FACULTY OF
BIOSCIENCE ENGINEERING

INSPIRING MORNINGS @ UGENT FBW

HEALTHY SOIL MATTER(S)

30 november 2017

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Crelan

WELCOME

BY GUIDO VAN HUYLENBROECK

PROMOTOR UGENT-CRELAN CHAIR

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Ghent University - Crelan chair

To enhance innovations for more sustainable agriculture

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STEYR

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Prof. Wim Cornelis	Soil structural degradation: the invisible enemy	Stefan Denayer -Bridgestone-
Prof. Abdul Mouazen	Potential of digital agriculture for improving soil fertility	Matthias Appel -Cofabel-

Coffee Break AppsforAgri

Prof. Stefaan De Neve	The earthy Trinity rules nutrient availability to plants	Karlien Vermeiren -DCM-
Prof. Monica Höfte	Soilborne diseases and their management by biological control	Mark van der Werf -Koppert-

SOIL STRUCTURAL DEGRADATION

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DEPARTMENT OF SOIL MANAGEMENT
SOIL PHYSICS GROUP

Soil structural degradation: the invisible enemy?

Wim Cornelis

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INTERNATIONAL CENTRE
FOR EREMOLOGY

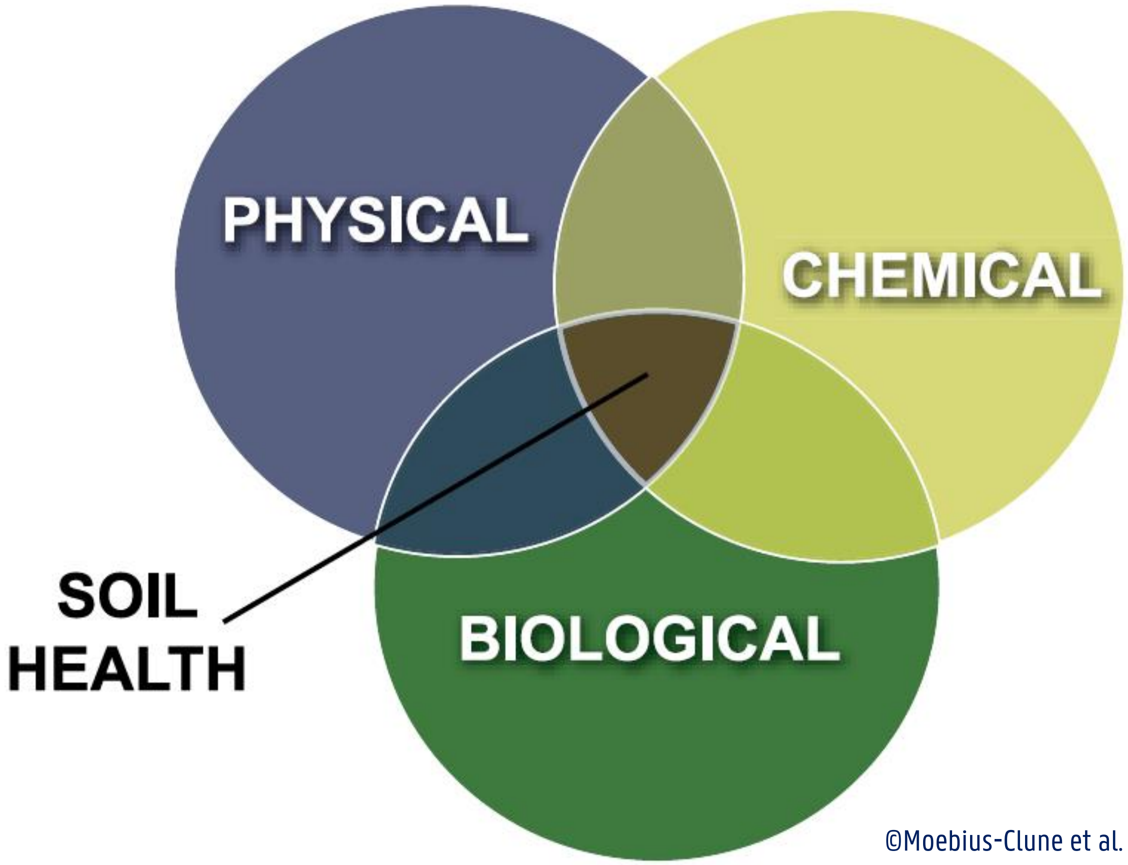
UNESCO

UGent
Soil Physics
Group

SOIL HEALTH

integration of physical, chemical and biological components of soil

soil structure (physical characteristic of soil) plays a central role



©Moebius-Clune et al. (2016)

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WELL-STRUCTURED SOIL

wide range of sizes of both stable aggregates & pores (edapholically)

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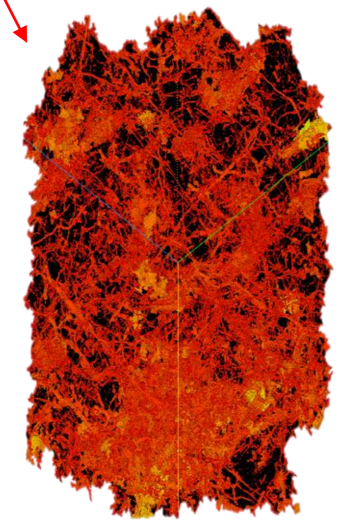
OM plays central role
as cementing agent



©UGent, CT scan

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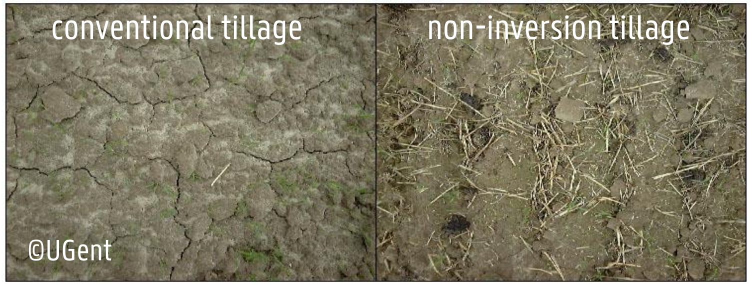
SOIL STRUCTURAL DEGRADATION

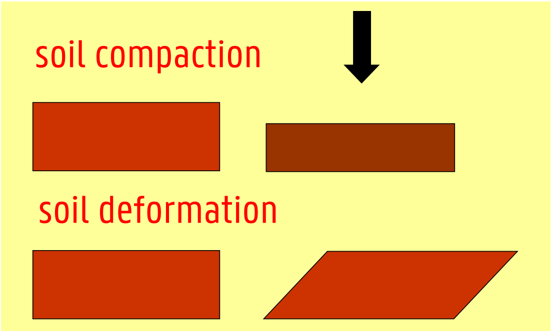
physical soil degradation

① poor aggregation
(decline in OM)



② soil sealing/crusting

③ soil compaction



©Jan Van den Akker

④ soil deformation

⑤ sodication

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CAUSES

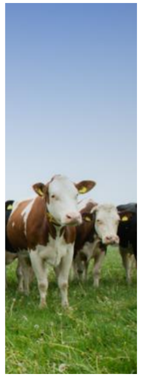
intensive tillage
1. limited use of soil-building crops & soil cover
2. low active rooting density + short duration

limited organic additions
low biological activity

cattle: density ↑
3. heavy machinery & tillage when wet
4. uncontrolled traffic patterns

tyre type & inflation pressure

5. irrigation



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INVISIBLE ENEMY

no clear visible exposure on soil surface

(except for surface sealing/crusting/sodication)

→ specific problems that are often blamed on other causes

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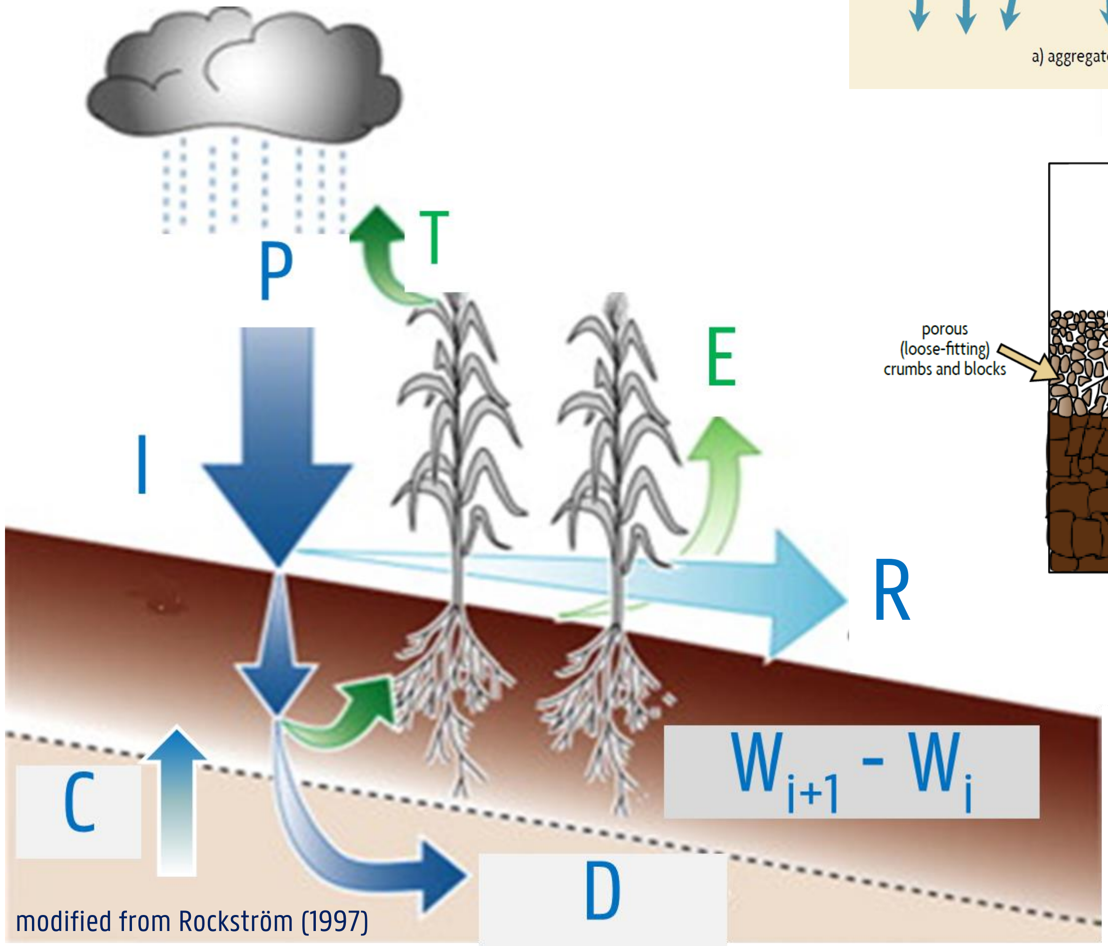
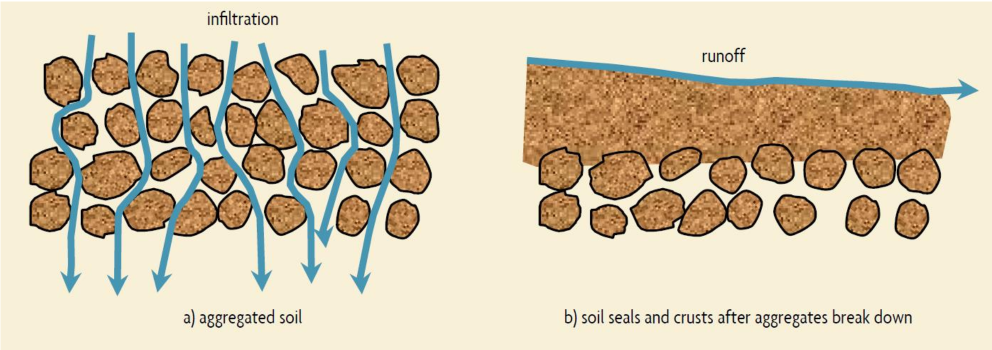
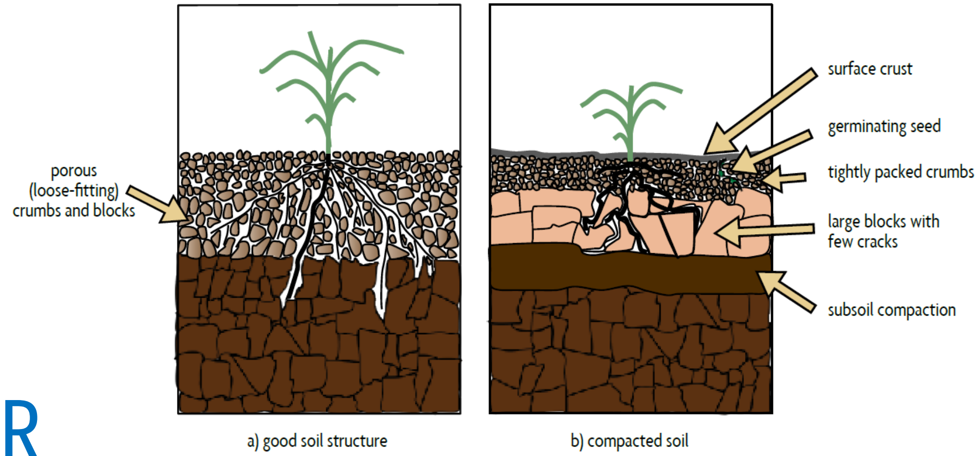
INVISIBLE ENEMY





©Magdoff and van Es (2009)



©Magdoff and van Es (2009)

disturbed soil hydrology

disturbed soil aeration

mechanical resistance ↑

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HEALTHY SOIL MATTERS: ENVIRONMENTAL

runoff & soil erosion ↓

runoff/leaching of nutrients & agrochemicals ↓ (water quality ↑)

drought & flood risk ↓ → resilience ↑

biodiversity ↑

N mineralisation ↑ → nutrient availability ↑

greenhouse gas emission ↓ : N_2O ↓, CH_4 ↓, CO_2 ↓ + NH_3 ↓

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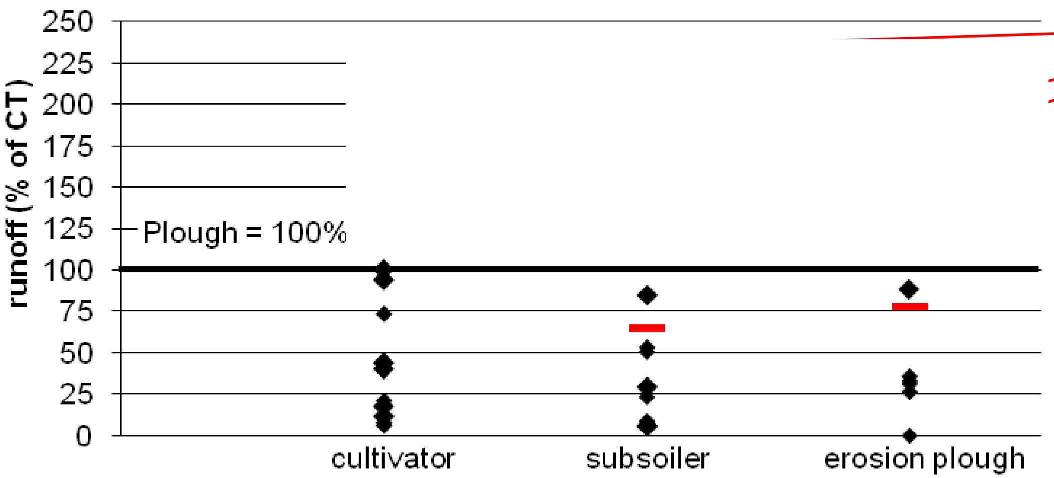
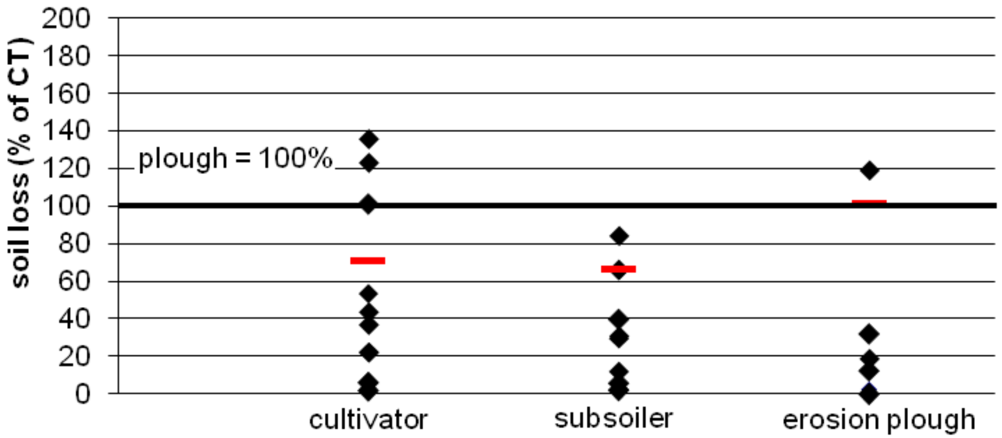
runoff: non-inversion tillage vs conventional ploughing 2003-2010



Vermang et al. (2011)

operations under too wet conditions in 2007
→ soil compaction

soil loss: non-inversion tillage vs conventional ploughing 2003-2010



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HEALTHY SOIL MATTERS: ECONOMIC

soil productivity ↑ → better plant growth, quality, and yield (?)

risk of yield loss ↓ during periods of environmental stress
(heavy rain, drought, pest or disease outbreak, ...)

better field access during wet periods → window of opportunity =
time the field is in state of 'readiness' for operations ↑

fuel costs ↓ → less tillage

input costs ↓ → use efficiency of fertilizer, pesticide, herbicide, and
irrigation applications ↑

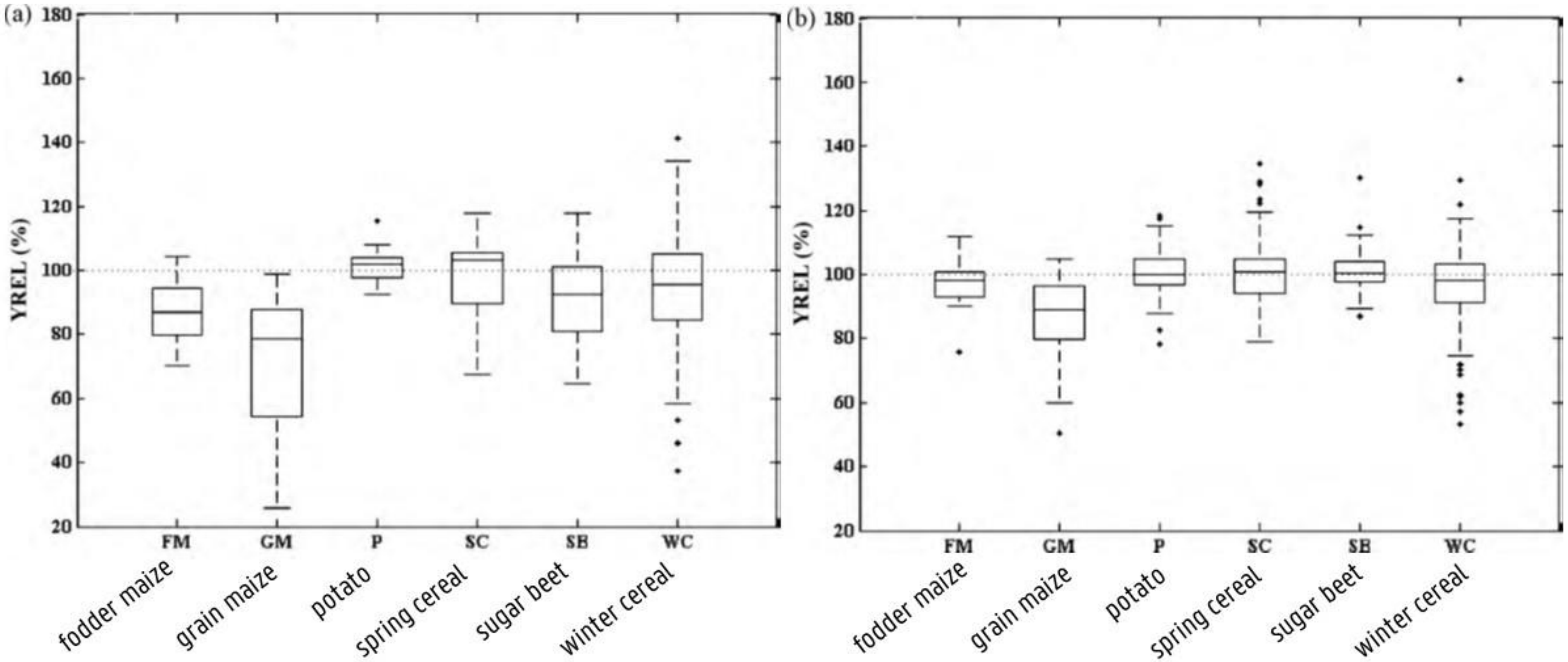
as fuel & input prices ↑ and resources becoming scarcer, profitability
of sustainable soil management & importance of healthy soils ↑

effect of tillage: relative yield YREL per crop (relative to conventional ploughing)

meta-regression analysis of 47 European studies

no till NT

reduced till RT



drier weather conditions

wetter weather conditions

Van den Putte et al. (2010)

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keep in mind:
no one-fits-all solutions, no recipe-type solutions

effect of soil compaction

some figures from studies in Europe and Flanders…

EU-project: survey in 2013 (Hack et al. 2015):

- 34% of Belgian farmers experiences soil compaction, 54% in Netherlands, 73% in Sweden
- negatively affects income of >80% of those

Europe: yield losses of 5-35% (Stanners & Bourdeau 1995)

Flanders (2012-2013): moderately compacted loamy soils (different fields) (Elsen et al. 2014)

- subsoiling → + 0.5 ton/ha grain maize + 50 EUR/ha
- subsoiling/ploughing → + 1.7 ton/ha potato + 200 EUR/ha
- non-inversion tillage → + 6.3 ton/ha sugar beet + 200 EUR/ha

Flanders (2004-2014): loamy soils (Dillen et al., in prep.)

- + 1 MPa penetration resistance → - 3.0 ton/ha potato - 350 EUR/ha
  → - 6.4-10.6 ton/ha sugar beet - 240-400 EUR/ha

Flanders (2017): sandy loam (PhD Lidong Ren)

- compacted vs normal → - 0.3 ton/ha dry biomass winter rye (cover crop)

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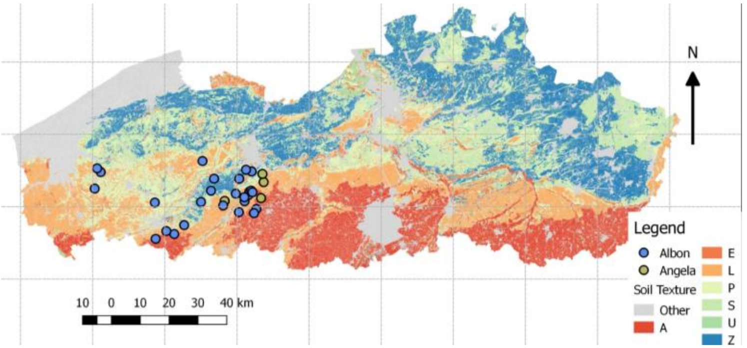
inventory of soil structural degradation in Flanders

30 cropped fields, across different textural classes



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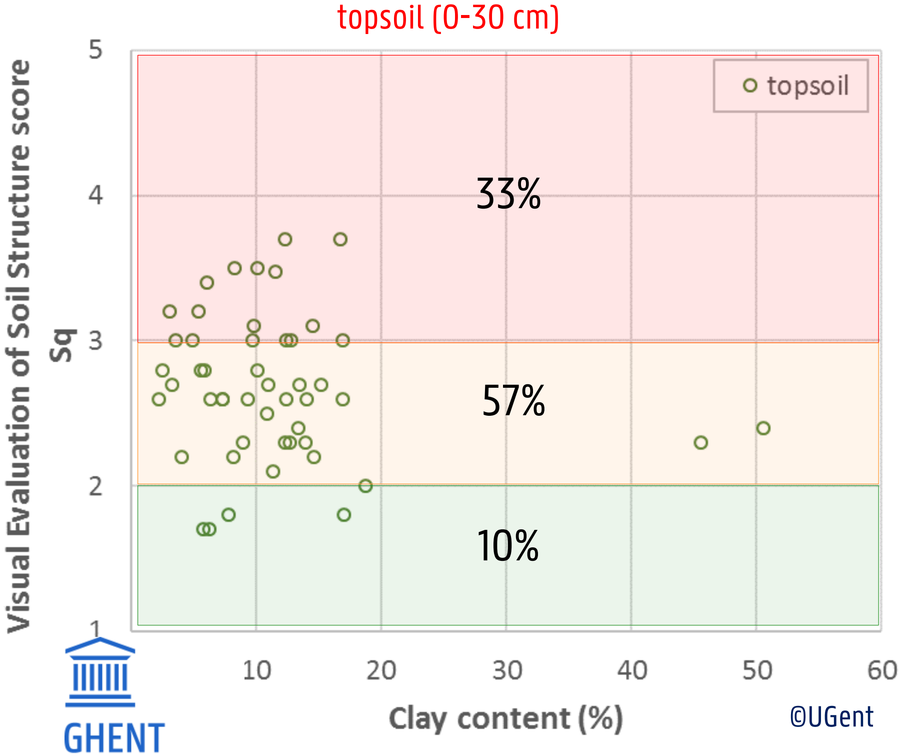
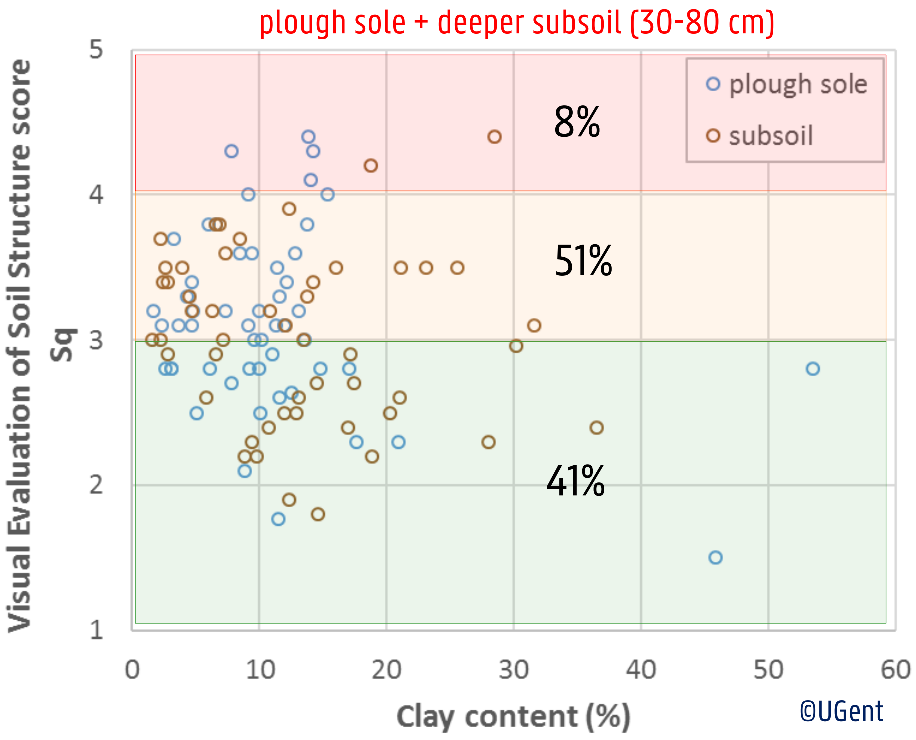
poor soil structural quality
→ short-term improvements

fair soil structural quality
→ medium- to long-term improvements

good soil structural quality
→ maintain good quality

categories:
Ball et al. 2007 for topsoil
Ball et al. 2015 for subsoil





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EVALUATION & EXAMINATION

direct

semi-quantitative

- Visual Soil Ev. & Ex. (scoring)
  - spade
  - core
  - profile

cfr. VSEE working group of ISTRO

quantitative

- aggregate stability
  - wet/dry sieving
  - turbidimetric
  - rainulator
- computed tomography CT (3D)
- microscopy (2D)

indirect

quantitative

- hydraulic conductivity
- penetration resistance
- air permeability
- macroporosity
- air capacity
- water retention capacity
- soil strength
- electromagnetic induction EMI
- electrical resistivity tomography ERT
- ground penetrating radar GPR

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Direct: Visual Evaluation of Soil Structure VESS – CoreVESS

→ integrated evaluation of soil structure = soil quality scores Sq

Structure quality	Aggregate (size & shape)	Visible Porosity & Breaking Difficulty	Clayey soils (>25 % clay)		Sandy soils (<15% clay & >50% sand)	
			Transect (sample broken in two)	3-5 cm large fragments	Transect (sample broken in two)	3-5 cm large fragments
Sq 1 (friable) - Crumbly structure	Mostly <6 mm after crumbling. Large aggregates are composed of smaller ones.	• Highly porous • Sample readily crumbles with fingers			*Difficult to obtain crumbly structure with sandy soils*	
Sq 2 (intact) - Porous - Rounded agg. easily detached (some subangular)	A mixture of porous, rounded fragile aggregates from 2 mm - 4 cm. Agg. crumble easily.	• Most aggregates are porous • Sample easy to break with one hand				
Sq 3 (firm) - Partly porous - Partly massive - Subangular agg.	A mixture of porous agg. from 2mm - 4 cm; Less than 30% are <1 cm; Some angular, non-porous agg. (clods) may be present.	• Macropores and cracks present. Few visible pores • Sample can be broken with one hand				
Sq 4 (compact) - Massive str. - Subangular or angular edges - Little porosity	No aggregates in the clod. Sub-angular non-porous. Horizontal/platy also possible. Less than 30% are < 4 cm	• Few macropores and cracks • Requires considerable effort to break sample with one hand				
Sq 5 (very compact) - Massive structure - Angular edges	No aggregates in the clod. Angular. Non porous.	• Very low porosity. Macropores may be present. May contain anaerobic zones • Difficult to break up			*Difficult to obtain angular edges with sandy soils*	

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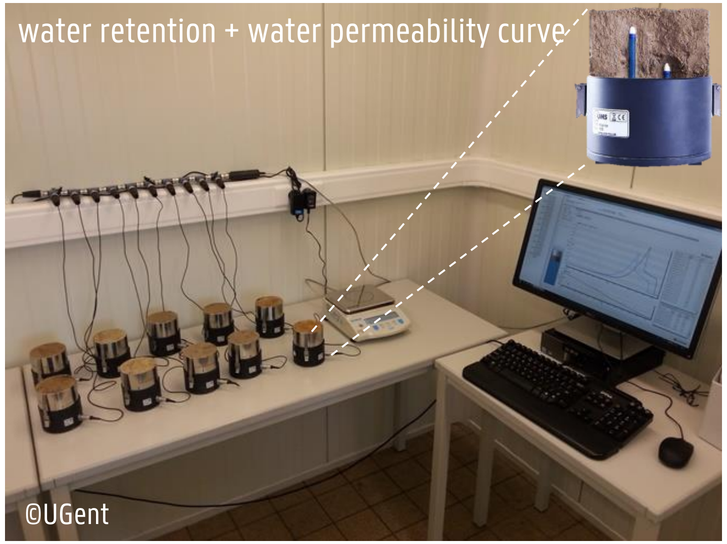
Direct + indirect: quantitative soil properties = soil physical quality indicators



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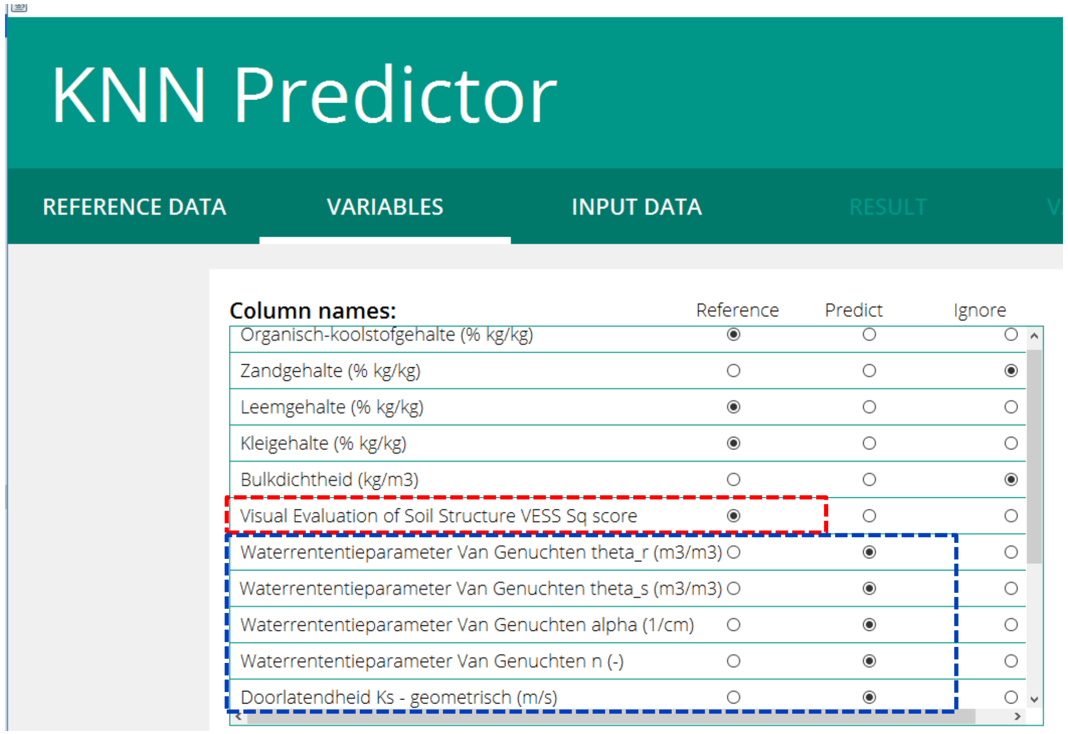
Predict effect of soil structure on soil hydraulic properties → on soil hydrology

kNN datamining technique



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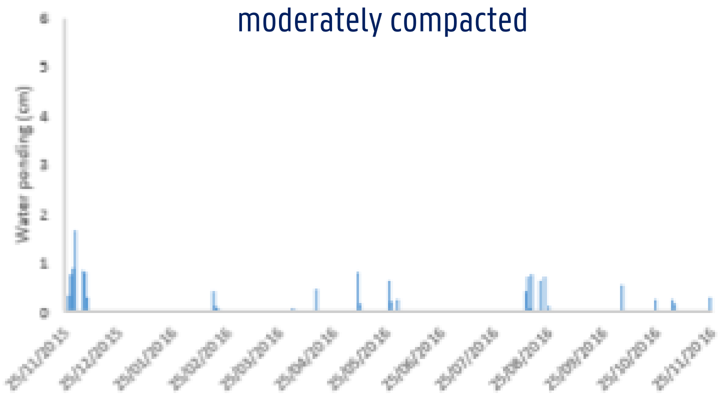
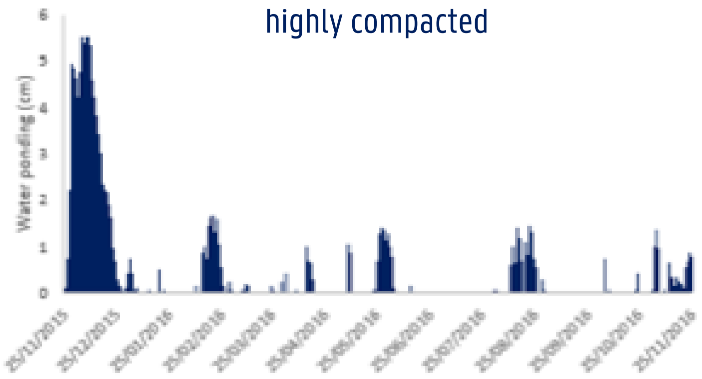
water transport model

water ponding sandy loam (Merelbeke) in 2100





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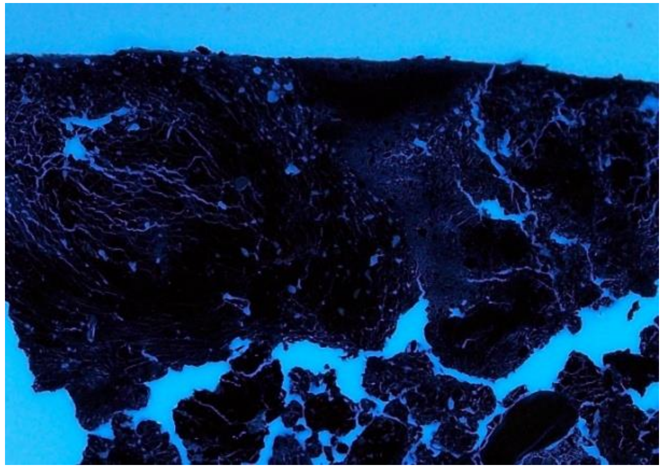
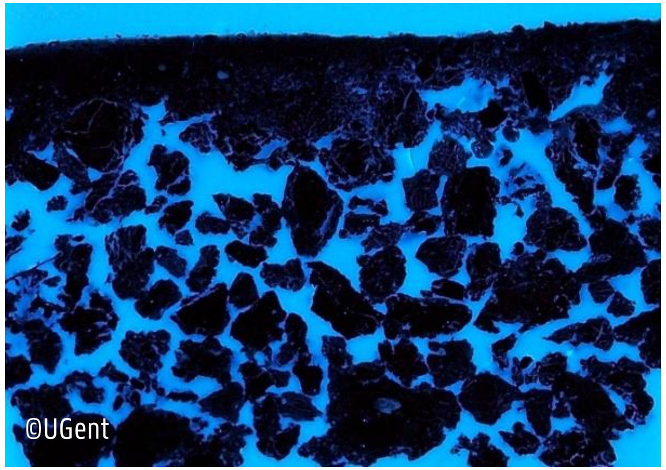
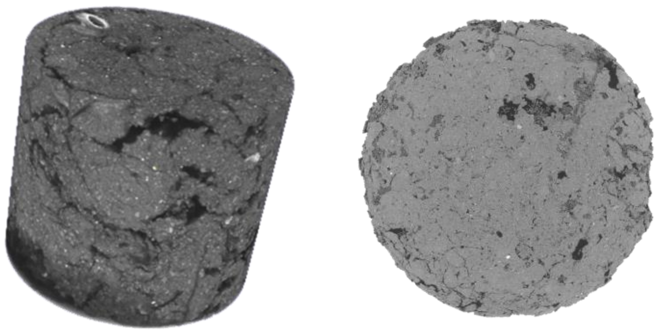
Direct: visualisation of soil architecture ⟶ pore network (pore size, connectivity, tortuosity)

microscopy (UV light) in 2D





CT scans in 3D



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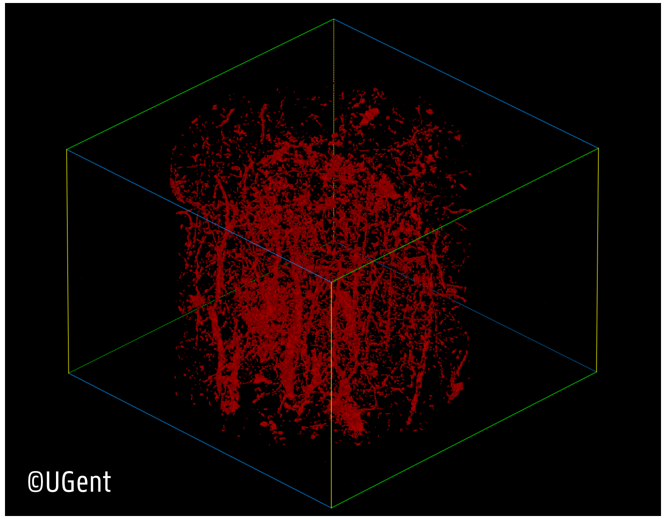

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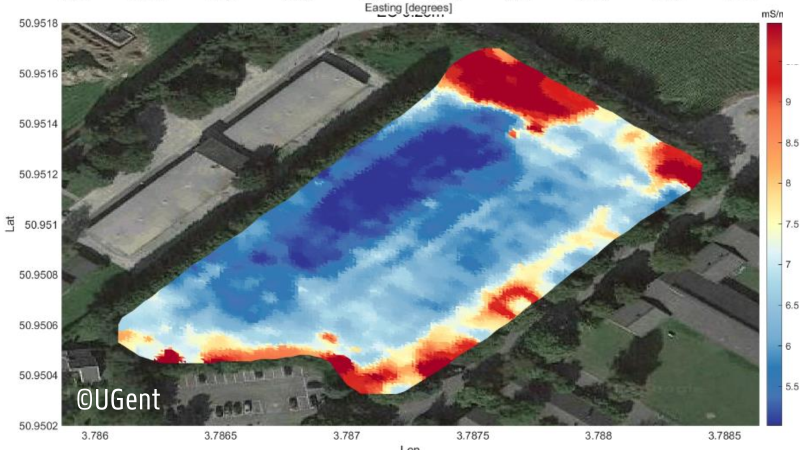
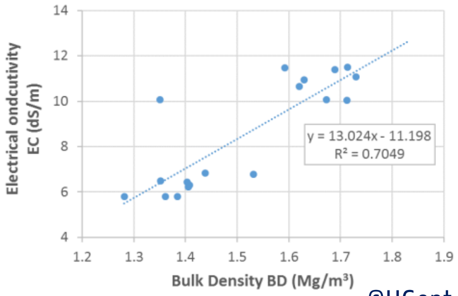
Indirect: geophysical methods → scan soil with proximal sensors (EMI, ERT)

Electromagnetic Induction EMI





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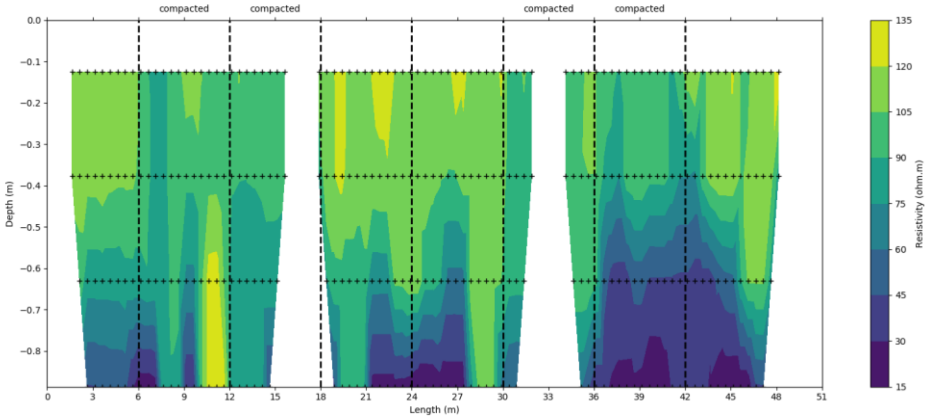
Electrical Resistivity Tomography ERT



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SOLUTIONS

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healthy soil matters, dad
just pretending, hmm...
“First, restoring health to soils is key... enhancing the capacity of soils to hold moisture...”
from new report by the **National Young Farmers Coalition** (NYFC) of Western USA on adapting to water-scarce future


Paris 2018
21st ISTRO conference
INTERNATIONAL SOIL TILLAGE RESEARCH ORGANIZATION
21ST ISTRO INTERNATIONAL CONFERENCE
PARIS, 24 – 27 SEPTEMBER 2018
Terres Inovia
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INRA SCIENCE & IMPACT

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Prof. Wim Cornelis

Stefan Denayer – Bridgestone

The BOSS and his SOIL

AG challenge

SUSTAINABLE farming

Increased Business UNCERTAINTY

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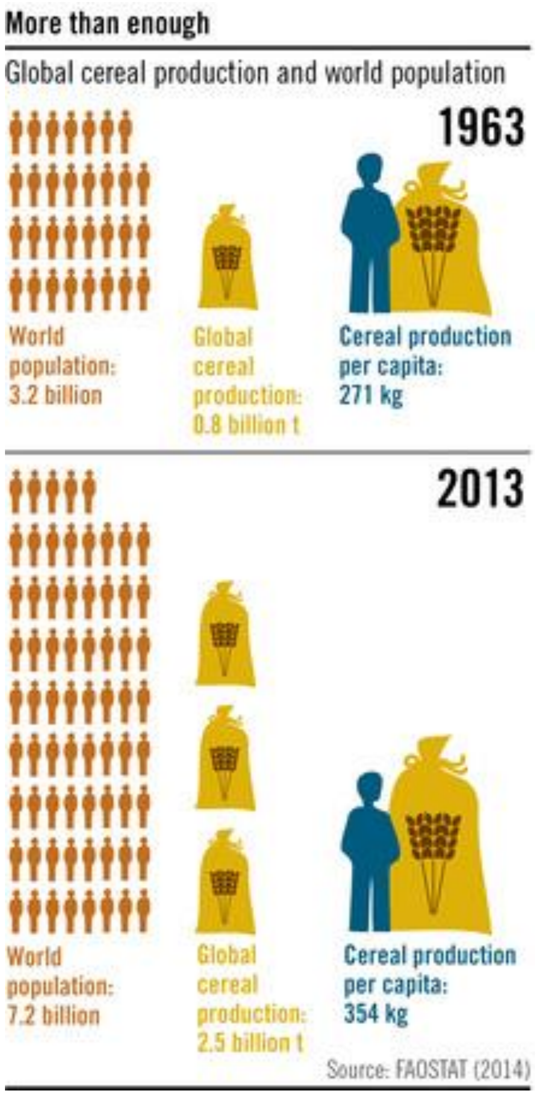
AG evolution



In general, the **large-scale industrialisation** of agriculture in the America's, Australia and Europe and the "Green Revolution" in Asia have led to **impressive successes** in increasing productivity over the past fifty years.

