EFFECT OF SOIL TYPE ON COTTON RESIDUE MINERALIZATION UNDER CONTROLLED INCUBATION

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Abstract

A Panoche clay loam (West Side Field Station, Site 1) and a Wasco sandy loam (Kings Co., Site 2) were incubated under controlled temperatures of 10 and 25°C for 203 days to evaluate the differences in microbial biomass activity, quantity and mineralized N. Soils from each site were collected from N rate plots established in 1998. Soil N levels of 50 and 150 lbs./a N included residual N in the top 2 feet plus supplemental urea. The soil used for this study was collected after the 1998 cropping season. This was the first cotton crop following a winter cereal rotation at Site 1, whereas Site 2 had been in continuous cotton. Labled cotton residue produced from ^{15}N microplots at each site was added as substrate prior to incubation. During the 203 day incubation period seven samplings occurred. At each sample date, net N mineralized was determined and additional chloroform fumigation incubation (CFI) analysis was performed to assess microbial biomass carbon and N. CO_2 measurements were performed using infrared gas analysis (IRGA). KCl extracts were analyzed for mineralized N (NO_3 and NH_4) by the DANR Analytical Laboratory, U.C. Davis. Phospholipid fatty acids analysis (PLFA) was performed to compare the microbial community structure.

Initial PLFA analysis of major fatty acid profiles indicates the microbial communities of the two soils were distinctly different. Soil N levels, to a depth of 20 cm, did not affect microbial structure. Microbial activity, as evident from CO_2 evolution, of Site 2, the sandy loam soil, was 20 percent higher than Site 1, the clay loam soil. Total values of microbial biomass carbon from Site 2 was only 46% of the final values from Site 1. Final values of mineralized N for the sandy loam, Site 2, decline to approximately half of the initial values. Where the mineralized N values from the clay loam soil, Site 1, remained relatively constant throughout the incubation period.

The observed differences (higher respiration rates, lower total microbial biomass and lower mineralized N of the sandy loam soil) supports the association of higher turnover rates of plant residues in lighter soils. The clay loam soil results suggest a longer residence time for mineralized N and lower turnover rates of plant residues. These differences could affect the turnover and plant availability of indigenous soil N.

The soil microbial community plays a major role in the processes of nutrient cycling. The results show that the microbial communities that affect the biological activity and mineralizable soil N are different in the two soil types. An important question raised from these results is whether the microbial community structure and activity differences are the result of physical and chemical differences between the soil types or from management factors. If management factors (i.e. soil moisture, residue quality from rotations) are the cause, then can these be manipulated to enhance the in-season utilization of indigenous soil N? A better understanding of the fate of applied N and the availability of indigenous soil N will help improve the overall efficiency of cotton N management.

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