Why we should consider arable soil function for sustainable production - Plant interaction with the soil N cycle as a case study

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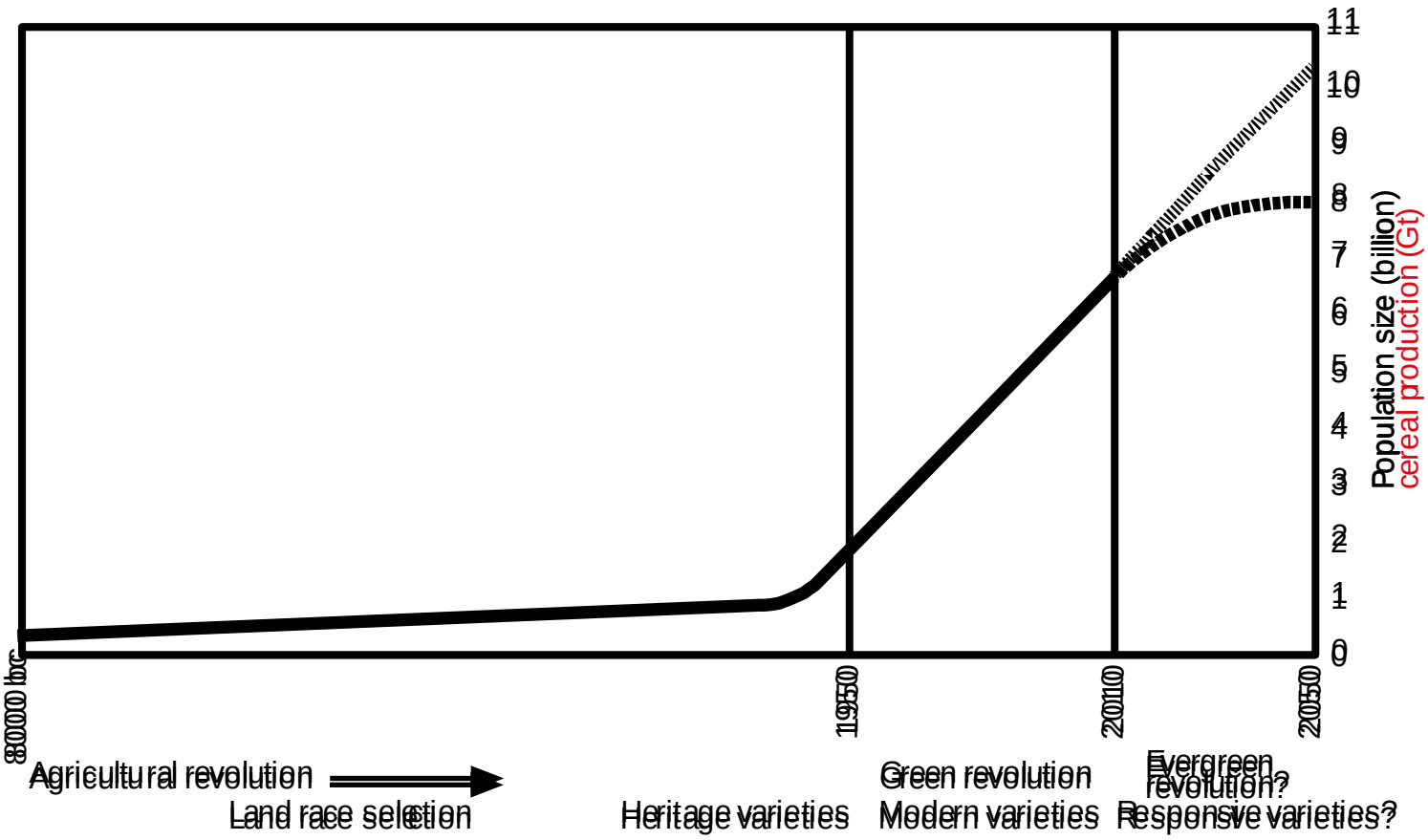
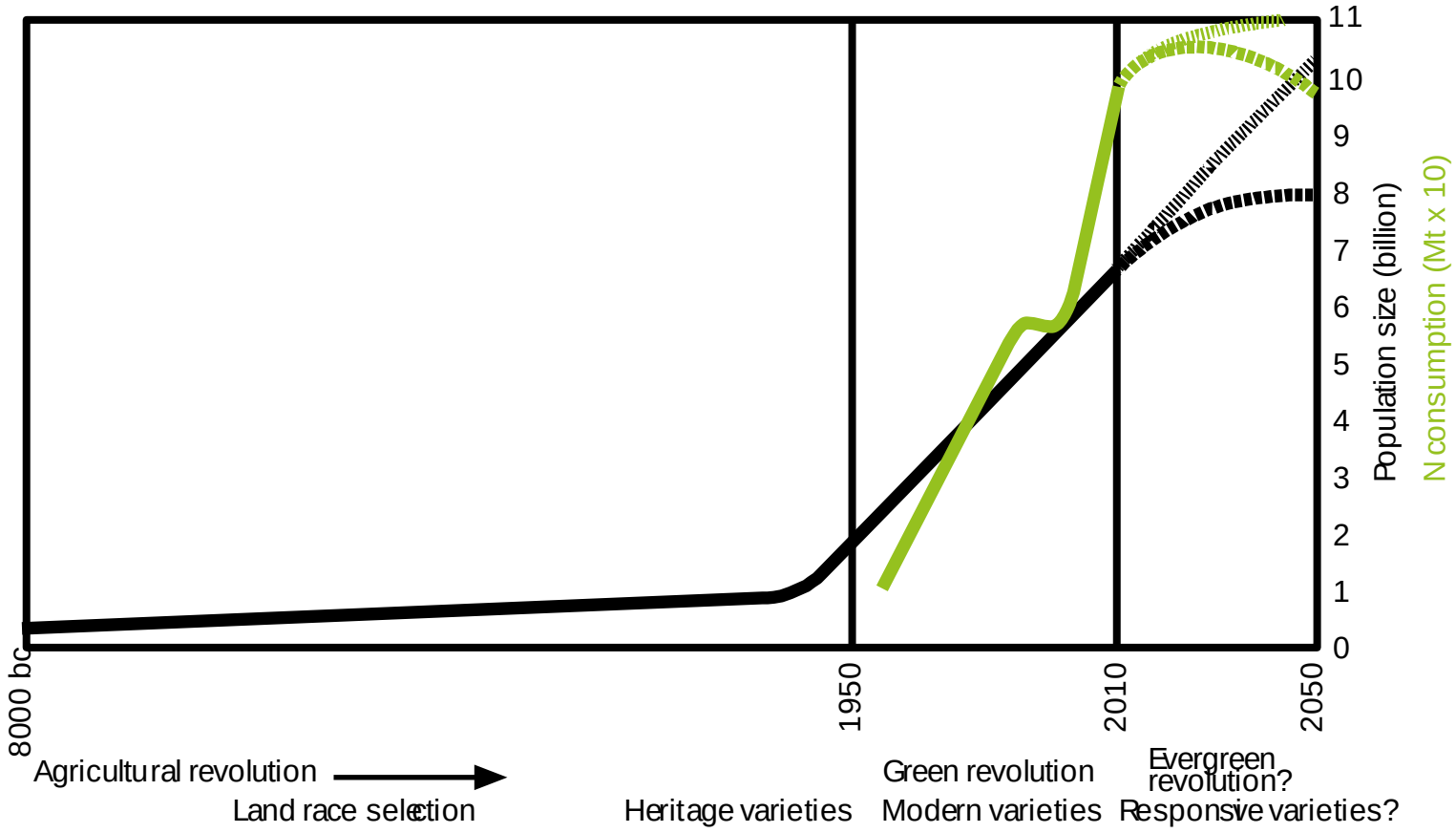
Tim Daniell

World population



2012. FAOStat Database. (http://faostat.fao.org/ **UN scenarios**

Is current agriculture sustainable?



