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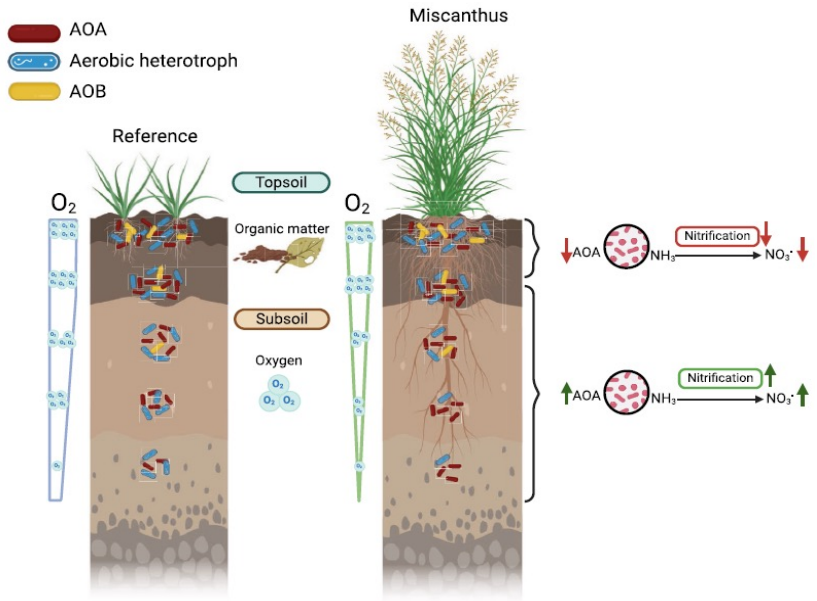
Distinct Mechanisms Drive Plant-Nitrifier Interactions in Topsoil and Subsoil

Background/Objective

- Plants can influence soil microbial communities with consequences for ecosystem function. However, it remains poorly understood how plants alter soil conditions to influence nitrifiers and nitrification rates, particularly in the subsoil.
- This work investigates how miscanthus, a deep-rooted perennial grass, shapes nitrifier community assembly and function along 1 meter soil profiles, as compared to adjacent turfgrass.

Approach

Soil samples were collected to 1m depth under miscanthus and in the adjacent plot alleyways. In situ O_2 measurements were collected along the same depth profiles. Soil microbial community composition was characterized via high throughput sequencing. Gross nitrification and nitrogen mineralization rates were measured via the ^{15}N stable isotope pool dilution technique.



Conceptual diagram showing microbial interactions along soil profiles under deep- (right) and shallow-rooted (left) plants.

Results

Distinct mechanisms drive plant-nitrifier interactions in topsoil and subsoil. In topsoil, strong plant-heterotroph-nitrifier competition induced by lower soil organic matter (SOM) and NH_4^+ can lead to ammonia oxidizing archaea (AOA) suppression. In subsoil under deep-rooted plants, lower soil O_2 can select against aerobic heterotrophs, freeing AOA from strong heterotrophic competition for NH_4^+ and resulting in higher nitrification rates compared to shallow-rooted plants.

Significance/Impacts

The role of O_2 in mediating competition between AOA and heterotrophs for NH_4^+ is a newly identified mechanism by which deep-rooted plants can affect nitrification in the subsoil.

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