Research Project Title: Mapping and confirming new genes in Arabidopsis involved in formation of distinct cellular domains on pollen surface

Student Presenter: Prativa Amom

Faculty Mentor: Anna Dobritsa

Faculty Mentor Department: Molecular Genetics

Research Abstract: Pollen wall exine is placed in species-specific patterns around pollen grains to protect them and facilitate plant reproduction. In the pollen of the model species Arabidopsis thaliana, exine is deposited non-uniformly, always resulting in the formation of three longitudinal gaps not covered by exine. These gaps are called apertures, and they help pollen to control its moisture content and allow emergence of the pollen tube during pollen germination. The precision with which apertures are formed, and the fact that their patterns are diverse across species, make pollen apertures a powerful model for studying how cells specify and develop extracellular domains. Previously, only one gene, INP1, had been known to influence pollen aperture formation in Arabidopsis. In order to identify other genes involved in this process, a genetic screen was performed on mutagenized plants. Five complementation groups defective in aperture formation have been found, and positional cloning isolated gene candidates for four of these groups. To confirm the identity of two of these genes, for mutant groups macaron and donut, and to initiate their characterization, multiple constructs containing wild-type versions of these candidate genes were created with the addition of YFP and transformed into each mutant population. T1 plants containing the constructs were selected and assessed for rescue of the wild-type phenotype.
Research Project Title: Investigation of the spatial distribution of plant species in coastal ecosystems at community and metacommunity scales, and their effect on plant-pollinator dynamics

Student Presenter: John Green

Faculty Mentor: Carol Landry

Faculty Mentor Department: EEOB

Research Abstract: Category: Ecology

Title: Spatial distribution, species composition and diversity in Bahamian coastal plant communities

Student presenter: Johnny Green

Faculty advisor: Landry, Carol

Abstract: There are six distinctive coastal plant communities in The Bahamas which are determined by their distance from the ocean, substrate composition and degree of disturbance. These coastal plant communities are dynamic, ever subject to change by the forces of nature. This is particularly true in The Bahamas where tropical storms and hurricanes are frequent. The coastal plant communities are important ecologically for their buffering and stabilizing effect, protecting the inland communities by aiding in dune formation and helping to retain sediment. In order to better understand these different communities, we collected data to determine the spatial distribution and species composition within four of the six coastal community types. We did this by setting up seven 100 m² plots, two in the Coccothrinax-shrub community, two in the beach-foredune community, two in the rock terrace community, and one in the shrub-thicket community. Each plot’s plant composition was determined, and the canopy area of each plant species was measured. We estimated species richness with a modified version of the Shannon’s index, in which we used the proportion of the total canopy area of each species with respect to the total canopy coverage, for each plot. We also calculated an evenness index for each community as the quotient of the Shannon’s index and the natural logarithm of the number of species for each plot. Though more sampling needs to be done to determine the plant diversity and composition of these communities, our preliminary results show that the Coccothrinax-shrub and shrub-thicket communities have the greatest canopy coverage and diversity. Their evenness index was also the largest of all communities.
Research Project Title: Effects of cadmium contamination on pollination services

Student Presenter: Rachel McLaughlin

Faculty Mentor: Frances Sivakoff

Faculty Mentor Department: Entomology

Research Abstract: Urban agriculture has grown in popularity across many cities throughout the world. Many of these cities have industrial pasts, resulting in soils contaminated with heavy metals such as lead (Pb), cadmium (Cd), and copper (Cu). Heavy metals are known to adversely affect human health, but their effects on the pollinators that provide critical pollination services to urban agriculture are largely unknown. Previous work has found Pb contamination decreases the length of bee visits in sunflowers, but it is unknown whether similar results on pollinator behavior could be expected from Cd contamination. The objective of this study was to understand the effects of Cd contamination on the pollination services provided by bees. Sunflowers grown in Cd-contaminated soil are expected to receive fewer pollination services than those grown in control soil, resulting in lower seed set. Mature sunflowers grown in the greenhouse in three soil treatments (uncontaminated potting media, and media with either 10 ppm or 50 ppm Cd, N = 24 for each treatment), were placed into the field and left open to pollination for six hours on three days. Additional flowers from each soil treatment were either hand pollinated (N = 24) or pollinators excluded (N= 24) to compare seed set to those naturally pollinated. Currently all test plants are being maintained in the greenhouse to allow seeds to mature. Generalized linear models (GLMs) will be used to determine if heavy metal contamination influenced pollination services (sunflower seed count, sunflower seed weight).
Research Project Title: Assessing hybridization in invasive purple loosestrife

