

# Maatregelen in natuurterreinen: Een zaak van PASsen en meten??

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Foto Hans Dekker



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## Target 1 of the EU biodiversity Strategy: Nature Conservation

By 2020, 100% more habitat assessments and 50% more species assessments under the Habitats Directive show an improved conservation status compared to current assessments



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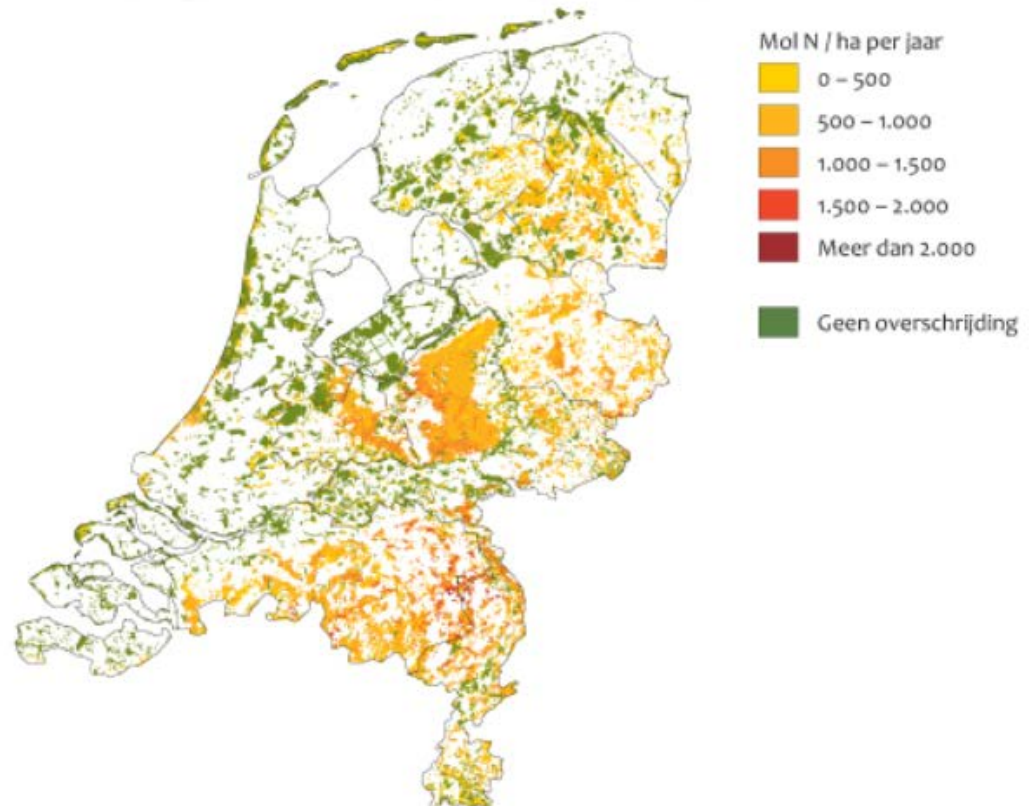


## **Target 2 of the EU biodiversity Strategy: Ecosystem maintenance and restoration**

By 2020, ecosystems and their services are maintained and enhanced by establishing green infrastructure and restoring at least 15% of degraded ecosystems

