

Effects of organic matter input and cropping system on nitrate leaching, crop yield and soil quality in arable farming

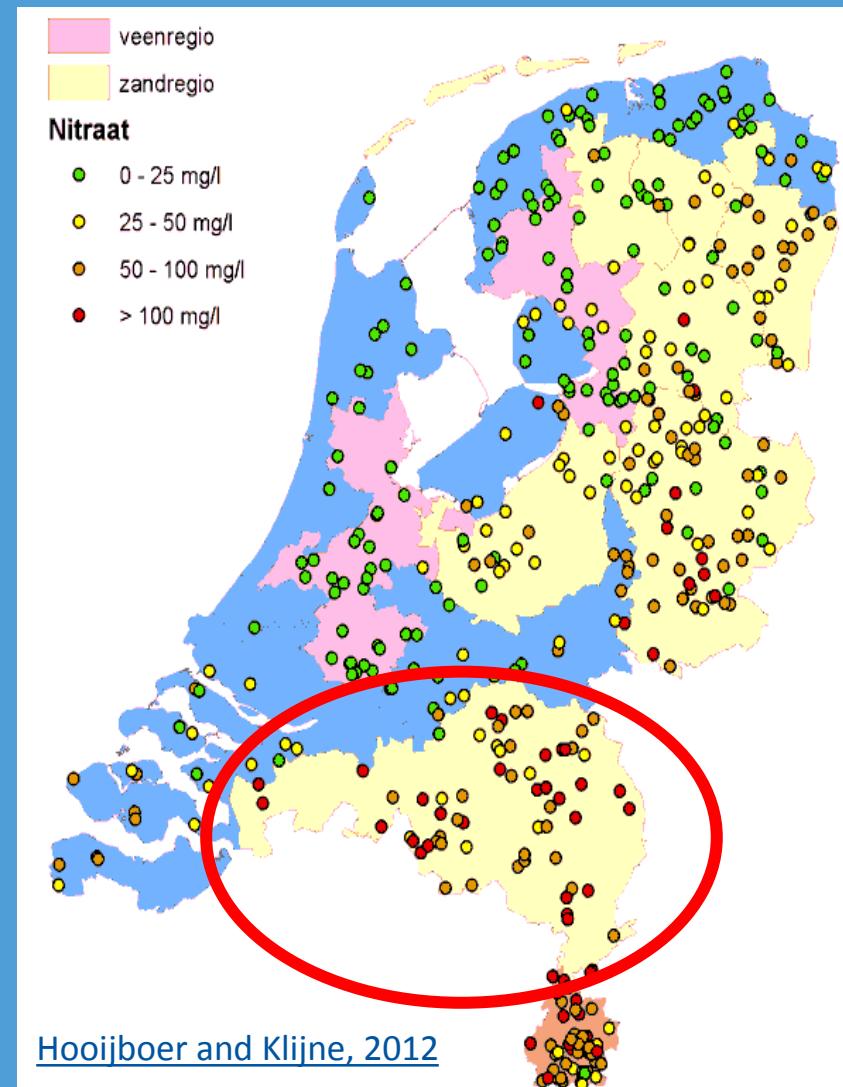
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Maarten Schrama, NIOO
N-workshop Lisbon, 2 July 2014*



High nitrate leaching in South East NL

Severe manure legislation

- Nitrate concentration too high
 - Arable farming sand region 79 mg/l
 - All farming Southern sand region 106 mg/l
- Legislation more severe
 - 2015: N-application norms leaching sensitive crops 30% lower than advice
- Decreasing crop yields and soil fertility expected



Is arable farming possible within the 50 mg/l?