2012. FAOStat Database. (http://faostat.fao.org/

GHG emissions

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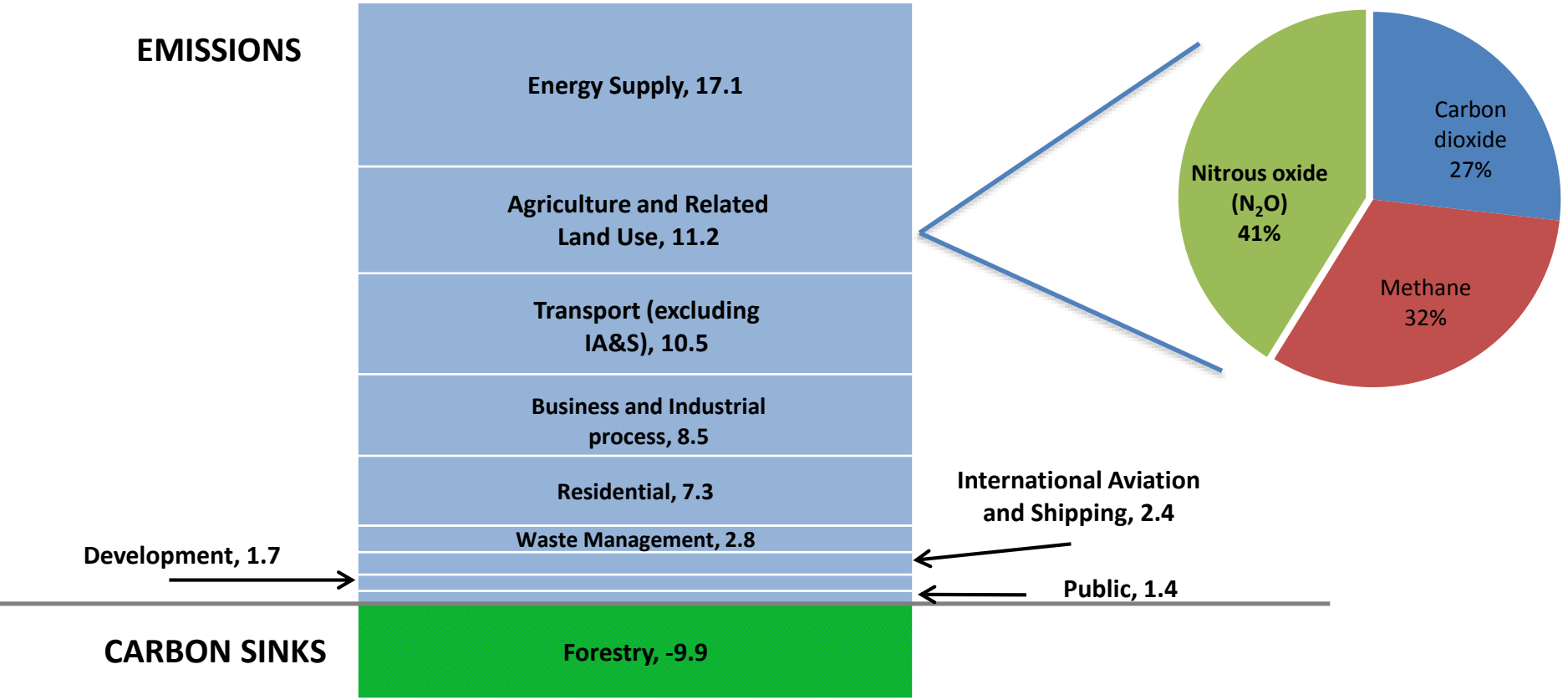
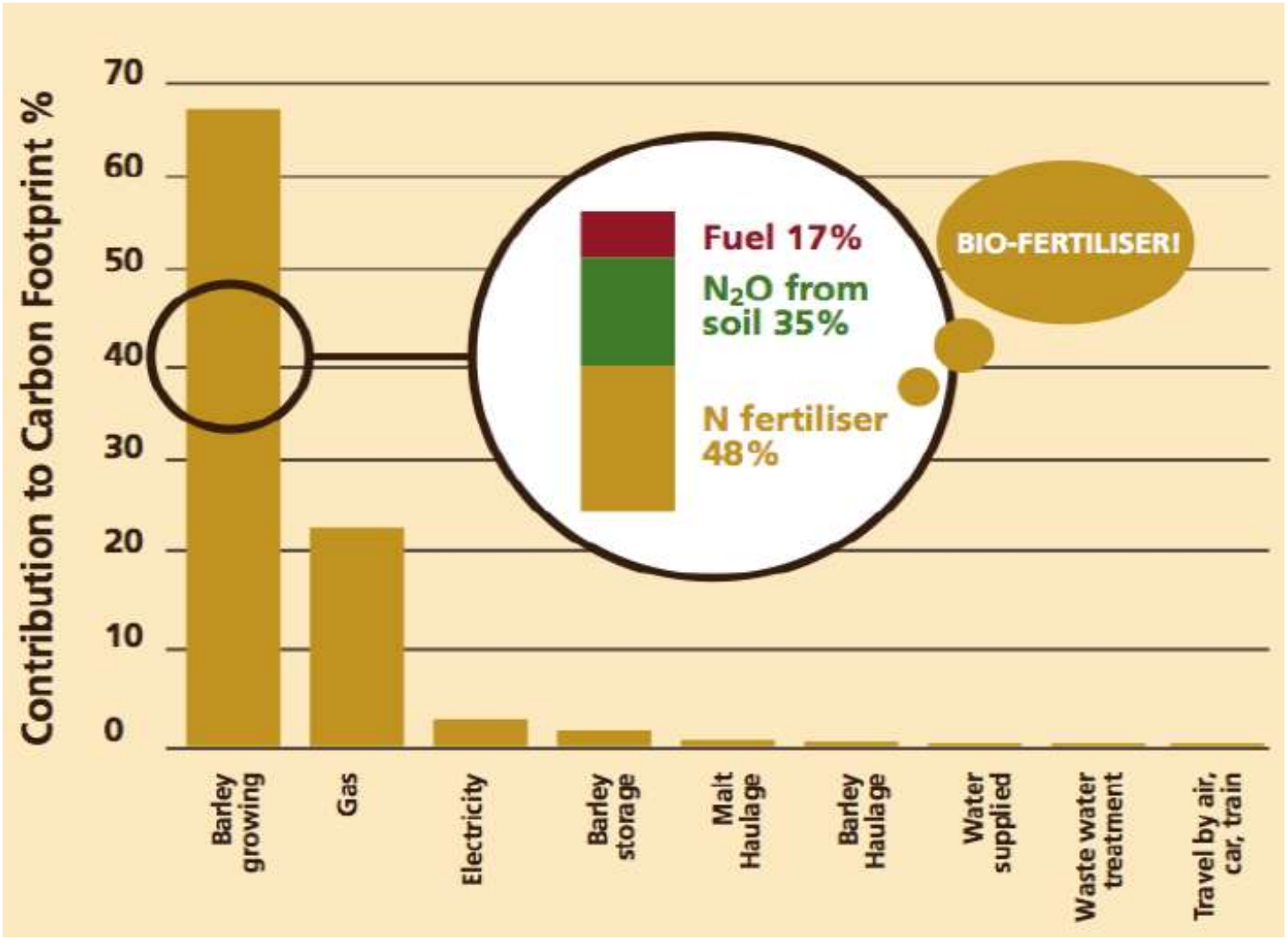
Sources of Scottish Greenhouse Gas Emissions, 2012. Values in Mt CO_2e