# Nature area exceeding Critical Load for nutrients (situation 2011)

Overschrijding kritische stikstofdepositie op natuur, 2009





# What happens when the Nitrogen supply increases?

- Nitrogen pool size increases
- Nitrogen decomposition rate increases



## Fungal channel “Miners”

- High C/N
- pH acid
- Litter on the surface



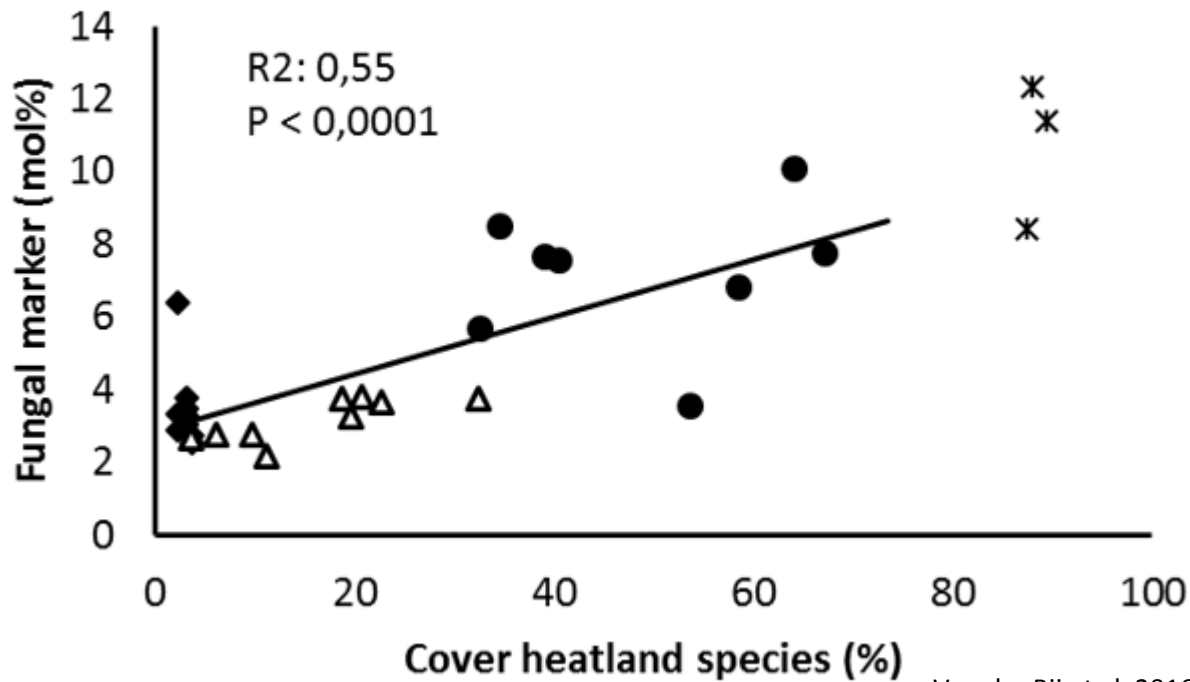
Van der Bij et al. 2016

## Bacterial Channel “Opportunists”

- low C/N
- pH neutral
- Litter incorporated into soil



### Cover heathland species - fungi



Van der Bij et al. 2016



- Techniques to mitigate the effects of enhanced nitrogen availability should either
- Decrease size of the N-pool AND (OR?)
  - Lower N-availability by shifting from bacterial to fungal channel OR
  - Lower the ambitions





Techniques to lower N-pool size:

“Classical” farming techniques:

- Grazing
- Cutting without fertilization
- Burning

“Restoration” techniques:

- Sod cutting/top soil removal
- Inversion of soil profile

Techniques to lower decomposition rate:

- Increase C/N ratio

# Grazing

A herd of goats is shown in a lush, green environment filled with trees and dense brush. The goats are of various colors, including white, brown, and spotted. One goat in the center is standing on its hind legs, reaching up to eat leaves from a tree. The scene illustrates the process of grazing in a natural setting.

- Very efficient for changing vegetation structure
- Removes only a minimal amount of nitrogen (generally  $< 2\%$ )



