LONG-TERM EFFECTS OF ROCK TYPE, WEATHERING, AND AMENDMENTS ON SOUTHWEST VIRGINIA MINE SOILS[1]

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Abstract. In Southwest Virginia and central Appalachia, native soils are often rocky, shallow, infertile and acidic which limits their use in coal mine reclamation and frequently leads to the utilization of topsoil substitutes derived from blasted rock spoils. Through careful selection and placement, and via addition of certain amendments, topsoil substitutes have generally been accepted as viable soil media for a range of post-mining land uses. The long term objective of this study is to measure the effects of various initial spoil rock types and surface amendments on mine soil properties and vegetation establishment patterns over 25+ years. The Controlled Overburden Placement Experiment (COPE) consists of a rock mix experiment comparing five different combinations of sandstone (SS) and siltstone (SiS) and a surface amendment experiment seeded over a constant 2:1 SS to SiS spoil ratio comparing a fertilized control, 112 Mg ha^{-1} sawdust, 30 cm of native topsoil, and biosolids at 22, 56, 112 or 224 Mg ha^{-1}. Since its construction and establishment in 1982, continued analysis of the COPE has produced a wide range of important findings on mine soil pedogenic processes, native and invasive vegetation response, and overall mine soil chemical and morphological properties. The plots within both experiments have been split between forest and herbaceous vegetation since 1983. The two experiments (rock mix and surface amendment) were sampled again in 2008 and 2009 and chemical and physical analyses have been completed.

Additional Key Words: mine spoil, revegetation, topsoil substitute, pedogenesis.

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[1] Paper was presented at the 2010 National Meeting of the American Society of Mining and Reclamation, Pittsburgh, PA ***Bridging Reclamation, Science and the Community*** June 5 - 11, 2010. R.I. Barnhisel (Ed.) Published by ASMR, 3134 Montavesta Rd., Lexington, KY 40502.

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On the rock mix experiment in 2008, the 2:1 SS:SiS plots yielded the highest standing biomass with 3.7 Mg/ha^{-1} followed closely by the pure SiS plots with 3.6 Mg/ha^{-1}. Litter layer accumulation was highest on the 2:1 SS:SiS plots with 7.3 Mg/ha^{-1} and the lowest on the pure SS plots with an average yield of 3.5 Mg/ha. When compared to the last biomass sampling taken in 1989, all plots in the rock mix experiment increased in average yield. The largest margin of increase was the 2:1 SS:SiS mix with an increase of 2.2 Mg/ha^{-1} between 1989 and 2008. The surface amendment experiment had a range of standing biomass from 4.1 Mg/ha^{-1} on the sawdust amended plots to 2.5 Mg/ha^{-1} in the control plots. Litter layers collected in 2008 was highest on the sawdust treatment at 5.8 Mg/ha^{-1} and the lowest on the 112 Mg/ha biosolids at 4.8 Mg/ha^{-1}. The biosolids amended plots (56, 112, and 224 Mg/ha) showed a decrease in biomass production from the 1989 results while the sawdust treatment exhibited the largest increase from 2.8 to 4.1 Mg/ha^{-1} between 1989 and 2008.

On the rock mix experiment, pH varied little in surface soil (0-5cm) but increased with depth (5-25cm) in all treatments. On the surface amended plots, the (0-5cm) and (5-25cm) plots exhibited little variability in pH. As expected saturated paste electrical conductivity (EC) decreased with depth across both experiments in all treatments due to long term weathering and leaching. Pure SS and 2:1 SS:SiS mine soils were sandy loam (SL) textures at both sampling depths.

In the 1:1 SS:SiS and 1:2 SS:SiS mixes a surface (0-5 cm) texture was loam (L) but was SL at depth (5-25cm). The siltstone plots were silty loam (SIL) textures at both depths. The surface amended treatments were a consistent L/SL in the 0-5cm depth and strictly SL in the 5-25cm depths on all plots.

Further analyses of mine soil C, nutrient and Fe-oxide content are still underway. Our combined results reveal that even after 25 years, significant effects of initial spoil rock mix type and surface amendments are still evident and exerting an influence on mine quality, plant biomass productivity and litter layer accumulation.