings indicate that applying Si (root and foliar) increase aboveground Si concentration s at 7mM Si.

#22

TITLE:
AN EVALUATION OF SUMMER COVER CROPS FOR AGROECOSYSTEM SERVICES IN SMALL GRAIN SYSTEMS

PRESENTER:
SHELBY WATKINS

ADVISORS:
HANNA POFFENBARGER & DAVE VAN SANFORD

ABSTRACT:

Cover cropping has been gaining popularity in recent years, specifically for its ability to improve soil properties and suppress weeds. However, cover crop species differ in the agroecosystem services that they provide. Our objective was to evaluate a variety of summer cover crop treatments and their ability to provide soil physical protection, increased yield and quality of subsequent small grains, nitrogen input reduction, and weed suppression. Six summer cover treatments were evaluated for these services in summer 2022 between wheat and barley crops on a silt loam soil in Loretto, Kentucky. The treatments included four cover crops (forage soybean (Glycine max), daikon radish (Raphanus sativus var. Longipinnatus), pearl millet (Pennisetum glaucum), and a mixture of forage soybean, daikon radish, and pearl millet) and two controls (weedy fallow and cash crop soybean (Glycine max)). Ground cover was measured in August 2022 while cover crop and weed aboveground biomass were collected just before termination in September. Pearl millet provided the greatest ground cover, aboveground biomass production, and weed suppression, with the Mix following directly behind. The Cash Soybean treatment provided the greatest soil inorganic N, while the Pearl Millet provided the lowest, and these differences in soil inorganic N supply corresponded with differences in small grain yield. Grain near-infrared spectroscopy results will be presented. Our results suggest that pearl millet is a highly productive summer cover crop in Kentucky that is effective at soil protection and weed suppression but may have detrimental effects on small grain yields after short-term adoption.

#23

TITLE:
NITROGEN DYNAMICS IN A CONTINUOUS CORN ROTATION UTILIZING POULTRY LITTER

PRESENTER:
STACY ANTLE

ADVISORS:
EDWIN RITCHEY

ABSTRACT:
Current mineralized nitrogen (N) estimates range from 30 to 70% when utilizing poultry litter (PL) as a N source for corn. These estimates vary depending on factors such as, environmental conditions, application timing, application rate, and soil N content. Providing a better understanding of how each factor influences PL-N mineralization, allows producers to more accurately determine the amount of total N needed for a growing season. Assuming 100% available N from PL, a nitrogen mass balance (NMB) is calculated to determine the assumption mineralization rate and quantify the different pathway losses. A three-year randomized split-plot block field study in Bowling Green, Kentucky is investigating N fate from no-till and tilled soils in a continuous corn rotation. Factors include N volatilization, greenhouse gas emissions, plant uptake, soil leaching, and residual soil N. Understanding nitrogen pathway loss factors can improve methods of estimating N rates needed for South Central Kentucky and may improve best management practices for a more cost-effective utilization of PL in a continuous corn rotation.

#24

TITLE:

ANALYZING CROP YIELD SIMULATION AND PARAMETER SENSITIVITY ANALYSIS USING SWAT MODEL IN WESTERN KENTUCKY

PRESENTER:

SUMEET SHARMA

ADVISORS:

OLE WENDROTH

ABSTRACT:

