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HARDWOOD REFORESTATION ON POST-MINED LAND UNDER VARYING SOIL REPLACEMENT STRATEGIES IN THE EASTERN INTERIOR REGION

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Project Description and Objectives:

The overall goal of this research project was to evaluate whether selected hardwood species would survive and become established on a reclaimed mine site using a modified soil replacement method. The specific objectives were to evaluate the effects of the traditional standard graded (GR) soil replacement and the newly proposed 'loosely dumped' (LD) soil replacement techniques on seedling survival and growth. Four representative hardwood species were used consisting of northern red oak, white oak, Shumard oak, and American chestnut.
This study was designed to determine the effects that the GR and LD soil replacement treatments have on the soil physiochemical and biological properties. Lastly, this study aimed to assess the relationship of soil physiochemical properties to the growth and root architecture of the four species.

Applicability to Mining and Reclamation:

This study provided contributions to surface mine reclamation efforts. The LD treatment was found to be a favorable alternative for reforestation in comparison to the GR treatment in terms of its ability to facilitate/support seedling growth and survival. However, it is recommended that this treatment be used on appropriate landscapes where natural drainage would be implemented.
Future studies examining the LD treatment will be able to apply recommendations from this study and increase the potential use of this method. The results from this study have application to improve post-mined land with productive, healthy hardwood forests.

ABOVE PHOTOS: Conventional Graded Soil Replacement (Top). Loosely Dumped Soil Replacement (Bottom).

Methodology:

The study site consisted of reclaimed land on Peabody Energy's Somerville Mine located between Evansville and Oakland City, Indiana. Soil replacement occurred in one of two ways: (1) the standard graded (GR) approach in which soil was 2.5 m deep, or (2) the loosely dumped (LD) approach.

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Methodology (continued):

In the LD technique, haul trucks unloaded B and C horizon soil in overlapping piles ranging from 1.5 to 4 m deep. Piles overlapped by 30-50%. The basic experimental design was a split plot, with four blocked replicates and two soil replacement treatment plots in each block. Within each plot, four tree species were planted, with approximately 100 plants per species completely randomized in each plot. Species selected included nursery grown (1+0) northern red oak (Quercus rubra), white oak (Quercus bicolor) and Shumard oak (Quercus shumardii) seedlings; as well as the blight resistant hybrid American chestnut (Castanea dentata) seedlings. Soil cores were collected during each year of the study to examine the relationship of soil physiochemical and biological properties to plant survival and growth. Quantitative assessment of seedling growth was accomplished by measurement of above-ground (root collar diameter, height, leaf dry weight) and below-ground (root biomass, volume, projected area) parameters. In addition, changes in root architecture were evaluated as a means of studying the impact of the two soil replacement methods.

Highlights:

Short term (2 years) effects of the two soil replacement strategies were shown to influence seedling survival and growth. At the end of the second growing season, seedling survival was significantly higher in the LD (53%) compared to the GR treatment (42%). Overall, the LD treatment was a favorable alternative for reforestation in comparison to the GR treatment. Positive root responses including lateral and tap root dry weights, root volume and projected root area were observed in seedlings grown on the LD treatment. This was attributed to the lower bulk density of the LD soil as it was able to provide a more open soil structure favorable for root growth. The conventional GR treatment, on the other hand, faced a number of negative factors including soil compaction, limited water availability, and lower total porosity. There were several factors (both anthropogenic and natural) that both treatments faced and many of which could have been avoided. The most important confounding factors being (i) the tap roots were severed prior to planting, (ii) the seedlings were poorly planted, (iii) competing vegetation, and (iv) development of ponds on the LD treatment. In addition, the soil fertility status was low and sub-optimal for seedling growth for both the LD and GR treatments.

Above Photos: Ponding on Loosely Dumped Soil (Top). Placement of Loosely Dumped Soil (Bottom).

Website Information:

The final project report can be found at: **http://www.techtransfer.osmre.gov/NTTMainSite/appliedscience.shtm**

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