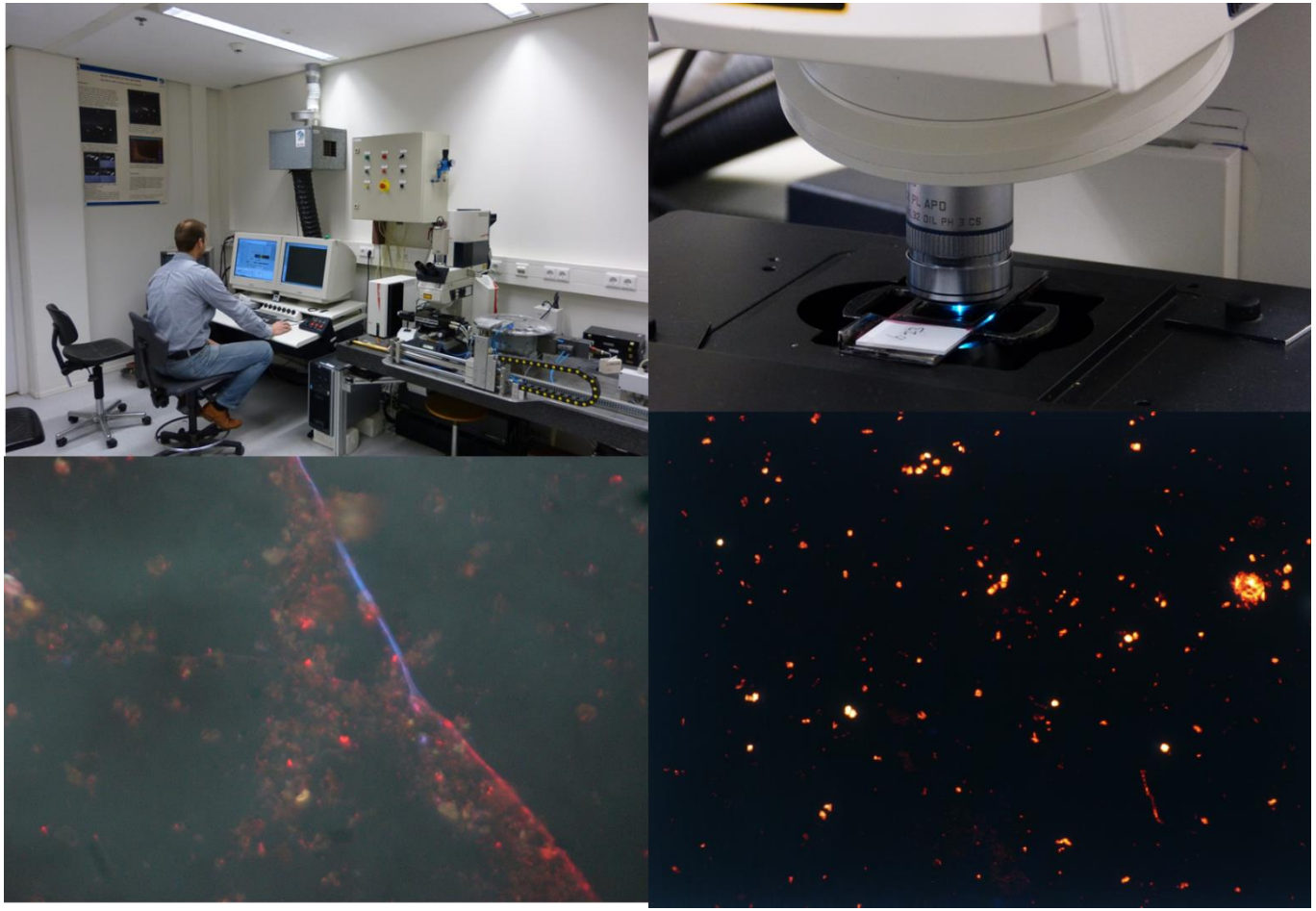
Micro-organismen
Effecten van kalk- en organische stofgehalte in de duinen

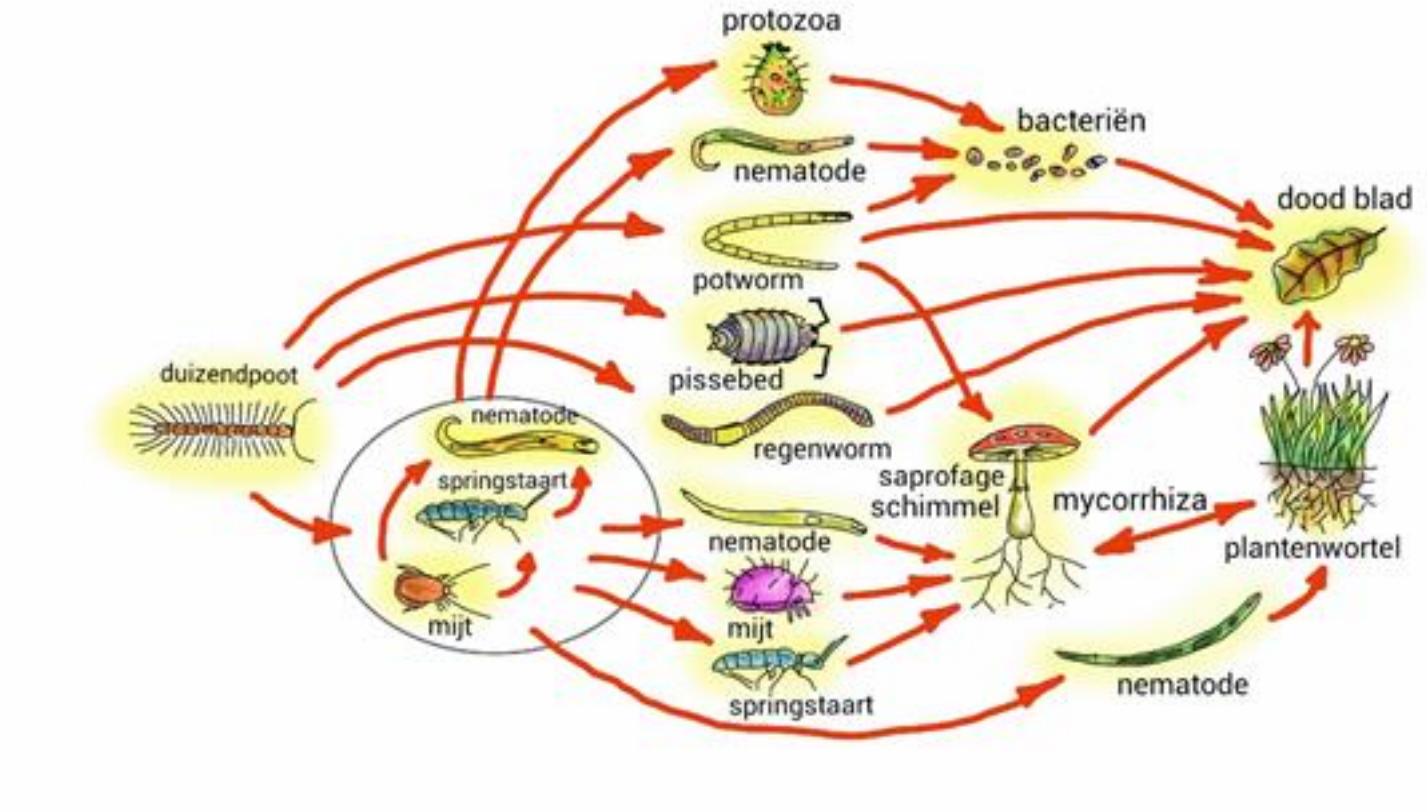
Jaap Bloem, An Vos en Rolf Kemmers



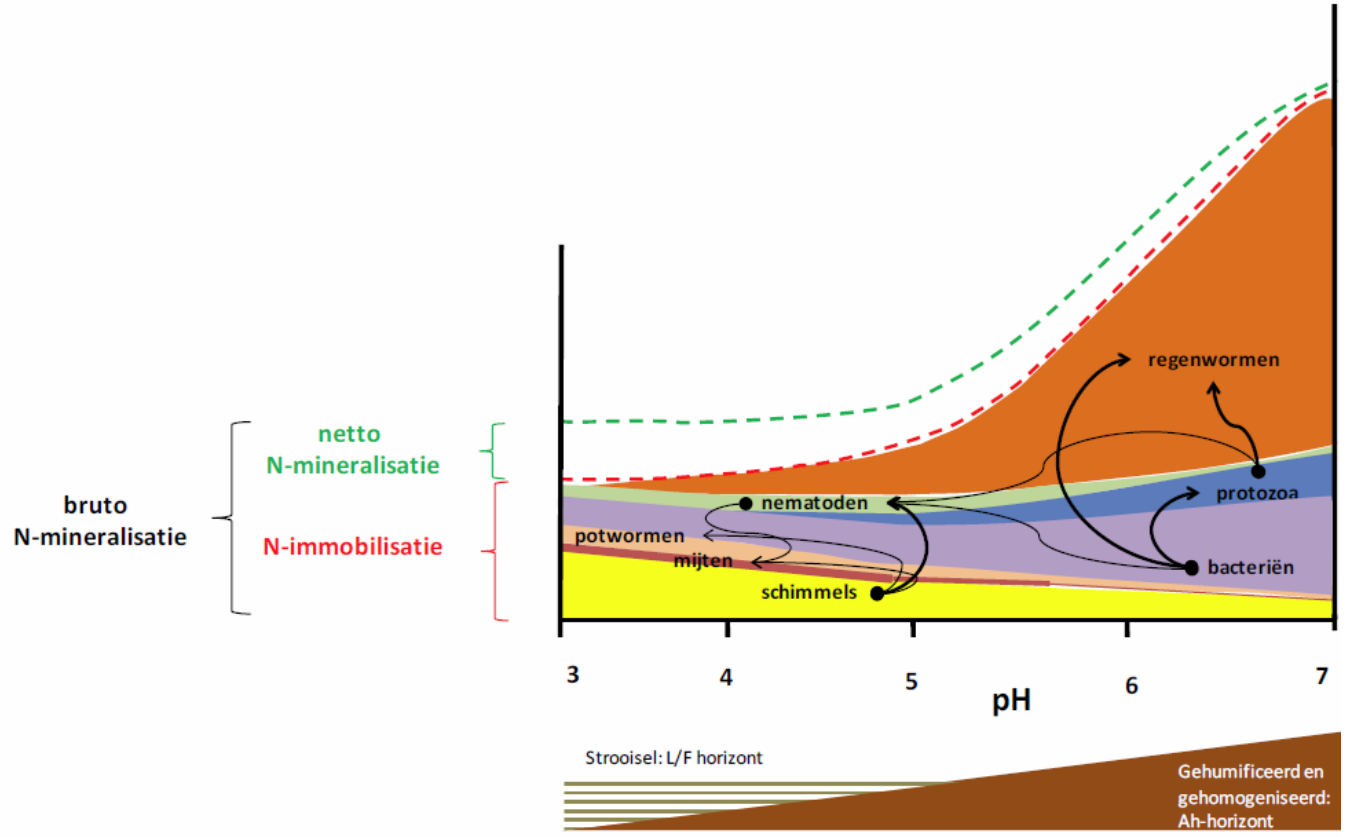
ALTERRA
WAGENINGEN UR

Bodemvoedselweb: bacteriën, schimmels en fauna

Figuur Ron de Goede, WU Bodemkwaliteit



Verstoring en verzuring remt bacteriën sterker dan schimmels
minder stikstof vastlegging, meer beschikbaar voor planten

