PGSAS 2008 Independent Study Projects

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PENN STATE

PENNSYLVANIA GOVERNOR'S SCHOOL FOR THE AGRICULTURAL SCIENCES

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2008 INDEPENDENT STUDY PROJECTS

AGRIBUSINESS

Exploring Navigation and Customer Usefulness of Agricultural Business Websites (6)
-Ms. Sara Roth, Senior Extension Associate
-Dr. Kathleen Kelley, Associate Professor of Consumer Horticulture

Scholars will select a category of agricultural products (i.e. dairy products, fruit and vegetables, or other edible products) to use as the basis for their research and conduct a search for agricultural businesses that offer these products for purchase online. They will then have the opportunity to make actual purchases from their chosen retailers and evaluate the business's website, online transaction processes, and quality of shipped products. Scholars will determine what features they believe an ag business's website should include and may possibly develop a mock site to illustrate this. Scholars will also develop a survey to investigate what website features appeal to consumers and administer the survey among fellow Governor's School participants. Survey results will be analyzed to learn what features are attractive or detractive to website visitors. **Prerequisites:** Familiarity with using the Internet for purposes other than Facebook and MySpace, i.e. research and shopping.

AGRICULTURAL & BIOLOGICAL ENGINEERING

Decontamination of Sliced Cheese with Pulsed-UV Light (2)
-Dr. Ali Demirci, Associate Professor
-Ms. Nene Meltem Keklik, Research Assistant

Microbial safety of foods is of great importance for our society. In the United States, around 76 million cases of foodborne illnesses, resulting in 325,000 hospitalizations and 5,000 deaths, are estimated to occur each year. Cheese, a popular dairy product, is an excellent source of calcium and protein. However, this product can be contaminated with pathogenic microorganisms during production and storage. Pulsed ultraviolet (UV) light is a novel technology, which offers effective inactivation of pathogens on food surfaces in very short times. Pulsed UV-light is considered to be a non-thermal and non-chemical method. It is also an alternative decontamination technique to irradiation. The goal of this project is to investigate the effectiveness of pulsed UV-light on the microbial load of sliced cheese. **Prerequisite:** Some background in microbiology.

Evaluation of various low-cost nitrogen sources for ethanol production by *Saccharomyces cerevisiae* (2)
-Dr. Ali Demirci, Associate Professor
-Mr. Kuan-Chen Cheng, Research Assistant

Ethanol, which is also called ethyl alcohol or EtOH, is a clear liquid alcohol. It is also used as a renewable energy source produced by the fermentation of biomasses which are high in carbohydrates such as starch, sugar, or cellulose by microorganisms such as *Saccharomyces cerevisiae* and *Zymomonas mobilis*. Bioethanol has been produced from waste biomass of agriculture and forest industries such as corn stover, sugar cane, wheat straw, and wood chips. Several organic and/or inorganic nitrogen sources were used during ethanol production. The purpose of this study is to evaluate various low-cost nitrogen sources for enhanced ethanol production by *S. cerevisiae*. **Prerequisite:** Some background in microbiology.

Alternate Fuels for Outdoor Power Equipment (6)

-Dr. Aaron M. Yoder, Instructor

-Dr. Douglas H. Schaufler, Instructor

Traditionally, outdoor power equipment has been fueled by petroleum based products, namely gasoline and diesel fuel. This project will look at the alternatives to these traditional products. Internal combustion engine experiments will be used to compare and contrast the use of ethanol and biodiesel for the replacement of gasoline and diesel, respectively.

AGRICULTURAL AND EXTENSION EDUCATION

Engaging Young Adults in Communities through Civic and Social Participation (4)

-Dr. Nicole Webster, Assistant Professor

-Ms. Audrey Stewart, 4-H Youth Program Staff Assistant

Engaging youth as partners in community change is a compelling idea. Translating that idea into effective practice, however, requires attention to several basic principles which can be implemented in a wide range of organizations whose goal is to strengthen their commitment to youth involvement. The goal of this project is for the scholars to conduct a small qualitative study to understand motivational factors which drive young college students to participate in civic activities. Scholars will learn the basics of conducting qualitative research through the methods of assisting in the design and implementation of focus groups, analyzing data, and writing up the results. Scholars will also have the opportunity to see how research turns into practice. They will have the chance to use results from the study to create 3-4 one page fact sheets and create a wiki blog. **Prerequisites:** Scholars must have a working knowledge of PowerPoint and Word.

