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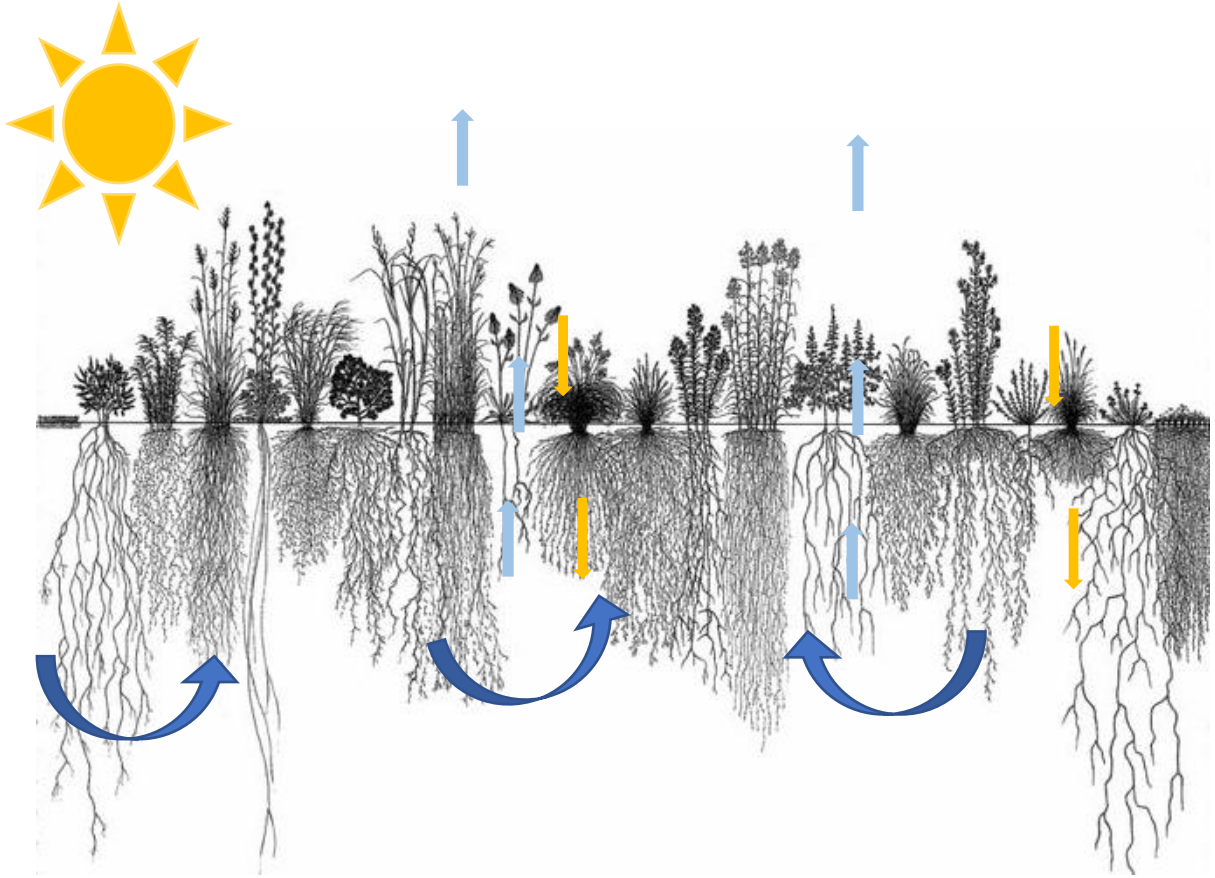
# Assessment of the sensitivity of a low-field NMR sensor by characterizing root water status of an herbaceous plant under drought conditions

Magali Nuixe, Amidou Sissou Traoré, Jean-Marie Bonny, Guilhem Pages and Catherine Picon-Cochard