Mowing with standard equipment



1 year



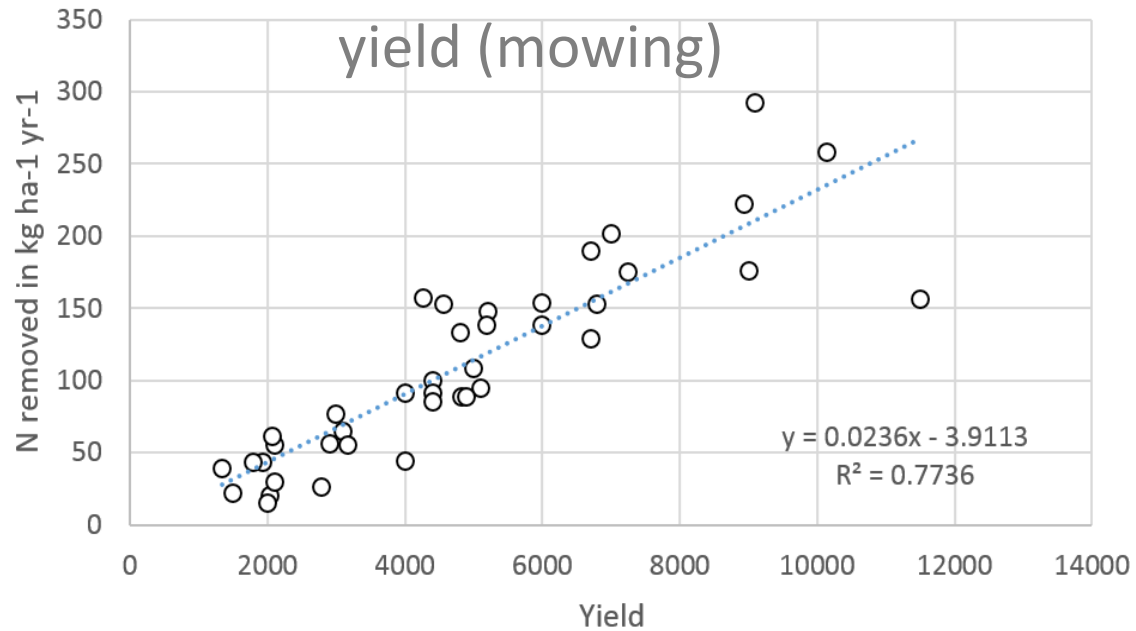
5 years



12 years

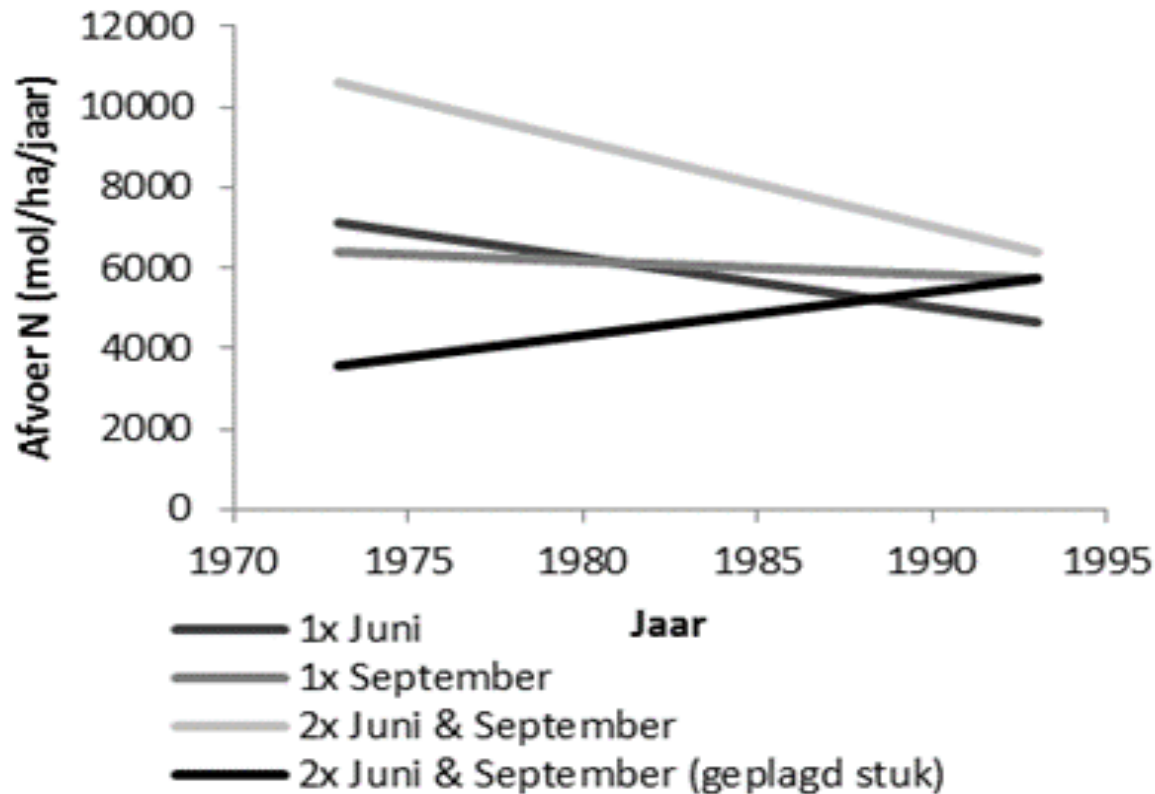


## N removal as a function of yield (mowing)



Based on data from Bakker 1989

# Removal of N over time by mowing



Based on data from Altena & Oomes 1995



A photograph of a heathland fire site. The ground is covered in dark, charred soil and numerous charred tree stumps and branches. Small green plants are beginning to regrow from the soil. The text "Effects of burning" is overlaid in the center of the image.

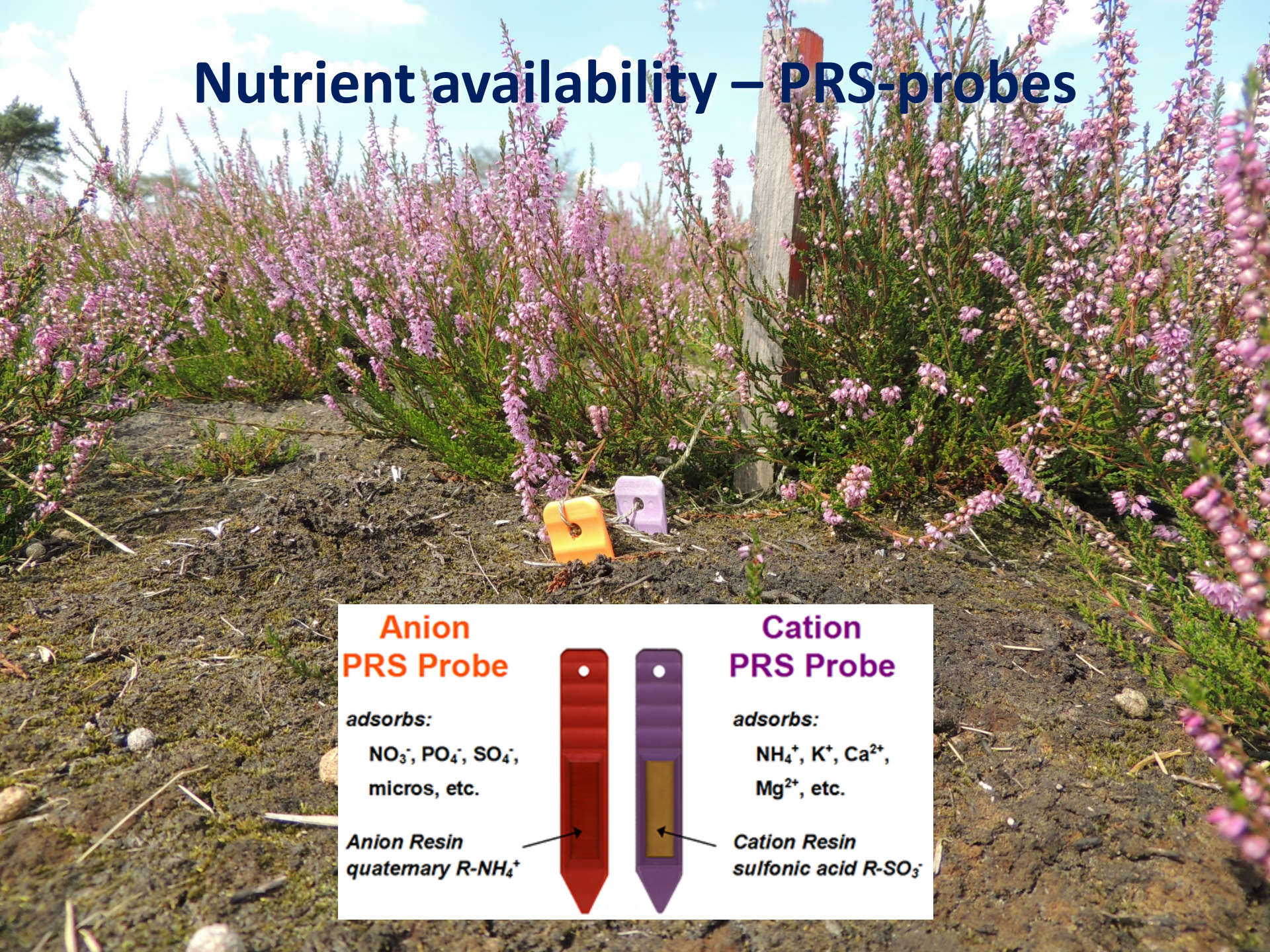
## Effects of burning

Background: English and German research showed a significant nutrient loss after a heathland fire

