Rozdílná dostupnost fosforu v konvenčně a ekologicky obhospodařovaných orných půdách

Jaroslav Záhora

Fosfor – aktuální otázky a řešení

14. - 15. 5. 2019, Brno

Mendelova univerzita v Brně

Faculty of Agronomy

SONDAR CZ-AT
Soil Strategy Network in the Danube Region

EUROPEAN UNION
European Regional Development Fund

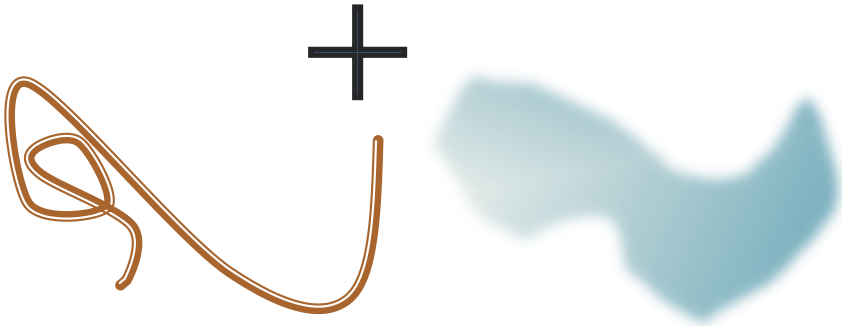
SPOLUPRÁCE CZ - KOOPERATION AT

inteko
innovative composting

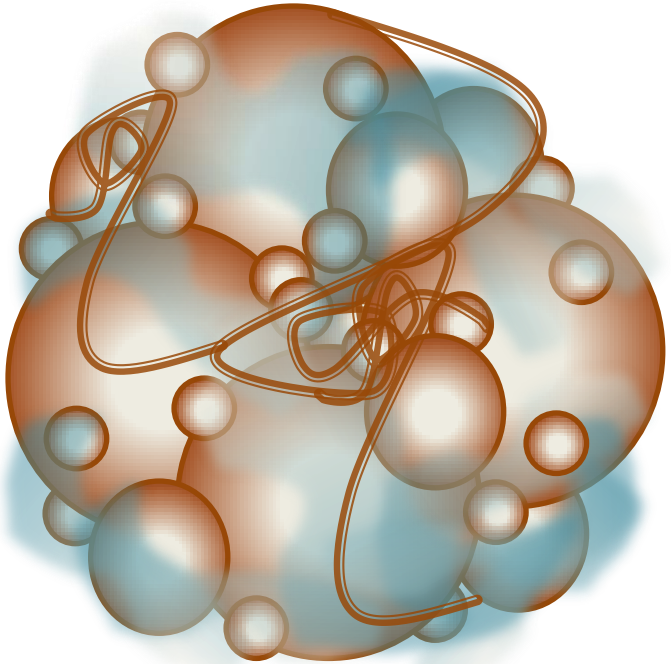
EUROPEAN TERRITORIAL CO-OPERATION
AUSTRIA-CZECH REPUBLIC 2007-2013
Gemeinsam mehr erreichen. Společně dosáhneme více.

Ton
< 2 µm ø

Schluff
2 – 63 µm ø



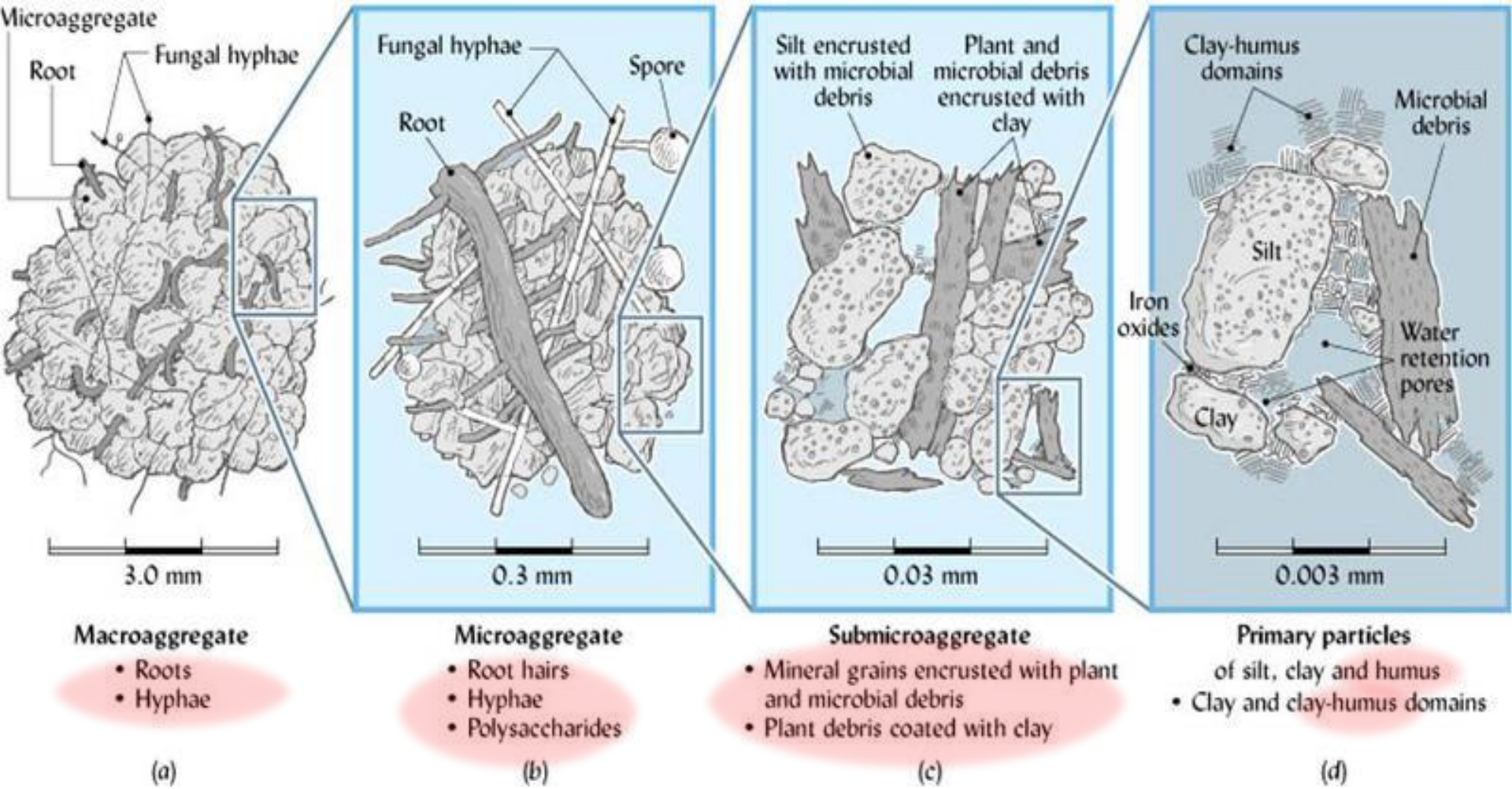
Sand
63 – 2 000 µm ø



Die Bodenarten

das Diagramm zeigt sie in Abhängigkeit der Korngrößen-Anteile

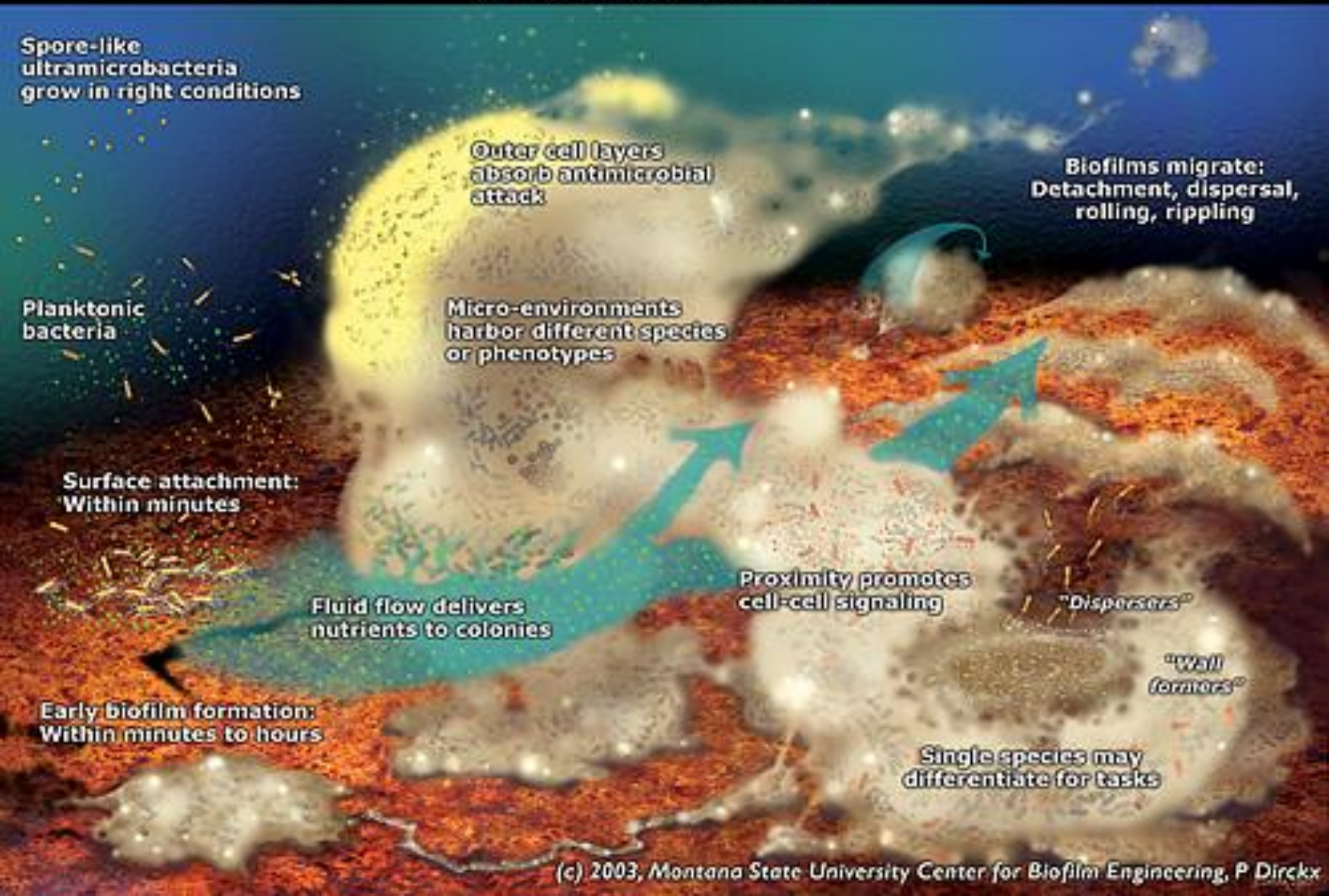
The importance of soil aggregates

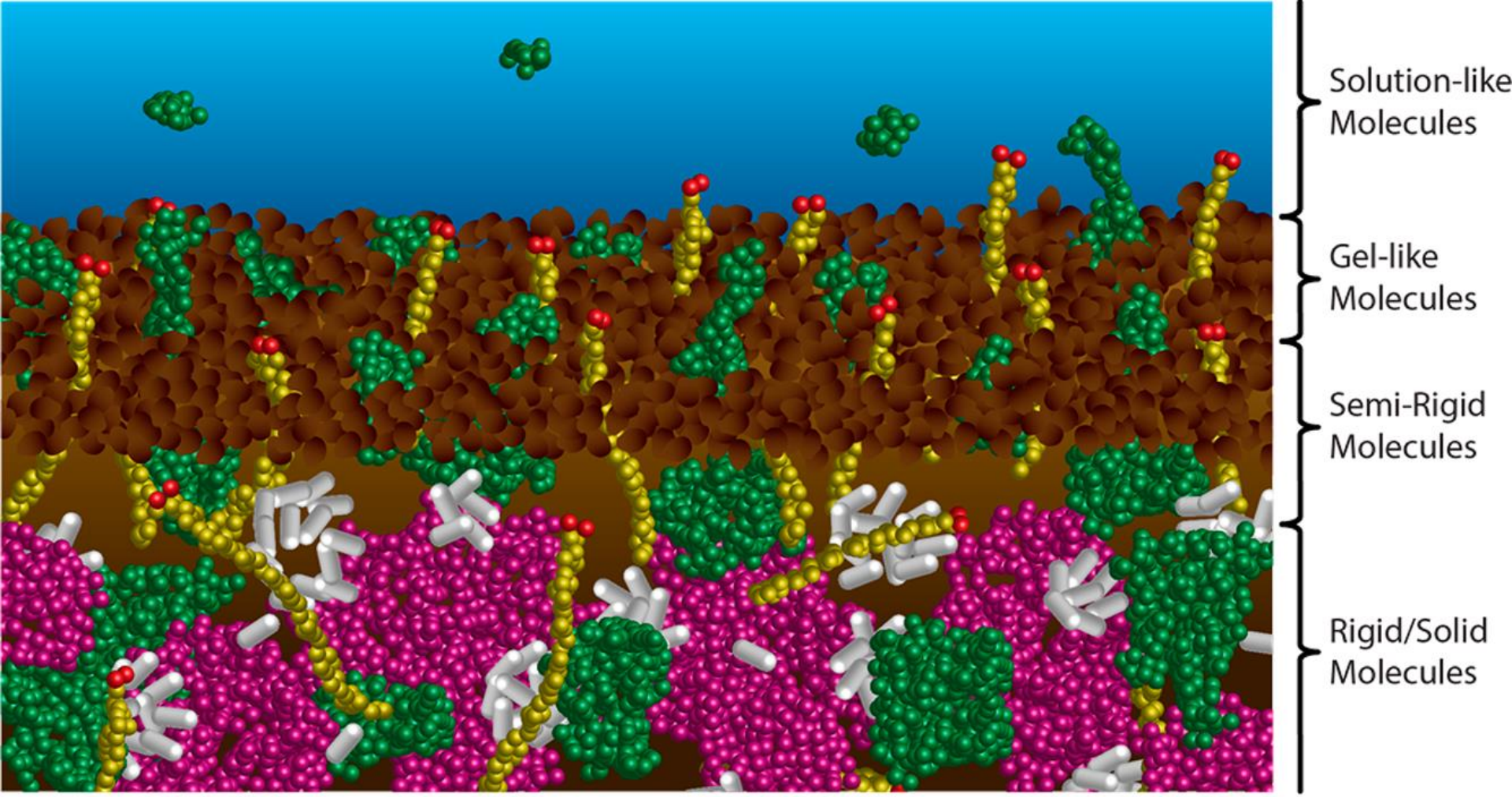


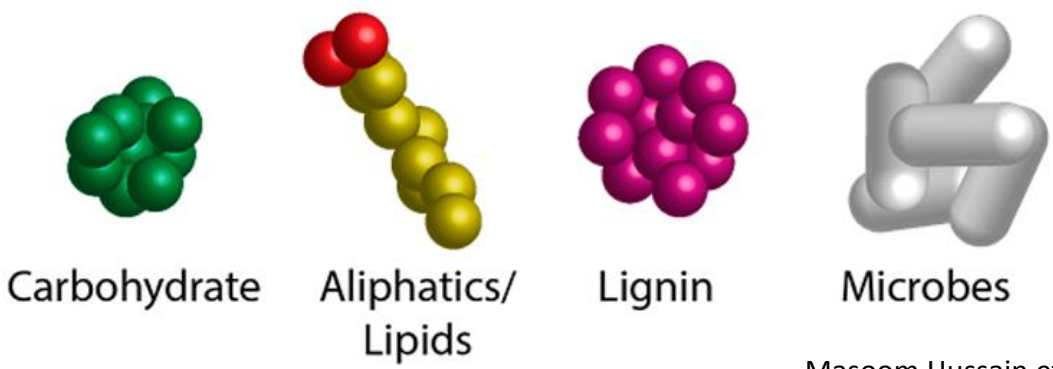
The organisms are crucial for formation of the soil, i.e. for aggregation of soil particles.

Microbial Biofilms: Sticking Together for Success

Single-celled microbes readily form communities in resilient structures that provide advantages of multicellular organization.

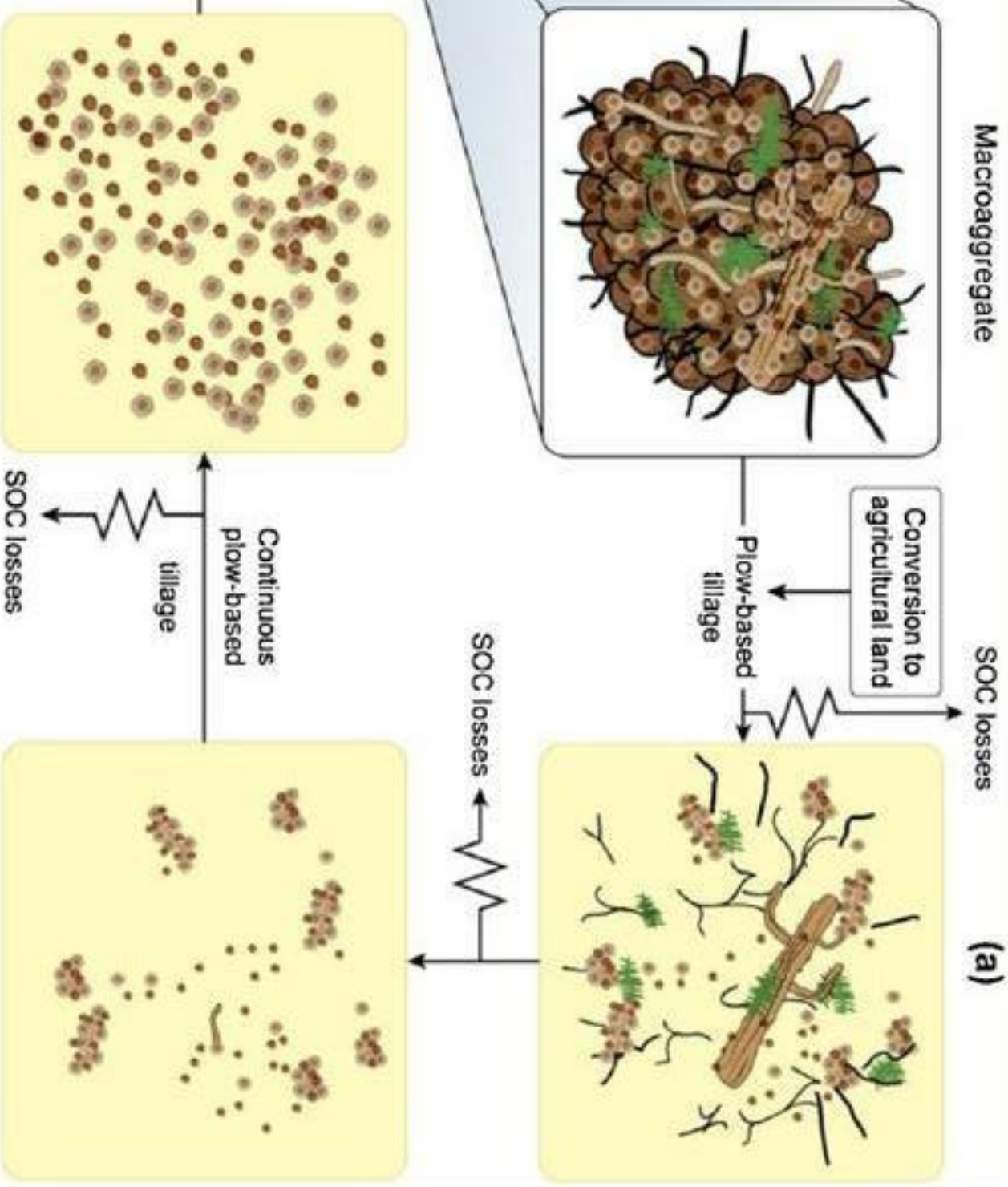






The vertical structure of soil microbial biofilm

Masoom Hussain et al., Environ. Sci. Technol. 2016, 50, 1670−1680



Soil & Tillage Research 126 (2013) 203–218

Contents lists available at SciVerse ScienceDirect

Soil & Tillage Research

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

Aggregate C depletion by plowing and its restoration by diverse biomass-C inputs under no-till in sub-tropical and tropical regions of Brazil

