Biologická podstata úrodnosti půdy /řádná péče o organickou hmotu/

Současné hospodaření na zemědělské půdě v měnících se podmínkách prostředí – SOM (půdní organická hmota), webinář 10. 12. 2020

Jaroslav Záhora

Faculty of Agronomy

Mendelova univerzita v Brně

SYM:BIO

inteko innovative composting

SONDAR CZ-AT

EUROPEAN UNION European Regional Development Fund

EUROPEAN TERRITORIAL CO-OPERATION AUSTRIA-CZECH REPUBLIC 2007-2013

Gemeinsam mehr erreichen. Společně dosáhneme více.

Van Deynze A, Zamora P, Delaux P-M, Heitmann C, Jayaraman D, Rajasekar S, et al. (2018) Nitrogen fixation in a landrace of maize is supported by a mucilage-associated diazotrophic microbiota. PLoS Biol 16(8): e2006352. https://doi.org/10.1371/journal.pbio.2006352

Here, we show that for one maize landrace Sierra Mixe grown in nitrogen-depleted fields near Oaxaca, Mexico, 29% - 82% of the plant nitrogen is derived from atmospheric nitrogen. High levels of nitrogen fixation are supported, at least in part, by the abundant production of a sugar-rich mucilage associated with aerial roots that provides a home to a complex nitrogen-fixing microbiome.

Residue	Weight (μg)	mole%[1]
Arabinose	113.7	13.7
Fucose	377.0	41.8
Xylose	27.1	3.3
Glucuronic acid	28.6	2.7
Galacturonic acid	0.0	0.0
Mannose	27.1	2.7
Galactose	354.3	35.8
Sum	927.8	100

[1]Values are expressed as mole % of total carbohydrate

Fig 2. Aerial root mucilage. The aerial roots of Sierra Mixe maize (left) secrete large quantities of mucilage between 3 and 6 months after planting. The mucilage is carbohydrate rich, with the composition dominated by arabinose, fucose, and galactose (side panel).

https://doi.org/10.1371/journal.pbio.2006352.g002

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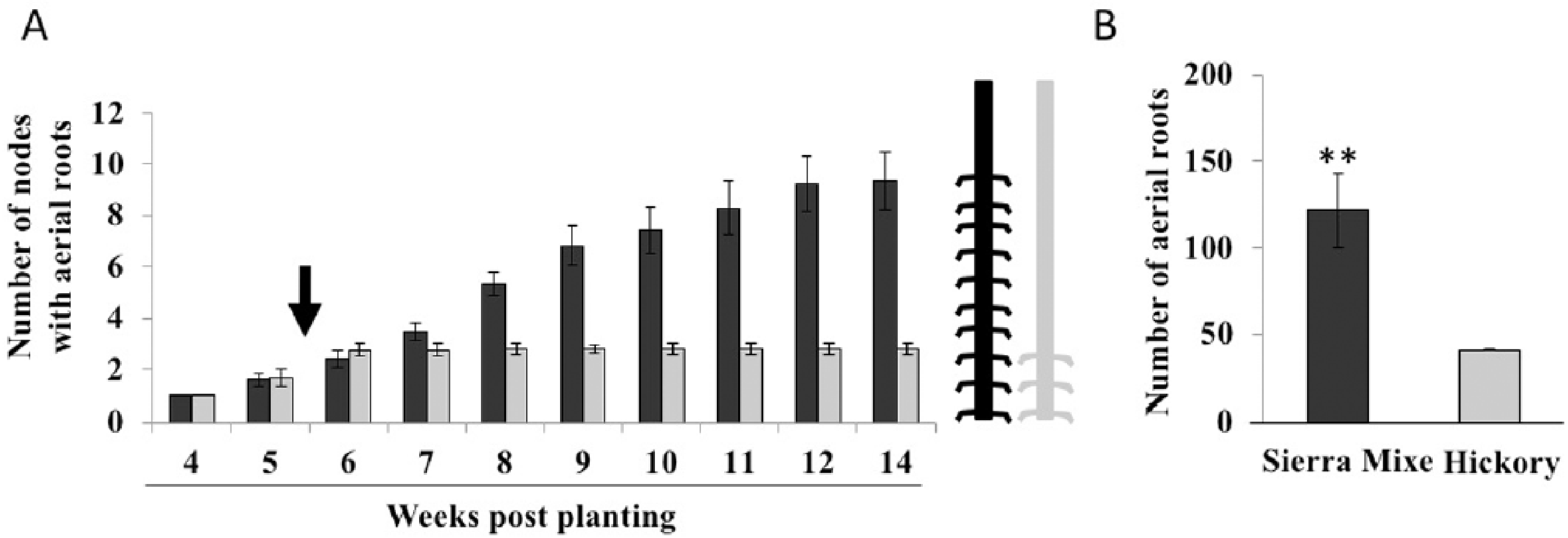


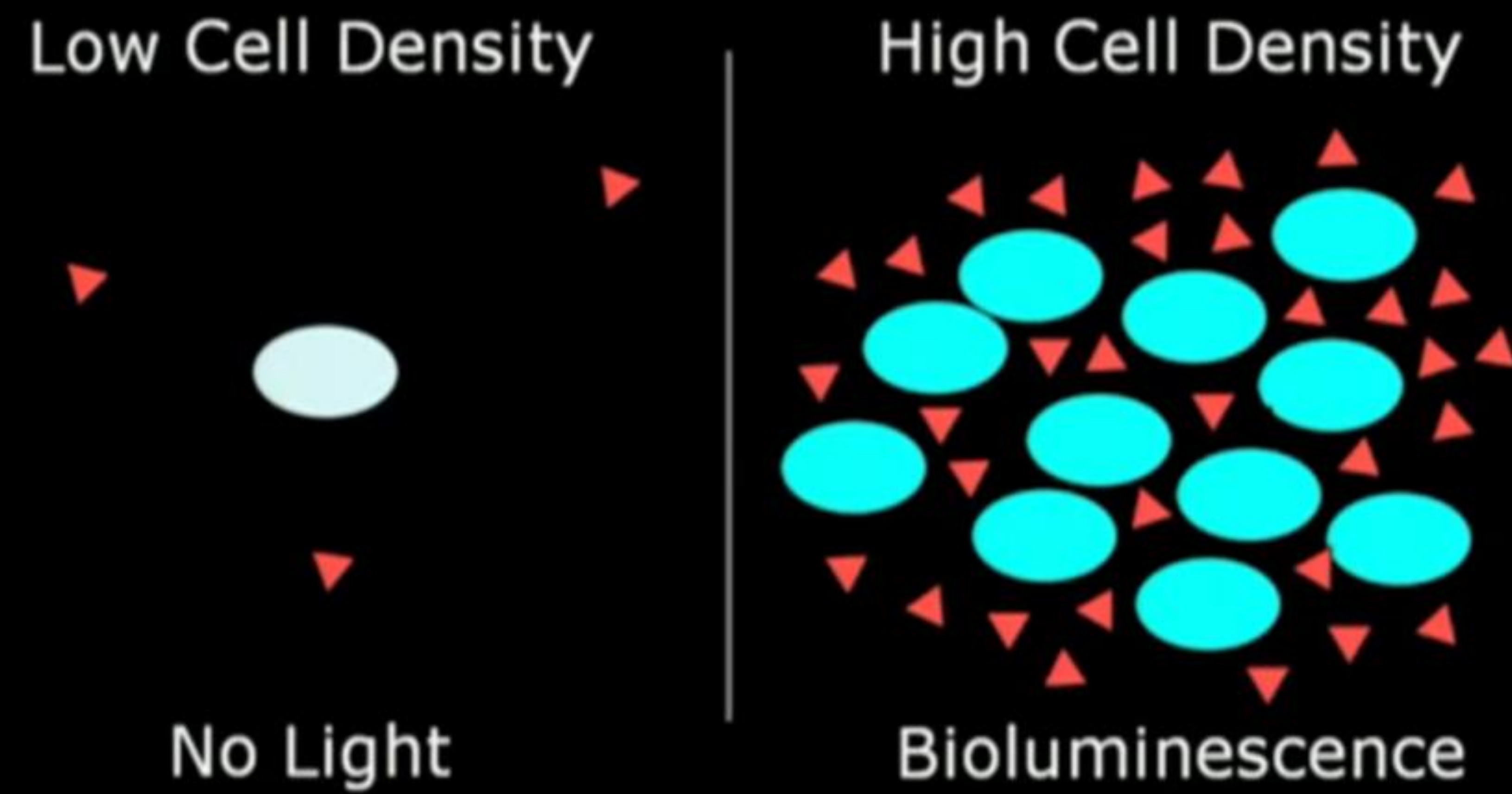
Fig 1. Physiological features of Sierra Mixe maize. (A) The transition between juvenile and adult phases (black arrow) occurs 5 weeks after planting in Sierra Mixe maize (black bars) and in the tall maize heirloom Hickory King (gray bars). (B) Number of aerial roots observed on Sierra Mixe maize and Hickory King after 14 weeks of growth in the field in Madison, United States of America. Error bars represent standard errors; an asterisk indicates a significant difference between Sierra Mixe maize and Hickory King (Student *t* test, $P < 0.01$). (Data at DOI: 10.6084/m9.figshare.6534545).