# Estimated nutrient losses by wildfire in Kalmthout (2011)

- Dry, non-degraded heath: 144 kg N and 7 kg P per ha;
- Dry, degraded heath: 96 kg N and 6 kg P per ha;
- Wet, non-degraded heath: 104 kg N and 2 kg P per ha;
- Wet, degraded heath: 50 kg N and 6 kg P per ha.
- N-deposition ca.  $30 \text{ kg N ha}^{-1} \text{ yr}^{-1}$
- This amounts to approximately 1% of the soil pool size (N) up to 1-5% (P)

# Nutrient availability – PRS-probes



**Anion PRS Probe**

*adsorbs:*  
 $\text{NO}_3^-$ ,  $\text{PO}_4^-$ ,  $\text{SO}_4^-$ ,  
micros, etc.

*Anion Resin*  
quatemary  $\text{R-NH}_4^+$

**Cation PRS Probe**

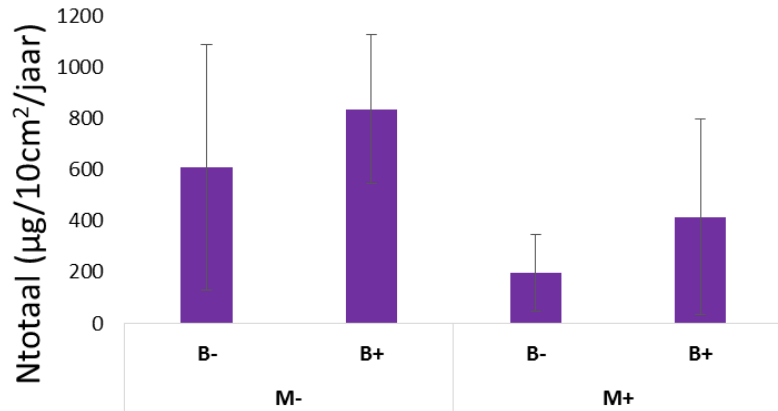
*adsorbs:*  
 $\text{NH}_4^+$ ,  $\text{K}^+$ ,  $\text{Ca}^{2+}$ ,  
 $\text{Mg}^{2+}$ , etc.

*Cation Resin*  
sulfonic acid  $\text{R-SO}_3^-$

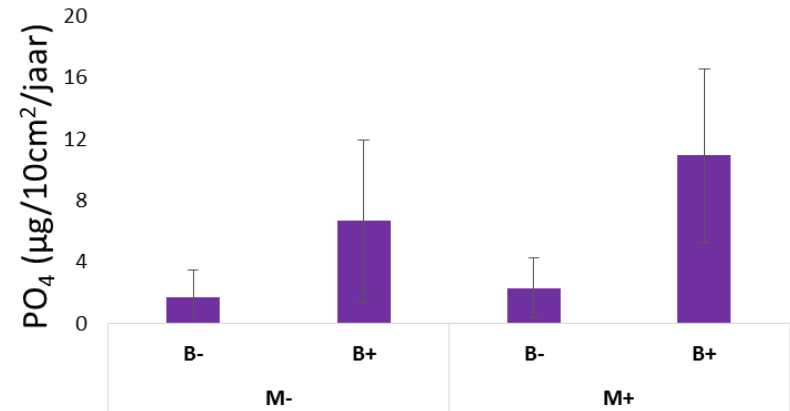
The image shows two PRS probes side-by-side. The left probe is red and labeled 'Anion PRS Probe'. It has a white dot at the top and a red resin column. The right probe is purple and labeled 'Cation PRS Probe'. It has a white dot at the top and a purple resin column. Arrows point from the text labels to the respective resin columns in the probes.

