

Weerbaarheid: wat wéten we (en wat kunnen wij ermee in de praktijk)

Plant-Microbe Interactions Team Utrecht (sinds 1917)



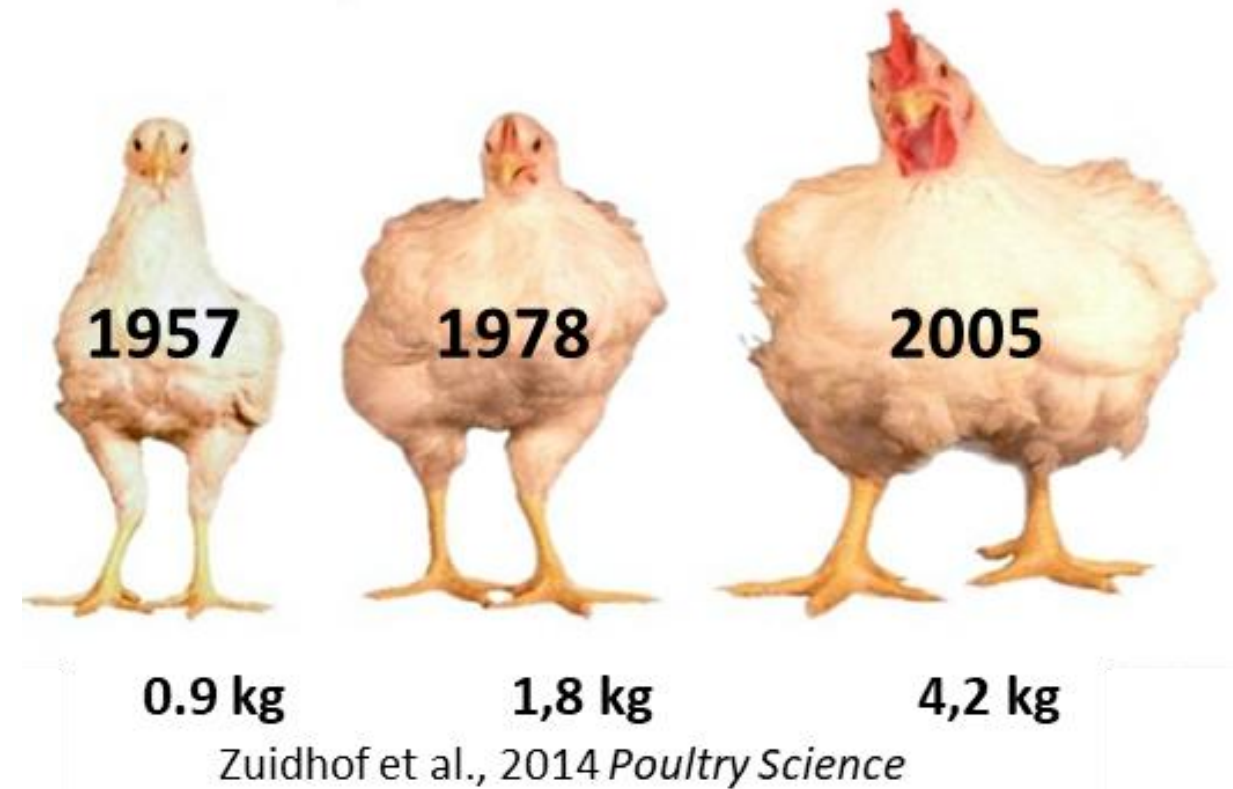
100% Groen Geteeld – Berkel & Rodenrijs – 18 maart 2026



Funded by
the European Union



“(R)evolutie in de land- en tuinbouw”

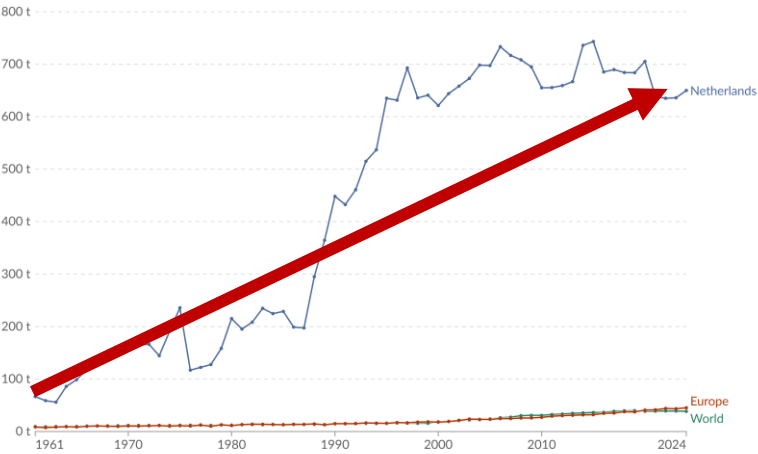


Opbrengst/ha (1961 – 2024)



Cucumber and gherkin yield

Yields are the amount of crop harvested per unit area of land. They are measured in tonnes per hectare.

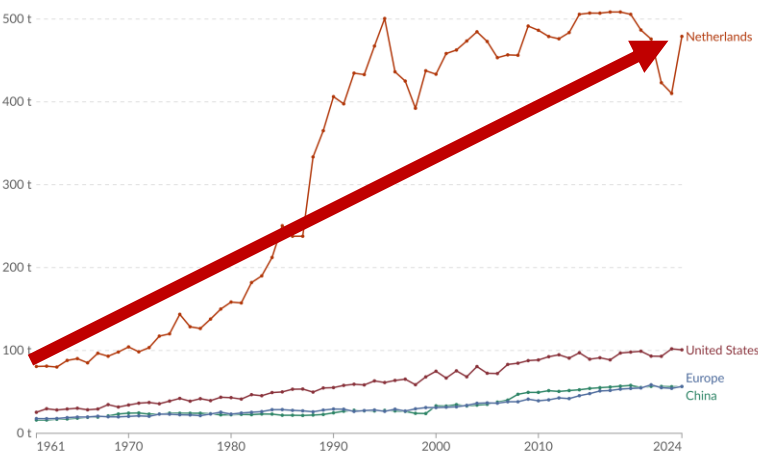


Data source: Food and Agriculture Organization of the United Nations (2025)

OurWorldinData.org/crop-yields | CC BY

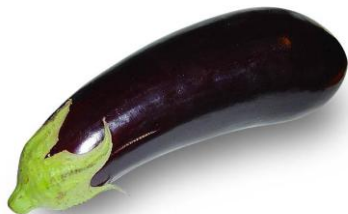
Tomato yield

Yields are the amount of crop harvested per unit area of land. They are measured in tonnes per hectare.



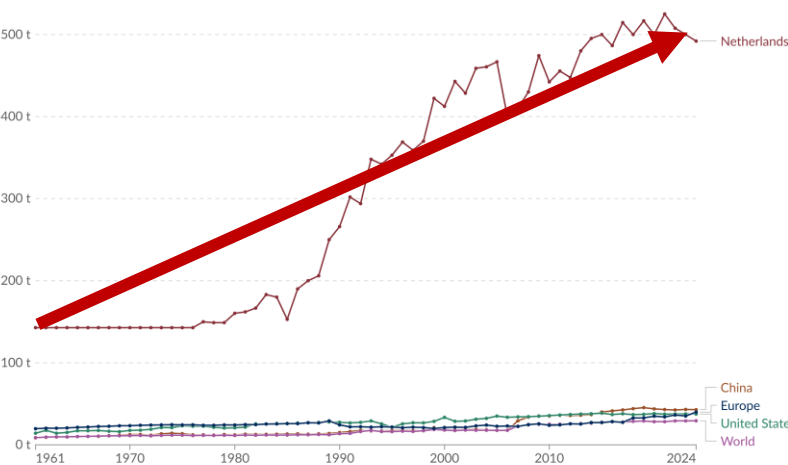
Data source: Food and Agriculture Organization of the United Nations (2025)

OurWorldinData.org/crop-yields | CC BY



Eggplant yield

Yields are the amount of crop harvested per unit area of land. They are measured in tonnes per hectare.



Data source: Food and Agriculture Organization of the United Nations (2025)

OurWorldinData.org/crop-yields | CC BY

Green chilies and peppers yield

Yields are the amount of crop harvested per unit area of land. They are measured in tonnes per hectare.



Data source: Food and Agriculture Organization of the United Nations (2025)

OurWorldinData.org/crop-yields | CC BY



Meststoffen



Meststoffen (1970 – 2023)

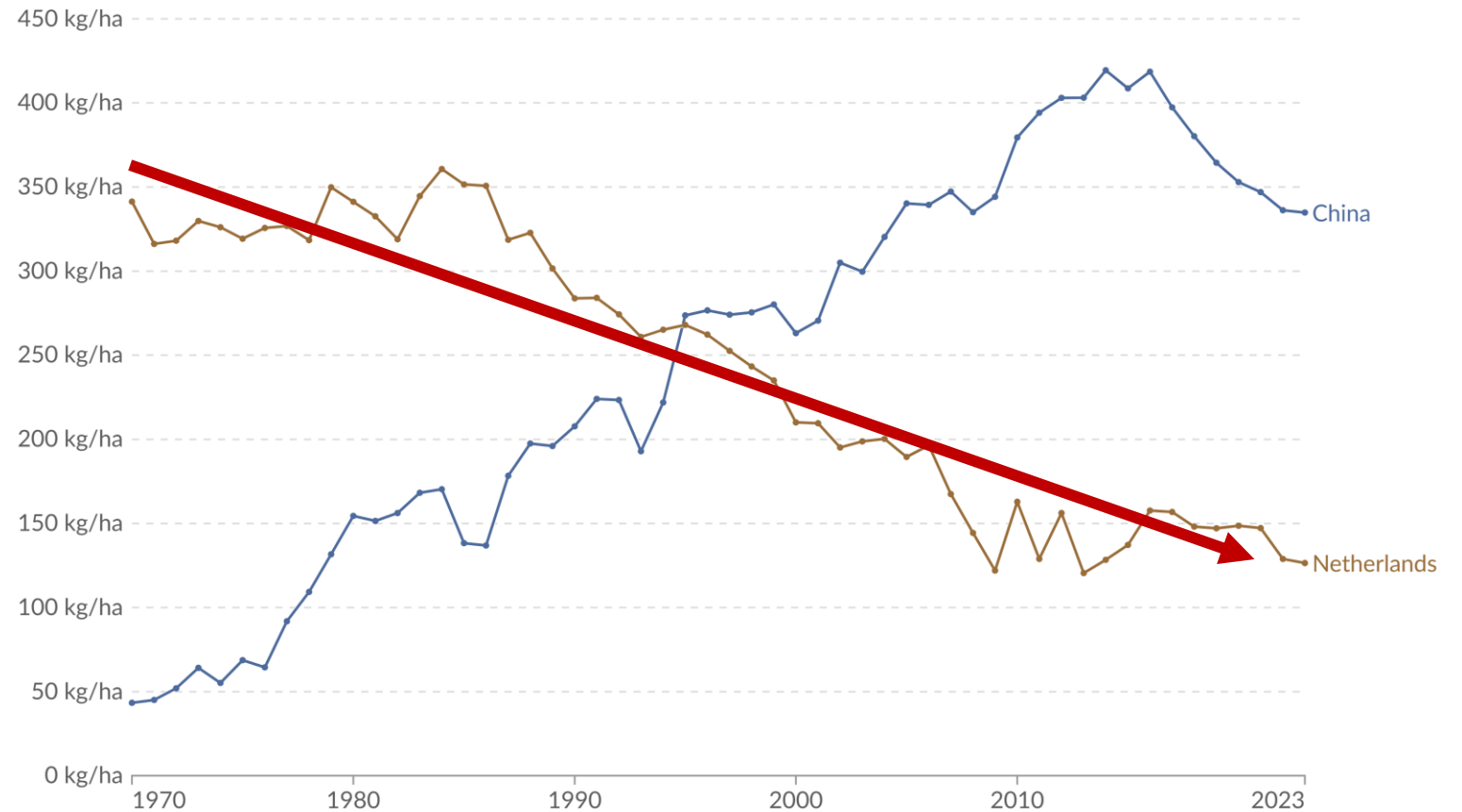
Fertilizer use per hectare of cropland, 1970 to 2023

Application of all fertilizer products (including nitrogenous, potash, and phosphate fertilizers), measured in kilograms of total nutrient per hectare of cropland.

