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Plant traits regulating N capture define microbial competition in the rhizosphere

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Global warming and nitrogen (N) deposition promote the invasion of neophytes (i.e. plant species non-native to a geographical region) and the displacement of native plant species that have similar ecological niches but lower competitive abilities under new conditions. These plant community changes alter the structure and functioning of the below-ground microbial community, especially in the rhizosphere – one of the most important 'hot spots' in soil. It remains unclear how plants with different competitive abilities alter microbial growth and turnover in the rhizosphere under high and low N input. We hypothesized 1) slower microbial growth in the rhizosphere of plants with smaller roots and 2) restriction of microbial growth under low versus high N amendment. These hypotheses were tested on two strawberry species: Fragaria vesca (native species) and Duchesnea indica (an invasive plant in central Europe) grown under intra-specific and inter-specific competition at very low and high N levels.

Species-specific traits of plant–microbial interactions mitigated N deficiency in the rhizosphere. At low N addition the native species F. vesca stimulated faster microbial growth and turnover than D. indica. F. vesca did this by increasing root mass and exudation at the expense of the shoots. In contrast, the invasive plant – D. indica – did not increase root mass under low N amendment, but did increase its N uptake rate. This resulted in N deficiency, retarding microbial growth and turnover in the rhizosphere, as revealed by the dominance of slow-growing microorganisms.

A low N level in the soil promoted root growth and rhizodeposition and thus accelerated microbial turnover correspondingly to increasing root mass. Fast N uptake by roots, however, may lead to N deficiency and did retard microbial growth in the rhizosphere. In conclusion, the plant species with the stronger competitive ability at low N level controls the microbial community in the rhizosphere.