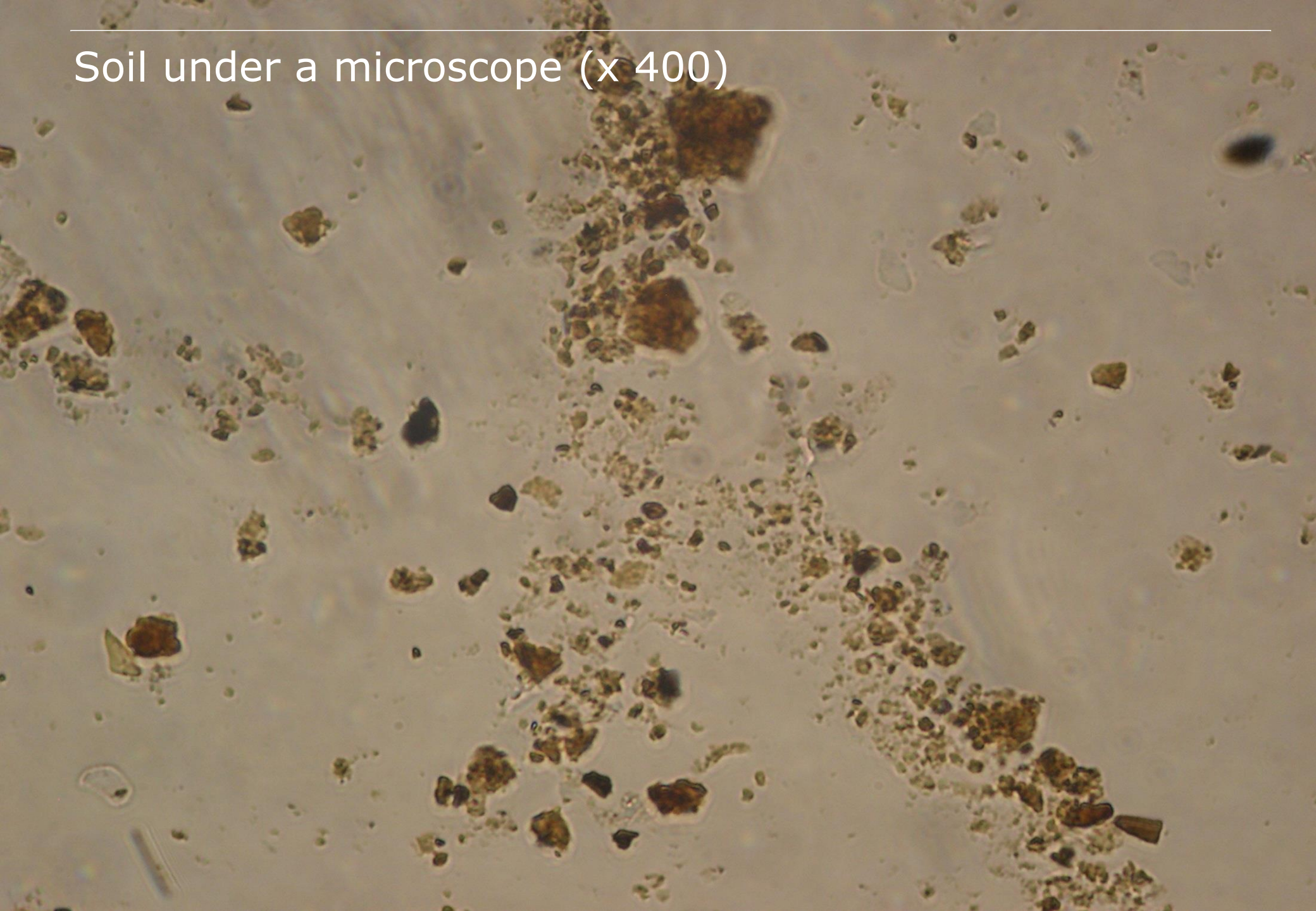


Kemmers, R. 2012. Zijn bodemorganismen van belang voor herstel van verzuurde bossen? De Levende Natuur 113, 24-28.

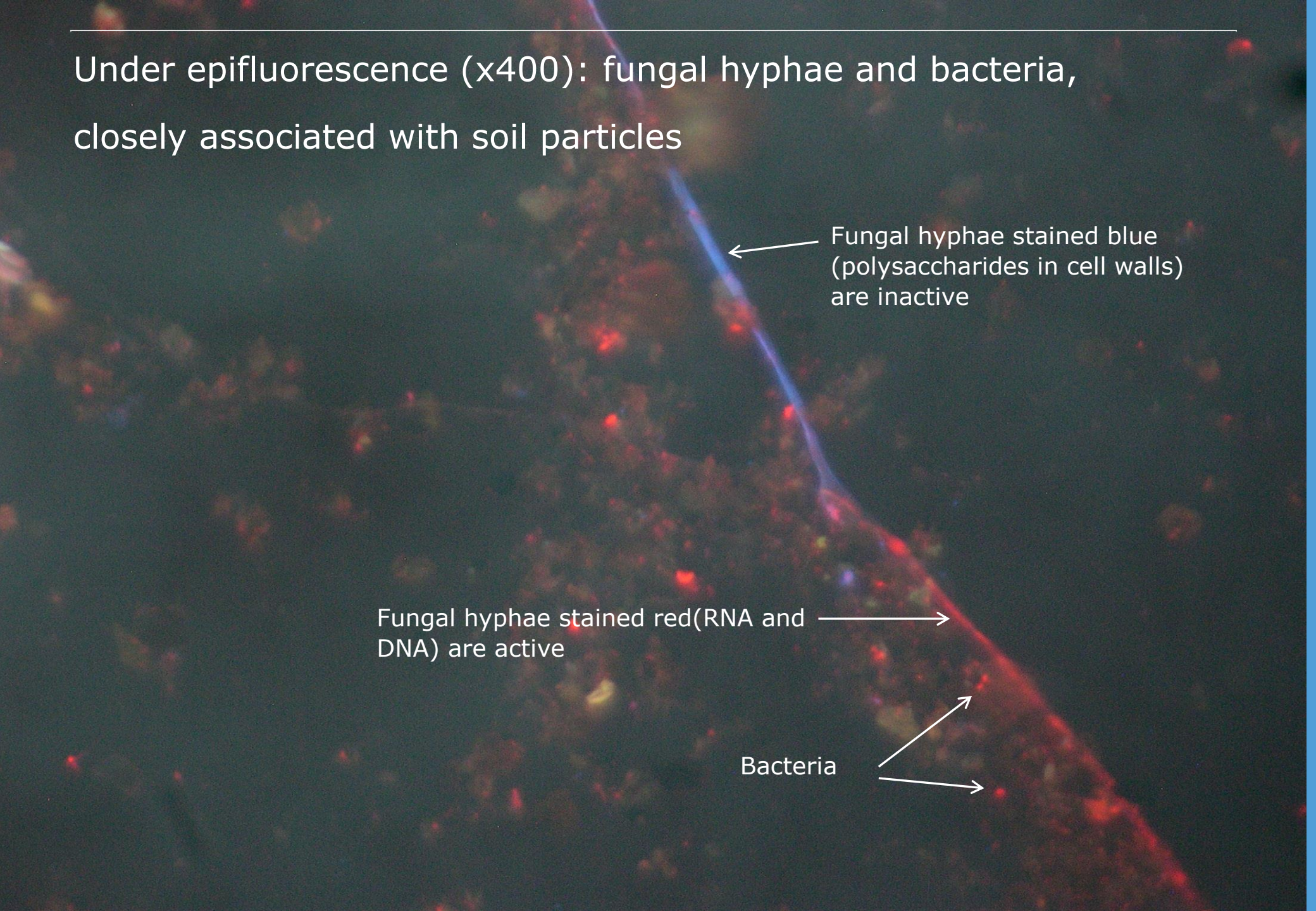
Kemmers, R.H.; Brinkman, E.P.; Bloem, J.; Faber, J.H.; Putten, van der W.H. 2011. Is bodembiodiversiteit van belang voor herstel van beekdalvegetaties? De Levende Natuur, 112, 4 - 9.

Kooijman, A.M., Kooijman-Schouten, M.M., Martinez-Hernandez, G.B. Alternative strategies to sustain N-fertility in acid and calcaric beech forests: Low microbial N-demand versus high biological activity (2008) Basic and Applied Ecology, 9, 410-421.