The expansive agricultural landscapes of Kentucky exhibit notable spatial variations in soil properties, posing challenges to effective land management. While numerical simulations of crop growth and soil dynamics enable site-specific predictions, inadequacies in capturing lateral flow processes hinder accurate representations in field experiments and computer simulations. Consequently, this study addresses the need for a multidimensional simulation tool to discern vital parameters essential for comprehensive modeling of above- and belowground processes, thereby predicting crop production and environmental consequences of varied management practices. Employing the Soil and Water Assessment Tool (SWAT) in Princeton, KY, this research delves into assessing parameter sensitivity for yield simulation across Kentucky's diverse terrain. Utilizing SWAT and SWAT-CUP (Soil and Water Assessment Tool Calibration and Uncertainty Procedures), the study integrates SUFI-2 (Sequential Uncertainty Fitting - 2 algorithm), a methodology focused on hydrological modeling, calibration, and uncertainty analysis. SUFI-2 facilitates refining model calibration and assessing uncertainties by exploring numerous parameter combinations, aiming to identify crucial parameters influencing crop productivity. Kentucky's heterogeneous topography significantly impacts hydrological processes, influencing agricultural systems. By focusing on critical parameters shaping crop yield and leveraging SWAT's skills in evaluating hydrological dynamics, this study emphasizes the integration of SWAT-CUP to enhance calibration accuracy, specifically addressing slope-related factors and diverse drainage components—surface flow, lateral flow, and subsurface flow. The research strategically evaluates parameter sensitivities, particularly concerning slope and drainage, uncovering fundamental variables governing crop productivity. Additionally, experimental observations collected during the growing season serve as invaluable inputs, augmenting model precision and facilitating comprehensive scenario-based assessments. By coupling the SWAT and SWAT-CUP, this study establishes an efficient framework for hydrological modeling, empowering informed decision-making to enhance crop productivity in Kentucky's diverse agricultural landscape and spatial variations in soil properties. Through a precise exploration of parameter sensitivities and experimental observations, this research explores how to optimize modeling accuracy, and facilitate sustainable agricultural water and other resources' management.

#25

TITLE:
LOCALIZATION AND TRANSMISSION OF SEED ENDOPHYTIC BACTERIA.

PRESENTER:
UPAMA DEV

ADVISORS:
LUKE MOE

ABSTRACT:

Seed endophytic bacteria can transmit vertically to the next generation, reflecting a potential beneficial role from germination through survival to crop production. Despite potential plant growth and promotion properties, there is little known about the selection and localization of seed endophytes or their impact on plant germination. We aim to isolate and characterize seed endophytic bacteria from maize. Endophytic seed bacteria are present in all parts of the seed and all stages of the plant life cycle, and to explore the specificity of bacterial transmission during seed germination, we will examine field-grown untreated seeds to isolate seed endophytic bacteria and characterize the endophytic microbiome using both culture-dependent and metagenomic analysis. With knowledge of the endophytic microbial content, we will explore the localization and transmission of individual microbes during germination. We will use confocal laser scanning microscopy coupled with fluorescence in situ hybridization to characterize the localization of bacteria within the seed. The confocal microscopy will enable us to investigate the colonization pattern of the endophytic bacteria within seeds and seedlings during germination. This work will enable future work on manipulating the maize seed microbiome to enhance plant health and yield.

#26

TITLE:
IDENTIFICATION AND CHARACTERIZATION OF NEW REGULATORS OF NICOTINE BIOSYNTHESIS

PRESENTER:
XIA WU

ADVISORS:
LING YUAN

ABSTRACT:

Nicotine is the major alkaloid that accounts for more than 90% of the total alkaloids produced in tobacco. Nicotine is synthesized in the root and transported to the leaf via vasculature. The Apetala2/Ethylene Responsive Factors (AP2/ERFs) in the NICOTINE1 (NIC1) and NIC2 loci and the basic helix-loop-helix (bHLH) transcription factor (TF) MYC2 are major regulators of nicotine biosynthesis. Nicotine content is significantly reduced but not eliminated in the nic1nic2 double mutant and MYC2 knock-out lines, suggesting that additional regulators are involved in the regulation of the nicotine pathway. The major objective of my research is the identification and characterization of new regulators of nicotine biosynthesis with focus on bHLH TFs. bHLH TFs are major regulators of many plant specialized metabolites. The phytohormone jasmonic acid (JA) elicits nicotine biosynthesis by inducing the expression of genes encoding enzymes and TFs in the nicotine pathway. Using JA-treatment time-course root transcriptomes, we identified two homoeologous bHLH TFs, NtbHLH14a and NtbHLH14b, as potential regulators of nicotine biosynthesis. Phylogenetic analysis suggest that NtbHLH14a/b belong to the bHLH subgroup IIId. Similar to most nicotine pathway genes expression, NtbHLH14a/b were induced by JA in roots. Unlike MYC2, NtbHLH14a does not interact with the tobacco Jasmonate ZIM-domain (JAZ) proteins. NtbHLH14a activated the promoter of a key nicotine biosynthetic gene, quinolinate phosphoribosyltransferase (QPT), but not putriscine methyltransferase (PMT), in tobacco cells. Molecular and biochemical analyses of NtbHLH14a overexpression and knock-down lines will allow elucidation its roles in nicotine biosynthesis, and NtbHLH14 may be a target for the generation of low-nicotine tobacco. The knowledge gained from my research will advance the understanding of transcriptional regulation of specialized metabolism.