**Compact NMR Conference II**

**October 11th, 2021**

# 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

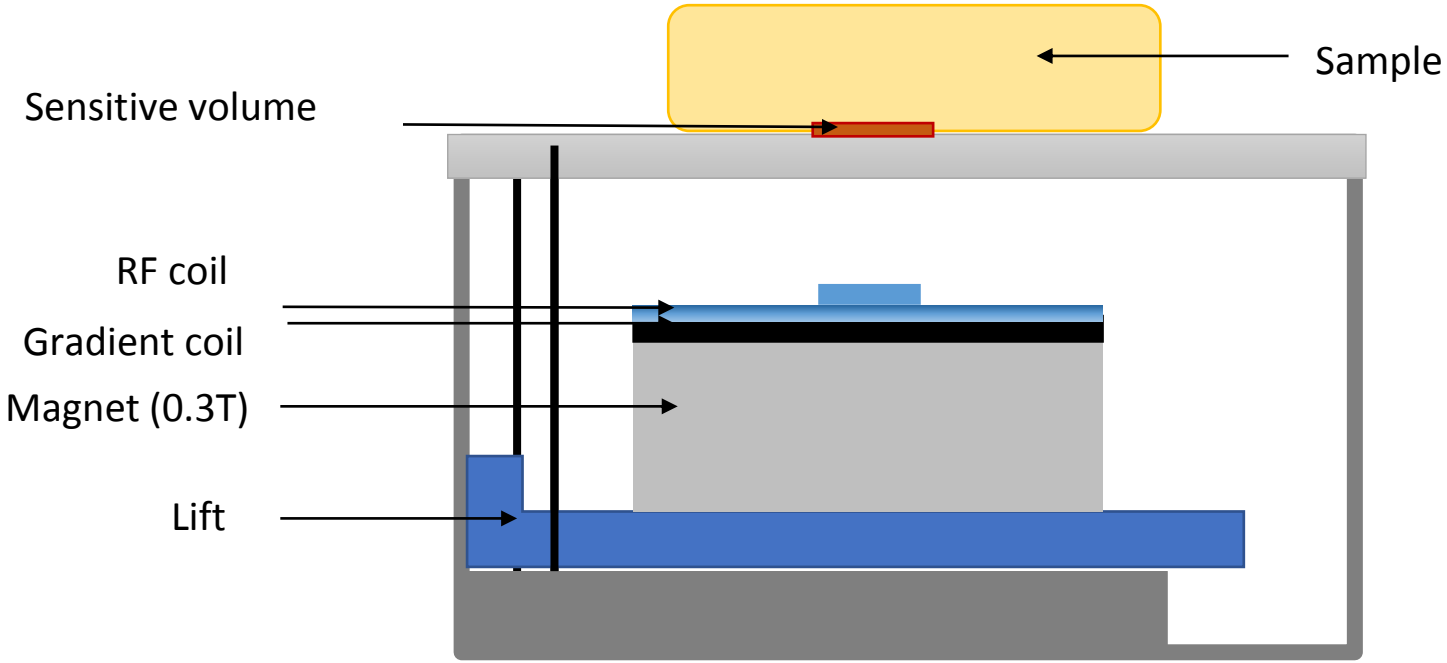
⇒ Interest to develop apparatuses to study plant water status *in situ*

