Fiber Rolls as a Tool for Re-Vegetation of Oil-Brine Contaminated Watersheds

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Research Category: Brine Scar Remediation

Description:

Historic oil brine scars (sites that repeatedly received produced water) are extremely difficult to remediate because these sites possess degraded, highly saline soils, erosion damage, little or no plant cover and an altered microbial community. Ecosystem function is diminished as a result of these impacts.

We are evaluating the contribution of fiber rolls to restoration of a historic oil brine scar in south Arkansas. Four treatments (natural attenuation, standard soil reclamation techniques, fiber rolls, and soil reclamation with fiber rolls) have been applied to plots within the site. Fiber rolls are tubes formed with a geotextile material and filled with organic fiber, mycorrhizal fungal inoculum, bacterial inoculum (soil) and salt-tolerant plants. Consequently, fiber rolls may serve a variety of ecological functions including primary productivity, filtering of sediments and moisture and nutrient retention. Rolls also serve as a source vegetative growth, seeds, microbial spores, organic matter and nutrients.

Objective(s) of the Research Project:

Our primary objective is to examine the utility of fiber rolls as an effective, inexpensive, and easy-to-use remediation tool at oil brine spill sites. Established fiber rolls and adjacent brine affected plots will be examined to determine the:

1) Structural integrity and ability of fiber rolls to withstand periodic flooding/water flow,
2) Amount of sediment accretion behind fiber rolls,
3) Survival, extent and type of vegetative growth in fiber rolls, and
4) Type and extent of vegetation expansion from fiber rolls onto adjacent soils.

Soil reclamation as a result of treatments will also be assessed through measurements of electrical conductivity, sodium adsorption ratio, and cation exchange capacity.

Progress Summary/Accomplishments:

Primarily, two tasks were accomplished this quarter: initial assessment of plant performance, and of fiber roll integrity within plots receiving four treatments (controls, standard soil reclamation, fiber rolls only and soil reclamation with fiber rolls).

Approximately 20 weeks after plants were placed in fiber rolls, mean vegetative cover (± SE) per roll was 14.5 (± 1.3) %. The majority of the vegetation was composed of grasses that had spontaneously germinated from hay seed. Preliminary analysis indicated that soil amendments did not affect plant cover within rolls. The lack of effect probably indicates that plant roots have not significantly moved beyond the organic matter in the rolls and onto the soil. Alternatively, the quantity of nutrients and organic matter in the rolls may be sufficiently large that the soil treatments did not affect plant performance within the rolls. Plant cover between fiber rolls in plots that received tilling, chicken litter and hay was greater than plots receiving rolls only or soil amendments only ($p=0.0026$). Plot surfaces that received no treatment, surfaces in plots between rolls without soil treatments and surfaces in plots receiving soil amendments only exhibited no plant cover.

Baccharis halimifolia (Groundsel) survival over the winter months was moderate. *Baccharis halimifolia* exhibited 61.1% survival. *Myrica cerifera* (Wax myrtle) exhibited only 6.25 % survival. Survival of *Trifolium repens* (White clover) was intermediate at 29.9 %. The transplanted individuals of *Cynodon dactylon* (Bermudagrass) and *Panicum virgatum* (Switchgrass) could not easily be separated from the plants from the hay seed and sown *Lolium multiflorum* (Ryegrass) seed. Therefore, survival was not estimated for these two species. From the time of planting until the end of November (2005), precipitation was 1.5 inches below normal. In December 2005, precipitation was 4.08 inches below normal. Fiber rolls were sprayed with water, however, at the time of transplanting (November 17 and 18) and sowing *L. multiflorum* seed (December 2) using a 50 gal hydroseeder. In addition in the November time period, three nights experienced temperatures below 32º F (25º as the lowest temperature). In December, 19 nights were below 32º F with 16º the lowest temperature. These below average precipitation values and cold nights occurred during the initial establishment phase of the transplants in the fiber rolls. These conditions may have influenced strongly the low survival rates.

One additional task was achieved this quarter: seeds of *Cynodon dactylon, Panicum virgatum, Trifolium repens* were sown onto roll surfaces to encourage additional plant growth. Presumably the plants of *Lolium multiflorum* from seeds sown on 2 December 2006 will be senescing shortly as temperatures begin to warm. Thus to maintain productivity, the additional species were sown. Two of the three species are warm season species. Additionally, a *Myrica cerifera* plant (grown in 4" square pots) was added to each pair of rolls to help replace the plants that did not survive the winter months.

No breaks were detected in the fiber rolls at the time of the first assessment.

Consequently based on the preliminary assessment, fiber rolls along with soil treatments appear to be an effective remediation technique on historic brine scars by providing a functioning plant community from which re-vegetation across the site can be initiated.

Figure 1. Fiber rolls ca. 20 weeks after planting. Rolls are located in an historic brine scar in south Arkansas.

Publications/Presentations

Future Activities

Future activities will involve continuing assessment of fiber roll integrity, plant survival, cover and spread to soils adjacent to the rolls, sediment accretion on the upslope side of the rolls, and changes in soil chemistry and composition.

Supplemental Keywords: Brine restoration; Historic Brine Scar; Fiber Roll; Bioremediation