



Università di Napoli Federico II



Inside-out

The inhibitory effect of self-DNA

Stefano Mazzoleni

24 Febbraio 2021



Il mio CV:



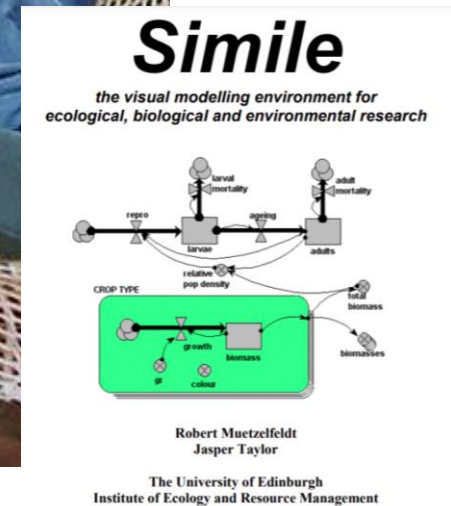
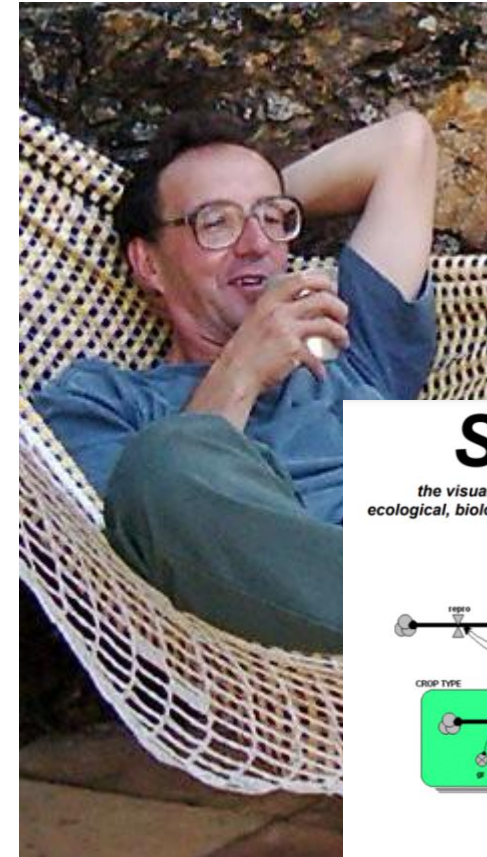
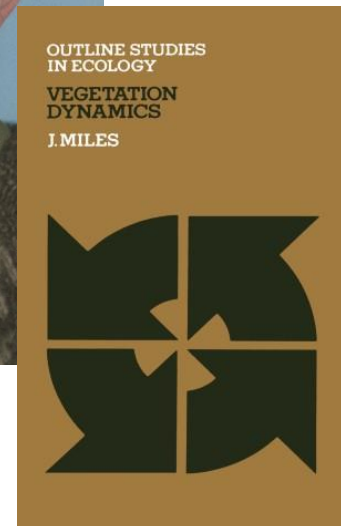
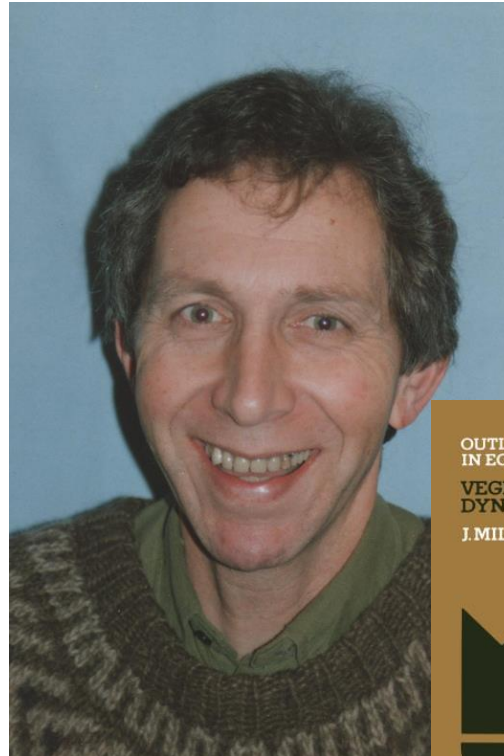
ITE - Scotland



THE UNIVERSITY
of EDINBURGH



I miei maestri:

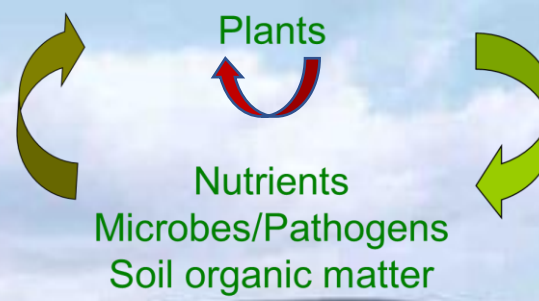


?

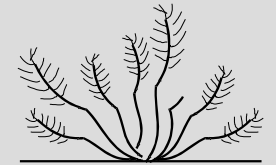
When and where soil-sickness occurs?



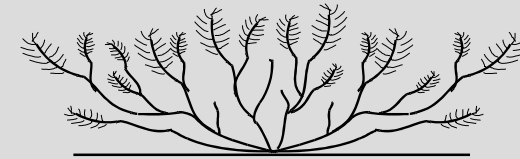
Why there are cyclic succession between heather and birch?



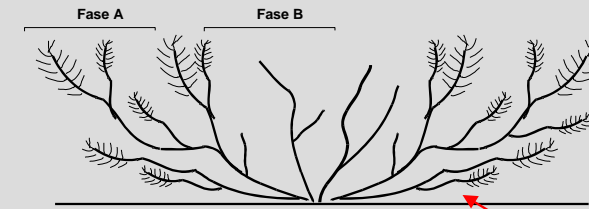
1) Fase di colonizzazione o costruzione (fase A)



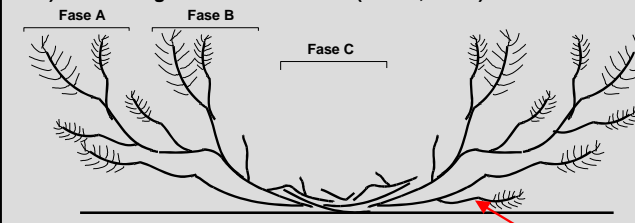
2) Fase di maturità (fase A)



3) Fase di degenerazione (fasi A e B)



