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# Response of soil microbial community structure and lignocellulolytic activities at a pine stand, five years after thinning

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## Introduction:

Forest management practices such as thinning can have crucial effects on soil organic matter turn-over and nutrient budgets. As a result of thinning, microclimatic properties are altered, as well as quantity and quality of substrate inputs into the soil. The most significant changes with potentially high impacts on soil microorganisms are increased soil moisture caused by higher through fall, higher soil temperatures caused by increased direct sunlight, and changes in soil pH value, carbon and nitrogen supply caused by lower input of organic residues into the upper soil layer. Thus, the composition of the soil microbial community or microbial activities can be altered. As a consequence, soil organic matter decomposition and humus dynamics might be accelerated with loss of stabilized organic matter or nutrient leaching. Such effects are a matter of considerable concern in forest management and therefore need detailed study. The aim of this study was to examine if thinning would increase soil microbial activities or alter the community composition of fungi and bacteria and thus potentially stimulate soil organic matter turn-over.

## Material and Methods:

A 62 year old pine stand located in northeastern Germany (Brandenburg, Ost-Prignitz, Revier Beerenbusch) was studied with respect to a thinned vs. an unthinned variant (year of thinning: 1999, degree of canopy opening: 0.4). Samples of the organic (O) and the mineral layer (A) of an acid brown earth were collected along a transect (total

distance 50 m, lag distance 5 m) at each variant in November 2003 and in April and November 2004. Substrate induced respiration and basal respiration were assayed as described in Maassen & Wirth (2004). A suite of soil enzymes involved in the degradation of lignocellulose (endo-cellulase, exo-cellulase, $\beta$-glucosidase, endo-xylanase, exo-xylanase, phenoloxidase, peroxidase) was determined photometrically. Microbial community structure and biomass of bacteria, actinomycetes and fungi, were assayed by PLFA analysis.

**Results and Discussion:**

Five years after thinning, total microbial biomass as derived from substrate-induced respiration as well as biomasses of bacteria, fungi and actinomycetes as derived from PLFA analysis showed no significant differences between the variants, while the biomass of the organic layer was significantly higher than the biomass of the mineral layer. Correspondingly, soil basal CO2 respiration as a measure of general microbial activity displayed no significant differences between the thinned and unthinned variant, but significant differences between the organic and mineral horizon. Moreover, the enzyme activities showed no significant differences between variants but significantly higher activities in the organic layer as compared to the mineral layer. From these data, no evidence is given yet for the hypothesis, that thinning would rapidly stimulate microbial activities and thus lignucellulose decomposition. Concerning community composition, PCA with the PLFA data provided significant differences between the thinned and unthinned variants (April 2004).

**Conclusion:**

The results of this study lead to the conclusion, that five years after thinning no significant differences in microbial activities could be found at the study site comparing thinned and unthinned variants, but first evidence of a change in the microbial community was provided. These results are to be confirmed for any particular site, in order to provide an early warning to forest management concerning increased humus dynamics or nutrient leaching. Thus, a continued monitoring of soil microbial biomass, activities and community structure is required. Additional analyzes are considered in order to assess organic matter turn-over and cellulose degradation by quantitative means, e.g. with in situ microcosm experiments and the use of tracer techniques.

**References:**

Maassen, S., Wirth, S., 2004: Soil microbiological monitoring of a pine forest after partial thinning for stand regeneration with beech seedlings. - Soil Science and Plant Nutrition 50 (6): 815-819.