Carbon Sequestration on Surface Mine Lands

Quarterly Report

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ABSTRACT

The January-March 2004 Quarter was dedicated to tree planting activities in two locations in Kentucky. During year one of this project there was no available mine land to plant in the Hazard area so 107 acres were planted in the Martin county mine location. This year 120 acres was planted in the Hazard area to compensate for the prior year and an additional 57 acres was planted on Peabody properties in western Kentucky. An additional set of special plots were established on each of these areas that contained 4800 seedlings each for special carbon sequestration determinations. Plantings were also conducted to continue compaction and water quality studies on two newly established areas as well as confirmed measurements on the first years plantings. Total plantings on this project now amount to 357 acres containing 245,960 tree seedlings.

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INTRODUCTION

EXECUTIVE SUMMARY

During the second tree planting season 183 acres were planted with 134,440 tree seedlings. This area consisted of 57 acres of ripped material and 69 acres of highly compacted spoil near Hazard, Kentucky and 57 acres of ripped and previously reclaimed area in western Kentucky. It was also comprised of an area of specially treated plots designed to determine the effects of mycorrhizal inoculation, mulching and ripping on the carbon sequestration process.

Preparation for the establishment of monitoring systems for all the new research areas was being conducted. Hydrology and water quality monitoring continues to be conducted on all areas. Weather data also continues to be recorded that measures precipitation values, temperature, relative humidity, wind speed and direction and solar radiation. Detailed studies to address specific questions pertaining to carbon flux has been established. The small mammal colonization study that was initiated to identify and quantify mammal invasion as vegetation develops is continuing.

EXPERIMENTAL

The study is taking place in three distinct mining regions in Kentucky's eastern and western coal fields regions. Specific mining sites are located in southeastern Kentucky near the West Virginia border, in southeastern Kentucky near Hazard and in western Kentucky near Central City.

Tree species selections are intended to provide a gradient of tree growth and litter quality. Tree species include white ash, yellow poplar, white pine and other available species. Seedlings of each species were planted randomly in mixed species plots on compacted (control), dozer ripped and Kentucky RAM #124 compliant loose-graded spoil (see Appendix I).

A monitoring program has been implemented to measure treatment effects on above ground and below ground C and nitrogen (N) pools for the planting areas. Sample plots have been established on last years plantings and are planned for the new establishment areas. The plots are designed in a manner to both adequately sample such species planted and to account for differences with respect to site preparation activities and micro-topographic variability amongst planting units.

Mineland Reforestation Mycorrhizae Study

Detailed studies to address specific questions pertaining to carbon cycling have been initiated with the development of additional manipulative plots to examine the influence of mycorrhizae, spoil chemical and mineralogical properties,' and use of amendments on forest establishment and carbon sequestration. Based upon earlier studies by UK and the

USDA Forest Service, mycorrhizal fungi have been shown to play a major role in the survival, nutrient uptake and biomass development (above and below ground) of seedlings planted on mined sites and abandoned industrial areas. Given that the current Reforestation study intends to examine the potential for enhanced carbon sequestration on mined sites via C accumulation in soil and forest biomass, then efforts to maximize seedling survival and growth are being further examined. As such, a factorial experiment using inoculated vs. non-inoculated species in non-fertilized, fertilized only, amended (organic mulch) only, and fertilized + amended plots was established in 2004.

Seedlings used for this study were grown at the Kentucky Division of Forestry Nursery, Morgan County nursery. The mycorrhizal trees were initially inoculated with *Pisolithus tinctorius* (Pt) and *Scleroderma cepa* (Sc) in the beds. The mycorrhizal plots will receive additional spore application in the field after they are transplanted. In the nonmycorrhizal plots, the fungicide Bayleton and/or Ridomil will be applied to suppress natural mycorrhizal infection. The research plots were established on mined sites in Knott and Muhlenberg Counties, KY (Figure 1). Fifty-four 15 x 15 meter plots were delineated on each site (Figure 2). Prior to planting, each site was ripped to a depth of approximately 2-meters using a dozer. Half of the area received an application of 40 tonnes per acre of a wood chip/manure compost mixture (Figures 3 and 4). The composted areas were subsequently ripped again to incorporate the material into the spoil. Two tree species; *Pinus taeda* (Loblolly Pine) and *Quercus rubra* (Northern Red Oak), were planted in the plots. Each plot received 100 seedlings spaced at *1.5* meter centers. Each treatment will be examined in triplicate for each species. At 100 trees per plot x 3 plots per treatment x 8 treatments x 2 species, 4,800 seedlings were planted per site. Additional plots with no trees planted were established as controls and to evaluate potential for carbon sequestration on sites planted with grass species. Half of the seedlings from each plot will be tagged and repeatedly measured for growth and survival statistics. Whole tree harvesting and tissue samples will be collected from the remaining seedlings. Soil samples were collected from the sites and will be analyzed to determine application rates for plots receiving additional fertilizer.

