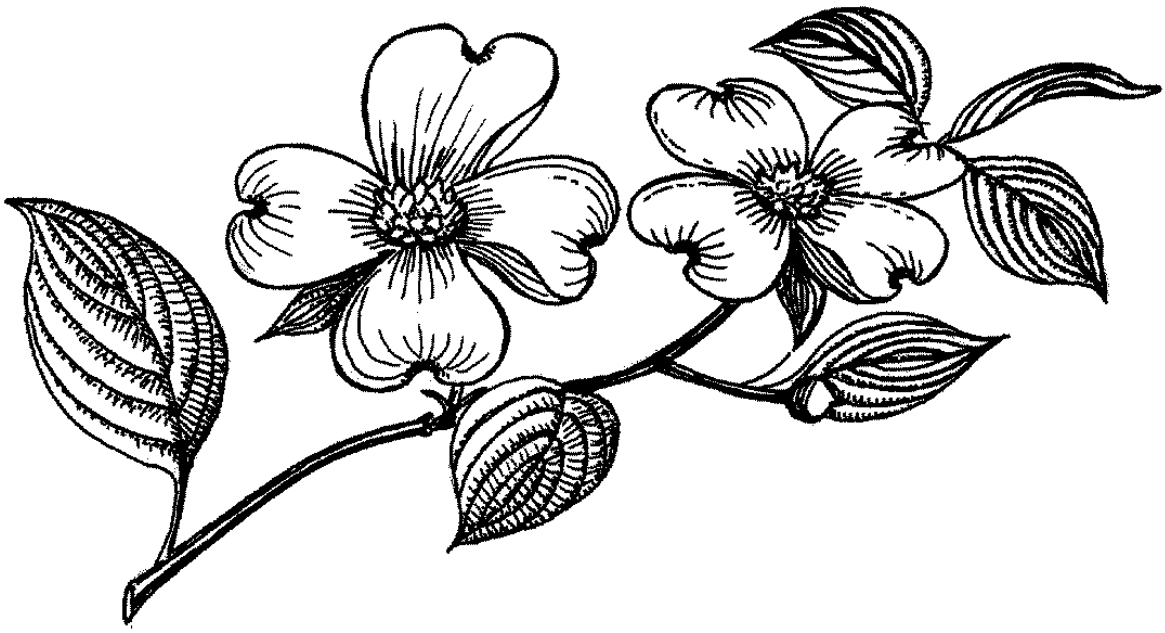
2022
Professor Donald L. Sparks & Professor Bill Witt Graduate Student Symposium



Integrated Plant and Soil Sciences Graduate Program

University of Kentucky
College of Agriculture, Food and Environment

Professor Donald Sparks Biography

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

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

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.

Professor Emeritus Bill Witt Biography

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.

Acknowledgements
The graduate students extend their deepest gratitude to Professor Donald L. Sparks, Professor Emeritus Bill Witt, and the University of Kentucky Graduate School Block Grant program for providing the funding for this symposium. We would also like to thank our faculty and postdoctoral judges for their time and consideration: Dr. Mark Coyne, Dr. Jan Smalle, Dr. David Van Sanford, Dr. Chris Matocha, Dr. Sharyn Perry, Dr. Rebecca McCulley, Dr. Tim Phillips, Dr. Christopher Shepard, Dr. Elisa D'Angelo, Dr. Rachel Rudolph, Dr. Tomo Kawashima, Dr. David Hildebrand, Dr. Ray Smith, Dr. Wei Ren, Dr. Kendall Corbin, Dr. Virginia Verges, Dr. Rebecca McGrail, Dr. Coral Kent-Dennis and Dr. Jason Unrine.

Schedule

8:30-9:00	**Coffee, Welcome**

Session I			
Time	**Student**	**Advisor**	**Moderator**
9:00-9:15	Paul Cockson	Pearce	Fridgen
9:15-9:30	Lichun Zhou	Hunt	
9:30-9:45	Brian Rinehart (zoom)	Poffenbarger; McNear	
9:45-10:00	Alayna Jacobs (zoom)	McCulley	
10:00-10:15	Joshua Singleton	Yuan	
10:15-10:30	***Break/Upload talks for session II***		

Session II			
Time	**Student**	**Advisor**	**Moderator**
10:30-10:45	Caleb Perkins	Bailey	Maupin
10:45-11:00	Maria Paula Castellari	Van Sanford	
11:00-11:15	Mohammad Foteh Ali	Kawashima	
11:15-11:30	Andrea Webb	Bailey	
11:30-11:45	Jarad Cochran	Tsyusko	
11:45-12:45	***Lunch on own/poster preview***		

Session III			
Time	**Student**	**Advisor**	**Moderator**
12:45-1:00	Amber Herman (zoom)	Legleiter	Banet
1:00-1:15	Jordyn Bush (zoom)	Teutsch	
1:15-1:30	Sara Qian	Unrine	
1:30-1:45	Jenni Fridgen	McGrath	
1:45--2:00	Fatemeh Sheikhi Shahrivar	Wendroth	

Session IV	**Poster Session – ES Good Barn**
2:10-3:30	Poster session judging
3:30-3:45	Judges scores due
3:45-4:00	**Awards**

Oral Presentations

Title: The impacts of micronutrients on the growth, leaf tissue Mn concentration, and cannabinoid accumulation of Cannabis sativa L. (cv: 'BaOx') from vegetative to flowering.

Presenter: Paul Cockson

Advisors: Bob Pearce

Abstract:

This study utilized a modified Hoagland's solution in which micronutrients (iron, manganese, boron, copper, and zinc) were altered at increasing concentrations of a full-strength Hoagland's solution with all other elements held constant. Plants were destructively harvested at the end of each of three distinct life stages of development (vegetative, pre-flowering, and flowering). The nutrient concentration of most recently mature leaves (MRML) and total plant above ground biomass (vegetative biomass) was measured at the end of each life stage with cannabinoids sampled after flowering. Regression analysis was conducted to evaluate the impacts of micronutrient concentrations on the dependent variables (biomass production, leaf tissue mineral concentration, and cannabinoid concentration), and means were analyzed using general linear model (proc GLM). Suggested tissue sufficiency ranges were identified between the upper and lower means after which increasing fertility did not result in statistically greater dependent variable response. These ranges and regression equations will help growers target optimal fertility based growth stage. For iron (Fe), copper (Cu), zinc (Zn), and manganese (Mn) no maximal leaf tissue accumulation was observed. This may indicate that these elements are needed in greater quantities than supplied or at a distinct stage as was the case with Cu and B for the vegetative stage. Cannabinoids were impacted the most by B given the lack of proper floral development at the lowest fertility concentration. This work has established initial nutrient sufficiency ranges, however additional research is needed to better define the top end of the ranges and explore potential micronutrient toxicities.

