Undergraduate Research Symposium May 18, 2018 Mary Gates Hall

Online Proceedings

Poster Session 1

Balcony, Easel 119

11:00 AM to 1:00 PM

Using Bacterial Endophytes to Increase Plant Salt Tolerance

Shruti Sanjay Parikh, Senior, Environmental Studies, Environmental Science & Resource Management

CoMotion Mary Gates Innovation Scholar, Mary Gates Scholar, NASA Space Grant Scholar, UW Honors Program

Mentor: Sharon Doty, Environmental&Forest Sciences

Plants are affected by various abiotic and biotic stressors such as pollution, high salinity, drought, and pathogens which can inhibit growth or cause disease. High salinity, a type of abiotic stress that decreases crop productivity and quality, is especially widespread with nearly half of the world's cropland facing salinity stress in 2010. This is problematic because there are very few plants that can tolerate high levels of salt and the process of remediation is water and energy intensive. However, endophytes, the beneficial bacteria that live within plants, have shown potential in helping plants tolerate these stressors in a more natural way either by directly reducing the stressor or indirectly by modulating the plant's response to the stress. The main goal of this study was to isolate and test endophytes to determine whether they colonize other plants and help these plants tolerate high salinity conditions. In this study, a total of 15 salt tolerant endophytes were isolated from pickleweed and wild wheat growing in a marine estuary. These strains were then tested on bush beans and poplar to test salt tolerance conference. There were visible signs of higher stress tolerance in bush beans inoculated with endophyte SSP1 and poplar inoculated with SSP8. The results for the remaining endophyte strains are pending. By improving plant growth under abiotic stress, these bacteria will help promote sustainable agriculture practices and bioenergy production.

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Interactions of Colonizing Endophytes in *Populus trichocharpa,* Explored via Fluorescent Microscopy and Digital Droplet PCR

Sam Cullen Scharffenberger, Senior, Environmental Science & Resource Management

Mary Gates Scholar, UW Honors Program

Mentor: Sharon Doty, Environmental&Forest Sciences

Microbes that live within plants, called endophytes, are being heavily researched on their ability to assist host plants in processes from nitrogen accumulation to drought tolerance. Two endophyte strains named WP5 and WP9 are known to colonize *Populus* trees. Previous research has shown that the presence of WP5 in a host plant allows for greater colonization by WP9 subsequently. This research is directed at replicating these results with more robust molecular biology techniques. Methods for experimentation include the growth of the endophytes in selective media and varying the optical densities of these liquid cultures before inoculating the poplar clones. The plants co-cultivate with the inoculum for 24 hours, at which point they are removed, washed and placed in limited nutrient media. After removal from the inoculum as well as at 7 and 14 days hence, the host plants will be sampled by performing genomic DNA extractions and subsequently analyzed through Digital Droplet PCR to quantify endophyte presence. Additionally, these strains have been marked with fluorescent tags to enable imaging under a microscope. The two endophytes were labeled with different colors, one red and one green, so that they could be visualized concurrently. Along the same sampling timeline, root samples will be taken to image through microscopy in order to visually investigate the colonization process of the two strains. The results of this research will help to shed light on the colonization abilities of these strains, and allow for the optimization of bio-fertilizers comprised of endophytic consortia.

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A Microbial Approach to Climate Change: Isolation of Heat Tolerant Endophytes

Matthew Ryan (Matt) Joseph, Senior, English

Mentor: Sharon Doty, Environmental&Forest Sciences

One of the most significant problems facing modern agricul-

ture is climate change. Plants thrive best within a fairly narrow range of temperatures. Outside of that range they have significantly reduced crop yield and significantly increased mortality. This imposes limitations on where certain crops may be grown. Due to rapidly growing populations, the industry must be allowed to expand into new regions, but climate change is reducing available regions. One possible solution is amplified heat tolerance due to symbiosis with endophytes. Endophytes are symbiotic microbes which live in the intercellular space within plants, and which may be used to improve plant fitness through stress tolerance, nutrient supply, and many other mechanisms. We chose a poplar tree which likely hosted beneficial microbes to alleviate heat stress due to its harsh environment, and have been working to isolate the relevant endophytes. I am using a plant-based isolation procedure using species such as rice and kale. By exposing the plants to the endophytes and then to heat stress, I assure that the endophytes have a broad host range because they must be able to survive in more than just their host plant, and I allow the plant to choose the most helpful endophytes to alleviate stress. Through multiple repetitions of this isolation procedure, I can increase the presence of heat-tolerance-conferring endophytes within the microbiome. These endophytes may eventually be used to expand growth into regions which are outside of conventional temperature ranges, or to remain in current regions in which temperatures are increasing.

SESSION 2S

HOT TOPICS: ROBOTS, AR, CV, AI

Session Moderator: Kurtis Heimerl, Computer Science and Engineering

JHN 175

3:30 PM to 5:15 PM

* Note: Titles in order of presentation.

Classification of Art Painting's Genre with Bag of Words Model Based on RGB-SURF Algorithm

Ximing Lu, Sophomore, Pre-Major (Arts & Sciences)
Mentor: Sharon Solis, Applied Mathematics
Mentor: J. Nathan Kutz, Applied Mathematics

With the spread of large digital painting collections, the demand for automatic theme classification has risen in both academic and commercial fields. Many researchers have investigated various techniques to implement automatic painting classification and developed several approaches to improve classification accuracy. SURF is one of the most commonly used local invariant feature descriptors for painting classification. However, the common method of classification based on traditional SURF local feature description makes the color feature information not comprehensive. Also, the feature space is high dimensional and sparse which will result in low classification accuracy, data redundancy and a time-consuming process. To overcome this drawback, we suggest a new method of classifying painting styles with bag of words (BOW) model based on the RGB-SURF algorithm. First, split RGB channels into separate images for each painting. Then, independently calculate key points and descriptor of each RGB channel using SURF and combine descriptors of each channel to obtain overall RGB-SURF feature for each painting. This approach is to compensate the loss of color feature brought by traditional SURF descriptor which mainly treats colorful images as gray images. Next, construct the visual vocabulary by reducing the number of features through quantization of feature space using K-means clustering to obtain BOW model. The histogram described by appearance frequency of the visual words is used to represent the content of the image. As a result, every image is viewed as a bag full of visual words. Finally, establish the support vector machine (SVM) classifier based on radial basis function (RBF) with the data above for training and testing. Compared to classification method based on the traditional SURF feature descriptor and other painting classification approaches, BOW method based on RGB-SURF algorithm shows the highest average classification accuracy, which means this method produces the most consistent automatic classification results with manual classification.