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Influence of soil nitrogen availability on C and N cycling in a mediterranean forest soil: experimental setup and preliminary results

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The soil inorganic nitrogen (N) availability controls, directly and indirectly, processes such as the organic matter decomposition, N mineralization, carbon (C) storage and plants productivity.
In natural forest ecosystems N input results from wet and dry depositions. Little is known on the potential impact of N depositions on soil biological activity and hence on C accumulation in Mediterranean forests. Semi-arid forests are ecosystems not well studied concerning this kind of biological aspects and few studies deal with long term incubation experiments with N-amendment. In the last 20 years incubation experiments with N addition have been performed on organic soils or mineral soils of temperate forests in north Europe and north America. In this work we investigated how altering soil N availability, mimicking the condition of N deposition, may affect microbial biomass, activity, C and N cycling and soil C storage in a Mediterranean forest soil.
A four months soil incubation experiment was carried out with organo-mineral soils from a Quercus cerris forest at the Roccarespampani site (Viterbo, Central Italy). All samples were incubated at 28°C and kept moist maintaining the humidity between 55 and 65% of the water holding capacity twice a week. Different amounts of N (NH4NO3) were added in solution once a week in order to mimic the N wet deposition and to let microbial community deal with a slow increase of inorganic N content. The amount of nutrient solutions was chosen depending on the average soil-water loss due to evaporation in one week. The total amount of N-NH4NO3 was chosen to be comparable with the range of N depositions currently reported in European forests, i.e. between 1 and 75 kg N ha-1 y-1. The total amount added at the end of incubation varied from 0, 10, 25, 50 and 75 kg N ha-1. Distilled water was added in the control soil in order to provide the same amount of solution as the treated soils. In order to discriminate the effect of N, the NH4NO3 solutions were adjusted to soil pH and phosphorus was added in order to prevent any nutrient limitation effect.
Inorganic N, C-mineralization, the activity of one oxidative enzyme (o-diphenolase) and 8 hydrolitic enzymes (alfa-glucosidase, beta-glucosidase, N-acetyl-beta-D-glucosaminidase, cellulase, leucine amino-peptidase, phosphatase, butyric esterase and xylosidase) were measured and analyzed during the incubation and at the end of the experiment as a proxy of microbial decomposition activity. At the beginning and at the end of incubation total organic C, total N and the microbial biomass C and N were investigated in the different N-treatments.
Mineral N in the form of ammonium and nitrate was determined colorimetrically in soil extracts. C mineralization was measured weekly using the alkali trap method. (Poly)phenol oxidative activity was determined spectrophotometrically following a procedure performed for evaluating the o-diphenol oxidative activity directly on soil sample rather than on soil extracts. This assay includes the activity of both tyrosinase and laccase, two important enzymes involved in polymerization and depolymerization of complex substances as lignin and other lignin-like substances. Hydrolitic enzyme activities were measured using a fluorimetric approach.
The preliminary results showed how the N availability affected processes related to C and N cycling over short time incubation period and during the 4 months period.
The highest N availability (75 kg N ha-1) seemed to repress microbial respiration activity, as reported in other studies, but had a stimulatory effect on microbial enzymatic activity, whilst in the treatments providing from 10 to 25 kg N ha-1 the opposite mechanism occurred. From these preliminary evidences, we support the hypothesis of a reallocation of C to biomass or extracellular enzyme production, suggesting a possible positive trend in C accumulation.