Presentation type: Research Results

Title: Natural variation of plant polyadenylation factors

Presenter: Lichun Zhou

Advisors: Arthur G. Hunt

Abstract:

Messenger RNA polyadenylation, the process wherein the primary RNA polymerase II transcript is cleaved and a poly(A) tract added, is mediated by a complex (the polyadenylation complex, or PAC) that consists of between 15 and 20 subunits. To gain further insight into novelty in the plant PAC, we have begun a study of variation in subunits of the complex. For this, we drew upon a database of naturally-occurring variation in numerous geographic isolates of Arabidopsis thaliana (1). Most of the subunits of the Arabidopsis CPSF and CstF complexes showed patterns of variability that were consistent with their roles as essential proteins in the cell. However, in some instances, the distributions of non-synonymous mutations in different of the core subunits suggests possible ancillary or regulatory functions apart from those needed for cleavage and polyadenylation. For a small subset of PAC subunits, the patterns of variability were characterized by relatively high ratios of non-synonymous/synonymous substitutions and the occurrence of premature stop codons in some Arabidopsis accessions. These features were most prominent with subunits encoded by gene families, and strongly suggest that several members of these families have lost function and are instead pseudogenes. In addition, some PAC subunits – isoforms of Pcf11, CFIm68, PAP, and FIP1 – have patterns of variation consistent with selection for new or altered function. We propose that the patterns of natural variation seen in Arabidopsis PAC subunits reflect both core functionality and also regulatory interactions important for differential usage of poly(A) sites during growth and development. 1. Genomes Consortium. Electronic address mngoaa, Genomes C. 2016. 1,135 Genomes Reveal the Global Pattern of Polymorphism in Arabidopsis thaliana. Cell 166:481-91

Presentation type: Research Results

Title: Root Litter Quality Effects on Soil Organic Matter Partitioning

Presenter: Brian Rinehart

Advisor: Hanna Poffenbarger, Dave McNear

Abstract:

Soil organic matter stability has traditionally been thought to derive in part from the chemical recalcitrance of the litter that forms it. However, it now seems that the mode of protection – within aggregates or associated with minerals – has a greater effect on soil carbon longevity. While recalcitrance itself no longer suffices as an explanation for stability, litter quality does appear to still affect how that carbon ultimately ends up being protected. The aim of this research is to investigate the decomposition of roots with a range of chemical qualities in multiple soils to better understand how quality affects how that root carbon becomes protected. Five replicates of 10 root litters in two soil types will be incubated for 180 days. At three points in the incubation, samples will be fractionated into particulate organic matter and mineral associated organic matter by density. Litter contributions to the fractions will be calculated using natural 13C abundance. To assess microbial activity, respiration will be measured throughout the incubation, and soil subsamples will be taken for community identification and enzyme analysis at the deconstruction points. The initial root litter quality, and the initial and final bulk soil and fraction quality will be assessed using Fourier Transform Infrared Spectroscopy and Solid State Nuclear Magnetic Resonance to capture how input quality is reflected in organic matter quality.

Presentation type: Research Proposal

Title: Feed supplementation with natural red clover product decreases ammonia emissions from soil-applied livestock waste

Presenter: Alayna Jacobs

Advisors: Dr. Rebecca McCulley

Abstract:

Livestock production is projected to increase over time, posing challenges to increase efficiency and limit adverse consequences of animal waste. Ruminant livestock production is the largest contributor of greenhouse gases within the food production sector. Recent work shows livestock feed supplementation with biochanin A (BCA), a naturally produced isoflavone compound present in red clover (Trifolium pratense [L.]), increases animal weight gains by altering rumen microbial communities. The environmental implications of BCA supplementation have not been investigated, including how animal waste affects soil microbial communities and trace gases emitted. This study evaluated soil amended with urine from lambs fed no BCA and lambs fed BCA at two dosages (0.45 and 0.90 g day-1). In laboratory mesocosms, ammonia emissions from soil amended with urine from lambs fed 0.90 g BCA per day were significantly lower than soils amended with urine from lambs fed no BCA for the first seven days of incubation (0.469 vs 0.324 mg ammonia m-3 day-1, respectively). However, results were not consistent between two repeated 60-day incubations, possibly influenced by urine metabolite levels of BCA and its breakdown products, genistein and 4-ethylphenol, varying not only by BCA dosage but also across feeding trials. BCA supplementation also produced distinct microbial communities assessed with phospholipid fatty acid analysis (PLFA). This study demonstrated that lamb BCA supplementation affects soil microbial communities and trace gas production, suggesting that natural plant products may be helpful in minimizing negative environmental consequences and maximizing production efficiency in the more intensive livestock production systems of the future.

Presentation type: Research Results

Title: Transcription Factor bHLH92 Affects Monoterpenoid Indole Alkaloid Biosynthesis Possibly via Protein-protein Interaction in Catharanthus Roseus

Presenter: Joshua James Singleton

Advisors: Ling Yuan

Abstract:

The medicinal plant, Catharanthus roseus produces pharmaceutically valuable monoterpenoid indole alkaloids (MIAs), such as the anticancer drugs Vinblastine and Vincristine. The low yield of these complex molecules in C. roseus results in high production costs. Metabolic engineering strategies have been hindered by our limited understanding of the regulation of MIA biosynthetic pathway. MIA biosynthetic pathway is known to be regulated by two classes of jasomonte (JA)-responsive bHLH transcription factor (TF), CrMYC2 (subgroup IIIe) and BIS1/BIS2/BIS3 (subgroup IVa). However, overexpression of these TFs does not lead to substantial increased MIA accumulation. In silico analysis revealed that the bHLH TF binding sites (G/E-box) are prevalently present in the promoters of MIA pathway genes. We thus speculated the involvement of novel bHLH activators in regulating the MIA genes. Through co-expression analysis we identified a previously uncharacterized bHLH TF, bHLH92 (subgroup II) which co-expresses with CrMYC2 and MIA pathway genes. Transient overexpression of bHLH92 in C. roseus upregulated MIA pathway genes. In Arabidopsis, subgroup II bHLH TFs commonly interact with subgroup III bHLH TFs to promote nuclear localization and subsequently activate target genes. We thus hypothesized that a subgroup III bHLH TF acts in combination with bHLH92. We subsequently identified a C. roseus subgroup III bHLH TF, a homolog of the Arabidopsis DYSFUCTIONAL TAPETUM 1 (AtDYT1), which co-expresses with the MIA genes. My ongoing efforts focus on the characterization of bHLH92 and its possible combinatorial regulation with DYT1 to regulate MIA pathway genes. In Arabidopsis, AtDYT1 is not known for the involvement in specialized metabolism. Our work suggests that C. roseus has evolved the co-regulatory mechanism of subgroup II-III bHLH TFs for the biosynthesis of specialized metabolites.

