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Physical Therapy and Regenerative Medicine: Current Knowledge and Future Prospects

Vance Pounders, Sarah McArthur, Julian Rinehart, Ryan McQueen, Edilberto Raynes, Melinda Roca-Menchavez, Edilberto Raynes (Research Advisor)

Disorders affecting the central nervous system (CNS) leave patients with life-altering disabilities. Injuries that occur in the brain and spinal cord are difficult to treat due to the lack of neuroregeneration in the CNS. Research demonstrates that regenerative medicine and physical therapy techniques can provide structural and functional improvements; however, there is limited research evaluating the combined approach. Regenerative medicine can mitigate the anatomical and physiological destruction caused by a CNS injury; while, physical therapy techniques can help the body restore normal function. The purpose of the study was to evaluate the efficacy of combination therapy using regenerative medicine and physical therapy and its impact on therapeutic outcomes for patients with CNS disorders. Using PubMed, Google Scholar, and other databases, a systematic review was conducted and ranked using the Oxford Levels of Evidence. Based on the gathered evidence, we surmised that combination of regenerative medicine and physical therapy approaches could facilitate treatment of CNS injuries and lesions.

Keywords: Central nervous system, regenerative medicine, physical therapy, injuries/lesions, stem cells, and exercise

Triclosan alters the ability of human immune cells to synthesize TNF alpha

Sara Jamal, Margaret Whalen (Research Advisor)

Triclosan (TCS) is an environmental contaminant added as an antibacterial agent to many products including mouthwashes, soaps, toothpastes, deodorants, and beauty products. It has been found in human blood plasma, urine, and breast milk. Tumor Necrosis Factor Alpha (TNF α) is an essential pro-inflammatory cytokine that is produced by monocytes, macrophages, lymphocytes and neutrophils. TNF acts as a systemic inflammatory mediator in response to sepsis and infectious disease. Increased levels of TNF α can cause the stimulation of macrophages and helper T cells to produce additional inflammatory cytokines contributing to inflammation. While a normal inflammatory response is critical to health, high levels of inflammatory proteins such as TNF α can lead to chronic inflammation, which contributes to a number of disease states including cancer. Alternatively, if immune cells are unable to secrete adequate amounts of TNF α this would leave the organism susceptible to infections. Previously, it was shown that exposure to certain concentrations of TCS caused increased secretion of TNF α within 24 h. We hypothesize that these increases in TNF α are caused by TCS-induced increases in TNF α synthesis. This study examines the effect of TCS on TNF α synthesis (secreted levels plus intracellular levels) in human immune cells. Peripheral blood mononuclear cells (PBMCs) were treated with TCS at concentration of 0.05-5 μ M for 24 h. Levels of secreted TNF α were measured by using enzyme-linked immunosorbent assay (ELISA) while intracellular levels were determined with western blot. The results indicate that a 24 h exposure to TCS caused an increase in TNF α synthesis at one or more exposure concentration. These data indicate that exposure of (PBMCs) to TCS not only increases secretion of TNF α but also increases the cells production of TNF α . Thus, TCS may have the capacity to cause chronic inflammation by increasing the synthesis and secretion of this potent pro-inflammatory protein.

The role of selected cell signaling pathways in pentachlorophenol-induced synthesis of IL-1 β

JaQuel Maise, Sahra Gabure, Tamara Martin, Margaret Whalen (Research Advisor)

Pentachlorophenol (PCP) has been widely used as a wood preservative, fungicide, pesticide, and herbicide. Pentachlorophenol cannot be broken down in the body. Serum levels of PCP as high as 5 μM have been found in individuals living in log cabin homes. Levels averaging 0.15 μM have been seen in the blood of persons with no known exposure. A previous study has shown that there is an increase in synthesis (intracellular + secreted levels) of the inflammatory cytokine interleukin-1 β (IL-1 β) in peripheral blood mononuclear cells (PBMCs) exposed to environmentally relevant concentrations of PCP. Inappropriately elevated IL-1 β is linked to tumor growth and chronic inflammation. This study examines the role of selected signaling pathways in the PCP-induced elevation of IL-1 β synthesis. Pathways studied are the mitogen activated protein kinases (MAPK) ERK 1/2 and p38, and phosphatidylinositol 3-Kinase (PI3K) pathways. ERK 1/2 pathway was inhibited with the MEK inhibitor PD98059, p38 with SB20350, and PI3K with LY294002. PBMCs were exposed to the appropriate inhibitor for 1 h prior to being treated with PCP at concentrations of 1-5 μM . The results of the study indicated that PCP-induced IL-1 β synthesis is dependent on PCP activation of the p38 MAPK pathway (cells from 4 separate donors). ERK 1/2 MAPK was required for PCP-stimulated IL-1 β synthesis in the cells from 2 of 4 donors. Thus, synthesis of the potent pro-inflammatory cytokine, IL-1 β , appears to require PCP stimulation of the p38 MAPK pathway.

Exposure of human immune cells to Triclosan alters synthesis of IFN γ

Farah Ismail, Wendy Wilburn, Margaret Whalen (Research Advisor)

The compound Triclosan (TCS) is widely used and thus contaminates the environment. TCS is used as an antifungal and antibacterial agent in many products such as: toothpaste, soaps, detergents, toys, surgical cleaning treatments, cosmetics, kitchenware, clothes, and office and school products. It is found in human blood and tissue samples. Interferon gamma (IFN γ) is a cytokine that is specialized for innate and adaptive immunity against viral infections. IFN γ is important for immunity against intracellular pathogens and for tumor control. As a pro-inflammatory cytokine, inappropriately elevated levels of IFN γ can cause chronic inflammation, which has been shown to enhance the development and progression of certain cancers as well as other diseases. Accurate regulation of IFN γ levels is important to avoid the loss of immune capability or the occurrence of chronic inflammation. Based on earlier studies showing that TCS exposure increases IFN γ secretion from immune cells, we hypothesize that this increase in secretion may be due to TCS-induced increases in synthesis of IFN γ . The aim of this study is to investigate whether TCS alters the synthesis (secretion plus intracellular levels) of IFN γ from human immune cells. Human peripheral blood mononuclear cells (PBMCs) were treated with 0-5 μ M TCS for 24 h, and 48 h. IFN γ secretion was measured by enzyme linked immunosorbent assay (ELISA), and the intracellular levels were measured by western blots. It appears that exposure to certain concentrations of TCS for 48 h increased the synthesis of IFN γ . The ability of TCS to increase IFN γ synthesis in vitro suggests the potential for TCS exposures to produce chronic inflammation.

The Effect of Sodium Glucose Transporter 2 Inhibitors on Proliferation and Growth Factor Signaling Pathways in Triple Negative Breast Cancer

Kierra Ware, LaMonica Stewart (Research Advisor)

Triple negative breast cancer (TNBC) is an aggressive form of breast cancer that does not express the estrogen receptor, progesterone receptor, and the HER2 receptor. Since it does not express these receptors, TNBC does not respond to many of the standard therapies for breast cancer. To decrease the number of deaths associated with breast cancer, we must identify therapeutic strategies that effectively prevent the growth and progression of TNBC. Recent studies from our laboratory and others show that the sodium glucose transporter 2 (SGLT2) inhibitor canagliflozin reduces proliferation of human prostate cancer cell lines. To determine whether SGLT2 inhibitors can also suppress TNBC growth, we tested the effect of canagliflozin and other SGLT2 inhibitors on proliferation and protein expression within the BT-549 human breast cancer cells. Presto Blue assays revealed that two SGLT2 inhibitors, canagliflozin and ipragliflozin, significantly inhibited BT-549 cell proliferation. However, the SGLT2 inhibitor empagliflozin produced little to no change in cell proliferation. We next examined the effect of SGLT2 inhibitors on Akt and Erk $\frac{1}{2}$ MAP kinase, two proteins that promote TNBC growth. Western blot analysis revealed that canagliflozin reduced phosphorylation of Akt and Erk $\frac{1}{2}$ within BT-549 cells. Therefore, the ability of canagliflozin to block BT-549 proliferation may be due in part to canagliflozin-mediated decreases in Akt and Erk activity. The epidermal growth factor receptor (EGFR) activates both Akt and Erk $\frac{1}{2}$ signaling in BT-549 cells. To determine whether inhibition of EGFR signaling would alter the response to canagliflozin, we tested the combined effect of canagliflozin and EGFR inhibitors on BT-549 cell proliferation. Canagliflozin alone was more effective at reducing BT-549 cell proliferation than the EGFR inhibitors gefitinib and lapatinib. However, the combined effect of canagliflozin and gefitinib as well as the combined effect of canagliflozin and

CpG Methylation Inhibits Prolidase Promoter Driven Transcription

Zeljka Miletic-Lanaghan, Chandravanu Dash (Research Advisor)

Prolidase, a cytosolic exopeptidase, is encoded by the PEPD gene in humans. Prolidase is the only enzyme which can cleave dipeptides containing hydroxyproline, and plays an essential role in protein metabolism, collagen turnover, and matrix remodeling. In initial studies, we observed a dense CG-rich portion around the transcription start site, suggesting a possible role of promoter methylation in the transcriptional regulation. From the human genome, we cloned the human PEPD promoter and inserted it into a luciferase reporter construct. Next, we performed in vitro methylation of the promoter using SssI methyltransferase which methylates DNA CpG islands. Methylation was confirmed by BstUI digestion. The CpG methylation significantly inhibited PEPD promoter activity in comparison to the unmethylated construct. We believe, these results will generate new knowledge on the molecular regulation of prolidase and provide better insight in our understanding of regulation of prolidase expression in various physiological and pathological conditions.

Effects of the Brominated Flame Retardant, Hexabromocyclododecane, on the Synthesis of the Pro-inflammatory Cytokine, Interleukin 1 beta, in Human Immune Cells

April Falconer, Syeda Shahid, Margaret Whalen (Research Advisor)

Elevated levels of pro-inflammatory cytokines such as interleukin 1 beta (IL-1 β) have been associated with a number of disease states including cancer. Thus, synthesis and secretion of this potent regulator of inflammation in the absence of infection or injury can lead to chronic inflammation and those diseases that result, such as tumor growth, rheumatoid arthritis, Crohn's disease, and multiple sclerosis. Hexabromocyclododecane (HBCD) is a brominated flame retardant used in polystyrene insulation as well as other products such as upholstery and has been found in human blood and other tissues. A previous study showed that HBCD at certain concentrations increased the secretion of IL-1 β from human immune cells. This study examines whether HBCD causes increases in the synthesis (intracellular plus secreted levels) of IL-1 β from monocyte-depleted human peripheral blood mononuclear cells (MD-PBMCs). IL-1 β secretion was measured by enzyme linked immunosorbent assay (ELISA) and intracellular levels were measured using western blot. Preliminary results indicate that certain exposures of MD-PBMCs to HBCD (ranging from 5-0.05 μ M) for 24 h increase synthesis of IL-1 β in immune cells. These results suggest that HBCD is not simply increasing the release of pre-existing IL-1 β (leading to increased secretion that would be self limiting) but is instead stimulating immune cells to synthesize this cytokine. Thus, HBCD may stimulate sustained elevation of IL-1 β and lead to chronic inflammation.

Improving quality assurance to increase client satisfaction

Lauren McKeever, Priscilla Randolph, Danielle Watson (Research Advisor)

The purpose of this study is to evaluate the efficacy of a quality assurance program currently being utilized by the TSU Speech and Language Clinic. Each semester, clients who attend the TSU Speech and Language Clinic are encouraged to complete and return a Client Satisfaction survey which examines a combination of factors including overall satisfaction and a series of attribute satisfaction and behavior measures. This study examined the data from two semesters: Summer 2018 and Fall 2018. An analysis of data indicated that out of 63 total clients served over the two semesters, only 32 completed and returned a survey. This data yields a response rate of 50%. Survey data further revealed that 95% of the Summer semester clients and 97% of the Fall semester clients rated their services as "Excellent". However, due to the low response rate, general assumptions about overall client satisfaction cannot be made. Additionally, in some cases, client comments were in contrast to the rating they provided. As a result of these factors, there is a need for an improved method for obtaining client feedback in the TSU Speech and Language Clinic. Implications and recommendations for improving a quality assurance program and increasing client satisfaction will be discussed.

Impacts of prescribed fire and forest thinning on tick populations and prevalence of tick-borne diseases in a southeastern mixed pine forest

Brent Newman, William Sutton (Research Advisor)

Landscape disturbance in the form of forest management can greatly alter habitat and climatic conditions causing shifts in host community composition as well as zoonotic disease pathways. However, the extent that tick populations and prevalence of tick-borne diseases are impacted by forest management in the southeastern United States remains poorly understood. From June to August 2016 and 2017, we evaluated the effects of prescribed fire and forest thinning on tick species diversity and abundance as well as tick-borne disease prevalence at 18 management stands within the William B. Bankhead National Forest, Alabama. Our results suggest heavy thinning may lead to a significant increase in tick populations while both heavy and light thinning coupled with prescribed fire application may significantly decrease tick populations. Tick species composition was unaffected by management as Lone star ticks (*Amblyomma americanum*) were the most commonly encountered species in 2016 and 2017 (93% and 94% of total specimens, respectively). *Borrelia lonestari* was detected from collected ticks (n= 20, 1.2%), however, forest management technique did not impact disease prevalence. Our data indicate that forest management may be an effective option for managing tick populations in the southeastern United States which may decrease opportunity for tick-borne disease transmission.

Funding: USDA, NIFA

DEVELOPMENT OF CYBER PHYSICAL IIOT MONITORING AND CONTROL SYSTEM

Anthony Wadsworth, Saleh Zein-Sabatto (Research Advisor)

Industries are always looking for ways to improve efficiency, productivity, and functionality of their industrial operations. With the inception of Industry 4.0 (the fourth industrial revolution), which includes the incorporation of networked sensors, actuators, and other embedded micro-systems (formally referred to as cyber-physical systems CPS), implementation of CPS became elements of the industrial internet of things (IIoT). The increase in online access and control given by the incorporation of the aforementioned systems introduced a new problem with securing the operations of the CPS. In other words, increasing the access of these systems inevitably increases the security risks. Furthermore, the integration of these smart things into the standard internet incites new challenges to network security as they are not supported by those standard protocols already in place. This ushers in an even greater reinforced need for better cyber security methods for these CPS systems. The proposed project includes the design of a local security protocol that will protect an IIoT system. This is accomplished by establishing a series of predefined boundary conditions of the safety critical parameters for which the system can safely operate within. If the system begins to operate outside of these parameters'™ safety limits, it will disconnect from all external network and default to some predefined safe-mode until the system has been evaluated by an administrator and released from the safe-mode setting.

Assessing the performance of a Forecasting Model and Published Forecast Advisories on Hurricane Storm Surge Generation and Propagation in Hurricane Rita Case Study

Abram Musinguzi, Muhammad Akbar (Research Advisor)

The hurricane's path is largely dictated by wind. As hurricanes invariably continue to pose coastal risk for damage, a method to accurately determine the wind field information remains a high-priority topic of research. The goal of this research is to assess performance of forecasted windfield on hurricane storm surge generation and propagation. Surface wind fields for Hurricane Rita are generated using both Weather Research and Forecasting (WRF) model and published hurricane advisories and are fed into Generalized Asymmetric Holland Model (GAHM) to force SWAN+ADCIRC, a storm surge model. Results of wind fields from Ocean Weather Inc. (OWI) Interactive Objective Kinematic Analysis (IOKA) model and best track wind data in GAHM are used to benchmark the forecasted results. Forecasted storm surge results are compared with hurricane observed data to assess the performance of wind fields on the storm surge generation and propagation.

Flexible Skin Design for Wing Morphing Applications

Bashir Alsaidi, Muhammad Akbar (Research Advisor)

The theory behind altering the geometry of the wing, known as the "wing morphing", is that it will lead to an improved performance and efficiency of flight of the vehicle. When any morphing wing structures and controls are considered, an important parameter is often overlooked, which is the skin for the wing. Conventional fixed wings only require a certain thickness of skin material/structure to endure aerodynamic loading in general. However, the nature of morphing wings that constantly change and adjust wing shapes to optimize the flight performance makes the skin design much more complicated and challenging. When the wing morphs, the skin should comply with the altered geometry while maintaining its stiffness for aerodynamic loadings in various flight modes. Advantages of flexible skins include their large deformation capability and low elastic modulus. However, many works in the design of skins for morphing wings, which typically use smart materials, consider only geometric or static deformations but not dynamic ones. A simple geometry-structured material for skin is not very compliant for multi-dimensional morphing motions such as camber change and twisting, limited in meeting various aerodynamic and structural loadings and stresses, and expensive to establish design process for customized skins for morphing wings. The main theme of this proposal is to design advanced skin structures for camber morphing wing aircraft. Thus, this study focuses on skin design process and procedure for Variable Camber Compliant Wings (VCCW) through modeling, stress/strain analysis, and experiments of solid and lattice structures.

The Saffir-Simpson Scale: Simple, Straightforward, and Insufficient

Kyra Bryant, Muhammad Akbar (Research Advisor)

Is the Saffir-Simpson Scale really the best way to communicate hurricane hazards to the public? It certainly serves its original purpose of forecasting structural damage imposed by hurricane winds, but historical and more recent storms have proven the cunning complexity of a hurricane. Wind is only one component of these massive, powerful, and devastating disasters. Measuring a storm by one single parameter to communicate to the public is misleading. As Hurricane Harvey (2017) and Hurricane Florence (2018) approached landfall, many mainstream media outlets used headlines reporting the storm had “downgraded” or “weakened”. In terms of wind, this was certainly true, but it inadvertently delivered a false sense of relief to the public. If rain and storm surge are a hurricane’s most destructive features, why use only wind to describe it?

Additionally, a six-week-span of the 2018 hurricane season witnessed five hurricanes undergo rapid intensification. This pattern suggests an increasing rate of intensification in today’s storms. Hurricane Florence increased 55 mph in 24 hours over the open Atlantic. Hurricane Michael (2018) repeated similar behavior, except it occurred right before landfall, proving to be catastrophic. While intensity forecasting is difficult and highly sought after, it still must be communicated to coastal communities appropriately.

This study explores the importance of increasing the public’s scientific literacy and surveys alternative warning systems for broadcasting that incorporate more than just a hurricane’s wind speed. Finally, a modified hurricane scale is proposed.

Methods to improve Photovoltaic Module efficiency using Finite Element Analysis

Rama Annamraju, Muhammad Akbar (Research Advisor)

We will research on the performance optimization of the PV solar cells and ways to improve the efficiency. Radiation from sunlight directly converted into electricity and studies have showed that the efficiency of the PV solar cells is inversely proportional to their operating temperature. The aim of our project is to design a photovoltaic solar module and carry out finite element analysis on the module in order to find ways to optimize its thermal efficiency. We have examined the effect of operating temperature and design parameters of a hybrid photovoltaic module on its overall energy efficiency. Based on this, we introduce some new design criteria to the standard production model such as finned components and the use of phase change materials (PCM) in the module to obtain higher efficiency than currently reported values at a maximum of 15%. Finite element analysis was carried out using ANSYS thermal and fluent software. A quarter section of the standard production panel is modeled to reduce the errors during numerical iterations. The input parameters include ambient temperature 30°C , heat flux on the components $733\text{W}/\text{m}^2$ and heat convection around the panel $5.8\text{ W}/\text{m}^2\text{K}$. The results of the design change decrease the average temperature of the panel to 53.2°C from 63.3°C . The introduction of the fins at the bottom of the panel resulted in the increase of the surface area reducing the average temperature of the panel.

Further study includes the introduction of phase change materials (PCM) which can act as both heat sink and heat storage. PCMs like paraffin wax are being used by the NASA for thermal management in the international space station. We will use the integration between Ansys thermal and fluent to analyze the effect of PCM as a heat sink. This study can help industries produce highly efficient solar panels using standard manufacturing processes.