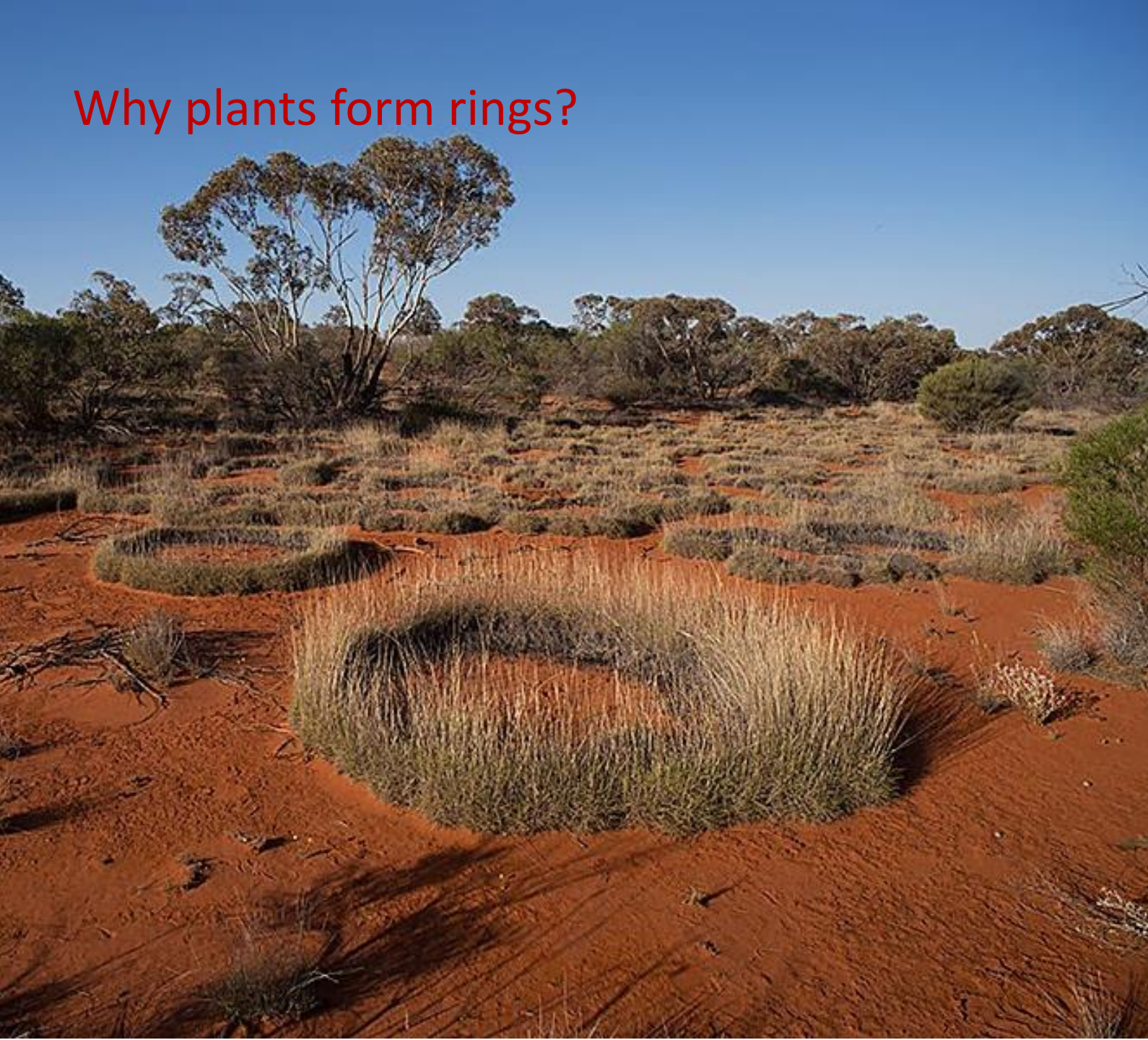
4) Fase di degenerazione avanzata (fase A, B e C)



Why plants form rings?



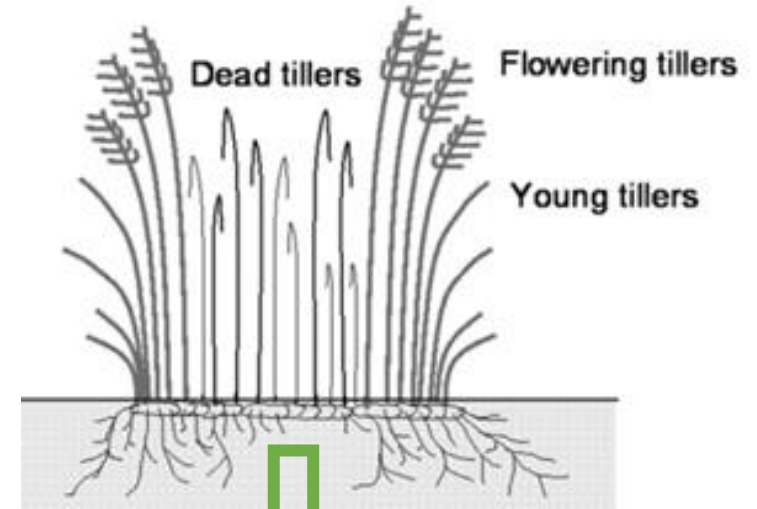
Why plants form rings?



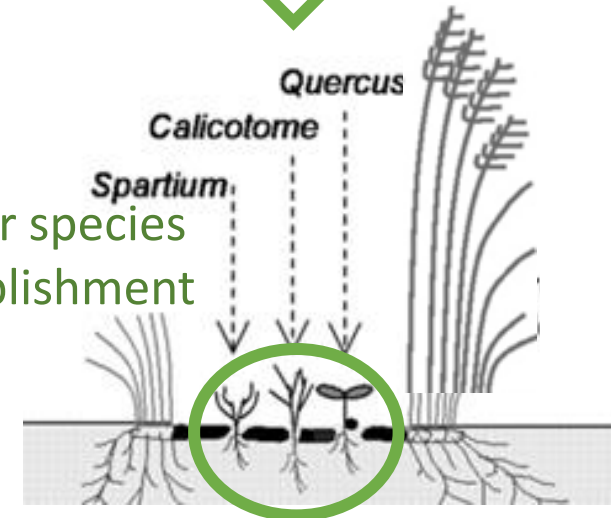
Why plants form rings?