However, the one-sided focus on productivity of industrial agriculture exploits the available natural resources of our planet to an untenable and **unsustainable** extent.

Industrial agriculture consumes large amounts of pesticides, mineral fertilizers, energy and freshwater resources, and produces large volumes of greenhouse gas emissions. Depleted and salt-affected soils, deforestation and the contamination of entire watercourses, as well as an unprecedented loss of biodiversity are the **ecological costs** of these advances.

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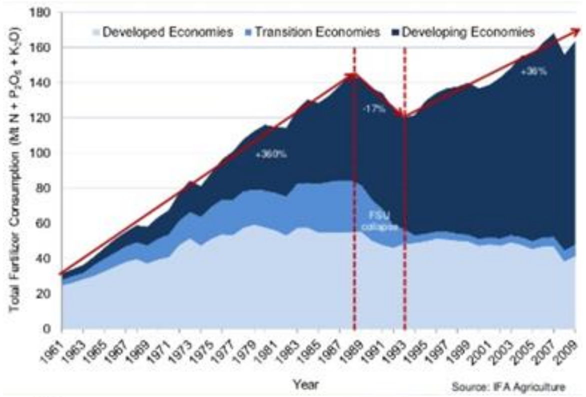
Source : http://www.globalagriculture.org/report-topics/industrial-agriculture-and-small-scale-farming

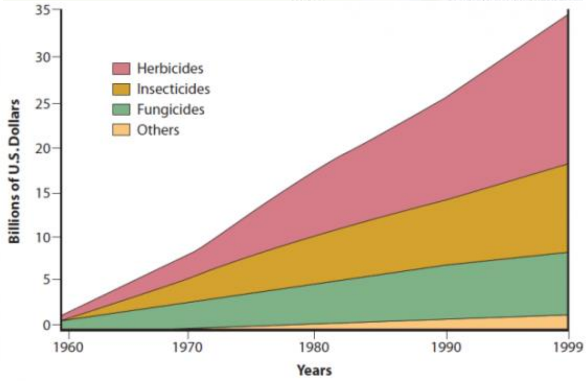
AG evolution : How have we done this?

- Increase yield by applying fertilisers



- Increase yield by applying pesticides

Insecticides Fungicides Herbicides



- Mechanisation replacing expensive human labour by larger & heavier machines.

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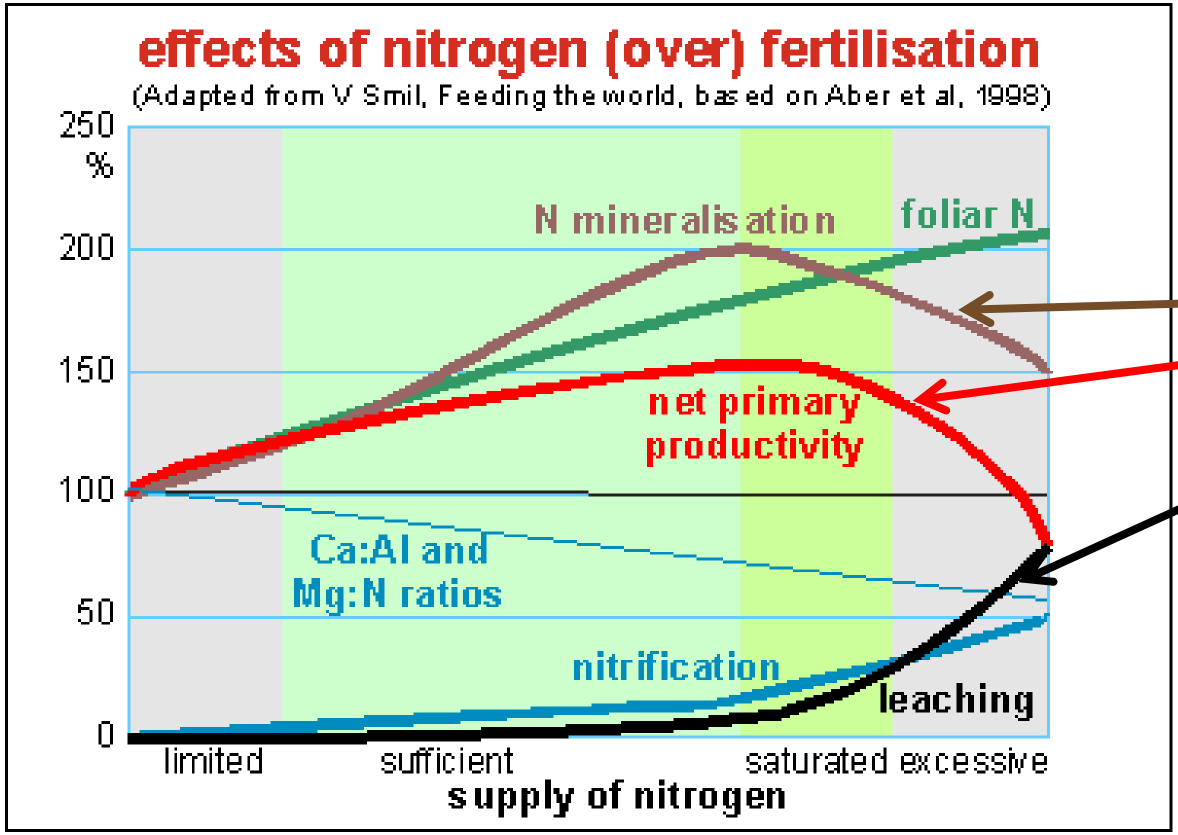
Key treats to soil in Europe

Many farmers experience over the last few years, that while continuing the traditional way of farming, it stopped achieving more crop yield.



UNSUSTAINABLE farming

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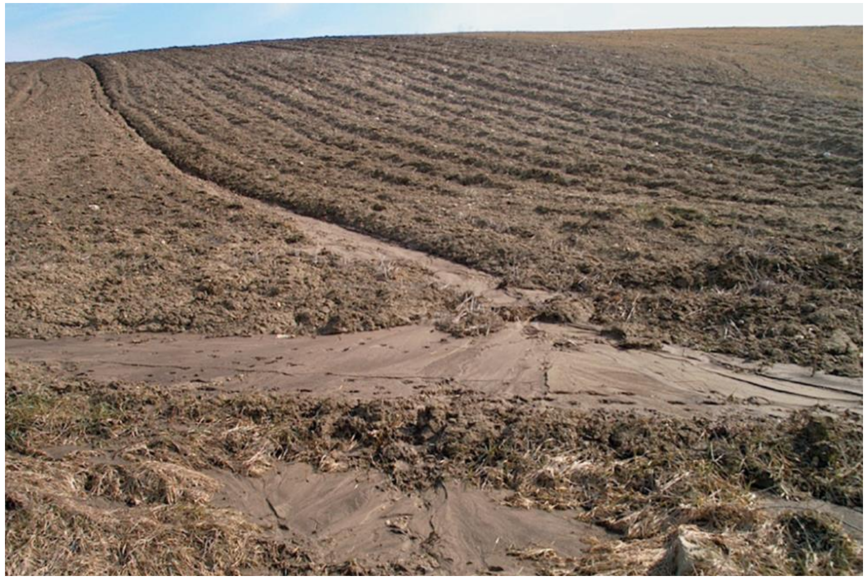


An example of poor land management practices.

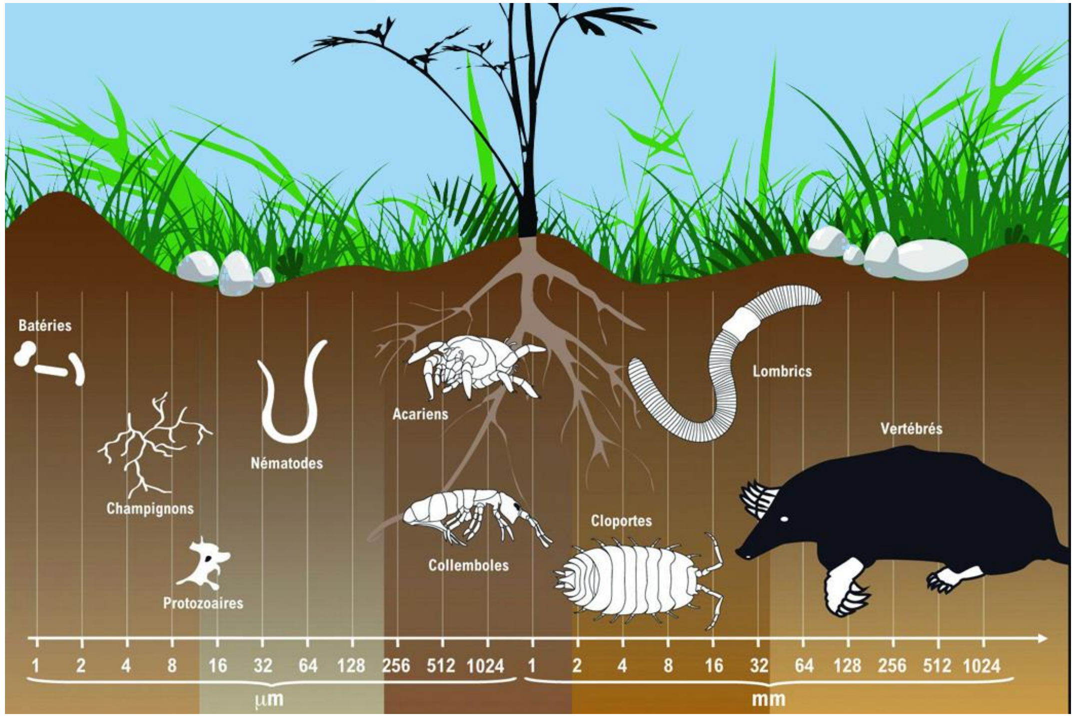
UNSUSTAINABLE farming

Erosion causing a 1m deep rill in the Severn Valley UK,

Key treats to soil in Europe

• **Decline in biodiversity** Nematode less efficient in compacted soils.

UNSUSTAINABLE farming



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The EU agricultural situation : Europe must avoid soil degradation.

To secure agricultural income, european farmers

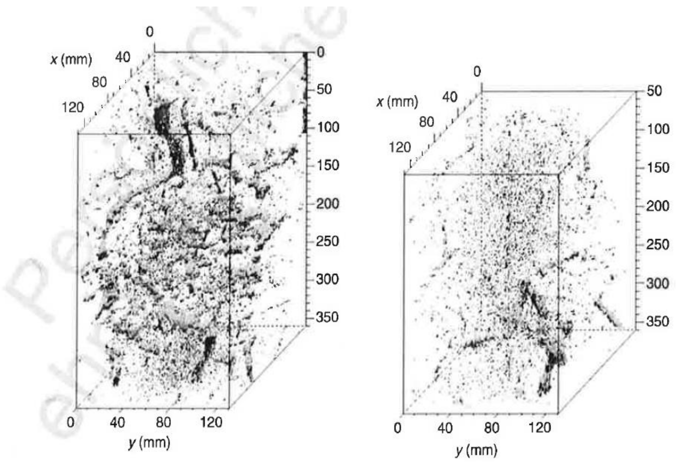
- ⇒ invest in **larger equipment** (saving labour costs),
- ⇒ need more horsepower to move **large equipment** on bigger tyres.
- ⇒ experience the **limit of yield** boost
  - ➢ through crop protection techniques
  - ➢ through soil erosion

⇒ How can tyre manufacturers contribute to soil care?

VT - TRACTOR

What VALUE could a tyre manufacturer add to the farmer?

The biggest advantage of VF tyres lies in their capacity of operating **under the lowest inflation pressure**, creating a large footprint, decreasing the pressure on the soil,
=> As such, decreasing soil compaction.



Macro-pores in the soil before and after a pressure of 250KPa,

Soil Care by Bridgestone

TYRE technologies – 3 standards

710/70 R42 173D 170E   Maxi Traction

IF 710/70 R42 179D 176E   Maxi Traction

VF 710/70 R42 179D 176E   VT Tractor

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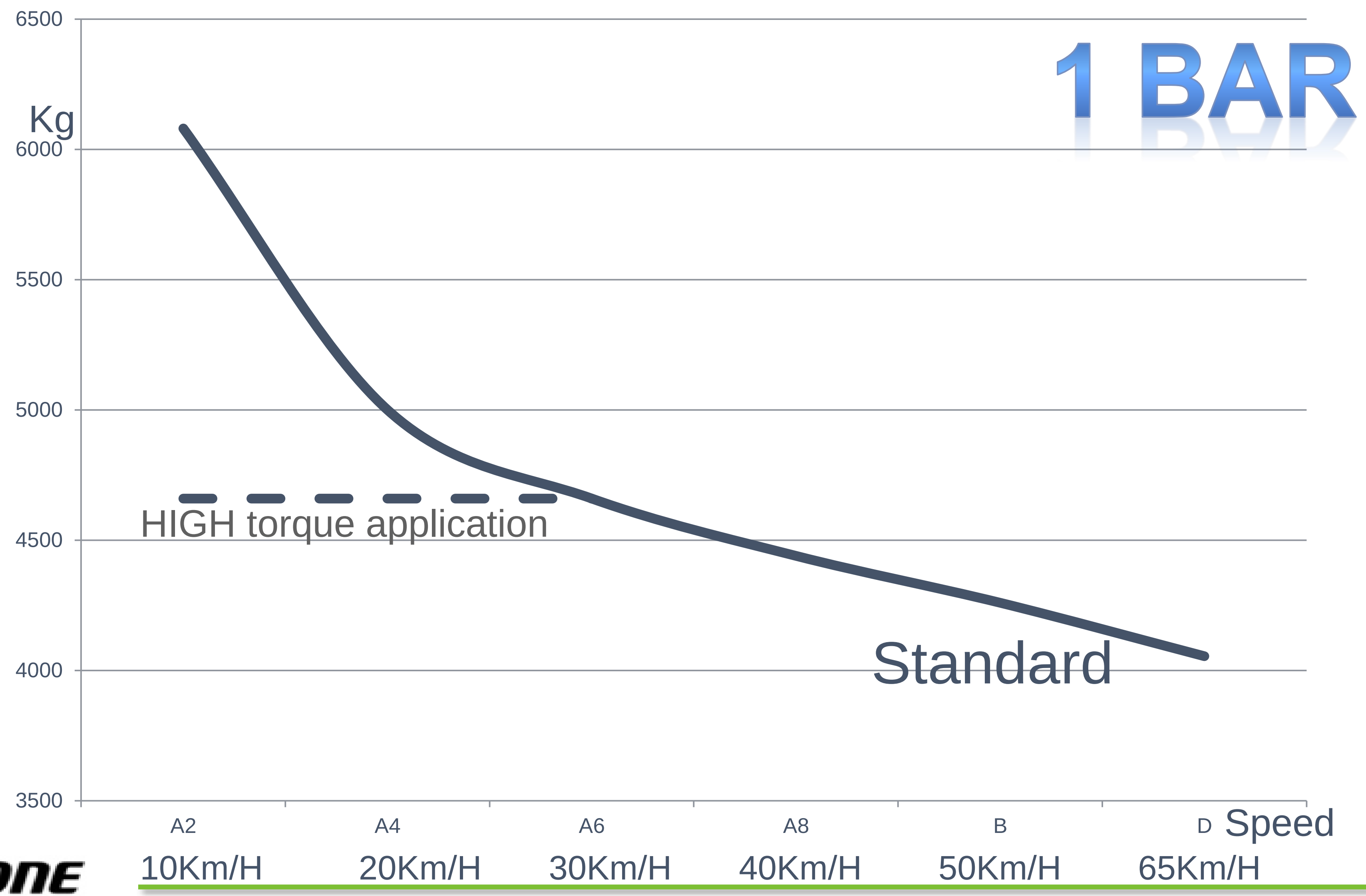
Tyre technology – Standard tech



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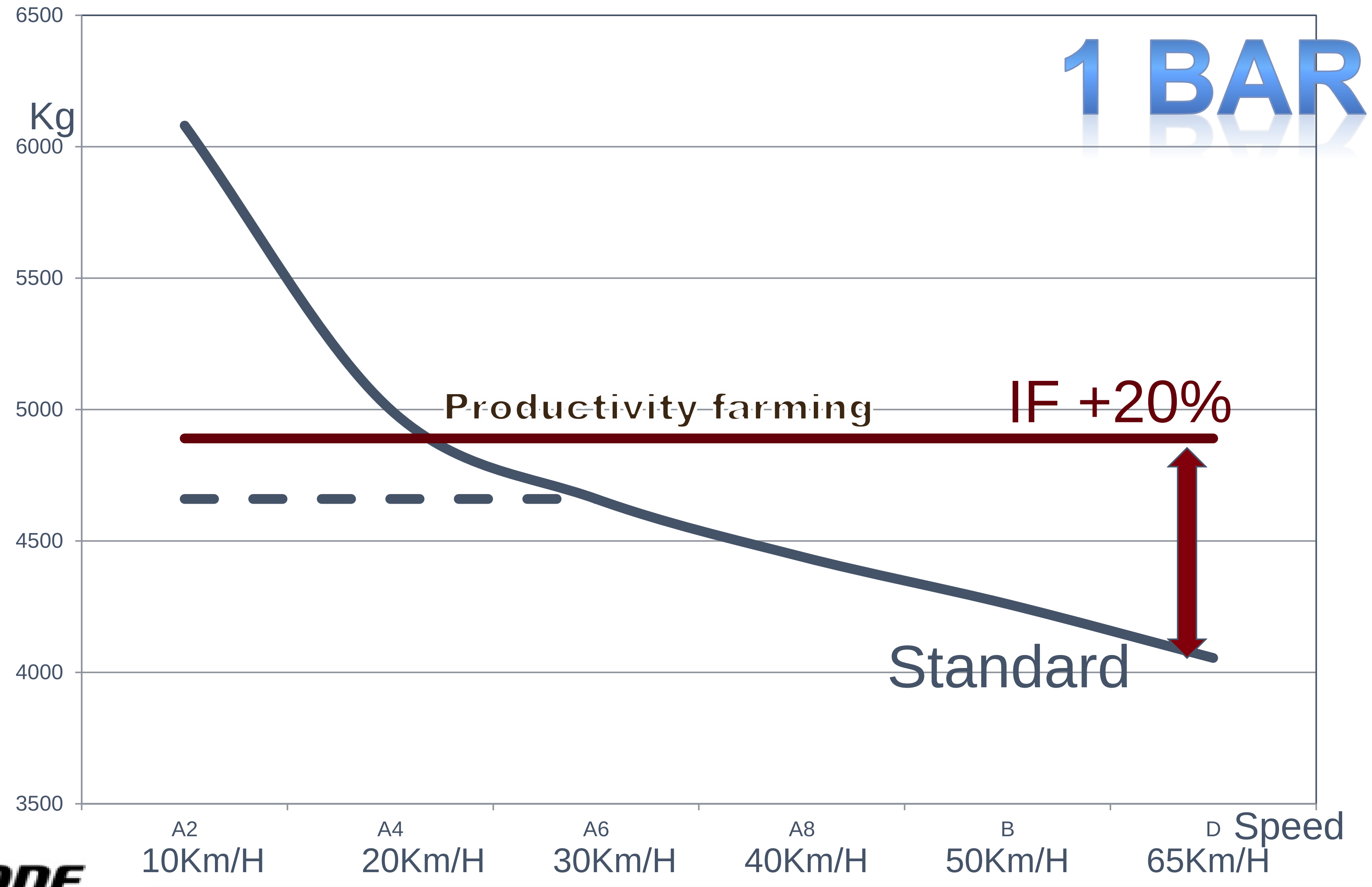
Tyre technology in agricultural ‘ IF ’ environment



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Maxi Traction or Maxi Traction IF?

New Maxi Traction IF =

Proven strengths standard Maxi Traction

+

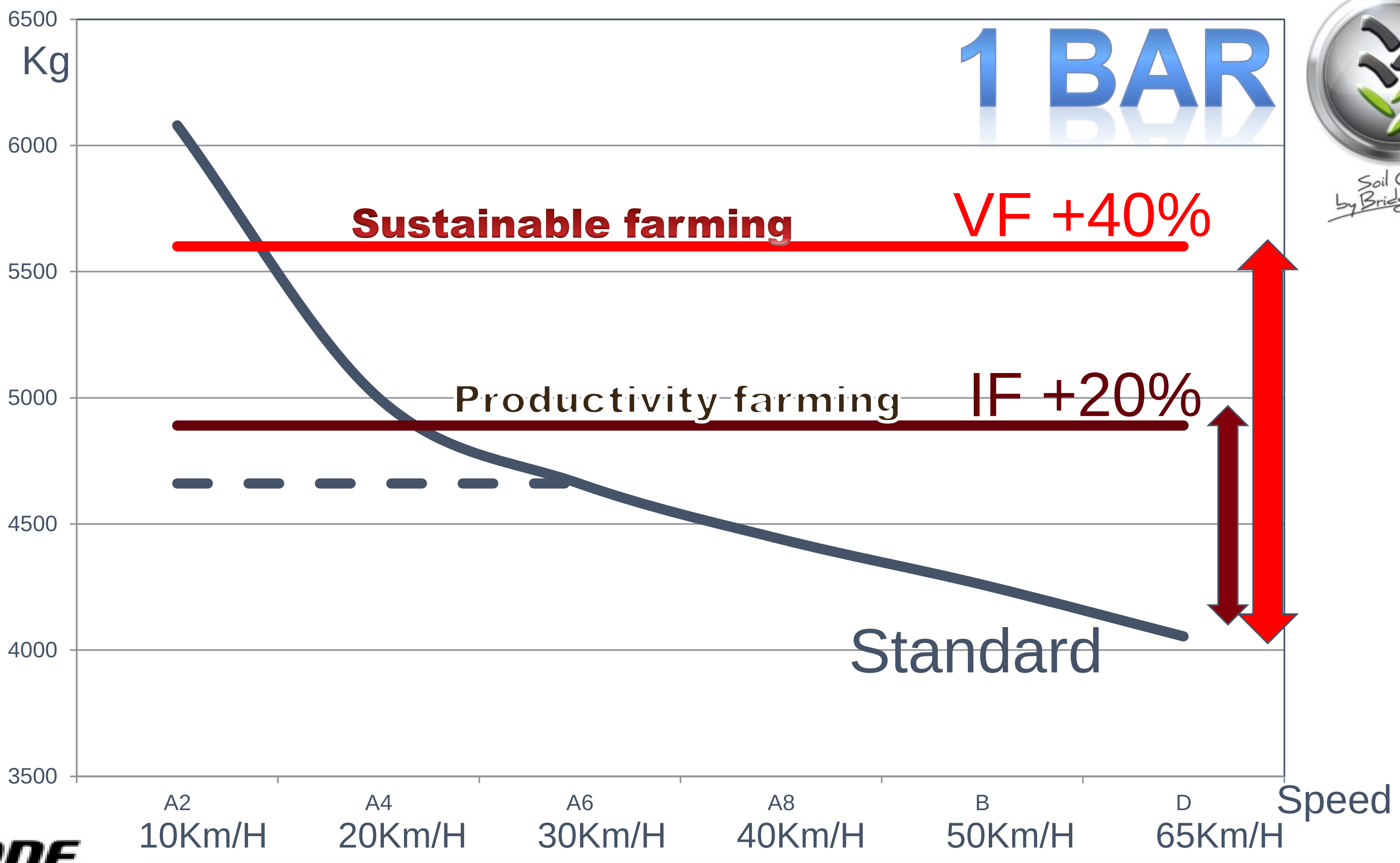
Reduced soil-compaction

Increased load- and speed capabilities

Improved driving comfort

Bridgestone Innovation– VF technology

Bridgestone developed a technology which allows tyres to reduce tyre pressure even more than IF technology, for existing tyre sizes & existing rims - NRO.



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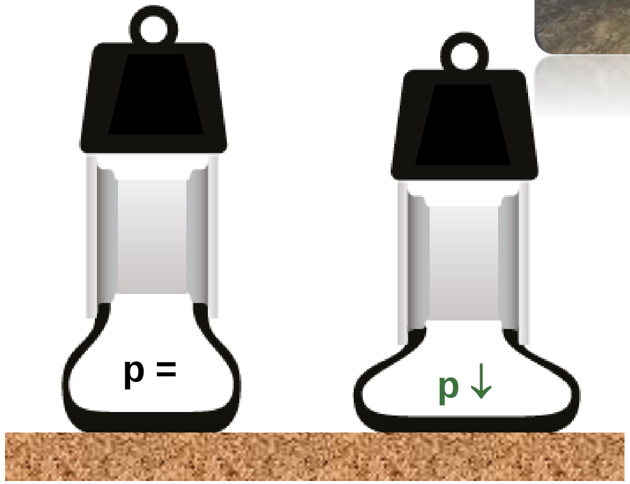
Bridgestone Innovation– VF technology

Soil Care by Bridgestone

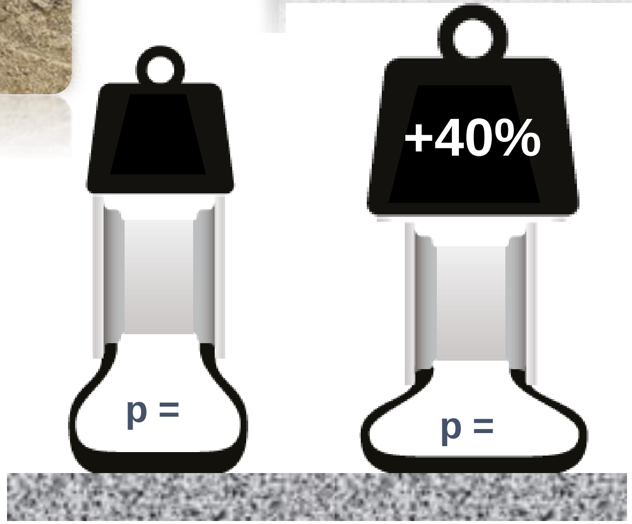
Lower pressure
Same load

Sustainable farming

40% more load
Same pressure



Standard tyre VF tyre



Standard tyre VF tyre

Bridgestone Innovation– VF technology

The special VF casing and bead construction allow for a greater degree of flexing and hence **operation at lower pressures than standard tyres.**

As a consequence, the VT-TRACTOR have an up to 26% larger lug contact area than competitor products

Lower Pressure
=
Bigger Footprint
=
Less Soil Compaction
&
Less Rutting

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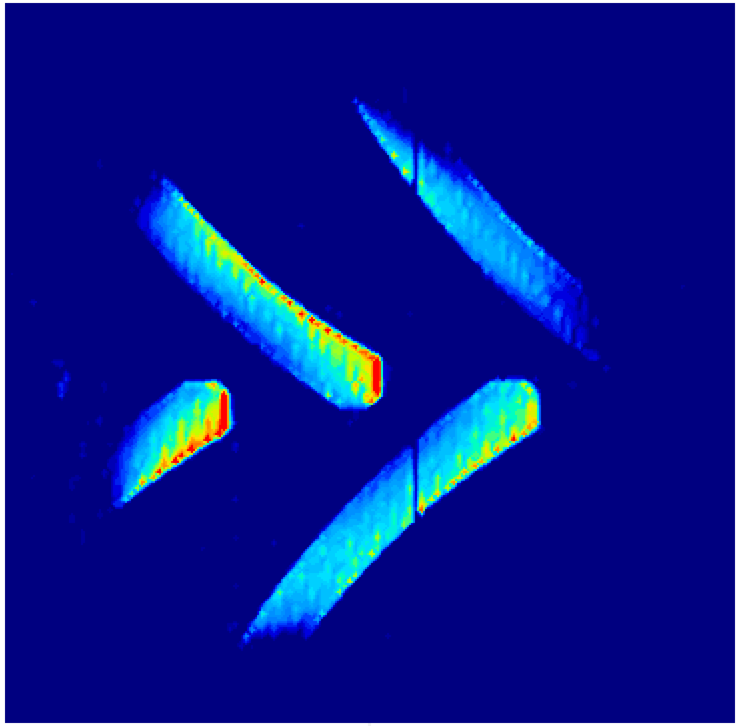
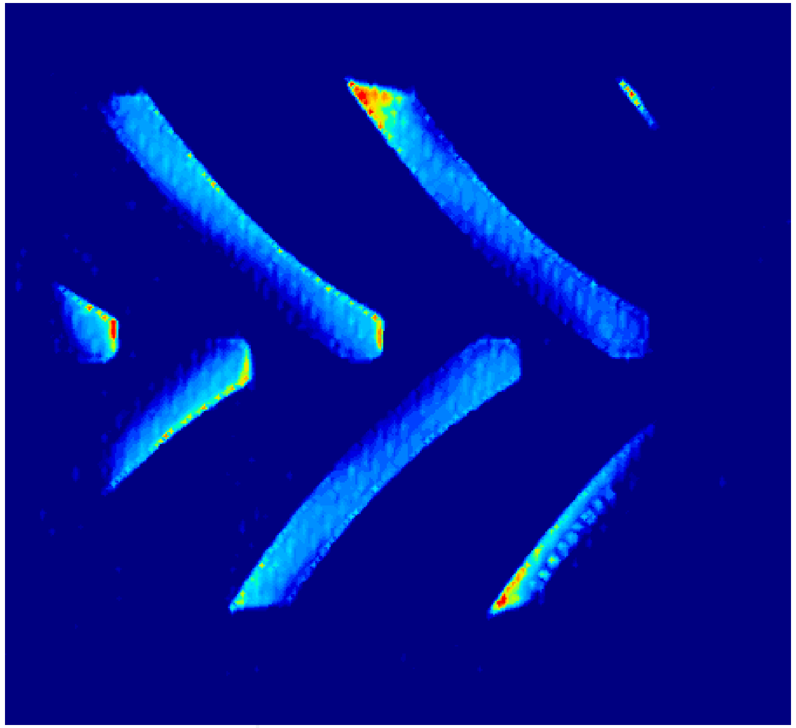
VF 650/65R42 NRO

1.6bar



Sensor/Group	Value
IX500:192.19...	
Avg Pres.	515.41
Area (cm^2)	569.03

0.6bar



Sensor/Group	Value
IX500:192.19...	
Avg Pres.	380.07
Area (cm^2)	874.84

- 26%
153%

Pressure mat data


Thank you

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INTERACTIVE QUESTIONS

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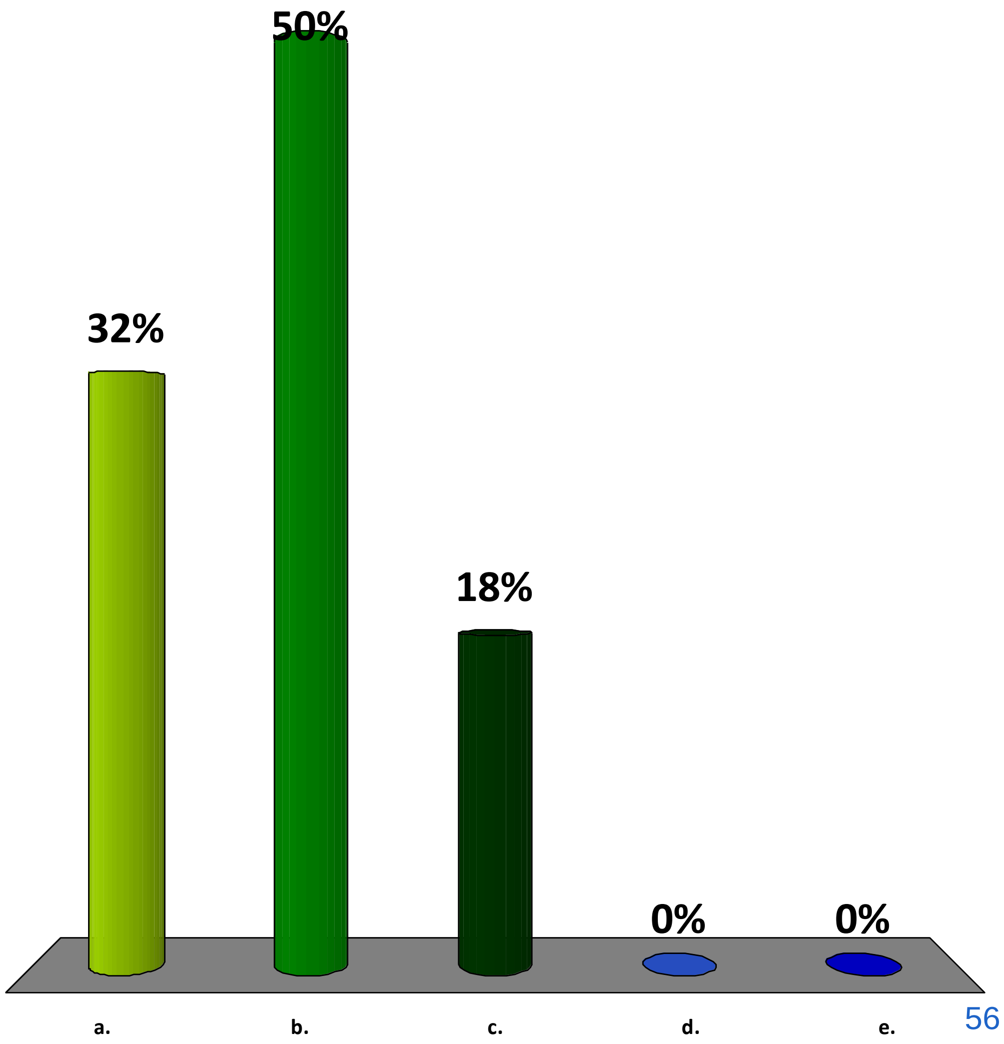
WHAT % OF EU FARMLAND: - IS SHORT IN ORGANIC MATTER? - IS COMPACTED?

a. 50% and 45%
b. 45% and 33%
c. 33% and 25%
d. 25% and 15%
e. 15% and 10%



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HOW CAN WATER STORAGE CAPACITY BEST BE IMPROVED IN SOILS?