https://doi.org/10.1371/journal.pbio.2006352.g001

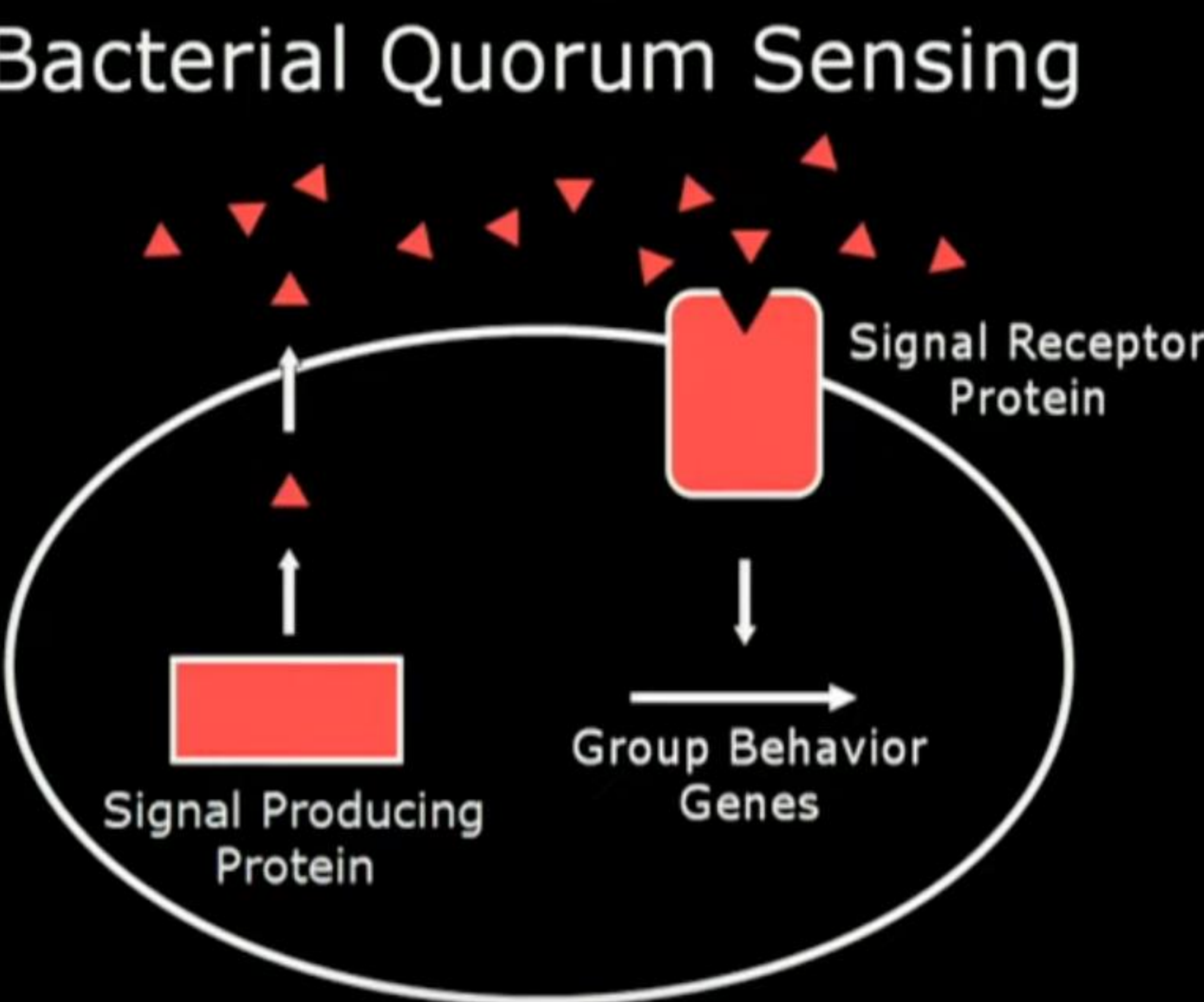
Van Deynze A, Zamora P, Delaux P-M, Heitmann C, Jayaraman D, Rajasekar S, et al. (2018) Nitrogen fixation in a landrace of maize is supported by a mucilage-associated diazotrophic microbiota. PLoS Biol 16(8): e2006352. https://doi.org/10.1371/journal.pbio.2006352


Aliivibrio fischeri (Vibrio fischeri)

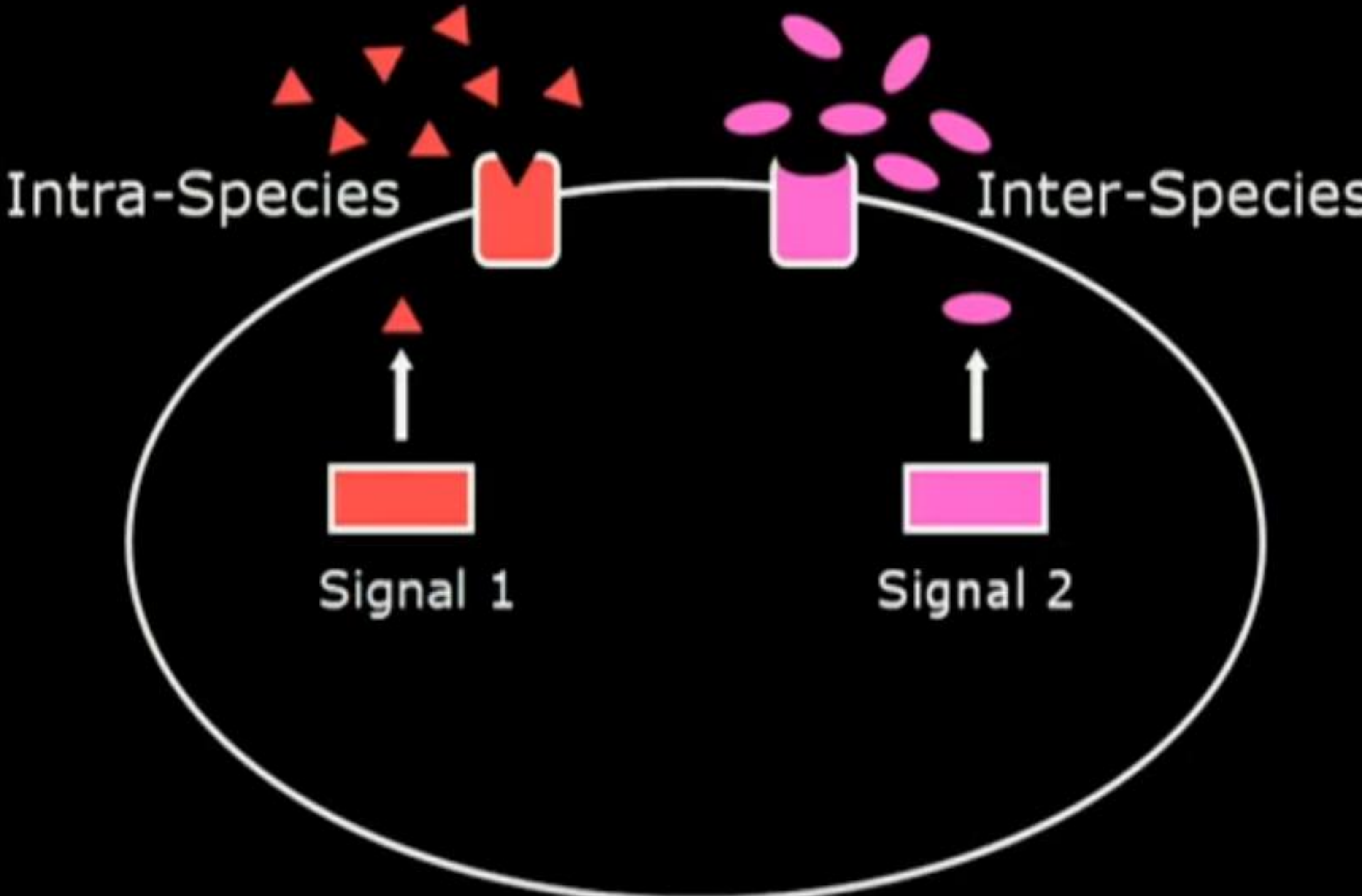
Vibrio fischeri Communication



Bacterial Quorum Sensing



Multi-Lingual Bacteria



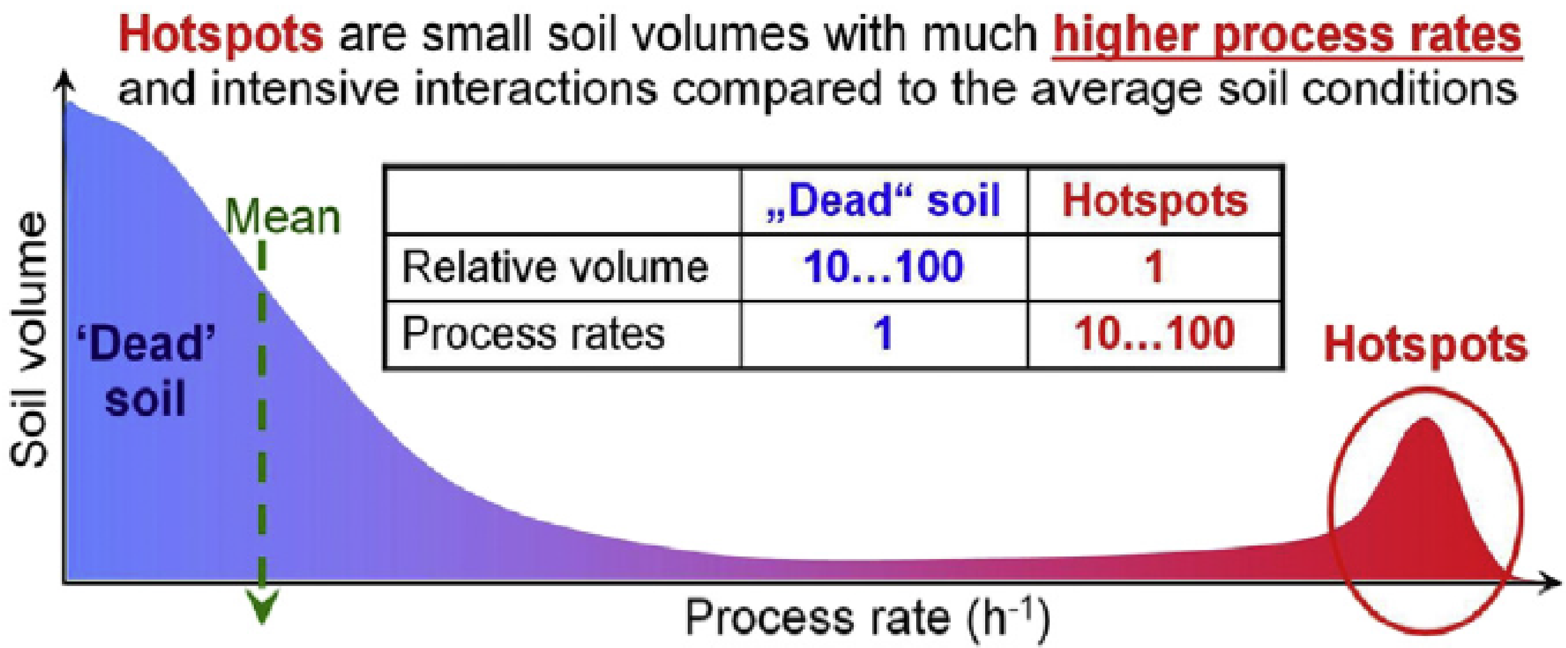
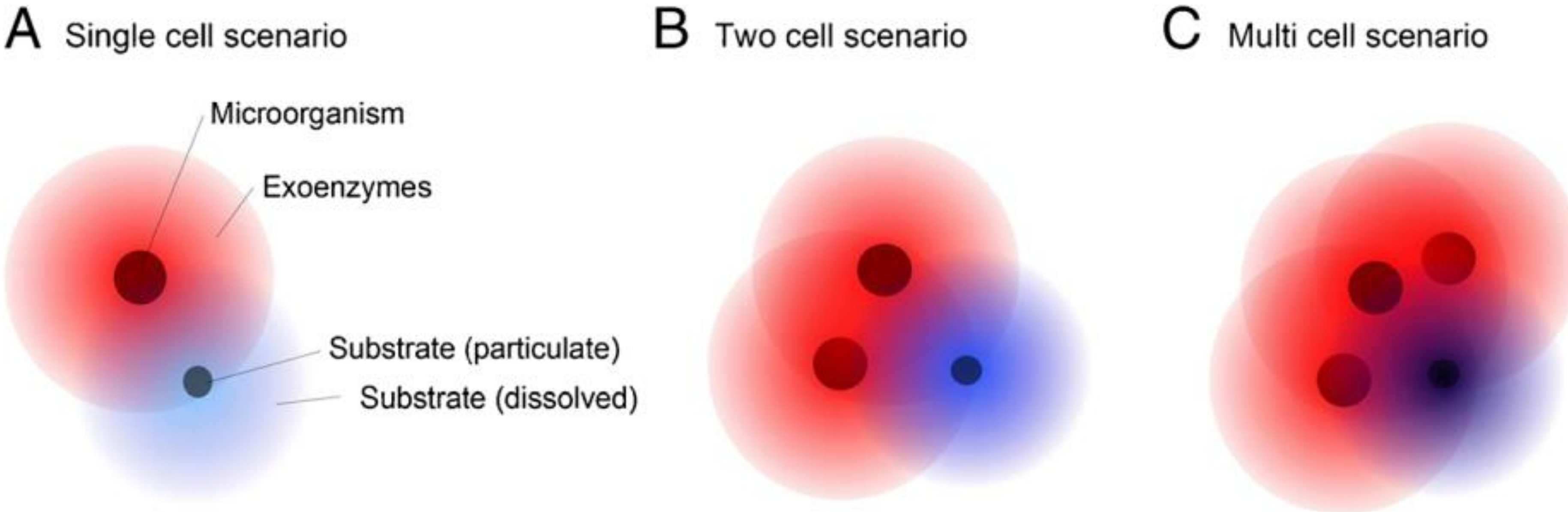


