CFANS UROP Project Ideas

1. Exotic earthworms and their impacts on soils in Alaska and American Samoa

Earthworms have taken great advantage of humans. Humans have served them very well by unintentionally giving them new habitats they could have not reached otherwise. One of these accidental habitats is the formerly glaciated forests in the Great Lakes Region where invasive earthworms' negative ecosystem impacts have been well documented. Now how about even colder ecosystems in Alaska? Or very remote islands like Ta'u in American Samoa in the middle of the Pacific? UROP projects will contribute to better understanding the origins of exotic earthworm populations and their impacts on soils in these remote parts of the world.

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2. Testing netting in gardens as a way to manage swede midge, a new invasive pest of brassicas

Swede midge (*Contarinia nasturtii*) is a small fly that is a new invasive pest of Brassica vegetables like broccoli, cauliflower, and kale. In 2018, it was a problem in community and private gardens in the Twin Cities area. The fly feeds on the growing points of host plants, causing deformed leaves, uneven development, and loss of floret heads or crowns. It's only about 1/16” long, and can overwinter in the ground, so is challenging to manage. Current recommendations for management of this pest is to not grow Brassicas in previously-infested ground for 3 years, plant Brassicas about a mile away from previously infested areas, or use insect exclusion netting. The first two options are undesirable or impractical for home gardeners.

The UROP will test the use of insect exclusion netting in gardens that have previously suffered swede midge infestation against no netting and mulch.

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3. Pairing manure application with cover crops for soil health and environment

Nitrogen (N) application for crop production should focus on improving soil health and crop utilization while minimizing environmental pollution. Pairing manure application with cover
crops may be one way to address some challenges in conserving nitrogen. In general, nitrogen in soil and soil amendments is converted to the nitrate form by soil bacteria and lost through subsurface leaching or denitrification before the following crop season begins. Cover crops can help farmers recapture nitrogen for future cash crops and conserve soil by reducing erosion into lakes, streams and rivers. However, due to variables such as weather, method of manure and cover crop application, timing of application, and selecting the right cover crop species, the adoption of such sustainable practices has been limited throughout the Midwest. This project will investigate the use of manure followed by the application of a winter-hardy cover crop - cereal rye - to help farmers understand the soil health benefits of such combination. This will be accomplished using laboratory microcosm experiments conducted by the student. Under our supervision, the student will learn about experimental design and how to set up experiments and analyze nitrate, ammonium, phosphorus, rye biomass, and other chemical constituents in soil and plants. The student will examine microcosms containing soil amended with different types of manure. The student will learn to navigate through scientific publications and will be exposed to scientific methods, from setting up a hypothesis to disseminating research findings.

UROP Project:

We are seeking a motivated and well-organized student with interests in sustainable agriculture and animal waste management to work with our team to conduct the study on use of rye cover crop paired with manure application. In Minnesota, we anticipate that a winter-hardy cover crop like cereal rye will continue to provide soil health benefits in spring before planting. This study could give us insights into future field applications. The successful candidate will represent our lab by presenting our findings in the UROP symposium.

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4. Integrating cover crops and fall-applied liquid manure for soil health

Cover crops are being adopted throughout the Midwest as an environmental practice for conserving nitrogen (N) in the soil and to improve soil health. Fall manure applications would greatly benefit from cover crops as the plants take up available N throughout the fall and then slowly release it for the following cash crop. Combining liquid manure application with cover
crop seeding, a practice known as manure slurry seeding, has allowed farmers to lessen environmental risks while saving money by combining field operations. However, adoption of the practice has been limited due to many unknown variables. Our research goal is to use laboratory and field studies to best evaluate farmer concerns. The main objectives are to assess which cover crops and manure application equipment are best suited for slurry seeding, to estimate N recovery of the cover crop, and to assess changes in soil health over time.

UROP Project:

We are looking for a student with interests in agriculture and sustainability to conduct germination studies for various types of cover crop seeds mixed directly with liquid manure. This will help us determine which types of cover crops are best suited for future field experiments with manure slurry seeding. Another project could compare growth in pots of slurry seeded cover crops versus cover crops without manure. The student(s) would evaluate the amount of biomass produced and N recovery. Again, this study could give us insight into what will work best in field studies.

