Developing a Cost-Effective Green Technology for In-Place Reclamation of Coal Mine Spoil Gob Piles in Abandoned Mine Lands

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Project Description and Objectives:

Mine spoils from coal mining activities accumulated as gob piles are difficult to reclaim due to constraints such as a steep slope, unsuitable pH, insufficient nutrient supply, metal toxicity, low water holding capacity, and poor soil structure. Reclamation of gob piles is often cost-prohibitive due to the lack of viable low-cost reclamation methods. This project aimed to develop, optimize, and demonstrate a low-cost, in-place sustainable reclamation technology on a field-scale using recycled organics (biochar and composts) for revegetation and stabilization of gob piles of mine spoils in the Carthage coalfield (CCF) in New Mexico.

Applicability to Mining and Reclamation:

This study provides crucial information that would help in optimizing a sustainable reclamation method for Carthage coalfield (CCF) in New Mexico and other abandoned mine sites in the surrounding areas. This study show that this sustainable and cost-effective reclamation method will be of value to the Office of Surface Mining and Reclamation Enforcement (OSMRE) and will have tremendous technology transfer potential with the help of local regulatory partners like New Mexico Abandoned Mine Land Program. This technology will attract the attention of regulatory agencies and the reclamation industry as a viable model to reclaim the many coal mine gob piles that are scattered around the Western region.

Methodology:

Project objectives were met via the implementation of four sequential tasks: (1) procurement and characterization of spoil materials, biochar, and composts; (2) incubation studies to identify the ideal mix of biochar/mine spoils and compost/mine spoils to generate the optimal water-holding and nutrient-holding capacity of the spoils without significant leaching of metals; (3) a greenhouse study to develop a vegetative cap using a high-biomass metal-tolerant grass with a long and dense root system, vetiver (*Chrysopogon zizanioides*) in comparison with a native tall fescue grass (*Festuca arundinacea*) to minimize soil erosion and promote site stabilization; (4) a small-scale simulated field study using three 7.0 ft. × 8.0 ft. × 1.0 ft. custom-made wooden platforms that were set up under the natural environment (open to natural elements) in New Mexico Tech (NMT) campus in Socorro which is only a few miles from the Carthage coalfield site.

Highlights:

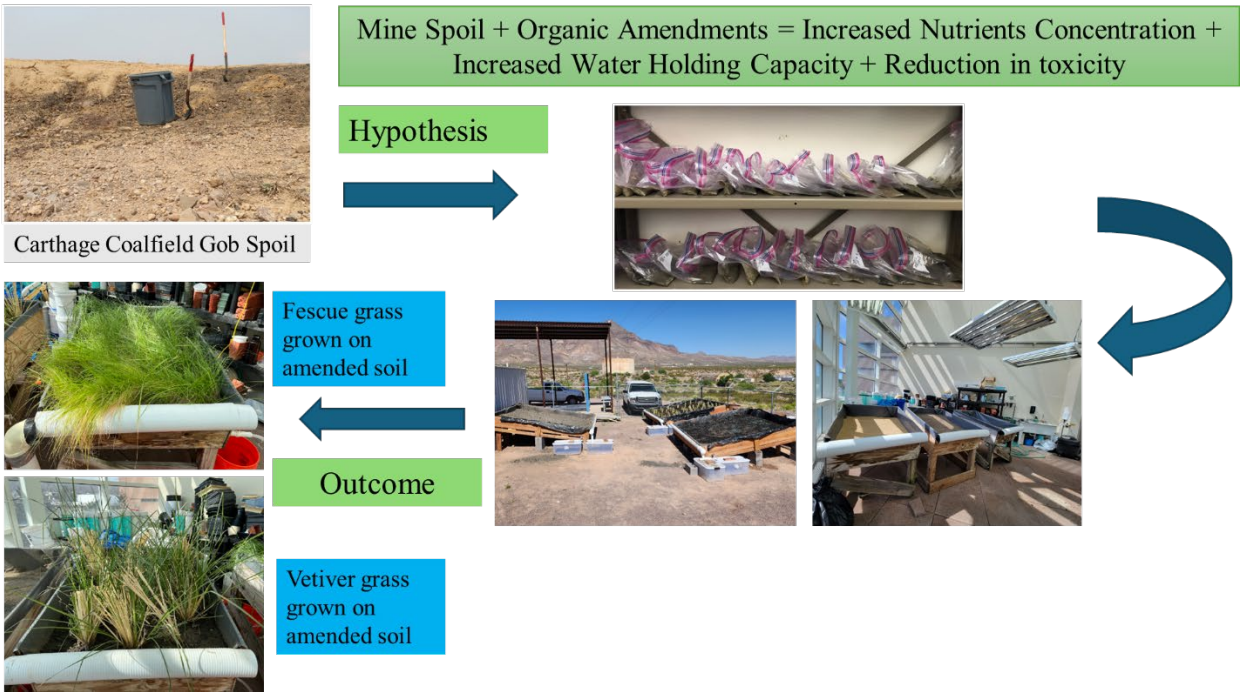
Important conclusions of the study include the following:

1. Organic amendment of the gob spoil soil by both biochar and compost led to a significant increase ($p < 0.05$) in its water-holding capacity leading to the enhancement in the soil quality for the growth of vegetation.

2. No significant increase ($p > 0.05$) in the organic matter (OM) content of the gob spoil soil was observed due to the organic amendments. However, as the soil itself had a good amount of organic matter (~28%), any enhancement in OM content due to the amendments is not expected to make a big difference in soil fertility.

3. The plant-available nitrogen and plant-available phosphorus content of the gob spoil soil was improved drastically due to the biochar and compost amendments.

4. The potentially toxic trace metal content in the CCF gob spoil soil was low and hence, any concern about organic amendments mobilizing toxic metals was negligible. The only exceptions were aluminum (Al) and iron (Fe), which did not show a significant increase in soluble and exchangeable fractions, which are the plant-available forms of the metals. Hence, no Al and Fe toxicity was observed in plants.



Pictorial representation of the study that shows the addition of organic amendments (biochar and compost) increased nutrient concentration and water holding capacity of mine spoil soil from Carthage Coalfield (CCF). Fescue and Vetiver grass were able to grow on amended soil from CCF.