Presentation type: Research Results

Title: Effect of fungicide programs and lower leaf removal on wrapper leaf production in Connecticut Broadleaf cigar wrapper tobacco. Perkins, C., Bailey, A., Rodgers, C., Keeney, A., Witcher, V.; University of Kentucky, Research & Education Center, Princeton, KY, USA

Presenter: Caleb Perkins

Advisor: Andy Bailey

Abstract:

Late-season frogeye leaf spot infection has been the greatest issue in producing Connecticut Broadleaf Cigar Wrapper Tobacco. Field trials took place at Princeton, KY at the University of Kentucky Research, and Education Center. Eleven fungicide programs were evaluated and focused on control of late-season frogeye leafspot in Connecticut Broadleaf tobacco. Other research included the effect of lower leaf removal at topping on late-season frogeye leafspot control and wrapper leaf production were evaluated. The fungicide programs started three weeks after planting and lasted until a week before harvest. Different spray regimens were followed for each product, according to the product labels. Significant differences were found in both fungicide and lower leaf removal trials.

Presentation type: Research Results

Title: Identifying Aroma, Flavor, and Dough Functionality of SRW Wheat for Local Artisan Bakeries

Presenter: Maria Paula Castellari

Advisor: David Van Sanford

Abstract:

Soft Red Winter (SRW) wheat is grown on almost 400,000 acres in Kentucky and sold to millers as an agricultural commodity. An interest in identifying value added markets for Kentucky wheat is growing rapidly as the industry and consumers are more eager to locally source ingredients for their baked goods. To address these needs, my research aims to understand if we can breed wheat that produces quality flour for these markets. To answer this question, 76 adapted SRW wheat lines of the 2020 and 2021 harvest seasons from the University of Kentucky Breeding Program were evaluated for flavor, aroma, and dough functionality using a sensory panel method. Protein content and kernel hardness were measured with a Near Infrared (NIR) Spectroscopy, and gluten strength was estimated through the Wheat Meal SDS Sedimentation Volume Test and loaf volume. Finally, we will estimate heritability of these traits. With these measurements, we hope to identify breeding lines that have desirable baking qualities in combination with superior agronomic traits as well as the capacity to be grown in Kentucky and sold to local artisan millers and bakers.

Presentation type: Research Results

Title: Understanding the cellular mechanism of the liquid endosperm to control the seed size

Presenter: Mohammad Foteh Ali

Advisor: Tomokazu Kawashima

Abstract:

In flowering plants, including Arabidopsis thaliana, the seed is generated by double fertilization. The pollen tube contains two sperm cells,one fertilizes the egg cell in the ovule to generate the diploid embryo, and the other fertilizes the homodiploid central cell to generate the triploid endosperm. The endosperm serves as a nourishing tissue for embryo development. Endosperm development mainly consists of four phases: coenocyte, differentiation, cellularization, and cell death. The endosperm enlarges rapidly during the coenocytic phase, and endosperm nuclei keep dividing without cytokinesis. After rounds of nuclear division, this one large coenocytic endosperm cell then undergoes cellularization. The duration of the coenocytic phase is linked with the final seed size; however, the detailed cellular mechanisms of the coenocytic phase of endosperm development are largely unknown. Using confocal microscopy live-cell imaging with a combination of genetic approaches, we identified the dynamics of the coenocytic phase of endosperm development. We demonstrated total of ten nuclear divisions and interval of each division. We identified that the filamentous actin (F-actin) in the coenocytic endosperm is uniquely structured and controls nuclear movement; however, microtubule is involved in nuclear division. Our results indicate that when the F-actin structure is disrupted in the coenocytic endosperm, the size of coenocytic endosperm and final seed size decreases. By contrast, stabilization of F-actin increases the size of coenocytic endosperm and final seed size. Our results provide a new insight into understanding the role of the F-actin during coenocytic endosperm development, which determines the final seed size.

Presentation type: Research Results

Title: Pseudomonas syringae pv. tabaci in Dark Tobacco Production

Presenter: Andrea Webb

Advisors: Andy Bailey

Abstract:

Pseudomonas syringae pv. tabaci is the causal agent of Angular Leaf Spot (ALS) in dark tobacco and is the most prevalent foliar disease in dark tobacco production to date. Field trials were established in 2015 and are ongoing at the University of Kentucky Research and Education Center in Princeton, KY and at Murray State University in Murray, KY. These field trials have been established to evaluate direct and plant-mediated inhibitory effects of fifteen different antibiotic, biocontrol and/or synthetic bactericide products. Products tested are either labeled or have the potential to be labeled for dark tobacco. Streptomycin is an antibiotic bactericide and the standard control used by dark tobacco producers to combat this bacterial disease. Data collected consisted of disease ratings, yield and grade quality index. Disease ratings will be the only results discusses due to not having data back for yield and grade quality index at this time. Results show that copper products such as Nordox show better control of ALS than the untreated control and the growers standard, Streptomycin. Key words: ALS, Streptomycin, dark tobacco, Nordox

Presentation type: Research Results

Title: Assessment of multiple stressors: combined effects from exposure to nanoparticles and pathogens in *Caenorhabditis elegans*

Presenter: Jarad Cochran

Advisors: Olga Tsyusko

Abstract:

Research utilizing the model soil nematode *Caenorhabditis elegans* has revealed that many agriculturally relevant nanoparticles, such as zinc-oxide NP (ZnONP), cause toxicity at low concentrations and disrupt molecular pathways of pathogen resistance. To better predict environmental consequences of NP release, more research is needed on the interactions of NP and pathogen stresses on organisms. This project assesses the synergistic/antagonistic effects of exposing *C. elegans* infected with a common pathogen, *Klebsiella pneumoniae*, to ZnONP or ionic Zn. Results showed that Zn ion and ZnONP exposure decreased reproduction in nematodes, with the EC30s of Zn ions and ZnONP being 7.5 ug/mL and 6.5 ug/mL, respectively. Additionally, exposure to *K. pneumoniae* significantly decreased reproduction compared to controls. To assess the combined stress of ZnONP and *K. pneumoniae*, *C. elegans* were exposed to EC30 of Zn ions or ZnONP along with the pathogen for 24 hours. Both Zn ions and ZnONP exposures not only reduced pathogen toxicity, but increased reproduction rates compared to control. To determine if the antagonistic effects of Zn exposure on the pathogen were due to Zn ions being captured in the *K. pneumoniae* biomass, total Zn was measured in the separate solutions after filtering out nematodes and bacteria through a 0.2 micron filter and all particles and proteins with a 0.9 nm filter. Results showed that free zinc ion concentrations in the 0.9 nm filtered solutions were not significantly lower in *K. pneumoniae* treatments. Next, transcriptomic responses of *C. elegans* under single and combined exposures will be investigated via RNA-seq.