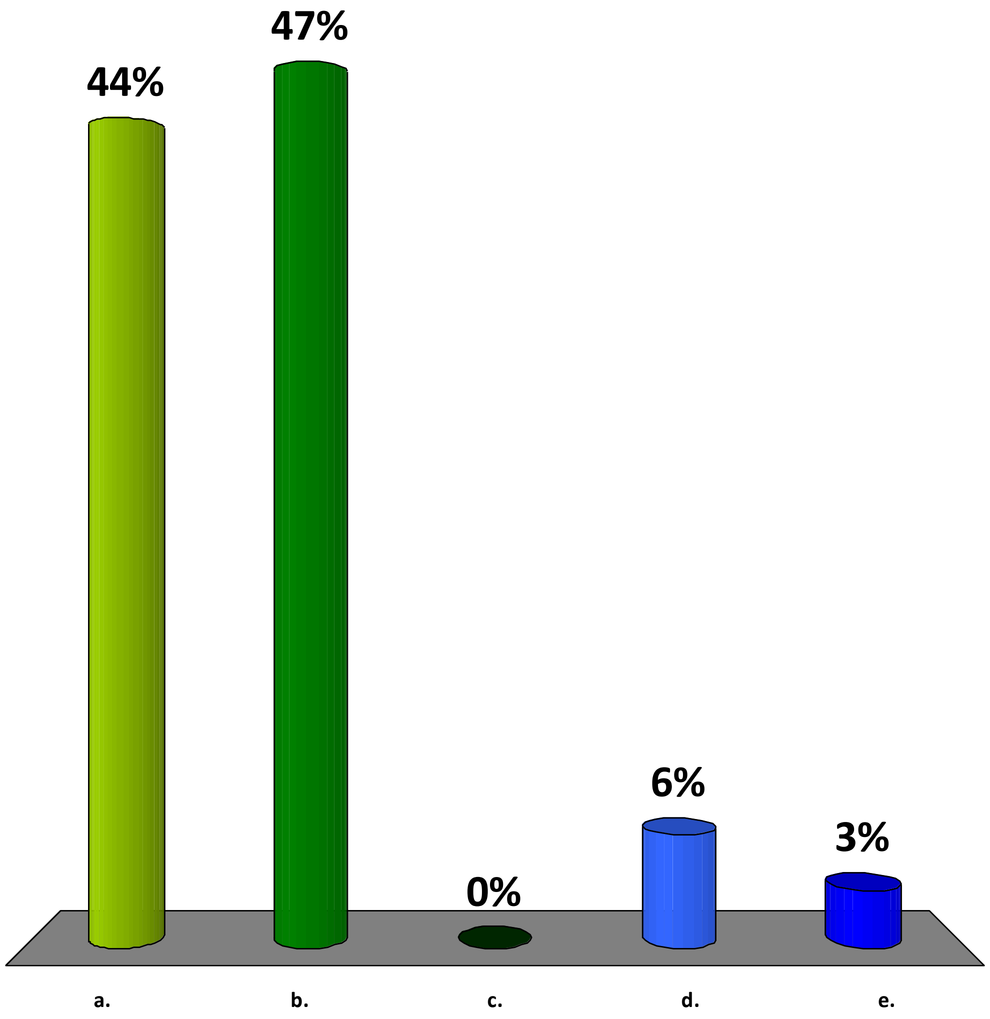
a. Increase organic matter

b. Prevent soil compaction

c. Anti-erosion measures

d. Zero tillage

e. Other



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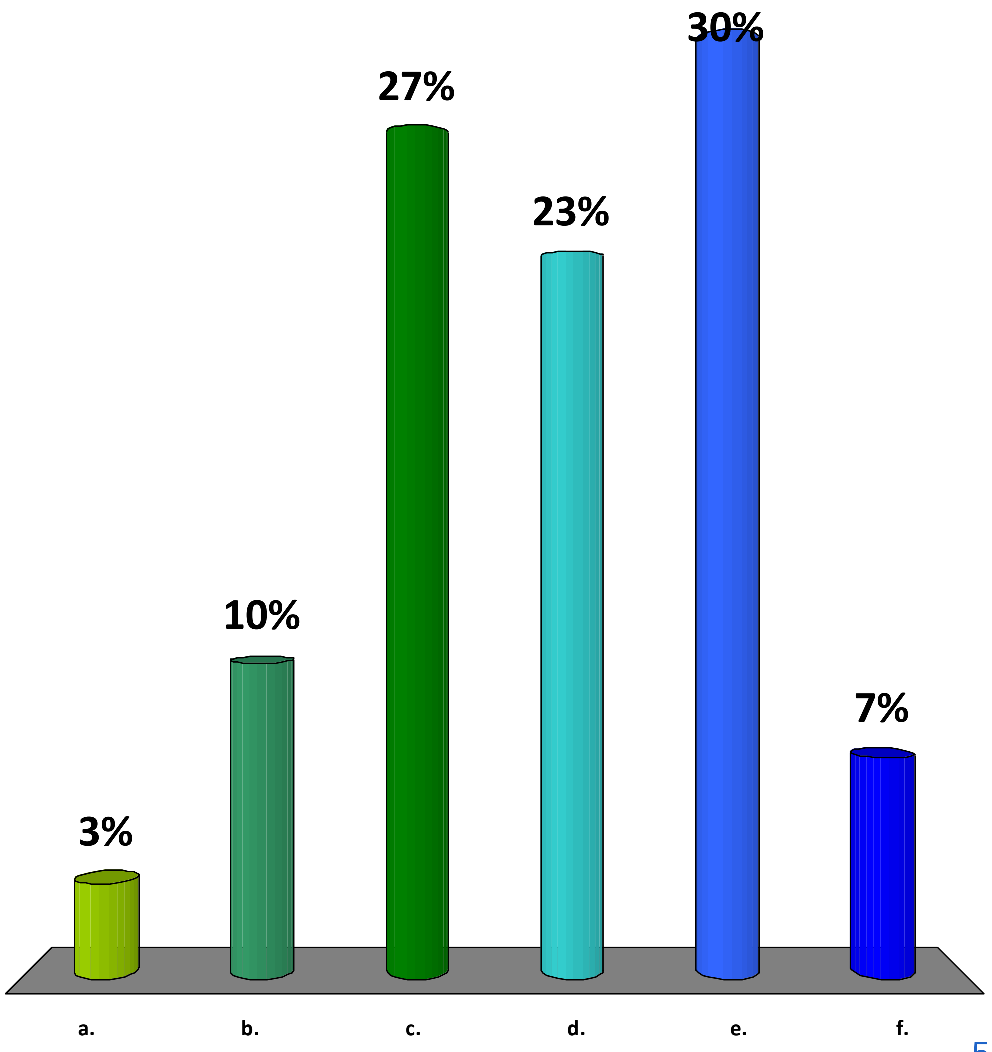
WHAT WOULD BE THE MOST EFFECTIVE MEASURE TO LOWER SOIL COMPACTION?

a. Smaller tractors (Farmers are using bigger tractors than necessary)
b. Innovative tyres / lower tyre pressure
c. Schedule farm operations to avoid working paddocks when wet
d. Control traffic patterns using tramlines
e. Context dependent
f. Other



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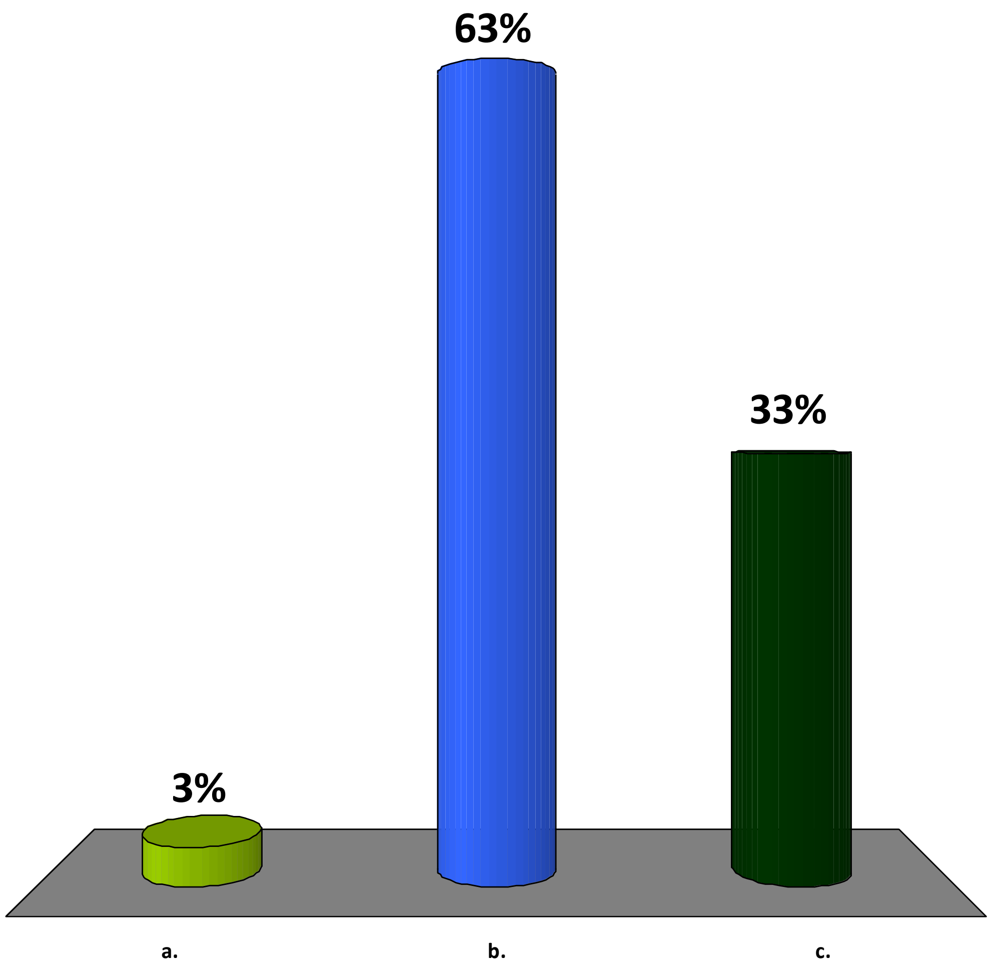
IS THE LINK BETWEEN SOIL COMPACTION AND PRODUCTIVITY (PROFIT) CLEAR ENOUGH FOR FARMERS?

a. Yes

b. Yes, but more communication is needed

c. No, more research is needed



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POTENTIAL OF DIGITAL AGRICULTURE TO IMPROVE SOIL FERTILITY

Prof. Abdul Mouazen

GHENT UNIVERSITY

FACULTY OF
BIOSCIENCE ENGINEERING

DEPARTMENT OF SOIL MANAGEMENT

PRECISION SOIL AND CROP ENGINEERING GROUP - SITEMAN

POTENTIAL OF DIGITAL AGRICULTURE FOR IMPROVING SOIL FERTILITY

Abdul M. Mouazen

Stakeholder Meeting 'Health Soil Matters'

30/11/2017

Gent, Belgium

OUTLINE

- Philosophy of precision agriculture
- Case studies
- Future prospective
- Conclusions

PHILOSOPHY OF PRECISION AGRICULTURE

The use of advanced sensing, modelling and control technologies for ***managing within field variability*** site specifically. This can be achieved by applying the right amount of farm inputs (fertilisers, seeds, pesticides, water) in the right place and time, using variable rate technologies.

Precision agriculture is:

1. multi-disciplinary: agronomy, environment, modelling, engineering, sensing, socio-economic science, ….

2. multi-functional: researchers, farmers, growers, agronomists, service providers, policy makers, machinery manufacturers,…..

OPPORTUNITIES

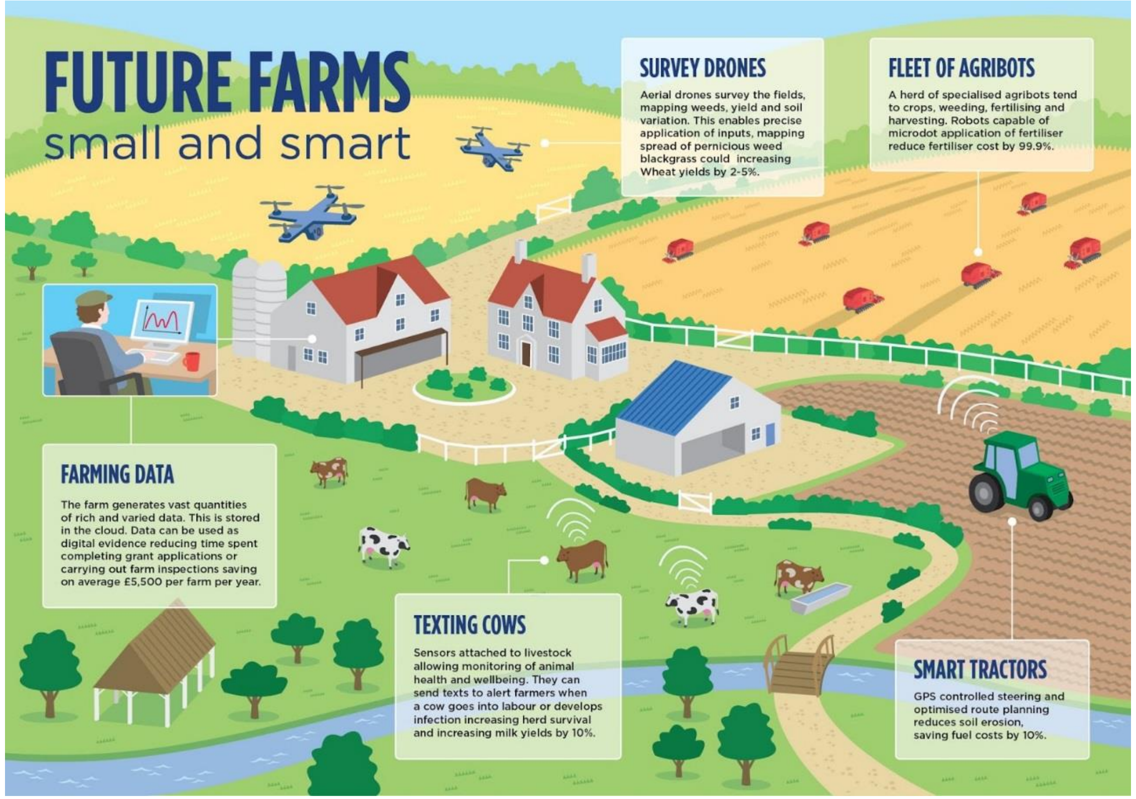
- Significant contribution to food security and safety
- Promote more sustainable ways of farming
- Increase farming efficiency by increasing yield at reduced input cost
- Reduce environmental impacts
- Trigger wider societal changes
- Improve soil fertility potential

CHALLENGES

•Low adoption of PA technologies by farmers

•Low policy makers' appetite for PA applications

•Research needs



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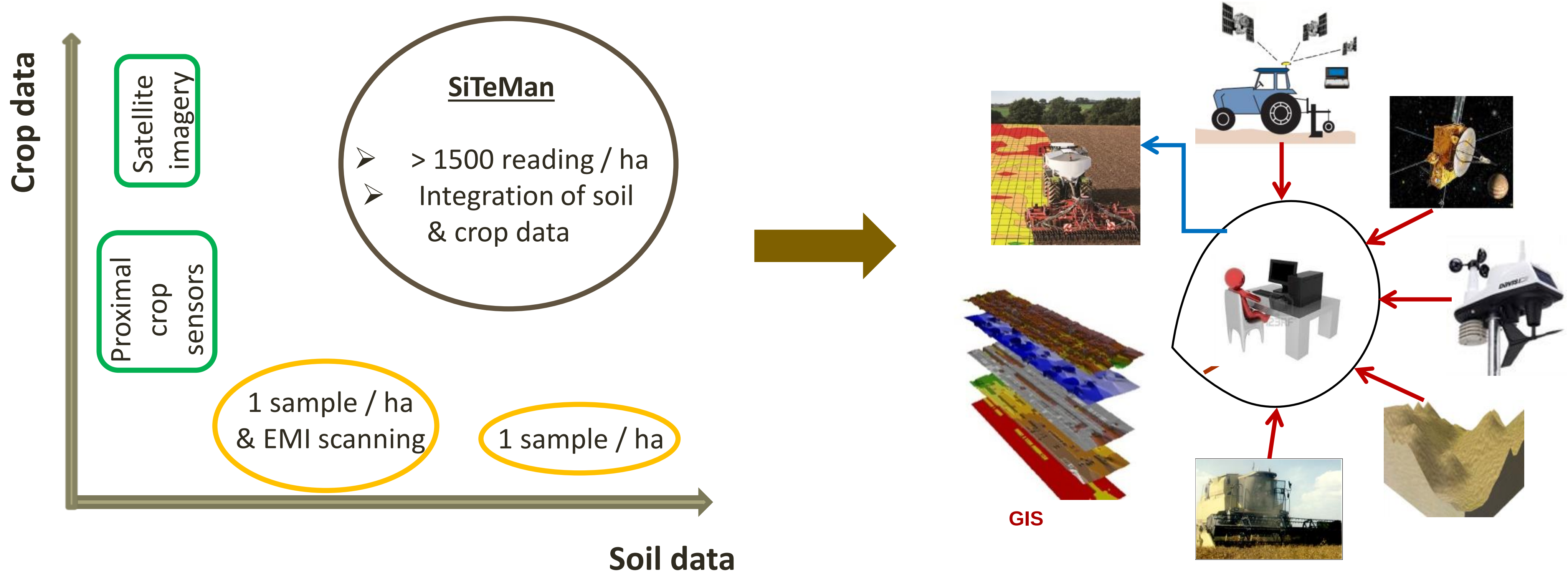
VISION



To combine cutting-edge sensors and advanced data fusion and geostatistical modelling approaches with system control technology to opitimise farm input at field/sub-field scales for sustainable increase in yield at reduced input cost.

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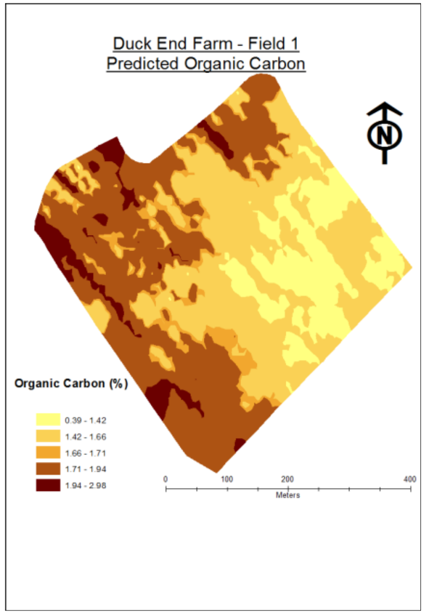
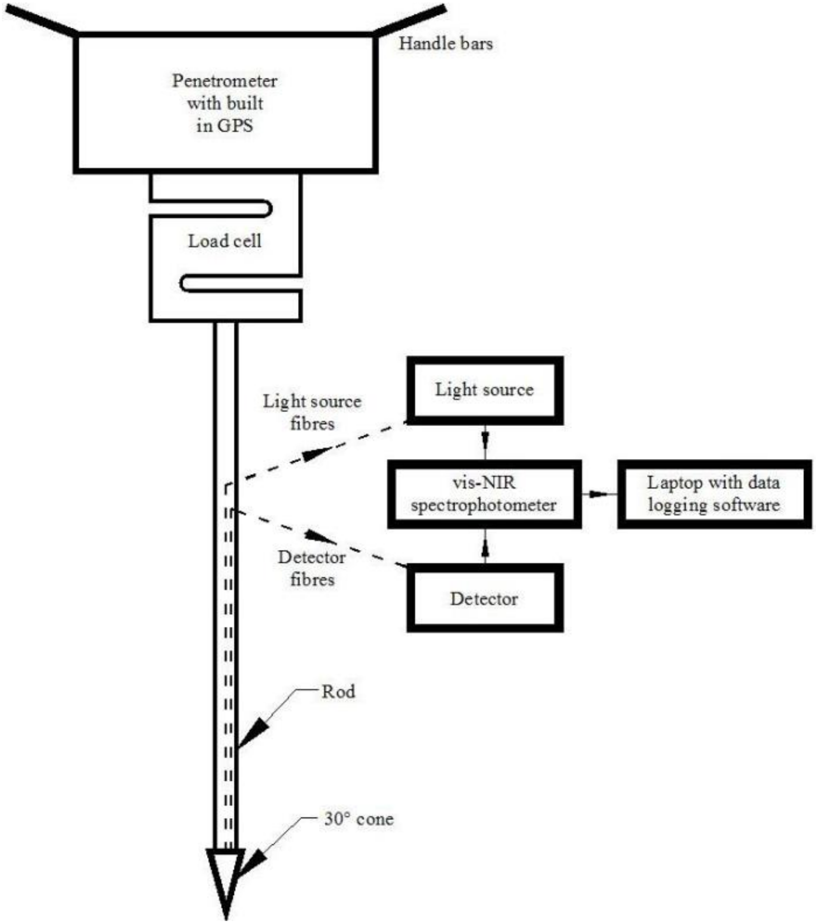
CORE COMPETENCY & INNOVATION





- High resolution data (1500 – 2000 readings per ha).
- Any depth between 5 – 50 cm.
- Can be fit onto different soil equipment e.g., tillage, planters & seeding machine.
- Particularly successful for organic carbon, moisture, total nitrogen, clay and organic matter.
- Less accurate for pH, phosphorous, calcium cation exchange capacity and magnesium.

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CASE STUDIES IN SITE SPECIFIC APPLICATIONS

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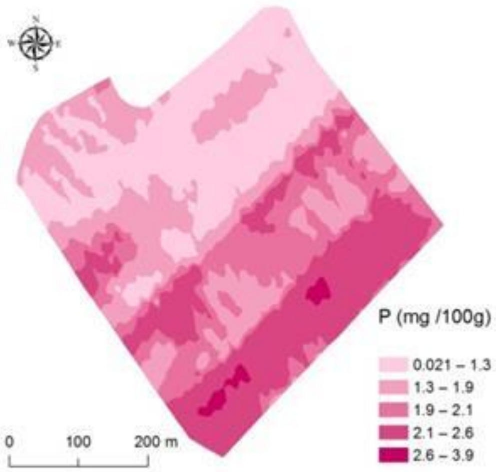
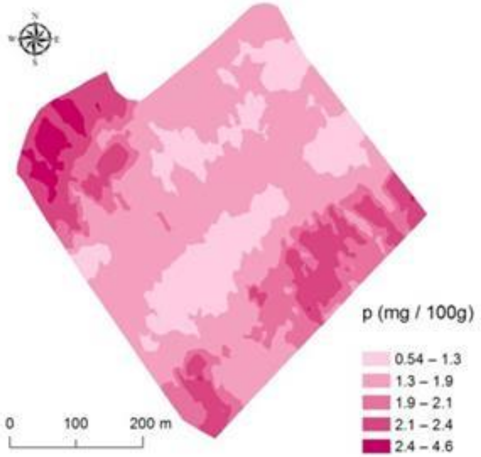
MAP-BASED SITE SPECIFIC P FERTILISATION

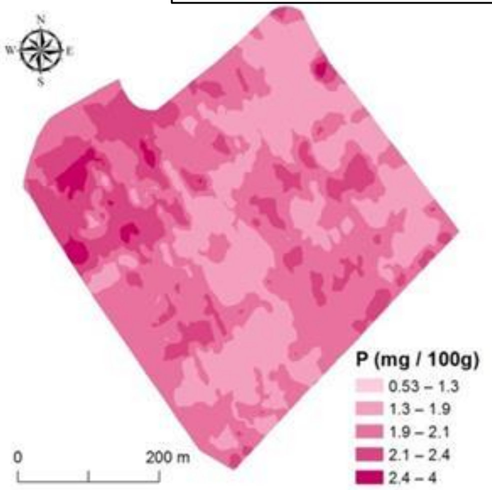
No cost-benefit or environmental analyses



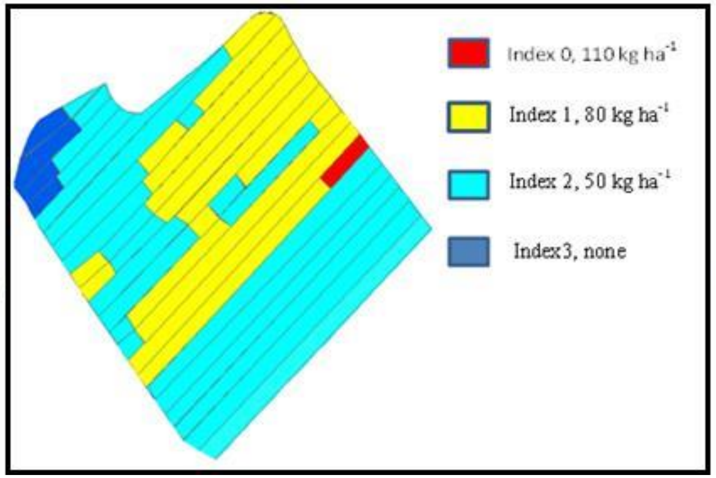
2011



2012



2013



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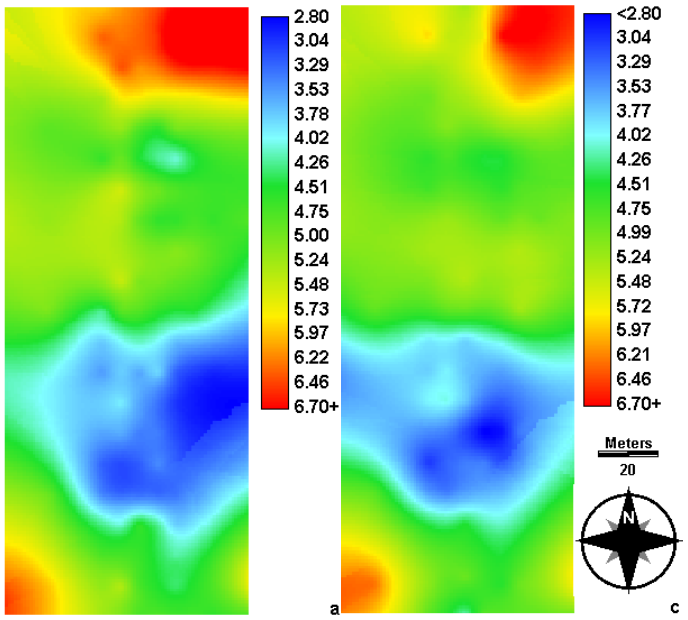
After: Mouazen et al. (2015), Soil & Tillage Research

SENSOR-BASED SITE SPECIFIC P FERTILISATION



Lab measured P   On-line measured P

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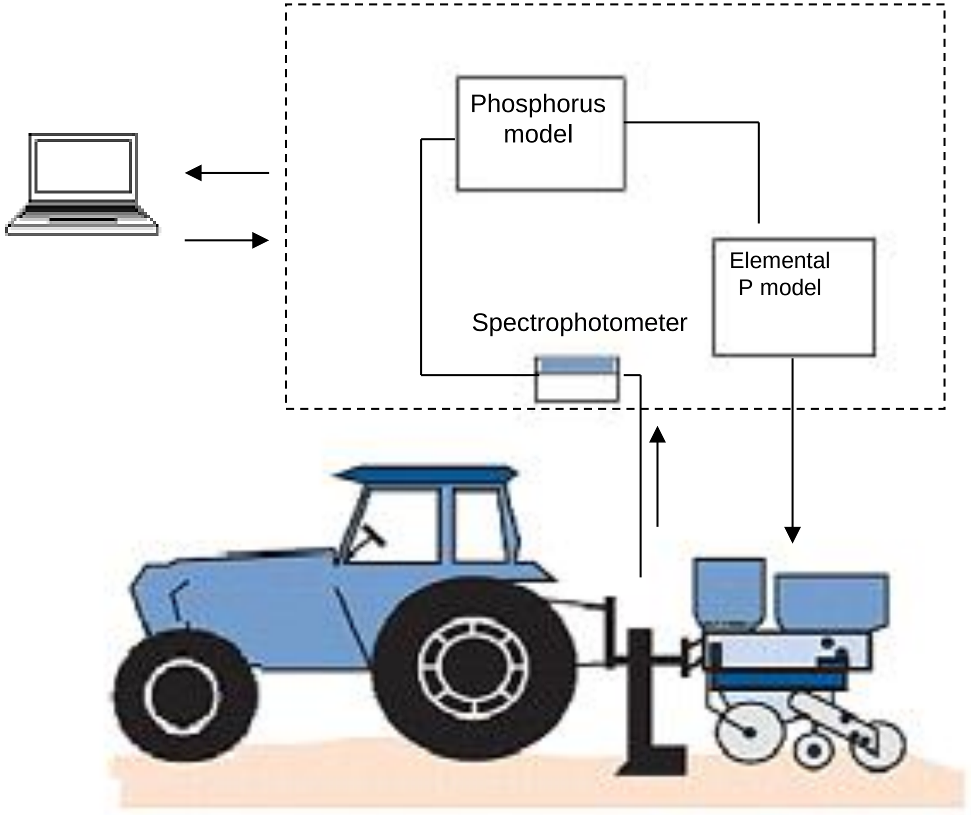
After: Maleki et al. (2008), Biosystems Engineering

SENSOR-BASED SITE SPECIFIC P FERTILISATION



After: Maleki et al. (2008), Biosystems Engineering

SENSOR-BASED SITE SPECIFIC P FERTILISATION

- **334 kg / ha increase in maize yield**
- **No reduction in P fertiliser applied**

Spectrophotometer

Optical sensor

Electronics

Actuator

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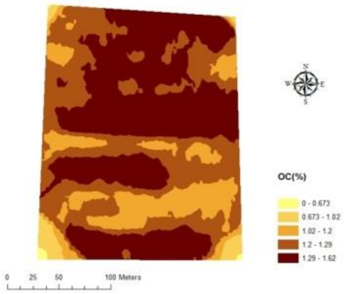
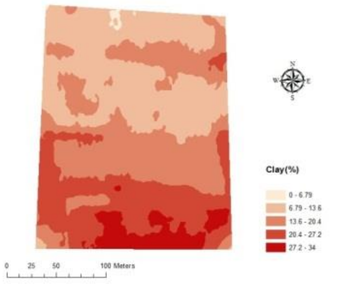
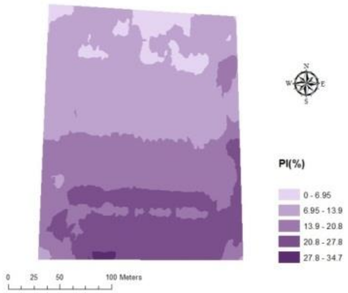
After: Maleki et al. (2008), Biosystems Engineering

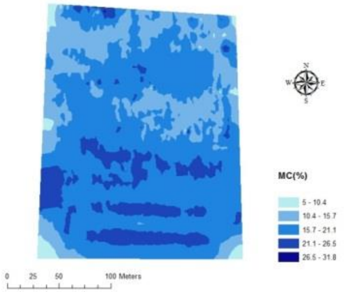
MULTI-SENSOR & DATA FUSION FOR SITE SPECIFIC IRRIGATION

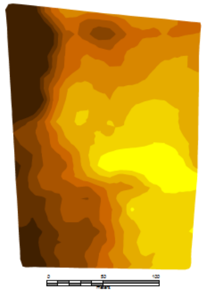




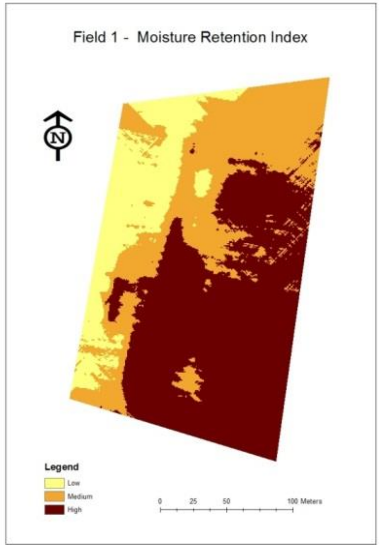
+







Fusion of 5 layers
on soil properties



- Increase energy consumption
- Water scarcity
- Increase GHG emission

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After: Mouazen et al. (2014) – Soil & Tillage Research

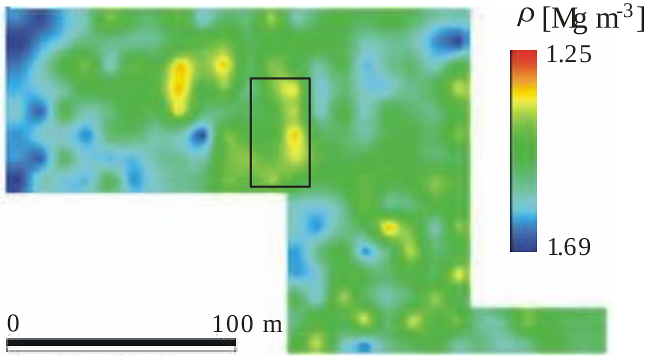
MULTI-SENSOR & DATA FUSION FOR SITE SPECIFIC COMPACTION MANAGEMENT

$$BD = \left(\sqrt[3]{\frac{D + 21.36MC - 73.9313d^2}{1.6734}} \right) \times (1.255 - 0.772MC)$$

- Reduce yield
- Increase energy consumption
- Increase GHG emission
- Increase risk for flood and erosion
- Reduce hydraulic conductivity

2

1



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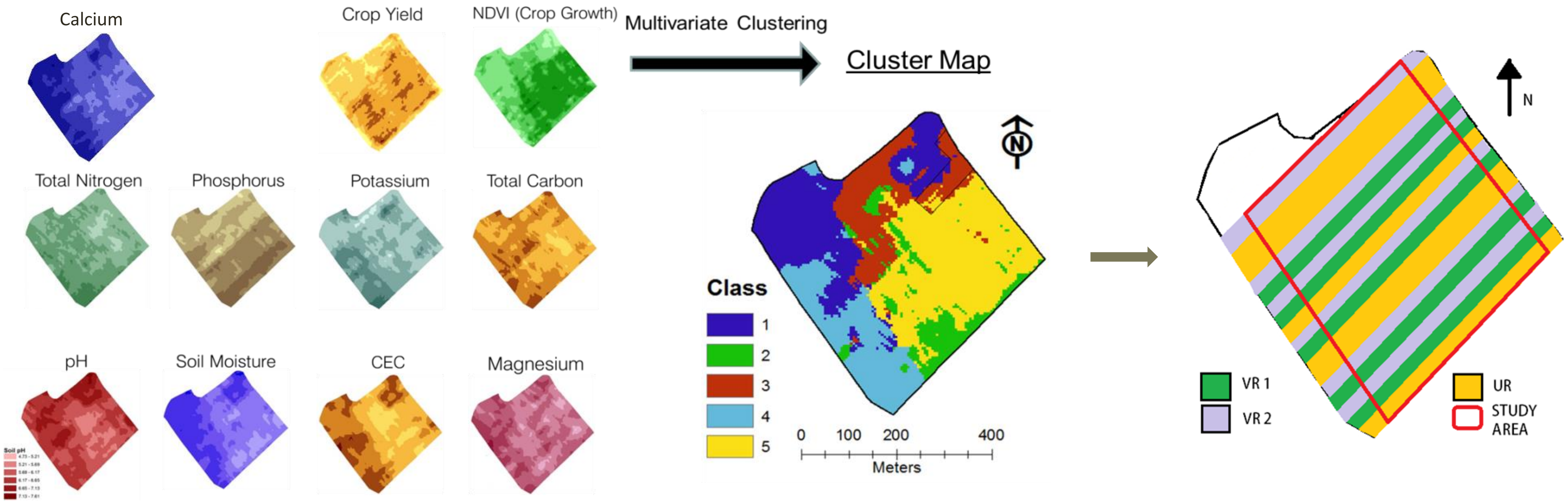
Reduction in energy consumption & CO_2 emission of 66-78%

After: Mouazen and Ramon (2006) & (2010), Soil & Tillage Res
Quraishi and Mouazen (2012), Soil & Tillage Res
Shamal et al. (2016), Soil & Tillage Res

MULTI-SENSOR & DATA FUSION FOR VR N FERTILISATION

- Common Raster Grid Creation
- Data Fusion by Clustering
- Mapping



Fertility zone map **N application map**

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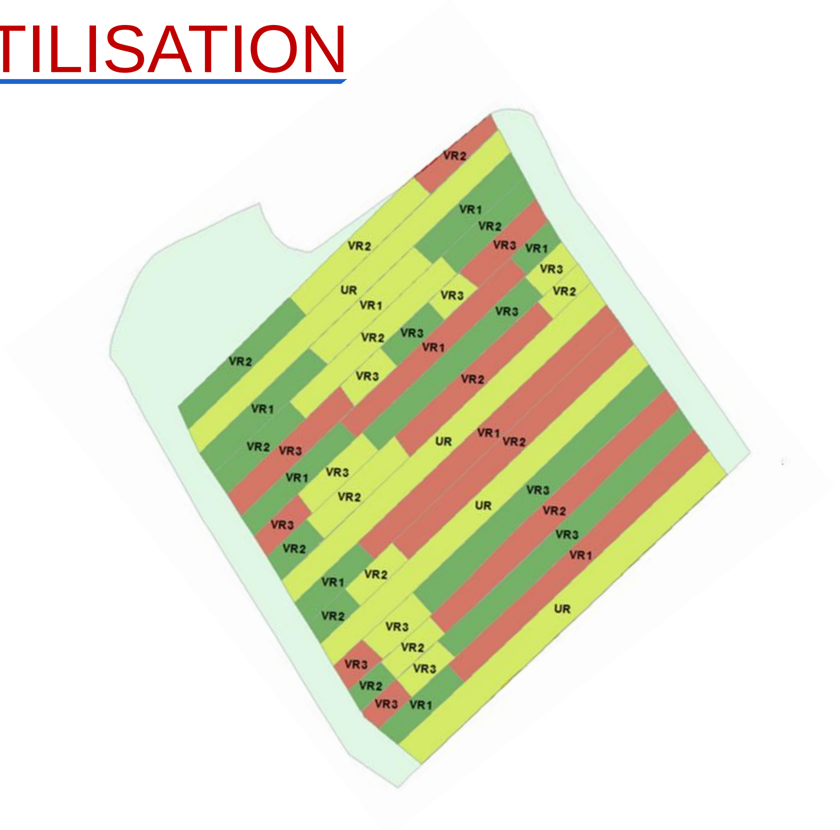
After: Halcro el al. (2013) – 3rd International Workshop on PSS

Nawar et al. (2017) – Advances in Agronomy

COST-BENEFIT ANALYSIS OF VR N FERTILISATION

	N fertilisation
Projected net benefit to farmer per ha per year (**innovative IVR-UR**)	**49.8**
Projected net benefit to farmer per ha per year **(innovative IVR-TVR)**	**25**

£72.8 per ha extra profit to farmer for N, P and lime



UR – Uniform rate
TVR – Traditional variable rate (NDVI)
IVR – Innovative variable rate (on-line soil data & NDVI)

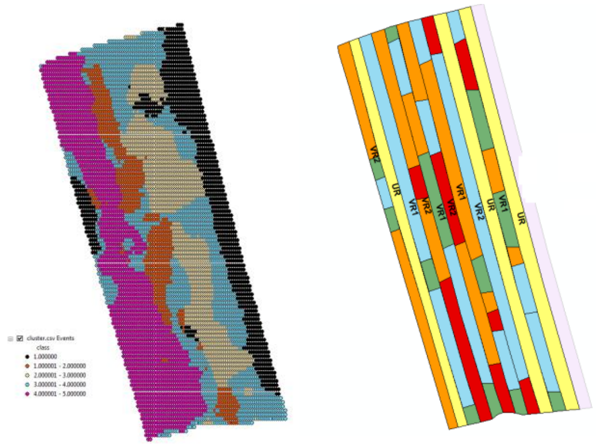
FarmingTruth – ESA – Unpublished data

PROFITABILITY

Field	Profitability IVR vs UR (€)		Profitability IVR vs TVR (€)		Fertiliser use IVR vs UR (€)		Fertiliser use IVR vs TVR (€)	
	2014	***2015***	***2014***	***2015***	***2014***	***2015***	***2014***	***2015***
UK*	24	46.56	15.6	22.2	-0.07	-0.52	10.94	3.18
Germany	-	98.81	-	39.21	-	-10.91	-	-21.81
Turkey**	304.5	355.17	-	50.55	-	-1.16	-	-

* VR N application in Fields in UK and Germany

** VR N, P & K in Field in Turkey



UR – Uniform rate
TVR – Traditional variable rate (NDVI)
IVR – Innovative variable rate (on-line soil data & NDVI)

ENVIRONMENTAL ANALYSES OF N FERTILISATION (£)

Impact	Receptor	Unit indicator	Cost		Annual non-market benefit per sensor
			Value	Unit	
Climate change impact	Atmosphere	CO_2e	58	£ t^{-1}	98,832
		N_2O	17,727	£ t^{-1}	
Air quality regulation	Atmosphere	NH_3	1,933	£ t^{-1}	11,565
Environmental water quality regulation	Rivers, canals	NO_3-N	180	£ t^{-1}	14,919
	Freshwater lakes	P	1,573	£ t^{-1}	
	Transitional water	NO_3-N	10	£ t^{-1}	829
Drinking water regulation	Drinking water	NO_3-N	192	£ t^{-1}	15,913
				Total benefit per sensor per year	**142,058**

Assumptions:

- 1 soil sensor measures about 6800 ha per year
- Figures are for N fertilisation only

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CONCLUSIONS

Need for advanced & integrated sensing, modelling and control technologies.

