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ALTA SCUOLA DEL SANGIOVESE

L'impatto del cambiamento climatico sulle caratteristiche fisico-chimiche e biologiche dei suoli e sulle malattie della vite

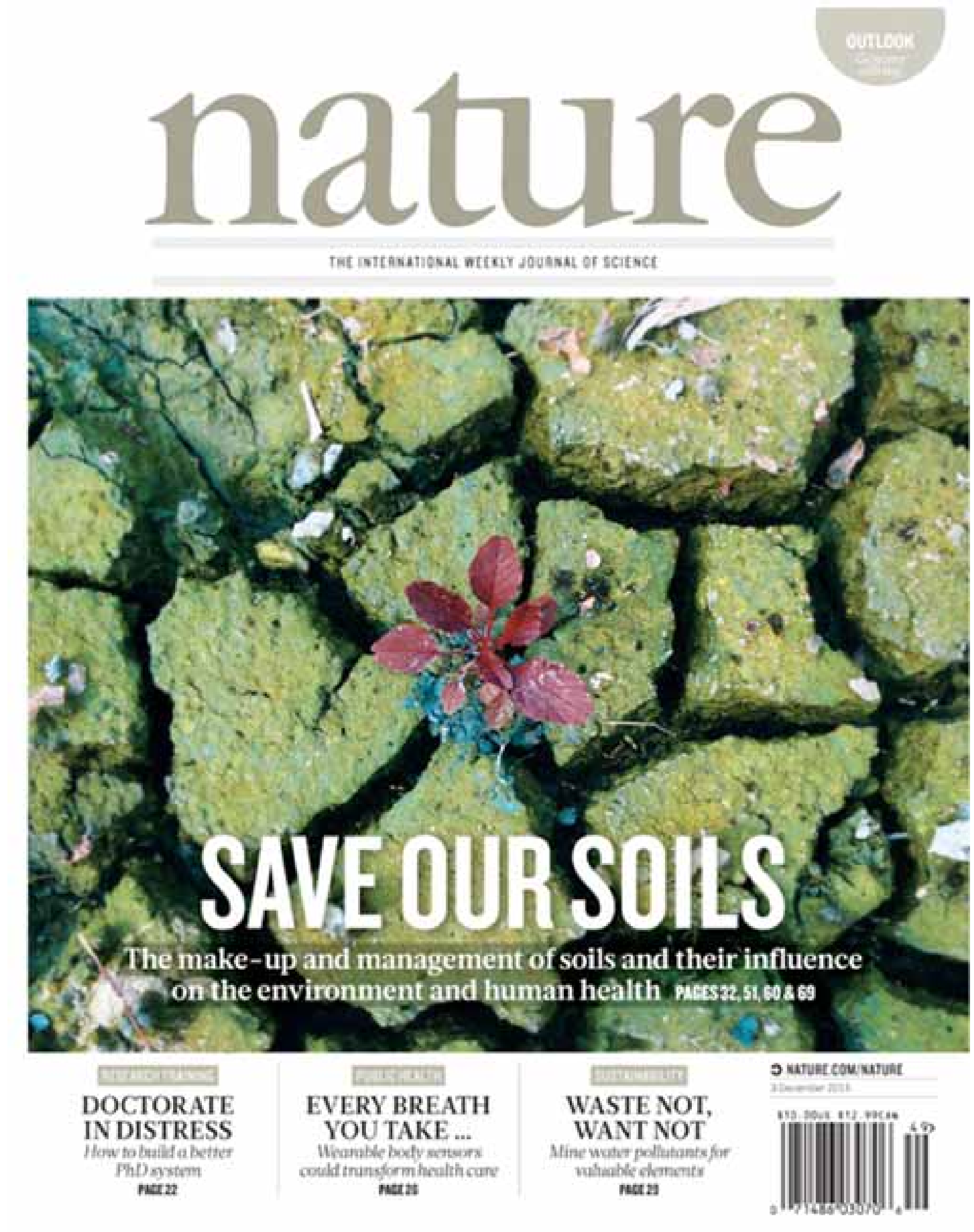
Effetti sul bioma del suolo e sull'attività vegetoproduttiva della vite

Topics:

- Climate change agents
- Rhizosphere soil in relation to the concept *thermodynamics vs kinetics*
- Impact of temperature
- Impact of CO_2 concentrations
- Impact od soil moisture
- Agronomic practices in a climate changed environment: is it possible to preserve soil fertility in a climate changed environment?

Impact of climate change on soil properties

http://www.humanosphere.org/environment/2017/01/china-india-not-deterred-trumps-apathy-climate-change/



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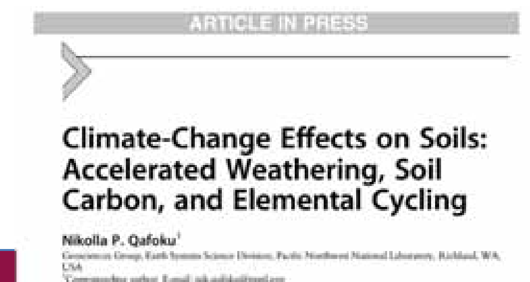
Definition of climate change

"Climate change is defined by high atmospheric carbon dioxide (CO2) concentrations (≥ 400 ppm); increasing air temperatures (2–4 ≥ °C or greater); significant and/or abrupt changes in daily, seasonal, and interannual temperature; changes in the wet/dry cycles; intensive rainfall and/or heavy storms; extended periods of drought; extreme frost; and heat waves and increased fire frequency, is expected to significantly impact terrestrial systems, soil properties, surface water, and streamflow; groundwater quality, water supplies, and terrestrial hydrologic cycle; and, as a consequence, food security and environmental quality"

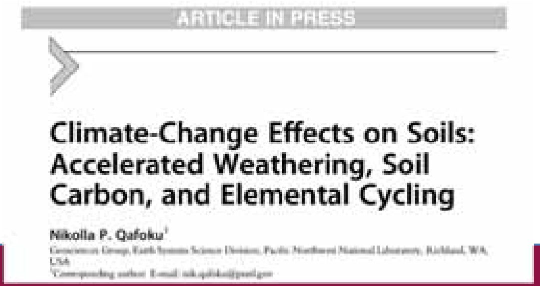

ARTICLE IN PRESS

Climate-Change Effects on Soils: Accelerated Weathering, Soil Carbon, and Elemental Cycling

Nikolla P. Qafoku[1]

Definition of climate change

"Climate change is defined by **high atmospheric carbon dioxide (CO_2)** concentrations (≥ 400 ppm); **increasing air temperatures** (2–4 ≥ °C or greater); significant and/or abrupt changes in daily, seasonal, and interannual temperature; **changes in the wet/dry cycles**; intensive rainfall and/or heavy storms; extended periods of drought; extreme frost; and heat waves and increased fire frequency, is expected to significantly impact terrestrial systems, soil properties, surface water, and streamflow; groundwater quality, water supplies, and terrestrial hydrologic cycle; and, as a consequence, food security and environmental quality"


ARTICLE IN PRESS

Climate-Change Effects on Soils: Accelerated Weathering, Soil Carbon, and Elemental Cycling

Nikolla P. Qafoku[1]

Climate Change in the Underworld: Impacts for Soil-Dwelling Invertebrates

Table 11.1 Summary of the Impact of Climate Change on Nematodes, Insects and Earthworms.

CLIMATE CHANGE	eCO_2	e Temp.	precipitation
nematode	– mostly negative -- mostly indirect *changes in soil properties* shifts in comm.	± variable — mostly direct shifts in comm.	± variable — mostly direct shifts in comm.
insect	– mostly negative -- indirect *changes in plant quality (higher C:N)* shifts in comm.	± variable — direct shifts in comm.	± variable — mostly direct
earthworm	+ positive -- indirect *changes in soil properties*	+ positive -- indirect *changes in rhizodeposition*	+ mostly positive — mostly direct shifts in comm.

Climate Change in the Underworld: Impacts for Soil-Dwelling Invertebrates

Ivan Hiltpold[1,2], Scott N. Johnson[1], Renée-Claire Le Bayon[3] and Uffe N. Nielsen[1]

[1] *Hawkesbury Institute for the Environment, Western Sydney University, Australia*
[2] *Department of Entomology and Wildlife Ecology, University of Delaware, USA*
[3] *Functional Ecology Laboratory, University of Neuchâtel, Switzerland*

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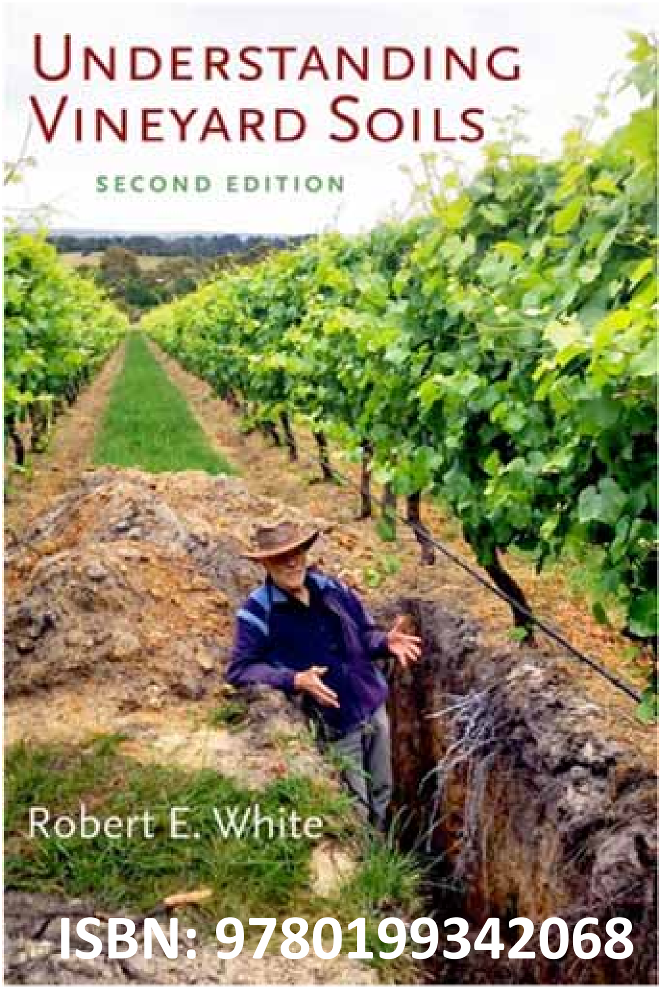
With respect to the Soil



http://www.thewinestalker.net/2016/02/soil2.html

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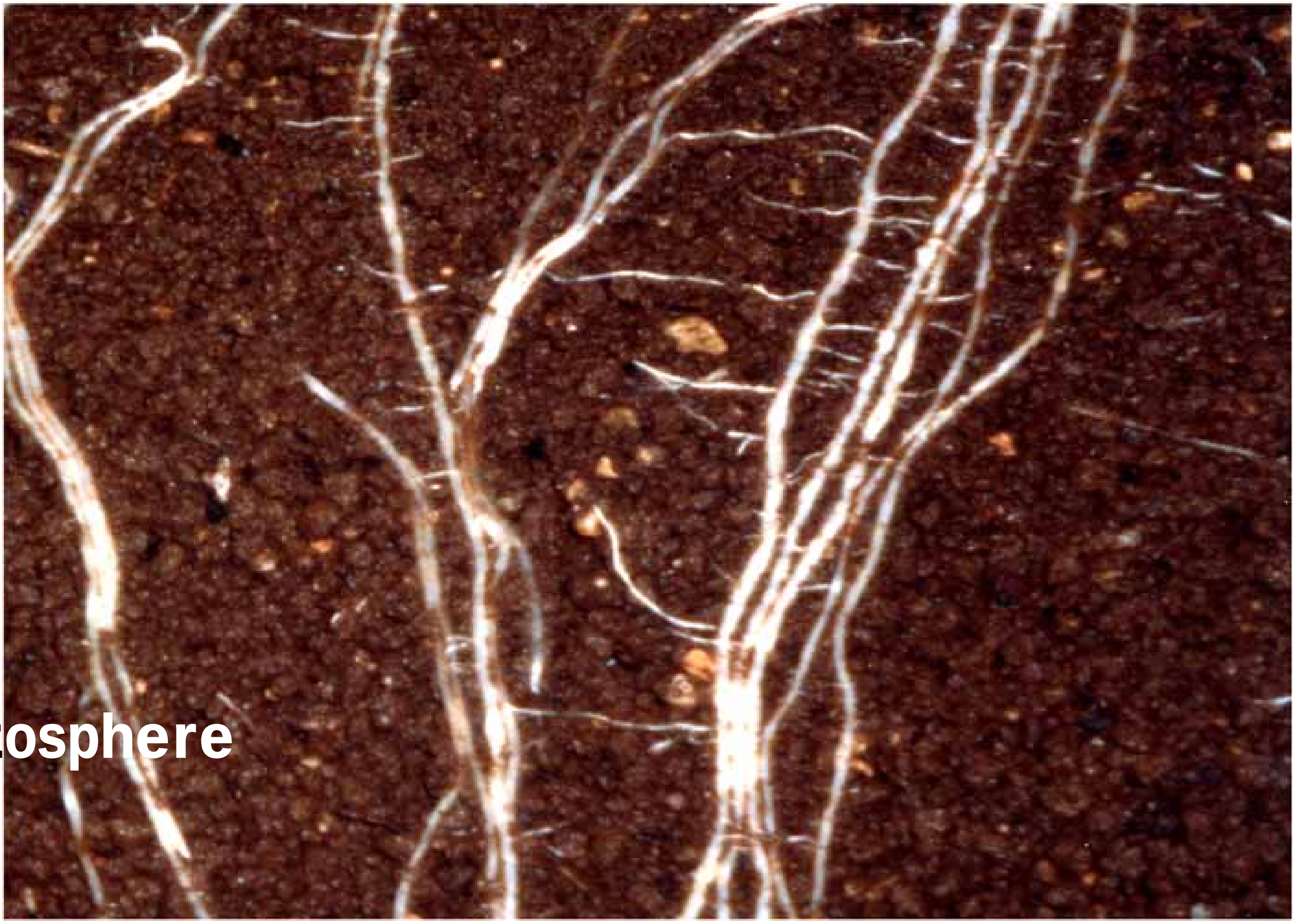
Soil as…

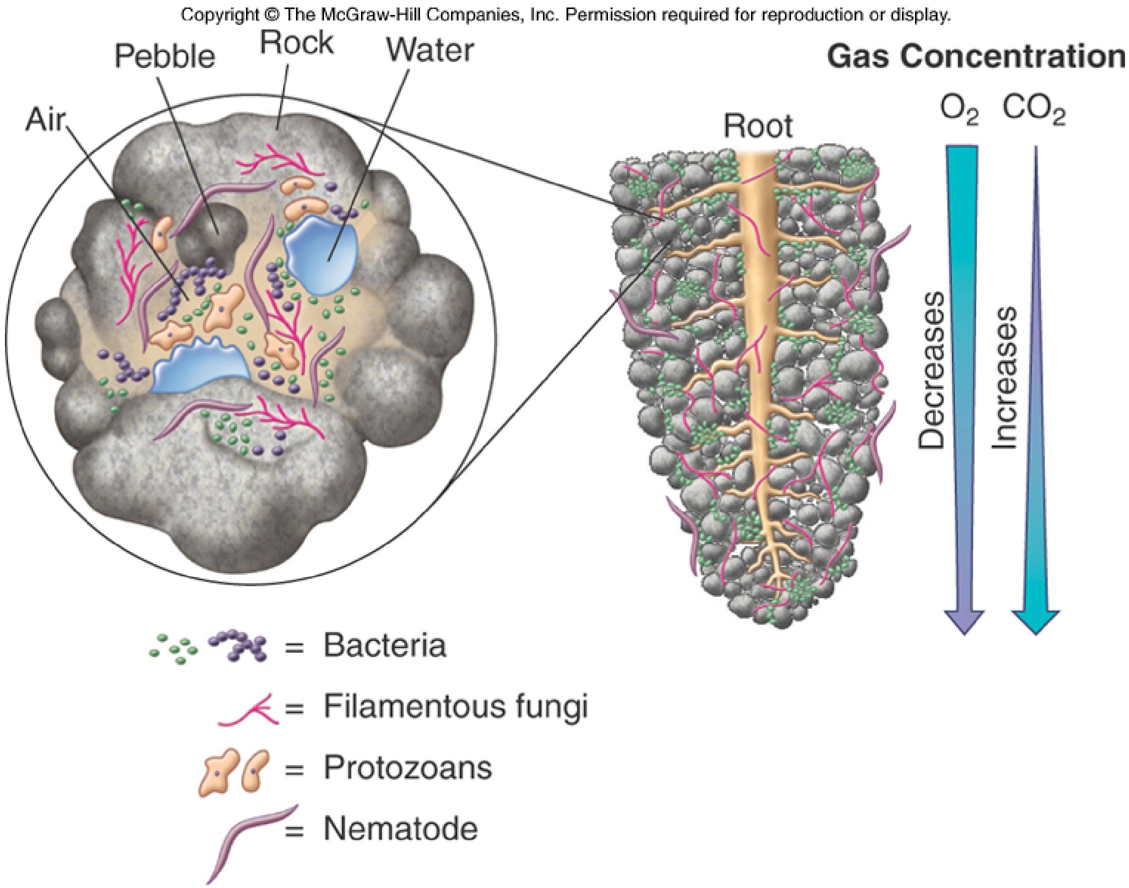


Bulk Soil vs Rhizosphere

The Rhizosphere

Rhizosphere: soil surrounding the root where highly complex relationships are established between soil, plants and soil biota (Hiltner, 1904)

https://public.ornl.gov/site/gallery/originals/SusBio-rhizosphere.jpg



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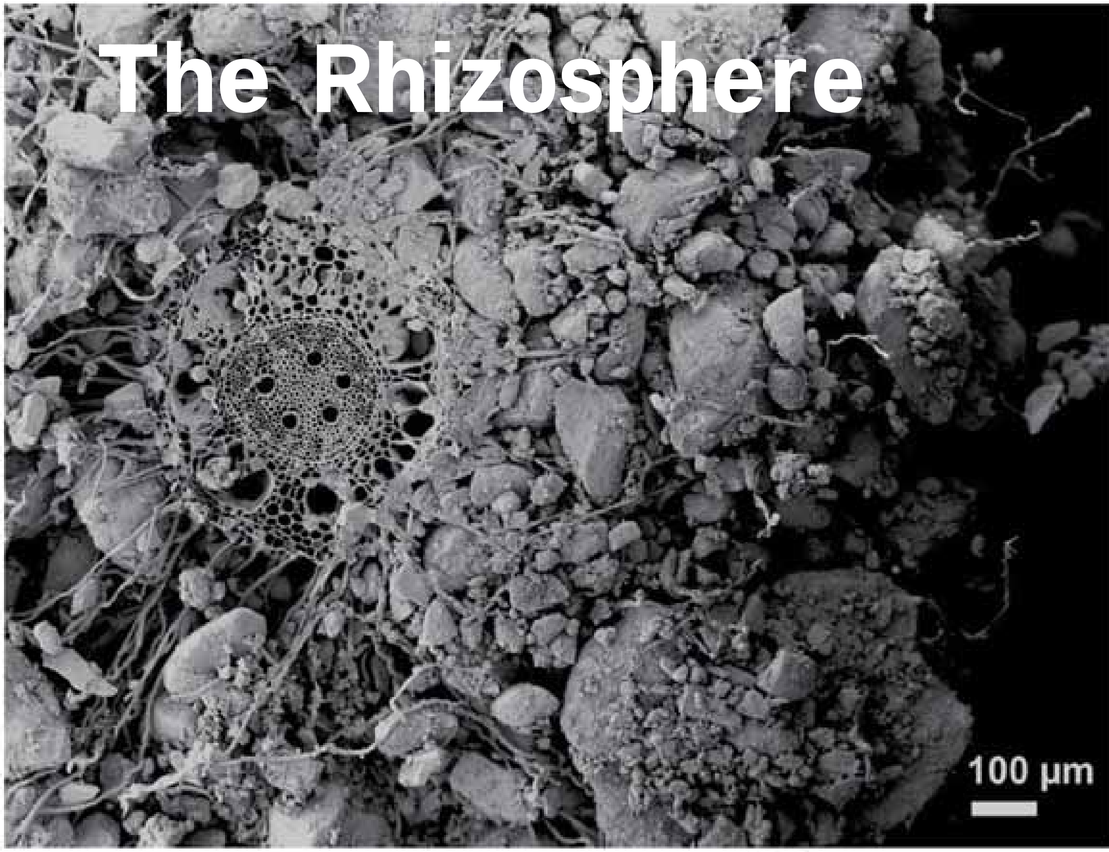
The Rhizosphere

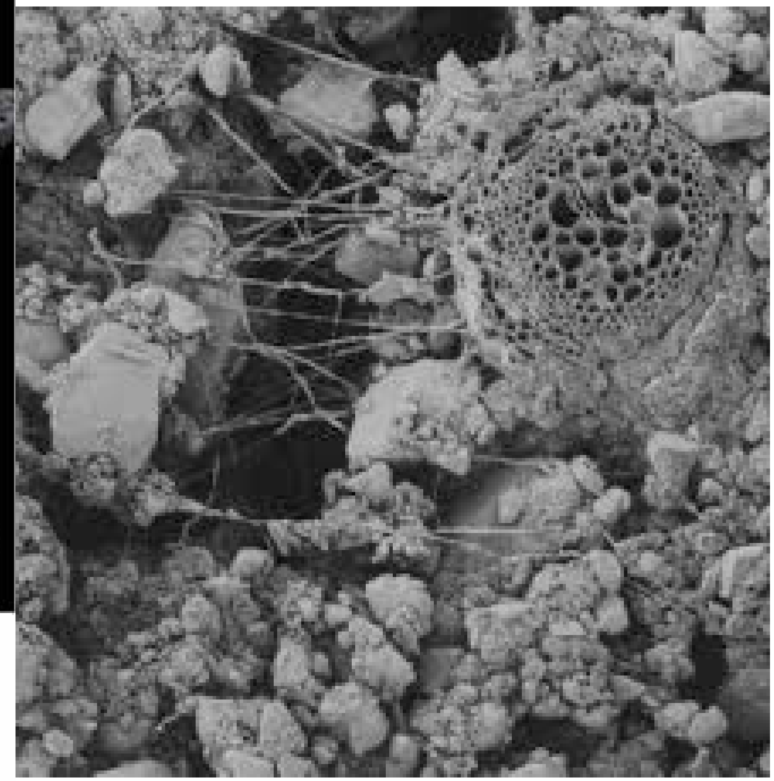


Journal of Experimental Botany, Vol. 67, No. 12 pp. 3629–3643, 2016
doi:10.1093/jxb/erw108 Advance Access publication 14 March 2016

REVIEW PAPER

The holistic rhizosphere: integrating zones, processes, and semantics in the soil influenced by roots

Larry M. York[1,*], Andrea Carminati[2], Sacha J. Mooney[1], Karl Ritz[1] and Malcolm J. Bennett[1]



New Phytologist Review

Research review

Rhizosphere geometry and heterogeneity arising from root-mediated physical and chemical processes

Author for correspondence:
Philippe Hinsinger

Philippe Hinsinger[1], George R. Gobran[2], Peter J. Gregory[3] and Walter W. Wenzel[4]