Aerodynamic Study of the SERI-8 Wind Turbine Blade Using CFD Techniques

Alhussien Alsamadani, Rama Annamraju, Muhammad Akbar (Research Advisor)

A detailed process of computational fluid dynamic (CFD) simulations of the medium size 20-100 kW horizontal axis wind turbine (HAWT) blade is investigated. The main objective is to understand the performance of HAWT-blades under different wind speeds. A Solar Energy Research Institute-8 (SERI-8) wind turbine blade is selected for this project. The blade has a span of 7.9 m, which starts with cylindrical shape at the root and transitions through various airfoil profiles all the way up to the tip. The blade is designed using 3D Solidworks software, which is then imported to ANSYS Fluent 18.2 for the CFD modeling.

Four scenarios with four different velocities (5, 10, 15, and 20 m/s) are studied. The conservation of mass and momentum (Navier-Stokes equations), as well as ϵ - k Shear Stress Transport (SST) turbulence model, are used to obtain an accurate flow around the blade. The simulated results are very comparable to the experimental values reported in the literature. The simulated torques are within 4.7, 2.6, 2.8, and 1.5% of those reported in the literature for wind speeds of 5, 10, 15, and 20 m/s, respectively. The results indicate that the CFD study performed here is correct and reliable for further aerodynamic and optimization study of the HAWT. Attempts are made to find out the optimum angle of attack for maximum torque produced for each wind speed. For this purpose, different angles of attack are chosen, such as 3° , 4° , 5° , 6° , 7° , 9° , and 11° . The output torque appears to initially increase and then decrease with angle of attack, indicating an optimum value for maximum power output. The results of the generated torques shows that the 5° angle of attack produces the highest output torque for all four-wind speeds used in the present study.

SKP2 Inactivation Suppresses Cell Proliferation and Regulates AR/FOXA1 Expression in Prostate Cancer Cells

Sherly Celada, Robert Matsik, Wenfu Lu, Guoliang Li, Thanigaivelan Kanagasabai, Xiaofei Wang (Research Advisor)

Increased levels of SKP2, an E3 ubiquitin ligase, is frequently seen in advanced stages of prostate cancer (PCa). Correlations between SKP2 and the ubiquitin-mediated degradation of key cell cycle regulators such as p21 and p27, and between SKP2 and the regulation of androgen receptor (AR) activity is frequently observed in PCa progression. Despite these associations, the molecular mechanisms responsible for the proto-oncogenic effects of SKP2 in PCa remain elusive. The transcription factor FOXA1 is known to induce AR activity, and by doing so cause the activation of AR target genes. Deregulation of the AR/FOXA1 complex has been found to contribute to the progression of PCa and castration-resistant prostate cancer (CRPC). We hypothesized that SKP2 impacts the function of both AR and FOXA1 contributing to the progression of CRPC. We established stable SKP2 knockdown PCa cell lines to investigate the effects of SKP2 on CRPC growth. Results demonstrate that SKP2 plays a critical role in the regulation of AR and FOXA1 expression in CRPC cell lines. SKP2 inactivation increased AR and FOXA1 levels in C4-2B and 22RV1 cells, two CRPC cell lines. Endogenous and Myc-tagged SKP2 as well as Flag-tagged FOXA1 immunoprecipitation displayed a physical interaction between SKP2 and FOXA1. Mechanistically, *in vivo* ubiquitination assay demonstrated that SKP2 is an E3 ubiquitin ligase for FOXA1 catalyzing the synthesis of K6 and K29-linked polyubiquitin chains. Furthermore, SKP2 knockdown significantly inhibited cellular proliferation and restored sensitivity to the AR antagonist (MDV3100) in C4-2B and 22RV1 cells. While combined exposure to the AR antagonist (MDV3100) and a SKP2 inhibitor significantly reduced cellular proliferation both *in vivo* in Pten/Trp53 mutant mice and *in vitro*, a result of cell cycle arrest and cellular senescence in C4-2B and 22RV1. Our findings present a potential SKP2-AR/FOXA1 signaling pathway that may be targeted therapeutically to inhibit CRPC malignancy.

Spatial Ecology of Eastern Hellbenders Prior to Translocation

Bradley Nissen, Emily Nolan, William Sutton (Research Advisor)

Successful translocation programs are dependent upon the quality of the habitats where animals are released, and a detailed knowledge of spatial ecology. Due to population declines throughout its range, the Eastern Hellbender salamander (*Cryptobranchus alleganiensis alleganiensis*) is a strong candidate for translocation in Tennessee. We used radio-telemetry to evaluate the spatial ecology (i.e. home range size and movements) and multi-scale habitat use of individual Eastern Hellbenders (N =27) in two sustainable populations to estimate suitable sites for translocations and to establish a baseline that can be used as a comparison after translocation. Our preliminary results of this on-going study show that most Hellbenders do not make frequent or large movements during summer months, and individuals spend most of their time under large (>30 cm) boulders. We found a median home range length of 133 m in Tumbling Creek and 79 m in Hiwassee River. We conclude that large boulders are a vital habitat requirement for translocation sites, and we predict that a successful translocation would involve hellbenders quickly locating suitable habitat and having similar sedentary movement patterns.

The effects of nitrogen fertilizer rates and winter canola cultivars on winter mortality and canopy coverage for two growing seasons in Middle TN

Kyle McGeary, Jason de Koff (Research Advisor)

The use of cover crops between annual crop rotations is a common conservation practice. There are many cover crops that farmers have available to them including using flowering crops which have the ability to provide the same benefits as non-flowering crops but can also support beneficial insect communities like pollinators. Winter canola (*Brassica napus* L.) production has steadily increased over the past few decades due to its ability to be utilized as a cover crop, rotational crop, pollinator habitat, and a biodiesel feedstock. Due to a lack of research in the southeastern U.S. on characteristics of winter canola, the objectives of this study sought to determine the effects of five different nitrogen (N) fertilizer rates on winter mortality and soil cover across three different cultivars from 2017/2018 and 2018/2019. Canola was grown in a randomized split plot design under 5 different N rates (0, 56, 111, 168, 223 kg N/ha) with three different cultivars (Hekip, Inspiration, Edimax CL/Phoenix CL) and four replications. Plant counts were collected in October 2017/2018 and March 2018/2019 to determine winter mortality, soil cover was determined using the Canopeo (Oklahoma State University) application. Winter mortality data from spring 2018 indicated large losses in all cultivars across all nitrogen rates and will be compared to spring 2019 results. Inspiration had the greatest soil coverage in 2017 and Phoenix CL was greatest in 2018. As expected, time had a greater effect on soil coverage than N rates.

Effect of biochar and nitrogen fertilizer on soil health characteristics in a switchgrass production system

Priya Saini, Jason de Koff (Research Advisor)

Switchgrass has gained much attention as a cellulosic biomass feedstock for the production of renewable fuels though maintaining ecosystem services, like good soil health, and reducing costs are also important in these systems. Switchgrass requires nitrogen (N) for proper stand maintenance and biomass production. Recently, biochar (a co-product of pyrolysis) has been proposed as a soil amendment, due to its several environmental benefits including carbon sequestration, soil fertility enhancement and crop yield improvement. Investigating soil health properties is crucial to ensure ecosystem benefits of switchgrass production and reduce the adverse effects of agricultural practices on soil. Aggregate stability is an important measure and a good indicator of soil stability and erodibility. Soil aggregates aid in physically entrapping soil carbon and making it inaccessible to soil microbes. Secondly, the active soil carbon pool is also an important soil health indicator for studying overall soil quality and soil carbon accumulation. It is hypothesized that biochar addition will both improve soil health and reduce the amount of N application required. The objectives of our study, therefore, are to identify the effect of different rates of N fertilizer and biochar applications on soil aggregate stability and active soil organic carbon pool in switchgrass field and also to compare and relate these changes to plant properties or yield data. Four rates of nitrogen fertilizer (0, 17, 34, 67 kg N/ha) and two rates of biochar (0 and 9 Mg/ha) were applied in a randomized complete block design. Soil samples were collected in 2017 and 2018 and analyzed to determine different soil health properties. Various lab experiments were conducted to analyze soil and plant characteristics. Results from these analyses will be discussed.

COMPARISON OF CHYTRID PREVALENCE IN EASTERN HELLBENDERS IN SOUTHEAST TENNESSEE STREAMS.

Emilly Nolan, Bill Sutton (Research Advisor)

Populations of Eastern Hellbenders have been declining across their historic ranges due to habitat loss, overcollection, and environmental degradation. The chytrid fungus *Batrachochytrium dendrobatidis* is a leading cause of amphibian species loss, and has been recorded in hellbenders throughout their range. In this study, 27 hellbenders from two streams in southeast Tennessee were implanted with radio transmitters to track daily movements, determine home range size as part of a larger translocation project. Determining disease prevalence in these hellbenders is crucial as it will help us to monitor overall health of study animals. Hellbenders were swabbed for chytrid once before receiving transmitters and opportunistically throughout the summer. Samples will be tested for presence of *B. dendrobatidis* and *B. salamandrivorans* using qPCR. Chytrid prevalence will be compared between the two study sites, and any infection differences in size class will also be calculated. Summer seasonality of chytrid infection in hellbenders will also be tested as it will provide us with an ideal sampling month for the disease, and to observe any clearing of infection. We predict that approximately 25% of our samples will test positive for *Bd* based on previous studies, and all will test negative for *Bsal* as it has not yet been detected in the U.S. This study will provide insights to amphibian disease susceptibility before and after translocation. We will continue to monitor for chytrid in these populations after translocation in order to make informed conservation management decisions for this species.

ASSESSMENT OF BIODIVERSITY RELATIONSHIPS IN TURTLE AND LEECH PARASITE-HOST ASSEMBLAGES IN MIDDLE TENNESSEE WETLANDS ACROSS A DISTURBANCE GRADIENT

Laura Horton, William Sutton (Research Advisor)

Wetlands are being lost at an alarming rate to anthropogenic disturbance and this has negative consequences for biodiversity, such as turtles, which rely on habitat provided by these ecosystems. Biodiversity indices can be used to evaluate the condition of environments, including freshwater wetlands. Further evaluations such as of species richness between turtles and their ectoparasites (leeches) can be used to understand the fluctuating dynamics between parasites and their hosts based on habitat quality and host species diversity. To better understand the effects of human influence on wetland turtles, we sampled 19 wetlands across an anthropogenic disturbance gradient for turtle and leech biodiversity. Wetlands were scored into three categories of anthropogenic impact; low disturbance (n=6), medium disturbance (n=6), and high disturbance (n=7) using two land-use, land-cover databases. Over the months of June through October of 2018 (total sample events n=50), wetland sites were sampled on two occasions per site (n=36) with 7 randomly selected sites resampled twice more (n=14), with 6 baited hoop-net traps deployed for 24 hours per each sampling event. Each captured turtle was weighed, measured, sexed, PIT tagged, examined for leeches, and returned to the site of capture. There were a total of 612 turtles; 99 *Chelydra serpentina*, 436 *Trachemys scripta elegans*, 76 *Sternotherus odoratus*, 9 *Apalone spinifera*, and 1 *Graptemys geographica*. Collectively, the interpretation of these data can be used to understand how the effects of anthropogenic disturbance affect wetland turtle-leech communities.

Pressure-Based Inactivation of Rifampicin-Resistant Shiga Toxin-Producing *Escherichia coli* O157:H7 and Six Non-O157 Serogroups

Abimbola Allison, Aliyar Fouladkhah (Research Advisor)

The active surveillance data of the Centers for Disease Control and Prevention estimates that foodborne Shiga toxin-producing *Escherichia coli* (STEC) causes 176,000 illnesses, 3,700 hospitalizations, and 30 deaths annually in the United States. Serogroups other than O157:H7 are currently responsible for more than 60% of STEC-related illness episodes. Both O157 and non-O157 serogroups are prevalent in peri- and post-harvest environments of meat processing. Hydrostatic pressure of 250 to 650 MPa were applied for 0 (untreated control), 1, 3, 5, and 7 min for inactivation of a six-strain mixture of rifampicin-resistant *Escherichia coli* O157 and a six-strain mixture of rifampicin-resistant *Escherichia coli* O26, O45, O103, O111, O121, O145. The processing unit was equipped with steel jacket surrounding the reaction chamber and connected to a circulating water bath for precise application of hydrostatic pressure at a controlled temperature of 4 °C. The experiment was conducted twice, as two biologically independent repetitions, each containing three replications. Treatments were conducted in Barocycler Reaction PULSE Tubes, with internal pressure, temperature, and compression rates monitored using Barocycler HUB PBI software. Results were analyzed using Tukey-, and Dunnett-adjusted ANOVA by SAS. The *Escherichia coli* O157 were reduced ($P < 0.05$) from 6.86 ± 0.2 to 4.56 ± 0.1 when exposed to pressure of 650 MPa for 7 minutes. Corresponding reductions ($P < 0.05$) for non-O157 STEC were from 7.08 ± 0.0 to 4.78 ± 0.2 for samples treated at 650 MPa for 7 minutes. The D-values at 4 °C and 650 MPa were 3.71 and 3.49 for O157 and non-O157 serogroups, respectively. Treatments at 250 MPa and for durations ≥ 3 min were less effective ($P \geq 0.05$) against O157 and non-O157 STEC. Results of this study indicate that an optimized pressure treatment could reduce various serogroups of STEC by more than 99%.

Elimination of Wild-type and Acid-adopted *Escherichia coli* O157 and Non-typhoidal *Salmonella* serovars using High Pressure Pasteurization in Orange Juice

Jayashan Adhikari, Aliyar Fouladkhah (Research Advisor)

Recent epidemiological studies indicate, non-typhoidal *Salmonella* serovars and *Escherichia coli* O157 are among the leading causes of foodborne illness, hospitalization, and death episodes, and DALY in the United States. Current study investigated efficacy of elevated hydrostatic pressure for inactivation of wild-type and acid-adopted *Escherichia coli* O157 and non-typhoidal *Salmonella* serovars in orange juice. Time intervals of 0 (untreated control), 2, 4, 6, and 8 minutes and intensity levels of 150 and 400 MPa of elevated hydrostatic pressure (Pressure BioScience Inc.) were investigated in two independent experiments for decontamination of acid-adopted and wild-type non-typhoidal *Salmonella* serovars (ATC 13076, 8387, 6962, 9270, 14028) and *Escherichia coli* O157:H7 mixtures (ATCC BAA 460, 43888, 43894, 35150, 43889 and 43890) inoculated in sterilized orange juice. Experiment's temperature was maintained at 4 °C using a circulating water bath attached to a stainless steel jacket surrounding the treatment chamber. Results were analyzed by GLM procedure of SAS using Tukey- and Dunnett-adjusted ANOVA. At 150 MPa, for treatments of 2 to 8 minutes, D-value of 8.00 and 8.92 min were observed for wild-type (WT) and acid-adopted (AA) *Escherichia coli* O157 at 4 °C. The pathogens counts were 6.45 ± 0.2 and 5.17 ± 0.6 log CFU/ml for AA and WT phenotypes, respectively before treatment and were reduced ($P < 0.05$) to 1.02 ± 0.4 , and 2.15 ± 0.4 , respectively, after an 8-min treatment at 400 MPa. The AA and WT *Salmonella* counts were 4.11 ± 0.8 and 4.32 ± 0.8 log CFU/ml, respectively, and were both reduced to the detection limit after 8-min treatment at 400 MPa. Results obtained from this experiment could be incorporated as part of hazard analysis in FSMA-based management systems and risk assessment analyses for mitigating the public health burden of non-typhoidal *Salmonella* serovars and Shiga toxin-producing *Escherichia coli*.

Assuring Safety of Infant Formula Using an Emerging Technology

Monica Henry, Aliyar Fouladkhah (Research Advisor)

Infections associated with *Cronobacter sakazakii* are often fatal in infants born premature and those younger than two months. Two historic outbreaks of *Cronobacter sakazakii* associated with infant formula in Tennessee in 1988 and 2001, and a 2016 infection episode of the bacterium associated with a premature infant in Pennsylvania had brought increasing attention to endeavors for decontamination of the bacterium from infant formula. Current study investigated effects of high pressure pasteurization at 4 and 50 °C for inactivation of the bacterium inoculated in reconstituted infant formula. Various times (0, 1, 4, 7 and 10 minutes) and two intensity levels of 310 and 380 MPa (e.g. 45K and 55K PSI) of elevated hydrostatic pressure were investigated for inactivation of 4-strain mixture of rifampicin-resistant *Cronobacter sakazakii*, inoculated in reconstituted infant formula. Experiment was conducted at 4 and 50 °C, in two biologically independent repetitions, as blocking factors of a randomized complete block design. Samples were enumerated on TSA supplemented with rifampicin and yeast extract. Analysis of variance was conducted followed by LSD-based mean separation using OpenEpi software. During treatments at 380 MPa at 4 °C, 1.59 and >6.01 log CFU/mL of inoculated pathogen were reduced ($P < 0.05$) after 1- and 10-minute treatments, respectively. At 50 °C and 380 MPa, corresponding reductions ($P < 0.05$) were >5.00, >5.90, >5.81, and >6.00 log CFU/mL after treatments for 1, 4, 7, and 10 minutes, respectively. At 310 MPa the reductions ($P < 0.05$) were ranging from 1.35 to 3.67 and 3.10 to >5.72 log CFU/mL for samples treated at 4 and 50 °C, respectively. Over 5-log reduction of *Cronobacter sakazakii* in reconstituted infant formula is achievable as result of optimized high pressure pasteurization that could be utilized to assure safety of infant formula particularly for premature newborns and those with elevated risk of *Cronobacter* infection.

Reducing the Cost Associated with High Pressure Processing: Efficacious Alternatives to the Current Standard Procedure in the Food Manufacturing

Anita Scales, Aliyar Fouladkhah (Research Advisor)

According to a report from the Centers for Disease Control and Prevention, advances made by food scientists for development of safe and nutritious food products were one of the top 10 public health achievements of the 20th century. Enhanced global commerce, increased in proportion of at-risk populations, and consumers' demand for non-traditional commodities and minimally processed products provide breeding ground for emerging, novel, and reemerging foodborne infectious diseases. This indicates the need for innovative solutions for assuring the safety of the food supplies using novel and emerging technologies. Current study is a summary of recent validation studies conducted in the Public Health Microbiology laboratory of Tennessee State University for enhancing the industrial adoption of pressure-based pasteurization. Special Emphasis is placed to measure efficacy of a pasteurizer for reducing the cost of the operations. Although utilization of elevated hydrostatic pressure at 87K PSI (600 MPa) for 3 min is a common practice in private food industry, results of our validation studies indicate duration and intensity of the operation could be modified based on synergism of pressure-based interventions with mild heat and natural antimicrobials to assure cost effectiveness of the operation. Validation studies considering various intrinsic and extrinsic factors of the product could lead to optimized and economically feasible utilization of high pressure processing in new array of products.

Particulate Flow through a Zigzag Channel

Simbarashe Kanjanda, Muhammad Akbar (Research Advisor)

There has been a steady increase in analysis of complex particulate flows, systems arise in the study of clustering and aggregation of particles in natural science applications where particles collide, cluster, and grow into larger objects. Understanding coupled phenomena in particulate flows is also of interest in modern industrial processes that involve spray processes such as epitaxy and sputtering as well as dust control, etc. For example, in many processes, intentional charging and heating of particulates, such as those in inkjet printers, is critical. Thus, in addition to the calculation of the dynamics of the particles in the particulate flow, thermal fields must be determined simultaneously to be able to make accurate predictions of the behavior of the flow. Although the zigzag air classifier is a well established apparatus, still many unknowns exist when describing the process dynamics and trying to optimize overall performance with respect to purity and efficiency. In order to foster understanding of the involved mechanisms, the current work investigates by simulation of the flow inside different models of a zigzag classifier under different operating conditions.