# Nutrient availability – 2012

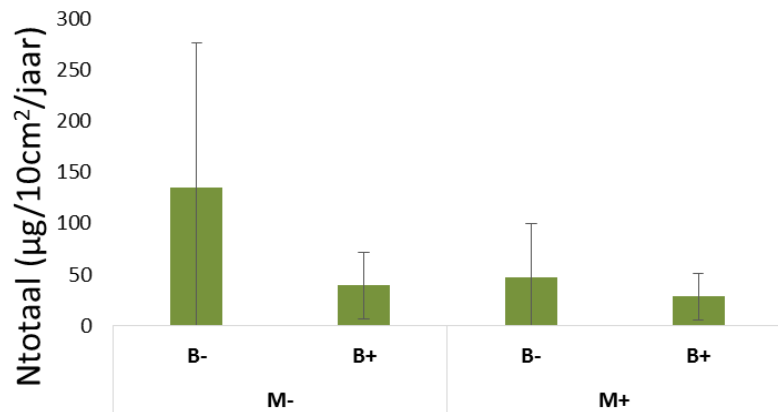
DH - stikstof



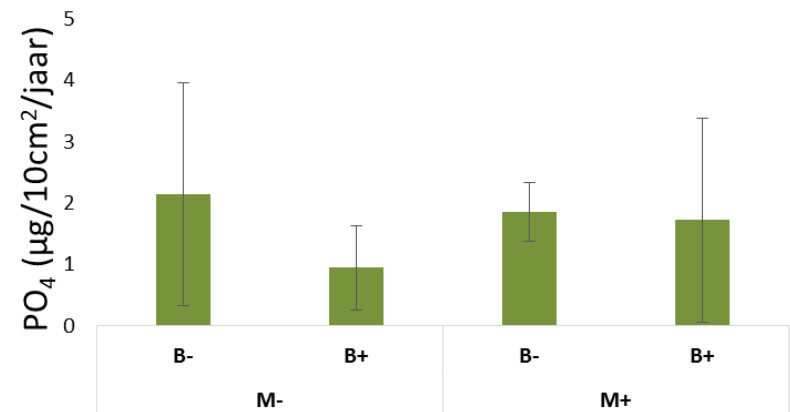
DH - fosfaat



NH - stikstof



NH - fosfaat



## Conclusions “classical” methods:

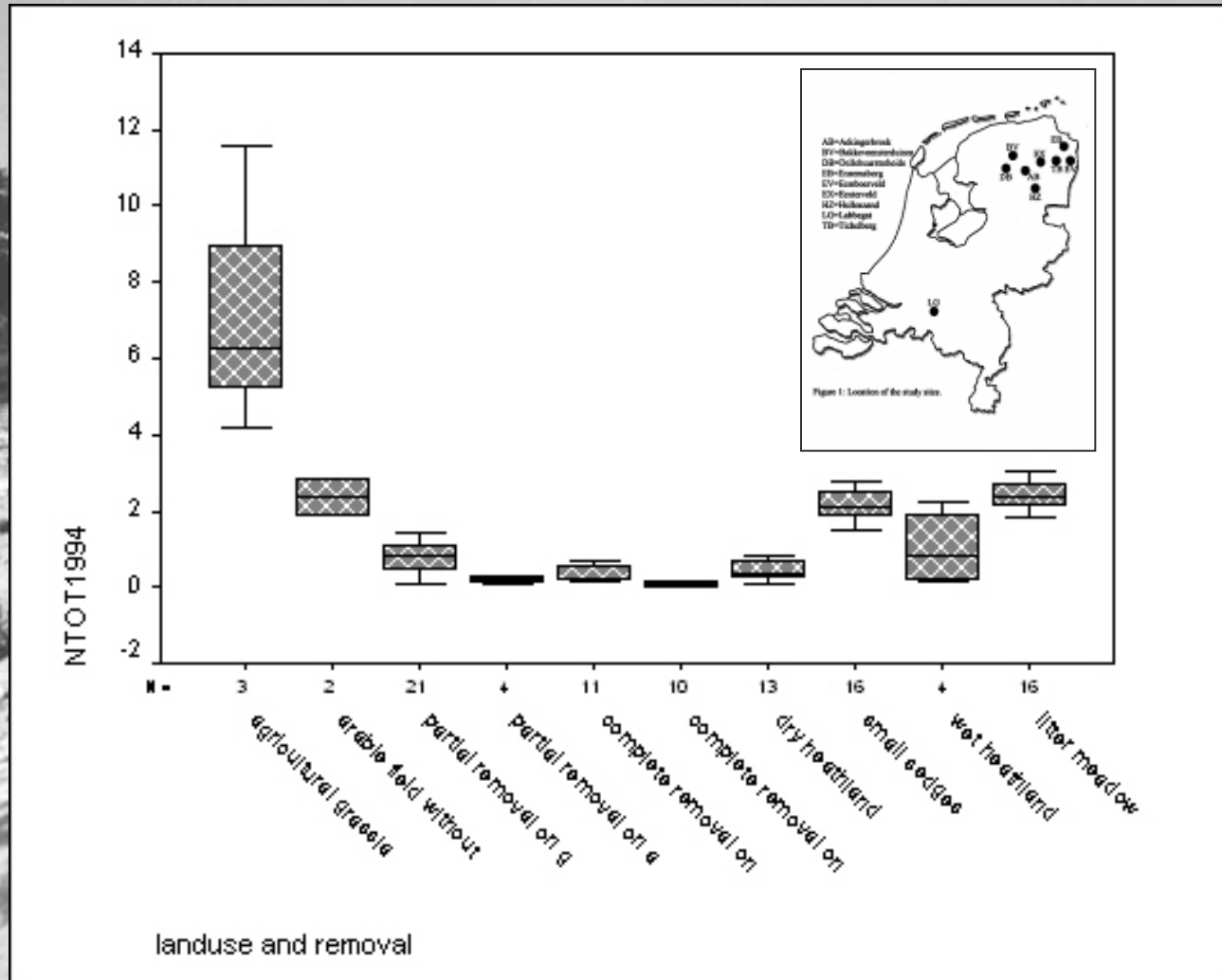
- Grazing cannot compensate for the effects of additional Nitrogen addition if this is more than a few kg's per ha per year;
- Mowing without fertilisation can to some degree compensate for additional N but it takes a long time and is unlikely to lead to low productive vegetation
- Burning removes (small) part of the N-pool but leads also to more easily decomposable organic matter

Altogether this implies that classical methods are insufficient to lower nutrient availability to such levels that the survival of nutrient poor communities is also guaranteed under conditions of increased N-deposition

# Restoration techniques

Sod cutting/top soil removal:  
A fast solution?

# Nitrogen in relation to removal depth and previous land use





Lowering nutrients alone is not enough. If you don't do anything else the result is often something like this.....



An aerial photograph of a large, rectangular experimental field. The field is divided into numerous smaller plots, some of which are covered with dark, possibly organic material. The surrounding landscape is a mix of green fields and brown, bare earth. A road or path runs along the right side of the field. The sky is clear and blue.

