Do Management Regimes of Organically and Conventionally Managed Golf Course Soils Influence Microbial Communities?

Elisha Allen, Daniel Manter and Geunhwa Jung
University of Massachusetts

Turfgrass and Environmental Research Online
Volume 13, Number 2 | March–April 2014

Objectives:

1. *Refine RT–PCR assays for detecting DMI resistance in S. homoeocarpa, using fungal culturing, as well as detection from dollar spot infected leaf blades.*
2. *Employ HRM technology for detecting genetic mutations associated with TM–resistance in S. homoeocarpa, also from fungal cultures and infected leaf material.*
3. *Optimize these assays for use as a diagnostic service to golf courses so that they can be provided quickly and inexpensively.*

The first and second field collections for this research project were completed in May and September of 2013 successfully. From the May 2013 collection all samples have been processed for nematode identification and counts, soil nutrient and texture analysis, and DNA has been extracted. The DNA extracts are currently at the USDA–ARS research laboratory and are in the process of being pyrosequenced. This process was delayed temporarily due to the government furlough, but has resumed. The qPCR for the relative abundance of fungi and bacteria has been completed by the USDA–ARS laboratory and are in the process of being analyzed.

The September 2013 samples have been processed for soil nutrient and texture analyses. The nematode identification and counts of all of the greens samples have been completed and counts on the fairways and roughs are in progress. DNA extraction of these samples is in progress. Particulate organic matter carbon and nitrogen analysis is being performed on the May and September 2013 collections this week. We have received additional funding from the New England Regional Turfgrass Foundation to complete this project.

The preliminary results on the nematodes counts between the different management areas for the May 2013 collection were presented at the University of Massachusetts–Amherst Turf Field Day and the University of Massachusetts–Amherst Plant Biology Symposium. We are preparing to present our preliminary research results at the Crop Science Meeting this November in Tampa, Fl.

Our results show a clear separation of the organic course from the conventional and hybrid courses using cluster analysis and principle component analysis based on the proportion of nematode trophic groups and soil edaphic properties. The results of our data suggest that the more intensely managed areas have higher plant pathogenic nematodes and fewer bacteriovores (as

Table 1. Average Total Nematodes Spring and Fall 2013. Lower case letters signify statistically significant differences by Student´s T test.

Management Area	Course	Average Total Nematodes	
		Spring 2013	Fall 2013
Rough	Conventional	349.89a	
	Hybrid	278.00b	
	Organic	91.22c	
Fairway	Conventional	333.33a	
	Hybrid	320.22a	
	Organic	404.78a	
Green	Conventional	213.00b	168.56b
	Hybrid	377.00a	332.56a
	Organic	188.10b	67.89c

TERO Vol. 13(2):32–35 | March–April 2014
USGA ID#: 2013–14–475
TGIF Number: 240133

demonstrated by the conventional greens versus the organic greens and the fairways and roughs). Furthermore, significant difference in relative abundance of both bacteria and fungi based on qPCR of 16S and 18S rRNA genes, respectively was observed among green, fairway, and rough within course.

Summary

- ANOVA results show that percent plant pathogenic nematodes are significantly lower on the roughs and greens of the organic course than the conventional and hybrid courses, with the most striking difference being the about 10% plant pathogenic nematodes on organic greens versus about 90% plant pathogenic nematodes on conventional and hybrid greens (Figs. 1 and 2)
- ANOVA results show percent bacteriovore nematodes are significantly higher on the roughs and greens of the organic course than the conventional and hybrid courses (Figs. 1 and 2)
- ANOVA results show carnivorous nematodes are significantly higher on the organic course (all areas: greens, fairways, and roughs) than the conventional and hybrid courses (Figs. 1 and 2)
- Cluster analysis (Figs. 3–4)
  - ◊ Grouped the organic course separately from the hybrid and conventional courses by both percent nematodes in each trophic group and by soil nutrients, texture, and percent organic matter
  - ◊ Consistent between both the May and September sampling dates
- Principle component analysis shows (Fig. 5)
  - ◊ The conventional and hybrid greens have an increase in percent plant pathogenic nematodes
  - ◊ The roughs and the fairways of all three courses have more similar proportions of nematode trophic groups with the organic having slightly more bacteriovores, omnivores, and carnivores
  - ◊ Approximately 60% of the variation we saw among the sites is explained by the two principle components analyzed
- qPCR data for the relative abundance of bacteria (16S), fungi (18S), and the ratio of bacteria to fungi for the Spring 2013 collection among the three courses and three management areas. (Table 2)
  - ◊ Relative abundance of both fungi and bacteria were significantly different among the three management areas within course but significance in the bacterial abundance was not observed among the three courses.