Our World
in Data

NL: 341 kg/ha → 126 kg/ha

(= -64%)



Data source: Food and Agriculture Organization of the United Nations (2025)

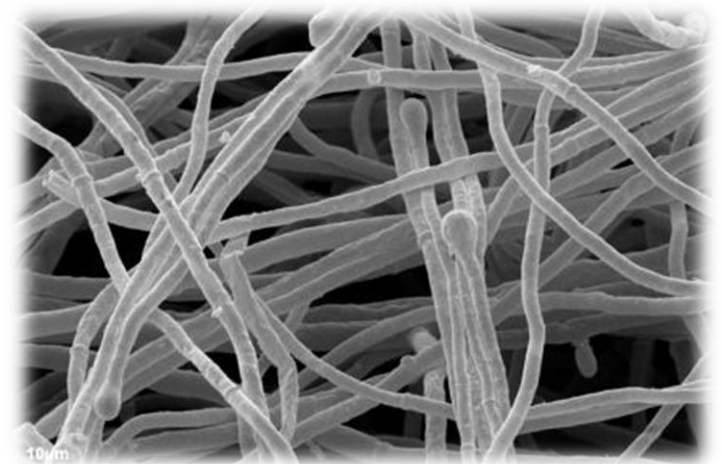
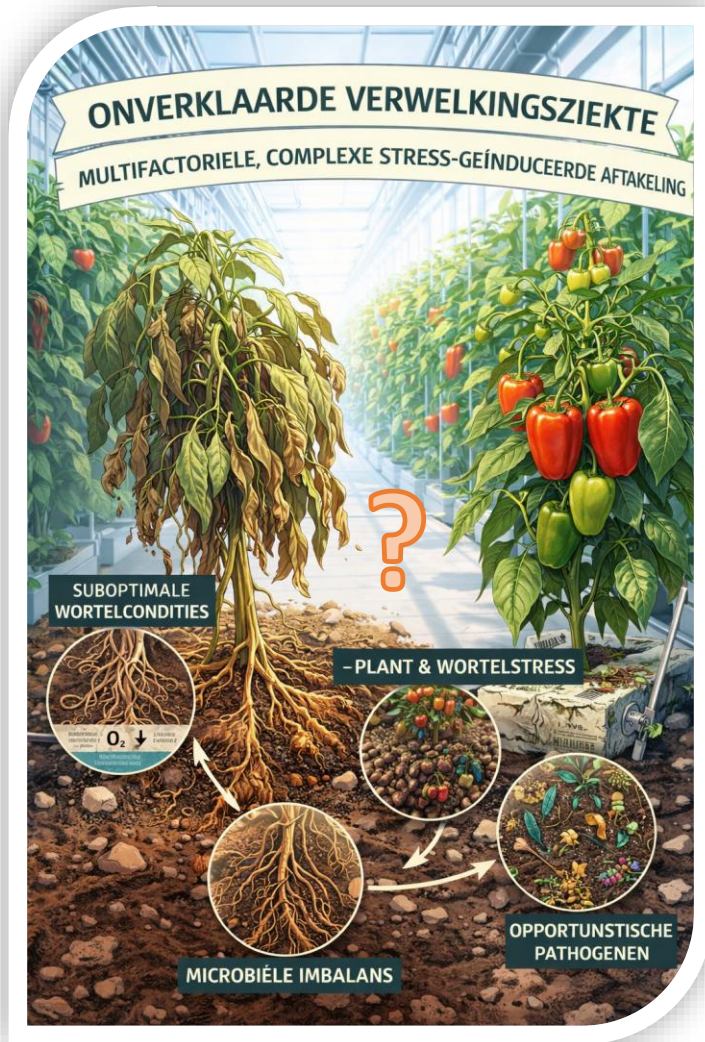
OurWorldinData.org/fertilizers | CC BY

Gewasbeschermingsmiddelen



Schimmelziekte

Fusarium





Schimmel:
Echte meeldauw

Oomyceet:

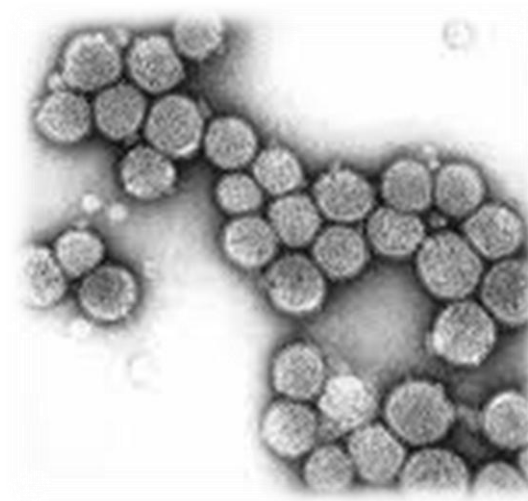
Valse meeldauw

Bremia



Virusziekte

Tomato Spotted Wilt Virus



Bacterieziekte

Erwinia vruchtrot



Biologische gewasbescherming

Probiotische en chemische biostimulanten



 **VAN IPEREN**
groeispecialist sinds 1921

 **Artemis**
Natuurlijk

Chitosan



Kaliumfosfonaat

Algenextract

Mycorrhiza

Aminozuren



Jasmonzuur



Bacillus


Koppert

Salicylzuur

Elicitoren

Bodemleven/microbioom

FRUTOGARD®

Het natuurlijke afweersysteem van de plant

Plant-Microbe Interactions Team Utrecht (sinds 1917)



