Geophysical Research Abstracts
Vol. 21, EGU2019-1437, 2019
EGU General Assembly 2019

Fine roots stimulate direct biochemical nutrient release during the early stages of litter decomposition in a tropical Amazonian forest

Nathielly Martins (1,3), Lucia Fuchslueger (2,1), Carlos Alberto Quesada (1), Katrin Fleischer (3,1), and the AmazonFACE team (1)

(1) Coordination of Environmental Dynamics (CDAM), National Institute of Amazonian Research, Manaus, Brazil (nathiellymartins9@gmail.com), (2) Department of Biology, University of Antwerp, Antwerp, Belgium (lucia.fuchslueger@gmail.com), (3) Land Surface - Atmosphere Interactions (LSAI), Technical University of Munich, Germany (katrin.fleischer@tum.de)

Low nutrient availability in large parts of the Amazon rainforest may prevent forest growth in response to elevated atmospheric carbon dioxide. Greater allocation of carbon belowground could however stimulate plant nutrient acquisition and alleviate this constraint. The ground litter layer is the main source of nutrients and fine roots are heavily exploring this layer. Therefore, we hypothesized that increased root growth in the litter layer could stimulate leaf litter decomposition and nutrient release, both by physical effect on litter fragmentation and by biochemical interactions, such as extracellular enzyme activity and labile carbon exudation. We carried out a leaf litter bag experiment (188 days) in a nutrient impoverished humid tropical rainforest in Central Amazonia to investigate: 1) the effect of roots, and 2) the effect of simulated root labile carbon inputs, on decomposition and nutrient release, and their interaction with microorganisms. We combined a root exclusion treatment and a labile carbon fertilization treatment with two different low molecular weight carbon compounds (citric acid; glucose) and analyzed the litter mass for carbon and nutrients (nitrogen, phosphorus, and cations), microbial carbon:nitrogen:phosphorus, and extracellular enzyme activity.

Contrary to our expectation, root exclusion and labile carbon inputs had no significant effect on leaf litter mass loss. Although mass loss was not affected, the presence of roots resulted in significant direct release of phosphorus and cations from the litter. On the other hand, labile carbon addition only influenced the release of potassium under citric acid inputs, which inhibited potassium release. We found no significant effect of roots and labile carbon addition on microbial carbon:nitrogen:phosphorus. Phosphatase activity was significantly reduced due to root exclusion by 24%. We show that root growth in the litter layer is an effective mechanism for direct nutrient release by plants, which occurred without affecting the litter mass loss rate. Our results further indicate that phosphatase exudation is likely a very effective plant-based mechanism for phosphorus release from litter. We suggest that labile carbon exudation is an ineffective way of acquiring nutrients since litter microbial activity was not limited by carbon. We conclude that higher allocation of carbon to root production and phosphatase exudation in the litter layer could liberate more phosphorus and cations for plant uptake under increasing atmospheric carbon dioxide.