

# Weerbaarheid



**Wietse de Boer**

**NIOO-KNAW (Microbiële Ecologie)**

**WUR (Bodemkwaliteit)**

**E-mail: [w.deboer@nioo.knaw.nl](mailto:w.deboer@nioo.knaw.nl)**



WAGENINGEN UNIVERSITY  
WAGENINGEN UR



# Ziekteverwekkers

Onderdrukkend  
Suppressief

Weerbaar  
Weerstand  
Werend

Stabiel  
Veerkracht

Actoren

Gevolg

Duur

Activiteit / Mechanisme



**Ziekteverwekkers**



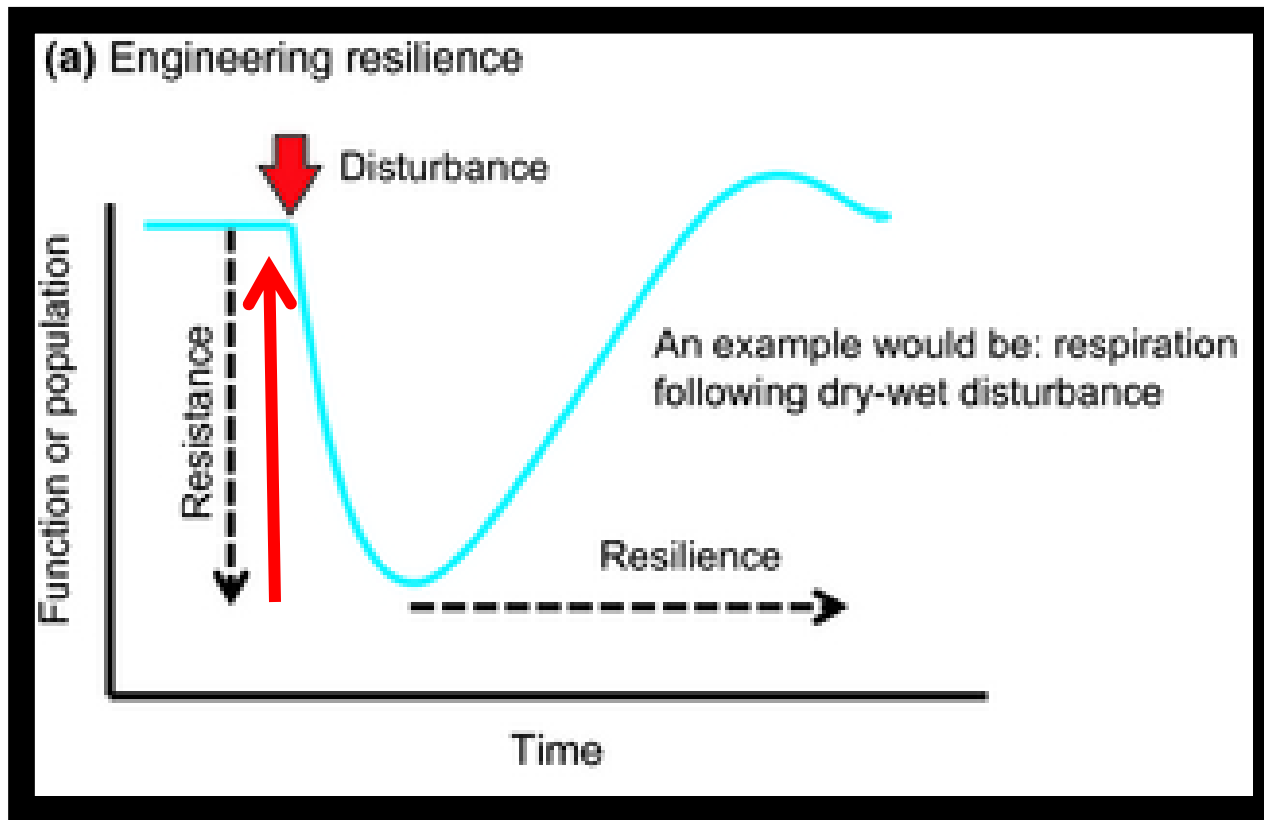
**Indringers**



**Verstoring**



# Weerstand en Veerkracht



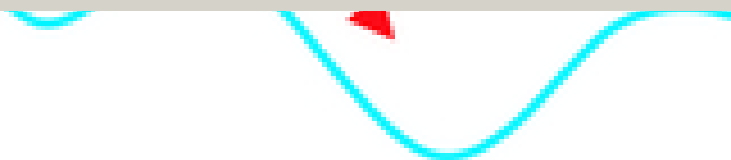
Griffiths & Philippot (2013) Insights into the Resistance and Resilience of Soil Microbial Communities. FEMS Microbiology Reviews 37 (2): 112-129

# Ecologische Veerkracht

(b) Ecological resilience

An example would be: shift from

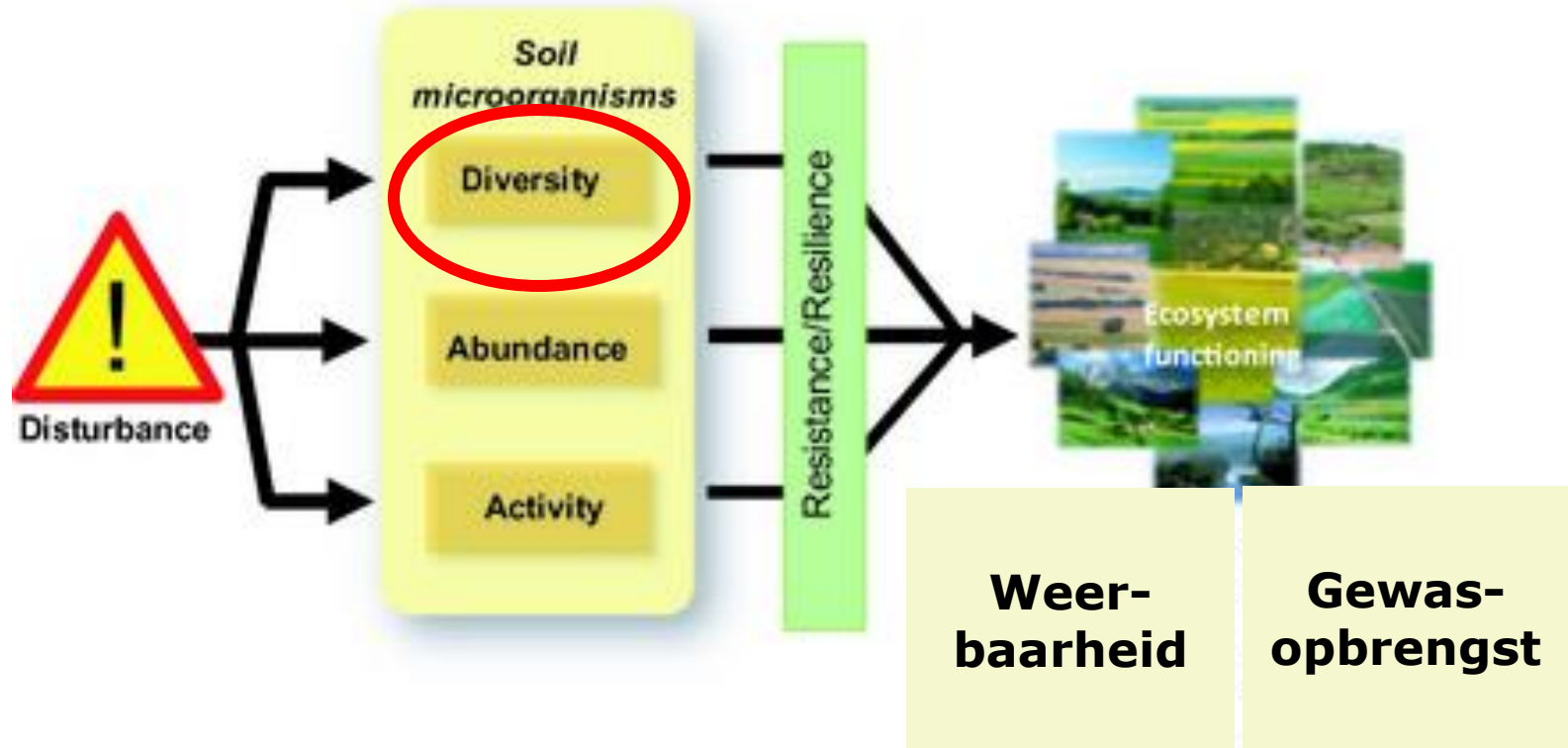
**Stabiliteit: Functie van weerstand en veerkracht**