Innovative multiple sensors and data fusion approaches.

Think out of the box for new technologies.

Integration of all information on soil, crop, weather, topography, etc. – Towards system approach.

Need for collaborations across the different disciplines and functions.

Potential to increase profitability, reduce environmental impacts and waste.

Efforts to convince farmers to adopt precision agriculture practices.

Long term research, and demonstration projects with continuous training to farmers.

Science-based approaches – *simplification, automation and convenience* are key parameters for adoption.

Encourage service provider business model.

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FACULTY OF
BIOSCIENCE ENGINEERING

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@ugent
Ghent University

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POTENTIAL OF DIGITAL AGRICULTURE TO IMPROVE SOIL FERTILITY

John Deere where Healthy Soil Matter(s)

Stakeholder Meeting UGent

Matthias Appel

COFABEL®

JOHN DEERE

Evolution of agriculture up to the year 2000

John Deere tools for a healthy soil

- How We Tackle Soil Compaction (CTF)
- John Deere Water Management & T3rra Cutta
- John Deere HarvestLab 3000
- John Deere Field Connect
- My John Deere

How We Tackle Soil Compaction (CTF)

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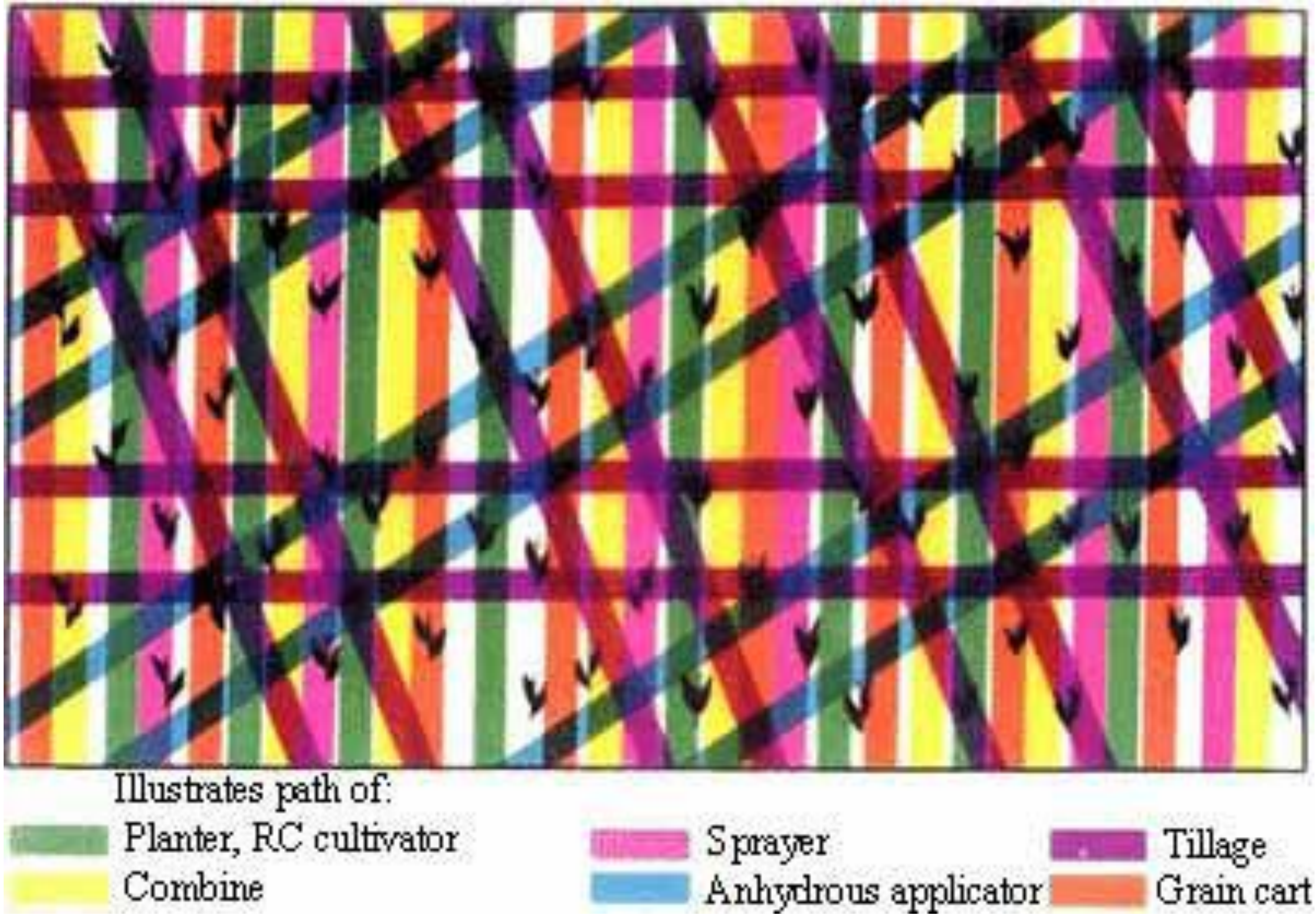
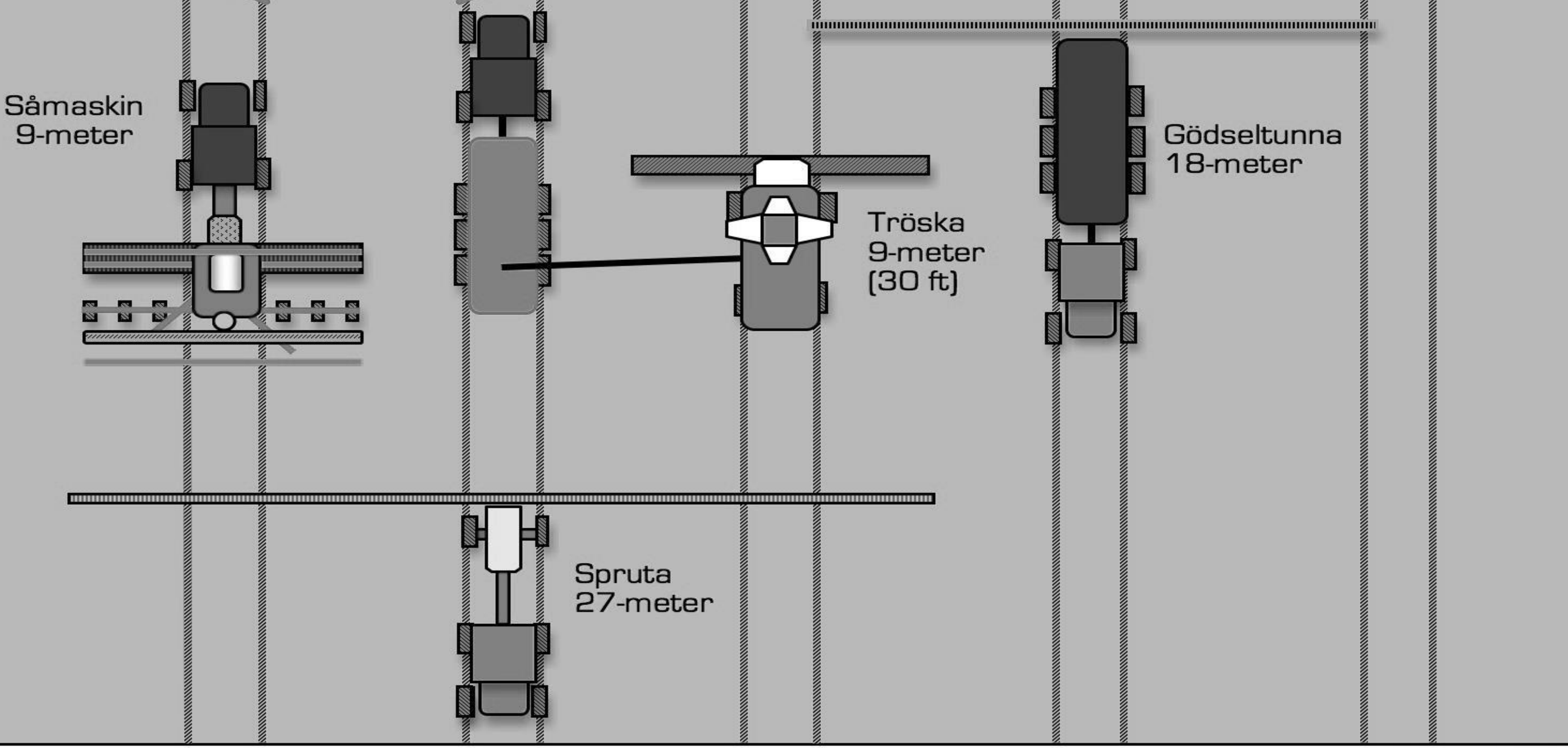
JOHN DEERE



Illustrates path of:
Planter, RC cultivator
Combine
Sprayer
Anhydrous applicator
Tillage
Grain cart



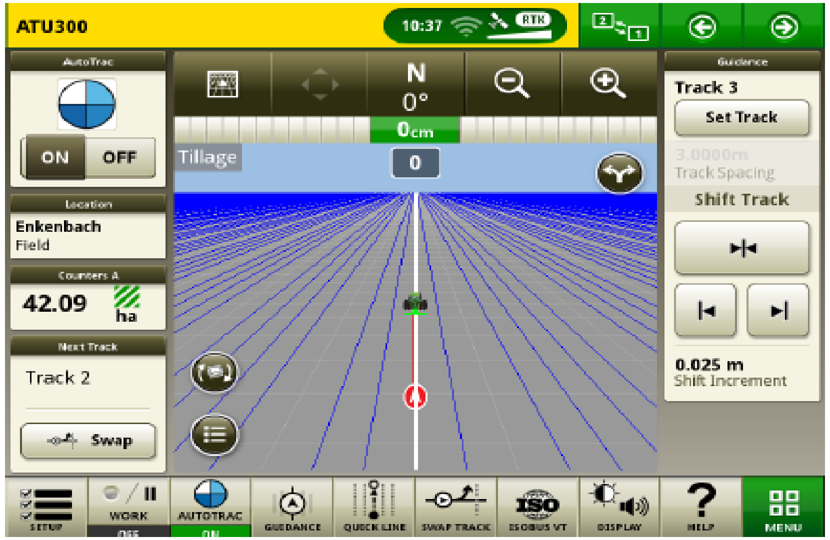
Hans Alvemar, 2015

TRAMLINES FOR GEN 4 AUTOTRAC

- Tram line feature for Gen 4 Display Family
- Setup and edit tramlines
- Straight track mode

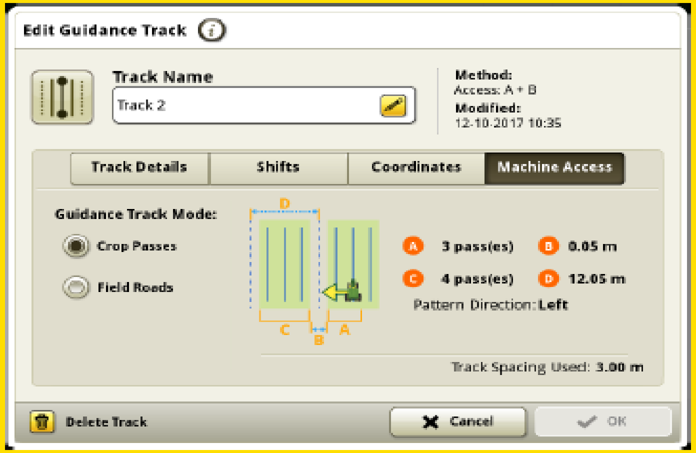
(AutoTrac activation required)

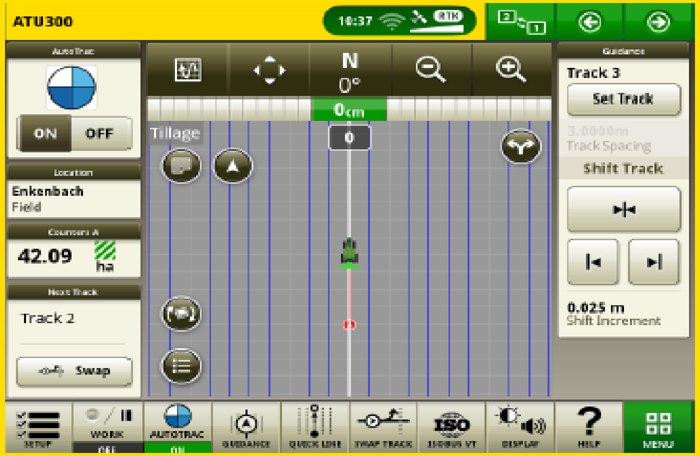
MACHINE ACCESS PATTERN FOR GEN 4 AUTOTRAC



Guidance with **two different track spacings**

e.G. 5 passes with 3m track spacing – two passes with 1m track spacing - …





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PERFECT TURNS WITH AUTOTRAC TURN AUTOMATION

- Fully automated headland turns
- Quick and easy setup
- Untrained drivers are also able to tap the full productivity
- Constant efficiency during the whole day
- Reduce of soil compaction on the headland due to optimized turn tracks
- Combination of Turn Automation and Implement Guidance possible

John Deere Water Management

COFABEL®

JOHN DEERE

What does excessive rain cause?

- Light risk soil top level closed
- Heavy soil saturation top level
- Heavy machinery cause soil compaction

- Need to enter wet fields
- Crop protection chemicals (soil herbicides) less effective, run off to ditch

Crop Quality

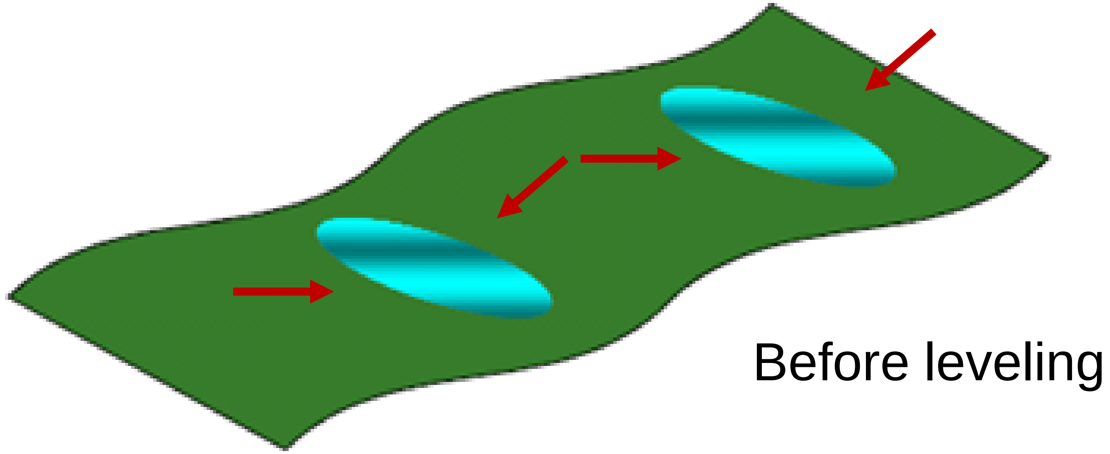
Yields

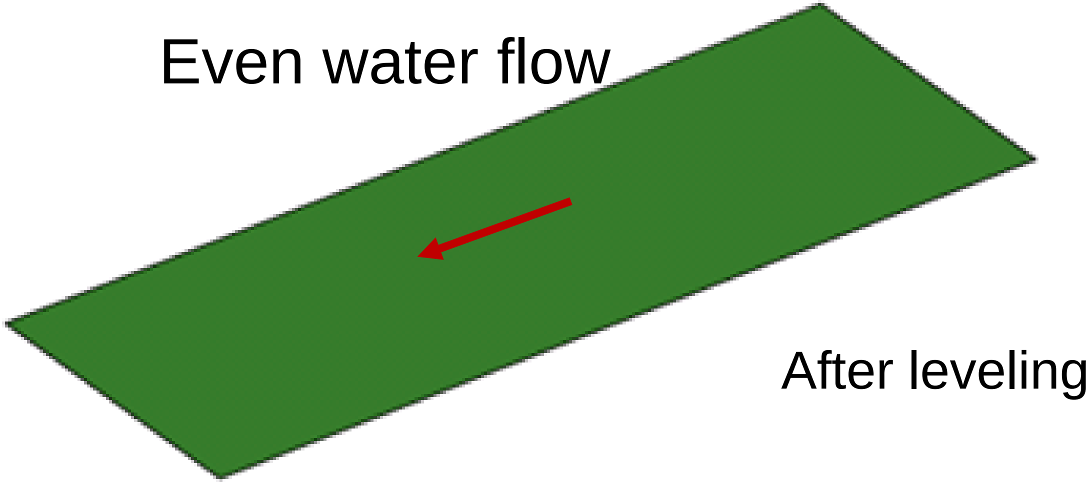
Labor cost

Machine cost

-/- € Profit

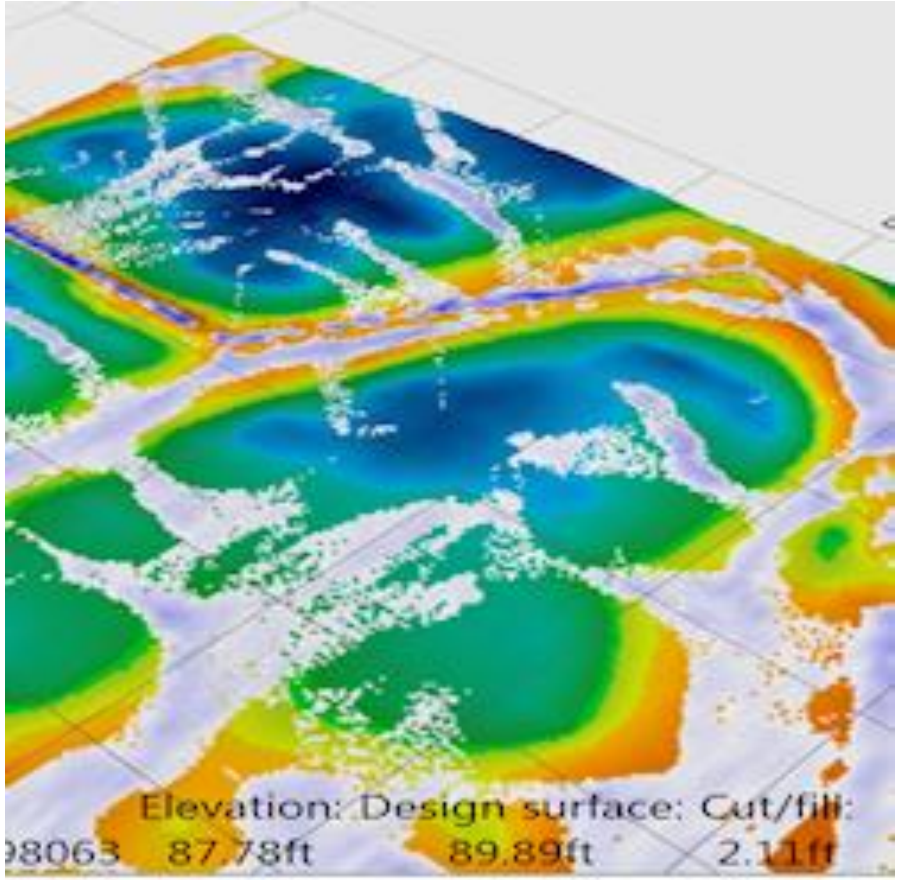
- Allow water to flow off field evenly
- Allow the soil to infiltrate water better, equally distributed





John Deere iGrade + T3RRA Cutta

Rainfall Simulation

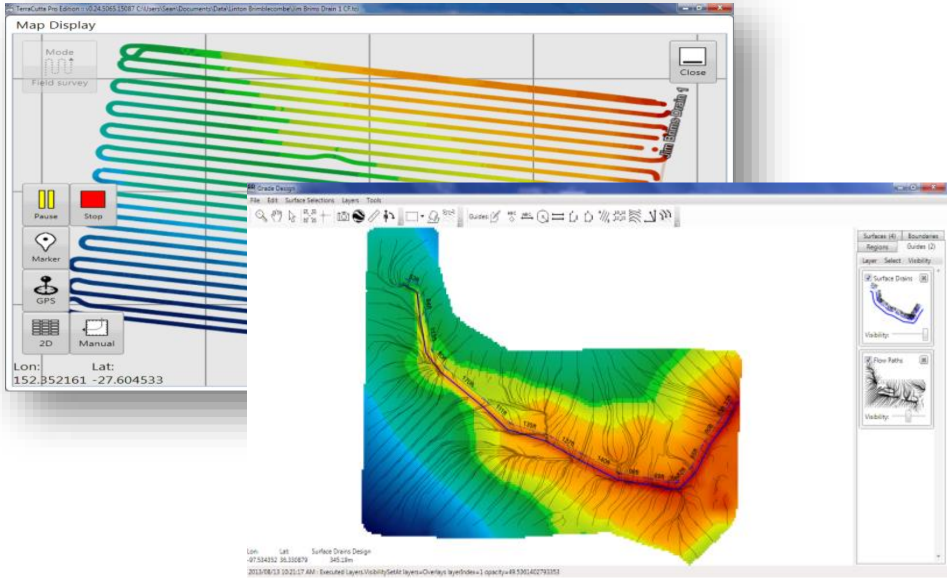


- A real time, dynamic indication of the effects of the terrain on water flow.
- See where the water drains
- See where the water ponds
- Before/after comparisons

iGrade + T3RRA Cutta

Workflow

2) Process / Design



1) Collect RTK Data

3) Implement Design

John Deere HarvestLab 3000

COFABEL®

JOHN DEERE

HARVESTLAB 3000

HARVESTLAB 3000 – ONE SENSOR THREE APPLICATIONS

HarvestLab 3000 mounted on a John Deere self-propelled forage harvester (SPFH)

HarvestLab 3000 Stationary Application

John Deere Manure Sensing

NEW FEATURES WITH HARVESTLAB 3000

Self-propelled forage harvester

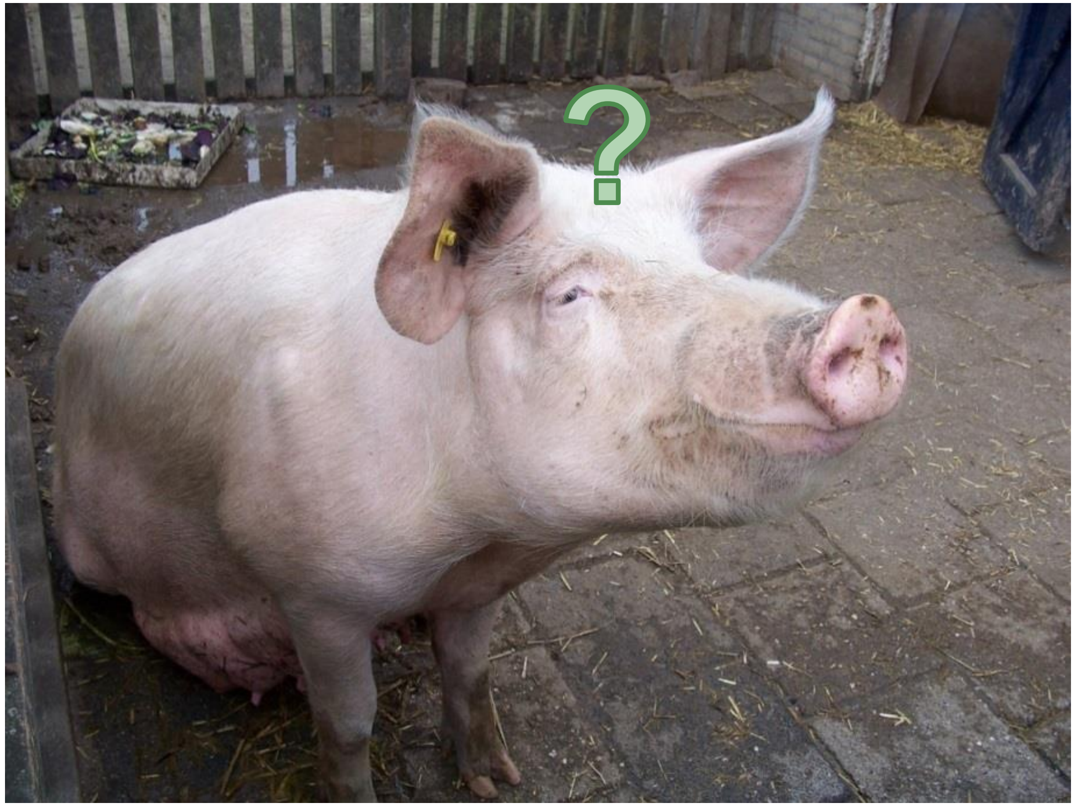
- Wider wavelength range
- **Crude ash**
- Up to 10 ingredients in the future

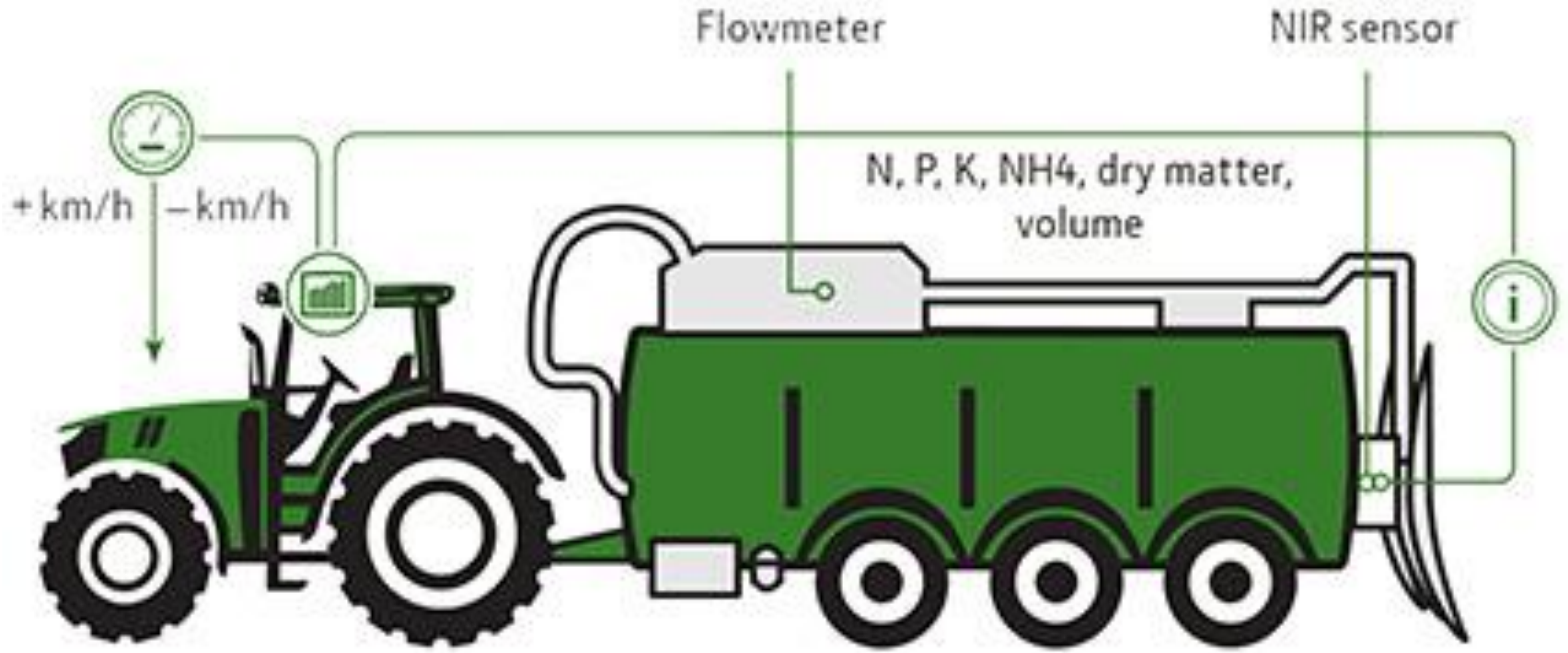
Stationary Application

- New user interface
- Up to 10 ingredients

Manure Sensing

- Wider temperature range -15 to +65 °C
- Generation 4 Display Family

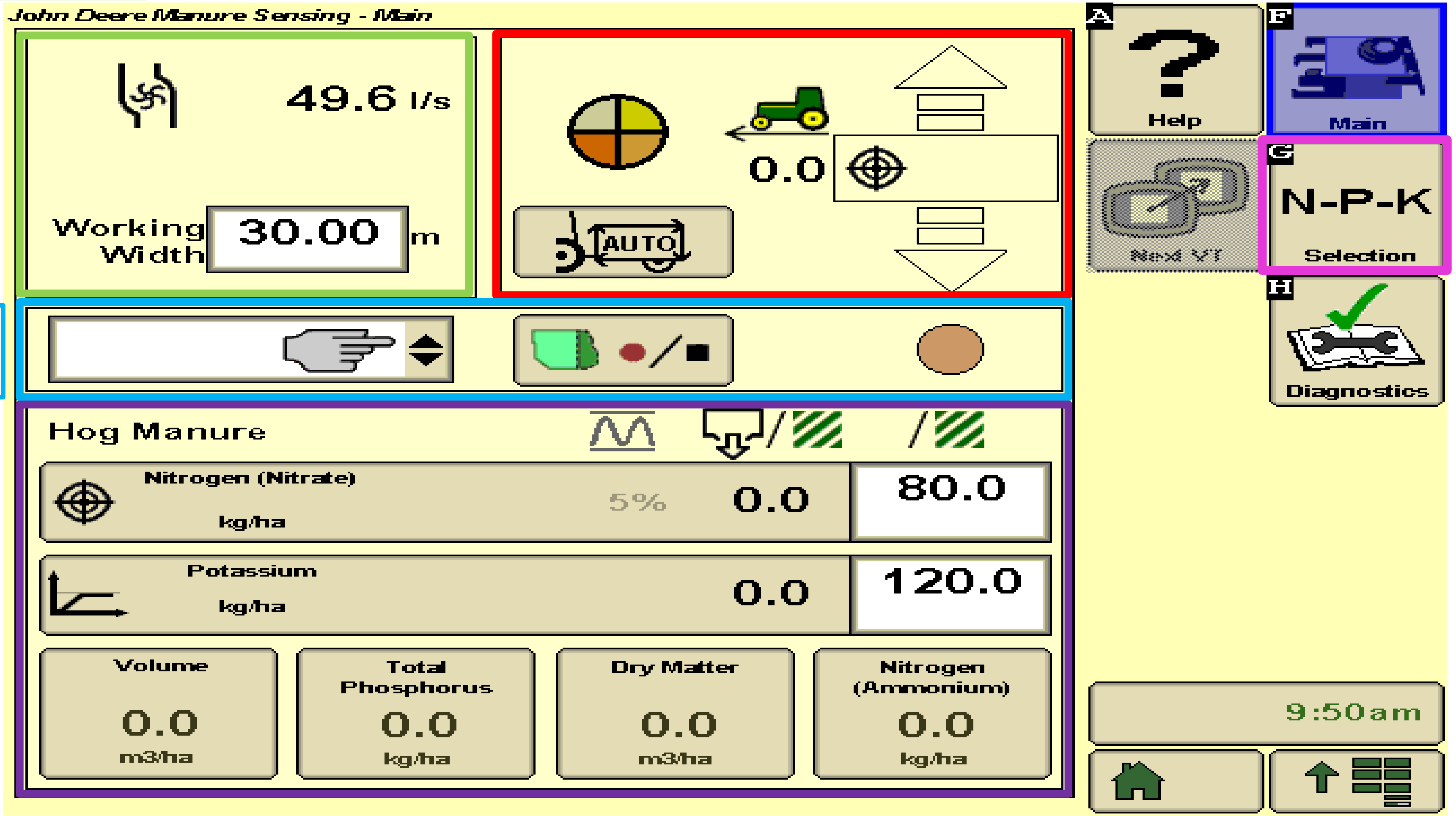




Flowmeter
NIR sensor
+ km/h
– km/h
N, P, K, NH4, dry matter,
volume

Flow value and working width

Speed automation

Recording settings



Constituent information

Documentation

Application based on prescription map

John Deere Field Connect

COFABEL®

JOHN DEERE

Field Connect

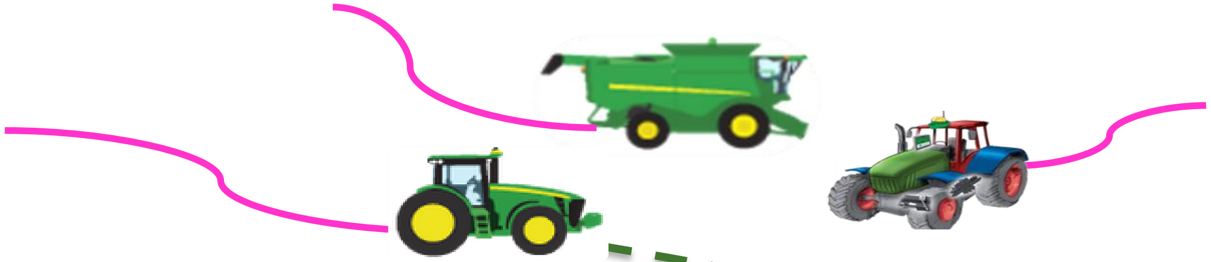
My John Deere

COFABEL®

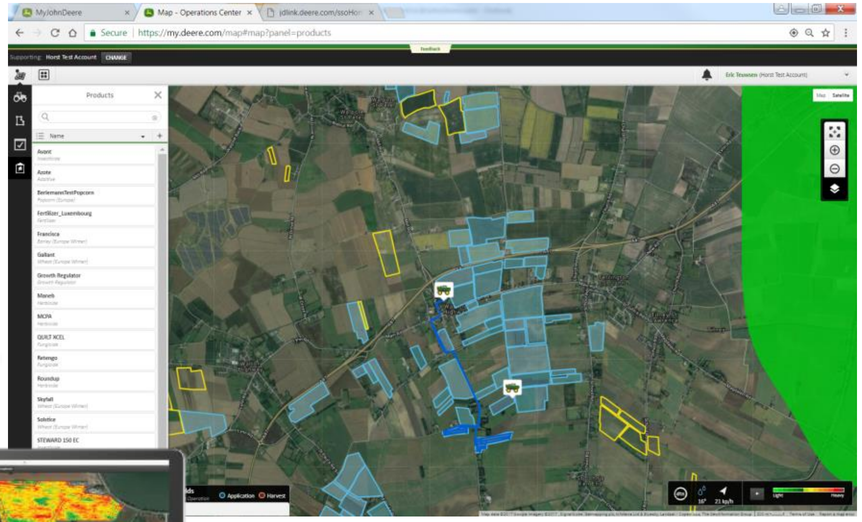
JOHN DEERE

MyJohnDeere.com

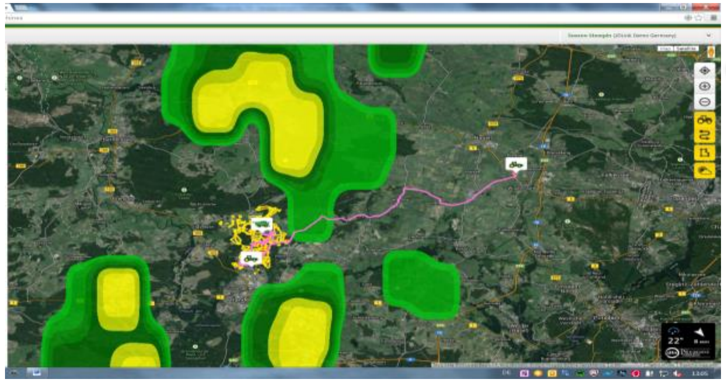
„With the Operations Center I can…



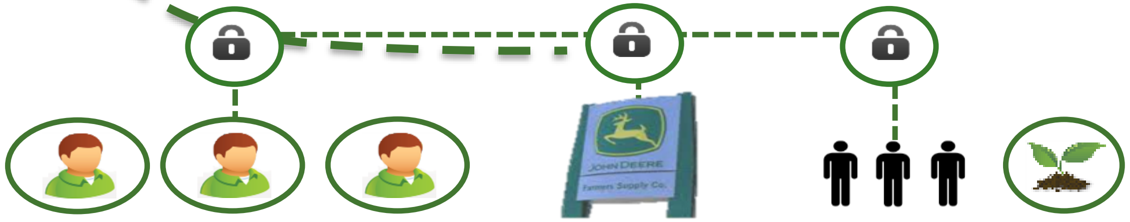
…Beheren van u vloot."



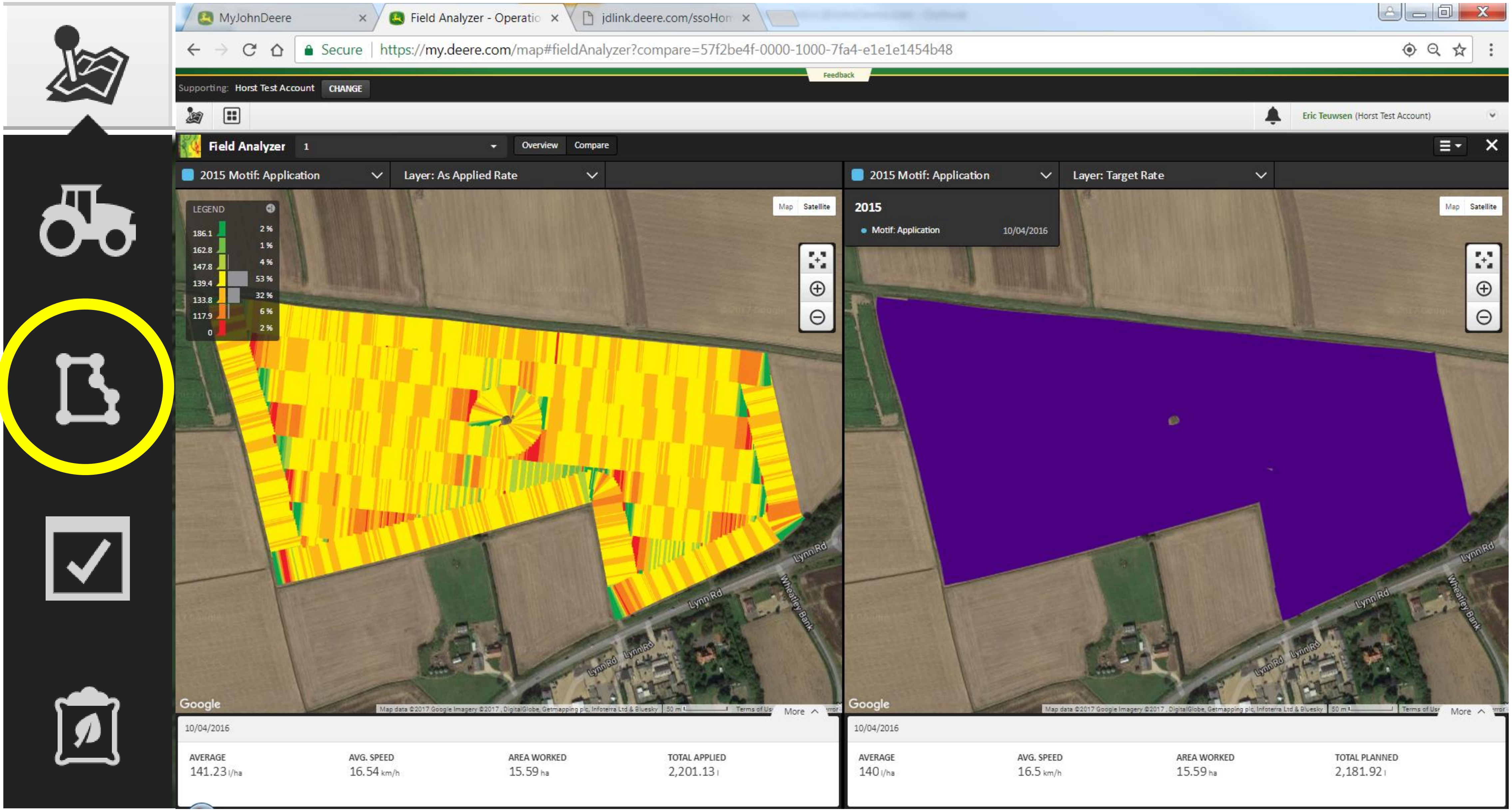
… visualisatie van u documentatie."



