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Response of soil microbial community to afforestation with pure and mixed species

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Abstract

© 2016, Springer International Publishing Switzerland.Objectives: Afforestation changes soil chemical properties over several decades. In contrast, microbial community structure can be shifted within the first decade and so, the direct effects of tree species can be revealed. The aim of this study was to determine the alteration of soil microbial community composition 10 years after afforestation by trees with contrasting functional traits. Methods: The study was conducted at the BangorDIVERSE temperate forest experiment. Soil samples were collected under single, two and three species mixtures of alder and birch, beech and oak - early and secondary successional species, respectively, and contiguous agricultural field. Soil was analysed for total carbon (C) and nitrogen (N) contents, and microbial community structure (phospholipid fatty acids (PLFAs) analysis). Results and conclusions: The total PLFAs content (370–640 nmol g−1soil) in forest plots increased for 30 to 110 % compared to the agricultural soil (290 nmol g−1soil). In contrast, soil C, N and C/N ratios were altered over 10 years much less - increased only up to 20 % or even decreased (for beech forest). Afforestation increased bacterial PLFAs by 20–120 %, whereas it had stronger impact on the development of fungal communities (increased by 50–200 %). These effects were proved for all forests, but were more pronounced under the monocultures compared to mixtures. This indicates that species identity has a stronger effect than species diversity. Principal component analysis of PLFAs revealed that under mono and three species mixtures similar microbial communities were formed. In contrast, gram-positive PLFAs and actinomycete PLFAs contributed mainly to differentiation of two species mixtures from other forests. Thus, at the early afforestation stage: i) soil biological properties are altered more than chemical, and ii) tree species identity affects more than species amount on both processes.

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Keywords

Ammonium and nitrate, Forest composition, Land use change, Microbial biomarkers, Plant microbial interactions, Soil solution, Tree identity, Woodland

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