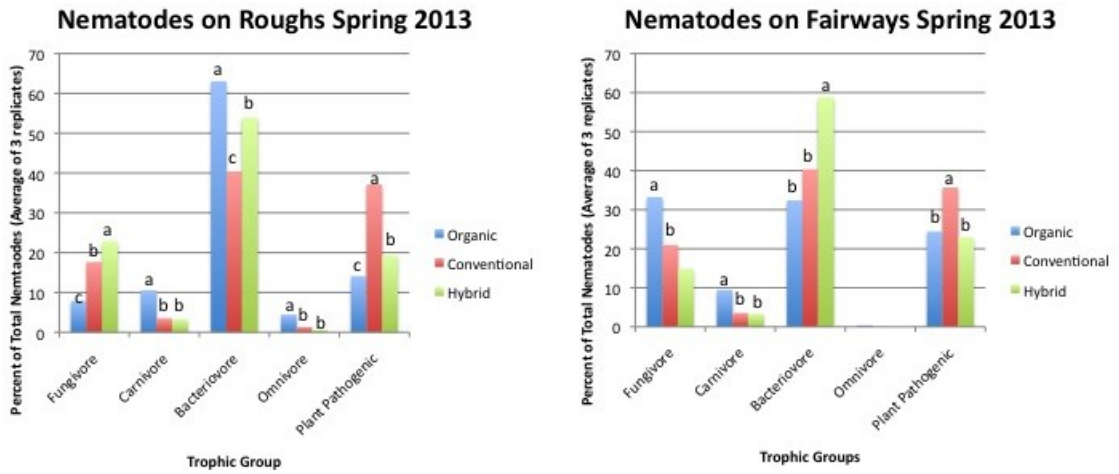

Figure 1. Percent nematodes in each trophic group on the roughs and fairways in Spring 2013. Lowercase letters represent statistically significantly differences by student´s T–test of least mean squared.

TERO Vol. 13(2):32–35 | March–April 2014
USGA ID#: 2013–14–475
TGIF Number: 240133

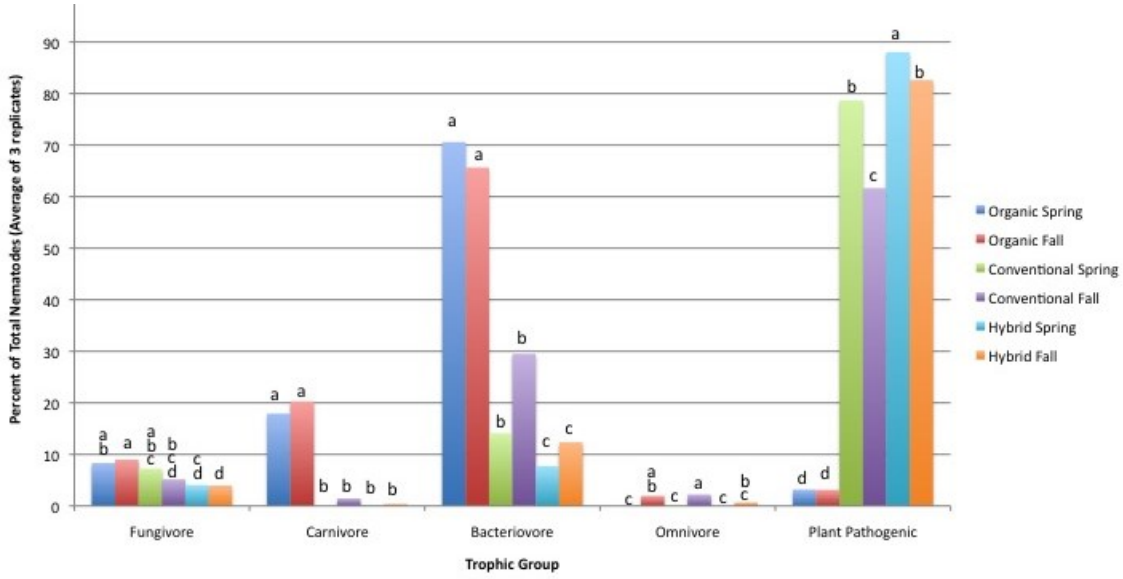

Figure 2. Percent nematodes in each trophic group on the greens in Spring and Fall 2013. Lowercase letters represent statistically significantly differences by student´s T-test of least mean squared.

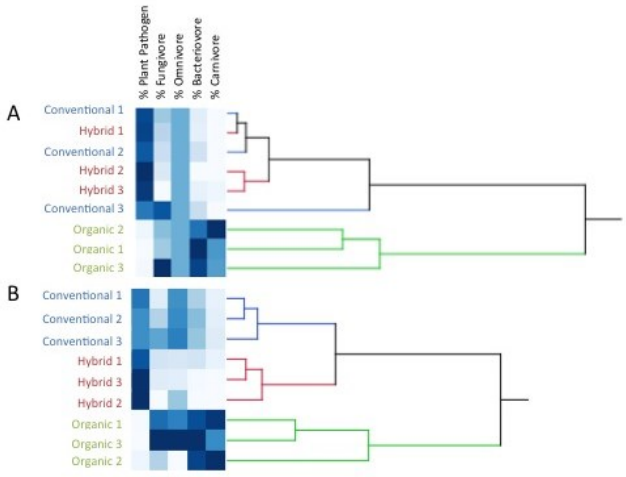

Figure 3. Cluster analysis of percent nematodes in each trophic group from A) the May 2013 collection and B) the September 2013 collection.