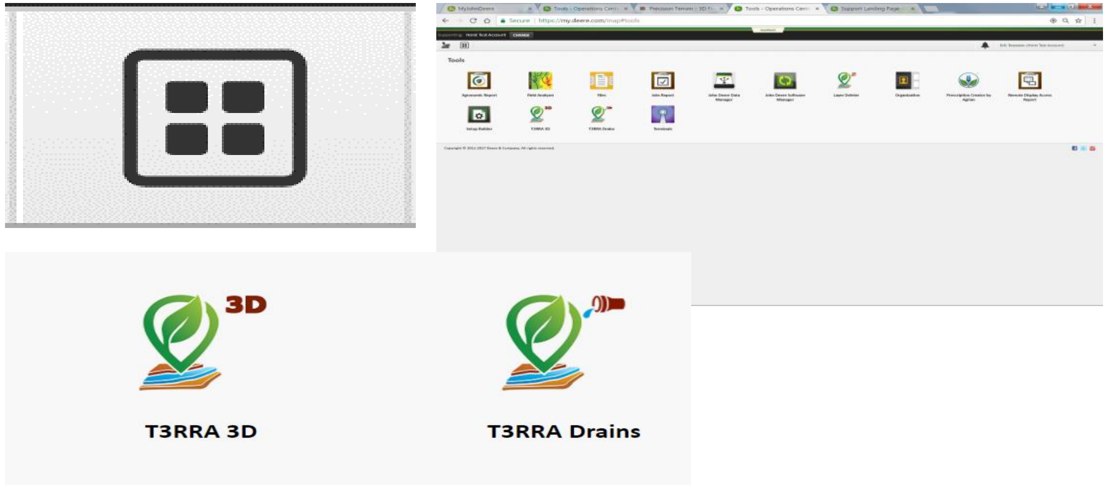
…werkzaamheden plannen op basis van live buienradar"

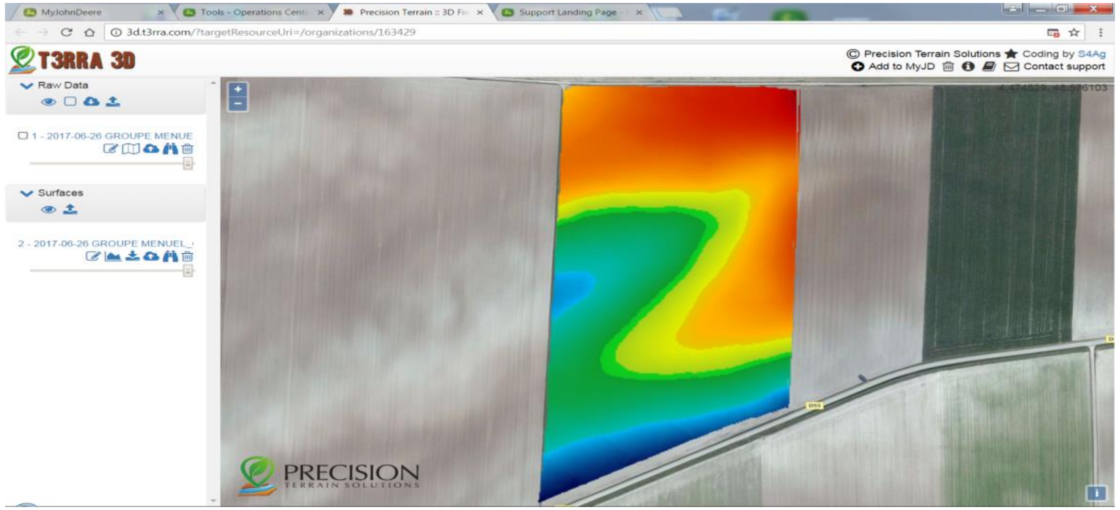


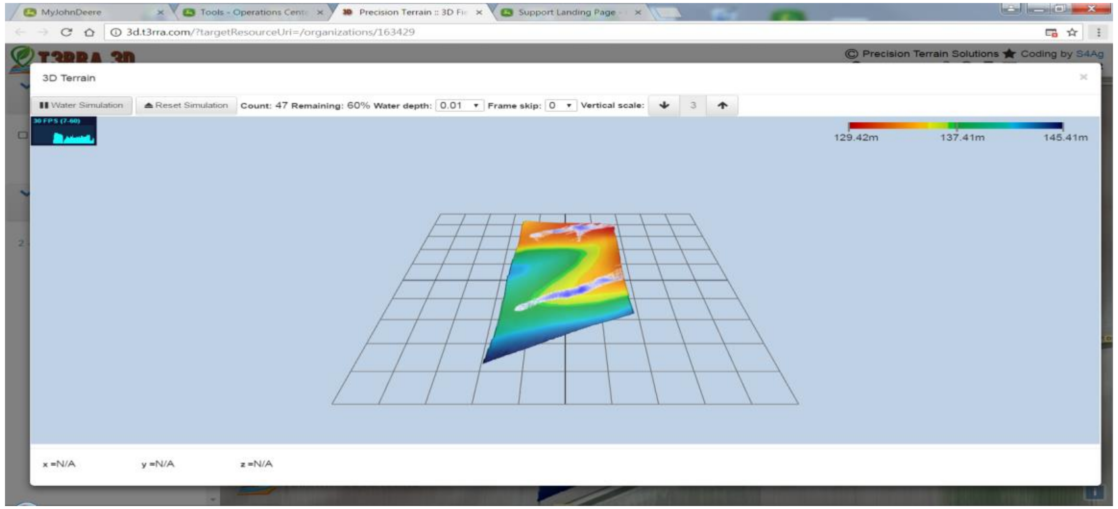
…Mogelijkheid om gegevens te delen met adviserend partners ."

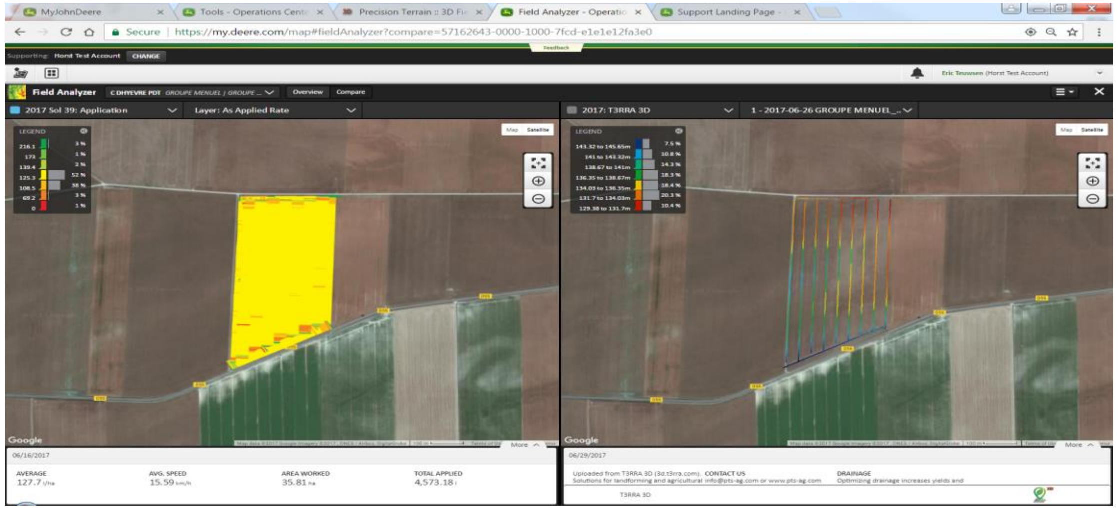

MyJohnDeere
Field Analyzer - Operatio
jdlink.deere.com/ssoHon
Secure
https://my.deere.com/map#fieldAnalyzer?compare=57f2be4f-0000-1000-7fa4-e1e1e1454b48
Feedback
Supporting: Horst Test Account
CHANGE
Eric Teuwsen (Horst Test Account)
Field Analyzer
1
Overview
Compare
2015 Motif: Application
Layer: As Applied Rate
2015 Motif: Application
Layer: Target Rate
LEGEND
186.1
162.8
147.8
139.4
133.8
117.9
0
2 %
1 %
4 %
53 %
32 %
6 %
2 %
Map
Satellite
2015
Motif: Application
10/04/2016
Lynn Rd
Wheatley Bank
Google
More
10/04/2016
AVERAGE
141.23 l/ha
AVG. SPEED
16.54 km/h
AREA WORKED
15.59 ha
TOTAL APPLIED
2,201.13 l
10/04/2016
AVERAGE
140 l/ha
AVG. SPEED
16.5 km/h
AREA WORKED
15.59 ha
TOTAL PLANNED
2,181.92 l

My Operations Center: tools/terra 3D/drains









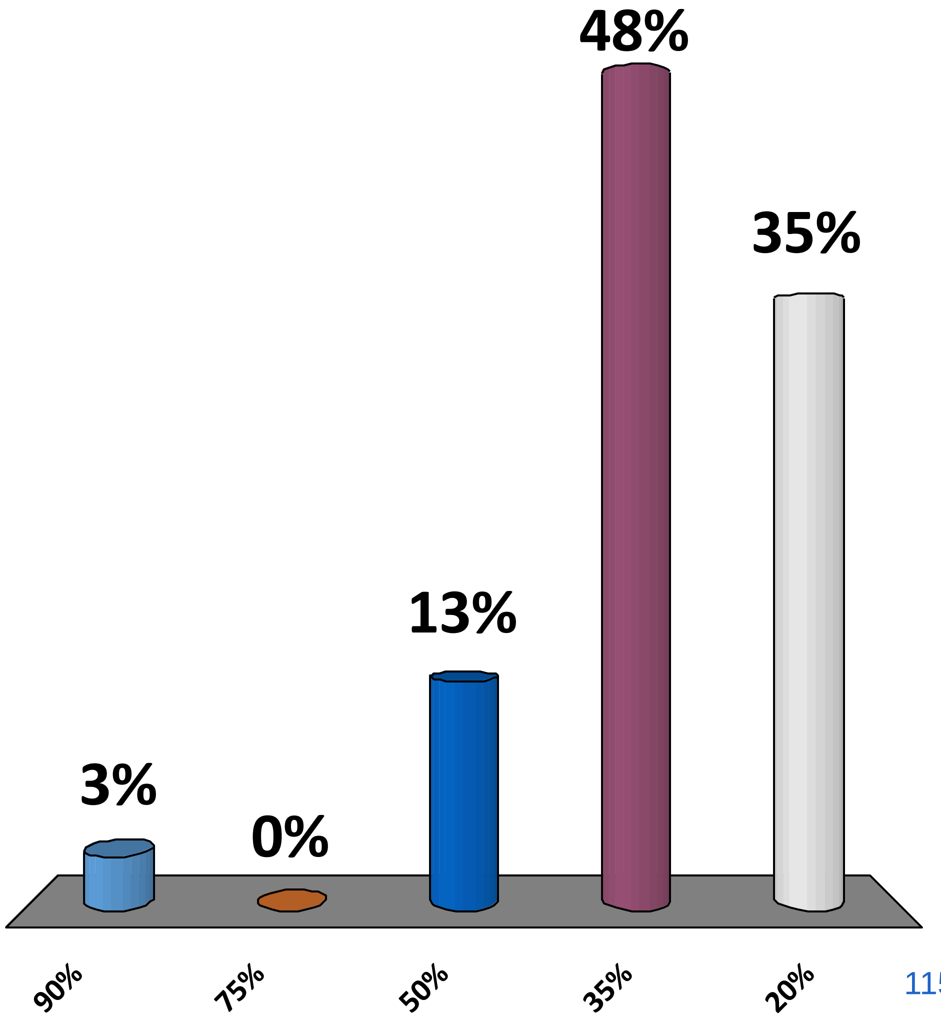

MACH
MICHELIN

JOHN DEERE

Interactive questions

WHAT % OF EU FARMLAND HAS BROAD BAND INFRASTRUCTURE?

a. 90%
b. 75%
c. 50%
d. 35%
e. 20%



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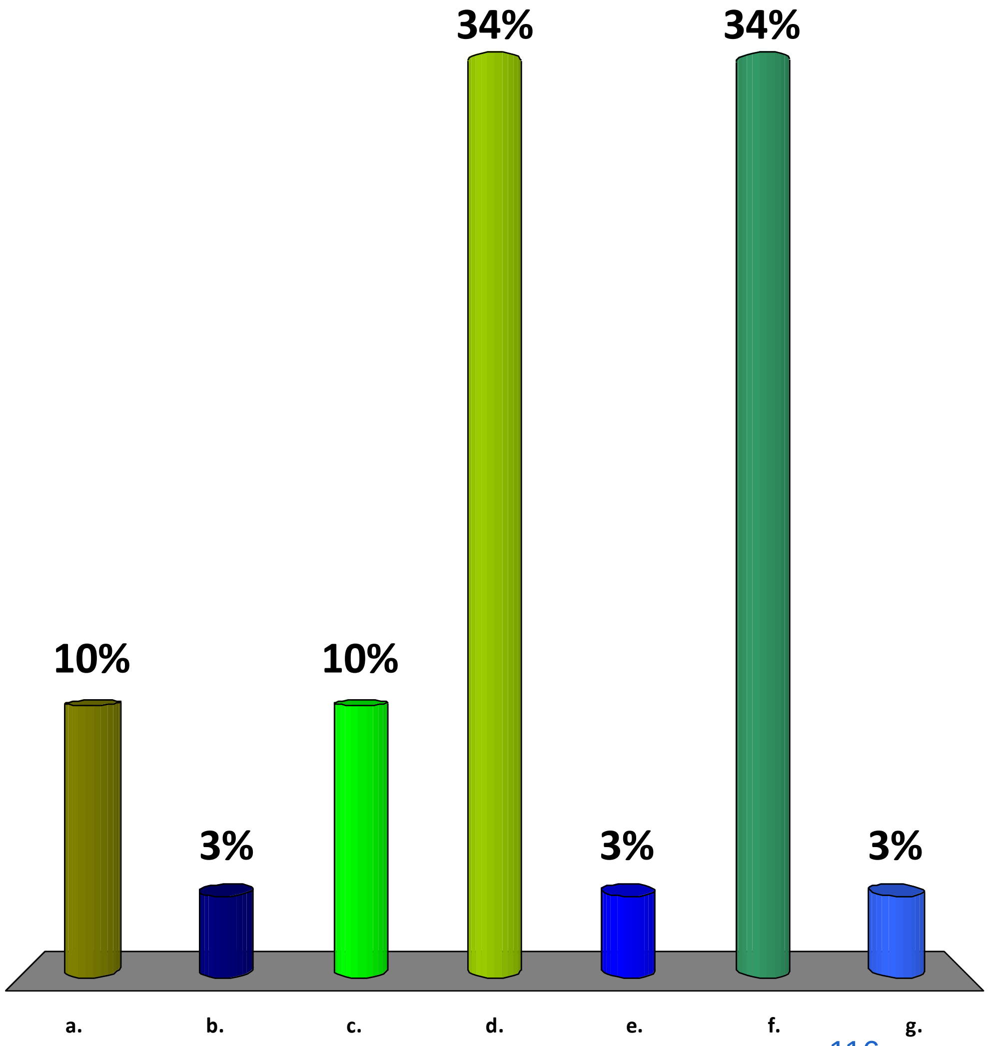
WHAT IS SLOWING DOWN THE GENERAL APPLICATION OF DIGITAL FARMING?

a. Some farmers hold on to tradition
b. Technology is not fully developed
c. Cost of Investment
d. Return on investment is not clear
e. Lack of standardization in data processing
f. Combination of the above
g. Other



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HOW CAN FARMERS ADOPTION OF DIGITAL AGRICULTURE TECHNOLOGIES BE ENHANCED?

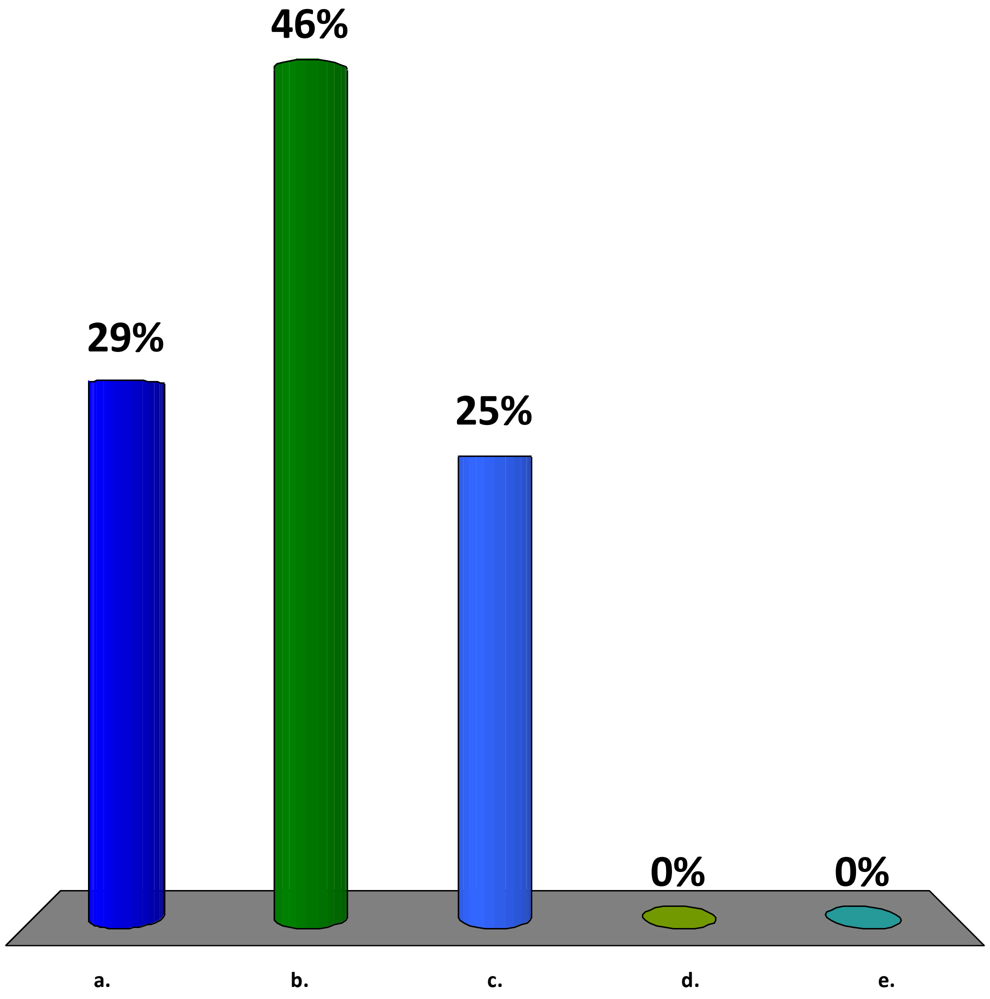
a. Workshops / demonstrations

b. More success stories needed

c. Investment support by government

d. More research

e. Other



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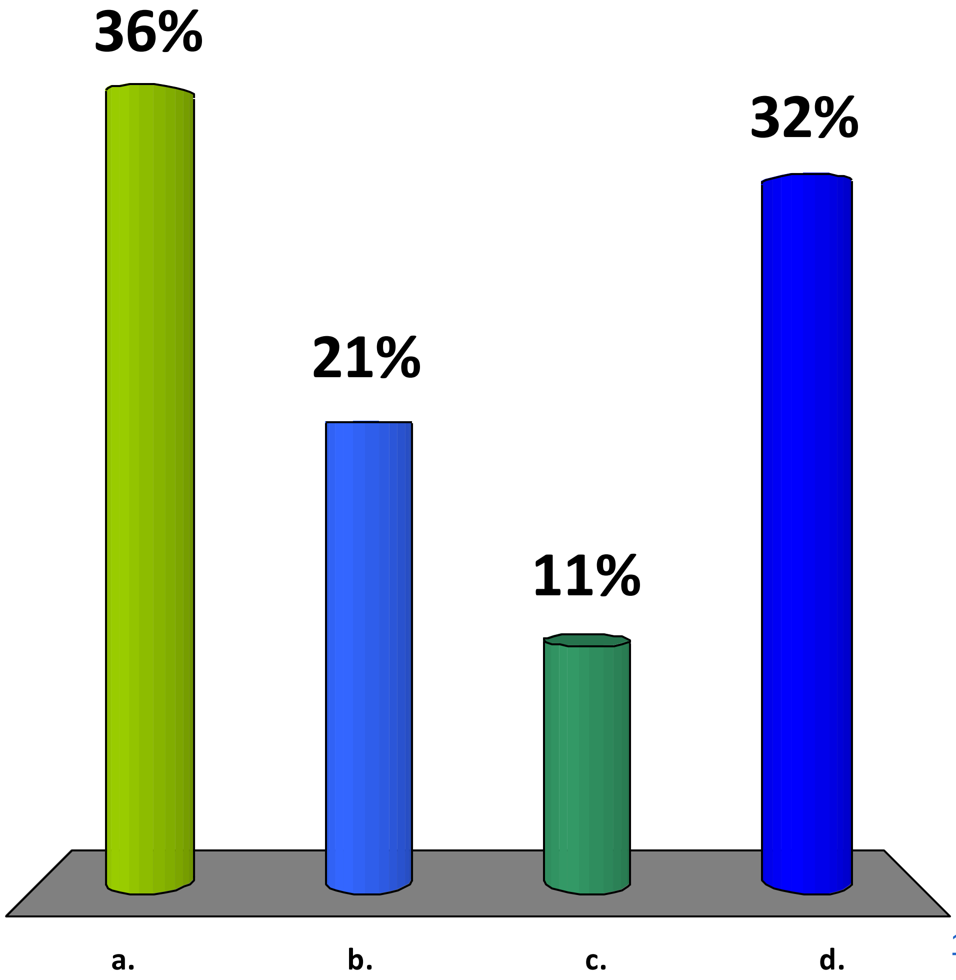
DO WE NEED TO CONVINCE FARMERS TO STOP CULTIVATING UNPROFITABLE PARTS OF THEIR FIELDS?

a. No,

b. No, it depends

c. Yes, but how?

d. Yes, but alternative uses, such as nature restoration, need to be better promoted



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THE EARTHY TRINITY RULES NUTRIENT AVAILABILITY TO PLANTS

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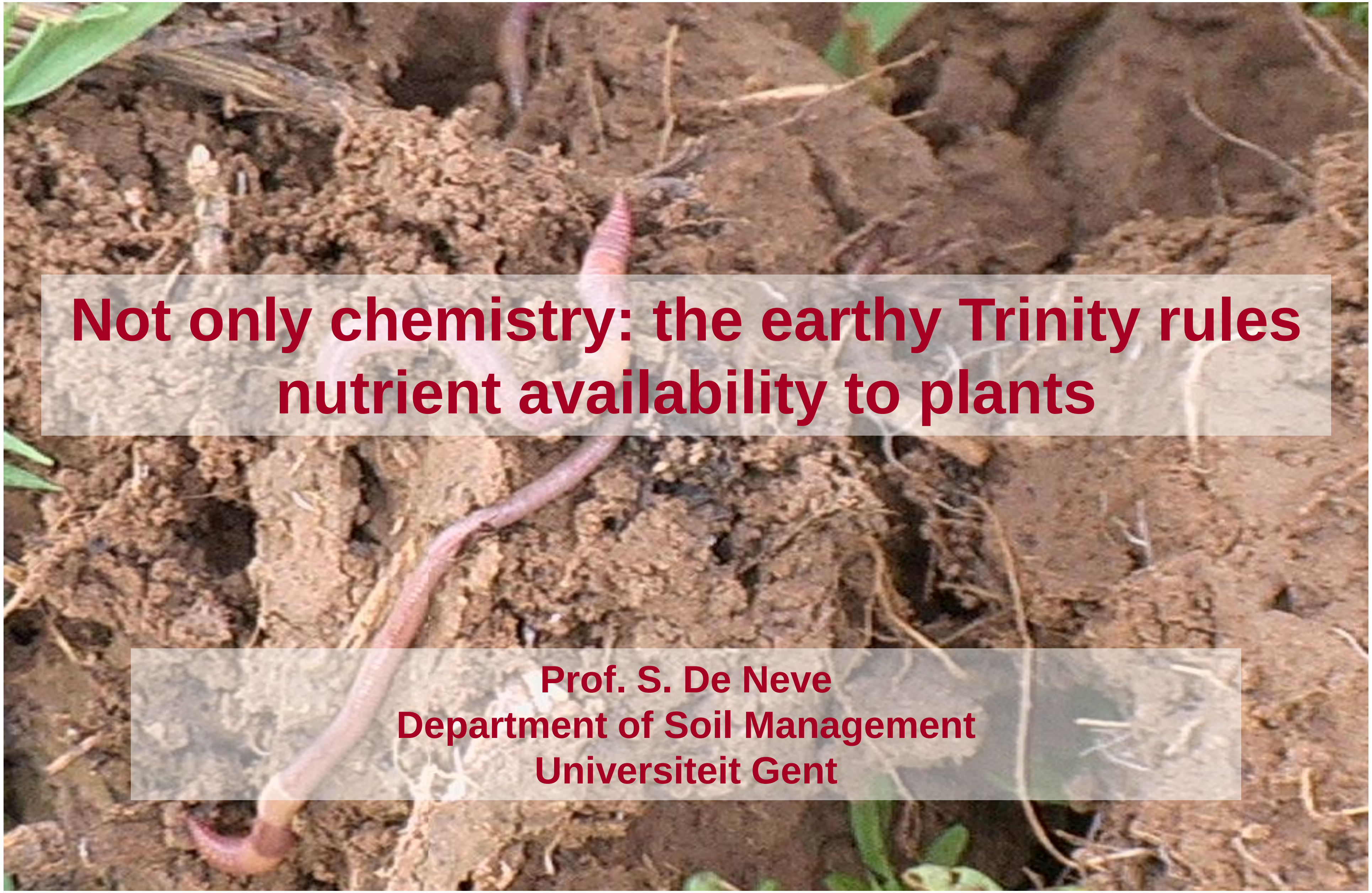

Not only chemistry: the earthy Trinity rules nutrient availability to plants

Prof. S. De Neve
Department of Soil Management
Universiteit Gent

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1. Introduction

What is soil fertility??

"the capacity of a soil to provide crops with essential nutrients"
(Merriam Webster dictionnary)

Does this include everything?

What about:

- Water and air?
- Plant growth promoting microorganisms?
- Crop protection?
- …

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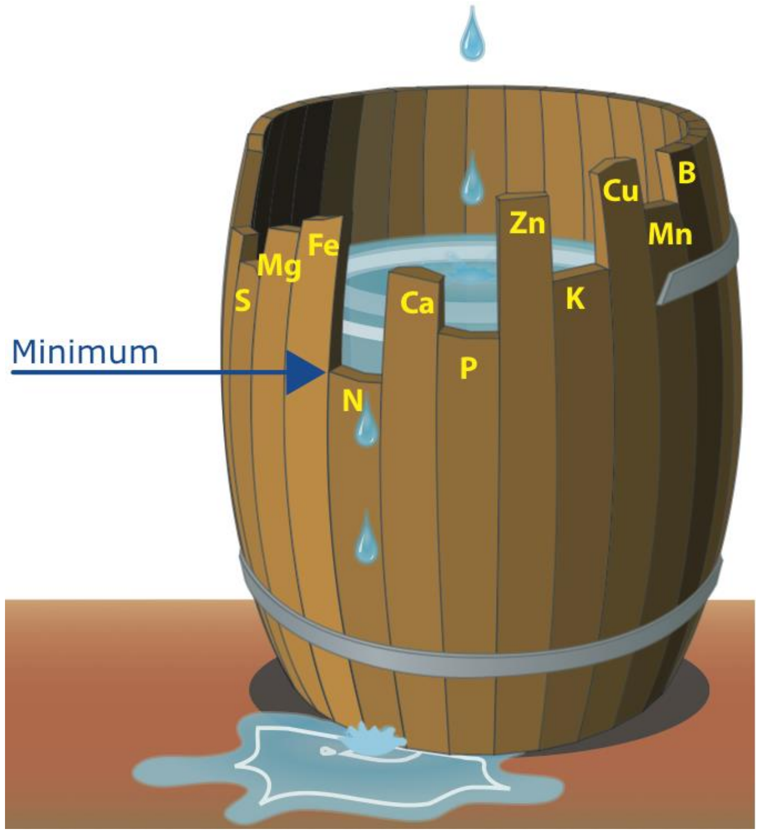
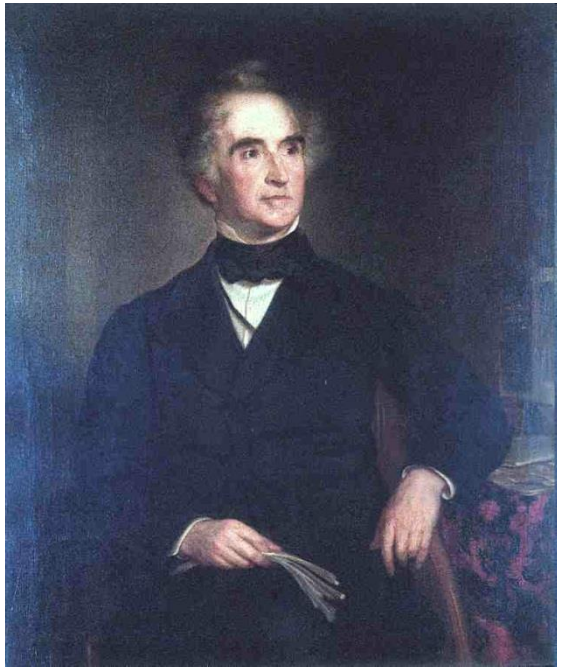
The chemical revolution





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The chemical revolution

Chemical crop protection started in the 19th century: highly toxic mineral components: arsenic, mercury, cyanides, …

Fromt the 1930's: organic herbicides and pesticides

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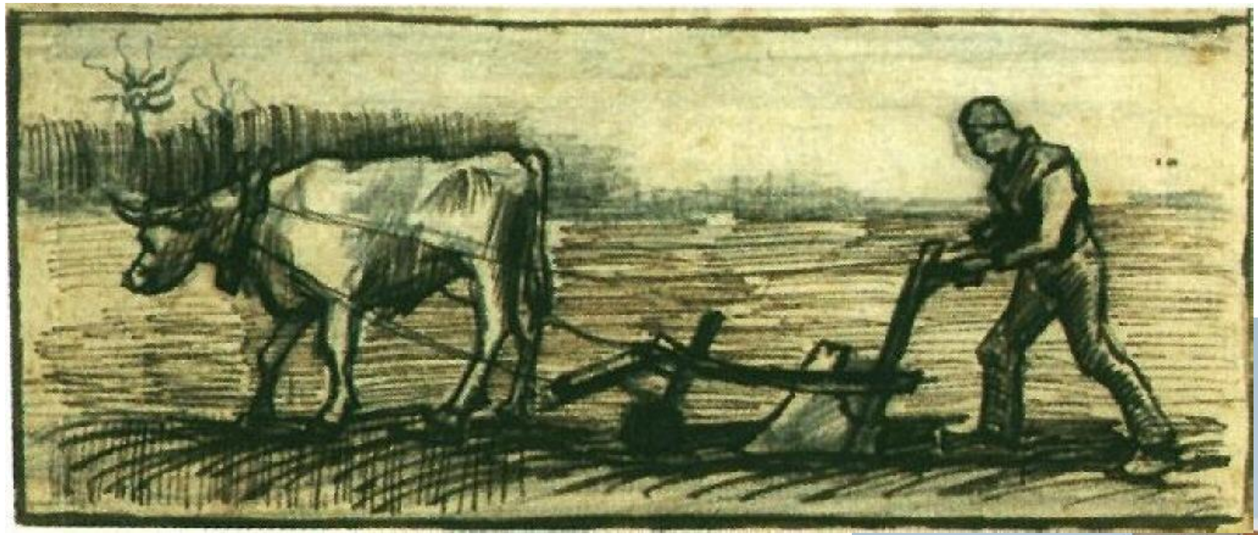
The mechanical revolution



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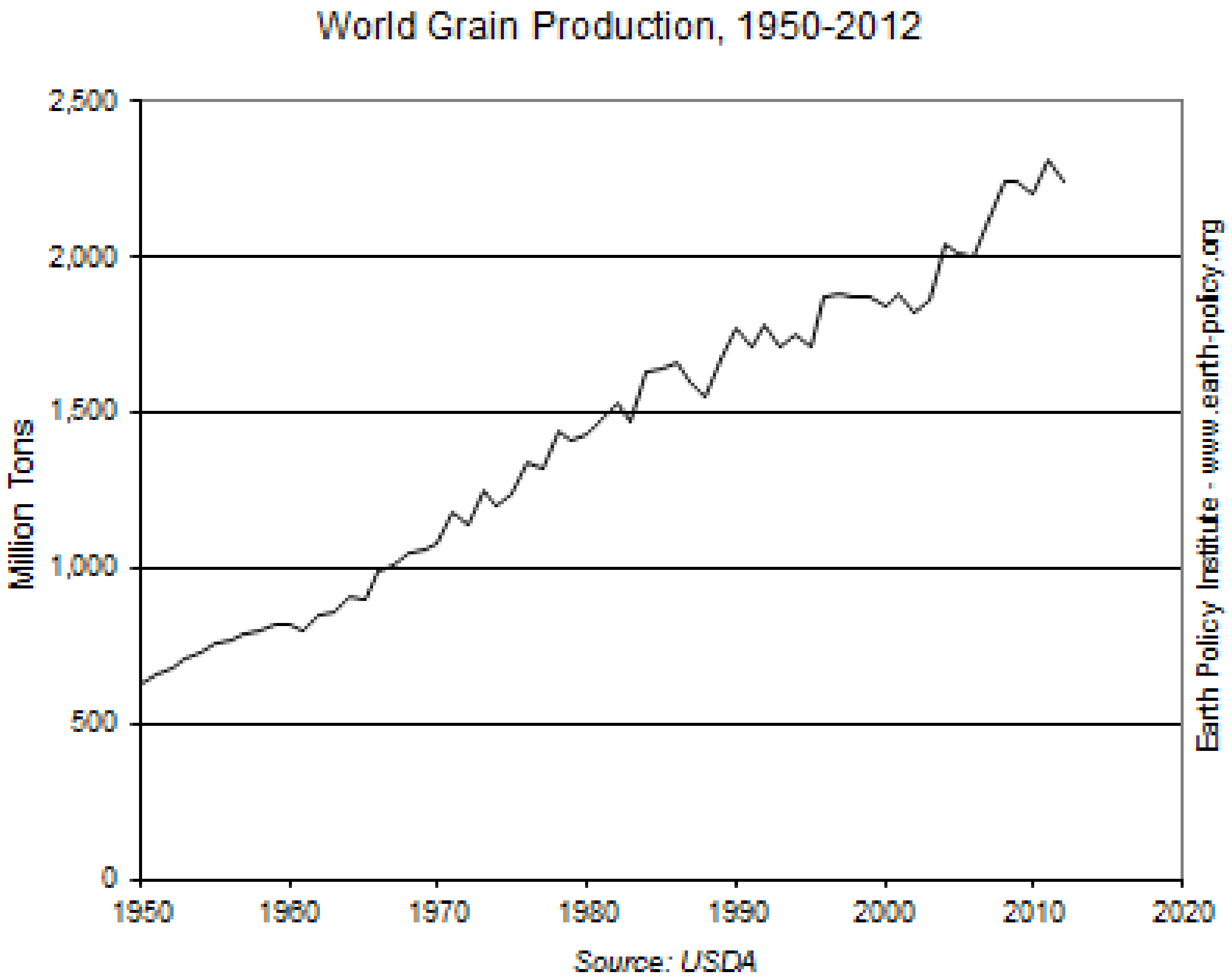
Results



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Are we then where we want to be?

BA3602 [RM] © www.visualphotos.com

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parameter	waarde	situatie t.o.v. streefzone*	Beoordeling	methode-nummer	analyse-datum
Grondsoort	40		Leem	458	13/02/2010
pH	6.9	6.7 - 7.3	Gunstig	089 B	13/02/2010
Koolstof	1.6 %	1.2 - 1.6	Normaal	452 B	13/02/2010
Humus (berekend)	2.8 %	2.1 - 2.8	Normaal	452 B	13/02/2010
Fosfor (P)	39 mg/100g DS	13 - 19	Hoog	376 B	13/02/2010
Kalium (K)	35 mg/100g DS	15 - 21	Tamelijk hoog	376 B	13/02/2010
Magnesium (Mg)	19 mg/100g DS	10 - 15	Tamelijk hoog	376 B	13/02/2010
Calcium (Ca)	235 mg/100g DS	169 - 370	Normaal	376 B	13/02/2010
Natrium (Na)	3.5 mg/100g DS	3.2 - 6.4	Normaal	376 B	13/02/2010

Is this sufficient to get a grip on soil fertility?

Soil = "mechanical anchoring for plant roots"?