Soil under a microscope (x 400)

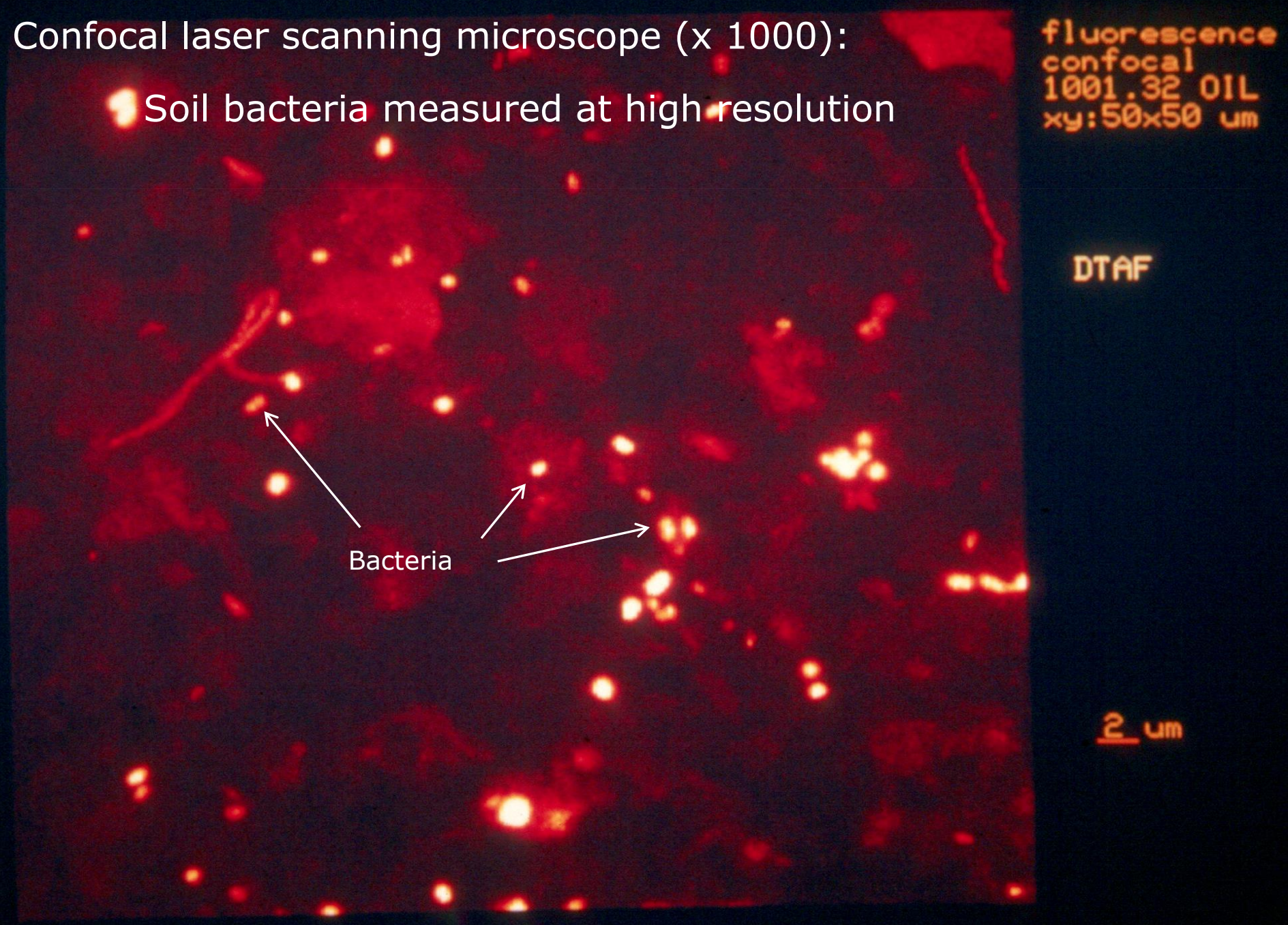


Under epifluorescence (x400): fungal hyphae and bacteria, closely associated with soil particles

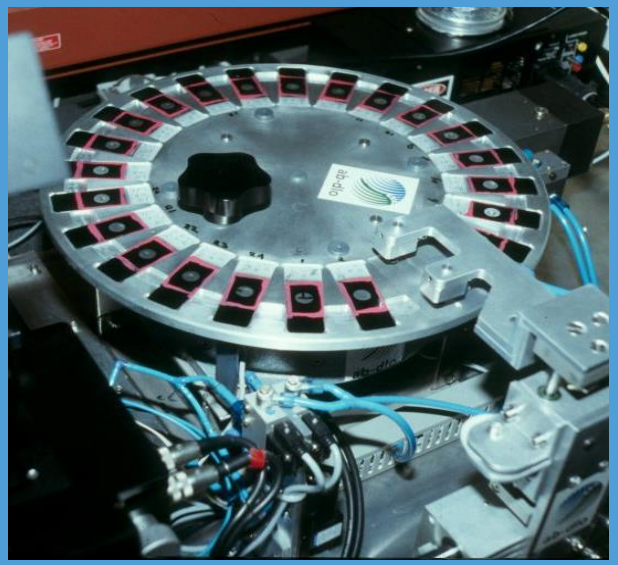


Confocal laser scanning microscope (x 1000):

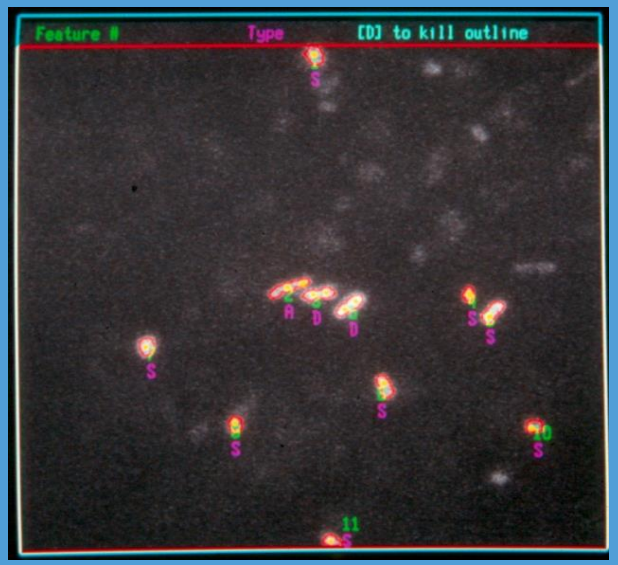
- Soil bacteria measured at high resolution



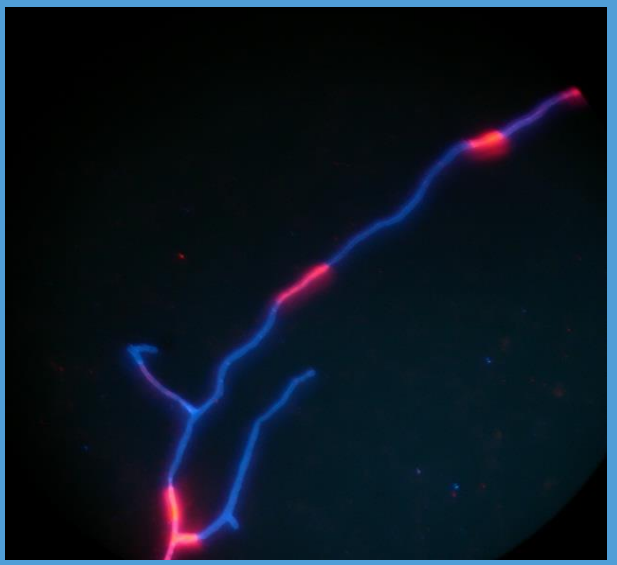
Biomass of bacteria and fungi measured by direct microscopy



Automatic scanning of soil smears



Bacteria measured by automatic image analysis



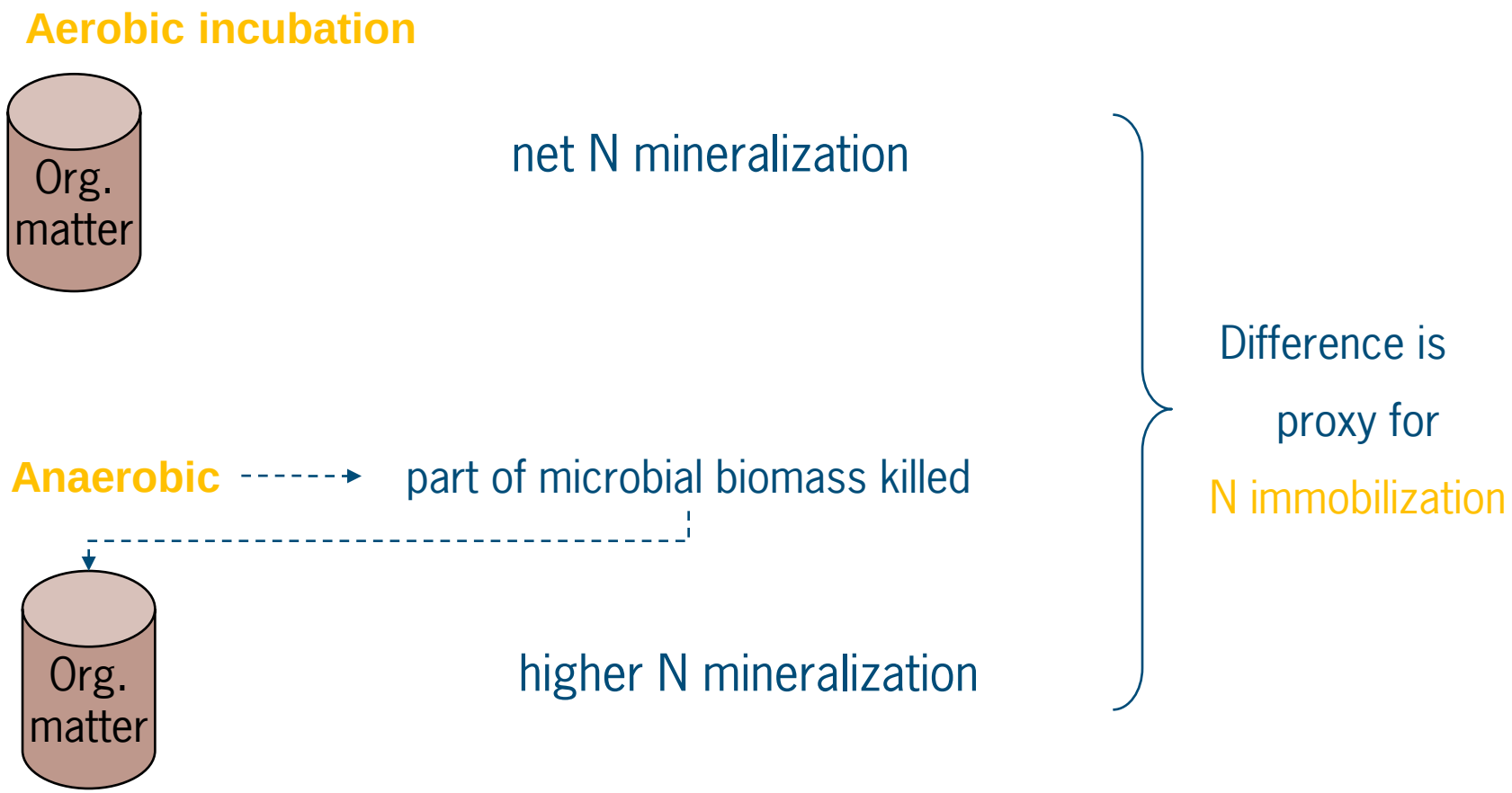
Fungal hyphae, active (red) and inactive (blue)

Bloem et al., 1995, Applied and Environmental Microbiology 61, 926-936.
Bloem, J. and A. Vos. 2004. In "Molecular Microbial Ecology Manual", 2nd edition

Bacterial activity

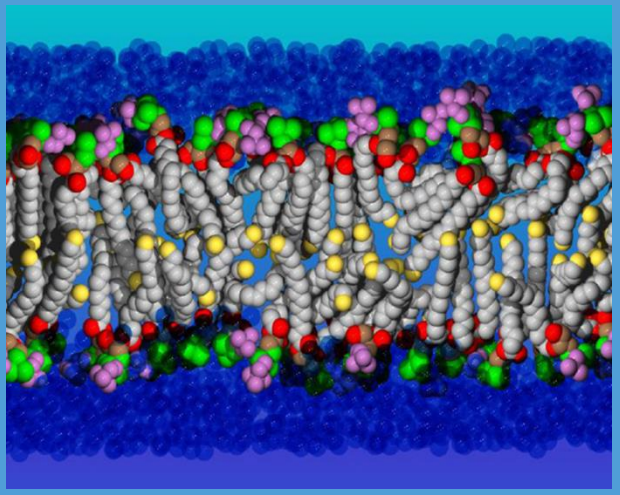
Bacterial growth rate: incorporation rate of ^{3}H-thymidine and ^{14}C-leucine into bacterial DNA and proteins during a short incubation (1h). Very sensitive.