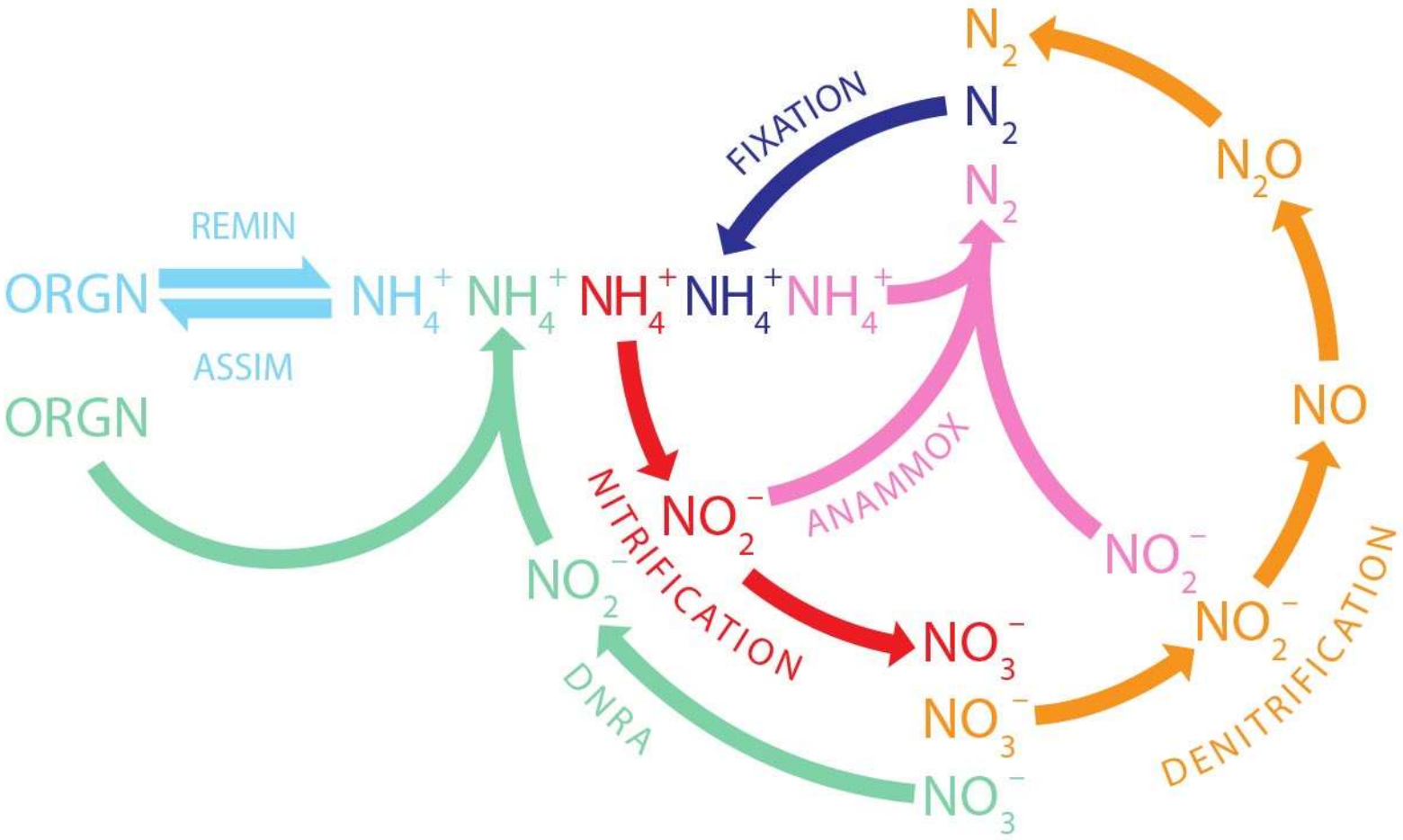
Scottish Greenhouse Gas Emissions 2012. Scottish Government

Carbon footprint malt production

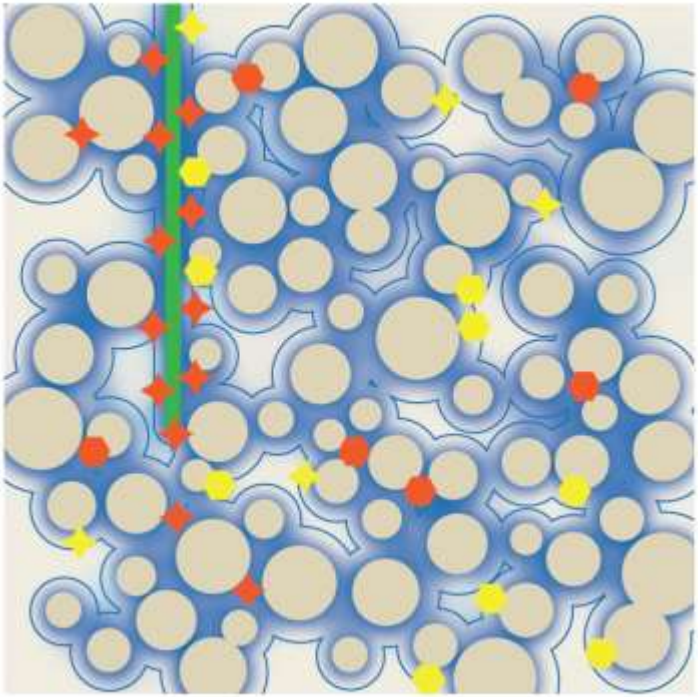


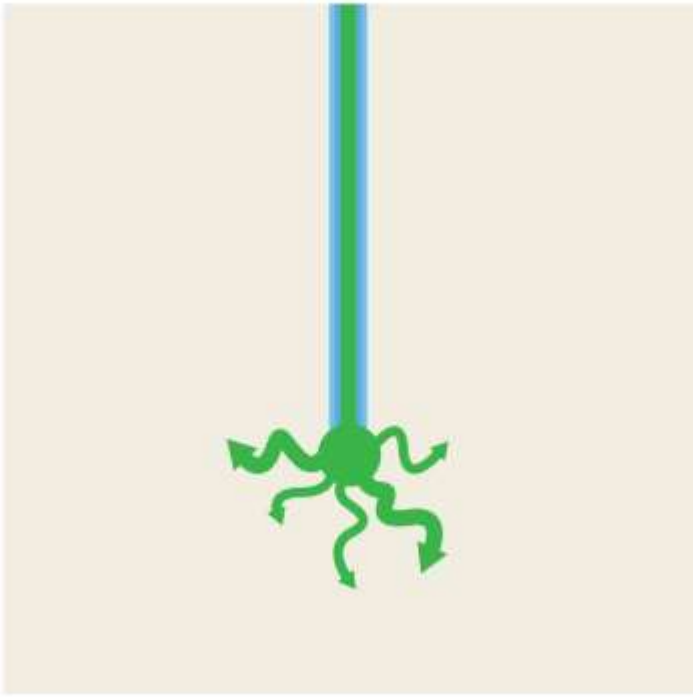
http://www.muntons.com/wp-content/uploads/2012/05/Carbon-Footprinting-Muntons-Low-Carbon-Malt-Pledge-1.pdf

