MICROBIAL HYDROLYSIS OF UREA AND ITS SUBSEQUENT NITRIFICATION IN EAST TEXAS LIGNITE MINE SPOIL

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A functional nitrogen (N) cycle within mine spoils is necessary for successful long-term revegetation. To initiate successful revegetation of mind lands, large inputs of N fertilizers are required. Urea is gaining worldwide popularity as an N source due to its high N content (47.0%) and economical price. Since little is known about the behavior of urea in the mixed overburden mine spoils of east Texas, a two-year study was conducted to determine rates of urea hydrolysis, and its subsequent nitrification and effects on microbial activity, at reclaimed sites of varied ages.

Newly-leveled, 1-, 4-, and 8-year old spoil and an unmined soil at the Big Brown Mine in Fairfield, Texas, were fertilized with 244 kg N ha^{-1} of $(NH_4)_2SO_4$ or urea. After fertilization, soils were periodically analyzed for microbial activity (arginine ammonification, AA; substrate induced respiration, SIR), ability to hydrolyze urea (UH), numbers of nitrifying bacteria, and nitrification potentials (NPs).

Only soils from the unmined and newly-leveled sites failed to show increased AA rates. Vegetated mine spoils showed AA rates ranging from 1.2 to 2.3 mg NH_4 + - N kg^{-1} soil; h^{-1} within seven days. Rates of AA were similar in soils fertilized with $(NH_4)_2SO_4$ or urea. Rates of SIR showed a similar pattern, being maximal in the 8-yr. spoil and rates were similar in soils fertilized with $(NH_4)_2SO_4$ or urea. Rates of AA and SIR were highly correlated ® = 0.59 to 0.93).

Revegetated mine spoils (4 to 8 yrs.) showed UH rates as high, or higher than those of the unmined soils. Rates of UH were greatest at the 8-yr. site (ranging from 3.0 to 3.5 mg urea-N hydrolyzed kg^{-1} soil h^{-1}) and lowest at the newly-levelled site (maximum rate of 0.5 mg urea-N kg^{-1} soil h^{-1}). Rates of UH were similar in soils fertilized with $(NH_4)_2SO_4$ or urea.

Nitrification potentials in vegetated spoil (1 to 8 yrs.) were similar to, or greater than those of the unmined soil (ranging from 2.4 to 5.2 mg NO_3^--N kg^{-1} soil d^{-1}. Peak NPs were observed two weeks after fertilization and the $(NH_4)_2SO_4$ and urea treatments showed similar rates.

Nitrifying bacteria regained pre-mining levels within one year in revegetated sites showed numbers similar to, or greater than, numbers in the unmined soil. Numbers of NH_4 + - and NO_2^--oxidizing bacteria were similar in soils fertilized with either N source. Bacterial numbers increased one order of magnitude after the newly-leveled site was sprigged,

suggesting an inoculation effect. Numbers of nitrifying bacteria and nitrification potentials were highly correlated ® = 0.75 to 0.94).

This study demonstrated the rapid recovery, to pre-mining levels, of selected soil microbial activities and populations of nitrifying bacteria in mixed overburden. Ammonium sulfate and urea produced very similar responses for the parameters measured. Urea appears to be as suitable an N source as $(NH_4)_2SO_4$ in the revegetation process.

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