MicroRNAs Based Functional Genomics Study on Bio-fuel Related Traits in Sweet Sorghum (Sorghum bicolor L.)

Binod Gyawali, AHMAD AZIZ (Research Advisor)

Sweet sorghum (*Sorghum bicolor* L.) is a C₄ plant and considered as an important bio-fuel crop due to high sugar content in its stems. However, sustainable production of bio-fuels through large-scale cultivation of sweet sorghum needs plant genetic improvement endeavors to increase yield and fermentable sugar quality. MicroRNAs (miRNAs) have been shown to play important roles regarding sugar accumulation traits, but mechanisms and exact roles are not yet discernible. In order to analyze the miRNAs and their targets, we extracted total RNAs from the stems and leaves of two sweet sorghum varieties, i.e., "Dale"™ and "Topper 76-6"™ at the vegetative and reproductive stages. Later, topmost significant 36 miRNAs and their 18 targets were identified through bioinformatics and literature survey followed by the expressional analyses through quantitative DNA amplifications. Our findings, both computational and experimental, provide valuable insights on the role of miRNAs during sugar accumulation stages. The identification of these differentially expressed miRNAs will help to explore the molecular mechanisms for sugar accumulation in sweet sorghum.

Design of an Impact of Jet Device for Undergraduate Laboratory

Abdullah Alotaibi, Amal Abdullahi, Ali Al Ibrahim, Muhammad Akbar (Research Advisor)

We will design and build an impact of jet experimental setup to help the student to understand some fundamental principles of fluid dynamics. This experimental setup will be used to demonstrate the principle of conservation of linear momentum by measuring the force generated on a target deflector by an impinging jet of water. This experiment inherently proves the validity of mass conservation principle as well. The results can be compared with analytical solutions obtained from the application of Reynolds Transport Theorem of fluid dynamics. This setup will allow students to learn the principle of linear momentum in a comprehensive manner.

The product structure will be performed, and physical elements of the system will be arranged in the CAD drawing of the initial design. The parts selection process will be applied to determine the appropriate components of the required system. The use of research and development will be used to help in determining the feasibility and design success. Analysis of the designed system will be performed in terms of cost, reliability and dependability. Specifically, the bottom up design methodology will be applied to design an impact of jet apparatus. A bottom-up approach is the piecing together of small subsystems to give rise to more complex systems. Bottom-up processing is a type of information processing based on incoming data from the environment to form a perception. So, according to this approach subsystems of the design will be considered like developing a CAD model, analyzing the dimensions of the system, selection of gauges, nozzle and impact plate will be the subsystems that will be combined to make whole project. Testing will be done if any errors are found, those will be corrected, either by redesign or simple tweaking of the parts.

Design of Microwave Plasma Chemical Vapor Deposition Reactor for Diamond Production

Samuel Scott, Armoni Towner, William Woodfork, Muhammad Akbar (Research Advisor)

Diamonds are one of the hardest materials and has very high thermal conductivity as well as many other useful properties that make it a great material. However, due to the high cost of diamonds and the inability to engineer the material, they often cannot be used in many situations where their properties would be optimal. This disparity has left diamonds to mainly be used as a gemstone. According to Bain & Company (<https://www.bain.com/>), A global management company, 133 Million Carats of Diamonds are produced each year, about 26,000 kg, but these are rough stones with varying properties and sizes. The purpose of the present Capstone is to design a reactor and process that can create high quality diamond material at a better rate than those currently exist.

Coupling the Incidence of Pharmaceuticals in Surface Water with Organic Carbon in the River.

Ravneet Kaur, Sam Dennis (Research Advisor)

Pharmaceuticals have been detected nationwide in different environmental matrices including wastewater effluents and surface water. Some studies have reported pharmaceuticals in aquatic plants, fish tissues and plasma of shark bulls. We initiated a study in the summer of 2018 in the Collins River. The Collins River is a 6th order river that drains a rural watershed (Warren County) in Middle Tennessee. The objectives were to 1) quantify the occurrence of selected pharmaceuticals in the surface water; 2) analyze total organic carbon in the Collins River and its effect on the concentration of target pharmaceuticals; and 3) monitor the water quality of the Collins River as a function of time. The pharmaceuticals of interest were atenolol (CAS # 29122-68-7), clofibrate (CAS # 882-09-7), diclofenac (CAS # 15307-79-6), ibuprofen (CAS # 15687-27-1), metoprolol (CAS # 51384-51-1), naproxen (CAS # 22204-53-1), and propranolol (CAS # 318-98-9). Grab water samples were collected weekly for six consecutive weeks from the river for analysis. Simultaneously, water quality parameters were also determined in situ using Eureka™ multi-parameter sondes. The water samples were analyzed for these pharmaceuticals of interest using GC-MS under full scan and SIM mode. The absolute recoveries for target pharmaceuticals were above 90 percent. Method validation was performed by evaluating specificity, reproducibility, and linearity of the response. Total organic carbon was analyzed for the respective water samples using a TOC analyzer (Shimadzu™). While pharmaceutical concentrations were in the parts per billion range (ppb) for the targeted pharmaceuticals, total organic carbon ranged from 9 to 12 parts per million (ppm).

Evaluation of selected bacteria for biological control of *Sclerotium rolfsii*

Bandana Bhusal, Ethan Swiggart, Steve Osborne, Margaret Mmbaga (Research Advisor)

Sclerotium rolfsii is a prominent plant pathogen affecting vegetable production in the southeast. Bacterial endophytes have shown promise in controlling fungal plant pathogens. Pathogenicity assay of *Sclerotium rolfsii* was done in cucumber which made the plant to die completely. *Bacillus* sp., *Serratia* sp., and *Stenotrophomonas* sp. were assessed for the control of *Sclerotium rolfsii* by dual culture technique. Eleven isolates of endophytic bacteria (B17A, B17B, PS, PSL, Prt, IMC8, YNP1, YNP2, YNP3, YNP4 and YNP5) were used for the control of *Sclerotium rolfsii*. The objective of this study was to evaluate the bacteria for control of *Sclerotium rolfsii*. PDA was used as the growth medium of pathogen and control agents. Spore soaking was done for the inoculation of bacteria and kept in the growth medium. Result was observed after one week which showed that PSL (*B. amyloliquefaciens*) and Prt (*B. subtilis*) controlled the pathogen by restricting its growth among all other bacteria.

Occurrence of Phytophthora disease on woody ornamentals

Milan Panth, Terri Simmons, Fulya Baysal-Gurel (Research Advisor)

Phytophthora vexans (previously named *Pythium vexans*) (Pythiaceae, Peronosporales) is a plant pathogen infecting citrus, forest trees and woody perennials. Ginkgo (*Ginkgo biloba*) plants grown in container and field in Tennessee have shown root and crown rot symptoms with reddish brown to dark brown lesions in 2017 and 2018. Above ground symptoms consisted of leaf necrosis and a general decline of the plants. Isolations were made from symptomatic roots. A number of *Phytophthora*-like colonies with spherical zoospores, ovoid to globose oogoni, and slow growing whitish mycelium, were isolated on PARPH medium. All isolates produced sporangia with prominent papilla. To confirm pathogen identity, total DNA was extracted using the PowerSoil DNA Isolation Kit directly from 3-day-old cultures grown in potato dextrose agar. The ribosomal DNA internal transcribed spacer (ITS) region was amplified by PCR using the primer pair ITS1 and ITS4 and sequenced. The sequences were 99% identical to *P. vexans* according to BLAST results. To complete Koch's postulates, a pathogenicity test was performed by drenching 105/ml zoospore suspension on 1-year-old potted ginkgo plants. Necrotic lesion development was observed in the root system 45 days after inoculation and *P. vexans* was re-isolated from roots. All control plants remained disease-free and no pathogen was re-isolated. To our knowledge, this is the first report of root and crown rot caused by *P. vexans* infecting ginkgo in Tennessee.

Modeling site productivity using soil characteristics

Matthew Purucker, Bharat Pokharel (Research Advisor)

Site productivity is a measure of the primary productivity potential of a forest ecosystem. It is characterized by an interaction of biotic and abiotic factors such as climate, soil and topography. An accurate site productivity characterization allows for efficient land use allocation, integrated ecosystem planning, and prescribed ecosystem management. Site index (SI), the height of the dominant or co-dominant trees at a reference age, is widely used surrogate of site productivity and has traditionally been used in many conceptual and simulation models of ecosystem dynamics. However, SI assumes that prior forest management techniques have no effects on site productivity, although, forest site productivity is dependent on both site and forest management practices. Better management of under-utilized woody biomass from forests, such as the removal of treetops, branches, twigs, bark, and limbs, could be the potential sources of feedstock needed in order to meet the growing demand for biofuels. We hypothesize that soil physical and chemical variables will be affected, causing a negative impact on forest site productivity and the subsequent ecosystem services these forests provide. This study aims to pair Forest Inventory and Analysis (FIA) plot data with forest management history and soil data along with topography variables to develop a model estimating site productivity across the forest landscape in Tennessee.

Responses of Soil Respiration and Enzyme Activities to Manipulated Precipitation Regimes in a Switchgrass Mesocosm Experiment

Madhav Parajuli, Siyang Jian, Jianwei Li (Research Advisor)

Precipitation regimes are important controls on soil respiration but the underlying microbial mechanisms that likely mediate the effects remain rarely studied, particularly in a bioenergy cropland such as switchgrass (*Panicum virgatum* L.). Based on a three-year switchgrass mesocosm experiment under five manipulated precipitation regimes representing simulated ambient precipitation amount (P0), two drought conditions (P-33 and P-50: 33% and 50% reduction relative to P0), and two wet conditions (P+33 and P+50: 33% and 50% enhancement relative to P0), soil samples (0-15 cm) were collected and soil organic carbon (SOC), total soil nitrogen (TN), SOC/TN (C: N), microbial biomass carbon (MBC), soil CO₂ respiration rate (Rs), and extracellular enzymes activities (EEAs) were quantified. The proxy variables for hydrolytic C acquisition enzymes (C-acq), N acquisition (N-acq), and oxidative decomposition (OX) were calculated as the sum of $\hat{1}\alpha$ -1,4-glucosidase (AG), $\hat{1}\beta$ -1,4-glucosidase (BG), $\hat{1}\beta$ -D-cellobiosidase (CBH) and $\hat{1}\beta$ -1,4-xylosidase (BX); $\hat{1}\beta$ -1,4-N-acetyl-glucosaminidase (NAG) and leucineamino peptidase (LAP); phenol oxidase (PHO) and peroxidase (PEO), respectively. The specific soil respiration rate (Rss), derived as the Rs per unit microbial biomass, was used to index microbial growth efficiency. Results showed insignificant differences in SOC and TN in all treatments. Relative to P0, Rs significantly increased by 121~312% and MBC little changed, leading to significantly higher Rss under P+33 ($P < 0.05$). Rs and MBC slightly decreased, resulting insignificant changes in Rss in the drought conditions (P-33 and P-50). These results suggest that the manipulative enhancement in precipitation amount stimulated soil respiratory C loss likely associated with both elevated hydrolases and reduced microbial growth efficiency. Whereas, microbial community responses to drought conditions are less pronounced in either hydrolases or microbial physiology in the switchgrass mesocosm experiment.

Driver behavior modelling and evaluation of the impact of traffic calming strategies-A microscopic simulation study on residential roads

Christian Mbuya, Deo Chimba (Research Advisor)

The aim of this study is to investigate driver behavior and to evaluate the impact of traffic calming strategies using a microsimulation approach. The study focused on two types of speed tables, speed humps and a raised crosswalk. A moving test vehicle equipped with GPS receivers that allowed calculation of speeds and determination of speed profiles at 1s intervals were used. Multi-regime model was used to provide the best fit using steady state equations; hence the corresponding speed-flow relationships were established for different calming scenarios. It was found that capacities of residential roadway segments due to presence of calming features ranged from 640 to 730 vph. However, the capacity varied with the spacing of the calming features in which spacing speed tables at 1050 ft apart caused a 23% reduction in capacity while 350-ft spacing reduced capacity by 32%. Analysis showed a linear decrease of capacity of approximately 20 vphpl, 37 vphpl and 34 vphpl when 17 ft wide speed tables were spaced at 350 ft, 700 ft, and 1050 ft apart respectively. For speed hump calming features, spacing humps at 350 ft reduced capacity by about 33% while a 700 ft spacing reduced capacity by 30%. The study concludes that speed tables are slightly better than speed humps in terms of preserving the roadway capacity.

The Development of Local Calibration Factors for Urban and Suburban Intersections Models in Tennessee

Suhad Al Zubaidi, Deo Chimba (Research Advisor)

The goal of this study was to determine local calibration factor (LCFs) to adjust the predicted fatal & incapacitating (F&I), and PDO crashes for Tennessee specific application of highway safety manual (HSM). Intersections are considered critical location in the roadway network and many studies have reported that more than 40% of motor vehicle accidents in US are at intersections or are deemed intersection-related. The LCFs were calculated for four types of intersections (four leg -signalized intersection (4SG), three leg-signalized intersections (3SG), two way stop controlled intersections (4ST), and one way stop controlled intersection (3ST) using Tennessee crash data from 2011-2015. For 4SG, the statewide calibration factors for multiple F&I crashes was found to be 0.183 and 0.2017 for multiple PDO crashes. The calibration factors for 3SG were found to be 0.269 for multiple F&I crashes and 0.3077 for multiple PDO crashes. In terms of 4ST crashes, the statewide calibration factors were found to be 0.257 and 0.214 for multiple F&I and PDO respectively. In addition, the calibration factors for 3ST were found to be 1.754 for multiple F&I and 1.351 for multiple PDO crashes, and for single crashes, the state-wide calibration factors for 4SG are, 3.76 for F&I crashes 3.25 for PDO crashes, the calibration factor for 3SG single crashes are 3.206 for F&I and 3.87 for PDO crashes, and For 4ST & 3ST the calibration factors for single F&I and PDO crashes are N/A, because there are no regression coefficients for single F&I predicted crashes formula in the high way safety manual model. the study further calculated the calibration factors specific per TDOT for regions. In general, the calibration factors were found to be above 1.0 implying Tennessee urban and sub urban intersections had more crashes than crashes estimated by using HSM models. The factors were comparable from some estimated from other states.

EVALUATION OF FREIGHT FLUIDITY ALONG FICs

Suleiman Swai, Deo Chimba (Research Advisor)

On Time delivery of the freight products by the minimum possible shipment time is the crucial factor in maintaining freight competitive market. The Freight intermodal connectors are the shortest portion of freight trip but have proven to be most difficult to travel. This research assesses the freight fluidity in the freight intermodal connectors by precisely locating the bottlenecks and connector segments travel time reliability. It provides the knowledge and set of approaches that Tennessee Department of Transportation (TDOT) and other Metropolitan Planning Organizations (MPOs) can integrate in their existing processes in the assessment of the freight fluidity. In this research the GPS spot speed data were collected during morning and evening peak hours from sample intermodal connectors in several Cities of Tennessee State (Memphis, Knoxville and Chattanooga). The collected data were pre-processed by the use of ArcGIS software by employing the Thiessen Polygon and buffer tool to remove the outliers from GPS approximated data and isolate opposite direction traveling traffic. Further processing where done in MS excel were graphical and statistical analyses were performed to determine the bottlenecks locations and the travel time reliability of the intermodal connector segments. Finally, models were used to determine and rank the bottlenecks according to the cost incurred by the freight companies traversing in these intermodal connector segments. The study managed to precisely identify the location of bottlenecks segments along the sample FICs and the average cost incurred by freight companies as a measure of freight fluidity. This provide an important input to State DOTs during planning and decision making regarding the performance and maintenance of FICs.

Evaluation of growth promoting bacteria for sweet pepper production

Bandana Bhusal, Steve Osborne, Margaret Mmbaga (Research Advisor)

Evaluation of growth promoting bacteria for sweet pepper production

Bandana Bhusal* Steve Osborne**, Ethane Swiggart Mmbaga, Margaret T. and Ondzighi-Assoume, Christine

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Plant growth promoting bacteria (PGPB) have been reported to increase plant yield by producing volatile and nonvolatile compounds. Selected bacteria, (Prt, PSL, PS, B17A, B17B, Y, IMC8 and YNP 1-5) were assessed for growth promoting properties on sweet pepper. Experiments conducted in growth chambers showed that the selected bacteria produced volatile compounds that influenced plant growth without bacteria cells touching any part of the plant. In addition, nonvolatile compounds from some of the selected bacteria exhibited growth promoting properties when the bacteria were applied by seed soaking in the bacterial suspensions for one hour before sowing in sterilized soil. Both studies showed that plant treatment with the selected bacteria grew bigger in size with greener leaves, and chlorophyll content was significantly higher ($p = 0.005$). Bacterial isolate Prt (*B. amyloliquefaciens*) had the highest chlorophyll content ($71.17 \mu\text{mol m}^{-2}$) and non-treated control had the lowest chlorophyll content ($3 \mu\text{mol m}^{-2}$). These studies showed that the selected bacteria were growth promoting by producing volatile and nonvolatile compounds, and it is projected that increases in chlorophyll content will likely cause increases in plant yield. This project is partly funded by Evans Allen Project and USDA-NIFA Capacity Building Grant Award no. 2017-38821-26418

*Graduate student Oral Presentation, ** Undergraduate co-author

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Evaluation of growth promoting bacteria for cucumber production

Steve Osborne, Bandana Bhusal, Christine Ondzighi-Assoume (Research Advisor)

Evaluation of growth promoting bacteria for cucumber production

Steve Osborne*, Bandana Bhusal, Ethane Swiggart, Mmbaga, MT and Christine A. Ondzighi-Assoume.

Vegetable production use a lot of agrochemical inputs for plant growth promotion and for disease and pest control. In recent years there has been an increasing consumer awareness of toxicity hazards posed by agricultural chemicals and organic production system has become the fastest growing agricultural production sector. Unfortunately, there are limited resources available to organic growers and prices for organic produce remain relatively high. Microbial organisms in soil and rhizosphere are viewed as potential resource that can be used to reduce the use of agricultural chemicals. The objective of this study was to evaluate selected bacteria for potential use in growth promotion and control of root rot pathogens. Selected rhizobacteria have been shown to produce volatile compounds that have the ability to stimulate plant growth and development. Growth chamber experiments were conducted to evaluate the effect of microbial volatiles on cucumber plants growth. Plants were grown in sterilized soil and exposed to bacterial volatile compounds on the roots with no contact between bacteria cells and the plant roots. Plants treated with the bacterial volatile compounds grew bigger and greener with significantly higher chlorophyll content and bigger leaf area. In-vitro studies showed that two of the bacterial isolates (*Bacillus* sp) suppressed growth of *Sclerotium rolfsii*, a root rot pathogen that has broad host range including cucumbers, tomatoes, sweet pepper and other cucurbits.. These results suggest that the selected rhizobacteria have great potential in both plant growth promotion and control of *Sclerotium rolfsii* in organic production of cucumbers. This project is partly funded by Evans Allen Project and USDA-NIFA Capacity Building Grant Award no. 2017-38821-26418

Evaluation of Row Covers in Yield Performance of the Leafy Green Vegetables in Organic Management System

Kripa Dhakal, Dilip Nandwani (Research Advisor)

Row covers are gaining interest in crop production to improve growth and yield in different agricultural climates and production systems. Growers use row cover to extend the production season, protect crop from frost and insect pest, increase water use efficiency and higher crop yield. The objective of this study was to evaluate the impact of row covers on the yield performance of leafy green vegetables in an organic production system. Four leafy greens; Kale, Collard, Swiss chard and Lettuce were evaluated in spring 2018 at the Tennessee State University organic farm in Nashville. Ten plants of each leafy greens were cultivated on 1â€™ spacing in drip irrigation on plastic mulch in three replications. Plants grown in three different types of row cover; insect net, agribon cloth, plastic and a control without row cover (open). The plant height, leaf number, leaf length, leaf width, fresh weight and dry weight observed significantly higher on agribon cloth on all four crops compared to open and plastic except fresh weight per plant in lettuce was on insect net. Preliminary trial indicate higher fresh weight on agribon (280.752 g/plant) than in control (184.821 g/plant). In kale, swiss chard and collard fresh weight per plant was more than 50 percent increase in agribon cloth in comparison to control (open). Most of the plants did not survive under plastic as temperature increased in late spring. Agribon cloth showed the best results in overall performance of growth parameters, yield and preferred row cover for organic leafy greens production.

