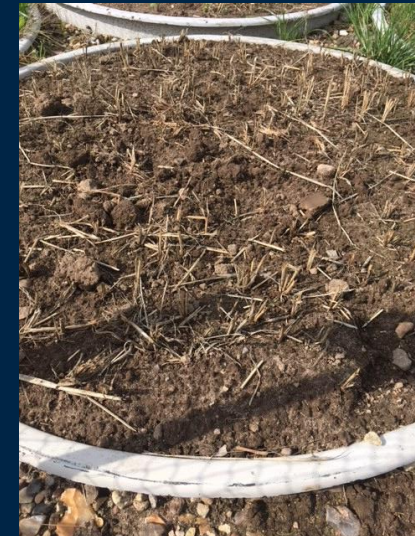
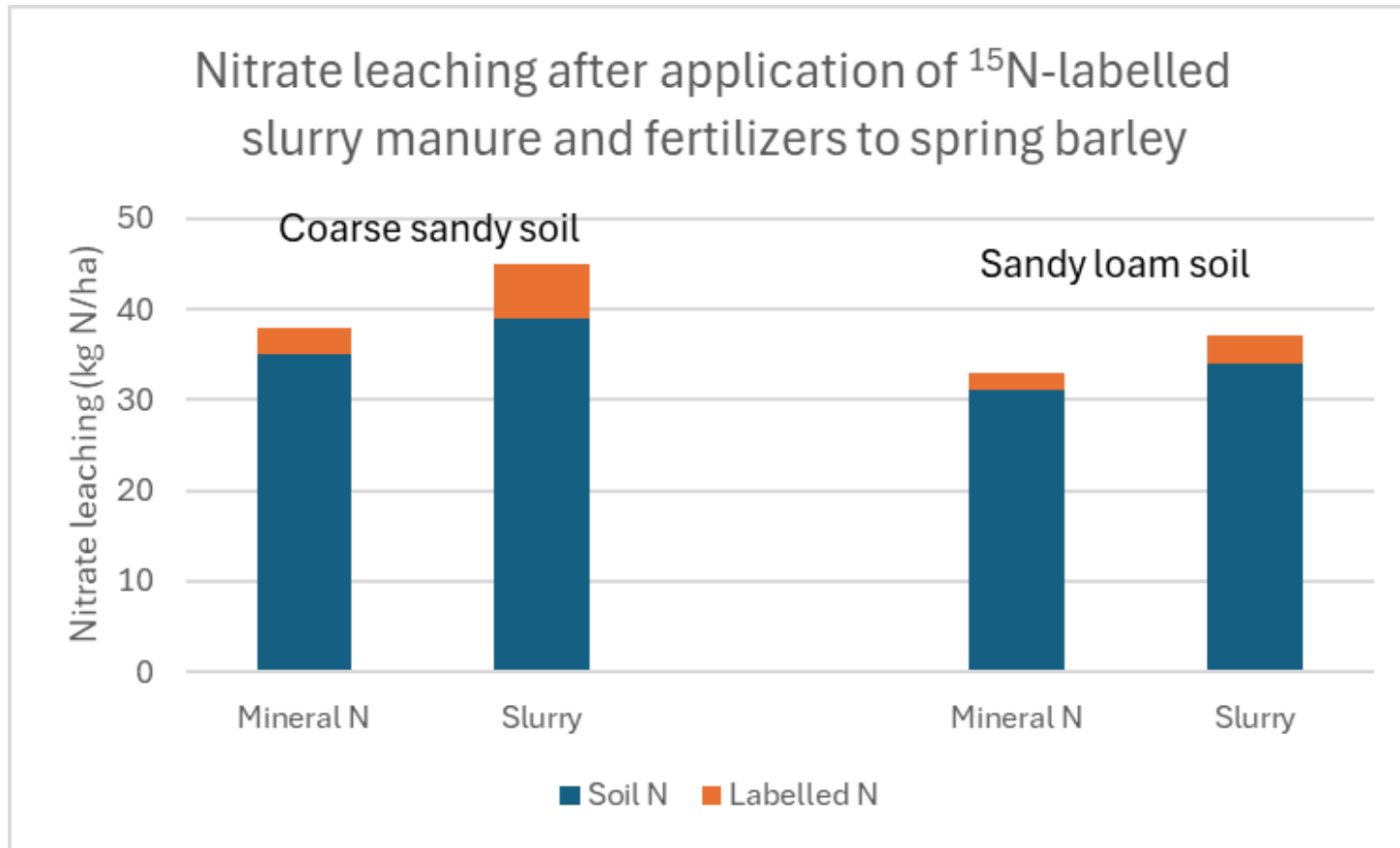


