RECOVERY OF SOIL NUTRIENT DISTRIBUTION AND MICROBIAL COMMUNITY IN A POST-LIGNITE MINING REHABILITATION CHRONOSEQUENCE IN EAST TEXAS[1]

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Abstract: A problem in reclaiming surface mines to native conditions is the poor soil quality that impedes revegetation in post-mined soils. Our objectives were to measure and compare the chemical characteristics and the distribution of nutrients in the soil profile to 1 m, and soil microbial community over a chronosequence of 40 years to determine when a reclaimed soil returned to premined conditions at Big Brown lignite mine in East Texas. In addition, we compared mine soils subjected to two different reclamation practices (crosspit spreader – CP, and mixed overburden - MO) at 20 years of age. Microbial diversity was determined using rRNA gene tag-pyrosequencing, and functionality was determined using a Biolog Ecoplate™. Soil quality indicators, including soil organic carbon, were able to reach and exceed premined concentrations shortly after reclamation began, although the distribution through the soil profile required at least 5 years before stratification was observed. Soil N maintained premined levels and profile distribution after 5 years of reclamation, while P was able to stratify after 5 years but not reach premined conditions. Other nutrients (K and Ca) were able to exceed premined conditions and develop native profile distribution after 10-15 years, while Mg, S, and Fe displayed an increase in depth. When comparing the two reclamation practices at 20 years of age, the CP treatment showed better stratification between 0-15 cm and deeper soil, but lower concentrations of nutrients compared to the MO treatment. A majority (70%) of the bacterial community was composed of Acidobacteria, Actinobacteria, and Proteobacteria. The Biolog Ecoplate™ showed that functionality in reclaimed soils exceeded native conditions. These phyla correlated well with soil organic carbon, soil N, pH, and P. The stratification of soil nutrients in post-mined soils indicate a return of biological activity, which is strongly influenced by the processes used to regrade the disturbed landscape and the timing of revegetation. We conclude that the more recent implementation of CP served as a better method to return mined soils to premined conditions, but more research should be conducted to determine how aggregates and biological activity from the soil microbial community are influencing the accumulation of soil organic carbon over surface mine reclamation age. A better understanding of the recovery of soil microbial communities during the reclamation process is important to the improvement of post-mine land reclamation practices and understanding microbial community succession.

Additional Key Words: surface mining, soil quality, organic carbon

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