Phosphorylation of STAT3 by Human Serotonin 2C Receptor

Musarrat Maisha, Zeljka M. Lanaghan, Hugh M. Fentress (Research Advisor)

Serotonin (5-HT) is an indolamine neurotransmitter involved in a variety of functions including regulation of mood, appetite, sleep, learning and memory, and neuronal excitability. 5-HT elicits its effects by binding to at least 14 different receptor subtypes that mediate both excitatory and inhibitory neurotransmission. The many classes of serotonin receptors have been subjected to significant studies in order to discern the functionality and produce effective therapeutic targets. One of the receptors, the 5-HT_{2C} receptor, has been studied and used as a target for antipsychotic medication. 5-HT_{2C} subtype receptor exists as a 7-transmembrane spanning G protein-coupled receptor (GPCR) found in the central nervous system, and is the only GPCR known to undergo RNA editing, creating 14 known isoforms in the human brain which affect its ability to couple with G proteins and other signaling proteins. The structurally similar 5-HT_{2A} receptor has been shown to activate the G protein independent JAK/STAT pathway. The purpose of this study was to determine if the human 5-HT_{2C} receptor also activates the JAK/STAT pathway. Human Embryonic Kidney (HEK) 293 cells were transfected with human 5-HT_{2C} receptors to produce stable cell lines. Cells were then treated with vehicle (control), 5-HT, olanzapine (antagonist), and SB206553 (inverse agonist) for 30 minutes or 1 hour. Treated cells were lysed, proteins were separated by SDS-PAGE, and levels of phosphorylated JAK2 and STAT3 were analyzed using western blots. In cells treated for 30 minutes with vehicle, phosphorylation of STAT3 was observed in cells transfected with the 5-HT_{2C} receptor but not in untransfected cells indicating constitutive phosphorylation of STAT3 by the 5-HT_{2C} receptor. Upon treatment with serotonin, phosphorylated levels of STAT3 were increased in cells expressing the 5-HT_{2C} receptor while STAT3 phosphorylation was completely blocked with cells treated with olanzapine or SB206553. Phosphorylated levels of JAK2 were unaffected across all treatments. Phosphorylated STAT3 levels showed the same patterns in cells expressing the 5-HT_{2C} receptor when treated for 1 hour. These findings indicate that 2C receptors are activating STAT3 independently of JAK2 and may be involved in cell growth, differentiation, transcription of other STAT genes, and immune response. Future studies will examine different edited isoforms of the 5-HT_{2C} receptor and whether STAT3 activation is dependent or independent of G-protein activation to elucidate the mechanism phosphorylation of STAT3 by the human 5-HT_{2C} receptors.

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Recovery in soil carbon stock but reduction in carbon stabilization after 56-year forest restoration in degraded tropical lands

Huiling Zhang, Dafeng Hui (Research Advisor)

Recovery in soil carbon stock but reduction in carbon stabilization after 56-year forest restoration in degraded tropical lands

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Afforestation is considered as an effective method for alleviating the rising of atmospheric carbon dioxide (CO₂) concentration through the accumulation and long-term storage of carbon (C) in the vegetation and soil. However, it is still unknown whether soil C accumulation in the restored forests could eventually recover to the equivalent level of the undisturbed forests and much less is known about how afforestation will affect C stabilization. Here we conducted a field study in degraded tropical forests of south China. The aim was to evaluate the recovery of soil C stock following afforestation by comparing different C fractions in soils (0-10 cm and 10-20 cm) in two reforested forests [a restored secondary forest (RSF) and a managed Eucalyptus plantation (MEP)] to those in a bare land (BL) and a nearby undisturbed forest (UF). Results showed that after 56-year afforestation at the bare lands, C stocks in both soil layers were significantly increased with an increase greater in the RSF than the MEP, while C recalcitrant indexes (RI) were reduced. Soil C stock in the RSF recovered to a similar level to the UF, but soil RI in the RSF was still lower than the UF particularly in the 10-20 cm layer. The calculated capacity of soil C sequestration with the product of soil C stock and its RI followed the order of UF>RSF>MEP>BL. Our results demonstrate that afforestation on degraded tropical lands could recover soil C stock within a few decades, but C stabilization would be reduced.

Effects of Precipitation Treatments on Switchgrass Biomass and Yield

Dilovan Yahya, Adrian Harris, Dalal Hamad, Dafeng Hui (Research Advisor)

Effects of Precipitation Treatments on Switchgrass Biomass and Yield

Dilovan Yahya, Fady Ajayby, Adrian Harris, Dalal H. Almotir, Hashim Alsadah, and Dafeng Hui

Plant biomass and yield are often influenced by climatic factors such as precipitation. But how switchgrass biomass, particular yield, are influenced by precipitation has not been well investigated. We have conducted a field precipitation experiment with switchgrass since 2013. The experiment used randomized complete block design with 5 precipitation treatment levels (-50%, -33%, ambient, +33%, and +50%). We measured switchgrass leaf physiology and biomass, and also yield in 2018. The results showed that precipitation significantly influenced leaf photosynthesis and biomass and biomass varied among years. We also found that responses of biomass to precipitation were asymmetric. We are working on to test whether yield was significantly influenced by precipitation in 2018. We will continue the field measurements and quantify the interannual variation of biomass and yield. This project is supported by the NSF and USDA.

Effects of Precipitation Changes on Leaf Chlorophyll Content: Multiple approaches

Dalal Hamad, Dafeng Hui (Research Advisor)

Effects of Precipitation Changes on Leaf Chlorophyll Content: Multiple approaches

Dalal H. Almotir, Fady Ajaby, Hashim Alsadah, and Dafeng Hui

Precipitation will have significant influence on plant growth and leaf characteristics. Leaf chlorophyll content as an important indicator of leaf N status could be significantly influenced by precipitation. How switchgrass leaf chlorophyll content is influenced by precipitation has not been well investigated. In this study, we set five different precipitation treatments from drought to ambient and to wet, and measured leaf chlorophyll contents using four different methods. Three chlorophyll meters (SPAD-502, CCM 200 and At-Leaf) and one destructive spectrophotometric method were used to measured switchgrass leaf chlorophyll contents under different precipitation treatments. We found significant correlations between the readings of SPAD-502 and At-Leaf but the readings of CCM 200 were lower and had no correlations with SPAD-502 and At-Leaf. We are comparing the meter readings with the spectrophotometer measurements and will determine which meter provide best fit. Further studies will be conducted to investigate the measurements at different plant growth stages. This project is supported by the NSF and USDA.

Social Science Perspective: Investigating Issues and Concerns

Savian Young, Larry McNary II, Sabrina Coffman, Chira Amedi, Aliyah Burnett, E. Kelly Sanford
(Research Advisor)

This panel Social Science Perspectives: Investigating Issues and Concerns will research a number of issues and concerns that have been researched using the scientific research design. Savian Young will present "An Invitation To Sociology" a descriptive analysis of the classic book by Peter Berger. Larry McNary II will present on the "Psycho/social Factors related to Health & Wellness; Sabrina Coffman and Chira Amedi will investigate " Cultural Differences in HBCU's vs PWI's" and Aliyah Burnett will complete the panel discussion on "The Continuation of Juvenile Delinquency in America". This research panel will allow audience to understand how social science research is used to investigate social issues and concerns in everyday life.

Genome Wide Association Mapping for Root Traits in the Andean Gene pool of Common Beans (*Phaseolus Vulgaris* L.)

Daniel Demissie, Matthew Blair (Research Advisor)

A global Andean Diversity Panel (ADP) of common beans, consisting of 260 genotypes collected from Africa, North America, Caribbean, and South America, was phenotyped for root traits using a high-throughput hydroponic system. The genotypes were planted in a lattice design arrangement with three replications. Phenotypic traits including total root length (TRL), average root diameter (ARD), number of root tips (NRT), total root volume (TRV), number of forks (NF) and root surface area (RSA) were recorded. The ADP was previously genotyped by the USDA with ApeKI complexity reduction and genotyping-by-sequencing (GBS). ANOVAs were conducted using GLM and revealed the presence of significant difference among the genotypes. Genotype x Trait biplot analysis indicated that 94.1% of the total phenotypic variation was explained by the first two major vectors. After filtering for 5% minor allele frequency and 10% missing data, a final total of 8,614 SNPs and 227 genotypes were used for the genome-wide association study (GWAS) based on a principal component analysis (PCA) and a kinship matrix in MLM of the genotypic data. We found highly significant marker x trait associations across the genome for ARD (14 SNPs), TRL (14) and RSA (2). Results showed that significant major QTL regions for ARD within Andean beans were located across the genome except on chromosomes Pv05, Pv06 and Pv08. Similarly, Pv01, Pv02, Pv3, Pv05, Pv07, Pv10 and Pv11 contained QTL associated with TRL. The QTL for RSA resided on two chromosomes, Pv02 and Pv05. Overall this study detected 30 SNP markers which can be used in selection or to clone candidate genes controlling important root traits in common beans.

Keywords: Genotype-trait biplot, GWAS, Kinship, PCA and QTL

Funding source: Evolutionary Genomics

Unprecedented cross coupling processes for the synthesis new series of esters

Arpona Hira, Mohammad Al-Masum (Research Advisor)

Esters are chemical compounds with many practical uses. These uses include but are not limited to major industrial petrochemicals, medical inhibitors, and cosmetic ingredients. Esters also observe as basic building blocks of life, animal cells. By creating two new methods, we are able to synthesize new series of ester compounds like arachidonic acid ester, folic acid ester, and cholesterol esters. These new results will display.

Introducing fluorine moiety by cross-coupling chemistry

Rebecca Welch, Mohammad Al-Masum (Research Advisor)

Currently, there is high demand for a mild-condition, low toxicity, highly regioselective process for the fluorination of hydrocarbons, largely due to the needs of the pharmaceutical industry. Fluorinated hydrocarbons appear in such drugs as Pfizer's Lipitor, GlaxoSmithKline's Seretide, and AstraZeneca's Crestor.

Current fluorination techniques involve multiple steps at extreme conditions and are most assuredly not green. Additionally, a great deal of current research concerns the use of F18, an isotope with a half-life of 109.7 minutes. This need for speed means that pharmaceutical synthesists are searching for a mild-condition, highly regioselective process by which they can create fluorinated hydrocarbons in house. In 2012 Fier and Hartwig successfully converted a variety of aryl iodides into aryl fluorides via a cationic copper reagent with silver fluoride. Similarly, Liu et al. showed alkyl fluorination via fluorine ions catalyzed by a manganese porphyrin complex. In 2013 and 2014, Al-Masum group showed how Nitration of styryl- and aryltrifluoroborates can be accomplished via Palladium catalyzed cross-coupling. Given the similarity in stoichiometric behavior of Nitro groups and Fluorine, we hypothesize that it would be possible to achieve fluorination with similarly high regioselectivity under similarly mild conditions by using a similar method.

DNA Extraction Techniques for Novel Legume Species for Sequencing Studies

Alyssa Hobbs, Taynan Cattozatto, Matthew Blair (Research Advisor)

Have you ever wondered how to collect the best form of DNA within plants? Well with the correct procedures, you can obtain a high quality of DNA with legumes at the early stages of plant growth. The use of In vitro culture with magenta boxes containing agar media and grown in growth chambers provide the soft tissues needed for high quality DNA extraction in several economically important types of legumes (beans and peas). *Crotolaria*, *Phaseolus* and *Vigna* are genera from the legume family of plants that can benefit from this technique avoiding starch and protein contamination of nuclei acids. Tissues are easy to collect at the early stage of growth and provide concentrated DNA for next generation full genome sequencing. In this presentation, we will talk about the materials and methods for Illumina sequencing of legumes used to make this project successful.

Collaborators: Taynan Cattozatto

Funding: TLSAMP, and USDA

Recent development of colloidal delivery vehicles for carvacrol: a review emphasizing on its antibiotic alternative application

pu wang, Ying Wu (Research Advisor)

Carvacrol has reported to possess various biomedical properties, including antimicrobial activities, antifungal effects, and antioxidant activities, while applications of the carvacrol as in food, supplement and pharmaceutical industries are often challenged because of its poor solubility, stability and bioavailability. Colloidal of delivery vehicles, consisting of carvacrol-loaded nanoparticles or microparticles, can overcome these drawbacks. This paper firstly describes its structure and physicochemical properties, which aids understanding of its biological activities. Based on the latest reports, several fabrication methods have been proposed to construct the delivery system of carvacrol, including microemulsions, nanoemulsions, emulsions, solid lipid nanoparticles, liposomes, and biopolymer microgels. Properly designed loading-vehicles will increase carvacrol applications in commercial products, especially as antibiotic alternative.

Analysis of the variation of profitability in selected fresh produce.

Ryan Smith, Prabodh Illukpitiya (Research Advisor)

Analysis of the variation of profitability in selected fresh produce.

Smith, R*; Illukpitiya, P; Bullock, R; Young, D. Department of Agricultural and Environmental Sciences, Tennessee State University, Nashville, TN 37209.

The changing dynamics of farming in the US are an important piece of the national context for the need of technical support to beginner farmers. The number of farms in the US has been declining for decades. If food is to remain abundant and affordable in the United States and readily available worldwide, there will have to be new farmers knowledgeable in farming operations. These changes on the ground mean the need for technical support help these diverse producers become economically self-sustaining and contribute to their communities. Beginner farmers have variety of issues and concerns, need proper guidance in farming operations since correct decision making is an important part in farm management. Given uncertainty in agriculture, risk management is an important part in decision making. The objective of this study is to quantify potential economic risk associated with the production of selected agricultural enterprises, namely cucumber, watermelon and tomato. Monte Carlo risk analysis was performed to obtain full range of net return given various risk factors. The analysis was based on the production costs, prices and yield obtained from secondary sources. The model results shows range of net return to farmers in growing these crops including potential for negative returns. The crop yield, product prices and unit costs of production is sensitive to profitability of these enterprises. The information is useful for beginner farmers in decision making in selecting agricultural enterprise.

Acknowledgement: Authors wishes to acknowledge USDA-NIFA for funding this beginner farmer's project.

Economic Contributions of Small Farms in Local Communities

Blessing Ajumobi, Enefiok Ekanem (Research Advisor)

Introduction: The existence of small farms in our local communities have made tremendous positive impacts in our communities. These contributions vary from economical, through psychological, social and wellbeing of the society.

Small family farms have succeeded in keeping the large conglomerate from controlling price of food by buying over U.S. small farms.

Goal and Objective: The goal of this research is to analyze economic contributions of small farms in local communities. The objective presents characteristics of small farms, their roles locally and nationally.

Hypothesis or Theory: Small farms operations have grossly moved from manual labors to a more technological and informed operations. Farmers no longer produce crops before searching for clients. The reverse is the case nowadays, through the training and statistical approach in today's farming. This shows that small farms will be faced with more and more challenges to stay afloat.

Materials and Methods: Literature review will be conducted to identify the challenges small farm owners face and the possible solutions. The internet, journals, textbooks and existing relevant literature will be used in formulating concepts and support research framework. Data will be taken from existing sources including published and recently collected surveys by the project. Secondary information from USDA, TNDA, US Census data and other sources will be used in developing this paper. Primary data from local marketing projects will be extracted for analysis and presented in the various sections of this paper.

Results: The research findings will be presented in table diagram and discussed to educate students, researchers, extension employees, and farmers. Conclusions and Recommendations for future programs, to benefit funders, farmers, students, researchers, educators and others interested in agriculture.

Financial Support from the USDA-NIFA/Small Farms Program and College of Agriculture.

Prevalence of antimicrobial resistance Enterobacteriaceae in plant-based milk

Winnie Mukuna, Margaret Mmbaga (Research Advisor)

Prevalence of antimicrobial resistance Enterobacteriaceae in plant-based milk.

Authors: Winnie Mukuna and A. Kilonzo-Nthenge

Introduction: Owing to the current life styles changes and increase of cow milk allergy, plant-based milk is becoming popular in many consumers's homes. However, studies evaluating microbial safety of plant-based milk are uncommon.

Purpose: This study evaluated the prevalence and antimicrobial resistance of Enterobacteriaceae in raw soy, almond, and cashew milk by using biochemical and molecular techniques.

Methods: Enterobacteriaceae were identified using API 20E test and then subjected to 8 antibiotics: Vancomycin (30 μg), Novobiocin (30 μg), Erythromycin (15 μg), Tetracycline (5 μg), Cefpodoxime (10 μg), Kanamycin (10 μg), Nalidixic acid (30 μg) and Imipenem (10 μg). Their susceptibility was determined using Bauer and Kirby disk diffusion technique and results interpreted based on Clinical and Laboratory Standards Institute values.

Results: A total of 111 Enterobacteriaceae were identified. The most prevalent species was *Enterobacter cloacae* (42.3%), followed by *Enterobacter cancerogenus* (35.1%), *Pantoea* (7.2%), *Klebsiella pneumoniae ozaenae* (5.4%), *Enterobacter sakazakii* (2.7%), among others. Resistance to vancomycin (88.3%) novobiocin (83.8%) and erythromycin (81.1%) was higher compared to tetracycline (59.5%), cefpodoxime (30.6%) and nalidixic acid (6.3%). All the bacteria were multidrug resistant and eleven multi-antimicrobial resistance patterns were identified. No resistance to imipenem and kanamycin was observed.

Significance: These data suggest that plant-based milk harbors antimicrobial-resistant Enterobacteriaceae, hence may play a role in dissemination of potentially pathogenic antibiotic resistant bacteria.