- Optimization of fertilization is not sufficient
 - Easy measures have only limited effect
 - Measures with large effect have large bottlenecks
 - costs, applicability, unwanted side-effects,
 - System change needed
 - Soil and organic matter management
- Results of farming system trial Vredepeel



Research question

- What is the effect of organic matter input on:
 - Nitrate leaching
 - Crop yield
 - Soil quality
- Effective organic matter (EOM)

Farming systems research

1989
2000



2001

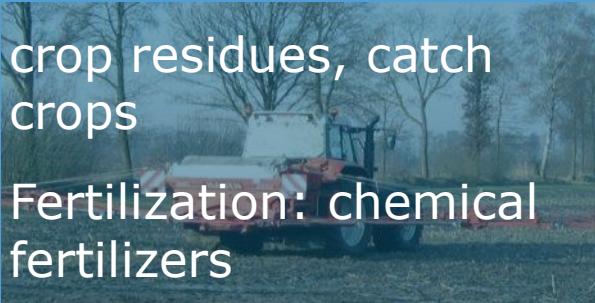
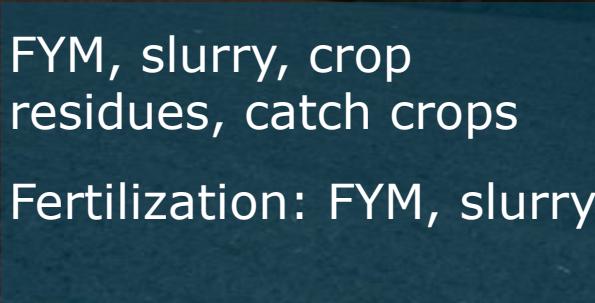


2005

Soil Quality on Sandy Soils

2008
2011
2016

Comparison effective organic matter input

Conventional	Organic
<i>Low EOM input</i> AF 800 kg eom/ha/yr	<i>Average EOM input</i> MAN 1550 kg eom/ha/yr
 crop residues, catch crops Fertilization: chemical fertilizers	 slurry, crop residues, catch crops Fertilization: chemical fertilizers, slurry
 <i>High EOM input</i> BIO 2750 kg eom/ha/yr	 FYM, slurry, crop residues, catch crops Fertilization: FYM, slurry

Crop rotation



- Full crop rotation
- Important crops of the region
 - Arable crops, vegetables and feed crops
 - Mow crops and root crops
- Maximum use of green manure crops
- Organic
 - Different rotation than conventional before 2011
 - Carrots in stead of sugar beet

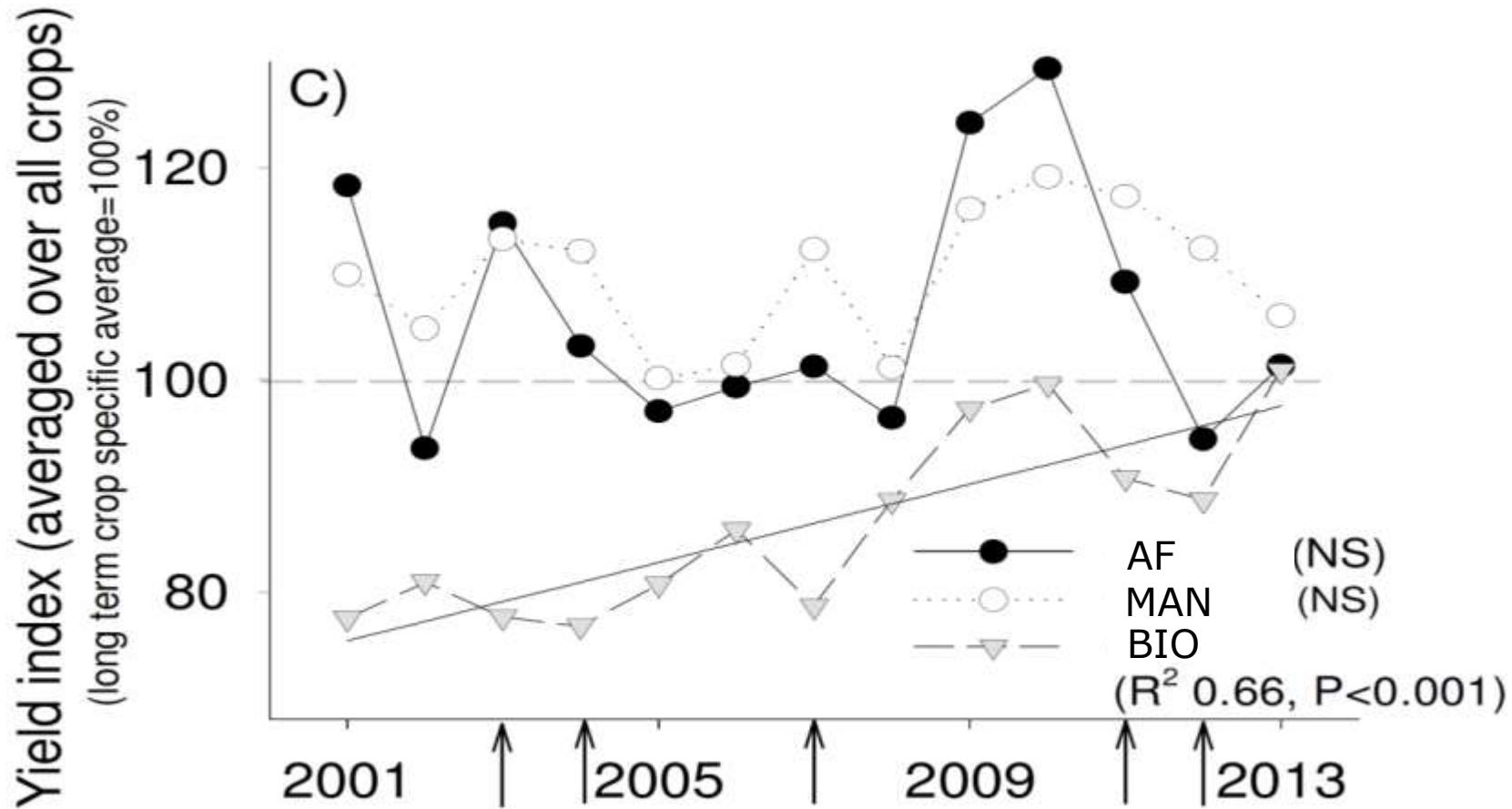
Difference in crop condition: MAN and AF