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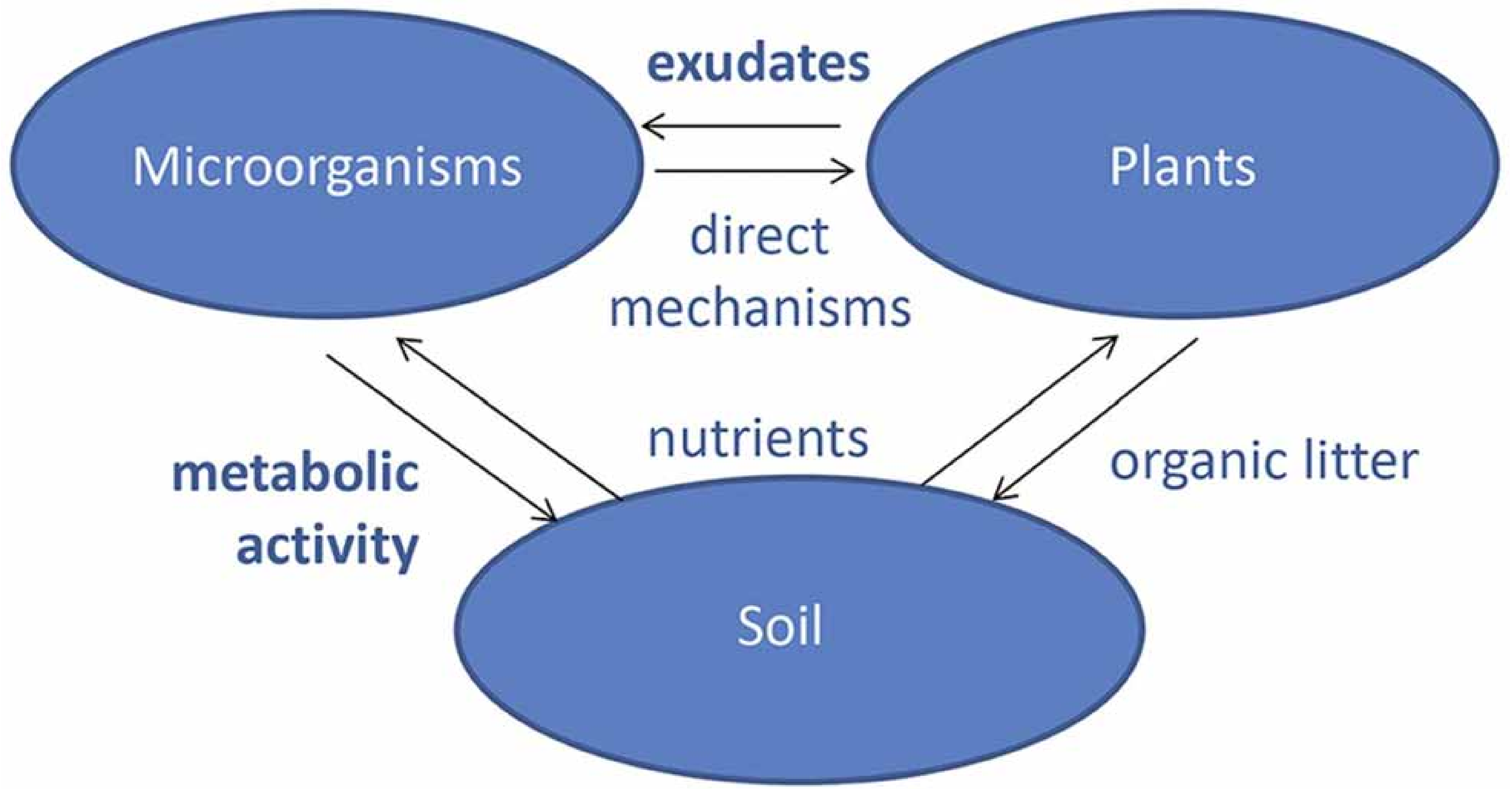
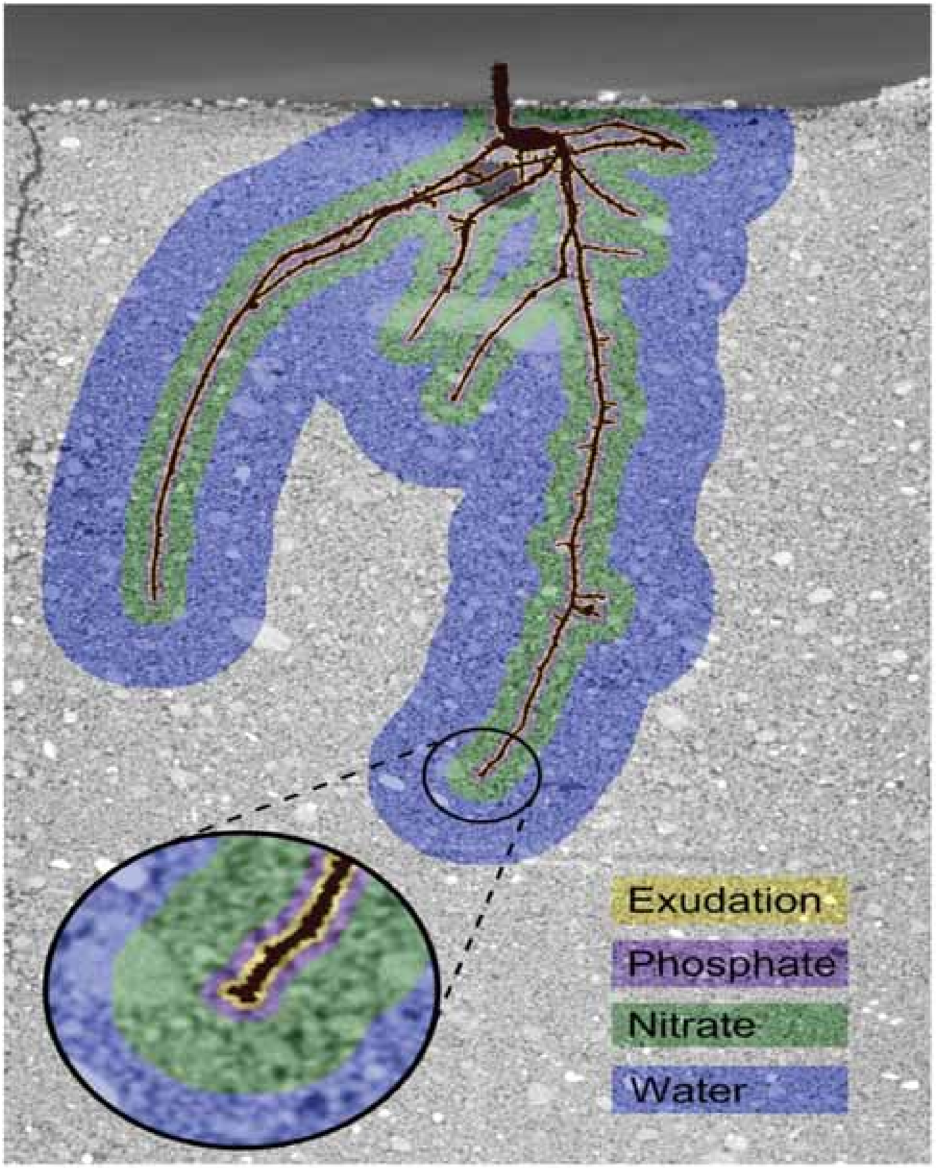
The Rhizosphere



The Rhizosphere



Journal of Experimental Botany, Vol. 67, No. 12 pp. 3629–3643, 2016
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REVIEW PAPER

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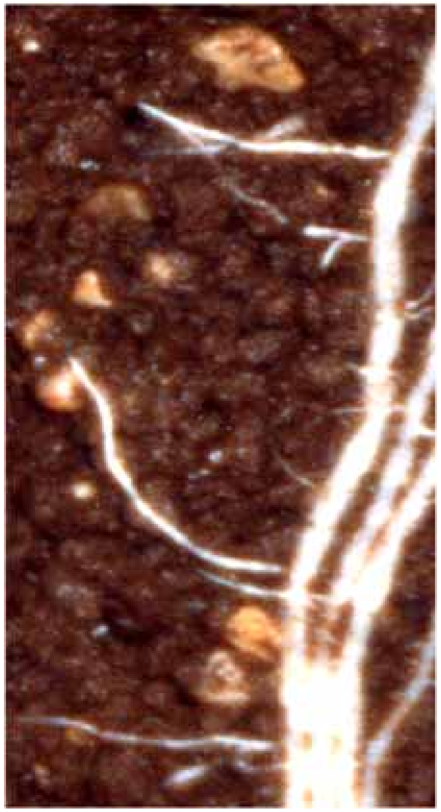
Larry M. York[1,*], Andrea Carminati[2], Sacha J. Mooney[1], Karl Ritz[1] and Malcolm J. Bennett[1]

The Rhizosphere

……. how does the complexity of the system and the dynamics influence the thermodynamics of the single process? Can chemical *equilibria* be really reached in the rhizosphere? ……..



kinetics vs thermodynamics

Plant Soil (2015) 386:399–406
DOI 10.1007/s11104-014-2308-1

COMMENTARY

Dynamics, thermodynamics and kinetics of exudates: crucial issues in understanding rhizosphere processes

Roberto Terzano · Stefano Cesco · Tanja Mimmo

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The Rhizosphere

soil fertility

Food and Agriculture Organization of the United Nations

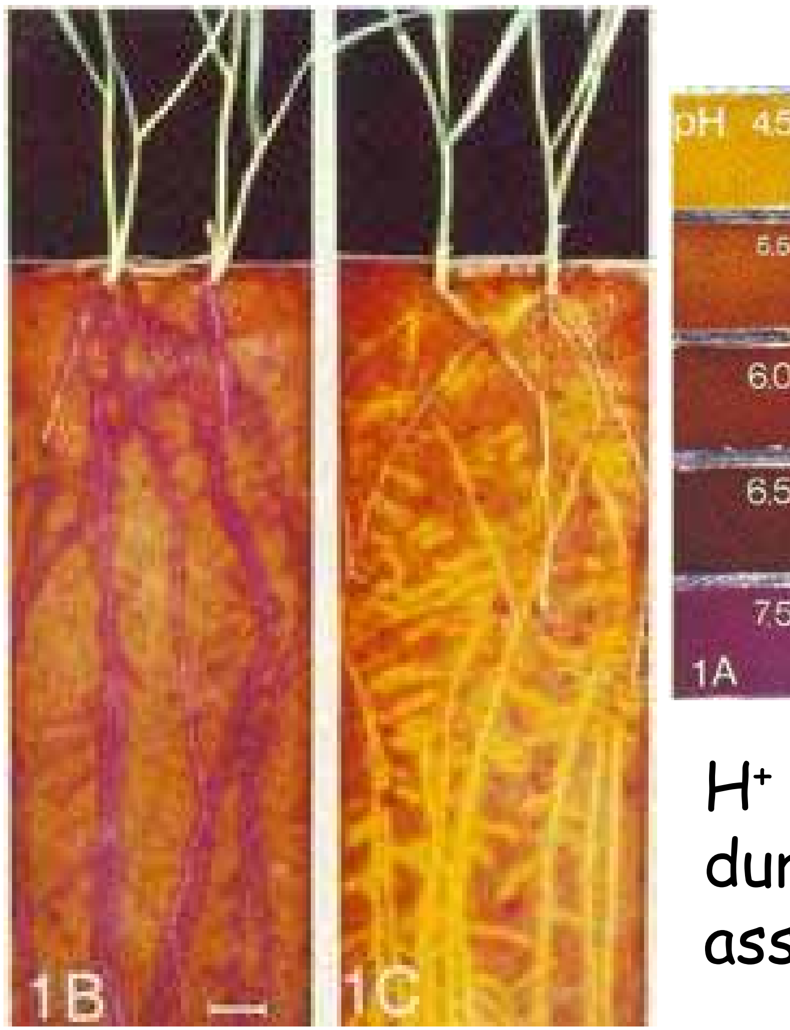
It is the capacity to receive, store and transmit energy to support plant growth

http://www.fao.org/tc/exact/sustainable-agriculture-platform-pilot-website/nutrients-and-soil-fertility-management/en/

The Rhizosphere

Effect of N form on the rhizosphere pH of barley

200 kg N/ha



NO_3^- NH_4^+

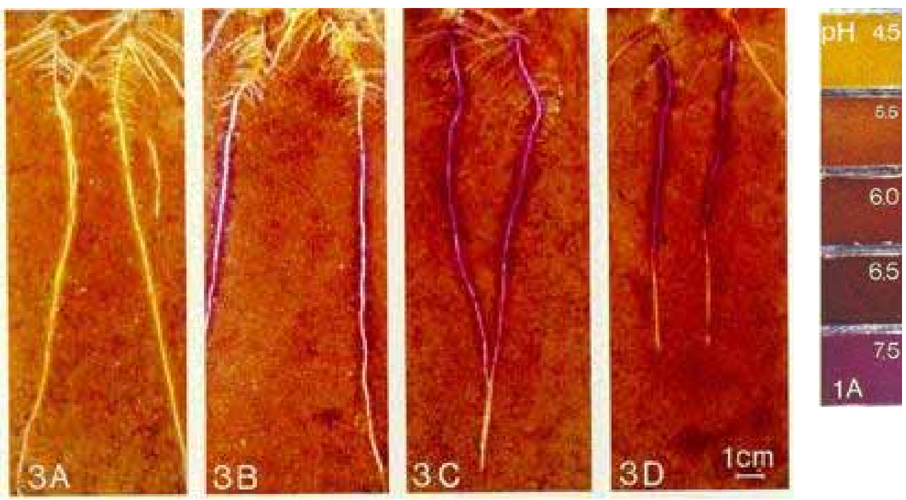
H^+ uptake (or OH^- release) during NO_3^- assimilation

H^+ release during NH_4^+ assimilation

Römheld 1986

The Rhizosphere

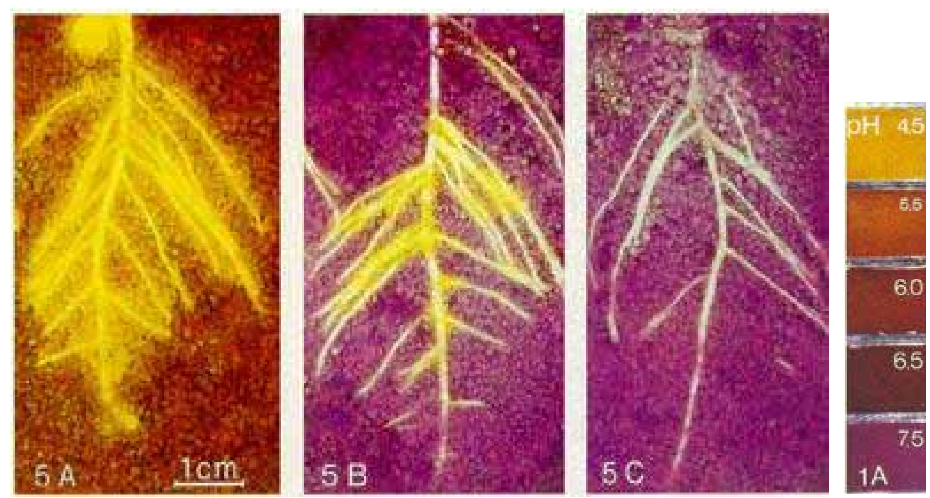
Soil nitrate concentration & rhizosphere pH of maize



75 125 200 400

NO_3-N (kg/ha)

Rhizosphere pH of chickpea with NH_4^+ supply in soil and different $CaCO_3$ addition

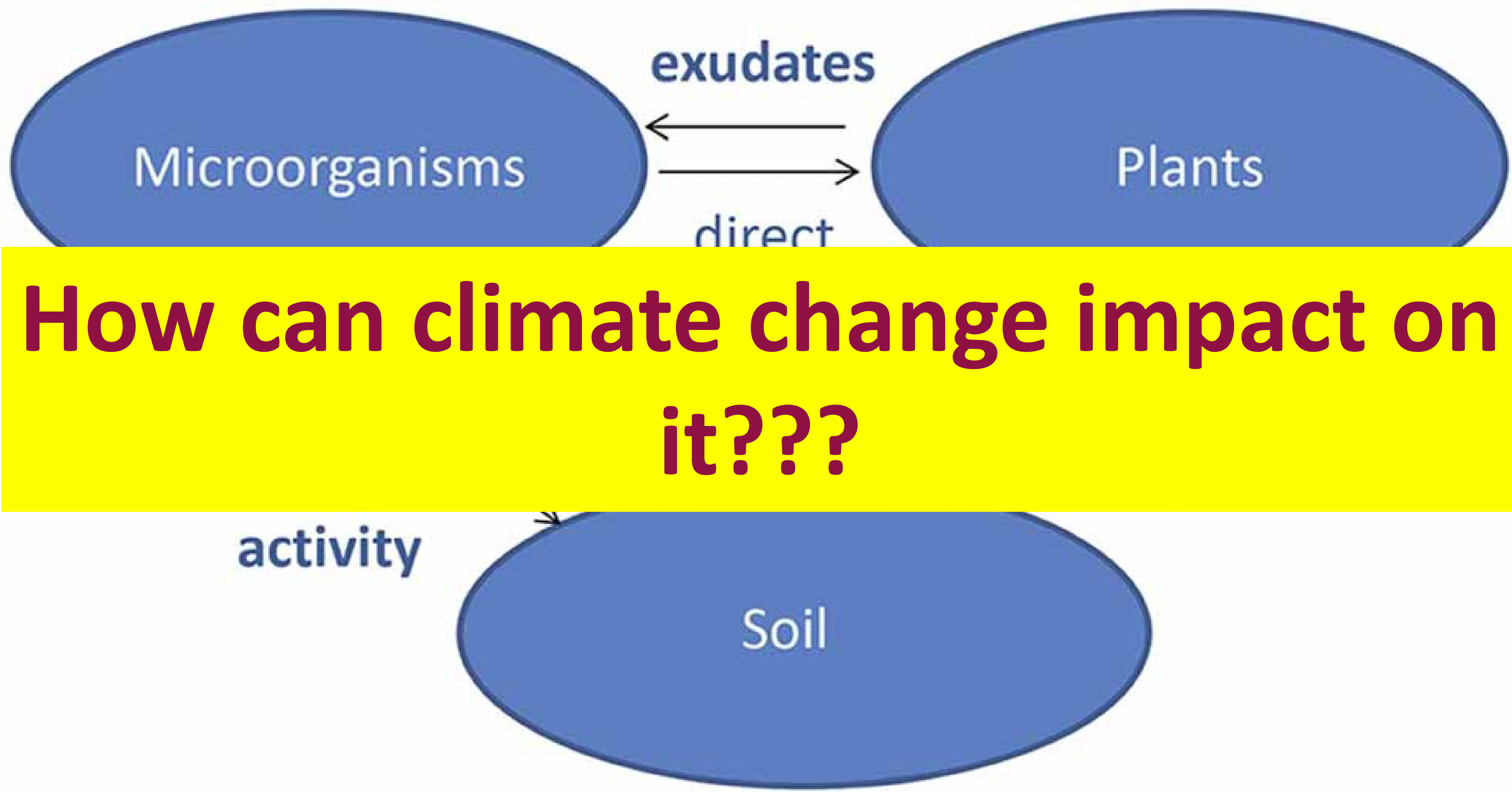


% $CaCO_3$ 1.5 3.0 6.0

Increasing soil pH & buffering

Römheld 1986

The Rhizosphere



How can climate change impact on it???

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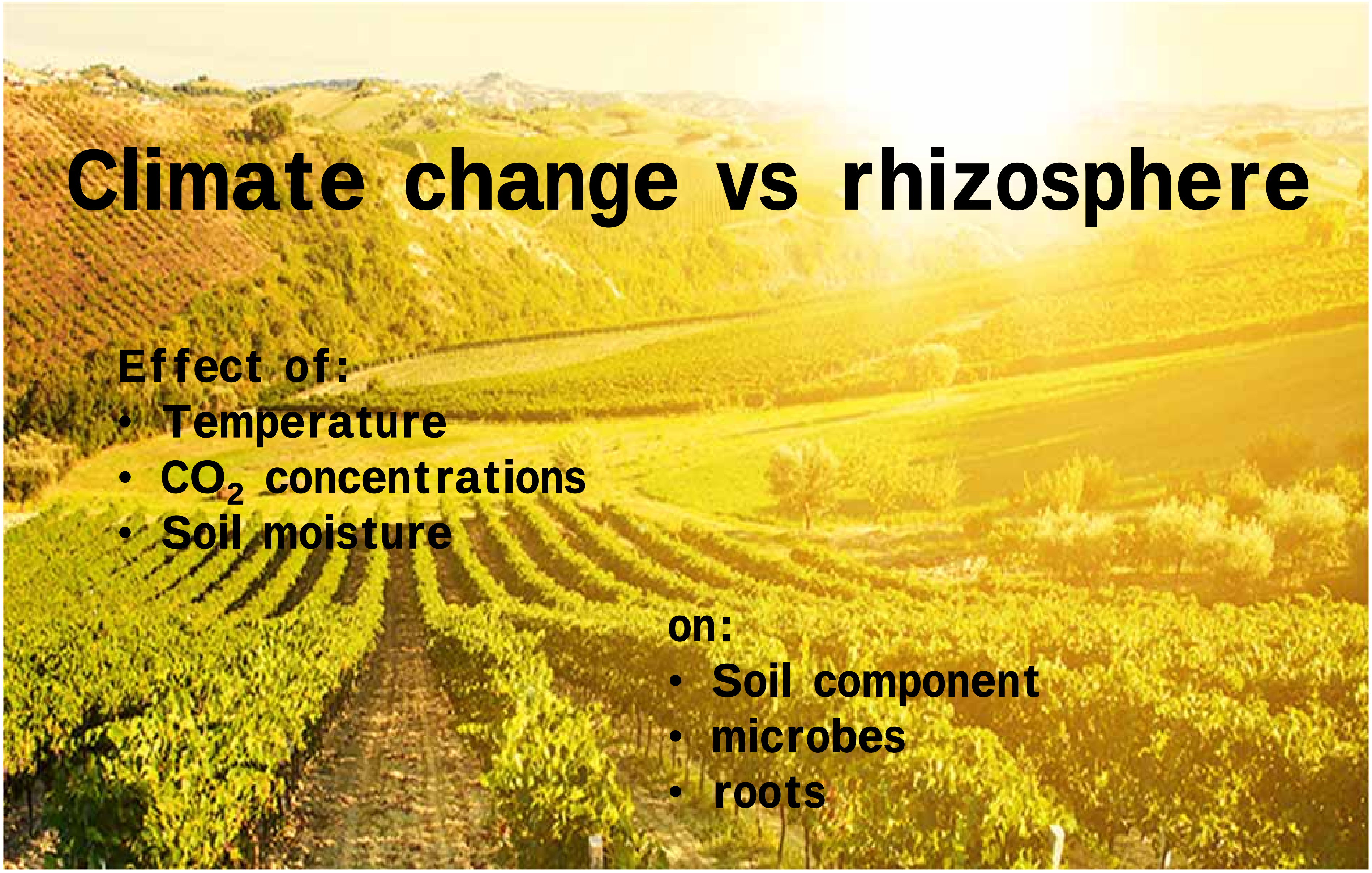

Climate change vs rhizosphere

Effect of:

- Temperature
- CO_2 concentrations
- Soil moisture

on:

- Soil component
- microbes
- roots

https://vinepair.com/wine-blog/climate-change-sours-grapes-for-some-but-new-yorks-future-looks-pretty-sweet/

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Temperature

http://www.proteawinesusa.com/2015/11/will-climate-change-redraw-the-wine-map/

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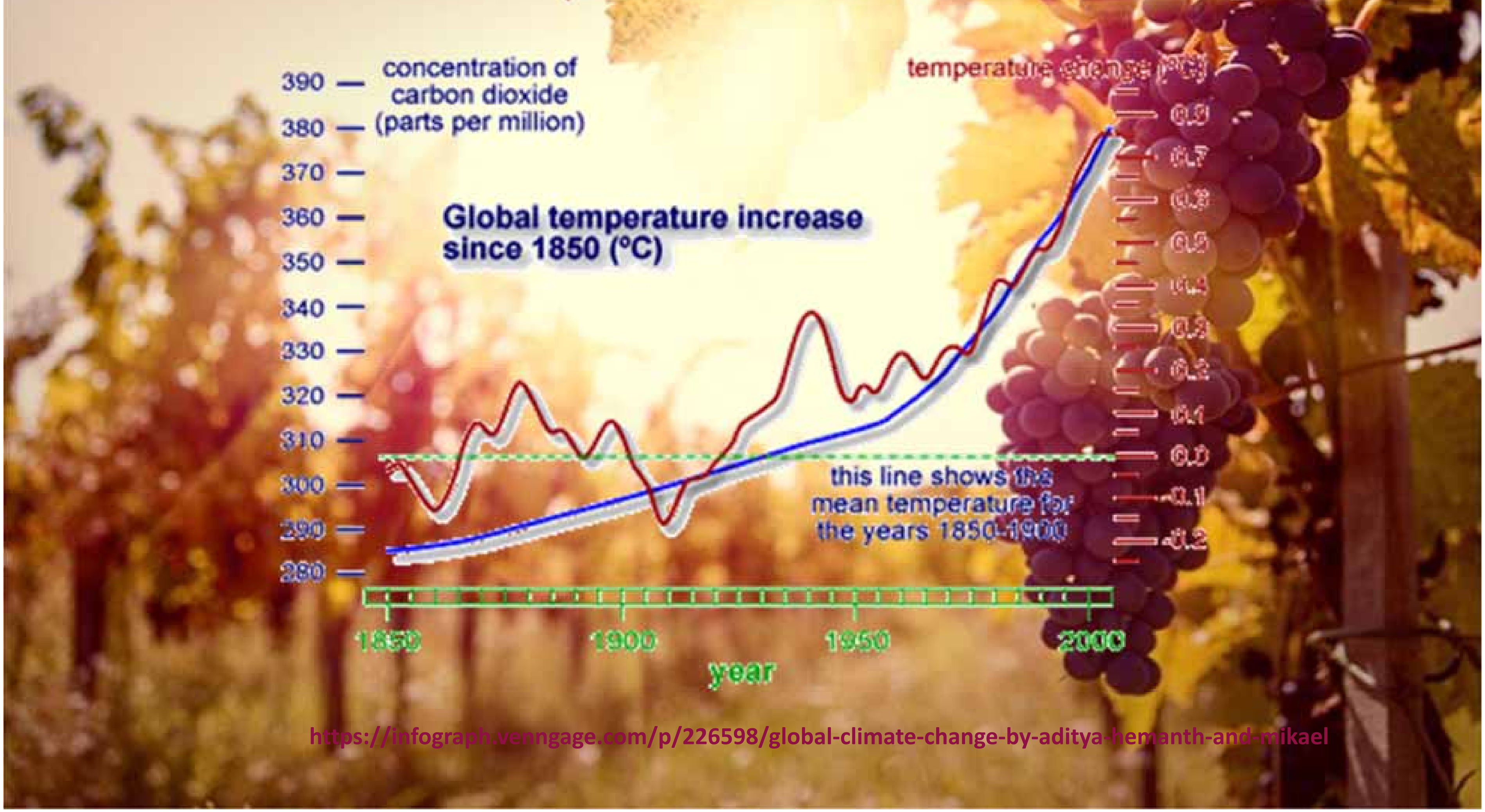
Global warming



http://www.proteawinesusa.com/2015/11/will-climate-change-redraw-the-wine-map/

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Global warming and soil temperature increase

In spite of comprehensive studies to investigate responses of various ecosystem processes to rising air temperatures under global warming, much less is known about changes in soil temperatures and their impact on below-ground processes, particularly deep in the soil profile. Temperature change can affect most soil processes, including decomposition and formation of soil organic matter, mineralisation/immobilization of nutrients (N, P, K, etc.), and the subsequent nitrogen transformation (nitrification and denitrification) processes.

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Published: 21 October 2016

SCIENTIFIC REPORTS

OPEN Rising soil temperature in China and its potential ecological impact

Hui Zhang, Enli Wang, Daowei Zhou, Zhongkui Luo & Zhengxiang Zhang

Global warming and soil temperature increase

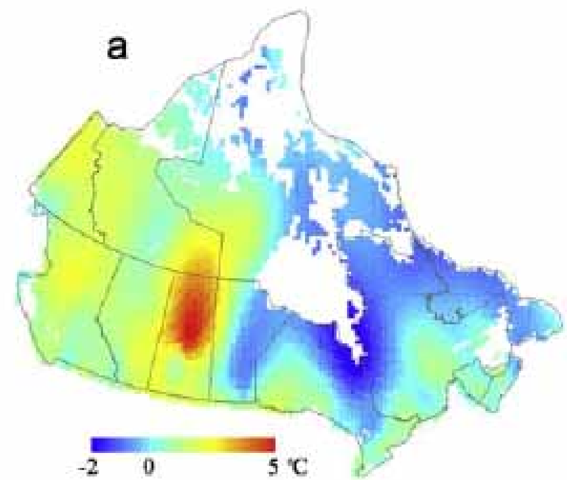
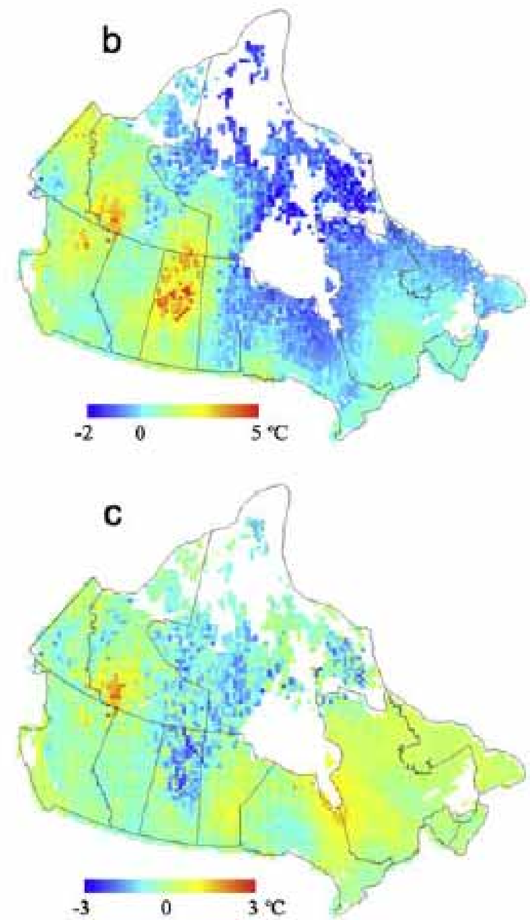


Figure 5. (a) Changes in the annual mean Ta during the twentieth century. (b) Changes in the annual mean Ts at 20 cm depth during the twentieth century. (c) Difference between the changes of Ts and Ta during the twentieth century. The changes in Ts and Ta were calculated as the difference between the averages in 1986–1995 and in 1901–1910.



JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 110, D03112, doi:10.1029/2004JD004910, 2005

Soil temperature in Canada during the twentieth century: Complex responses to atmospheric climate change

Yu Zhang and Wenjun Chen
Canada Centre for Remote Sensing, Natural Resources Canada, Ottawa, Ontario, Canada

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Issues...

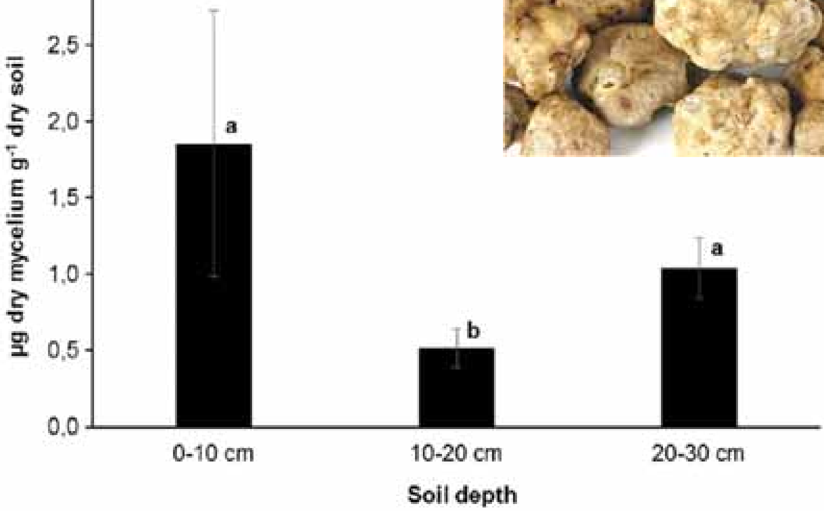
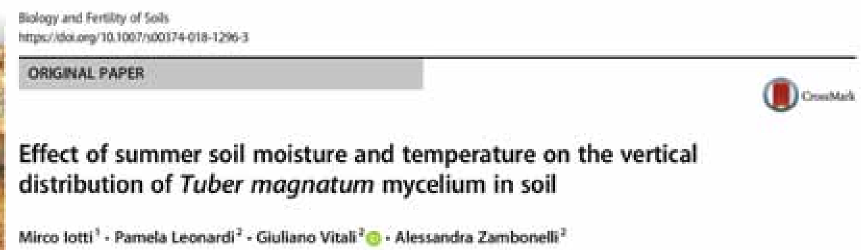


Fig. 4 Mean amount of extra-radical soil mycelium of *T. magnatum* in the different soil layers (0–10, 10–20, and 20–30 cm). Error bars represent standard error ($n = 32$). ANOVA was carried out on log-transformed values [$y = \log(x + 1)$]. Different letters indicate significant differences between soil layers ($p < 0.036$)



Biology and Fertility of Soils
https://doi.org/10.1007/s00374-018-1296-3

ORIGINAL PAPER

Effect of summer soil moisture and temperature on the vertical distribution of *Tuber magnatum* mycelium in soil

Mirco Iotti[1] · Pamela Leonardi[2] · Giuliano Vitali[2] · Alessandra Zambonelli[2]

The optimal temperature (20 °C) and water potential (~ 0 kPa) for growth of *T. magnatum* mycelium in soil

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The model developed in this work predicted *T. magnatum* dynamics in summer, the most critical season because of high soil temperatures and water scarcity.

Issues…

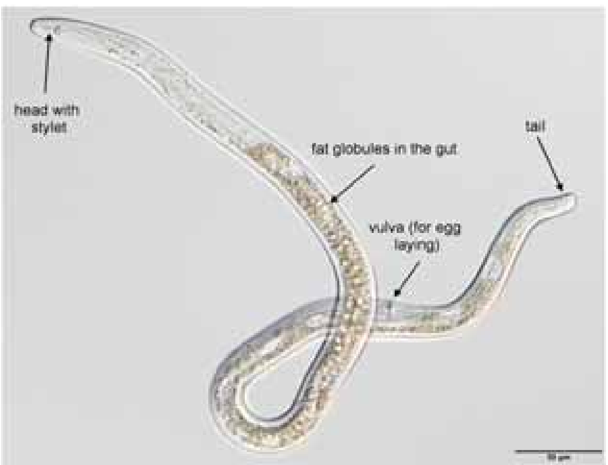
Biology and Fertility of Soils (2018) 54:243–257
https://doi.org/10.1007/s00374-017-1256-3

ORIGINAL PAPER

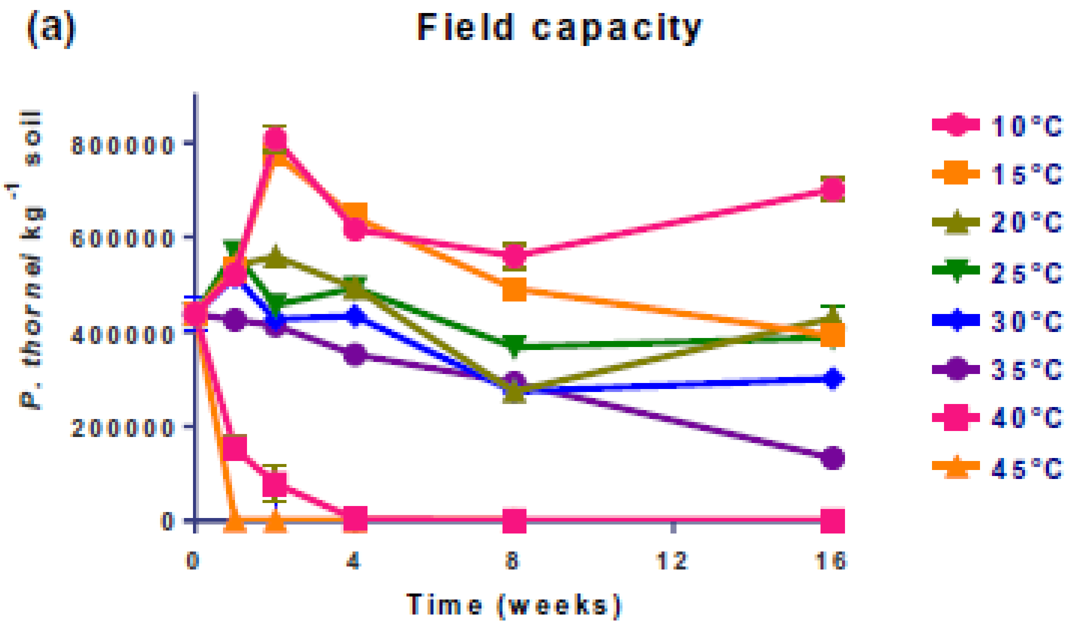
Elevated temperature reduces survival of peak populations of root-lesion nematodes (*Pratylenchus thornei*) after wheat growth in a vertisol

J. P. Thompson[1] · H. E. Rostad[1] · B. J. Macdonald[2] · J. P. M. Whish[3]

Received: 17 August 2017 / Revised: 10 November 2017 / Accepted: 13 November 2017 / Published online: 29 November 2017



http://www.croppro.com.au/crop_disease_manual/ch03s07.php



Elevated temperature of itself plus faster soil desiccation with increasing temperature are the likely causes of the faster decline in *P.thornei* population abundances in the topsoil than in the subsoil

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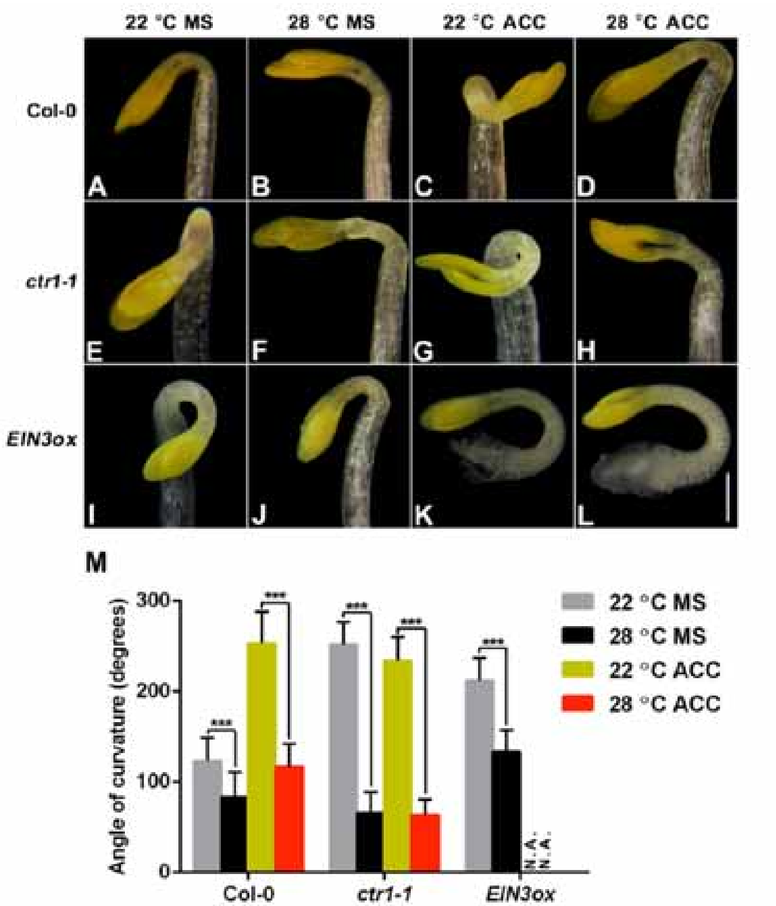
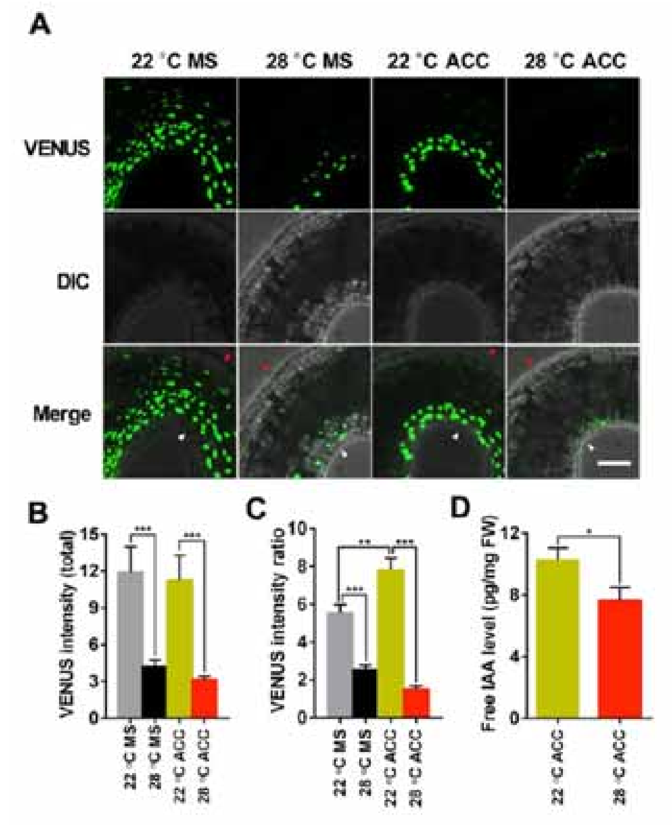
Issues...

Apical hook phenotypes in etiolated seedlings





High temperature reduces auxin activity

Received: 19 April 2018 | Revised: 27 July 2018 | Accepted: 28 July 2018
DOI: 10.1111/pce.13417

Check for updates

ORIGINAL ARTICLE

WILEY

High ambient temperature antagonizes ethylene-induced exaggerated apical hook formation in etiolated Arabidopsis seedlings

Huanhuan Jin[1] | Lei Pang[2] | Shuang Fang[3] | Jinfang Chu[3] | Ruixi Li[2] | Ziqiang Zhu[1]

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Issues...

Citrus Tifoliate Rootstock

http://www.justfruitsandexotics.com/JFE/olympus-digital-camera-39/#lightbox/0/

...Due to global warming, temperatures will increase in coming years and **it is important** for the citriculture **to find rootstocks not only tolerant to high temperatures**, but **also capable of withstanding other co-occurring stress conditions** such as soil toxicity or mechanical wounding...

Physiologia Plantarum

An International Journal for Plant Biology

Special Issue Article | Full Access

High temperatures change the perspective: integrating hormonal responses in citrus plants under co-occurring abiotic stress conditions

Damián Balfagón, Sara I Zandalinas, Aurelio Gómez-Cadenas

First published: 09 August 2018 | https://doi.org/10.1111/ppl.12815

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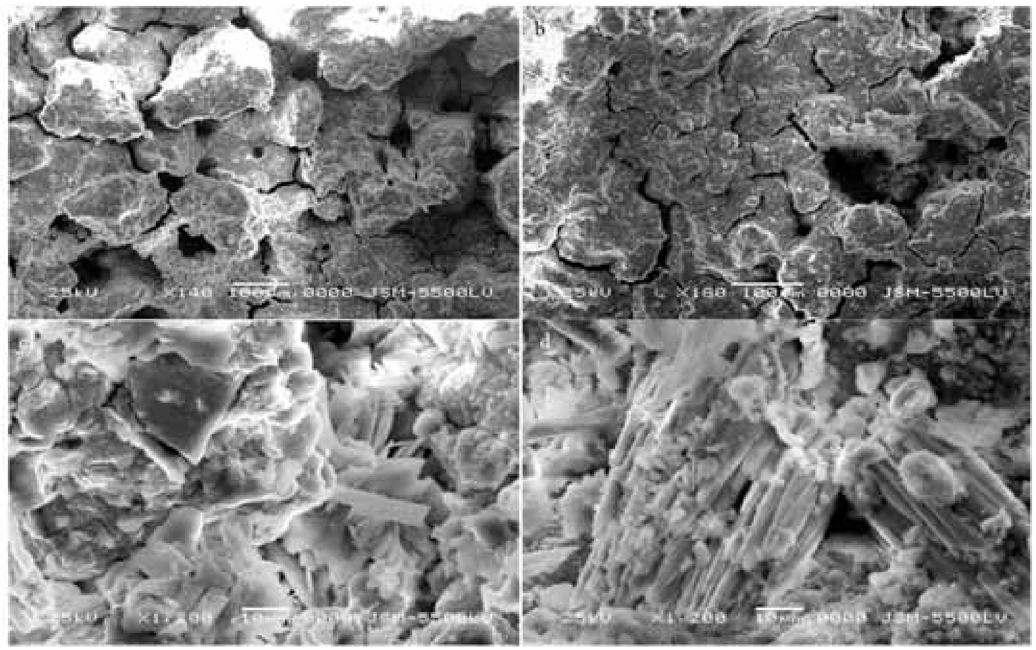
Accelerated weathering of the rocks and minerals in soils can be promoted by temperature which increases the extent and rates of weathering

http://geologylearn.blogspot.com/2015/08/weathering-and-erosion.html



http://html.scirp.org/file/8-1210395x24.png
http://dx.doi.org/10.4236/ojg.2015.511071

...also salt growth and freeze-thaw actions

As the temperature increases, microbial community structures are altered and processes like respiration are also accelerated