Florent Tivet[a,c,*], João Carlos de Moraes Sá[b], Rattan Lal[c], Clever Briedis[d], Paulo Rogério Borszowskei[d], Josiane Bürkner dos Santos[d], Anderson Farias[e], Guilherme Eurich[e], Daiani da Cruz Hartman[e], Mario Nadolny Junior[e], Serge Bouzinac[a], Lucien Séguy[a]

MICROBIAL AND FUNGAL
BYPRODUCTS GLUE
THE PARTICLES TOGETHER

DISPERSED STATE

AGGREGATED STATE

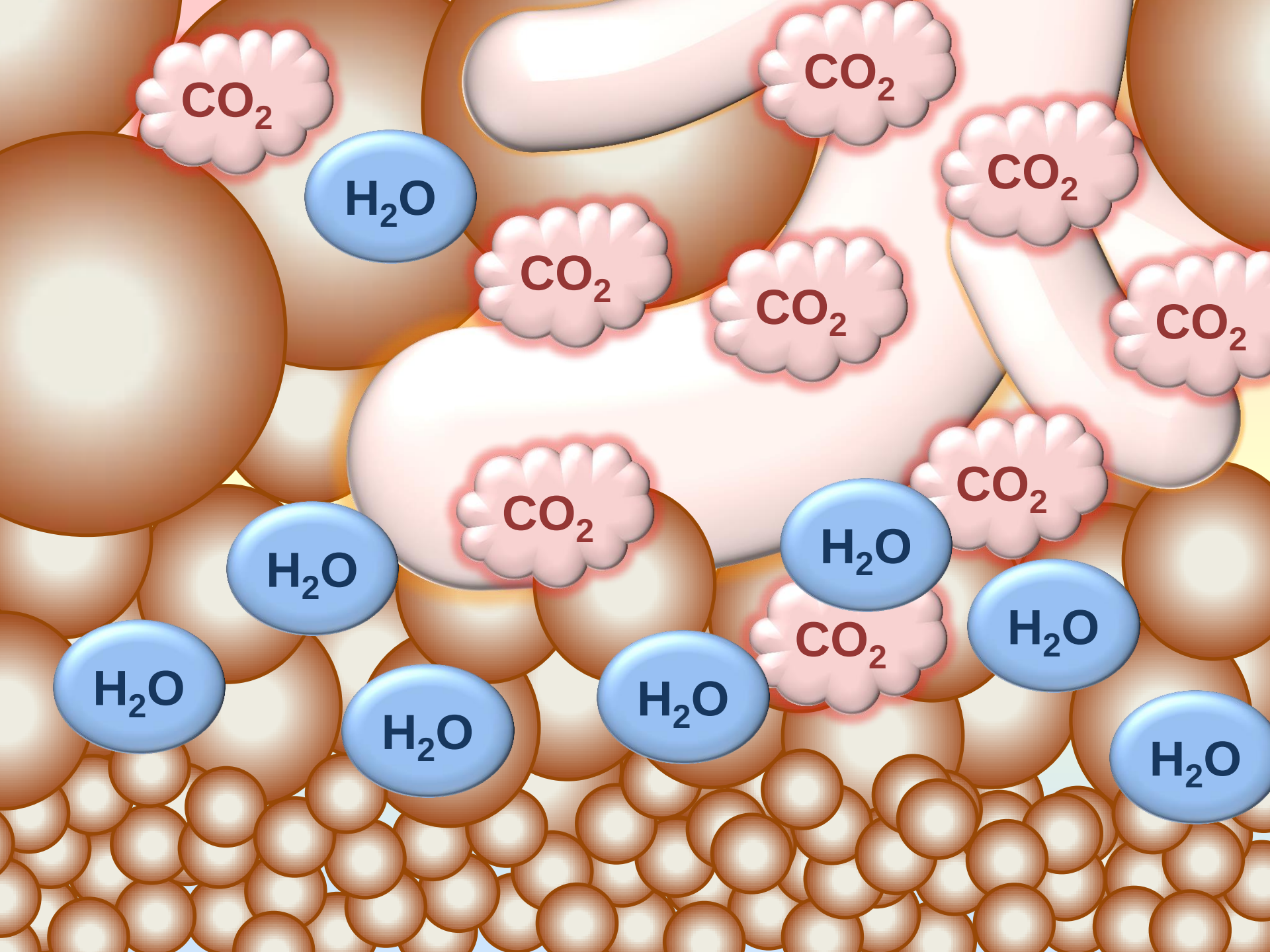
Chemical Soil

Tight Soil
Low Infiltration
Low Oxygen
Small Roots

MicroLife Soil

Friable Soil
Higher Infiltration
Bigger Roots
More Water Stored

Biological degradation leads to soil compaction that accelerates soil erosion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CO_2
CO_2
CO_2
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CO_2
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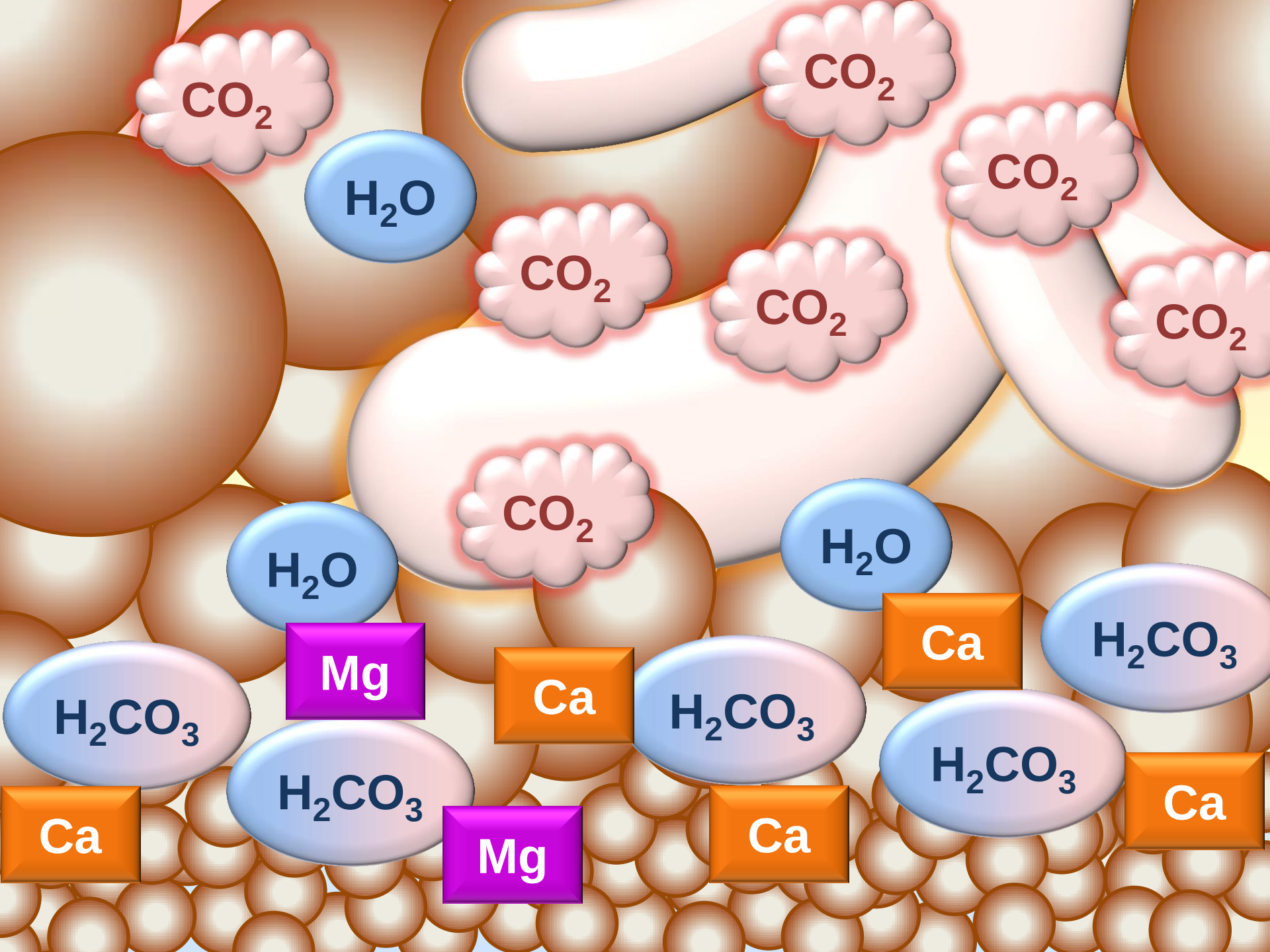
H_2O
H_2O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CO_2
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H_2O
Mg
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H_2CO_3
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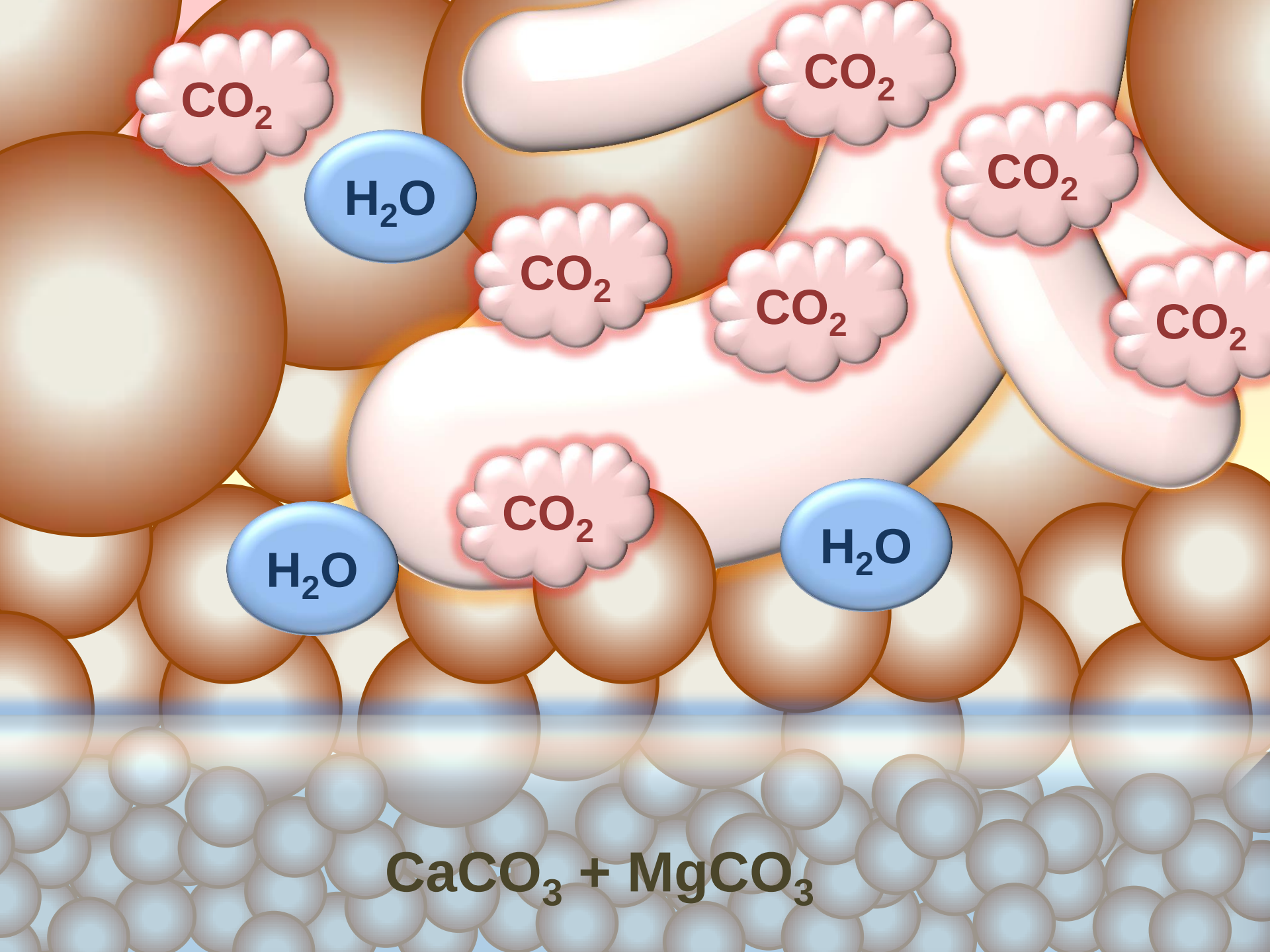
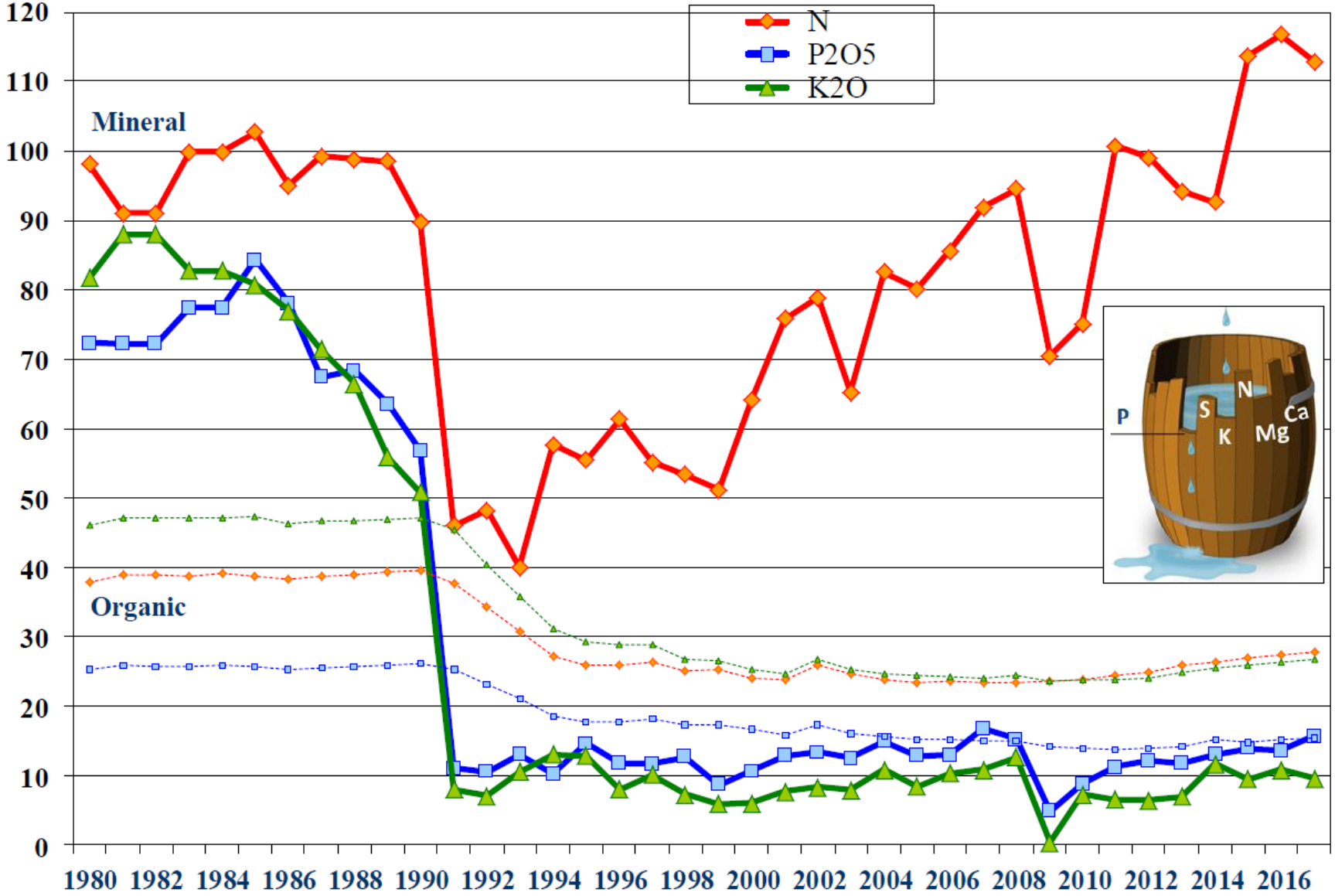
H_2CO_3
H_2CO_3
Ca
Mg
Ca
Ca


CO_2
CO_2
CO_2
H_2O
CO_2
CO_2
CO_2
CO_2
CO_2
H_2O
H_2O
$CaCO_3 + MgCO_3$

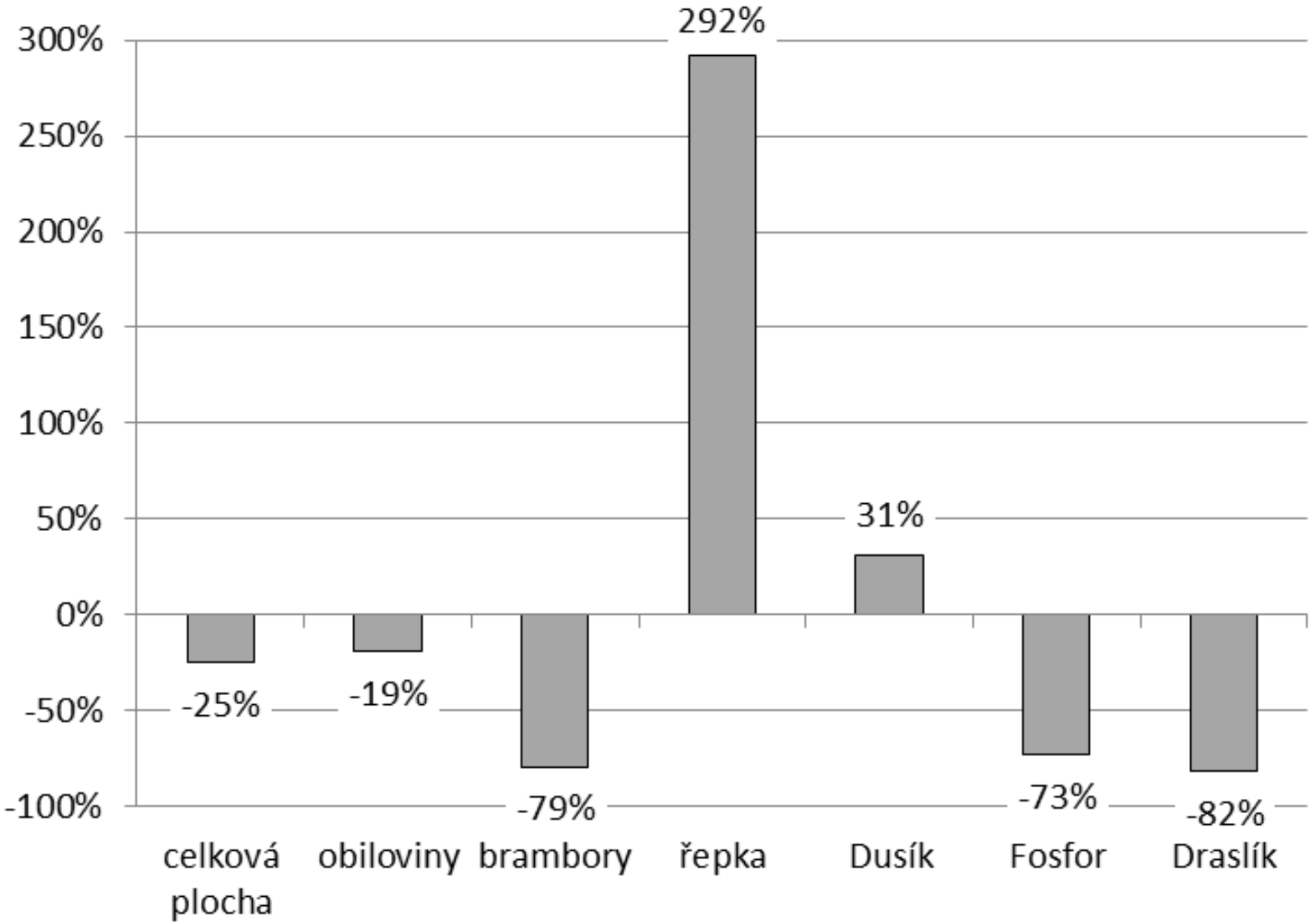
Average fertilizers consumption in the Czech Republic