So we made a **LARGE** experiment in which we manipulated plant species availability and soil community availability

October 2011

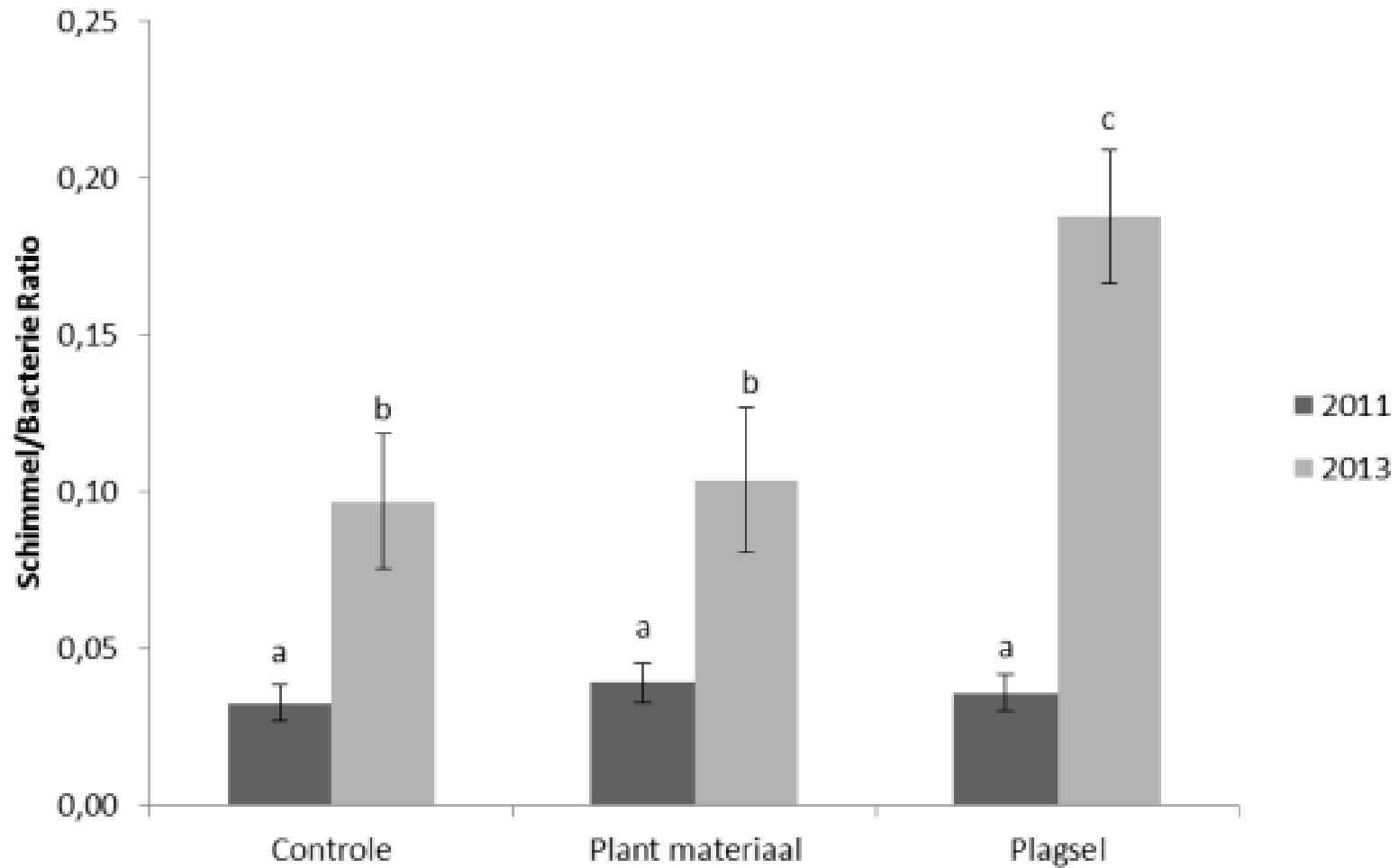
A photograph of a field of vegetation. The foreground is filled with dense, low-growing green plants with numerous small purple flowers. The middle ground shows a transition to taller, golden-brown grasses. In the far distance, a person is visible walking across the field under a clear sky.