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5. Developing Distinct Levels of Precision Nitrogen Management Strategies for Sustainable Development of Minnesota Agriculture

Precision nitrogen (N) management (PNM) aims to match N fertilizer supply with crop N demand in both space and time, and thus has great potential to improve N use efficiency (NUE), increase farmer profitability, and reduce N losses and negative environmental impacts. However, current adoption rate of PNM is still low in Minnesota crop production, and most farmers apply all N fertilizer before planting. This may be due to the attitude on new technologies and knowledge background of the farmers, high cost and complexity of current PNM technologies, lack of technology support, and the weaknesses and limitations of some of the available PNM technologies, etc. To overcome some of these barriers, this project aims to develop distinct levels of PNM strategies and technologies to facilitate the adoption of PNM by Minnesota crop producers.

For producers who are more risk-averse, we will develop simple calibration strip-based PNM strategies that can be used to guide field-specific uniform or site-specific variable rate N applications without previous database establishment. Crop growth models will be calibrated, validated and evaluated for their performance in simulating N dynamics in the plant-soil system, and the best performing model will be used to determine optimum N rates of corn and potato for different soil types and regions of Minnesota based on long-term simulations using historical data. It will also be used to guide in-season N management decisions based on current season and historical weather data. For more risk-tolerant producers, we will evaluate
and incorporate innovative new sensing technologies including leaf chlorophyll fluorescence sensor - Dualex Scientific+, light handheld multispectral canopy sensor – RapidSCAN CS-45, the integrated multi-parameter canopy sensor - Crop Circle Phenom and integrated custom-designed multispectral and thermal camera Multi-Camera Array Wireless (MACAW) for UAV-based remote sensing. These new sensing technologies offer the potential of early and more accurate detection of crop N stress, and differentiation of N vs. other abiotic stresses like water. More advanced integrated PNM strategies will be developed based on current and new sensing technologies, crop growth modeling and their combinations.

The students will have the opportunities to learn new sensors and UAV remote sensing, image analysis, crop growth modeling as well as field sampling and data analysis.

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6. Conservation biocontrol of native good bugs, including monarchs and bumblebees

Restoration projects for bees and monarch butterflies need information on the best management practices for using pesticides around restorations. Serious concerns are being discussed on the potential of drift from pesticides on monarch and bee conservation from urban and agricultural use into areas with restored native plants.

Research on the factors that contribute to good bug decline is needed so practices can be changed to conserve butterflies, lady beetles, and bees. More than 99.9% of all insects are beneficial and these insects rely on pollen and nectar from plants to complete their life cycle. Conservation biocontrol is the use of sustainable, cultural tactics, such as overwintering sites, conservation of ground nesting sites, mulch piles (banks), and appropriate mowing practices. In addition, landscapes and restorations must be managed thru the principles of Integrated Pest Management (IPM). IPM promotes multiple tactics to manage pests, including biocontrol, conservation biocontrol, and using biorational insecticides friendly to beneficial insects, and proper use of conventional insecticides.

Although monarchs and native rusty patched bumblebees are in serious decline, we know little about the factors that may contribute to this decline. Research needs to address whether current insecticide use in urban areas and around restorations are reducing populations of butterflies and bees.

Monarch butterflies may be killed by pesticide use along roadsides and landscapes. However, data is not available to determine if current insecticide use will kill monarch larvae and nectar feeding adults as well as native bumblebees. Plants visited by foraging bees (dandelions) growing near these fields were found to contain around 4 ppb clothianidin. Dead bees collected near hive entrances during the spring sampling period were found to contain clothianidin as well
(Krupke 2012) The highest levels of contamination in pollen of wildflowers were pyrethroid insecticides targeting mosquitoes and other nuisance pests (Long and Krupke 2016). We will study how to manage lands to increase good bug abundance and diversity. We will preform studies on whether current insecticide use is killing monarch butterflies and native bees and whether insecticides considered friendly to bees may replace more toxic insecticide in IPM programs.

