Purdue University
Department of Entomology
Undergraduate Capstone
Project Summary

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Project Title:

Influence of endophyte infection and nitrogen fertility on the abundance of oribatid mites in tall fescue turfgrass

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Introduction

The long-term goal of this project is to understand how endophyte infection influences nutrient cycling in turfgrass. In working toward this goal, the objective of this project was to examine how endophyte infection and nitrogen fertility influence the abundance of oribatid mites in tall fescue lawns.

Neotyphodium endophytes are symbiotic fungi that reside in the above-ground tissues of several important turf and pasture grasses. These endophytes provide their grass host with a series of defensive alkaloids that act as a defense against surface-feeding insects. Because of the antimicrobial and anti-herbivore activity of the defensive alkaloids associated with endophyte infected plants, it is possible that endophyte-mediated alkaloids may influence nutrient cycling in turfgrass systems by altering the rate of leaf litter (clippings) decomposition.

Nitrogen fertilization is a common and essential turfgrass management practice and up to 20% of the annual nitrogen budget for turfgrass is supplied by returning grass clippings to the soil. Nitrogen fertilization may influence litter decomposition directly by altering the C:N ratio of clippings (lower C:N = faster decomposition, higher N-mineralization). However, N-fertilization may also influence litter decomposition by increasing levels of endophyte mediated alkaloids in clippings.

Oribatid mites (Fig. 1) are essential decomposers, found in the soil and litter layers of most terrestrial systems. These mites play an important functional role by aiding in the recycling of plant material to soil organic matter. The potential influence of endophyte-mediated alkaloids on populations of oribatid mites is presently unknown, but may have important implications for nutrient cycling.

Because of the anti-microbial and anti-herbivore activity of the defensive alkaloids associated with endophyte infected plants and because of the tendency of N-fertilization to increase alkaloid levels, I hypothesized that the abundance of decomposers, oribatids in particular, would decrease as endophyte infection and N-fertility increased.

Materials and Methods

Experimental plots (2 x 3.5 m) were established in September, 2006 by seeding tall fescue at a rate of 390 kg/ha. Half of the plots were seeded using high endophyte seed (60% E+) and half were seeded using low endophyte seed (20% E+). After establishment, plots were maintained at one of three different annual N-fertility rates (0, 1.13, or 2.27 kg N/ha/y). Each endophyte x N-fertility treatment was replicated 4 times in a randomized block design and plots were mowed three times each week from April to December.

Three soil and turf samples were collected from each plot in October, 2007 using a standard golf course cup cutter (10.8 x 5.0 cm). Samples were placed into plastic bags and transported to the lab in coolers where they were removed from the bags and placed on Berlese funnels for 72 hours. Oribatid mites and other arthropods were collected at the bottom of each Berlese funnel into a vial of 70% ethanol and the number of oribatid mites in each sample was quantified with the aid of a stereoscope. The mean number of mites per sample was calculated for each plot and data was analyzed with factorial analysis of variance.

Results and Discussion

Results indicated that variation in oribatid abundance was more tightly linked with endophyte infection in tall fescue than N-fertility, although the influence of endophyte infection was not strong (Fig. 2). The lack of stronger trends in the data may have been related to several factors. First, samples were only collected once, during late October, when soil temperatures are decreasing and natural decomposition is declining. Second, differences between high endophyte and low endophyte treatments averaged only 40% and within treatment variation may have obscured my ability to detect all but the largest of differences between treatments.

Future efforts to examine how endophyte infection and N-fertility influence arthropod decomposer communities should take into account the possibility that differences in alkaloid levels between high and low endophyte plots may be greater than differences between fertility rates. Direct measures of the alkaloid levels associated with experimental treatments and greater differences in endophyte infection rates between high and low endophyte treatments may aid in clarifying hypothesized mechanisms. Samples should also be collected at different times during the season to account for seasonal variation in decomposition.

