Source characterisation of NO_3^- under legume-containing grassland by ^{15}N and ^{18}O analysis

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THE JENA EXPERIMENT

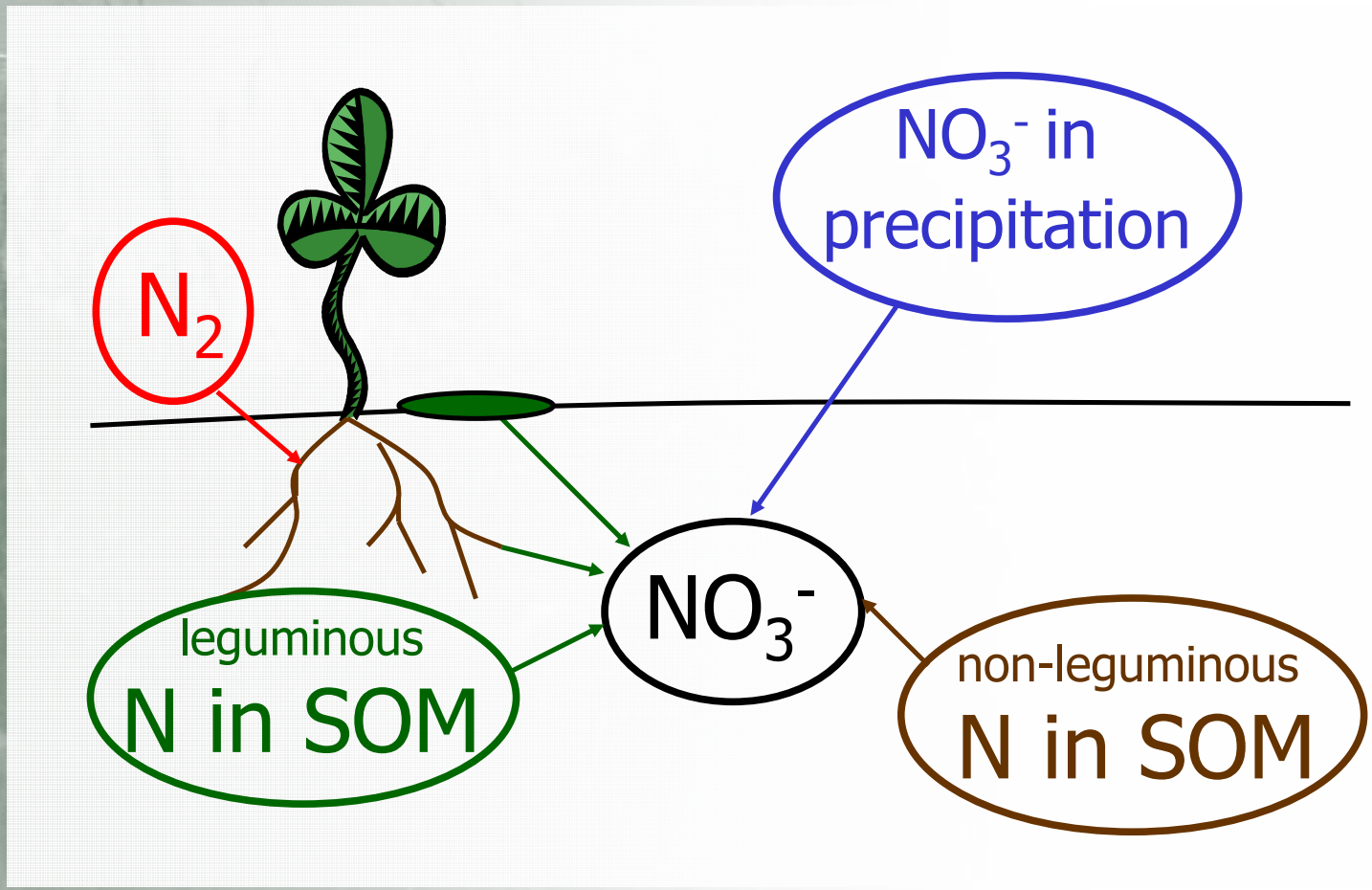
Introduction

- Intercropping with legumes improves soil N availability.
- Particularly legume monocultures are prone to N leaching.
- To optimise management, the contribution of legume-derived N to mineralised N must be known.