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7. Call of the wild: Exploiting wild species for cultivated cereal improvement

Research Description
Since the time of first domestication, genetic diversity in cereal crop species has been seriously eroded. This has resulted in genetic vulnerability to many pathogens and insect pests. The wild relatives of wheat, barley, and oat are virtual treasure troves of diverse alleles that can be exploited for use in improving the cultivated species. Our laboratory conducts evaluations of wild germplasm collections to a wide array of different fungal pathogens for the purpose of mapping and cloning the underlying resistance genes. These resistance genes are then incorporated into the cultivated species by both conventional and molecular methods.

UROP Project
We are seeking a highly motivated student to assist and lead parts of our research program on characterizing the disease resistance of various wild wheat, barley and oat species in the greenhouse, analyze data, and map underlying resistance genes. The successful candidate will have the opportunity to present research findings in the UROP symposium and possibly to serve as an author on resulting publications.

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8. Understanding the benefits and limitations of using goat browsing for invasive plant control

Research description:
The use of goat browsing for invasive plant control is increasing, yet few data exist to quantify the effects of goat browsing on invasive species populations or native plant community composition. The cost of this management strategy is also elevated in the Midwestern and Eastern United States due to mortality caused by a parasite of white-tailed deer, meningeal worm (Parelaphostrongylus tenuis). Few management options exist for this parasite, and it is a
particular problem for goats used in invasive plant control due to their exposure to intermediate gastropod hosts in areas where infected deer defecate. To address these issues, we use Rhamnus cathartica as a focal host to quantify the short-term effects of goat browsing on defoliation, as well as the long-term effects on population growth rates. We are also examining whether goat browsing achieves a common goal of invasive plant management by determining whether native plant abundance and diversity are actually increased by goat browsing. Further, we will evaluate the use of goose and duck co-grazing in goat-browsing areas to reduce the abundance of gastropod intermediate hosts as a means of mitigating P. tenuis infection in goats. This information will elucidate the efficacy of goats for invasive species control as well as explore a novel mitigation strategy for protecting goat health through the process.

UROP Project:
We are looking for a motivated student with an interest in one or more of the subtopics covered in the research description, with a preference for someone interested in learning about terrestrial gastropods of deciduous forest ecosystems. Activities depend on the research question of most interest to the student, but may include fieldwork, laboratory work, visits to the Bell Museum mollusks collections, data analysis, and the presentation of results at the UROP symposium.

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9. Gone to the dogs: what’s happening in local dog parks?
Dog ownership continues to grow in the United States and the world. A conservative estimate is that, about one-third of the U.S. population owns a dog: dog ownership has increased 29% since 2007 (Research & Markets, 2017). This project would provide students the opportunity to explore dog-park permit holders norms, attitudes and constraints to visitation to inform park and urban planning. Survey data were collected among more than 2000 dog park permit holders in Minneapolis to assess a variety of variables. The UROP student would work on reviewing recent literature on behavioral norms, analyzing the data and applying this literature to the data findings to develop recommendations. Small group work possible and encouraged with other grads and undergrads working with me.

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10. Perspectives on pine barren restoration
Forest landscape restoration is increasingly advocated as an alternative approach to forest management, particularly for ecological communities where traditional timber-driven
silvicultural systems do not match well with that landscape’s natural disturbance patterns or other environmental and social goals (Stanturf et al. 2012). Such is the case with the northern dry forest and barrens ecological communities of the Upper Great Lakes Region, fire-dependent landscapes that exhibit a gradient of closed-to-open conditions (WDNR, 2015). Building on previous work, the overarching goal of this research is to understand public stakeholder perceptions and landscape preferences for silvicultural treatments used to restore northern dry forest and barrens ecological communities. This project would provide students the opportunity to collect onsite visitor data in Wi, enter and analyze the data and co-create a report for the Forest Service. Small group work possible and encouraged with other grads and undergrads working with me.