Presentation type: Research Results

Title: Evaluation of Italian Ryegrass (Lolium perenne spp. Multiflorum) Seed Dispersal Prior to and at Wheat Harvest:

Presenter: Amber Herman

Advisors: Travis Legleiter

Abstract:

Harvest weed seed control is being evaluated to control herbicide resistant Italian ryegrass (Lolium perenne spp. multiflorum) in Kentucky wheat. A seed destructor is a viable option if Lolium multiflorum seed is retained on the seed head up to harvest and enters the combines chaff flow. Seed retention and dispersal of Lolium multiflorum were evaluated in 2020 and 2021. All preharvest and harvest samples were cleaned before analyzed for the total number of Lolium multiflorum seed. Before harvest, Lolium multiflorum seed heads and the top layer of soil debris were collected from a m2 area for approximately each 0.2 ha of Lolium multiflorum infestation in four Kentucky wheat fields. The preharvest samples showed that 11,500 seeds m-2 remain on the heads whereas 1500 seeds m-2 were on the soil surface. Additionally, one site per year was split into 0.4 ha blocks to be evaluated for Lolium multiflorum seed dispersal at harvest. In each block, 4 header loss and 4 chaff samples were taken within a m2 along with a grain tank sample. The harvest samples revealed that 4000 seeds m-2 passed through the combine, 2900 seeds m-2 were in the grain tank, and 2300 seed m-2 were lost at the header. The seed found in header loss, chaff collection or grain tank were not significantly different. Most of the Lolium multiflorum seed remain on the seed heads up to wheat harvest, most of that seed needs to enter the combine for harvest weed seed control to be a viable option.

Presentation type: Research Results

Title: Measuring crabgrass encroachment in tall fescue using digital camera and drone imagery

Presenter: Jordyn Bush

Advisors: Chris Teutsch

Abstract:

Climate change is altering farm management, and forage production is no exception. The ratio of warm to cool season (C3) grasses may change with warming temperatures across the US, especially in transition zones like Kentucky. Alternate growth and dormancy periods create a color dichotomy between cool and warm season grasses which can be detected in photographs from drones and digital cameras. The objective of this study was to use remote sensing to measure ratios of tall fescue and crabgrass throughout the year. Tall fescue mosaics of 1m x 1m squares were 0, 25, 50, 75, or 100% converted to crabgrass, creating a known ratio of cool and warm season grasses. These mosaic plots were photographed using a Nikon digital camera or a DJI Phantom V2.0 drone in spring, summer, fall, and winter. Photos were analyzed for green canopy cover using Canopeo for MATLAB. The highest correlation between expected and measured values was seen in the winter sampling, with regression equations for the drone images and digital camera images being $y=0.49x + 0.24$ ($R^2=0.95$) and $y=0.56x+0.97$ ($R^2=0.95$) respectively. Future applications of remote sensing in pasture analysis include measuring and monitoring cool and warm season grass ratios to observe how they may change over time, and to help farmers make management decisions based on these measured changes.

Presentation type: Research Results

Title: Silicon application effects on growth and silica body formation of bentgrass (Agrostis stolonifera) in hydroponics system

Presenter: Sara Qian

Advisor: Jason M. Unrine

Abstract:

Silicon (Si), although not essential, is an important micronutrient for some plants, particularly in grasses. Si appears to help increase leaf erectness and dry biomass and may play a role in resistance to mechanical, heat, drought, and insect stress in many species. However, there have been few systematic studies of the benefits of Si supplementation in turfgrass. In this study, we assessed the effect of silicon on aboveground biomass production and root length of bentgrass (Agrostis stolonifera), in a hydroponic system in which four concentrations (0, 0.5, 1, 2, 4 mM) of Si were supplied as Na2SiO4. Fluorescence microscopy leaf ash slides showed that elevated silicon supply promoted Si deposition in bentgrass leaves as silica bodies. All Si treatments increased root length significantly. Aboveground biomass was enhanced by Si supply, but only significantly at the highest concentration (4 mM Si). These findings clearly indicate that supplying dissolved Si is not only essential for silica body formation, but it also promotes growth of bentgrass.

Presentation Type: Research Results

Title: Spatial Estimation of Soil Test Variables in Kentucky Soils

Presenter: Jenni Fridgen

Advisors: Dr. Josh McGrath

Abstract:

Site-specific nutrient recommendations are generated from interpolated grid soil sampled datasets through geostatistical processes, where samples are close enough to be correlated. Varying grid soil sampling resolutions for soil test P (STP), soil test K (STK), and soil pH were evaluated to access the accuracy and precision of site-specific fertilizer recommendations. Soil samples were collected at 4 fields in 2018 and 2019 at a high-density grid resolution of 20-m where for comparisons the equivalent of 67-m and 100-m grid resolution (common grid size for production agriculture) was extracted for analysis. Spatial correlation was determined by autocorrelation analysis and the spatial estimation of STP, STK and soil pH were determined by ordinary kriging. The results of autocorrelation indicated STP, STK and soil pH were spatially correlated at the 20-m, 67-m, and 100-m distances. Explanations of the distribution of the population, mean, and median were provided for each grid size. Spatial grid resolutions were not significantly different however, there were differences as seen with skewness of data detectable at 20-m, 67-m, and 100-m spatial resolutions. Results indicated using the 100-m grid resolution for interpolation, approximately 85% of the field area was on average 63 kg 0-46-0/ha either over or under the recommended fertilizer rate according to University of Kentucky fertilizer equations. Overall fields utilized in this study exhibited spatial autocorrelation at the 20-m, 67-m, and 100-m grid resolution. However, kriging interpolation of STP, STK and soil pH for the 20-m grid resolution demonstrated more precise and accurate nutrient recommendations.