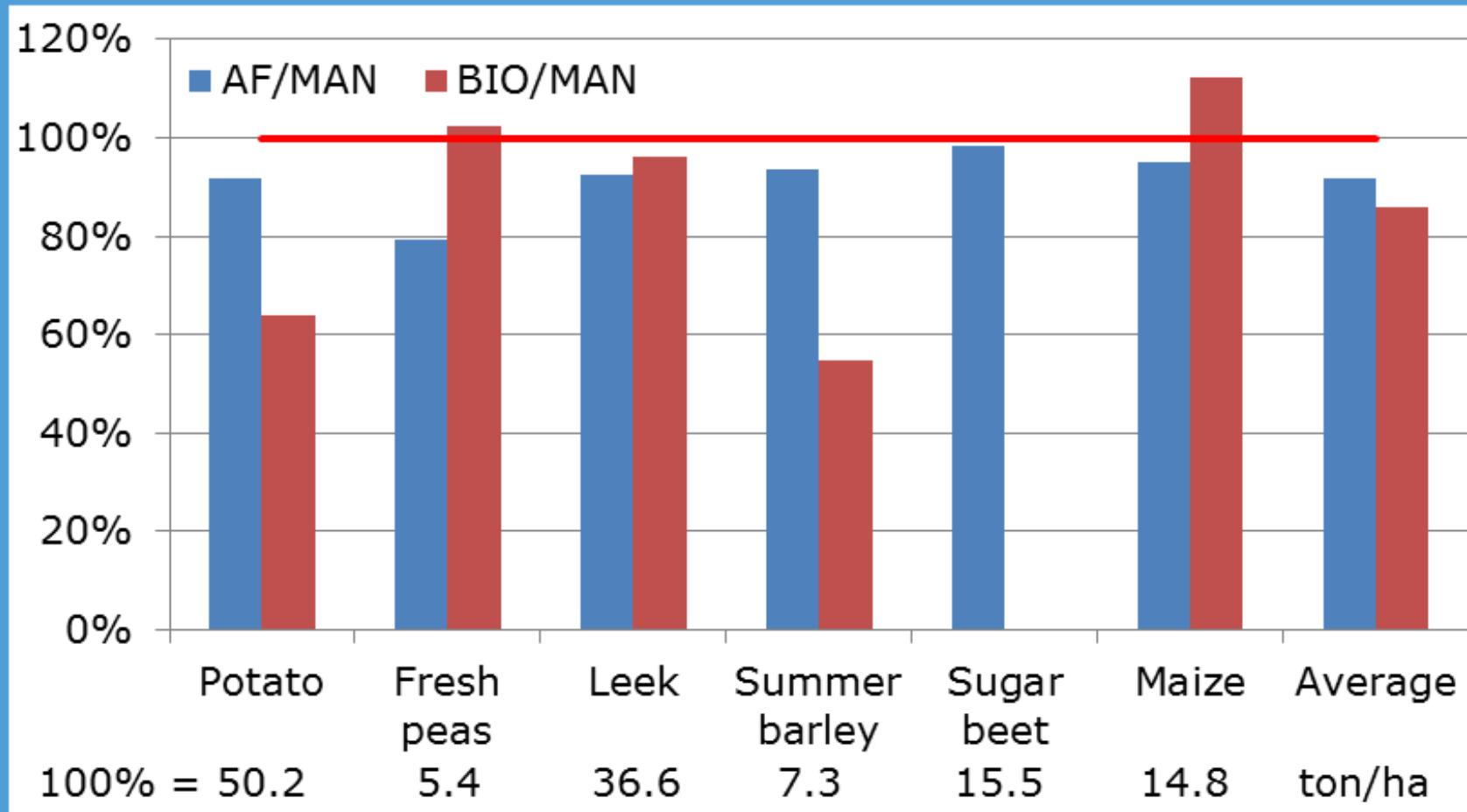
Difference in crop condition: AF and MAN