Soil life is dangerous and needs to be eliminated

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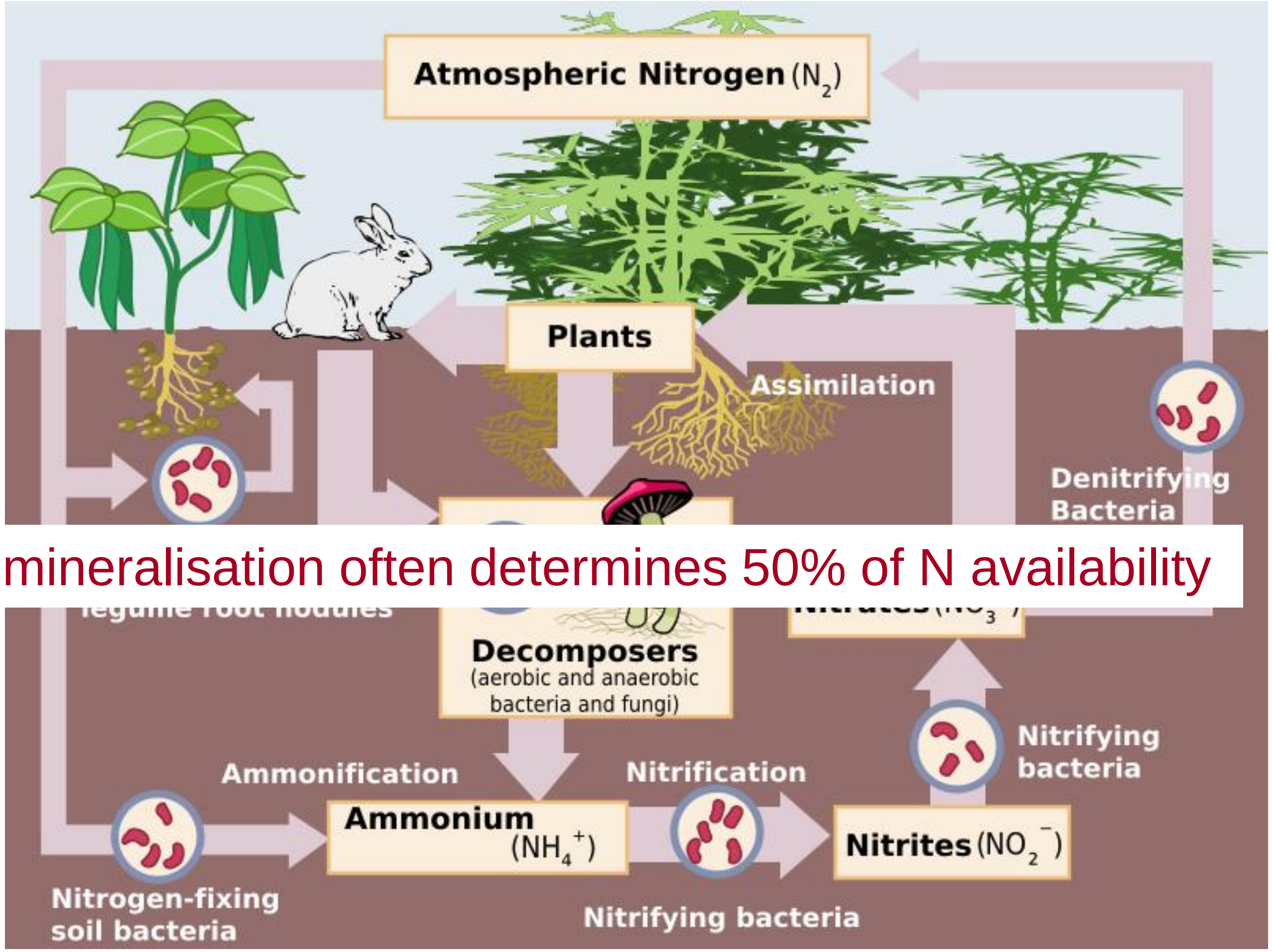
2. Measuring soil fertility: more than chemistry

Measuring soil fertility: more than a chemical analysis!

The example of nitrogen



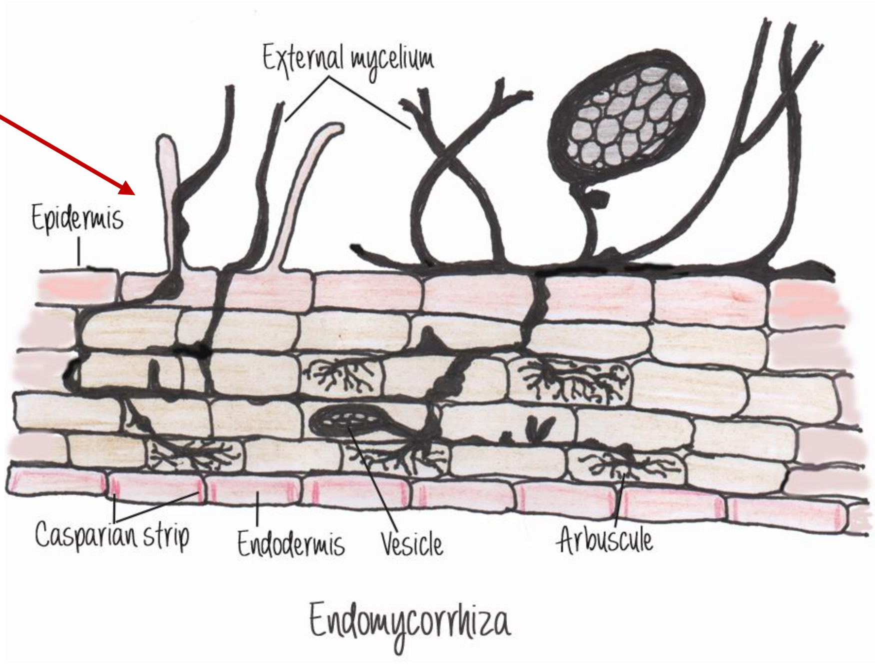
N mineralisation often determines 50% of N availability

2. Measuring soil fertility: more than chemistry

Phosphorus

Endomycorrhiza

Phosphate solubilizing bacteria



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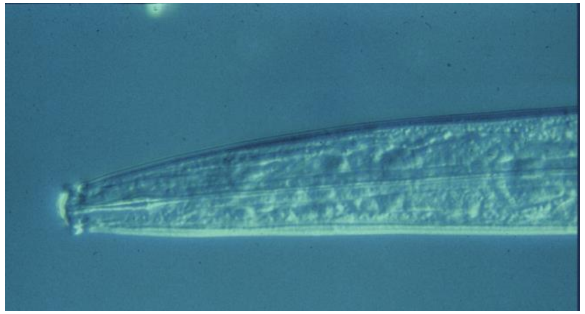
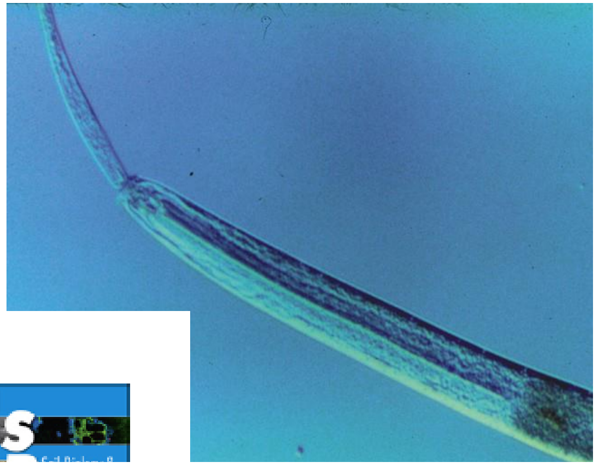
2. Measuring soil fertility: more than chemistry

“The soil foodweb”: also includes fauna





Soil Biology & Biochemistry 60 (2013) 142–155

Contents lists available at SciVerse ScienceDirect

ELSEVIER

The effect of free-livin
disturbed soil cores

David Buchan*, Mesfin Tseg
Department of Soil Management, Faculty of Bio

Soil Biology & Biochemistry 70 (2014) 131–141

Contents lists available at ScienceDirect

Soil Biology & Biochemistry

journal homepage: www.elsevier.com/locate/soilbio

ELSEVIER

Quantifying the influences of free-living nematodes on soil nitrogen and microbial biomass dynamics in bare and planted microcosms

CrossMark

Mesfin Tsegaye Gebremikael*, David Buchan, Stefaan De Neve
Department of Soil Management, University of Gent, Coupure Links 653, 9000 Gent, Belgium

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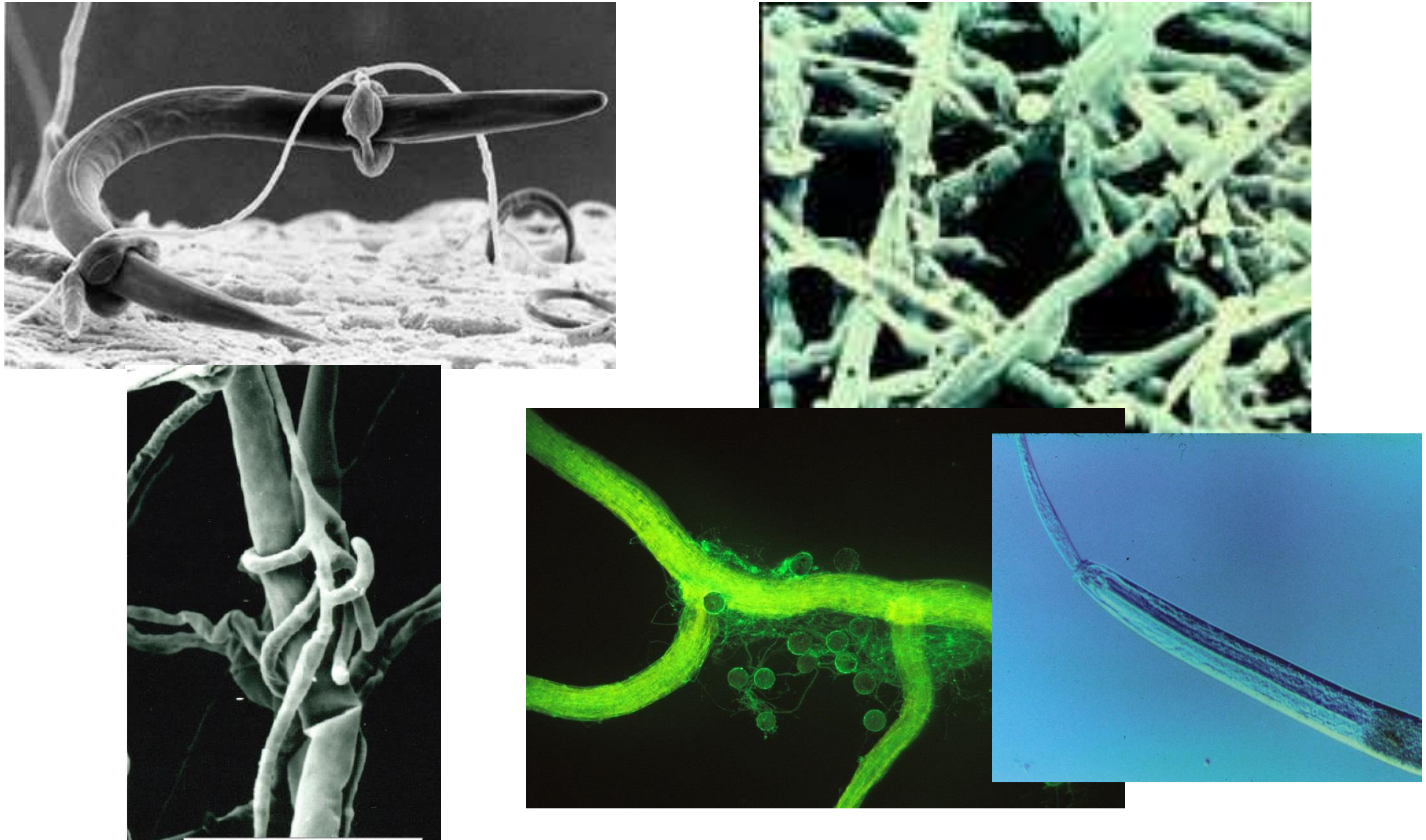
2. Measuring soil fertility: more than chemistry

Soil fertility is also about crop protection: “**disease suppressive soils**”



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2. Measuring soil fertility: more than chemistry

Soil biological activity and soil structure are mutually reinforcing

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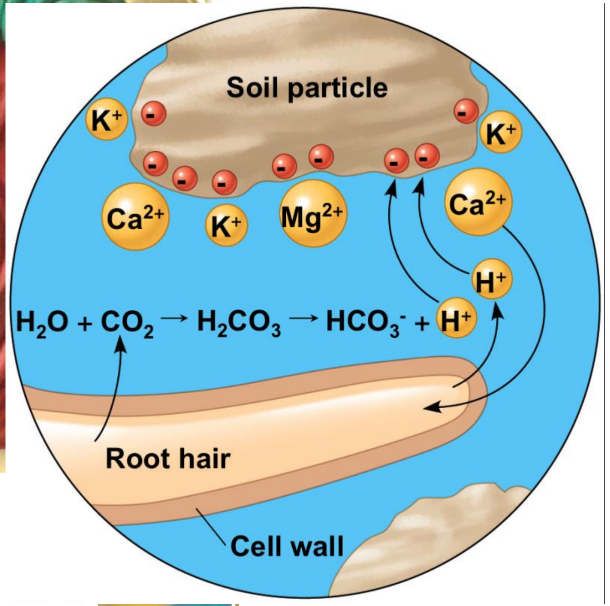

The Earthy Trinity

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3. Implications for fertilizer advices

parameter	waarde	situatie t.o.v. streefzone*	Beoordeling	methode-nummer	analyse-datum
Grondsoort	40		Leem	458	13/02/2010
pH	6.9	[illegible].3	Gunstig	089 B	13/02/2010
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Natrium (Na)	3.5 mg/100g DS	3.2 - 6.4	Normaal	376 B	13/02/2010

?

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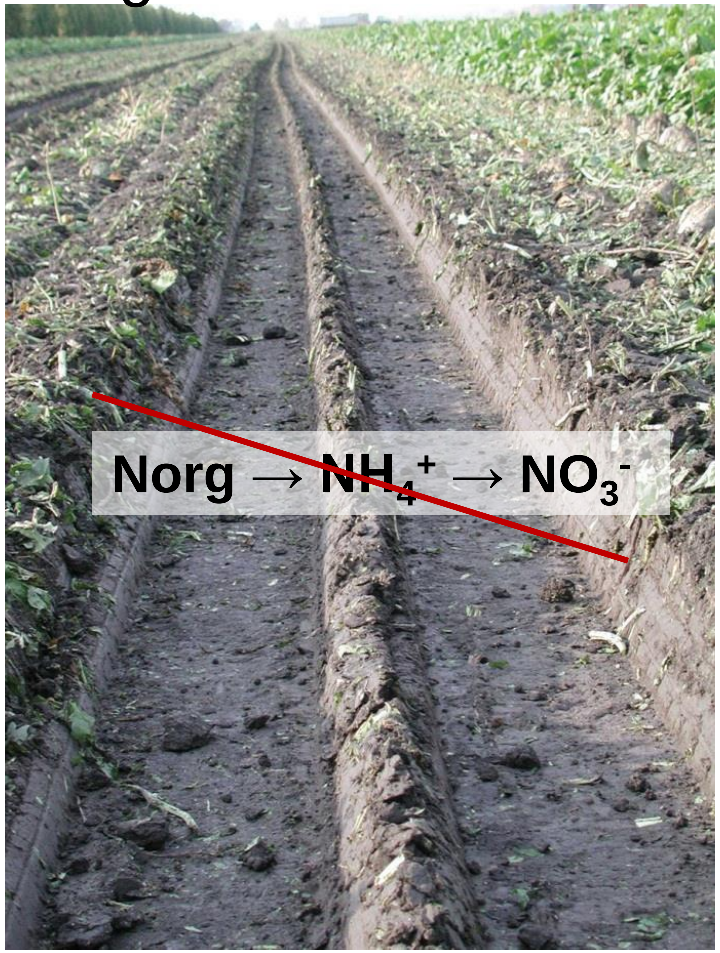
Some examples

Degradation of soil structure :



Reduced N release

$N_2O + N_2$

Gaseous N losses: low efficiency of N fertilizers

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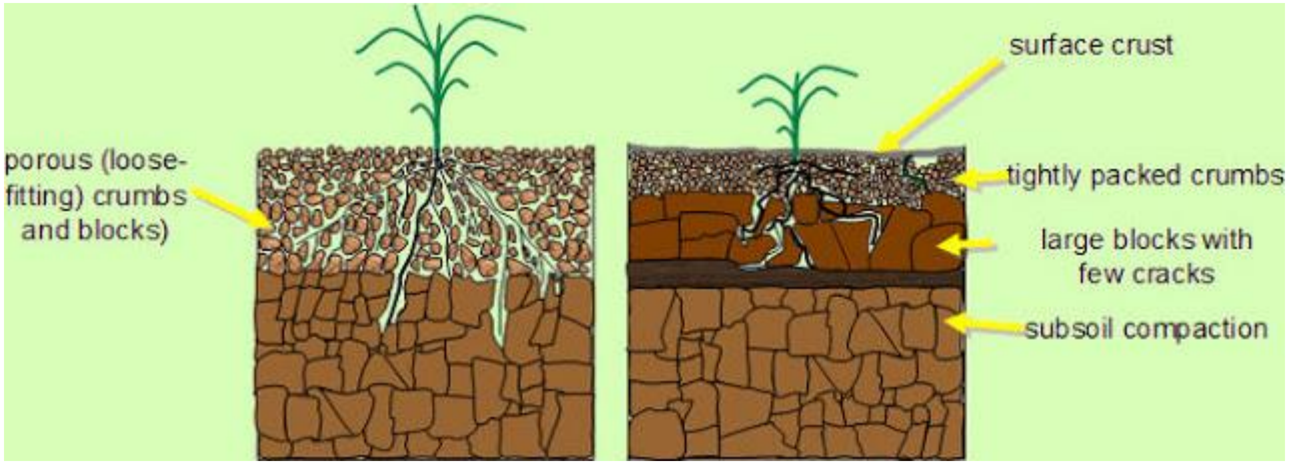
3. Implications for fertilizer advices

Some examples

Superficial rooting



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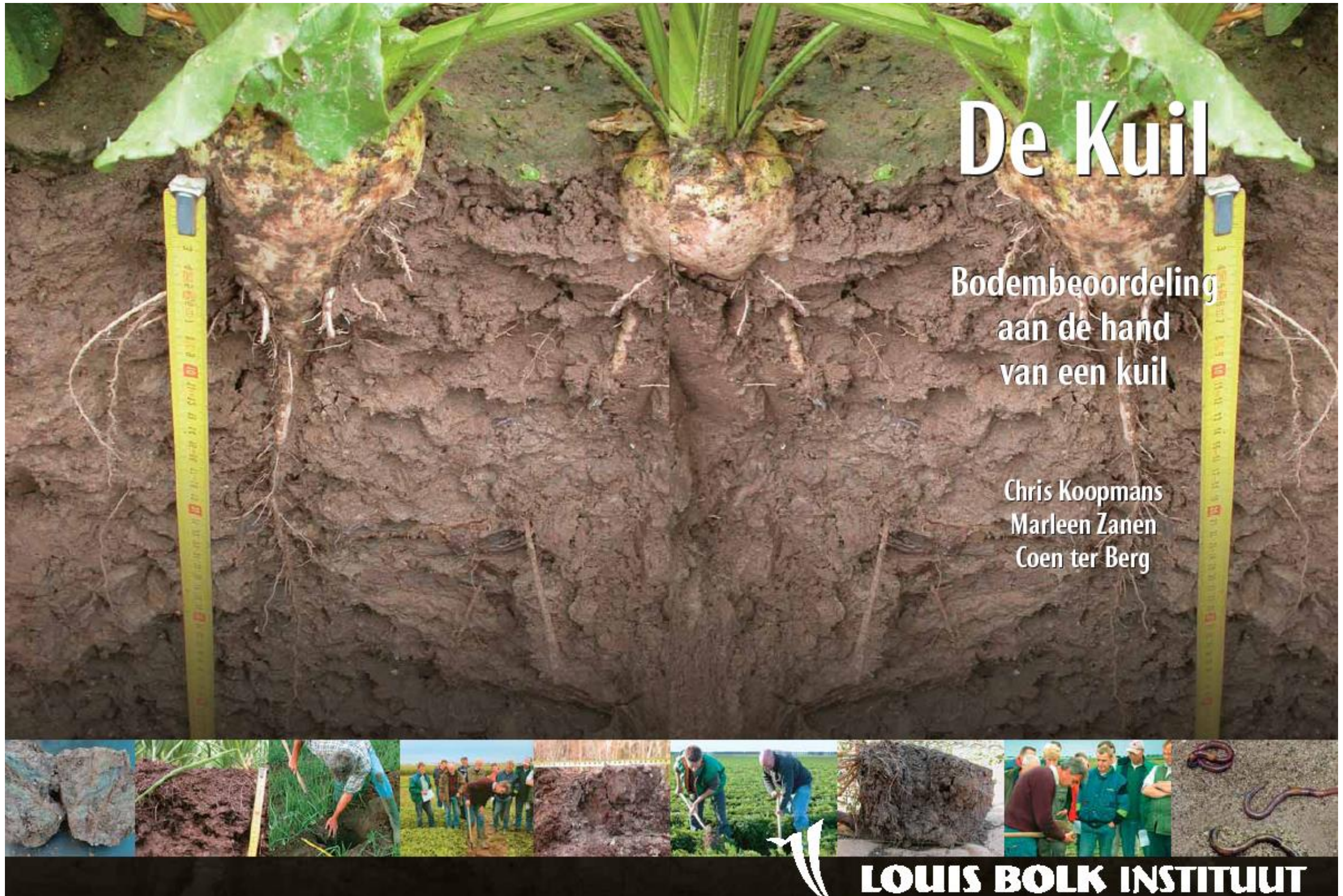
3. Implications for fertilizer advices

Fertilizer advice on a pure chemical basis is pointless in these cases

How to determine physical and biological soil quality?

Farmer, look into your soil!



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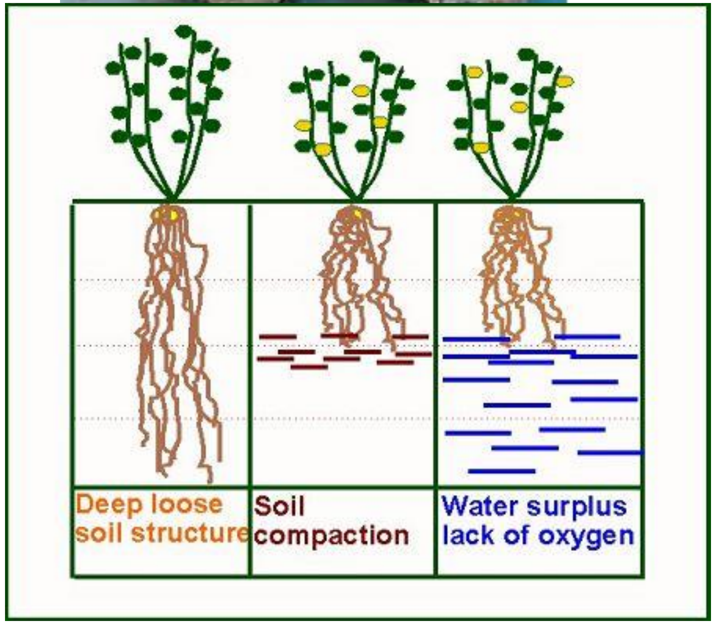
3. Implications for fertilizer advices

O_2 deficit



Root architecture

Soil life

No soil life

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3. Implications for fertilizer advices

Fertilizer advice on a pure chemical basis is pointless in these cases

How to determine physical and biological soil quality?

Farmer, look into your soil!

Biological soil fertility is measured commercially: reliability of such advices?

http://www.eurolab.nl/

europa.eu | Koch Bodemtechniek Eurol...

KOCH - EUROLAB

Research & routine lab voor bodemvruchtbaarheid en diergezondheid

6-Mar-2014

A→A <=Grotere letter?

GROENVOORZIENING | GLASTUINBOUW | VEEHOUDERIJ | AKKER & TUINBOUW | MILIEU

Prijzen analyses en monsters inzenden

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Deutsch:
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Belgie:
0032 (0)36 5183 53
Francais:
0032 (0)25 8818 44

ISO 9001

Certificaat specificatie

Nog twijfel over welke analyses in uw situatie het beste passen?
Klik hieronder op één van de plaatjes voor uitleg en de bijbehorende pakketten:

Groenvoorziening en boomverzorging

Of kies hier uw interesse gebied: VEEHOUDERIJ

Onderzoeksmogelijkheden

Klik één van de onderzoekspakketten voor verdere informatie zoals: **analyse voorbeelden**, **monstername instructies** en **inzendformulieren**

RUWVOEDER / VOERHEK

FECES / RECTALE MEST

BODEM-GROND PAKKET 2 - BODEMVRUCHTBAARHEID EN BEMESTING

BODEM-GROND PAKKET 3 - BODEMLEVEN SCREENING + AALTJES

WATER ANALYSES

ORGANISCHE MEST SAMENSTELLING STALMEST, DRIJFMEST E.D.

BODEM CHECK-UP

Om de PDF bestanden ([PDF]) te openen, dient u een PDF reader te installeren. Deze kunt u gratis downloaden op http://get.adobe.com/nl/reader/

Wilt u de monsters laten nemen door onze buitendienst(klik).

Link naar: BODEMWOORDENBOEK voor uitleg van diverse bodem- en bemestings termen.

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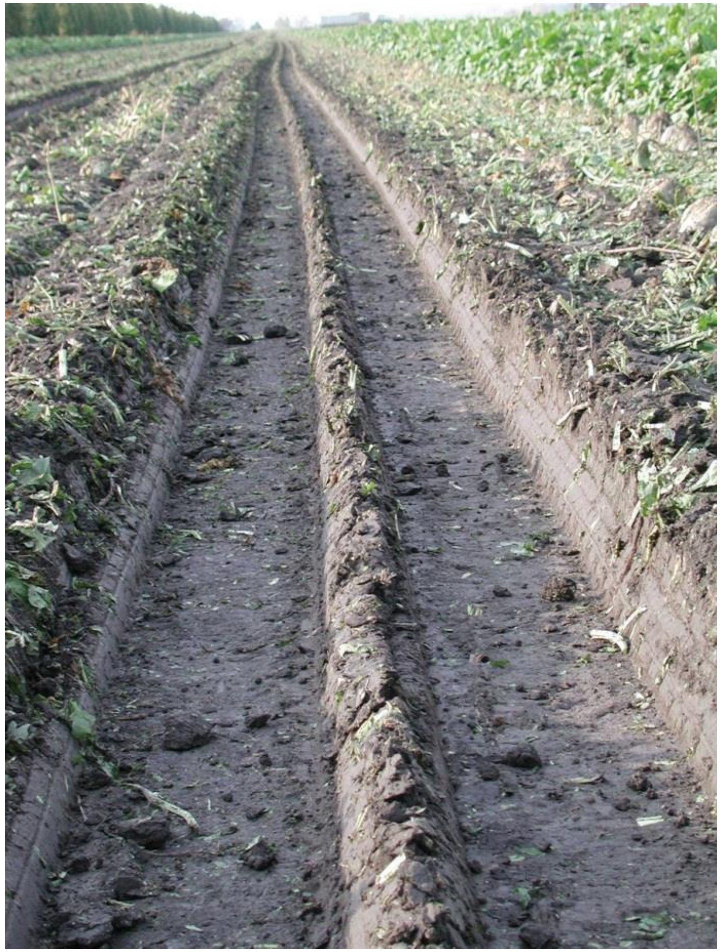
Fertilizer as a substitute for good soil structure?



Fertilizer limits (MAP)?

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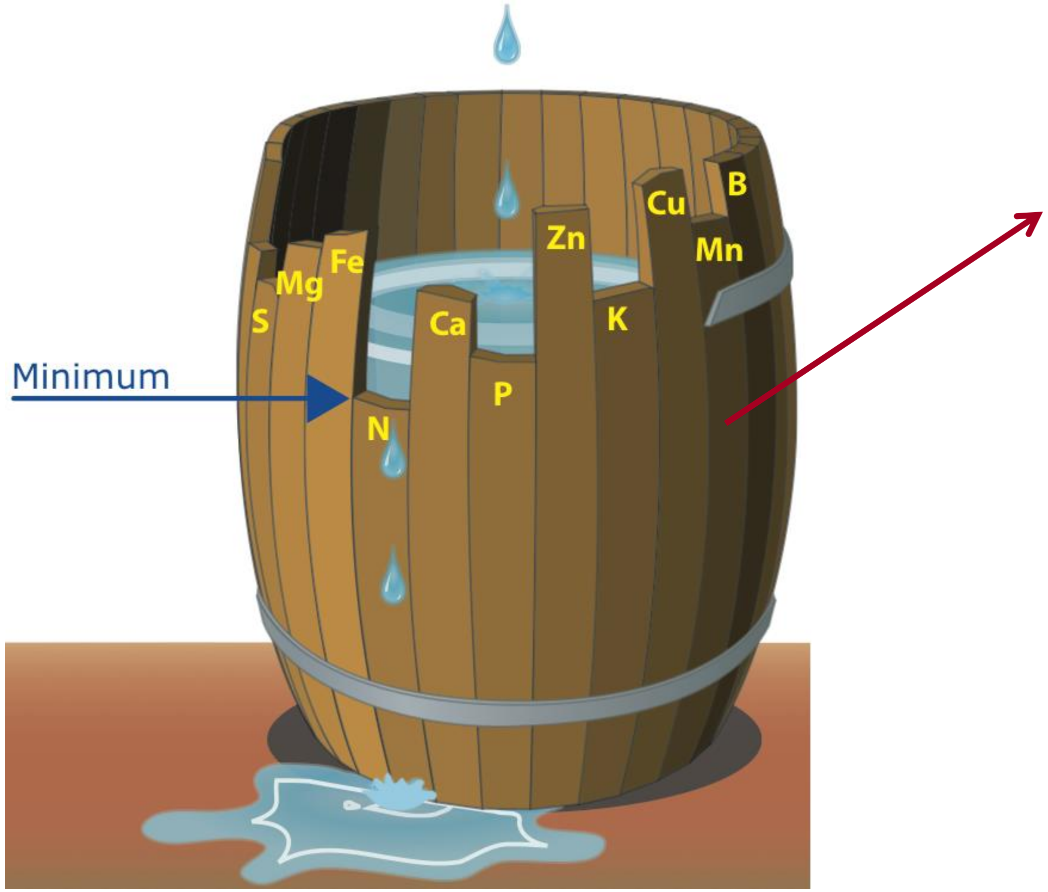
Is chemical soil fertility not important at all?

Yes, the nutrients need to be present in soil somewhere.



Availability??

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FACULTY OF
BIOSCIENCE ENGINEERING

Prof. Stefaan De Neve
Department of Soil Management

E stefaan.deneve@ugent.be
T +32 9 264 60 61

www.ugent.be

Ghent University
@ugent
Ghent University

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THE EARTHY TRINITY RULES NUTRIENT AVAILABILITY TO PLANTS

Prof. Stefaan De Neve

Karlien Vermeiren - DCM

Nutrient availability:
chemical, biological and physical interactions

Practical Examples DCM

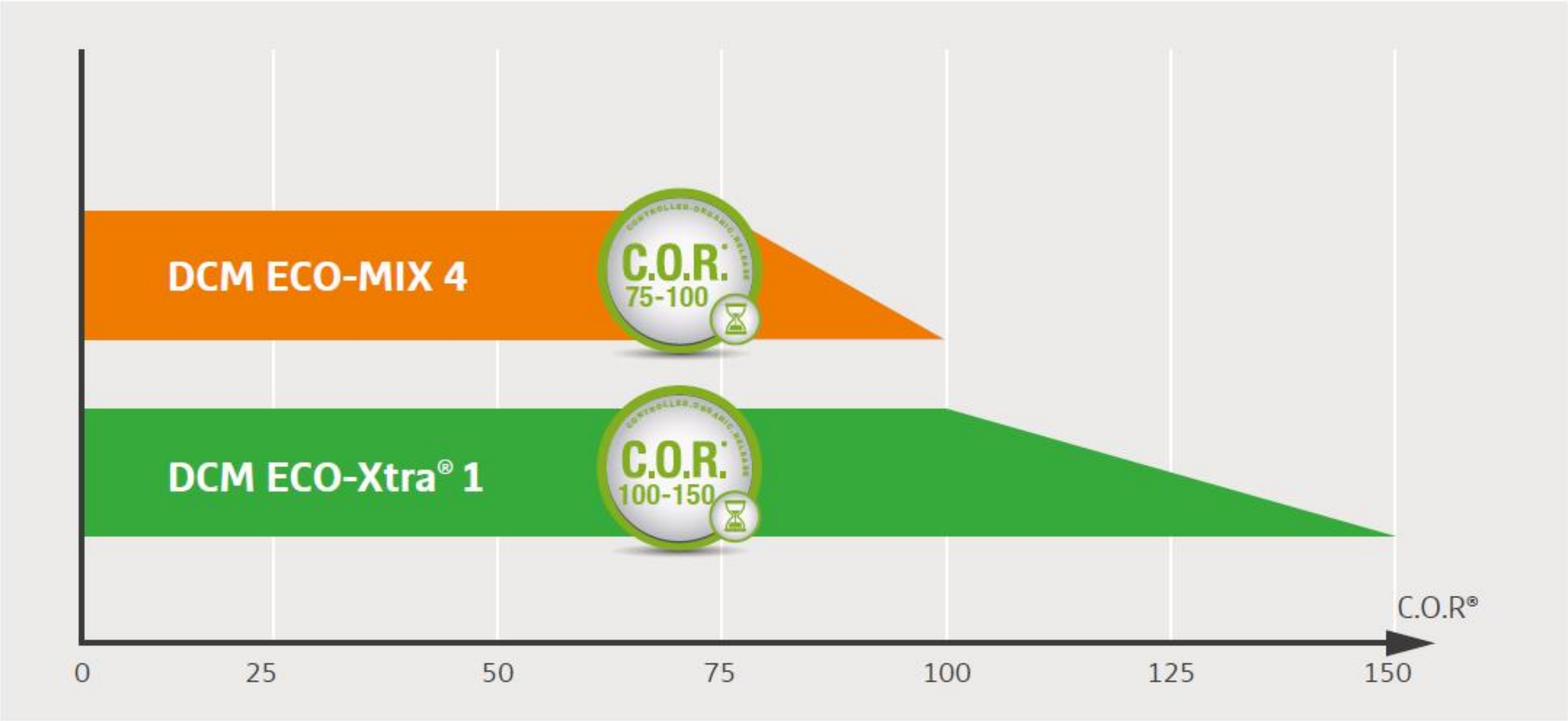
EXAMPLE 1

Slow down the initial mineralization of organic fertilisers by complexing the nutrients with natural plant extracts

DCM®

CONTROLLED.ORGANIC.RELEASE

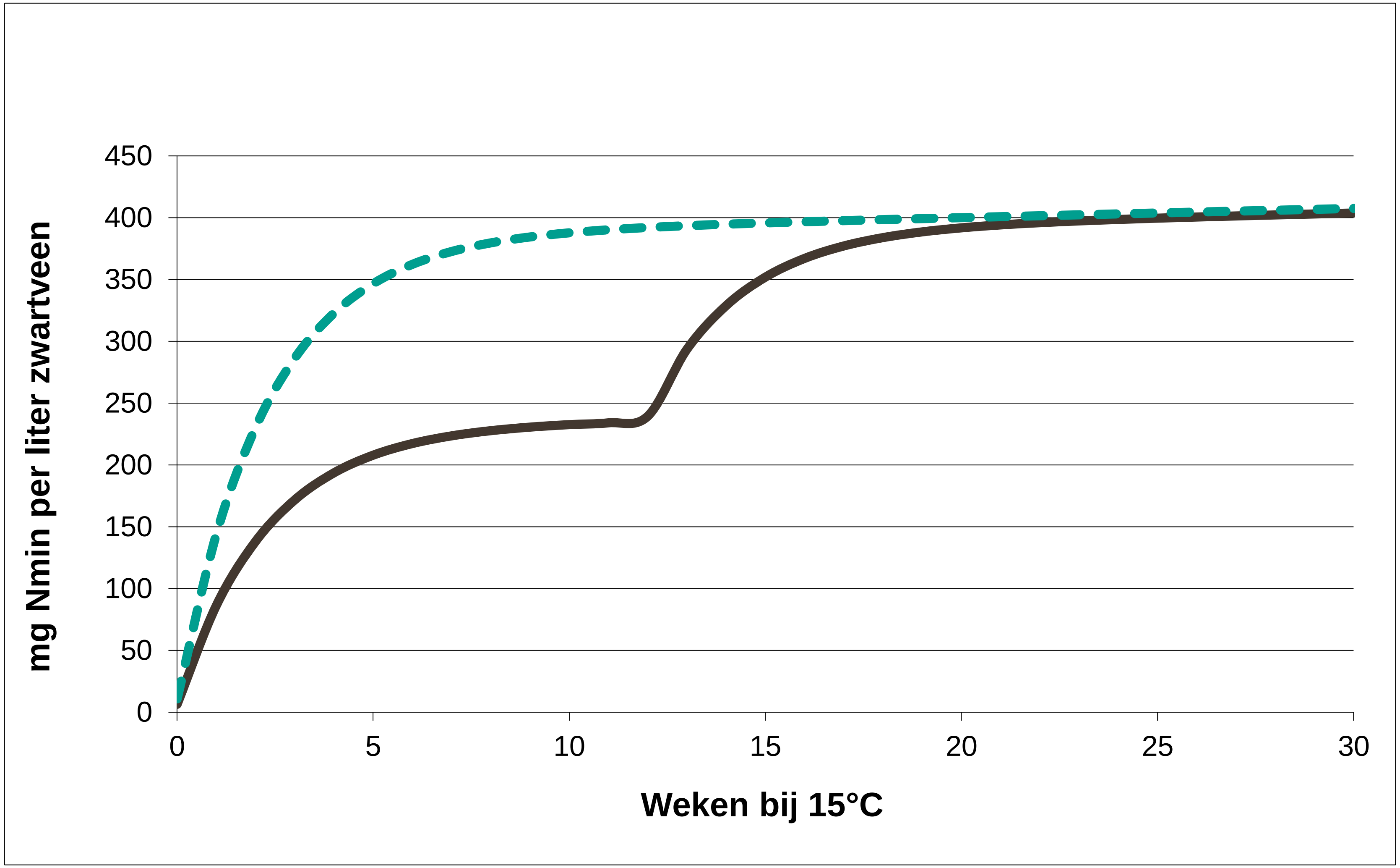
C.O.R.®



Nutrient release trial, Scientia Terrae, Sint-Katelijne-Waver, Belgium.

Base fertilization: DCM ECO-MIX 1; 4,5 g/L
After 12 weeks: DCM ECO-MIX 1; 3 g/L

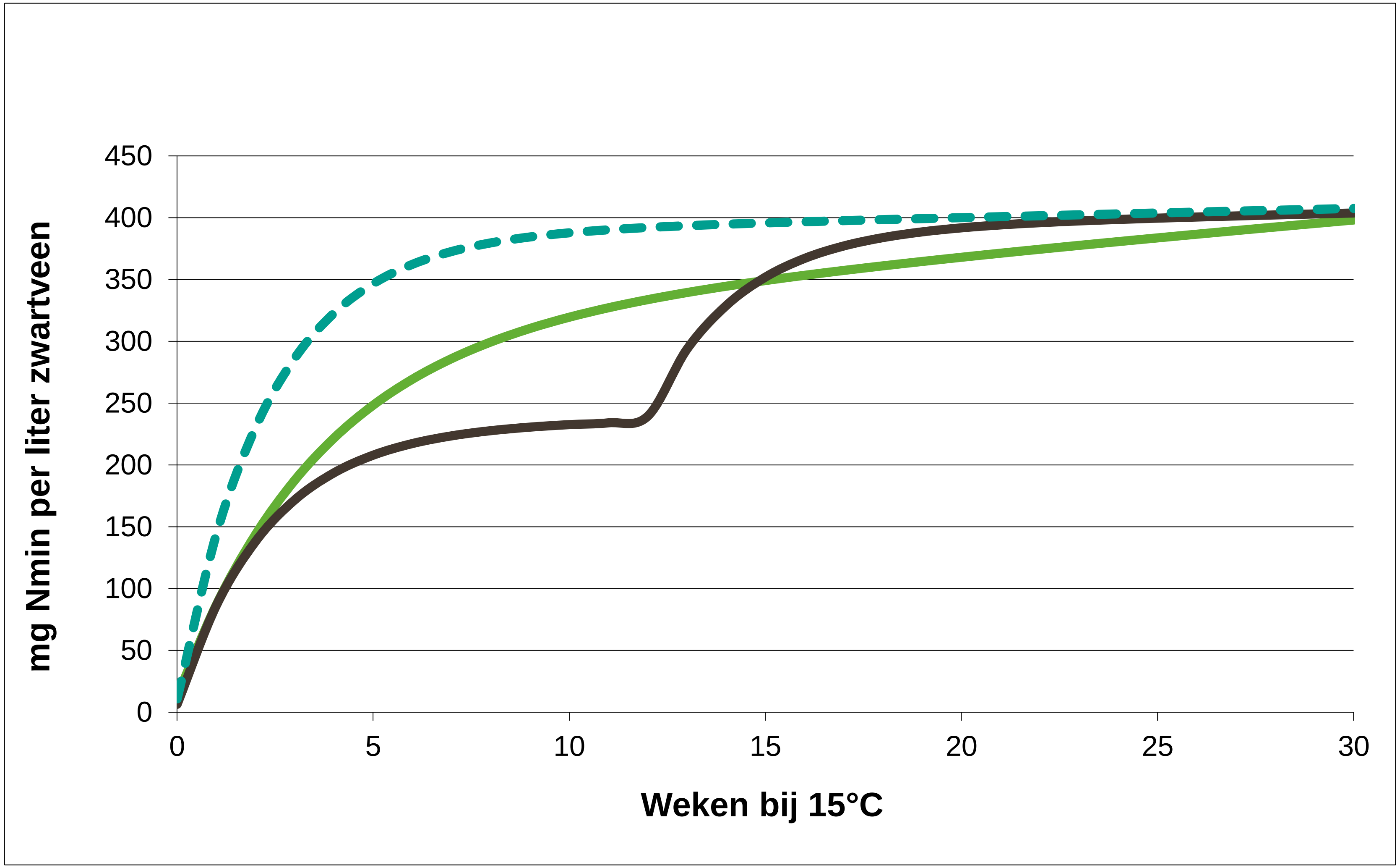
Base fertilization: DCM ECO-MIX 1: 7,5 g/L



Base fertilization: DCM ECO-MIX 1; 4,5 g/L
After 12 weeks: DCM ECO-MIX 1; 3 g/L

Base fertilization: DCM ECO-MIX 1: 7,5 g/L

Base fertilization: DCM ECO-Xtra® 1: 8,3 g/L



Lavender

1 : standard organic fertiliser **2: DCM ECO-Xtra® 1**

after 7 weeks

Hydrangea

Standard = 4,5 kg/m³ chemical slow release fertiliser 8 m.

