Impact of the Tree Component on N Cycling in Agroforestry Systems under Subhumid Tropical Conditions

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Abstract

The tree component of agroforestry systems may interfere with N cycling in several ways. In alley cropping systems, first of all, the prunings added during the different activities have a certain biochemical quality and subsequent N release characteristics. Secondly, the quality of the complete organic matter pool or part of it and associated N release characteristics may be related to the quality of the added materials. Thirdly, the tree itself may recover part of the nutrients released from the added prunings. In this report, the impact of the tree component on the fate of freshly applied residue N and the relation between the demand for and supply of the residue N, or the degree of synchrony, are discussed. After application of the labeled residues, residue N incorporated in the particulate organic matter (POM) (the soil organic matter fractions larger than 0.053 mm), was shown to have the highest turnover rate. Crop uptake of applied residue N was low and especially limited to the first maize crop after residue addition. Substantial differences in hedgerow recovery of applied residue N were found between the *Leucaena* and *Dactyladenia* hedges. Though the *Leucaena* hedge recovered a significant proportion of the applied *Leucaena* residues, substantial amounts of added residue N remained in the soil profile in a bare microplot, during the first 7 weeks after residue addition. In the cropped microplot, maize removed all residue-derived mineral N from the soil profile in the *Dactyladenia* treatment and lowered the residue derived mineral N in the *Leucaena* treatment. Large discrepancies were observed between N release from the *Leucaena* surface litter and N uptake by the maize crop. However, after inclusion of the POM pool at the N supply side and hedgerow recovery and immobilization in the stable SOM at the N demand side, N supply seems to be relatively well balanced by N demand. Some possible research directions related to N cycling and synchrony in agroforestry systems and other improved cropping systems are highlighted.

Introduction

Integrated Soil Fertility Management aims at maximal utilization of available plant nutrients and consequent minimal reliance on external inputs to sustain crop yield (Dudal and Roy, 1995; Vanlauwe *et al.*, 2002). The development of such systems is essential for large regions in the tropics where soil intensification is needed and where mineral fertilizers are costly or not available at all. In alley cropping systems, food crops are grown between hedges of preferably N_2-fixing trees which are cut back regularly to minimize tree–crop competition for light, water, and nutrients. Tree canopy nutrients that are derived from sources not accessible to crop roots may contribute to crop nutrition after being added to the soil surface and, therefore, reduce the need for external inputs.