Griffiths & Philippot (2013) Insights into the Resistance and Resilience of Soil Microbial Communities. FEMS Microbiology Reviews 37 (2): 112-129

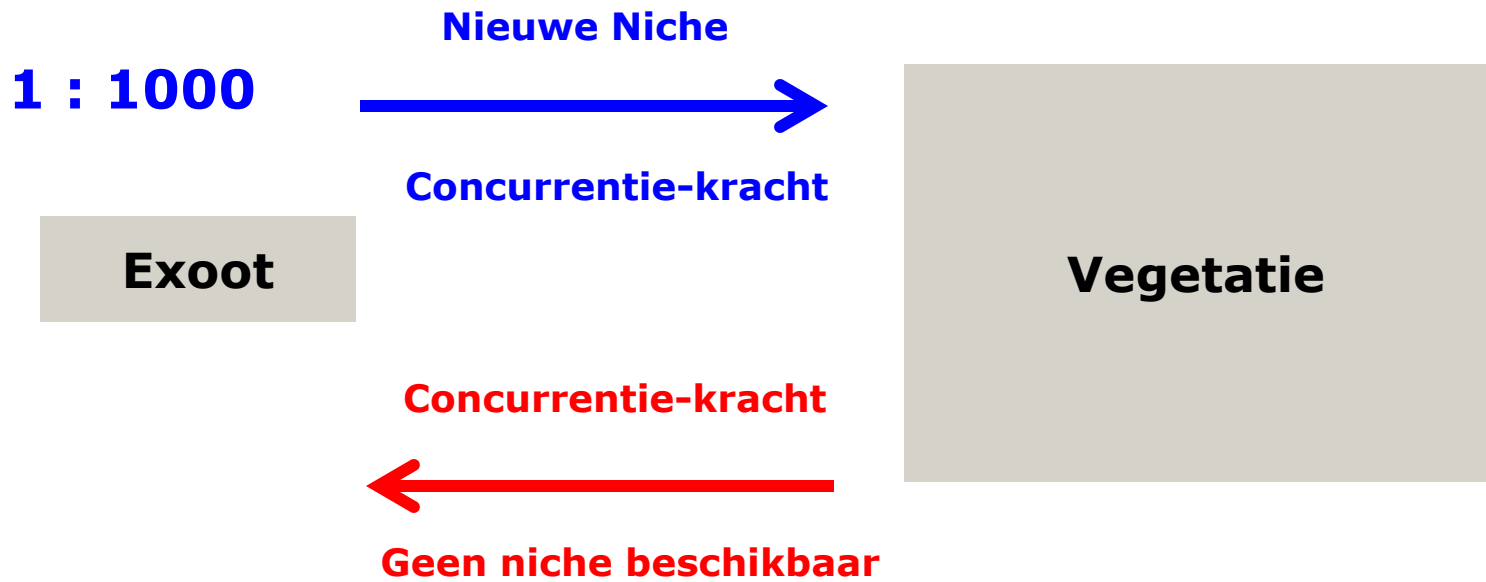


# Verstoring



Griffiths & Philippot (2013) Insights into the Resistance and Resilience of Soil Microbial Communities. FEMS Microbiology Reviews 37 (2): 112-129

# Verstoring door Indringers



# Weerbaarheid - Biodiversiteit

MacDougall et al. (2009) Plant invasions and the niche. Journal Ecology 97: 609-615.