Funded by
the European Union





Het immuunsysteem
plant vs dier



Het immuunsysteem van plant en dier

> 4 lagen



Barrière immuniteit

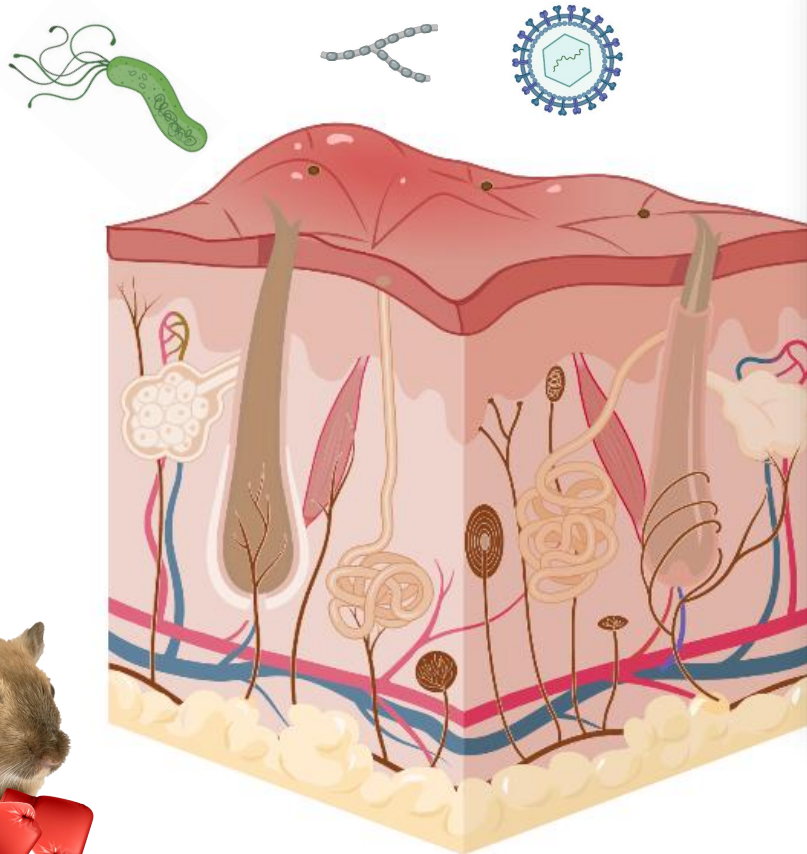
Aangeboren immuniteit

Verworven immuniteit

Microbioom



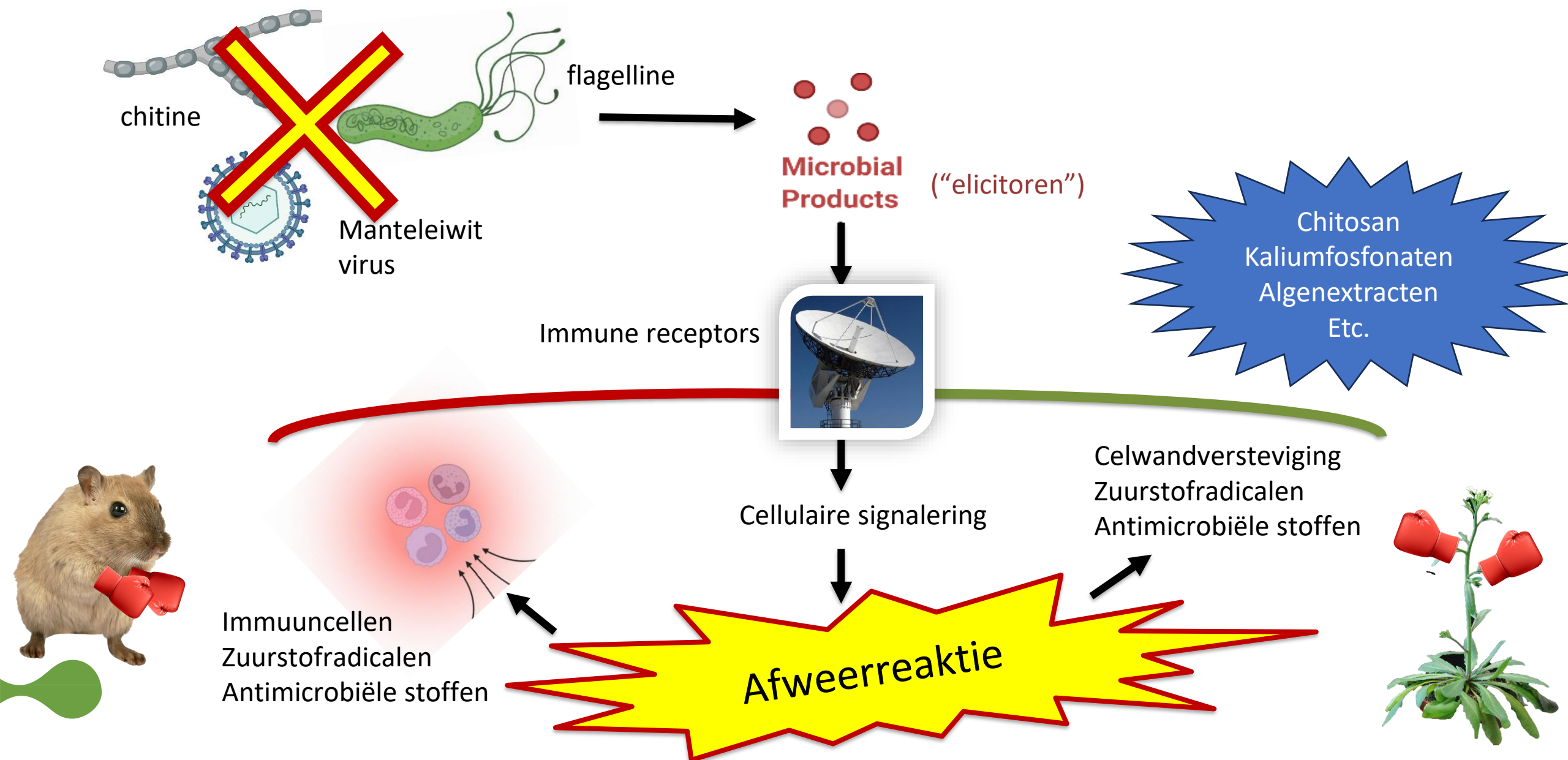
Laag 1: Barrière immuniteit



- Structurele barrière (epidermis, trichomen, ..)
- Chemische barrière (antimicrobiële stoffen)

