Assessment of the sensitivity of a low-field NMR sensor by characterizing root water status of an herbaceous plant under drought conditions

Magali Nuixe, Amidou Traoré, J.-M. Bonny, Guilhem Pagès, Catherine Picon-Cochard

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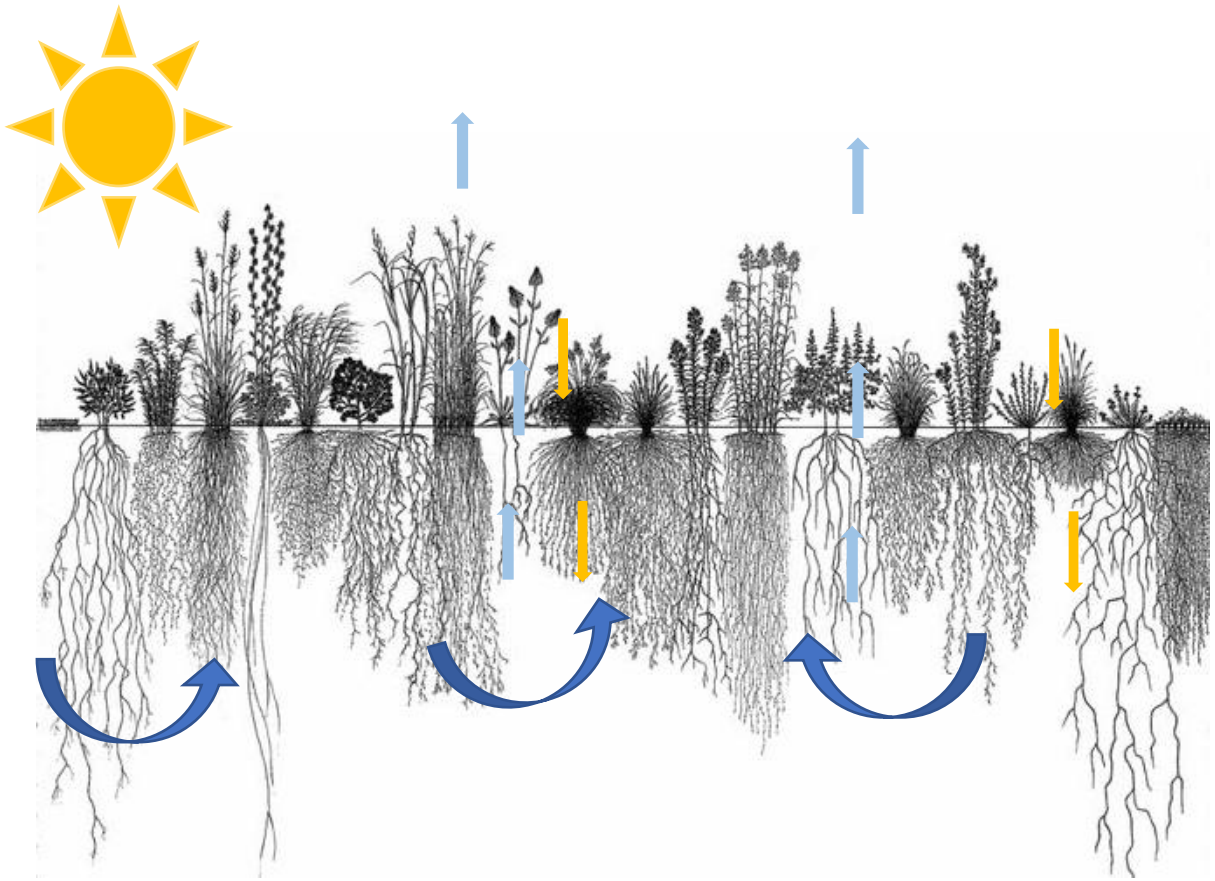
Context and aim of the study



Grasslands enable carbon sequestration especially in the underground biomass *(IPCC, 2001)*