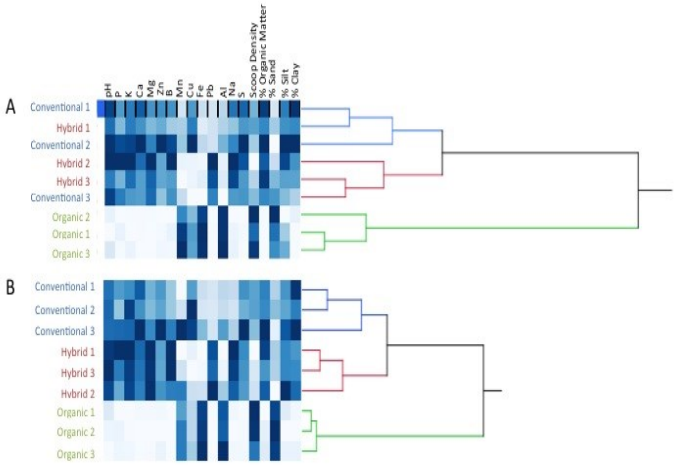

Figure 4. Cluster analysis of soil pH, soil nutrients (ppm), percent organic matter, and soil texture from A) the May 2013 collection and B) the September 2013 collection.

TERO Vol. 13(2):32–35 | March–April 2014
USGA ID#: 2013–14–475
TGIF Number: 240133

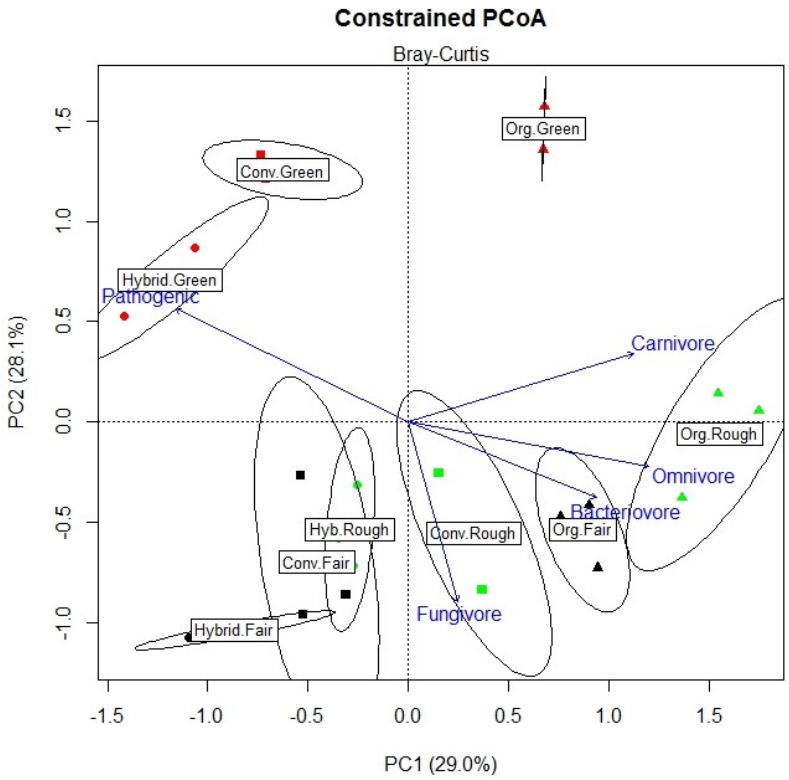

Figure 5. Principle component analysis bi-plot for soil nutrients and texture analysis, percent organic matter, and percent nematodes in each trophic group.

Table 2. ANOVA of qPCR data for the relative abundance of bacteria (16S), fungi (18S), and the ratio of bacteria to fungi for the Spring 2013 collection among the three courses and three management areas.

	Source	DF	Sum of Squares	F Ratio	Prob > F
Bacteria	Course	2	1.455e20	2.9129	0.057
	Management Area (Course)	6	1.603e21	10.700	<0.001
Fungi	Course	2	1.717e19	14.368	<0.001
	Management Area (Course)	6	5.708e19	15.922	<0.001
Bacteria:Fungi	Course	2	1591.706	15.223	<0.001
	Management Area (Course)	6	4204.080	13.402	<0.001

TERO Vol. 13(2):32–35 | March–April 2014
USGA ID#: 2013–14–475
TGIF Number: 240133