Evaluation of Surfactant Coated Seed in Water Repellent Soil and Deficit Irrigation

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Water restrictions due to drought or limited water supplies have increased the likelihood of seed germination under water deficit. Soil application of aqueous surfactant spray solutions is a strategy to enhance the water holding capacity and wettability of soils, thereby increasing seed germination and yield. However, commercial acceptance of this strategy has been mixed at best. A novel surfactant seed coating technology (SET) was evaluated in South Florida, USA, to determine if turfgrass seed would germinate in hydrophobic soils under severe deficit irrigation. Perennial ryegrass (*Lolium perenne var.* 2190) seed was coated with 10% w/w surfactant (US 20100267554 A1). Seed was sown by weight at a rate of 39 g/m^2 into pots containing one of the following: hydrophobic sand:peat (90:10 v/v) soil (HSP), hydrophilic sand:peat (90:10v/v) soil (SP), 100% hydrophobic sand (HSS) and a 100% hydrophilic sand (SAND). Irrigation was reduced to 0.25 cm every other day until maximum emergence was reached; thereafter treatments were subjected to dry downs. Preliminary results indicate that in SAND, SP and HSP soils, SET treatment significantly increased volumetric water content and improved re-wettability of soils when compared to the untreated seed. Under severe environmental stress, SET treatment increased turfgrass establishment, root biomass and tissue yield across all treatments despite being sown at half the rate as the untreated seed. This technology may deliver a strategy to improve seedling establishment under severe water deficit conditions and improve crop productivity – in amenity grasses and potentially in agriculturally important species.

Global Soil Nitrous Oxide Emissions in a Dynamic Carbon-Nitrogen Model

Yuanyuan Huang and Stefan Gerber

Nitrous oxide (N_2O) is an important greenhouse gas that also contributes to the depletion of stratospheric ozone. However, a quantitative understanding of terrestrial N_2O emissions and responses to climate change is challenging. We added a soil N_2O emission module to the dynamic global land model LM3V-N, and tested its sensitivity to mechanisms that affect mineral N availability in soil. The model is capable of reproducing global mean natural N_2O emissions from other modeling and inverse methods, and the average of observed cross-site annual mean behavior. Processes that regulate N availability have strong controls on N_2O fluxes in addition to the parameterization of N_2O loss through nitrification and denitrification. Modelled N_2O fluxes were also highly sensitive to water filled pore space (WFPS), with a global sensitivity of 0.25 TgN per year per 0.01 change in WFPS. The global response of N_2O emission to CO_2 increase was largely determined by the response of tropical forests. Emissions first decreased caused by N limitation under higher CO_2 level, and was alleviated through feedbacks such as biological N fixation after a few decades. The extratropical response to higher CO_2 was weaker and generally positive. These resultshighlighting the need to expand field studies in tropical ecosystems. Warming generally enhanced N_2O efflux, and the enhancement was greatly dampened when combined with elevated CO_2. Our analysis suggests caution when extrapolation from current field CO_2 enrichment and warming studies to the globe.

Understanding the Persistence of *Salmonella enterica* in the Environment, and Its Implications for Food Safety

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The increase in salmonellosis outbreaks linked to fruits (especially tomatoes), vegetables, sprouts, and nuts has become a major concern for food safety. Understanding the ecology of this pathogen under production-relevant conditions is essential to promote safer pre and post-harvest practices and requires the creation of an avirulent surrogate strain suitable for field studies. To address these points, we identified *Salmonella* genes required for proliferation within tomato fruits. Genes involved in nitrogen metabolism, including the biosynthesis of arginine, glutamine, leucine, valine, isoleucine, methionine, serine, threonine and tryptophan, were required for *Salmonella* proliferation. The tomato genotype also influenced *Salmonella* amino acid requirements. Biosynthesis of lipopolysaccharide, a bacterial resistance factor to host defenses, was necessary for proliferation within tomatoes. We also developed a surrogate *Salmonella* strain without its virulence determinants to be used as a tool to understand *Salmonella* ecology in the environment and food-industry related conditions. The surrogate strain was confirmed to be avirulent in mouse models. The persistence of the surrogate strain in tomatoes, cantaloupes, spinach, and soil did not differ from those of the wild type. Biofilm formation was 3-fold higher on polystyrene and 2-fold higher on polypropylene. A loss-of-function marker was engineered into the surrogate to facilitate its identification. We concluded that *Salmonella* central nitrogen metabolism and resistance to host defenses are required to proliferation within tomatoes, although the virulence determinants are not required for its persistence in the environment. In addition, we created a safe surrogate strain with potential to improve food industry practices.

