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# Recovery of soil structure by Alnus glutinosa and its impact on soil-atmosphere fluxes of $CH_4$ and $N_2O$

Hannes Warlo and Helmer Schack-Kirchner

Albert-Ludwigs-Universität Freiburg, Institute of Forest Science, Chair of Soil Ecology, Germany
(hannes.warlo@bodenkunde.uni-freiburg.de)

Mechanized logging leads to soil compaction and deformation on around 10-20 % of the forest area when dedicated skid trails are used in distances of 20-40 m to each other. Such soil-physical alterations can cause anaerobic conditions with the possible consequence of decreased $CH_4$ uptake and increased $N_2O$ efflux. Planting black alder *(Alnus glutinosa)* is regarded as one option to accelerate the regeneration of soil structure due to its ability to grow roots under anaerobic soil conditions. However, due to its ability to fix atmospheric nitrogen, unwanted side-effects on greenhouse gas fluxes are possible. We compared soil structure parameters as well as $CH_4$ and $N_2O$ exchange rates on a skid trail planted with 15 year old alders to a skid trail planted with 15 year old beech (*Fagus sylvatica*). On undisturbed control plots, $N_2O$ emissions were around 8 times higher under alder (8.5 g $N_2O$ $ha^{-1}d^{-1}$) than under beech (1.1 g $N_2O$ $ha^{-1}d^{-1}$), presumably associated with symbiotic N-fixation by alder. $CH_4$ uptake was less than half under alder (4.0 g $CH_4$ $ha^{-1}d^{-1}$) compared to beech (10.1 g $CH_4$ $ha^{-1}d^{-1}$). On the skid trail, $N_2O$ and $CH_4$ fluxes were not significantly different between beech (6.7 g $N_2O$ $ha^{-1}d^{-1}$ and 4.3 g $CH_4$ $ha^{-1}d^{-1}$) and alder (5.5 g $N_2O$ $ha^{-1}d^{-1}$ and 3.7 g $CH_4$ $ha^{-1}d^{-1}$), even though evidence for regeneration of soil structure was found under alder in the upper 16 cm. Here as well, N-fixation may counteract the effect of a better soil aeration in case of $N_2O$. Our results confirm superficial soil structure regeneration by *Alnus glutinosa*. Furthermore, the results indicate that alder controls the greenhouse gas exchange of forest soils by soil structure formation and by controlling nitrogen concentrations in the soil solution.