CENTRAL
DIE-BACK

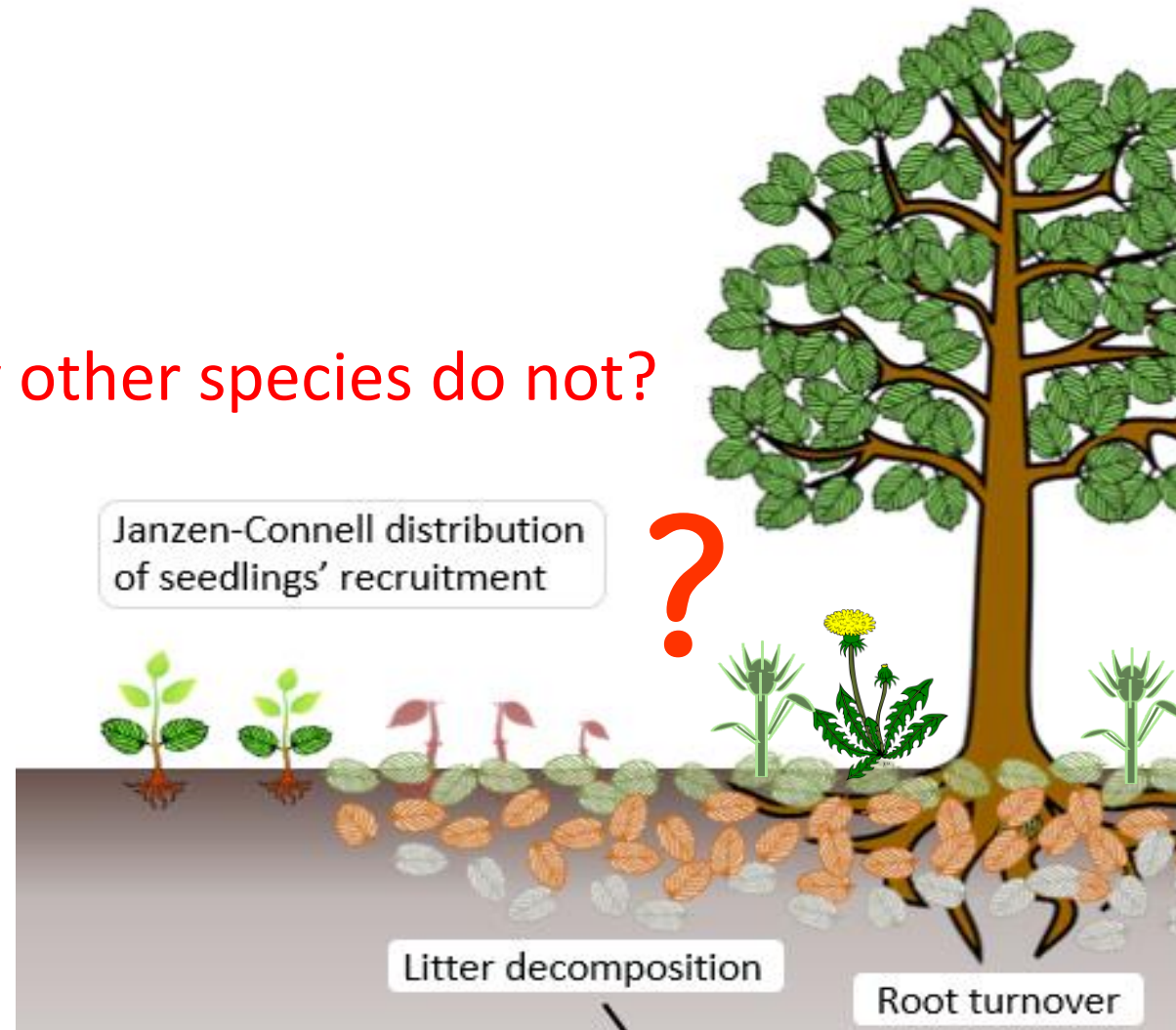


Other species
establishment

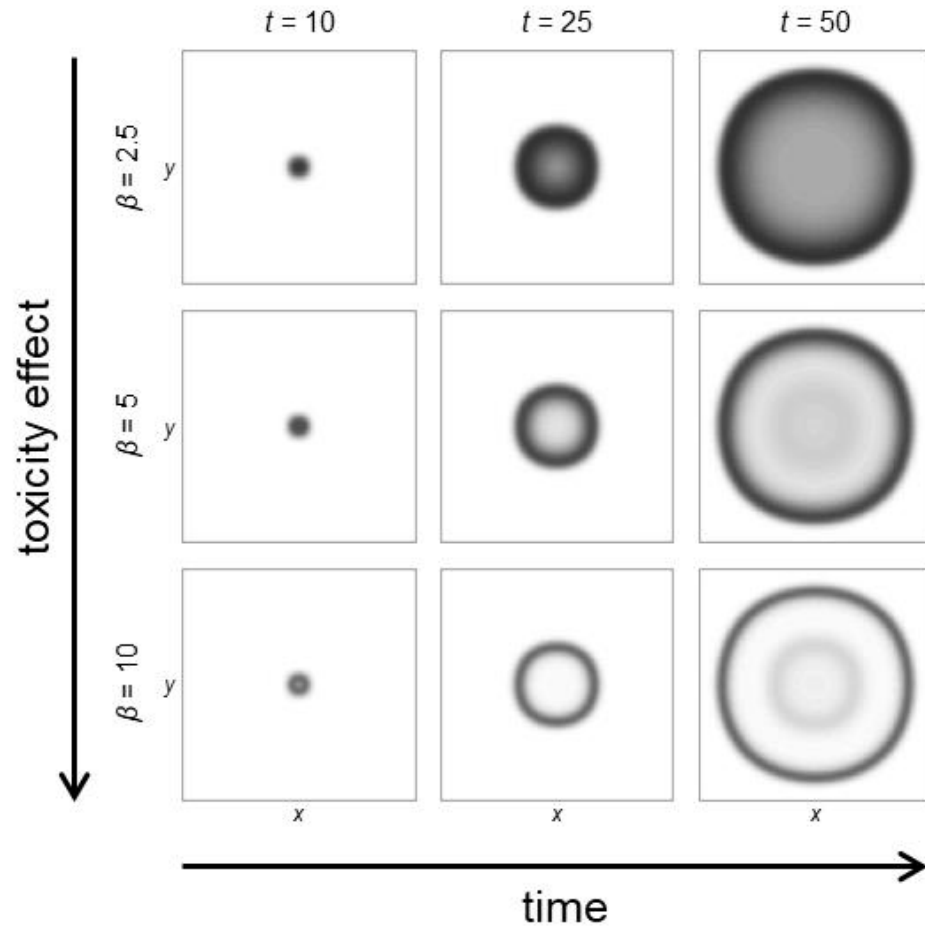


Why in forests seedlings die under their mother plant?