OPEN ACCESS Science International

Review Article
Potential Effects of Climate Change on Soil Properties: A Review

Rajib Karmakar, Indranil Das, Debashis Dutta and Amitava Rakshit

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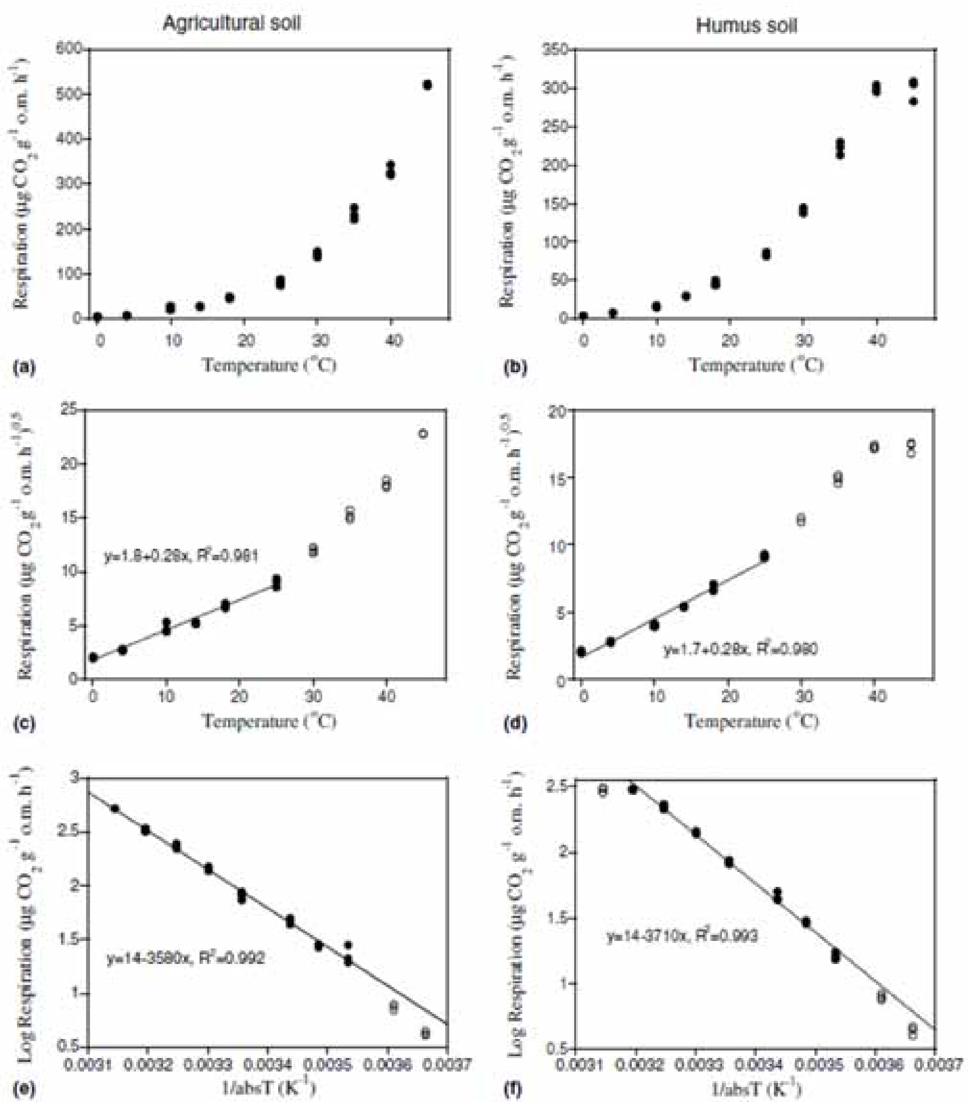
https://www.noble.org/news/publications/ag-news-and-views/2001/august/what-does-organic-matter-do-in-soil/

Temperature

Organic component



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ELSEVIER

FEMS Microbiology Ecology 52 (2005) 49–58

FEMS MICROBIOLOGY Ecology

www.fems-microbiology.org

Comparison of temperature effects on soil respiration and bacterial and fungal growth rates

Janna Pietikäinen [a,b], Marie Pettersson [a], Erland Bååth [a,*]

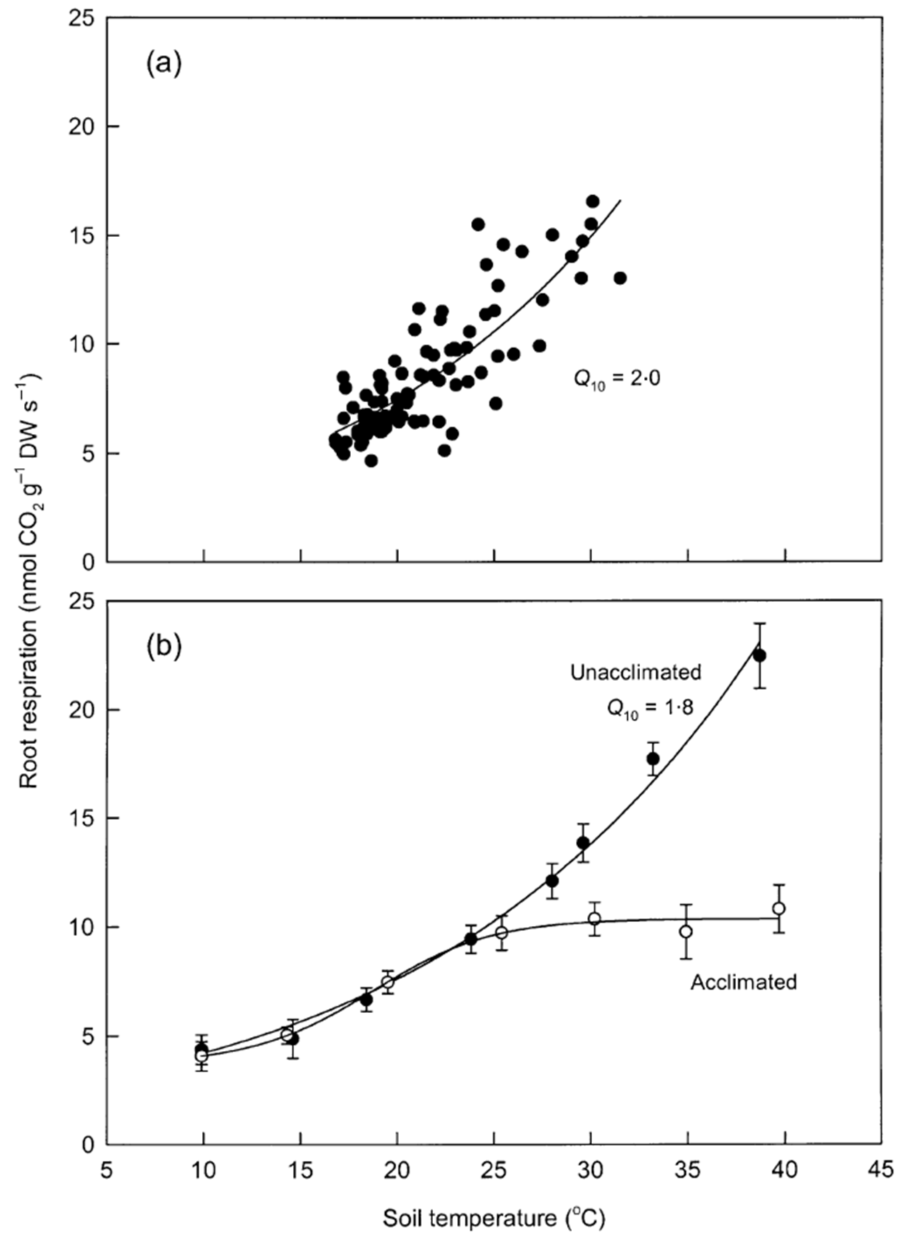
Plant, Cell and Environment (2001) **24**, 781–790

Influence of temperature and soil drying on respiration of individual roots in citrus: integrating greenhouse observations into a predictive model for the field

D. R. BRYLA,[1] T. J. BOUMA,[1*] U. HARTMOND[2] & D. M. EISSENSTAT[1]

[1]*Department of Horticulture, The Pennsylvania State University, University Park, PA 16802, USA and* [2]*Citrus Research and Education Centre, University of Florida – IFAS, Lake Alfred, FL 33850, USA*

Root respiration



Ordinarily, plant respiration increases exponentially as a function of temperature under normal growing conditions, suggesting that respiratory costs are higher in warmer soils

The main outcome of root respiration is the evolution of CO_2

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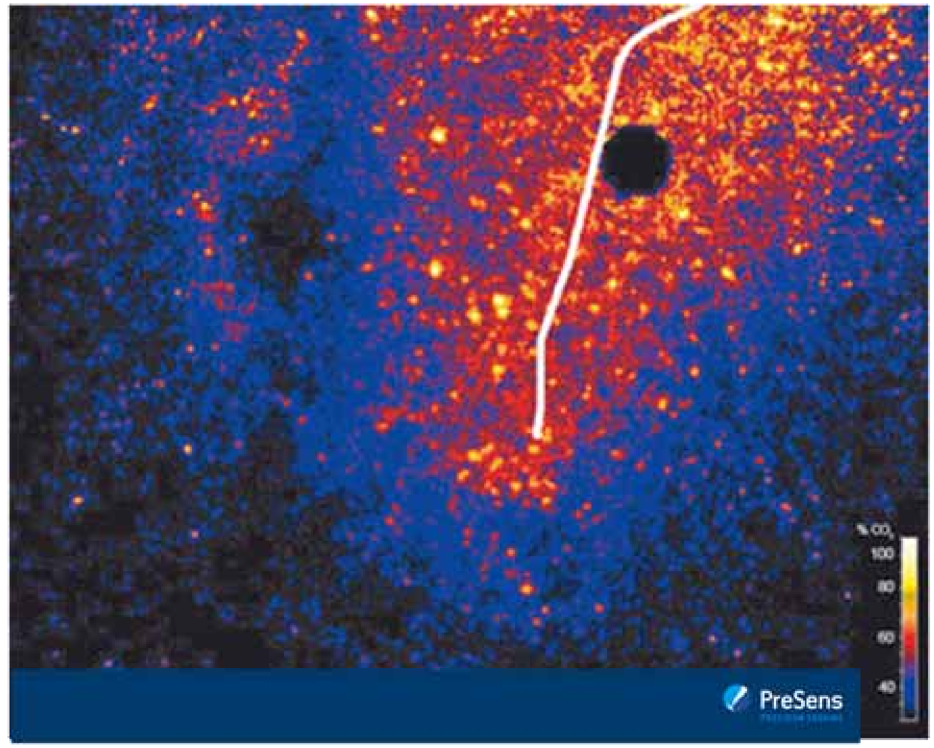
Temperature

Root respiration

increase of CO_2 → acidification and, thus, alteration of rhizosphere minerals

$$CO_2(g) + H_2O \leftrightarrow H_2CO_3 \leftrightarrow HCO_3^-(aq) + H^+(aq)$$

CO_2 map displaying pCO_2 distribution around *V. juncea* root (white line), taken from a 72 h pCO_2 monitoring; blue colors indicate low pCO_2, yellow colors high pCO_2. (Image: © Forschungszentrum Jülich)




< Back

Imaging Rhizosphere pH and CO_2 Dynamics

Plant Root - Soil Interactions Quantified with Prototype VisiSens Systems

S. Blossfeld[1], C. M. Schreiber[2], G. Liebsch[3], A. J. Kuhn[1], and P. Hinsinger[2]
[1]Forschungszentrum Jülich GmbH, Institute of Bio- and Geosciences, IBG-2: Plant sciences, Jülich, Germany
[2]INRA, UMR Eco&Sol, Montpellier, France
[3]PreSens Precision Sensing GmbH, Regensburg, Germany

https://www.presens.de/knowledge/publications/application-note/imaging-rhizosphere-ph-and-co2-dynamics-645.html

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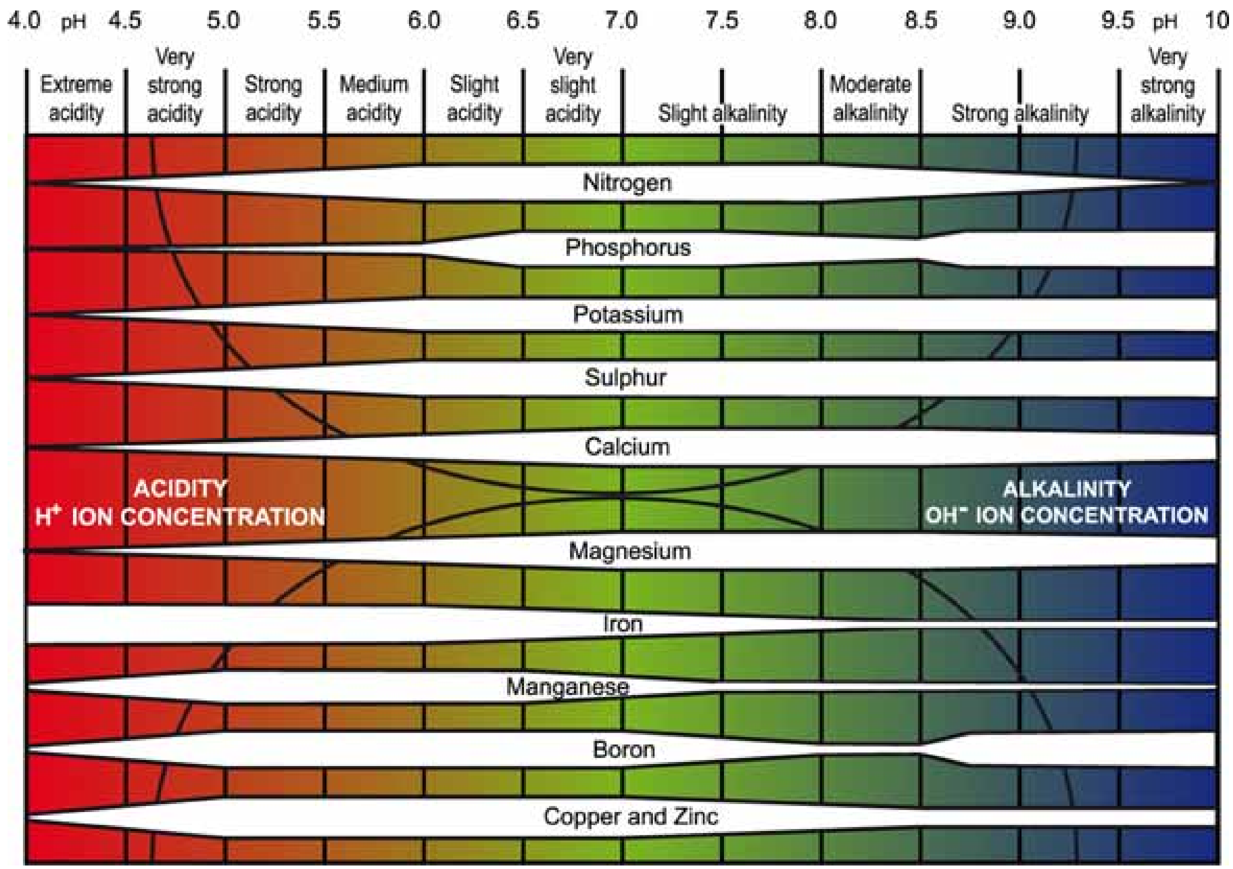
Temperature

Root respiration

decrease of pH modifies the availability of nutrients and/or trace metals in the rhizosphere

This can also lead to toxicity and/or deficiency phenomena



(redrawn for PDA from Truog, E. (1946). Soil reaction influence on availability of plant nutrients. Soil Science Society of America Proceedings 11, 305-308.)

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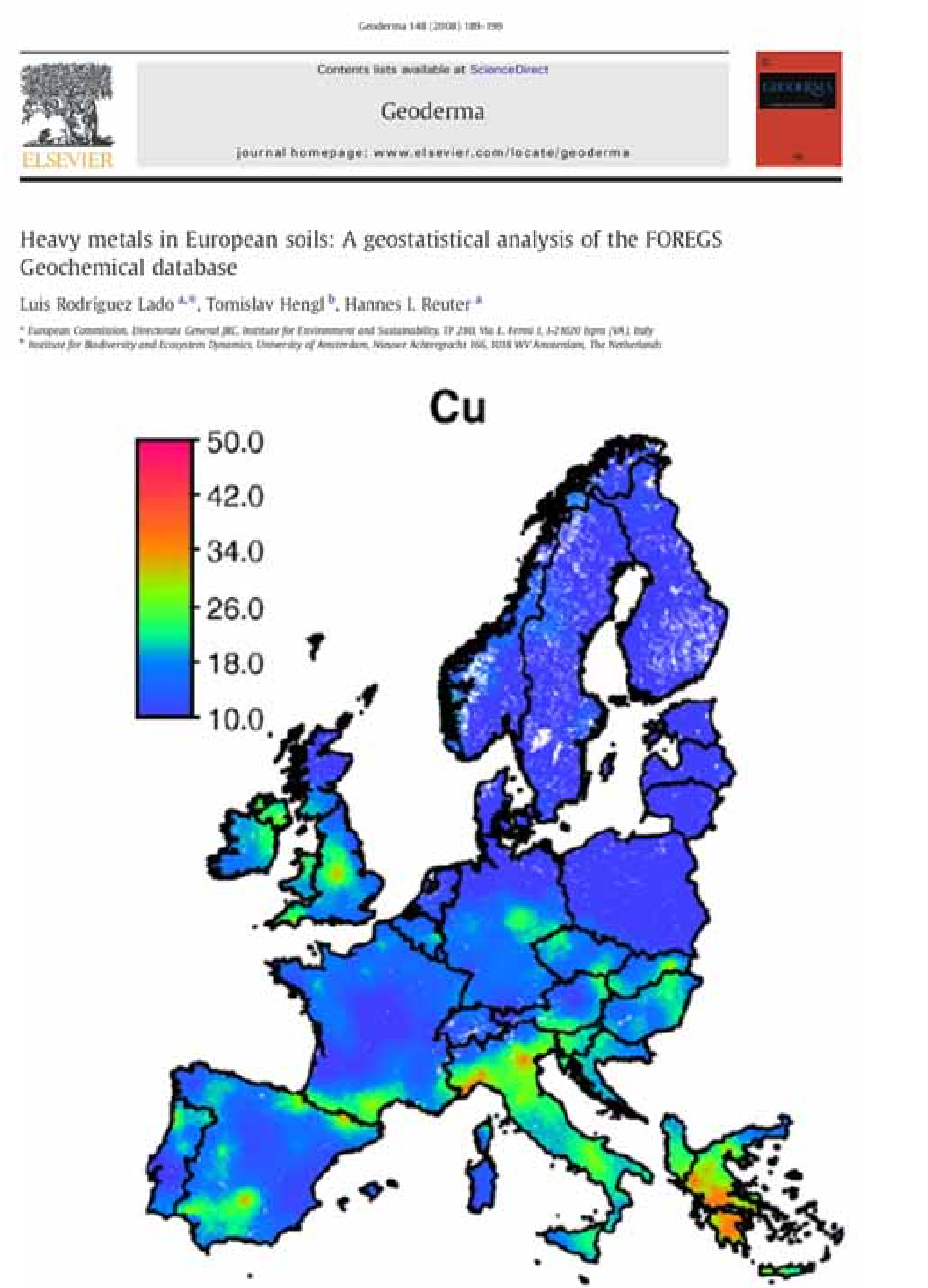
Soil contents of Cu in EU

Infezioni da *Plasmopara viticola*


Geoderma 148 (2008) 189–199
Contents lists available at ScienceDirect
Geoderma
journal homepage: www.elsevier.com/locate/geoderma

Heavy metals in European soils: A geostatistical analysis of the FOREGS Geochemical database

Luis Rodríguez Lado [a,*], Tomislav Hengl [b], Hannes I. Reuter [a]
[a] European Commission, Directorate General JRC, Institute for Environment and Sustainability, TP 280, Via E. Fermi 1, I-21020 Ispra (VA), Italy
[b] Institute for Biodiversity and Ecosystem Dynamics, University of Amsterdam, Nieuwe Achtergracht 166, 1018 WV Amsterdam, The Netherlands

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Biol Fertil Soils (2014) 50:973–982
DOI 10.1007/s00374-014-0919-6

ORIGINAL PAPER

Nutrient accumulation in leaves of Fe-deficient cucumber plants treated with natural Fe complexes

Nicola Tomasi · Tanja Mimmo · Roberto Terzano ·
Matthias Alfeld · Koen Janssens · Laura Zanin ·
Roberto Pinton · Zeno Varanini · Stefano Cesco

nutrients interaction

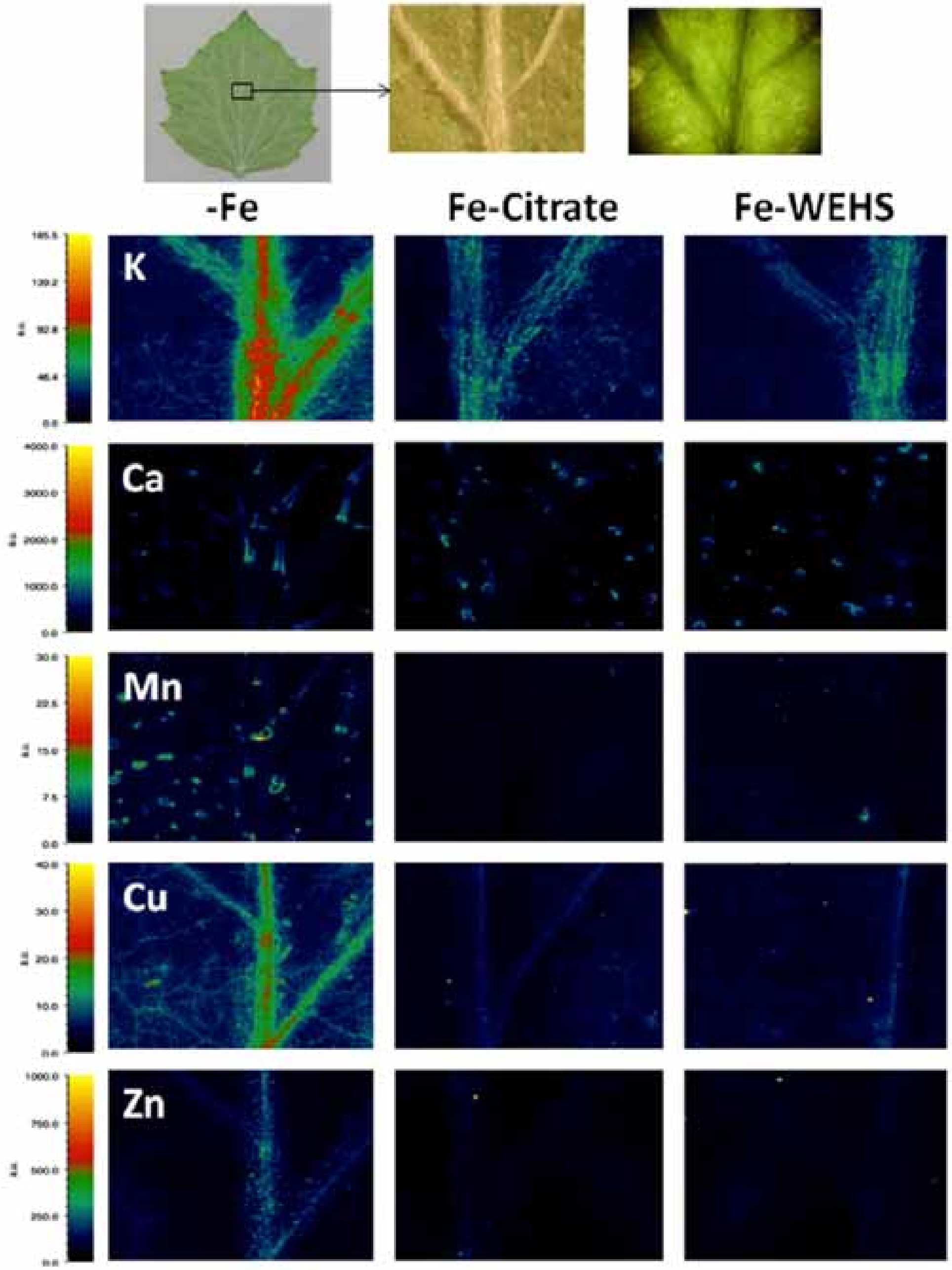

Fig. 3 Distribution of K, Ca, Mn, Cu, and Zn on a 3×2-mm^2 area of a leaf imaged by 2D-scanning µ-XRF after 5 days of treatment. All the XRF intensities are calculated relatively to the signal of Br, used as an internal standard. Different images for the same element can be visually compared

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Journal of Cereal Science 83 (2018) 74–82

Contents lists available at ScienceDirect

Journal of Cereal Science

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

Does Fe accumulation in durum wheat seeds benefit from improved whole-plant sulfur nutrition?