The Nitrogen Cycle

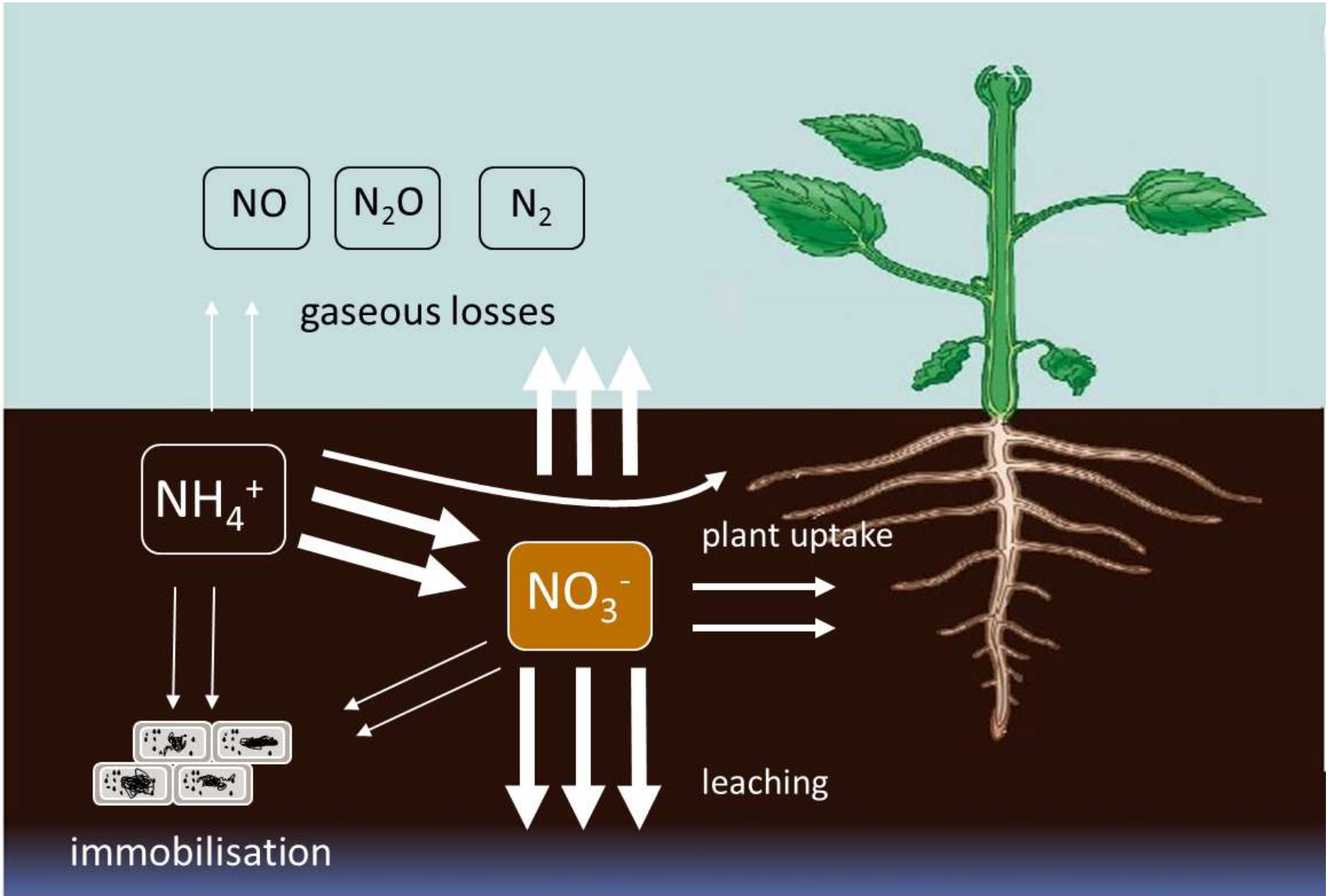


Why do we fail to connect flux and community





Losses of N in nitrification dominant systems



Fate of N in high-BNI systems

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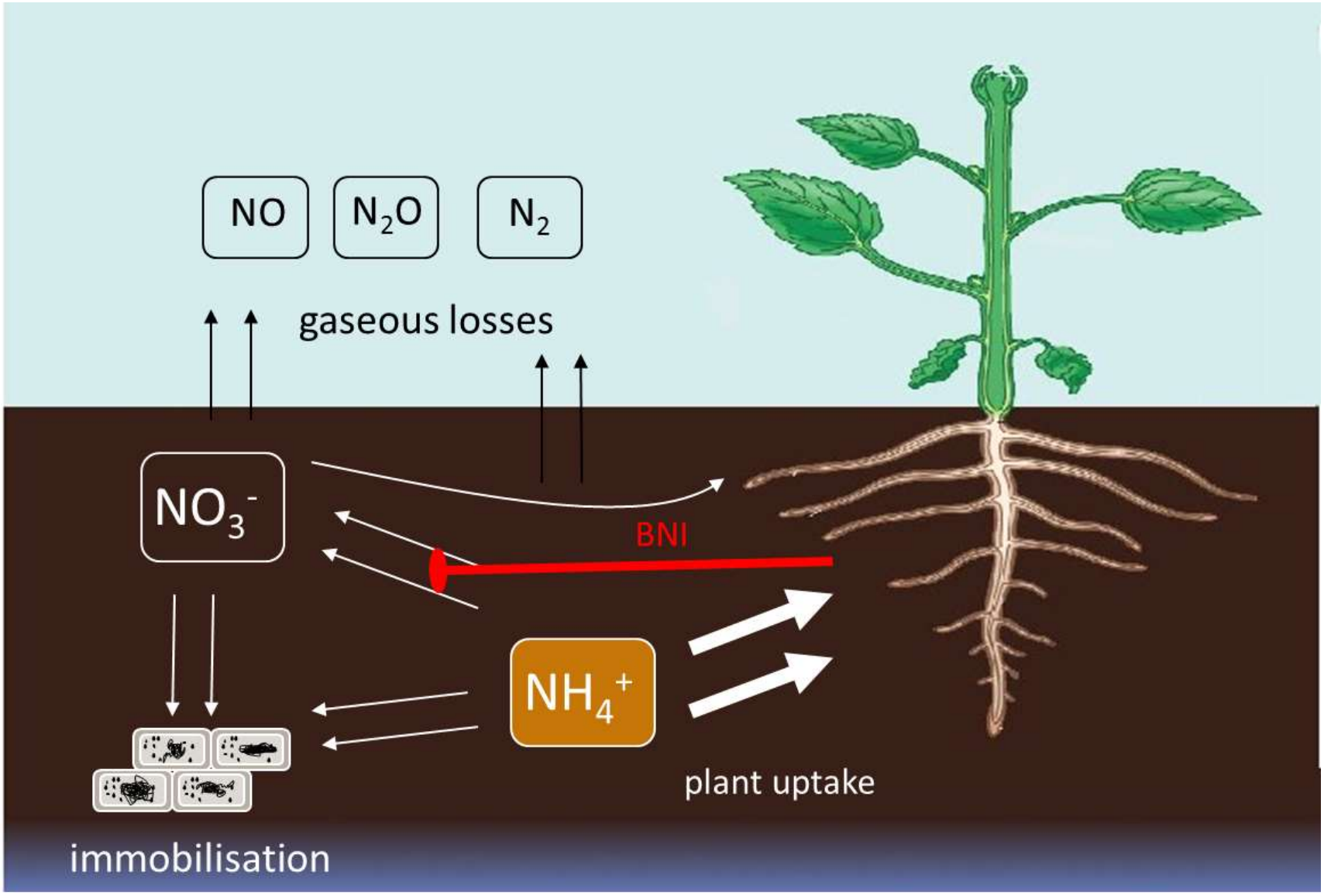
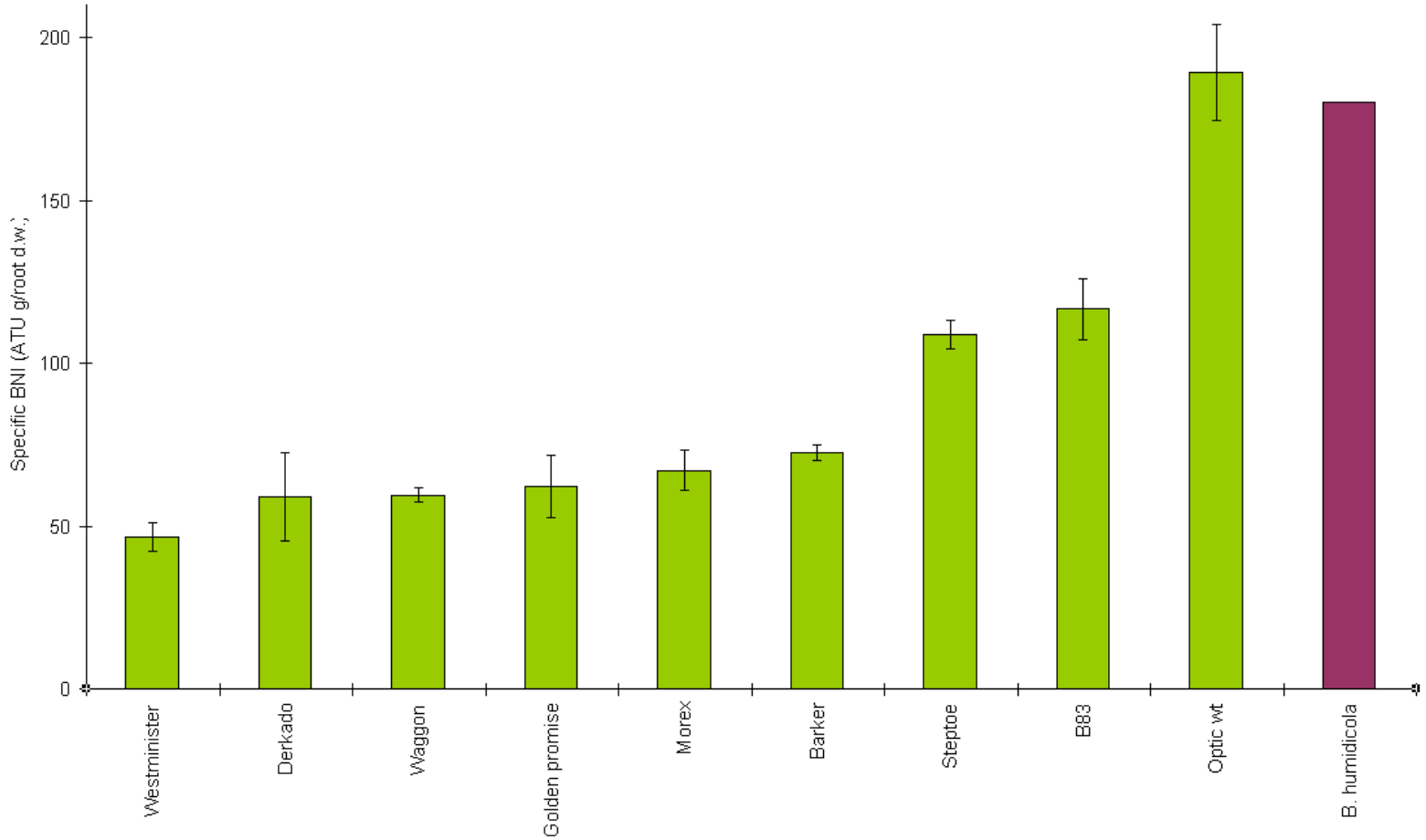
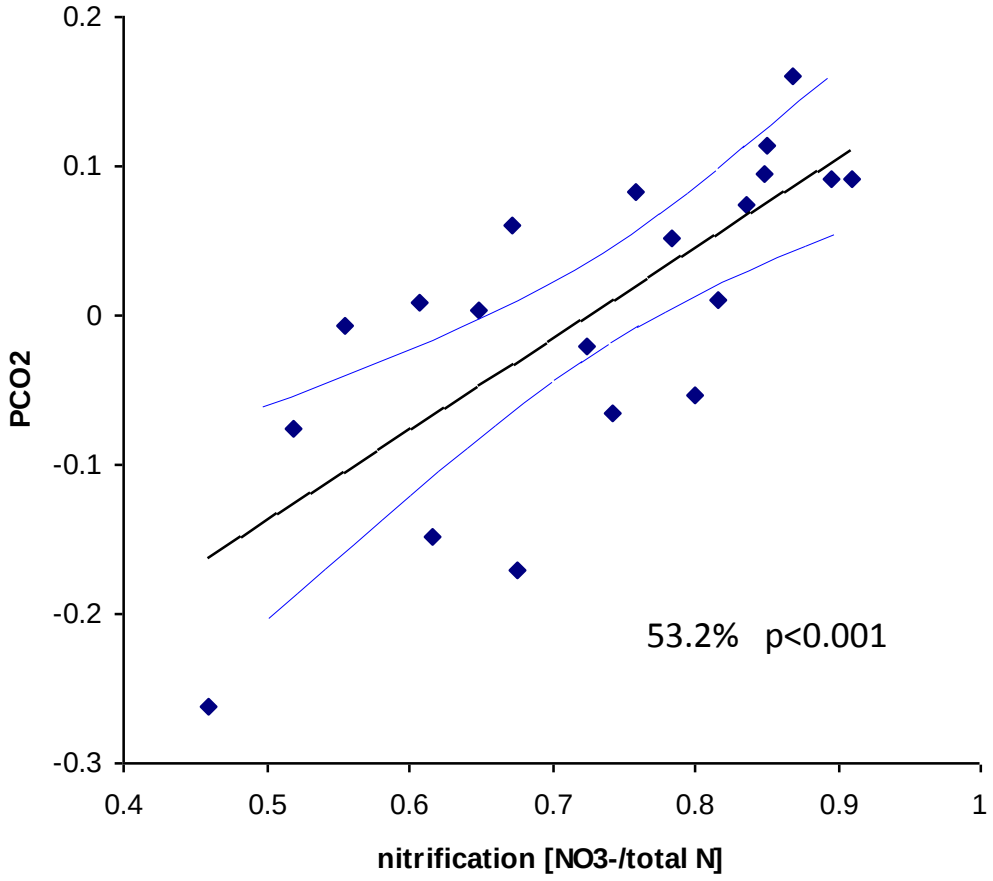