This process depends on the water availability and on plant water status

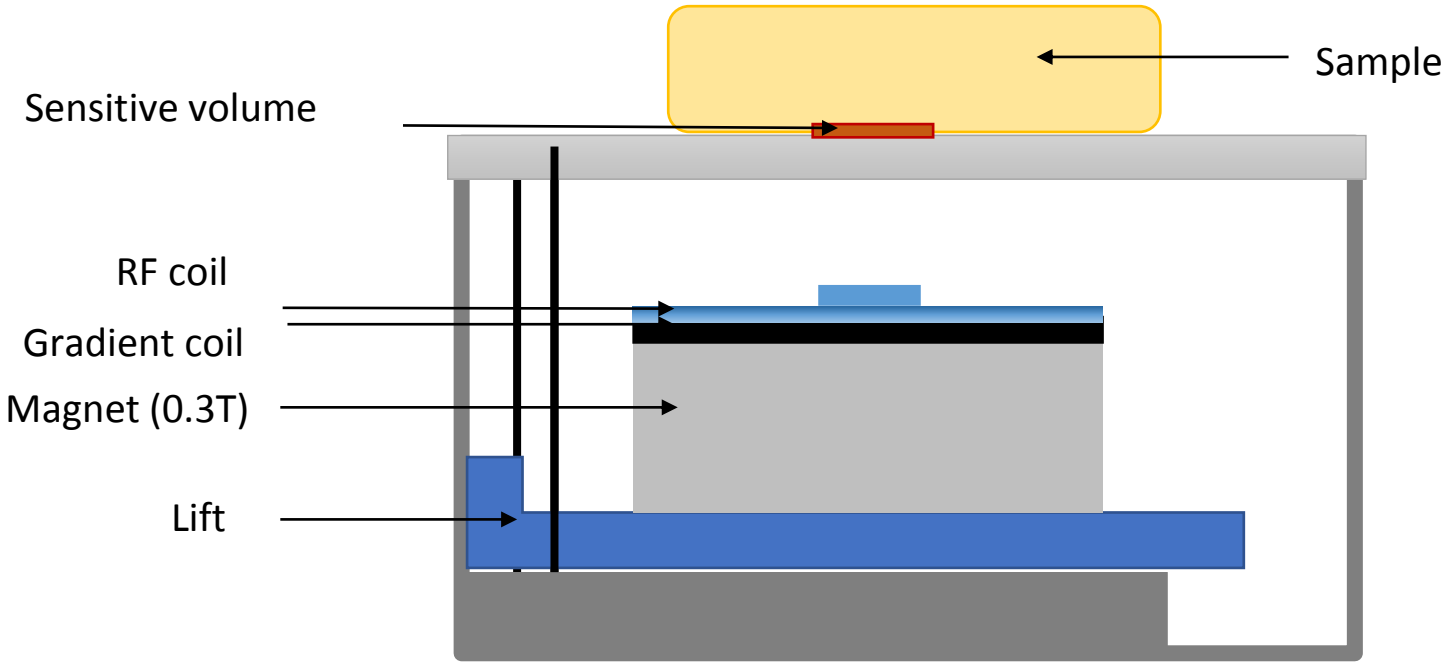
⇒ Interest to develop apparatuses to study plant water status *in situ*

⇒ NMR and especially low field NMR is an interesting tool to achieve this goal

Context and aim of the study

NMR MOUSE (Mobile Universal Surface Explorer) *Eidmann et al. 1996*

B_0 gradient : depth localization



After demonstrating the feasibility of low field NMR to study root water status in herbaceous plants *(Nuixe et al. 2021),* we want **to determine the sensor sensitivity**

Material and Methods

A *Rumex acetosa* was cultivated in a rhizotron and positioned in a climatic chamber

(Day : 21°C, lights on from 08:00 to 22:00; Night : 18°C, lights off from 22:00 to 08:00)