# Leaching of mineralized soil nitrogen is highly influenced by vegetation type

**Peter Sørensen,** Betina N. Pedersen, Ingrid K. Thomsen, Jørgen Eriksen & Bent T. Christensen



# Most nitrate-N leaching derives from mineralization of soil N



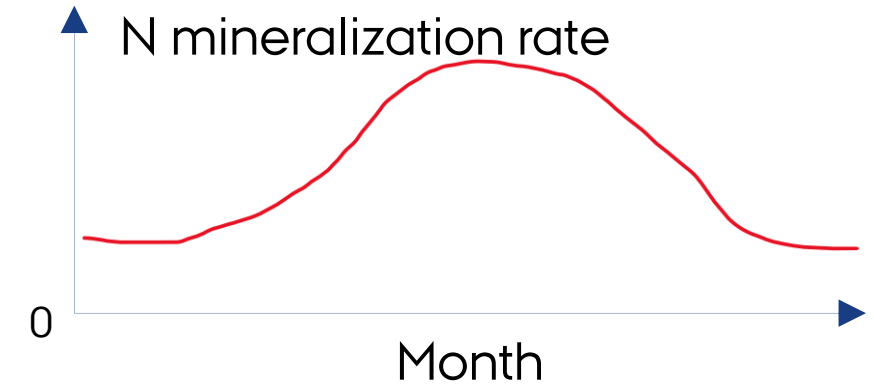
- Lysimeter study at Askov Exp. Station
- Nitrate leaching measured over one year after fertiliser application in spring
- Spring barley (no cover crop)
- Mineral  $^{15}\text{N}$ : 60 kg N/ha
- Manure  $^{15}\text{N}$  (slurry): 120 kg N/ha

Data from Thomsen et al 1997. Plant and Soil 197, 233

# Nitrate leaching from mineralized soil N

## - by tracing $^{15}\text{N}$ -labelled fertilisers after 30 yrs

- The mineralization of organic N in soil is a **continuous** proces.
- Vegetation cover in autumn and winter is critical for nitrate leaching losses as water percolation is highest in this period when nitrate is still formed.
- A study with  $^{15}\text{N}$ -labelled soil N derived from labelled fertilisers applied 25-30 years ago.
- **Aim: quantification of nitrate leaching from mineralised N under different vegetation types in Denmark.**