Presentation type: Research Results

Title: Effect of gypsum on potassium and iron release from phlogopite to alfalfa

Presenter: Fatemeh Sheikhi Shahrivar

Advisor: Prof. Ole Wendroth

Abstract:

This study evaluated the effects of gypsum on the release rate of potassium (K) and iron (Fe) from phlogopite to alfalfa under greenhouse conditions. The medium was a mixture of quartz sand as filling material, K- and Fe-bearing micaceous mineral (phlogopite) and different levels of gypsum (0%, 2%, 5%, 12% and 25%). During the 6-month cultivation period, the pots were irrigated and/or fed with distilled water and four different nutrient solutions. The results showed statistically significant effects of different levels of gypsum on dry weight and K and Fe concentration of shoots and roots. It seems that an increase in calcium (Ca) concentration, due to the addition of gypsum, changes the equilibrium of K and Fe in the root zone and plant tissues. The results of this study show that the rate of K and Fe release from micaceous minerals is extremely reduced in the presence of gypsum.

Presentation type: Research Results

Poster Sessions

Title: How do environmental stress regulate nicotine biosynthesis via MAPK signaling pathway

Presenter: Yan Zhou

Advisor: Ling Yuan

Abstract:

Due to climate change, plants increasingly suffer from severe environmental stresses. Specialized metabolism is one of the strategies that plants developed to resist biotic and abiotic stresses. One way plant regulate metabolic pathways is through phosphorylation of pathway enzymes and regulatory factors. MAP kinases add phosphate groups to the downstream transcription factors or enzymes and are well-known stress-responsive regulators. However, how MAP kinases regulating specialized metabolism is poorly understood. Moreover, how environmental stresses affecting MAP kinases in specialized metabolism is of special interest. We found the tobacco MAP kinase 4 (MPK4) positively regulates biosynthesis of nicotine, a defense alkaloid, although the mechanism underlying the post-translational regulation remains unclear. To experimentally address these questions, I employed phosphorylation biochemical assays, protein-protein interaction, transcriptomic and bioinformatic analyses, and transgenic plant generation, and identified two putative kinases that are upstream of MAP Kinase 4. I hypothesized that the MEKK1-MPKK2-MPK4 kinase cascade is involved in the regulation of nicotine biosynthesis. My ongoing research is to further investigate the downstream target transcription factors by generating MAP Kinase mutants to be tested under various stress conditions to measure the effects on nicotine contents. I will also conduct detailed biochemical analysis to determine the enzymatic modifications of amino acid residues that control the amplitudes of protein functions. The expected outcomes of my work will advance our understanding of the roles of specialized metabolism in plant response to environmental stresses, as well as regulation of alkaloid biosynthesis by phosphorylation.

Presentation type: Research Proposal

Title: Nitrogen Mass Balance Dynamics for Poultry Litter in a Continuous Corn Rotation

Presenter: Stacy Antle

Advisor: Edwin Ritchey

Abstract:

Cost effective and agronomical optimized nitrogen (N) rates can be established by knowing the N use efficiency (NUE) that is utilized by the plant. Nitrogen availability with organic fertilizer sources, such as poultry litter (PL), can vary due to manure type, application method, environmental conditions, crop, and application rate. Knowing NUE for organic and/or inorganic N will help a producer apply the proper amount of N. Nitrogen mass balance will be determined by investigating source uptake and loss to establish a more efficient NUE. Assuming 50% of organic N becomes available for plant uptake in the first year, a three-year field study in Bowling Green, Kentucky will investigate direct plant uptake, along with the overall mass balance of N. This field study will determine the fate of the applied N in a continuous corn rotation. An additional year will investigate residual N from previous applications to determine if mineralized N can sustain a corn crop during a growing season with no additional inputs. Knowing the fate and factors that contribute to N transformations of PL may provide insight to best management practices that improve the NUE and lead to more cost-effective use of PL.

Presentation type: Research Proposal

Title: Managing Root-knot Nematodes in Kentucky using Grafted Rootstock

Presenter: Victoria Bajek

Advisor: Rachel Rudolph

Abstract:

Root-knot nematodes (RKN; Meloidogyne spp.) are one of the most destructive agricultural pests worldwide with a host range of over 2,200 plant species. Infection of RKN leads to root galling and reduces the host plant's ability to take up water and nutrients. Specifically, protected cropping systems create highly conducive environments through hot and humid temperatures, and annual yield loss of horticultural crops can be up to 60%. In Kentucky, increased demand for intensively cultivated horticultural crops such as tomatoes in high tunnels has contributed to lack of rotation and as a result the need for sustainable management strategies to overcome RKN. Grafting RKN resistant rootstock has been gaining interest in the production of cucurbits and solanaceous crops in the United States. The primary objective of this two-year, two-site study was to determine if grafting resistant rootstock could be a viable management strategy in naturally RKN-infested high tunnels. Since the RKN species determines the management strategy, another objective is to identify the species distribution across the state of Kentucky. In 2020 and 2021, three of the four grafted rootstocks produced significantly higher yield than the non-grafted control. All grafted rootstocks had significantly fewer RKN eggs/g of dry root compared to the non-grafted control. Statewide soil sampling revealed that Meloidogyne incognita to be most prevalent in Kentucky with some areas displaying Meloidogyne hapla. Understanding the effectiveness of grafting resistant rootstock and RKN species distribution will allow Kentucky growers to potentially maintain crop productivity in soils infested with RKN.

Presentation type: Research Results

Title: In-situ Root Imaging: Changes in Maize Roots Traits Over Decades of Crop Improvement

Presenter: Travis Banet

Advisor: Hanna Poffenbarger

Abstract:

Maize yields in the U.S. have increased over 6-fold since the 1930s due to a combination of genetic and agronomic improvements. While several aboveground changes have been observed, little is known about how the crop has changed below the soil surface over time. A recent study conducted in a greenhouse suggested that modern hybrids have lower total root length compared to historic hybrids. In surface soils, a separate study found that modern hybrids have fewer roots than historic hybrids, and significantly different crown root diameter. The objective of this study was to compare the differences between historic and modern maize root systems in a field environment at depth (~60 cm deep). Four maize hybrids, with release years of 1936, 1946, 2013, and 2014 were planted in-field in May 2021 in a randomized complete block design. Following plant emergence, mini-rhizotrons were installed 10 cm away from the crop row at a 45º angle to image in-situ root growth. Root images were collected in ~20 cm increments at the V3 and V7 growth stages, and post-harvest. Images were analyzed using RootSnap! software to quantify root length, diameter, and number of roots. Preliminary results comparing the hybrids from 1936 and 2014 are consistent with previous studies and suggest that modern hybrids have shorter and fewer roots than historic hybrids, though no difference in root diameter was detected. Image analysis will be expanded to include all four hybrids (i.e., 1936, 1946, 2013, and 2014) and will help provide more clarity on these early findings.