# Amerikaanse Vogelkers

**Agressieve inheemse Pythium stammen**

Range,  $P = 0.017$

**Inheemse Pathogenen beperken inheemse Prunus uitbreiding**

Range,  $P = 0.0068$

**Inheemse Pathogenen =  
Minder onderdrukking van Exotische Prunus**

0 10 20 30 40 50 60

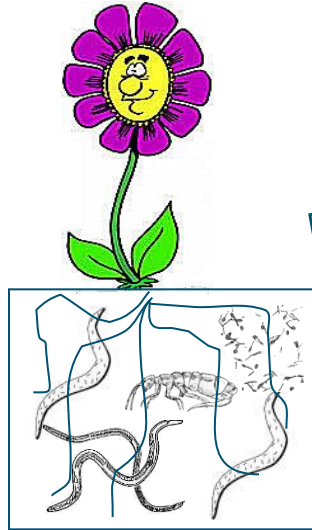
Distance (m) from nearest tree



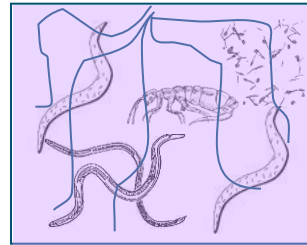


# Plant-Bodem Terugkoppeling

plantensoort A

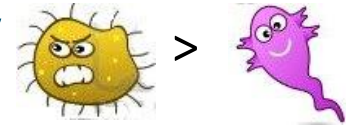


bodemgemeenschap X

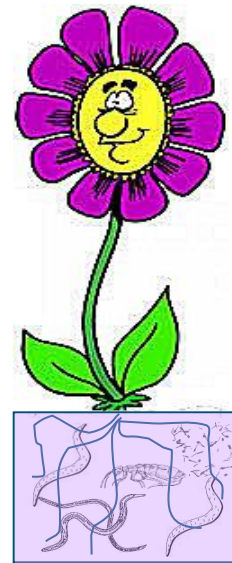


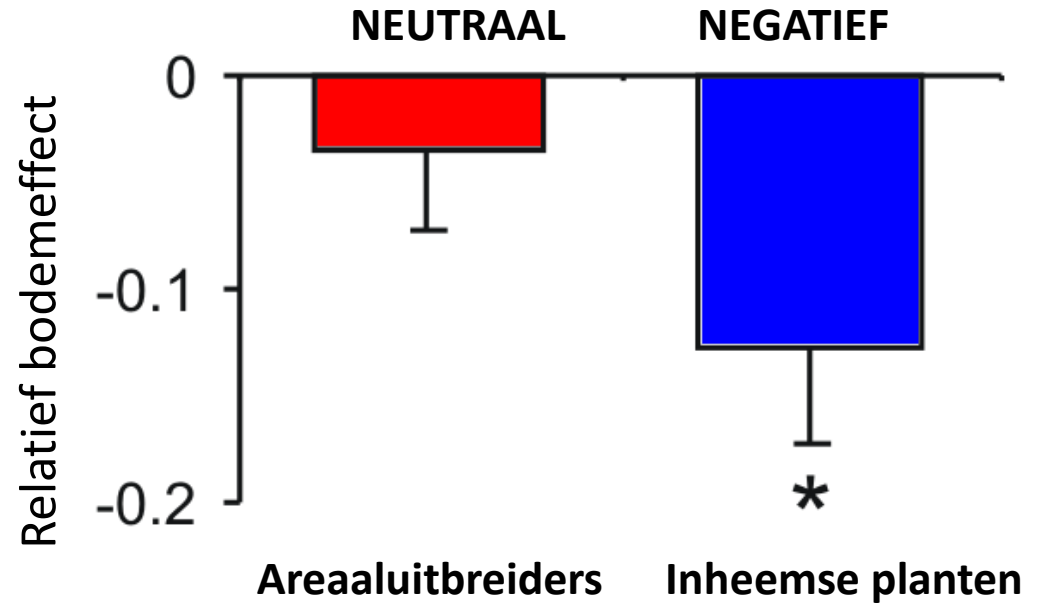
bodemgemeenschap A

-

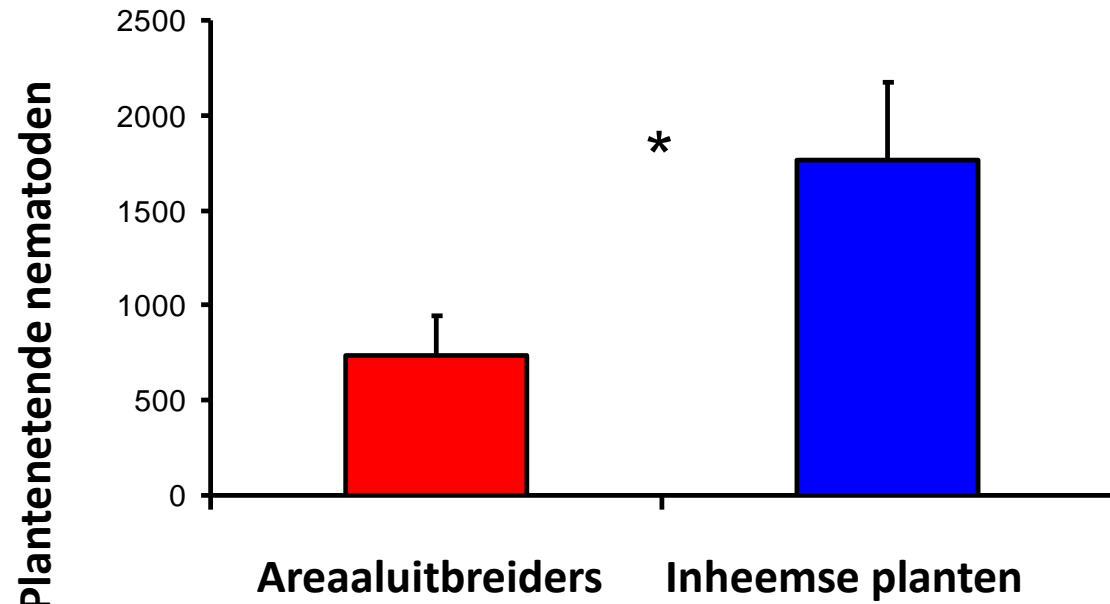


+





Bron: Engelkes *et al.* 2008, Nature



Bron: Morriën *et al.* 2011, OIKOS

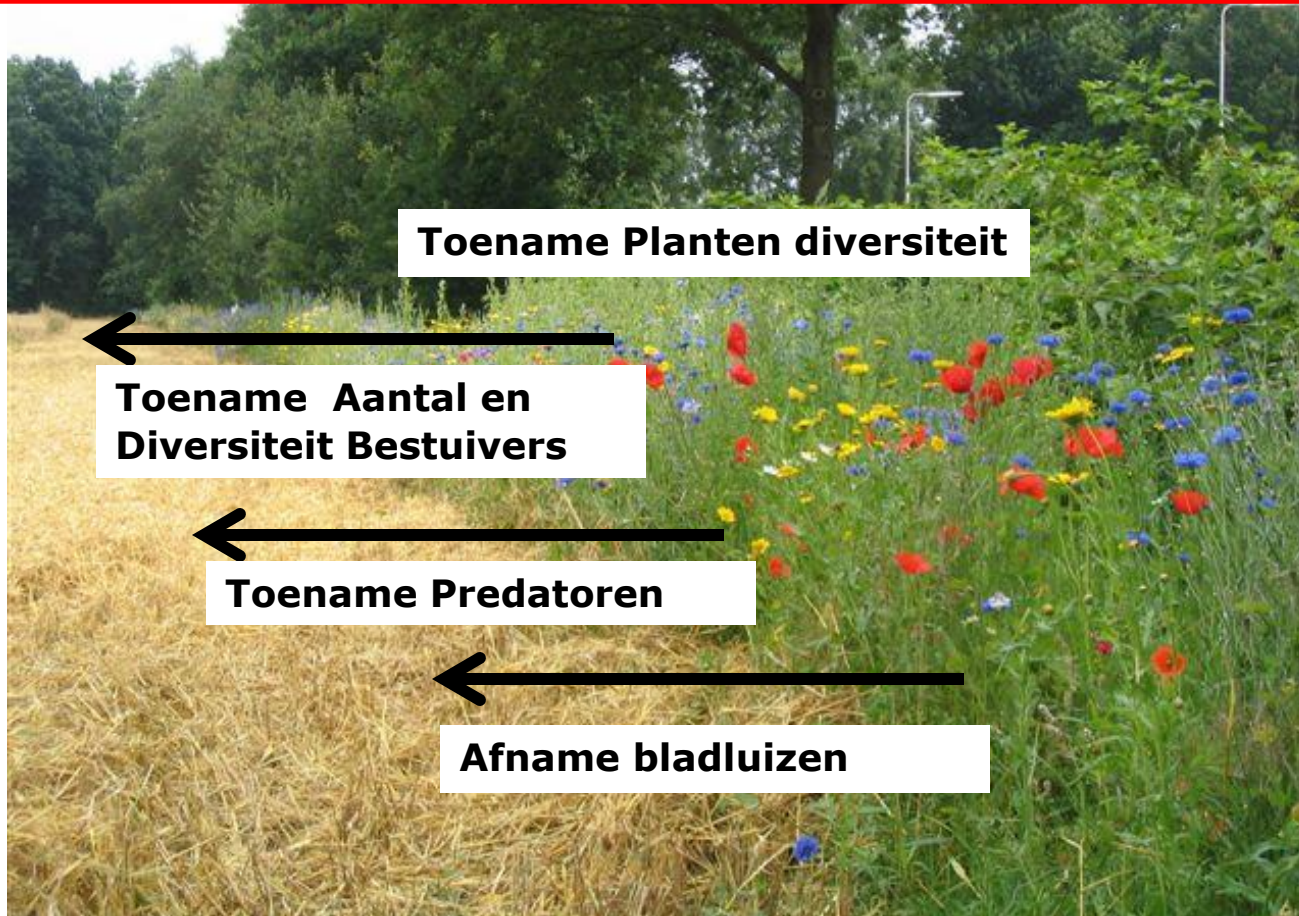
# **Weerbaarheid vegetatie tegen exoten en rol van plantendiversiteit ?**