Fig. 1. Concept of microbial hotspots in soil: Hotspots are small soil volumes with much higher process rates and intensive interactions compared to the average soil conditions. The Table inset represents the relative volume and process rates in the hotspots and bulk soil. "Mean" represents the weighted average process rates by soil mixing.

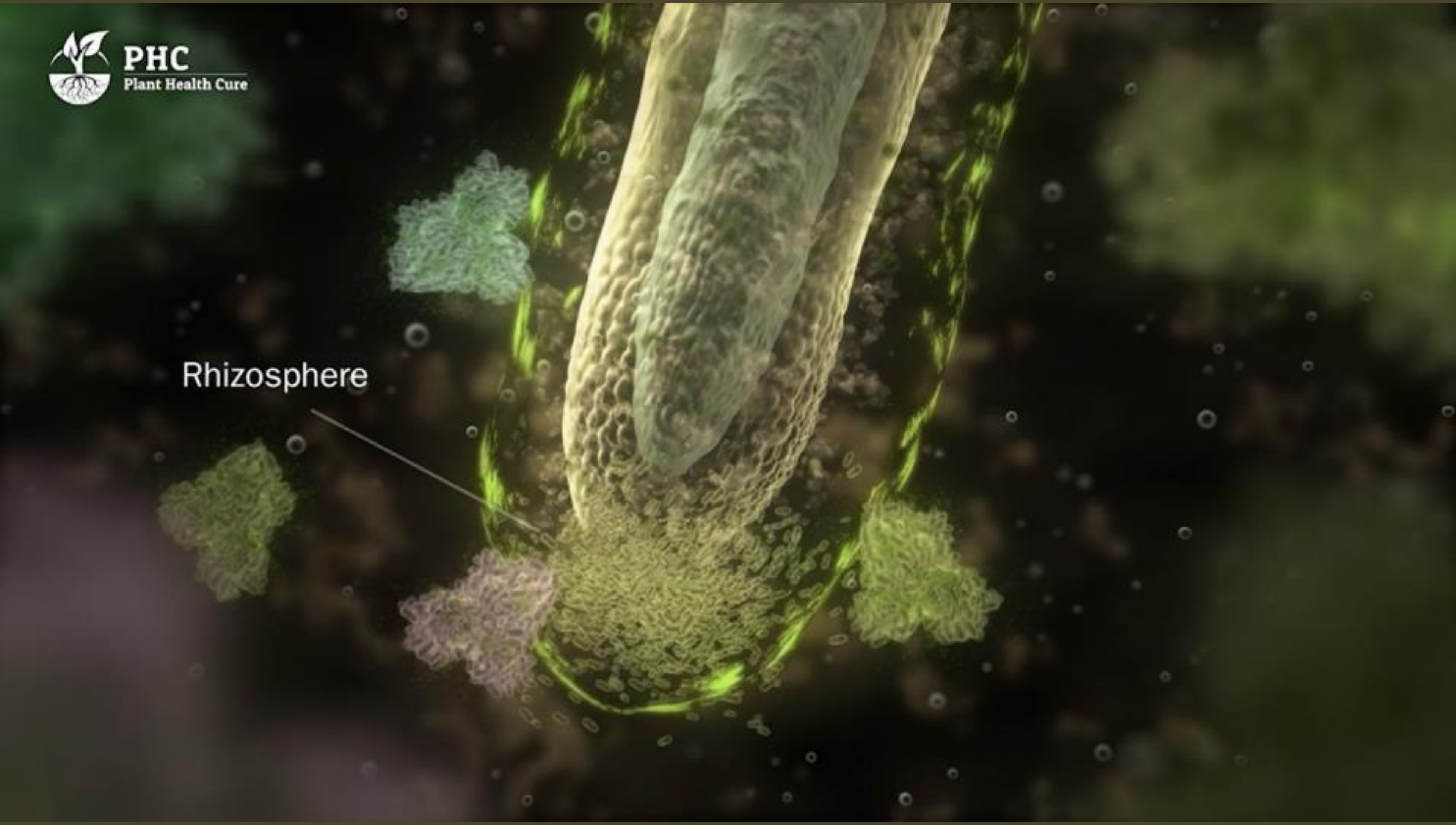
Y. Kuzyakov, E. Blagodatskaya / Soil Biology & Biochemistry 83 (2015) 184–199

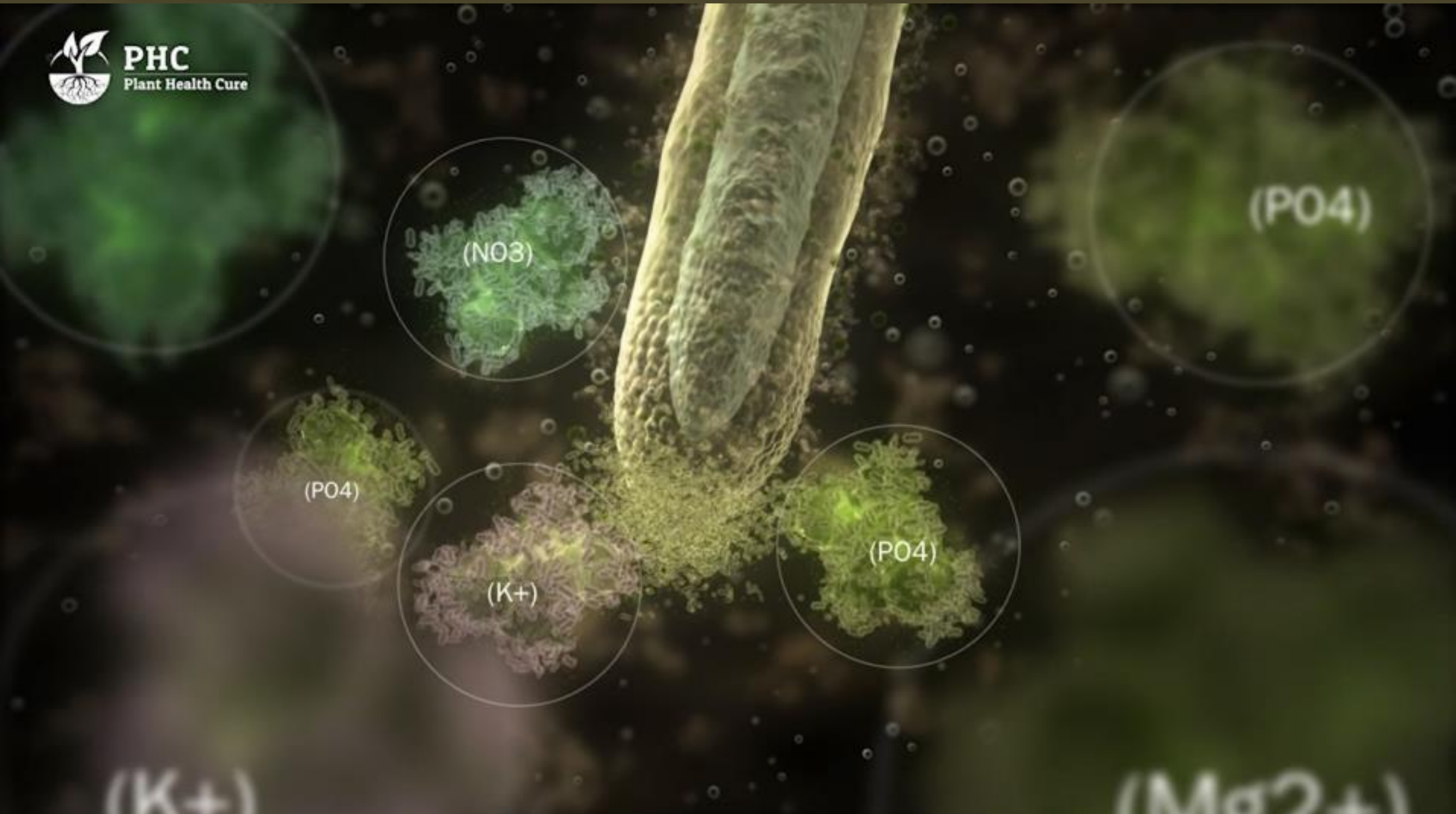


Hypothesized concept of synergistic interactions of exoenzyme - producing soil microorganisms. In bulk soil, a high proportion of exoenzymes released by a soil microorganism is lost without any benefit for it (a). With increasing number of exoenzymes the concentration of products of enzymatically catalyzed reactions increases (as indicated by the increase in the intensity of the blue color, b). Thus, exoenzyme-producing microorganisms can benefit from each other, which might contribute to the high microbial activity at hotspots of enzyme activity (c)

Das Gruppenverhalten!!!