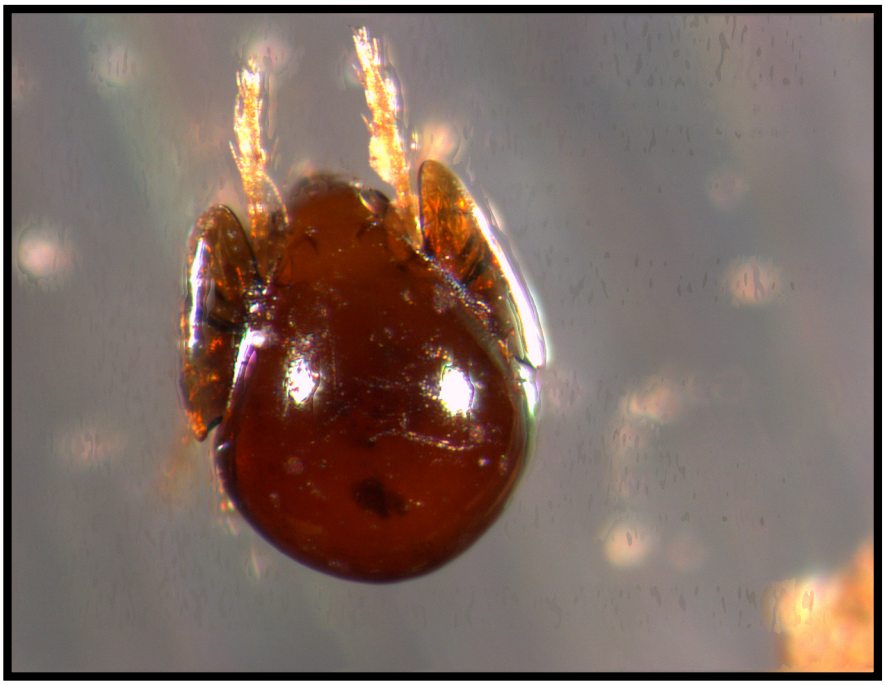

Figure 1. A winged oribatid mite collected from tall fescue turfgrass

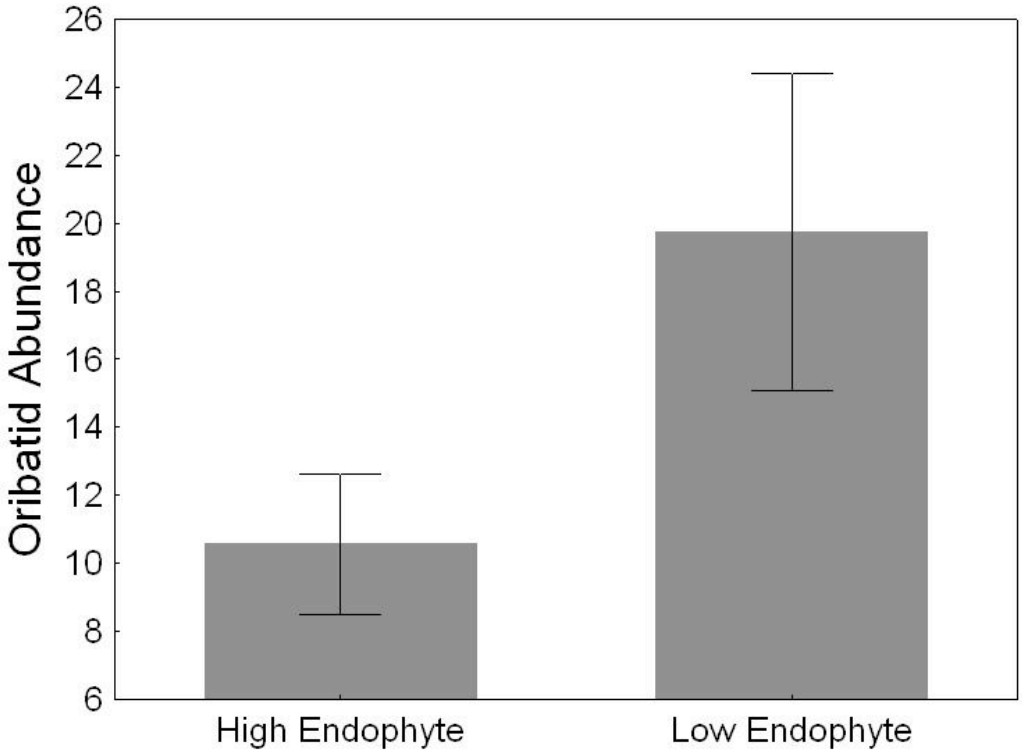

Figure 2. Influence of endophyte infection on the abundance of oribatid mites in tall fescue turfgrass

Resources

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