**Positieve Relatie**

**Succesvolle exoten: concurrentiekrachtig of  
eigen niche**

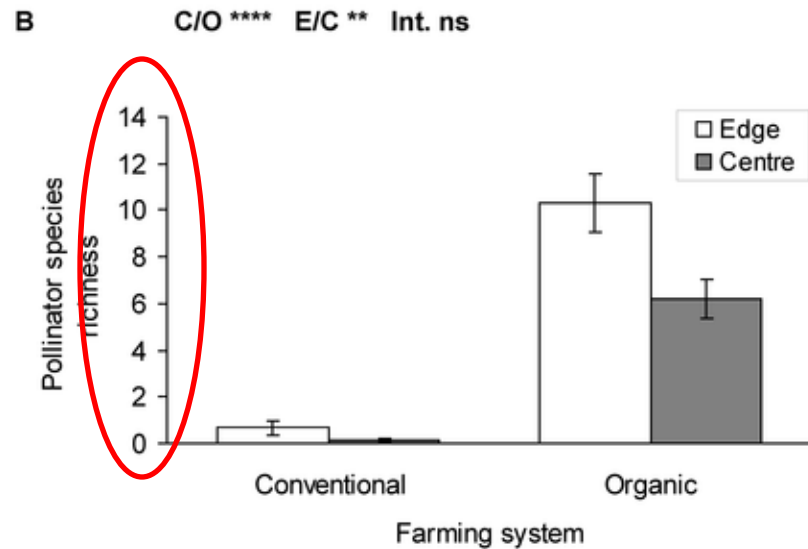
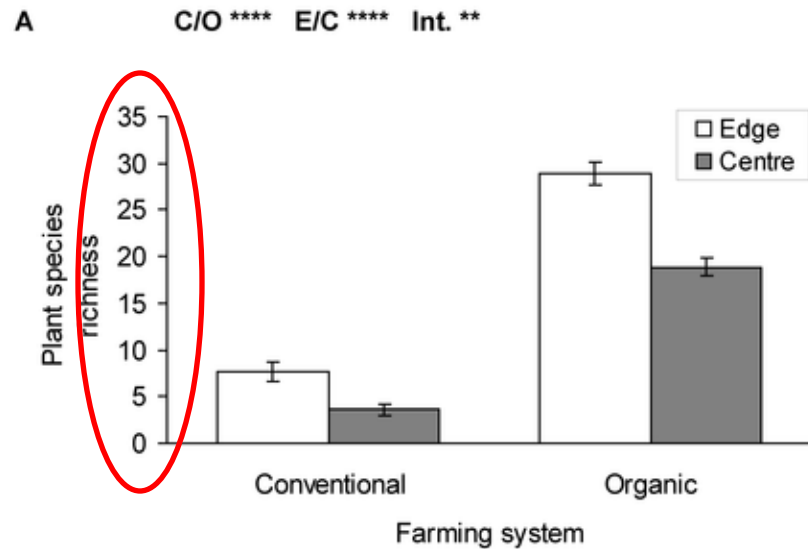


# Plantendiversiteit & Weerbaarheid tegen Herbivoren



Krauss et al. (2011) Decreased Functional Diversity and Biological Pest Control in Conventional Compared to Organic Crop Fields. PLoS ONE 6(5): e19502.

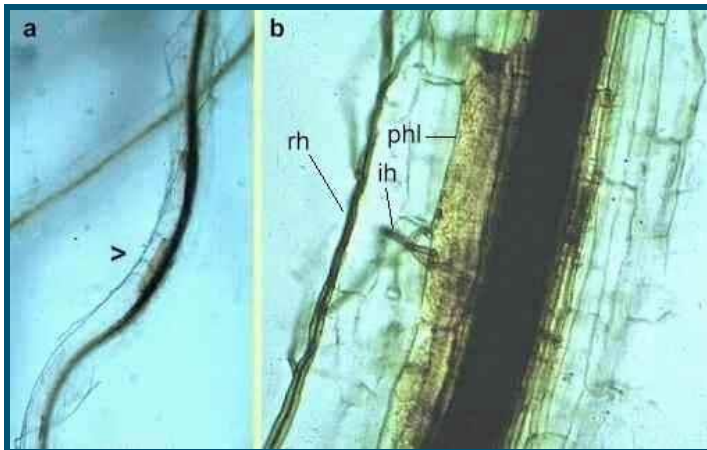
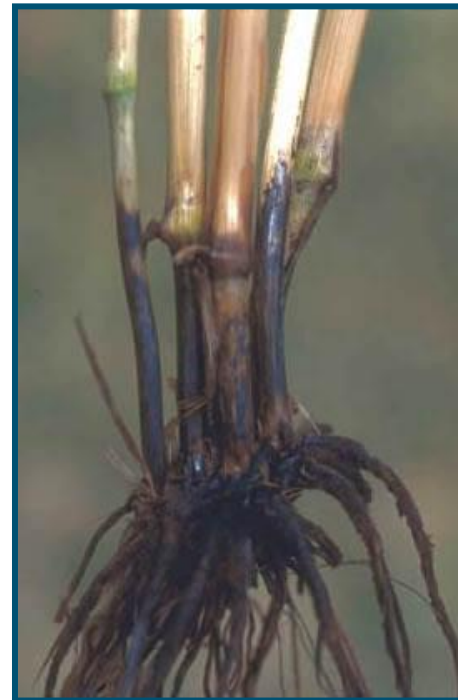




**Krauss et al. (2011) Decreased Functional Diversity and Biological Pest Control in Conventional Compared to Organic Crop Fields. PLoS ONE 6(5): e19502.**



