

The relationship between root decomposition and plant biodiversity

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Introduction

The Visiting Scholars agreement between the Central Grasslands Research Extension Center (CGREC) and the Chinese Academy of Science allowed me to come to North Dakota as a visiting scholar for four months in 2007. I returned again in May 2008 for six more months of study.

My research was designed to examine the relationship between root decomposition and plant biodiversity. Root decomposition is an important process that influences other processes in the soil, such as water movement, microbial activity, nutrient availability, and carbon dioxide release.

Root decomposition has often been studied (Vivanco and Austin 2006; Dormaar and Willms 1993; Ostertag and Hobbie 1999), but little is known about the relationship of root decomposition to plant biodiversity. Few studies look at root decomposition of individual species and their interactions, and this is our interest.

Plant species composition affects nearly all terrestrial ecosystem processes, including primary production (Tilman and Downing 1994; Tilman et al. 1996; Hector et al. 1999), decomposition (Wardle and Lavelle 1997; Madritch and Hunter 2002; Zimmer 2002), and nutrient cycling (Hobbie 1992; Cornelissen 1996; Cornelissen and Thompson 1997).

Grassland is a very important component of the whole biosphere and more people have become interested in grassland management in recent years. We know that human management of the grassland influences plant biodiversity, and thus nutrient cycling in the ecosystem. We may be able to improve the nutrient cycle if we understand more about the relationship between root decomposition and plant biodiversity. If the nutrient cycle is healthy, the whole ecosystem will benefit. From that, the best way to manage the grassland can be found.

Methods and Results

This experiment included six grass species common to the area: Kentucky bluegrass (*Poa pratensis*), blue grama (*Bouteloua gracilis*), western wheatgrass (*Agropyron smithii*), needle-and-thread (*Stipa comata*), little bluestem (*Andropogon scoparius*) and smooth brome (*Bromus inermis*); and one perennial forb: Maximilian sunflower (*Helianthus maximiliani*).

The roots of Kentucky bluegrass and smooth brome were gathered from pastures at CGREC and roots of the other species were from plots at the Plant Material Center in Bismarck ND. These roots were washed and dried at 150 F for 72 hours. Then exactly 8.00 grams of roots were placed into 5.9 in. X 5.9 in. individually weighed bags made of nylon with a mesh size of 0.04-0.08 in. Table 1 shows the 21 species combinations and each combination had five replications.

Each bag was buried separately 4 in. deep in an 8 in. X 8 in. plot at CGREC on July 5, 2008. The site was in an ungrazed mixed-grass native prairie with soil typical of overflow range sites. The bags were removed at the end of the growing season on September 30, 2008. The bags were washed carefully, dried at 150 F for 72 hours, and then weighed. The final root weight (filled bag weight minus initial empty bag weight) was divided by the initial root weight to determine the fractional weight loss due to decomposition over the three-month period. The results are shown in Table 1 and Figure 1. The total rainfall over the period was 17 % above normal, 8.03 in., and the total soil water in the top 5.9 in. of soil was on average 17 % of total soil volume.

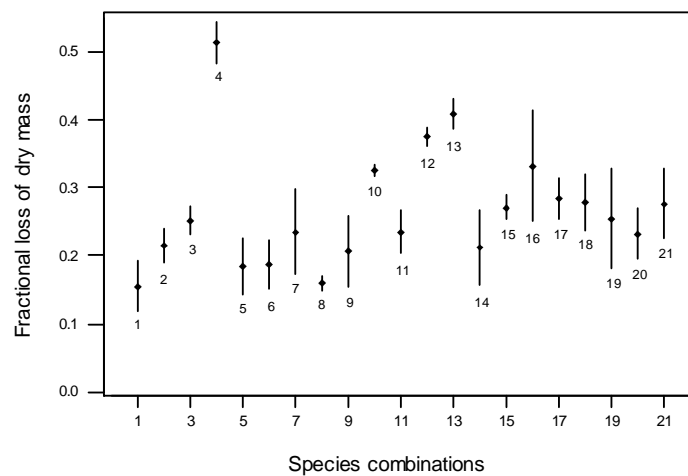


Figure 1. Fractional loss of dry root mass for each species combination. Species combinations are listed in Table 1.

Conclusion

The results show that the amount of Maximilian sunflower root decomposition was much higher than others (Table 1 and Figure 1). Nearly all species combinations with sunflower roots had more decomposition than those without. Also, we find that as the number of species combined increased, the decomposition rate tended to increase. A nutrient analysis of the roots will be made this winter. Using both the root decomposition and nutrient data, a full data analysis will be completed. With this information, we hope to better understand the interactions between species and the relationship between root decomposition and biodiversity.

Work on Other Research Projects

This summer, I also assisted the CGREC range scientists in measuring the soil water and the leaf area index (LAI) of range plants, and processed the data. We also collected data describing plant communities, such as frequency and density, and sampled above ground biomass for productivity. Another experiment we worked on was to measure the root respiration of plants grown in the greenhouse and in the field.

I have learned much about range plants, as well as new field methods and how to use different types of scientific equipment, such as the LI-6400 Portable Photosynthesis System, the PAR/LAI Ceptemeter, the Depth Moisture Gauge, and so on. Working here, I improved my English and learned about the American culture by interacting with other people who work at the Center.

I enjoyed my life here, based on my views of the beautiful landscape and friendly people. It will be a wonderful memory and I will never forget it.

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