Stefania Astolfi[a,*], Youry Pii[b], Roberto Terzano[c], Tanja Mimmo[b], Silvia Celletti[a,b], Ignazio Allegretta[c], Domenico Lafiandra[a], Stefano Cesco[b]

nutrients interaction

C=control
F=Fe deficiency
E=excess S supply
EF=excess S supply and Fe deficiency

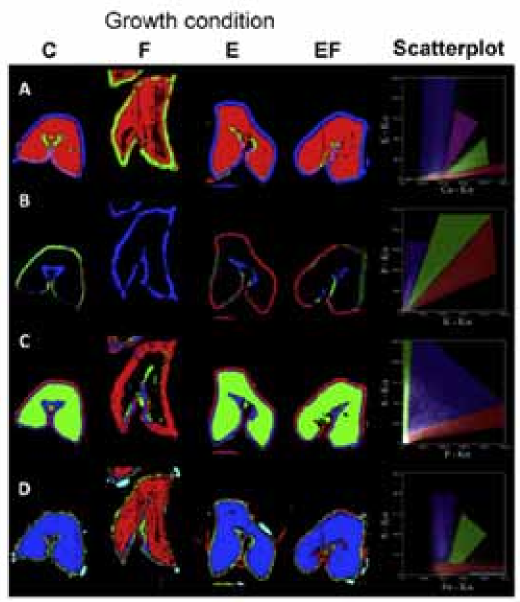
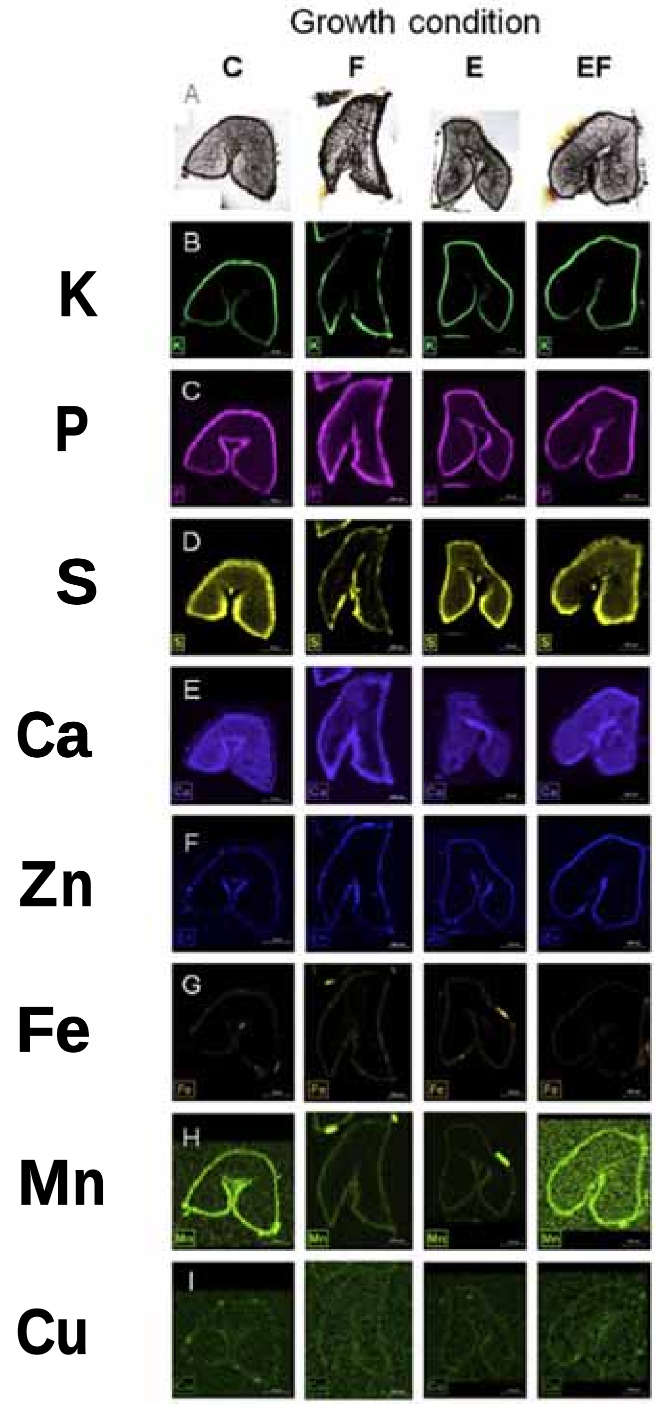


Fig. 6. Representative μ-XRF correlation maps of K/Ca (A), P/K (B), S/P (C) and S/Fe (D). Scatterplots of the elemental XRF signal intensities are also reported for each element pair.



fondazione banfi

SANGUIS JOVIS

Plant, Cell and Environment (2009) **32**, 666–681 doi: 10.1111/j.1365-3040.2009.01926.x

Regulation and function of root exudates

DAYAKAR V. BADRI & JORGE M. VIVANCO

Centre for Rhizosphere Biology and Department of Horticulture and LA, Colorado State University, Fort Collins, CO 80523, USA

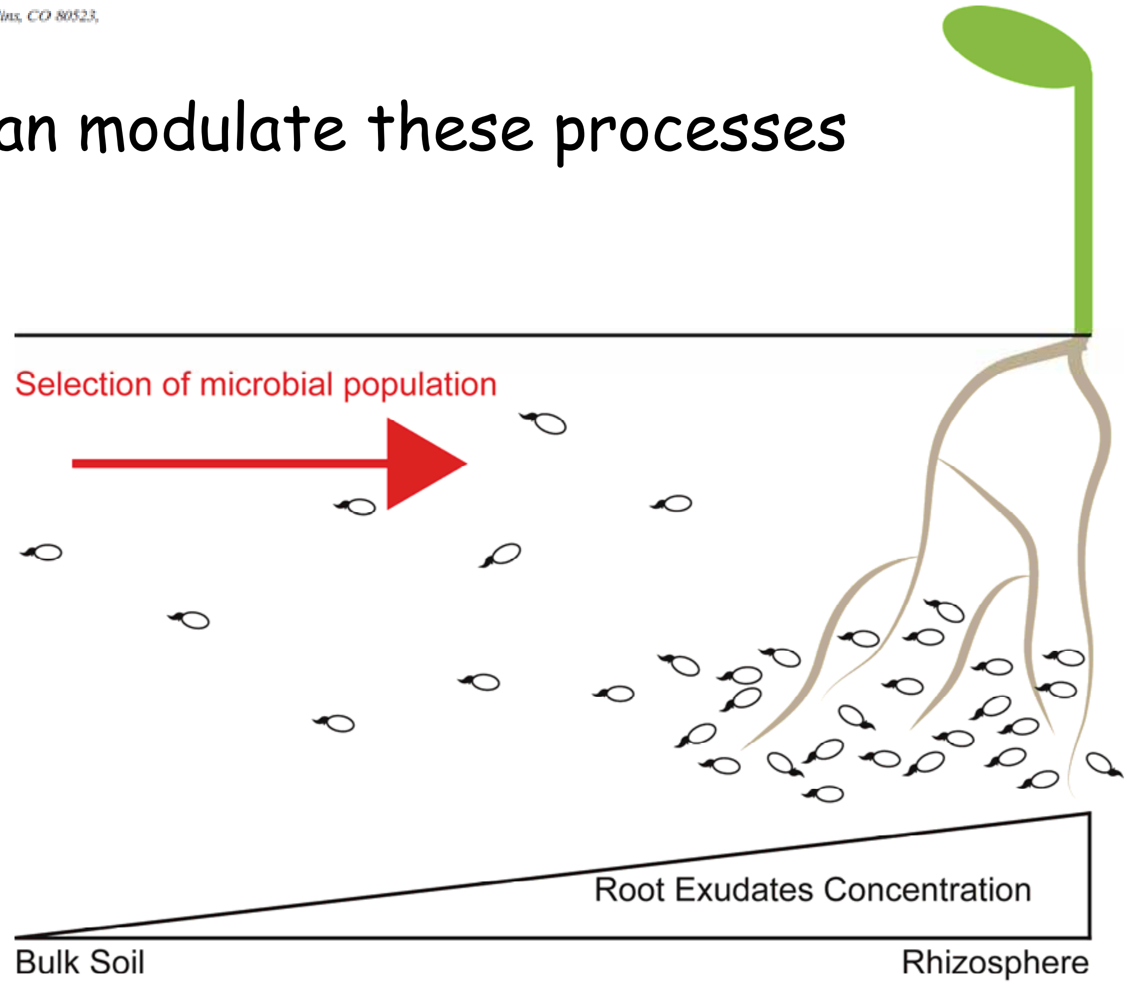
Temperature

Root exudation

temperature can modulate these processes

Credit: Glyn Bengough

Exudate at the tip of a maize root



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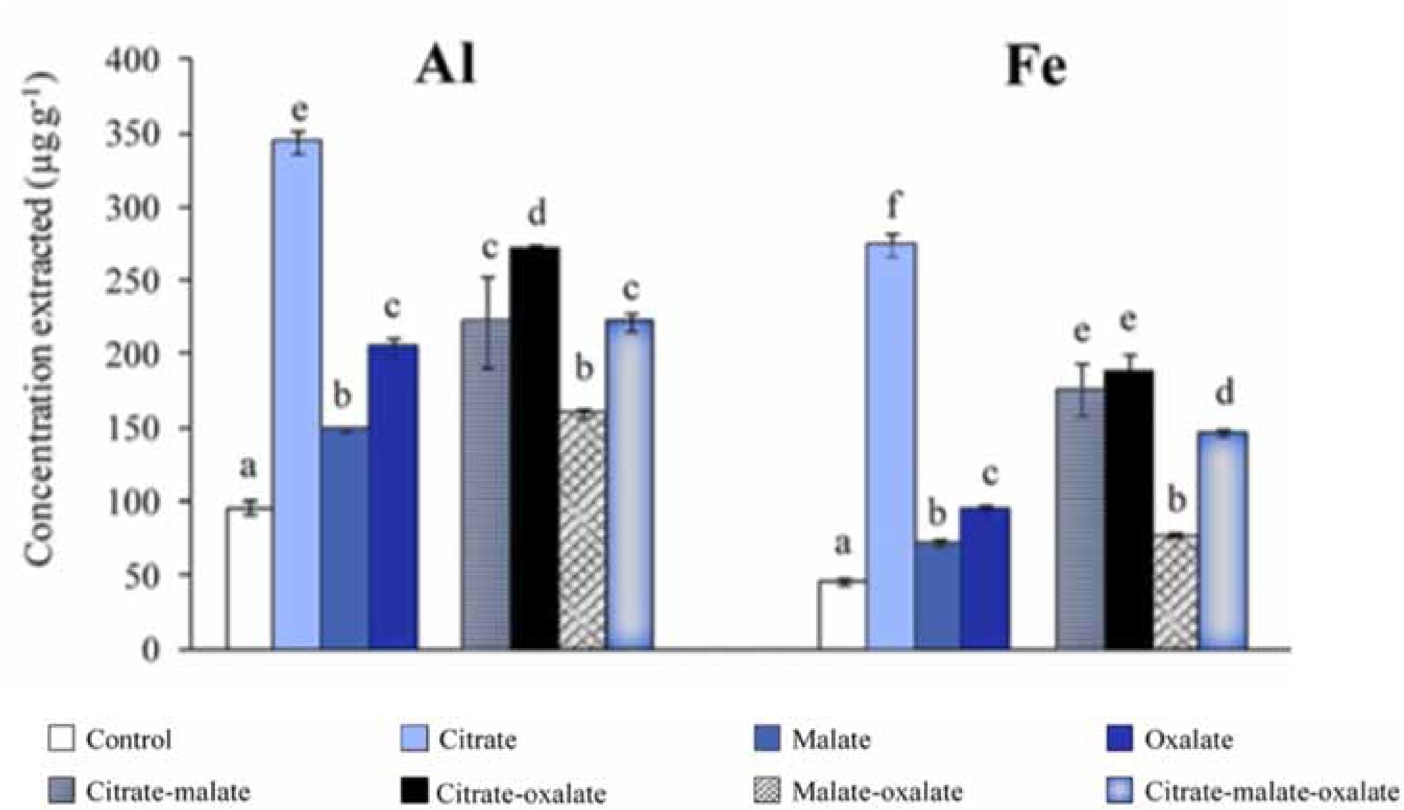
Exudation of tannins and phenolic compounds in *Vicia faba* was greatly reduced at 4 °C compared to the amounts at 30 °C (Bekkara et al. 1998)

Temperature

Root exudation



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SANGUIS JOVIS

Biol Fertil Soils
DOI 10.1007/s00374-015-1009-0

ORIGINAL PAPER

Combined effect of organic acids and flavonoids on the mobilization of major and trace elements from soil

Roberto Terzano[1] · Giovanni Cuccovillo[1] · Concetta Eliana Gattullo[1] · Luca Medici[2] · Nicola Tomasi[3] · Roberto Pinton[3] · Tanja Mimmo[4] · Stefano Cesco[4]

Temperature

Root exudation

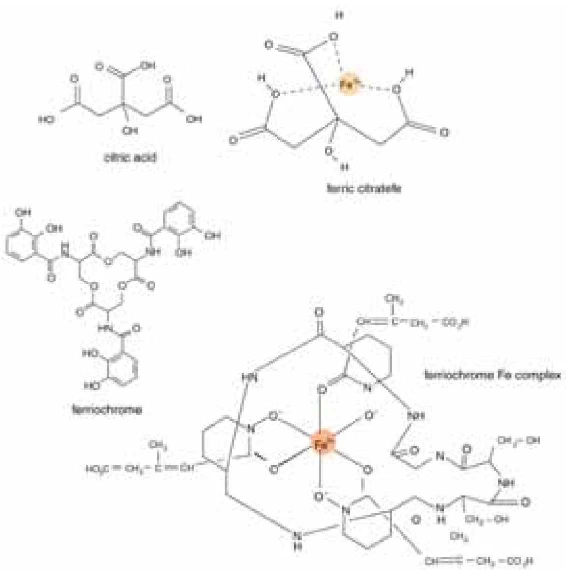
microorganisms MDPI

Article

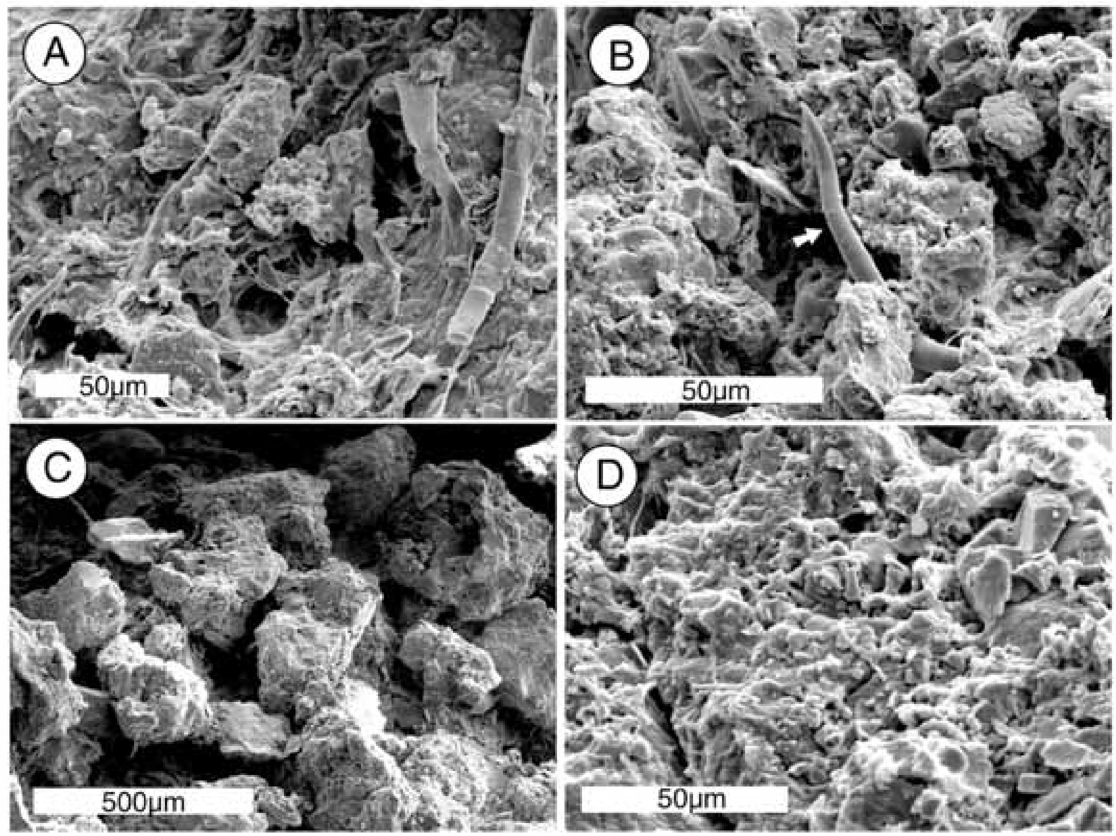
Biogenic Weathering: Solubilization of Iron from Minerals by Epilithic Freshwater Algae and Cyanobacteria

George E. Mustoe
Geology Department, Western Washington University, Bellingham, WA 98225, USA; mustoeg@wwu.edu;
Tel.: +1-360-650-3582

Received: 8 December 2017; Accepted: 9 January 2018; Published: 15 January 2018



In general, the dominant chemical process for biogenic weathering is chelation



biofilm-forming microorganisms that inhabit the surface zone of the porous arkose (Figure 9A,B), and evidence of rock weathering (Figure 9C,D)

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SANGUIS JOVIS


PHYS ORG Nanotechnology Physics Earth Astronomy & Space Technology

Home » Earth » Environment » April 18, 2018

Root exudates affect soil stability, water repellency

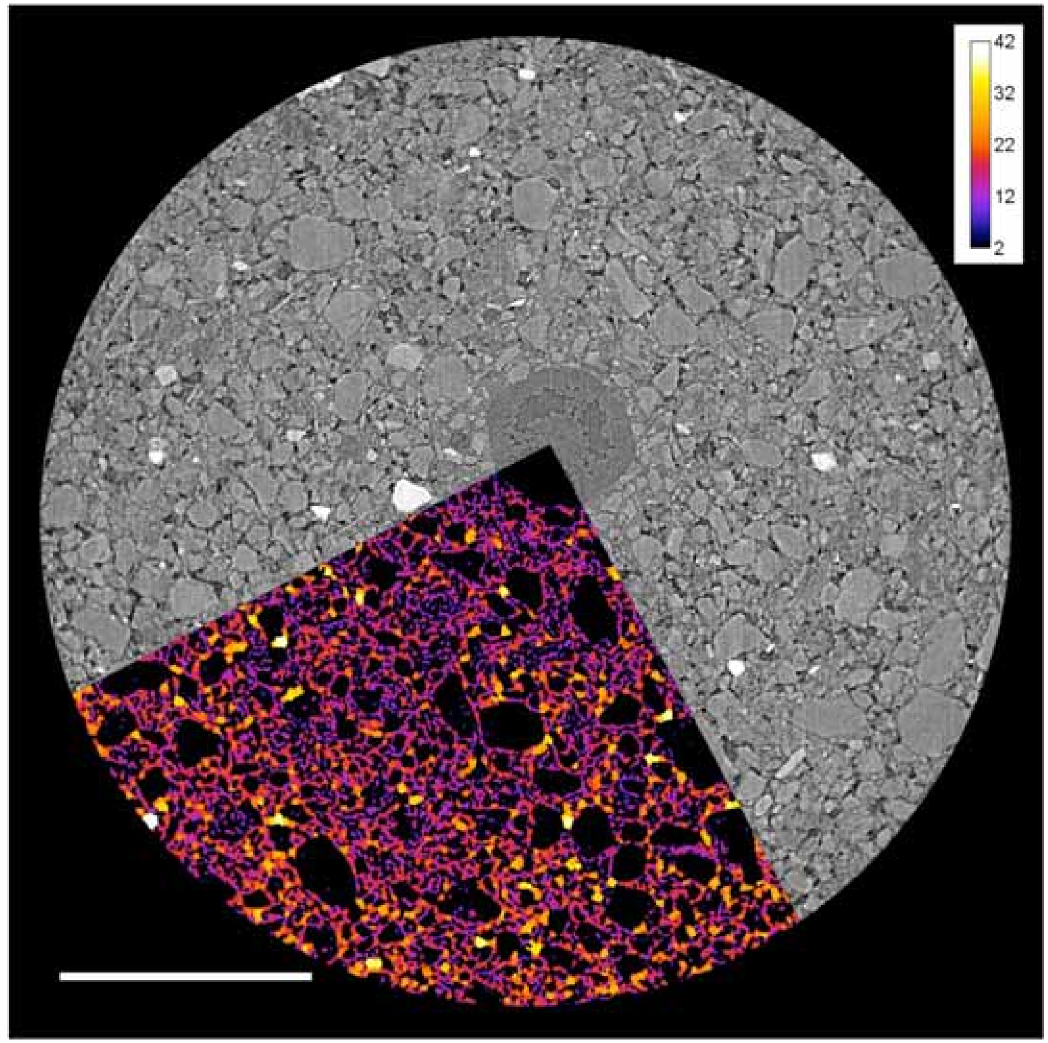
April 18, 2018, American Society of Agronomy

2018 from https://phys.org/news/2018-04-root-exudates-affect-soil-stability.html

Temperature

Root exudation

At the center of the image a barley root is visible



Credit: Diamond Light Synchrotron facility

…Roots continuously secrete chemicals into the soil as a way to liberate nutrients that are attached to soil particles….