⇒ 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

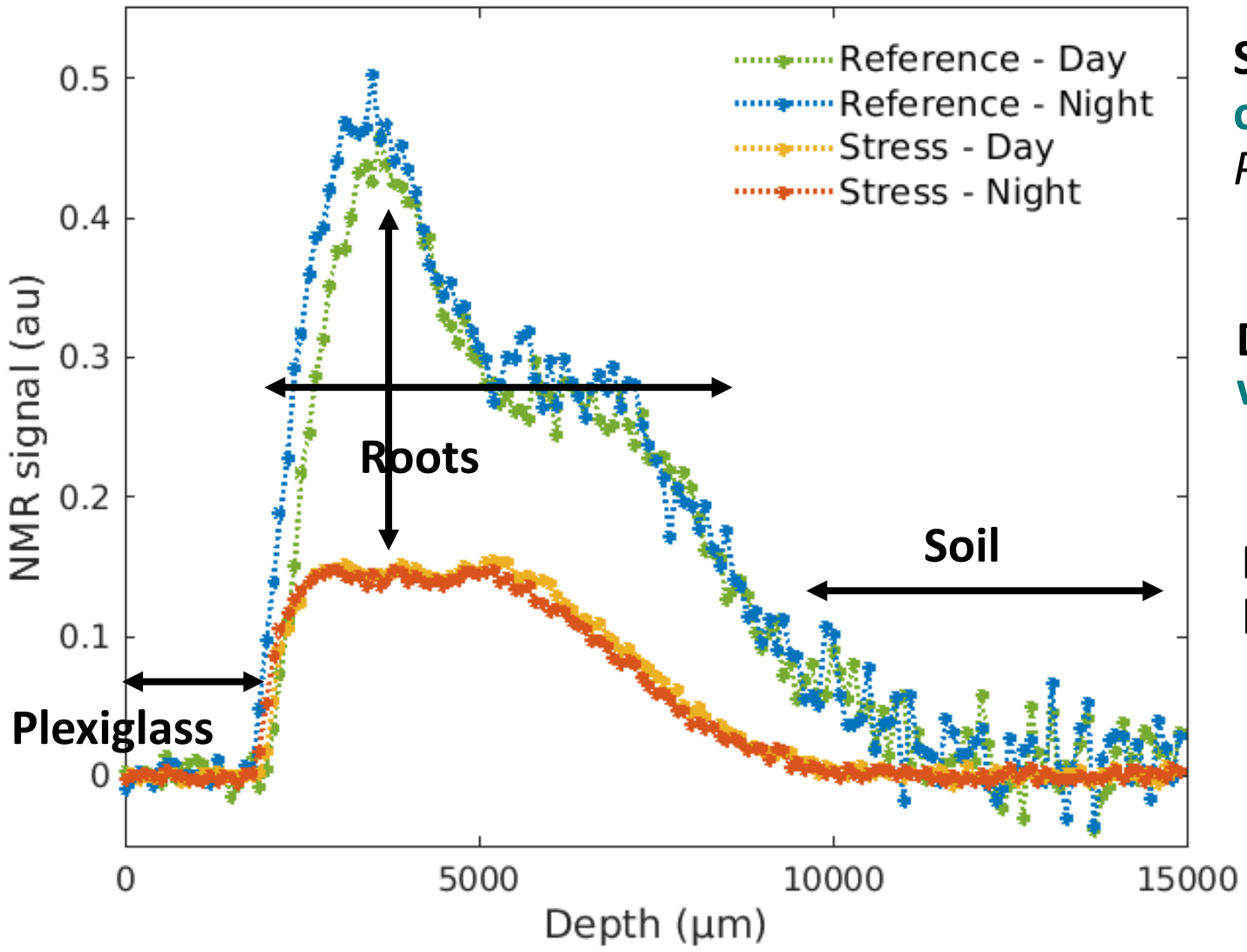
Plant was submitted to 3 hydric conditions :

- ❑ 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)
- ❑ **$T_2$** (mono-exponential fit on the filtered averaged profile decay)
- ❑ **Ecophysiological measurements**

# Results – Profiles

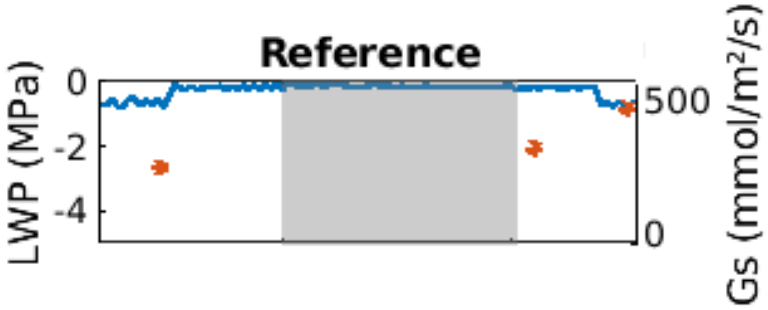



**Soil/roots difference** due to the **water content** but also to **$T_2$** *(Bagnall et al. 2020, Pohlmeier et al. 2010)*

