

# Effect of catch crops (CC) on $\text{NO}_3$ in groundwater

3-4 years of using various CC after maize and potato in NL

Willem van Geel, [René Rietra](#), Kevin Duan, Piet Groenendijk & John Verhoeven

LuWQ, session G1, Tuesday 3 June 2025 10:30, Aarhus



# content

- Problem
- Hypotheses
- Materials & methods (2)
- Results & discussion (7)
- Conclusions



-split-plot design, 4 replica's,  
-plots of 4.5 m x 12 m.

# problem

- NO<sub>3</sub> is exceeded in 60% of arable farms in Sand region of the Netherlands (period 2016-2019)
- Method: NO<sub>3</sub> in upper groundwater

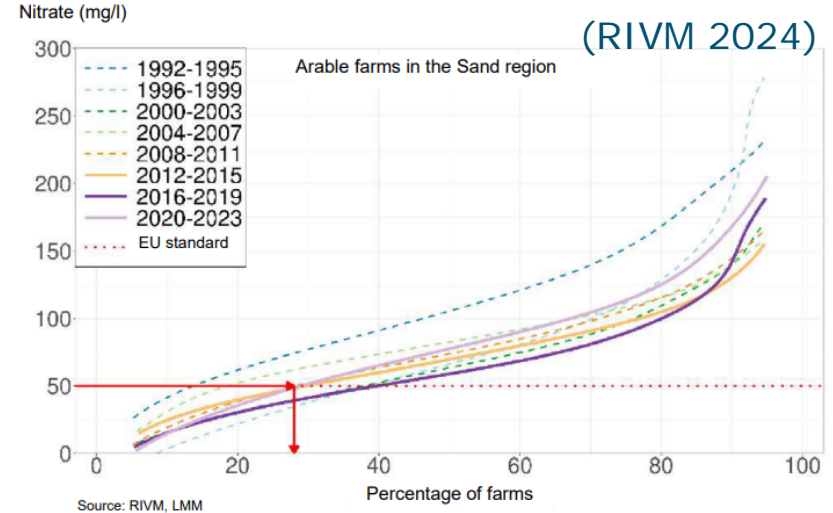
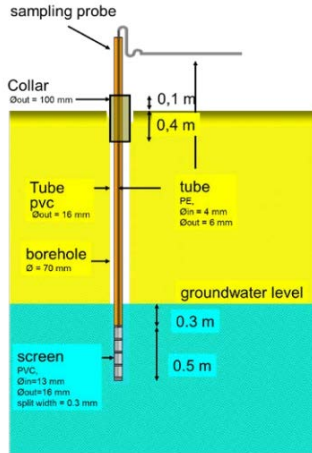
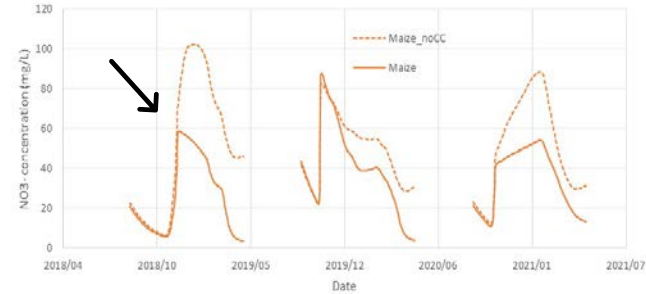


Figure 4.15 Nitrate concentration (as NO<sub>3</sub> in mg/l) in water leaching from the root zone on arable farms in the Sand region, shown as an acreage-weighted cumulative distribution of farm averages per period. (See Inset 4.3 for an explanation.)

