No. 107

Nutrient dynamics in soil solution after fire-free land preparation in Eastern Amazonia

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The objective of this study is to evaluate the effects of methods of land preparation on the dynamics of nutrients in the soil solution. The field experiment was conducted on a small holder farm in the municipality of Igarapé Açu, PA, Brazil on an Ultisol. The treatments were two methods of land preparation: slash-and-burn (SB) and slash-and-mulch (SM), which were done before the first crop of rice, followed by cowpea and cassava. The experimental plots were repeated six times and no fertilizer was applied. Samples of soil solution were collected in suction probes placed at the a depth of 40 cm for each treatment. Suction was performed at a negative pressure of -800 hPa and sampling was done every two weeks. In soil solution samples, NH_4-N and NO_3-N were determined colorimetrically, K and Ca were analyzed by means of an atomic emission spectrometer (ICP-AES). Results of the soil solution showed that NH_4-N concentration decreased rapidly after the first land preparation (beginning of cultivation of rice) in both treatments (SB and SM) and remained at a low level of 0.07 mg l^{-1} thereafter. The only significant treatment difference was observed right after land preparation where SM had the higher values of 2.6 mg l^{-1} over SB with 1.6 mg l^{-1}. On the other hand, NO_3-N concentrations were higher in SB than in SM at land preparation. Later on, they very much reflected crop growth and post harvest below-ground and above-ground decay of rotting straw and roots, as was to be expected. The major difference between SB and SM was found in the very beginning, when SB had significantly higher NO_3-N concentrations than SM. Concentration of K in soil solution was high in the initial phase of cultivation, when burning was used for land preparation (SB), reaching values of 12 mg l^{-1}, which was twice the values observed in SM. It decreased afterwards in both treatments towards the end of the rice growing cycle. In the following cowpea and cassava cycles K concentrations had a similar dynamic as NO_3-N, only not being so expressed. Ca also followed the same patterns observed for NO_3-N, showing greater values after burning (SB, 16.1 mg l^{-1}) which decreased rapidly until the end of the rice cultivation, increasing again with cowpea and cassava growth. In mulch treatment (SM), Ca concentration was low at first (rice cultivation), increasing after rice harvest during cowpea and cassava growth. All above mentioned nutrients had very low concentrations as of the second year, when there was merely cassava and later the beginning fallow. Looking only at concentrations, treatment differences can be mainly observed in the beginning, right after land preparation by SB and SM, respectively when neither decomposition processes nor water conservation by the mulch layer play a role. NO_3-N started showing different dynamics in SB and SM as of the onset of the dry season in July, which was due the counteraction of the largely decomposed organic mater of the mulch layer (contributing to high concentrations by N-mobilization) with the water conserving impact of the mulch layer (contributing to low concentrations by N-dilution) making it difficult to draw conclusions, when comparing to SB. This of course has to be verified by measuring and/or calculating nutrient amounts and has to be followed for a longer period of time in order to look at long-term decomposition effects of the mulch layer.

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