(kg of nutrients per 1 ha UAA: 3,5 mil. ha in 2017)



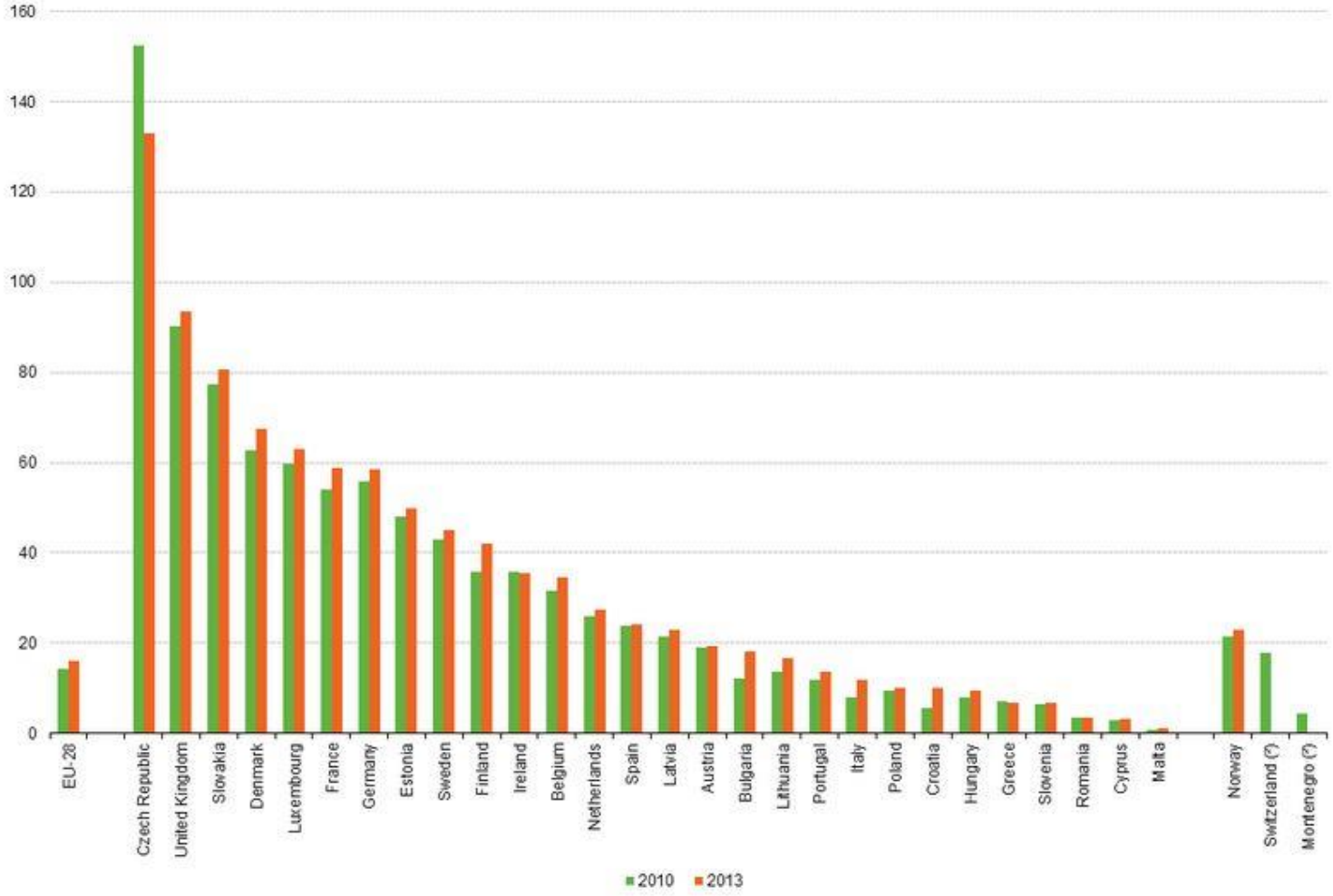
Soil structure, fertilizer management and crop cultivation in Czech agriculture

Jan Klír, Crop Research Institute, Praha – Ruzyně; Michal Hejcman, Czech University of Life Sciences Prague


300%
250%
200%
150%
100%
50%
0%
-50%
-100%
292%
31%
-25%
-19%
-79%
-73%
-82%
celková plocha
obiloviny
brambory
řepka
Dusík
Fosfor
Draslík

File:Average utilised agricultural area per holding, 2010 and 2013 (¹) (hectares) YB16.png

File File history File usage



(¹) Iceland not shown for reasons of scale: 2010 value was 616 hectares.
(²) 2013: not available.
Source: Eurostat (online data code: ef_kvaareg)

Considerations for No-Till

Tyler Williams
University of Nebraska
Extension Educator
Applied Ag Climatologist

Visualizing roots impact on soil structure

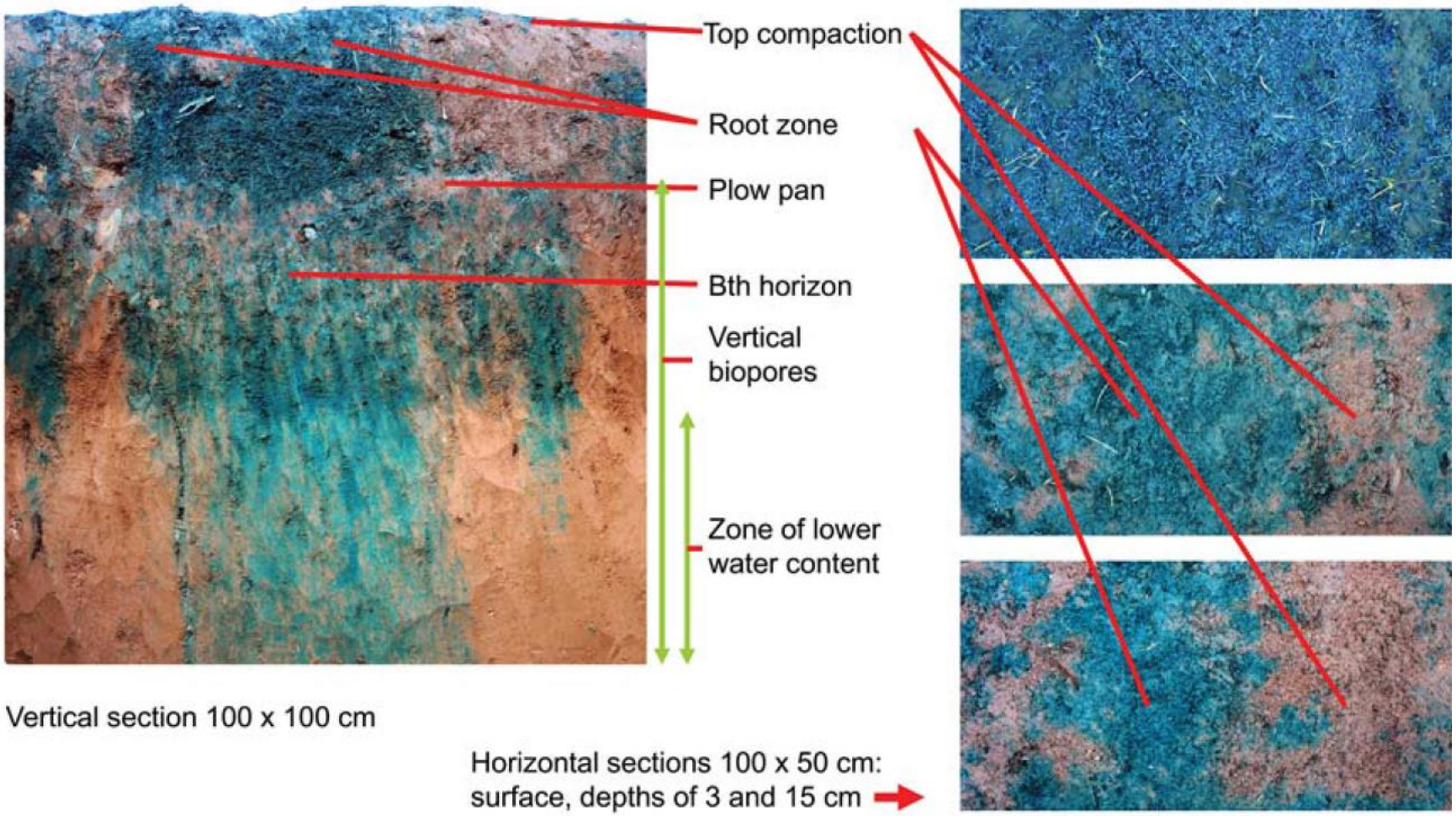
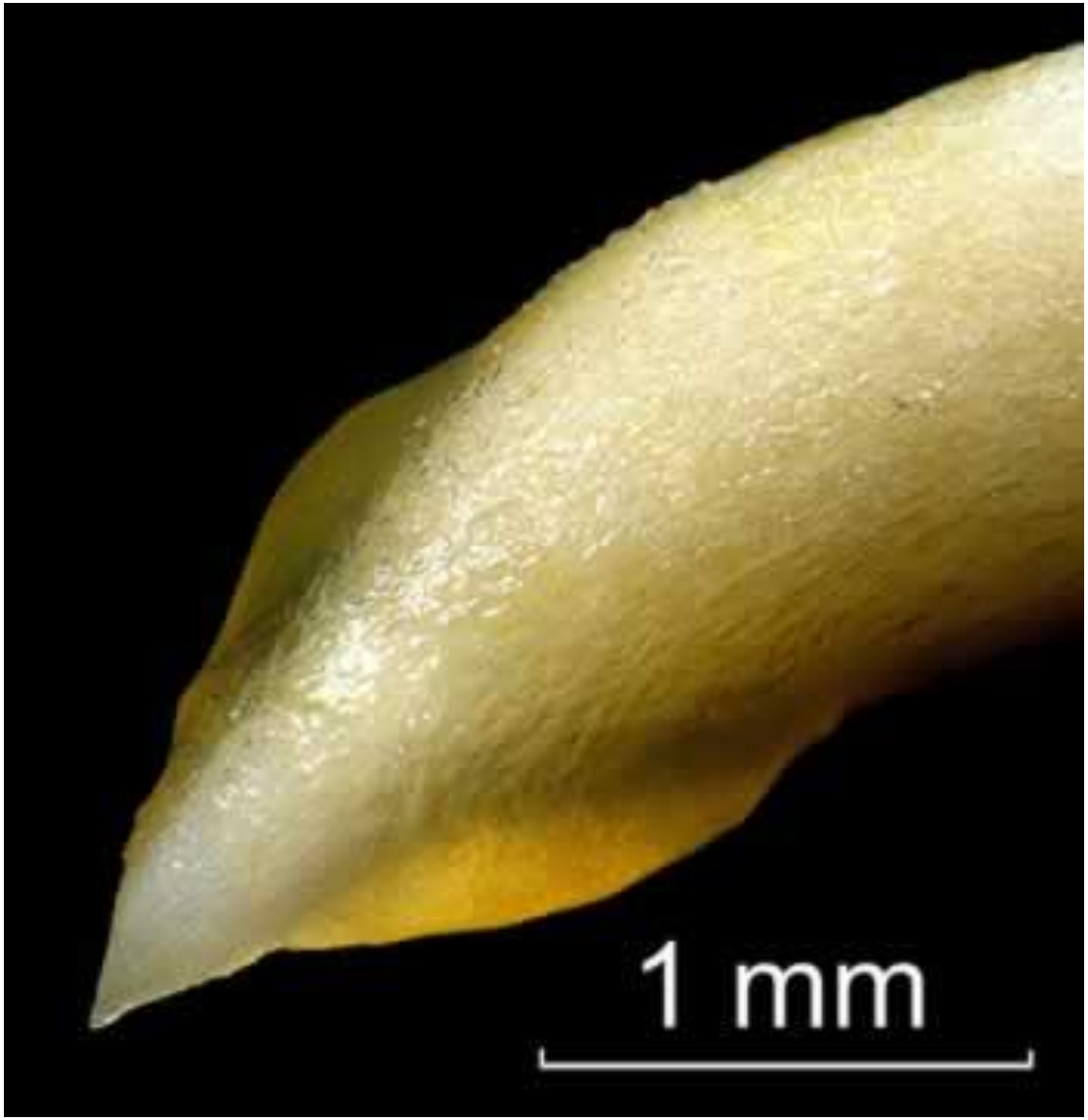


Fig. 1. Field soil sections.

Kodešová, R., et al. 2015: Using dye tracer for visualizing roots impact on soil structure and soil porous systém. Biologia 70/11: 1439—1443



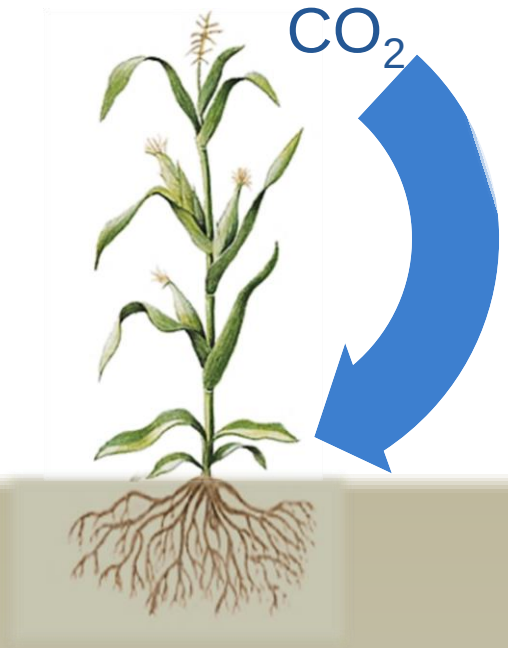
Micrograph of root cap with mucilage produced by the plant (maiz)

(Source: V. Sobolev, Agricultural Research Service, United States Department of Agriculture - ARS USDA)

Hnojení syntetickým dusíkem

Hnojení syntetickým dusíkem

Hnojení syntetickým dusíkem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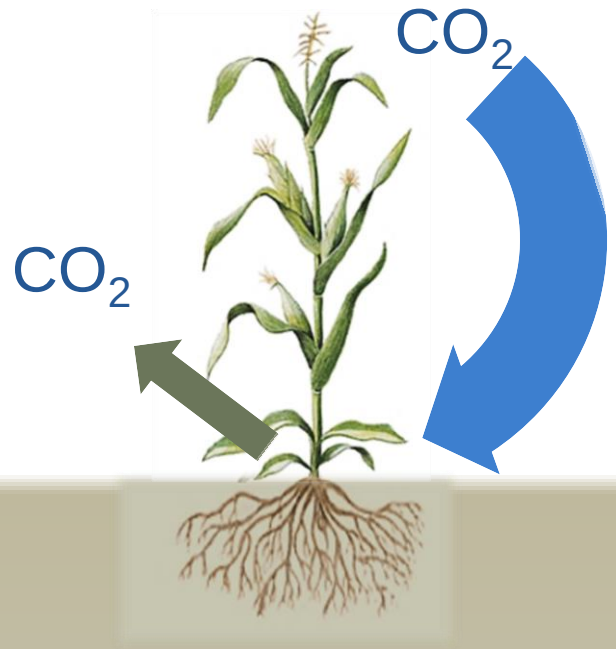
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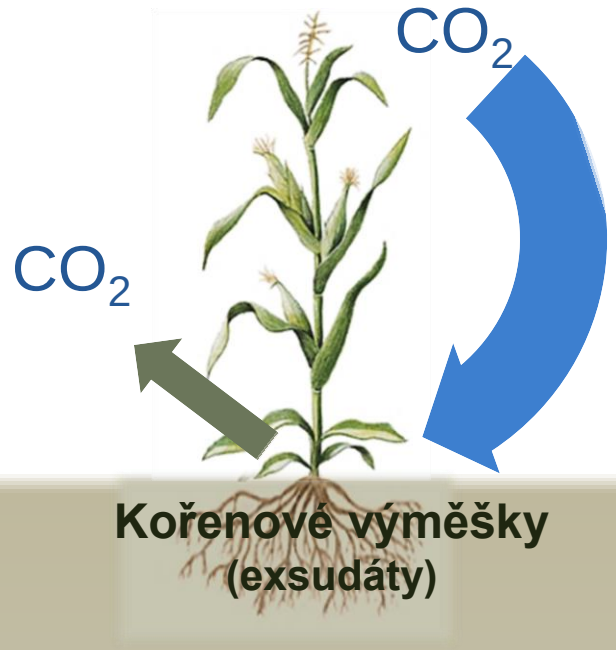
CO_2