CROP AND SOIL SCIENCES

Soil Temperature and Moisture Impacts on Ammonia and Nitrous Oxide Emissions (2)

-Dr. Curtis Dell, USDA-ARS and Adjunct Assistant Professor

-Mr. Bart Moyer, Support Scientist, USDA-ARS

Emissions of the nitrogen gases, ammonia and nitrous oxide, from agricultural soils reduces air quality through smog formation (ammonia) and contribute to greenhouse gas concentrations (nitrous oxide). Both gases are greatly influenced by soil condition at the time that fertilizers or manures are applied to soil, which complicates prediction of the quantities of the gases emitted. In the proposed study, scholars will measure ammonia and nitrous oxide emission under combinations of soil temperatures and moistures following livestock manure application. Scholars will have the opportunity to use gas monitoring equipment including a photoacoustic instrument and gas chromatography. **Prerequisites:** High school chemistry and biology.

Genetic and biochemical characterization of maize line for resistance to Northern Leaf Blight (2)

-Dr. Surinder Chopra, Associate Professor
-Dr. Iffa Gaffoor, Postdoctoral Fellow
-Mr. Mandeep Sharma, Graduate Assistant
-Mr. PoHao Wang, Graduate Assistant

Plants are continuously attacked by a variety of organisms and have adopted numerous strategies to avoid or minimize these effects. One way plants defend themselves against fungal attack is to produce antifungal compounds or phytoalexins (compounds that are toxic to fungi) and thereby ward off disease. Our aim is to engineer the production of these defense related compounds in maize and there by confer or increase resistance to several fungal pathogens. These compounds are not produced at right place in maize, for example in leaves due to the absence of expression of genes required for their production. We have produced new maize germplasm with modified genetic constitution. In the current study we want to analyze these new maize plants for their ability to produce phytoalexins when plants are challenged with the fungus.

The scholars will be responsible for testing maize plants for the confirmation of new genes in both field and lab. Students will also get hands on training for testing maize seedlings and mature maize plants for resistance to Northern Corn Leaf Spot disease. They will learn to screen these tissues both visually and biochemically for the induction of defense related compounds.

DAIRY AND ANIMAL SCIENCE

Development of Routine Equine Health Educational Materials (4)

-Dr. Ed Jedrzejewski, Unit Manager, Herdsman, Horse Barn
-Mr. Brian Egan, Instructor
-Mr. Chris Grant, Assistant Barn Manager

Preparation of educational materials for Ag Progress Days. Scholars will prepare educational posters to complement educational talks presented at an annual three day agricultural educational event in August held at Rock Springs, PA.

Understanding Dairy Genetic Evaluations (8)

-Dr. Chad Dechow, Assistant Professor
-Mr. Dale Olver, Instructor

Scholars will review principles of USDA genetic evaluations for production and Holstein USA evaluations for type. They will learn concepts of linear type evaluation and basic functions of dairy herd management computer programs. Scholars will then evaluate the correlation between sire genetic evaluations and results seen in the Penn State dairy herd.

ENTOMOLOGY

Experience and Learning: testing parasitoid wasp plant preferences with different foraging experiences. (2)

-Dr. Mark Mescher, Assistant Professor
-Dr. Consuelo De Moreaes, Associate Professor
-Mr. Tom Bentley, Graduate Assistant

Plants release particular volatile chemicals (odors) into the air in response to attack by insect herbivory. These odors, called herbivore-induced plant volatiles, differ depending on which herbivore species attacks the plant. The odor blend also differs between plants of different species attacked by the same herbivore. Natural enemies of herbivorous insects, particularly parasitoid wasps, can use herbivore-induced plant volatiles in order to find their prey, but they must recognize the correct blend. *(continued)*

Parasitic wasps can often instinctively respond to odor blends emitted in response to their natural prey by plant species with which the parasitoids have shared evolutionary history. Many parasitic wasps can also learn to respond to odor blends that are associated with their prey during foraging.