Student Presenter: Alex Miller

Faculty Mentor: Steve Hovick

Faculty Mentor Department: Evolution, Ecology, and Organismal Biology

Research Abstract: Purple loosestrife is a non-native plant that was brought to North America from Europe and Asia. There are two species of purple loosestrife that are important to this experiment; Lythrum salicaria and Lythrum virgatum. Lythrum salicaria came to North America through ships' ballast and as an ornamental plant around the 1830s and has naturalized into the wild populations, crowding out natives. It is currently illegal to sell in Ohio and most other states. Lythrum virgatum was introduced more recently through the horticultural industry as a supposedly sterile cultivar that would be a safer alternative to L. salicaria. However, L. virgatum has been shown to cross pollinate with co-occurring naturalized populations of L. salicaria and produce viable seeds. This crossing is an example of interspecific hybridization, a process that has been linked to increased invasiveness in other plant systems. The goal of the current experiment is to establish genetic markers using SRAP (sequence-related amplified polymorphisms), a PCR-based genetic marker system, that can be used to distinguish between the two species. Here we describe the identified markers and test their ability to differentiate between the two species and their hybrids. Development of these markers will be useful for examining naturalized, invasive loosestrife populations for evidence of hybridization.
Research Project Title: Assessment of smallholder urban and peri-urban dairy production with zero-grazing practices in Kampala, Uganda

Student Presenter: Taylor Klass

Faculty Mentor: David Barker

Faculty Mentor Department: Horticulture and Crop Science

Research Abstract: Many people in Kampala, the capital city of Uganda, own a few dairy cows to provide milk and income for their family. Most of these dairy farmers feed their cows with a system called zero-grazing, where the cows are confined and feed is brought directly to the cows. This research project evaluated the smallholder dairy system in urban and peri-urban Kampala, Uganda. Research studies have been conducted on specific parts of smallholder, non-grazing dairy farms in Africa before. However, this project was unique in the fact that it focused on the urban, smallholder dairy farming system as a whole. The main objective of this research project was to collect information from urban and peri-urban dairy farmers that could be used to better understand their production systems and how they can be improved to benefit the farmers and their families. 10 farms that use zero-grazing practices to feed their dairy cows were surveyed. Each survey included four different parts: Feed analysis, cow evaluation, milk yields, and milk marketing. This project showed that many of these farmers struggle with the same challenges, which include feed scarcity, herdsmen, vet, and inseminator unreliability, and lack of capital. The dairy cows in Kampala are not getting enough feed, which results in low milk production levels and reduced fertility. Each family interviewed recognized the nutritional importance of the milk they collect and consume. Where there is lack of good management knowledge, education can help. However, the bigger problem for these smallholder farmers is the lack of support and capital to put into practice beneficial management procedures for their cows. This project provided much needed information on the smallholder, urban dairy system in Kampala as a whole and showed the small amount of education and empowerment needed to make these farmers more productive and resilient.
Research Project Title: Adsorption of organophosphates using activated carbon from seed waste

Student Presenter: Caleb Mathias

Faculty Mentor: Thomas Mitchell

Faculty Mentor Department: Plant Pathology

Research Abstract: A constant concern in modern agricultural production is pesticide runoff. Pesticides can leach into groundwater or be released into the atmosphere and return as contaminated rainwater. One method of mitigation is in the form of activated carbon, which possesses a net negative charge and functional groups which allow for the adsorption of chemicals from water. For this study, pyrolized seed was treated with phosphoric acid to increase the porosity of the char. This increased porosity leads to a greater surface area, and thus more room for the pesticide molecules to bind.

