Distinct microbial processes and functions of maize stalk- and fertilizer-N in arable soil

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Crop residue returning is one of the key practices for the improvement of soil fertility and consequently the sustainability of agroecosystems. Under this management, both fertilizer and crop residue derived nitrogen (N) are important anthropogenic N sources for microbial immobilization in arable soils. However, how N applied with these different sources is dynamically involved in microbial-driven N cycling in the soil-crop system remains unclear. A field experiment with annual maize stalk mulching was conducted in an Alfisol of a temperate agro-ecosystem but only the first-year applied chemical fertilizer and maize stalk were crossly ^{15}N-labeled. Compound-specific ^{15}N enrichment in soil amino sugars was temporally measured to gain insights into microbial immobilization of fertilizer and maize stalk derived N and furthermore the involvement of extraneous N in soil N retention. The initial transformation (in the first year) of fertilizer-N into amino sugars was much more rapid than maize stalk-N, but the eventual accumulation of maize stalk-N in amino sugars was significantly larger than fertilizer-N over five experimental years. Throughout the experiment, most of the residue N was retained in soil, compared to the less proportion of fertilizer N in soil (73.8% vs. 40.9%). Simultaneously, the contribution of microbial residues to maize stalk-N retention in soil was significantly larger than those of fertilizer-N, implying the higher stability of maize stalk-N in soil matrix. Therefore, the anthropogenic N in different forms played distinct functions in N cycling in soil-crop system. Maize stalk-N was expected to play an important role in building up and sustaining long-term N reserve in the arable soil, being as an important foundation for effective crop uptake of reactive fertilizer-N.