In this project, scholars will investigate the response of two parasitic wasps to volatile blends induced by the wasps' natural prey, a moth larvae, on several species of tobacco. The project will focus on the effect of foraging experience on the wasps' preference for different species of tobacco. Under the supervision of a graduate research assistant (Tom Bentley), scholars will conduct bioassay experiments in which wasp odor preferences are examined. The scholars will learn about hypothesis testing and the biology and behavior of parasitoid wasps. This project will contribute to a larger study that has potential for publication in a scientific journal. **Prerequisite:** One basic biology course.

Insect-plant-disease interactions: examining the performance of aphids on legumes infected with *Cucumber mosaic virus* and *Bean yellow mosaic virus* (2)

-Ms. Kerry Mauck, Graduate Student

-Ms. Janet Saunders, Research Assistant

-Ms. Lori Shapiro, Graduate Assistant

Cucumber mosaic virus (CMV-L) and *Bean yellow mosaic virus* (BYMV) are common plant pathogens that infect numerous crop and weed species worldwide, including many crops in the economically important Fabaceae family. These viruses are vectored from plant to plant by aphids: insects in the order Hemiptera that feed on the fluids in plant vascular tissues. Bush beans and alfalfa are key crops in the Fabaceae which can incur significant yield losses due to CMV-L and BYMV infection. When these crops become infected they show distinct symptoms that change their appearance and nutrient metabolism (and therefore attractiveness to aphids that vector them to new hosts). Aphids use many sensory mechanisms to choose the best host plants to feed on, including taste, smell, and touch. By choosing a host plant with the most available nutrition an aphid increases its growth and reproduction. Nutrient changes induced by CMV-L and BYMV infection may alter the attractiveness of plants to aphids, with consequences for aphid populations and the spread of viruses to new hosts. However, the host-mediated influence of virus infection on aphid growth is not well understood.

In order to better understand how CMV-L and BYMV interact with aphids through effects on a host plant, the scholars will examine the growth and reproduction of aphids on plants infected with virus relative to uninfected plants. Each scholar will examine a virus-plant-aphid interaction (CMV-L or BYMV) in bush beans and alfalfa. The results of these experiments will contribute to our understanding of the ecology of host plant-virus-vector interactions.

Under the supervision of a graduate assistant (Kerry Mauck) scholars will set up experiments in a greenhouse setting. Scholars will also have the opportunity to observe similar experiments taking place in a field setting. Through this project the scholars will learn the basics of designing and analyzing factorial experiments and become familiar with the biology of plant pathogens and their vectors through hands on experience and review of the literature. This work will also contribute to a larger project that has potential for publication in a scientific journal. **Prerequisite:** One basic biology course.

Hygienic Behavior in Honeybees (2)

-Ms. Tracy Conklin, Graduate Assistant

-Mr. Dan Schmehl, Graduate Assistant

-Dr. James Frazier, Professor

This project will focus on the response of honeybees to pathogens and parasites in the hive. When honeybees clean out or kill these invaders, they are said to be exhibiting "hygienic" behavior. Students will have the opportunity to design experiments to quantify hygienic behavior in honeybee hives and examine factors that influence hygienic behavior such as queen presence, temperature, and type of pathogen or parasite. Currently, an alarming decline in honeybee populations is occurring worldwide due to Colony Collapse Disorder, which may be caused by pathogens and parasites. This research may help us to understand how to better protect honeybees by increasing hygienic behaviors. During this project students will learn about honeybee biology and beekeeping at the Penn State apiary, and get hands-on experience in microbiology, chemistry, and insect behavior.

Investigating the effects of herbicide on interactions between beneficial soil bacteria, herbicide-resistant soybeans, and insect herbivores (2)

-Dr. Mark Mescher, Assistant Professor

-Dr. Consuelo De Moreaes, Associate Professor

-Ms. Beth Irwin, Graduate Assistant

The use of genetically modified (GM) plants in agriculture has increased dramatically in recent years, and the potential impacts of genetic engineering on the interactions between crop plants and other organisms is an issue that requires significant study. GM soybeans engineered for herbicide-resistance allow herbicides like Roundup to kill weeds without damaging crop plants. While "Roundup-Ready" GM soybeans can tolerate the herbicide, the nitrogen-fixing bacteria (rhizobia) that form a symbiotic relationship with soybean roots apparently cannot, and the mutualism can be disrupted when Roundup is applied.