Figure 1. Compost amended site, Knott Co. KY

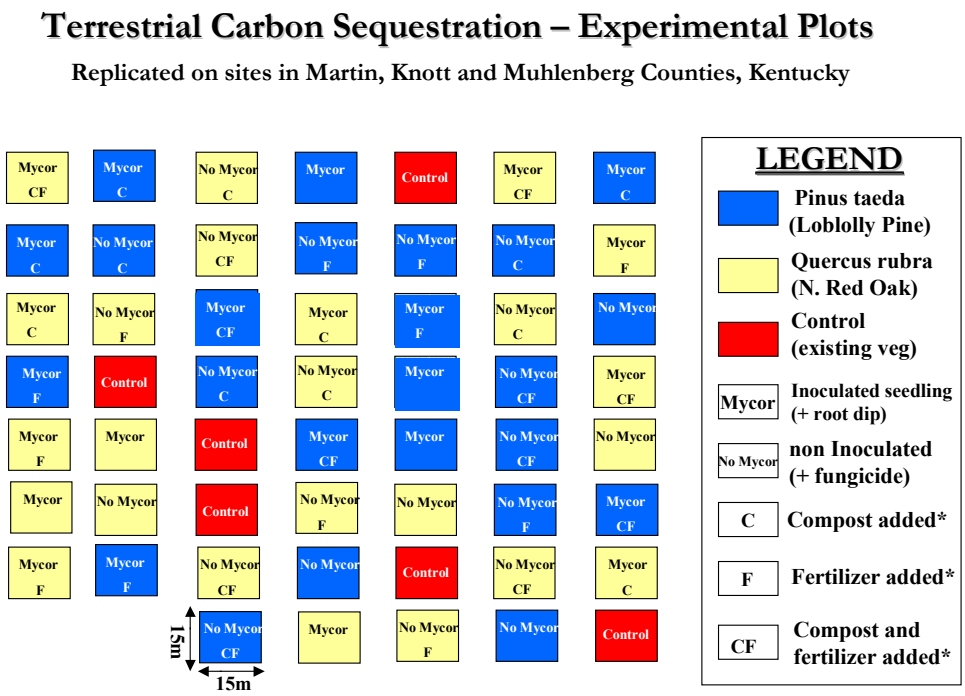

Figure 2. Conceptual plot layout for mycorrhizal study.