- *research problem:*  
*limited data, on Winter Rye, and on rarely on NO<sub>3</sub> in gw*

# Hypotheses of effect of CC on $\text{NO}_3$



1. CC ↘  $\text{NO}_3$  leaching after maize and potato
2. choice of CC crop (Winter rye, Winter barley, Black oats)
3. Sowing time of CC after maize and potato (Sept, Oct)
4. Undersowing CC between maize  $\approx$  autumn CC (Italian rygrass, Tall fescue)
5. C increase denitrification (groundwater sampling)

# Materials & methods<sup>1/2</sup>

- Winter rye, Winter barley, Black oats after maize and potato

2 densities, 2 sowing dates and maize harvest dates (Sept, Oct),

two potato varieties x 2 N levels\*

- Italian ryegrass, Tall fescue undersowing of maize

4years, 1 N level\*, 3 maize types, 2 harvest moments

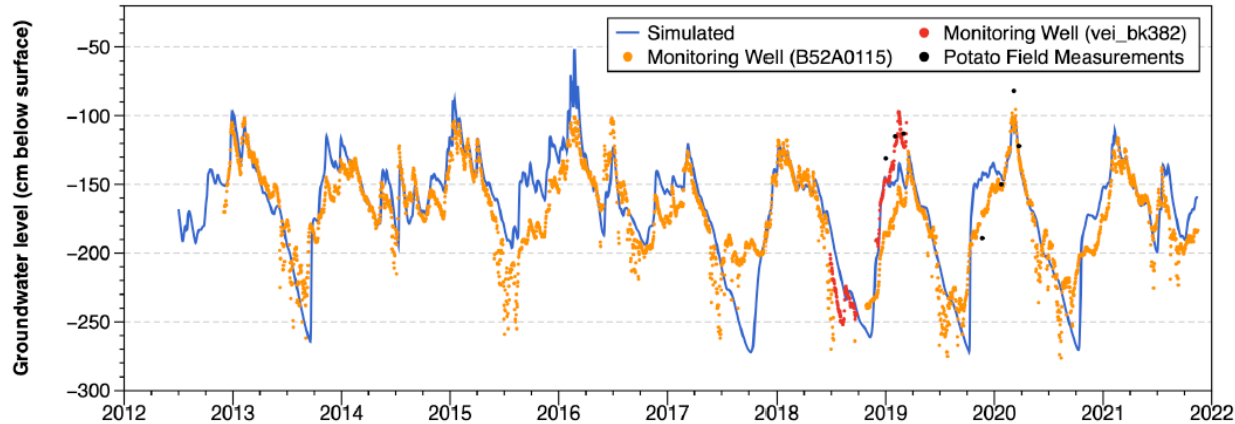
=>Every year new fields were used.

\* cattle slurry+CAN



# Materials & methods<sub>2/2</sub>

- 4 sampling moments between December-March
- $\text{NO}_3$  ,  $\text{NH}_4$ ,  $\text{PO}_4$ , DOC in groundwater
- $N_{\text{min } 0-90\text{cm}}$  in autumn and spring
- yield, N uptake by CC (including roots).
- Groundwaterlevel



# Results & discussion 1/7: Yields of potato and maize

## ■ Maize

	Yield ton/ha	Yield kg N/ha
None	19.1 b	223 b
Tall fescue	18.5 a	210 a
Italian Rye	19.2 b	222 b