Spohn, M. et Kuzyakov, Y. / Plant Soil (2014) 379:67–77


PHC
Plant Health Cure
Rhizosphere


PHC
Plant Health Cure
(NO3)
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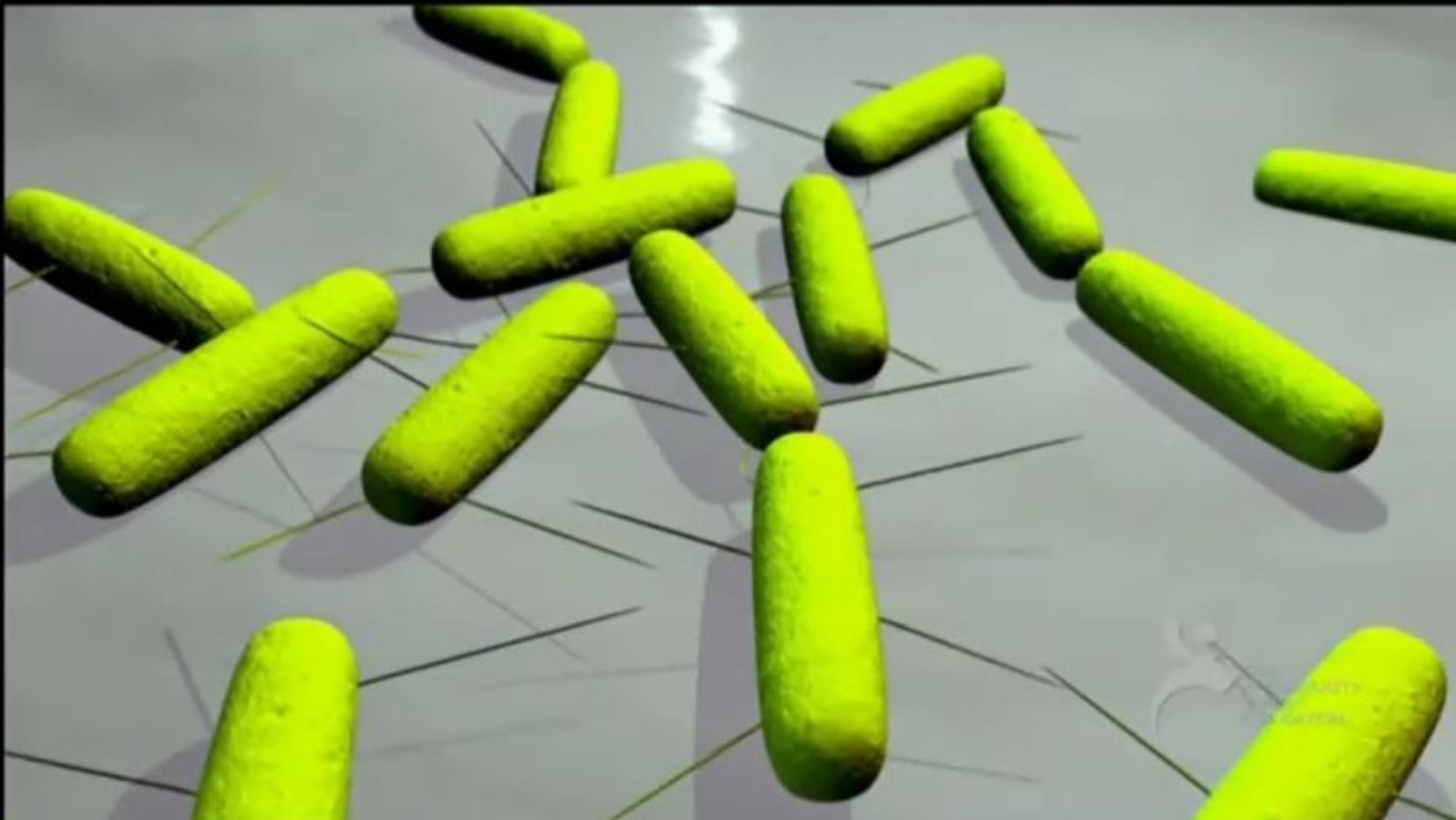
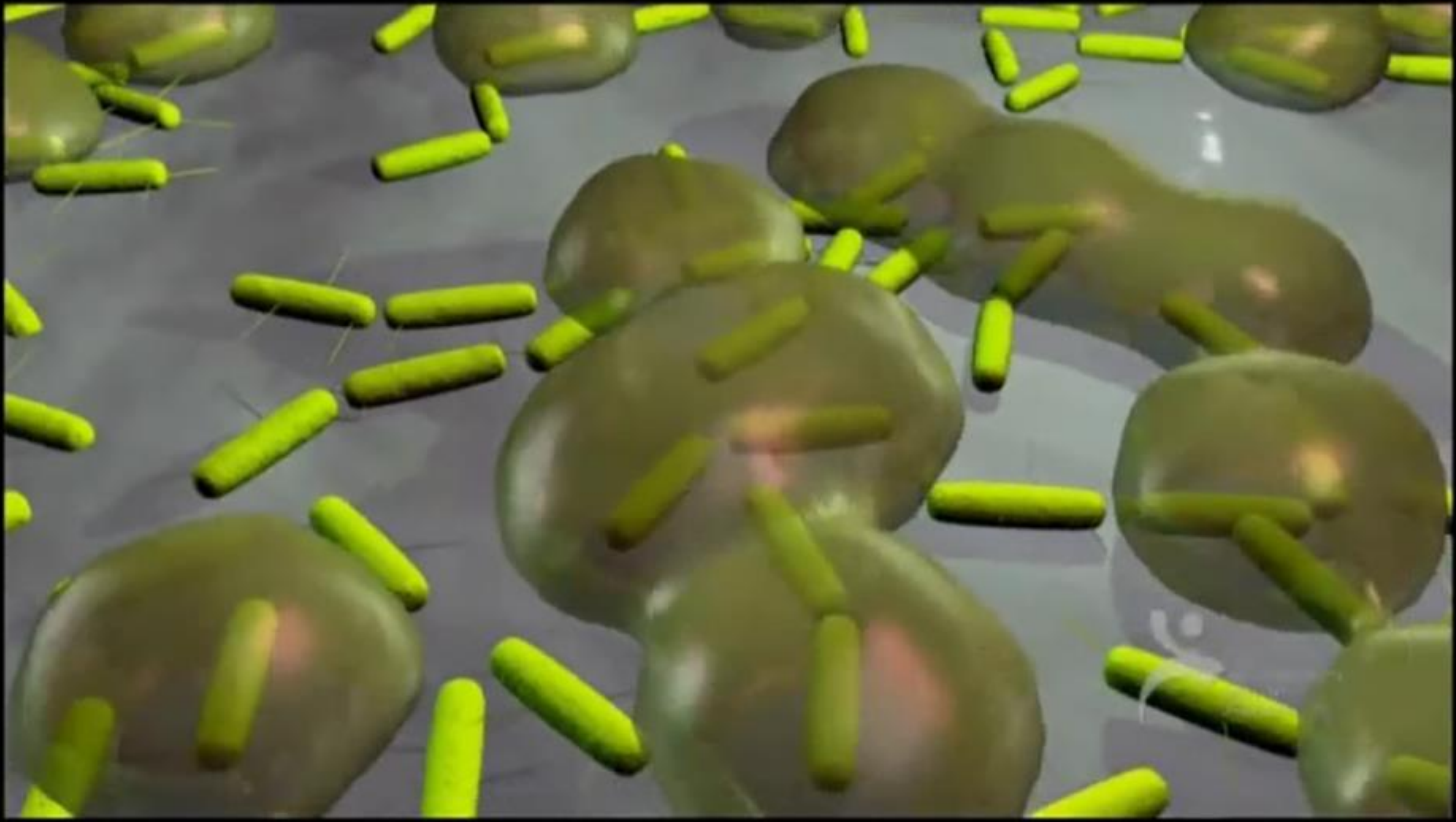
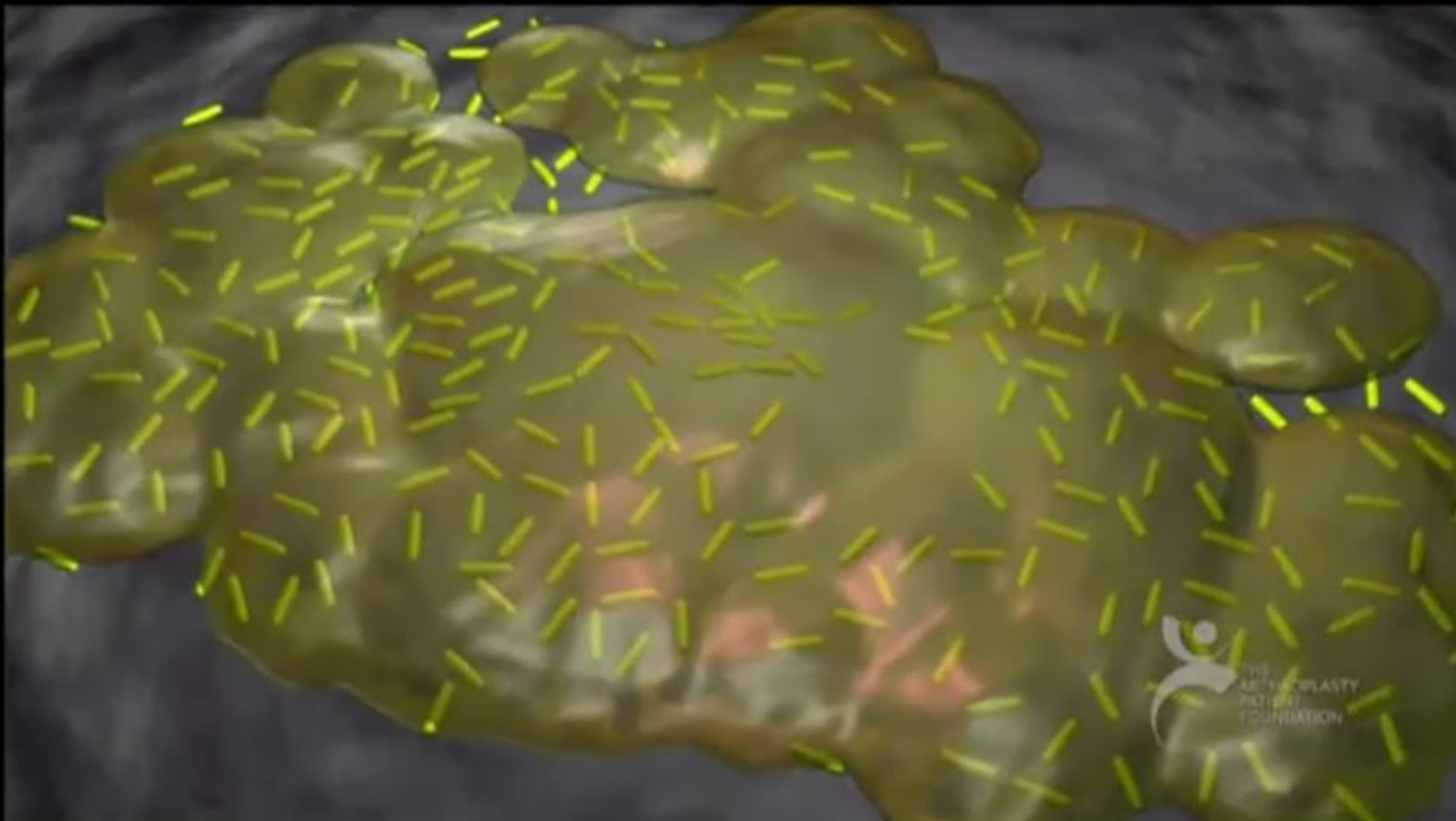
(PO4)
(K+)

