Belowground biomass is as heritable as aboveground biomass in *Miscanthus sinensis*

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Introduction

- Miscanthus, a perennial C4 grass thriving on marginal lands offers significant ecological benefits.
- With its **high biomass production**, it serves as a promising option for renewable energy (Arnoult et al., 2015), green chemistry, and bio-based products, contributing directly to the bioeconomy.
- It also provides ecosystem services (water and soil protection, carbon sequestration, phytostabilisation…).
- Its efficient **nitrogen recycling** allows no need for nitrogen fertilization minimizing its environmental impact (Cadoux et al., 2014) and can be beneficial for water and soil protection.
- Most of the cultivated area in Europe is grown with a single clone of *Miscanthus × giganteus.*

  It represents a risk in the slight event of climatic or phytosanitary hazards.
- It has narrow genetic background.

  Hence, we need to diversify the varietal offer for which ***Miscanthus sinensis*** is a very good alternative.
- We need a genetic approach to integrate biomass production that meets both industrial requirements and ecosystem services.

Miscanthus sinensis

- **Huge genetic variability** (Sun et al., 2010)
- **Phytostabilisation** (Nsanganwimana et al., 2015)
- **Better abiotic stress tolerance** (Lewandowski et al., 2016)
- **Intraspecific variability** (Zub and Brancourt-Hulmel, 2010)
- **Able to recycle nitrogen as efficiently as *M. x giganteus*** (Leroy et al. 2022)

Objective

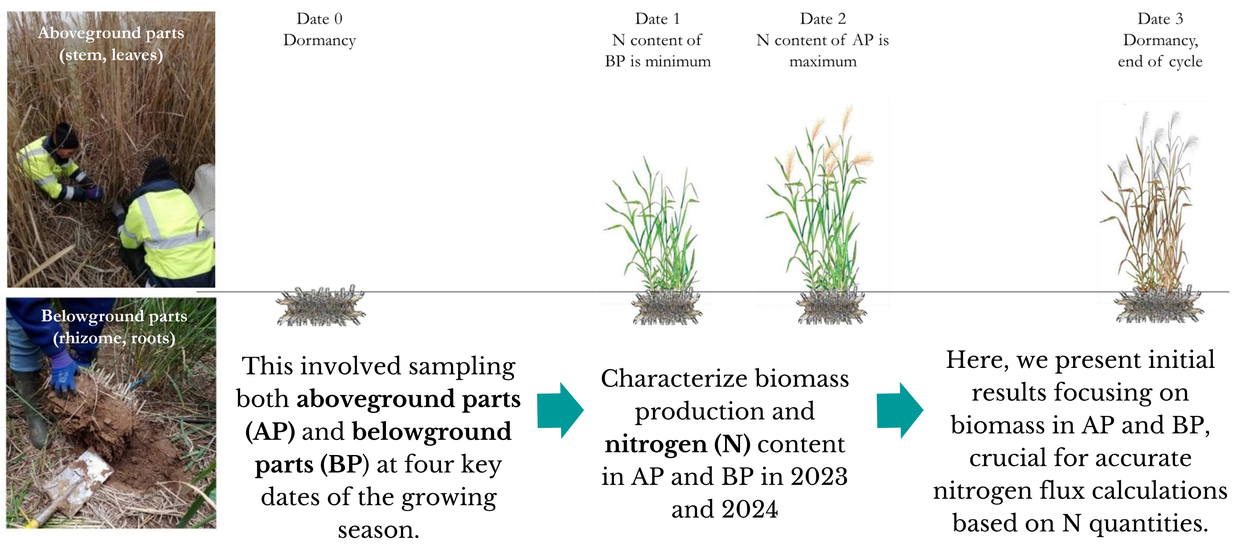
Our aim was to explore the genetic variance and heritability of nitrogen recycling in *Miscanthus sinensis* by studying fluxes between aboveground and belowground parts of the plants.

Material

Progeny of a diploid *Miscanthus sinensis*

Eighty genotypes were established in the field in 2018.

Methodology



This involved sampling both **aboveground parts (AP)** and **belowground parts (BP)** at four key dates of the growing season.

Characterize biomass production and **nitrogen (N)** content in AP and BP in 2023 and 2024

Here, we present initial results focusing on biomass in AP and BP, crucial for accurate nitrogen flux calculations based on N quantities.