BNI activity in barley



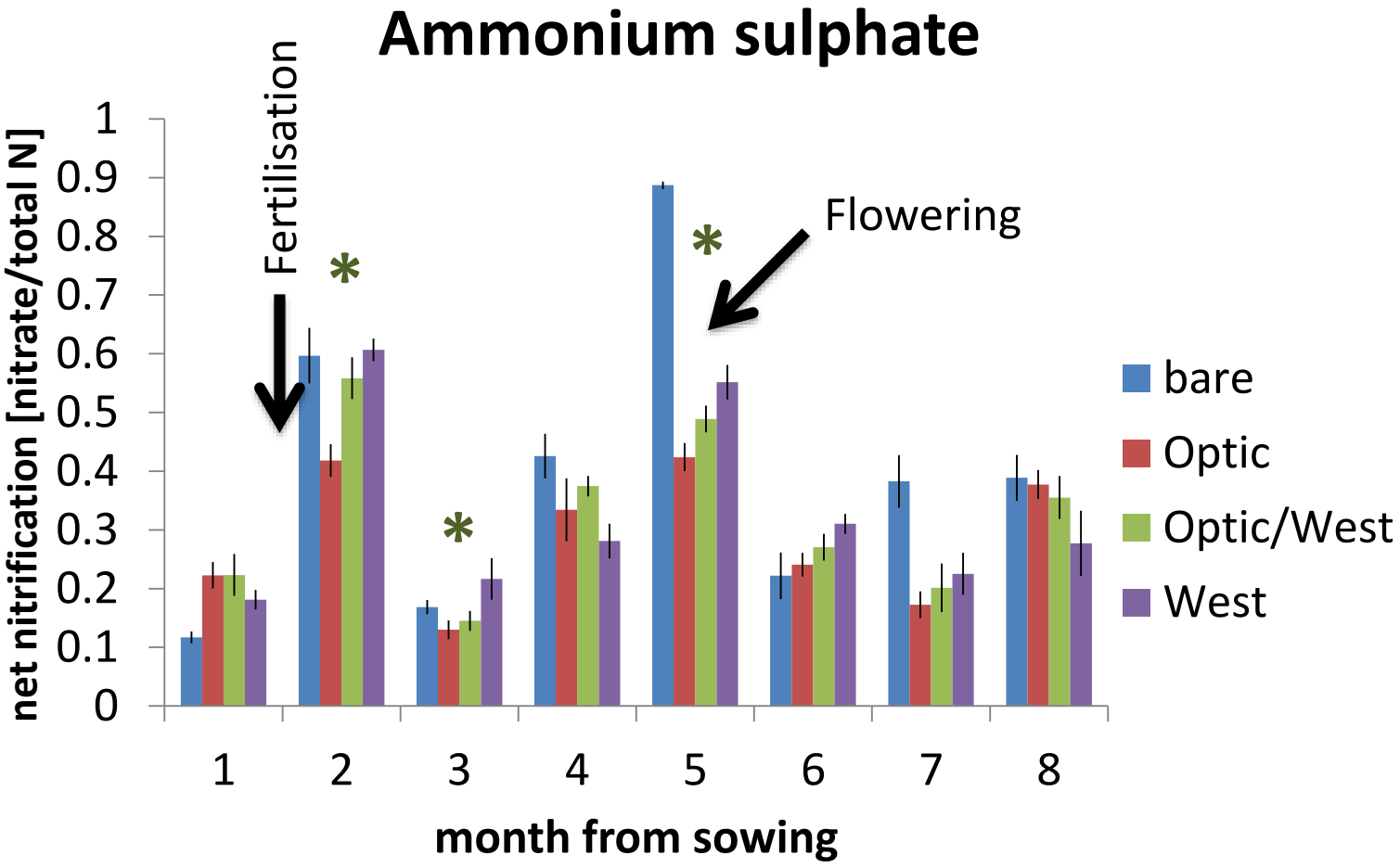
AOB community correlated with nitrification