# Verstoring door Bodempathogenen



*Gaeumannomyces graminis*

# Plantendiversiteit & Weerbaarheid tegen Bodempathogenen



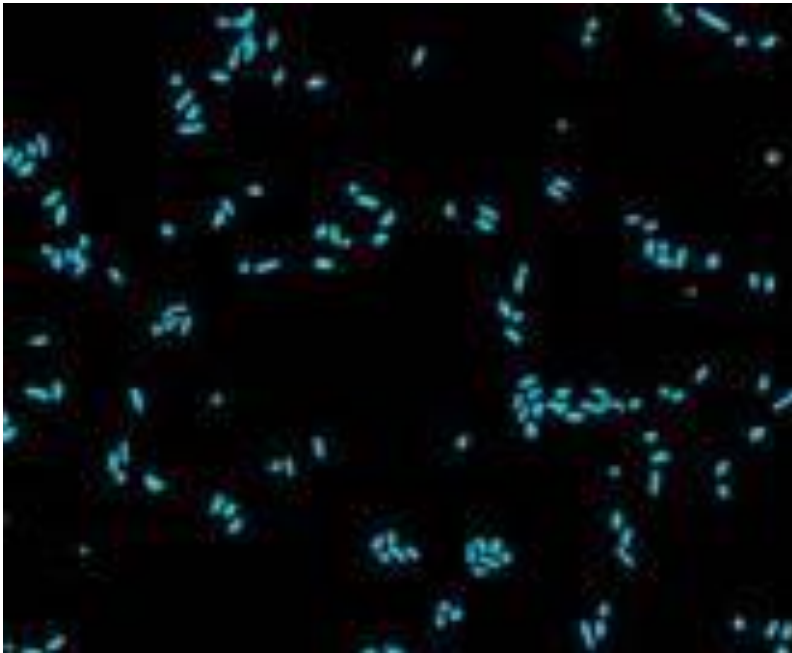
**Mengteelt**



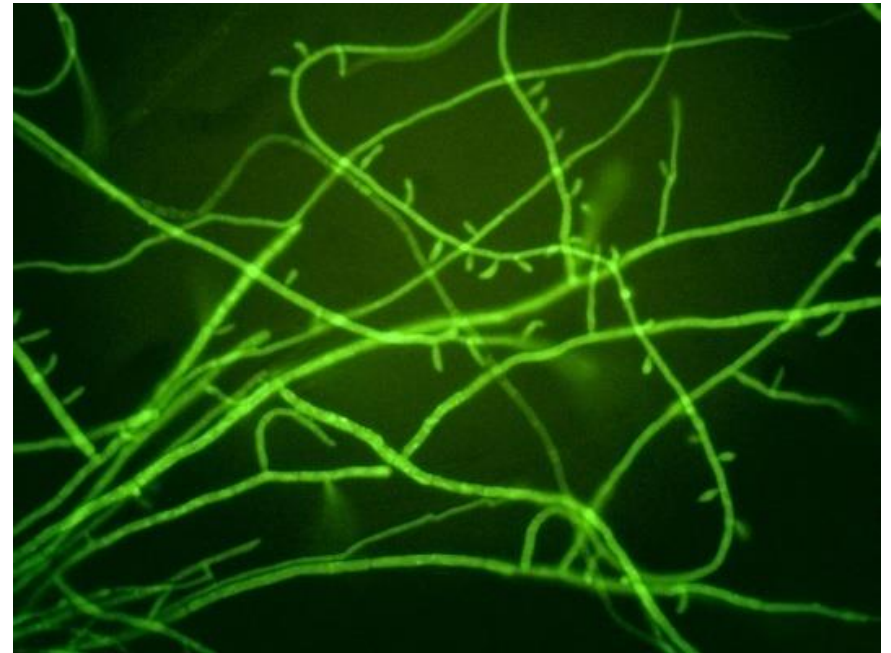
**Gewasrotatie**

Letourneau et al. (2011) Does plant biodiversity benefit agroecosystems. A synthetic review. Ecological Applications 21:9-21

# Microbiële diversiteit & Weerbaarheid tegen Pathogenen



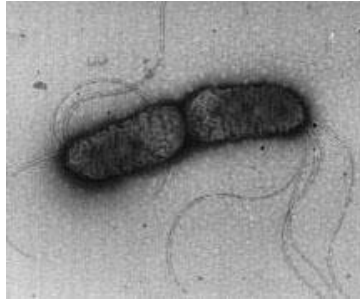
**Bacteriën**



**Schimmels**

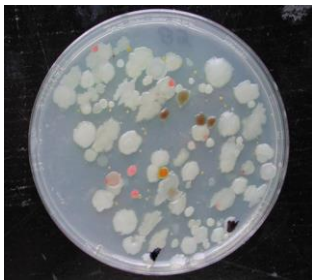


# Kweekbare *versus* niet-kweekbare Bacteriën



**Totale aantallen:  $10^8 - 10^{10}$  per gram droge grond**

**Kweekbare aantallen:  $10^6 - 10^8$  per gram droge gram grond**



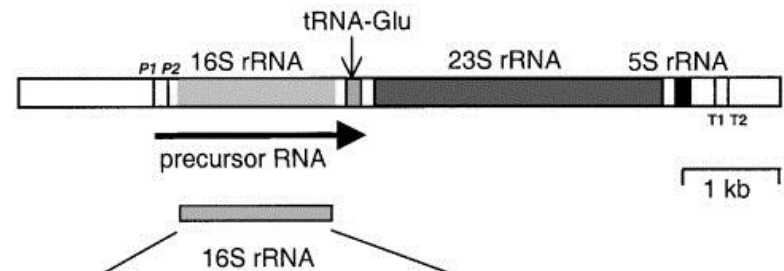
**1 - 10 %**



# Wat is een bacterie soort ?

## Bacteriële Streepjescode

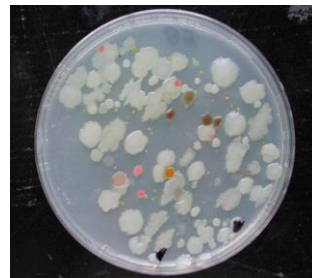
*rrnB* operon



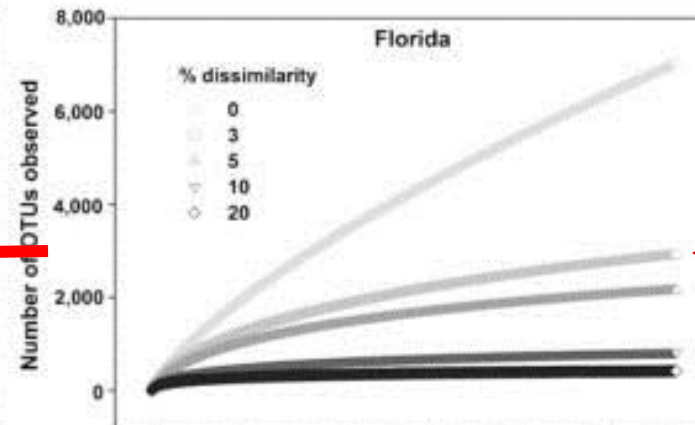
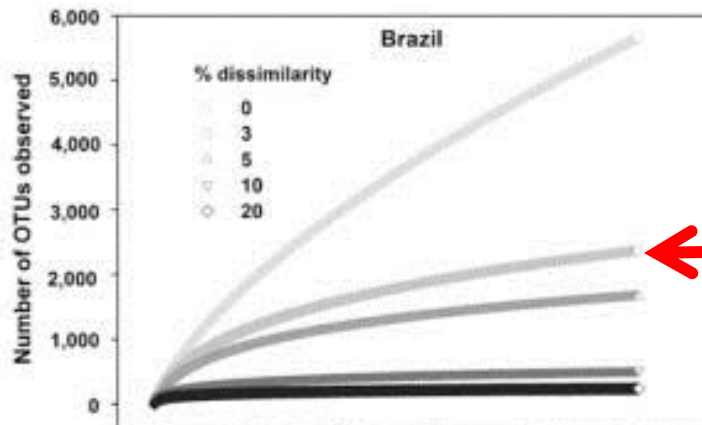
DNA direct uit bodem > 97% overeenkomst = OTU