Hypotheses

- Nitrate leaching under legume monocultures reaches a similar order of magnitude as bare ground plots.
- The contribution of legume-derived N in NO_3^- can be calculated with the help of natural abundance ^{15}N and ^{18}O analysis.

Rationale


NO_3^- in precipitation
N_2
leguminous N in SOM
NO_3^-
non-leguminous N in SOM

Methods

Soil Solution

- Biweekly sampling with suction plates
  (0.3 m depth, vacuum manually regulated according to soil matrix potential, three legume monocultures -*Medicago x varia* Martyn, *Onobrychis viciifolia* Scop., *Lathyrus pratensis* L. - and three bare ground plots)

Precipitation

- Biweekly sampling of precipitation in 2 L PE bottles
  (1 m above surface)

- Sampling from April 2003 to May 2004

Methods (2)

Mineralisation of leguminous SOM and non-leguminous SOM

- Sampling of nine soil cores (depth 0.04 m, ∅ 0.07 m) *Medicago x varia* Martyn - monoculture (31.08.2004)
- Soil placed in Falcon® bottle top filters, application of vacuum (30 kPa, 2 h)
- Leaching with 0,1 L of a N-free nutrient solution (30 kPa vacuum, repeated weekly, 70 days, 20 °C)

➢ Determination of NO_3^- and $\delta^{15}N$ and $\delta^{18}O$ analyses in NO_3^- (Silva et al. 2000)

Methods (3)

Calculation of water fluxes

- Determination of soil water content, calculation of evapotranspiration (PET after Penman), calculation of water fluxes with a simple budget approach