To test the adsorptive capacity of the acid-treated seed biochar, three organophosphates were prepared at various concentrations for equilibrium and kinetic adsorption experiments. Parathion, malathion, and diazinon were reacted with the biochar and samples were taken using a syringe with a 0.2μm filter then examined via HPLC analysis to determine the concentrations left in the solution by utilizing the area under the produced curve. These samples were also compared with those of a control activated carbon source, F300 carbon from Calgon. The pesticides were chosen due to their heavy usage in agriculture and the carbon source was chosen as it does not have as much literature surrounding it as the other sources of activated carbon do. Initial kinetic studies have shown that the acid-treated seed approached a concentration of 0.000 PPM at a faster rate than the F300 for parathion and diazinon, with the malathion solution reaching 0.5901 PPM at 24 hours for the acid-treated and 0.000 PPM for the F300.
Research Project Title: Tracking Xanthomonas gardneri infection of tomato fruit

Student Presenter: Margaret Moodispaw

Faculty Mentor: Sally Miller

Faculty Mentor Department: Plant Pathology

Research Abstract: Bacterial diseases are a problem for crops worldwide. Bacterial pathogens spread quickly, are not easily managed, and disease severity can vary, depending on the developmental stage of the plant. Specifically, the genus Xanthomonas encompasses 27 species that collectively can infect more than 400 different plant hosts. Bacterial spot is a devastating disease in the United States, and it is usually associated with four different species of Xanthomonas (X. euvesicatoria, X. vesicatoria, X. perforans, and X. gardneri). In Northeast Ohio, Xanthomonas gardneri is common. Bacterial spot is most commonly a seed-borne disease but can also be transmitted by water splashing and mechanically. However, little is known about how the seeds become infected. The goal of this study is to determine if broken trichomes on tomato fruits can be a point of entry for the bacterial pathogens, in our study Xanthomonas gardneri. Also, the colonization and movement of the pathogen was tracked over time to evaluate the eventual infection of the seeds. This study was conducted by inoculating with a transformed bioluminescent strain of Xanthomonas gardneri tomato fruits of three different sizes (small, medium and large) and different trichomes density. To track the bacterial population during the infection process we utilized an in vivo Imaging System (IVIS). Also, seeds from infected fruits will be extracted and assessed for the presence of the pathogen. IVIS imagining will be used to determine if the seedlings are infected. Preliminary results indicate that small fruits can be infected and the bacterium is present in the locular cavities and, thus, on the seed coat. Future data will be generated for the other two classes of fruits (medium and large). These results will help to understand how the seeds become infected and, consequently, spread the disease.
Research Project Title: Exploring innovations in soil moisture and UAV-borne sensing to serve Ohio agriculture

Student Presenter: Nischay Soni

Faculty Mentor: Bryan Mark

Faculty Mentor Department: Geography & Byrd Polar and Climate Research Center

Research Abstract: Agriculture is at the root of how mankind has developed and revolutionized our existence. According to the USDA, the agriculture, food, and other related industries represented 5.5 percent of the U.S gross domestic product in 2015. Farmers are consistently presented with both challenges and opportunities, from climate change to advanced technology. Right here in Ohio, farmers have a strong desire to continue to produce high quality food, make it more accessible those who sleep hungry, while maintaining sustainability and a profitable practice. Indeed, agriculture remains a critical sector of the economy of Ohio.

The mission of the State Climate Office of Ohio (SCOO) is to serve as data stewards to connect Ohioans with weather and climate information necessary to improve lives, and agriculture is an important part of our mission. Recently through a Connect and Collaborate grant, SCOO applied resources toward the development of the Fertilizer Application and Resource Monitor that allows farmers to freely access future and past precipitation forecasts. This resource provides farmers with high-resolution guidance to better manage (timing) fertilizer and manure applications. This ultimately saves time and money for the farmers by reducing nutrient runoff, which also creates a healthier water ecosystem throughout the state.

Within this framework, additional aid can be achieved with more accurate soil moisture monitoring. SCOO utilized funds to purchase and install soil moisture monitoring equipment at two depths (5 and 10 cm) at four locations in Ohio - part of the OARDC Ag Weather network. An undergraduate student helped install sensors and collect additional data using handheld soil moisture probes. Here, we present the first data recorded from this equipment. To begin to explore the spatial heterogeneity of the soil moisture around the station, another student has begun to explore the areas around the sensors using multispectral imagery mounted on an Unmanned Aerial Vehicles (UAV). Creating a platform for farmers to remotely sense their surrounding region helps them to maximize profits by understanding their land layout, gives them the confidence to invest by studying and researching certain statistical data (precipitation, temperature, nutrients), in turn helps maintain a healthy food-production ecosystem.
Research Abstract: By observing temporal changes in vegetation, we can better understand how vegetation is altered by natural and anthropogenic processes. Arid landscapes have long harbored humans, whose long-term anthropogenic impacts have been difficult to disentangle from the effects of climate change. As climates change, environments and available resources for subsistence are altered. Human responses may include social changes (e.g., group size, territorial behaviors), which feed back into desert vegetation. Due to the lack of lakes from southern Arabia, there is no easy access to proxy records of ancient vegetation after 8000 cal. yrs. BP. My research uses plant and seed fragments found within fossilized latrine deposits of desert rock hyraxes (Procavia capensis) to study the vegetation changes in the Dhofar Region of Oman. The desert rock hyrax is a small, shy herbivore which grazes in a close radius to its nest. Its diet reflects a small area. The hyrax’s latrine deposits over a long time can assess the vegetation in one location.

