RECLAMATION OF MINED LAND UTILIZING NATIVE WARM SEASON GRASSES

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Project Overview

The Surface Mining Control and Reclamation Act (SMCRA) requires all reclaimed mined lands to include ground cover to prevent erosion. Reclamation involves the grading and compaction of the land to reduce erosion along with seeding or spraying vegetation. Standard mined land ground covers lack nutrition needed for forage and provide few benefits beyond erosion control. Mine soils of the central Appalachian mining region are typically coarse-textured, rocky, and have weathered oxidized soils or unweathered non acid forming soils with pH ranges from 3.0 – 8.0 (Daniels and Zipper, 1997). Unweathered rock materials typically used as topsoil substitutes limit the establishment and survival of vegetation (Haering et al., 2000). In sites where reforestation is not pursued due to livestock grazing or soils are too compacted and need to be ripped through mechanization, Native Warm Season Grasses (NWSG) can provide a viable and profitable alternative.

NWSG have deep rooting systems that are able to break up compacted soils and can aid in nutrient recycling and soil aggregate formation. NWSG provide considerable nutrition for livestock grazing, wildlife habitat, and land conservation (Vogel et al., 2002). Furthermore, the vegetation can be harvested for biomass energy content using existing farm equipment and incinerated in coal power plants.

Previous research has shown switchgrass and other grass species exhibiting positive symbiotic relationships with arbuscular mycorrhizal fungi (AMF) in nutrient limiting and acidic soil conditions. AMF enhancement of mineral acquisition and protection from toxins for associated plants resulted in increased plant root and shoot densities (Clark, 2002).

In conjunction with Virginia Tech’s Department of Crop and Soil Sciences and the Powell River Project, we are conducting research on a half acre at the PRP in southwest Virginia. Soils have a combination of grey siltstones and brown sandstones and are rocky with an average pH from 4.5-5.0. NWSG species that are native to Appalachia and that dominated the unforested landscapes in the Eastern United States include switchgrass (*Panicum virgatum*), big bluestem (*Andropogan gerardi*), and atlantic coastal panic grass (*Panicum amarum*) (Tilman, Hill, & Lehman, 2006).

The research will be conducted by Samir Doshi, a PhD candidate at the University of Vermont, as a part of his dissertation. Field work includes eliminating any existing vegetation, preparing the field plots for seeding, application of amendments, planting the grasses, and inoculating the fungi. Three species of grasses along with a control are seeded at two different fertility levels – one level has no additional nutrients and the other has N, P, and K distributed at the rates of 50 lb/acre, 300 lb/acre, and 150 lb/acre, respectively. These rates have been determined by previous research at the PRP (Daniels and Zipper, 1997). Additionally, each fertility/grass combination will have a subplot with mycorrhizal inoculation and one without. Therefore, each whole plot includes 16 subplots (3 grass species/1 control with 2 levels of fertility amendments with 2 levels of fungi amendments) and each whole plot is replicated 4 times (Figure 1).

