

Microbial species loss changes above-belowground interactions

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As a result of increasing awareness of ongoing climate changes, energy demands are to be fulfilled in a more sustainable way. Currently the production of energy from biomass has received a lot of attention and has been stimulated by international policy. However, growing crops especially for biofuel production will put more pressure on land use, resulting in further intensification with increasing inputs of fertilizers and pesticides. The consequences of this intensification for biodiversity and subsequent ecosystem services are not known, but most likely it will cause biodiversity loss. We will present results of a study analyzing how loss of soil biodiversity may change plant performance and interactions with aboveground plague organisms.

Opposite to how many biodiversity studies have been designed, species loss is not a random process. Species loss will depend on, for example, abundance and sensitivity to disturbances. We used a soil dilution technique where (serial dilutions of) microbial suspensions were inoculated into sterilized soils in order to create soils that differ in biodiversity. In this way, the High diversity treatment contains most low-abundant species, in addition to abundant species. The Low diversity treatment contains abundant species only, since low-abundant species disappeared after dilution.

Plant biomass was reduced in High diversity soil. Nitrogen levels and glucosinolate concentrations in the shoots were lowest in plants growing in High diversity soil. The effect of nematodes and aphids on plant quality depended on the microbial community composition. Nematodes did less damage to plants in the Low diversity soil compared to plants in the High diversity soil. Aphids reduced levels of amino acids in the plants in High diversity soil, but increased levels in plants in Low diversity soil. For glucosinolates the results were opposite: aphids induced glucosinolates in plants in High diversity soil, but reduced levels in Low diversity plants. Nematodes always had a negative effect on body size of aphids, but the effect was strongest in the Low diversity soil.

Other studies that used dilution-to-extinction approaches to get insight in the relation between microbial biodiversity and function pointed at high redundancy for specific ecosystem processes, such a mineralization and nitrification. In our experiment, we did not measure a single process but rather the sum of many processes, which showed us that the soil microbial community reduced plant biomass and complicated multitrophic interactions.