

Root Zone Microbial Activity in Relation to Putting Green Quality

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INTRODUCTION

In natural ecosystems, plant health often reflects the status of the root zone microbial community. This community contains bacteria, actinomycetes, fungi, and algae, and all can be used as biological indicators of soil quality. These microorganisms are highly diverse in numbers, activity levels, and functions and in their population dynamics. It is through these characteristics that the microbial communities display responses to changes in cultural practices and the environment. It is not known how important these activities and functions are in a highly managed environment like a putting green.

The microbial community is linked to soil health and subsequently, to plant health through nutrient cycling and beneficial plant relationships. The majority of the microbial population degrades organic matter. Through the breakdown of organic matter, the microbial biomass initiates the cycling of carbon, nitrogen, phosphorus, and sulfur. Non-nutritional benefits involve regulation of root pathogen populations and production of plant growth stimulants.

The overall purpose of this research is to determine the relationship between microbial activity and putting green quality. The specific objectives are:

Objective #1: Measure microbial activity level, functional diversity, and community composition.

Objective #2: Compare microbial activity and community composition to turf visual quality ratings and nutrients taken up by the turfgrass.

Objective #3: Determine the influence of commercially available products on soil microbial activity and relate this to putting green quality.

METHODS

This experiment made use of five commercially available microbial stimulant compounds. The six treatments were:

- 1) Colonizer T&O from Plant Health Care Inc.
- 2) Flexx-Plus from Plant Health Care Inc
- 3) Experimental Product A from Ocean Organics
- 4) Experimental Product B from Ocean Organics
- 5) Raiz-Mor from Jay-Mar Inc.,
- 6) Control (Isotek fertilizer alone)

Their plant nutrient concentrations are given in table 1.

Table 1: Mineral analysis of the commercial products

Products	% Nitrogen	% Phosphorous	% Potassium	% Iron
Flexx-Plus	0.075	0.20	8.84	4.81
Colonize T&O	0.067	2.58	9.32	0.0186
Experimental A	2.92	0.03	1.08	2.35
Experimental B	3.19	0.023	0.935	2.06
Raiz-Mor	1.51	0.13	0.021	0.0007

The first application was on 5-22-2000 and subsequently every two week. These treatments are applied at manufactures recommended rates and frequencies. In addition each plot received 0.25 lbs. of N every two weeks in the form of Isotek 18-3-16. The management practices involved mowing 6 days a week at a height of 0.156 inches and daily irrigation at 100% of evapotranspiration (ET).

To determine the microbial activity, soil samples were taken every two weeks. Each plot had 12 cores removed to a six-inch depth. The soil samples are being analyzed for 4 soil enzymes: invertase, xylanase, cellulase (Shinner and Von Mersi, 1991), and dehydrogenase (Cassdia, 1964), the Biolog assay to reveal bacterial function diversity (Balsler, 2000), and Phospholipid Fatty Acid Analysis to determine the microbial population composition (Acosta-Martinez et al., 1999).

In order to correlate turf grass quality to microbial activity, visual quality ratings are recorded weekly. Clippings were collected periodically to characterize shoot growth rates and provide tissue samples for nutrient analysis. Root mass was determined near the end of the summer stress period and again in October. In October, we removed root samples to check for the presence of mycorrhizae (VAM) in the root system.

RESULTS

For the 2000 Season, there was a treatment response to the microbial stimulant products. Something in the system changed compared to the control causing putting green color and quality to improve (Table 2). The important item to note is that the control (with fertilizer alone) had both the lowest color and quality ratings.

Table 2: Treatment effects on bentgrass color and putting green quality.

Treatment	Bentgrass Color	Putting Green Quality	Treatment Rating	
			Color	Quality
Flexx-Plus	6.70a	7.38a	4	3
Colonize T&O	6.55b	7.05a	5	4
Experimental A	6.77a	7.40a	1	2
Experimental B	6.75a	7.40a	3	2
Raiz-Mor	6.76a	7.43a	2	1
Control	6.46b	6.78b	6	5

In 1999, Kussow demonstrated a positive relationship between dehydrogenase concentrations and visual quality. The same relationship was expressed in the current year's research (Figure 1 and 2). This relationship suggests that some component the microbial population favorably alters dehydrogenase levels and this associated with comparable improvements in turfgrass color and putting green quality. The key question here is how this relationship arises.

To determine whether the improvements in turfgrass color and quality were nutritional in origin. Clipping samples were analyzed for macro- and micronutrients. Nitrogen was the only nutrient in the clippings that related to turfgrass color (Figure 3) and putting green quality. This suggests that the primary mode of action of the products applied was the alteration of the nitrogen status of the turfgrass. This may have occurred through influences on the rate of biocycling of N or through more efficient utilization of N by the turfgrass. We are now analyzing soil samples for their inorganic N concentrations to check on the possibility that more rapid biocycling occurred.

Analysis for the enzymes: invertase, xylanase, and cellulase were recently complete, but we have not had time to statistically analyze and interpret the data. The Biolog analysis is nearing completion and PFLA analysis will commence in a few weeks.