Presentation type: Research Results

Title: A multivariate analysis of predictive variables associated with stalk lodging resistance

Presenter: Norbert Bokros

Advisor: Seth DeBolt

Abstract:

Maize stalk lodging is a global, multi-billion-dollar problem where crop yield is reduced 5-20% per year due to a critical failure in below-ear structural tissues. Despite a growing body of research characterizing biotic and abiotic covariates of stalk lodging resistance, uncertainty persists regarding even the identity of the most influential predictors of maize stalk lodging. Leveraging a preliminary dataset compiled from ~14,000 individual stalks of maize representing 420 inbred genotypes, the focus of this research is to elucidate and highlight the magnitude and importance of the most important environmental, morphological, and structural phenotypic predictors of maize stalk lodging. While data compilation is ongoing, early results suggest significant variations in phenotypes exist – predictive of both stalk failure patterns (characterized as Root, Stalk, or Crown lodging) and stalk bending strength – a material property previously verified as an excellent predictor of crop standability and lodging resistance in grains. These findings, although under active refinement, represent the highest resolution and most comprehensive empirical examination of the underlying precursors of maize stalk lodging to date.

Presentation type: Research results.

Title: Localization and transmission of seed endophytic bacteria

Presenter: Upama Dev

Advisor: Luke A. 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 about 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 both 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. We hypothesize that bacterial transmission is controlled by the plant during germination. This work will enable future work on controlling the maize seed microbiome to enhance plant health and yield.

Presentation Type: Research Proposal

Title: Investigating the Role of the Class XI Myosin in F-actin Dynamics required for Sperm Nuclear Migration in the Arabidopsis Central Cell

Presenter: Umma Fatema

Advisor: Dr. Tomokazu Kawashima

Abstract:

Fertilization is the process of fusion of haploid male and female gametes to develop a new individual. In most animals, microtubules drive the migration of the female pronucleus toward the male pronucleus for fertilization. By contrast, the fertilization process in flowering plants is dependent on actin filament (F-actin) dynamics; F-actin, not microtubules, is responsible for sperm nuclear migration. The molecular and cellular mechanisms by which flowering plants utilize F-actin for fertilization are largely unknown. Using the pharmacological and genetic approaches with the combination of live-cell confocal imaging, we have identified the involvement of a class XI myosin, XI-G in the active movement of F-actin essential for sperm nuclear migration. The primary function of plant myosins is a cargo transporter along F-actin, and we discover a non-canonical function of the myosin XI-G that can generate forces for the dynamic movement of F-actin for fertilization. I am further investigating the mechanism of how class XI-G plays its role in the unique F-actin dynamics in the female gametophyte. Knowledge from this project will shed light on our profound understanding of fertilization and cytoskeleton usage in flowering plants.

Presentation type: Research Results

Title: Comparison of Five Methods of Botanical Analysis Across Kentucky

Presenter: Echo Gotsick

Advisor: Ray Smith

Abstract:

Botanical composition shows ecological diversity, provides an indication of forage quality and palatability, and identifies the species with potential toxicity like tall fescue. The objective of this study is to determine the most accurate and efficient method for measuring botanical composition in pastures. This observational study is being conducted on six cattle farms across Kentucky, two pastures per farm, and six sampling dates over two years. These farms represent four of the five geographical regions of Kentucky: Bluegrass Region, The Cumberland Plateau, the Western Coal Field, and the Pennyroyal Region. The five different methods of botanical composition used in this study are: Step Point, Visual Estimation, Occupancy, Point Quadrat, and Pasture Scoring. Three of the methods (visual estimation, occupancy, and point quadrat) will involve 20 sample locations randomly selected across each pasture and these methods will be repeated from the digital images take at each sample location. The step point method involves 100 precise point measurements in a random grid pattern and the pasture score method is a modification of the USDA-NRCS Pasture Health Score Card providing general categorical rating of each pasture. The measurement dates include Spring to establish a baseline of the cool season grass growth. Summer to determine the pasture composition change due to warm season grasses/ forbs. Fall contrast dying warm season grasses and cool season grasses. Data analysis is preliminary and ongoing. The overall goal of this study is to determine an accurate and efficient method of botanical composition for researchers, practitioners, and students.

Presentation type: Research Results

Title: Summer Lovegrass/Teff: An evaluation of forage and seed traits in Eragrostis tef

Presenter: Eric Luteyn

Advisor: Tim Phillips

Abstract:

Teff (Eragrostis tef) is a summer annual grain crop species that's widely cultivated in the Horn of Africa. Countries like Ethiopia and Eritrea depend greatly on teff for its nutritional value and reliability as a stable food source. The grain is commonly used to make a flatbread (injera) and the straw provides a good source of nutrients for livestock. The plant's high-quality biomass and nutrient rich grain has led to growing interests in developing teff for Kentucky agricultural systems. In this study we compare 367 different teff accessions to 12 commercially available varieties. The two goals of the study are to evaluate teff for its potential use in Kentucky and compare the forage and grain traits between current commercial varieties and the USDA's germplasm collection. The results of this study show that although many accessions looked very similar to what can be found commercially, a few accessions have traits that vary greatly, with significant differences in both biomass yield and flowering date. The wide range of traits suggest that teff germplasm could benefit from breeding practices such as speed breeding and maker assisted selection. To further develop teff for Kentucky agricultural systems, research should focus on developing cultivars with disease and lodging resistance to help produce more resilient plants.