Roundup has been shown to delay nitrogen fixation, decrease crop biomass, and decrease nitrogen-accumulation in soybeans treated with commercial rhizobia inoculants at planting. However, soybeans also commonly interact with naturally occurring rhizobia, and the effect of Roundup on these local strains remains completely unexplored. There is also evidence to suggest that these local strains of rhizobia benefit non-GM soybeans by reducing aphid populations, but nothing is known about the effects of Roundup on GM soybean defenses against insect herbivores.

Scholars will work closely with a graduate student mentor (Beth Irwin) to determine how Roundup affects the natural relationships between local strains of soil bacteria, soybean plants, and insect herbivores. Working with their mentor, scholars will design an experiment to meet the goals of this project and then carry out their study in the greenhouse. Scholars will also have the opportunity to observe similar experiments on Roundup-Ready GM soybeans taking place at a research farm and participate in data collection that may contribute to publication in a scholarly journal. Through this project, students will gain direct exposure to all aspects of the scientific method, including hypothesis formulation, project design, data collection and analysis, and formal presentation of results. Scholars will be introduced to various aspects of microbiology, botany, and ecology through their own experimentation as well as a review of the current literature and their work will enhance our understanding of microbe—plant—insect interactions. **Prerequisite:** One general biology course.

Sublethal effects of pesticides on honeybees (2)

-Mr. Daniel Schmehl, Graduate Assistant

-Ms. Tracy Conklin, Graduate Assistant

-Dr. Jim Frazier, Professor

-Ms. Sara Ashcraft, Research Technician

Honeybees are generalist pollinators that are exposed to numerous pesticides while foraging for pollen and nectar. Many different pesticides have recently been found to accumulate in the hive and can have a negative effect on honeybee health and behavior. While there is little known about the exact cause of Colony Collapse Disorder (CCD) responsible for the recent international honeybee decline, pesticides are thought to be one contributing factor. The combination of several pesticides within the hive may have synergistic, sublethal effects. Sublethal effects could affect honeybee learning, dance behavior, location of food sources, detection of harmful compounds, pheromone production, brood rearing, and hygienic behavior.

In order to better understand sublethal pesticide effects on honeybees, scholars will examine the Proboscis Extension Response (PER) after exposure to different pesticides (both individual and pesticide combinations). These experiments will take place both in the field and in the lab under the guidance of their graduate assistant mentor. They will have the opportunity to learn about honeybee biology with first-hand experience working in the Penn State Apiary, and learn about laboratory techniques for experimental insect physiology and behavior using PER. Through these experiments, students will gain a thorough understanding of the harmful effects of pesticides on honeybee health.

ENVIRONMENTAL AND FOREST RESOURCES

Invasive Plants and Organisms in Pennsylvania's Forests (6)

-Dr. Sanford Smith, Extension Specialist, Natural Resources and Youth Education

Scholars undertaking this ISP project will explore the issue of invasive plants and organisms in Pennsylvania's forests. Numerous invasive plants, animals, and diseases pose serious threats to our forests. We need to understand these organisms and develop biologically sound ways to control them. ISP scholars will do assigned readings on Invasion Ecology, observe invasives in the field, and develop an educational poster on one or several invasives of importance.

Effects of Removing Small Dams on Aquatic Biota (2)

-Dr. Paola Ferreri, Associate Professor, Fisheries Management

-Ms. Brianna Hutchison, Graduate Research Assistant

Removal of small dams is becoming increasingly popular as a stream restoration tool. Although there is much information in the literature about the effects of dams on river systems and on the effect of removing dams on the physical character of streams, little information exists regarding the effects of dam removals on biotic communities. The scholars working on this project will review literature regarding the effects of dam removals on biological assemblages and work in the lab on existing samples of benthic macroinvertebrates from an on-going dam removal project. In the lab, the students will learn to sort and identify benthic macroinvertebrates to the Family level. Using existing data, as well as data generated from the literature review and current lab work, scholars evaluate potential differences in the macroinvertebrate assemblage above and below a dam.