Keywords: Plant milk, foodborne pathogens, antimicrobial resistance

Physical therapy early mobilization in the Intensive Care Unit: A systematic review

Colton Bradfield, Kris A. Camelio, Brady John McWilliams, Nathanael Stokes, Karen Coker (Research Advisor)

Purpose: The purpose of this review is to evaluate available literature concerning the efficacy of structured early mobilization programs for reducing incidence of sequelae associated with staying in the medical and surgical intensive care unit. **Background/Significance:** Patients in the intensive care unit (ICU) are at an increased risk for ICU-acquired delirium, ICU-acquired weakness, skeletal muscle atrophy, increased anxiety, pressure injuries, and secondary infections. The effects of prolonged immobility associated with severe illness are understood to compound patients' disease processes, which can further reduce mobility, and worsen discharge outcomes. **Subjects:** Systematic review of published, peer-reviewed articles on cohorts staying in medical and/or surgical intensive care units. **Methods and Materials:** Peer reviewed journal articles published within the last fifteen years concerning early mobility in the intensive care unit were systematically obtained via online searches of collectively developed keywords. These articles were reviewed, and data was extracted independently by four reviewers. One final reviewer applied analysis of the process and data retrieved. **Analyses:** Summary data and topical data was collected during this systematic review. Studies were categorized by type and dependent variables related to patient outcomes. **Results:** 48 articles met inclusion criteria and were reviewed. Eight observational studies, thirteen RCTs, and three SRs addressed discharge status. Eight observational studies, seven RCTs, and three SRs addressed risk of sequelae. Four observational studies, nine RCTs, and five SRs addressed mobility capacity. **Conclusions:** Structured, multidisciplinary early mobilization programs implemented by qualified allied health professionals were not reported to increase safety risks. Currently available literature supports the benefits of structured, multidisciplinary early mobilization programs for reducing the incidence of delirium, ICU-a

Factors impacting bone remineralization in children with through knee amputation: A systematic review

Douglas Hubbert, Karen Coker (Research Advisor)

Purpose: This study aims to identify the factors that impact positive bone remineralization in children with through knee amputation. **Background/Significance:** A relationship between bone density and prosthetic use exists among all individuals with lower limb amputations. The selection of suspension in prosthetic design and distal limb weight bearing affect the bone density of the residual limb. **Subjects:** Systematic review of factors related to bone density. **Methods and Materials:** Peer reviewed journal articles of physical therapy interventions, prosthetic socket and suspension design, and through knee amputations in children were sourced via online searches of key words that were systematically obtained, reviewed, and data extracted independently by two reviewers. The following search engines were utilized: EBSCO, CINAHL Complete, Pub Med, Science Direct, PLOS ONE, Academic OneFile, and the Cochrane Library. Sackett's Levels of Evidence were used to classify the strength of the literature reported. **Analyses:** Summary data and topical data was collected during this systematic review. **Results:** Eighteen articles met the inclusion criteria and were reviewed. Three systematic reviews, four randomized control trials, two literature reviews, five case-controlled studies, four case studies were reviewed. **Conclusions:** Bone mineral density loss after an amputation surgery is typical but the extent of loss can be minimized by the multi-focal approach of physical therapy with gait training, properly fitting prosthetics with weight-bearing designs. Physical therapists are crucial to this process with assessment and training in mobility and gait, especially in children post amputation. The through knee amputation allows for increased weight bearing as well as the skin fit suspension and socket design. By weight bearing, remineralization of lost bone in the residual limb is possible in the patient with through knee amputation. **Funding:** No funding source.

Effectiveness of pelvic physical therapy compared to traditional approaches to alleviate coccydynia: A systematic review

Shay Anderson, Rodgers Clay, April Collins, Autumn Yates, Karen Coker (Research Advisor)

Female patients with coccydynia often complain of pain with prolonged sitting, defecation, and sexual intercourse which often has a negative impact in their quality of life. Traditional therapies include invasive interventions such as coccygectomy and pain injections. The need for conservative treatments that restore musculoskeletal, neuromuscular and muscular performance to alleviate deficits and restore normal pelvic floor and pelvic girdle function for the treatment of coccydynia and prevention of recurrence. Peer reviewed journal articles of traditional, conservative, and pelvic physical therapy approaches to coccydynia were sourced via online searches of key words that were systematically obtained, reviewed, and data extracted independently by five reviewers. One final reviewer applied analysis of the of the process and data retrieved. Sackett's Levels of Evidence were used to classify the strength of the literature reported. Analyses: Summary data and topical data was collected during this systematic review. Thirty-two articles met inclusion criteria and were reviewed. Three systematic reviews, eight randomized control trials, three cohort studies, eight case- controlled studies, three literature reviews, and four case studies were reviewed. Five studies specifically addressed surgical approaches. Seven studies addressed pharmacological approaches, two studies compared pelvic floor physical therapy to other approaches, five studies addressed various interventions and related outcomes. The current literature demonstrates that the benefits of pelvic physical therapy provide effective, conservative treatment and management of coccydynia. Physical therapy should be considered as the primary conservative treatment option of choice. Additional studies are needed to determine if physical therapy is more effective than surgical and pharmacological treatments currently available. No funding sources were used.

Effects of Tributyltin Exposures on Translation Regulation in Human Immune Cells

Amanda Ruff, Shyretha Brown, Nafisa Hamza, Margaret Whalen (Research Advisor)

Tributyltin (TBT) contaminates the environment due to its use as a biocide. It is found in human blood (ranging as high as 261 nM). TBT is able to increase the synthesis of pro-inflammatory cytokines such as interferon gamma (IFN γ), tumor necrosis factor alpha (TNF α), interleukin 1 beta (IL-1 β), and interleukin 6 (IL-6) in human immune cells. This TBT-induced increase in pro-inflammatory cytokines could contribute to chronic inflammation, which is a risk factor for a number of diseases including several cancers. TBT appears to utilize the ERK1/2 and/or p38 MAPK pathways to stimulate pro-inflammatory cytokine synthesis in immune cells. MAPK pathways have the capacity to regulate translation including processes leading to the phosphorylation (activation) of eukaryotic initiation factor 4E (eIF4E), eIF4B, and the S6 ribosomal subunit. We hypothesize that TBT may influence the activation state of these translational regulators as part of its mechanism of increasing cytokine synthesis. Studies to examine the levels and phosphorylation state of eIF4E, eIF4B and S6K after varying lengths of exposure to TBT in monocyte-depleted peripheral blood mononuclear cells (MD-PBMCs) were carried out. Initial results suggest that TBT caused increased phosphorylation (activation) of eIF4E and S6. These results may indicate that TBT is elevating the synthesis of key pro-inflammatory cytokines in immune cells by its ability to activate translation.

Flame Retardant, Hexabromocyclododecane, Alters Secretion of Interleukin 6 from Human Immune Cells

Elizabeth Shelby, April Falconer, Margaret Whalen (Research Advisor)

Hexabromocyclododecane (HBCD) is a brominated flame retardant compound. It is used in polystyrene insulation, accumulates in living organisms and is highly toxic to aquatic organisms. Interleukin 6 (IL-6) is a pro-inflammatory protein that is produced by T lymphocytes and monocytes (as well as other cells). It regulates cell growth, tissue repair, and immune functions. Previous studies have shown that HBCD alters the secretion of cytokines IL-1 β , TNF α , and INF γ from human immune cells. Due to the important role IL-6 plays in immune responsiveness, it is important to understand whether exposures to HBCD are able to disrupt its secretion. HBCD is found in human blood and previous studies have shown that it inhibits the ability of human NK lymphocytes to destroy tumor cells. This study examines whether HBCD affects the secretion of IL-6 from monocyte-depleted (MD) human peripheral blood mononuclear cells (PBMCs). IL-6 secretion was measured by enzyme linked immunosorbent assay (ELISA). Results indicate that exposures of MD-PBMCs to different concentrations of HBCD (ranging from 5-0.05 μ M) for 24 h increase secretion of IL-6 from these immune cells. Thus, exposure to HBCD may potentially disrupt the immune regulation mediated by IL-6.

Signaling Pathways Involved in Pentachlorophenol Induced Elevations of Interleukin-6 Synthesis

Sahra Gabure, Margaret Whalen (Research Advisor)

Pentachlorophenol (PCP) is a compound that was widely used in the formulation of pesticidal solutions and more commonly as a wood preservative for railroad ties, utility poles, and log cabins. Its usage has become restricted as scientific studies indicate that exposure to this compound can have carcinogenic effects alongside acute or chronic effects on the cardiovascular system, liver, kidney, blood, and immune system. Previous studies in our laboratory indicated that PCP increases the synthesis of the pro-inflammatory cytokine, Interleukin-6 (IL-6). PCP increased synthesis of Interleukin-6 in peripheral blood mononuclear cells (PBMCs) at concentrations ranging from 5-0.05 μM . IL-6 is secreted by immune cells to promote inflammation. Overproduction of this cytokine, as can be stimulated by PCP, can lead to chronic inflammation and inflammatory diseases such as Rheumatoid Arthritis, Lupus Erythematosus, and Crohn's Disease. The current study evaluated the role of signaling pathways that regulate the synthesis of IL-6 in PBMCs in the PCP-stimulated increases in IL-6 synthesis. The ERK1/2 and p38 MAPK pathways were blocked with the inhibitors PD98059 and SB20350, respectively. The PI3 Kinase pathway was inhibited with LY294002. PBMCs were pre-treated with inhibitors prior to exposure to concentrations of PCP known to increase IL-6 synthesis (5-1 μM). Synthesis of IL-6 (intracellular + secreted level of IL-6) was determined using Enzyme Linked Immunosorbent Assays (secretion) and Western Blots (intracellular levels). The results indicate that PCP-induced increases in IL-6 were dependent on p38 MAPK pathway. The ERK 1/2 pathway was also needed for PCP to stimulate IL-6 synthesis in cells from some donors. PCP appears to stimulate pathways that should normally be activated in response to infection or injury leading to inappropriate elevation of the potent inflammatory stimulus. IL-6.

Synthesis of Tumor Necrosis Factor Alpha (TNF α) and Interferon Gamma (IFN γ) in Human Immune Cells Exposed to the Brominated Flame Retardant, Hexabromocyclododecane

Syeda Shahid, April Falconer, Margaret Whalen (Research Advisor)

Interferon gamma (IFN γ) and tumor necrosis factor alpha (TNF α) are both pro-inflammatory cytokines secreted by immune cells. As such, they have the capacity to cause chronic inflammation if they are secreted in the absence of injury or infection. Chronic inflammation is associated with a number of disease states including cancer. Hexabromocyclododecane (HBCD) is a brominated flame retardant used in polystyrene insulation as well as other products such as upholstery and has been found in human blood and other tissues. HBCD has been shown to increase the secretion of both IFN γ and TNF α from human immune cells. This study examines whether the increased secretion of these 2 cytokines from immune cells that were exposed to HBCD is due to increased synthesis (intracellular plus secreted levels) of the cytokine or simply due to release of pre-existing cytokine. Monocyte-depleted human peripheral blood mononuclear cells (MD-PBMCs) were exposed to 0-5 μ M HBCD for 24 h. TNF α or IFN γ secretion was measured by enzyme linked immunosorbent assay (ELISA) and their intracellular levels were measured using western blot. Preliminary results indicate that certain exposures of MD-PBMCs to HBCD increases synthesis of both TNF α and IFN γ in immune cells. The ability of HBCD to increase synthesis, rather than just simulate release, of these cytokines could lead to sustained elevation of IFN γ and TNF α contributing to chronic inflammation.

Factors Influencing Osteoarthritis and Preventative Treatment Recommendations for People with Traumatic Transtibial Amputation: A Systematic Review

Rebecca Slape, Lauren Atkinson, Andrew Blank, Edilberto Raynes, Edilberto Raynes (Research Advisor)

Long-term lower extremity prosthetic use has been linked to several secondary conditions, including osteoarthritis of the intact limb. Two hypotheses have been posited for this increased prevalence of osteoarthritis among amputees: altered gait mechanics and degeneration of articular cartilage due to lack of loading. The purpose of this review was to determine preventative strategies for reducing the incidence of osteoarthritis among people with traumatic unilateral transtibial amputations. Using the Oxford Center for Evidence-Based Medicine, studies were explored and ranked to identify factors influencing osteoarthritis, as well as preventative strategies to reduce its incidence and prevalence in this population. The results revealed that loading the intact joints, weight distribution training, cardiovascular training and weight management, use of advanced prostheses, and reevaluation of prostheses influence the development of osteoarthritis. Therefore, a perioperative exercise routine, regular follow-up rehabilitation, and regular prosthetic evaluation may be recommended as preventative strategies to reduce the occurrence of osteoarthritis. Further evidence is suggested to gain a better understanding of the outcomes of these preventative strategies.

Keywords: osteoarthritis, transtibial amputation, and prevention

Modulation of Lipid Peroxides in Human Liver Microsomes Following Exposure to the Flavonoids, Quercetin and Genistein.

Camille Stevenson, Dontrez Johnson, William Boadi (Research Advisor)

Plant flavonoids have been shown to offer more protective health benefits against oxidative deoxyribonucleic acid (DNA) damages caused by γ -ray radiation, UV irradiation, chemicals, and endogenous oxidative stress. The above compounds have been shown to be capable of modulating the activity of enzymes, and affect the behavior of many cell systems. While these may account for the anti-mutagenic activities of flavonoids in experimental systems, relatively little is known about the mechanisms of the modulation of lipid peroxides in human liver microsomes. The objectives of this study was to investigate the effects of two flavonoids: quercetin and genistein on the levels of lipid peroxides in human microsomes. Cells were seeded and were exposed to each of the flavonoid at concentrations of 0, 5, 10, 15, 20 and 25 μM and the lipid peroxides (i.e., Malonaldehyde (MDA before and after the oxidative stress) levels were measured. The results indicate the flavonoids decreased lipid peroxides in the microsomes. The effect of quercetin was more pronounced followed by genistein following the oxidative damage through the Fenton's chemistry. The findings suggest that the flavonoids play an important role in controlling oxidative stress in microsomes.

Lipid Peroxides Levels in the Commercial Oil Canola Following Exposure to the Flavonoids, Quercetin and Genistein.

Hilbeen Galnasky@my.tnstate.edu, William Boadi (Research Advisor)

Quercetin and genistein are natural flavonoids that have been reported to prevent oxidation of several biomolecules such as proteins, lipids, DNA and to prevent gene mutations and cancer. The purpose of this study was to investigate the respective contributions and physiological amounts of quercetin and genistein can prevent peroxidation in Canola oil a commercial and edible oil used for cooking purposes. Controls, samples, and blanks were prepared in triplicates. The control contained buffer solution Tris-HCl buffer containing 0.2% SDS and 0.05 M KCl, pH 7.4, Canola oil, and hydrogen peroxide (50 μM). The samples contained all of the control ingredients in addition to 0, 5, 10, 15, 20 and 25 μM for each respective flavonoid. Levels of lipid peroxides measured as, thiobarbituric reactive substances (TBARS), were quantified using the molar extinction coefficient of thiobarbituric acid of 1.56 $\text{M}^{-1}\text{cm}^{-1}$. The effect of incubating Canola oil for 24hrs with the respective flavonoids following the oxidative damage through the Fenton's pathway resulted in a dose-dependent decrease of TBARS. The results indicate that the exposure of quercetin compared to genistein reduced lipid peroxidation in Canola oil that could help promote healthy eating and reduce the obesity syndrome.

The Efficacy of Dry Needling Treatment for Chronic Tension-Type Headaches

Alex Whitfield, Braden Askvig, Brian Matthews, Ken Melrose, Richard Clark (Research Advisor)

Multiple studies have been done on dry needling and have provided inconclusive results on the efficacy of it as a treatment for chronic tension-type headaches (CTTH). Research has shown that headaches can result from a variety of conditions such as restricted joint movement (hypomobility), facet lock, referred pain, or musculoskeletal dysfunction. Facet lock commonly results from a dysfunctional movement pattern and involves the articulating surfaces of the joint “sticking” together and failing to move freely. Causes for CTTH have been widely speculated but research has shown minimal supporting evidence. These causes are thought to be trigger points in the head and neck, myofascial pain syndrome, forward head posture (FHP). This systematic review seeks to confirm the efficacy of dry needling as a treatment for headaches originating from the cervical spine, or structures in it, due to various causes and attempts to incorporate multiple studies to lead to a more compelling conclusion about the efficacy of dry needling. Our findings are that while dry needling is beneficial as a stand-alone treatment, more research is needed to ascertain how effective it is when compared to other established physical therapy treatment methods.

A review of the effects of aquatic exercise and fall risk in the older adults

Blake Huddleston, Mahaley Keele, Megan Lurty, Jennifer Thomas, Derek Charles (Research Advisor)

Introduction: One-third of adults >65 years old will sustain injuries such as fractures or traumatic brain injuries after a fall. Traditional fall prevention programs occur on land but aquatic based exercise may offer an alternative and safe option due to the unique properties of water. The purpose of this review was to examine the relationship between aquatic exercise and fall prevention in older adults.

Methods: The literature review was conducted using the databases PTNow, PubMed, Google Scholar, and SciHub and the search terms physical therapy, aquatic exercise, balance training, and fall risk. Inclusion criteria included English-language, peer-reviewed journals; participants > 65 years old with a history of falls or at risk; aquatic therapy as an intervention; randomized control trials, cohort studies, and systematic reviews; and inclusion of standardized outcome measures. Studies with insufficient data were excluded and articles were assessed using the Grading of Recommendations, Assessment, Development, and Evaluations (GRADE) scale.

Results: The final analysis included 14 studies with an overall moderate quality rating. Aquatic exercise had a direct effect on decreasing fall risk in older adults which was attributed to decreased pain, improved muscle performance, joint mobility, static and dynamic balance, coordination; and improvements in gait.

Discussion: While there were no significant differences between land-based and aquatic exercise in reducing fall risk, the increased perception of safety patients experience in water makes this environment a viable option to traditional exercise programs. Perceived benefits most often included an improvement in ambulation endurance, breathing, and pain with activity. This was especially true for individuals with a heightened fear of falls or those reluctant to participate with physical therapy.

Conclusion: Moderate evidence correlates aquatic exercise to improvements in function and the reduction of falls in older ad

United States vs. Scandinavia: A comparison of functional outcomes for individuals with ACL injury.

Ben Moroney, Brent Coleman, Audrey Powers, Killian Barry, Richard Clark (Research Advisor)

Background and Purpose

Moderately active individuals who have ruptured their anterior cruciate ligament have to make a decision between surgery and a more conservative approach for rehabilitation. The United States and Scandinavian countries differ in the amount of conservative therapy required and in the proportion of patients that choose surgical repair. The purpose of this systematic review is to examine outcomes between these two regions as well as compare the results of surgical and non-surgical interventions.

Methods

A systematic search for relevant peer-reviewed articles was performed in an effort to identify the differences in subjective and objective outcomes between conservatively and surgically treated patients in the United States and Scandinavia. Once the data was collected, the study was limited to two subjective measures, the KOOS and the IKDC, and one objective measure, the single leg hop for distance.

Results

The results show very little difference between outcomes of conservatively and surgically treated patients. While the conservatively treated patients reported higher perceived knee function on the KOOS, there seemed to be no difference in objective data taken from the single leg hop for distance between surgically and conservatively treated groups in Scandinavia and the United States.

Conclusion

Our conclusion is that patients who are moderately active and not in a hurry to return to sport are good candidates for non-surgical avenues of recovery. Pending compliance with rehabilitation protocol, patients who opt for conservative ACL treatment may report higher perceived knee function and similar objective measures as those who elect for ACL reconstruction.

Level of Evidence: 2c

The use of blood flow restriction training after an ACL reconstruction

Drew Palmer, Caleb Reyes, Ryan White, Derek Charles (Research Advisor)

Introduction: Quadriceps atrophy and weakness are common impairments after surgical reconstruction of the anterior cruciate ligament (ACL). Normalizing muscle circumference and strength is a common rehabilitation goal in order to return to previous level of function. Blood flow restriction (BFR) training is a technique with the potential to increase the strength and diameter of connective tissue by promoting the release of growth hormones and growth factors. The purpose of this report was to review the potential for BFR training to promote quadriceps changes and ligament healing after an ACL reconstruction.

Methods: The literature review was conducted using the databases PubMed, Medline, and Google Scholar. Key words included blood flow restriction training, ACL reconstruction, quadriceps, and ligament healing. Inclusion criteria included: English language, peer reviewed journals; randomized control trials; publication after 1990; articles related to blood flow restriction training and ACL reconstruction or ligament healing in general. Exclusion criteria included non-English language publications; studies without a control group; or studies with insufficient data to analyze the methodology.

Results: Four articles met the inclusion criteria and the strength of evidence for each article was evaluated using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) system. Also assessed were risk of bias, sample sizes, reliability and validity. Areas of interest included the cross-sectional area of the femoral muscles, knee flexor and extensor torque, and production of endogenous growth factors and hormones.