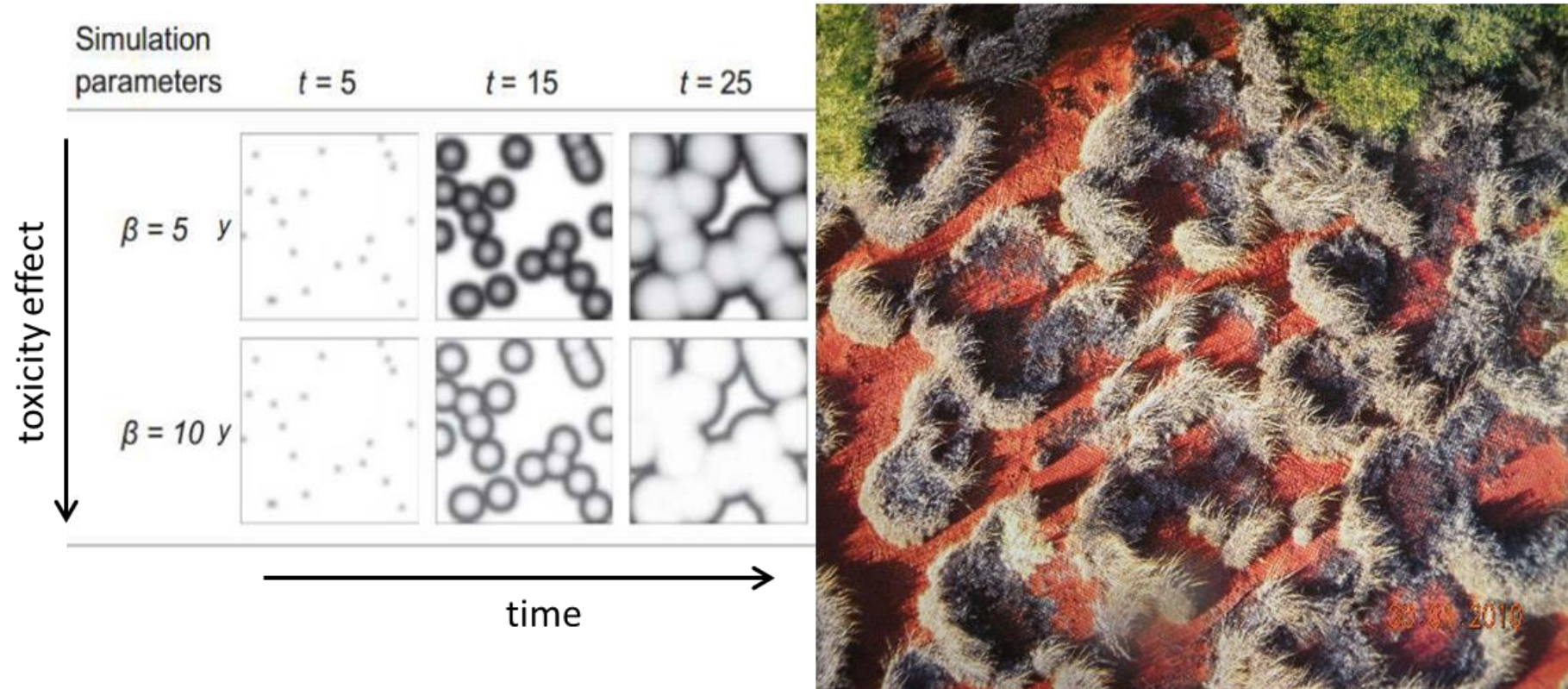
... but why other species do not?