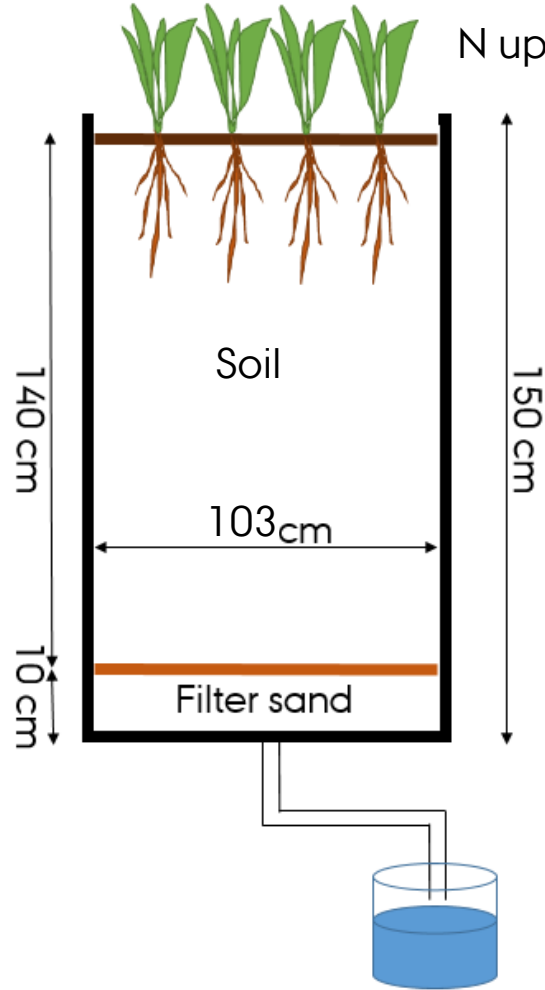


# Lysimeters



Area: 0.83 m<sup>2</sup>

Lysimeter illustration



Water sampling  
Nitrate leaching

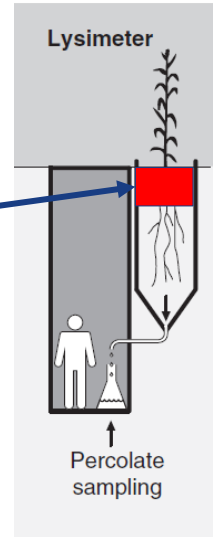
Water sampling



# Experiment: History of soil and $^{15}\text{N}$ application over ca 30 years at Askov, DK



Field plot (20 m<sup>2</sup>)



Set-aside grassland with cuts returned 2004-2017 (13 yrs)



**Test period 2 yrs:**  
(1) Fertilized grass  
(2) Vegetation free  
(3) Spring barley  
(4) Spring barley + CC

$^{15}\text{N}$ -labelled mineral fertilizers

Crops with unlabelled N fertilisation

Topsoil (0-20 cm) moved to lysimeters and topsoil replaced



1989-1993

2003

2018-20

Timeline

# Treatments 2018-20

- (1) **Fertilized grass**, 2-3 cuts/yr (grass continued)
- (2) **Vegetation free** (set-aside grass incorporated and tilled)
- (3) **Spring barley** (bare soil after harvest)
- (4) **Spring barley + cover crop** (sown after harvest)

- All plots received 150 kg N/ha/year in NPK fertilizers (unlabelled)
- High water percolation:
  - Year 1: 460-600 mm
  - Year 2: 780-1000 mm
- Topsoil with 11% clay