Crop yield trend 2001-2013

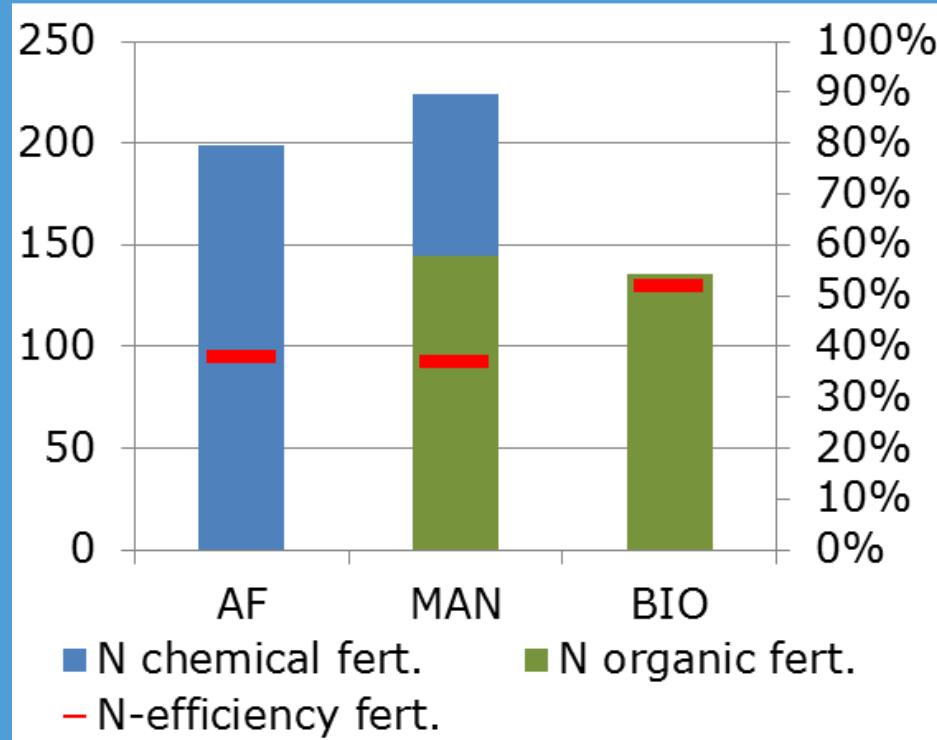


Relative crop yield AF/MAN and BIO/MAN average 2011-2013

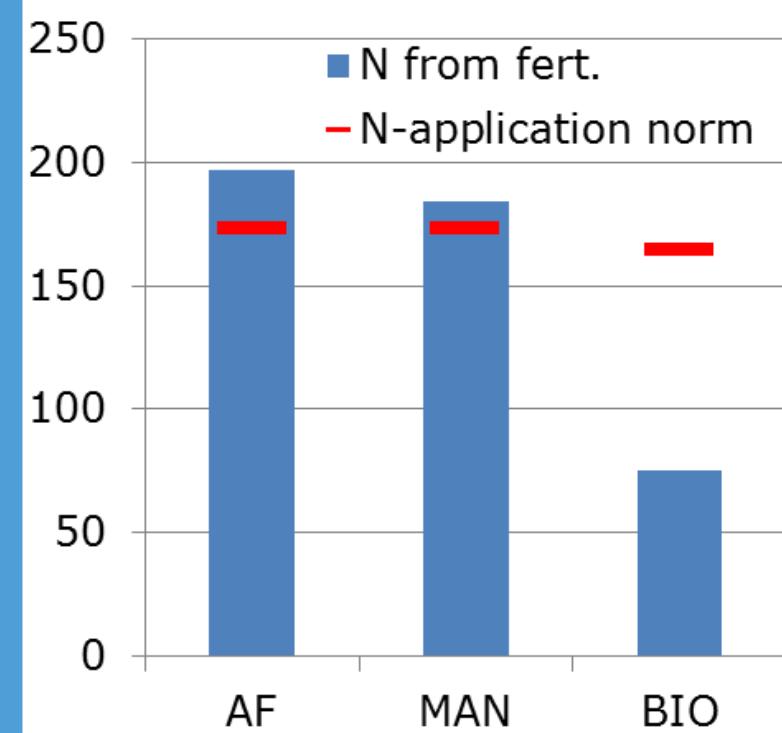


Nitrogen input 2011-2013 (kg/ha)