N mineralization and mineralizable N



Microbial community structure measured by PLFA

- Phospholipid fatty acids (PLFA) are membrane components of all living cells
- Fingerprint of microbial community structure (about 30 PLFAs)
- Biomarkers: fungi, total bacteria, major groups of bacteria (actinomycetes, Gram +, Gram -,...)



Microbial biomass

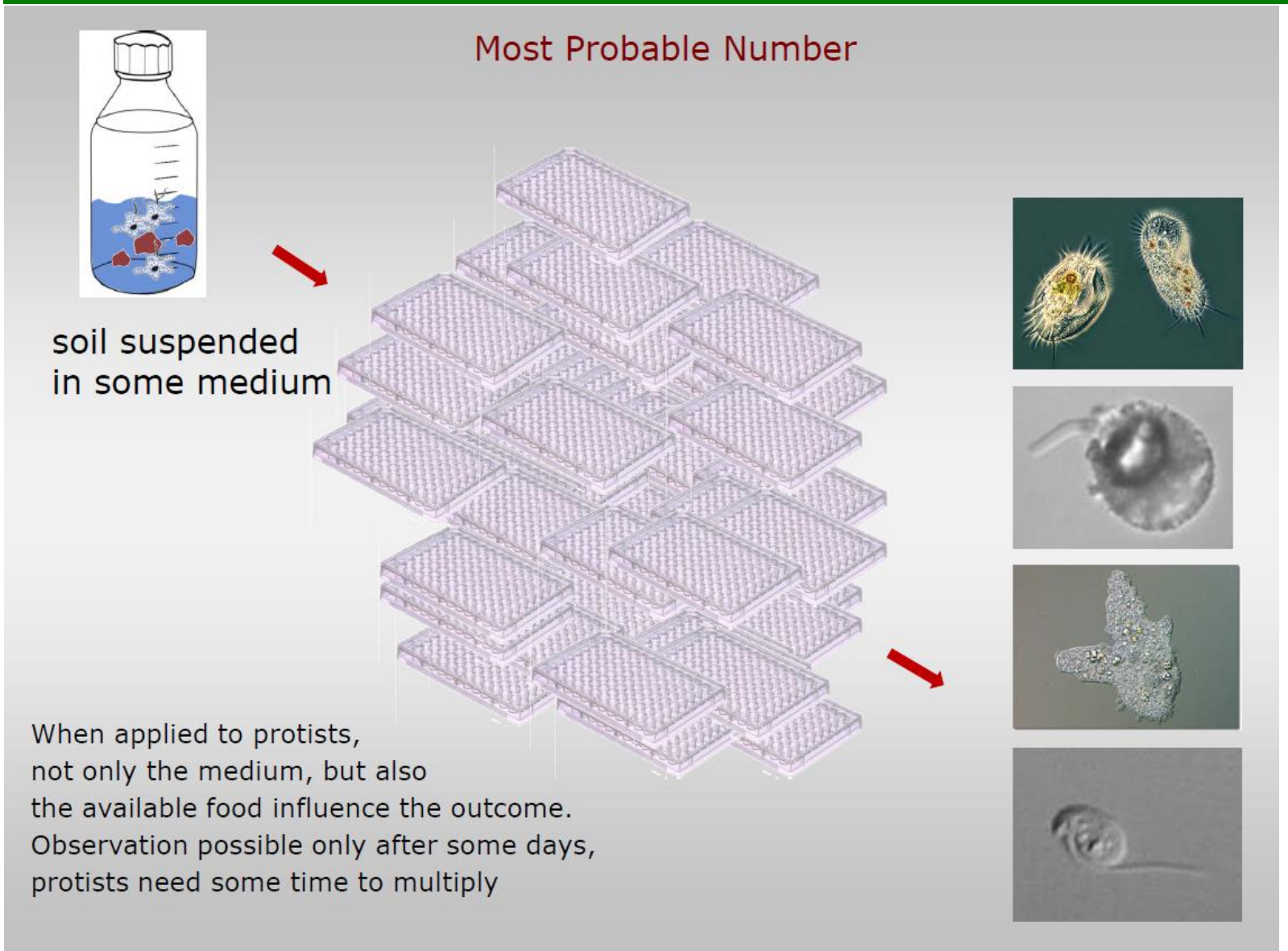
- Direct microscopy (may be combined with automatic image analysis): number and body size (biomass) of different functional groups i.e. fungi, bacteria, protozoa....; biomass calculated from biovolume

- Chloroform fumigation extraction (CFE): soil is fumigated with chloroform, increase in extractable organic carbon (and nitrogen) is a measure of total microbial biomass (C and N)

- Amounts of PLFA also used as proxy for biomass

Protozoën geteld na seriële verdunning in voedingsmedium

(next figures: Dr. Anna Maria Fiore-Donno, University of Cologne)