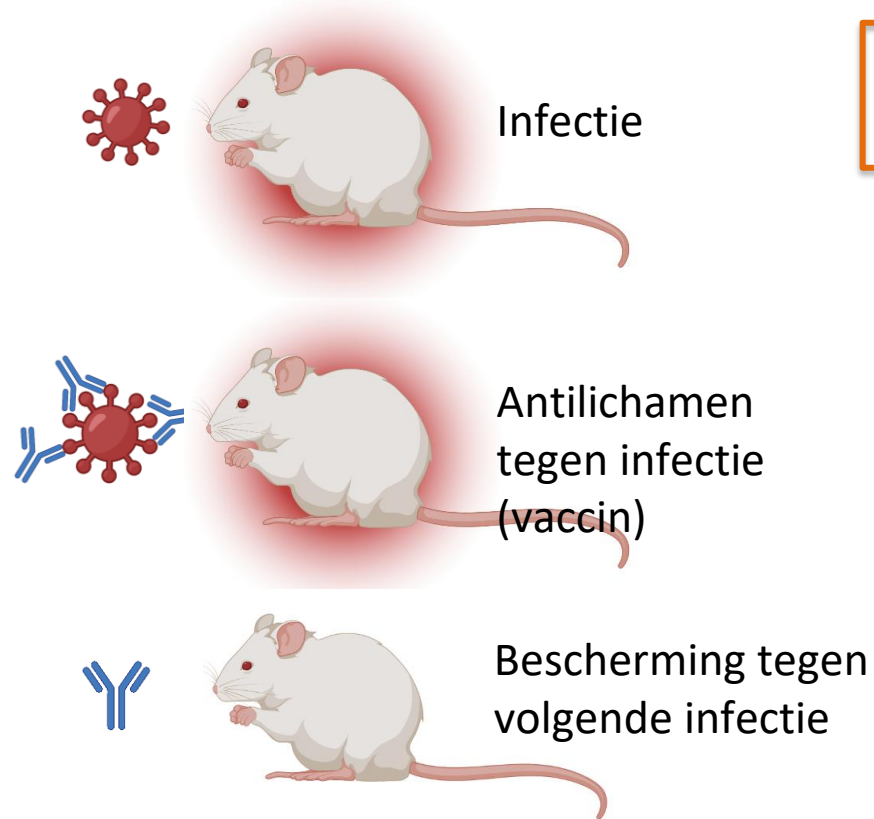


Laag 2: “Aangeboren” (*innate*) immuniteit

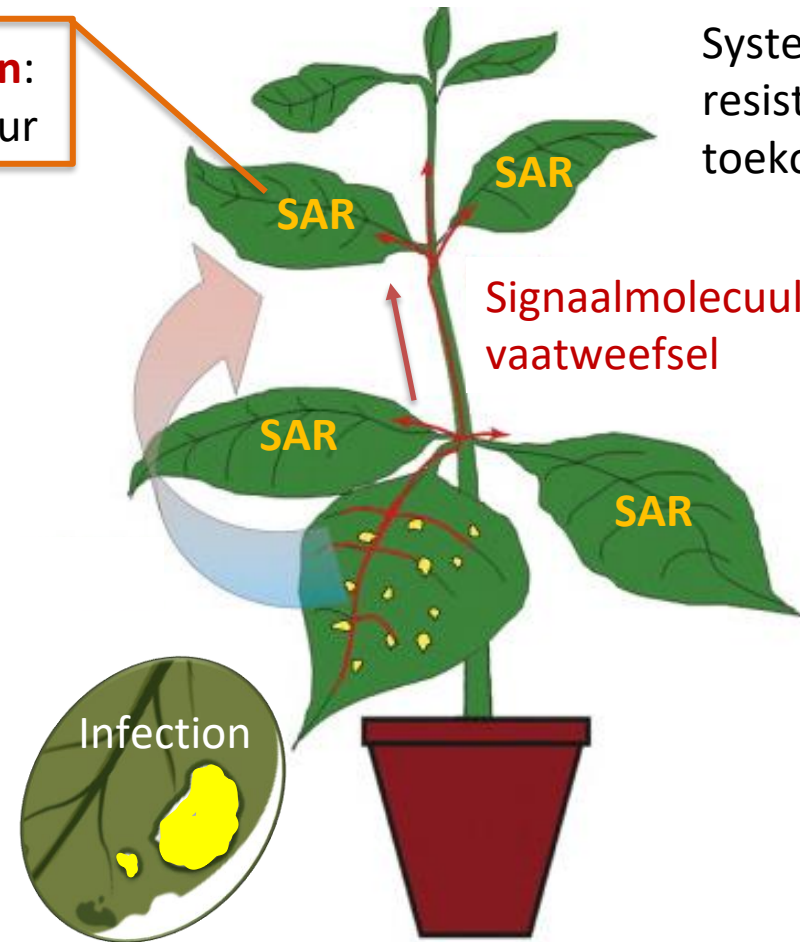


Laag 3: Verworven resistentie

> Ontwikkelt zich ná een infectie



Hormoon:
Salicylzuur

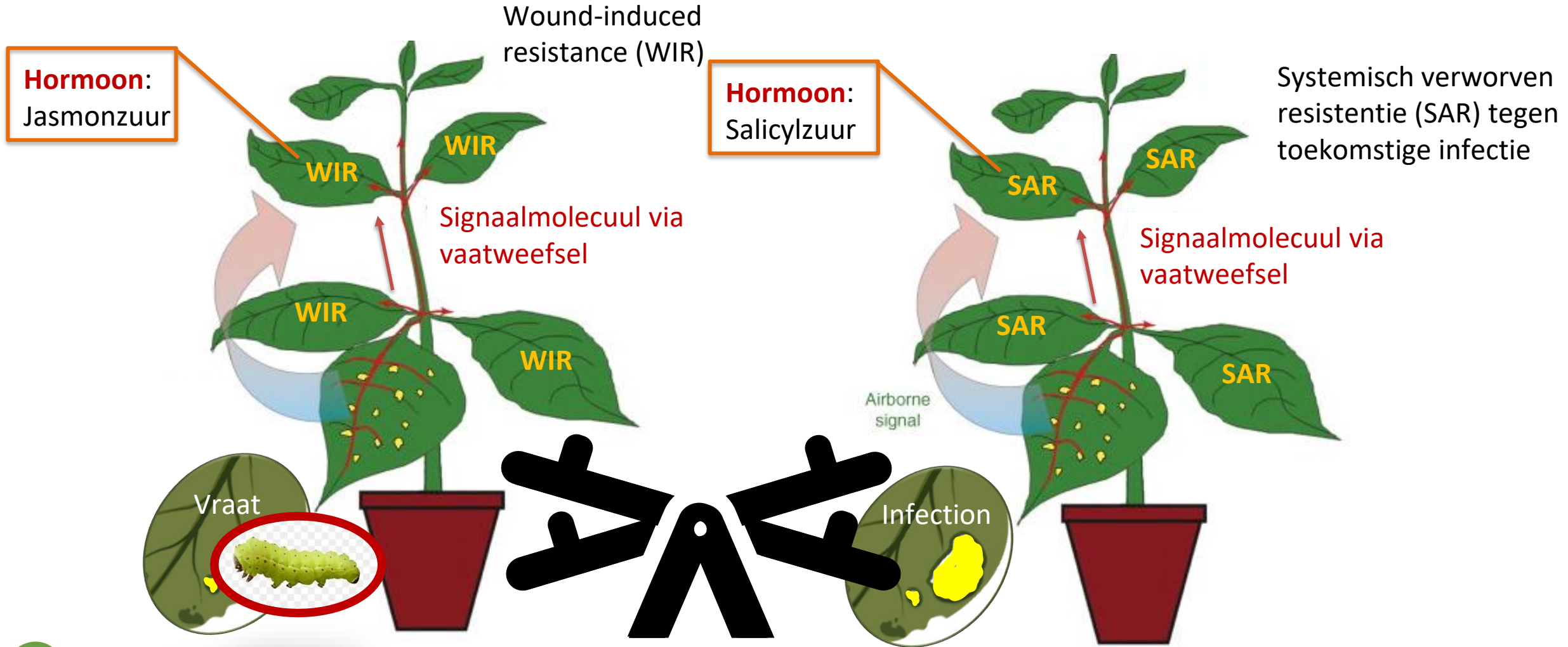


Systemisch verworven resistentie (SAR) tegen toekomstige infectie

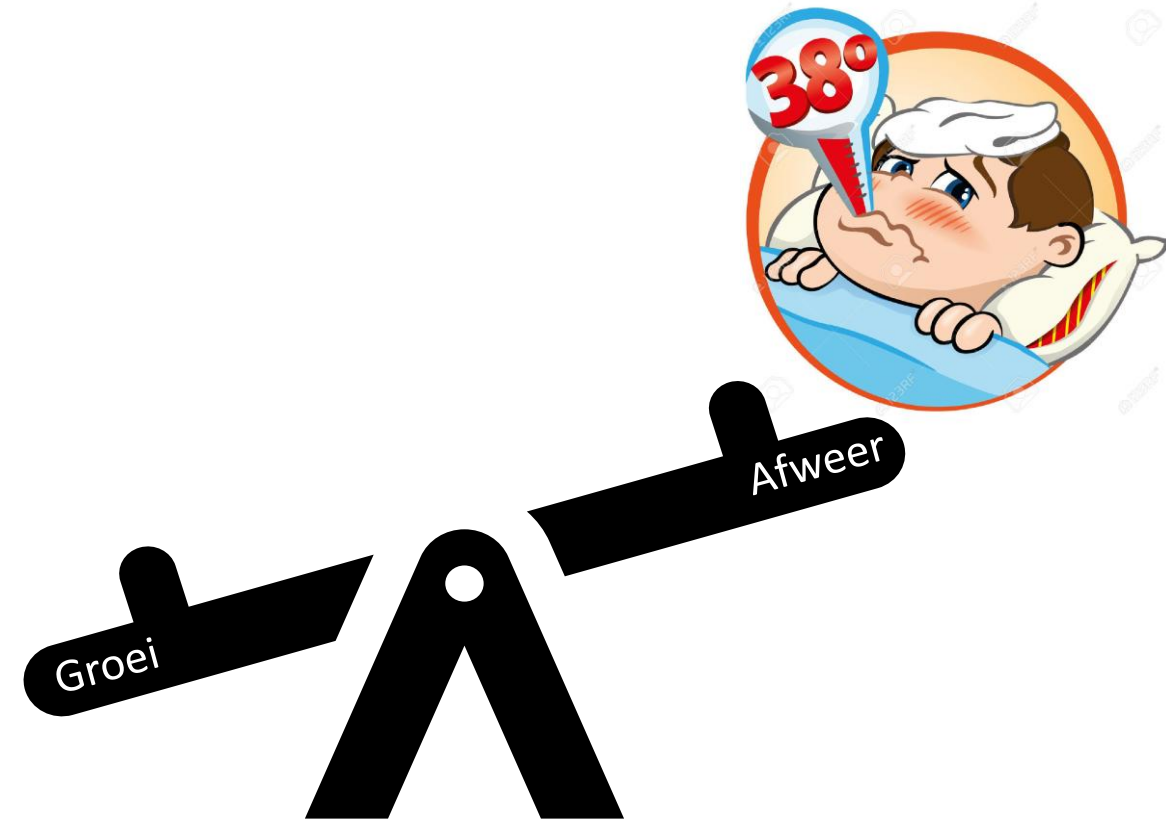


Laag 3: Verworven resistentie

> Ontwikkelt zich ná een infectie

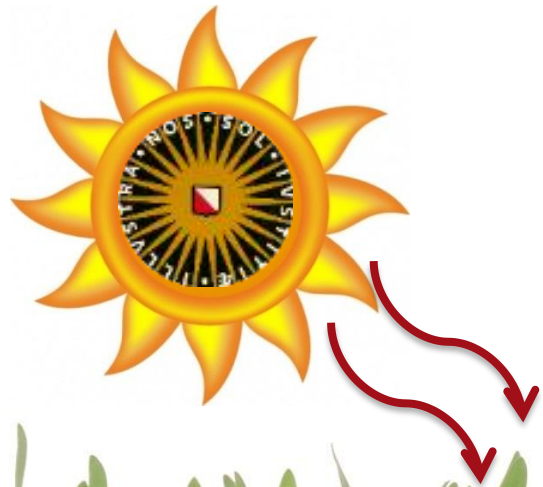


Balans tussen groei en afweer



Laag 4: Het wortelmicrobioom

> hulptroepen uit de bodem



Stress tolerantie
(Droogte, verzilting)

Weerbaarheid
(Ziekten, plagen)

Fotosynthese → suikers, groeistoffen

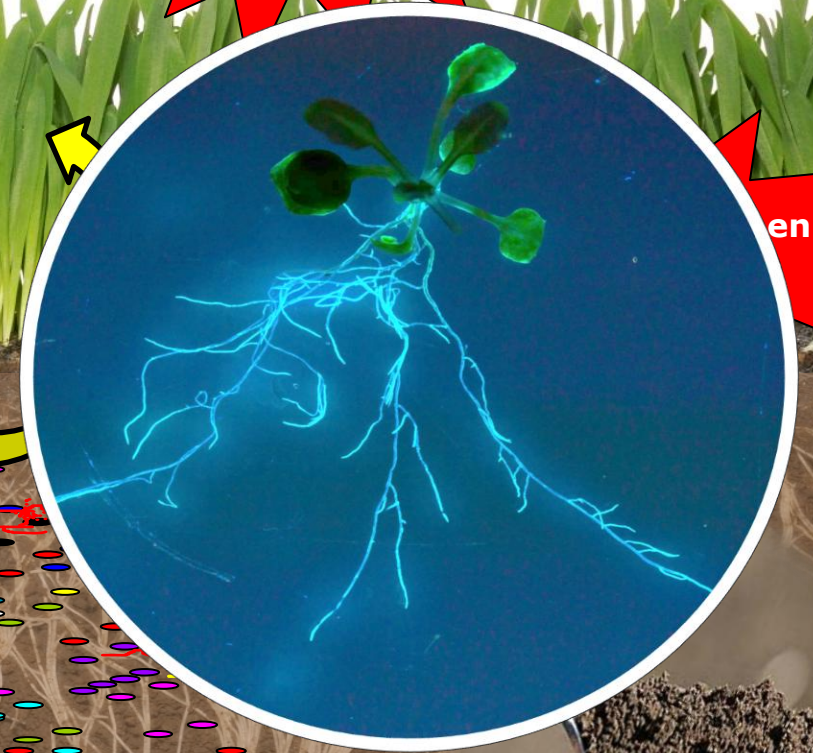
20%

Wortelexudaten

Microbioom

Probiotics

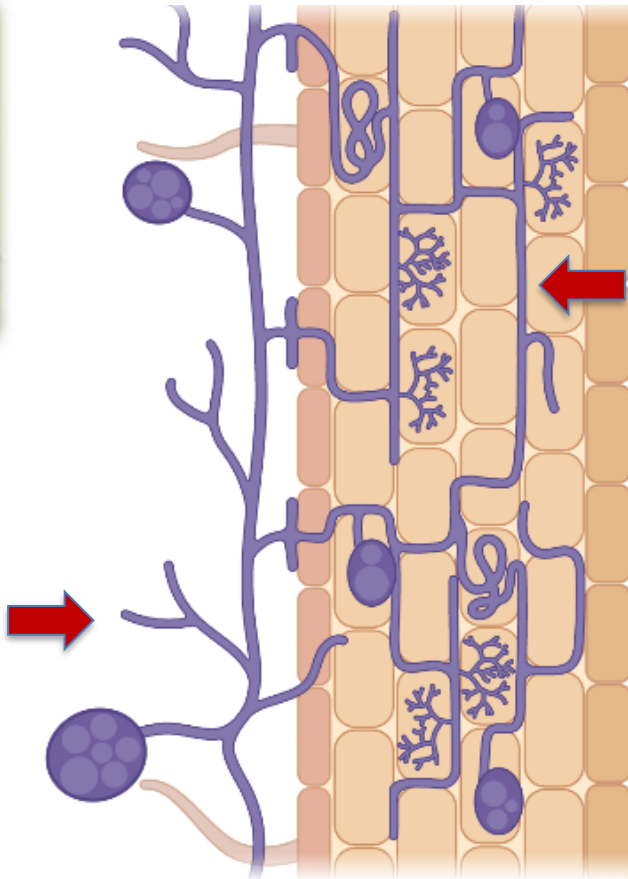
Bacteriën,
Schimmels, etc.



Microbiom: opname voedingsstoffen en water (direct)