**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

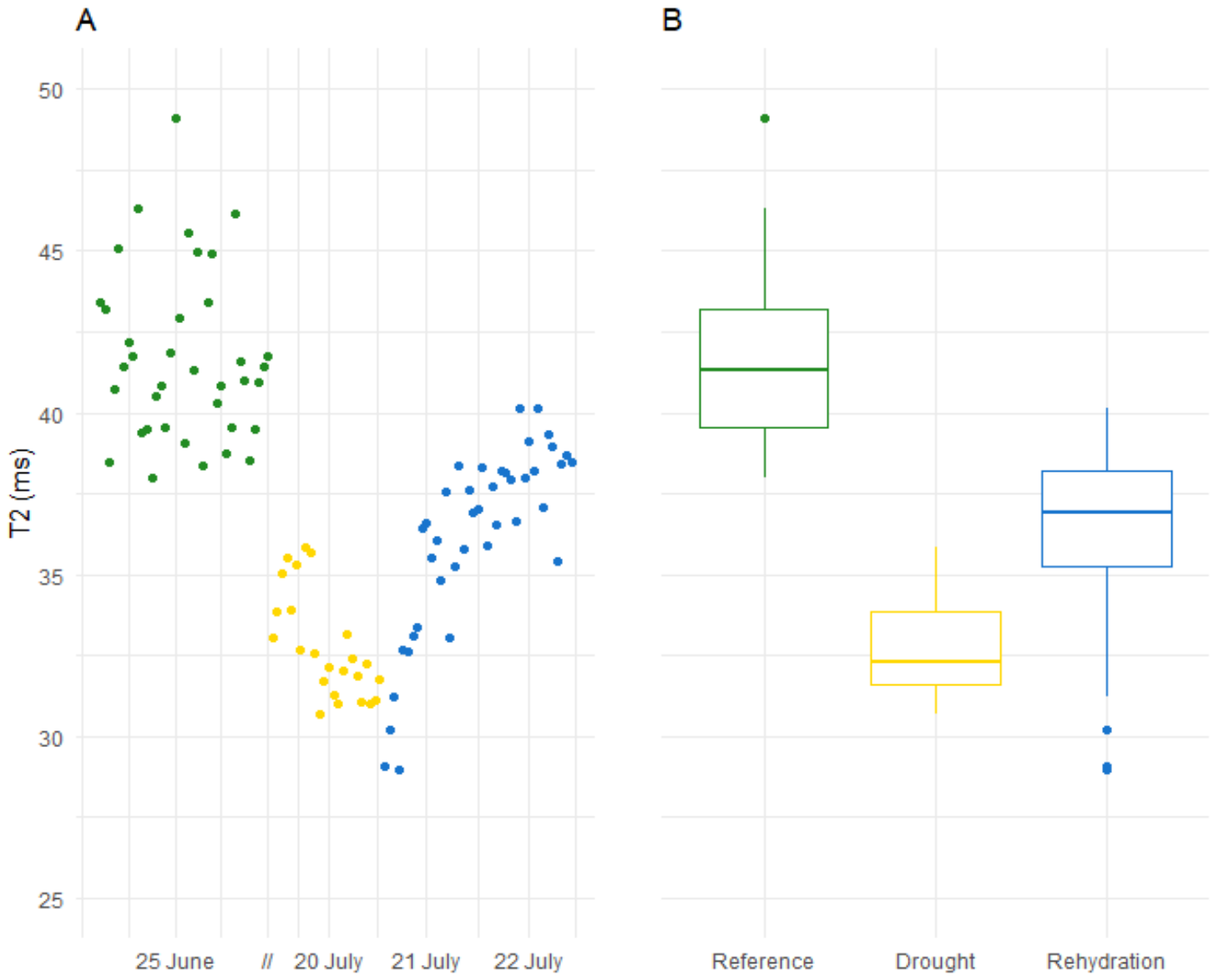
⇒ In agreement with ecophysiological measurements

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

PROJET FINANCÉ PAR L'ANR - PROJECT FUNDED BY THE ANR

CAP 20-25

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