Principal Coordinates Analysis of T-RFLP reveals significant differences in AOB community structure between barley lines

PCO 2 – 7.6% variation

Effective in the field



Variation in plant driven denitrification

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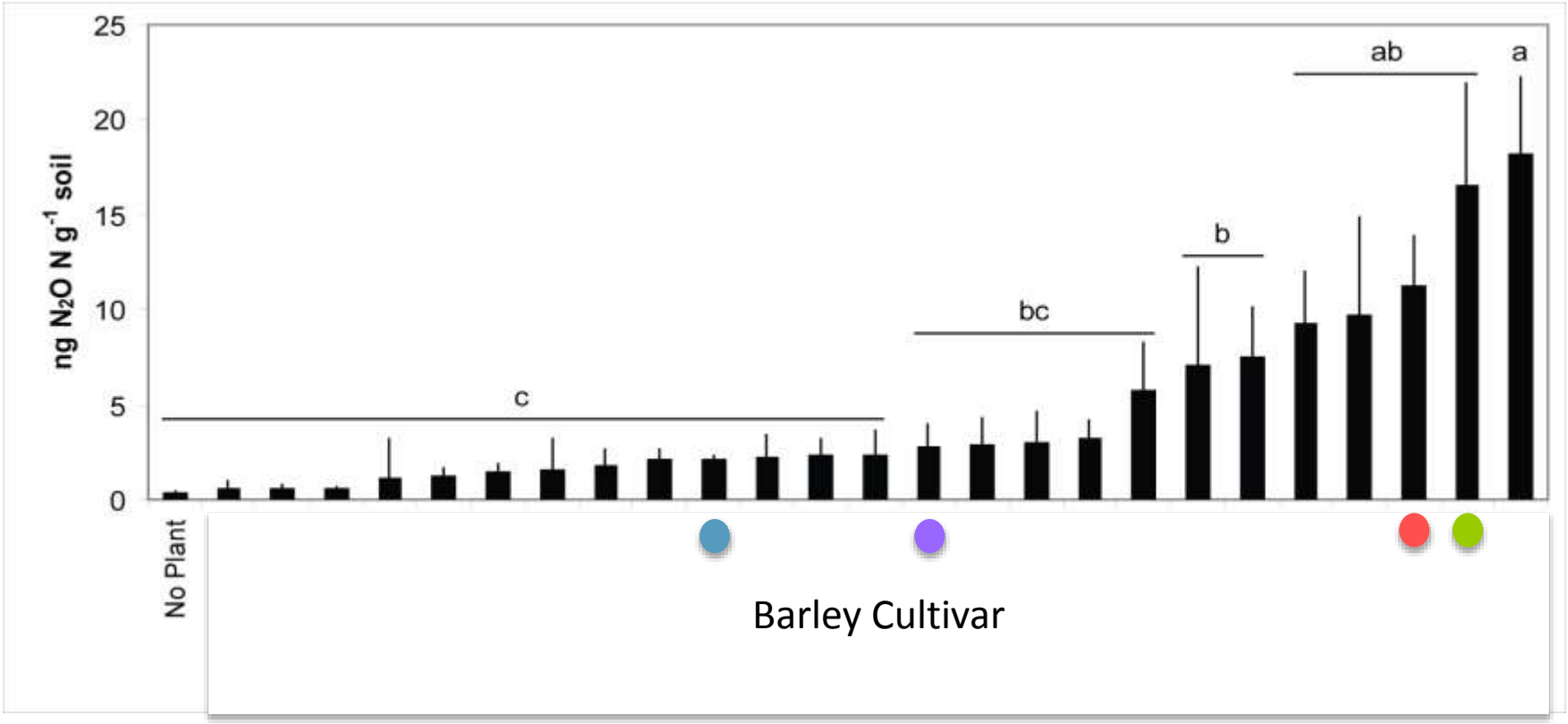
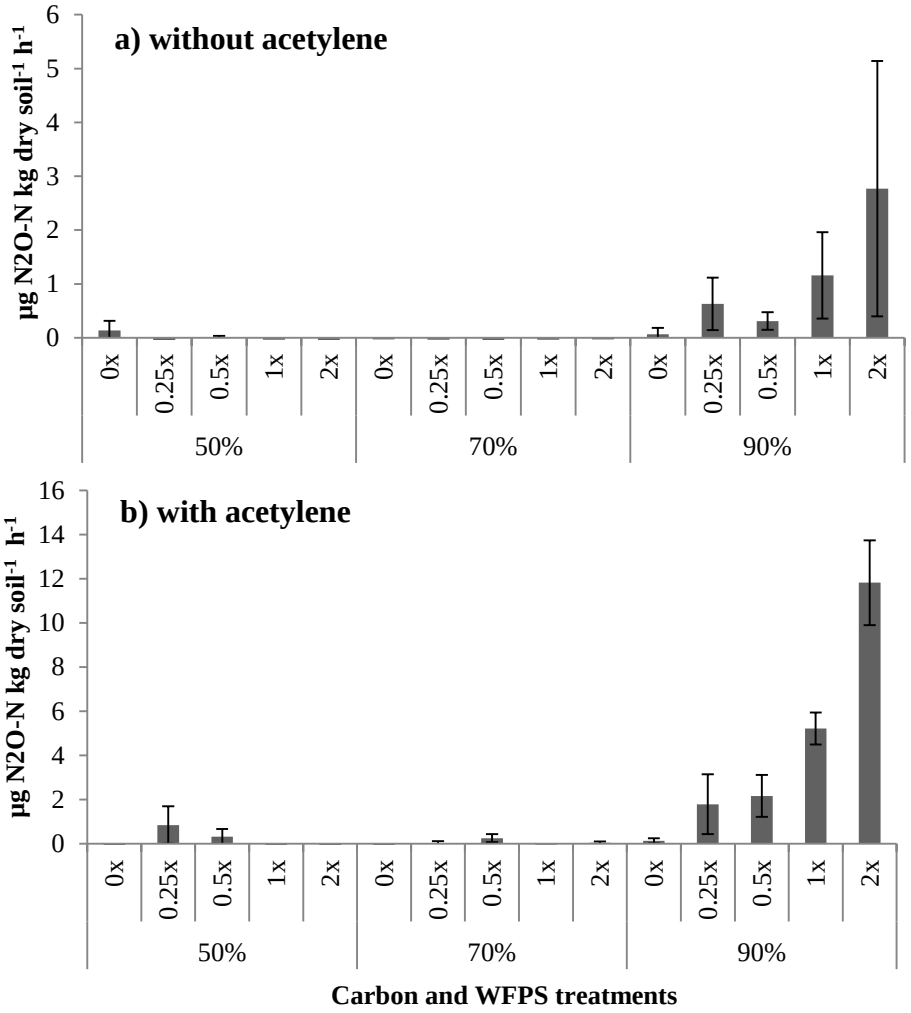
- Barley as a plant model
  - Size
  - Diploid nature
  - Access to resources
- Screen to identify variation in emission
- Dissection of plant development
- Assessment of effects of soil condition

