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Improving Predictions of White Grub Distribution in Turfgrass

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White grub management is a perennial problem in turfgrass involving accurate identification and quantification of larvae as well as characterization of larval distribution in order to make management decisions that are both economically and ecologically sound. Characterizing white grub pest distribution, however, presents major logistical challenges. White grubs tend to be distributed patchily throughout the soil environment, and despite decades of research, the factors that determine where white grub outbreaks will occur remain poorly understood. Combined with the fact that few turf managers have the time required to conduct thorough scouting for soil-dwelling pests, this means that insecticides are often over-applied against white grubs. In fact, previous work in NY State has determined that roughly 80% of insecticide applications for grubs are unnecessary. Clearly, there is a need to improve our understanding of the factors that determine grub distribution in turfgrass.

Some environmental characteristics influencing white grub pressure are well established. For instance, it is clear that soil moisture and precipitation during typically dry summer periods can promote grub development and enhance damage. White grubs are also known to cease egg laying below critical moisture levels. However, more moisture is not always a bad thing, as it can buffer turf from grub damage and assist in recovery from grub feeding during late summer and fall. Yet, while precipitation may be an important predictor of overall grub pressure in a given turf area, it still does not fully explain their patchy occurrence within a given area.

Chemical and physical soil properties can also impact grub populations and in some cases can limit their distribution. Specifically, organic matter and sand content are important determinants of egg deposition in soil by Japanese beetle. Despite the value of these findings, we still lack a working knowledge of the factors that determine where and when annual white grubs will occur in large enough numbers to warrant pest management action. In an effort to improve understanding of these factors our lab has been characterizing soil chemical, physical and biological conditions in golf course fairways with and without historical presence of annual white grubs. Our goal is to identify soil characteristics that can serve as indicators of areas vulnerable to grub infestation in the future. Our lab sampled four fairways on each of eight golf courses across central NY State in Monroe, Wayne, Ontario, Onondaga, and Oswego counties in spring and fall of 2014 and 2015. At each golf course, two fairways were identified with a history of annual white grub damage (predominantly

Japanese beetle), and two additional fairways were identified with no history of grub pressure. Soil samples were collected from each fairway and analyzed for physical (soil texture), chemical (organic matter content), and biological (microbial biomass and activity) properties (Figure 1).

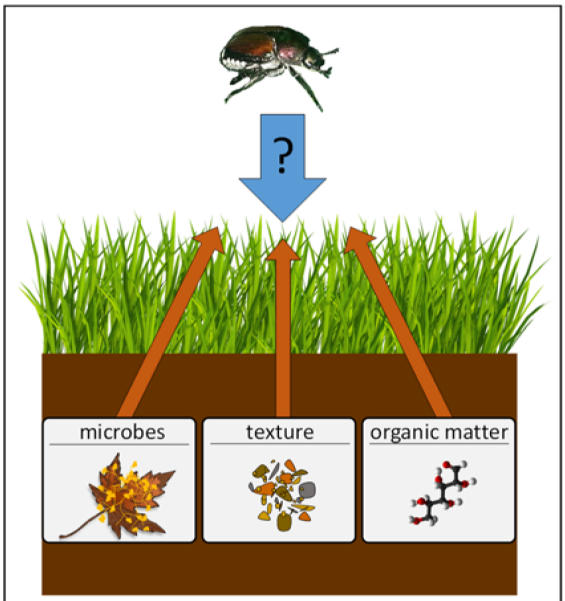

Figure 1. Potential factors influencing white grub site selection and larval distribution in turf soils.

We found that fairways with historical grub pressure do show a trend toward lower sand content than those with no history of grubs, however, the difference was minor (Table 1).

Table 1. Soil texture analysis in fairways with and without historical grub pressure.

	Sand%	Silt%	Clay%
grubs	48.9	37.2	13.9
grub-free	58.1	31.4	10.5

Sand content ranged widely from 28-79% across fairways and we observed considerable variability among individual golf courses. However, the trend in sand content observed in our study does agree with previous findings that annual white grubs tend to avoid high-sand soils.

Unlike previous studies we found no clear relationship between historical grub presence and total organic matter content (Figure 2a). However, historically infested fairways did support significantly lower microbial biomass than fairways with no history of grubs during fall in both years of the study (Figure 2b). This indicates that the living, microbial component of soil organic matter may be a more important indicator of grub distribution in the field than total organic matter content. There are many possible explanations for this finding. For instance, decreased microbial biomass may reflect a lower density of beneficial insect pathogens in soil, however, our approach did not allow us to test for this specifically.

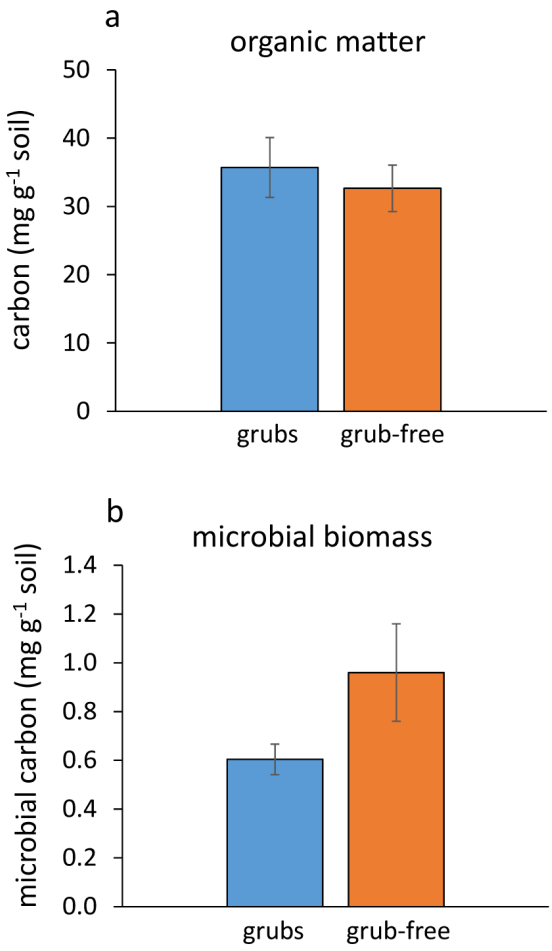

Figure 2. Soil organic matter content (a) and microbial biomass (b) averaged across 2014 and 2015 in fairways with (blue) and without (orange) a history of white grub presence.

We set out to pinpoint soil traits that can improve our predictions of annual white grub distribution in turfgrass, and found that a single environmental factor, microbial biomass, was consistently lower in fairways with historical grub pressure. Our lab is continuing to explore the links between soil microbial communities and white grub distribution, and our long term goal is to use our findings to enhance the monitoring and sustainable management of these cryptic and patchy belowground pests.