Grass

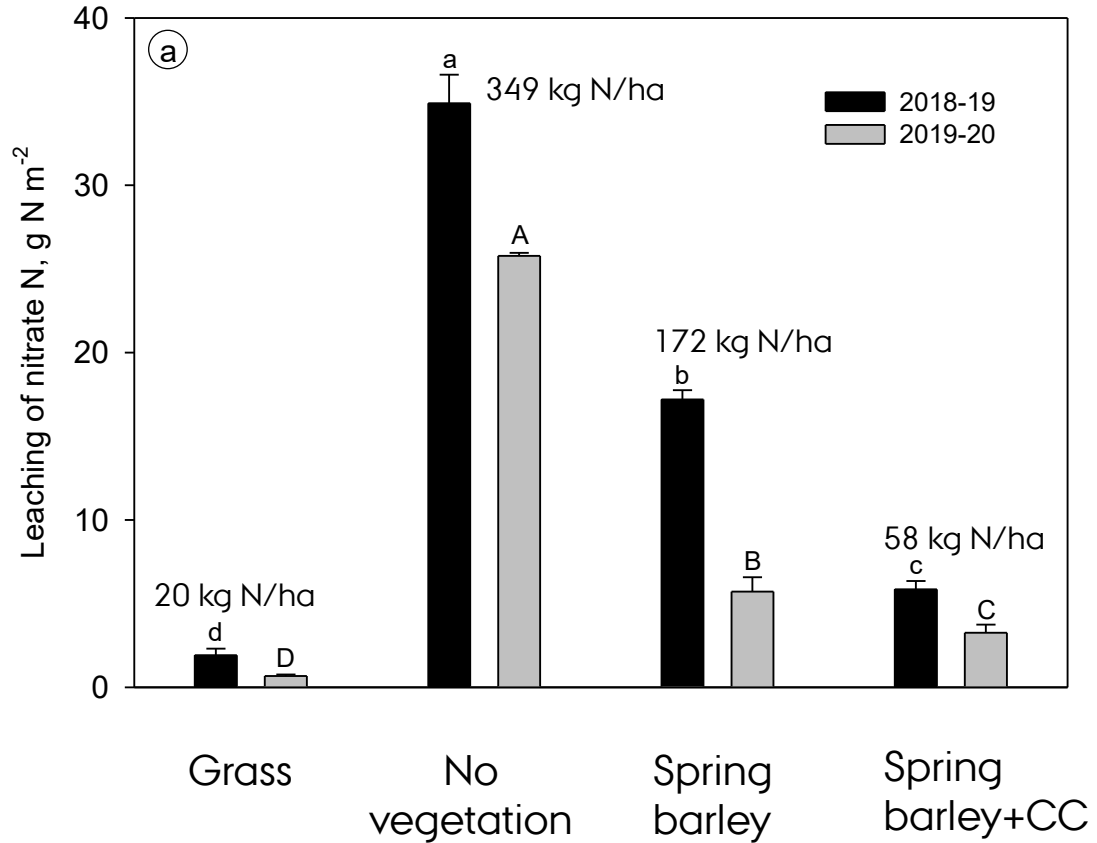


Emerging cover crop

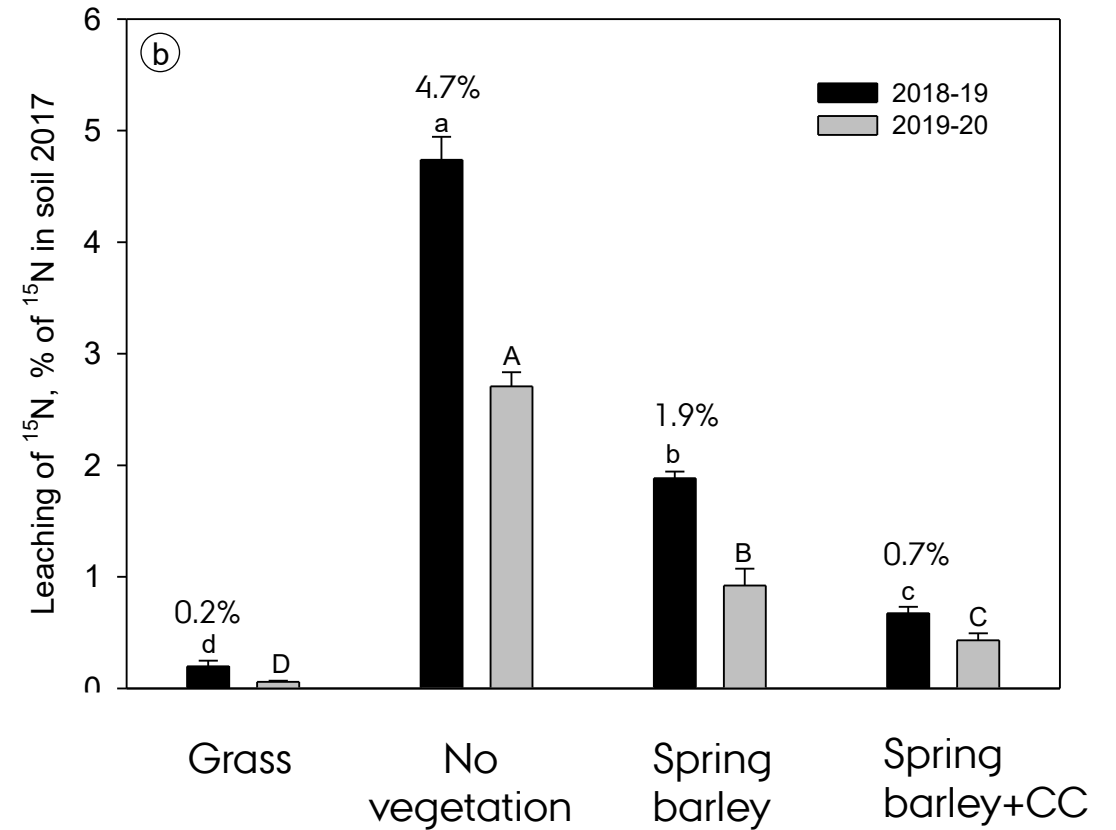


# Nitrate leaching by