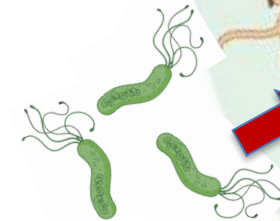


Schimmel levert
P en N aan plant

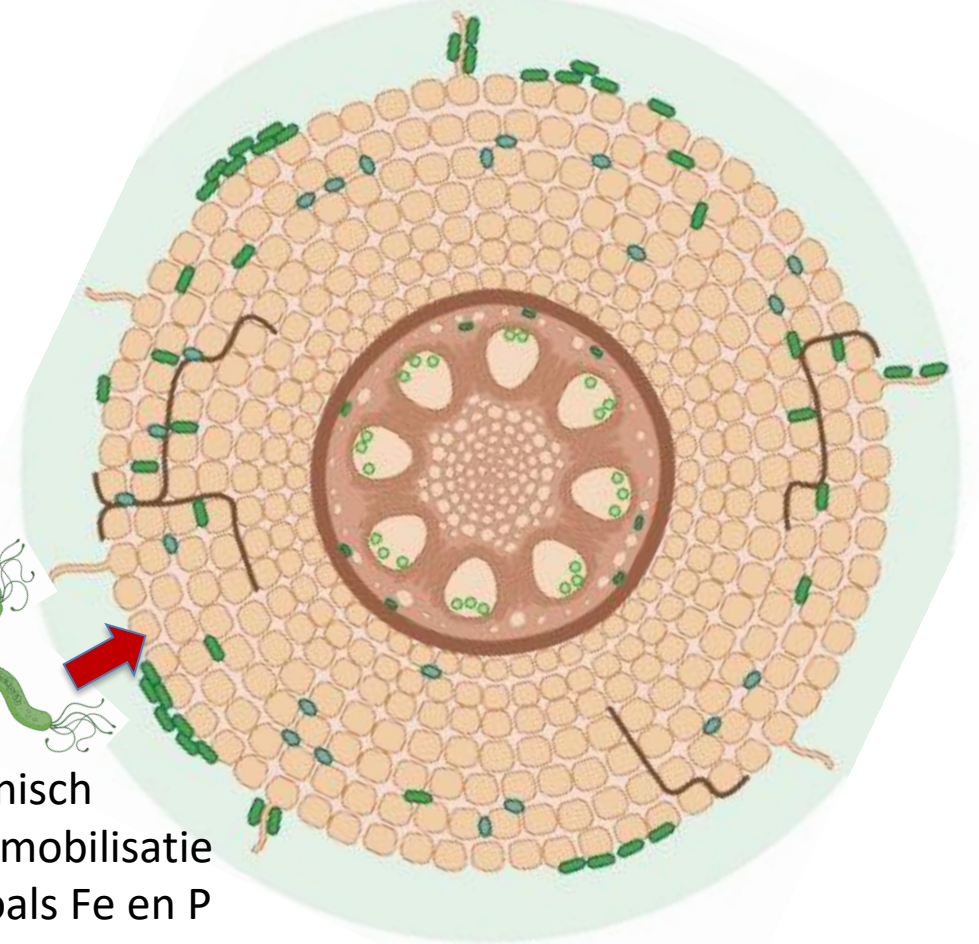


Mycorrhiza schimmels

Plant levert
koolstofbronnen
aan schimmel



Afbraak organisch
materiaal en mobilisatie
nutriënten zoals Fe en P



Bodembacteriën en endophyten

Probiotische *Pseudomonas* bacteriën



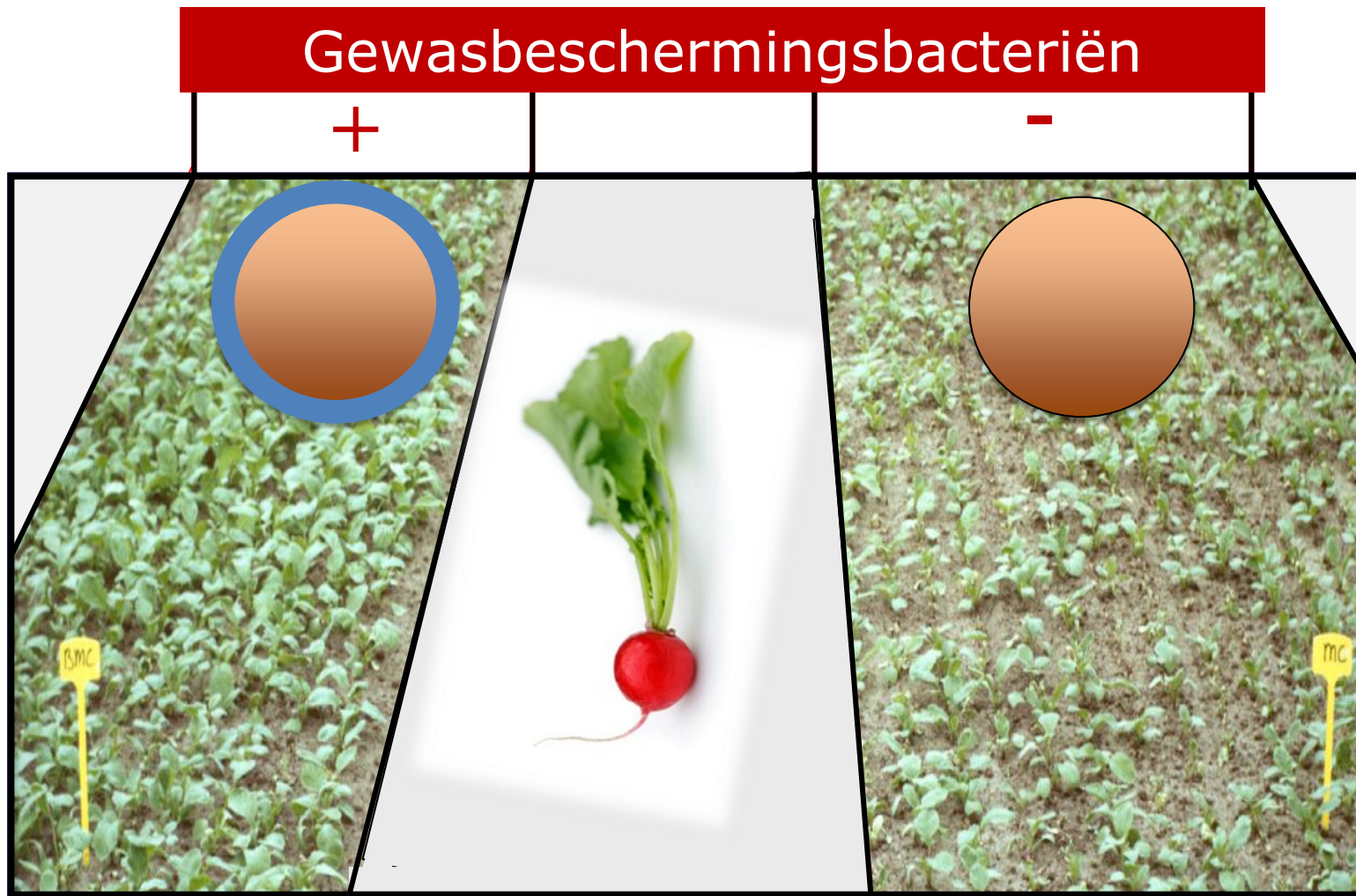
Microbioom: opname water en voedingsstoffen (indirect)



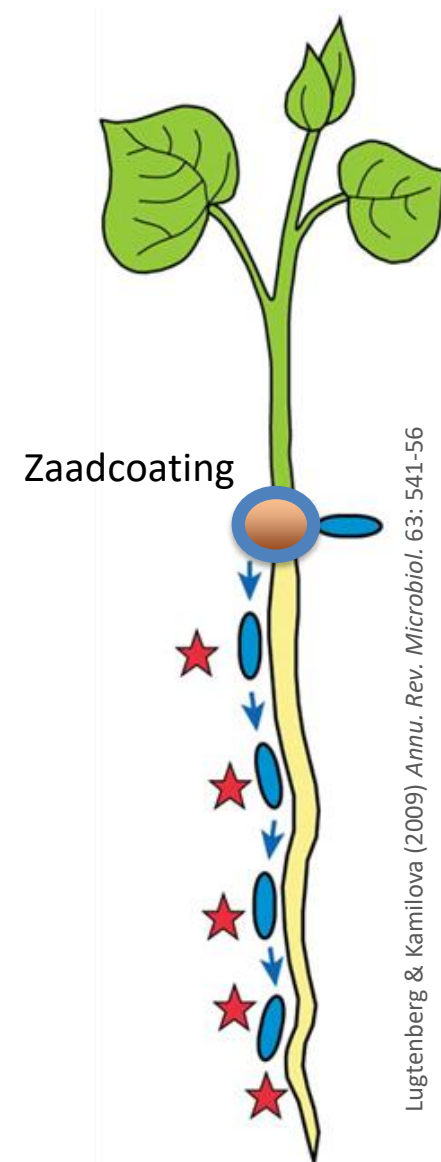


Praktijkproef biologische bestrijding tegen ziekten

Gewasbeschermingsbacteriën

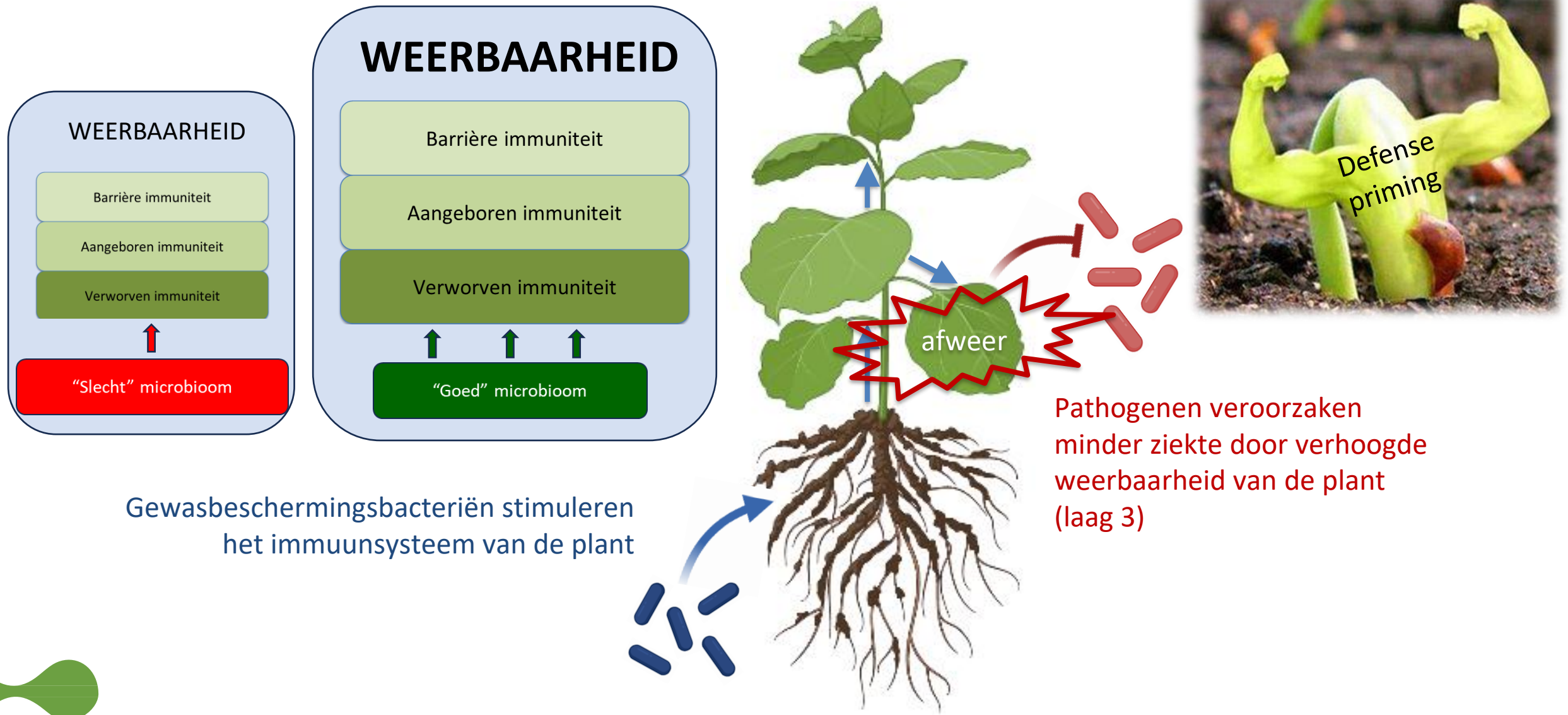


Radijs - *Fusarium* verwelkingsziekte



Microbioom: **bescherming tegen pathogenen**

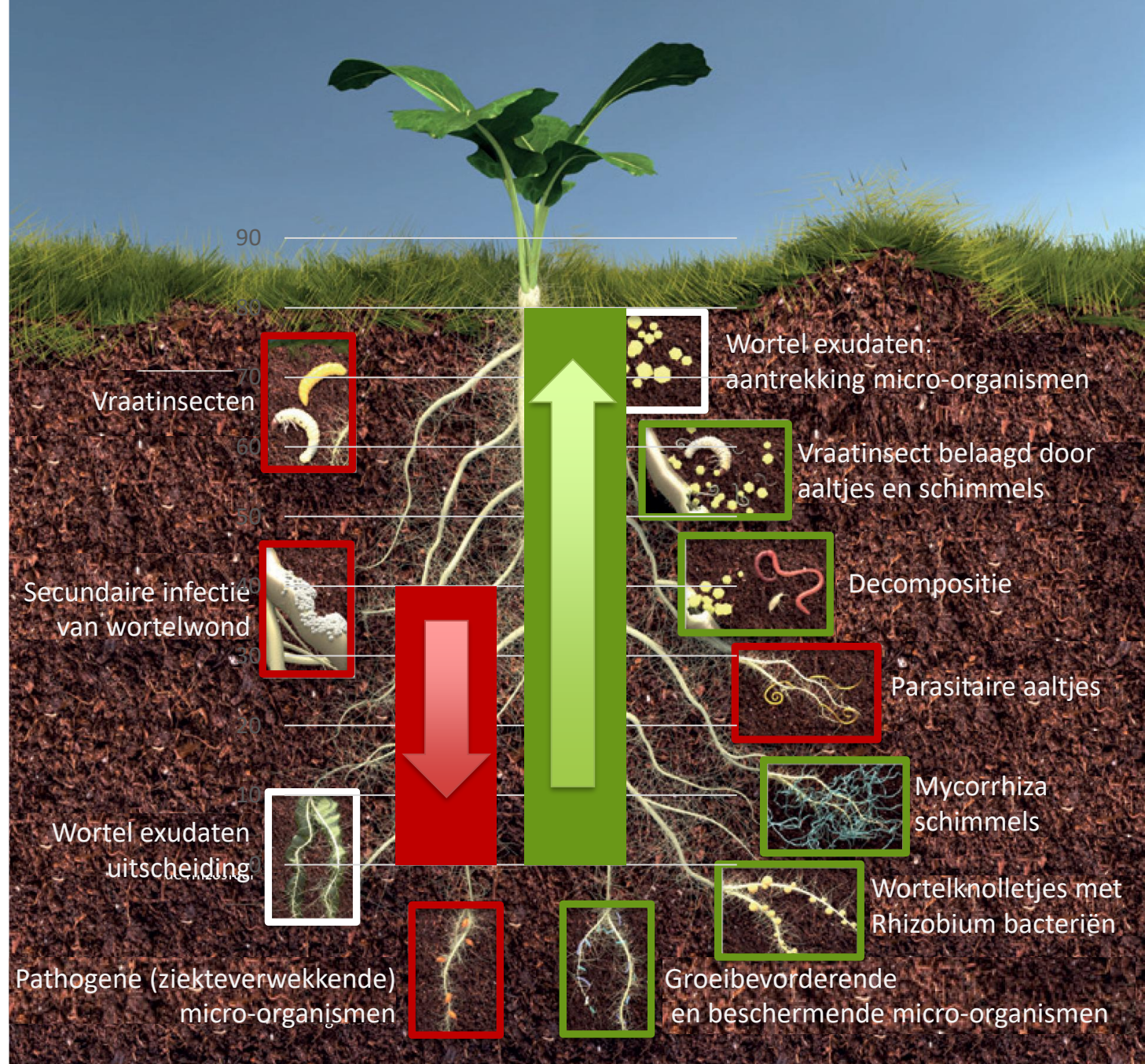
> Stimulatie van het immuunsysteem → Verhoogde weerbaarheid van de plant