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11. Evaluating river conditions for optimal recreation experience

UMN students are lucky to be located close to amazing recreational and scenic resources that provide numerous benefits to communities, ecological systems and visitors, including the St. Croix National Scenic Riverway. In 2017, observational research summarized location-specific visitor use patterns, visitor behavior issues, and proportion of non-commercial users at three landings, including Osceola (Schneider, Carlson, Pflughoeft, & O’Connor, 2017). In summer 2018, visitor surveys assessed visitor experiences, preferences and travel behaviors at one landing. This project would provide students the opportunity to collect onsite visitor data in Wi, enter and analyze the data and co-create a report for the Park Service. Small group work possible and encouraged with other grads and undergrads working with me.

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12. Identifying feeding attractants in an invasive fish

Living in a dark and turbid world, fish have evolved to recognize food items using the chemicals they release. Further, as every fisher knows, species have different preferences and these can be manipulated. These preferences are mediated by highly developed senses of smell and taste. One species of special interest is the common carp, an invasive fish from Europe that is famous because of its ability to find food in the bottom and its broad range of feeding preferences which includes certain plants. It has an extremely sensitive sense of smell and taste. Flavors such as strawberry, tigernut and corn are often used to catch this interesting fish but have never been systematically tested in the laboratory to determine what works best and why. This study of fish behavior will test these odors as well as conventional fish baits such as
amino acids to determine what works best and why. Results can be used to both understand fish behavior and in invasive fish control. Work could start this spring, perhaps with pay.

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13. Comparing soil respiration methods across Minnesota farms

Research Description: Farmers across Minnesota are interested in improving and understanding their soil health, which incorporates soil biological, chemical and physical properties. Soil respiration is an integral part of many soil health assessments available to farmers and can give a valuable snapshot as to microbial activity. However, methods vary between commercial and scientific labs. In order to interpret soil respiration tests for farmers and land managers, we need to understand the relationship between field and lab-based respiration methods. A large NRCS project is investigating soil health across Minnesota farms, incorporating soil respiration data with infiltration, soil structure and other metrics.

UROP Project: The UROP participant would investigate various methods of measuring soil respiration in soils across the state. This would include simple commercial tests as well as precise laboratory methods involving an infra-red gas analyzer. Depending on availability, the student could be involved in soil sampling on farms statewide. The position would be advised by Drs. Cates, Gutknecht and Jelinski in the Department of Soil, Water and Climate.

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14. Exploring the microbiome in food and animal systems.

The microbiome; the trillions of microbes that inhabit environmental surfaces and colonize the anatomy of humans and animals; plays indispensable roles in nutrition, physiology and health; As such, a recent surge in microbiome research, potentialized by advances in molecular and computational biology, has focused on exploring the factors that shape the composition and function of the microbiome in different human populations, and in animals with importance for human nutrition. The Gomez lab is seeking for an undergraduate research assistant to help us in our quest to explore the microbiome in food and animal systems, including characterizing the composition and functions of the microbes present in the environment swine and cattle are raised in; and studying how the external environment and diet influences the microbiome that animals and humans acquire in their overall anatomy. These studies will help us determine how the environment can be potentially modified or modulated to make food animals healthier and more
efficient from a productive stand point, and devise dietary interventions that improve health in humans.

Interested candidates will work with the principal investigator, graduate students research scientists and postdocs in the lab to take samples from different animals and animal facilities, use molecular techniques to determine the microbial make up of each sample (Including but limited to DNA extraction) and employ computational and statistical tools to make sense of microbiome data.

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15. Protecting Food Flavorings From Deterioration

Food flavorings are very prone to degradation during storage particularly through oxidation. Unfortunately, the loss in flavor quality tends to occur well before any loss of nutritional quality. Thus, nutritious foods are often disposed of because they do not taste good. To extend the flavor quality of a food longer, we usually encapsulate the flavoring in a starch/hydrocolloid solution and then spray the solution into a hot air dryer. This results in the flavor being wrapped up in a protective starch/hydrocolloid coating.

