Interacting Effects of Soil Microbes and Spiders on Plant Growth

Authors: Gabriella Smith and Dr. Shawn M. Wilder*

Abstract: Biotic factors contribute greatly to the success of nutrient cycling, this is done by recycling and translocating nutrients microbe"". Research has shown that high densities of predators affect the amount of nutrients deposited into soil and the flow of nutrients within an ecosystem. A recent study has shown that spiders consume 400-800 million tons of food per year, although, for such a large group of predators little is known about the relationship between spiders and nutrient cycling. The goal of this study was to test if the presence of a single spider and the presence of soil microbes plant growth. To do this, we collected soil and female Carolina wolf spiders (*Hogna carolinensis*) from a local field. Half of the soil was sterilized, while the other half was left natural. Within these two groups of sterile and natural soil, some containers contained a spider while others were left empty to act as controls. After feeding the spiders for 2 months I soil respiration, and plant growth. interaction between spiders and soil microbes plant mass, plant height, and the number of flowers produced.

Keywords: Microbes, Spiders, Plant Growth, Soil

Introduction

Nutrient cycling is the movement and usage of nutrients within an ecosystem, this process relies on both biotic and abiotic factors that can modify the composition and activity of microbial communities in soil (Bever et al. 1997). Biotic factors like animals contribute greatly to the success of nutrient cycling by recycling and translocating the vital nutrients and chemicals necessary for microbe productivity (Vanni 2002). The role of microbes like bacteria and fungi in the process of nutrient cycling is to break down animal carcasses and nutrients back into the soilhe process of microbe productivity and organic matter decomposition the presence of abiotic chemicals such as nitrogen and phosphorus (Sinsabaugh and Moorhead 1994). The nutrients and chemicals necessary for microbe productivity are deposited by animals via nutrient recycling and or nutrient translocation. The process of nutrient recycling occurs when an animal releases nutrients within the habitat that food was ingested, while in nutrient translocation, nutrients are moved across several ecosystems (Vanni 2002). It is through these processes that animals regulate the transfer of nutrients within an ecosystem.

Predatory animals in particular, affect the amount of nutrients deposited into soil and the flow of nutrients within an ecosystem (Ngai and Srivastava 2006, Hawlena et al. 2012). , n an ecosystem of bromeliads and detritivores, the flow and abundance of nitrogen is greater when a predator is present (Ngai and Srivastava 2006), and the presence of terrestrial predators like spiders can impact the body nutrient content of their cricket prey (Hawlena and Schmitz 2010). The nutrients in prey can then affect the amount of nitrogen deposited into the soil through predator excrement, causing the change in nutrient content to affect the decomposition process (Hawlena et al. 2012) the presence of spiders on natural soil would promote greater plant growth and soil respiration.

Methods

The 1.1-liter soil arenas were filled with a cup and a half of soil, and 2 grams of leaf litter collected from the same field as the soil. Spiders were fed 2 half inch crickets once every week, and live crickets placed inside of control arenas were removed 2 days after feeding. To keep a sterilized environment all surfaces used for feeding were be wiped down with 70% ethanol, and arenas in the sterile group were opened

* Faculty Mentor, Department of Integrative Biology

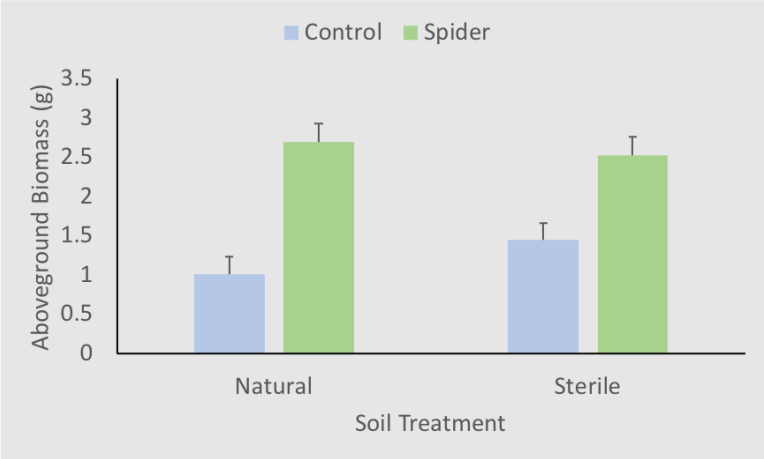

Figure 1: Effects of soil type and spiders on the aboveground biomass produced at the end of the experiment. Values represent the mean +1 standard error.