Barley cultivars affect N_2O emission

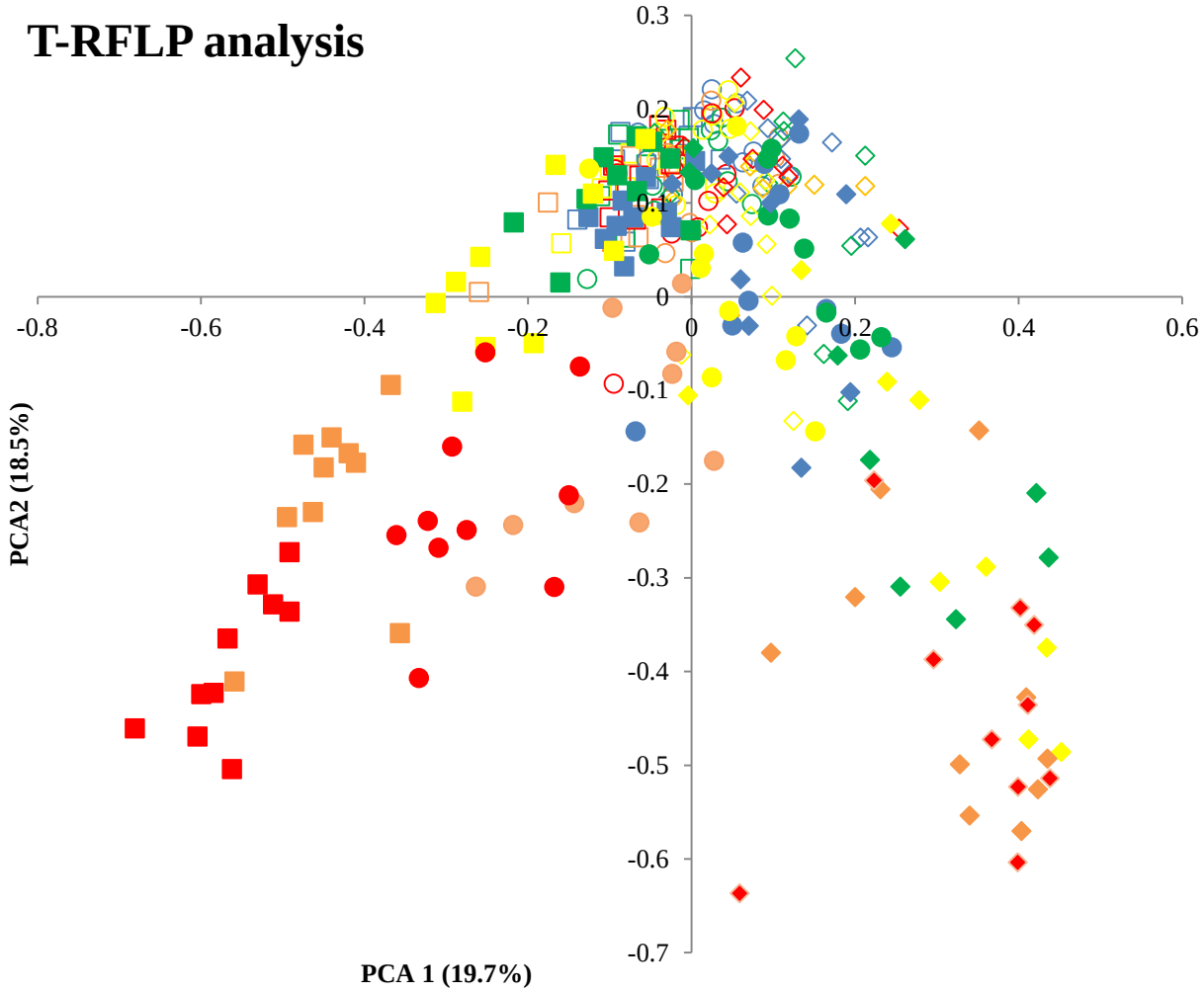


Addition of artificial root exudate



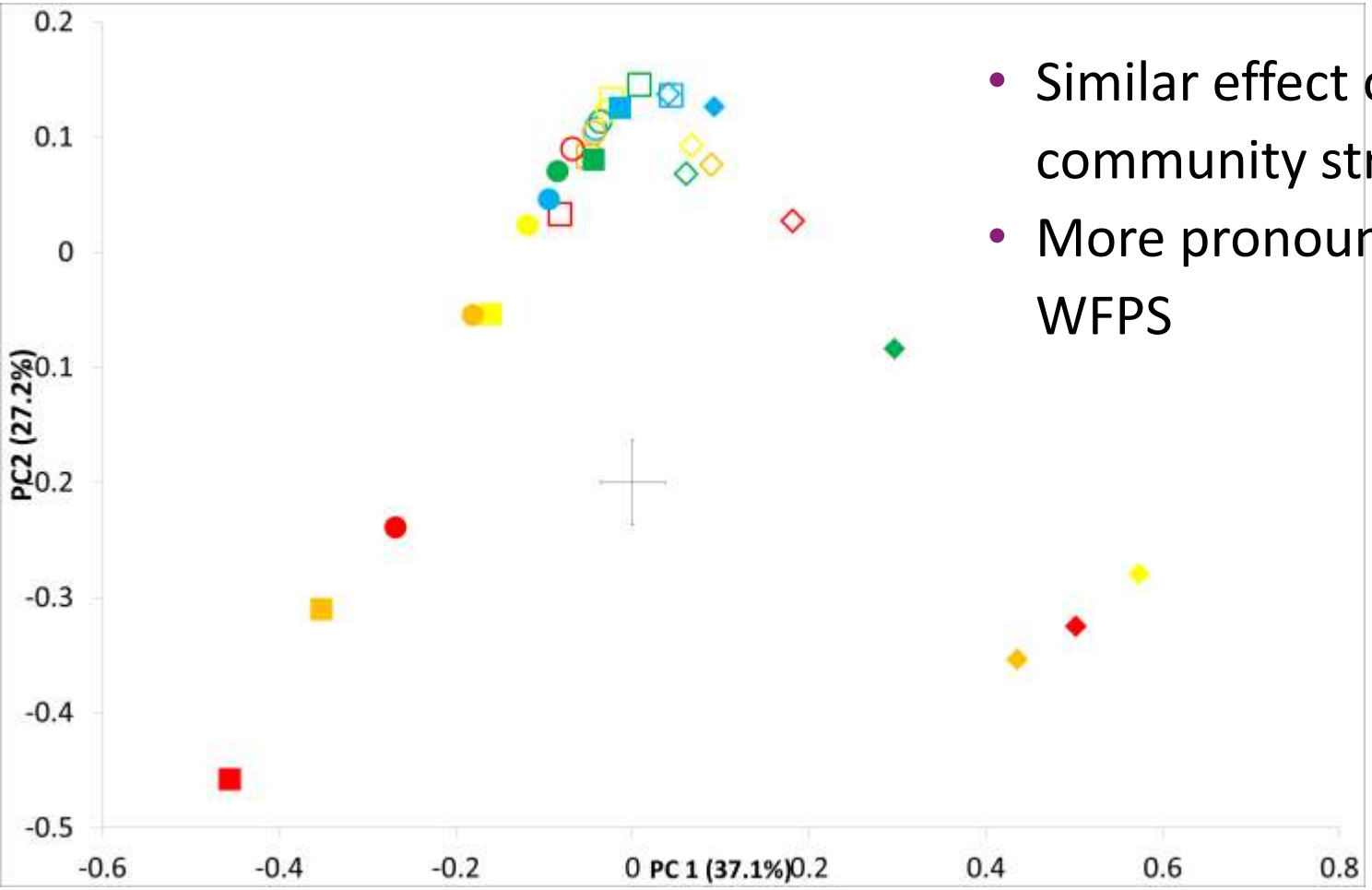
- Carbon levels critical for emission
- Low emission at 50% and 70 % WFPS
- Higher but variable emission at 90% WFPS
- Acetylene stabilises emission
  - Variable nitrous oxide reductase activity