Our research interest is to determine how encapsulation protects the flavoring materials. There are three separate barriers to oxygen movement into the particle: the surface of the drying particle, the bulk of the protective starch/hydrocolloid material, and finally the surface between droplets of flavor and the encapsulation material. It has been commonly assumed that the most important barrier is the bulk of protective starch/hydrocolloid material but recent work in our laboratory has put this hypothesis in question. We are looking for a student to help us in preparing different encapsulated materials by spray drying and then carrying out an accelerated shelflife study to determine how these different materials protect our flavor from degradation.

While this study sounds fairly fundamental, it has major application in the industry.

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16. Why is it so difficult to create good flavored high protein foods?

The global demand for protein ingredients, including plant and animal sources, is expected to reach 4.6 million tons ($34 billion) by 2020. This is an estimated growth of 6.5% yearly between 2014 and 2020 (1). Interest in plant proteins, specifically, is on the rise globally for several reasons. Increases in vegan population and health conscientious consumers are two of the main drivers for plant protein popularity. The greatest barrier to the consumption of plant proteins is the difficulty in flavoring the foods initially and then having the flavor maintain quality during storage. Unfortunately, plant proteins are highly reactive and thus tend to form chemical bonds with flavor compounds resulting in partial or complete loss of the flavoring. There is very little information in the literature on how flavors react with proteins. We want to have a student do a project where known flavor compounds are added to different plant proteins, storing the products under controlled atmospheric conditions, and then monitoring the loss of flavor compounds. We expect this will lead to a much better understanding of how we can better flavor the foods that consumers are asking for.

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17. Edible Insects: From Western Taboo Food to Healthy, Eco-friendly Diet of the Future?

We are conducting research on promoting insects as sources of human food. Why? To address the looming food security challenge given the human population growth rate, and concerns about the environment. By 2050 it is estimated that there will be over 9 billion on our planet, and not enough land to feed all. The idea of insects as an alternative human food may appear strange, creepy and yukky in the US but many cultures commonly include insects in their diets. Compared with livestock, insects are a healthy, eco-friendly sustainable food source as they are efficient in feed-to-protein conversion, require little land for production, and emit few greenhouse gases. In addition, insects pose low risks to transmission of diseases compared with livestock which transmit diseases such as mad cow disease.

We are seeking students interested in addressing social attitudes towards eating insects. Students will engage in assessing human perceptions of insects as food. The project will provide experience in conducting a literature review, designing and implementing surveys, organizing and analyzing data, interpreting the results and preparing a presentation for a broad audience. Data from the student project will help us with future promotion of edible insects for humans. The project is ideal for students interested in gaining research experience in an emerging field
while addressing global challenges of food availability, protein enriched diets, and environmental stewardship.

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18. Where will the ash wood go? Gaining forest industry perspectives on the use of ash wood in anticipation of emerald ash borer

Minnesota is home to one million acres of ash forests across the state. However, the state is expecting significant mortality in these ash forests due to the expansion of the emerald ash borer (EAB), an invasive insect that impacts all ash species in the state. Before EAB reaches Minnesota’s expansive ash forests, forest managers are considering accelerated harvesting of existing ash in preparation of an EAB outbreak. However, the current and future capacity for Minnesota’s forest products industries to utilize ash wood is not well understood. This project would design and deliver a survey to forest products companies, analyze the compiled data, and write reports detailing the current and future use of ash wood by forest industries. The survey will help reveal opportunities to expand the use of ash, through products such as hardwood cross-laminated timber, outdoor siding, and others. Research results would help inform the management and utilization of ash across Minnesota. Project partners include the University of Minnesota Extension and Minnesota State Wood Innovation Team.