This study tests the hypothesis that there have been vegetation changes within the Dhofar over the past 1500 years BP. From 5 middens samples, I extracted identifiable thorns, seeds, stems, and small insects. I use incident light microscopy and digital camera to compare specimens with modern reference material and to document unknown specimens into types. By identifying the fragmented macrobotanical plants, I will assess the past vegetation of the region.

While there are differences among fossil latrines, they also reflect desert flora. The oldest latrine is composed of 0.38% of identifiable plant mass and the most recent latrine is 0.59% of identifiable plant mass. By weighing and separating the samples, I found that Ziziphus leucodermis and Aerva were both in the oldest and youngest macrobotanical samples. These plants, are also abundant in the fossil pollen found in the middens and are plants common in the modern flora. I recognize many distinct types and categories of taxa that provide quantifiable proxies of desert vegetation. To date the latrine deposits, I rely on radiocarbon ages from 3 of the 5 latrines. These ages establish a timeline spanning from modern day to 1500 years BP. My preliminary analysis of plant matter suggests that the plant vegetation in these locations has changed over the last 1,500 years. My results further suggest that there is no large structural change, such as rain forests to deserts, but there is change within the composition of taxa.

Overall, these comparisons between pollen data and macrobotanical identifications suggest that the vegetation, of the Dhofar Region, developed for more arid climates and has remained relatively stable despite small changes in climate and human land use.
Research Project Title: Optimization of transplantation protocols for the endangered species, running buffalo clover

Student Presenter: Jonathan Kubesch

Faculty Mentor: David Barker

Faculty Mentor Department: Horticulture and Crop Science

Research Abstract: Introduction: Over the past 30 years, conservationists discovered and protected wild populations of endangered running buffalo clover, Trifolium stoloniferum. Currently few researchers call for ex situ conservation or intervention studies despite the high fatalities of field translocations in Ohio and neighboring states. Low survival rates in these cases doom the clover’s already small populations, and thus an improved intervention strategy is imperative.

Methods: Stolon segments were collected from three protected locations in Ohio during spring 2017 (permit ODNR CP-2017-5). The sampled material typically comprised of a rooted node, two to four meristematic nodes, and the active stolon tip. Stolons were planted in site-inoculated greenhouse media, and made prolific vegetative propagation during May-October, 2017. Replanting to the original sites occurred during October/November, 2017. Each location comprised a generally uniform area of about 100 sqm that was free of any natural RBC plants. This minimized potential disturbance of the original population. Transplants comprised of approximately 3-4 months old; and approximately 4 weeks old plants. The greenhouse-grown plants were field acclimated for 2 weeks before planting. Transplants were planted in 1m grid spacing, with half receiving a 19-19-19 fertilizer treatment. Stolon number and length of each transplant was measured in situ; thus easing spring growth monitoring. The statistical analysis comprised of a completely randomized 3-way factorial design: 20 genotypes x 2 fertilizers (none vs 2.4 g per plant) x 2 plant sizes (large, 3-4 months old vs small, 4 weeks old). Additional replication was provided by plants in a buffer strip surrounding the study.

Results: In total, 94, 77, and 102 transplants were planted at Bosch Hollow, Shawnee Lookout, and Miami Whitewater Forest, respectively. The 77 transplants at Shawnee Lookout comprised 22 different genotypes, an average of 2.1 stolons per plant, and an average of 13 cm per stolon. The transplants at Miami Whitewater Forest comprised 20 different genotypes, an average of 1.9 stolons per plant, and an average of 4 cm per stolon.

Conclusion: Preliminary analysis of populations suggests that RBC can easily be clonally propagated from field-sampled stolons. The specimens resulted from, i) the high (approximately 80%) of stolons nodes that produced roots and branches, and ii) continued stolon extension, producing new nodes thus new plants.