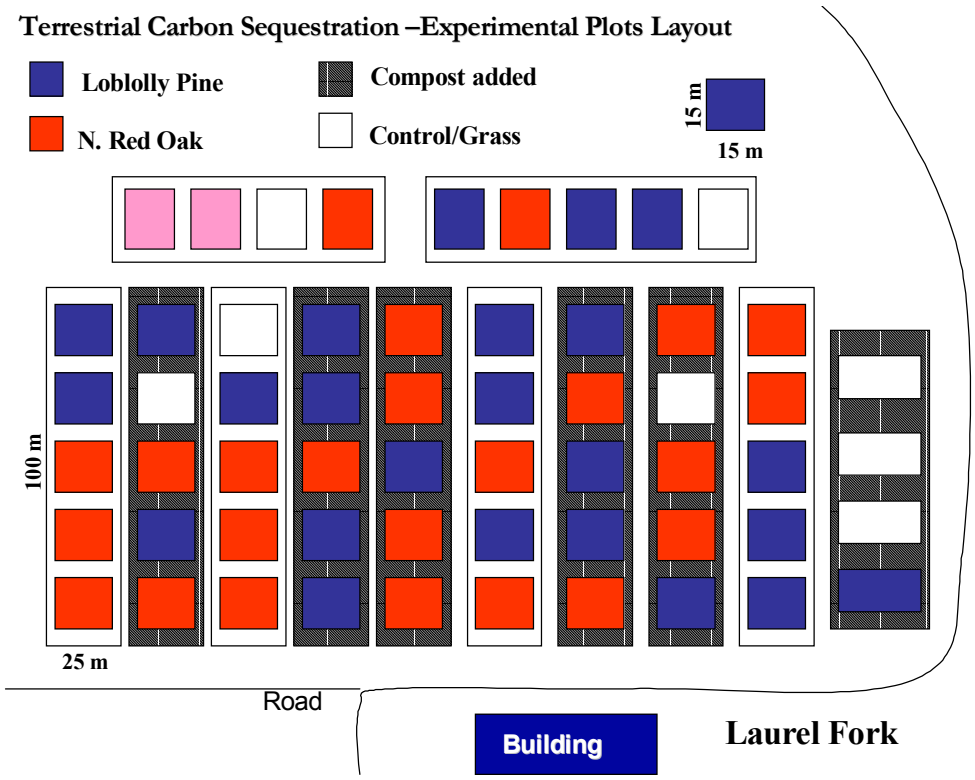

Figure 3. Actual plot layout on site in Knott Co. KY.

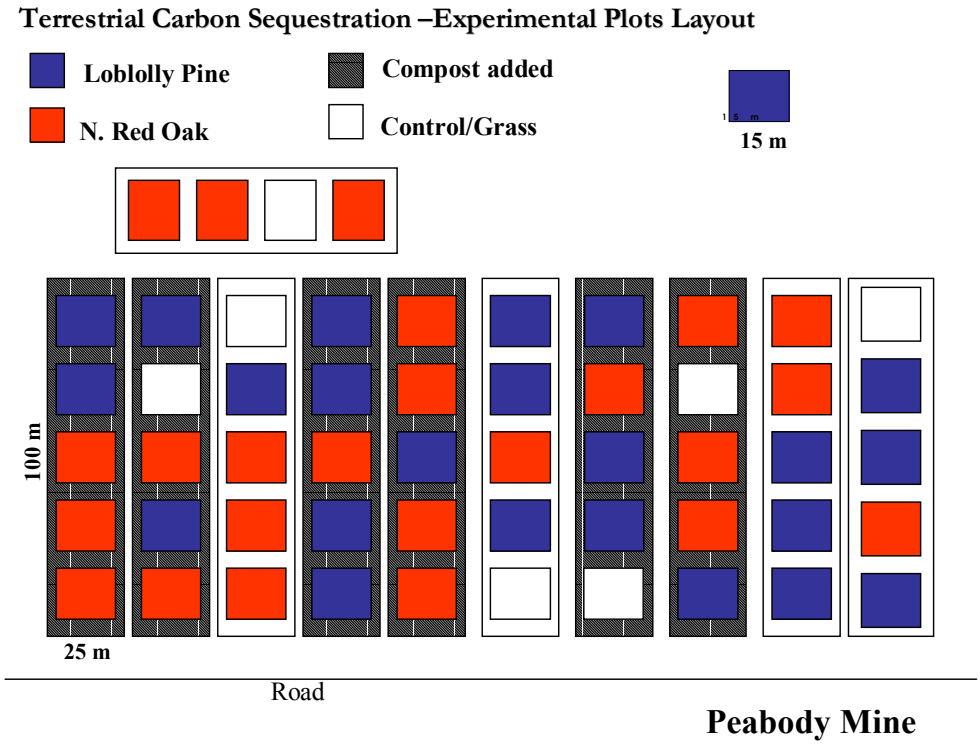

Figure 4. Actual plot layout on a site in Muhlenberg County, Kentucky

SITE SAMPLING, EXPANSION AND MAINTENANCE

All previously installed sites were revisited and examined. Testing of all monitoring equipment was conducted and repaired if necessary. New equipment was purchased for all the new planting areas. An additional seven monitoring sites will be installed during the 2004 monitoring season. The preliminary data analyses for the western Kentucky site have been completed and new personnel have been trained to begin the new season.

RESULTS AND DISCUSSIONS

The present status of data analysis has been discussed in previous reports. Remeasurement of previously established tree seedlings and the initial measurement of the new plantings will yield new results and items for discussion as the year progresses. There will be new water quality and quantity data as well as spoil density measurements that will correlate to the growth responses that will be measured. As the vegetation continues to grow and develop there will be additional data relative to small mammal use of the areas.

CONCLUSIONS

There are no conclusions at this time. The project is scheduled to continue for two more growing seasons before terminating.

APPENDIX I

Appendix I-1. Dozer ripper used on previously reclaimed sites.

Appendix I-2. Loose dumped site in Eastern Kentucky planted February 2004.

Appendix I-3. Ripped site in Eastern Kentucky planted February 2004.

Appendix I-4. Compacted site in Eastern Kentucky planted February 2004.