Microbioom:

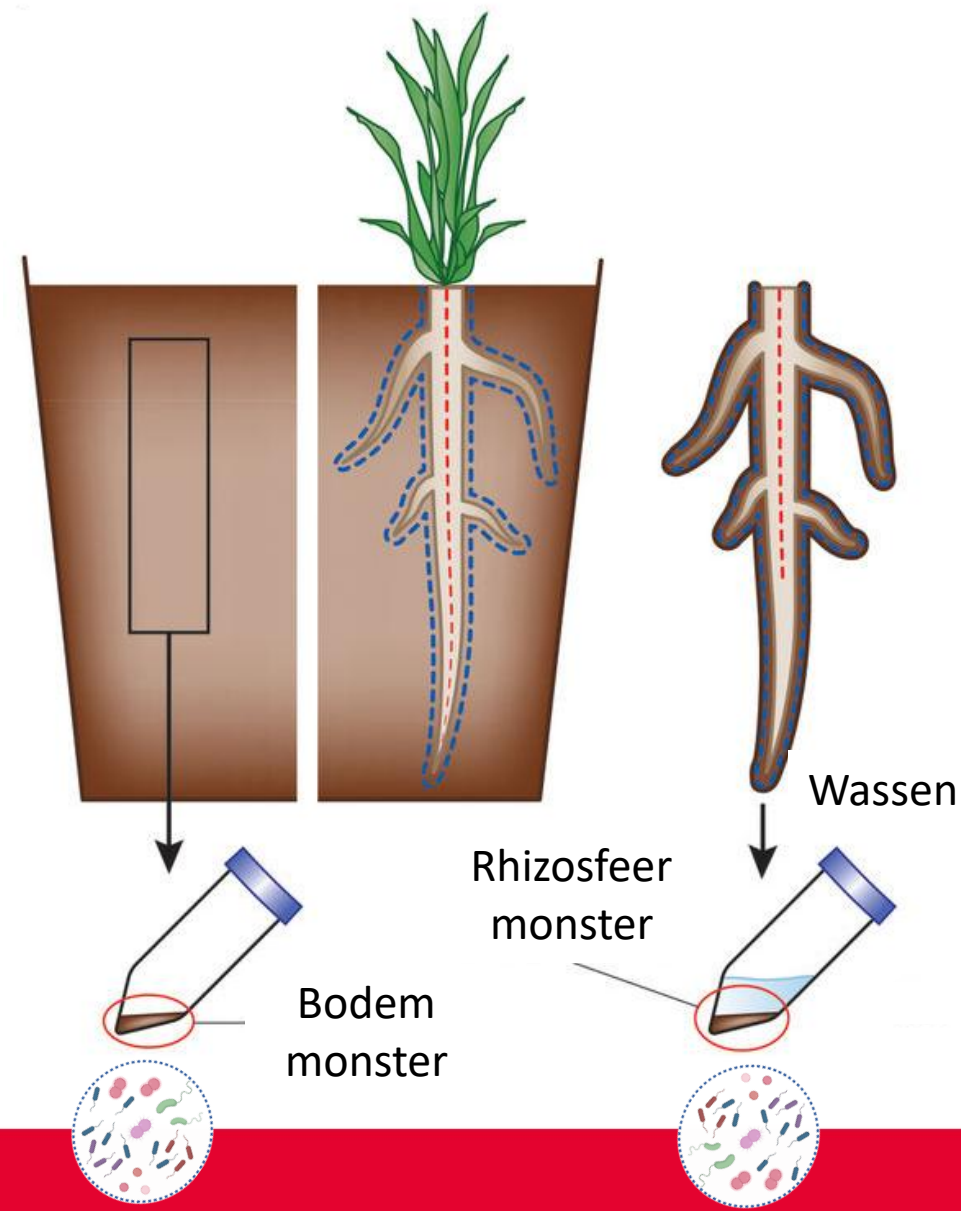
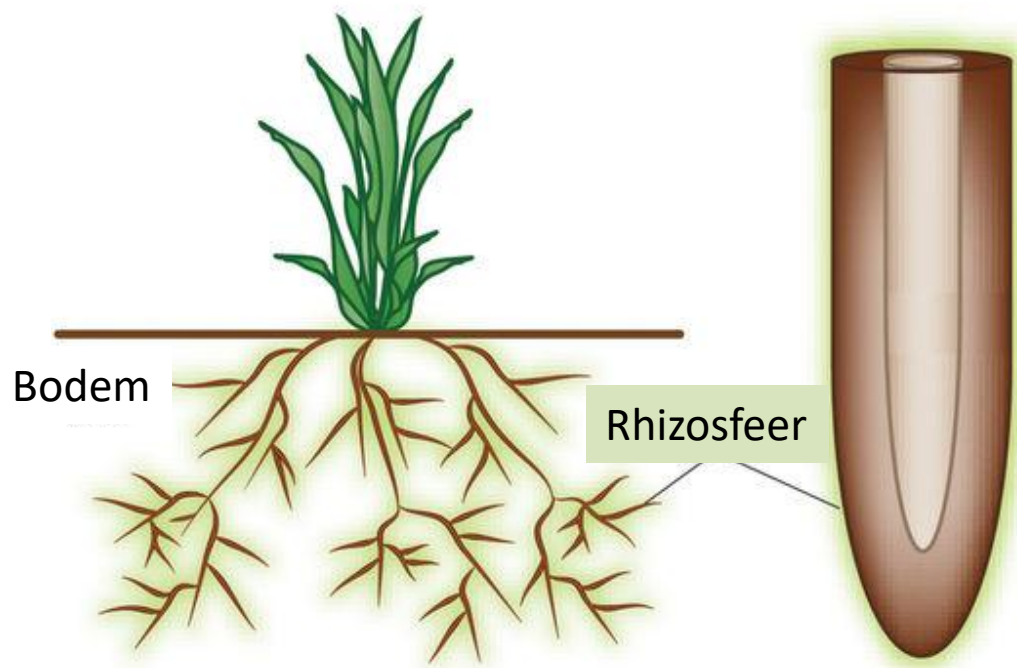
- Microbiële bodemleven
- Bodembioologie
- Bodemgezondheid/weerbare bodem





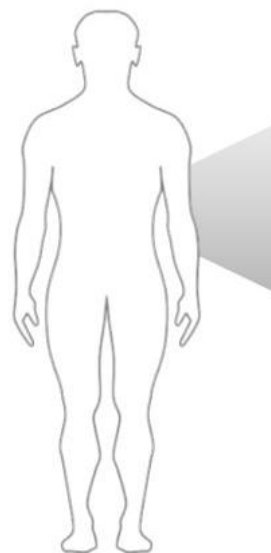
Analyse samenstelling wortelmicrobioom

> Microbioom fingerprinting



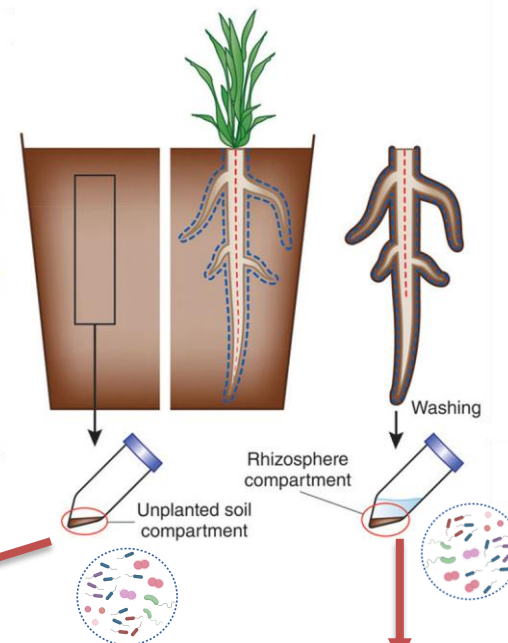


Analyse samenstelling microbioom (plant/mens/dier/bodem)