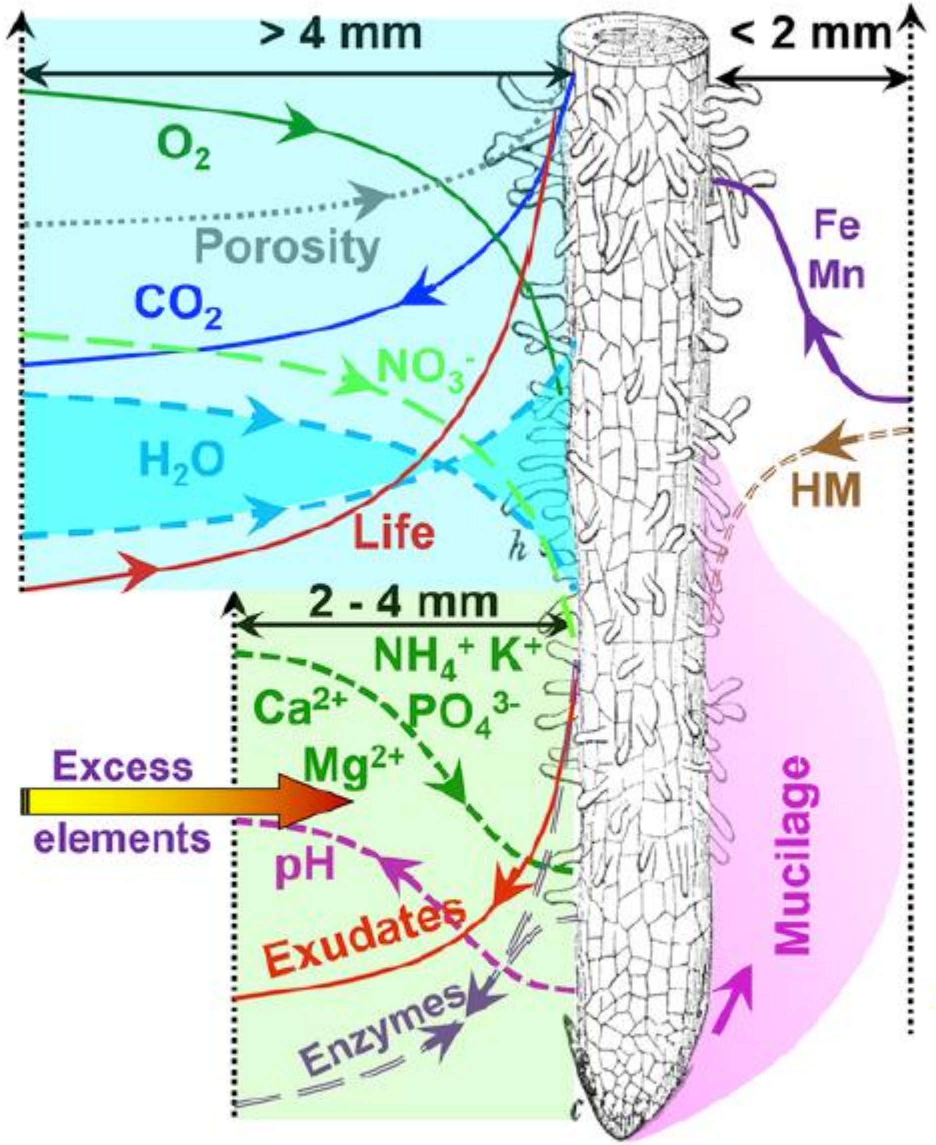

Lumbar Prosthetic Infection Site
THE ARTHROPLASTY PATIENT FOUNDATION





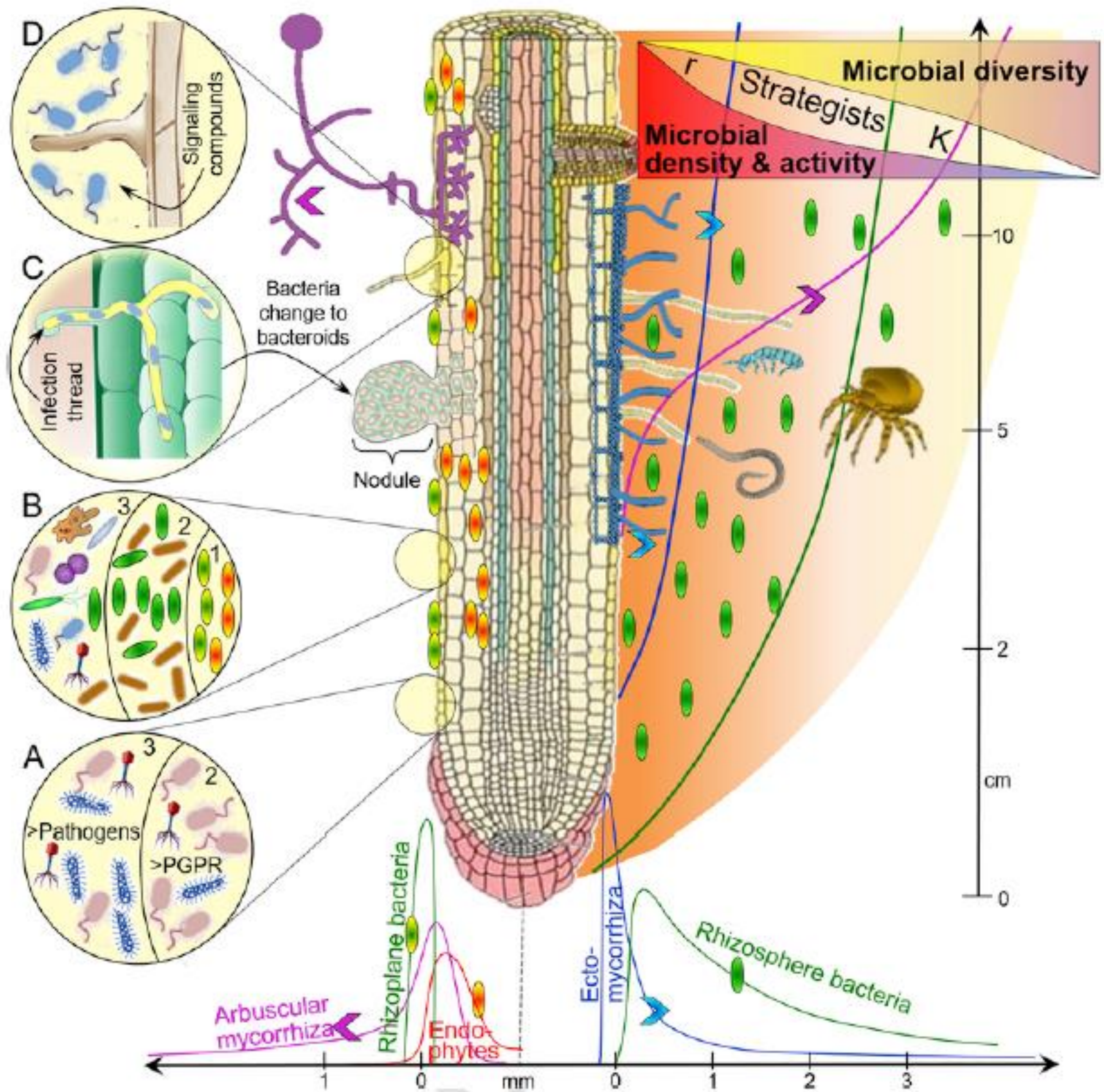


Kuzyakov et Razavi, 2020(?): Rhizosphere size and shape: Temporal dynamics and spatial stationarity SBB