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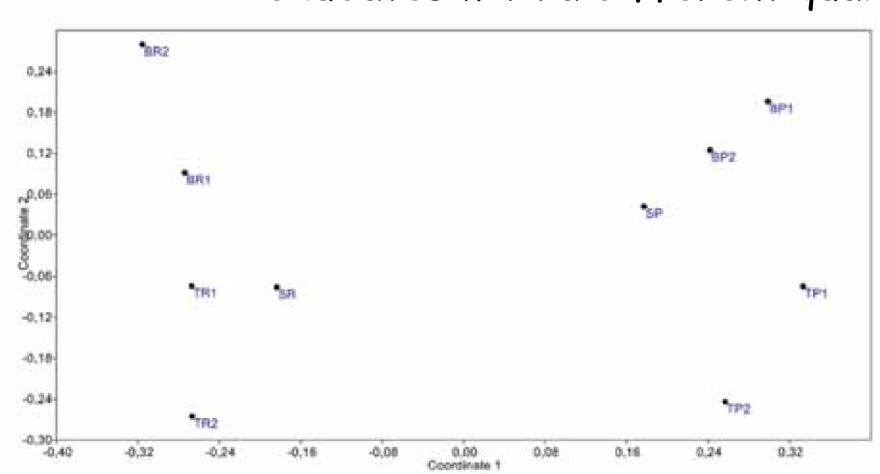
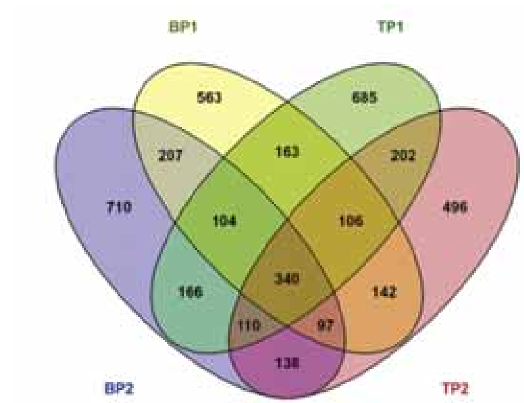
Temperature

Root exudation

Different crop plants, characterized by distinct Fe acquisition strategies, could similarly affect the rhizosphere microbial community through the release root exudates with a different quali-quantitative pattern





developmentally distinct plants grown in limited Fe availability regimes can use different tools to pursue the same objectives

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SANGUIS JOVIS

Plant Physiology and Biochemistry 99 (2016) 39–48

Contents lists available at ScienceDirect

Plant Physiology and Biochemistry

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

Research article

The interaction between iron nutrition, plant species and soil type shapes the rhizosphere microbiome

Youry Pii [a,*,1,2,3,4], Luigimaria Borruso [a,2,3,4], Lorenzo Brusetti [a,3], Carmine Crecchio [b,3], Stefano Cesco [a,1,3,4,5], Tanja Mimmo [a,1,2,3,4,5]

[a] Faculty of Science and Technology, Free University of Bolzano, Piazza Università 5, I-39100 Bolzano, Italy

[b] Department of Soil, Plant and Food Sciences, University of Bari "Aldo Moro", via Amendola 165/A, I-70126 Bari, Italy

CO_2 concentrations

http://www.proteawinesusa.com/2015/11/will-climate-change-redraw-the-wine-map/

fondazione banfi

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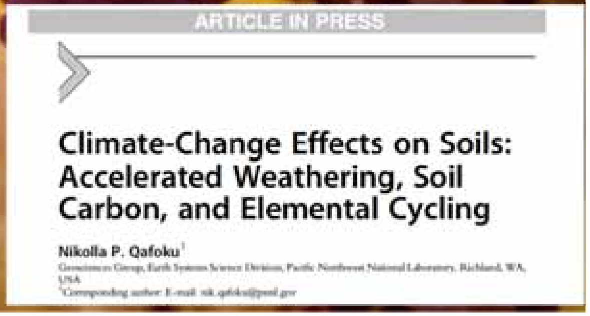
The dissolution of atmospheric CO_2 gas in soil water and the subsequent formation of carbonic acid followed by its dissociation cause a decrease in soil pore water pH as a result of aqueous phase proton enrichment

$$CO_2(g) + H_2O \leftrightarrow H_2CO_3 \leftrightarrow HCO_3^-(aq) + H^+ (aq)$$

Experimental and modeling studies conducted with soil and subsoil materials have shown a decrease in aqueous pH of 1 to 3 units in soil pore water as a result of excess exposure to CO_2 gas


ARTICLE IN PRESS

Climate-Change Effects on Soils: Accelerated Weathering, Soil Carbon, and Elemental Cycling

Nikolla P. Qafoku[1]

http://www.proteawinesusa.com/2015/11/will-climate-change-redraw-the-wine-map/

Dissolution of soil minerals such as calcite, feldspar (albite) and a typical 1:1 phyllosilicate (kaolin) in the presence of an excess amount of CO_2 gas

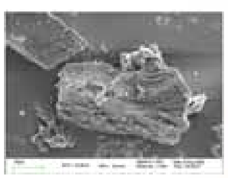
$$CaCO_3 + CO_2(g) + H_2O \rightarrow Ca^{2+} + 2HCO_3^-$$

$$2NaAlSi_3O_8 + 11H_2O + 2CO_2(g) \rightarrow Al_2Si_2O_5(OH)_4 + 2Na^+ + 2HCO_3^- + 4H_4SiO_4$$

$$Al_2Si_2O_5(OH)_4 + 5H_2O + 6CO_2(g) \rightarrow 2Al^{3+} + 6HCO_3^- + 2H_4SiO_4$$

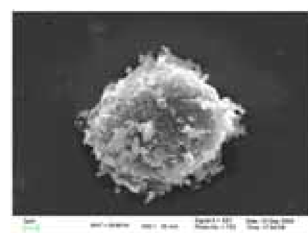
Harvey et al., 2013

feldspar



http://www.scielo.org.ar/scielo.php?script=sci_arttext&pid=S0327-07932007000200005

kaolin



http://www.scielo.org.ar/scielo.php?script=sci_arttext&pid=S0327-07932007000200005

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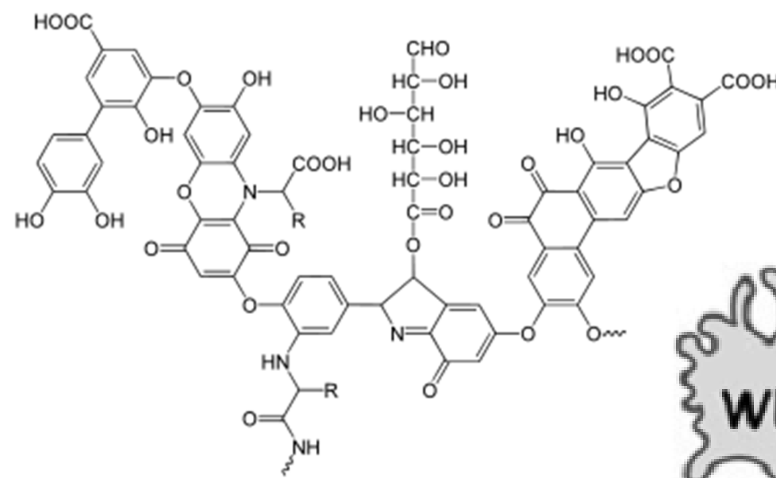
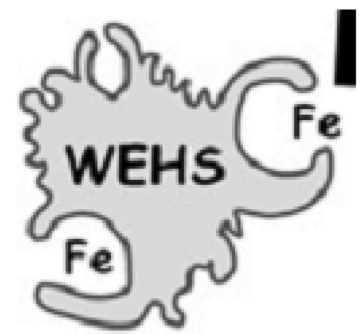
SANGUIS JOVIS

Decrease in soil pH can chenge the reactivity of the humified components of the soil leads to a reduction in the cation complexation capacity



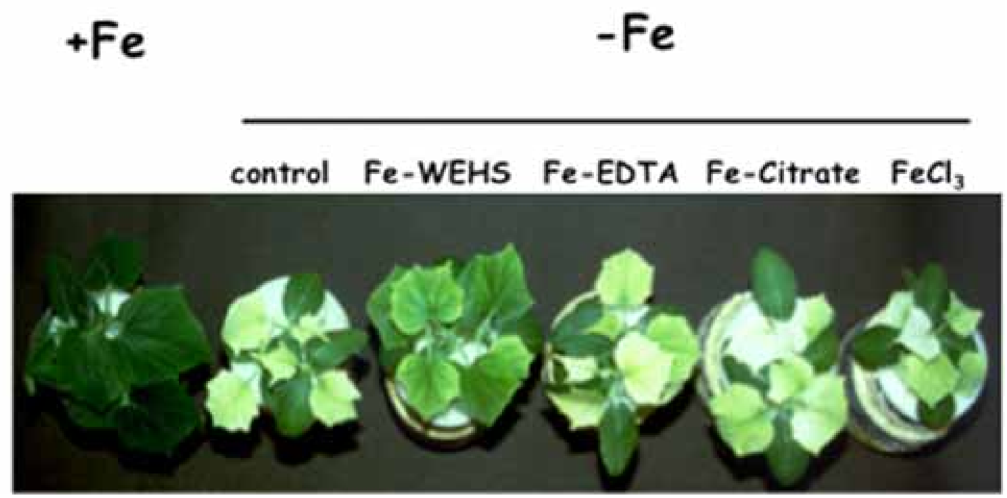


Plant and Soil 210: 145–157, 1999.

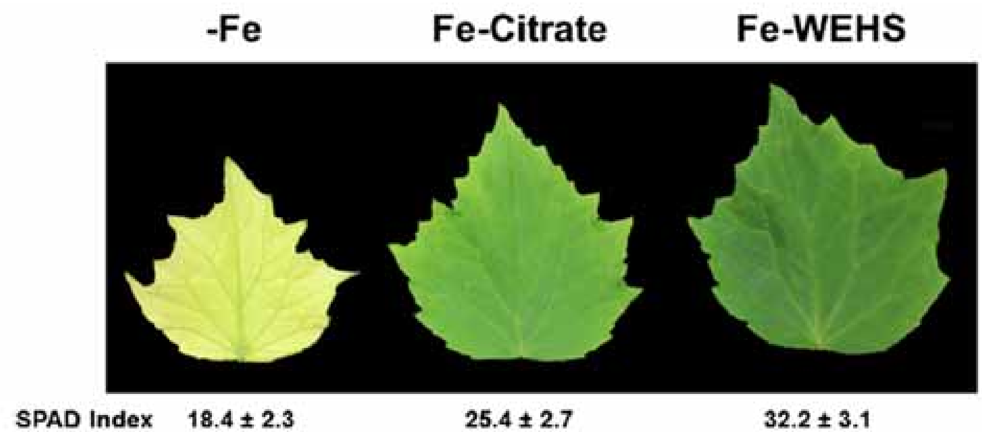
145

Water-extractable humic substances enhance iron deficiency responses by Fe-deficient cucumber plants

R. Pinton*, S. Cesco, S. Santi, F. Agnolon and Z. Varanini



Organic component



Biol Fertil Soils (2014) 50:973–982
DOI 10.1007/s00374-014-0919-6

ORIGINAL PAPER

Nutrient accumulation in leaves of Fe-deficient cucumber plants treated with natural Fe complexes

Nicola Tomasi · Tanja Mimmo · Roberto Terzano · Matthias Alfeld · Koen Janssens · Laura Zanin · Roberto Pinton · Zeno Varanini · Stefano Cesco

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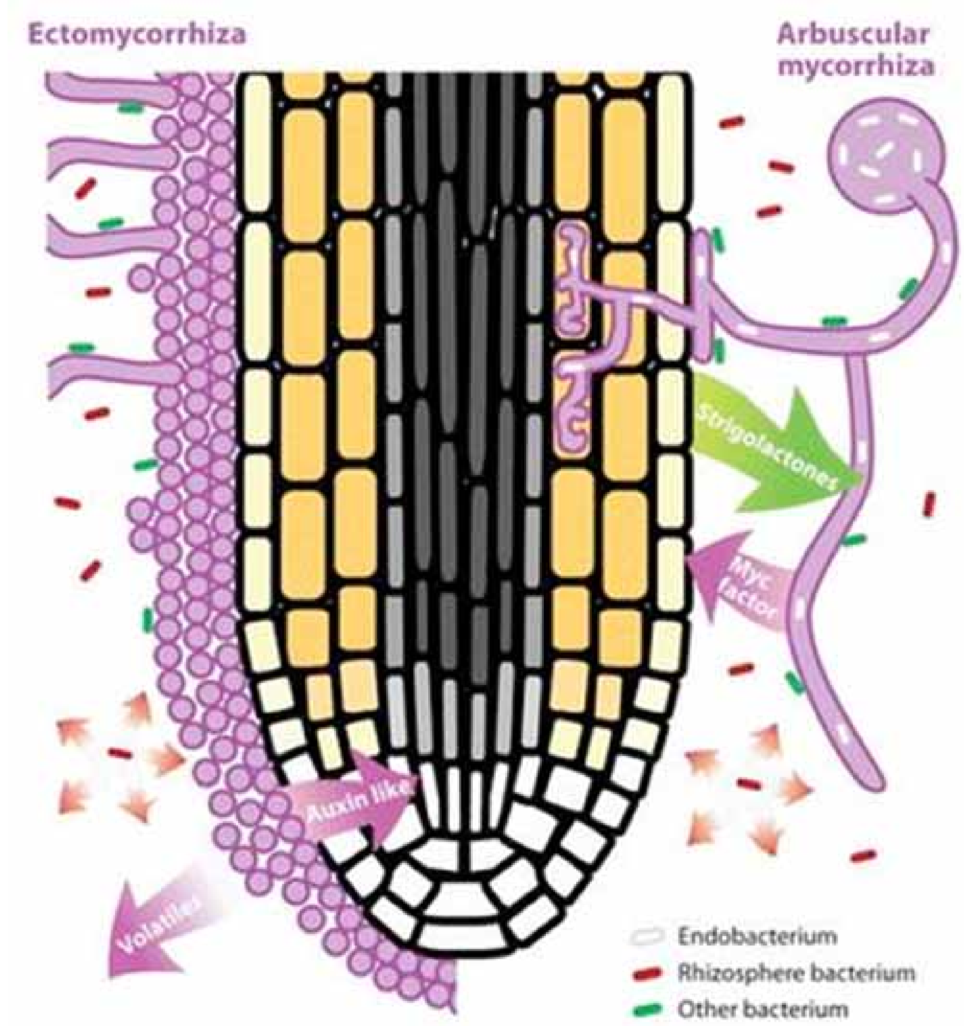
SANGUIS JOVIS

The majority of studies showed that elevated CO_2 had a positive influence on the abundance of arbuscular and ectomycorrhizal fungi



http://www.s-ag-solutions.com/News-or-Reviews.html

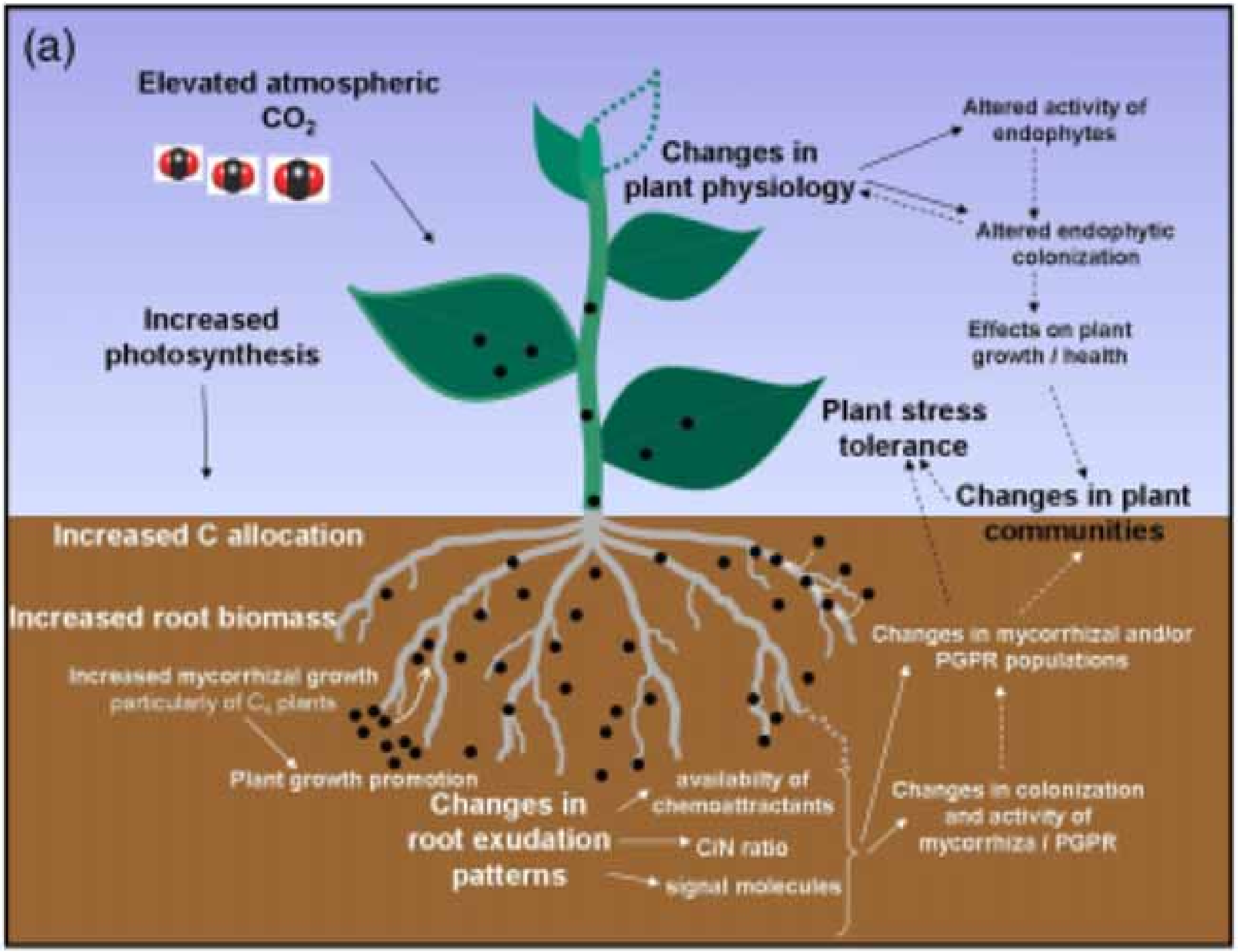


Fig. 1. Potential effects of (a) elevated CO_2 concentrations and (b) warming and drought on beneficial plant–microbe interactions. •, AMF, EcM, fine endophytic PGPF and PGPB; see text for more details.

CO_2 concentrations

Organic component

the effects on plant growth-promoting bacteria and endophytic fungi were more variable

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MINIREVIEW

Climate change effects on beneficial plant–microorganism interactions

Stéphane Compant[1], Marcel G.A. van der Heijden[2,3] & Angela Sessitsch[1]

[1]AIT Austrian Institute of Technology GmbH, Bioresources Unit, Seibersdorf, Austria; [2]Agroscope Reckenholz-Tänikon ART, Zürich, Switzerland; and [3]Plant–Microbe Interactions, Institute of Environmental Biology, Faculty of Science, Utrecht University, Utrecht, The Netherlands

Effect of CO_2 on P mobilization

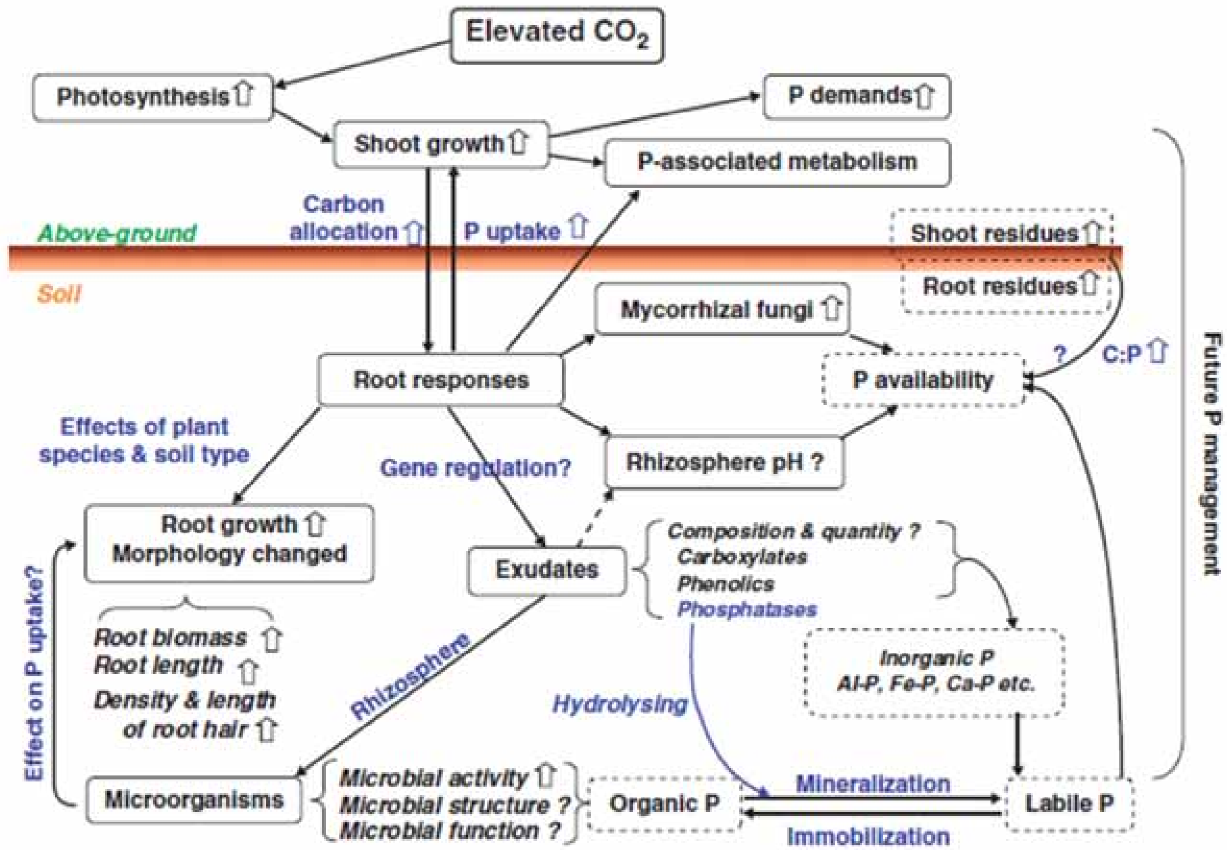

FIG. 1. Proposed mechanisms by which elevated CO_2 impacts plant P nutrition. ⇧ indicates an increase and "?" indicates an unknown effect.

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Annals of Botany 116: 987–999, 2015
doi:10.1093/aob/mcv088, available online at www.aob.oxfordjournals.org

ANNALS OF BOTANY

REVIEW: PART OF A SPECIAL ISSUE ON PLANTS AND CLIMATE CHANGE

The impact of elevated carbon dioxide on the phosphorus nutrition of plants: a review

Jian Jin[1,2], Caixian Tang[1,*] and Peter Sale[1]

http://www.proteawinesusa.com/2015/11/will-climate-change-redraw-the-wine-map/

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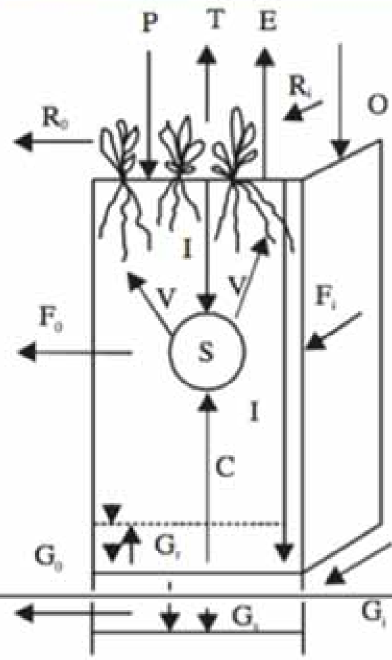
Components of the field water balance and soil moisture regime and the influence of four potential climate scenarios on these factors: i and I: slight and great increase, d and D: Slight and strong decrease, E: No change (equilibrium).