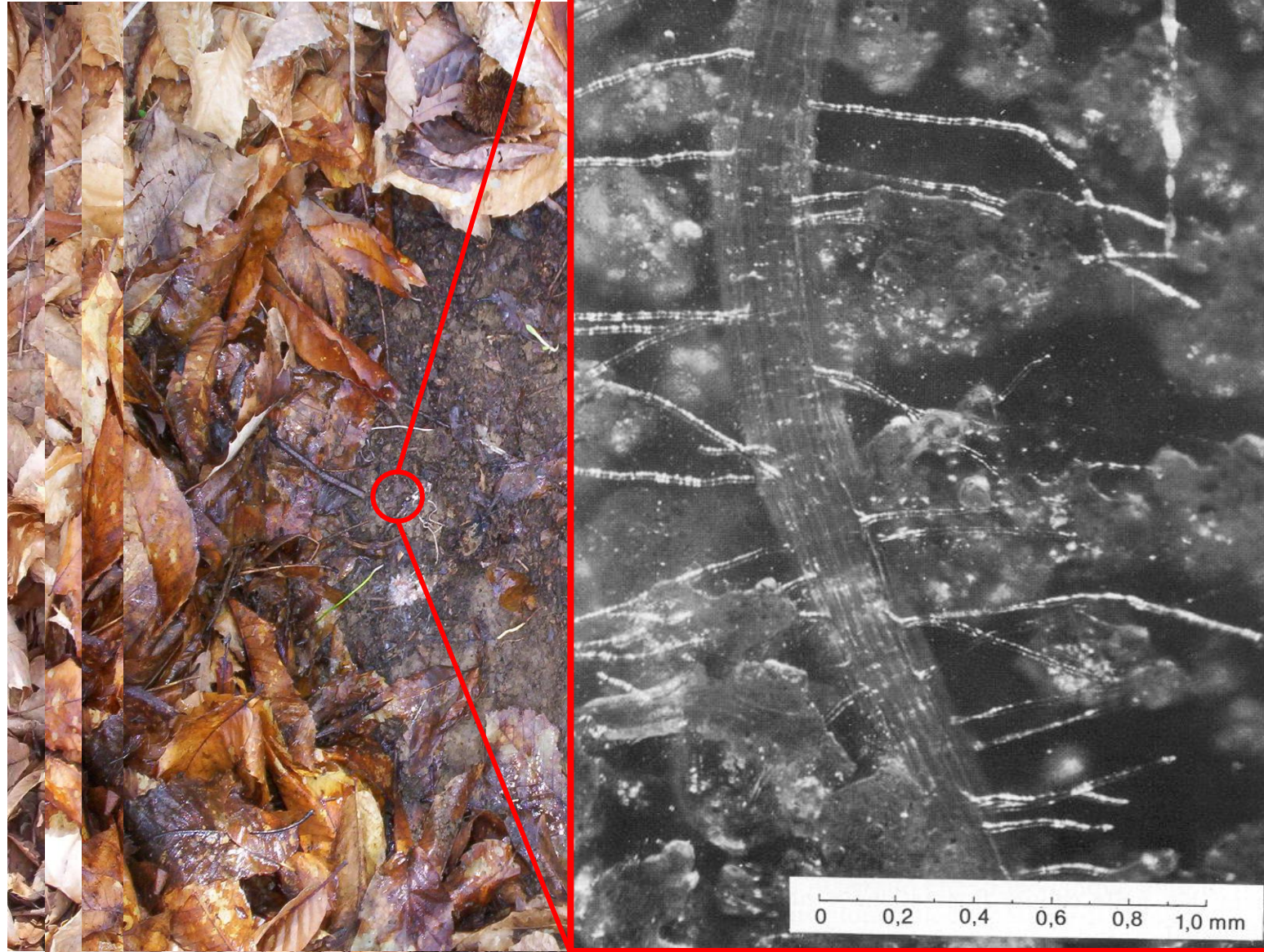
Modelling plant-soil negative feedback



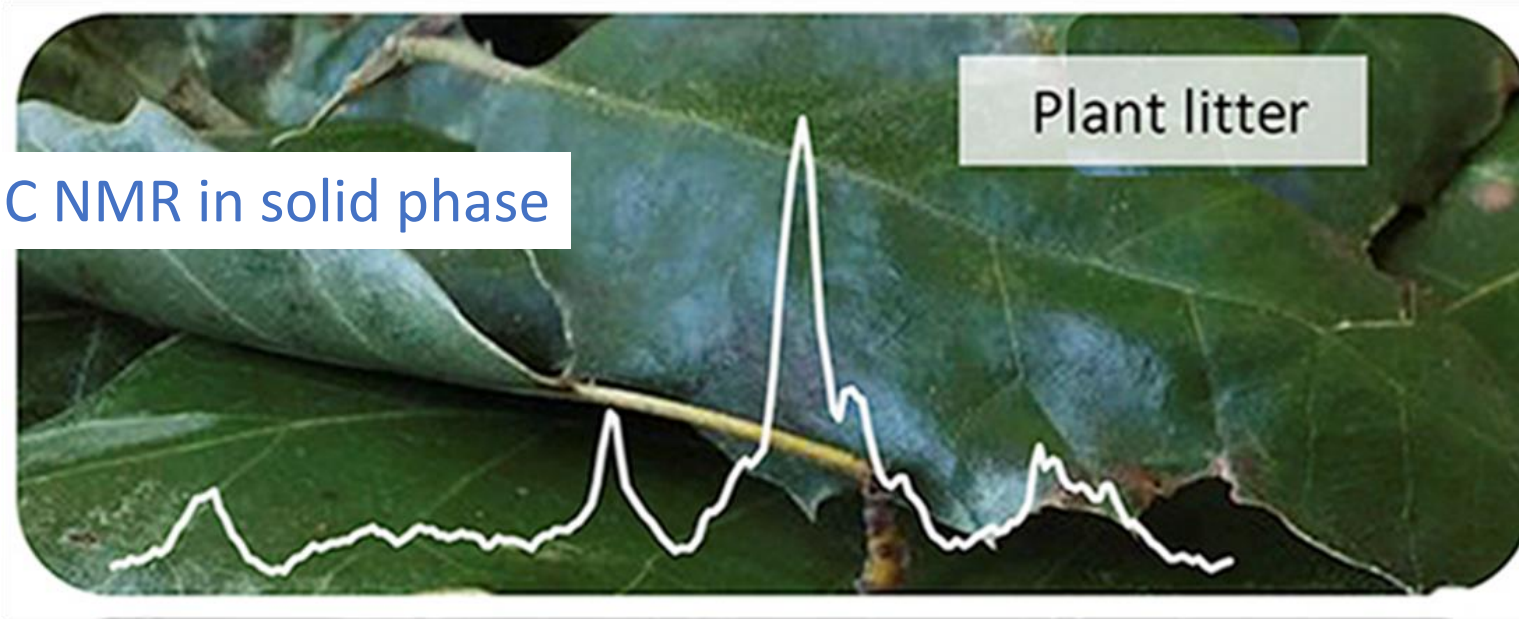
Modelling plant-soil negative feedback



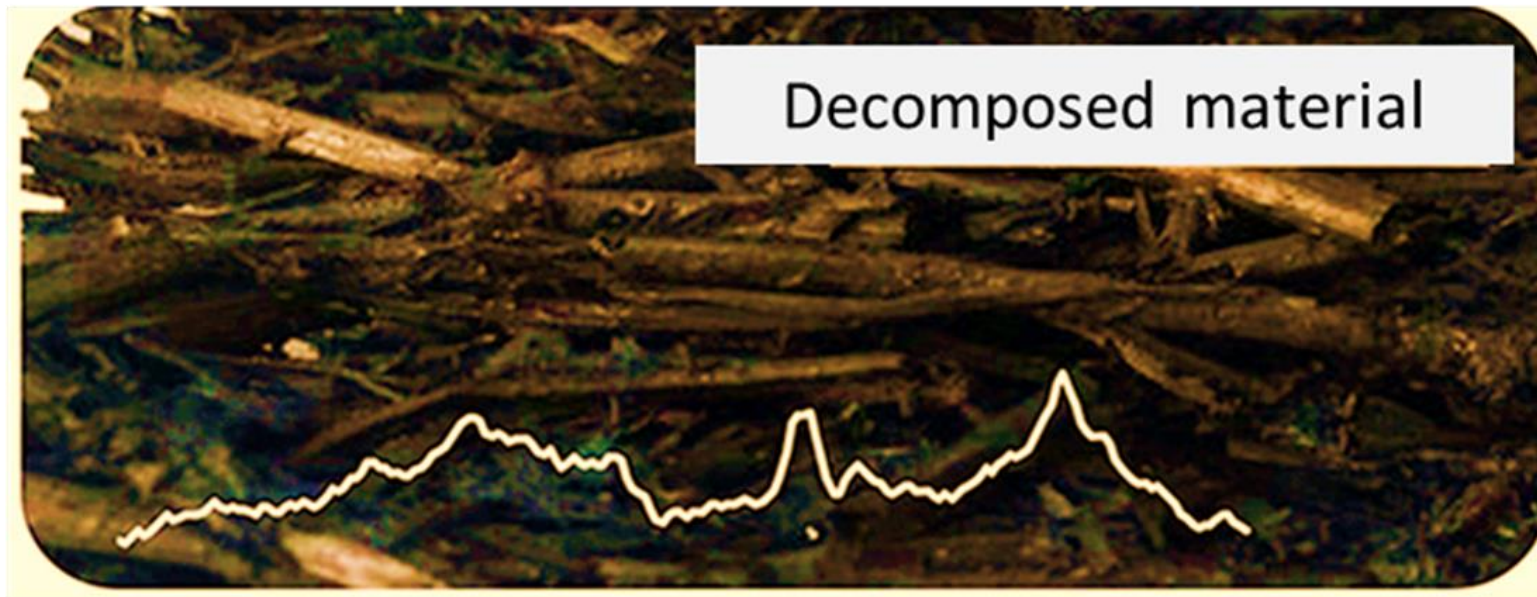
Decomposition: a key process



^{13}C NMR in solid phase