Microbiome sample

Extract DNA



Plant selecteert microben uit de bodem



Microbioom
fingerprinting



Bodem



Soorten
samen-
stelling

Rhizosfeer



CropXR



Stijn
Nagelkerke



Jochem
Huijben



Marciel
Pereira-Mendes



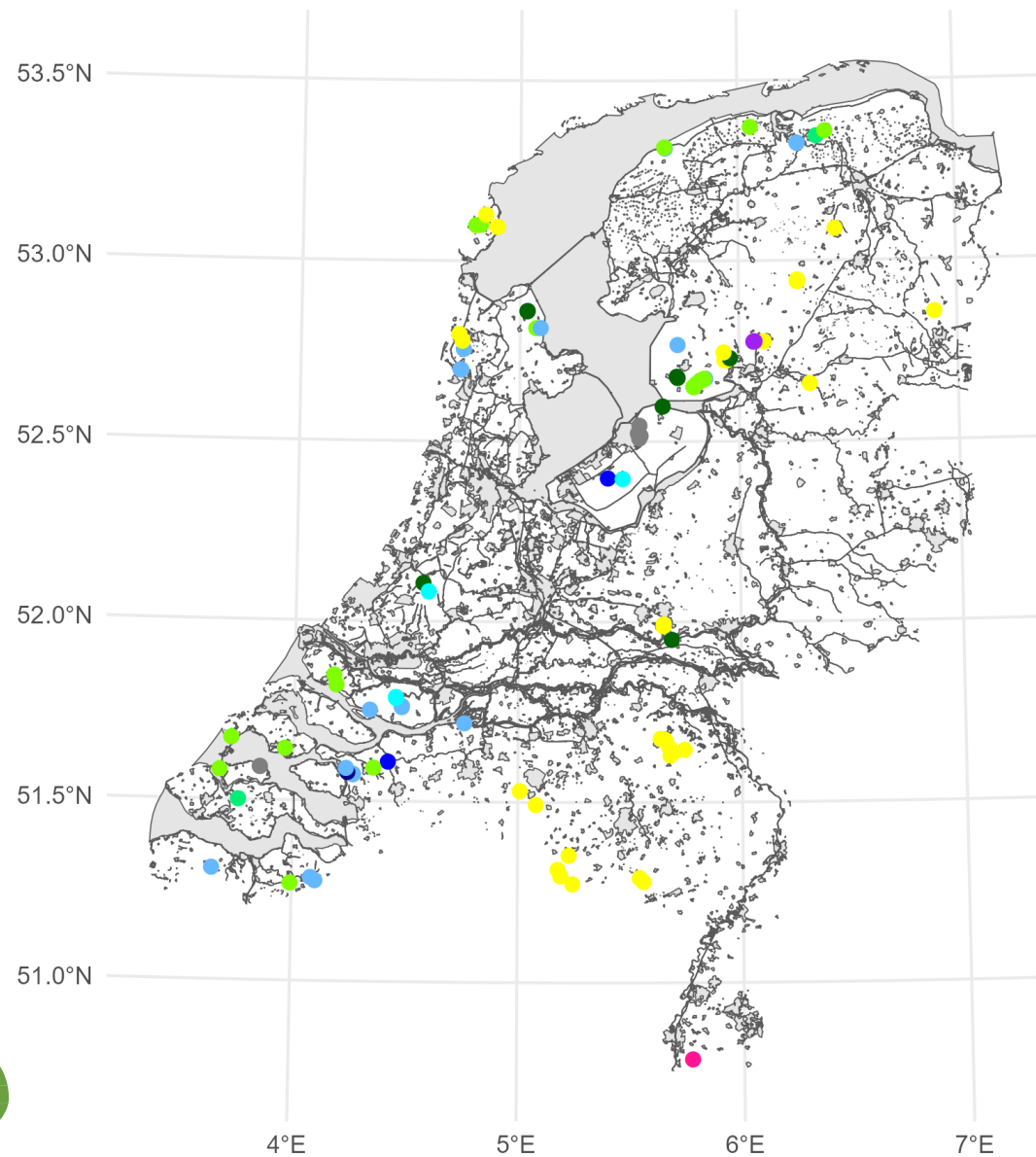
Roeland
Berendsen



100 Nederlandse bodems



Potato production field sampling locations



Soil Type

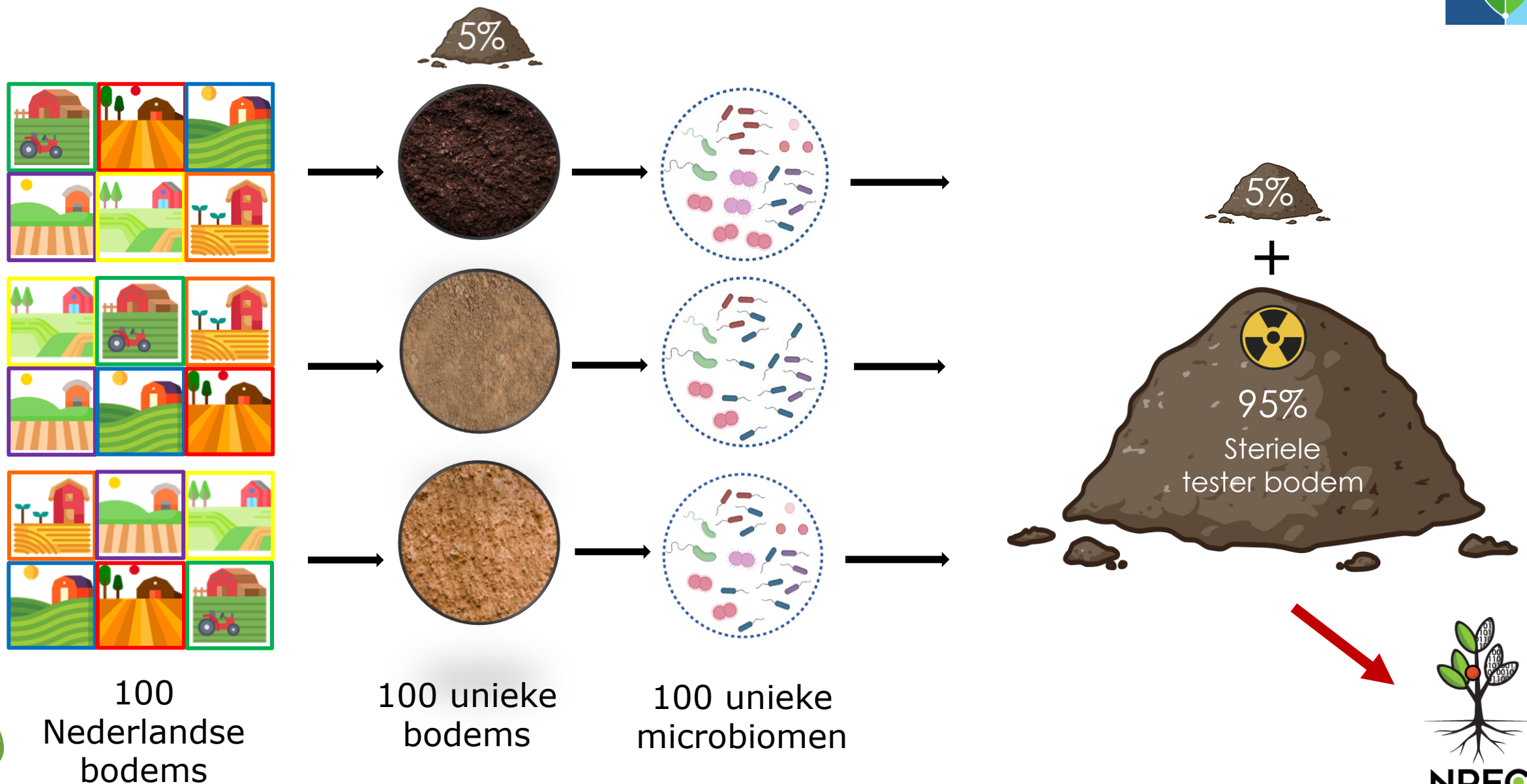
- light clay
- clay
- heavy clay
- old sea clay
- light sandy clay
- sandy clay
- heavy sandy clay
- sand
- peat
- loam
- NA



CropXR
Soil bank
100 soils



Effect bodemmicrobioom op plantengroei





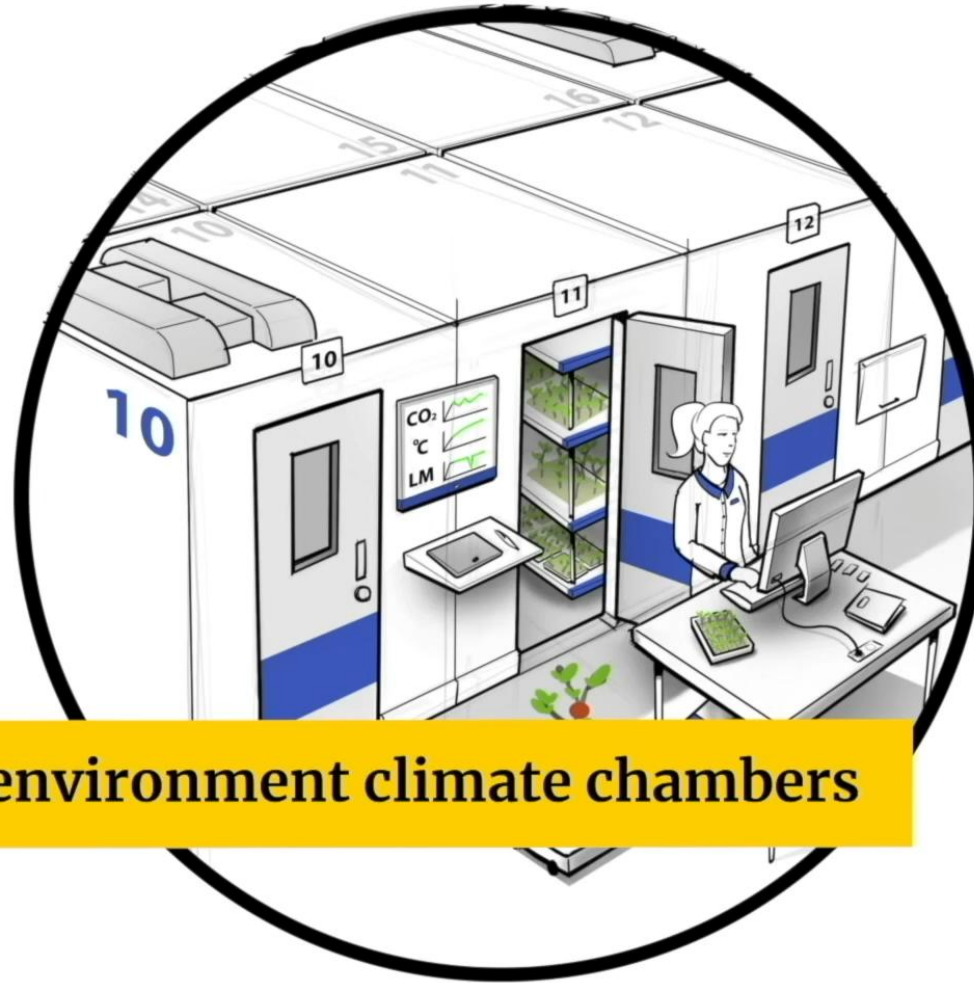
Netherlands Plant Eco-phenotyping Centre