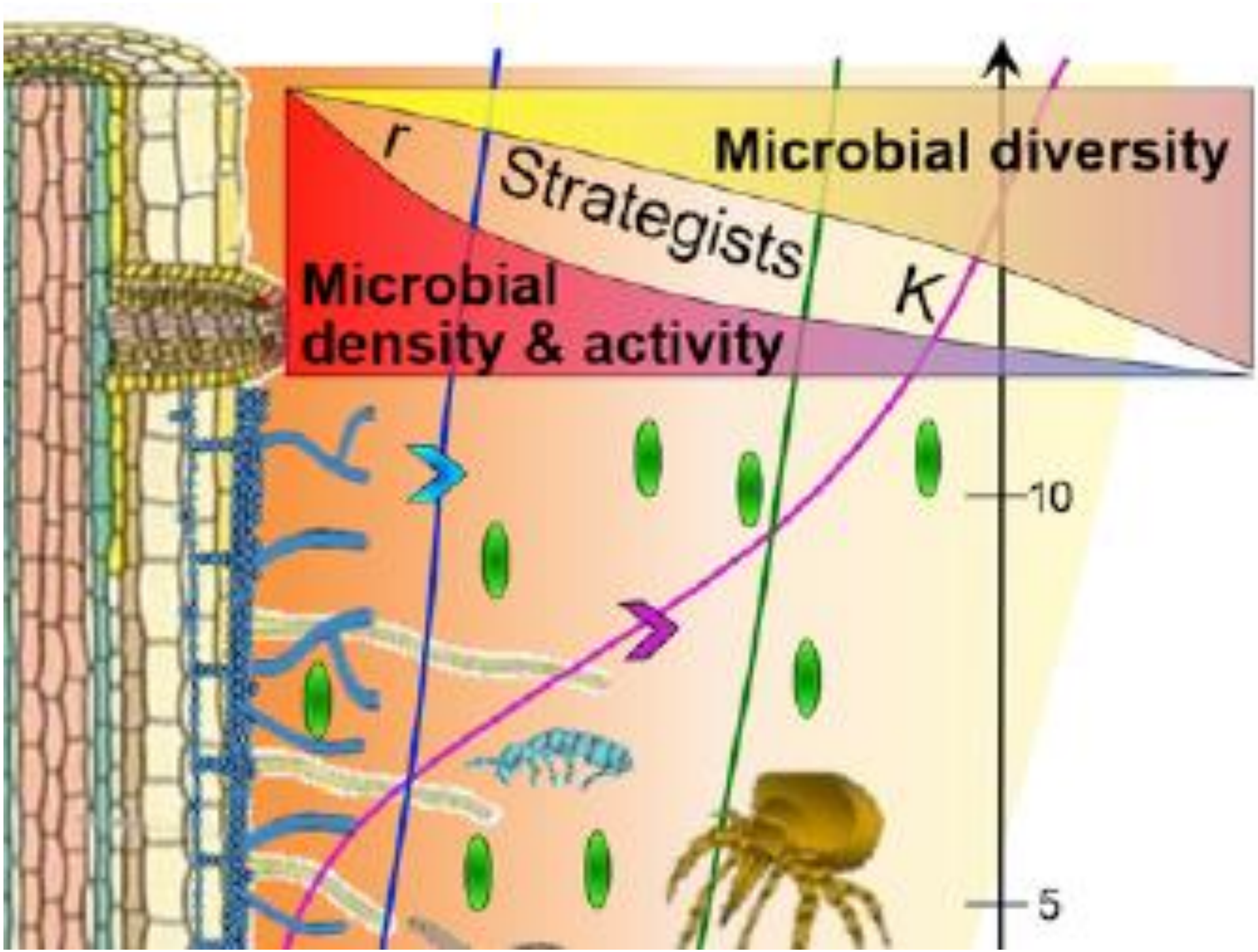


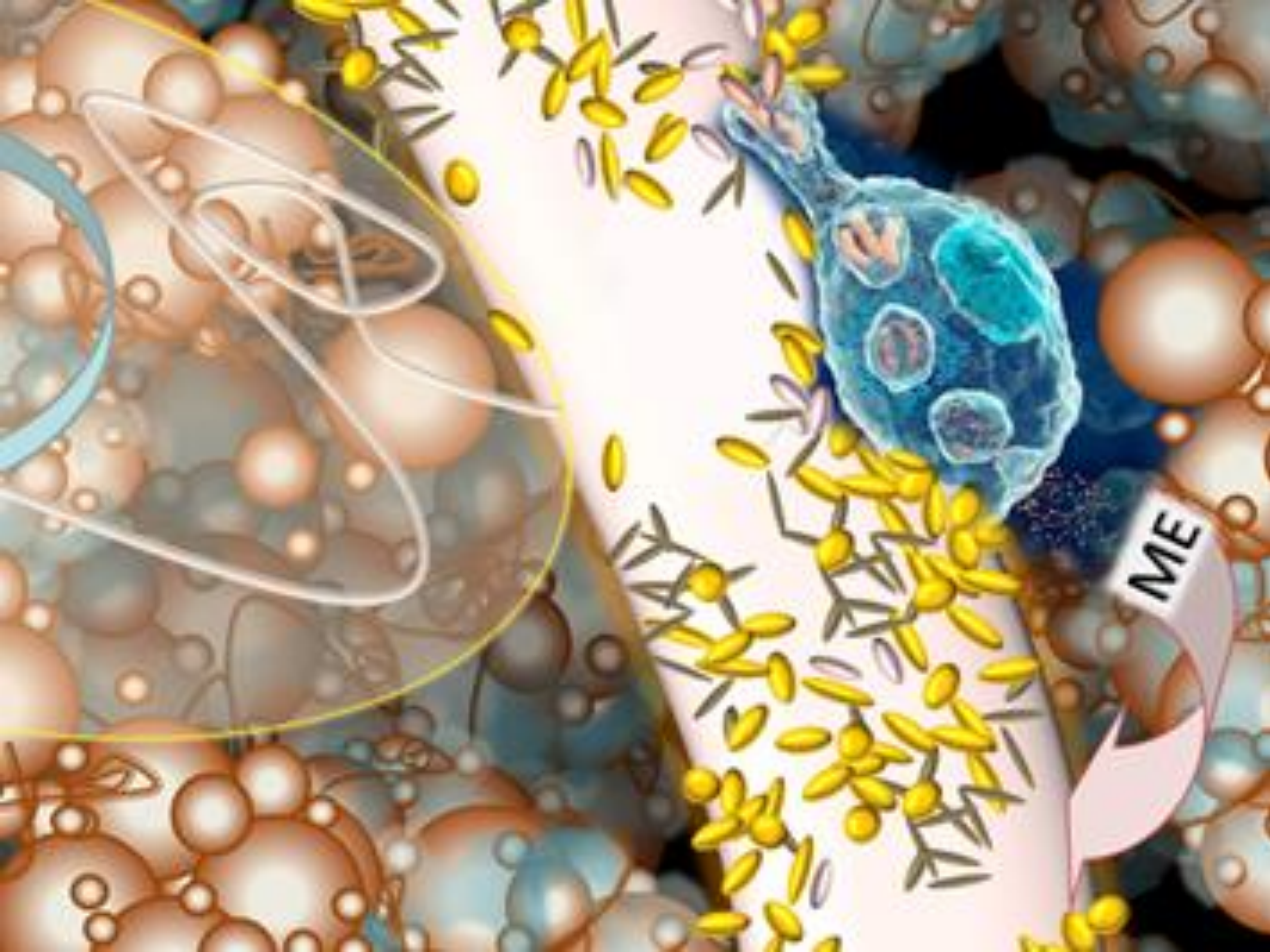
Generalization of rhizosphere extents and gradient types for the most investigated parameters: Gases, Root exudates, Nutrients and Excess elements, pH and Eh, Enzyme activities and microorganisms (Life). Three groups of rhizosphere extents were typical: 0.5–2mm (right), 2–4mm (left bottom), and >4mm (left top). The shapes of the curves reflect the "diffusion" (D) or "sigmoidal" (S) gradients (compare Fig. 9). Despite the dynamic nature of each parameter, these gradients are quasi-stationary because of opposite directions of their formation processes. HM: heavy metals (Zn, Cu, Ni, Co, Pb, Cd, As).

Kuzyakov et Razavi, 2020(?): Rhizosphere size and shape: Temporal dynamics and spatial stationarity SBB



Kuzyakov et Razavi, 2020(?): Rhizosphere size and shape: Temporal dynamics and spatial stationarity SBB

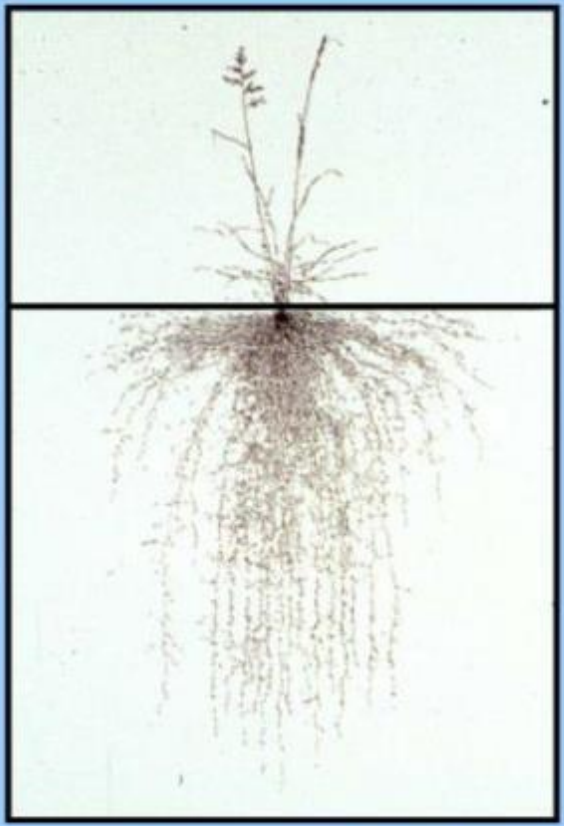


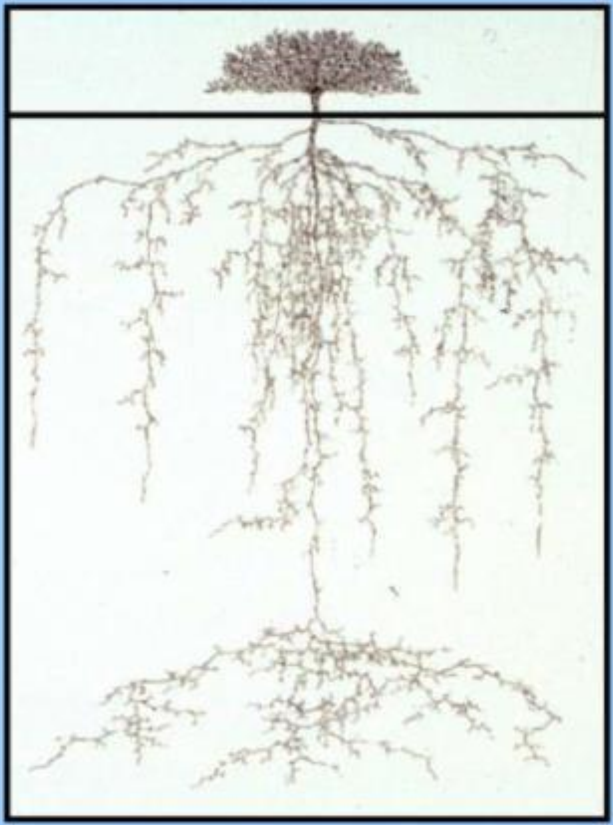

ME

bioforschung austria

Belegaufnahmen auf der Dachterasse des Pflanzen-soziologischen Institutes im 12. Stock über Klagenfurt.
Foto: W. Hartl