Total nitrogen input & efficiency

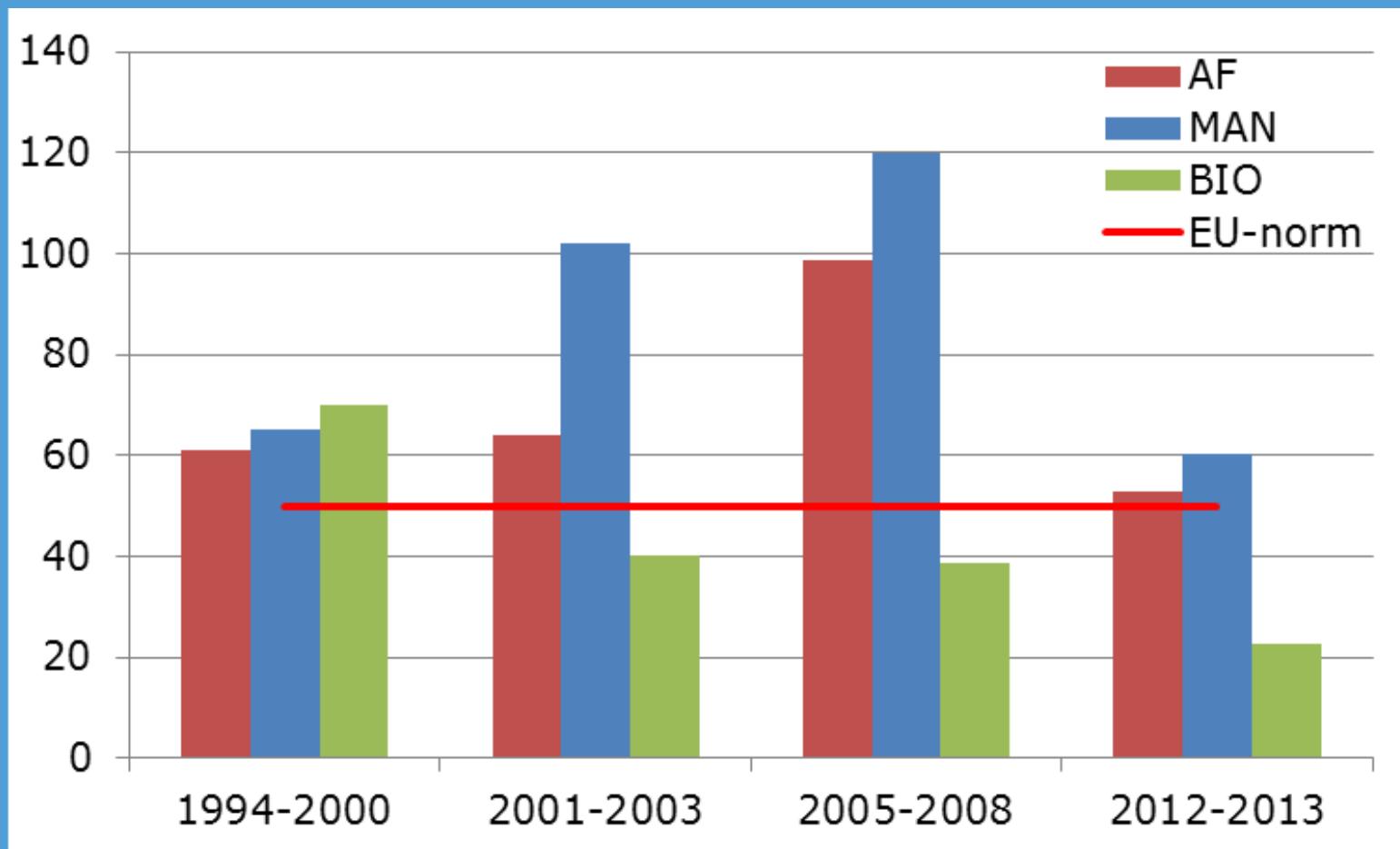


Available nitrogen input