different vegetation

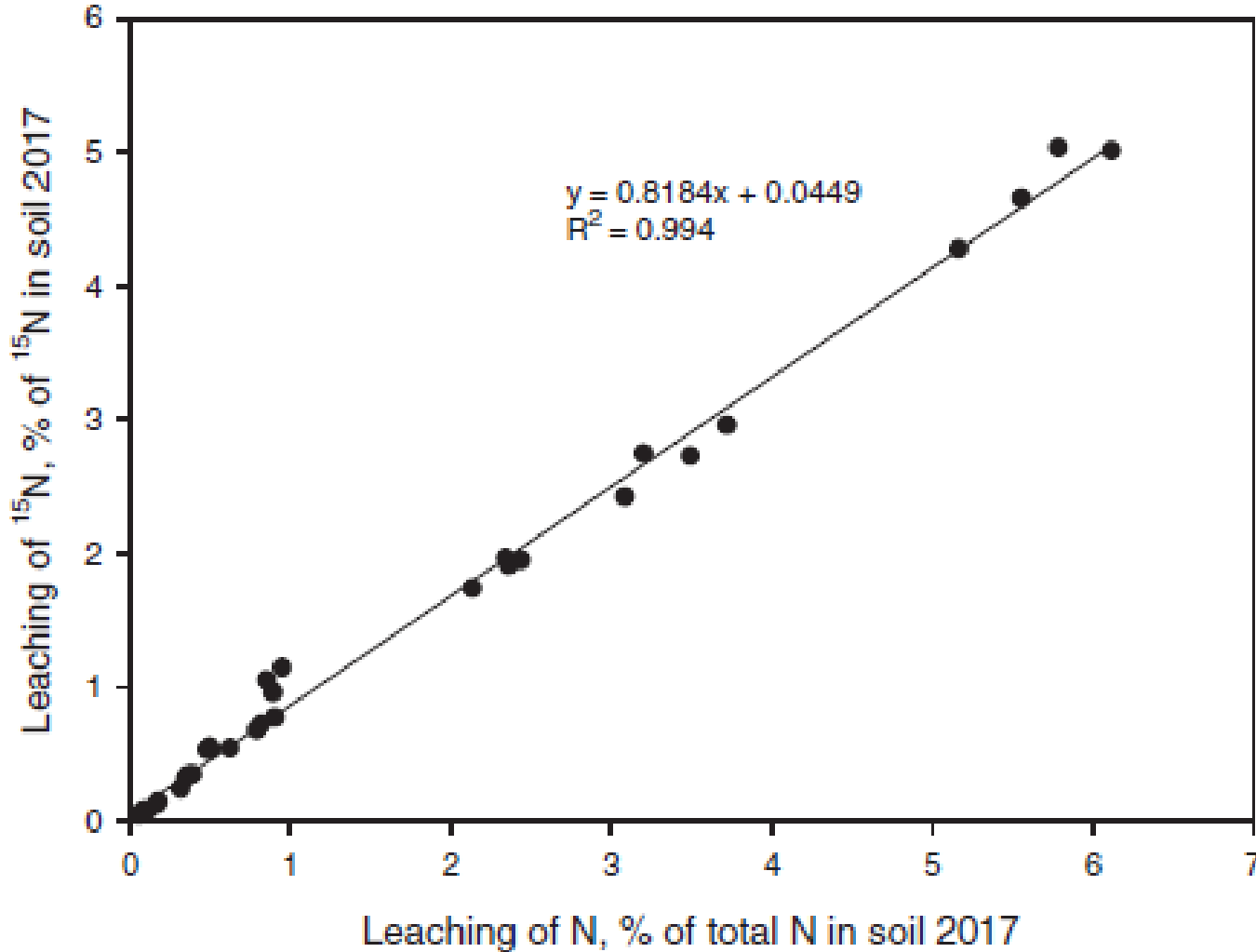
Nitrate leaching during two seasons



Leaching of labelled N (% of soil <sup>15</sup>N)