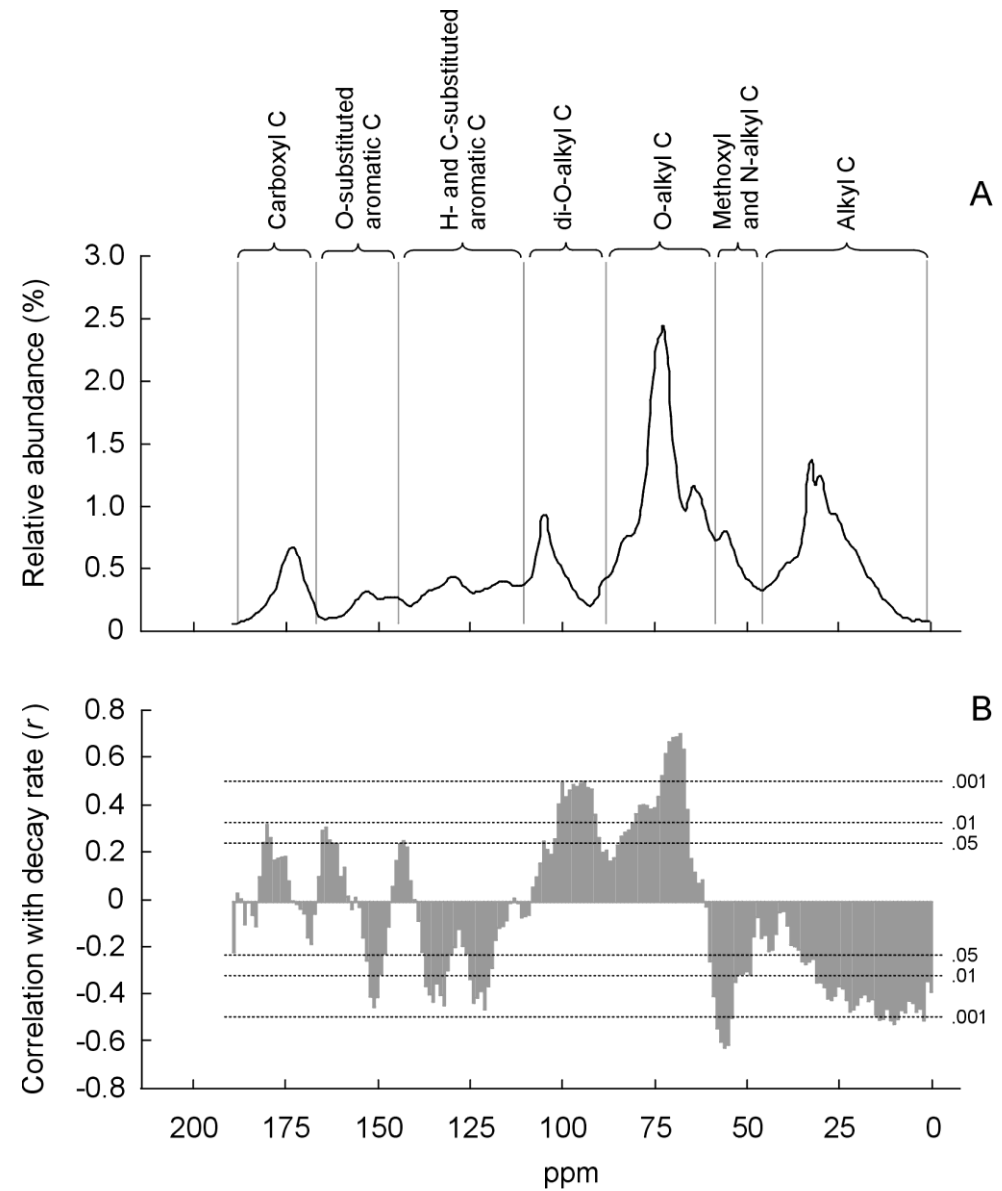


Decomposed material



Decomposition as “chemical changes” vs “mass loss”

^{13}C NMR in solid phase



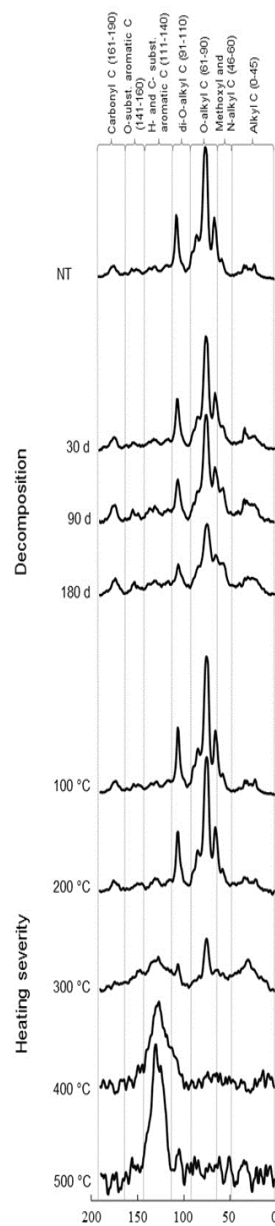
Litter decomposition experiment



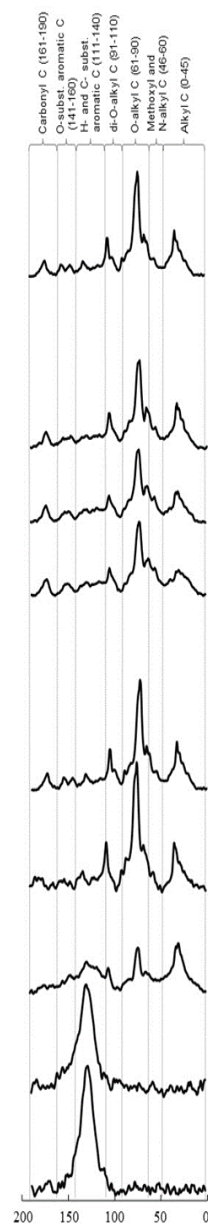
Decomposition days 0 \longrightarrow 120