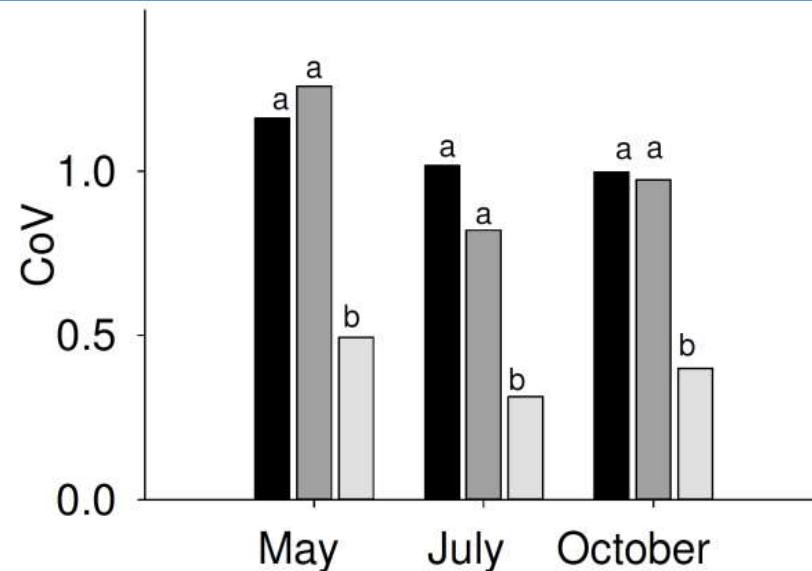
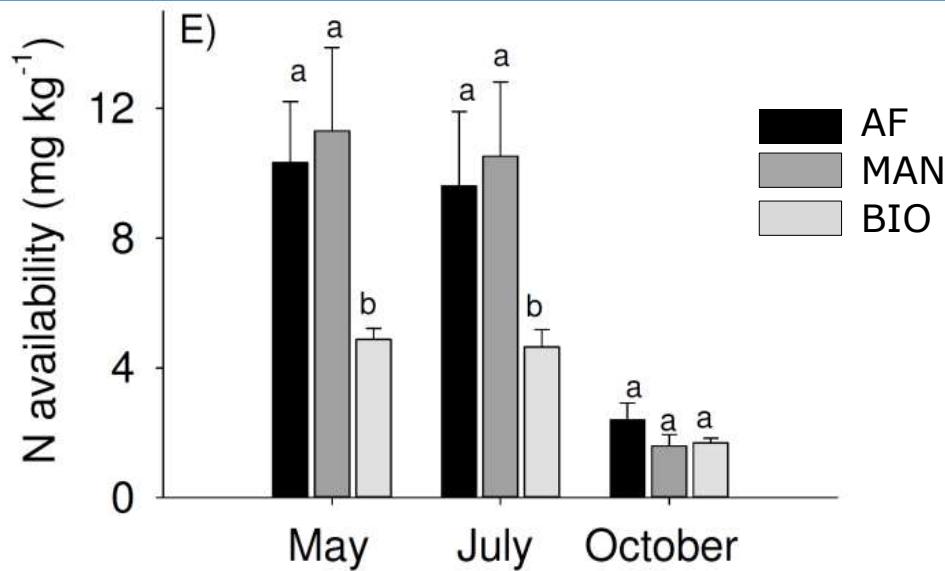


