Mycorrhiza and Rangelands

Objectives

1. To learn basic concepts about the importance of mycorrhiza to rangeland ecosystems
2. To determine the effect of different mycorrhizal strains on growth of several range plants

Introduction

Current and future agriculture and biology graduates will be entering a workplace where biological (as opposed to strictly synthetic) approaches to enhancing yield and sustainability are increasingly in demand. In the space provided below, list examples of how biological approaches are being used to deal with important natural resource management issues and problems.

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Mycorrhiza, a biological association between certain fungi and plant roots, occurs naturally in many undisturbed ecosystems, including range ecosystems. Several types of soil dwelling fungi (Basidiomycetes, Ascomycetes and Zygomycetes) form beneficial (sometimes called symbiotic) associations with the roots of many plants.
It has been suggested that the increased use of mycorrhiza to increase nutrient and water uptake efficiency by forage plants may enhance the sustainability of natural grasslands and rangelands, which comprise approximately 50-60% of U.S. land resources.

As a result of this generally symbiotic relationship between plant and fungus, the plants receive greater access to essential mineral nutrients in the soil (e.g. phosphorus). In turn, the fungi receive energy in the form of photosynthetically derived carbon compounds. A number of different types of mycorrhizal associations have been identified, including:

- Vesicular-arbuscular mycorrhiza (VAM) - also known more recently as simply arbuscular mycorrhiza or AM, and
- Ectomycorrhiza (ECM)

In general, the distinction between the two types has to do with the extent of hyphal penetration. Specifically, the hyphae of VAM penetrate inside the root cells. For this reason VAM have also been known as endomycorrhiza. The hyphae of ECM grow around the root cells without actually penetrating them and are commonly known as ectomycorrhiza.

The presence of mycorrhiza in a crop ecosystem or a natural ecosystem potentially provides a number of important benefits to the plants, including:

- Enhanced nutrient uptake
- Enhanced water uptake and drought resistance
- Enhanced growth rate and yields
For these reasons, range scientists are interested in the presence and activity of mycorrhiza on rangelands. Your participation in this laboratory will allow you to gain a modest amount of experience in this important aspect of range management.

Materials and Methods

Materials

1. Range plant seed (to be determined by availability) – Western Wheatgrass (*Pascopyrum smithii*), Smooth Bromegrass (*Bromus inermis*), Russian Wildrye (*Psathyrostachys juncea*)
2. Pots – 6” diameter or other size specified by your lab instructor
3. Mycorrhizal Inoculant – 3 different types / formulations
4. Lab Balances and Bench Scale
5. Scissors
6. Paper Bags
7. Cloth Bags
8. Drying Oven
9. Tape and markers
10. Mower
11. Rakes
12. Field Soil and/or potting soil

Methods

Part 1 – Greenhouse Experiment

1. At the direction of your lab instructor, obtain field soil and/or potting soil, and fill 3 pots with the soil (3 pots per research team)
2. Apply mycorrhiza to the soil as directed (Note: Some formulations are designed to be applied to the seed – if so, you may skip this step)

3. After treating soil or seed with the mycorrhizal inoculant, plant 12-15 seeds of each species in each pot

4. Moisten the surface of the soil and make arrangements with group members to keep the soil moist to insure good germination.

5. Periodically water plants as needed.

6. Measure growth rate as height from plant base every week, once plants have emerged.

7. After a suitable growth period, use the scissors to carefully cut plants from each of the three pots and place in 3 separate, labeled paper bags.

8. Place the bags in a 70°C drying oven.

9. When plants are dry, determine dry weight by using the lab balance. Record the dry weight in the data table provided by your instructor.

10. Time permitting, enter the yield data in an Excel™ spreadsheet and conduct appropriate statistical analysis (e.g. ANOVA) as directed by your instructor

Part 2
Field Biomass Determination

1. Carefully mow the marked area within each field research plot.

2. Rake clippings into a central pile and place into a cloth yield bag

3. Weigh yield bags on the bench scale
4. Remove a sub-sample of fresh tissue (about one hand full) from each bag and place in a labeled paper bag
5. Weigh the paper bags with the fresh tissue and record data in the table provided
6. Place paper bags into a 70°C drying oven
7. When plant tissue is dry, weigh each sample and record data in the table provided
8. Using the fresh and dry weight data for sub-samples, calculate % dry matter
9. Using the % dry matter data, convert the fresh weight yield of each plot to a dry weight basis

Part 3 – Transplanting

1. At the direction of your instructor, you will transplant selected plants from the greenhouse experiment into field research plots

Lab Review: What did I learn today?

1. True / False  It has been suggested that the increased use of mycorrhiza to increase nutrient and water uptake efficiency by forage plants may enhance the sustainability of natural grasslands and rangelands, which comprise approximately 50-60% of U.S. land resources.

2. It’s said that mycorrhizal fungi form a symbiotic relationship with many plants. What primary benefit do the fungi receive as part of this relationship?
3. Briefly describe the distinction between endomycorrhizal and ectomycorrhizal fungi.