# Development vegetation

Year 3 with sods

Foto Arrie van der Bij

# Fungi:Bacteria Ratio

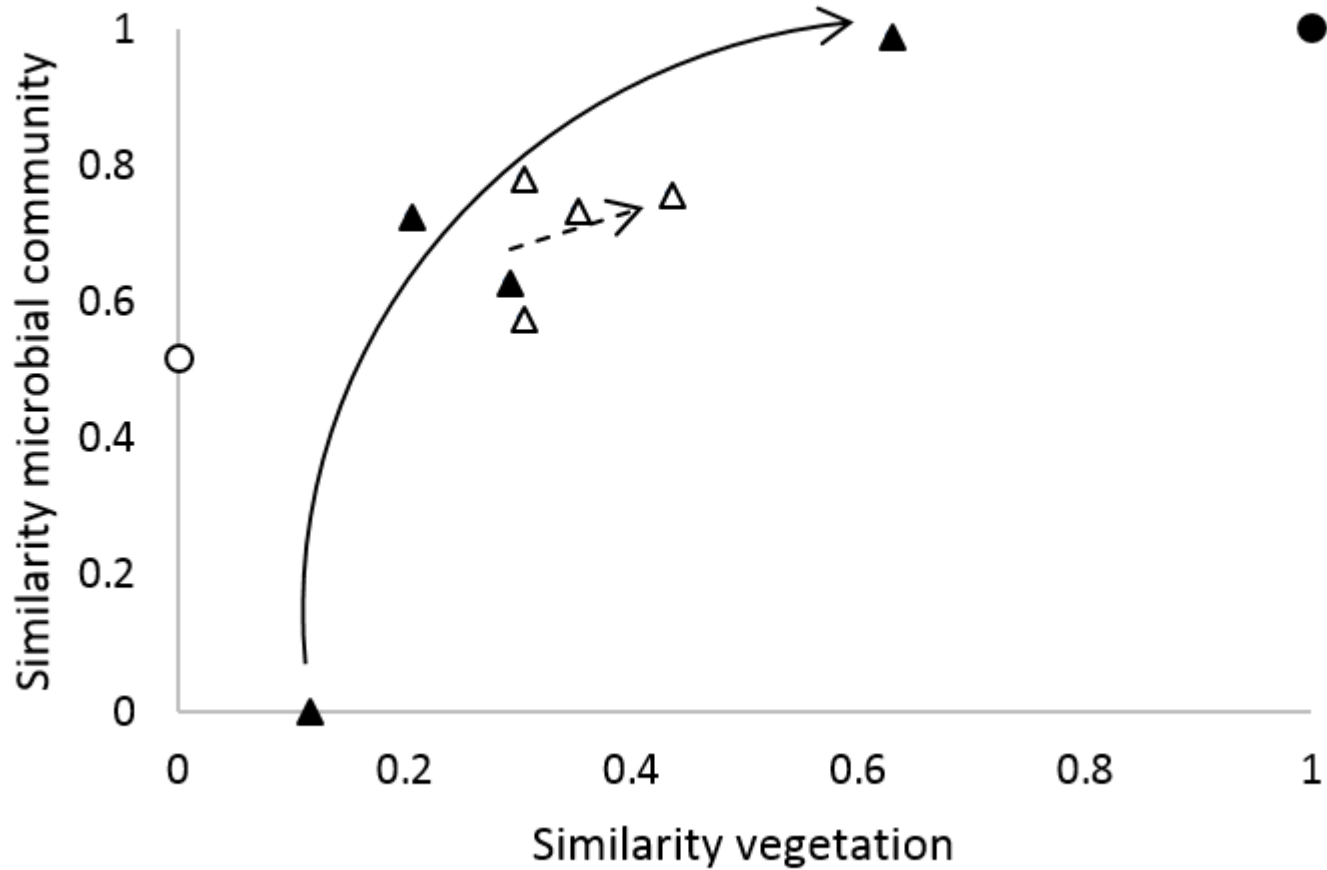


Te onderzoeken percelen

10

5

## Vegetation - microbial community



Van der Bij et al. 2013

# Topsoil Inversion



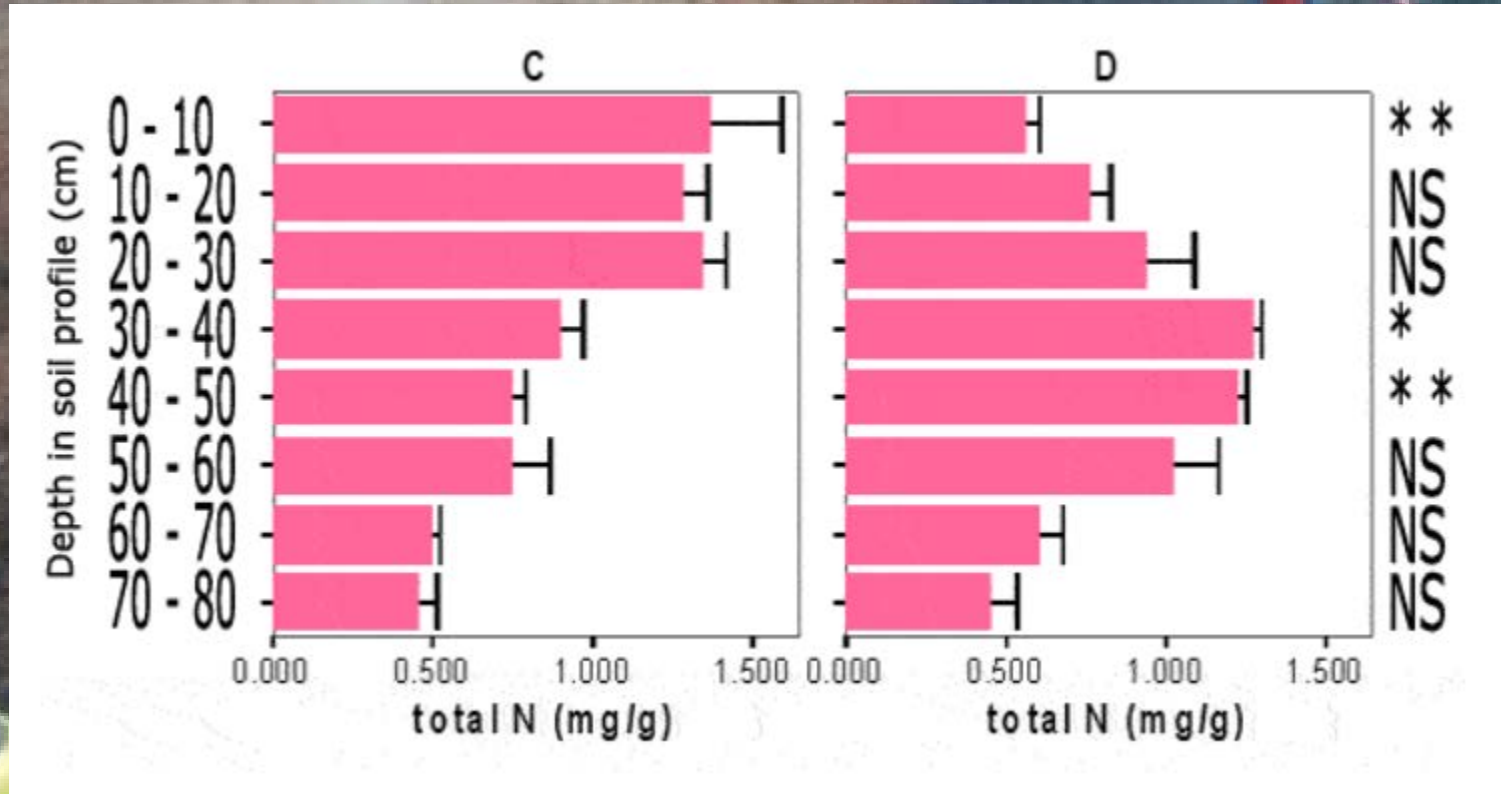
*Inverted soil profile.*

 Topsoil  
 Subsoil



**Landlife: Topsoil Inversion Profile 2004**

# Topsoil Inversion



Glen, E., J. Barker, L. Thompson, E.A.C. Price, S.J.M. Caporn, J. Carroll, M.L.M. Jones & R. Scott (2005) "Creative conservation on agricultural land using topsoil inversion."