Results

(1) Correlation analysis between aboveground and belowground biomass

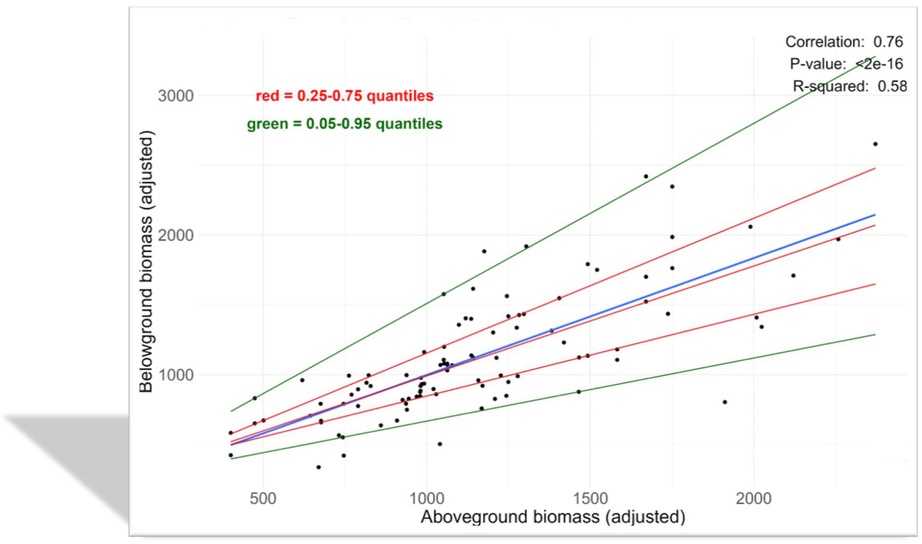


Fig 1: Relationship of **aboveground** and **belowground** biomass for the Date 0.

- The correlation coefficient between aboveground and belowground biomass in Date 0 was 0.76, with consistent correlations of 0.69, and 0.64 across the Date 1 and Date 2 respectively.
- The consistent correlation across dates implies that genetic factors influencing AP biomass are also affecting BP biomass, suggesting that BP would be as heritable as AP.

(2) Distribution of aboveground and belowground biomass in the progeny

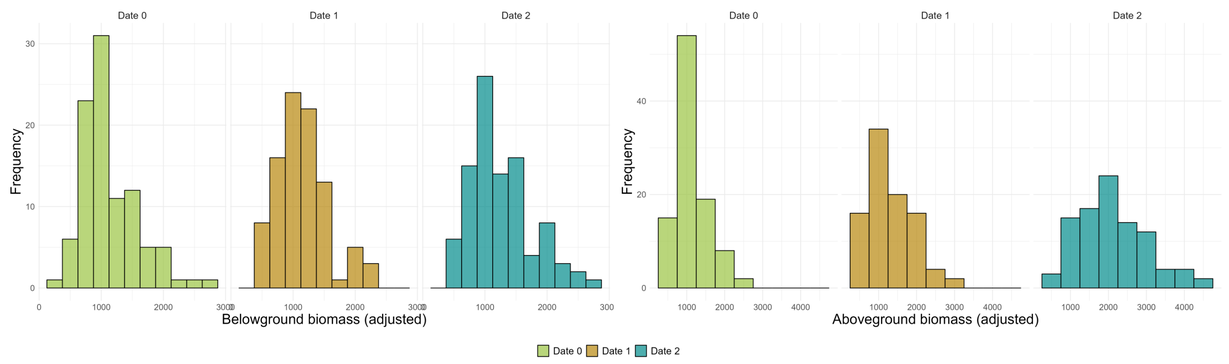


Fig 2: Distribution of the progeny for **aboveground** biomass (left-hand side) and **belowground** biomass (right-hand side) across the three dates (Date 0, Date 1 and Date 2).

- We highlighted a high distribution of the progeny in both aboveground and belowground biomass across the first three dates.
- So, we can expect high genetic variance for both traits as illustrated in figure 3.

(3) Variance and heritability estimates of aboveground and belowground biomass

- High individual plant broad-sense heritability values (H^2sl) were observed for aboveground biomass, ranging from 0.60 to 0.80,
- While for the belowground biomass, the values ranged from 0.86 to 0.90 for the three dates.
- Additionally, we noted higher progeny mean broad-sense heritability (H2Pi) for both traits in each period.

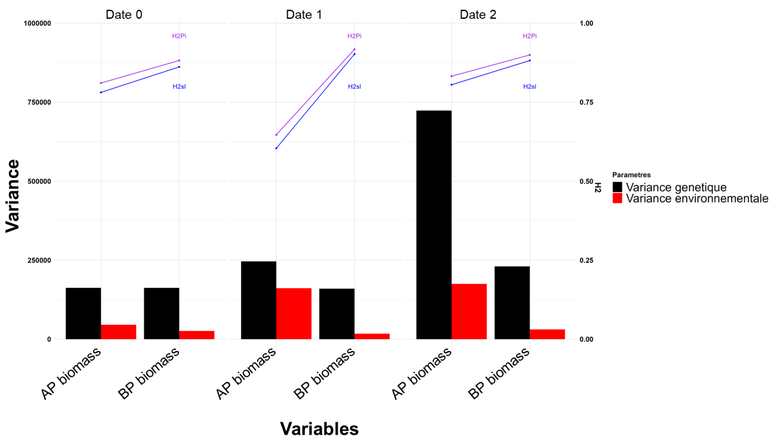


Fig 3: Genetic parameters of **aboveground** (AP) and **belowground** biomass (BP) for the three dates (Date 0, Date 1 and Date 2)

Previously unexplored in miscanthus, belowground biomass shows a heritability similar to aboveground biomass in *Miscanthus sinensis*, suggesting significant potential for genetic studies on nitrogen recycling.

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