Nitrate concentrations in groundwater

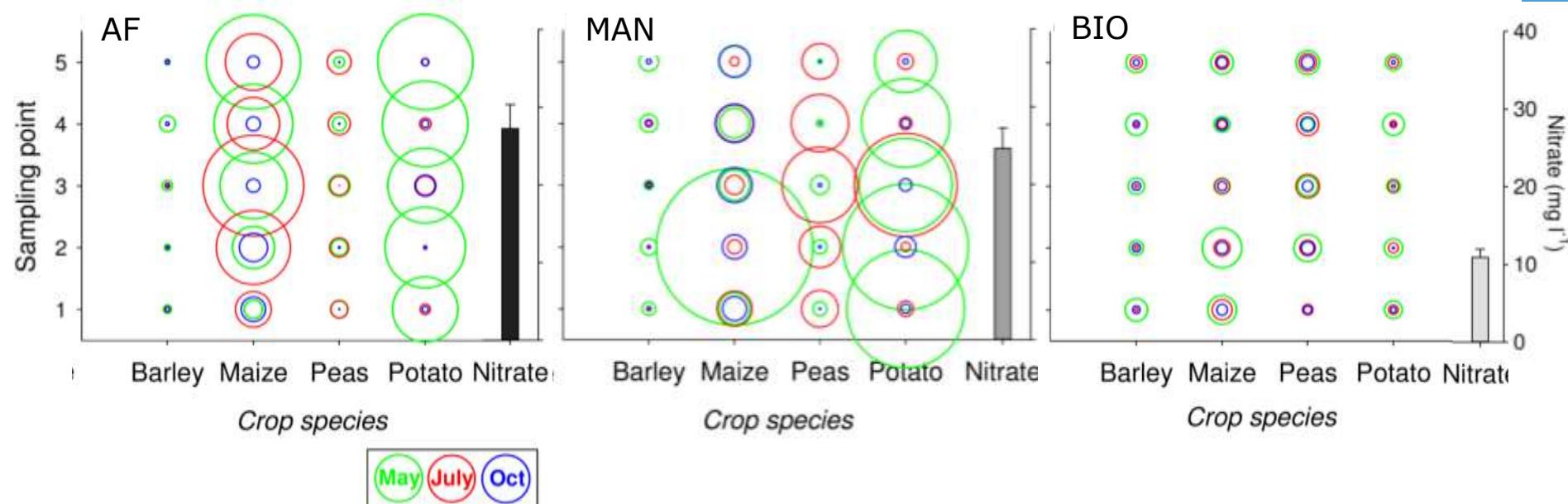
mg NO₃⁻/l



Spatial variation of mineral nitrogen



Spatial variation of mineral nitrogen



Conclusions AF/Low organic matter input

AF has compared to MAN:

- Decreasing yields (ns)
- Relative small decrease in nitrate leaching
- Similar fertilization level
- Higher costs and lower returns
- Decreasing soil quality?

→ *No feasible solution to reduce nitrate leaching*

Conclusions BIO/High organic matter input

BIO has compared to MAN:

- Increasing yield level
- Low nitrogen fertilization
- Low nitrate leaching
- Higher potential C- and N-mineralization
- Low spatial and temporal variability: higher stability

→ *What is the cause: organic matter input or no chemicals*
→ *From 2011 plots in MAN and AF with additional compost*

Thank you for
your attention

