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Nitrification Inhibitors Have Minimal Impact on Microbial and Collembola Communities in Danish Arable Soil

This study aimed to investigate the targeted and non-target impacts of nitrification inhibitors (NIs) on the soil microbial and collembola communities in arable soils under a spring barley cultivation system. By assessing soils where inhibitors were repeatedly applied alongside fertilizers, we evaluated the short-term effects of NI use on soil biodiversity and function composition using a combination of microscopic identification, quantitative PCR (qPCR) and amplicon sequencing. Our results revealed that neither ammonia-oxidizing microorganisms nor non-target bacterial and fungal communities, as well as collembola, were not significantly affected by short-term NI application, even at tenfold dosages than recommended. However, the choice of fertilizer—organic or chemical—had significant effects on microbial and collembola communities. The neutral community model (NCM) analysis indicated that bacterial communities under chemical fertilizer treatments and fungal communities under organic treatments were primarily governed by stochastic processes, highlighting the resilience and functional redundancy of these communities. Despite the limited direct impact of NIs, high concentrations of organic matter correlated significantly with microbial community structures under high NI conditions, underscoring the buffering role of organic matter. These findings suggest that while fertilizer type plays a crucial role in shaping soil ecology, NIs have minimal impact on both targeted and non-targeted groups in the short term. Future research should focus on the role of complete ammonia oxidizers (comammox) to gain a more comprehensive understanding of nitrogen cycling dynamics in these systems.

Key words: Nitrificaiton Inhibitor, metabarcoding, soil microbiology, qPCR, environmental DNA

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