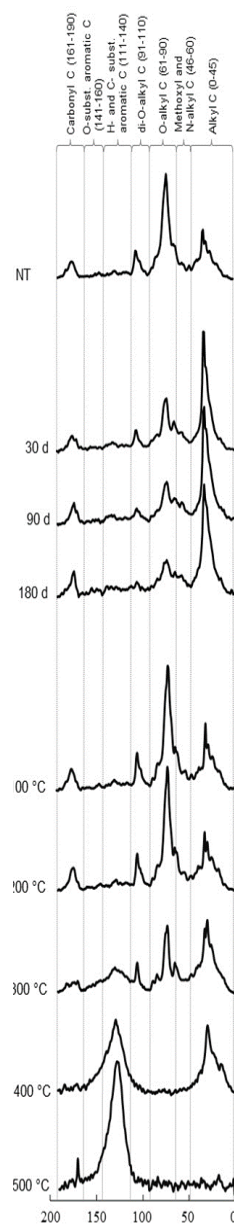
Ampelodesmos mauritanicus



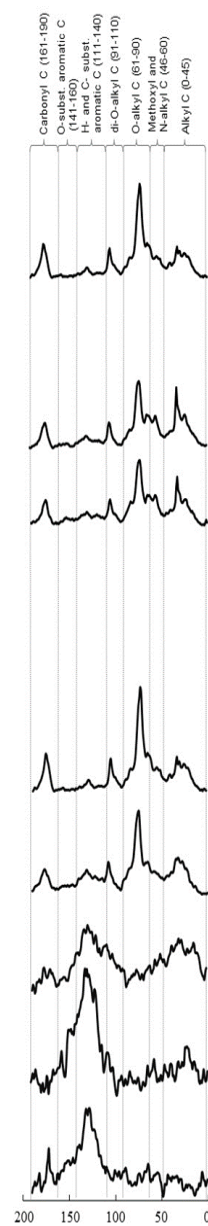
Pinus halepensis



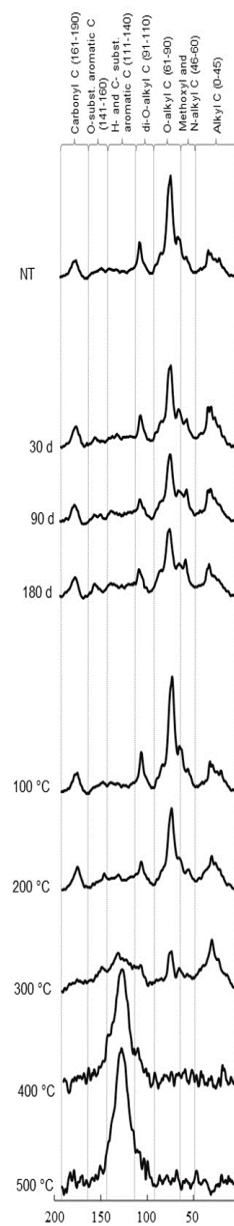
Hedera helix



Medicago sativa



Castanea sativa



Toxicity experiment

Control



Quercus ilex

LITTER

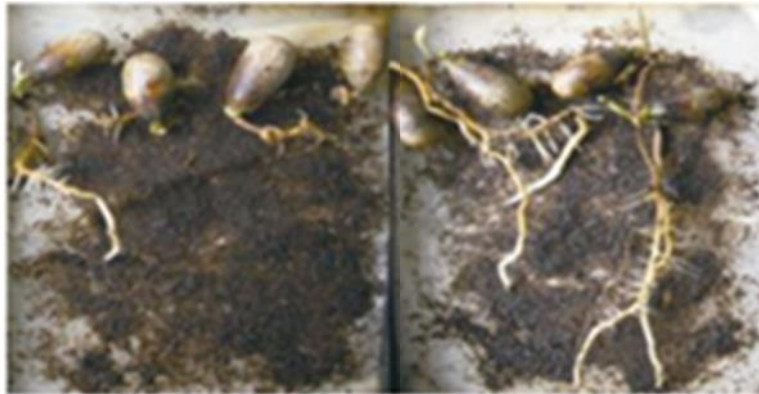
Heterospecific

Conspecific

Decomposition
days

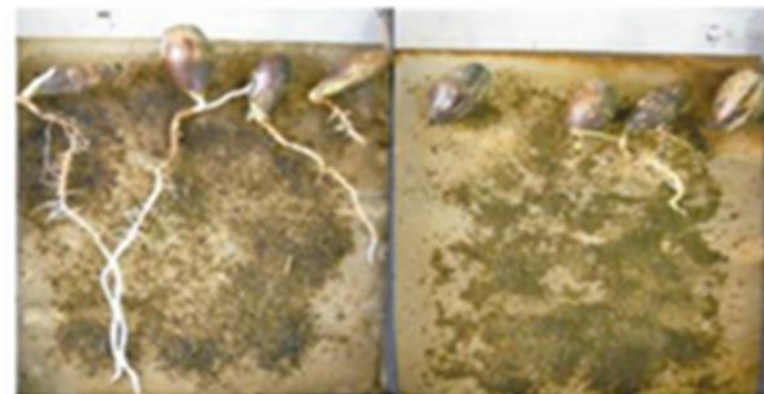
0

120

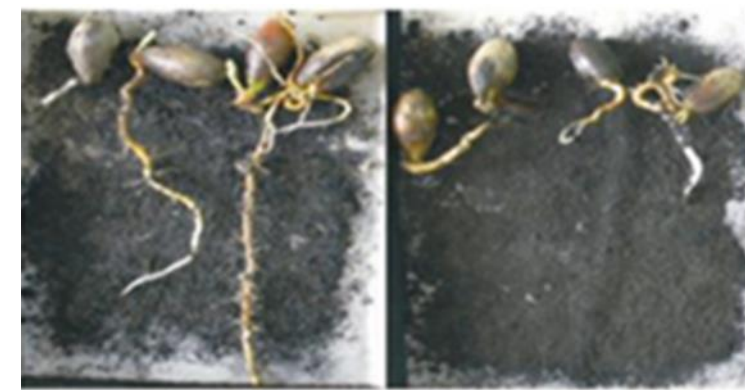


0

120

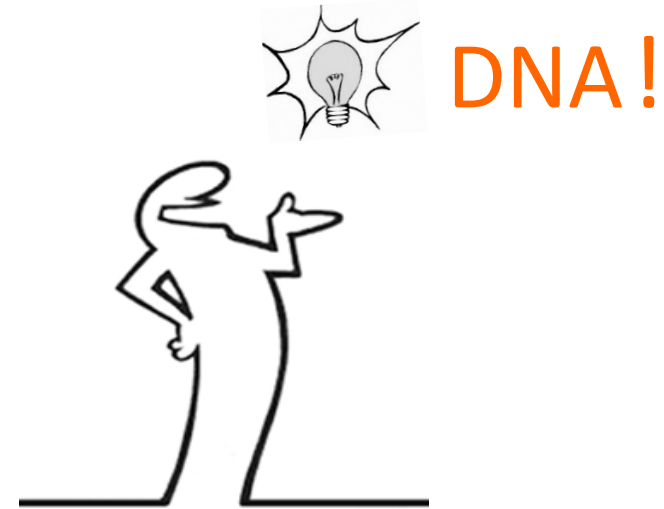


AC +