SUMMARY

While a lot of data are yet to be gathered, analyzed, and interpreted, indications are that there is a consistent relationship between soil dehydrogenase activity and turfgrass color and putting green quality. This relationship appears to originate from influences the products had on the nitrogen status of the turfgrass.

Figure 1: Dehydrogenase vs. color rating

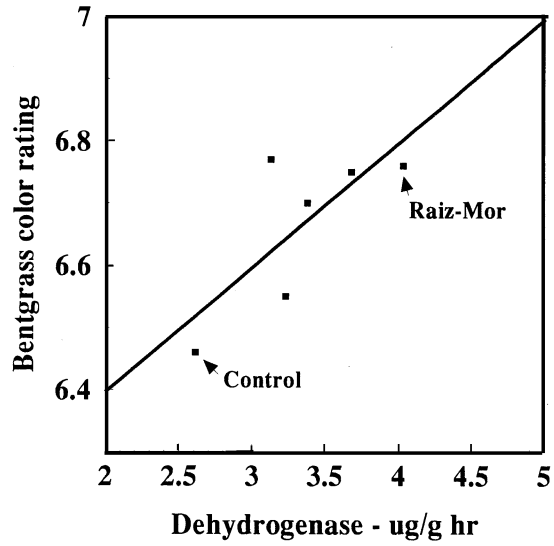


Figure 2: Dehydrogenase vs. quality ratings

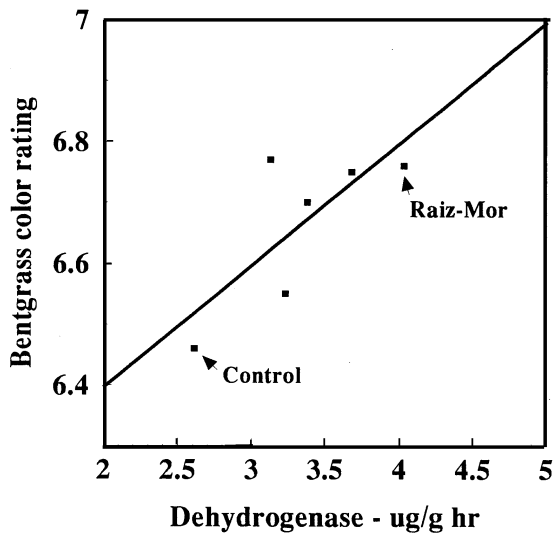
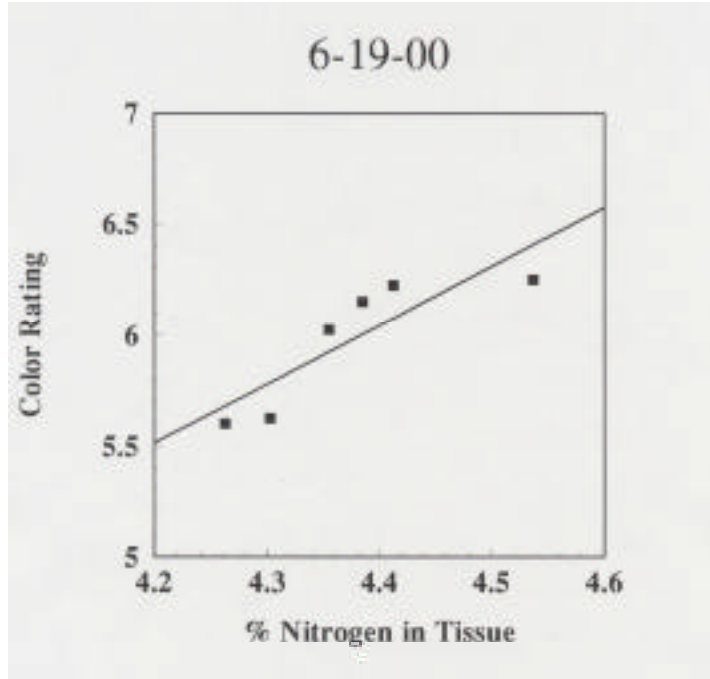


Figure 3: The relationship of bentgrass color and percent nitrogen in the tissue.



References

- Acosta-Martinez, V., Z. Reicher, M.Bischoff, and R.F. Turco.1999. The role of tree leaf mulch and nitrogen fertilizer on turfgrass soil quality. *Biology and Fertility of Soils*. 29:55-61.
- Balser, T.C. 2000. Linking microbial communities and ecosystem functioning. Doctoral Dissertation. University of California, Berkeley.
- Casida, L.E., Jr., D.A. Klein, and T.Santoro. 1964. Soil dehydrogenase activity. *Soil Sci.* 98:371-276.
- Kussow, W.R. 1999. Commercial products effects on microbial activity in a USGA putting green- preliminary study. p.121-129. *In Wisconsin Turf Grass Research: Results of 1999: volume XVII.*
- Schinner, F. and W. von Mersi.1990. Xylanase, CM-cellulase- and invertase activity in soil: an improved method. *Soil Biol. Biochem.*22 (4): 511-515.