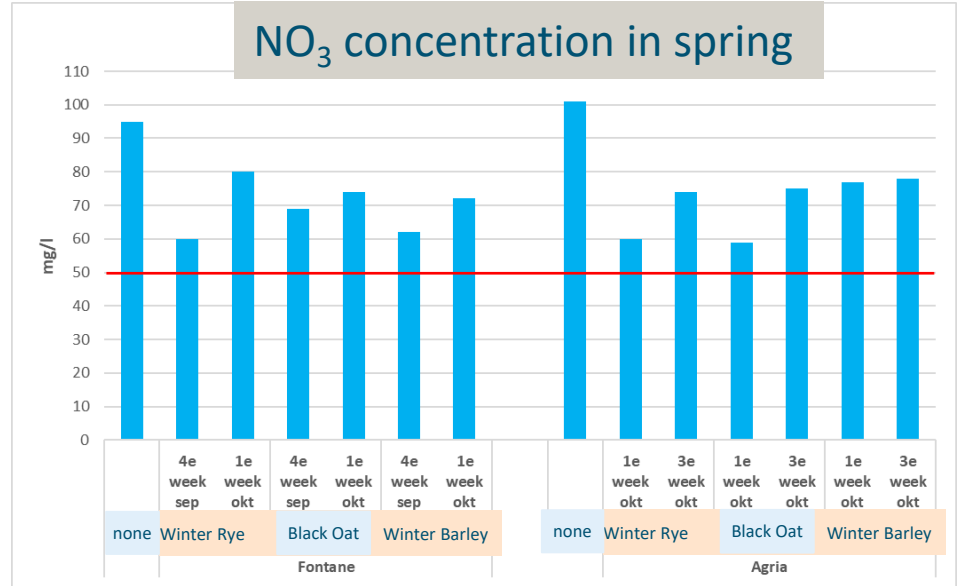
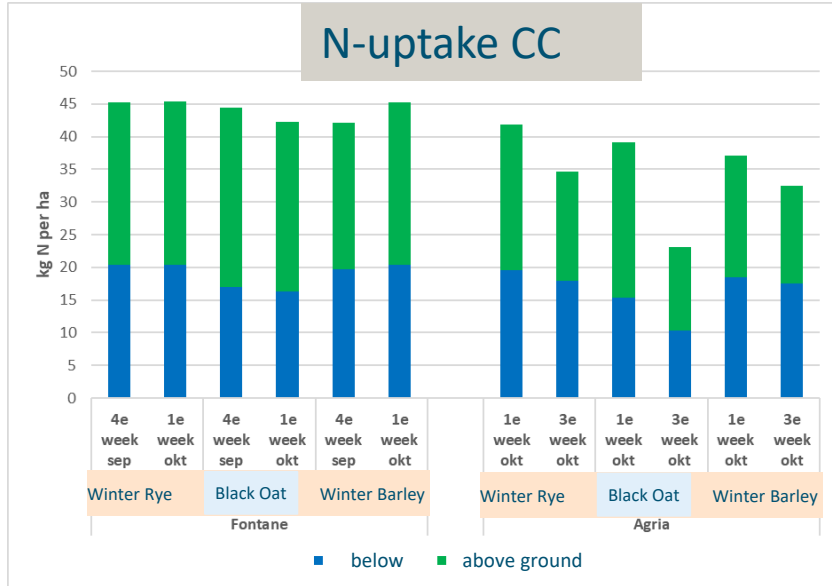
effect of  
undersowing CC

## ■ Potato

type	N fertilisation ton/ha	Yield ton/ha	Yield kg N/ha
fontane	High	12.7 b	197 c
	Low	12.5 b	176 b
Agria	high	12.1 ab	178 b
	low	11.9 a	158 a