CO_2
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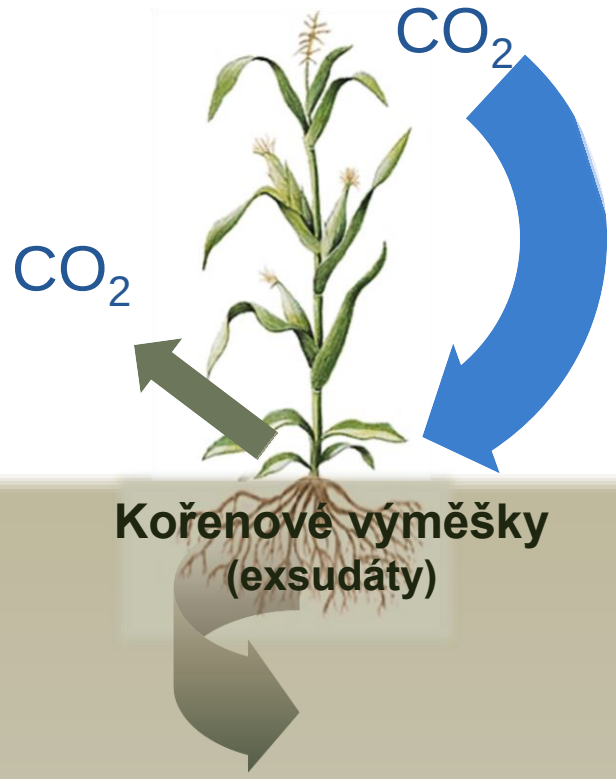
Kořenové výměšky
(exsudáty)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Kořenové výměšky
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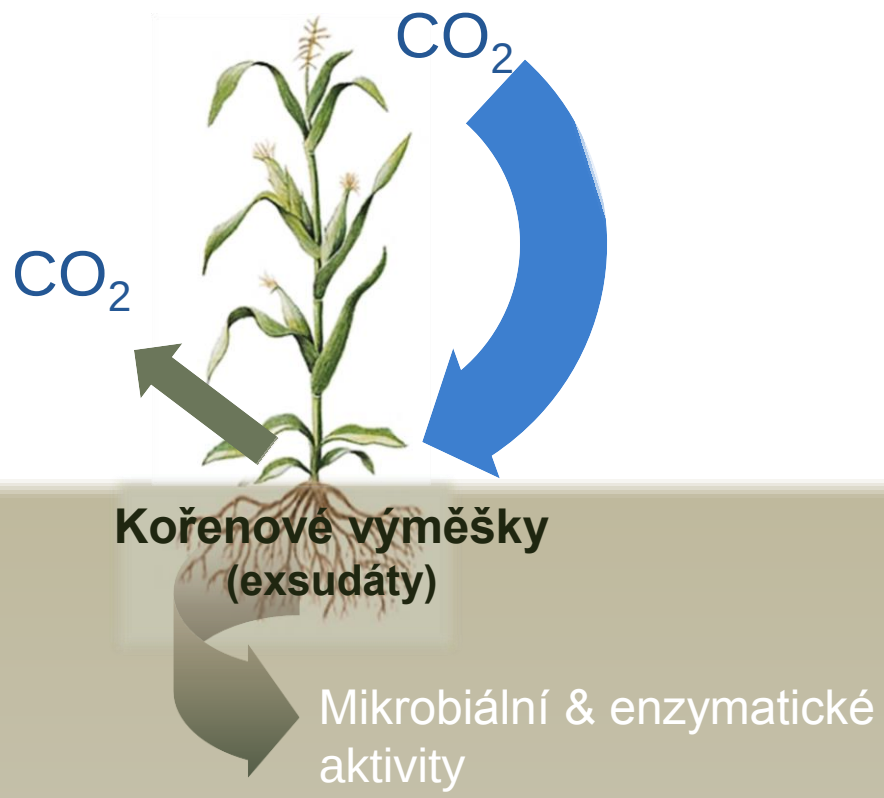
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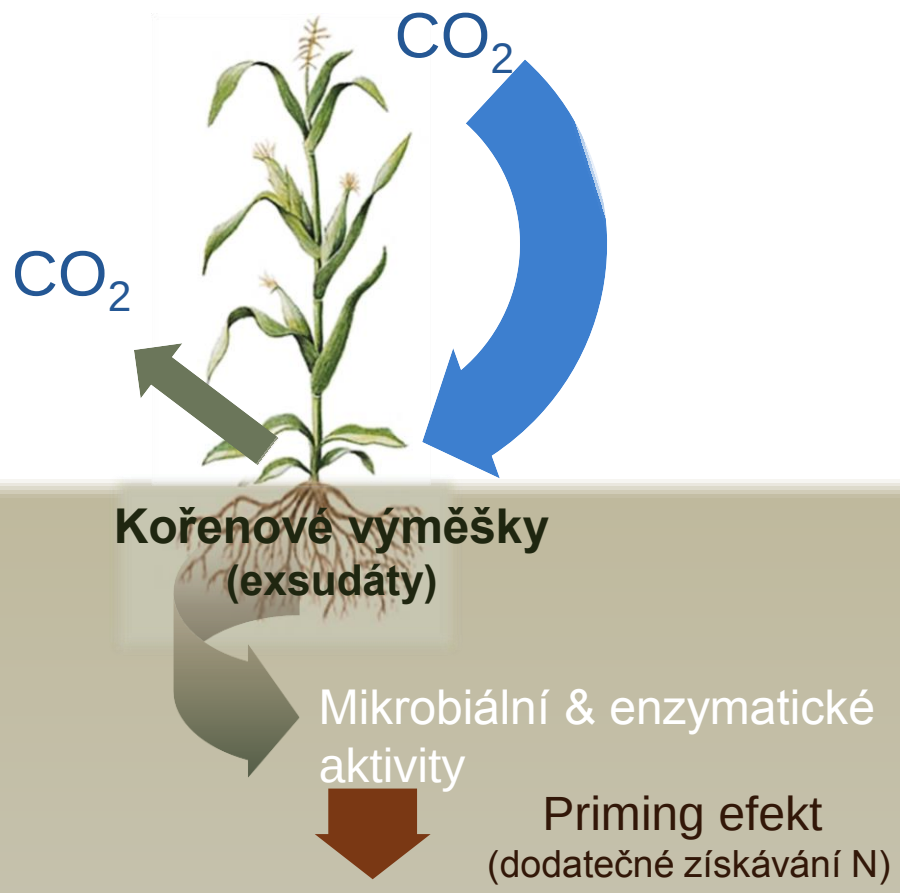
Kořenové výměšky
(exsudáty)
Mikrobiální & enzymatické aktivity