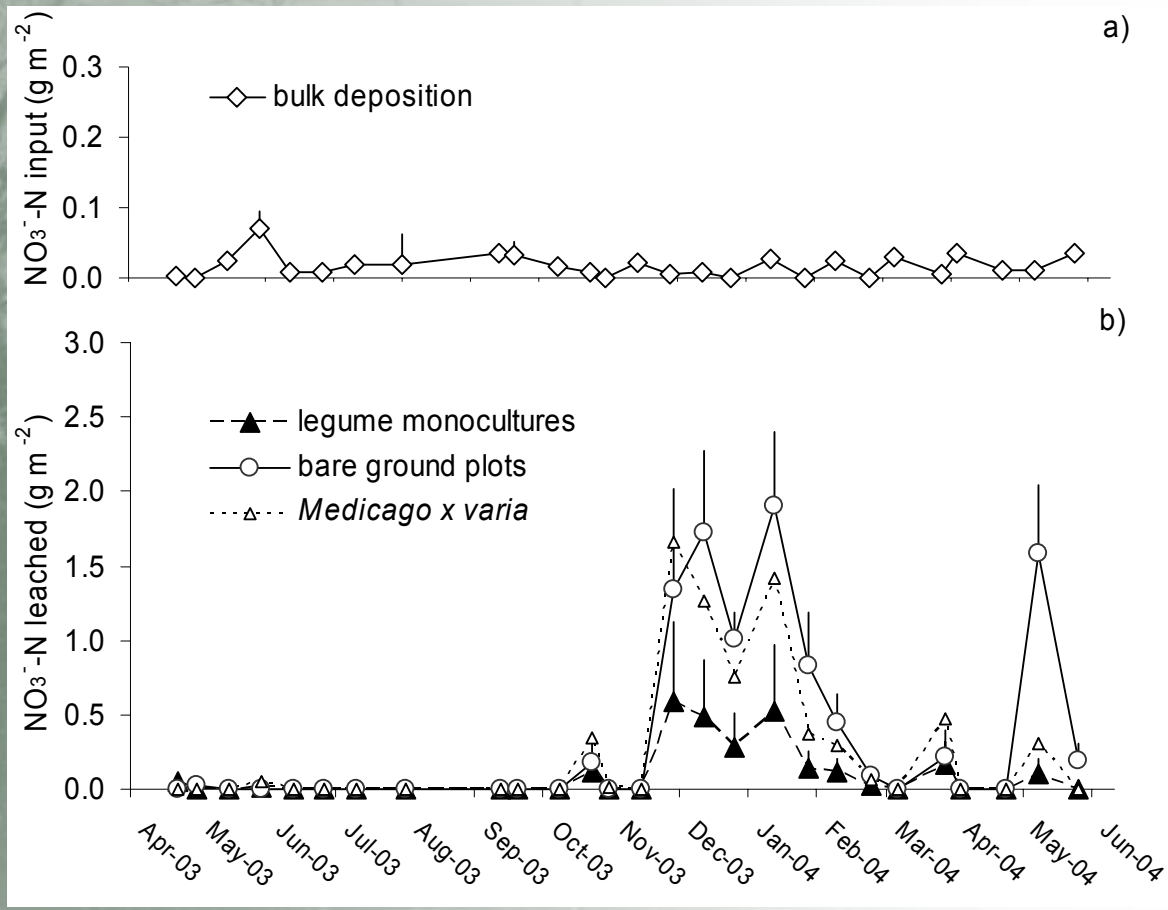
Source calculation

- Three-end-member mixing-model with $\delta^{15}N$ and $\delta^{18}O$ values of mineralisation of **leguminous SOM**, **non-leguminous SOM**, and **precipitation** as end-members