Discussion/Conclusion: Exercise performed at a low to moderate level using moderate restriction of blood flow had positive changes on femoral muscle diameter and knee extensor strength without placing stress on the healing ACL graft. An increased production of growth hormones and growth factors also occurred in response to BFR training. BFR trai

FIELD MONITORING OF ORIUS INSIDIOSUS AND THRIPS IN SWEET PEPPER USING HERBIVORE INDUCED PLANT VOLATILES

Uzoamaka Abana, Kaushalya Amarasekare (Research Advisor)

High pest populations in crop fields affect the performance of yields either in the quality or quantity or even both. Herbivore induced plant volatiles (HIPVs) are used as plant defensive mechanisms against insect herbivores. They act as kairomones in attracting natural enemies in pest-affected cropping systems. Thrips are a major pest species of sweet peppers in Tennessee. Insidious flower bug (*Orius insidiosus*) is considered as one of the most important generalist predators of thrips and other small-soft bodied arthropod pest species in the U.S. We hypothesized that the use of HIPVs is an effective method in attracting *O. insidiosus* into sweet pepper fields with high populations of thrips. We also speculated that the HIPV lures can be used as a suitable method to trap thrips species, especially the Western flower thrips, *Frankliniella occidentalis* in cropping systems. Therefore, the objective of this study was to find the effectiveness of two HIPV lures to monitor field populations of *O. insidiosus* and study the suitability of these lures as a pest management technique. A field experiment was conducted in summer and fall 2018, in Nashville, TN using sweet pepper as the target crop. The experimental treatments were two HIPVs [methyl salicylate (MS) and Neryl (S)-2-methylbutanoate (NMB)] and a no-lure control. This experiment was replicated using a randomized complete block design. Results show that a moderate numbers of *Orius* and a significantly higher number of thrips were attracted to the experimental HIPVs. The traps with MS lures caught the highest number of thrips compared with the number of thrips caught in the traps with NMB and the no-lure control. This study shows that the use of HIPVs is effective in the control of thrips populations in the field. There is no difference between the MS, NMB and no-lure control for the *Orius*.

Training with Instructional Cues Improves Automatic Control of Gait for People with Parkinson's Disease

Shannon Brady, Wasit Chuasiriporn, Lisamarie Labella, Elaina Lakos, David Lehman (Research Advisor)

Introduction: People with Parkinson's disease (PD) have decreased step length. Studies show cueing leads to increased step length, decreasing possible falls. Training with verbal cues leads to changes in the automatic control of step length. Purpose: To assess training using the instructional cue "take long steps" to improve step length while performing a secondary task. Methods: Eleven individuals with PD were randomly assigned to a treatment or control group. Pre and post training measurements included three trials under four conditions: no secondary task/no cue, secondary task/no cue, no secondary task/cue, and secondary task/cue. Treatment included a 10-day walking program using the instructional cue. Measurements were taken on the last day, one week, and one month after treatment. Analysis: A 2 (Group) x 2 (No Cue/Cue) x 2 (No Task/Task) x 4 (Time) ANOVA with repeated measures on the last three factors determined there were significant differences amongst the mean step lengths for all testing conditions. A Tukey HSD post-hoc analysis determined the significant differences between individual means.

Results: There was a significant three-way interaction of Group by Time by No Task/Task conditions for step length, $F(3, 27) = 3.127$, $p = .042$, $\eta^2 = .258$, $\text{power} = .661$. For the treatment group, step lengths were not significantly diminished by the tasks. The treatment group showed significantly increased step lengths at all post-tests for the secondary task conditions. Conclusion: Significant improvements in step length were found throughout post-testing. Step length of the treatment group was greater than that of the control group under all post-test conditions. Step length was unaffected by task conditions in post-test measurements, implying changes within the automatic program of gait. Discussion: The instructional cue training had an immediate and durable impact on gait, suggesting changes in the automatic motor program.

Meharry-Vanderbilt-TSU Cancer Outreach Core: Improving Community Advisory Board Engagement

Nora Cox, Oscar Miller (Research Advisor)

Meharry-Vanderbilt-TSU Cancer Outreach Core:

Improving Community Advisory Board Engagement

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Abstract

The Meharry-Vanderbilt-TSU Cancer PartnershipTMs (MVTCP) Cancer Outreach Core (COC) Community Advisory Board (CAB) was created to facilitate input into MVTCP activities and research projects and to promote community awareness of the MVTCP. Establishing CABs that are mutually beneficial for community members and researchers is a vital component of CAB effectiveness. The purpose of this assessment was to evaluate the MVTCP CABTMs effectiveness, in terms of CAB member engagement and established approaches to improve CAB member engagement. An existing survey instrument, "Community Advisory Board Effectiveness," was used. CAB members completed a 26-question survey, which measured their level of importance and their level of agreement with indicators of CAB processes and performance. Participation in the survey was voluntary and anonymous. Descriptive data analyses showed areas of CAB engagement that could be improved, therefore several approaches were implemented over the next 11 months to improve CAB member engagement. CAB members repeated the 26-item survey after changes were implemented. CAB-members participated in a focus-group to provide feedback on CAB effectiveness. Descriptive and bivariate analyses were performed and results from surveys were compared. Qualitative responses were reviewed and summarized.

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Abundance of the Green Lacewing *Chrysopa nigricornis* in Peach and Apple Orchards in Middle Tennessee

Kyle Williams, Kaushalya Amarasekare (Research Advisor)

Green lacewings (Neuroptera: Chrysopidae) are important generalist predators of soft-bodied arthropods in many agricultural cropping systems including tree-fruit orchards. They play an important role in the integrated pest management (IPM) of arthropod pests. Information on green lacewings in Tennessee is scarce. Genus *Chrysopa* and *Chrysoperla* are the two most important genera of green lacewings in the family Chrysopidae. *Chrysopa nigricornis* is a large and robust green lacewing species that is commonly found in the tree-fruit orchards in the U.S. Both larvae and adults of *C. nigricornis* are predacious while only the larvae are predacious in the genus *Chrysoperla*. We investigated the seasonal abundance of *C. nigricornis* and *Chrysoperla* species of green lacewings in apple and peach orchards in three middle Tennessee counties (Davidson, Chatham and Sumner) from March to October 2018, using two herbivore induced plant volatile (HIPV) treatments [squalene (*C. nigricornis*) and a combination of geraniol, methyl salicylate and 2-phenylethanol (*Chrysoperla* species)] using Delta traps with sticky liners. Lures were prepared in the laboratory using polyvinyl tubing and cotton wicks. The treatments were replicated four times and were arranged in a randomized complete block design (RCBD). Each trap (with a lure and a sticky liner) was hung on a tree branch approximately 1.5 - 2.0 m above ground. Lures and liners were replaced monthly and weekly, respectively. Each collected liner was covered with polythene wrap and stored in a freezer until the lacewing identification. Weekly collections of sticky liners from the squalene lure traps showed two peaks of *C. nigricornis* populations. The peaks occurred in May and late-August, respectively. Due to this discovery, it is believed that *C. nigricornis* is bivoltine in Tennessee. We observed a low population of *Chrysoperla* species. We also speculate that temperature plays an important role in the seasonal abundance of *C. nigricornis*.

Secondary Analysis of 1998 to 2017 Foodborne Outbreak Data: Comparison of Tennessee Foodborne Disease Burden to the National Statistics

Anita Scales, Aliyar Fouladkhah (Research Advisor)

Foodborne diseases could affect healthy individuals and more severely at-risk groups such as the very young, the elderly, pregnant women, and the immunocompromised. It is estimated that around 30% of US population are currently considered as at-risk for foodborne diseases. Recent epidemiological estimates of the Centers for Disease Control and Prevention indicate as high as 1 in 6 Americans experience foodborne diseases every year, leading to more than 127,000 episodes of hospitalizations and around 3,000 deaths. From 1998 to 2016, there have been more than 19,900 single or multistate outbreaks leading to about 380,000 illness with 4% rate of hospitalization. Information derived from active surveillance data of the Centers for Disease Control and Prevention from 1998 to 2016 were analyzed and will be presented in the current poster. Particular emphasis has placed on comparison of Tennessee-related food safety outbreaks, illnesses, hospitalizations, and death episodes as related to national statistics.

Synergism of Mild Heat, Nisin, and Lysozyme for Pressure-based Inactivation of *Bacillus amyloliquefaciens*, *Geobacillus stearothermophilus*, and *Bacillus atrophaeus* Spores

Abimbola Allison, Aliyar Fouladkhah (Research Advisor)

Commercial adoption of high-pressure processing is gaining momentum and industrial importance with recent advances in the engineering of pressure-based pasteurization units. The main curtailment of the technology is limited efficacy for inactivation of microbial spores. Current study investigated synergism of elevated hydrostatic pressure, mild heat, and two antimicrobials (nisin, and lysozyme) for inactivation of three spore suspensions. Various times (0, 3, 5, and 10 minutes) at pressure intensity level of 650 MPa (e.g. 94K PSI) of elevated hydrostatic pressure (Hub880 Explorer, Pressure BioScience Inc), were investigated at 50 °C for inactivation of *Bacillus amyloliquefaciens*, *Geobacillus stearothermophilus* (ATCC 7953), and *Bacillus atrophaeus* (ATCC 9372). The selected strains are currently considered as one of the most pressure-resistant natural isolates, the biological indicator for heat-based sterilization, and indicator for heat- and chemical-based decontamination interventions, respectively. The spore suspensions exposed to treatments at the above-mentioned intensity with and without the presence of Lysozyme (22.4 ml/L), and Nisin (5000 IU/ml) in HEPES buffer. The ANOVA conducted followed by LSD-based mean separation by OpenEpi software. Counts of *Bacillus amyloliquefaciens* were 6.75 ± 0.1 prior to the treatment and were reduced to 4.32 ± 0.1 after the treatment for 10 minutes at 650 MPa for 50 °C. These reductions were augmented in presence of nisin where the spore suspension was reduced by 2.21 Log CFU/mL. Nisin was similarly efficacious ($P < 0.05$) for reducing *Bacillus atrophaeus* by 3.31 Log CFU/mL after the above-mentioned treatment for 10 minutes while was not capable of significant reductions ($P \geq 0.05$) of *Geobacillus stearothermophilus*. Lysozyme, similarly, lead to 2.62 and 2.65 Log CFU/mL reductions of *Bacillus amyloliquefaciens*, and *Bacillus atrophaeus*, respectively. Results of current study indicate an optimized pressure-based intervention in presenc

Assuring the Safety of Apple Cider from Non-Typhoidal Salmonella Serovars and Rifampicin-Resistant Escherichia coli O157:H7 using High Pressure Pasteurization

Jayashan Adhikari, Aliyar Fouladkhah (Research Advisor)

With recent advancements in design and engineering of high-pressure pasteurization units, the application of elevated hydrostatic pressure is gaining rapid adoption across various sectors of food processing. Hurdle validation studies could facilitate the microbiologically effective and economically feasible utilization of the technology. Current study discusses microbiological challenge studies for inactivation of non-typhoidal Salmonella serovars and Escherichia coli O157:H7 exposed to various times (0 to 8 min) and intensity levels (0 to 650 MPa) of elevated hydrostatic pressure (Pressure BioScience Inc.). The temperature was maintained precisely at 4 °C by a circulating water bath and stainless steel jacket surrounding the reaction chamber and monitored by k-type thermocouples. Studies were conducted in two biologically independent repetitions, as blocking factors of a randomized complete block design, containing three repetitions per time/treatment/pathogen within each block, using 5-strain mixture of Salmonella serovars and Escherichia coli O157:H7. Results were analyzed by the generalized linear procedure of SAS at type one error level of 5% using Tukey- and Dunnett-adjusted ANOVA. The D-value and Kmax were additionally calculated using best-fitted (maximum R², $R^2 = 0.05$) model obtained by GlnaFit software. Under the condition of experiments, 2.50, 2.28, 1.74, 1.25, and 0.65 logs CFU/mL reductions ($P < 0.05$) were observed for Escherichia coli O157:H7 cells exposed to 650, 550, 450, 350, and 250 MPa of elevated hydrostatic pressure, respectively. At 380 MPa, D-value of 1.19 min and inactivation Kmax value of 2.87 1/min were observed for non-typhoidal Salmonella serovars. Treatments below three min were less effective ($P \neq 0.05$) for the pathogens' cell reduction, in the vast majority of tested time/pressure combinations. This study exhibits that a validated pressure-based pasteurization could achieve reductions of >99% for the inoculated pathogens. Results of this stu

Sensitivity of Wild-Type and Rifampicin-Resistant *Cronobacter sakazakii* and Background Microflora of Infant Formula to Elevated Hydrostatic Pressure

Kaleh Karim, Aliyar Fouladkhah (Research Advisor)

Cronobacter sakazakii could survive and proliferate in dry, low moisture environments such as infant formula. Infections caused by the bacterium are often fatal in infants born premature and those younger than two months. Purpose of this study is to investigate effects of mild hydrostatic pressure for decontamination of infant formula from wild-type and rifampicin resistant *Cronobacter sakazakii*. Up to 9 cycles of mild elevated hydrostatic pressure (350 MPa, 30 seconds) were investigated for inactivation of 4-strain mixture of wild-type and rifampicin-resistant *Cronobacter sakazakii*, at 4 and 55 °C, respectively. In a companion experiment, survival of the 4-strain mixture *Cronobacter sakazakii* in infant formula was investigated during aerobic storage at 10 and 25 °C. The experiments were conducted in two biologically independent repetitions, as blocking factors of a randomized complete block design, containing three repetitions per cycle/phenotype within each block. Study was analyzed by LSD-based ANOVA using OpenEpi software. Counts of *Cronobacter sakazakii* were reduced ($P < 0.05$) from 5.50 ± 0.5 to 4.74 ± 0.2 log CFU/g (approximately <90% reduction) during a 14-day aerobic storage at 25 °C. Counts of background microflora were similarly reduced ($P < 0.05$) from 7.19 ± 0.4 to 5.03 ± 0.2 log CFU/g (approximately >99% reduction), during a 14-day aerobic storage at 25 °C. At 55 °C, >2.04 and up to 6.56 log reductions ($P < 0.05$) of wild-type *Cronobacter sakazakii* were observed as result of application of elevated hydrostatic pressure at 350 MPa (51K PSI). At 4 °C, >1.06 and >5.23 reductions ($P < 0.05$) of wild-type *Cronobacter sakazakii* were observed as result of application of elevated hydrostatic pressure at 350 MPa (51K PSI). Overall the survival of the pathogen and spoilage organism were similar ($P > 0.05$) during storage at 10 °C and 25 °C. Reductions of rifampicin-resistant phenotype at both temperatures were similar ($P \approx 0.05$) to wild-type pathogen, thus indicating the phenotypes could

Effects of nisin and pressure-based pasteurization for inactivation of *Listeria monocytogenes* in buffered environment

Sadiye Aras, Aliyar Fouladkhah (Research Advisor)

Epidemiological evidence derived from CDC's active surveillance data indicate >98% of human Listeriosis cases are foodborne in nature with about 94% and 15.9% hospitalization and death rates, respectively. Current study investigated inactivation of *Listeria monocytogenes* using mild heat, hydrostatic pressure, and nisin in buffered environment. Four-strain mixture of *Listeria monocytogenes* were exposed to 0, 3, 6, and 9 minute of six treatments: A) hydrostatic pressure at 4 °C; B) hydrostatic pressure and nisin at 4 °C; C) nisin at 4 °C; D) heat at 40 °C; E) hydrostatic pressure at 40 °C; F) hydrostatic pressure and nisin at 40 °C. Pressure intensity level of 400 MPa (Hub880 Explorer, Pressure BioScience Inc), and nisin concentration of 5000 IU/ml were used for the experiments of inoculated pathogen in phosphate buffered saline. The unit temperature was precisely controlled and monitored by a stainless steel water jacket surrounding the pressure chamber connected to a refrigerated circulating water bath. Analyses of variance were conducted followed by LSD-based mean separation by OpenEpi software. The six treatments after 9 minutes were all resulted in reductions ($P < 0.05$) of the pathogen. These reductions were 4.5, 4.3, 4.9, 3.1, 5.2, and 4.5 log CFU/ml for treatments of A to F, respectively. Under the condition of this experiment, antimicrobial efficacy of nisin was affected only modestly through synergism with elevated pressure and mild heat. As an examples, counts of samples treated for 6 minutes were similarly ($P \geq 0.05$) 2.9 ± 0.4 , 3.3 ± 0.7 , and 2.9 ± 0.5 for samples treated with nisin alone, nisin and hydrostatic pressure, and nisin and heat, respectively. Results of this study could be incorporated as part of hazard analysis for meeting requirements of FSMA Human Food rule for mitigating the public health burden of foodborne Listeriosis.

Inactivation of wild-type and pressure-stressed Shiga toxin-producing *Escherichia coli* at planktonic and sessile stages

Monica Henry, Aliyar Fouladkhah (Research Advisor)

Biofilm of microbial pathogens are major concern in manufacturing and healthcare settings and estimated to be the etiological agent of >80% of bacterial infections. Current study evaluates the sensitivity of a quaternary ammonium compound-based sanitizer (QAC) against two phenotypes (Wild-type [WT] and Pressure-stressed [PS]) of O157, O26, O45, O103, O111, O121, and O145 Shiga toxin-producing *Escherichia coli* at 7 and 25 °C. A 6-strain mixture of WT and PS *Escherichia coli* O157, non-O157 *Escherichia coli* (CDC's *E. coli* O157:H7) were utilized for biofilm formation for up to 2 weeks on surface of stainless steel (finish 2b) coupons at 7 and 25 °C. After removal of loosely attached cells, samples were neutralized using D/E neutralizing broth and removed from coupons using sonication, prior to culture dependent analyses. The PS phenotypes were prepared by exposing the isolates to sub-lethal elevated hydrostatic pressure of 15,000 PSI (c.100 MPa) for 15 minutes. The experiment was analyzed statistically by SAS, using a Tukey-adjusted mean separation. Counts of WT and PS *Escherichia coli* O157 at 7 °C were 2.04 ± 0.7 and 3.29 ± 0.2 prior to treatment, respectively. These counts on day-0 were reduced ($P < 0.05$) to 0.63 ± 0.2 and 0.98 ± 0.3 , respectively, after the treatment. In contrast, counts of two-week mature biofilm of WT *Escherichia coli* O157 were 5.22 ± 0.1 and 4.56 ± 1.0 before and after treatment, respectively, exhibiting low efficacy ($P \geq 0.05$) of the sanitizer against two-week mature biofilm. The tested serogroups and phenotypes of pathogen exhibited similar biofilm formation capability and sensitivity to QAC. The sanitizer tested at the highest concentration recommended by the manufacturer appears to be efficacious only against planktonic cells while exhibiting inability for the complete removal of one- and two-week mature biofilms.

Antibacterial and Antifungal Agent, Triclosan (TCS) Alters Secretion of Interleukin 1 beta and Interleukin 6 from Human Immune Cells

Wendy Wilburn, Dylan Brooks, Margaret Whalen (Research Advisor)

Triclosan (TCS) is an antimicrobial compound that is widely used in personal hygiene products such as mouthwash and toothpaste. TCS can be ingested or absorbed through the skin and has been found in human blood, breast milk, and urine. Interleukin (IL)-6 and IL-1 beta (IL-1 β) are important pro-inflammatory cytokines produced by lymphocytes, monocytes, and other cells. Both regulate cell growth, tissue repair, and immune function, increased levels of each have been associated with a number of diseases including rheumatoid arthritis and certain cancers. TCS has been shown to inhibit the lytic function of human natural killer (NK) lymphocytes and to decrease expression of key cell surface proteins on NK cells. Here we will examine whether TCS will alter the secretion of IL-1 β and IL-6 from human immune cell preparations. Human peripheral blood mononuclear cells (PBMCs) and monocyte-depleted (MD)-PBMCs will be exposed to TCS at concentrations of 0-5 μ M. Cytokine secretion will be measured at 24 h, 48 h, and 6 days using enzyme-linked immunosorbent assay (ELISA). In this study, both IL-1 β and IL-6 secretion could be increased at one or more concentration of TCS at one or more length of exposure. Effects of 24 h exposure to 0.0, 0.25 and 1.0 μ M TCS on IL-1 β secretion from PBMCs treated with selective pathway component inhibitors in individual donors were measured. These results should indicate that TCS has the capacity to disrupt secretion of these two important pro-inflammatory cytokines.