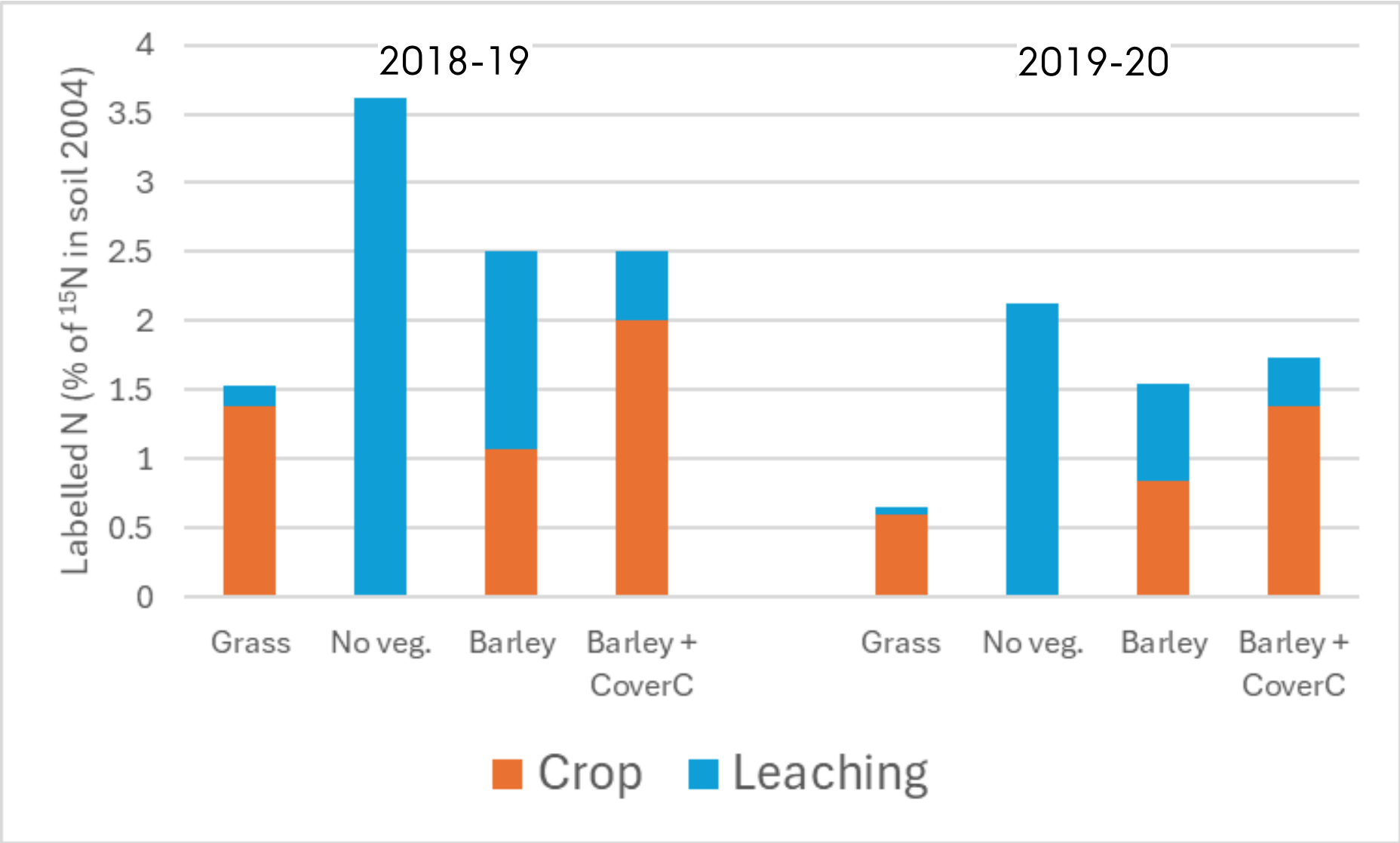
# Similar relationship between leaching of N and <sup>15</sup>N in all treatments



