Reexamining the Use of Coal Fly Ash in Agriculture: Utilization as Soil Amendment in Biofuel Feedstock Production

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ABSTRACT

Increasing fiscal, human and environmental costs of coal fly ash (FA) management and disposal are leading to advocacy for greater beneficial uses of the byproducts as soil amendments in agriculture. Greenhouse experiments were conducted in a silt loam soil that was amended with combinations of FA (10% w/w) and poultry litter (PL=75 mg N/kg) to determine biomass productivity by eastern gamagrass (GG), a warm season perennial grass (WSPG) that could serve as complementary biofuel feedstock to bioenergy model, switchgrass (SG). FA was obtained from a site at the 2008 Ash Spill in in Kingston Tennessee. GG and SG were grown individually in 15cm W x 41cm H treepots, each containing 6kg soil (ods) and treatment combination consisted of FA amendment with or without PL addition. Each treatment was replicated eight (8) times, the treepots were randomly arranged on greenhouse benches and they were watered as needed. Biomass production was assessed in soil adjusted to initial pH=4.5 or 6.5. After 12 weeks in acid soil, total biomass productivity of GG was in the order 10FA/PL> 0F/PL=10FA/0PL>0FA/0PL. At pH=6.5, there were no differences in total biomass productivity among the treatments. Similarly, there was no difference in biomass productivity of SG regardless of pH. X-ray imaging and analysis of selected washed roots grown at pH 4.5 confirmed significant enhancements of root system architecture (RSA), i.e., root length, area and numbers in the 10FA/PL treatments over all others. Our results can contribute greatly towards goals for beneficial utilization of wastes (FA and PL) to produce biofuel feedstock in acid impacted soil while addressing accumulations of such wastes. Understanding RSA could lead to development of strategies for enhanced biofuel feedstock production under conditions of soil acidity and potentially other abiotic stressors.

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