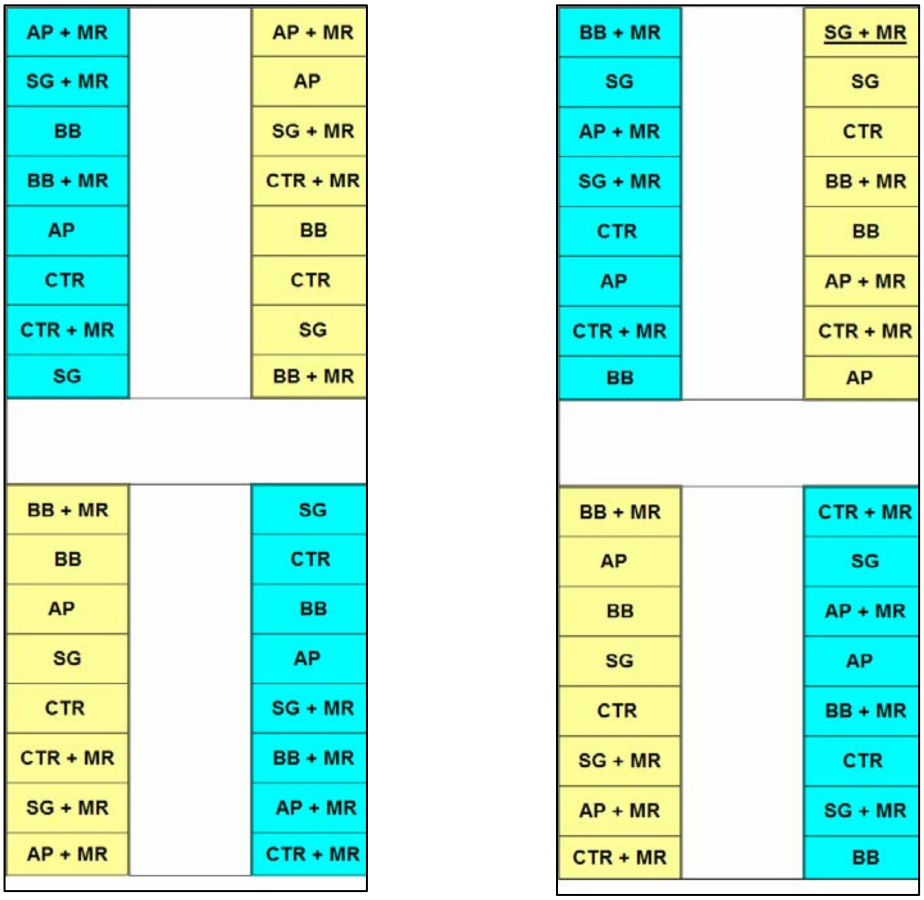

Figure 1. Plot design of research experiment. Each whole plot is replicated 4 times. 3 species of grasses are grown, switchgrass (SG), big bluestem (BB), atlantic coastal panic grass (AP), and a control with no vegetation (CTR). Subplots are then split between those with inoculation of mycorrhizae (MR) and those without. Subplots in yellow have no fertilizer added; subplots in blue have fertilizer added.

Objectives of research

1). Biomass Energy Production:

Determine which of the three tested grass species will output the highest amount of aboveground biomass. Yields will be determined by annual harvests for each successive year by measuring aboveground biomass of each vegetation for a 3 ft strip across each sub plot.

2). Soil Reclamation

Determine the effects of the experiment application on underground soil physics, chemistry, and biology. Physical characteristics include texture, bulk density, particle density, porosity, and water content. Chemical characteristics include organic matter, nutrient content, and pH. Biological characteristics include microbial biomass. The objective of improved soils is applicable in reclaiming mined lands for reforestation without heavy mechanization to reduce compaction or other productive land uses.

3). Minimize Inputs

Determine the minimal amount of inputs fertilizer and preparation of mined land through mechanization that will yield the highest biomass energy production and result in productive soil physical, chemical, and biological characteristics.

4). Mycorrhizal Interaction

Determine if mycorrhizal inoculation and increased microbial biomass will benefit Objectives *1)* and *2).* Fungal biomass will be determined by utilizing fluorescent microscopy to analyze the enzyme *glomalin*, which is produced by AMF.

Research to date

The first field season has been completed in the summer of 2007. Pesticides were applied to the field plots to eradicate any preexisting invasive and cold season vegetation that will compete with and inhibit NWSG growth. The plots were flagged and then prepared by removing large obstructive rock elements. Additional plot preparation included using a chain drag to smooth and pack soils for proper seed – to – soil contact when using the seed drill. 2 L of each subplot was sampled to determine the following baseline characteristics in the lab: soil texture, bulk density, particle density, porosity, water content, organic matter, nutrient content, and pH. Seeds were planted using a drill and fertilizers were added after seeding to minimize competition during the initial growth. Mycorrhizae will be inoculated next year and the species of AMF will be determined by observing the first year's aboveground and belowground growth.

References

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