Leaching from each individual lysimeter in 4 treatments and 2 periods



# Crop N uptake + nitrate-N leaching related to labelled soil N (% of $^{15}\text{N}$ in soil in 2004)



We assume:  
All  $^{15}\text{N}$  from  
mineralization

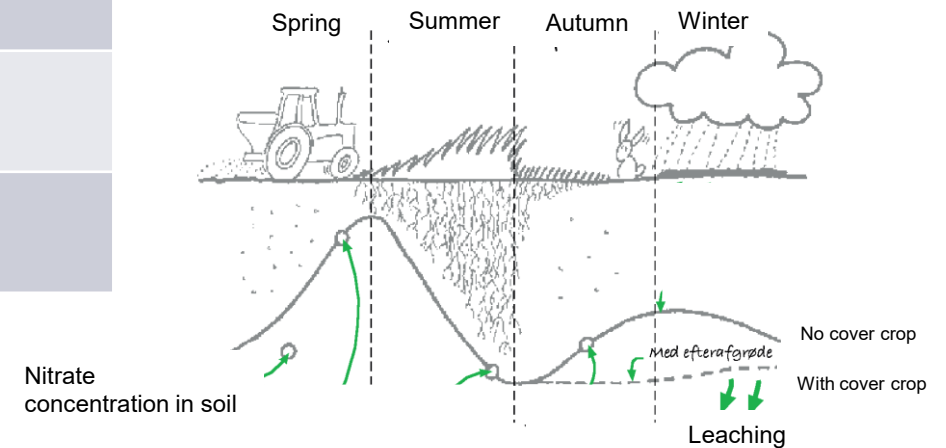


# Ratio of leaching to crop $^{15}\text{N}$ uptake

Crop	Leaching of $^{15}\text{N}$ / $^{15}\text{N}$ in crop
Permanent grass	0.1
Spring barley	1.1
Spring barley + cover crop	0.25

# Proportion of mineralized N lost by N leaching under different vegetations

Crop	Mineralised N leached as nitrate
Permanent grass	2-4 %
Spring barley	33-40 %
Spring barley + cover crop	14-16 %



Assuming that all mineralized  $^{15}\text{N}$  was leached from lysimeters without vegetation (supported by low nitrate concentrations in leachates in late winter)

Data from Sørensen et al. (2023).

# Conclusions

- Autumn vegetation is crucial for nitrate leaching deriving from mineralization of soil N
- A cover crop after a cereal crop reduced nitrate leaching from mineralized N by 52-65%
- A permanent grass vegetation had far lower nitrate leaching than a cover crop after spring barley. (20 kg N/ha vs 57 kg N/ha)
- High N leaching after tillage of set-aside, especially by no vegetation – e.g. by conversion of set-aside to forest!  
(349 kg N/ha leached with 150 kg N/ha in applied NPK)

# Thank you



Reference: Sørensen, P, Pedersen, BN, Thomsen, IK, Eriksen, J & Christensen, BT. 2023. Plant availability and leaching of  $^{15}\text{N}$ -labelled mineral fertilizer residues retained in agricultural soil for 25 years: A lysimeter study. *J Plant Nutrition and Soil Sci* 186, 441-450.