P = Precipitation
O = Irrigation water
$R_i R_o$ = Surface runoff (in and out)
$F_i F_o$ = Filtration in the unsaturated zone (in and out)
$G_i G_o$ = Groundwater flow (in and out)
G_r = Rise of water table
G_s = Lowering of the water table
I = Infiltration into the soils
i = Infiltration into the groundwater
S = Storage within the soil (recharge)
V = Filtration to the plant roots Uptake by plants
T = Transpiration
E = Evaporation
C = Capillary transport from grounwater

Factors	CI			
	Cold, wet	Cold, dry	Hot, wet	Hot, dry
P	I	D	I	D
R	I	d,D	I	D
G	i	d	i	D
I	I	d	I	D
I	i	D	(i)	D
S	I	d	(I)	D
E	D	E	E	I
T	D	E	i	I
F	-	-	-	-
G_r	i	-	(I)	-
G_s	-	I	-	I


OPEN ACCESS Science International
ISSN 2305-1884
DOI: 10.17311/sciintl.2016.51.73
Review Article
Potential Effects of Climate Change on Soil Properties: A Review
[1]Rajib Karmakar, [1]Indranil Das, [1]Debashis Dutta and [2]Amitava Rakshit

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SANGUIS JOVIS

Higher precipitation will reduce, lower precipitation and higher temperature will intensify salinization/sodification processes:

Salinization/sodification

Higher rate of evapotranspiration increasing capillary transport of water and solutes from the groundwater to the root zone + no or negligible leaching

Outcrop of marine substratum in a vineyard

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SANGUIS JOVIS


pagepress

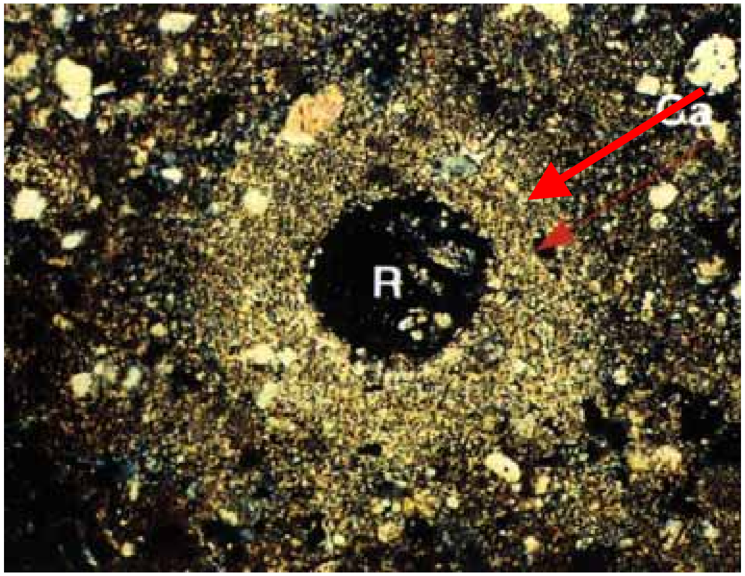
Italian Journal of Agronomy 2013; volume 8:e28

Soil degradation processes in the Italian agricultural and forest ecosystems

Edoardo A.C. Costantini, Romina Lorenzetti

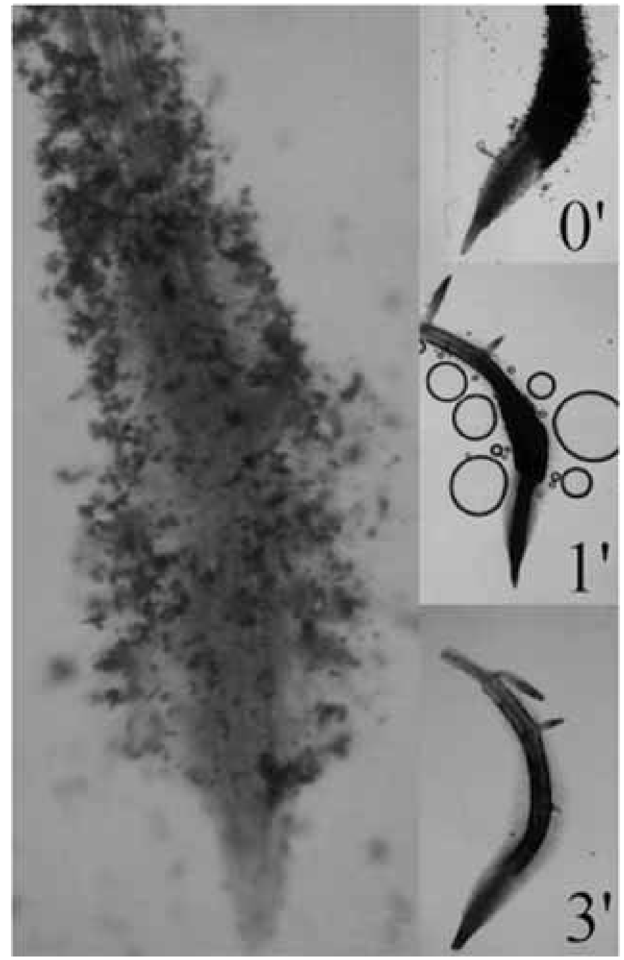
Consiglio per la Ricerca e la Sperimentazione in Agricoltura – Centro di Ricerca per l'Agrobiologia e la Pedologia, Firenze, Italy

Ca accumulation in soil around an old root channel



(*Callot et al., 1982*)

Ca accumulation around a cucumber root



MODULAZIONE DELLA RISPOSTA ALLA Fe-CARENZA IN PIANTE DI CETRIOLO: MODIFICAZIONI MORFOLOGICHE E FISIOLOGICHE INDOTTE DAL $CaCO_3$

MODULATION OF Fe-DEFICIENCY RESPONSE IN CUCUMBER PLANTS: MORPHOLOGICAL AND PHYSIOLOGICAL MODIFICATIONS INDUCED BY $CaCO_3$

F. Agnolon, S. Cesco, Z. Varanini, R. Pinton

XVII Convegno SICA

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Table 1. SOM mineralization in dependence on the level of soil moistening

Soil	Water content, wt %	Actual mineralization of the SOM carbon		Potentially mineralizable carbon (C_{pm})*		
		mg/kg	% of C_{org}	mg/kg	% of C_{org}	mg/kg per day**
Gray forest	10	508	5.5	653	7.1	6.53
	25	565	6.1	803	8.7	6.42
	40	612	6.7	965	10.5	6.76
	Mean	562	6.1	807	8.8	6.57
Podzolized cher-nozem	10	577	2.3	731	2.9	6.58
	25	837	3.3	953	3.8	11.44
	40	953	3.8	1067	4.3	13.87
	Mean	789	3.1	917	3.7	10.63
Dark chestnut	10	400	3.6	480	4.3	5.28
	25	477	4.2	533	4.8	6.93
	40	584	5.2	648	5.8	9.07
	Mean	487	4.3	554	4.9	7.09

Notes: * Calculated according to Eq. 1.

** Calculated from equation IM = Ck, where k is the constant of mineralization, day^{-1}.

ISSN 1064-2293, Eurasian Soil Science, 2009, Vol. 42, No. 11, pp. 1241–1248. © Pleiades Publishing, Ltd., 2009.
Original Russian Text © A.S. Tulina, V.M. Semenov, L.N. Rozanova, T.V. Kuznetsova, N.A. Semenova, 2009, published in Pochvovedenie, 2009, No. 11, pp. 1333–1340.

SOIL CHEMISTRY

Influence of Moisture on the Stability of Soil Organic Matter and Plant Residues

A. S. Tulina, V. M. Semenov, L. N. Rozanova, T. V. Kuznetsova, and N. A. Semenova

In contrast to shoot growth, **root growth is often maintained, or may even be stimulated in response to drought stress**

Observations of enhanced root growth and shifts to a deeper root depth distribution in response to drought through manipulation of the root's response to gravity has been reported in numerous species.

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Developmental Biology 419 (2016) 64–77

Contents lists available at ScienceDirect

Developmental Biology

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

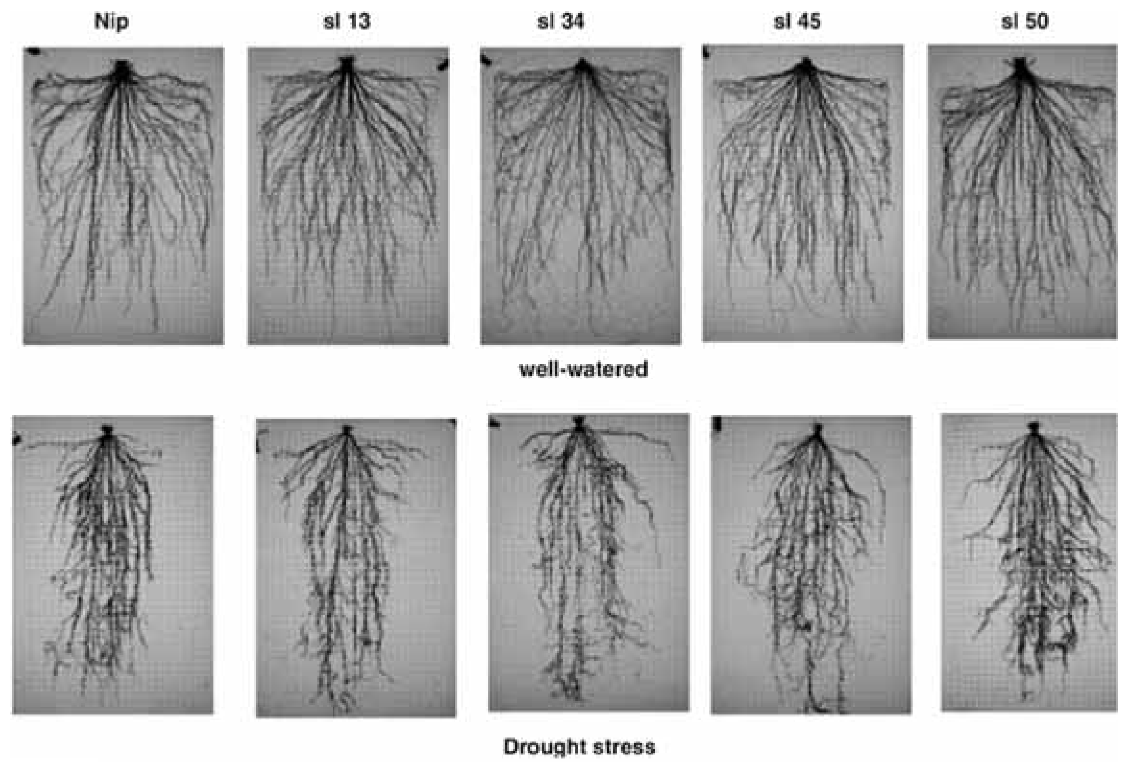
Plant developmental responses to climate change

Sharon B. Gray [a,*], Siobhan M. Brady [a,b,**]

[a] Department of Plant Biology, University of California, Davis, 2243 Life Sciences Addition, One Shields Avenue, Davis, CA 95616, USA
[b] Genome Center, University of California, Davis, 451 Health Sciences Drive, Davis, CA 95616, USA

In a broad sense, drought stress causes plants to invest resources in root tissue at the expense of shoot tissue

measured as an increased ratio of root:shoot biomass, and at the molecular level, shifts in allocation of resources from shoots to roots (changes in metabolite profiles of each tissue)



Critical Reviews in Plant Science, 28:199–217, 2009

ISSN: 0735-2689 print / 1549-7836 online
DOI: 10.1080/07352680902952173

Advances in Drought Resistance of Rice

Muhammad Farooq,[1] Abdul Wahid,[2] Dong-Jin Lee,[3] Osamu Ito,[4] and Kadambot H. M. Siddique[5]

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SANGUIS JOVIS

dynamics of root elongation responses to drought in maize roots at a range of distances from the root apex

elongation peaked at a lower rate, and at a shorter distance from the root apex in water stressed plants compared to well-watered plants, resulting in a shorter elongation zone

Plant Physiol. (1988) 87, 50–57
0032-0889/88/87/0050/08/$01.00/0

Growth of the Maize Primary Root at Low Water Potentials[1]

I. SPATIAL DISTRIBUTION OF EXPANSIVE GROWTH

Received for publication September 17, 1987 and in revised form January 13, 1988

Robert E. Sharp*[2], Wendy Kuhn Silk, and Theodore C. Hsiao
Department of Land, Air and Water Resources, University of California, Davis, California 95616

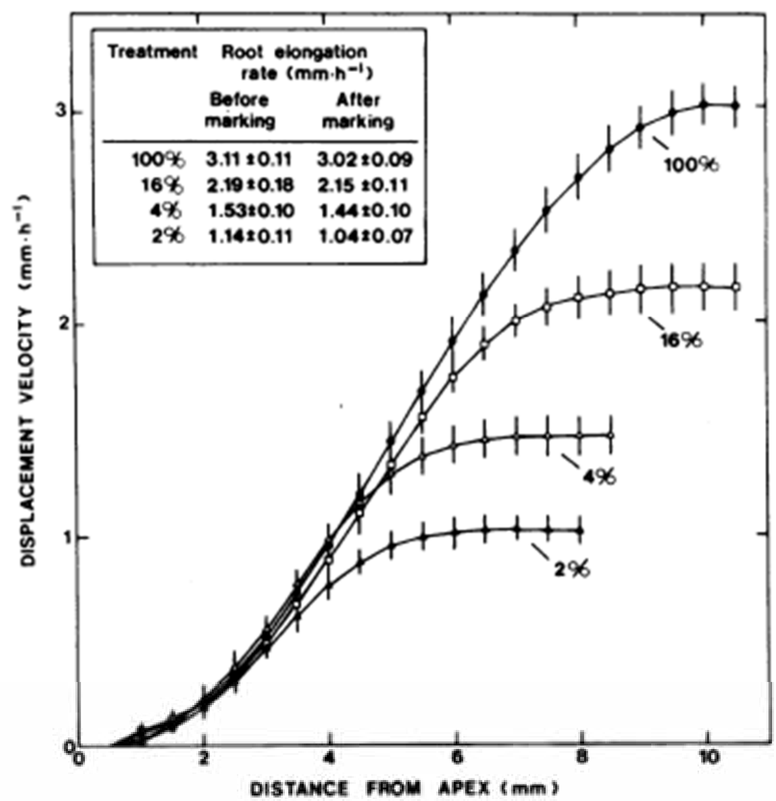


Fig. 4. Displacement velocity (rate of displacement from apex) as a function of distance from the apex of roots growing at various vermiculite water contents. Data were evaluated from time lapse photographic records of the growth of marked roots. The inset shows elongation rates of the same roots immediately before marking and during the 1 h period of photography. Data are means ± 1 SD (n = 5–6).

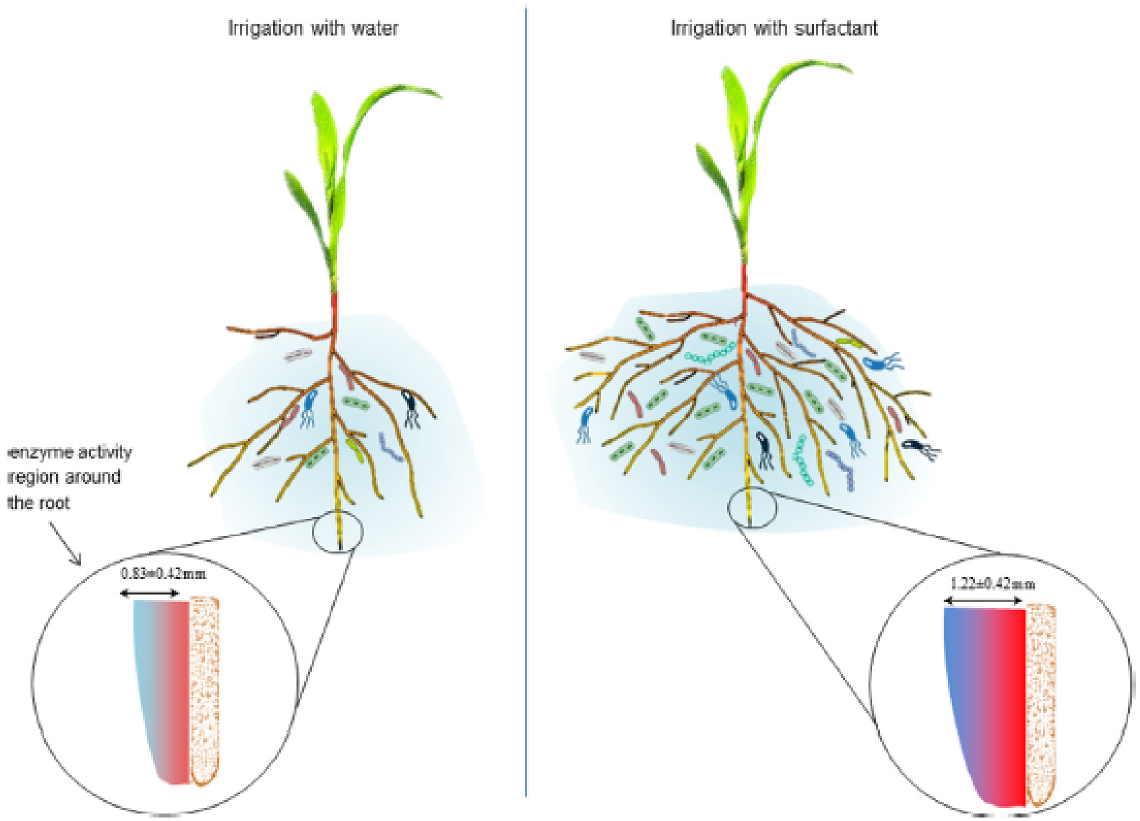
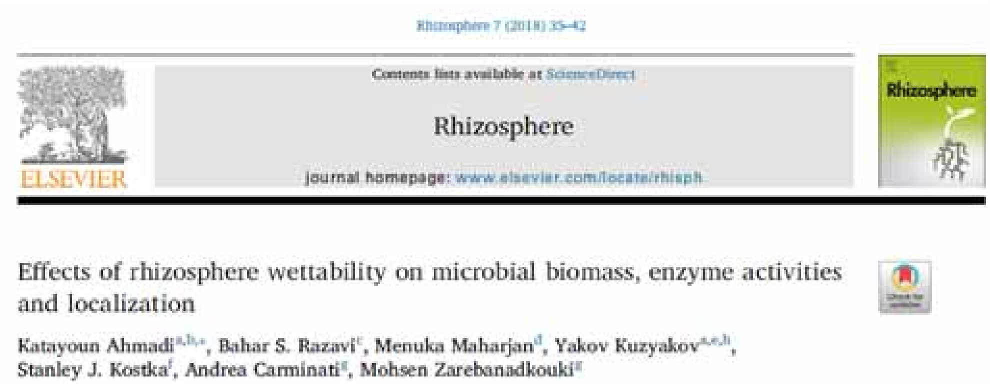


Fig. 7. Conceptual patterns of the root growth, microbial biomass and distribution of enzymes activities in soil surrounding maize roots irrigated with water and surfactant. The right figure shows that plants irrigated with surfactant have wetter rhizosphere (darker blue color), higher root and larger microbial biomass. The magnified pictures show distribution of enzyme activities around the root and extended of the high-activity region in the rhizosphere under irrigation with water alone (left) and with surfactant (right). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)


Rhizosphere 7 (2018) 35–42

Contents lists available at ScienceDirect

Rhizosphere

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

Effects of rhizosphere wettability on microbial biomass, enzyme activities and localization

Katayoun Ahmadi[a,b,*], Bahar S. Razavi[c], Menuka Maharjan[d], Yakov Kuzyakov[a,e,h], Stanley J. Kostka[f], Andrea Carminati[g], Mohsen Zarebanadkouki[g]

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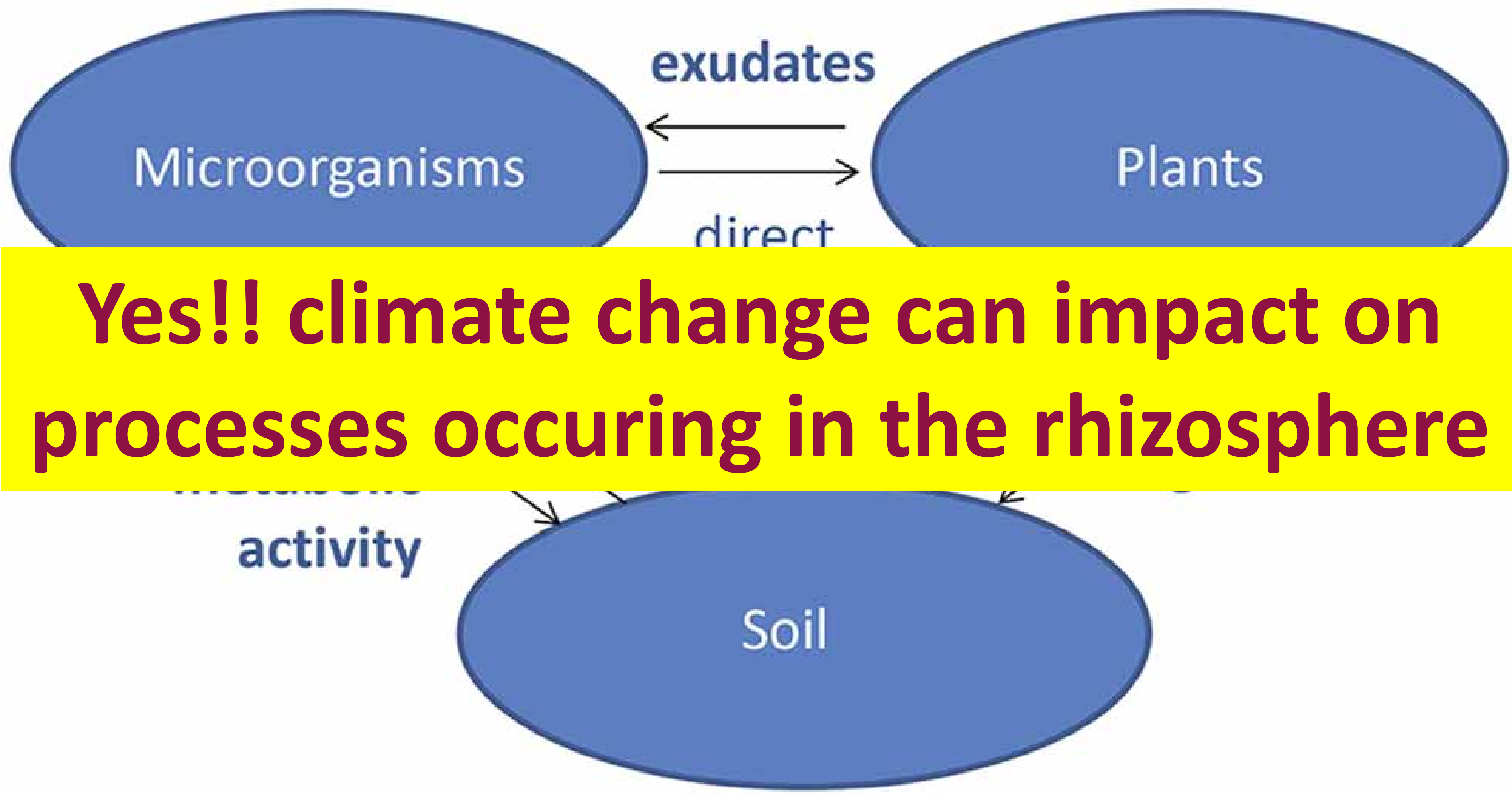
SANGUIS JOVIS