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19. Smartphone application development for in-season underground potato tuber detection using ground penetration radar

In-season potato tuber characterization is of interest to the potato industry. Ground penetration radar (GPR) is a nondestructive field test that can provide a continuous profile of existing conditions. This proposed project will explore an application for radar sensor to characterize the potato tubers without removing the plants from the field. Therefore, it is a non-destructive and non-invasive way. Fresh potato during the crop season has a water content of as high as 80%. In theory, water-filled voids are detectable using GPR because the dielectric constants of water (81) are substantially different than dry/wet sandy soil materials (up to 30). This project will be developed based on the outcome of a BBE capstone project and the expected deliverable is a smartphone application that read Walabot images and indicates the underground tuber distribution.
20. Evaluating Diets of Brook Trout

The brook trout (Salvelinus fontinalis) is native to North America and Canada and effective management of it is crucial to sport fisheries within the state of Minnesota. In order to maintain self-sustaining populations of brook trout, a knowledge of their diets and how they change seasonally is necessary. In contrast to brown trout, whose diets have been recently studied in our streams in Minnesota, little research has been conducted on diets of brook trout.

This project consists of sorting, identifying and quantifying the gut contents from about 200 brook trout gut samples. Gut samples were collected from heritage-strain brook trout in Ike’s Creek, an urban trout stream located on the Minnesota Valley National Wildlife. Trout were electroshocked in September 2017 and March 2018 and samples were collected using the gastric lavage technique. A student with previous experience in identifying aquatic macroinvertebrates is preferred; however, learning to use aquatic macroinvertebrate keys will be a part of the UROP experience and provide the applicant with a valuable work skill.

Students will work with a Graduate Research Assistant on a regular basis, and meet with Professor Ferrington on at least a weekly basis to review progress. Students who complete this UROP will gain the following skills and knowledge:

1. Practical experience in identifying aquatic macroinvertebrates in a lab setting using standardized taxonomic keys
2. Experience in quantifying invertebrates and estimating their volume and mass
3. Data input and management practices using Excel
4. An overall understanding of trout diets in the fall and spring
5. Experience working as part of a research team with day-to-day supervision by a Graduate Research Assistant in the Department of Entomology

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21. Diploid Identification from Dihaploid Induction of Tetraploid Potato Cultivars

Potato is the most important vegetable crop in the world and is a staple in millions of diets across the globe. However, unlike other staples like corn and rice, potato breeding remains a slow process with little improvement achieved each year. This is due in part to the nature of potato
genetics; cultivated potato is autotetraploid, which greatly complicates models and techniques used in genomic analysis. Recently, there has been growing interest in the deployment of diploid breeding programs, which would make deploying models used in other cropping systems possible. One method for establishing a diploid breeding germplasm is through dihaploid extraction, in which a commercial tetraploid cultivar is pollinated with an inducer line. At low frequencies, the resulting seed from this pollination contains only maternal parent chromosomes and is thus a diploid. However, this type of induction is extremely inefficient, with only 1 of 150 pollinations resulting in a diploid individual. There is a high number of self-pollinations that occur, resulting in tetraploid individuals, as well as triploid individuals when the genetic material from the inducer line is incorporated in the nucleus of the offspring.

There are many methods currently in use to identify the diploid individuals from the tetraploid and triploid individuals, many of which are extremely time intensive and can be inaccurate, resulting in discarded diploid individuals. There has yet to be a side-by-side comparison of these methods to evaluate the efficiency of each. The student working on this project will evaluate the efficiency of each method, taking into account time spent, cost of reagents used, and accuracy of the method. The ideal candidate will have an interest in plant genetics.

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22. Dihaploid Extraction from Commercial Tetraploid Potato Cultivars

Potato is the most widely grown vegetable crop in the world however compared to other staples (rice, corn, etc.) we know much less about the potato genome and consequently, the process of breeding improved potato varieties is slow. This is in part because potatoes are autotetraploids, which complicates all the models and techniques we use for genomics. One method for simplifying potato genomics is to turn potatoes into a diploid crop. We can do this through a process called dihaploid extraction in which a tetraploid potato is pollinated with an inducer which at low frequency fertilizes the endosperm but not the nucleus leading to offspring which contains two of the four maternal parent chromosomes and none of the paternal parent chromosomes. This process is inefficient, with about 1 in 150 pollinations resulting in a diploid individual.