FOOD SCIENCE

Glycemic index of foods (2)

-Dr. Swamy Anantheswaran, Professor

-Tanuj Motwani, Graduate Assistant

The glycemic index (GI) ranks carbohydrates according to their effect on our blood glucose levels. Choosing low GI carbohydrate containing foods is the secret to reducing the risk of heart disease and diabetes and key to sustainable weight loss. We will examine the release of soluble sugars by different food products by analytical methods and correlate them with their glycemic index. **Prerequisite:** An interest in physical/engineering sciences.

Modeling the inactivation of microorganisms by ultraviolet light (2)

-Dr. Swamy Anantheswaran, Professor

-Minal Lalpuria, Graduate Assistant

Ultraviolet light is being increasingly used as a means to pasteurize juice products without any of the thermal degradation in juice quality. The inactivation kinetics of microorganisms in model juice products will be studied in juice products. **Prerequisite:** An interest in physical/engineering sciences.

Methods to improve shelf-life of fresh mushrooms (2)

-Dr. Swamy Anantheswaran, Professor

-Rohan Tikekar, Graduate Assistant

The mushroom industry is in constant need of improved methods for increasing the shelf-life of fresh mushrooms. The shelf-life is impacted by browning reactions, bacterial growth, weight loss and opening of the cap. The effect of different washing treatments, anti-browning agents and antimicrobials on the shelf-life of fresh mushrooms will be studied. The effect of these treatments on color, maturity index and weight loss of mushrooms, stored at different temperatures will be evaluated. **Prerequisite:** An interest in physical/engineering sciences.

HORTICULTURE & LANDSCAPE CONTRACTING

Green roofs, living walls, and constructed wetlands (6)

-Dr. Robert Berghage, Associate Professor

-Mr. Robert Cameron, Ph.D. Candidate

-Ms. Katie Sanford, Graduate Assistant

Scholars will be working with a green roof, a living wall, and a constructed wetland characterizing the function of the 3 integrated systems and evaluating waste water treatment. The depth of the project will depend on the number of students involved.

Study of Row Cover on Light Levels and Light Quality in an Apple Orchard (2)

-Dr. Robert Crassweller, Professor

-Dr. Dennis Decoteau, Professor

-Mr. Donald Smith, Research Assistant

-Dr. Greg Krawczyk, Research Associate

Light is the most important factor in fruit production. Light affects fruit size, flower formation, return bloom, and fruit color. The most productive and efficient orchards are those whose canopy intercepts the maximum amount of light. When levels fall below 50% of full sunlight fruit size is reduced, when they fall below 40% of full sunlight fruit color is reduced and when they fall below 30% development of spurs in apples and flowers are reduced. Recently a new product has become available in the U.S. that was developed in New Zealand. The product Extenday® has been shown to increase fruit color when the fabric is spread on the orchard floor. The fabric is a woven polypropylene of sufficient

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strength and quality that it can support the use of tractors. A team of two scholars involved in this study would work in a block of Honeycrisp apples at the Horticulture Research Farm at Rock Springs. The reflective fabric has been installed underneath several trees. Scholars will take light level measurements on a periodic basis at different levels in the canopy and take light quality measurements in trees and compare them to similar measurements taken in trees that do not have the cloth.

POULTRY SCIENCE

Taking Flight! (2)

-Dr. Guy Barbato, Associate Professor

Evolutionary progress of reptiles to birds. The project will involve detailed anatomical investigation of the reptile vs. bird – culminating in the construction of a dinosaur skeleton and/or fossil from chicken bones.

Gamete-gamete interactions: Proteins and fertilization (2)

-Dr. Guy Barbato, Associate Professor

Oocyte proteins involved in sperm recognition. The project will involve the isolation and characterization of oocyte proteins involved in sperm-egg binding via gel electrophoresis, western blotting, and ELISA-like assays . **Prerequisites:** Preferably scholars who have had chemistry (e.g. can calculate molarity, % solutions, etc.); big advantage if they have run gels in bio or chem labs.

*The **(#)** indicates the number of scholars to be assigned to each project.*