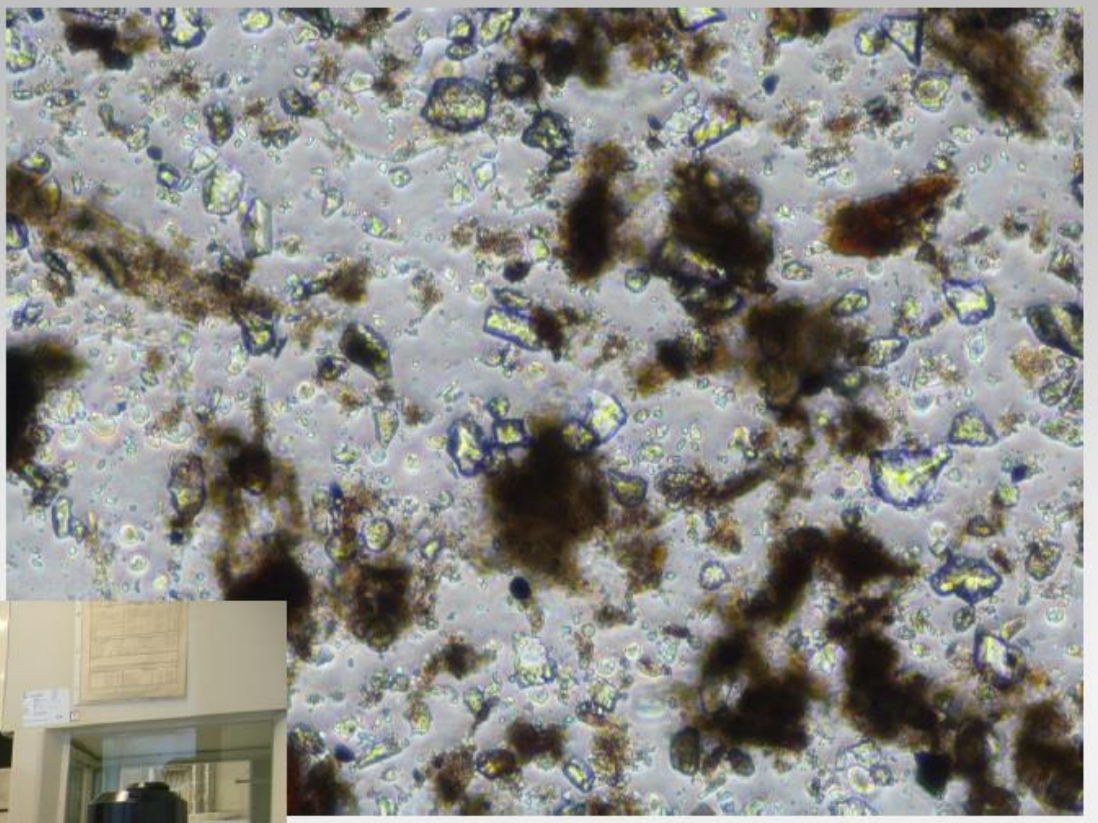
Ciliaten

Schaal-amoebe

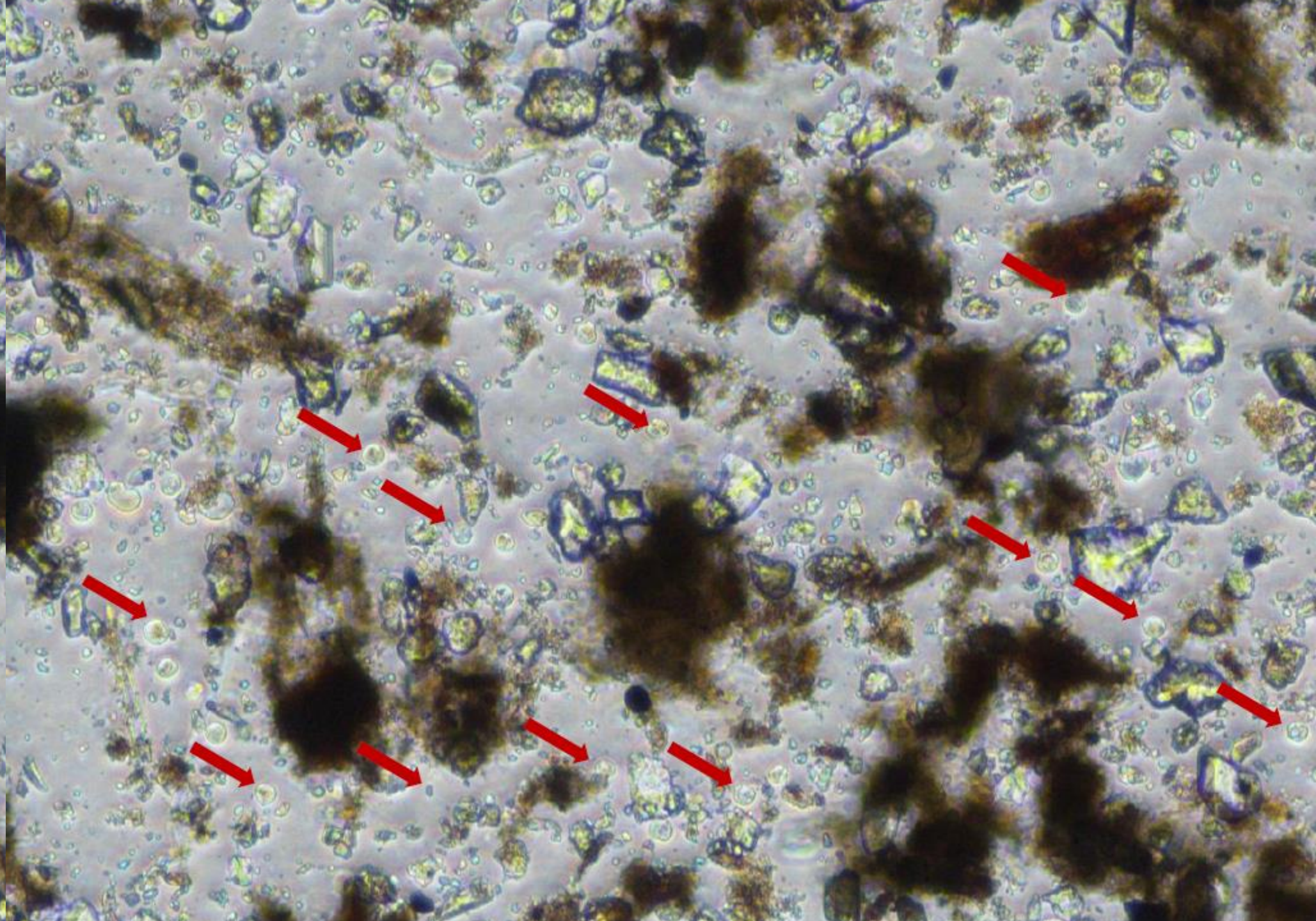
Amoebe

flagellaat

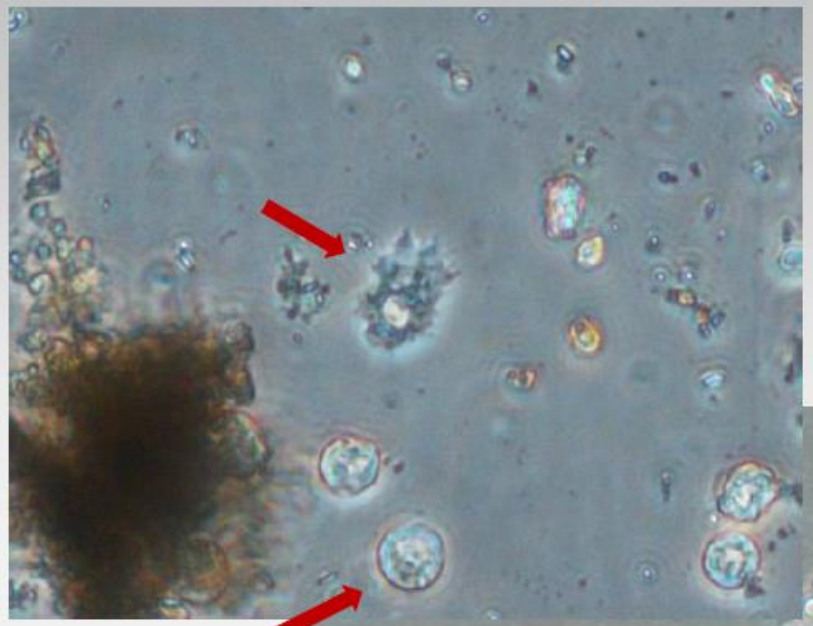
A difficult and repetitive task



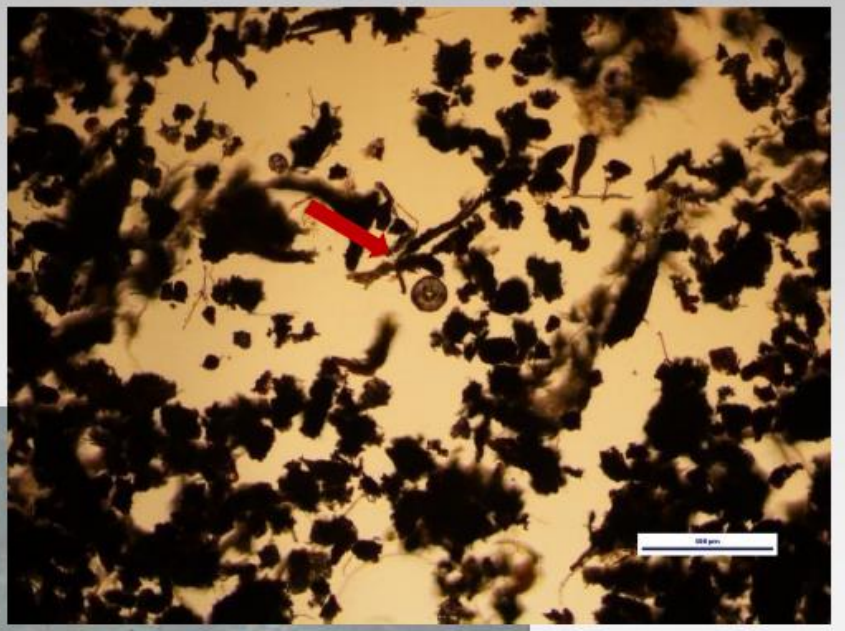
... that is what they see



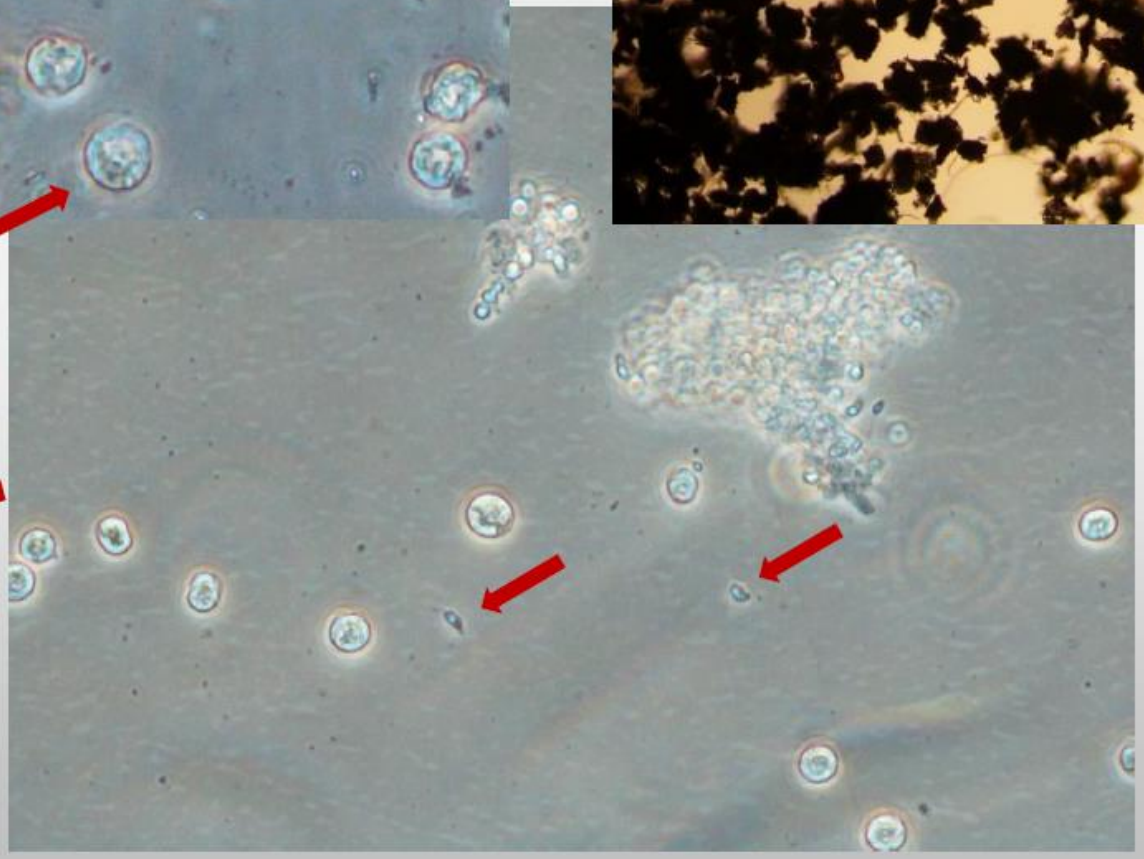
Acanthamoeba sp.



Testate amoeba (Arcellina)