Further, this process has been shown to be widely influenced by the cultivar that is being induced. The student working on this project will be involved in creating and identifying dihaploids through pollinations, microscopy, and genotyping. They will be evaluating the efficiency of induction in several cultivars that will be collected from commercial farms and pollinated with the inducer line. The ideal candidate will have an interest in plant genetics.

Contact:

Dr. Laura Shannon
Department of Horticultural Science
23. **Testing for introgression in potato**

Potato was domesticated from a species complex and remained in close proximity to that complex and other wild relatives for much of its history. Furthermore, potato breeders have used wild relatives as sources of disease resistance alleles. For this reason, commercial potatoes often have multiple introgressions from wild species. We are currently working on the first fully phased and sequenced autotetraploid potato genomes and we’d like to know the history of introgression from wild relatives into the 6 sequenced individuals. The student on this project would align sequence from published wild relatives to the potato pan genome in an effort to identify regions with high homology to the wild relative. This project will be entirely computational although there will also be opportunities for the student to participate in lab wide projects related to the potato breeding program. The ideal student candidate will have some experience with scripting for the command line, and an interest in computational genetics.

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24. **Measuring greenhouse gas emissions from high tunnel agriculture**

The greenhouse gas emissions of agricultural coping systems is an important aspect of determining whether agricultural systems contribute to, or mitigate climate change. Different management practices can also play a role in the level of greenhouse gases, and the levels of greenhouse gases might especially be high in High Tunnel production systems with intensive management and extended growing seasons. Some greenhouse gases such as carbon dioxide and nitrous oxide also provide information about microbial activity in the soil.

**UROP project:** In this project, the UROP student would travel to Lamberton twice a month to measure greenhouse gas emissions with a portable infrared analyzer. The experiment is a high tunnel cropping systems either with or without sustainable management strategies of including leguminous cover crops. The UROP would also learn how to process and interpret rich datasets of multiple simultaneous greenhouse gases and would be part of a large collaborative team including cooperation with a scientist at the University of Kentucky taking the same measurements on a sister project. The UROP would be coadvised by Dr. Julie Grossman in Horticulture and Dr. Jessica Gutknecht in the Department of Soil, Water, and Climate. This project will ideally begin in late spring and go through the 2019 summer. If this project lasts into the fall, additional resources will be provided by the coadvisors.

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25. Using Remote Cameras for Wildlife Research

UROP Project Description:

Remote cameras are a fascinating tool for observing wildlife, documenting species presence, and learning about animal behavior. As use of remote cameras has become more widespread, methods for surveying wildlife using these cameras have improved and become more robust. Current interest centers around ways to use cameras to learn more about wildlife conservation and, more recently, to apply these tools to urban settings. Some cryptic and secretive mammal species are doing better than we previously knew. Red fox and Coyotes are examples of mesocarnivores doing especially well in urban settings. Otters are another carnivore that is present and has been studied in urban settings, especially as bio-accumulators of environmental pollutants, but little is known about their habitat use and requirements specifically in these settings.

For this project, a student may choose to use remote cameras to:

1) Monitor carnivore presence at otter latrine sites, expanding on recent research conducted in a large natural area in New Jersey (2016) and applying that work to an urban setting.

2) Occupancy of Red fox and Coyotes and possible niche separation based on habitat quality, expanding upon recent research being carried out in Wisconsin (2018) in an urban setting or across an urban-rural gradient.

3) Seasonal/diel patterns and frequency of otter visitation at latrine sites, expanding upon work in a large natural area in Illinois (2015) and applying that work to an urban setting. Remote-camera use will be focused in the Vadnais Lake Area watershed (~15 minutes from campus). If a student chooses to make comparisons between urban and rural/natural areas, they may add a rural/natural area in addition to sites available in VLA watershed. Students need to be responsible with dept. equipment, able to travel to and from Vadnais Heights to check cameras, work well independently, and will coordinate with Dawn Tanner, Adjunct Faculty in FWCB and Project Development Coordinator at VLAWMO.

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