Presentation type: Research Results

Title: Evaluating Growing Degree-Days as a Predictor for Cool-Season Vegetable Crop Growth

Presenter: Chelsea Maupin

Advisor: Krista Jacobsen

Abstract:

Crop planning tools based on growing degree-day (GDD) modeling help farmers optimize production systems through crop planning based on temperature. This research seeks to elucidate how well GDD modeling approaches predict crop growth, and to identify areas of poor model fit where additional environmental factors may need to be considered. Three cool season vegetable crops utilized by UK Dining in a farm-to-campus initiative have been selected for this project (i.e., lettuce, carrot, and spinach). GDD models are based on crop growth stage that documents the vegetative and root growth appropriate to the crop. Data are collected from three planting successions in spring and fall at the University of Kentucky Horticulture Research Farm and three collaborating farms in central Kentucky. Crops are grown in open field conditions or in high tunnels based the participating farmer's management system. Crop growth is evaluated via non-destructive (e.g., leaf count and/or root diameter) and destructive (i.e., dry biomass) sampling methods. For all crops, leaf counting had reasonable model fit (lettuce and spinach $R2 > 0.80$; carrot $R2 > 0.64$), with improved model fit with dry biomass for lettuce and carrots ($R2 > 0.84$). Spinach had poor model fit with dry biomass ($R2 < 0.43$) likely due to the large variation of plant sizes in the sample. Lettuce model fit was consistently higher in the spring planting dates than the fall planting dates, likely due to a light limitation in the fall. An additional season of data collection will inform results for the development of a crop planning tool.

Presentation type: Research Results

Title: Soil Solarization: An Eco-friendly approach to control soilborne Sclerotinina and Meloidogyne spp

Presenter: Sapana Pandey

Advisor: Dr. Rachel Rudolph

Abstract:

Soilborne plant pathogen Sclerotinia spp and plant-parasitic root-knot nematode Meloidogyne spp are serious challenges for farmers. They can survive in the soil for many years and are considered the most destructive pathogens that significantly reduce yield and quality in high-tunnel vegetable production systems. Soil solarization is an eco-friendly, non-chemical approach to control soilborne pathogens with high temperatures using different transparent plastic sheets. The research objective is to evaluate whether we can use the same type of polyethylene plastic tarping used to cover high tunnels for season extension for effective soil solarization to manage Sclerotinia and Root Knot Nematode Meloidogyne spp. This research will evaluate the effect of solarization on both Sclerotinia spp. and Meloidogyne spp. as well as the duration required to reach lethal temperatures for both organisms, the maximum temperatures that can be reached at different depths, and the optimal time of year to effectively solarize the soil. Keywords: High tunnel, Vegetable production, Soilborne, Soil solarization, Eco-friendly

Presentation type: Research Proposal

Title: Combining Flavor, Dough Functionality And Scab Resistance In A Diverse Wheat Population

Presenter: Joyce Robinson

Advisor: David Van Sanford

Abstract:

Kentucky's soft red winter wheat (Triticum aestivum L.) crop has been used historically for baked products that do not require high protein and strong gluten: cookies, pancakes, biscuits, and crackers, for example. In recent years, however, local bakers have expressed interest in sourcing the wheat flour they use for artisan bread baking from locally produced wheat. Artisan bread loaves require a strong gluten matix – consisting of gliadin proteins affecting extensibility of the dough, and glutenin proteins that influence dough elasticity. Beyond dough functionality, bakers are interested in the flavor imparted by the wheat to the bread, since artisan loaves typically consist only of flour, water, salt and yeast, or sourdough starter. We know for the wheat to be grown successfully in Kentucky it must have resistance to Fusarium head blight (FHB), also known as head scab. To explore the possibility of combining these 3 traits we will use the F2 population from a 3 way cross: 'Catawba'//'Pembroke 2021'/'Pembroke 2014'. Catawba is a weak gluten SRW line from NC with excellent flavor. Pembroke 2021 and Pembroke 2014 are from the UK wheat breeding project; the former has a gene for strong gluten and several small effect scab resistance genes while the latter has the large effect scab resistance gene Fhb1. The F2 population was planted in the scab nursery in October 2021; in May and June we will select clean, scab free heads and from these heads derive breeding lines to evaluate for baking quality and flavor.

Presentation type: Research Proposal

Title: Genetic mechanism of endosperm development and how it controls the final seed size

Presenter: Vijyesh Sharma

Advisor: Tomokazu Kawashima

Abstract:

One of the fundamental questions in plant biology is what factors control the final seed size during seed development. In the seed, not only the embryo, but also the endosperm, which nourishes the embryo, develops through a unique process: nuclear divisions without cytokinesis, generating a multinuclear endosperm cell (liquid endosperm), followed by cellularization. Studies have shown a correlation between the duration of liquid endosperm phase with the final seed size, i.e., shorter liquid endosperm phase leads to smaller seeds whereas a prolonged period leads to larger seeds. In Arabidopsis, a MADS-BOX transcription factor AGL62 controls the timing of endosperm cellularization, but how it does this job is still unanswered. AGLs form dimers to be transcription factors and many other AGLs are co-expressed in the endosperm. In our study, we are first identifying the interacting partner proteins of AGL62 using yeast-two hybrid system to understand how AGL62 controls the endosperm cellularization timing. Recent studies have suggested that the turgor pressure developed in the liquid endosperm is associated with the final seed size. We have developed a system where a microindentation device measures seed stiffness, which is proven to be equal to the endosperm turgor pressure when it is a liquid form. Using this system, we will measure the seed stiffness/liquid endosperm turgor pressure from mutants and transgenics which alter the final seed size, including AGL62 manipulated lines to understand how endosperm development determines the final seed size.

Presentation type: Research Proposal

Title: Effect of elevated temperature on soybean early seed development

Presenter: Ashwini Shivakumar

Advisor: Dr. Tomokazu Kawashima

Abstract:

Temperature changes are a major threat affecting agricultural crops worldwide. An understanding of crops at the molecular, cellular, and physiological levels, grown under different temperatures, will pave the way towards development of better crops for the future. Accumulating evidence points to early seed development (lag phase) being crucial for seed size, number, and final yield. Additionally, an elevated temperature (non-stressful) specifically during the lag phase reduces the final seed size and duration of seed filing period. However, the mechanisms behind how early seed development determines yield characteristics are largely unknown. Using Soybean as a model crop plant, we will quantify effects on seed development caused by an elevated temperature specifically at the lag phase. Aspects of affected seed development include embryo and endosperm growth, cotyledon cell count and changes in seed quality. Further, we will carry out transcriptome analysis to identify differentially expressed genes influenced by the temperature shift. With this data, we expect to understand the importance of lag phase on soybean yield characteristics under changing global warming conditions and aid improvement of soybean yields.