CO_2
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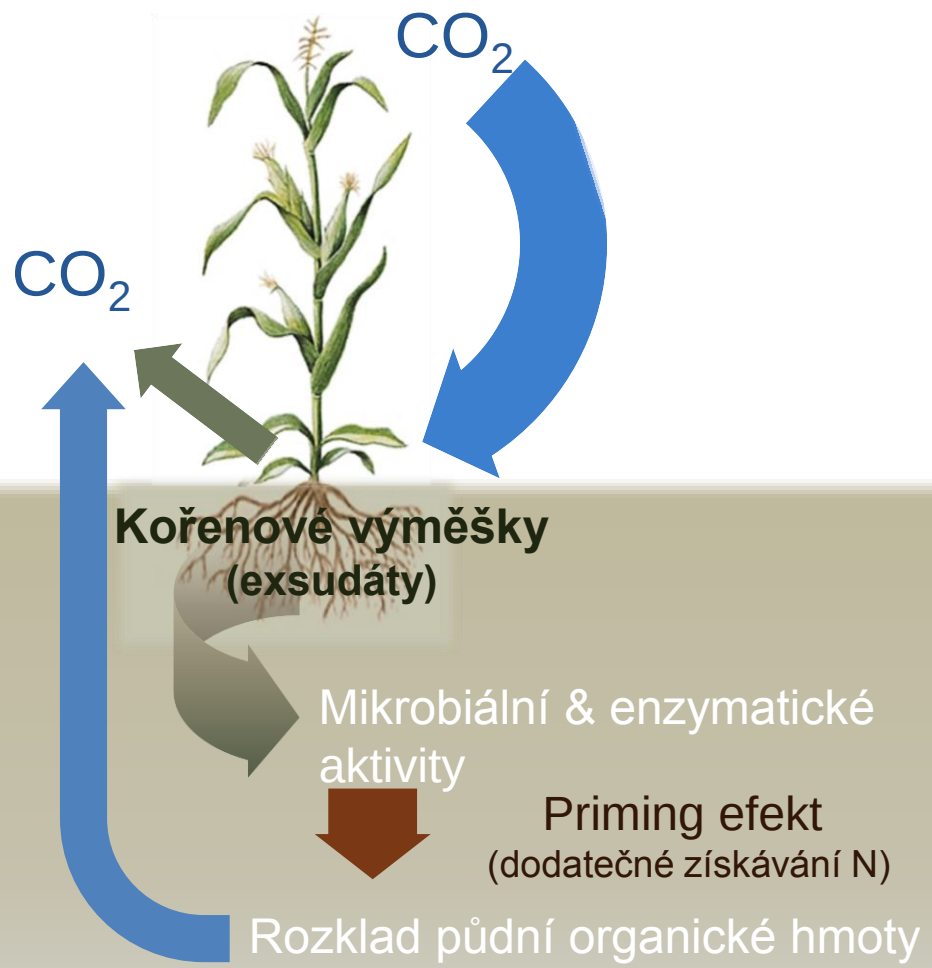
Kořenové výměšky
(exsudáty)
Mikrobiální & enzymatické aktivity
Priming efekt
(dodatečné získávání N)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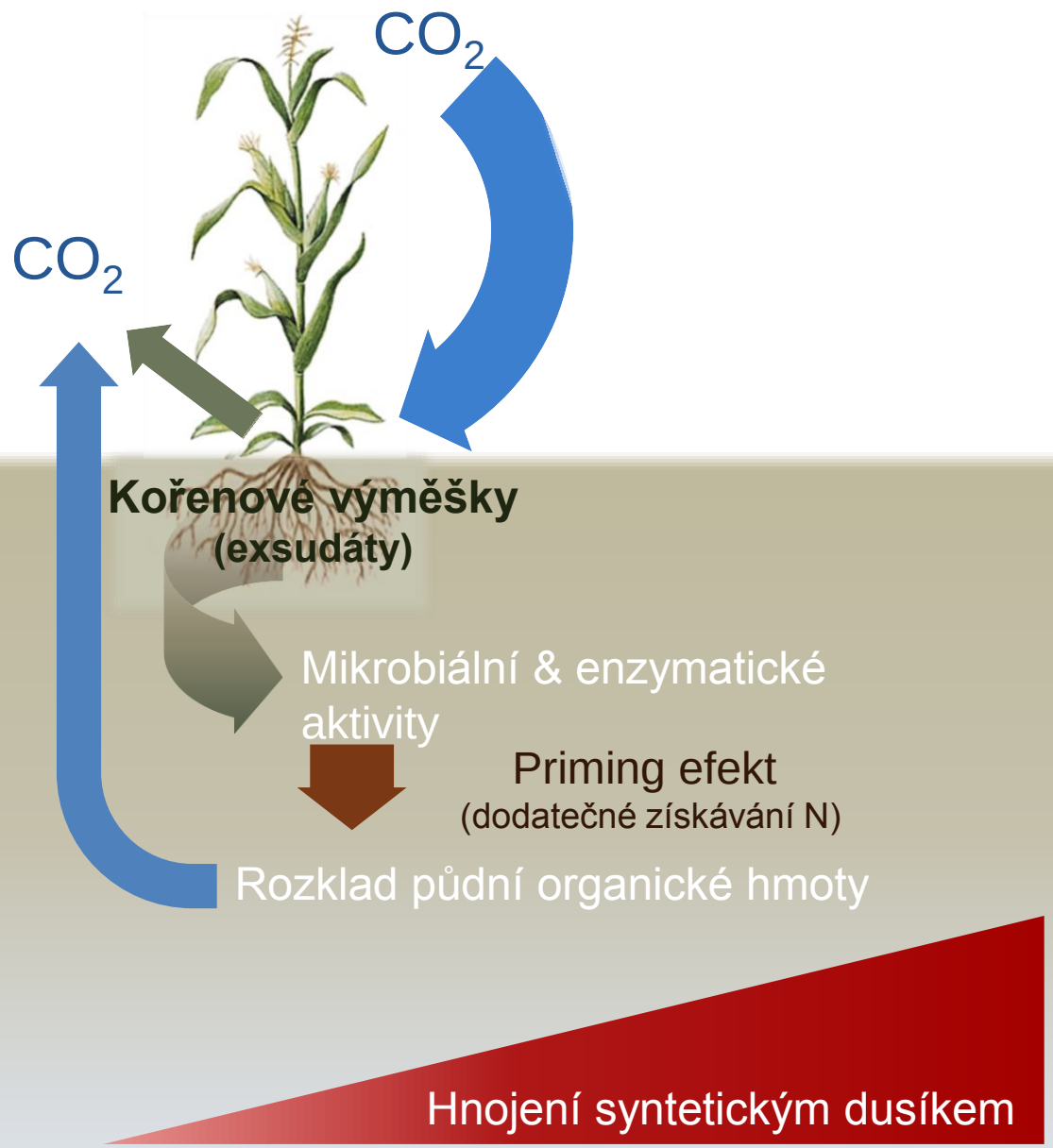
Kořenové výměšky
(exsudáty)
Mikrobiální & enzymatické aktivity
Priming efekt
(dodatečné získávání N)
Rozklad půdní organické hmoty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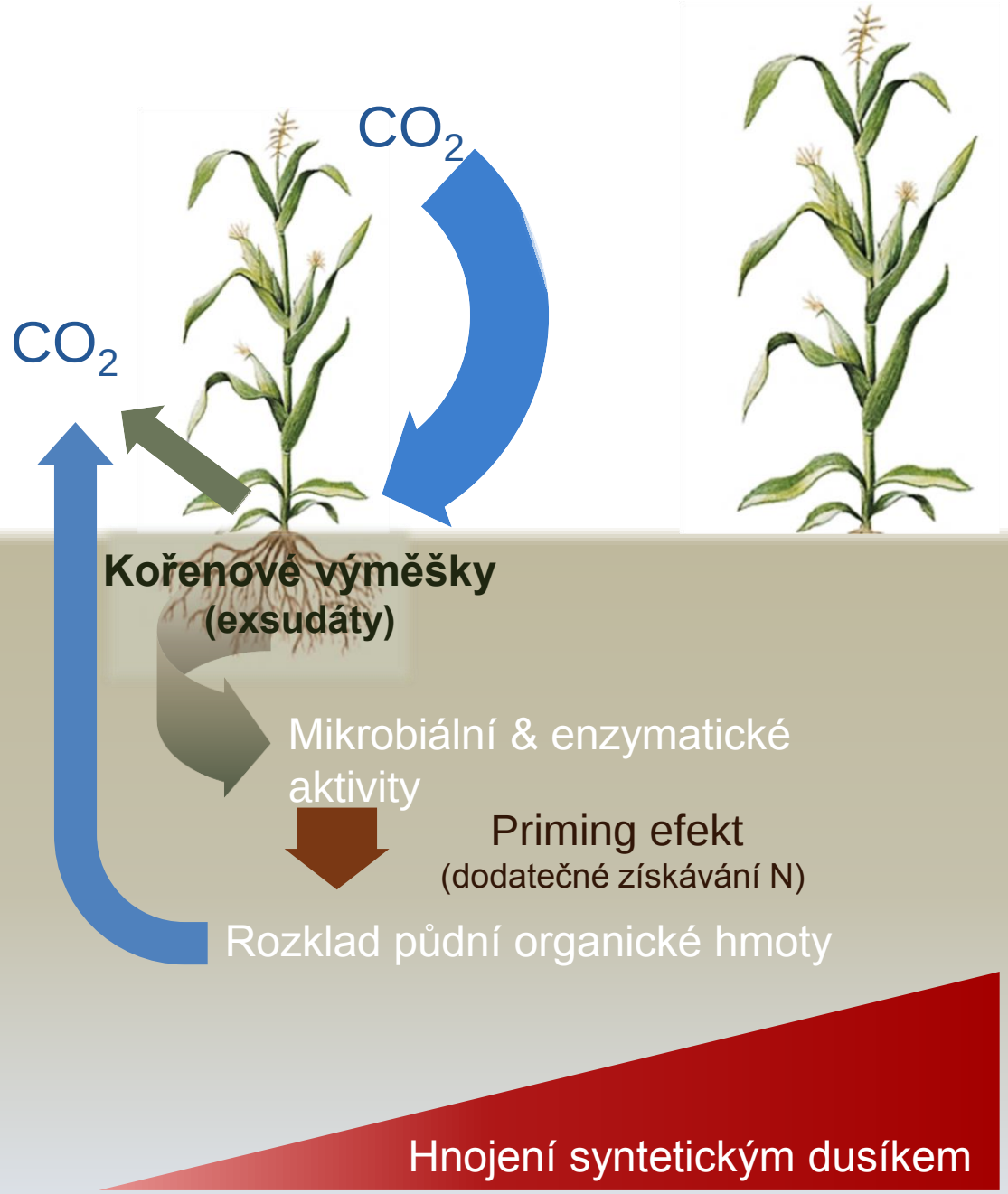
Kořenové výměšky
(exsudáty)
Mikrobiální & enzymatické aktivity
Priming efekt
(dodatečné získávání N)
Rozklad půdní organické hmoty
Hnojení syntetickým dusíkem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Mikrobiální & enzymatické aktivity
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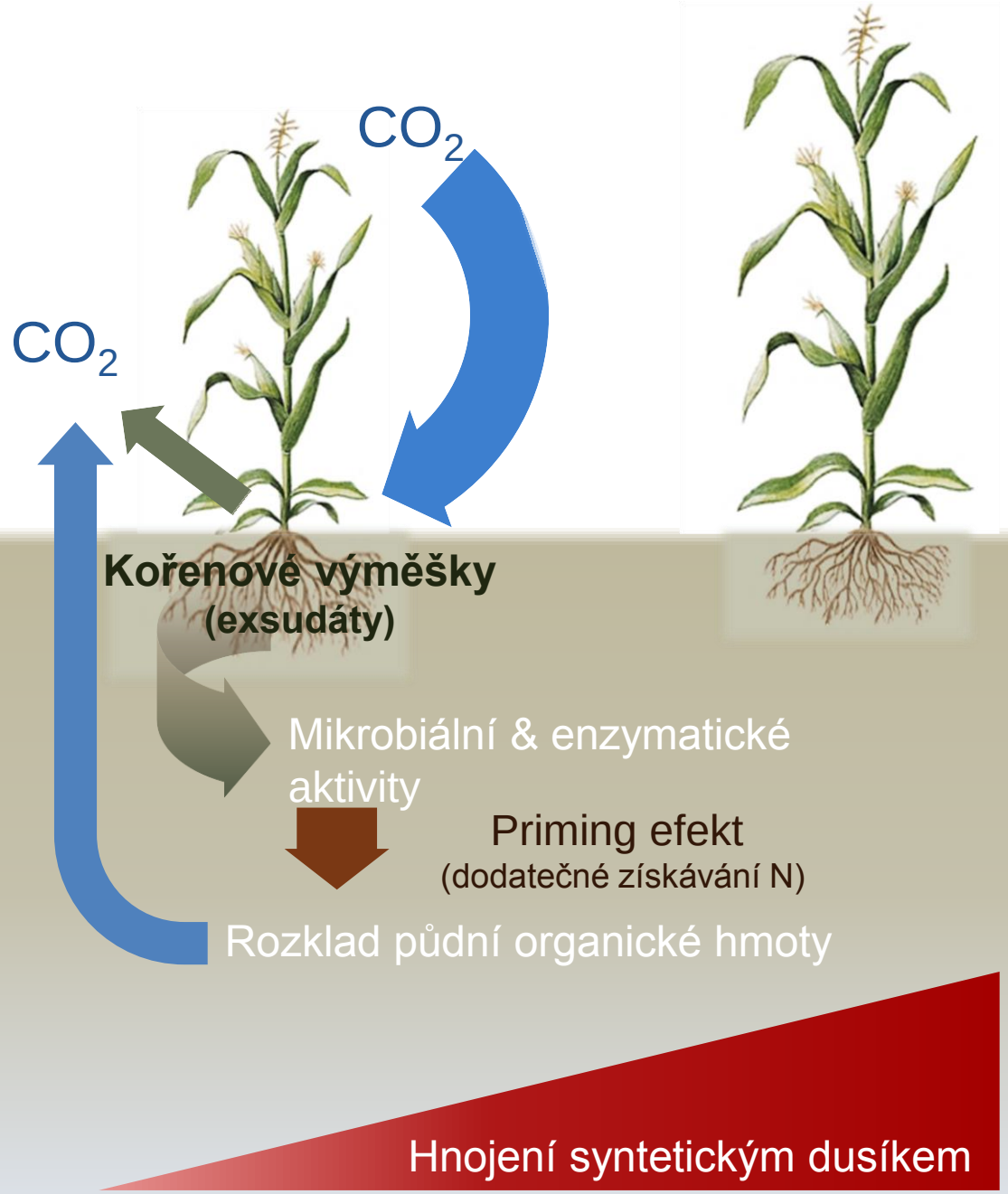
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Mikrobiální & enzymatické aktivity
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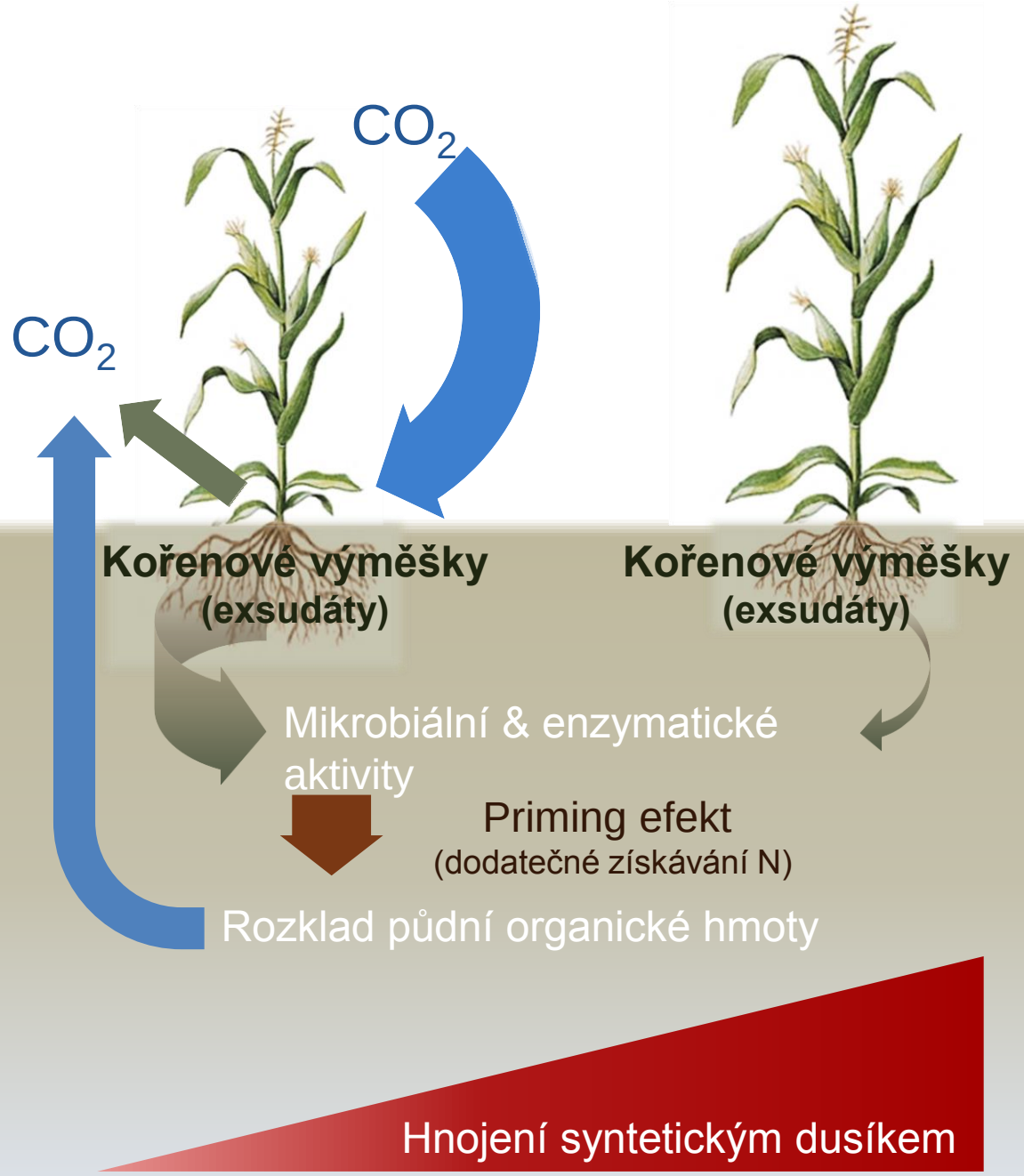
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Kořenové výměšky
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Kořenové výměšky
(exsudáty)
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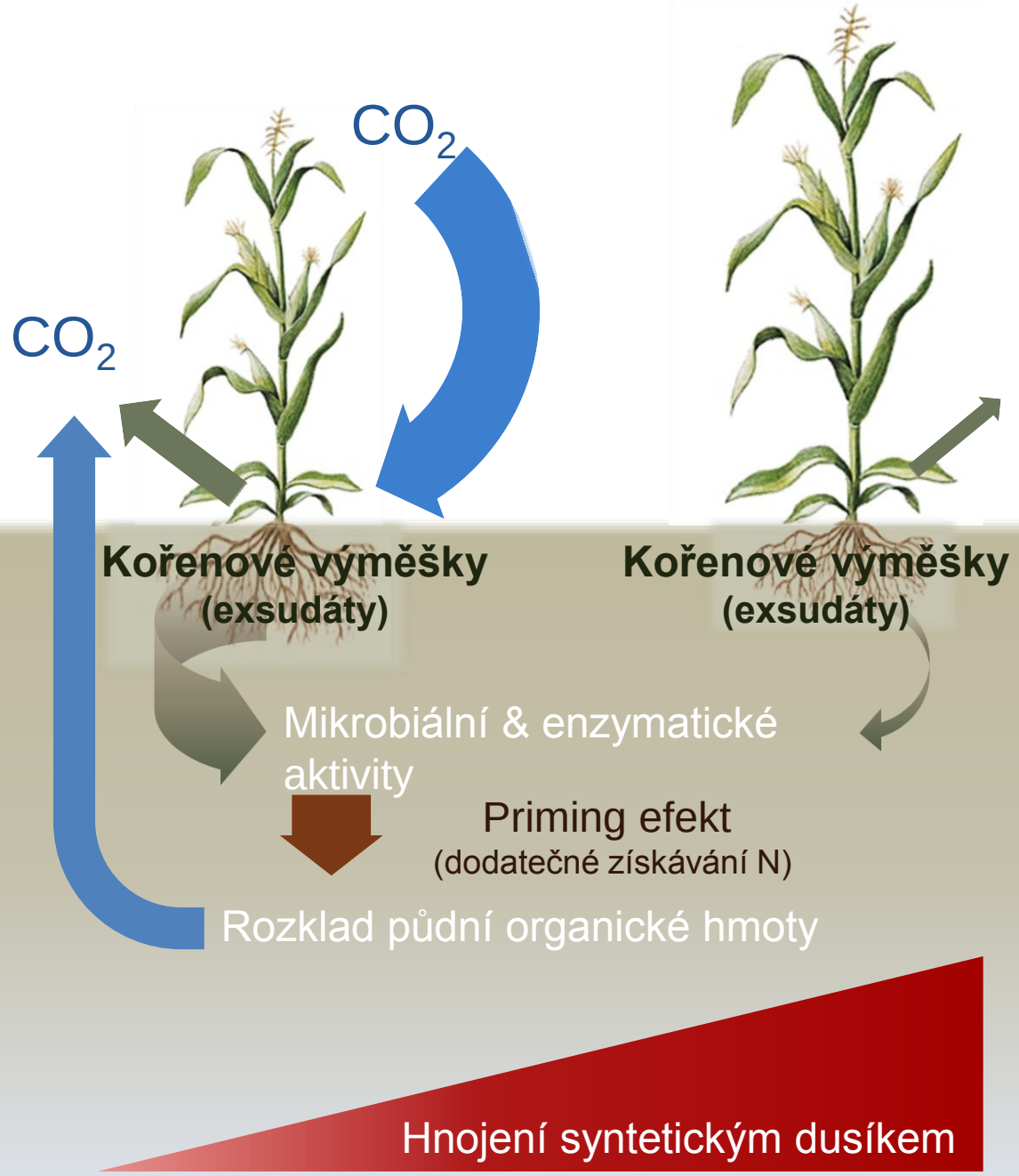
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Kořenové výměšky
(exsudáty)
Mikrobiální & enzymatické aktivity
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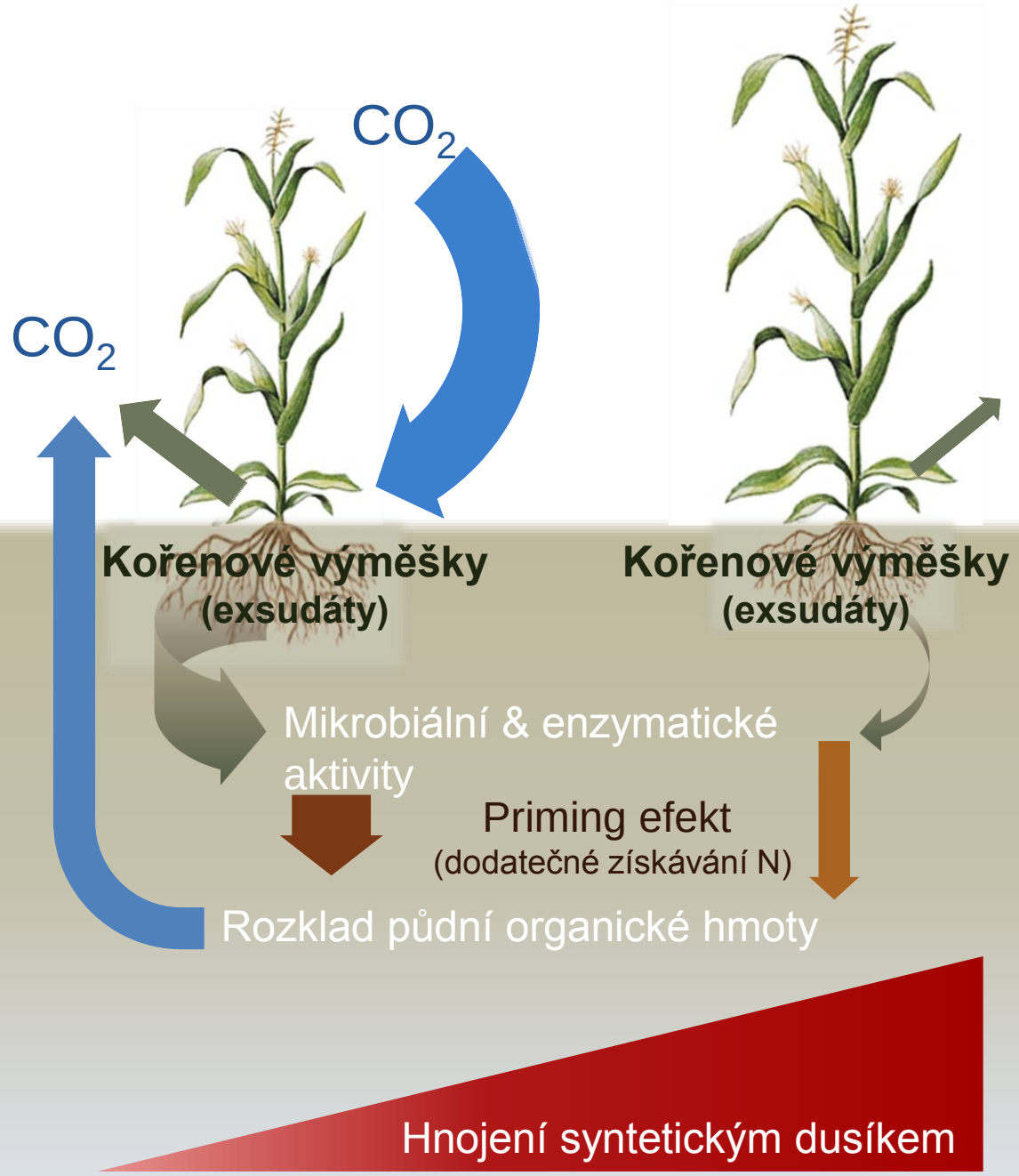
Hnojení syntetickým dusíkem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Kořenové výměšky
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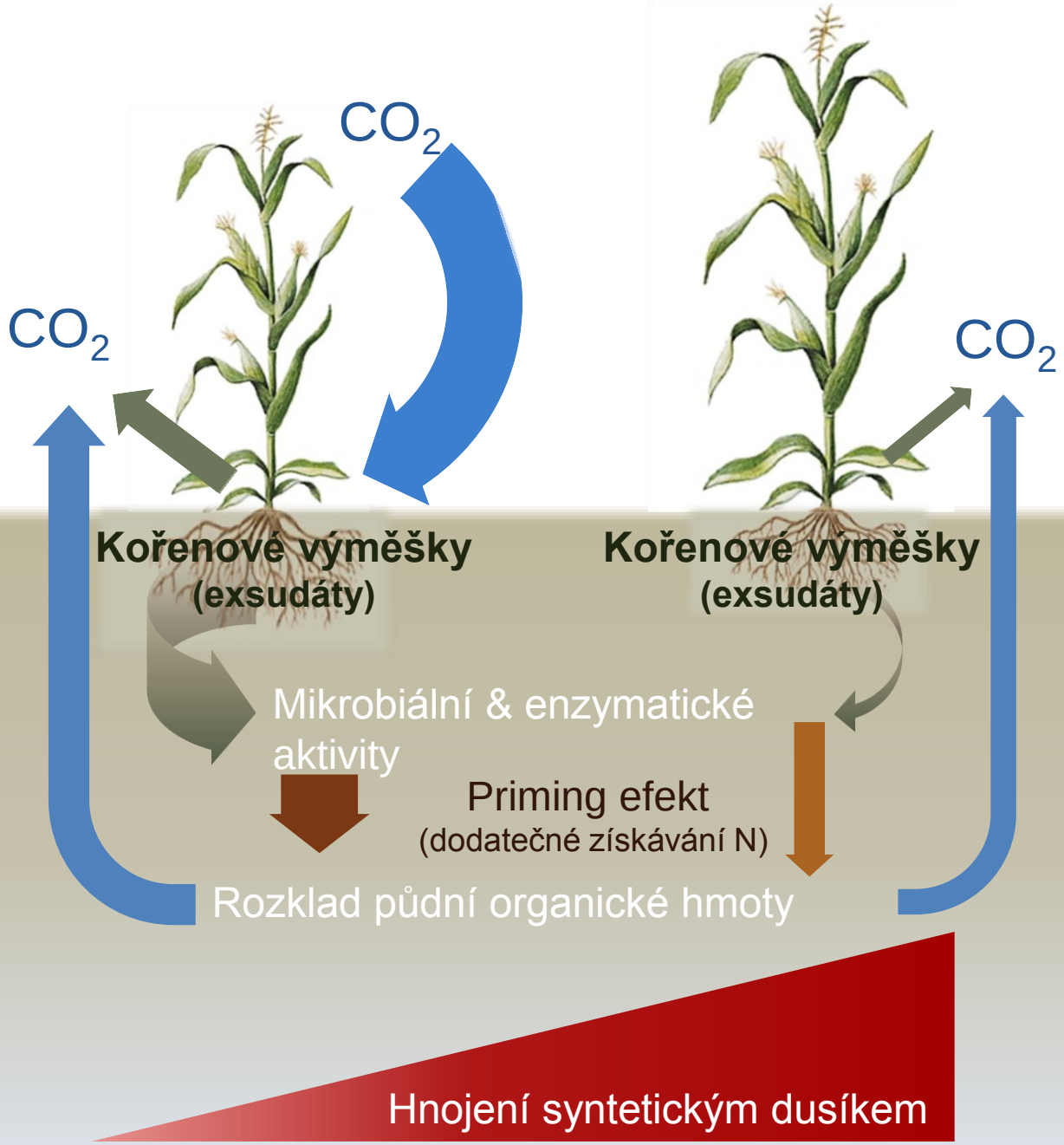
Kořenové výměšky
(exsudáty)
Mikrobiální & enzymatické aktivity
Priming efekt
(dodatečné získávání N)
Rozklad půdní organické hmoty
Hnojení syntetickým dusíkem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Kořenové výměšky
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Kořenové výměšky
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Mikrobiální & enzymatické aktivity
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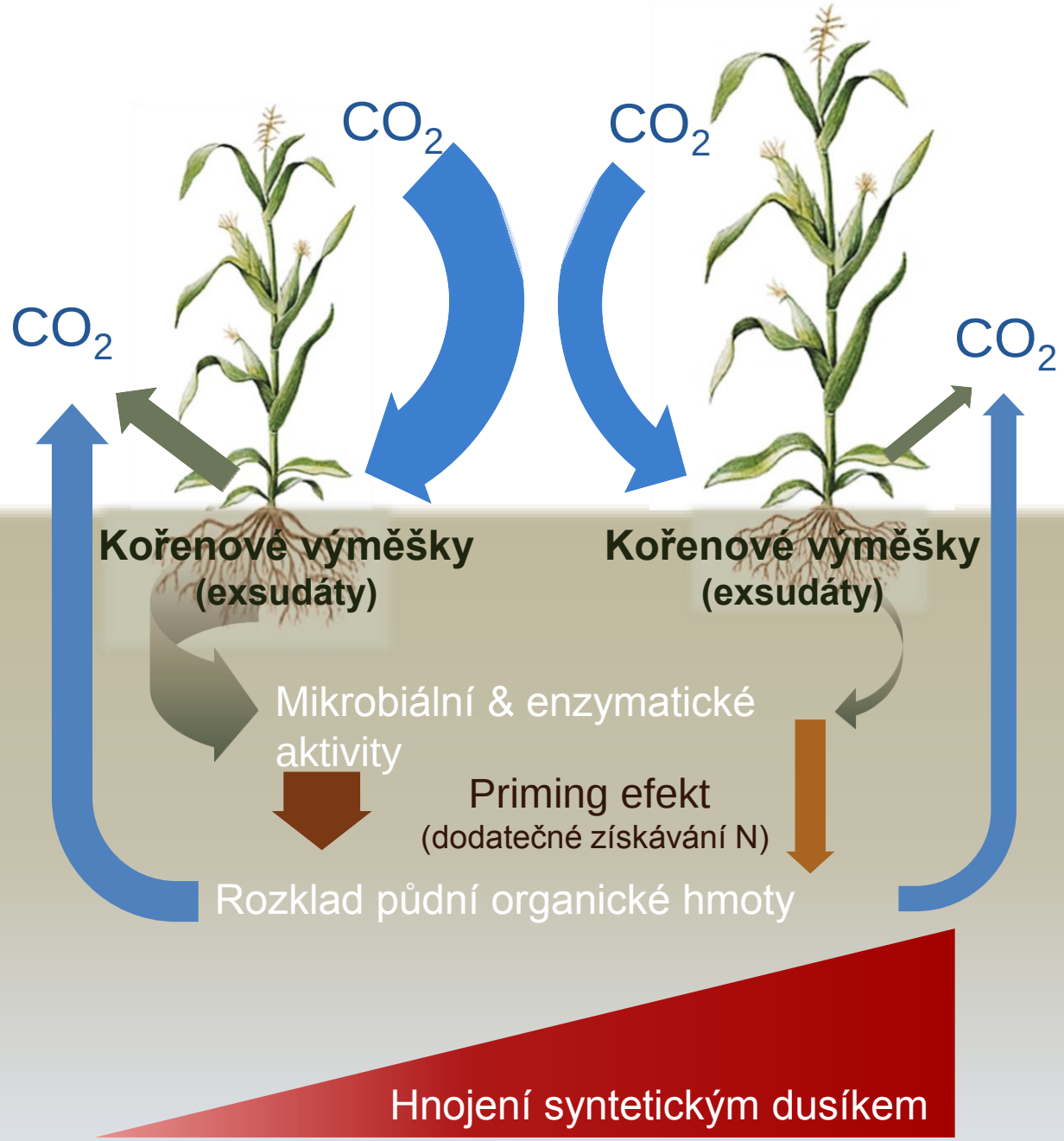
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Kořenové výměšky
(exsudáty)
Mikrobiální & enzymatické aktivity
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(dodatečné získávání N)
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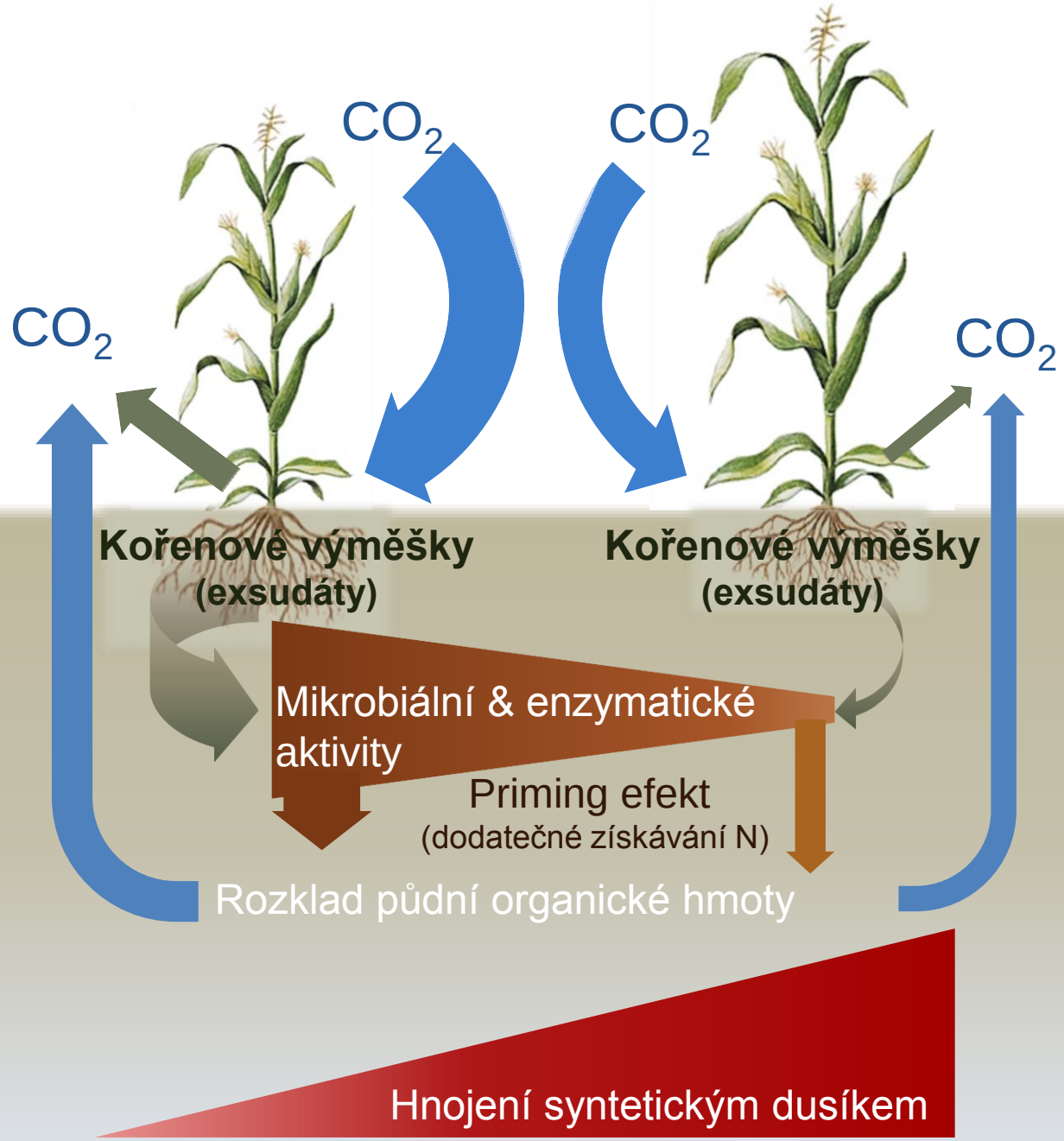
Hnojení syntetickým dusíkem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Kořenové výměšky
(exsudáty)
Mikrobiální & enzymatické aktivity
Priming efekt
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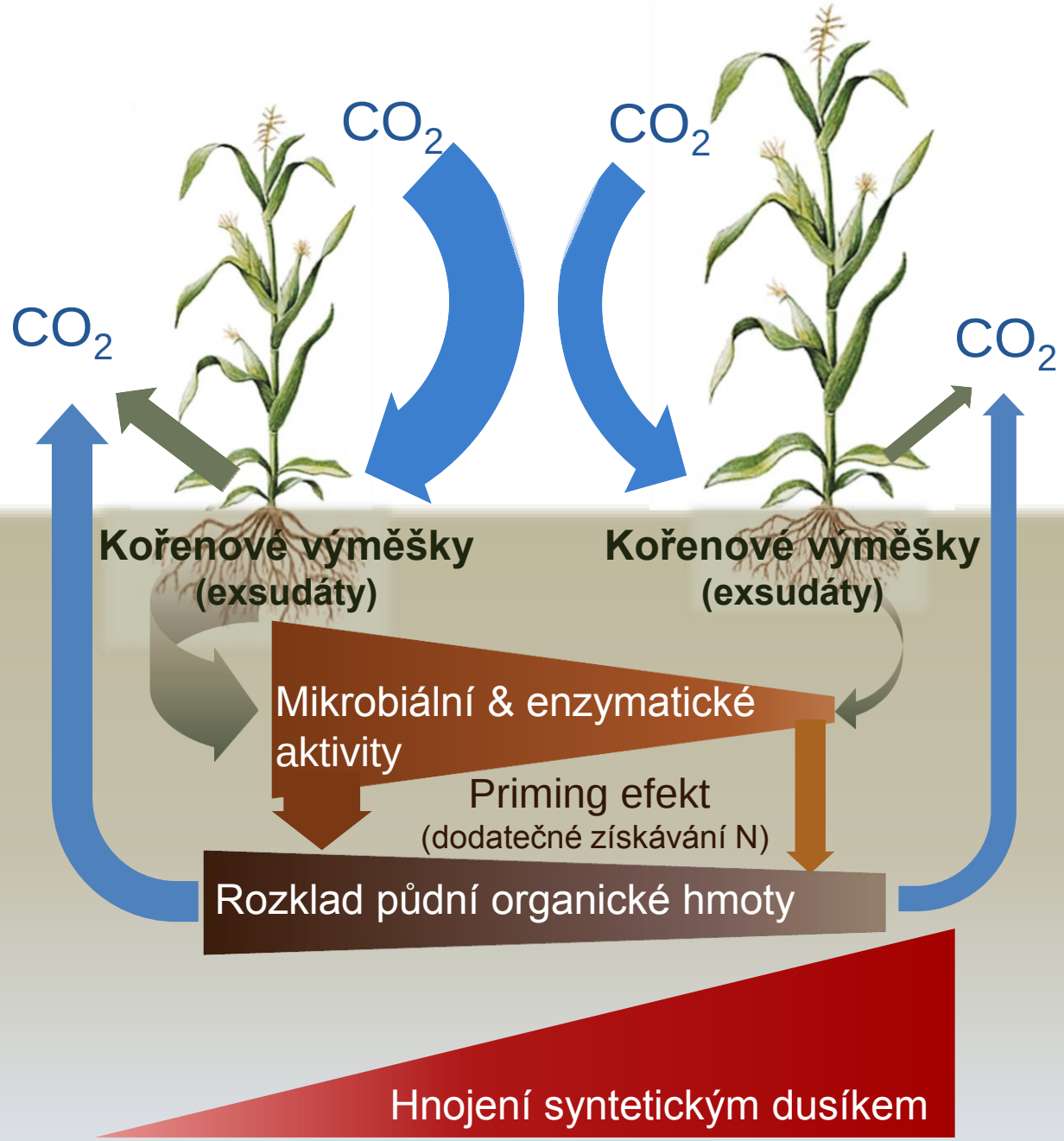
Rozklad půdní organické hmoty
Hnojení syntetickým dusíkem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Kořenové výměšky
(exsudáty)
Kořenové výměšky
(exsudáty)
Mikrobiální & enzymatické aktivity
Priming efekt
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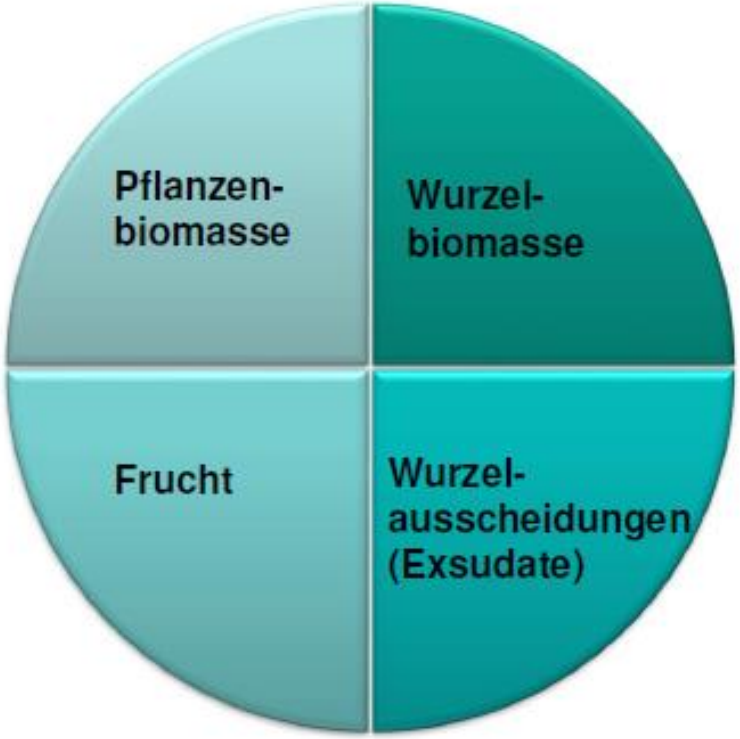
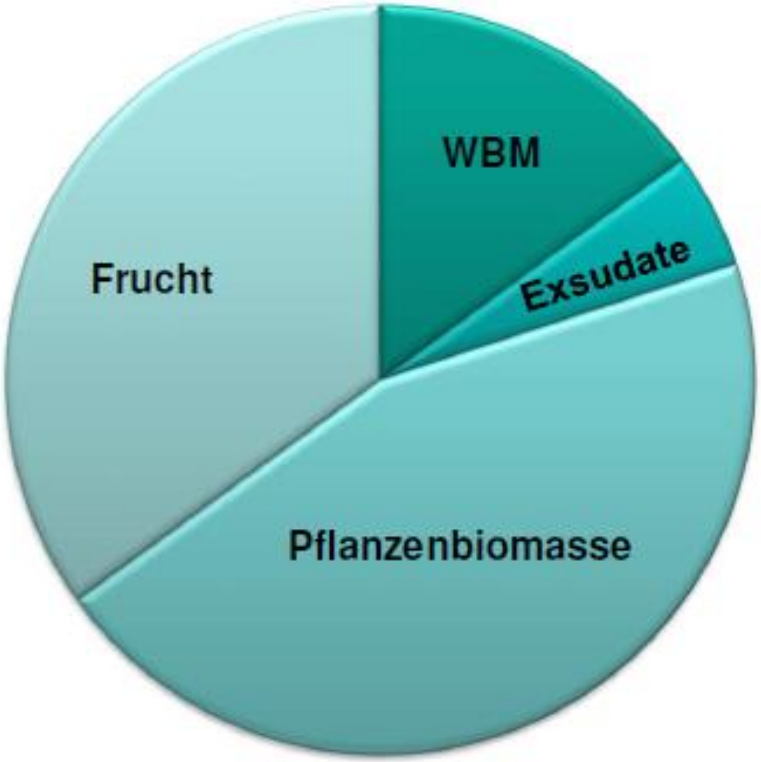
Rozklad půdní organické hmoty
Hnojení syntetickým dusíkem