Example of the rhizotron model

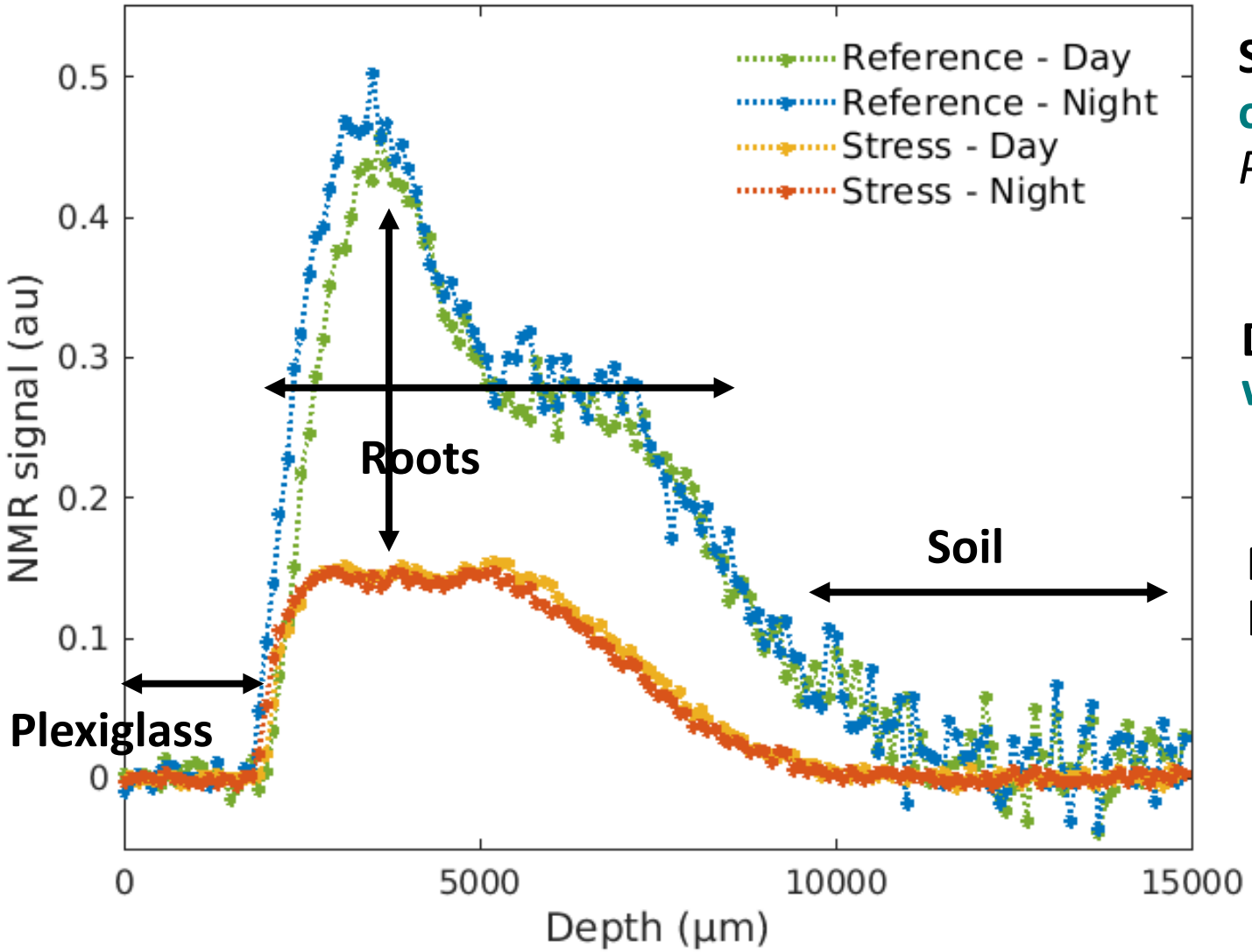
Plant was submitted to 3 hydric conditions :

- ❑ Reference conditions (250mL of water twice per day)
- ❑ Drought conditions (after 3 weeks without irrigation)
- ❑ Rehydration conditions (200mL of water three times per day during 3 days)

Acquisition of

- ❑ **NMR profiles** (CPMG, TE 116µs, TR 3s, 256 echoes)
- ❑ $\mathbf{T_2}$ (mono-exponential fit on the filtered averaged profile decay)
- ❑ **Ecophysiological measurements**

Results – Profiles

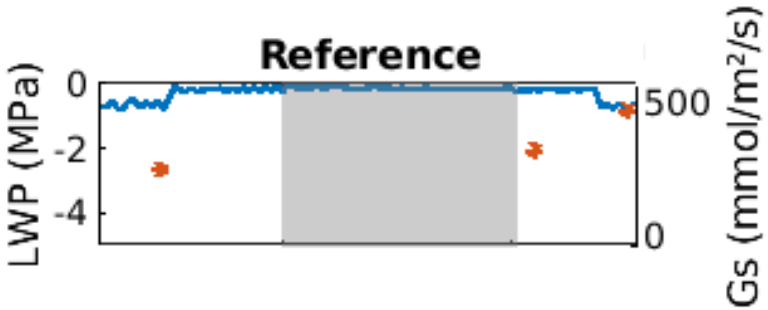


Soil/roots difference due to the **water content** but also to T_2 *(Bagnall et al. 2020, Pohlmeier et al. 2010)*

Day/Night difference due to the **increase of water mobility**

Reference to stress conditions characterized by a decrease of **65.2%** of root NMR area

Results – Profiles



Reference state :