The Rhizosphere



Yes!! climate change can impact on processes occuring in the rhizosphere

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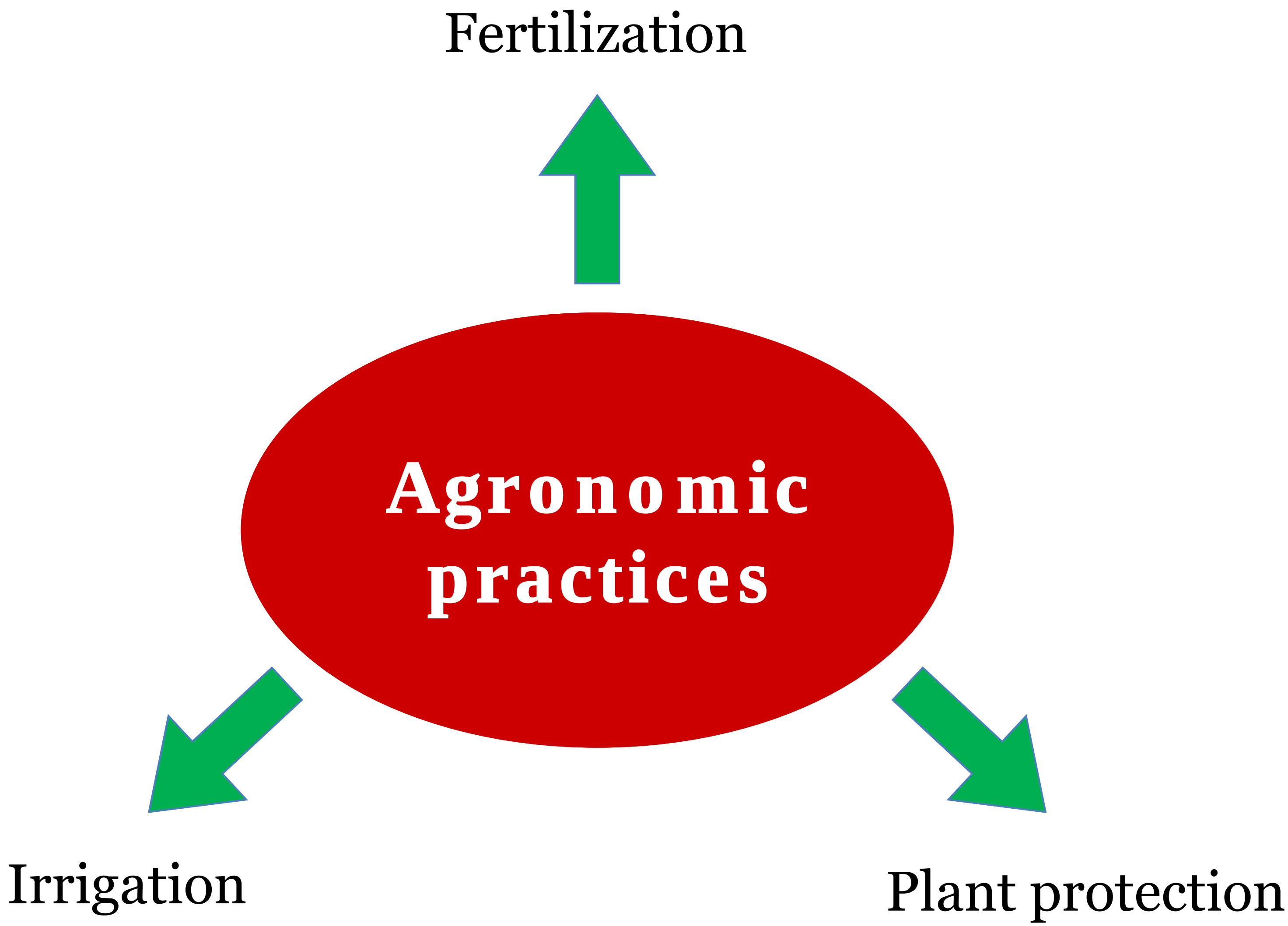
SANGUIS JOVIS

Agronomic practices in a climate changed environment: is it possible to preserve soil fertility in a climate changed environment?

fondazione banfi

SANGUIS JOVIS



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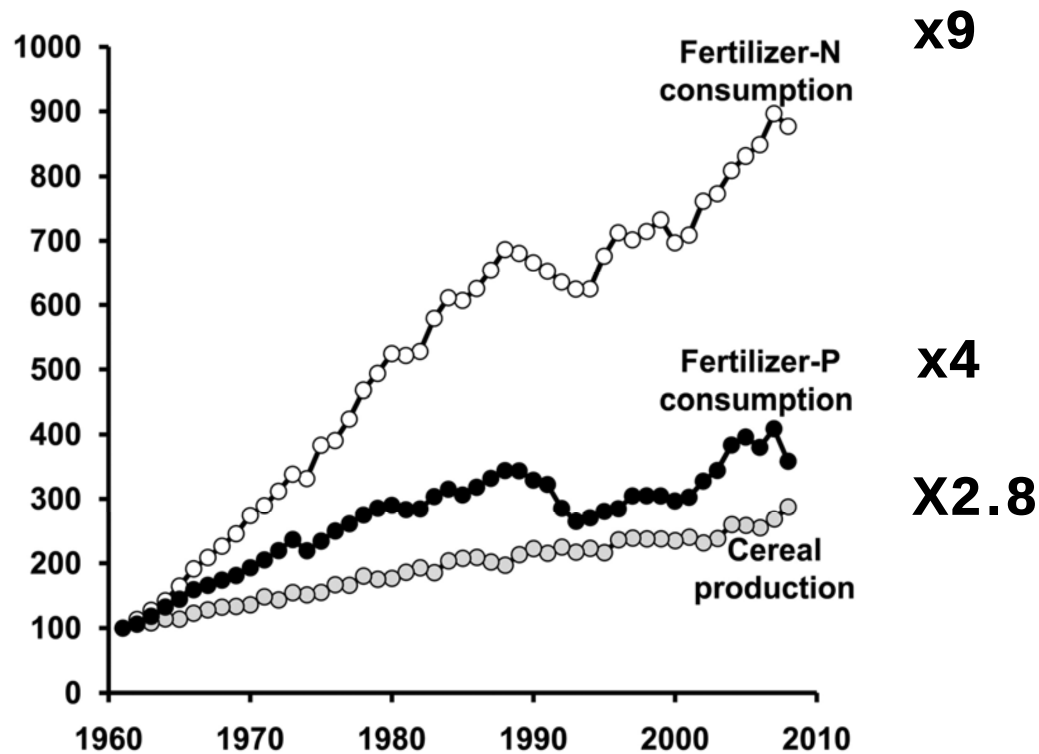
SANGUIS JOVIS

Agronomic practices: 1) fertilization

- **Global decrease of N and P efficiencies in agroecosystems is no longer affordable**



Relative increase in world annual production of cereals, and global annual consumption of fertilizer -N and -P over the 1961-2008 period.

fondazione banfi

SANGUIS JOVIS

data from FAOSTAT, http://faostat.fao.org/ accessed 20th February 2011

(Hinsinger et al. 2011 - Plant Physiol. 156)

Agronomic practices: 1) fertilization

the availability of soil N may affect the soil microbial community, and hence obviates their role in the turnover of soil organic matter

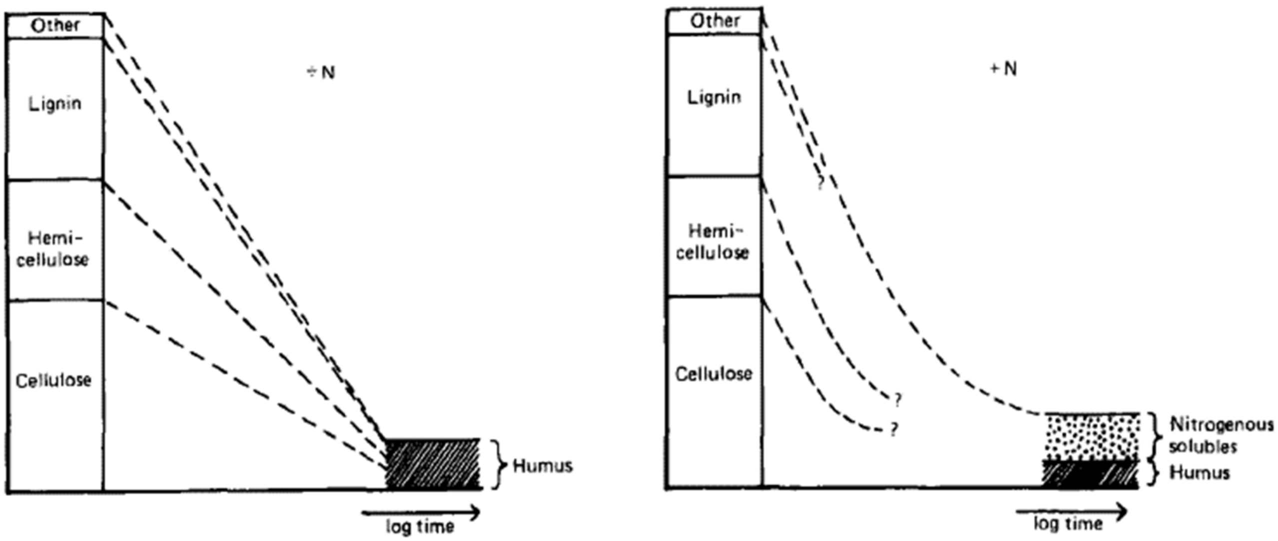


Fig. 2. Schematic illustration of possible transformation of plant constituents during decomposition without and with N addition.

Biol. Rev. (1988), **63**, *pp.* 433–462
Printed in Great Britain
433

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THE EFFECT OF ADDED NITROGEN ON THE RATE OF DECOMPOSITION OF ORGANIC MATTER

By KÅRE FOG

*Royal Veterinary and Agricultural College, Chemistry Department, 40 Thorvaldsensvej, DK-1871 Frederiksberg C, Denmark**

Agronomic practices: 2) irrigation

Soil microbial community structure are expected when anaerobic conditions develop from flooding

Flood treatment	Microbial biomass(mg C g^{-1} soil)	%				
		Aerobic bacteria	Anaerobic bacteria	Gram-negative bacteria	Gram-positive bacteria	Mycorrhizal fungi
Control	154.70 b (23.12)	6.58 b (0.41)	5.86 (0.98)	5.65 a (0.35)	19.36 b (3.28)	5.61 a (1.03)
Intermittent	189.50 a (73.81)	9.08 a (1.55)	6.28 (1.02)	4.04 b (0.65)	8.71 c (1.16)	4.01 c (0.43)
Flowing	183.34 ab (43.83)	5.53 b (0.85)	6.57 (0.74)	3.48 b (0.75)	22.60 a (3.91)	3.07 b (1.11)
Stagnant	83.28 c (27.10)	4.13 c (2.51)	6.55 (3.39)	1.73 c (0.87)	8.50 c (0.51)	2.67 c (1.45)

Note: TN = total N; TOC = total organic C; C:N = carbon to nitrogen ratio.

Mean values (and standard deviations) for soil microbial community characteristics and soil chemical analysis from phospholipid fatty acid analysis of a Nodaway silt loam subjected to three flood (stagnant, flowing or intermittent) and three residue (tree, legume, grass) treatments (data not shown) and controls over a 56-day period in a greenhouse experiment. Flood treatment means with the same letter are not significantly different (a = 0.05).

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Contents lists available at ScienceDirect
Applied Soil Ecology
journal homepage: www.elsevier.com/locate/apsoil
ELSEVIER

Flooding effects on soil microbial communities

Irene M. Unger[a,*], Ann C. Kennedy[b], Rose-Marie Muzika[a]

Agronomic practices: 2) irrigation

to meet the specific requirements of individual plants and minimize adverse environmental impact

under precision irrigation applications, water and associated solute movement will vary spatially within the root zone and excess water application will not necessarily result in deep drainage and leaching of salt below the root zone.

Irrig Sci (2007) 26:91–100
DOI 10.1007/s00271-007-0075-y

ORIGINAL PAPER

Soil–water and solute movement under precision irrigation: knowledge gaps for managing sustainable root zones

S. R. Raine · W. S. Meyer · D. W. Rassam ·
J. L. Hutson · F. J. Cook

Fig. 2 Salt rings formed on soil surface due to evaporation of saline irrigation water from drip irrigation of grapes (Courtesy G Schrale)

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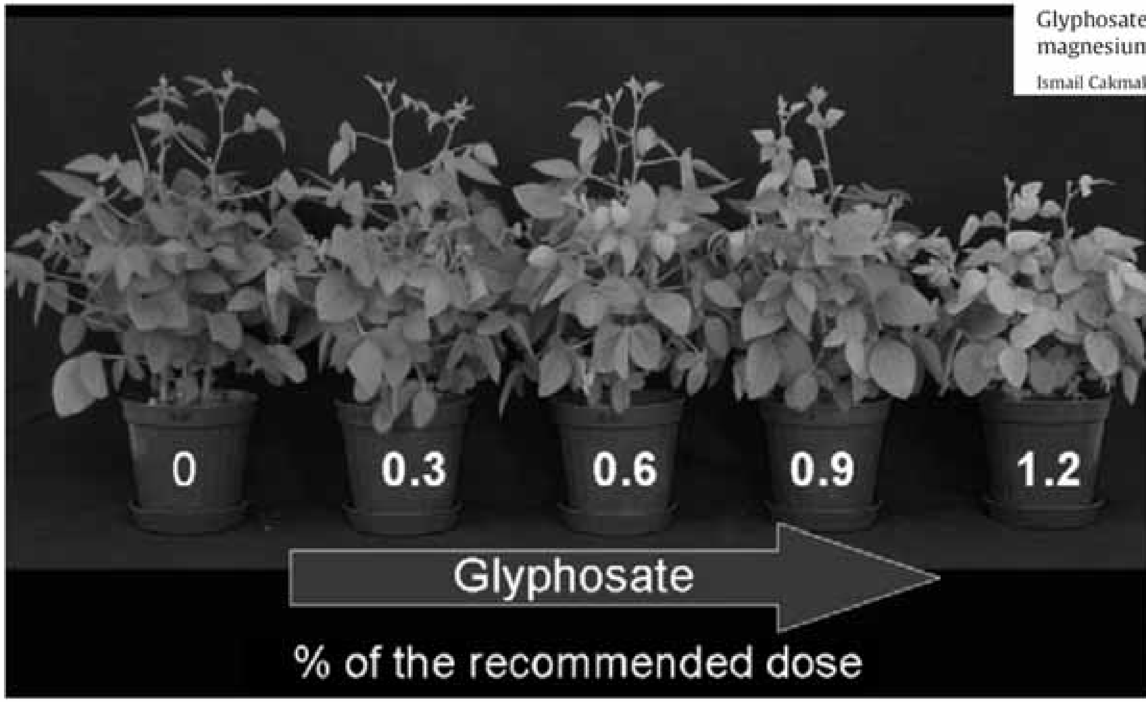
Agronomic practices: 3) plant protection

Europ. J. Agronomy 31 (2009) 114–119
Contents lists available at ScienceDirect
European Journal of Agronomy
journal homepage: www.elsevier.com/locate/eja

Glyphosate reduced seed and leaf concentrations of calcium, manganese, magnesium, and iron in non-glyphosate resistant soybean

Ismail Cakmak*, Atilla Yazici, Yusuf Tutus, Levent Ozturk



(*Cesco,* et al. 2006)

Journal of Plant Diseases and Protection
Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz
Sonderheft XX, 963-969 (2006), ISSN 1861-4051

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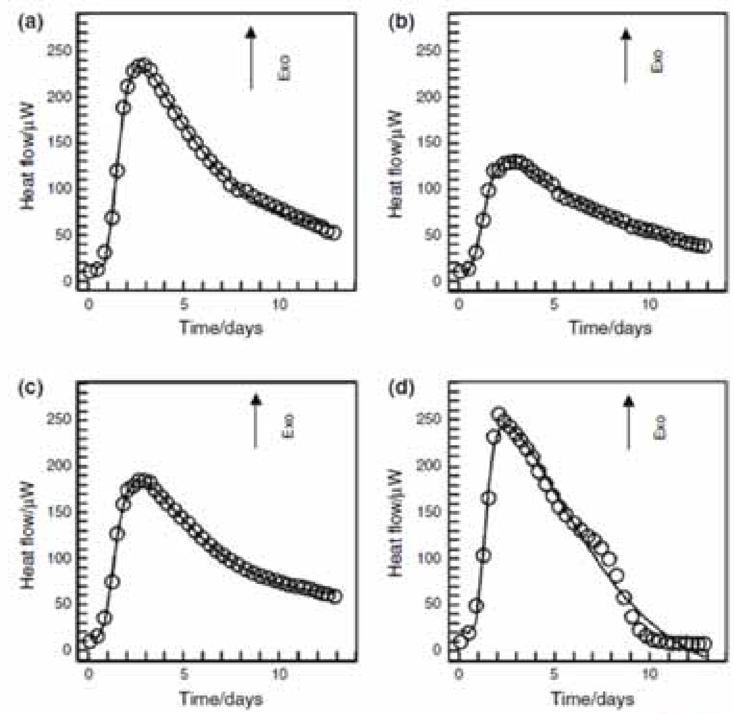
Relevance of glyphosate transfer to non-target plants via the rhizosphere

G. Neumann[1*], S. Kohls[1], E. Landsberg[1], K. Stock-Oliveira Souza[1], T. Yamada[2], V. Römheld[1]

Agronomic practices: 3) plant protection

The accumulation of agrochemicals in the soil due to increased temperatures can lead to a transfer of them from the weeds to non-target plants

Fig. 5 IC curves of yeast growth in grape must. Letters corresponds to: *A* only urea *B* only glyphosate; *C* control (no treatment); *D* glyphosate and nitrogen treatment



J Therm Anal Calorim
DOI 10.1007/s10973-016-5891-y

CrossMark

Indirect effect of glyphosate on wine fermentation studied by microcalorimetry

Ksenia Morozova[1] · Carlo Andreotti[1] · Mariachiara Armani[1] · Luciano Cavani[2] · Stefano Cesco[1] · Luca Cortese[1] · Vincenzo Gerbi[3] · Tanja Mimmo[1] · Pasquale Russo Spena[1] · Matteo Scampicchio[1]

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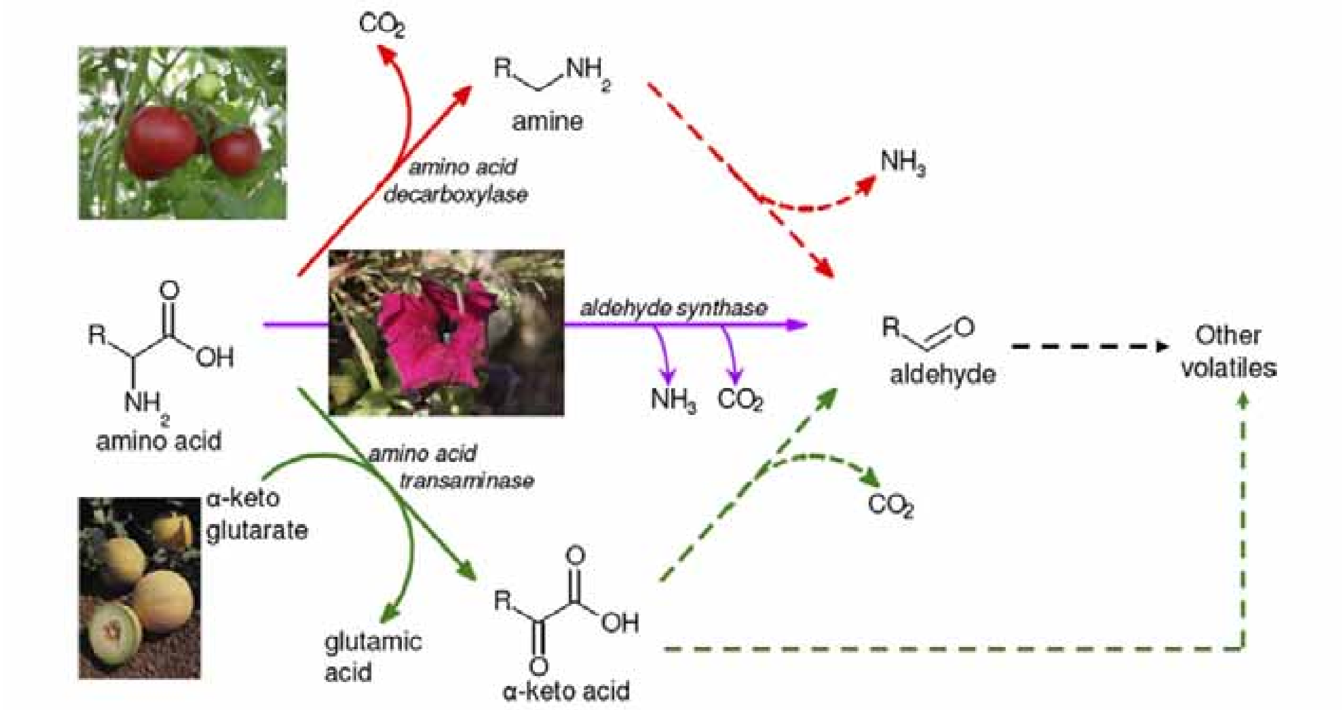
Branched-chain and aromatic aa catabolism into aroma volatiles in *Cucumis melo* L. fruit

Biosynthetic routes for amino acid degradation to volatiles in plants and microorganisms



Gonda et al., Journal of Experimental Botany, Vol. 61, No. 4, pp. 1111–1123, 2010 doi:10.1093/jxb/erp390

List of Agronomical Practices to preserve soil fertility

- ✧ Use plants to grow soil carbon
- ✧ Use microorganisms to convert soil carbon into stable forms
- ✧ Avoid farming techniques that destroy soil carbon:
    - Reduce nitrogen applications
    - Carbon eaters rather than carbon builders
    - Reduce herbicides, pesticides and fungicides
    - Use correct tillage methods
    - Control weeds without soil damage
    - Avoid erosion
    - Encourage vegetation cover
    - Bare soils should be avoided as much as possible

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OPEN ACCESS Science International

ISSN 2305-1884
DOI: 10.17311/sciintl.2016.51.73

Review Article

Potential Effects of Climate Change on Soil Properties: A Review

[1]Rajib Karmakar, [2]Indranil Das, [3]Debashis Dutta and [4]Amitava Rakshit

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Rhizosphere 5

July 7 - 11, 2019
Saskatoon, Saskatchewan (Canada)
www.rhizo5.org
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Shining light on the world beneat

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Rhizosphere 5 Theme Areas

- The root microbiome
- Plant holobiont
- Root imaging & phenotyping
- Rhizosphere processes for sustainable agriculture & nutrient cycling
- Natural (forest and grassland) ecosystem rhizosphere
- Rhizosphere of extreme environments
- Rhizoremediation
- Climate change, abiotic stress and the rhizosphere
- Rhizosphere modelling
- Cutting edge approaches and methods

Climate change, abiotic stress and the rhizosphere

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Grazie dell'attenzione

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