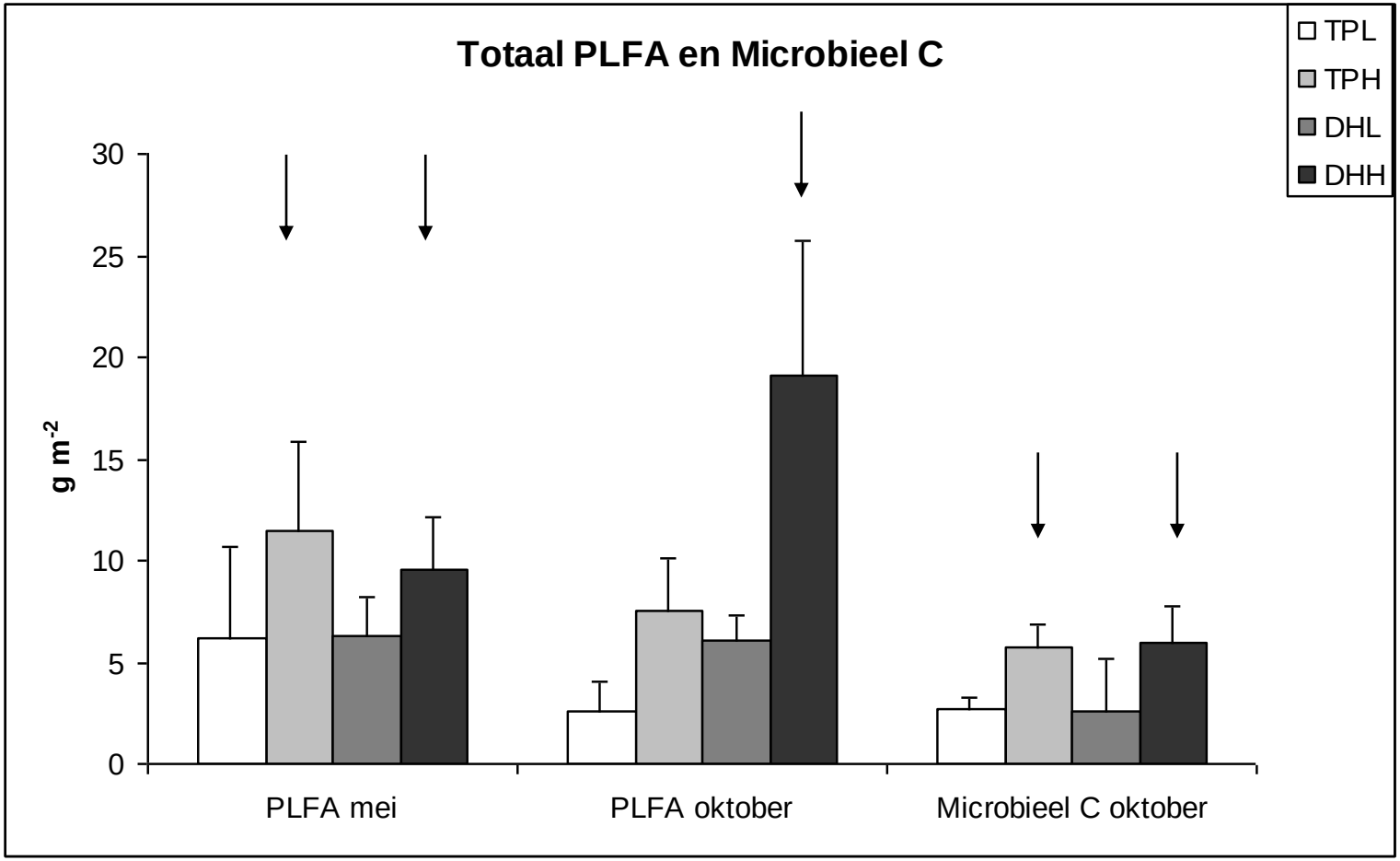


Testate amoebae (Rhizaria)



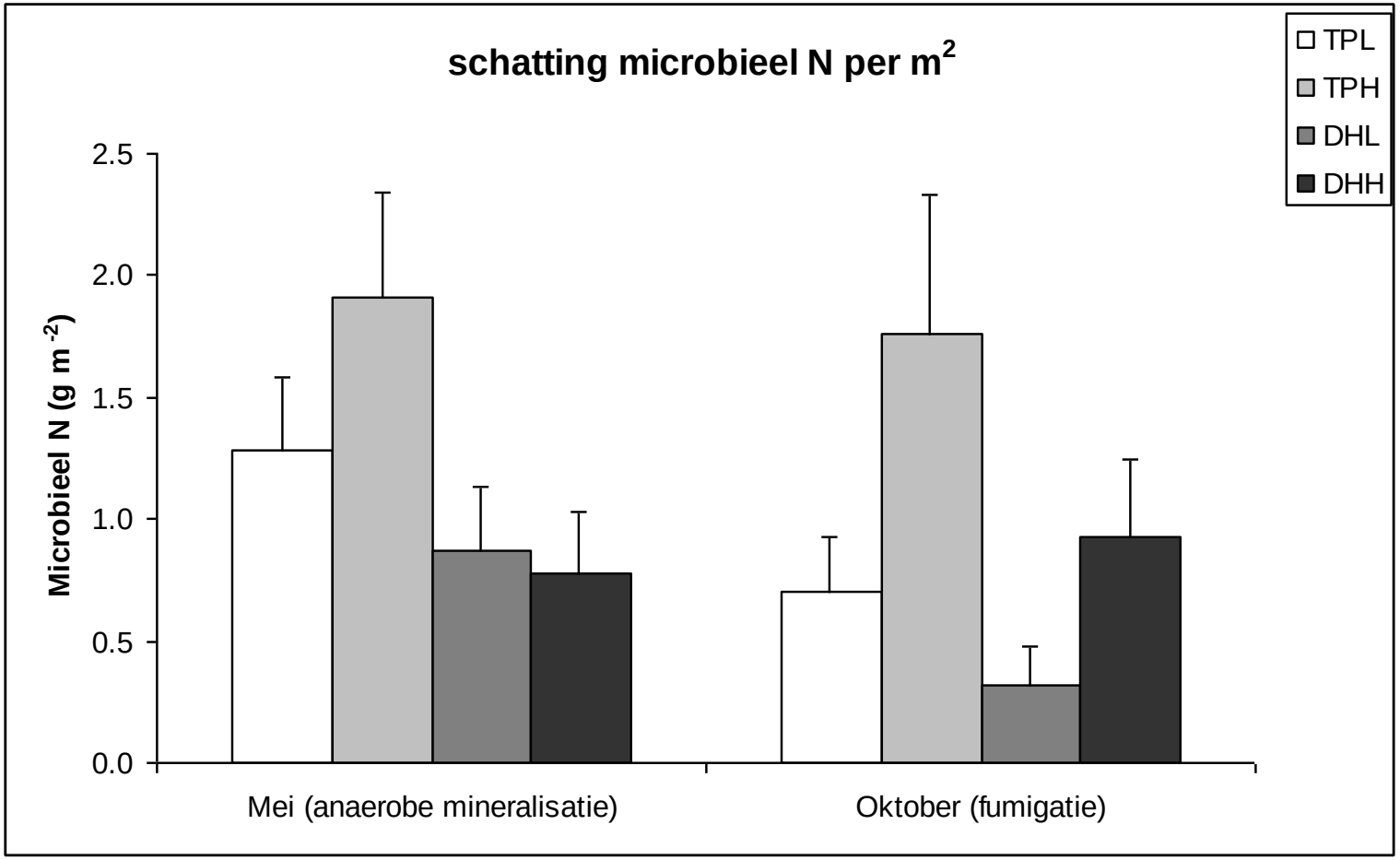
Flagellates (Cercozoa)

Microbiële biomassa C en PLFAs
hoger met meer organische stof, geen effect van kalk



kalkrijk, OS Laag
kalkrijk, OS hoog
kalkarm, OS laag
kalkarm, OS hoog

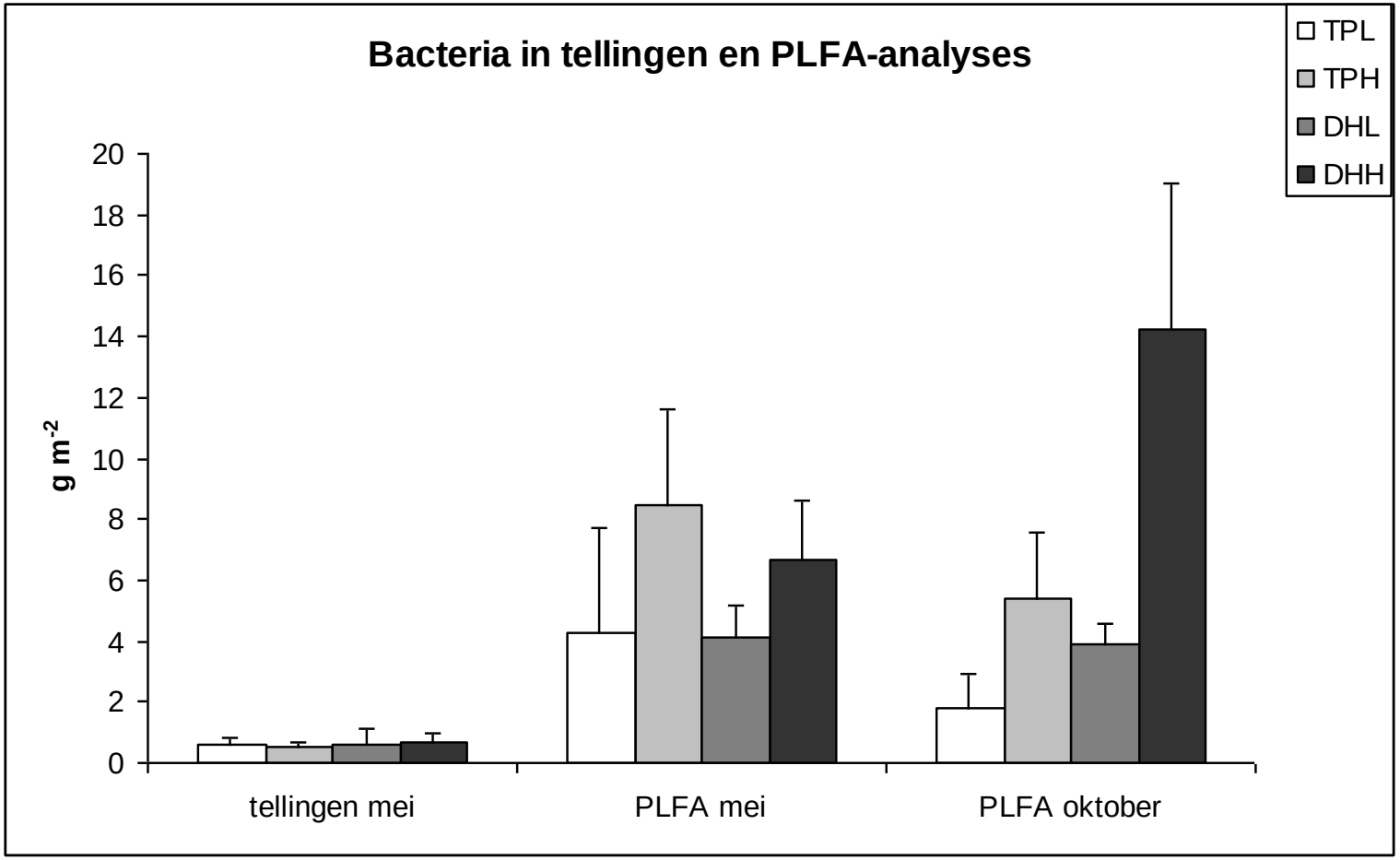
Microbiële biomassa-N
Hoger met kalk (en met organische stof in oktober)



kalkrijk, OS Laag
kalkrijk, OS hoog
kalkarm, OS laag
kalkarm, OS hoog

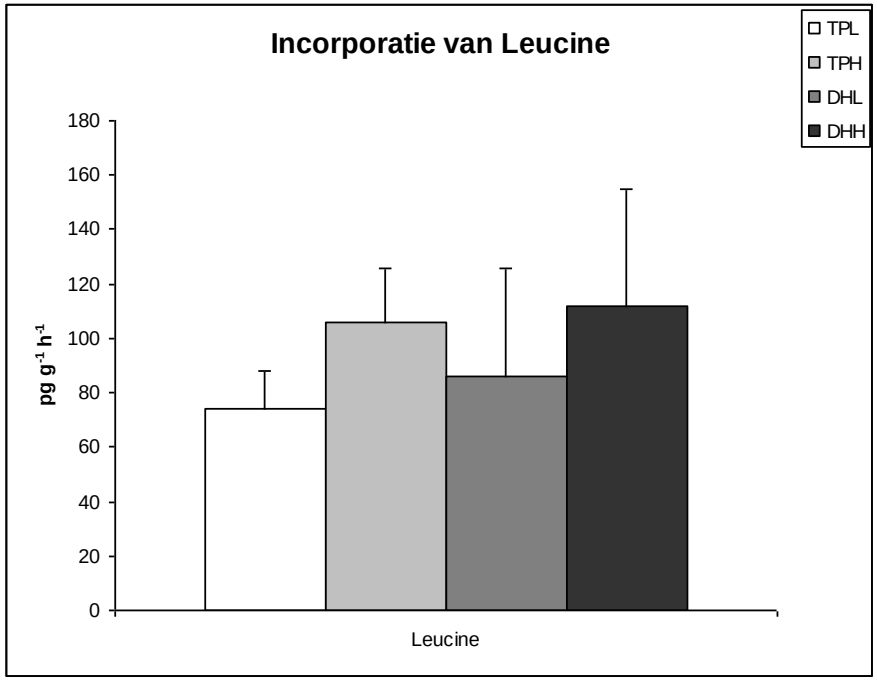
Kalk	+	+	-	-		+	+	-	-
OS	-	+	-	+		-	+	-	+

