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Methods comparison to assess root mortality in grass species

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Introduction

Accurate assessment of root turnover in terrestrial ecosystems is limited by current techniques for estimating root mortality under field conditions. Determination of dead roots has been assessed by different time consuming methods: e.g. mass differences, vital colorations, manual and visual assessment, and minirhizotron. In the present study, we compared NIRS spectra with root and soil respiration, vital coloration and minirhizotron.

Materials and Methods

Root mortality was induced by removing total above-ground material of five grass species in 50L containers. Cores of root were collected three times: just after above-ground material (T0), one (T1) and two (T2) months later. Roots were washed, dried, milled and measured with NIRS apparatus from 400 to 2500nm (Foss 6500, USA). Root and soil respiration were measured with a closed chamber (Li6000-09, Licon, USA). Demography of root was measured with a minirhizotron system (Bartztechnology, USA). Vitality of roots was assessed with neutral red after cutting the roots at 110 to 150µm with a manual vibrating microtome (Vibratome®1500).

Results

- **NIRS**: Higher root absorbance spectra for dead treatment were observed in comparison with alive treatment, as previously observed by Picon-Cochard et al 2009. Differences were more pronounced for Ao and Fr.
- **Minirhizotron**: Root mortality of dead treatment reached 10% of total root length that was two times higher than for alive treatment.
- **Vital coloration**: Cortex sloughing observed one month after treatment application and two months after for the stele, indicated cessation of root functionality and start of root decomposition.
- **Respiration**: Sharp declines of soil (SR) and specific root respiration (SRR) for dead treatment after one month of treatment beginning. After two months, very low values of SR and increase of SRR for 2 species were observed, that could correspond to root decomposition.

Conclusions

Histological observations, root and soil respiration and NIRS spectra were more accurate methods to assess root mortality than minirhizotron. NIRS measures changes of chemical composition and possibly cell wall disintegration during root decomposition.

Perspectives

Extend methodology on grassland subjected to extreme event such as summer drought and heatwave.