effect of potato

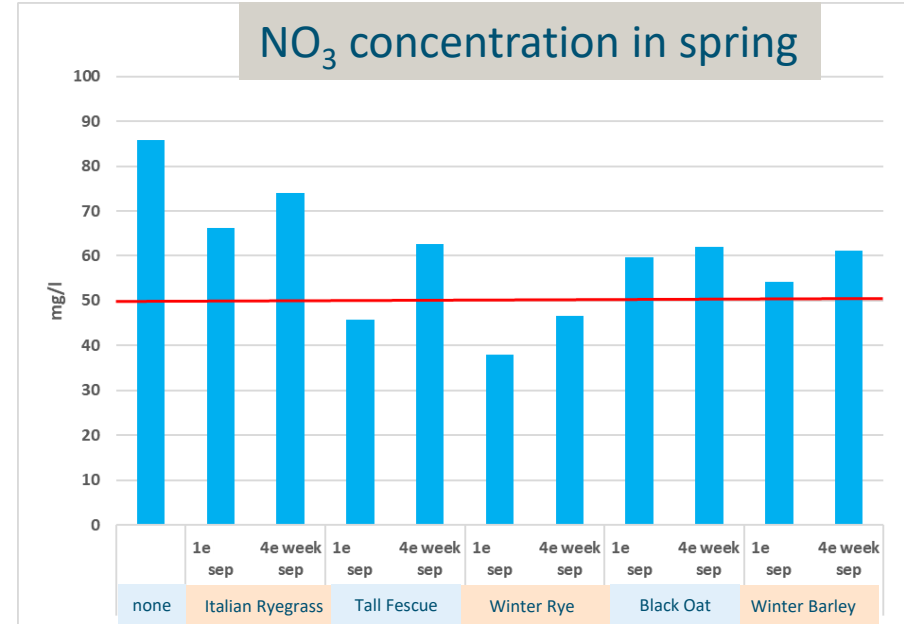
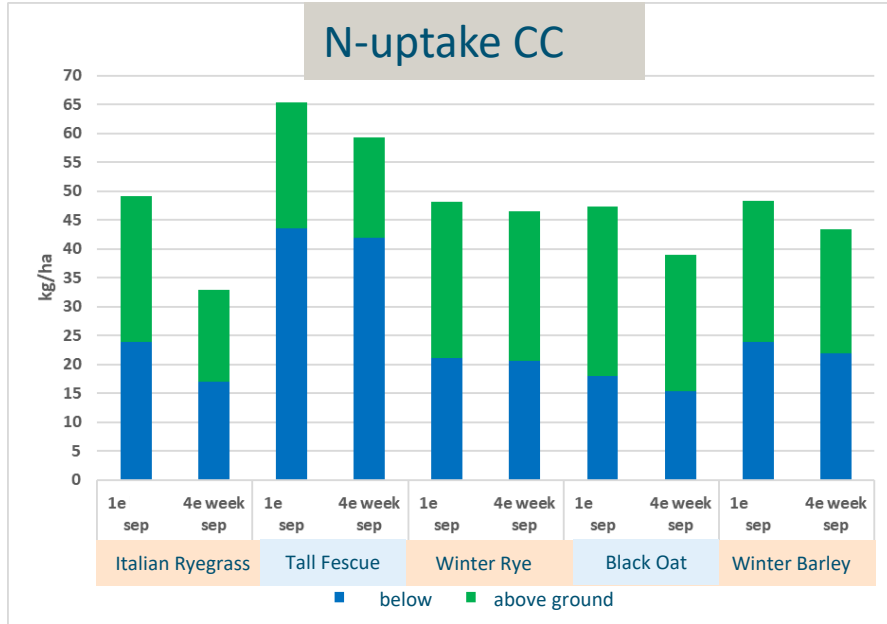
# Results<sub>d 2/7</sub>: Effect CC after potato



- NO<sub>3</sub> monitoring period was short (Dec-March)

	mg NO <sub>3</sub> L <sup>-1</sup>	kg N ha <sup>-1</sup>
None	98 b	38 c
Winter Rye	68 a	25 a
Black Oat	69 a	26 ab
Winter Barley	72 a	28 b

# Results<sub>d 3/7</sub>: Effect CC after maize



- N-uptake > decrease N leaching: short measuring period

	mg NO <sub>3</sub> L <sup>-1</sup>	kg N ha <sup>-1</sup>
None	87 c	32 c
Winter Rye	42 a	15 a
Black Oat	61 b	22 b
Winter Barley	56 b	21 b



# Results<sub>&d 4/7</sub>: Effect sowing time CC after maize

	mg NO <sub>3</sub> L <sup>-1</sup>	kg N ha <sup>-1</sup>
None	87 b	32 c
2-13 sept	50 a	18 a
23-25 sept	56 a	21 b

- Effect of CC is large, much more than effect of sowing time

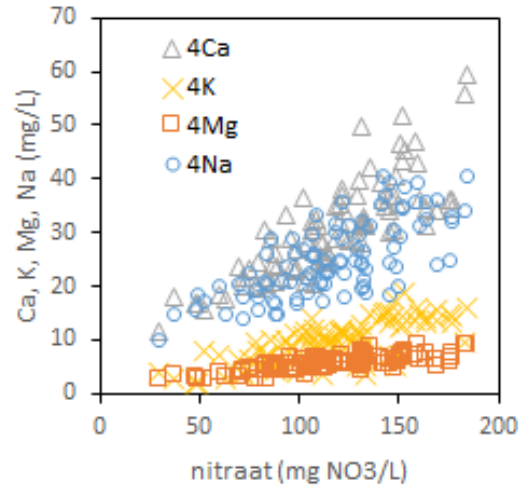
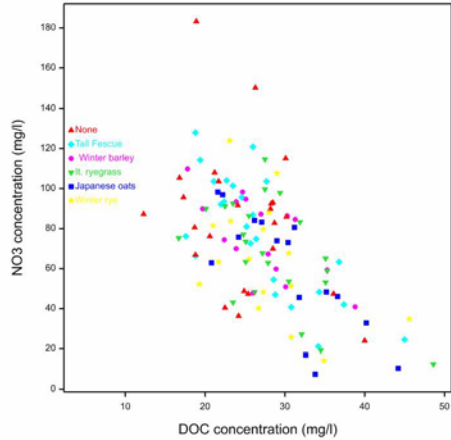
# Results<sub>&d 5/7</sub>: Effect CC undergrowth in maize



	mg NO <sub>3</sub> L <sup>-1</sup>	kg N ha <sup>-1</sup>
None	86 c	32 c
Tall Fescue	55 a	20 a
Italian Ryegrass	70 b	26 b

