Field Assessment of the Impacts of Wetting Agents and Plant Growth Regulators on Turfgrass Soil Microbial Communities

Introduction

Because of the pressure to maintain high quality turf under climatic, pest and use-induced stresses, superintendents use several turfcare products. Among the most commonly used products are wetting agents and plant growth regulators (Karnok et al., 2004). However, the impacts of these products on soil microbial communities is not clear.

Wetting agents are used to address the problem of localized dry spots (LDS) prevalent in turfgrass soils during the summer and caused by soil water repellency. The occurrence of LDS causes water stress and negatively affects turf quality. Despite differences among products, several studies have reported wetting agents to be effective in reducing LDS in golf courses. However, some wettings agents can cause phytotoxicity in turf and require irrigation immediately following application to minimize turf damage (Karnok, 2006). The effect of wetting agents on the turfgrass soil microbial communities is unknown. Some studies have reported the inhibition of microbially mediated decomposition of pollutants due to surfactants in non-turfgrass soils, with subsequent changes in microbial populations (e.g., Laha and Luthy, 1991).

Plant growth regulators are used to promote healthier turf with the ability to withstand various types of stresses. Growth regulators are designed to slow down production of hormones (e.g., gibberellic acid) and thereby to minimize vertical shoot growth while promoting lateral and below-ground root growth. There are several studies that tested their efficacy on turfgrass growth and quality with mixed results (McCann and Huang, 2007; Gardner and Wherley, 2005) but their impact on the turfgrass soil microbial communities has not been examined. It is important to study whether these products have similar inhibition effect on the microorganisms, and what the implications would for their use in turfgrass system.

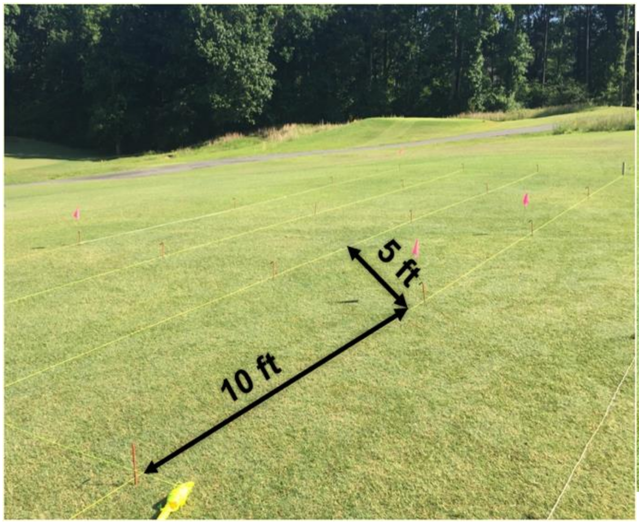
Research is needed to understand how wetting agents and growth regulators affect the soil microbial communities, which play a central role in the establishment and maintenance of a healthy and sustainable turfgrass system. Decomposition of organic matter is one of the central roles microorganisms play. This process releases nutrients from organic to inorganic forms that can be used by the turf and controls the excessive accumulation of thatch (Myrold and Bottomley, 2008). Microorganisms also contribute to the nutrient content of the turfgrass soil through nitrogen fixation and mycorrhizal relationship (Hartnett and Wilson, 2002; Charest et al., 1997; Boddey et al., 1986). The role of soil microorganisms in disease suppression is well documented too (Kerry, 2000).

The objectives of the project are to: 1) determine the impact of selected wetting agents and plant growth regulators on the abundance of turfgrass soil microbial communities, and 2) determine the impact of selected wetting agents and plant growth regulators on the activity/function of turfgrass soil microbial communities.

Methods and Materials

Test products, study site and experimental plots

Fields studies were started in June/July 2018 to examine the impacts of three wetting agents (Sixteen 90, Cascade/Duplex, Revolution) and three plant growth regulators (Trimmit, Primo Maxx, Cutless). The plots for the wetting agents (WAs) were established on greens in UGA Griffin Campus. The plots for the plant growth regulators (PGRs) were in established on fairways in the Rivermont Golf Club, Johns Creek (see figure below). Each set of plots included a water control (non-treated), and treatments were replicated five times with randomized complete block design. Each plot is 5 ft x 10 ft. Treatments are applied monthly at half field use rates to provide double coverage with a backpack sprayer. The plots have received three applications since start of the study this year.



Fields plots for PGRs in Rivermont Golf Club

Fields plots for WAs in UGA Griffin Campus

Sample collection and analysis

Soil samples have been collected twice since June from the top 10 cm and analyzed for indicators of microbial activities that include soil respiration and enzyme activities (urease, phosphatase). Soil respiration is an indicator of organic matter decomposition and overall microbial activity. Urease and phosphatase are enzymes that catalyze hydrolysis of urea and mineralization of phosphorous. Since the enzymes are produced by microorganisms, they act as proxies for measuring microbial activities in relation to nutrient cycling.

The samples are also being processed to quantify microbial abundance (total fungi, total bacterial, ammonia oxidizers and arbuscular mycorrhizal fungi) with culture-based and molecular methods.

Preliminary Results

Result are preliminary as the study was recently started, and we are still in the process of collecting and analyzing samples. However, based on our limited data, bacteria were more sensitive to wetting agents than fungi. Bacteria were the only microbial group to exhibit any response to plant growth regulators, specifically to Primo Maxx, which caused a temporary increase in their abundance as compared to the non-treated control. This suggested the presence of some bacterial groups that are efficient in metabolizing it. Phosphatase activity was unaffected by all treatment applications, but urease activity was stimulated by Cascade and Duplex and depressed by Cutless. Soil respiration data suggested immediate but short-term microbial response to wetting agents and plant growth regulators.

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