ATCG

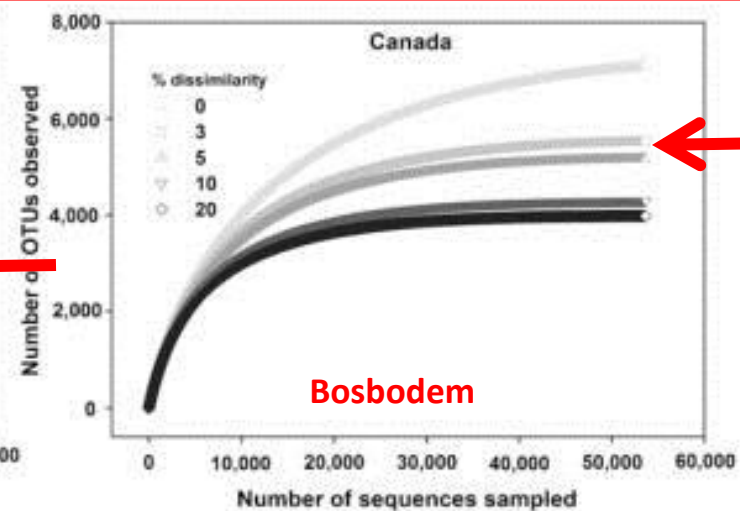
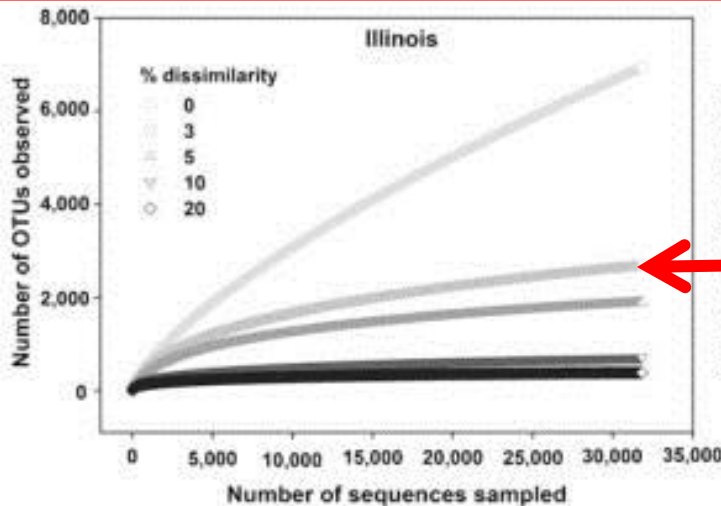
Soort > 97% overeenkomst



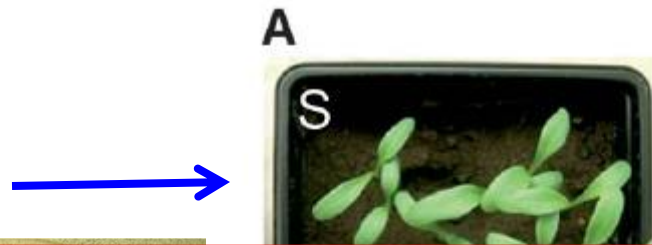
# Diversiteit bacteriën in landbouwbodems



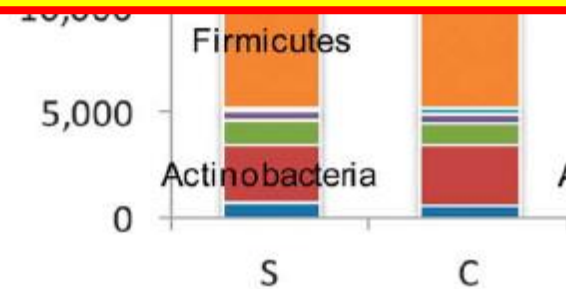
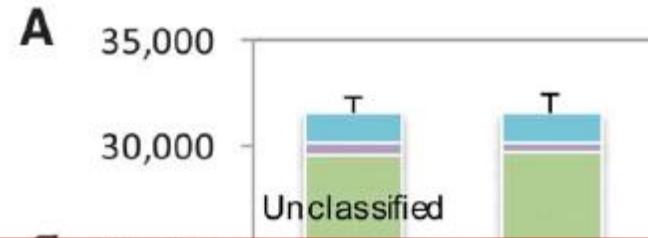
Ongeveer 2000 OTU's per gram of landbouwbodem