Presentation type: Research Proposal

Title: Dopamine and Hormone Signaling in Plants

Presenter: Tim Shull

Advisor: Jan Smalle

Abstract:

Dopamine biosynthesis is highly conserved in the plant kingdom and its exogenous application has been shown to alter plant growth and development. Despite its widespread presence, the underlying mechanisms of dopamine's morphogenic effects on plants remains inadequately explored. I will be presenting my analysis on the impact of dopamine on auxin and cytokinin signaling networks and will illustrate dopamine's capacity to increase plants sensitivity to the naturally occurring auxin, IAA. Continued research on dopamine's influence on plant physiology has the potential to shed light on dopamine biochemistry and uncover how dopamine came to play a central role in divergent eukaryotic biological mechanisms.

Presentation type: Research Results

Title: Lateral Spacing of Subsurface Poultry Litter Bands - Impact on Nitrous Oxide Emissions and Corn Yield

Presenter: Jason Simmons

Advisor: Edwin Ritchey

Abstract:

A new application method was developed for banding poultry litter (PL) below the soil surface with minimal soil disturbance to reduce ammonia (NH3) volatilization. There is limited knowledge on how this application method will impact nitrous oxide (N2O) emissions. The objectives of this study were to determine if adjusting PL lateral subsurface band placement in relation to corn rows can affect N2O and corn yield. A two-year field experiment was initiated May 2014 on a Crider silt loam. Treatments consisted of an untreated control (UTC), 32% urea ammonium nitrate surface banded (Fert), PL surface broadcast (PLBr), and 3 subsurface banded PL treatments. The subsurface PL treatments were 1 (PLSub1), 2 (PLSub2), or 3 (PLSub3) lateral bands in the inter-corn row area. Treatments receiving N amendments were applied at the rate of 180 kg total N ha-1 each spring prior to corn planting. Nitrous oxide emission results varied each growing season and pulses of N2O coincided with rainfall events larger than 1-cm. Subsurface banding of PL resulted in significantly lower ($P<0.1$) N2O emissions compared to PLBr in 2014. That same trend continued in 2015 with the PLSub2 treatment. Subsurface application of PL in 1 and 2 bands resulted in corn grain yields similar to Fert and significantly greater than PLBr and UTC when averaged across years. Aboveground biomass yields for all PLSub treatments were greater than PLBr and similar to Fert. These results suggest that subsurface banding PL can conserve N and increase no-till corn yield over traditional surface broadcast PL.

Presentation type: Research Results

Title: Evaluation of winter rye (Secale cereale L.) resistance to fusarium head blight in Kentucky.

Presenter: Ela Szuleta

Advisor: Tim Phillips

Abstract:

Fusarium head blight (FHB) is a fungal disease that causes yield and quality loss in cereal crops. Winter rye FHB in Europe is not a major problem, and its resistance was not thoroughly explored. While trying to bring back winter rye production in Kentucky, farmers face Fusarium kernel damage and difficulties in protecting rye from this fungal disease. In 2020 and 2021 we tested 24 commercially available winter rye varieties for FHB resistance in the Fusarium inoculated nursery in Lexington, Kentucky. Traits measured included heading date, incidence, severity, FHB index on a 0-9 scale, and Fusarium damaged kernels (FDK) percentage measured with light seeds vacuum sorter. In 2021 we measured heading date, FHB index and toxin (DON) content. Overall, the most FHB - resistant varieties were Daniello and Kentucky line KYSC1710 (with the FHB index 0.5), followed by hybrids Bono and Serafino and population variety Wheeler (FHB index 0.7). Over two years of observation, the most susceptible varieties were Wrens Abruzzi, Rymin and Kentucky line KYSC1704. FHB index means were statistically higher in 2020 compared to 2021. 2020 data analysis showed a weak positive correlation (0.27) between the FHB index and FDK. We found a strong negative correlation (-0.57) between earliness and FDK, a moderate correlation (0.45) between earliness and incidence, and a negative correlation (-0.47) between earliness and FHB index. The next step will be to identify the best sources of winter rye FHB resistance and to begin incorporating the resistance into the breeding program.

Presentation type: Research Results

Title: Management adaptation and Diversification strategies to increase Soybean Productivity

Presenter: Mounica Talasila

Advisor: Montserrat Salmeron Cortasa

Abstract:

Majority of soybean [Glycine max (L.) Merr.] grown in the US is under rainfed conditions and subject to yield fluctuations due to changes in year-to-year precipitation. The opportunity to increase soybean yield stability and producer's net returns through diversification of management practices has not been quantified yet. Kentucky's climate provides excellent environmental conditions to quantify the potential to increase yield stability and net economic returns if producers adopt informed management adaptation and diversification strategies. This study uses data from field trials conducted in Lexington from 2017-20 to calibrate and evaluate the DSSAT-CROPGRO (v.4.8) crop simulation model. The trials included cultivar maturity groups (MG) from 2 to 5, planting dates in May and June, and irrigated and rainfed conditions. After calibration, a range of management scenarios will be simulated under 30-years of historical and future climate at seven locations in KY. The management scenarios consist of irrigated and rainfed conditions, planting dates from mid-March to mid-July, three soil types, and cultivar MGs from 2 to 5. A frontier analysis of risk – return tradeoffs will be used to identify a portfolio of diversification strategies which reduce the risk of yield loss and increase net productivity. Preliminary results from field trials and 30-yr simulations under historical weather will be discussed. Through this study, location specific management choices (MG x PD combinations) and diversification strategies in irrigated and rainfed conditions for lowering risk and increasing net returns will be identified that can help soybean producers make informed management decisions.

Presentation type: Research Proposal

Title: Predicting corn phenology shifts to reduce crop production risk under future climate scenarios

Presenter: Yanjun Yang

Advisor: Wei Ren

Abstract:

Crop phenology is widely accepted as a robust indicator of the impacts of environmental changes on crop production. Shifts in crop phenology and changes in the timing of the growing season might either alleviate or aggravate the adverse effects of climate extremes on grain yield under changing climate, leading to substantial economic losses. However, spatially explicit variations in crop phenology and how they would affect crop production under future climate change are far from certain. This gap has hindered our efforts to make appropriate adaptive strategies for reducing crop production risk in the context of changing climate. This study integrated remote sensing imagery, machine learning, and process-based agroecosystem modeling to predict future crop productivity in the US corn cropping system under the RCP 4.5 and 8.5 scenarios, with a focal analysis of crop phenology effects. The agroecosystem model was calibrated and evaluated against field observations, flux data, and agricultural survey data. We then used the model to investigate changes in crop yields driven by different crop phenological data under two scenarios. We also examined the potential production risks and mitigation opportunities related to shifted crop phenology. This study highlights the need to develop optimal crop planting dates to manage production risk and mitigate climate change impacts on agriculture.

Presentation type: Research Results