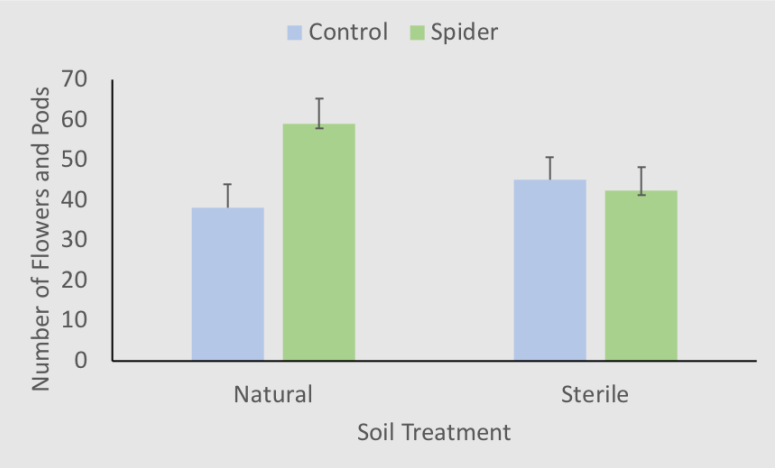

Figure 2: Effects of soil type and spiders on the number of flowers and pods produced at the end of the experiment. Values represent the mean +1 standard error.

prior to arenas in the nonsterilized group. Spiders were fed for 2 months. Following feeding trials, soil from each treatment was used to test plant growth and respiration. Soil respiration was tested by placing a CO2 analyzer into 0.5-liter cups. Plant growth was tested by planting 2 seeds of Wisconsin fast plants in the rosette dwarf genotype (Brassica apa) in each soil container and allowing the plants to grow for 4 weeks.

Plants were grown in 0.5-liter cups filled with 1 cup of soil. Plants were measured in centimeters, and weighed in grams. Data was analyzed in 2 factor ANOVA. Tests to examine soil nutrient content may also be used to gain further understanding of the final results.

Results

The interaction between spiders and soil microbes affected plant mass, height, and the number of flowers produced.

There was no effect of soil type on plant mass (Figure 1, 10 =2.72 p= 0.13). There was a significant effect of spiders on plant mass with higher plant mass in containers that held spiders (Figure 1, 69 = 44.96 p= 0.0001). There was also a significant interaction between soil type and spiders (Figure 1, 65= 7.69 p=0.01). Spiders have a larger effect on plant mass in the natural soil treatments compared to the sterilized soil.

There was an effect of soil type on the number of flowers produced (Figure 2, 19 = 0.22 p=0.65). There was a significant effect of spiders on the number of flowers and pods produced in containers that had spiders (Figure 2, 54 =6.36 p= 0.01). There was also a significant interaction between soil type and spiders (Figure 2, 52= 3.33 p= 0.07). Spiders had a larger effect on the production of flowers and pods in the natural soil treatments compared to the sterilized soil.

There was an effect of soil type on plant height (Figure 3, 14 = 0.67 p = 0.42). There was a significant effect of spiders on plant mass with greater plant height in containers that had spiders (Figure 3, 62=12.64. p=0.0007). There was also a significant interaction between soil type and spiders (Figure 3, 61= 8.97 p= 0.004). Spiders had a larger effect on plant height in the natural soil treatments compared to the sterilized soil.

Discussion

The results found support my hypothesis that the presence of spiders on natural soil will promote greater plant growth and soil respiration. The presence

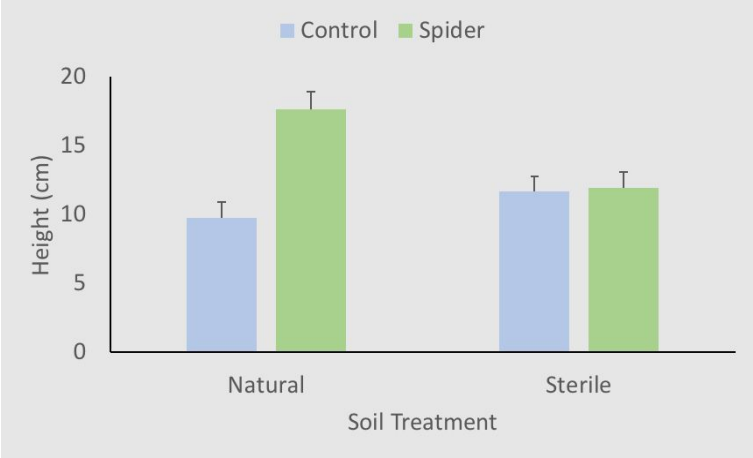

Figure 3: Effects of soil type and spiders on plant height at the end of the experiment. Values represent the mean +1 standard error.

of spiders increased plant growth, and this increase as found to be greater when natural soil microbes were also present. This work shows similar patterns to previous studies that indicate predators increase nutrient cycling under natural conditions. Past work has assumed that predators benefit nutrient cycling primarily by depositing nutrients into the soil that are then used by plants. This research demonstrates that there may be more complex relationships between spiders and soil microbes than initially believed. The nutrients might not go directly to plants but rather might change the microbial community that then affects the plants in some way.However, many questions remain. How does the presence of spiders on soil interact to affect plant growth? What is the mechanism responsible for this interaction to occur? One explanation is that spider excreta affects microbe communities, if this is the case how do microbe communities change in the presence of a spider? Another explanation is that spiders add nutrients to the soil, but what nutrients are added? Tests to examine soil nutrient content, and microbe communities found in soil will help to answer these questions and gain further understanding of the final results.

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