Bacteriebiomassa: PLFA hoger met meer organische stof microscopische tellingen zeer laag

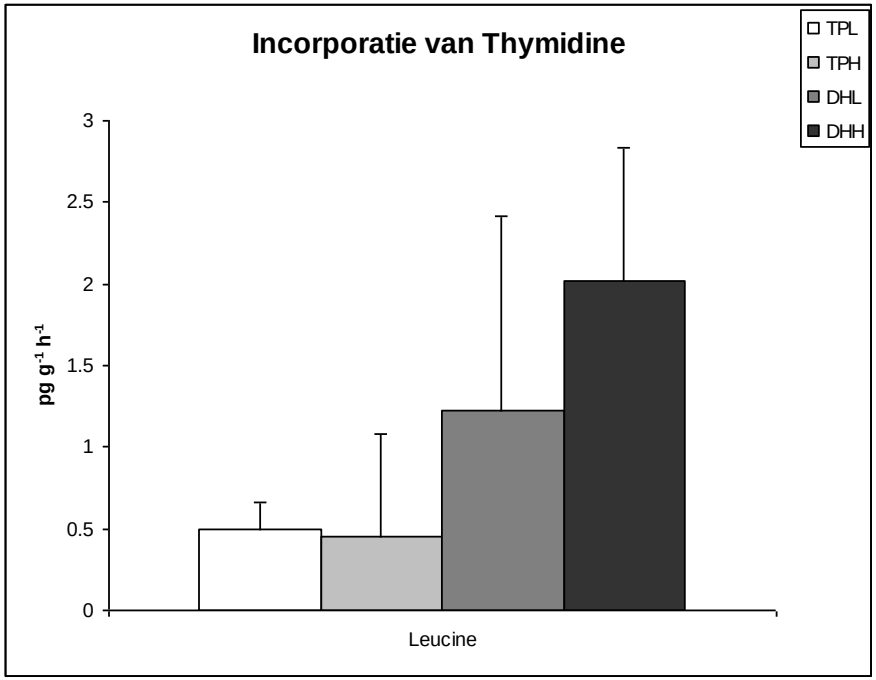


kalkrijk, OS Laag
kalkrijk, OS hoog
kalkarm, OS laag
kalkarm, OS hoog

Bacteriële productie: DNA synthese (thymidine inbouw) *hoger* in kalkarm, alle waarden erg laag



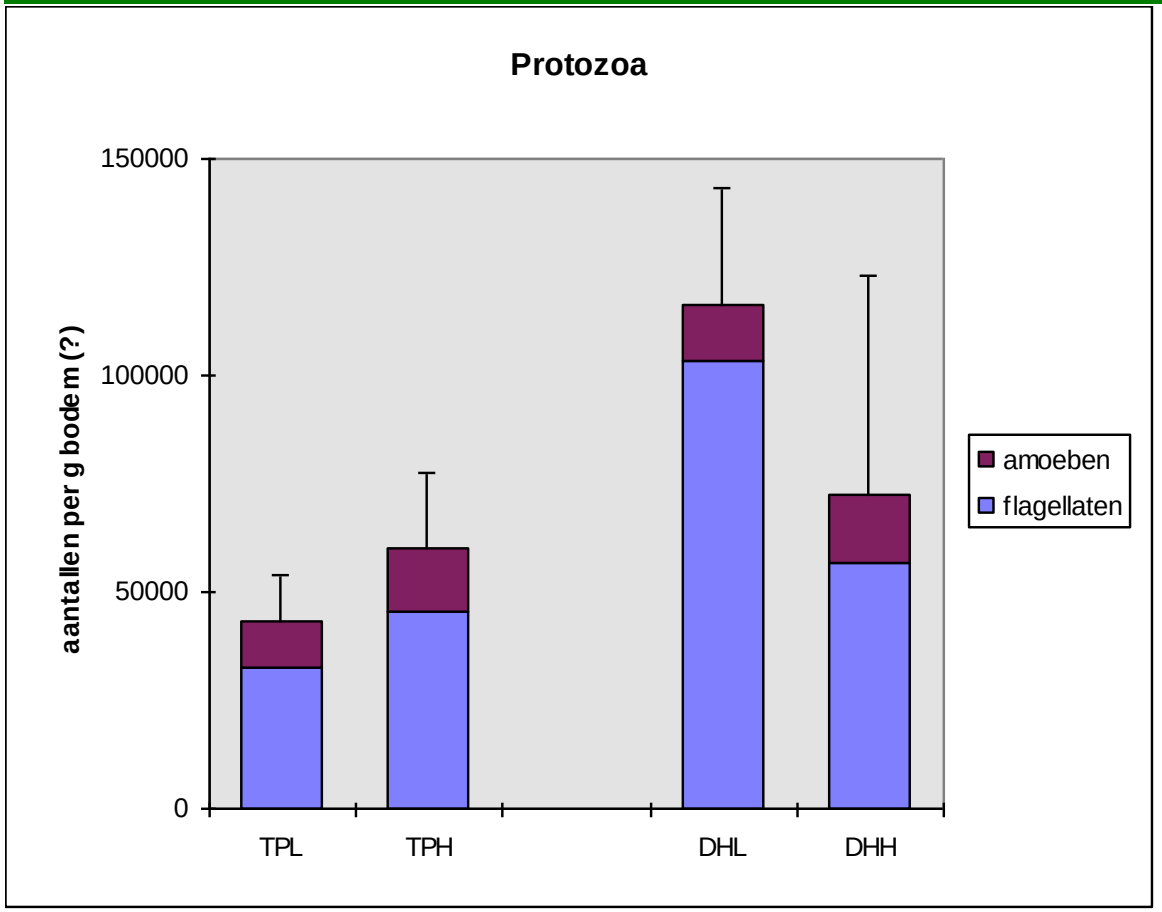
kalk	+	+	-	-
OS	-	+	-	+



kalk	+	+	-	-
OS	-	+	-	+

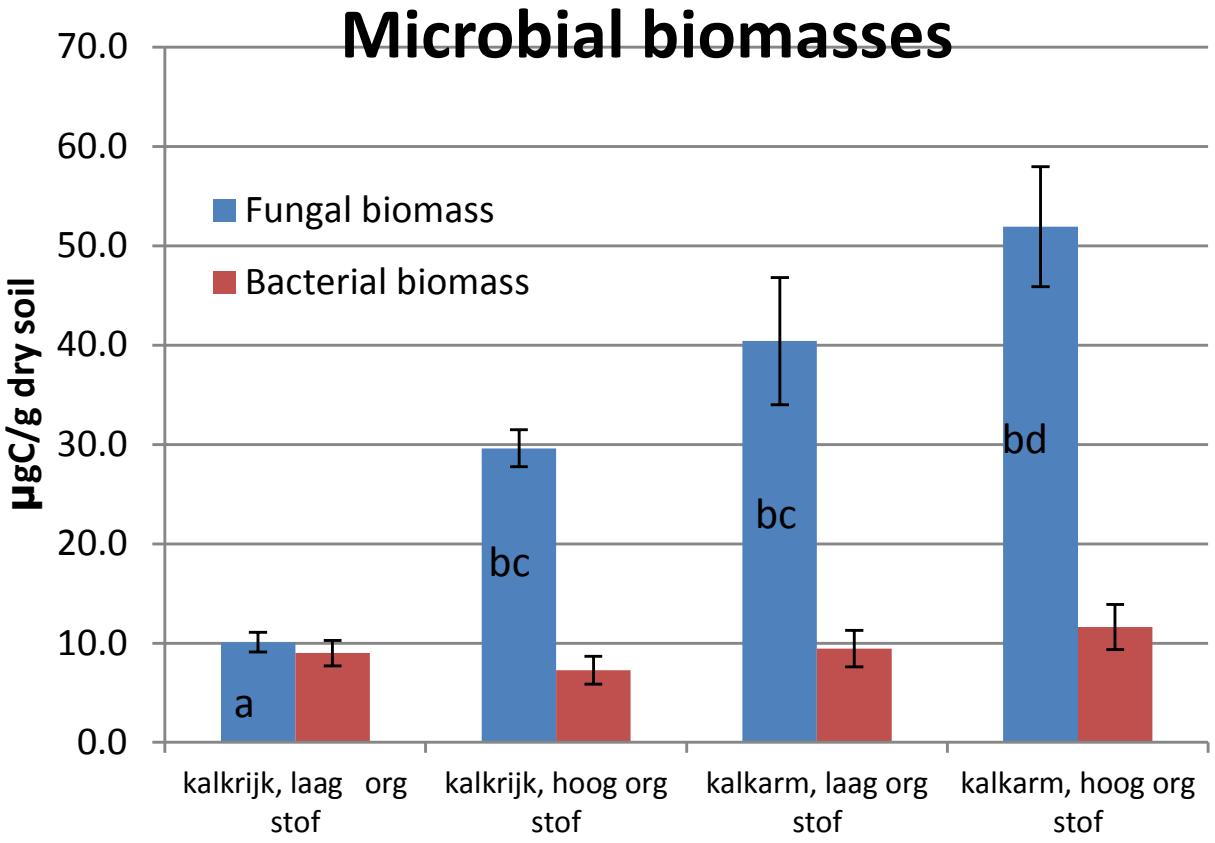
kalkrijk, OS Laag
kalkrijk, OS hoog
kalkarm, OS laag
kalkarm, OS hoog