# Results<sub>&d 6/7</sub>: 6/7. Relations NO<sub>3</sub> with other ions

4 sampling occasions in each year    1 sampling occasion in spring

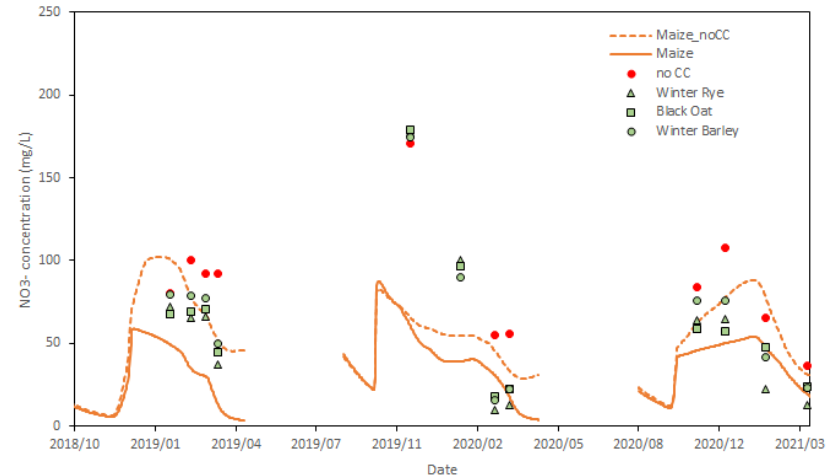
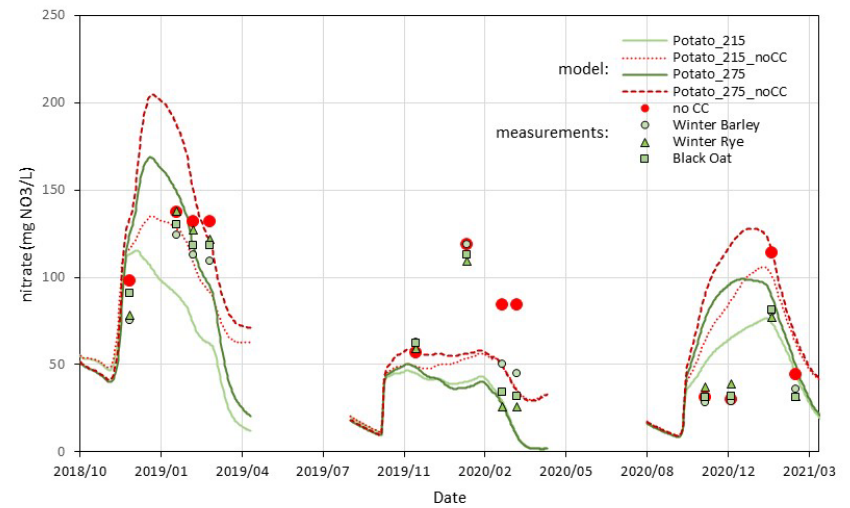


1. Denitrification?
2. Influence on NO<sub>3</sub> by uptake of Ca, Mg, K, Na?
3. Or just effect of ionic strength on soluble DOC?

# Results<sub>&d 7/7</sub>: modelling

## ■ Predictions (no denitrification)

Variation and uncertainty in measurements is large



# Conclusions

Experiment testing  $\text{NO}_3$  in groundwater, similar to national monitoring:

- CC decrease  $\text{NO}_3$  concentrations
- $\text{NO}_3$  exceed limit of 50 mg/l, also using CC.
- Effect depends on type of CC.

Questions:

- Relation with cations and DOC, and extrapolation to different soils.

# questions