# Vergelijking ziekteverende en ziektegevoelige bodems

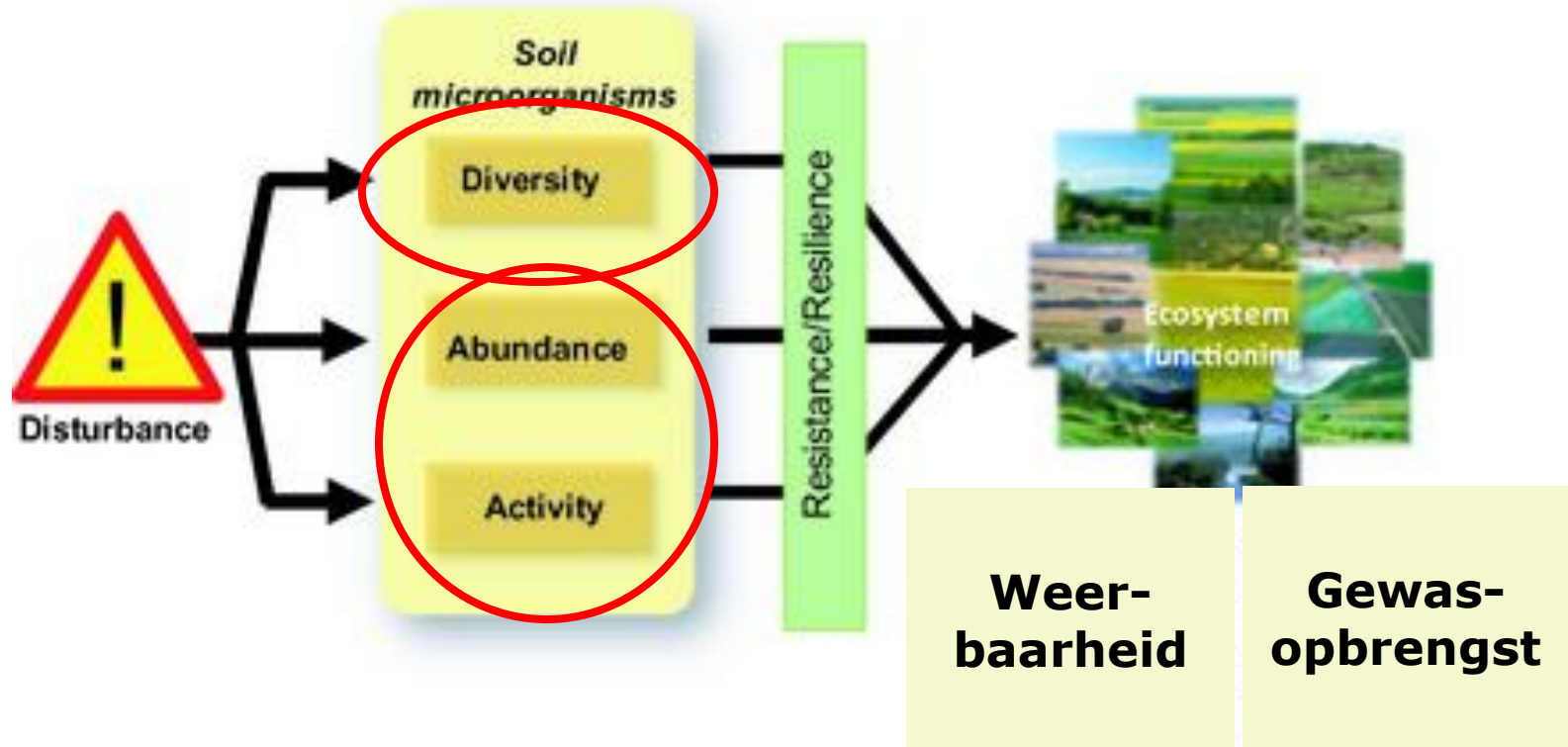


- Geen verschil in diversiteit
- Geen verschil in samenstelling phyla
- Verschil in samenstelling soorten



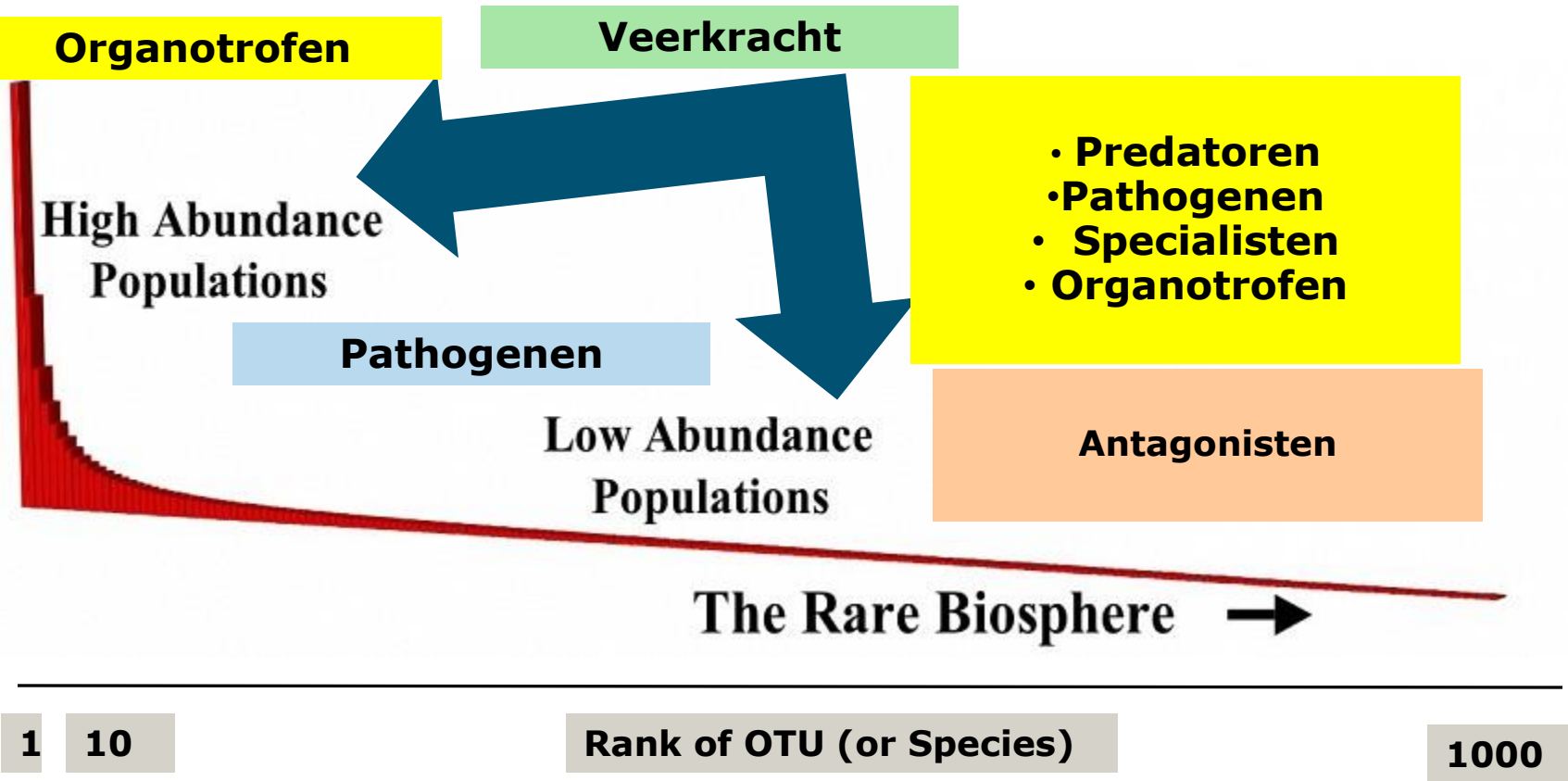
Mendes et al (2011) Science 332:1097-

# Verstoring



Griffiths & Philippot (2013) Insights into the Resistance and Resilience of Soil Microbial Communities. FEMS Microbiology Reviews 37 (2): 112-129

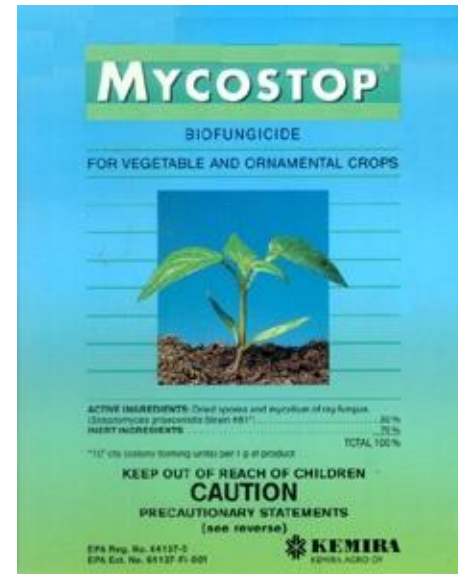
# Frequentie verdeling van Bacterie soorten