Protozoën
meer flagellaten in kalkarme bodem, komt overeen met bacterieproductie

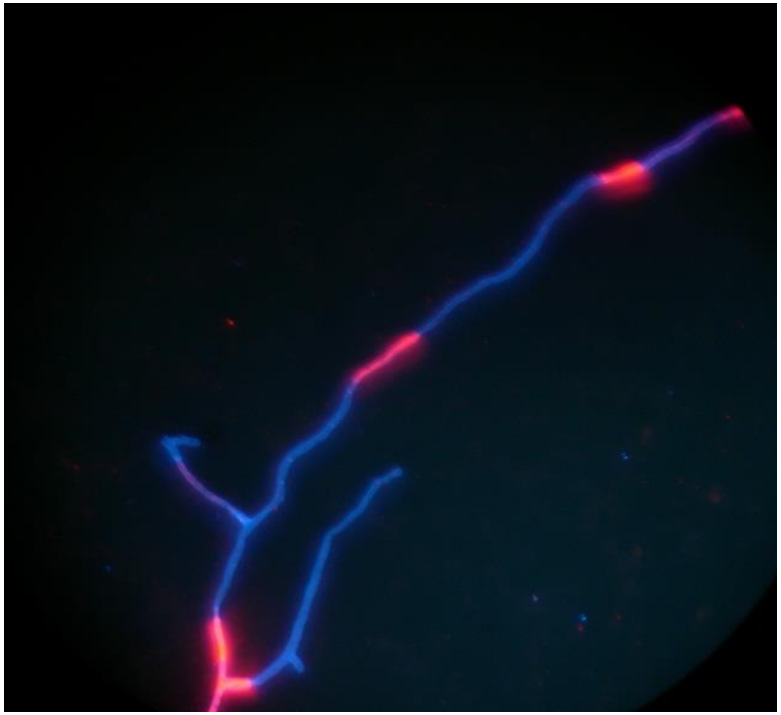


kalk	+	+	-	-
OS	-	+	-	+

Biomassa van schimmels en bacteriën (microscopische metingen) schimmel-gedomineerde bodems



Gekleurde (hyaline) en ongekleurde (melanine) schimmels

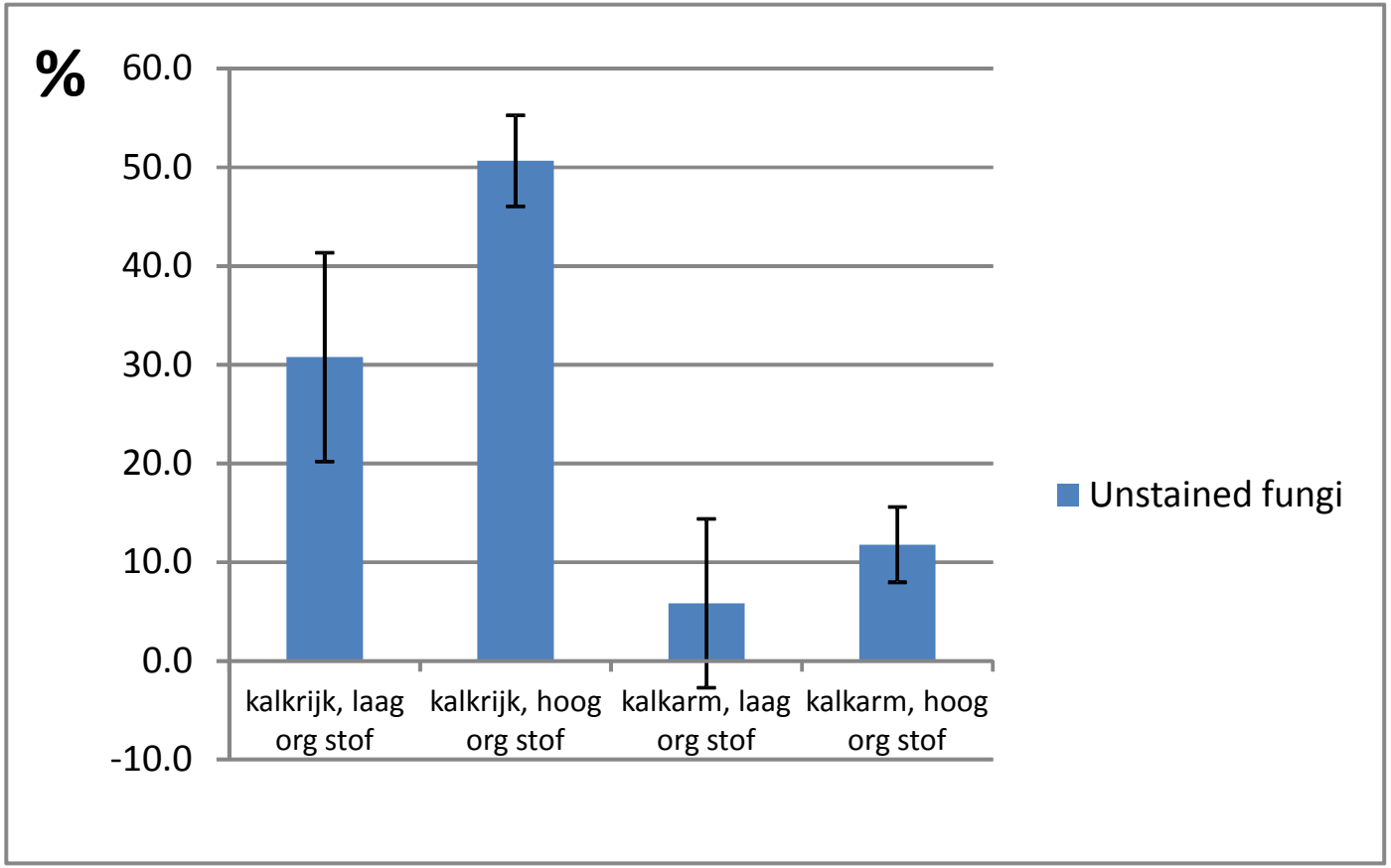


Melanine is donker pigment in celwanden

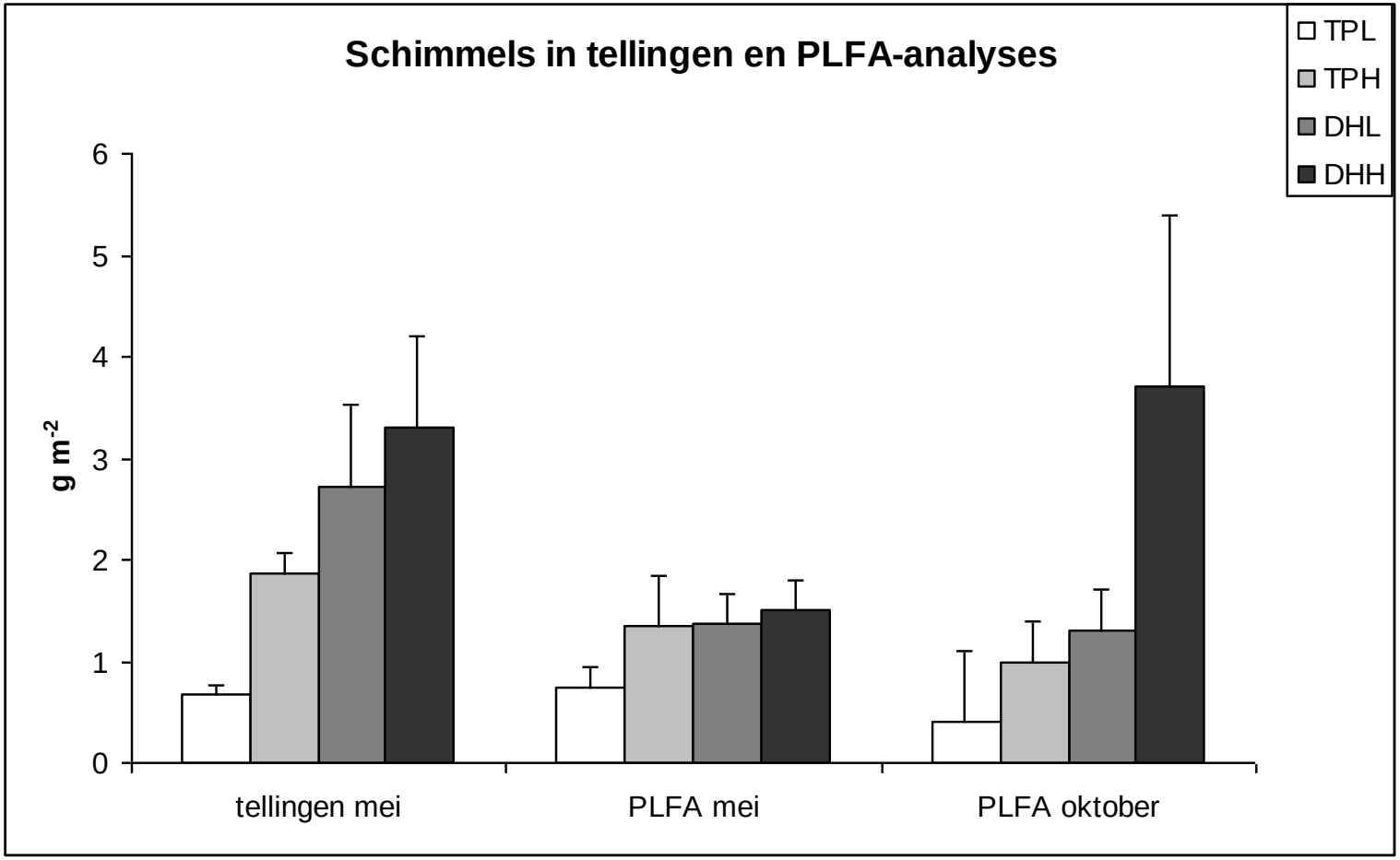
bescherming tegen stress: straling, hitte, droogte, antagonisten, infecties en grazers

complexe ringstructuren, moeilijk afbreekbaar, vertraagt afbraak necromassa, speelt rol bij humusvorming

Kalkrijke bodem meer (niet gekleurde) melanine schimmels



Schimmelbiomassa
Hoger in kalkarme bodem, neemt toe met organische stof



kalkrijk, OS Laag
kalkrijk, OS hoog
kalkarm, OS laag
kalkarm, OS hoog

Conclusies

- Microbiële biomassa neemt toe met organische stof

- Kalk geen effect op biomassa C
- Kalkrijke bodem
  - meer biomassa N
  - meer mineraliseerbare N
  - groter aandeel melanine schimmels
- Kalkarme bodem
  - meer schimmels
  - hogere bacteriële groeisnelheid (celproductie)
  - meer flagellaten (bacterivore protozoën)

- Microbiële biomassa sterk gedomineerd door schimmels, bacterie activiteit laag:
  - wijst op weinig N vastlegging via bacteriële voedselweb.
  - mogelijk wel N vastlegging via schimmels (celwanden en residuen)