National roadmap facility for large research infrastructure

NWO – UU – WUR

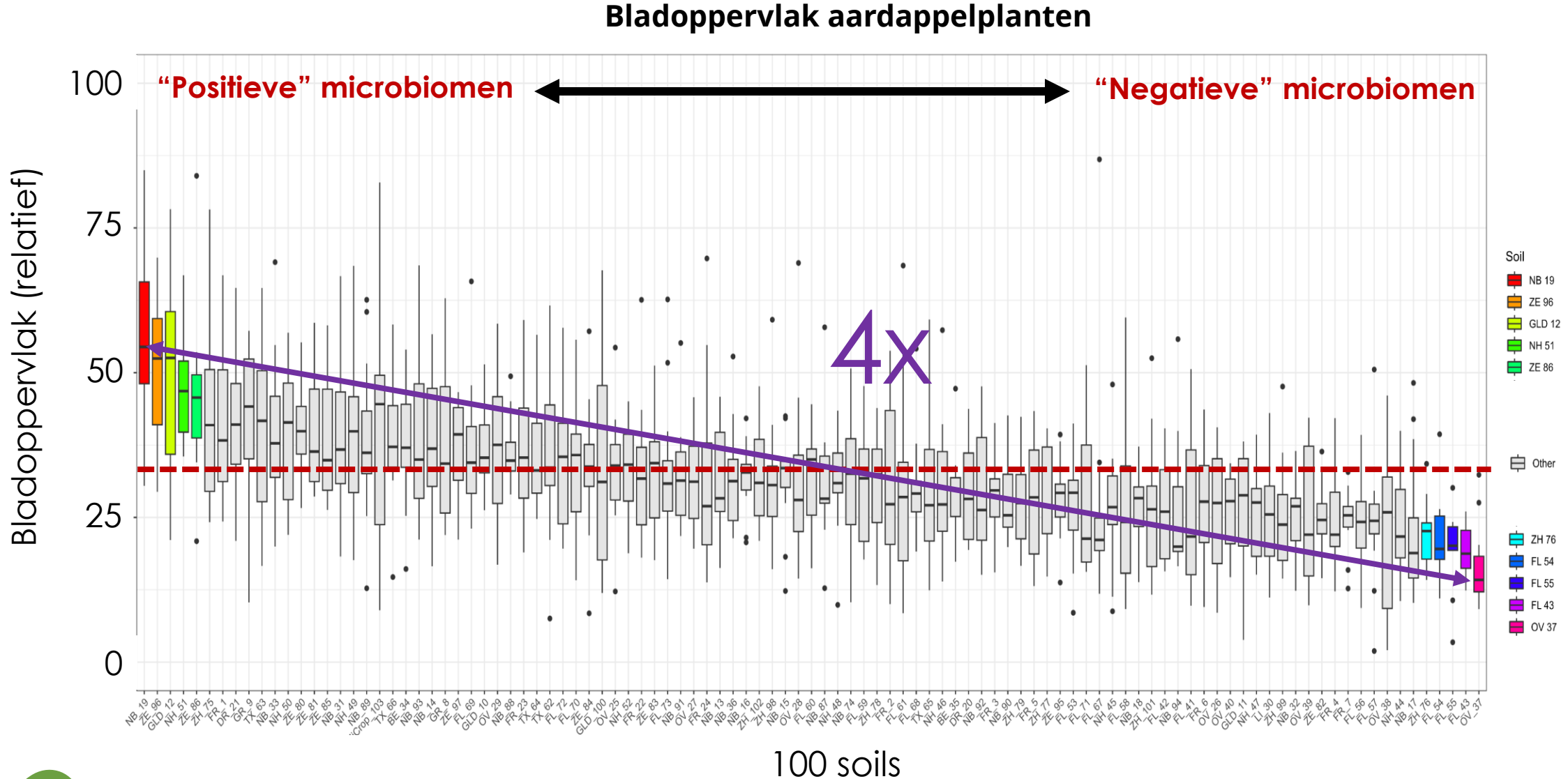


Netherlands Plant Eco-phenotyping Centre (NPEC)



Multi-environment climate chambers

Groeisnelheid aardappel wordt beïnvloed door bodemmicrobioom



Stijn
Nagelkerke



Jochem
Huijben

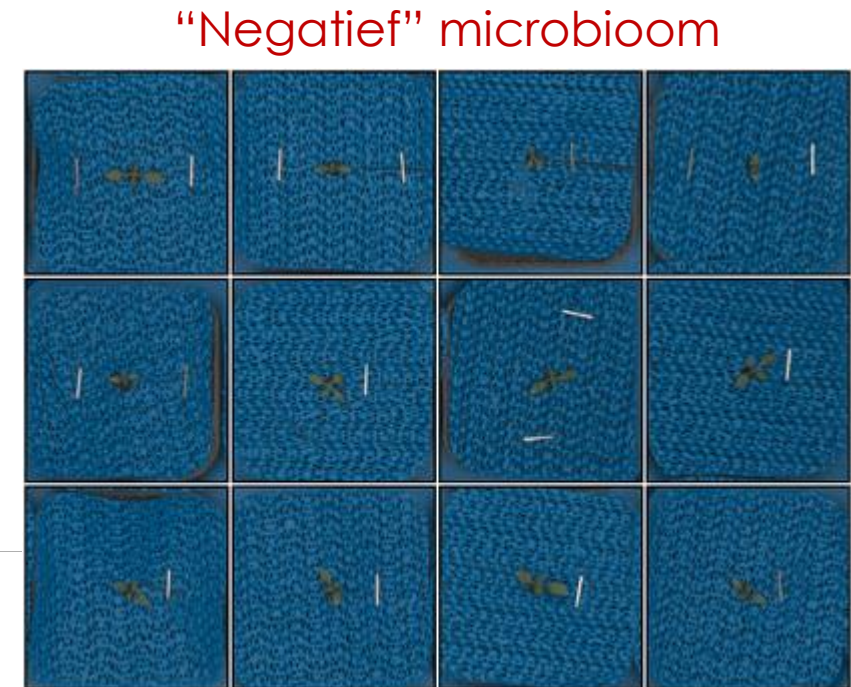
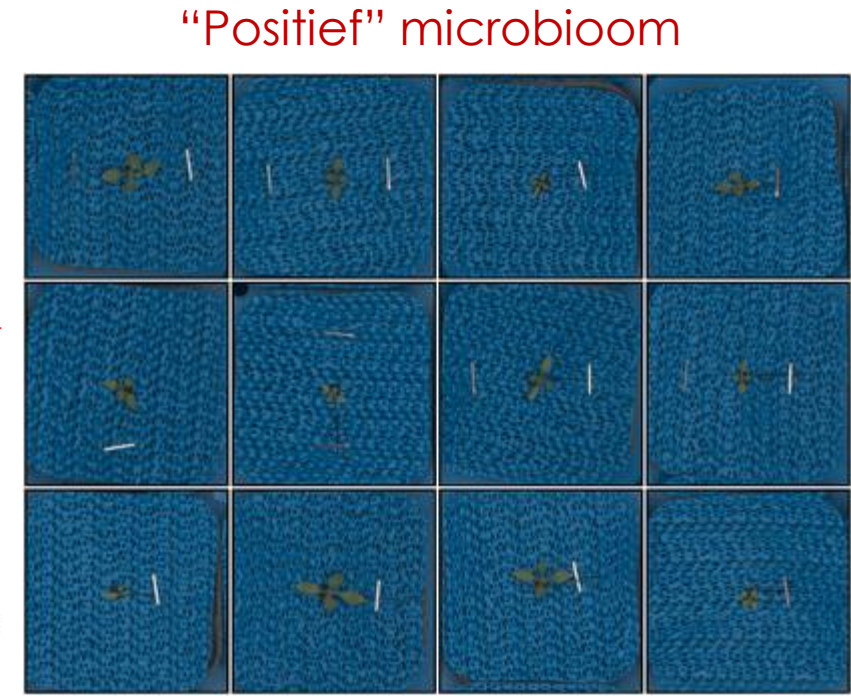
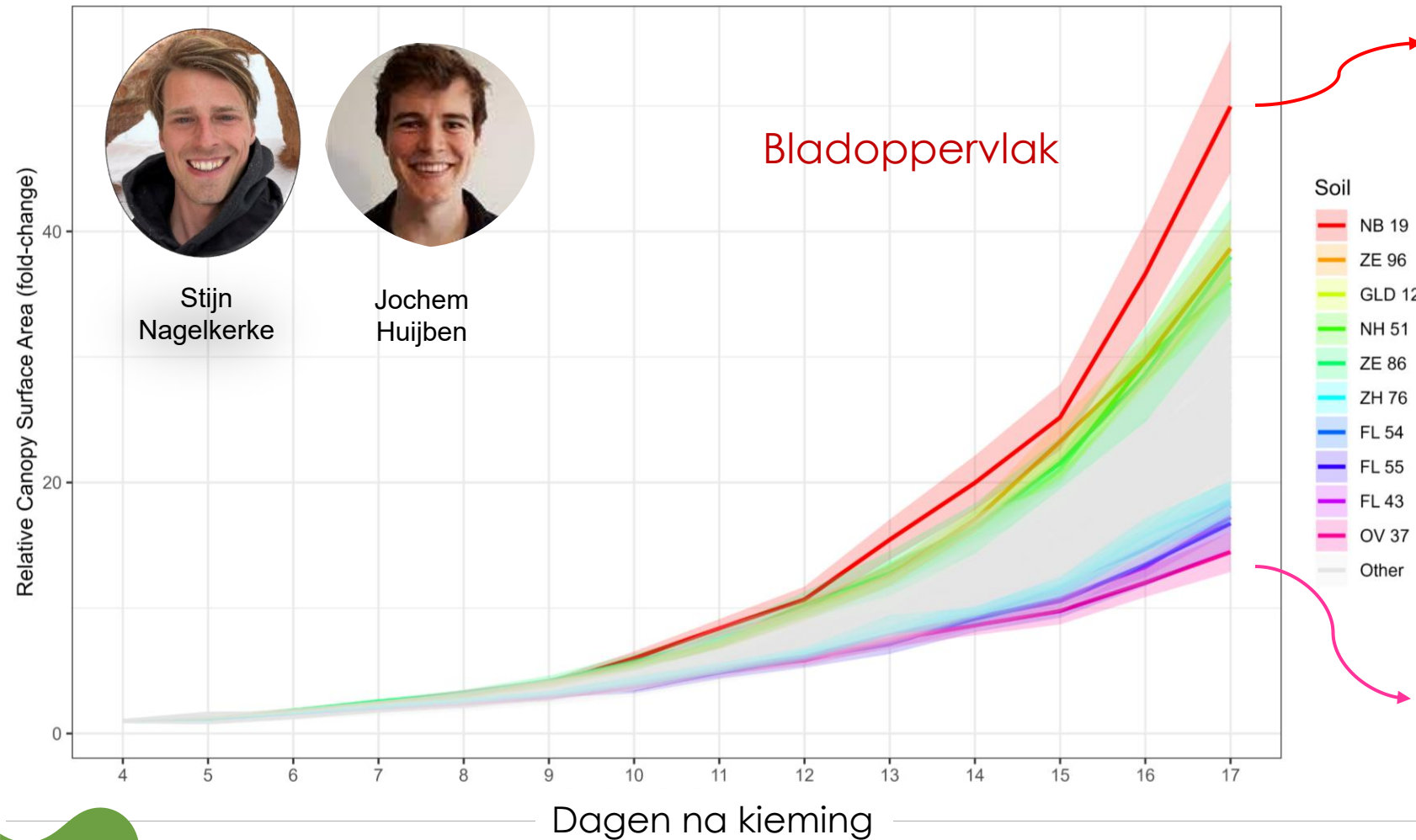
plantengroei over de tijd



Stijn
Nagelkerke



Jochem
Huijben



5% donor bodem + 95% gamma gesterilizeerde tester bodem

Bodem versus sustraat

Bijdrage microbiom:

- Micro-biologie +++
- Voedingsstoffen +++
- Weerbaarheid +++

Bodemleven in balans

Bodemleven kan ziekteverwekkers onderdrukken



Bijdrage microbiom:

- Micro-biologie ---
- Voedingsstoffen ---
- Weerbaarheid ---

Microbiële disbalans

Ziekteverwekkers kunnen zich ongehinderd ontwikkelen



Plantweerbaarheid: wat kunnen we ermee in de praktijk?

1. Microbiële biostimulanten
2. Chemische biostimulanten
B.v. elicitoren afweersysteem
3. Microbioom-geoptimaliseerde gewassen
Cultivars geselecteerd op verbeterde relatie bodemleven
4. Cultuurmaatregelen
Bodem/substraat management, verbetering bodemleven





Universiteit Utrecht

*Gratis PDF via Google zoektermen:
Biocahier Plantgezondheid*