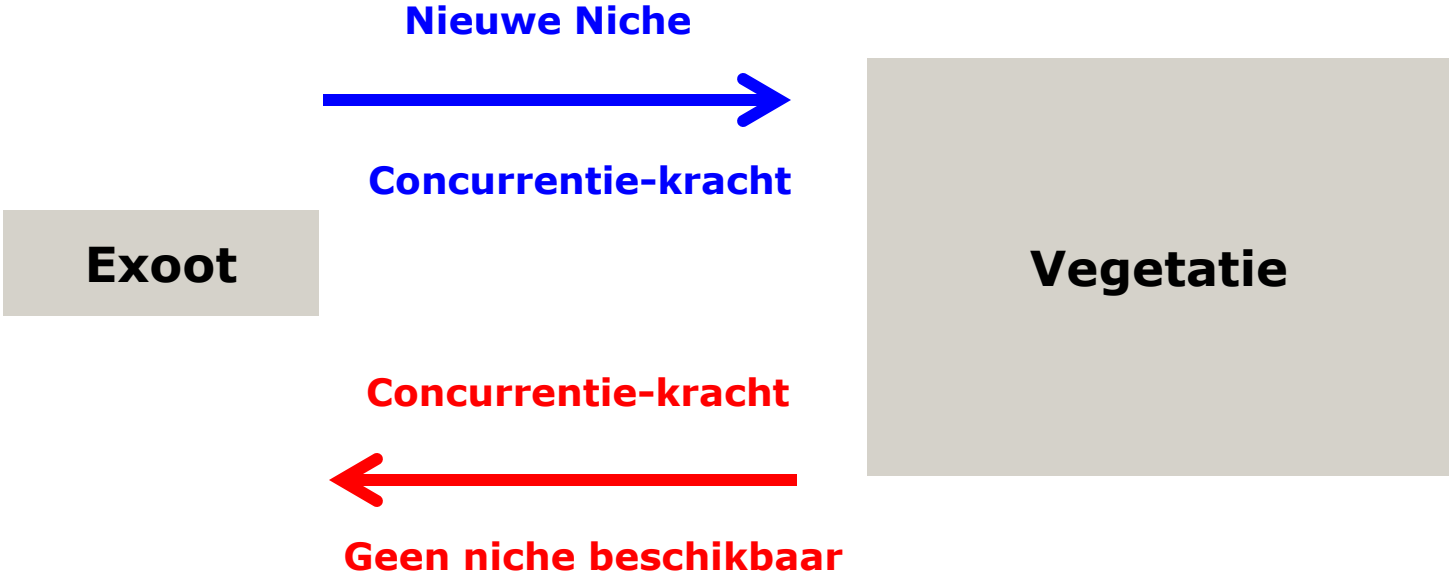
# Verhoging Weerbaarheid met Biocontrole Microorganismen

## KONI WG

Biofungicide used in biological control against white rot (sclerotinia)



# Verstoring door Indringers



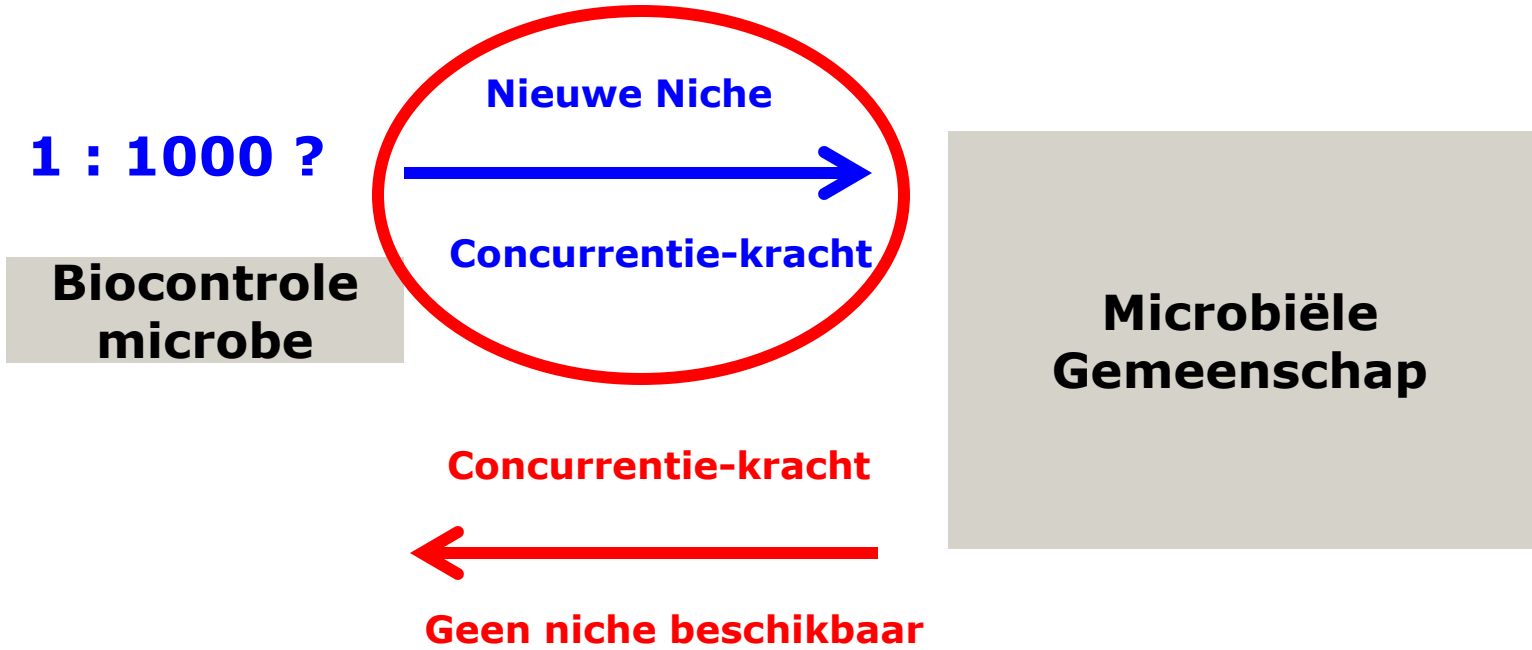
# Weerbaarheid - Biodiversiteit

MacDougall et al. (2009) Plant invasions and the niche. Journal Ecology 97: 609-615.





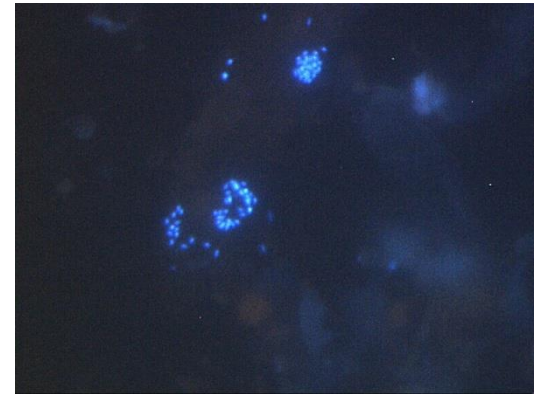
# Verstoring door Indringers



# Weerbaarheid - Biodiversiteit



# Verhoging Weerbaarheid



**Stimuleren van "bodem-eigen" biocontrole microben**