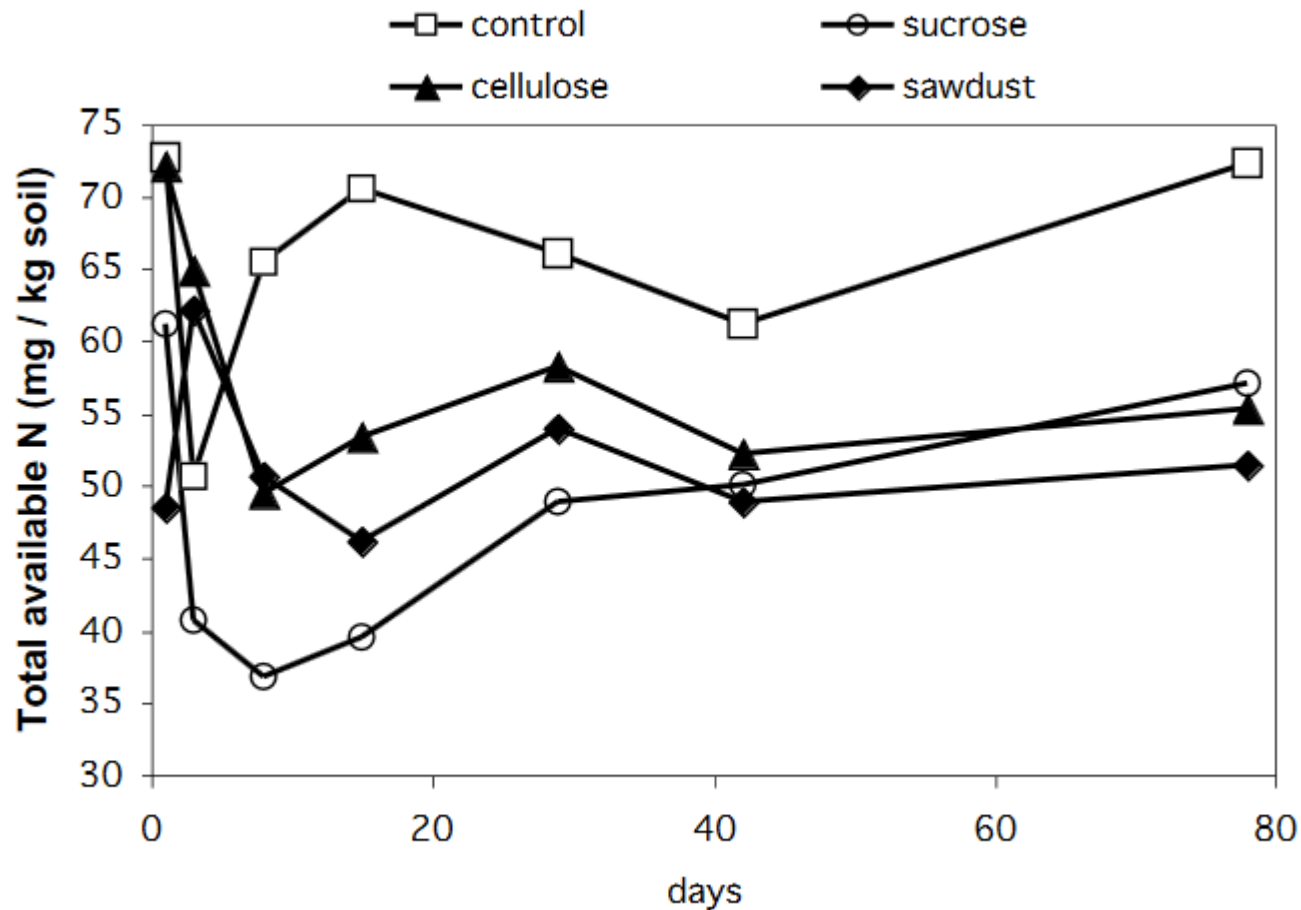
# Conclusions restoration techniques

- Topsoil removal and soil inversion appear to be more effective than classical methods in lowering nutrient availability quickly
- At the same time they require a large amount of additional actions making them very expensive
- They have additional disadvantages, e.g. by destroying the soil archive
- They cannot be used on a regular bases (soil inversion can only be used once) and must be followed by classical management

Foto Jaap van Roon

# ADDITIONAL METHODS

□ N<sub>t</sub>



soil



# Lower ambitions

## Species-poor *Holcus* grassland

Enhancing the species richness of such sites might require some of the techniques mentioned before and could be very costly!

# Finally

- Optimal techniques to lower nutrient availability differ from situation to situation and from target to target
- It may be especially difficult to compensate effects of increased nitrogen deposition on nutrient poor communities on poorly buffered soils
- Restoration-based techniques promise faster results but are very costly and have their own trade offs
- If we don't invest much effort in improving the quality of existing nature we will not be able to reach the EU Biodiversity targets