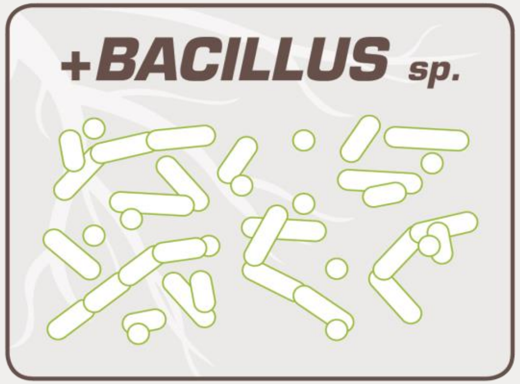
DCM = 6 kg/m³ DCM ECO-Xtra 1

EXAMPLE 2

Improve nutrient availability in the soil/substrate by using extra bacteria

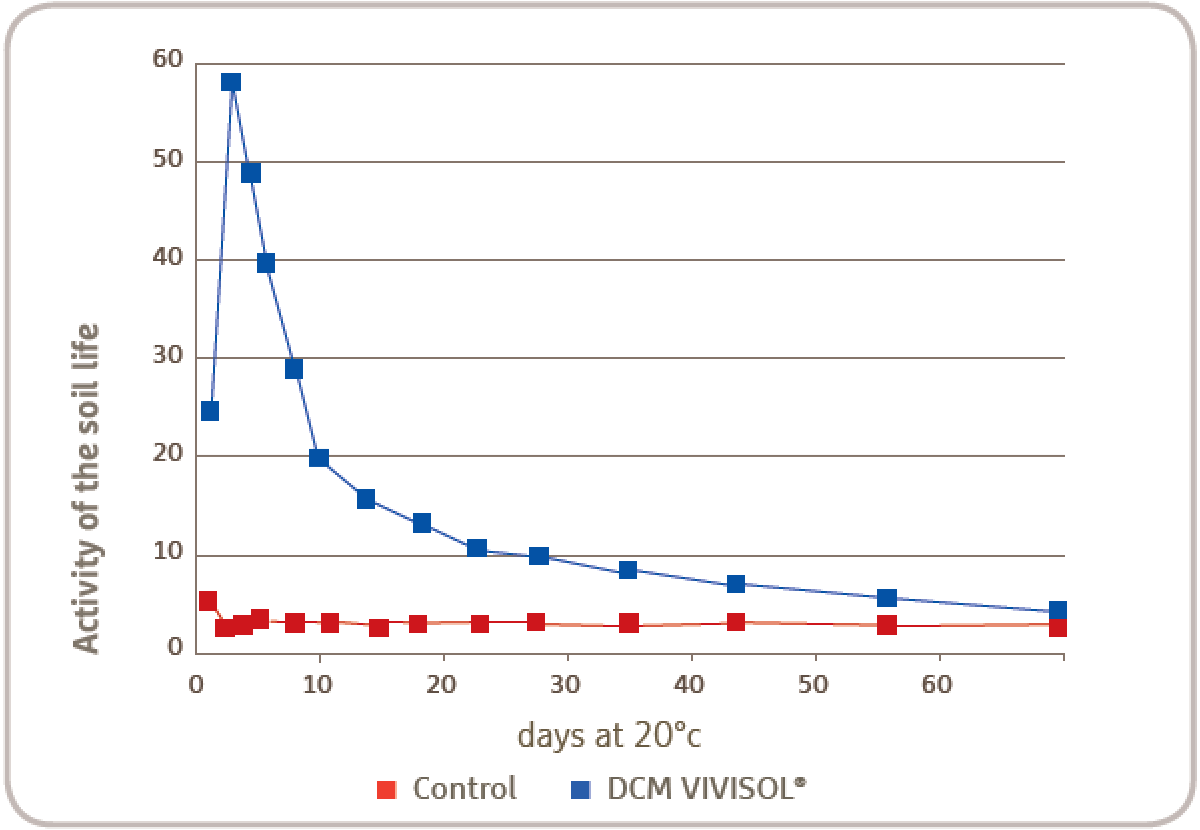
DCM VIVISOL®

- ***Bacillus sp.*** 10^6 CFU/gram
- Inoculated onto vegetal raw materials, rich in organic matter



- Creates ideal soil conditions: both physically and biologically
- Guarantees a fast colonization of the rhizosphere
- Releases soil phosphorus and makes it uptakeable for the plant roots
- Optimizes the health of plants and roots
- Produces stronger plants boasting improved growth and quality
- Scientific research proves added value for many crops

More active soil life



Soil life activity determined by measuring the microbial respiration rate, (mg C-CO_2 / kg / day) Scientia Terrae vzw, Belgium

Colonisation of the root surface

Controle

\+ Bacillus

Arabidopsis, KULeuven

DCM VIVISOL®
= better quality, less losses

A quality
= sufficient size,
few to no brown branches

B quality
= insufficient size,
few to no brown branches

C quality
= commercially unacceptable
/ loss

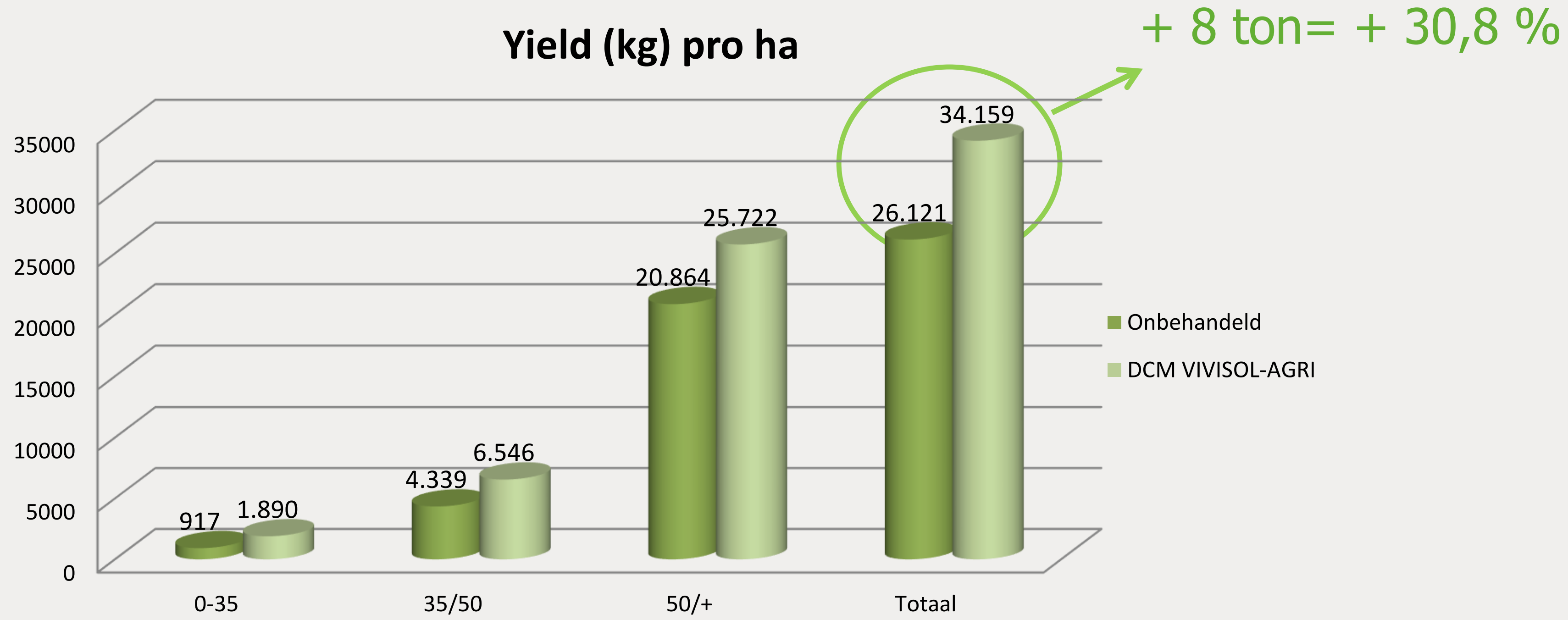
Erica darleynsis in container, Aegisto/Delphy, Wageningen, the Netherlands, 2016

DCM Vivisol®-Agri potatoes *Anosta*

3/08/2017

DCM Vivisol®-Agri potatoes *Anosta*

- Harvest: 03/08/2017



Culture:	Potatoes (consumption), Anosta
Grower:	Wim Calrysse, Wingene, West-Vlaanderen
Soil:	loamy sandsoil
Soil conditions:	Dry (spring - summer 2017)

EXAMPLE 3

Improve nutrient availability in the soil/substrate with biostimulants

DCM VITACT®

What?

Biostimulant

Bacillus

Complex carbon chains of vegetable origin

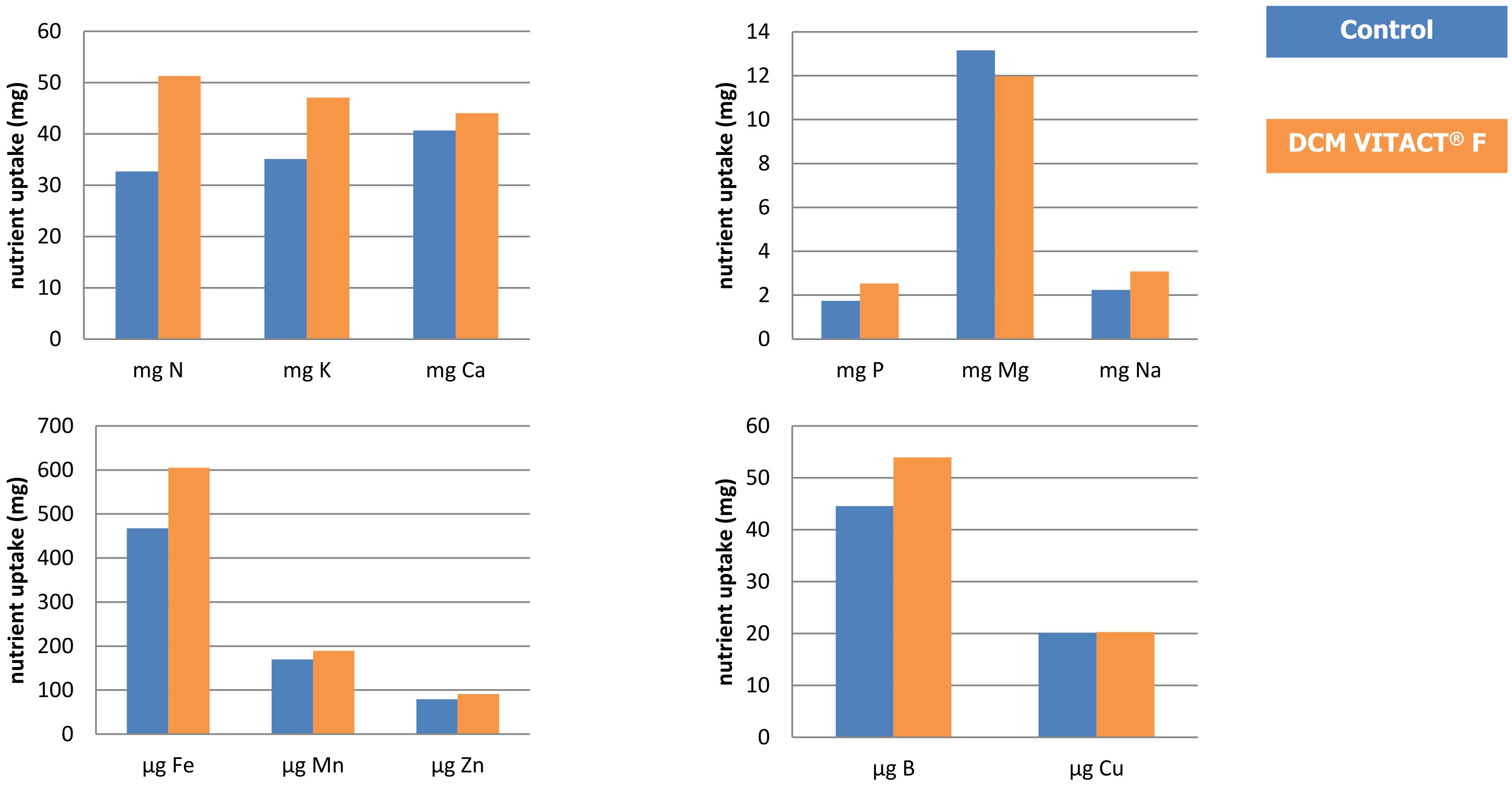
Bacteria (Bacillus sp.): 10^9 CFU/g

Combined action

DCM VITACT® F :
Stimulation of root formation with more fine root-hairs

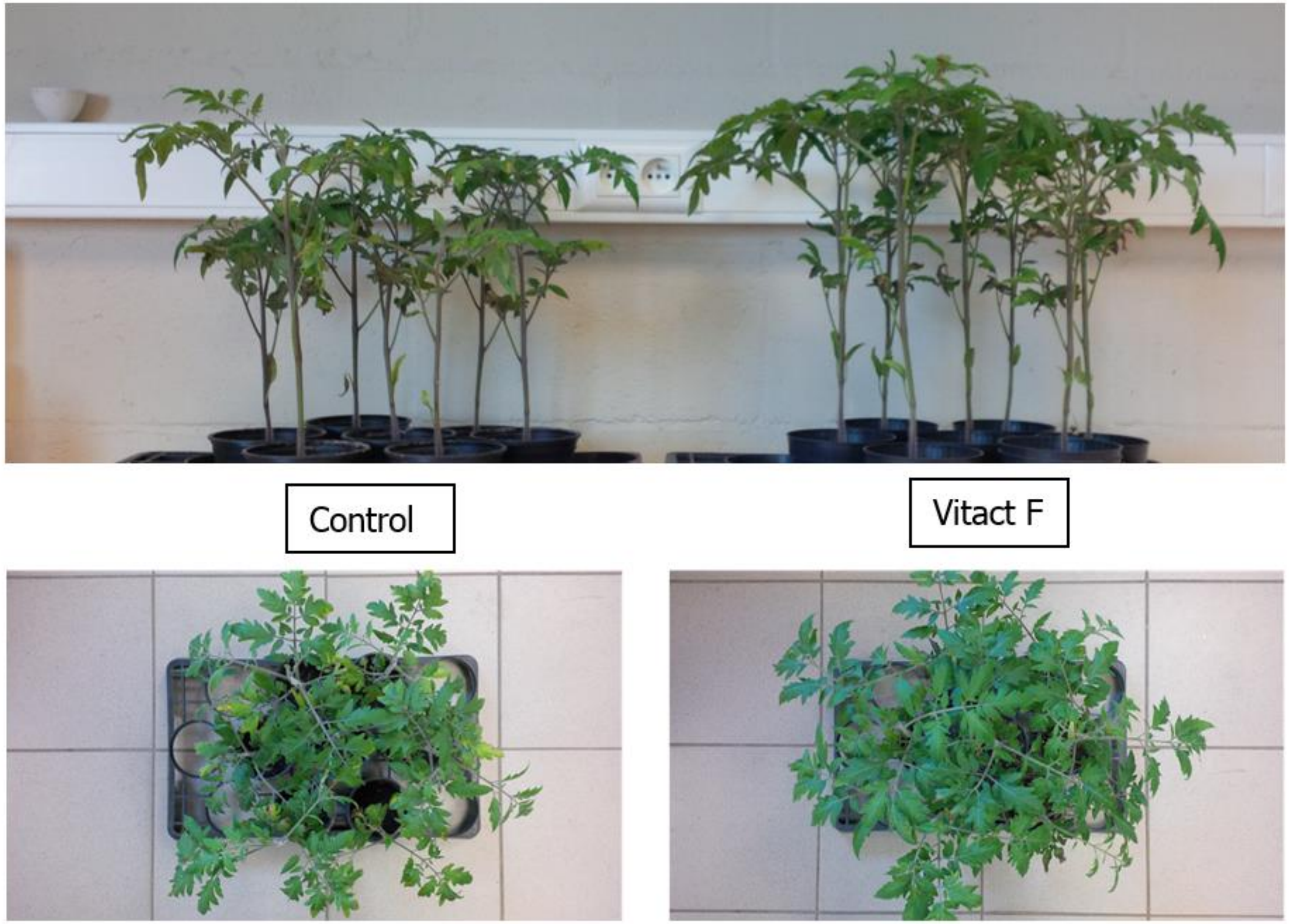
Tomato – Kanavaro, Dose-response test DCM VITACT F, 2017
1 application of DCM VITACT F (different dosages); 11 days after application

DCM VITACT® F :
Better nutrient uptake



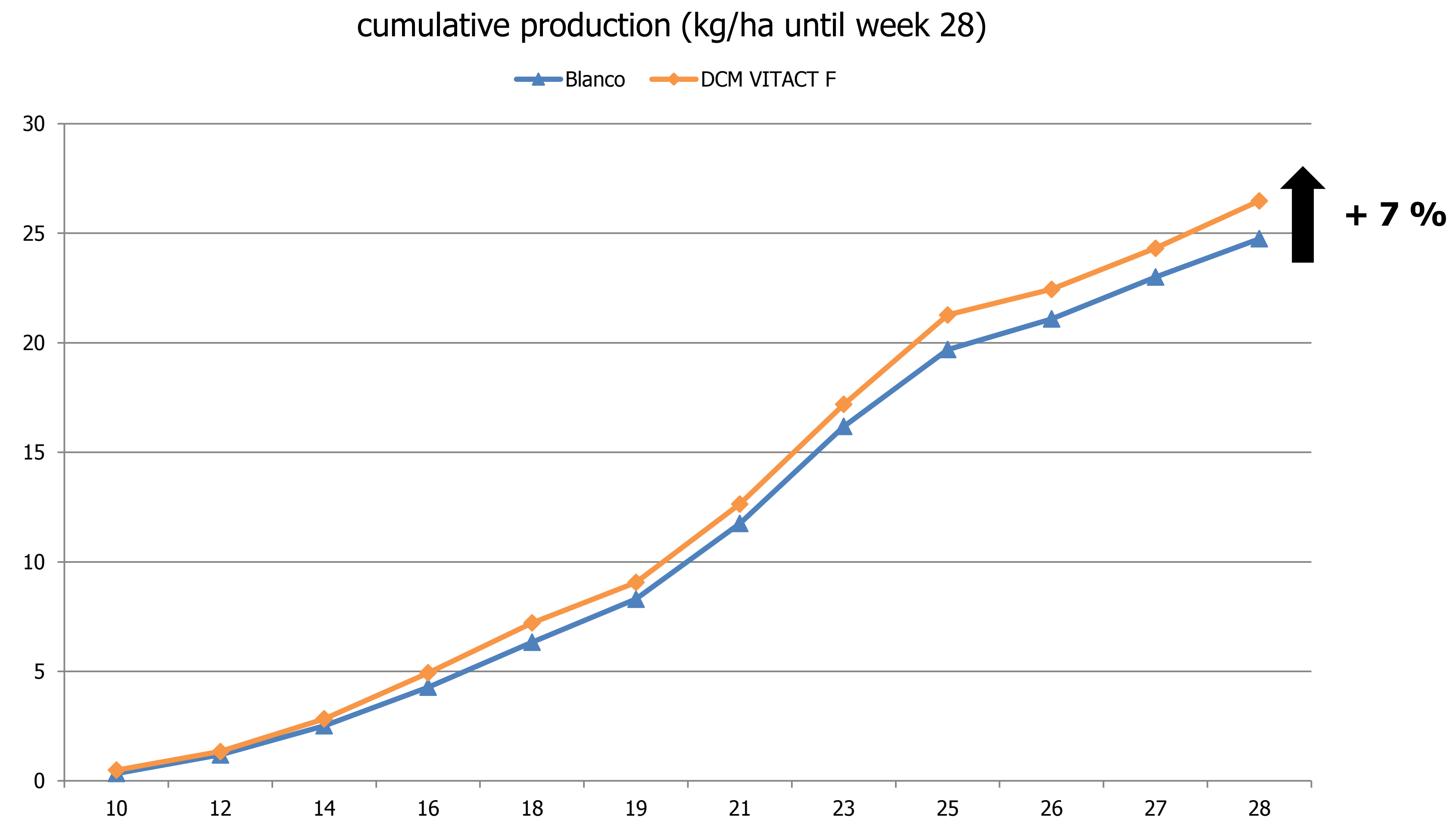
Effect of biostimulant products on P nutrient stress – Tomato; leaf analysis; Scientia Terrae

DCM VITACT® F :
Stimulation of the (aboveground) vegetation



Effect of biostimulant products on P nutrient stress – Tomato; Scientia Terrae

DCM VITACT® F: more tomatoes



Effect of biostimulant on yield – Tomato; Noud Steegh, Grenspaal, Nederland; 2015

Thank you!

Interactive questions

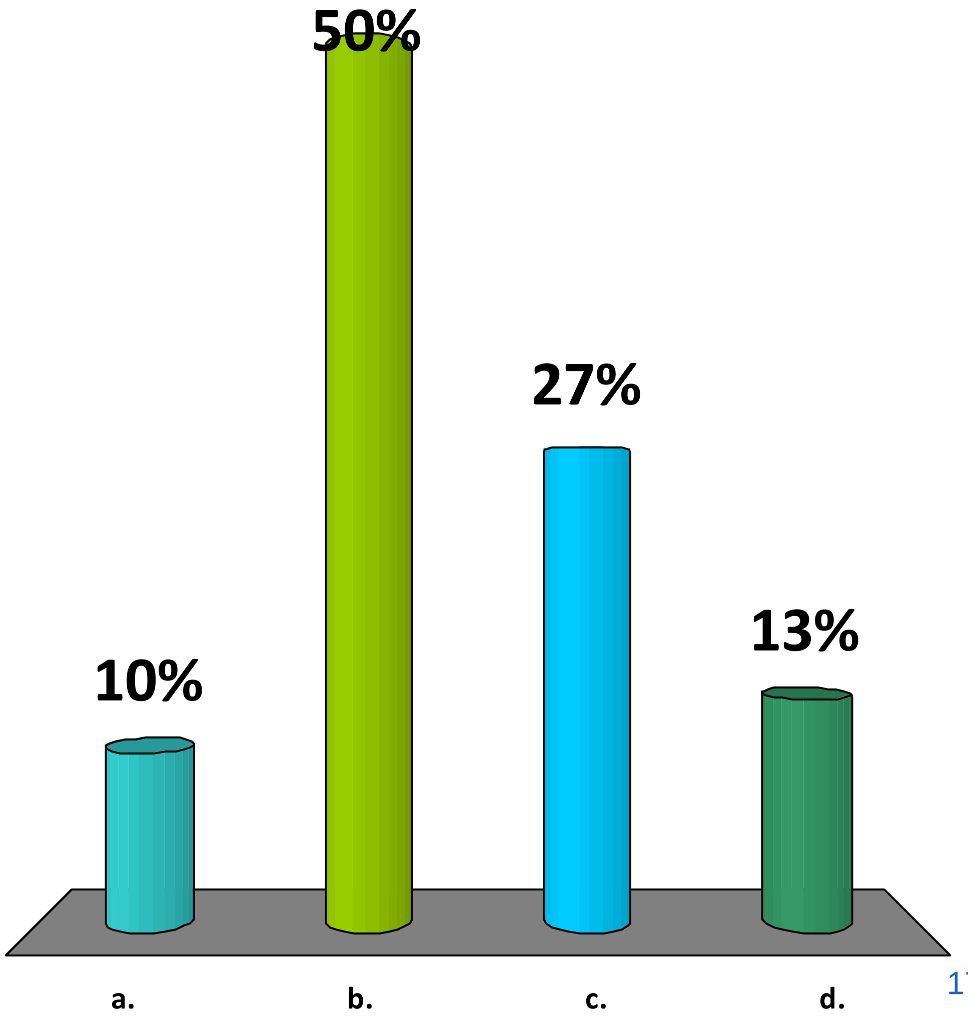
HOW BIG IS THE NUTRIENT SURPLUS IN FLANDERS AS N & P MEASURED BY MAP IN 2017?

a. 10% N and 40 % P

b. 20% N and 65 % P

c. 30% N and 50% P

d. 40% N and 60% P



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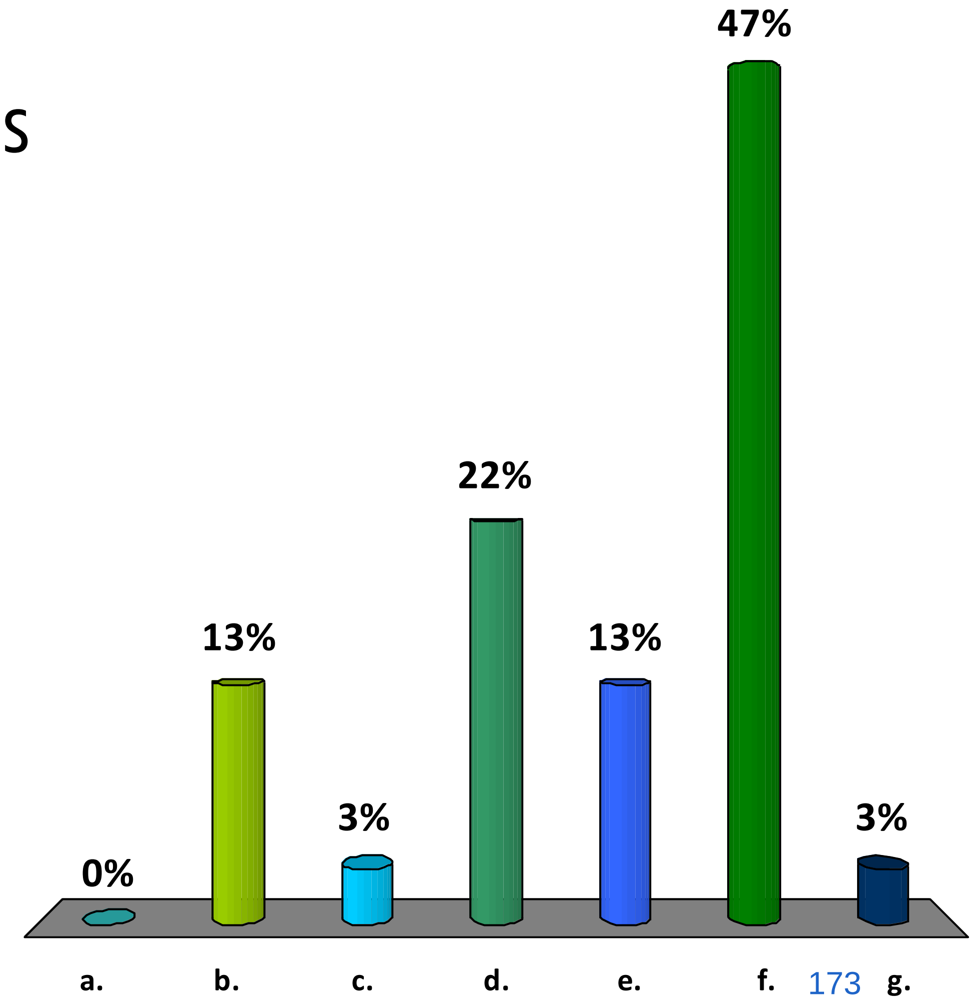
HOW CAN THE NUTRIENT SURPLUS IN FLANDERS BE BETTER MANAGED?

a. Slow release fertilizers
b. Increase bio availability of existing soil nutrients
c. Use more bio fertilizers
d. Use of precision farming
e. Policy and awareness
f. Combination
g. Other



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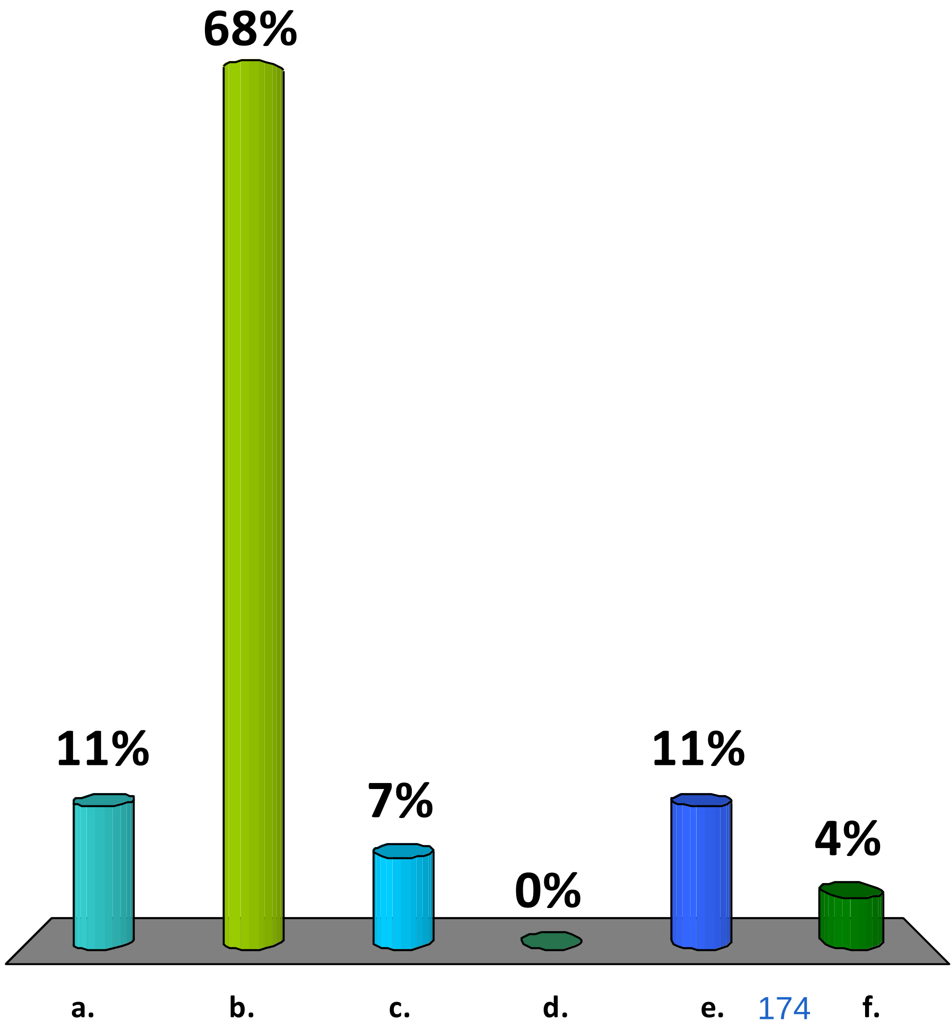
WHAT SHOULD BE THE MAIN FUTURE FOCUS OF INNOVATIONS IN THE FERTILIZER INDUSTRY?

a. Products that improve the bio-availability of the nutrients that are present
b. Products that improve soil structure and soil biological activity
c. New formulations like controlled release
d. Products that improve plant resilience, e.g. vaccins
e. New application technologies
f. Other



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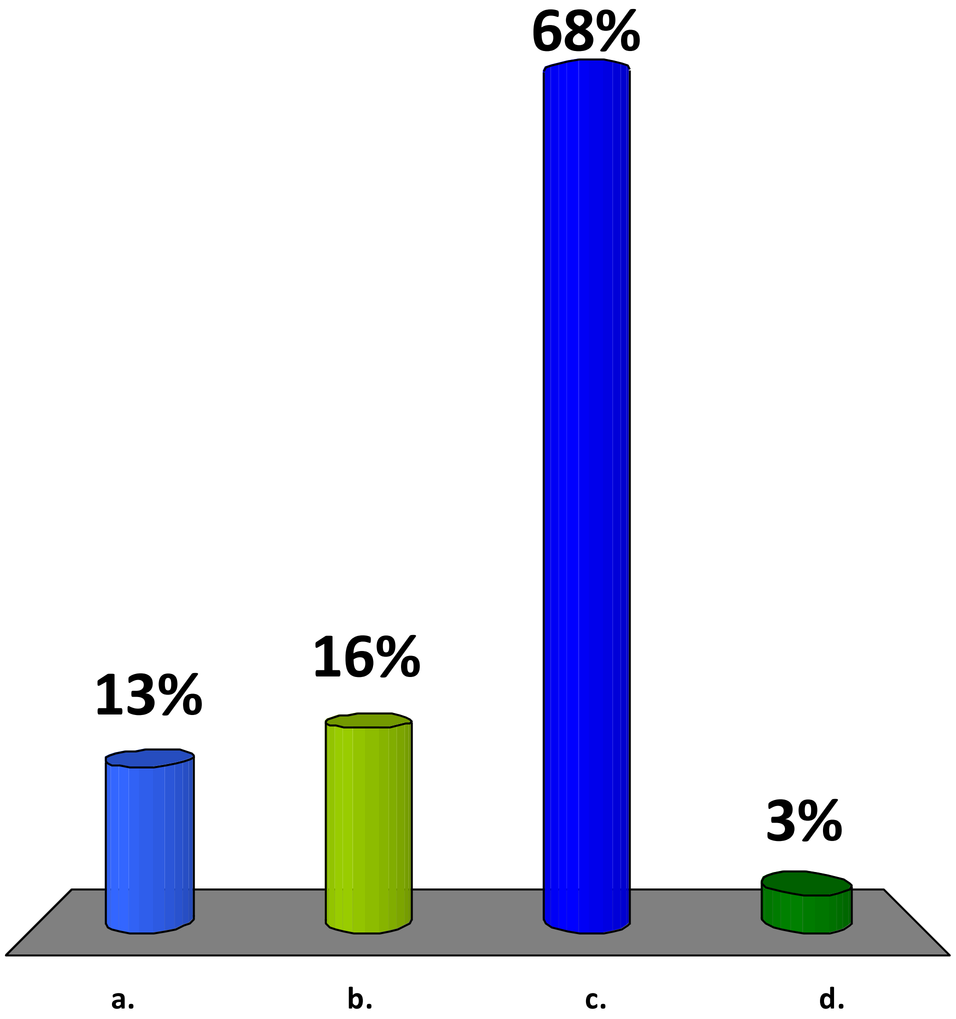
HOW CAN FUTURE FERTILIZER ADVICE SYSTEMS BEST BE IMPROVED?

a. Quantifying soil properties with precision farming
b. Quantifying plant needs with precision farming, e.g. green seekers
c. Focus on general soil fertility (physical, chemical, biological), not only chemistry
d. Other



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SOILBORNE DISEASES AND THEIR MANAGEMENT BY BIOLOGICAL CONTROL

Prof. Monica Höfte

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SOILBORNE DISEASES AND THEIR MANAGEMENT BY BIOLOGICAL CONTROL

Monica Höfte, Department Crop Protection

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SOILBORNE DISEASES

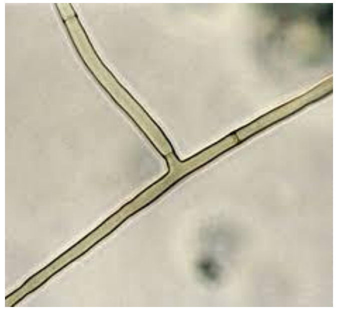





Extremely rare in natural habitats – enhanced by agricultural practices

SOILBORNE PATHOGENS

- Fungi (Sclerotinia, Fusarium, Rhizoctonia, Verticillium)
- Oomycetes (Pythium, Phytophthora)
- Rhizaria (Plasmodiophora, Polymyxa)
- Nematodes, bacteria, viruses
- Usually necrotrophic, with a wide host range

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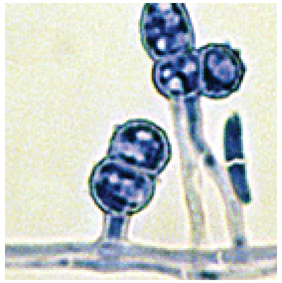
SURVIVAL IN SOIL


- Sclerotia, chlamydospores, oospores, thick-walled conidia or hyphae, resting spores, ...
- Survival in plant roots and crop residues
- Survival in soil for many years in some cases

DESASTROUS EXAMPLE

- Fusarium wilt on lettuce
- Spreading very quickly in the Netherlands, Belgium, UK, France
- Some growers in Belgium have already stopped producing lettuce
- The end for lettuce production in soil?

MANAGEMENT OF SOILBORNE PATHOGENS

- Prevention
  - Certified seed and planting material
- Crop rotation
- Host resistance
  - Grafting susceptible crops on resistant rootstocks
  - Feasible for some pathogens (e.g. Fusarium)
  - No host resistance against necrotrophic fungi
- Chemical control

CHEMICAL CONTROL

- In intensive production systems, soilborne pathogens used to be effectively controlled by methylbromide (CH_3Br)
- Methylbromide is a total soil fumigant that kills fungi, insects, nematodes and weeds
- MB is also an ozone depleting gas
- Use is completely banned in Belgium since 2006

CHEMICAL ALTERNATIVES

- Other fumigants
  - Dazomet, Metam-P, Metam-K
  - Chloropicrine
  - 1,3-dichloropropene (1,3-D)
- Fungicides
  - Do not usually kill survival structures
  - Often not effective
  - Many active ingredients will be lost

Directive 2009/128/EC: sustainable use of pesticides
Priority to non-chemical methods and practices

NON-CHEMICAL ALTERNATIVES

- Steam application
- Soilless cultivation
  - High initial investment costs
  - Requires disinfection of recirculating nutrient solutions

BIOLOGICAL ALTERNATIVES

Biological soil disinfestation

- Biofumigation
- Biofumigation + solarization
- Anaerobic soil disinfestation
  - – Organic amendments + flooding
  - – Organic amendments + tarping

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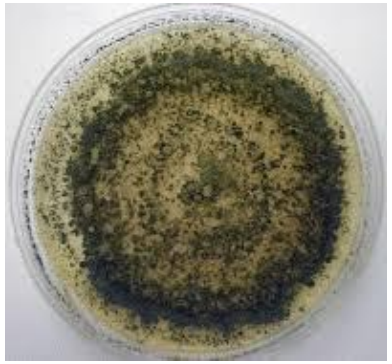
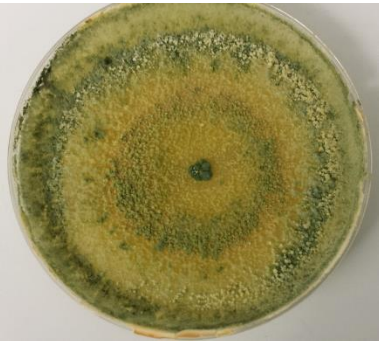
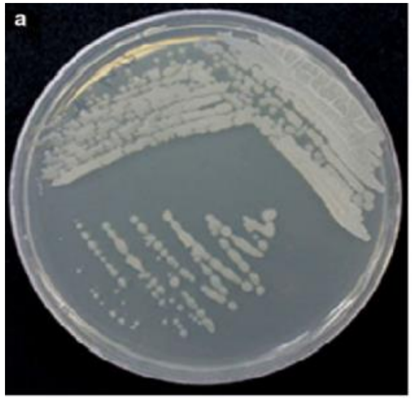
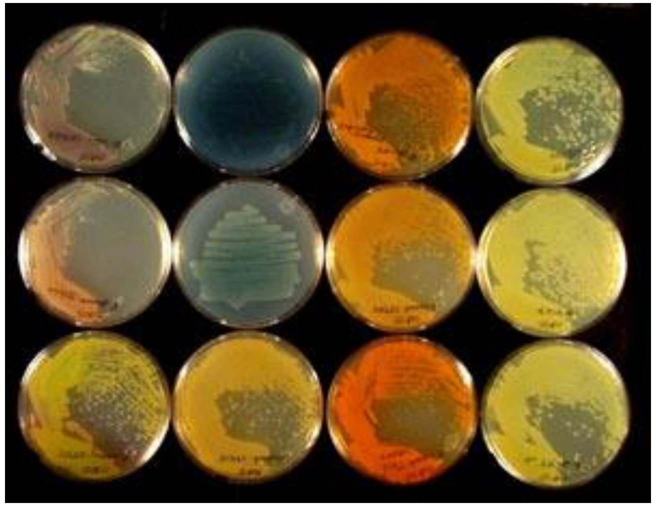
MICROBIAL BIOCONTROL AGENTS

- Fungi: *Trichoderma, Gliocladium, Coniothyrium*
- Bacteria: *Pseudomonas, Bacillus, Streptomyces*









DIRECT ANTAGONISM

- Antibiosis: antibiotics, toxins, volatile organic compounds, biosurfactants
- Competition: for nutrients or minerals (Fe)
- Parasitism: chitinases, cellulases

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INTERACTION WITH THE PLANT

- Phytohormones
  - Production of phytohormones
  - Interference with phytohormones
- Nutrient acquisition
  - Nitrogen fixation
  - Phosphatase activity
- Induced resistance
  - Plant recognizes Microbial Associated Molecular Patterns (MAMPs)
  - Activation of plant defense mechanisms

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FROM CHEMICAL TO BIOLOGICAL CONTROL STRATEGIES

- Much more knowledge about pathogens is needed
- Proper identification becomes important
- Knowledge about biology and ecology of the pathogen becomes important
- Has led to more attention for crop and soil health

BIOPESTICIDES OR MANAGEMENT OF THE NATIVE SOIL MICROBIOME?