#27

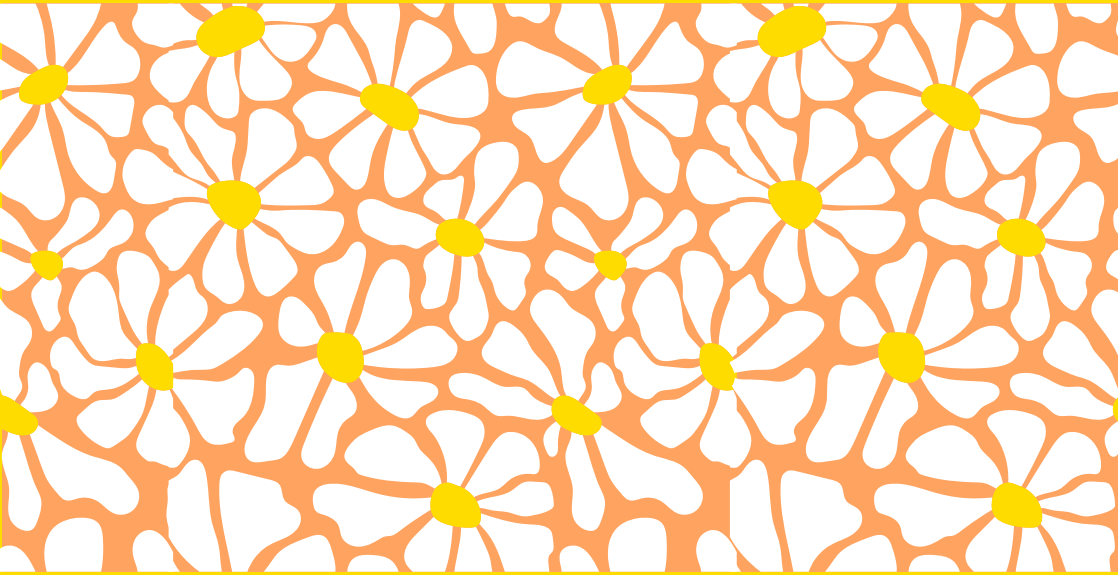
TITLE:
COVER CROP EFFECTIVENESS ON WEED SUPPRESSION --- A REVIEW

PRESENTER:
YIFEI WANG

ADVISORS:
OLE WENDROTH, ERIN HARAMOTO, & HANNA POFFENBARGER

ABSTRACT:
Cover crop has being used for many purposes, these include weeds control, soil nutrients and water retention, as well as nitrogen fixation. Weed management has also increasingly become more challenging due to factors such as herbicide resistance, climate change and issues related to invasive species. So using cover crops as a way to control weeds has also increasingly become a hot topic due to its perceived effectiveness on weed control as well as its environmental-friendly pespective, economic potential. In this review study, I'd like to look at how effective are cover crops in terms of weed control based on a series of relevant research studies. Examining any challenges that have occurred as well as improvements could be done across these studies. Depending on cover crop species, aling with their seeding density, planting dates as well as their combinations with other weed control methods, notably in combination with herbicides, the weed control results may vary based on weed species diversity, weed biomass and weed density. Common challenges may include cover crop termination effectiveness, time of termination, cover crop competition with primary crops on water and nutrients. So far, in many cases, cover crops cannot be solely relied on weed control. Herbicides still play an essential role on weed control.

#28



Martin-Gatton
College of Agriculture,
Food and Environment