Christoph Felgentreu
Deutsche Saatveredelung AG
Kaindorf, 23.01.2018

Maiswurzelspitze mit Schleimabsonderung (Exsudat)

Ergebnis im gestörtem Boden:

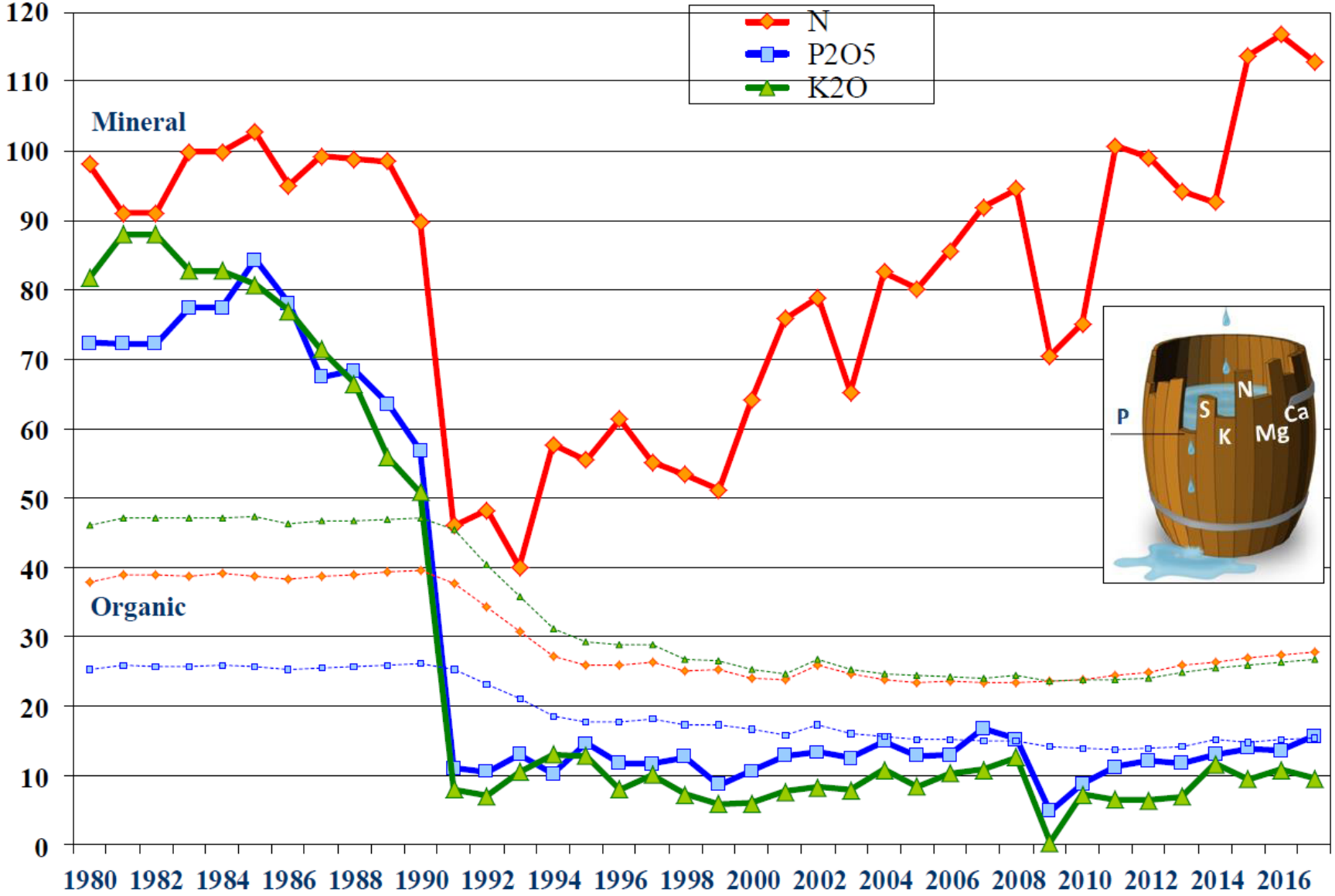




ca. 50 % der Pflanzenbiomasse befindet sich im Boden

Average fertilizers consumption in the Czech Republic

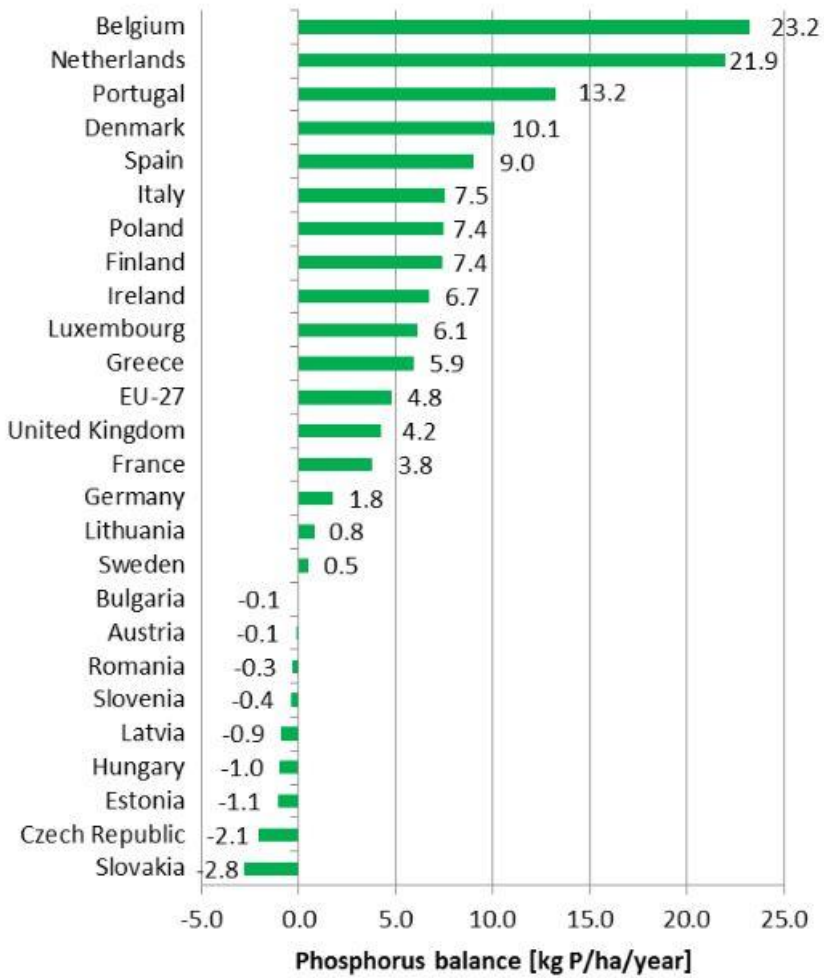
(kg of nutrients per 1 ha UAA: 3,5 mil. ha in 2017)



