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N Dynamics of Leguminous Tree Residues as Indicator Plant under Greenhouse Conditions

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Abstract

In the Amazon, slashing and burning activities converted large areas of primary forest to intermittently used agricultural land. Thus, the fallow vegetation plays an important role to maintain or restore soil productivity. However, the intensification of land use has caused drastic reduction of the fallow period. Therefore, the soil quality has to be restored in shorter time period. The general objective of this work was to monitor the influence of leguminous tree species on soil N dynamics, simulating a situation when burning is replaced by mulching so-called *slash-and-mulch systems*.

The greenhouse experiment was divided in two parts: first, ^{15}N-urea fertilizer (3.92 mg N pot^{-1} with 5.34 atom % ^{15}N) and leguminous leaf material (*S. paniculatum*, *I. edulis* and mixture) with N natural abundance were combined to assess microbial immobilization and soil fixation. The second experiment, N-urea fertilizer (3.92 N mg pot^{-1} with N at natural abundance) and ^{15}N-labeled leguminous organic material from the same species with 0.392 atom % ^{15}N, and 0.390 atom % ^{15}N, respectively, were used to assess the amount of mineral-N that coming from organic matter decomposition and the extend of competition between microorganisms, soil + organic matter fixation, and rice absorption.

For all treatments, microbial net N-immobilization was higher than net N-mineralization after 50 days of rice plant growth. After 50 days of incubation, *S. paniculatum* and the mixture had C-to-N ratios of 16.5 and 14.7, respectively, which was significant higher than for *I. edulis* (13.0) and the control (12.5). Amounts of ^{15}N recover by rice in this experiment were significant higher ($p < 0.05$) in the treatment with the mixture of the two species in comparison with the same species separately. The same trend was found in the cumulative total N in the plant and the cumulative plant biomass.

The treatment with mixture between two species had an intermediate cumulative immobilisation of ^{15}N by soil microbes, higher cumulative rice biomass and total N, and higher recovery of ^{15}N from urea fertilizer. This indicates that interaction of two contrasting leguminous species increase the nitrogen absorption by rice, apparently by an increase of mineral N and decrease of gross microbial N immobilization.

Keywords: Amazon, ^{15}N, N microbial immobilization, N mineralization, slash-and-mulch systems

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