Visualization of **variation of root and soil NMR signals** according to the ecophysiological measurements

⇒ Variation due to the transpiratory flux

⇒ In agreement with our previous study

Stress conditions :

No longer variation of root and soil NMR signals

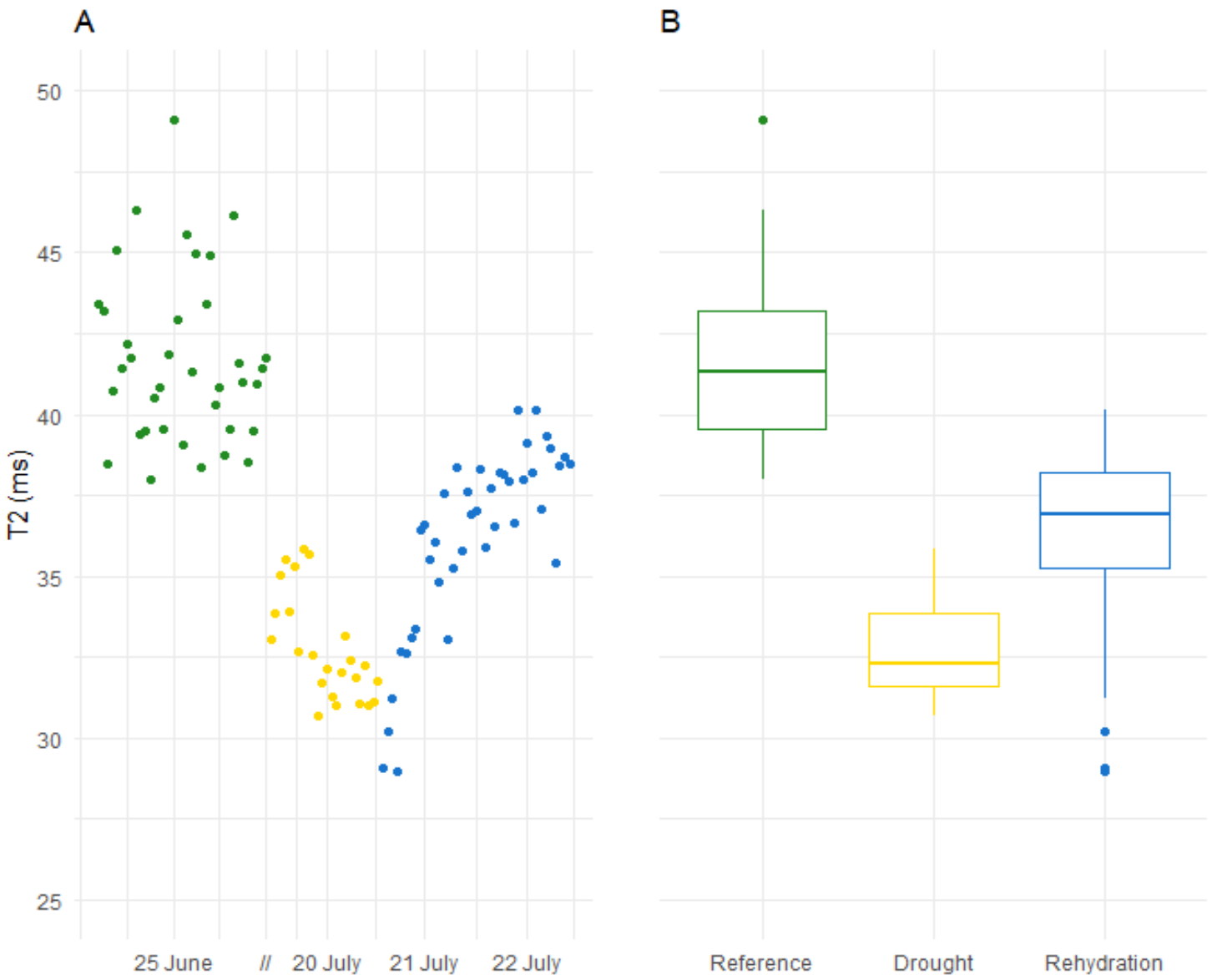
⇒ In agreement with ecophysiological measurements

Decrease by:

- 93.4% for Gs
- 53.8% for SWC

⇒ No transpiration

Results – T_2



The 3 conditions are clearly different:

- ❑ $T_{2ref} > T_{2drought\ or\ rehydr.}$

Stress :

Shorter T_2 = Water less mobilizable

Greetings

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