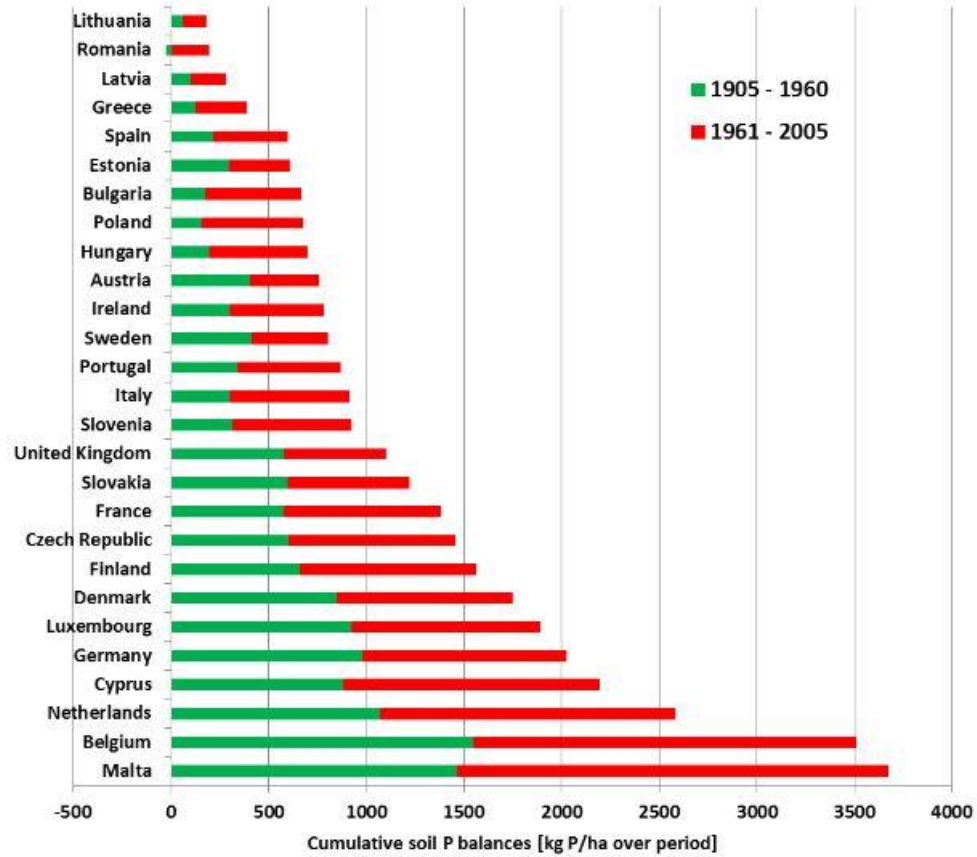
Soil structure, fertilizer management and crop cultivation in Czech agriculture

Jan Klír, Crop Research Institute, Praha – Ruzyně; Michal Hejcman, Czech University of Life Sciences Prague

Agricultural P balances per country for 2005 & period 1905 - 2005

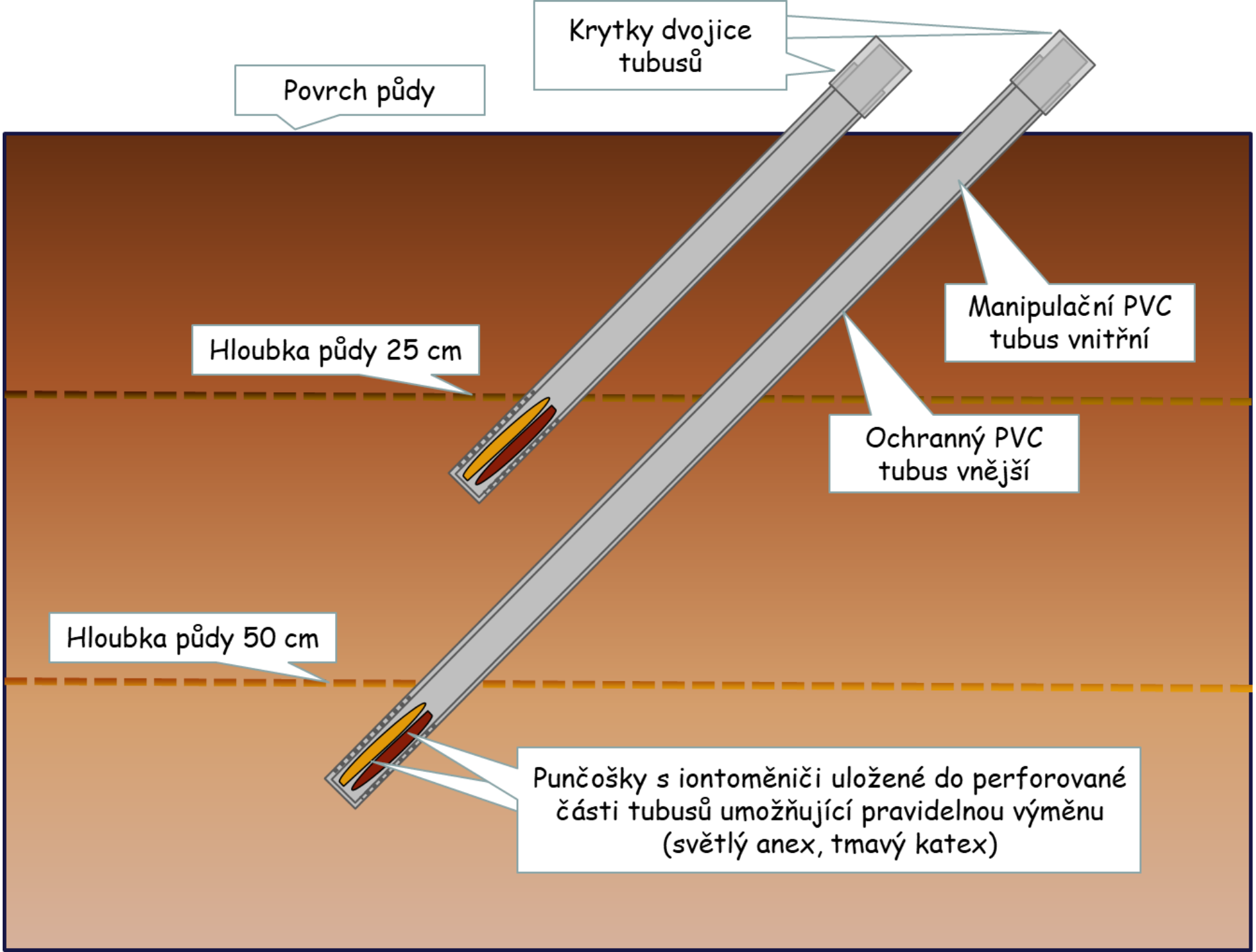


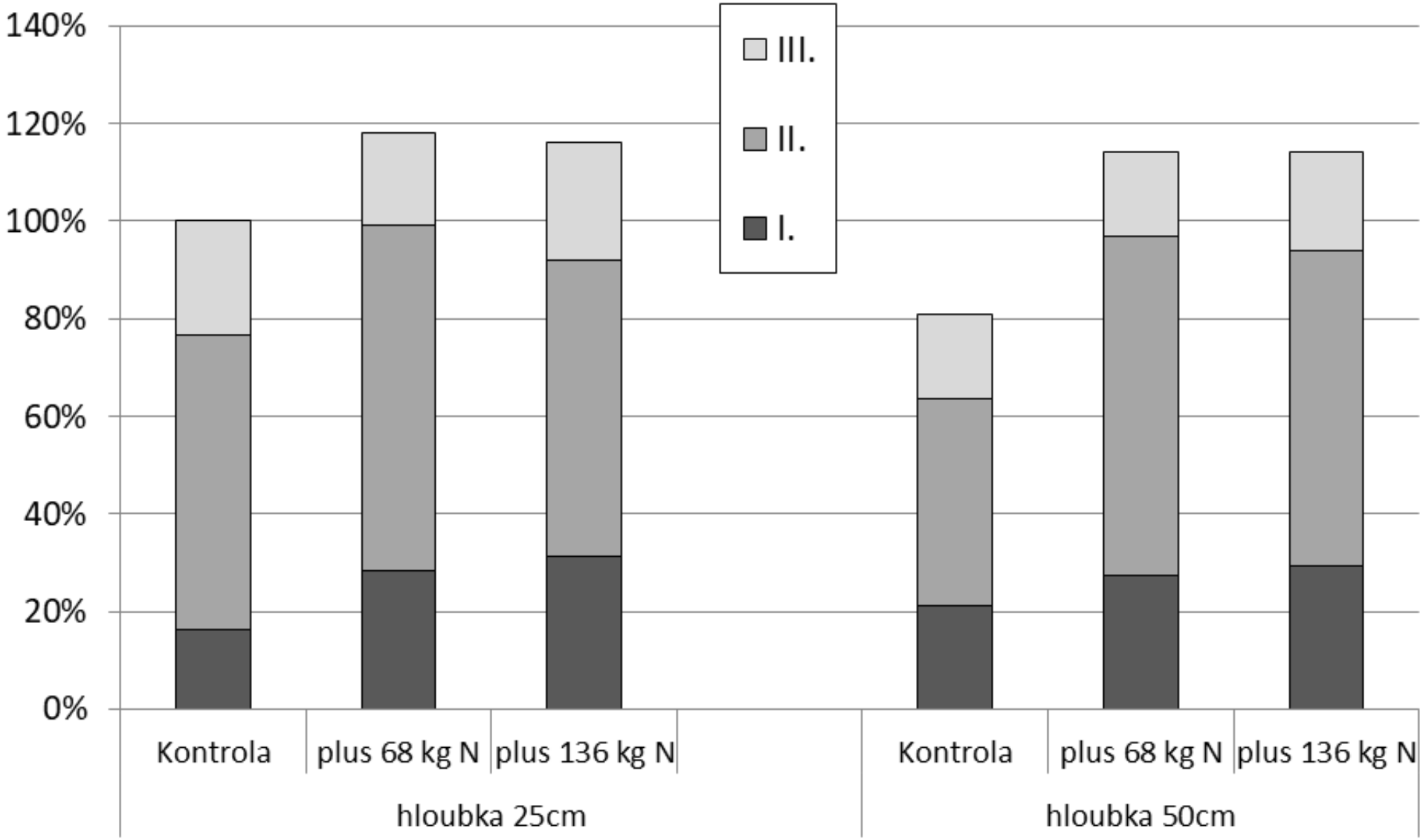
128 Mtons P accumulated in agricultural soils between 1905 -2005

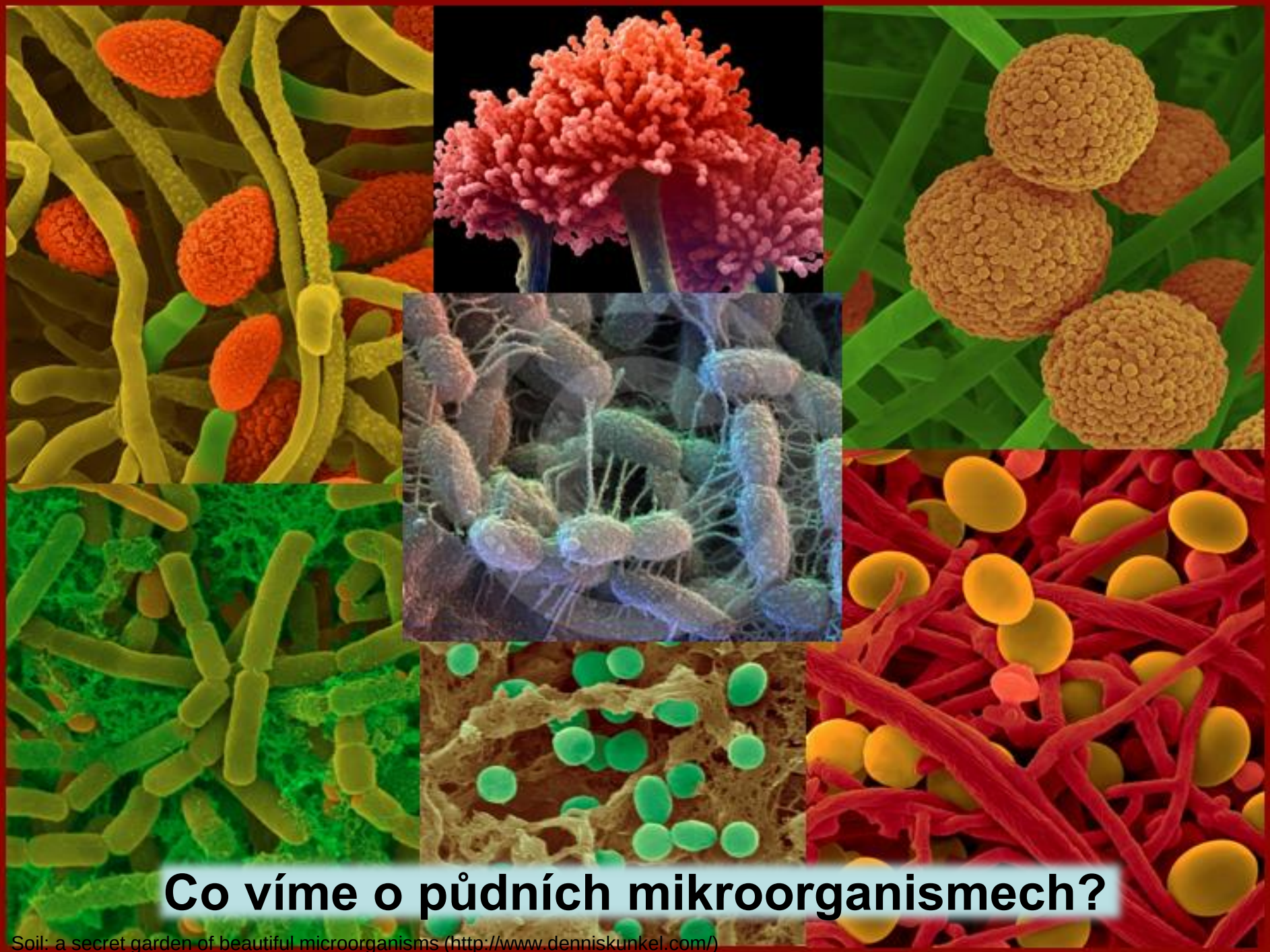


Van Dijk et al. (2015)

Van Dijk et al. (submitted)

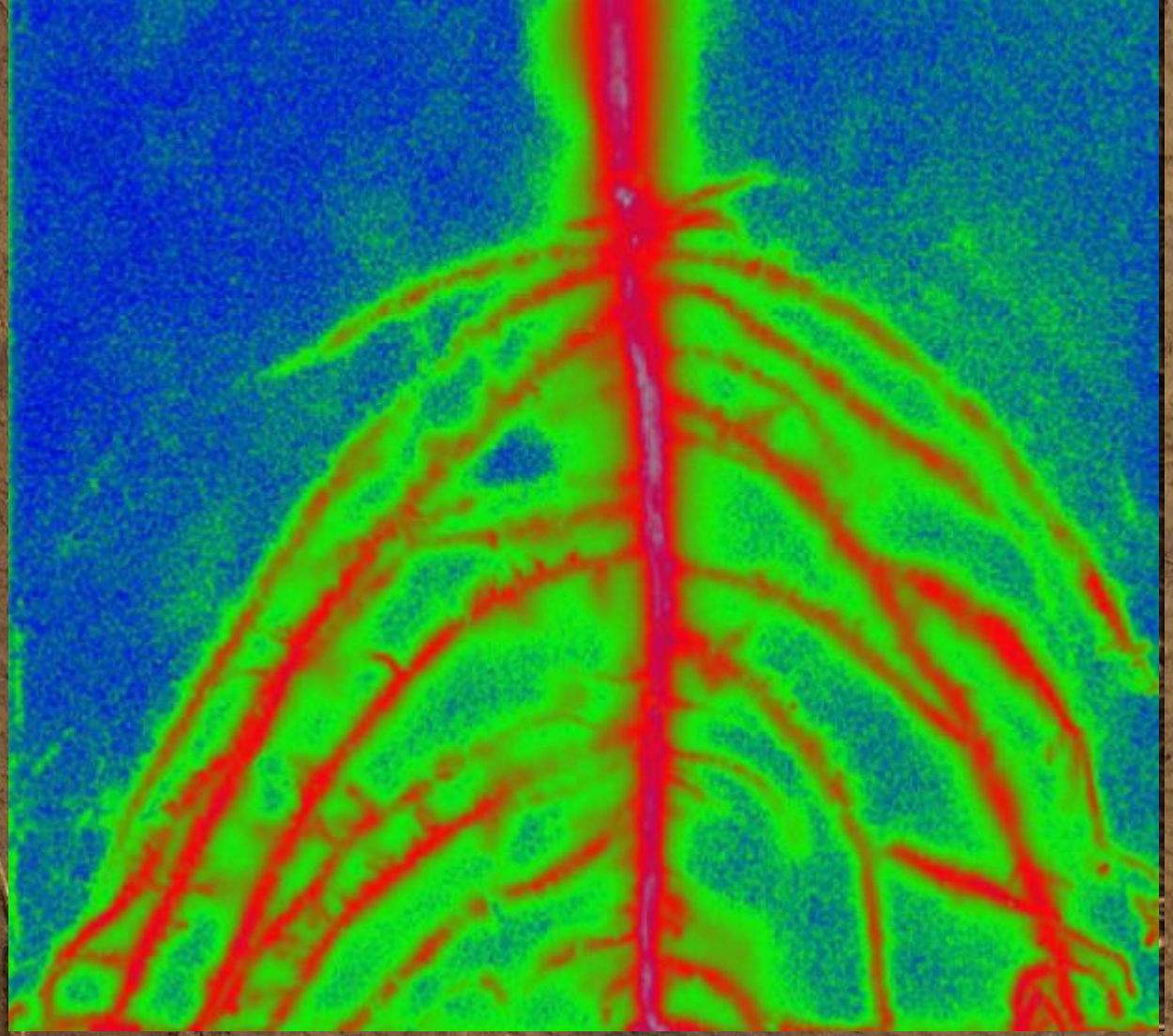

Krytky dvojice tubusů
Povrch půdy
Manipulační PVC tubus vnitřní
Hloubka půdy 25 cm
Ochranný PVC tubus vnější
Hloubka půdy 50 cm
Punčošky s iontoměniči uložené do perforované části tubusů umožňující pravidelnou výměnu (světlý anex, tmavý katex)


140%
120%
100%
80%
60%
40%
20%
0%
III.
II.
I.
Kontrola
plus 68 kg N
plus 136 kg N
Kontrola
plus 68 kg N
plus 136 kg N
hloubka 25cm
hloubka 50cm