Managing Expectations: Creating a Community Based Stormwater Pond Nutrient Management Program

Charles Patrick Nealis and Mark Clark

Degradation of surface waters is a critical concern in the state of Florida. Regulatory frameworks and best management practices (BMPs) exist to protect the designated uses of natural surface waters and reduce the impact of runoff from upstream activity. Stormwater ponds (SWPs) are an increasingly popular BMP in residential developments and are assumed to remove at least 80% of the nutrient load from the contributing watershed to meet regulatory requirements. Residential SWPs also generate a property value premium by creating “waterfront” property with social expectations related to aesthetics and recreational value. The management of SWPs to meet social expectations often includes the removal of biological responses to increased nutrient concentrations, resulting in a reduction of the nutrient removal efficiencies and failure to meet regulatory requirements. In this study, a method was developed to quantify social expectations of SWPs and define numeric nutrient criteria required to meet social demands and regulatory criteria. Nutrient and chlorophyll-a water column concentrations in SWPs within a southwest Florida community were sampled and significant nutrient-response relationships were established for clear and colored systems. The SWP nutrient-response relationships were compared to those established for Florida’s numeric nutrient criteria for natural lakes and found to be weaker but significantly different. To quantify social expectation criteria, a web-based survey was created to identify thresholds of impairment based on water column chlorophyll-a concentrations. Results indicated mean community-based thresholds range from 20-30 $\mu\cdot^{-1}$. Preferred thresholds were found to increase with frequency of use for recreational activities and respondents who correctly identified the role of algae in SWPs had significantly greater thresholds than those who did not. Age, seasonality of residence, sex and presence of children in the household were also found to have a significant impact on preferred thresholds. Based on the identified community-based thresholds and nutrient-response relationships, SWP numeric nutrient criteria were established and the potential impacts were estimated. The findings and methods identified in this study indicate the significant potential to effectively meet regulatory requirements and social expectations of SWPs, improving management practices and reducing downstream impacts of runoff from residential development.

Region-wide Soil Carbon Assessment across "The Land of Pines"

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The US Southeast is dominated by forested ecosystems, of which nearly 85 million hectares are timberland. These forests account for more than 1/3 (~12 Pg C) of the conterminous US forest C stocks and sequester 76 Tg C annually, equivalent to 13% of the regions GHG emissions. Additionally, these forests store a substantial amount of soil organic carbon (SOC), commonly exceeding twice the carbon measured in above ground biomass. However, due to the spatial-variation of SOC, these estimates have a large degree of uncertainty.

Current projections for the region indicate a likely warmer and dryer future climate. As such, typical recurring questions are: "How vulnerable are these carbon stocks to altered climate conditions?" and "How will we measure this change without accurate baseline estimates?"

To answer these questions, PINEMAP (Pine Integrated Network: Education, Mitigation, and Adaptation Project) established a multi-tiered monitoring network to provide baseline measurements for carbon, water, and nutrient storage and fluxes in forested ecosystems across the Southeastern US. Here, we present preliminary findings from a region-wide modeling approach in an attempt to understand how various scenarios of climate change may affect carbon stocks in these ecosystems. To achieve this, the DayCent biogeochemical model was parameterized and calibrated with site-specific data from the PINEMAP Tier 3 network. Preliminary results indicate the model performed well, with an R^2 = 0.86 for simulated vs observed SOC and R^2 = 0.97 for simulated vs observed net primary productivity (NPP). The model is currently being scaled up to the Tier 2 network, which consists of 324 plots, to provide more representative estimates across the entire Southeastern US. The results of this transdisciplinary research project will be used to improve decisions regarding management and carbon sequestration strategies.