

HARDWOOD TREE GROWTH AFTER EIGHT YEARS ON BROWN AND GRAY MINE SOILS IN WEST VIRGINIA

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Abstract: Surface coal mining in Appalachia disturbs hundreds of hectares of land every year and causes disruption of valuable and ecologically diverse eastern deciduous forests. After the passage of the Surface Mining Control and Reclamation Act (SMCRA) in 1977, coal mine operators began planting a variety of grasses and legumes as a fast and economical way to re-establish a permanent vegetative cover in order to meet erosion and site stabilization requirements. However, reclamation practices such as substitute topsoil materials and excessive soil compaction have slowed the re-colonization of native hardwood tree species on these reclaimed sites. In an effort to evaluate tree growth on selected spoils and determine the effects of compaction, three 2.8-ha experimental plots were established at Catenary Coal's Samples Mine in Kanawha County, West Virginia. Two plots were constructed of weathered brown sandstone and the third plot was constructed of un-weathered gray sandstone. Half of each plot was compacted while the other half of the plot was left non-compacted. Each plot was hydroseeded with a low competition herbaceous cover and planted with eleven hardwood tree species. Soil chemical properties and tree growth have been measured each year since 2005. After eight growing seasons, average tree volume index was nearly ten times greater for trees grown in the brown sandstone treatments, 3853 cm³, compared to 407 cm³ in the gray sandstone treatment. Trees growing on compacted treatments had a lower mean volume index, 2281 cm³, than trees growing on non-compacted treatments, 3899 cm³. Average pH of brown sandstone was 5.2 to 5.7 while gray sandstone was 7.9. The gray sandstone has continued to resist breakdown. As a comparison to tree performance on the un-weathered gray sandstone treatment, which appeared to have exceptionally poor tree growth, two other areas on the mine site that were similarly reclaimed in 2005 with un-weathered gray sandstone were measured for chemical properties and mean tree volume index in 2012. One site was compacted while the other site was compacted and then ripped. Average pH was 7.4 on the compacted site and 7.3 on the ripped site while mean tree volume was almost identical at 909 cm³ and 885 cm³, respectively. Although slightly higher, no significant differences in mean pH and mean tree volume index were found between the original gray sandstone treatment and the two reclaimed gray sandstone areas. After eight years, brown sandstone has shown significantly greater tree growth and is a more suitable topsoil substitute than the gray sandstone plots on this site.

An additional study was established to evaluate the effect of topsoiling materials (brown and gray) and bark soil amendments on tree growth. A 2.8-ha experimental plot was established, with half of the plot being constructed of weathered brown sandstone and half constructed of unweathered gray sandstone. Bark mulch was applied to an area covering both sandstone types, and the ends of the plot were hydroseeded with a tree-compatible herbaceous seed mix, resulting in eight soil treatments. Twelve hardwood tree species were planted, and soil chemical properties and tree growth were measured annually from 2007 to 2012. After six growing seasons, average tree volume index was higher for trees grown on brown sandstone (5333 cm³) compared with gray sandstone (3031 cm³). Trees planted in mulch outperformed trees on nonmulched treatments (volume index of 6187 cm³ vs. 4194 cm³). Hydroseeding with a tree-compatible mix produced greater ground cover (35 vs. 15%) and resulted in greater tree volume index than nonhydroseed areas (5809 vs. 3403 cm³). Soil chemical properties were improved by mulch and

improved tree growth, especially on gray sandstone. The average pH of brown sandstone was 5.0 to 5.4, and gray sandstone averaged pH 6.9 to 7.7. The mulch treatment on gray sandstone resulted in tree growth similar to brown sandstone alone and with mulch. After 6 yr, tree growth on brown sandstone was about double the tree growth on gray sandstone, and mulch was a successful amendment to improve tree growth.