Field Site

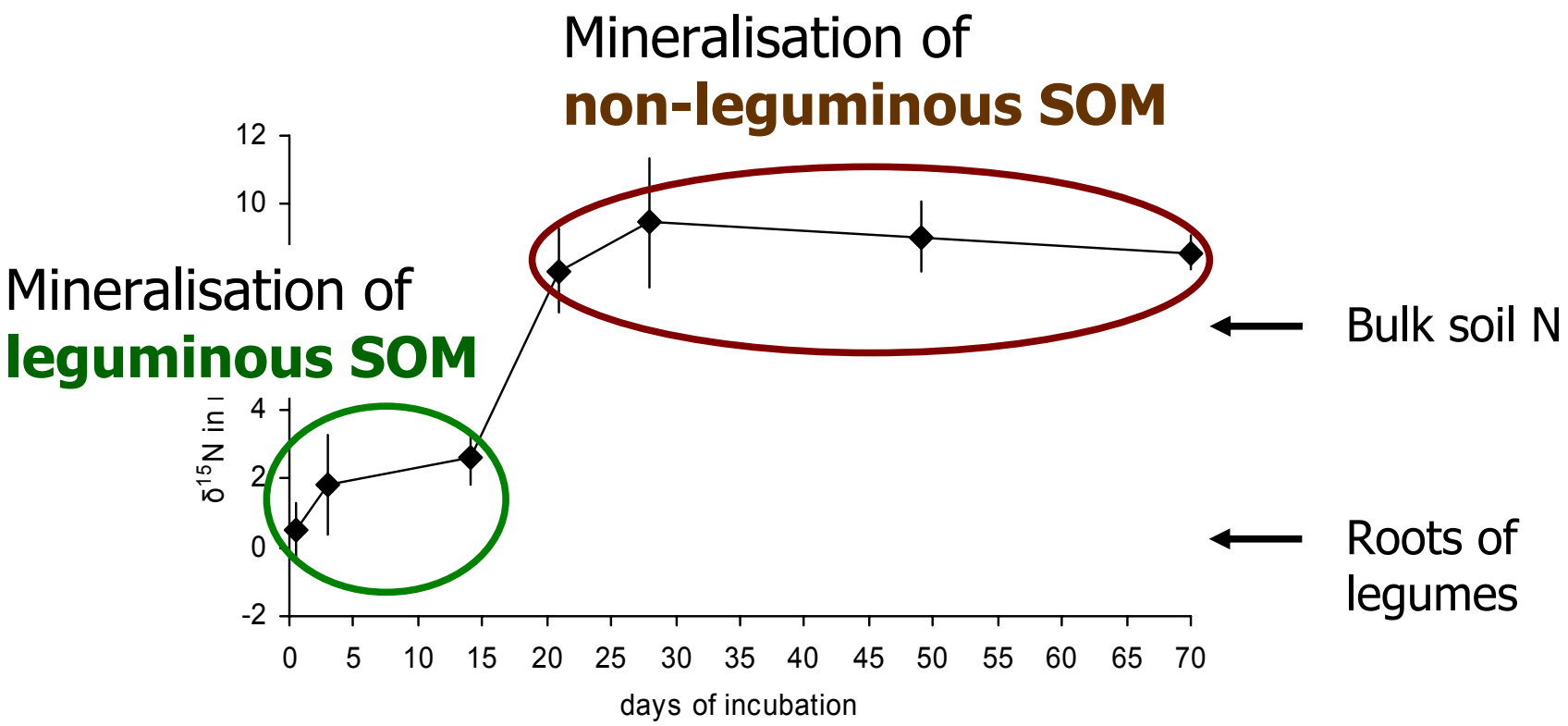
The Jena Experiment

Results: NO_3^--N leaching



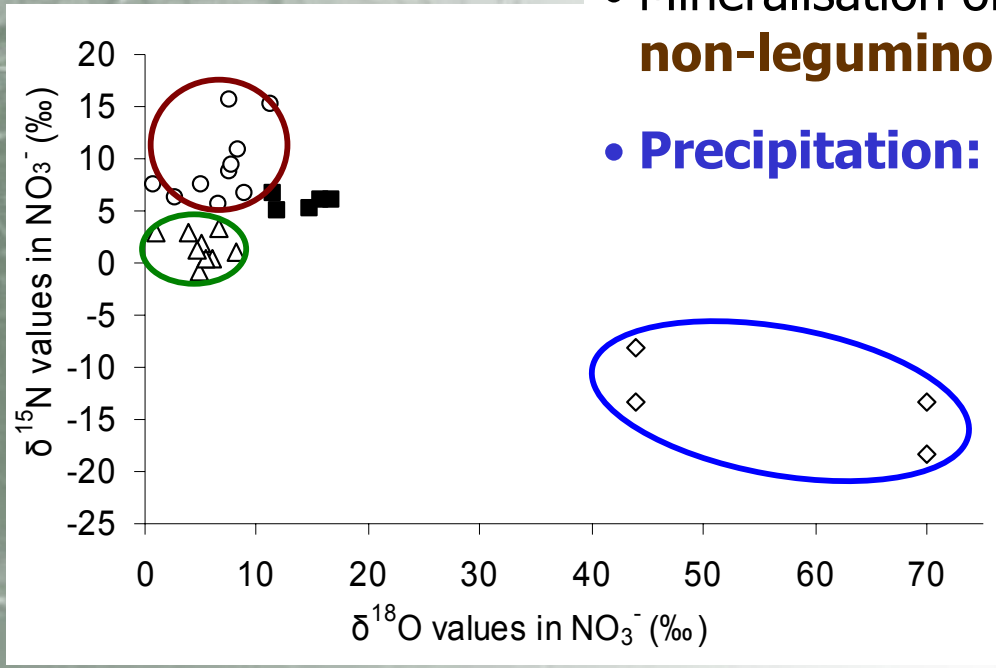
- On average, NO_3^--N leaching under legume monocultures lower than under bare ground plots
- However, NO_3^--N leaching under *Medicago x varia* similar to bare ground plots

Results: ^{15}N and ^{18}O



Results: ^{15}N and ^{18}O analyses

- Mineralisation of **leguminous SOM:** **0-17%**
- Mineralisation of **non-leguminous SOM:** **71-81%**
- **Precipitation:** **12-17%**



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Conclusions

- Nitrate leaching under legume monocultures reaches similar magnitudes compared to bare ground plots.
  - ➢ particularly under *Medicago x varia*
- The contribution of legume-derived N in NO_3^- can be calculated with the help of natural abundance ^{15}N and ^{18}O analysis.
  - ➢ leguminous SOM: 0-17%

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