Effects of long-term tillage systems and manure application on soil fertility and microbial status of Southeastern, USA soils.

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Abstract

Concerns for environmental quality have prompted interest in recent years to develop agricultural practices that mitigate nutrient loss to the environment. It is imperative that management practices are developed that maximizes the use of plant nutrients while minimizing environmental degradation. Thus, the main aim of this dissertation was to evaluate the impact that soil under different environmental conditions, soil types, and management practices have on nutrient cycling. This dissertation consists of four parts: (1) Residual effects of long-term tillage and manure application on carbon and nitrogen mineralization (2) Mineralization of N in soils amended with dairy manure as affected by wetting/drying cycles (3) A seasonal nitrogen mineralization study as influenced by soil properties and landscape position (4) Soil microbial community dynamics as influenced by soil properties and landscape position. In the first study, C and N cycling was evaluated in the laboratory experiment using soil collected for long-term tillage and manure (poultry litter) plots. No-tillage (NT) with litter contained the highest total organic carbon (TOC) in the 0-5 cm depths, which corresponded to significantly higher C and N mineralization occurring compared to the other treatments. Carbon and nitrogen mineralization was higher in the 0-5 cm for NT, while the conventional tillage CT was higher in the 10-20 cm depths. In the second study, N mineralization was influenced by manure addition, this was most evident at higher soil temperatures. The rate of N mineralization was mainly attribute to soil series, Catlin (silt loam)> Goldsboro(loam)> Bama (sandy loam). No significant differences were observed between constant and cycling moisture regimens. In the third study, dairy compost manure greatly influenced N mineralization by season with the summer months mineralizing the most N. Landscape and soil texture also played an important role in mineralization. During the winter months the soil type with the greatest percent sand located in a low lying area lost most of the added N from manure while the loam soil with the greatest water holding capacity mineralized the most N during the summer. In the fourth study, dairy compost manure caused a shift in microbial dynamics, which was most evident during the summer compared to winter months. Landscape and soil type was also shown to affect microbial properties. A loam soil located in a depressed area was shown to have the highest microbial biomass and microbial activity. Canonical discriminate analysis was performed using phospholipid ester-linked fatty acid (PLFA) profiles utilized to confirm changes in microbial properties. This analysis indicated that a shift in lipid composition occurred between season, manure application, and soil landscape. The knowledge acquired from this has improved our understanding nutrient cycling and could aid in the development better management practices that increases the N use efficiency.