Bacterial community structure



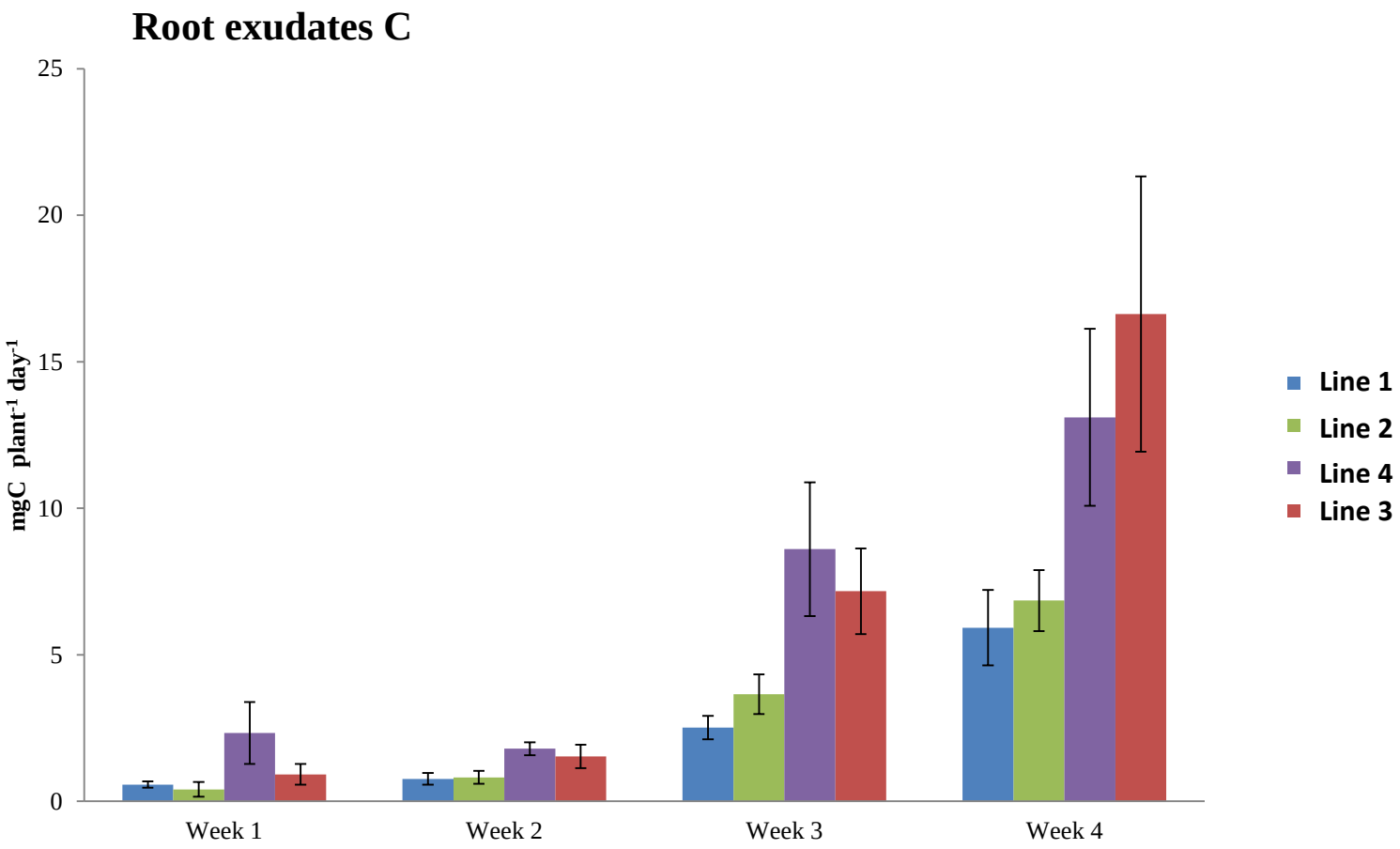
- Clear structuring of bacterial community structure
- No effect in bulk soil
- Strong C quantity effect in PC2
- Strong WFPS effect in PC1
  - Separates denitrifying community
  - Driven by C availability

Denitrifier community structure (nosZ)

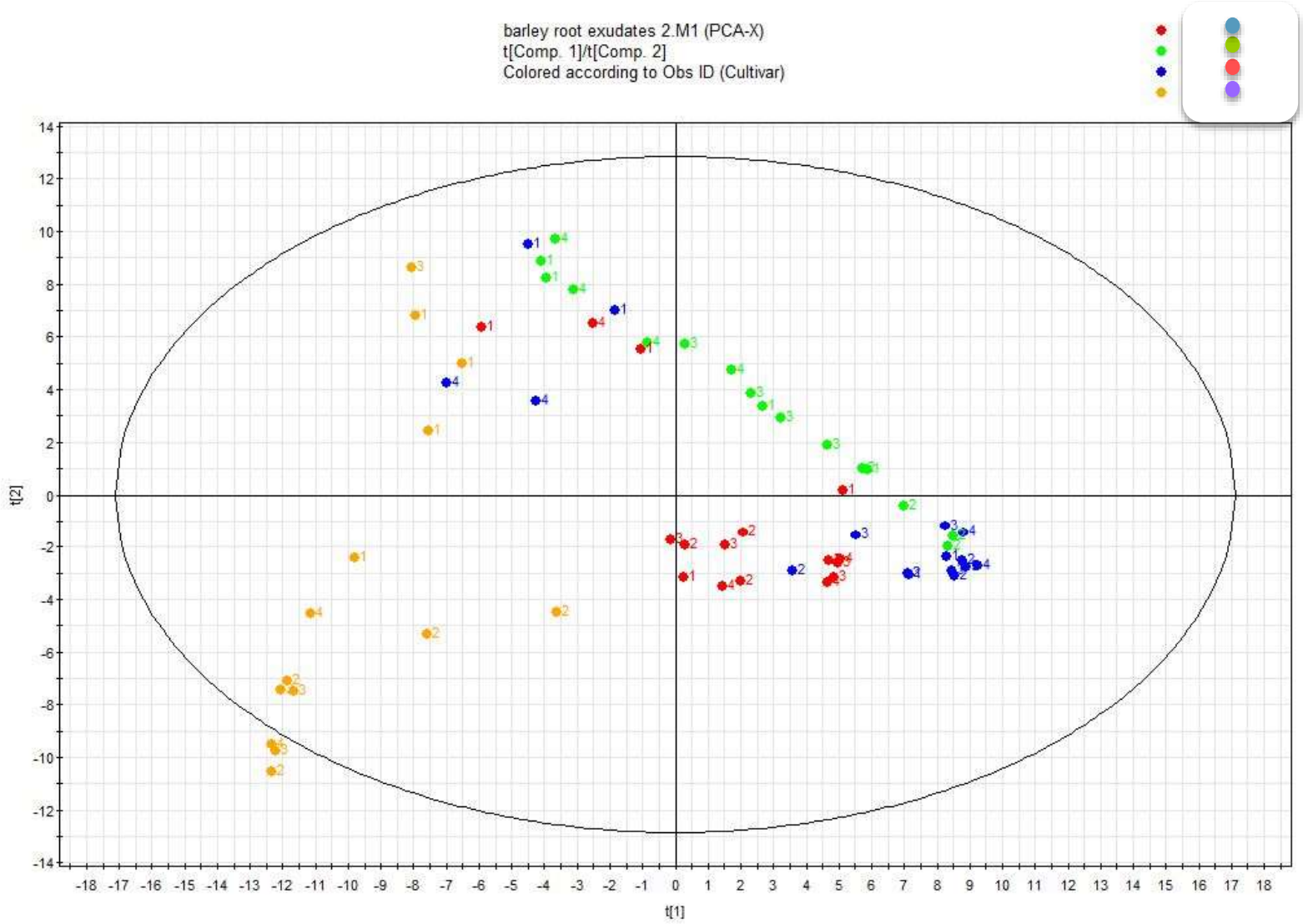


- Similar effect on nos Z gene community structure
- More pronounced at 90% WFPS

Variation in absolute exudate C



Root exudation differences



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Riaghaltas na h-Alba