- Failure of introduced microbial agents to consistently and effectively provide biological control
  - Persistence and expression of functional traits is influenced by competition, plant genotype, abiotic soil characteristics
- Multistrain or multimechanistic options?
- Can we learn from disease suppressive soils?
- Change the soil microbiome by organic inputs
- Influence of host genotype

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SOILBORNE DISEASES AND THEIR MANAGEMENT BY BIOLOGICAL CONTROL

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KOPPERT

BIOLOGICAL SYSTEMS

Management of soil-borne diseases (practical example)

Mark van der Werf BSc – November 30 2017

KOPPERT BIOLOGICAL SYSTEMS

KOPPERT'S CORE DISCIPLINES:

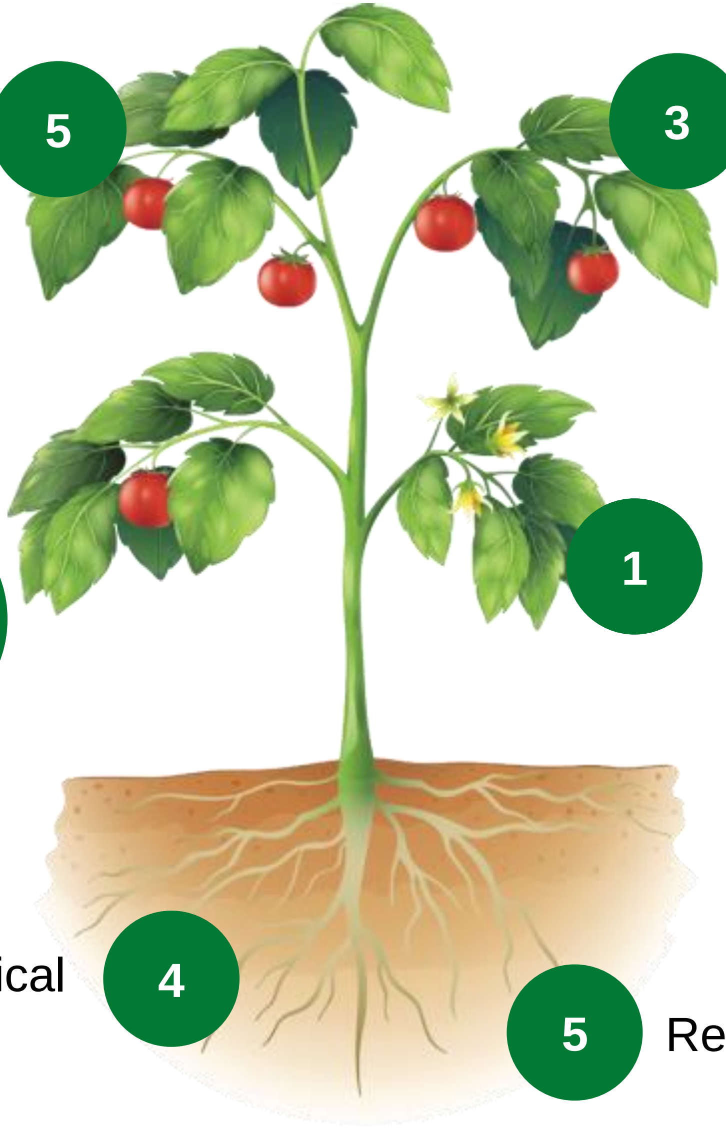
- Research and development
- Know-how and knowledge sharing
- Worldwide production and distribution of solutions
  - Biological pest and disease management
  - Natural Pollination
  - Application techniques & monitoring
  - Seed treatment
  - **Resilient Growth with NatuGro**

KOPPERT INTEGRATED CROP MANAGEMANT

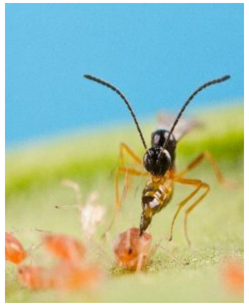
KOPPERT
BIOLOGICAL SYSTEMS

5 Resilient cultivation - Natugro

3 Technical supervision/ Knowledge!



1 Pollination



2 Biological Control

4 Microbiological

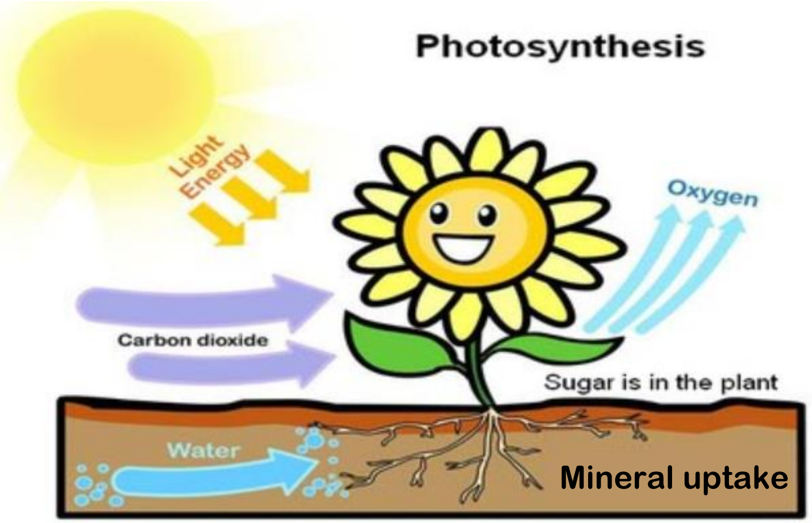
5 Resilient cultivation - Natugro

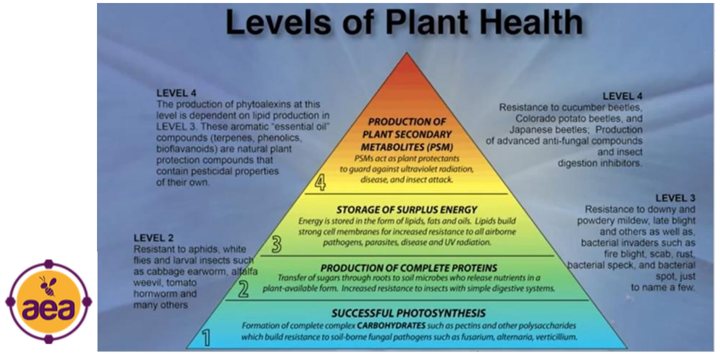
MANAGING SOIL DISEASES (THEORY)

KOPPERT BIOLOGICAL SYSTEMS

1. Make sure plants are no foodsource for the pathogens.

2. Create competition between beneficial microbes and the pathogens.





MANAGING SOIL DISEASES (PRACTICAL 1)

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BIOLOGICAL SYSTEMS

SUBSTRATE (soil, substrate or water)

WATER QUALITY AND WATERING STRATEGY

CROP PROTECTION (fungicides, insecticides and herbicides)

CLIMATE (always “room for exudates” to support microbials/soil food web around the roots)

MANAGING SOIL DISEASES (PRACTICAL 2)

KOPPERT BIOLOGICAL SYSTEMS

VIDI PARVA: ROOT GROWTH (growth, weight, quality and health)

TRIANUM: BIODIVERSITY

VIDI FORTUM: SUPPORTING (root exudates)

VIDI TERRUM: ENERGY (growth, flower, fruits & resilience)

EXAMPLE: STRAWBERRY PROPAGATION - PROTOCOL

			0[1)]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
			0	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
Trianum-P[2)]	0,5	kg/ha	1									1													
VidiParva	5,0	ltr/ha	1	1									1		1										
VidiFortum	5,0	ltr/ha			1		1		1		1														
VidiTerrum	5,0	ltr/ha		1	1		1		1		1			1			1			1					
VidiFol-D[3)]	2,0	ltr/ha	1	1	1		1		1				1				1				1				
VeniCalcium	2,5	ltr/ha					1				1				1				1						
Trianum meting uitvoeren									x																

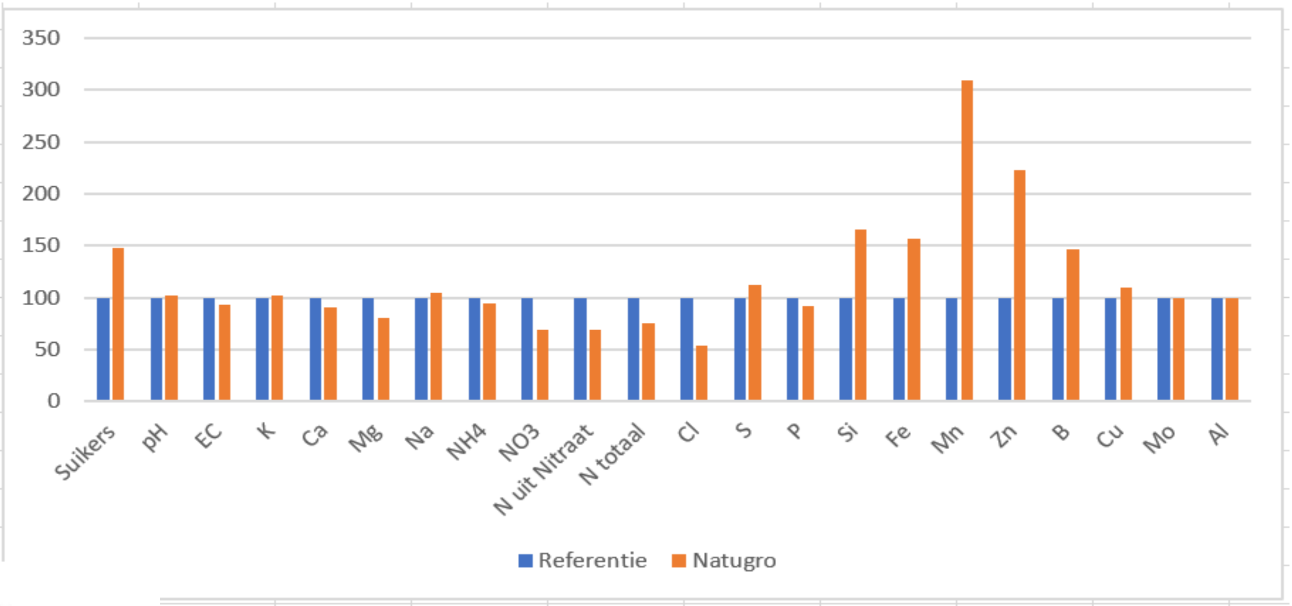
Crop cycle: July/Aug – Nov/Dec

Runners in substrate (in trays)

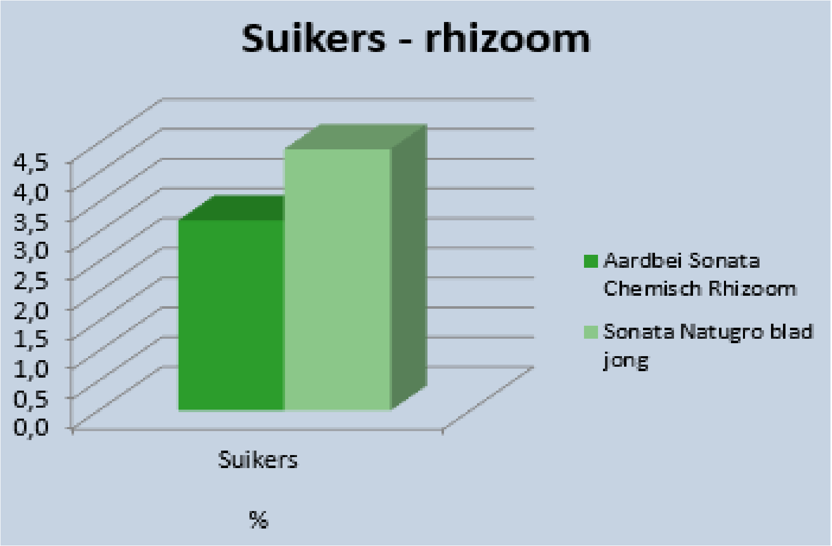
Problems: Phytopthora cactorum & Pestalotiopsis spp (5-25% plant loss)

Standard chemical schedule vs. NatuGro protocol

EXAMPLE: STRAWBERRY PROPAGATION - RESULTS



- Less plant loss;
- Stronger and healthier plant (plant sap analyses: more nutrients in leaves and rhizome);
- Cheaper schedule;
- Easier to manage;
- Better start in production.



EXAMPLE: STRAWBERRY PRODUCTION OUTDOOR (US)

KOPPERT BIOLOGICAL SYSTEMS

Crop: November – September/October;

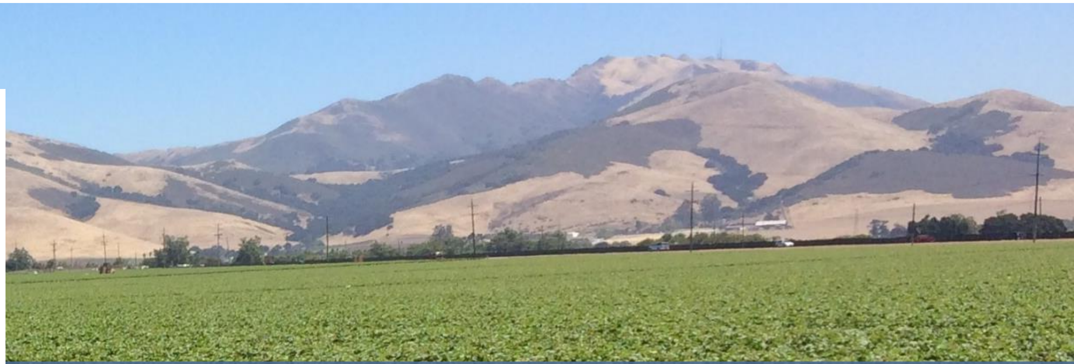
Ever-bearer

Goal: less soil pathogens and higher production

Standard cropmanagement (irrigation and fertilizer)

vs

Standard crop including NatuGro protocol



Result:

10% more yield (more fruits and less plant loss caused by soil-borne diseases)

Natugro schedule strawberries Salinas (current schedule)

			Time-line (crop wk's)																																										Total (per ha)
	rates/ha		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	total
Trianum	750	gr				1												1												1												1							3000
ProParva	5,0	ltr				1								1																													1					1	20,0
ProFortum	2,5	ltr								1		1																																					5,0
ProTerrum	5,0	ltr								1		1		1		1		1		1		1		1		1		1		1		1		1		1		1		1		1		1		1		1	100,0
VidiFunda	250	kg	1																																														250

EXAMPLE: STRAWBERRY PRODUCTION (NETHERLANDS) - PROTOCOL

KOPPERT BIOLOGICAL SYSTEMS

Crop: August – December

June-bearer

Goal: higher production (because of better quality) and resilience (no use of fungicides);

Standard crop management (irrigation and fertilizer)

vs

Standard crop management including NatuGro protocol

	Cropstage										flowering							harvest				
Producten				32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Trianum-P	drench	250	gr/ha	2																		
Parva	drench	3,0	ltr/ha	1	1		1		1		1					1		1		1		
Fortum	drench	2,0	ltr/ha									1	1	1								
Terrum	foliar spray	2,0	ltr/ha			1		1		1					1	1	1		1			
Fortafol	drench	1,0	ltr/ha				1			1			1			1						
Veni-Ca	foliar spray	2,5	ltr/ha																			

EXAMPLE: STRAWBERRY PRODUCTION (NETHERLANDS) - RESULTS

Excellent start (good roots and plant growth)

No problem with soil diseases

Since October struggling with powdery mildew

						beoordeling mate van kolonisatie door Trianum (op basis van kolonie vormende eenheden (kve)/gram drooggewicht wortel)[*)]			
monsternummer	groei medium	gewas	monsternaam	monstergrootte (g)	kve/g	te laag voor detectie	redelijke kolonisatie	goede kolonisatie	uitstekende kolonisatie
NL1564	kokos	aardbei	Penninx	3,17	7,0E+05				

**) in geval van grondmonsters: kve/g versgewicht grond*

Koppert Biological Systems kan niet aansprakelijk worden gesteld voor eventuele schade als gevolg van onjuistheden en/of onvolledigheden in deze uitslag.

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BIOLOGICAL SYSTEMS

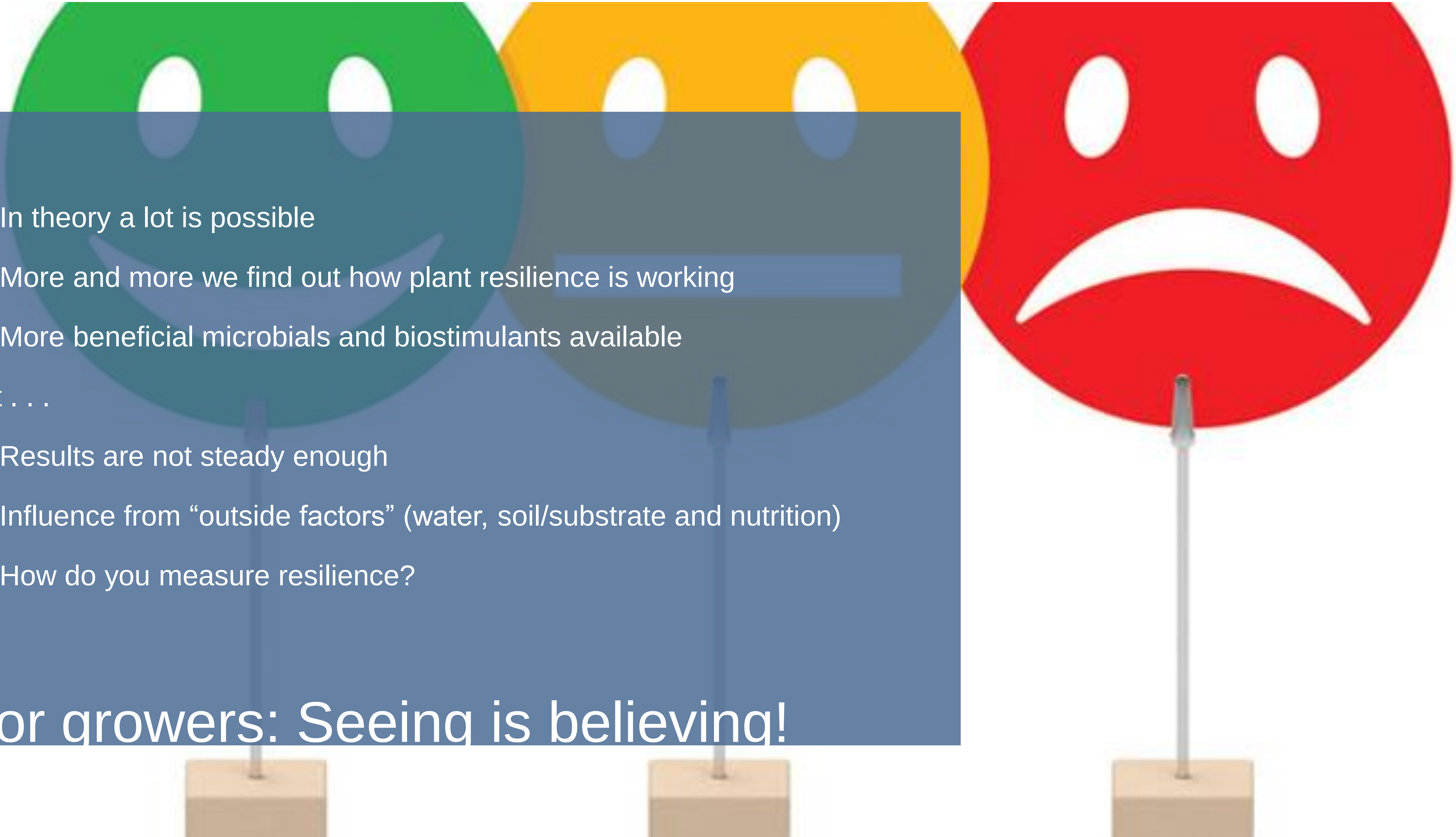
Stimulating growth/production:

- Blueberry;
- Phalaenopsis/Orchids;
- Rose;
- Cutflowers (Amarillus, Chrysanthemum);
- Strawberry production.

Plant resilience:

- Blueberry / Phalaenopsis / Rose;
- Bulb production;
- Tree nursery;
- Propagation strawberry;
- Organic vegetables;
- Tomatoes.

CONCLUSION



- In theory a lot is possible
- More and more we find out how plant resilience is working
- More beneficial microbials and biostimulants available

But . . .

- Results are not steady enough
- Influence from “outside factors” (water, soil/substrate and nutrition)
- How do you measure resilience?

For growers: Seeing is believing!

CLOSING

KOPPERT
BIOLOGICAL SYSTEMS

THANK YOU FOR YOUR INTEREST!

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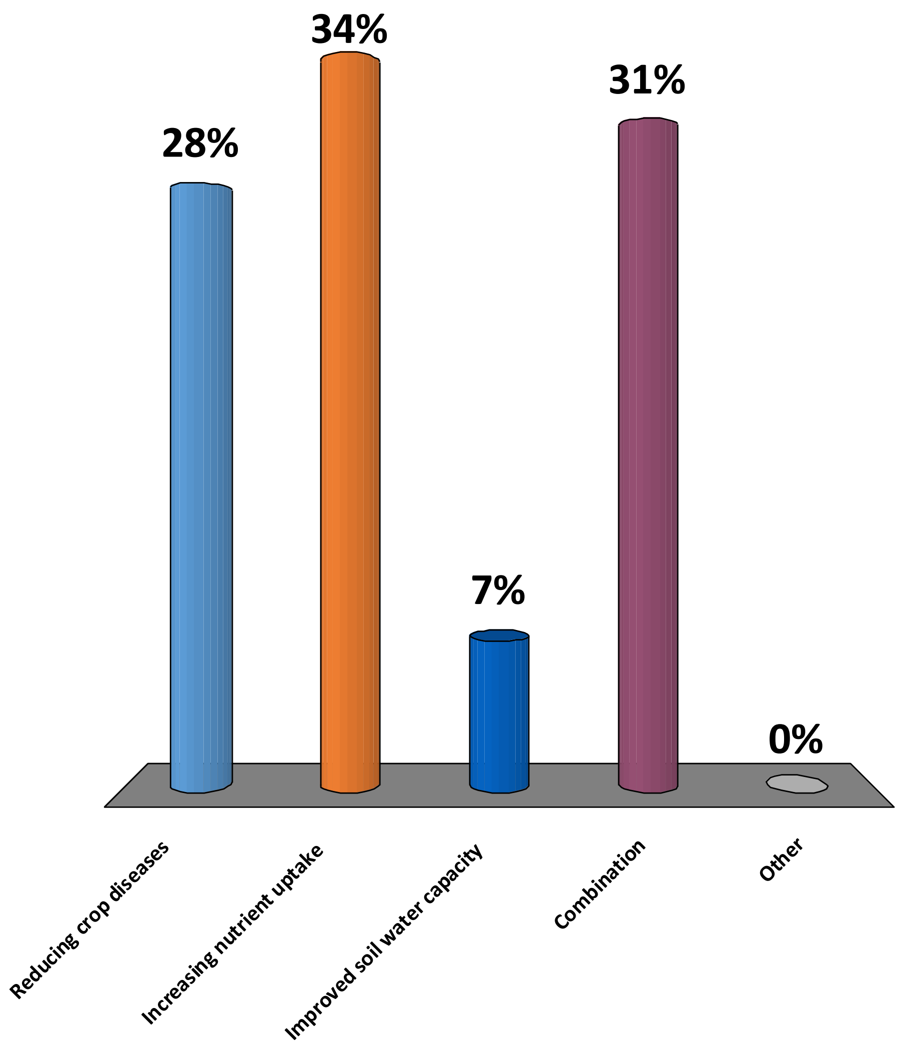
INTERACTIVE QUESTIONS

WHAT DO YOU CONSIDER TO BE THE MAIN BENEFIT OF GOOD SOIL BIOLOGY?

A. Reducing crop diseases
B. Increasing nutrient uptake
C. Improved soil water capacity
D. Combination
E. Other



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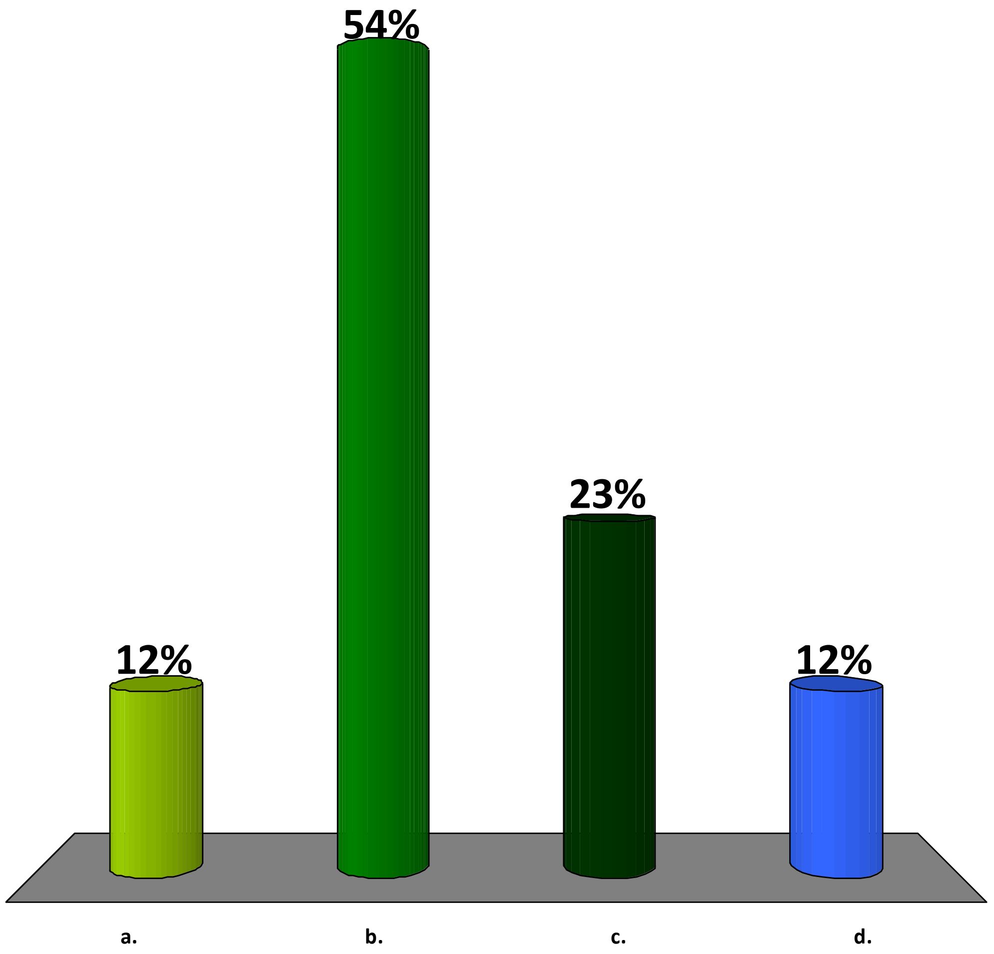
HOW CAN WE INCREASE AWARENESS ON THE IMPORTANCE OF BIOLOGICAL DRIVERS OF SOIL FERTILITY?

a. More studies on economic benefits

b. More successful use cases

c. Improving soil biology should be the goal in itself not the means

d. Other



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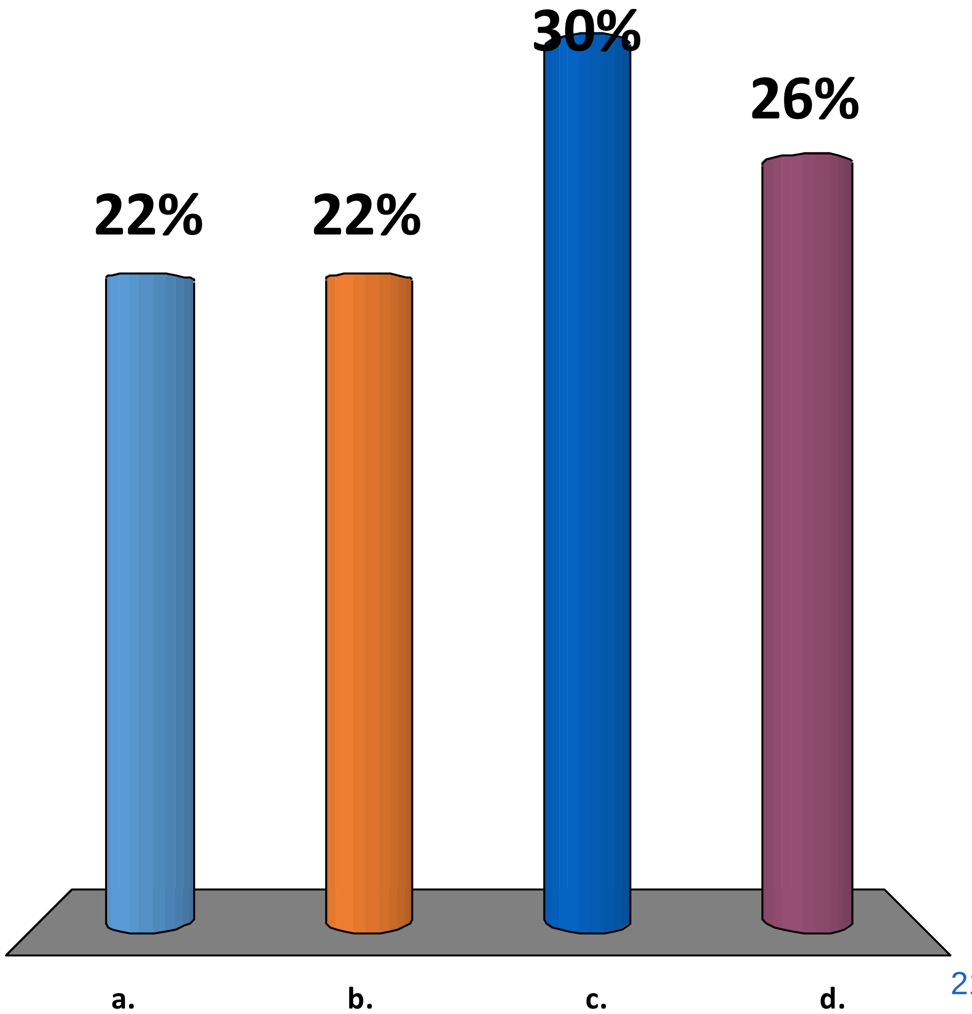
FUTURE RESEARCH ON THE SOIL MICROBIOME SHOULD MAINLY FOCUS ON..?

a. Better characterization of the soil microbiome

b. Changes in microbiome related to soil management

c. Specificity between microbiome and plant species

d. Other



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WHAT IS THE BIGGEST CHALLENGE FOR BIOLOGICAL CONTROL OF CROP DISEASES?

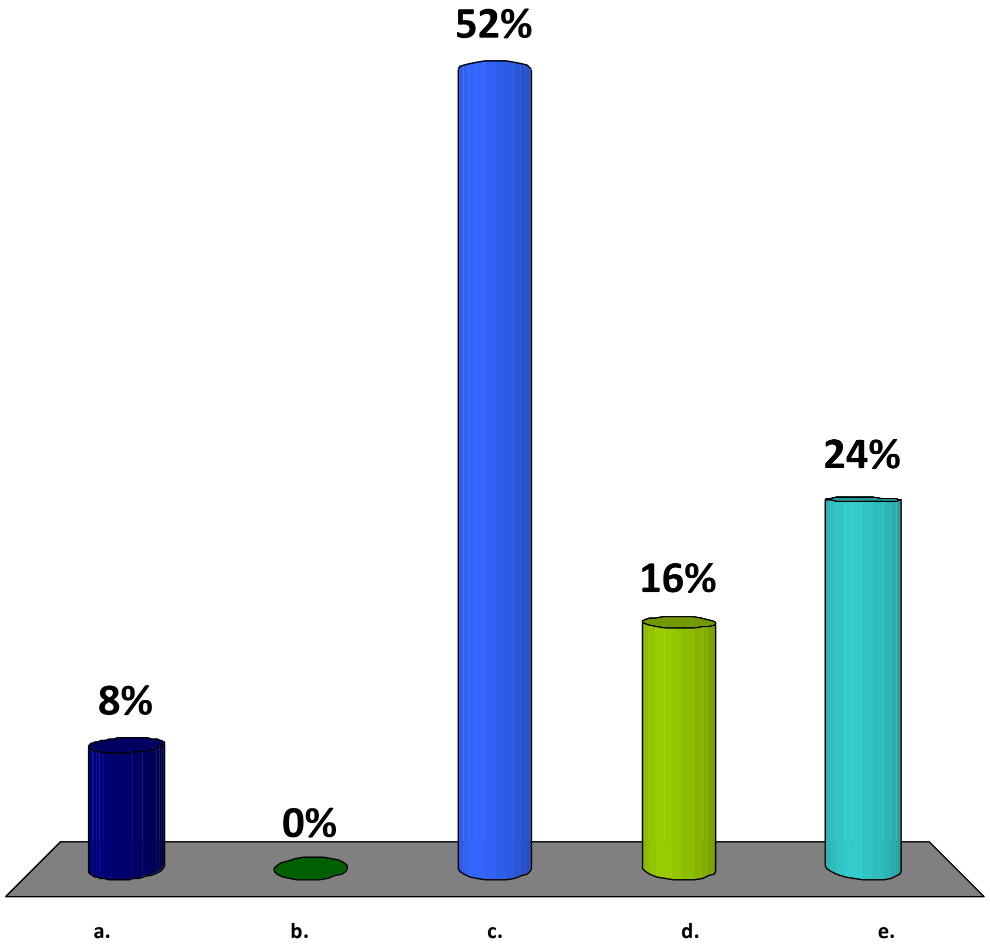
a. It is a slow process

b. Cost of start up

c. It does not work in every environment (different countries, soils, etc.)

d. Can sometimes fail in its specificity

e. Other



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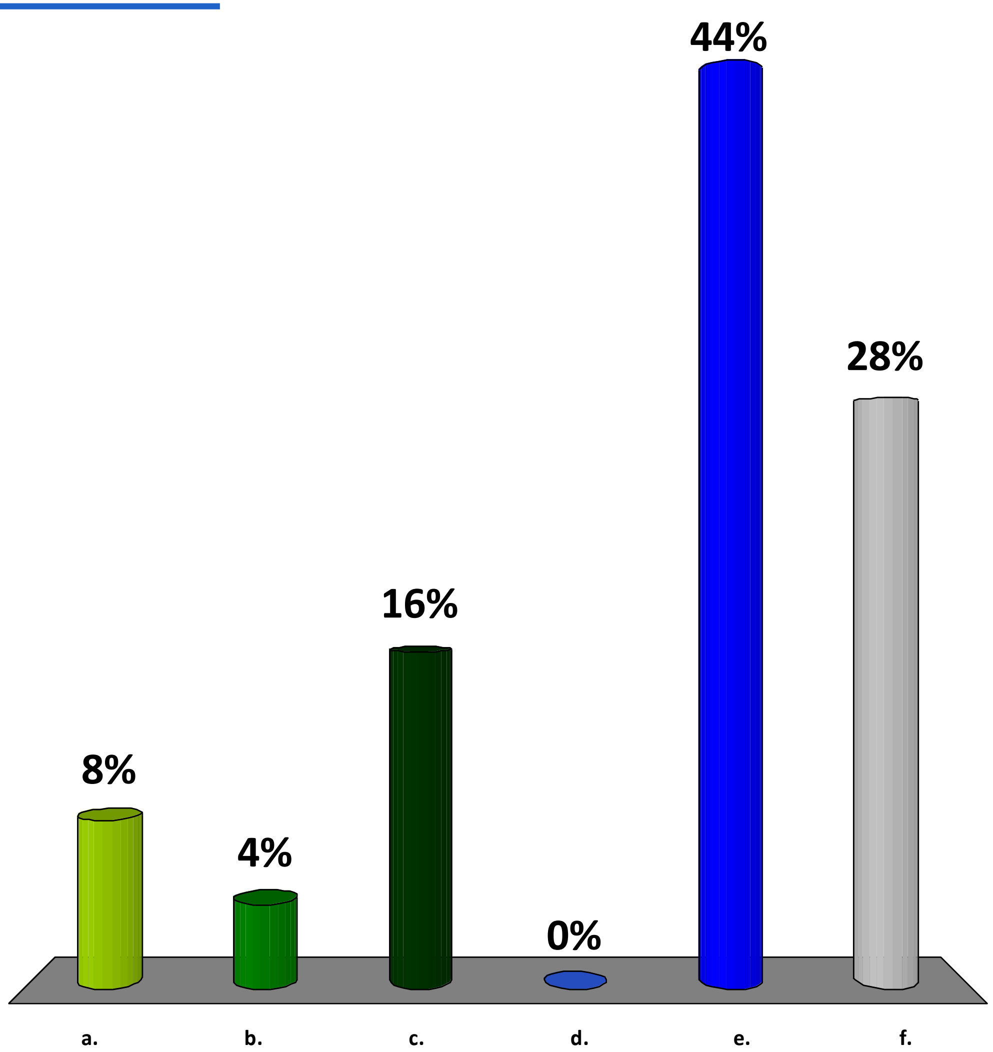
WHO IS BEST SUITED TO INCREASE AWARENESS AMONG FARMERS THAT INVESTING IN A HEALTHY SOIL MATTERS?

a. Research institutions
b. Industry
c. Governement
d. NGO's
e. Advisors to farmers
f. Other



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Inspiring Mornings @ UGent FBW:

Healthy Soil Matter(s)

Thank you!

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Crelan


INFORMATION IS LIKE COMPOST:
IT DOES NO GOOD UNLESS YOU SPREAD IT AROUND.

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