Examining the assimilation of Landsat 8, Sentinel 1 satellite data and derived indices in mapping softwood forest species in Tennessee

Eze Amadi, Akumu Clement Elumpe (Research Advisor)

Remote sensing classification is useful in delineating and mapping of land cover types such as softwood forest species including southern yellow pines. However, the degree of accuracy in classification varies because of several factors such as mixed pixel, factor of scale, spectral information and classification techniques. This study explored different remotely sensed digital data integration to examine the classification and mapping accuracies of softwood forested species in Tennessee. The aim of the study was to classify, map and examine the accuracy of southern yellow pines (loblolly, short leaf and virginia pines) under three dataset integration scenarios i.e. 1) Landsat 8 only classification; 2) Landsat 8 and fusion with sentinel 1 classification and; 3) Landsat 8, fusion with sentinel 1 and derived indices classification. Machine learning remote sensing classifier (random forest) was used to classify the softwood forest species. We found significant differences in the classification and delineation of southern yellow pines from the three data integration scenarios. The assimilation of sentinel 1 and Landsat 8 spectral information could significantly improve the delineation and mapping of softwood forest species such as southern yellow pines.

Electrical Stimulation for Upper Extremities After Stroke

Jordan Carman, Ashley Hernandez, Juan Onate, Alexandria Stewart, David Lehman (Research Advisor)

OBJECTIVE: This purpose of this systematic review is to determine if electrical stimulation (ES) is an effective intervention for upper extremity function affected by stroke.

METHODS: The articles included in this systematic review were extracted from the CINAHL Complete database via EBSCO Host. Inclusion criteria for evidence reviewed included: age 18-80, post-stroke (acute, subacute, or chronic), surface electrode stimulation as an intervention, and systematic reviews of Random Controlled Trials (RCT) and RCT studies. Exclusion criteria were studies not translated to English, pathologies other than stroke, treatment was not for Upper Extremity (UE), ES with robotic limbs, duplicate articles, co-existing neurological conditions along with stroke involving the UE, participants who had severely impaired cognition and/or communication, and studies that allowed participants with Botox injections in the affected UE muscle within 3 months of the study.

RESULTS: Several studies showed some improvement within the ES treatment groups versus the control group, while other studies did not find any clinical significance between groups. However, the studies that revealed improvements were often based on improvements to ROM and strength, which may or may not contribute to functional and participatory gains. Positive changes in function and/or participation were less clear.

CONCLUSION: The studies of ES for UE hemiparesis caused by stroke reveal minimal and/or inconclusive evidence. Evidence shows conflicting results due in part to limitations that were not or could not be controlled for. Factors such as severity of stroke, phase of stroke, comorbidities, parameters of ES, and age makes it difficult to determine effectiveness of ES on UE function and what parameters of ES are best. More conclusive evidence is needed to support ES as an intervention for UE deficits following a stroke.

Productivity Requirements & Perceived Quality of Life for Practitioners

Lora Doherty, Christine Watt (Research Advisor)

This project explores current trends in productivity requirements for occupational therapists, and how practitioners feel regarding their expected rates. The ethics of productivity rates, combined with the overall effects of productivity requirements on practitioners will be studied in order to gain insight into whether or not this occupational therapy needs to address productivity expectations.

The Correlation Between Lifestyle Choices that Cause Hip Flexor Tightness and Nonspecific Chronic Low Back Pain

Autumn Trimble, Jill Harris, Christine Watt (Research Advisor)

This project is a stepping stone on the path to creating more effective and efficient treatments for nonspecific chronic low back pain. The results from this project will provide evidence for whether or not there is a correlation between the amount of time the hips are in a flexed position and nonspecific chronic low back pain. If there is a positive correlation, there will be a basis for further research to be conducted on the effect of reducing hip flexion time for those with nonspecific chronic low back pain. If there is not a positive correlation, further research time and efforts can be directed elsewhere.

Reading with Dogs

Sydney Kauf, Ashton Dorsey, Alexis Brandon, Christine Watt (Research Advisor)

Our plan for this project is to assess the effectiveness of increasing the confidence of children ages 7-12 reading after practicing by reading to a dog. While assessing confidence we are also assessing the effectiveness of increasing the words read correctly per minute in children ages 7-12 after practicing by reading to a dog. Five to ten children will be recruited from flyers posted in public settings. Subjects will volunteer with permission from parent/guardian. Children will be assigned randomly to two different groups. Each child will be given a unique series of numbers in place of their name for privacy. Group A the experimental group meaning they will be exposed to reading to the dog first. Group B the control group meaning they will read with no dog present. Once placed in their groups, each child will read for 10 minutes in given condition for 2 sessions.

How an elevator speech reveals professional identity and role certainty: A comparison between current and former occupational therapy students in one program of study

Kahlie Calderon, Hannah Brown, Christine Watt (Research Advisor)

This study will use survey methodology to gather data for qualitative analysis. Email requests will be sent to current and former students asking them to take a survey on Google forms. The survey will remove all identifying information links, so anonymity is retained for all applicants. The survey will inquire about grade level, years of professional experience, ability to communicate profession and confidence with profession. A 5-point Likert scale will be used to rate responses and data will be analyzed for themes and patterns related to the progression of professional identity and role certainty. We hope to find that levels professional identity and role certainty will increase through years of experience as measured by ease and understanding of elevator speech.

Health Conditions of Manual Labor Workers and How Their Work Behaviors Affect Their Health: A Research Study

Allison Elliott, Tierney D. Williams, Dacy Thomasson, Christine Watt (Research Advisor)

The overall purpose of this research project is to determine if there is a direct relationship between an individual and his or her behaviors at his or her working environment. Individuals in the manual labor sector are especially at risk for developing varying health conditions from acute injuries to chronic pain, and we, the researchers, are wanting to conduct a study to determine if the choices one makes daily while at work can adversely affect his or her health. Our plan to conduct this study and obtain information is to invite approximately 60 workers from three different companies in the greater Nashville area (crane operators, concrete mixers/pourers, water and sewer rehabilitation workers) to complete an online anonymous survey. The survey is approximately twenty questions in length, in addition to a demographics section at the beginning; the individual completing the survey will be allowed to terminate the survey at anytime if he or she would not like to continue. As an incentive, at the end of the survey, individuals will have the opportunity to leave their email address to be entered in to win a drawing for a \$20 gift card to a restaurant in the greater Nashville area. We hope that this research project can bring awareness to healthcare providers to know how to work and treat those who work in the manual labor sector in order to have a more client-centered approach when treating an individual.

Does Yoga Have an Effect on Mood for Adolescents With Down Syndrome

Alyssa Papan, Maggie Brewer, Margaret Rittler, Paige Wheeler, Jessica Viola, Christine Watt
(Research Advisor)

The purpose of this project is to determine the role yoga has on the mood of individuals with Down Syndrome. GiGi's Playhouse is a local organization that caters to this population. We plan to utilize their biweekly yoga class in order to conduct our research. Participants will be given a brief mood survey before the yoga class that will consist of faces representing different moods (happy, sad, tired, calm, excited, etc.). After the yoga class, an electronic survey will be sent out to the parents/caregivers of the participants. The survey will ask detailed questions about the mood of their child. Because the yoga class is biweekly, the electronic survey will also be sent out on the weeks without yoga. This will allow us to determine whether yoga has an effect on the mood of the participants.

Perceived Levels of Support: Is There a Difference Among Single Foster Parents and Couple Foster Parents?

Lauren Weaver, Christine Watt (Research Advisor)

The overall purpose of this study is to look at the difference among single foster parents and couple foster parents and their levels of perceived support - does having a partner significantly impact perceived support or can support be found elsewhere? Mental health is prevalent in the foster care community which often times requires families to need additional support. This study aims to look at the different support systems foster families feel they have.

The Effect of Music on Perceived Exertion During Exercise

Sarah Clifford, Meagan McCoy, Lindsey Ruthven, Karly Hollis, Siobhan O'Donnell, Christine Watt (Research Advisor)

In this randomized crossover design, thirty invited participants enrolled in the TSU Biomechanics course will be healthy students over the age of 18 with no prior significant medical history. Screening of each participant's health and medical history will be taken prior to each session. All researchers are trained in CPR and safety protocols such as relevant emergency devices, TSU emergency department numbers, and other health precautions will be in place during the activity. The 30 invited participants will complete two exercise circuits (one with music & one with no music). One week will be one circuit with or without the music and the following week will be the opposite circuit. At the end of each session, each participant will complete the Borg's Rating of Perceived Exertion Questionnaire. We will compare the effects of music on each individual's perceived exertion during the activity. The overall purpose of this study will be to understand how exercise with music will affect one's perceived exertion.

A Comparison of Physical Activity and Free Play on a Child's Attention

Heather Markum, Rachel Ward, Brenna Gorman, Samantha Cowie, Christine Watt (Research Advisor)

We are observing whether free play or structured physical activity is more beneficial for attention during sedentary classroom activities. We are hypothesizing that children will attend better to sedentary classroom activities after structured physical activities as opposed to free play. We are observing children ages 3-5 at a gymnastics facility daycare program using a pre-test and a post-test. Observations will be made by researchers regarding the children's attention using a tally system to record the quantity of poor attention behaviors. Observations will be made during circle time, a coloring worksheet, and a handwriting worksheet before and after structured physical activities and free play.

OT in the Opioid Crisis

Kara Bell, Christine Watt (Research Advisor)

I am using the Model of Human Occupation's Self Assessment (MOHO-OSA) to evaluate women seeking substance use treatment. Through the use of this assessment I am exploring if an occupational dysfunction exists and, if so, how can occupational therapy impact these women in the future. Research has shown that engaging in new occupations may help women develop new roles and interests and can play an important role in recovery and prevention of future relapse. The findings of this study may be useful in informing future occupational therapy practice.

Occurrence of Fusarium Crown Rot on Oakleaf Hydrangea (*Hydrangea quercifolia*)

Mary Holden, Terri Simmons, Fulya Baysal-Gurel (Research Advisor)

The oakleaf hydrangea (*Hydrangea quercifolia*) cvs. "Pee Wee"™ and "Ruby Slippers"™ grown in pot-in-pot in Tennessee have shown symptoms resembling those of Fusarium crown rot after late spring frost in May 2018. Symptoms were premature defoliation and crown rot. Two species were recovered: *Fusarium oxysporum* (FOX) and an undescribed species designated *Fusarium* sp. (FUS). The internal transcribed spacer and translation elongation factor 1-alpha of the isolate were amplified using primers ITS-1/ITS-4 and EF1-728F/EF1-986R, respectively. Sequence identity for ITS and EF-1± was 99% with the sequences from FOX. FUS appears to be taxonomically distinct from other species, and currently its identity is under investigation. To demonstrate pathogenicity, two methods (with and without cold shock) were used to inoculate 1-year old oakleaf hydrangea cvs. "Pee Wee"™ and "Ruby Slippers"™ with FOX and FUS. Disease symptoms occurred consistently on inoculated plants similar to those observed in the field, while the control plants remained healthy. Symptoms were most severe on plants inoculated with FUS and much less severe on plants inoculated with FOX. Disease severity increased when the plants were treated with cold shock. Disease severity was greater in the oakleaf hydrangea cv. "Pee Wee"™. This study demonstrated that Fusarium crown rot of oakleaf hydrangeas is caused primarily by FUS but that it also can be caused by FOX. This disease may become a significant problem for oakleaf hydrangea production and management practices such as resistant cultivars are needed to avoid potential loss it might cause. Results showed that the screened cultivars are susceptible to both FUS and FOX. Harmony, Pee Wee, Muchkin, and Back Porch were affected severely by FOX and Snowflake, John Wayne, and Queen of Hearts were affected severely by FUS. Further identification of FUS is underway.

Examining distribution of farms involved in agritourism activities in Tennessee: Location, activity types, and factors

Emmanuel Wallace, Ummey Honey, Michael Crawford, Aditya Khanal (Research Advisor)

With recent development, agritourism—visiting a working agricultural setting such as farm and ranch for leisure, recreation, or education purposes is gaining popularity as a viable alternative to enhance income for farmers. Statistics show around \$600 million increase in agritourism-related receipts between 2002 and 2012 in the US. Studies suggest that proximity to urban/rural, structure-composition of consumer markets and amenities scores of a county could play a key role to start an agritourism operation. Tennessee is one of the states with increased agritourism operations in recent years. Using Zip-code level location information of agritourism farms in Tennessee, this study maps agritourism locations by activity and recreational services and examines role of structural factors in determining location.

Evaluation of fungicides at different application intervals for the control of powdery mildew of dogwood

Milan Panth, Mary Holden, Ravi Bika, Terri Simmons, Fulya Baysal-Gurel (Research Advisor)

The efficacy of fungicides at different application intervals on powdery mildew disease was investigated on flowering dogwood (*Cornus florida*) cultivar Cherokee Princess seedlings. Four single-plant replications per treatment were arranged in a randomized complete block design in a greenhouse at the Otis L. Floyd Nursery Research Center in McMinnville, TN. Treatments (Mural 45WG at 5 and 7 oz/100 gal and Concert II at 35 fl oz/100 gal) were applied to run-off using a backpack CO₂-pressurized sprayer at 40 psi on a 14- or 21-day interval. The severity of powdery mildew was evaluated using a scale of 0-100% foliage area affected, and the area under the disease progress curve (AUDPC) was calculated. Plant quality was evaluated using a scale of 1-9 where 1 is dead, 7 is commercially acceptable, and 9 is a perfect plant. All treatments significantly reduced powdery mildew severity and disease progress compared to the non-treated control. However, there were no significant differences in disease progress among treatments. Plants treated with the low and high rates of Mural on a 14-day application interval, with the high rate of Mural on a 21-day application interval, and with Concert II on a 14-day application interval, had significantly less powdery mildew than those treated with the low rate of Mural or Concert II on a 21-day application interval. Plant height and width were not significantly different among treatments on 19 Jul. Phytotoxicity was not observed in any of the treated dogwood seedlings. Non-treated control plants were not commercially acceptable due to disease at the end of the experiment.

Evaluation of bacteria as potential growth promoting agent for sweet pepper production

Bandana Bhusal, Margaret Mmbaga (Research Advisor)

Plant growth promoting bacteria (PGPB) have been reported to increase plant yield by the help of volatiles they produce. To assess the growth of sweet pepper by PGPB, we conducted an experiment in growth chamber using seven different PGPB (Prt, PSL, PS, B17A, B17B, Y and IMC8). Known volume of PGPB were inoculated in small petridishes at the time of transplanting. Significant difference in the chlorophyll content (p -value=0.005) was observed when analysis was done. Among all, sweet pepper inoculated with Prt (*B. amyloliquefaciens*) was seen to have the highest chlorophyll content ($71.17 \mu\text{mol m}^{-2}$) and the lowest chlorophyll content was observed in control ($3 \mu\text{mol m}^{-2}$). Having increased chlorophyll content would eventually differ the yield among treatments and control.

VOLATILE PROFILE OF FRUIT JUICES BY ELECTRONIC NOSE

Michael Addogoh, Ramasamy Ravi (Research Advisor)

Hypothesis

Change in volatile profiles of foods can be used to assess their quality, authenticity, shelf life and consumer liking. Changes in volatile profile of fruit juices from production to storage are detected by electronic nose (EN) in a rapid manner to save time and cost.

Objectives

The main objective is to explore the volatile profile of fruit juices using EN and also to estimate the volatile profile of fruit juices using EN which in turn predicts the shelf-life of fruit juices.

Materials and methods

Three varieties of fruit juices, Cranberry juice, Watermelon Juice and Pineapple juice were used for the experiment. The HERCALES GC Flash electronic nose was used to discriminate the aroma profiles of the fruit juices. 10ml of each juice was measured and transferred into a septa-sealed screw cap vial. And the aroma headspace volatiles introduced into the electronic nose at the speed of 270 μ l/s. For calibration C6-C16 was used and Kovats indices along with RT was used to identify the volatile compounds using AromaChemBase software.

Results

Butane-2,3-dione was the compound with the highest surface percentage in Cranberry Juice followed by Ethyl Hexanoate. In Watermelon juice, myrcene had the highest surface percentage followed by ethyl-3-(methylthio)-propanoate. Butanal was the most prominent compound in Pineapple Juice followed by 2,6-dimethyl pyrazine. The EN volatile profiles data subjected to PCA analysis which indicated different clusters for different samples may be to their differential volatile compounds and composition.

Conclusion

The EN aroma profiles generated for fruit juices unique, can be stored as a library for retrieving to compare with unknown samples, monitoring shelf life of food products. Electronic nose profiles can be generated very fast and the results are reliable and repeatable. The results can be stored and retrieved for the sample comparisons or to establish bench marks

ELECTRONIC NOSE VOLATILE PROFILES OF FRUIT JUICES

Michael Addogoh, Ramasamy Ravi (Research Advisor)

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Evaluation of growth promoting bacteria for cucumber production

Bandana Bhusal, Steve Osborne, Ethan Swiggart, Margaret Mmbaga (Research Advisor)

Volatile compounds produced by rhizobacterium have the ability to stimulate plant growth and development. Evaluations of *Bacillus* sp. and *Serratia* sp. were carried out under growth chamber conditions to determine plant growth promotion and enzyme activity in cucumber plants. Leaf area and polyphenol oxidase activity were significantly increased when either bacterial species was present. Two *Bacillus* sp. were successfully able to suppress growth of *Sclerotium rolfsii*. These results suggest rhizobacterium to be a useful tool for the southeastern cucumber producer.

Non-destructive technique of diagnosing iron deficiency symptom in *Rubus* species cv. 'Caroline. Glencoe and Natchez'TM

Matthews Spartks, Steven Kennedy, Dharma Pitchay (Research Advisor)

Generally, appearance of iron deficiency symptoms as interveinal chlorosis of young leaves is common among the *Rubus* genus of rosacea family. Iron deficiency symptoms can be diagnosed in several ways. But the challenge is diagnosing the symptoms at an early stage to minimize the damage by taking the appropriate measures. The objective of the study was to induce and determine the visual symptoms of iron deficiency using non-destructive techniques versus visual. For this purpose, an experiment was conducted in Tennessee State University greenhouse (36°09'57.15" N -86°49'49.21" W) by growing three species of genus *Rubus* var. 'Caroline. Glencoe and Natchez'TM. The plants were grown hydroponically in complete nutrition solution until it attained active vegetative growth (three weeks). Plants were then subjected to iron deprived nutrient solution and complete nutrient solution. The leaves were measured for green pigmentation (chlorosis) discoloration using the Spad value, Hunter L, a, b and CIE 1976 L*a*b* (CIELAB) with the progression of the interveinal chlorosis. There is a difference in the values of initial as well as advanced stage of iron deficiency. There was also a significant reduction in the leaf area, shoot and root biomass, more so at the advanced stage. Images of the visual interveinal chlorotic symptoms, at various stages, and the values associated Spad value, Hunter L, a, b and CIE 1976 L*a*b* (CIELAB) for these species will be presented as a guideline to assist growers in diagnosing severity of iron deficiency.