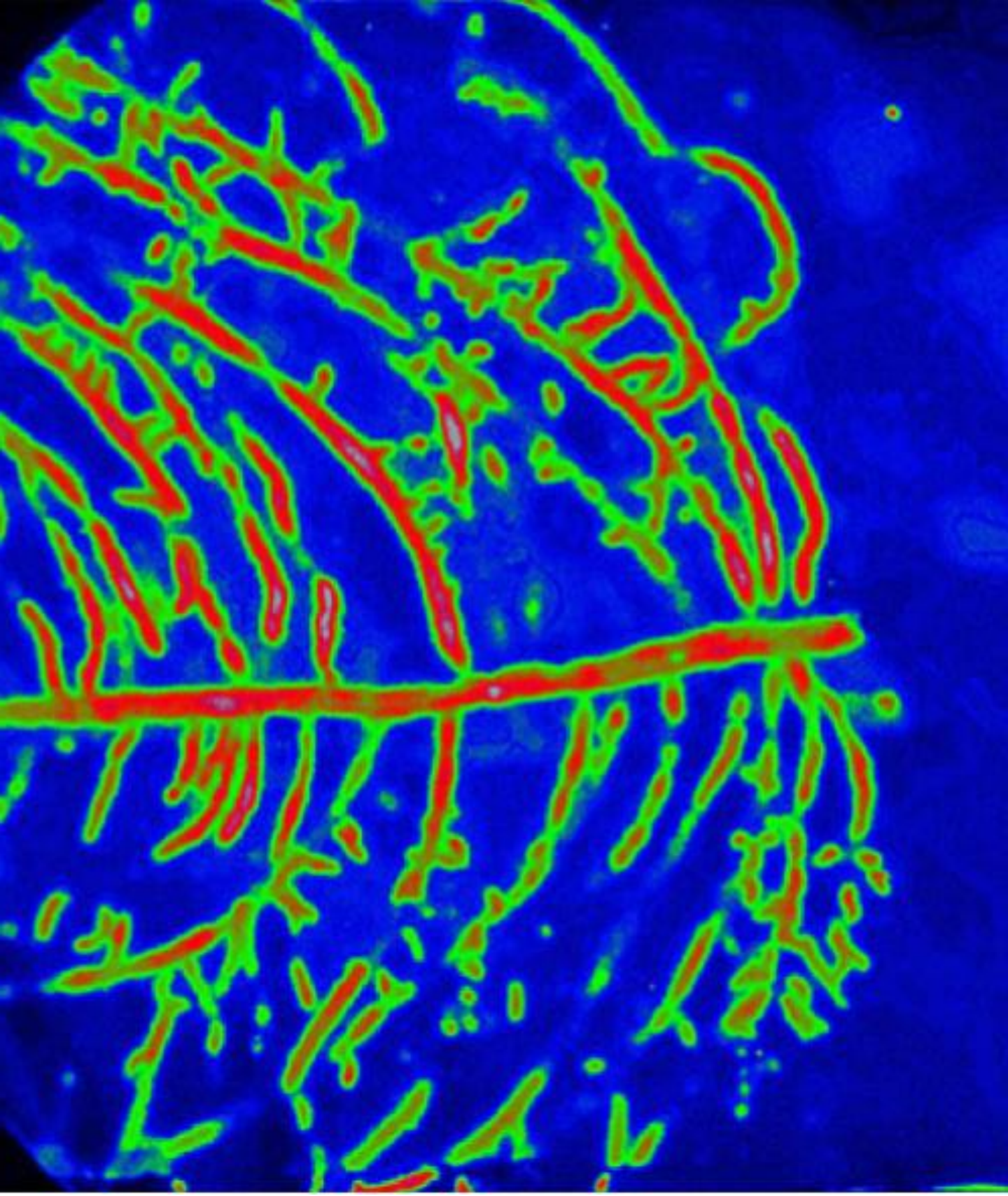
Co víme o půdních mikroorganismech?

Soil: a secret garden of beautiful microorganisms (http://www.denniskunkel.com/)



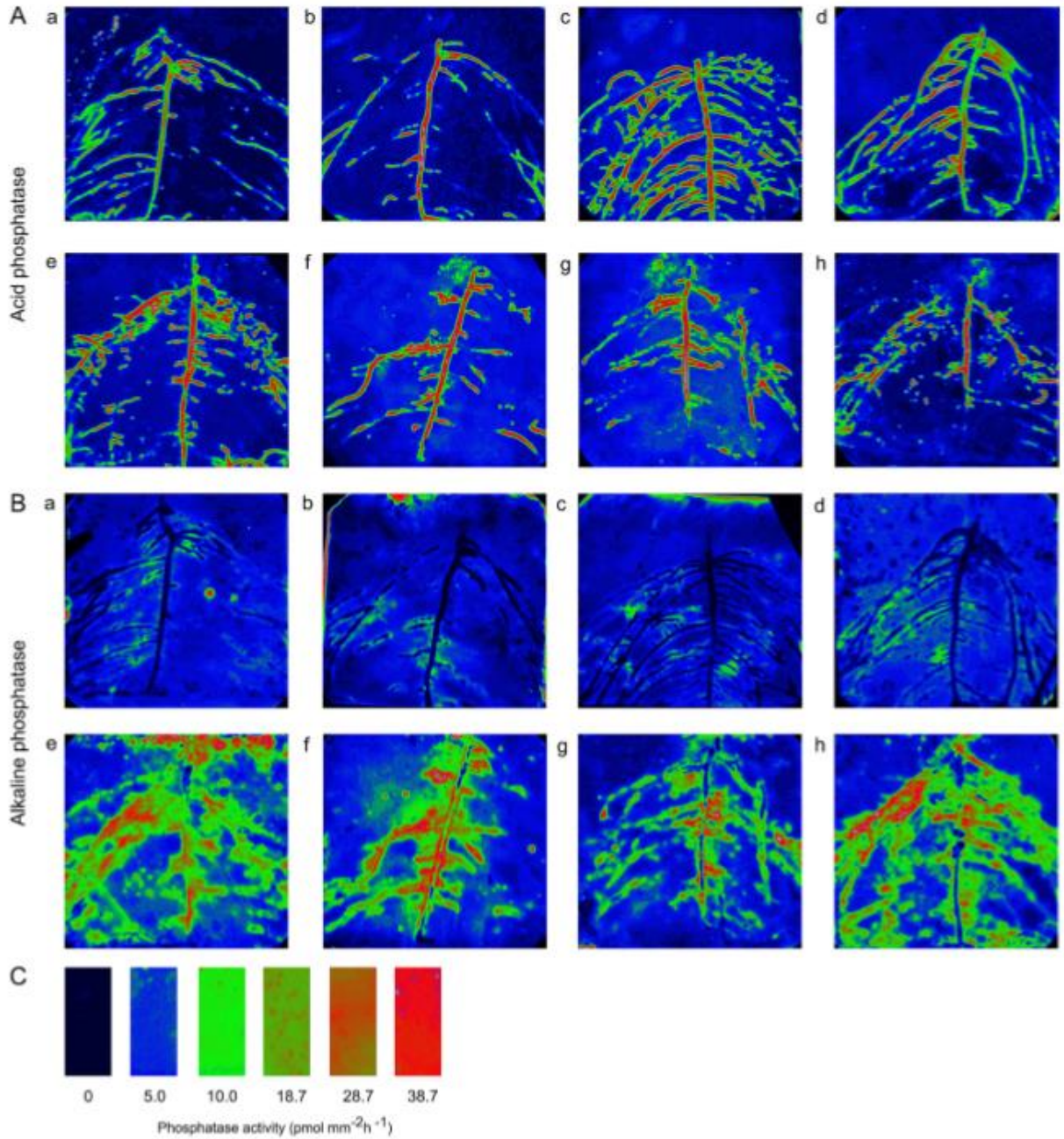
Rhizodeposition assessed by ^{14}C imaging.

Kuzyakov et al. , University of Göttingen, Germany



Activity of acid phosphatase by zymography of lupine roots.

Kuzyakov et al. , University of Göttingen, Germany



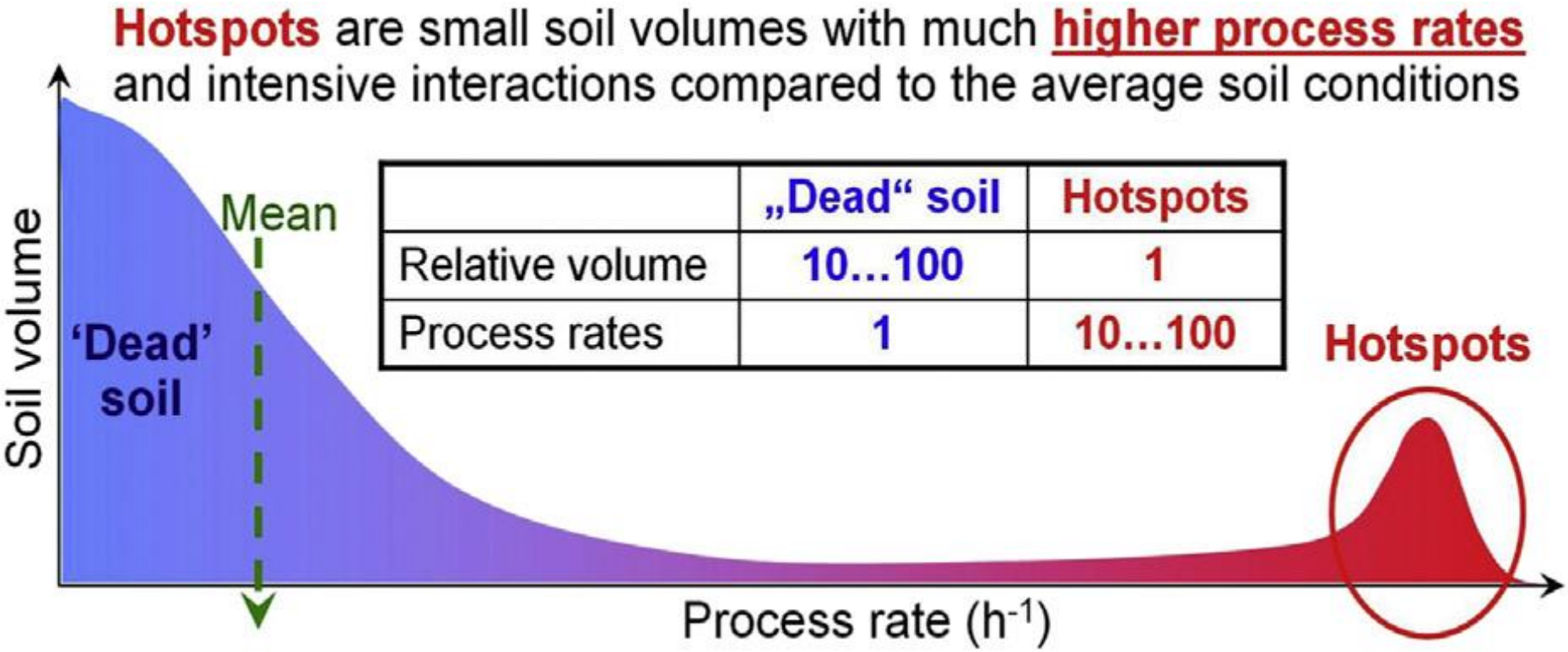
Soil + P

Control soil

Soil + P

Control soil

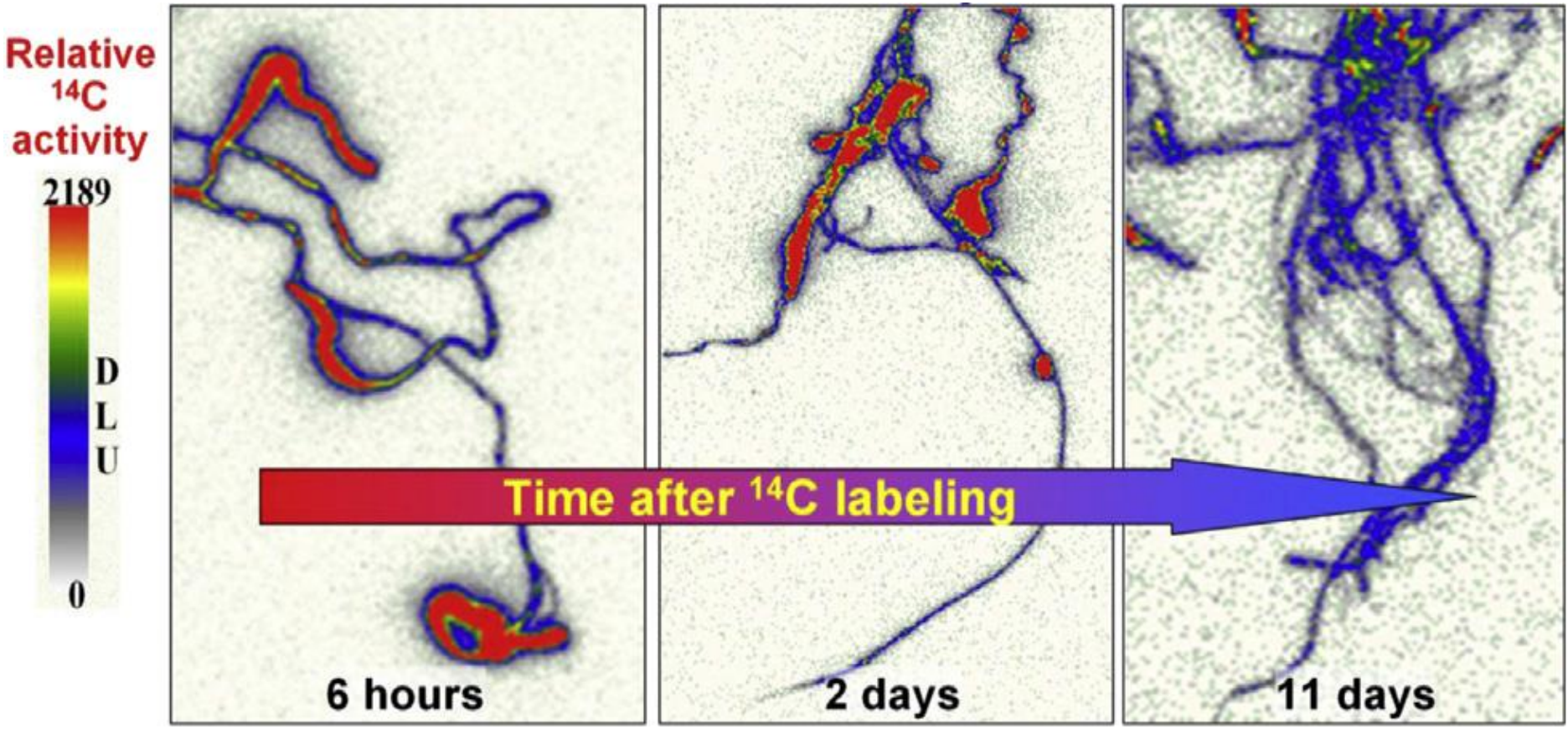
Fig. 2. Zymograms showing acid phosphatase (A) and alkaline phosphatase (B) together with the calibration line (C) that is composed of six calibration membranes. Images a–d show P amended soils and images e–h show control soils.



	„Dead“ soil	Hotspots
Relative volume	10…100	1
Process rates	1	10…100

Concept of microbial hotspots in soil: Hotspots are small soil volumes with much higher process rates and intensive interactions compared to the average soil conditions. The Table inset represents the relative volume and process rates in the hotspots and bulk soil. “Mean” represents the weighted average process rates by soil mixing.

Y. Kuzyakov, 186 E. Blagodatskaya / Soil Biology & Biochemistry 83 (2015) 184-199



^{14}C imaging of relative ^{14}C activity at the root tips at increasing time after labeling of *Lolium perenne* in $^{14}CO_2$ atmosphere: 6 h, 2 d, and 11 d after the ^{14}C labeling. The color scale presents the ^{14}C activity as digital light units (DLU) (from Pausch and Kuzyakov, 2011, changed)

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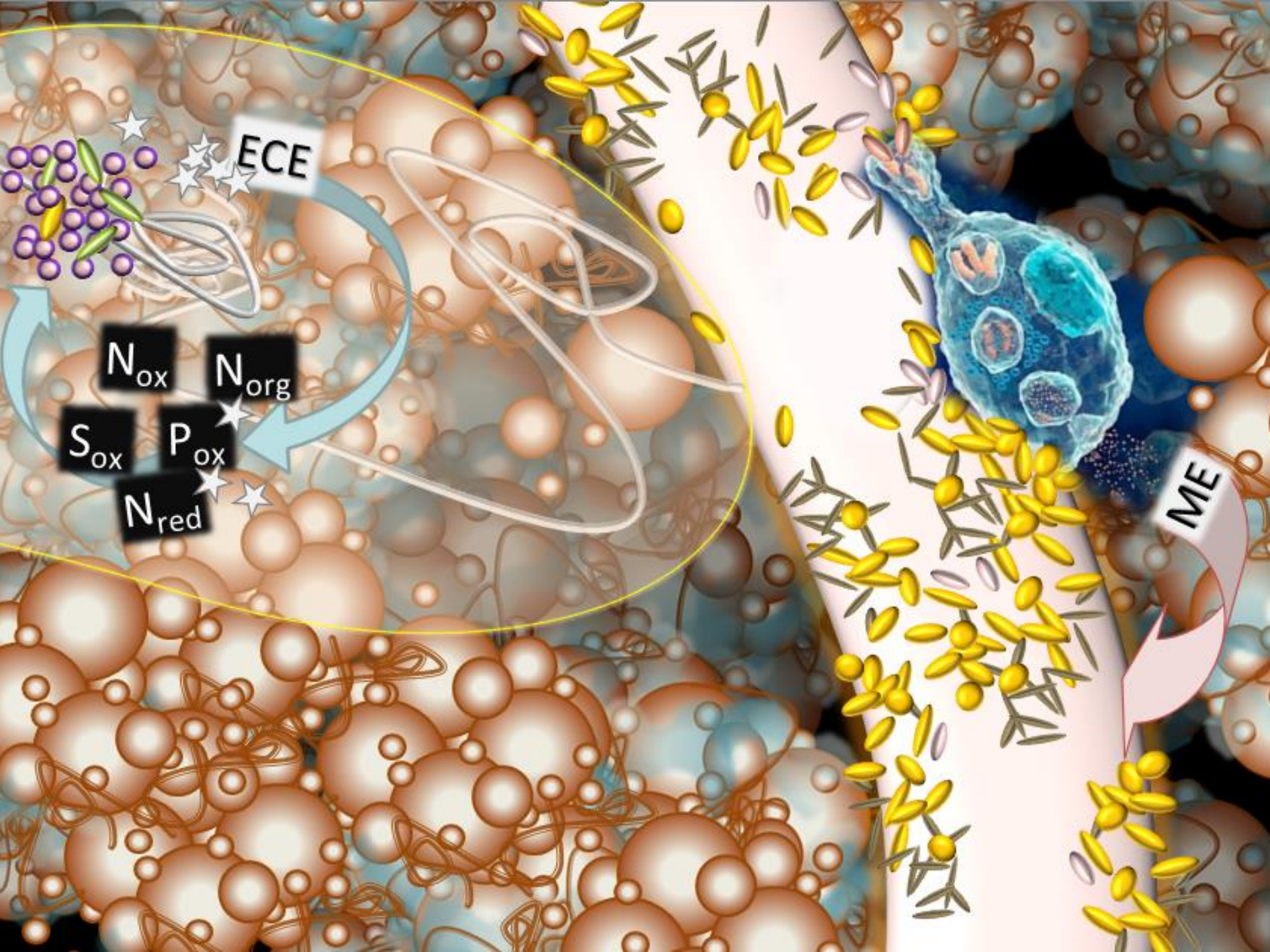
ECE
N_{ox}
N_{org}
S_{ox}
P_{ox}
N_{red}
ME

The goal:

- *minimizing of soil tillage*
- *continuous vegetation cover*
- *biodiversity as much as possible*
- *dissemination of new approaches and practices among farmers*

Unterirdische Leistung der Begrünungspflanzen,
Begrünungsversuch Stockerau 2010

Unterirdische Leistung der Begrünungspflanzen,
Begrünungsversuch Stockerau 2010


Děkujeme