The rhizosphere comprises ≥ 50% of the biomass of the plant





(From Kutschera, L & Lichtenegger, E. 1992 Wurzelatlas Mitteleuropaischer Grundpflanzen Gustav Fischer Verlag Stuttgart)

"There is more biomass below the earth's surface than above it."

Faktor relativního příspěvku uhlíku z kořenů vůči uhlíku z nadzemní biomasy

Druh	Relativní příspěvek
Kukuřice	1,65 - 3,30
Ječmen	1,33
Vojtěška	1,24
Jetel plazivý	1,30
Jílek	1,24
Kostřava (*Festuca vivipara)*	1,50 – 2,10
Řeřicha	1,33
Průměrně	**1,66**

Rasse, D. P., Rumpel, C., Dignac, M-P. 2005. **Is soil carbon mostly root carbon? Mechanisms for a specific stabilisation,** Plant and Soil 269: 341–356.

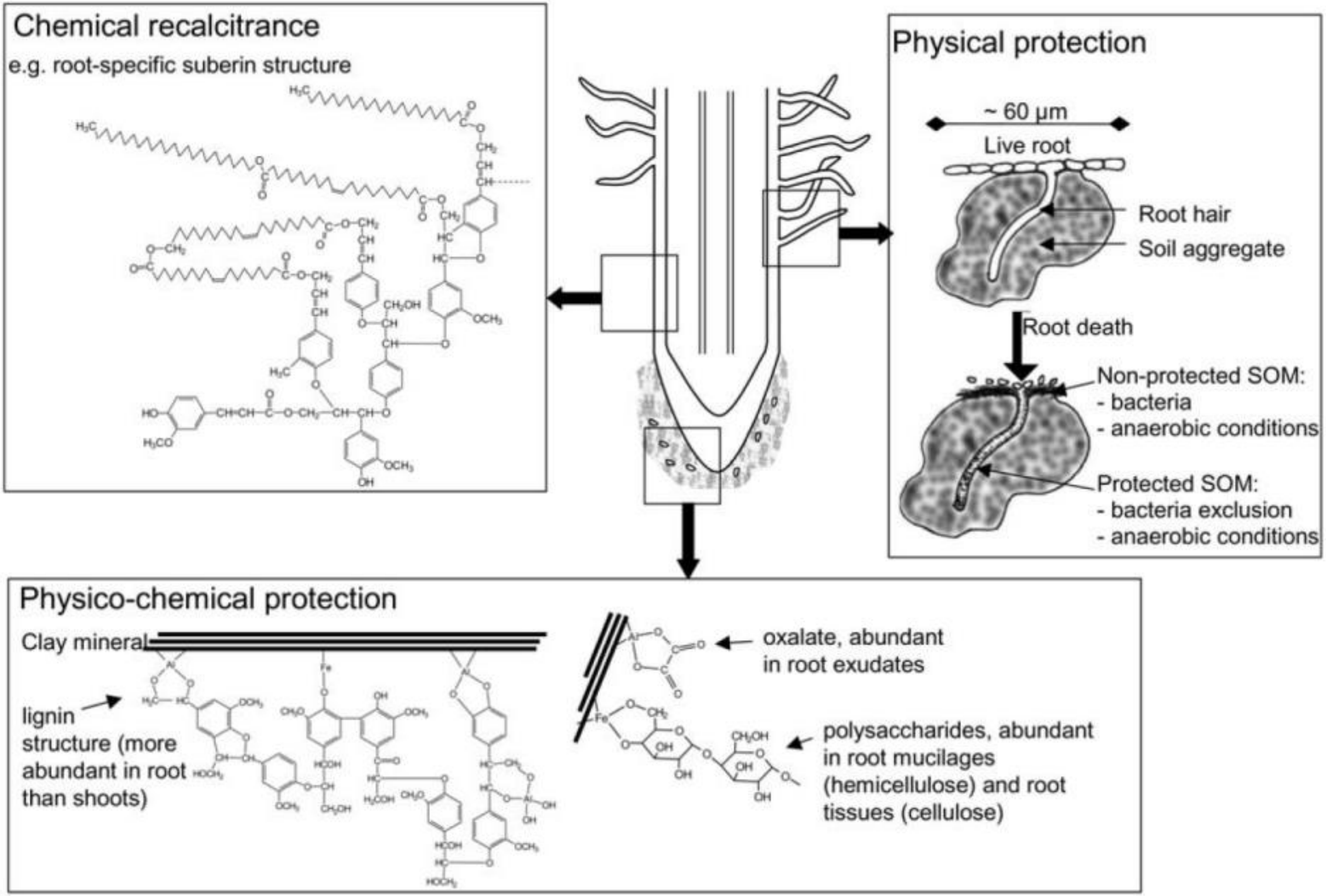


Figure 1. Schematic representation of the main processes resulting in the specific protection of root C in soils

Rasse, D. P., Rumpel, C., Dignac, M-P. 2005. **Is soil carbon mostly root carbon? Mechanisms for a specific stabilisation,** Plant Soil 269: 341–356.

Podíl nadzemní a podzemní biomasy přispívající k tvorbě POH

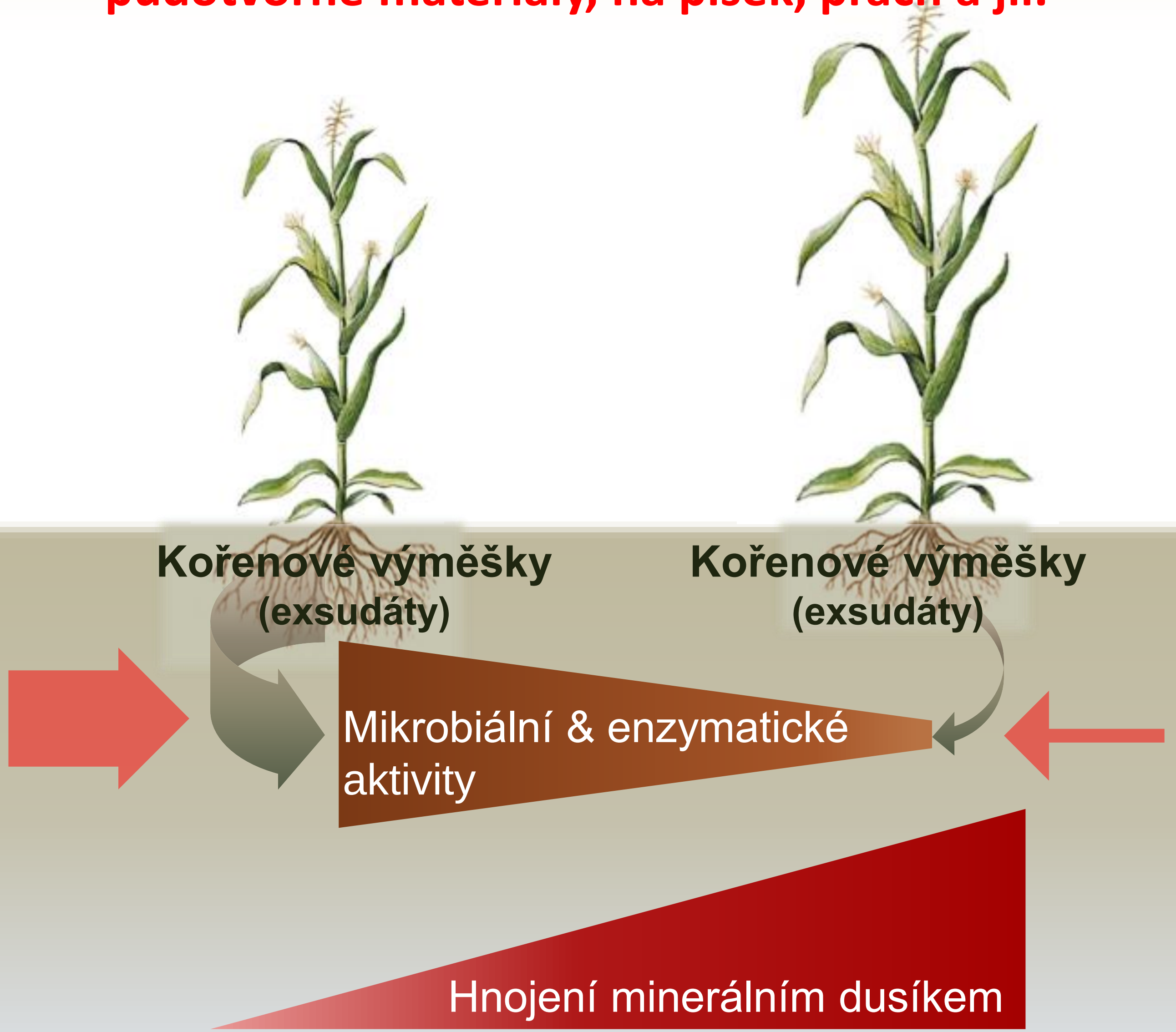
(*in situ* studie prováděné většinou pomocí značených izotopů)