Modeling aboveground woody biomass and carbon stock using airborne LiDAR

Durga Joshi, Bharat Pokharel (Research Advisor)

Light Detection and Ranging (LiDAR) method of acquiring data has gained popularity among resources managers, researchers and landowners to estimate forest biomass and carbon stock across the forest landscape. Predicting and mapping spatial distribution of woody biomass is a prerequisite for a continuous supply of feedstock for biofuel production. We hypothesized that data matrix derived from LiDAR point clouds will improve the prediction accuracy of forest stand level variables such as biomass or carbon stock per unit area. LiDAR derived variables, national land cover dataset (NLCD), and digital elevation model were paired with Forest Inventory and Analysis from selected counties in Kentucky and Tennessee. We fitted both parametric and non-parametric models and compared their model fit statistics. LiDAR's canopy height model and canopy cover percent from NLCD data were the important variables in both models. The model fit statistics were compared between two modeling approaches and map-models were used to generate predictive map of forest biomass and carbon stock across the forest landscape. It is important to estimate above ground forest biomass and carbon stock in order to estimate the role of forest in the regional and global carbon cycle and developing science-based forest management and climate change mitigation strategy through forest management at local, regional and national levels.

Clustering the effects of traffic control type, functional class and spatial distributions to intersections traffic safety

1Brionne Henderson, Deo Chimba (Research Advisor)

This project examined the effects of traffic control type, spatial distribution and functional class to the traffic safety at intersections. The goal is to correlate crash occurrences to intersection types based on the amount of traffic volume entering the intersection, functional classes of intersecting streets, traffic control type, and the location with respect to Central Business District (CBD) areas. Using data from Davidson County in Nashville Tennessee, The study found that signal controlled intersection crash rates are higher within the CBD areas but lower in non-CBD areas. However, all-way stop controlled intersections have high crash rates than signalized intersections in non-CBD areas. The overall finding is that the signal controlled intersections are more hazardous within CBD areas relative to non CBD areas compared to stop controlled intersections. The study found that signal controlled intersections crash rates are lowest when the municipal roads are intersecting state roads. Stop controlled intersections have high crash rates when two municipal roads are crossing compared to other combination of functional classes. The intersection of municipal and state roads showed the lowest crash rates for non CBD areas. The statistical modeling validated the findings by quantifying the effect of these variables and their direction of impact. The findings can be of interest to traffic authorities and policy makers in reinforcing intersection traffic safety control measures in the cities.

Evaluating the Impact Responses of Median Cable Barriers

Dante Ferguson Jr, Deo Chimba (Research Advisor)

This study evaluated the effectiveness of cable barriers in reducing injury crashes and post impact performance when considering posted speed limit, the curvature of the roadway, surface type, vehicle type, shoulder width, the initial run-off lane and offset of installation. Crash reconstruction has been used by some researchers in determination of impact conditions (impact angle and speed) and relates them with the vehicle-cable impact outcomes. Based on that, in-service performance evaluation has been conducted to evaluate vehicle-cable impacts outcomes like vehicle rollover and penetrations. Four vehicle-cable impact responses namely containment, re-direction, rollover and penetration to evaluate the performance of the cable barriers were considered. Apart from the descriptive statistics, the paper used Multinomial Logistic regression (MNL) and determined marginal probabilities to model the influence of such attributes to the vehicle-barrier impact responses. The paper determined that reduced cable barrier offset, and involvement of heavy vehicles increases the probability of being involved in rollover and penetration crashes. The model can be used in the identification of sites characteristics attributed to poor cable barrier performance.

Analyzing Factors Impacting Transit Bus Travel Time

Darren Evans, Deo Chimba (Research Advisor)

This study evaluated the factors impacting transit bus travel time through statistical modeling and sensitivity analysis. With increasing transportation costs and congestions, travelers are leaning much towards bus transit transportation as an alternative; hence knowledge of the impact of some factors influencing travel time is essential for planning, scheduling and operational purposes. A full bus survey on bus service in Nashville Tennessee was conducted to facilitate this study. Four travel time components extracted from the survey data including time spent at link segments, delay at signalized intersections, dwelling time and delay due to route specifics were evaluated. The results showed that bus dwelling time has the strongest impact to bus travel time while intersection delays have the lowest significant impact. The type of land use along the bus route was found to influence travel time but with insignificant effect. Sensitivity analysis of the impact of individual variables such as posted speed limit, signalized intersections density, bus stops density, and dwell time, cycle length at intersections, green time, service rate and demand were also performed. Change in bus stop density was found to be the most sensitive variable to bus travel time as it controls dwelling time which was also found to be a major determinant of total bus travel time.

Vehicle Emissions Evaluation on Intersections along “First-last mile”™ Freight Intermodal Connectors

Tinotenda Jonga, Deo Chimba (Research Advisor)

Freight transportation is a pivotal aspect in several sectors in the United States. For efficient freight movement, the road segments that facilitate this movement ought to be in desired service conditions (operational, safety, and environmental) that are capable of accommodating truck and freight needs. Occurrences such as traffic congestion which result from inadequate capacity dramatically increase energy consumption, and air pollution. This study analyses freight intermodal connectors (FICs) by evaluating emissions at the intersections along these FICs. EPA mobile source emissions model (MOVES) was used to estimate vehicle emissions at the studied intersections on a second-by-second basis using microsimulation. Vehicle specific power (VSP) and scaled tractive power (STP) calculated from the second-by-second data is used as input in MOVES. Attention is given to carbon dioxide (CO₂), nitrogen oxides (NO_x), particulate matter (PM_{2.5}), total gaseous hydrocarbons, non-methane hydrocarbons (NMHC) and volatile organic compounds (VOC) emissions.

Evaluation of selected bacteria for biological control of *Sclerotium rolfsii*

Bandana Bhusal, Steve Osborne, Margaret Mmbaga (Research Advisor)

Evaluation of selected bacteria for biological control of *Sclerotium rolfsii*

Bandana Bhusal*, Ethane Swiggart, Steve Osborne**, Mmbaga, MT, and Christine A. Ondzighi-Assoume

College of Agriculture

Department of Agricultural and Environmental Science

Sclerotium rolfsii is a prominent plant pathogen affecting vegetable production in the southeast USA with a broad host range including tomato, pepper, onion, beet, lettuce, cucumber, melon, carrot, asparagus and parsley. The disease is favored by warm weather with temperature ranging from 27 to 35°C as optimum and dry conditions that are prevalent in the southeastern USA. Bacterial isolates that can colonize plants internally without causing symptoms have shown promise in controlling fungal plant pathogens. Isolates of *Sclerotium rolfsii* were evaluated for pathogenicity on cucumbers and inoculated plants developed necrotic lesions on the crown region and on roots and died within one week after inoculation. Eleven isolates of selected bacteria (B17A, B17B, PS, PSL, Prt, IMC8, YNP1, YNP2, YNP3, YNP4 and YNP5) were evaluated for the control of *Sclerotium rolfsii* using dual culture technique. Result from this invitro study showed that among all bacteria tested PSL (*B. amyloliquefaciens*) and Prt (*B. subtilis*) were highly effective in suppressing growth of this pathogen and completely restricting its growth. The invitro studies show that PSL and Prt have great potential as biological control agents for controlling this disease; investigation of their effect on plants inoculated with *S. rolfsii* is in progress. This project is partly funded by Evans Allen Project and USDA-NIFA Capacity Building Grant Award no. 2017-38821-26418

Synthesis and Virtual Screening of Novel Acridone Derivatives as Potential Topoisomerase II α Catalytic Inhibitors

Abiodun Samuel Oyedele, Cosmas Okoro (Research Advisor)

We report on the synthesis of a novel series of fluorinated acridones from 5-trifluoromethyl, and 5-phenyl-1,3-cyclohexanediones, respectively. The products (3a-3j) were characterized by spectroscopic methods (NMR, IR, and MS) to confirm their structures. The compounds were further subjected to virtual screening using Autodock Vina, a computational program software. Several of the molecules displayed good binding affinities to human topoisomerase II α ATPase. We hypothesize that the acridone derivatives of the above series are catalytic inhibitors of Topo II α . The synthesis, binding affinities, and molecular properties of compounds 3a-3j will be presented.

CpG Methylation Inhibits Prolidase Promoter Driven Transcription

Zeljka Lanaghan, Hugh M. Fentress (Research Advisor)

CpG Methylation Inhibits Prolidase Promoter Driven Transcription

Zeljka Miletic Lanaghan, Michael Ivy, Hugh Fentress, and Chandravanu Dash

Tennessee State University and Meharry Medical College, Nashville, TN

Prolidase, a cytosolic exopeptidase, is encoded by the PEPD gene in humans. Prolidase is the only enzyme which can cleave dipeptides containing hydroxyproline, and plays an essential role in protein metabolism, collagen turnover, and matrix remodeling. In initial studies, we observed a dense CG-rich portion around the transcription start site, suggesting a possible role of promoter methylation in transcriptional regulation. From the human genome, we cloned the human PEPD promoter and inserted it into a luciferase reporter construct. Next, we performed in vitro methylation of the promoter using SssI methyltransferase which methylates DNA CpG islands. Methylation was confirmed by BstUI digestion. The CpG methylation significantly inhibited PEPD promoter activity in comparison to the unmethylated construct. We believe, these results will generate new knowledge on the molecular regulation of prolidase and provide better insight in our understanding of regulation of prolidase expression in various physiological and pathological conditions.

Supported by NIH Grants DA037779 and MD007586 (to Jui Pandhare). DA024558, DA30896, DA033892, DA021471, AI22960 and MD007586 (to Chandravanu Dash). Also, RCMI Grant G12MD007586, the Vanderbilt CTSA Grant UL1RR024975, the MeTRC CTSA grant (U54 RR026140 from NCRR/NIH, the U54 Grant MD007593 from NIMHD/NIH, and the Tennessee Center for AIDS Research (P30 AI110527).

Exploring Relationship Between Median County Income & Rates of Suicide in Tennessee

Porsche McGee, Amanda Donovan, Poliala Dickson (Research Advisor)

The purpose of this study was to explore the relationship between Median County Income and rates of suicide in Tennessee. Data for Median County Income was collected from the County Health Rankings and Roadmaps. Data for Rates of Suicide was collected from the Tennessee Department of Health. The data from both sets were analyzed using a Pearson R correlation in SPSS. Results showed a significant negative correlation between Median County Income and Suicide County Total ($p < 0.01$) and between Median County Income and Suicide County White ($p < 0.01$). In conclusion, the results show that if Median County Income is high, then Rates of Suicide is low and if Median County Income is low, then Rates of Suicide high.

Underserved Population in Cardiac Rehabilitation

Porsche McGee, James Heimdal (Research Advisor)

Heart disease is the leading cause of mortality in the United States (Center for Disease Control (CDC, 2017) and World Health Organization (WHO, 2018). Cardiac Rehabilitation (CR) is a medically supervised program for individuals that have experienced a cardiac event such as a heart attack, heart failure, angioplasty, or heart surgery (AHA, 2016). The purpose of this study was to investigate previous research articles and determine who the underserved population is, the reasons why, and to discuss possibilities of increasing CR utilizations in the underserved populations. Several research articles that discussed disparities in CR were examined and analyzed. Some reasons for low utilization included referrals from healthcare providers, racial disparities, and day to day barriers cardiac patients face. To conclude, there is a need to make sure that all people who have experienced a cardiac event are aware of CR and are utilizing it.

Risk Factors for Intimate Partner Violence in TN Teens: Results of the 2017 Youth Risk Behavior Survey

Moesha Overstreet, Emmonie Henderson, Dimante Givens, Charity Whitehead, Dominique McDonald, Kelly Ford, Poliala Dickson (Research Advisor)

Intimate Partner Violence (IPV) includes physical, psychological, and sexual abuse by men and women toward romantic partners. Physical violence ranges in severity from light pushes and slaps to extreme violent acts of beating and lethal violence. These occurrences can have lasting emotional and psychological impact. While experienced by both males and females, it typically occurs slightly more in women and is one of the most common causes of injury in women. The purpose of this study was to identify behavioral risk-factors that predict the risk of experiencing IPV. Data from the 2017 Youth Risk Behavior Survey (YRBS) was used to conduct this study.

Agent Issues Arising from the NCAA

Ashley Allen, James Heimdal (Research Advisor)

This study explored the issues that arise from agent regulation in college athletics and examined three areas. The agent role and the rules and regulations of the National Collegiate Athletic Association (NCAA), an evaluation of the college model, agent mentality, and problems that arise while recruiting college athletes with professional level talent, and an assessment of the differences of agent policies between college hockey, baseball, football, and basketball. Several variables were investigated to determine agent practices, such as sports journals, articles, NCAA ByLaws and case law from court rulings. Results indicate that with the rules set out by the NCAA, student-athletes are not adequately prepared to interact with agents. Results also suggest that the intercollegiate sport mentality is a serious economic exploitation of profit-athletes, mainly for basketball and football players. In recent years, changes have been made by the NCAA that allow more positive agent interaction. However, this research indicates that the NCAA and agent regulation issues are far from being resolved and unethical behavior is likely to continue unless the NCAA is restructured.

Inhibition of the spectraplaklin protein MACF1 sensitizes glioblastomas and lung cancer subtypes to treatment

Kala Bonner, Quincy Quick (Research Advisor)

Glioblastoma heterogeneity and diversity is recognized as a major contributing factor to the resistance of this cancer to clinical chemo- and radiotherapy treatment regimens. This diversity is attributed in part to a plethora of novel unevaluated proteins whose functions participate in glioblastoma etiology, progression, and recurrence. One such protein is the cytoskeletal cross-linker, Microtubule Actin Crosslinking Factor 1 (MACF1), which has been previously shown to be expressed at high levels in glioblastoma tissue as compared to its absence in normal brain tissue. In support of these findings immunoblotting expression analysis in this study showed that MACF1 protein expression was upregulated in response to BCNU exposure in glioblastoma cells. MACF1 is not only glioblastoma specific but it can be found in lung cancer as well. Examination with immunohistochemistry expression analysis revealed that MACF1 is highly expressed in several lung cancer subtypes. Subsequently, experiments were conducted to assess the combinatorial effect of MACF1 inhibition in conjunction with BCNU treatment. A CRISPR-Cas9 genome editing approach was used to inhibit MACF1 function prior to drug exposure. Cell proliferation analysis revealed a cooperative synergistic effect of MACF1 inhibition and BCNU treatment on the reduction of glioblastoma cells as compared to cells treated with either BCNU or CRISPR inhibition of MACF1 alone. Additionally, this study demonstrated that MACF1 inhibition is a novel neoadjuvant approach that enhances the therapeutic efficacy of BCNU.

Screening Cowpea (*Vigna Unguiculata* (L.) Walp) Genotypes for Enhanced N₂ Fixation And Water Use Efficiency Under Field Conditions In Ghana

Yahaya Damba, Matthew Blair (Research Advisor)

To explore the variations in symbiotic N₂ fixation and water use efficiency in cowpea, this study evaluated 25 USDA cowpea genotypes subjected to drought under field conditions at two locations (Kpachi and Woribogu) in the Northern region of Ghana. The ¹⁵N and ¹³C natural abundance techniques were respectively used to assess N₂ fixation and water use efficiency. The test genotypes elicited high symbiotic dependence in association with indigenous rhizobia, deriving between 55% to 98% of their N requirements from symbiosis. Consequently, the amounts of N-fixed by the genotypes showed remarkable variations, with values ranging from 37 kg N-fixed ha⁻¹ to 337 kg N-fixed ha⁻¹. Most genotypes elicited contrasting symbiotic performance between locations, a finding that highlights the effect of complex host/soil microbiome compatibility on the efficiency of the cowpea-rhizobia symbiosis. The test genotypes showed marked variations in water use efficiency, with most of the genotypes recording higher ¹³C values when planted at Kpachi. Despite the high symbiotic dependence, the test cowpeas, grain yield was low due to the imposed drought, and ranged from 56 kg/ha to 556 kg/ha at Kpachi, and 143 kg/ha to 748 kg/ha at Woribogu. The fact that some genotypes could grow and produce grain yields of 627 – 748 kg/ha under drought imposition is an important trait that could be tapped for further improvement of cowpea. These findings highlight the importance of the cowpea-rhizobia symbiosis and enhanced water relations in the crop's wider adaptation to adverse edapho-climatic conditions

Economic Diversification in Tennessee

Jahnari Edwards, Prabodh Illukpitiya (Research Advisor)

The importance of economic diversification has gained interest in recent times. The more diversified economies can withstand in the event of economic and financial crisis. Therefore, economic diversification is viewed as a critical component to build economic resilience of the regions which are vulnerable to economic crisis. Diversified economy is less sensitive to the ups and downs associated with any particular industry since risk is spread more evenly across a number of industries. With diversification, even if some industries are suffering, other stronger industries will help the economy maintain healthy growth. The presence of many industries would be expected to offer opportunities for employment in growing sectors to compensate for employment losses in declining sectors. Many regard economic diversification as an employment insurance, since more diversified economies experiencing lower unemployment during cyclical downturns. Given this, the objective of this study is to analyze and measure economic diversification in Tennessee. The analysis was based on Economic Census data in 2007 and 2012. Using North American Industry Classification System (NAICS) codes in 18 key sectors, number of establishments, sales, annual payroll and number of paid employees was considered for the analysis. County level data were used to analyze and compare economic diversification in county level. Trend analysis was used to measure changes in above sectors. Entropy Index was used to quantify the changes in economic diversification between 2007-2012 periods. The study shows the variation in economic diversification in Tennessee counties.

ECONOMIC ANALYSIS OF LOCAL FOOD MARKETS IN TENNESSEE

Eraina Stringer, Enefiok Ekanem (Research Advisor)

Abstract

Over the years, local food demand by consumers has significantly increased. In 2016, farmers in the United States were selling billions of dollars worth of product to direct markets. Direct marketing is defined as the business selling products or services directly to the public, meaning there is no middleman in the process. The contribution of local food varies by region due to a difference in population, the distance to farms, and the products grown within the region. In the southeast region, 68 percent of markets in urban counties are accounted for. The main objective of this poster is to 1) determine the economic impact of local food markets in Tennessee and 2) to determine the different marketing tools used to raise awareness to local food markets. According to previous research, local food markets have positively impacted the economy. Both primary and secondary data from USDA National Agricultural Statistics Service (NASS), and other sources will be used in developing this poster. In order to analyze and report findings in this research, IMPLAN, an economic impact assessment software will be used to determine the impact of local markets on Tennessee's economy. Findings from this research will benefit others because it will provide insight of the importance of local food markets to the economy.

Sources of Financial Support: This study is supported with grant funds from USDA-Evans-Allen project and the College of Agriculture and Department of Agricultural and Environmental Sciences.

COMPARISON OF CHYTRID PREVALENCE IN EASTERN HELLBENDERS IN SOUTHEAST TENNESSEE STREAMS

Emilly Nolan, William Sutton (Research Advisor)

Populations of Eastern Hellbenders have been declining across their historic ranges due to habitat loss, overcollection, and environmental degradation. The chytrid fungus *Batrachochytrium dendrobatidis* is a leading cause of amphibian species loss, and has been recorded in hellbenders throughout their range. In this study, 27 hellbenders from two streams in southeast Tennessee were implanted with radio transmitters to track daily movements, determine home range size as part of a larger translocation project. Determining disease prevalence in these hellbenders is crucial as it will help us to monitor overall health of study animals. Hellbenders were swabbed for chytrid once before receiving transmitters and opportunistically throughout the summer. Samples will be tested for presence of *B. dendrobatidis* and *B. salamandrivorans* using qPCR. Chytrid prevalence will be compared between the two study sites, and any infection differences in size class will also be calculated. Summer seasonality of chytrid infection in hellbenders will also be tested as it will provide us with an ideal sampling month for the disease, and to observe any clearing of infection. We predict that approximately 25% of our samples will test positive for *Bd* based on previous studies, and all will test negative for *Bsal* as it has not yet been detected in the U.S. This study will provide insights to amphibian disease susceptibility before and after translocation. We will continue to monitor for chytrid in these populations after translocation in order to make informed conservation management decisions for this species