Vegetation type or treatment	Belowground carbon inputs retained in SOM (%)	Aboveground carbon inputs retained in SOM (%)	Ratio	Reference
Conventional agriculture	35%	4.8%	7.4	Kong & Six 2010
Low-input agriculture	65%	4.9%	13.2	Kong & Six 2010
Organic agriculture	91%	3.6%	25.6	Kong & Six 2010
Mixed C_3 and C_4 crops	36%	4.0%	9.0	Ghafoor et al. 2017
Mixed C_3 and C_4 fertilized crops	18%	10%	1.8	Ghafoor et al. 2017
Maize	61%	5.0%	12.2	Mazzilli et al. 2015
Soybean	80%	3.0%	26.7	Mazzilli et al. 2015
Rye cover crop, 5 months	26%	5.2%	5.0	Austin et al. 2017
Rye cover crop, 12 months	27%	3.5%	7.7	Austin et al. 2017
Rye cover crop	24%	5.9%	4.1	Austin et al. 2017
Maize	21%	12%	1.7	Bolinder et al. 1999
Maize	38%	11%	3.5	Balesdent & Balabane 1996
Maize	73%	14%	5.1	Clapp et al. 2000
Maize, fertilized	58%	16%	3.6	Clapp et al. 2000
Vetch	49%	13%	3.7	Puget & Drinkwater 2001
Maize	34%	8.0%	4.3	Barber 1979
Mix C_3 and C_4 crops	39%	17%	2.3	Kätterer et al. 2011
Average, median	46%, 39%	8.3%, 6.6%	8.1, 5.0	

Average, median 46%, 39% 8.3%, 6.6% 8.1, 5.0

The Ecology of Soil Carbon: Pools, Vulnerabilities, and Biotic and Abiotic Controls Robert B. Jackson, Kate Lajtha, Susan E. Crow, Gustaf Hugelius, Marc G. Kramer, Gervasio Piñeiro Annual Review of Ecology, Evolution, and Systematics 2017 48:1, 419-445

Vlivem zvyšujících se dávek minerálního dusíku dochází k silné redukci kořenových výměšků a k postupné degradaci půdy až na výchozí půdotvorné materiály, na písek, prach a jíl.

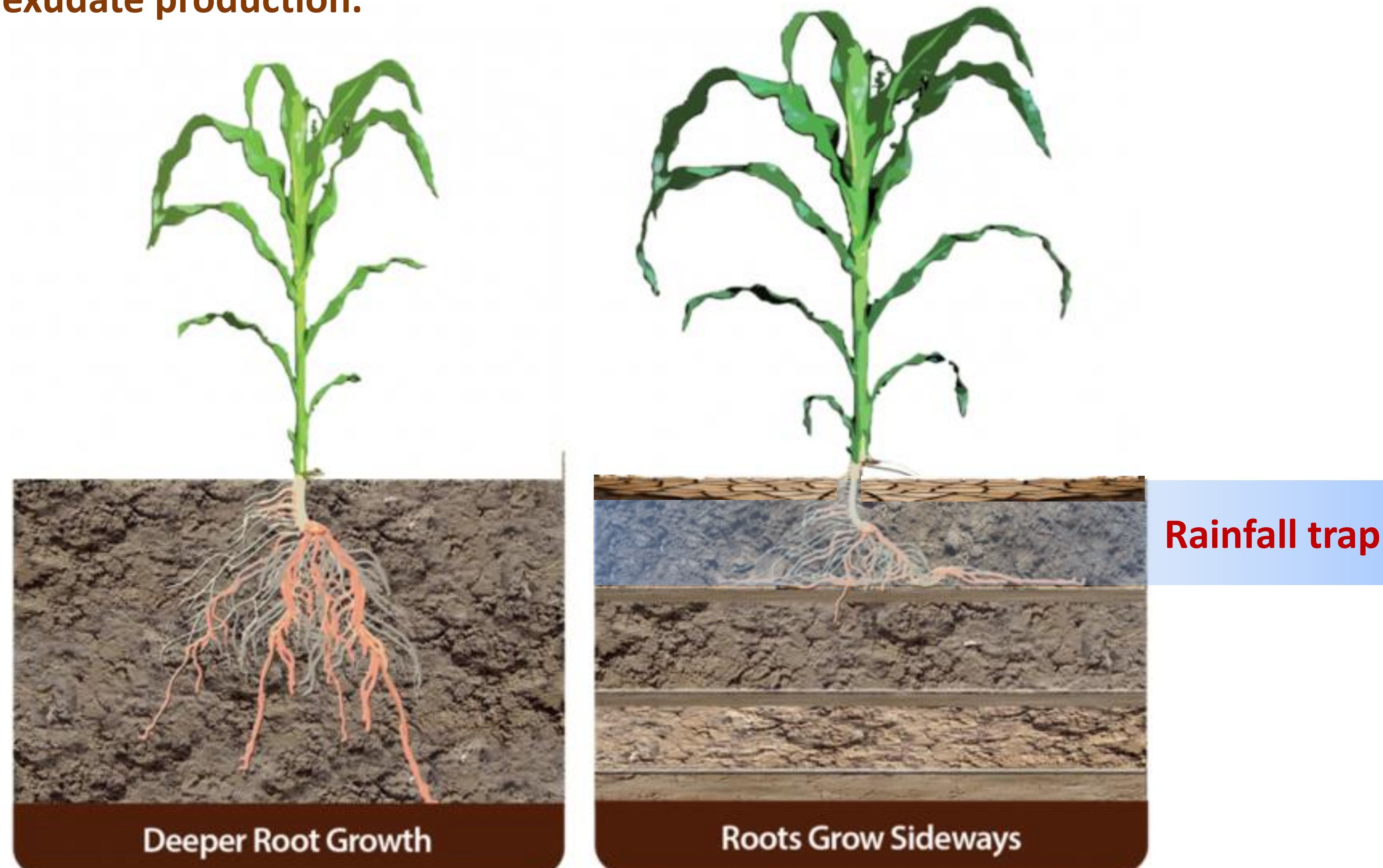


Kumar et al., Plant Soil (2016) 409:87–97


22. 6. 2019

Crop growing in well-aggregated soil has to invest some of the photosynthates in root formation and root exudate production.

Water trapped in rainfall traps enriched with mineral fertilizers and pesticides enables higher crop production.



Source: https://www.greatplainsag.com/en/cdn/farfuture/LL65bx4Fz_EmkqWw4rv3i4cXcUAq9E6yMsOAkfLALg4/mtime%3A1545083046/sites/default/files/styles/large/public/field/image/planthealth2-01-01.png

Úplně degradovanou půdu již nelze snadno regenerovat aplikací statkových hnojiv …..

….. tato mikromísta mají spíš charakter mikrobiálních spaloven organické hmoty

Kořeny a jejich výměšky mohou půdu regenerovat 5 – 30krát rychleji ve srovnání se statkovými hnojivy!

Dr. Christine Jones, Soil Ecologist, Australia, Conservation Tillage and Technology Conference, March 5 - 6, 2019, Ada, OH, USA.

Cíle:

- *Minimalizovat zpracování půdy*
- *Permanentní kryt půdy vegetací*
- *Co nejbohatší biodiverzita*
- *Šíření nových přístupů mezi zemědělce*

2. Meziplodinová směska druhově co nejbohatší

(zde 10 druhů)

Hlavní zásady nově se šířícího zemědělství, které více zohledňuje biologické principy:

1) - minimalizace zásahů do půdy a respekt k osevním postupům,
2) - využívání druhově co nejbohatší směsky meziplodin,
3) - nutnost trvalého vegetačního pokryvu půdy.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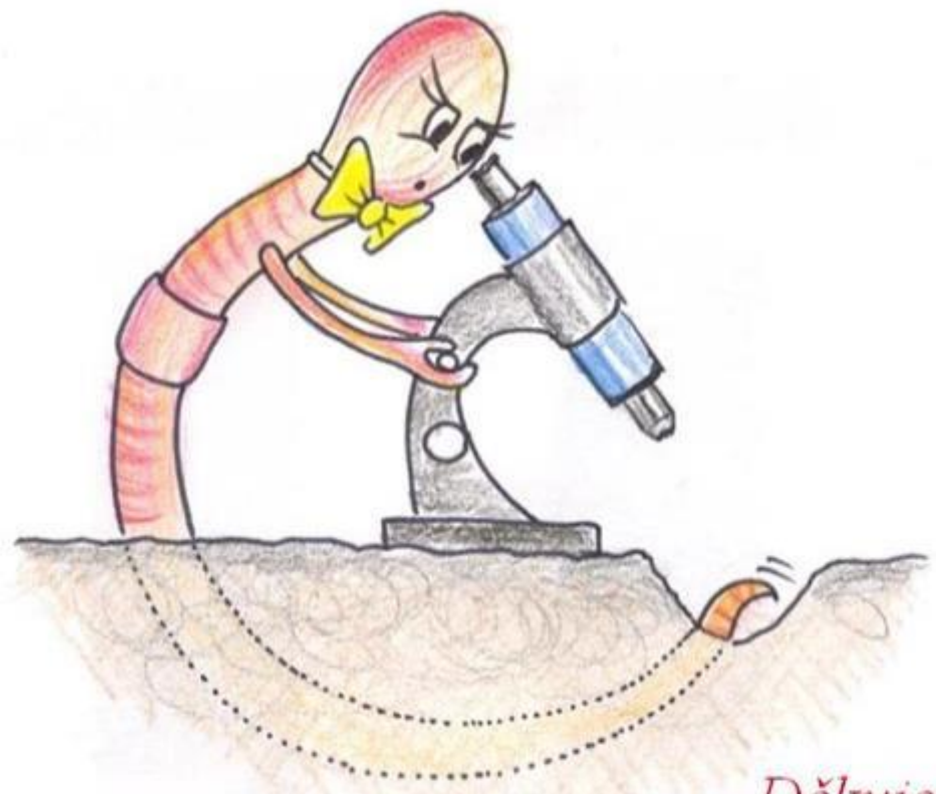
OČP

Obnovování červivosti půdy

Wiederherstellung von Boden Würmstichigkeit



SYM:BIO

Děkujeme za pozornost

Vielen Dank für Ihre Aufmerksamkeit

Interreg Rakousko-Česká republika

inteko innovative composting

ZERA

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