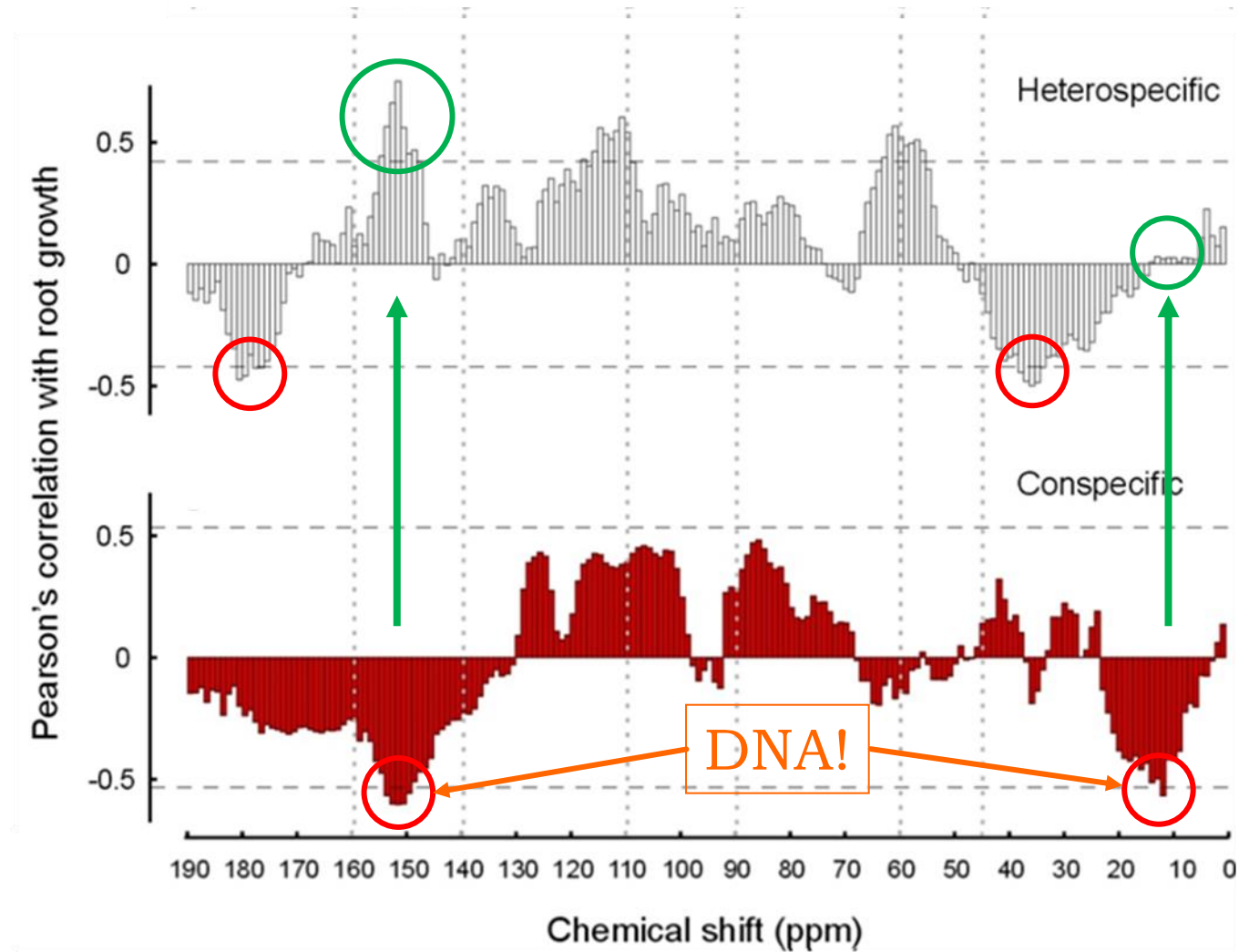


EXPERIMENTAL EVIDENCES

- autotoxicity was demonstrated, but:
 - unexpected results of timing of appearance :(
 - timing compatible with build-up of soil sickness in agriculture :)
- the chemical compound had to be:
 - 1 - Resistant
 - 2 - Not removable by charcoal
 - 3 - Water soluble
 - 4 - Species-specific



^{13}C CPMAS NMR – Correlation analysis with phytotoxicity

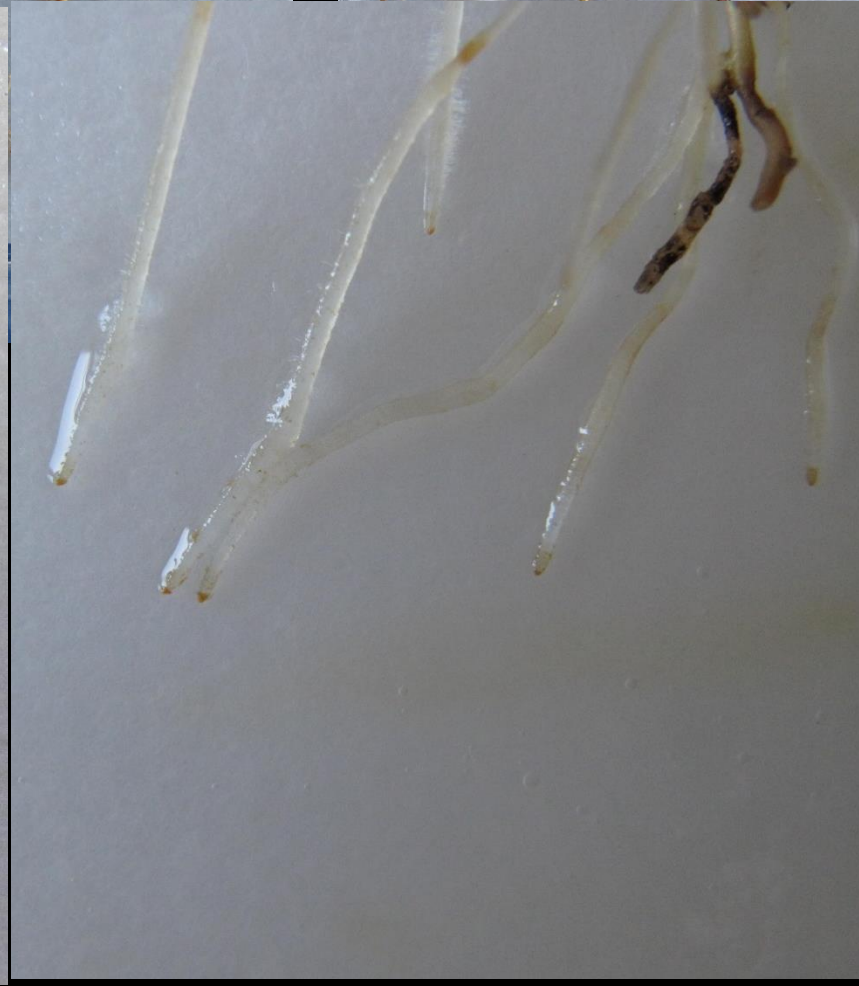


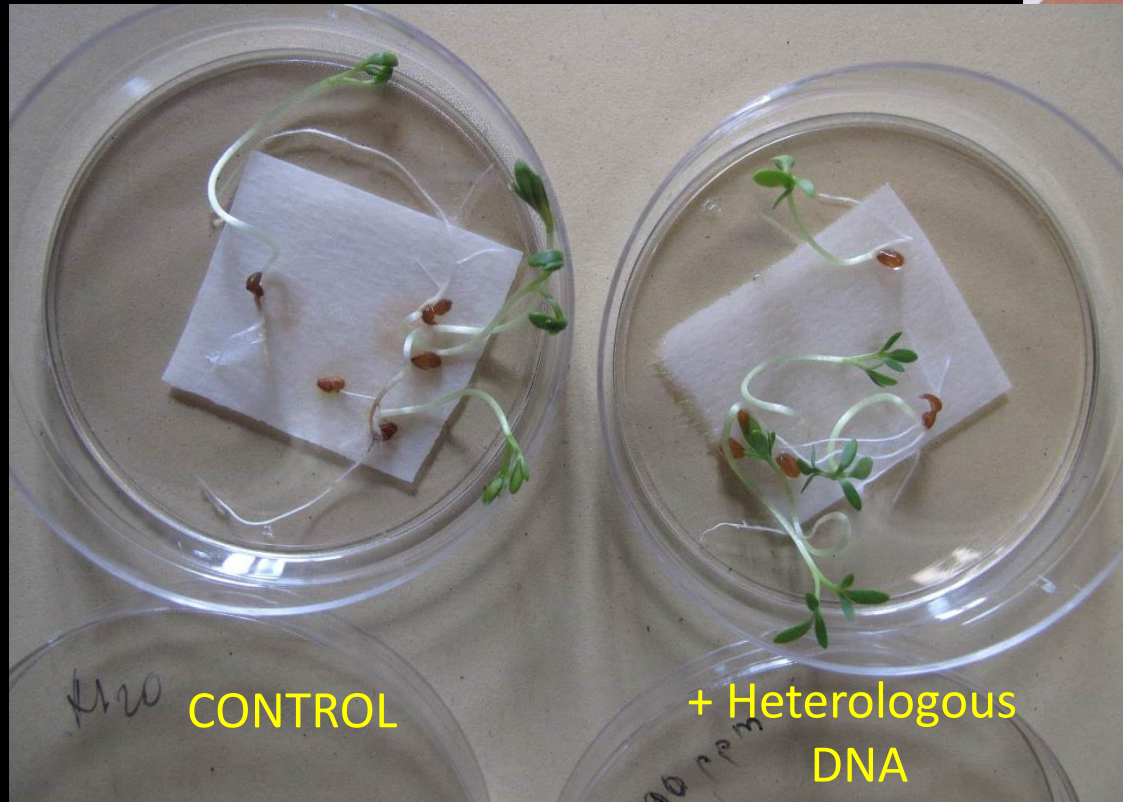


CONTROL



+ SELF DNA

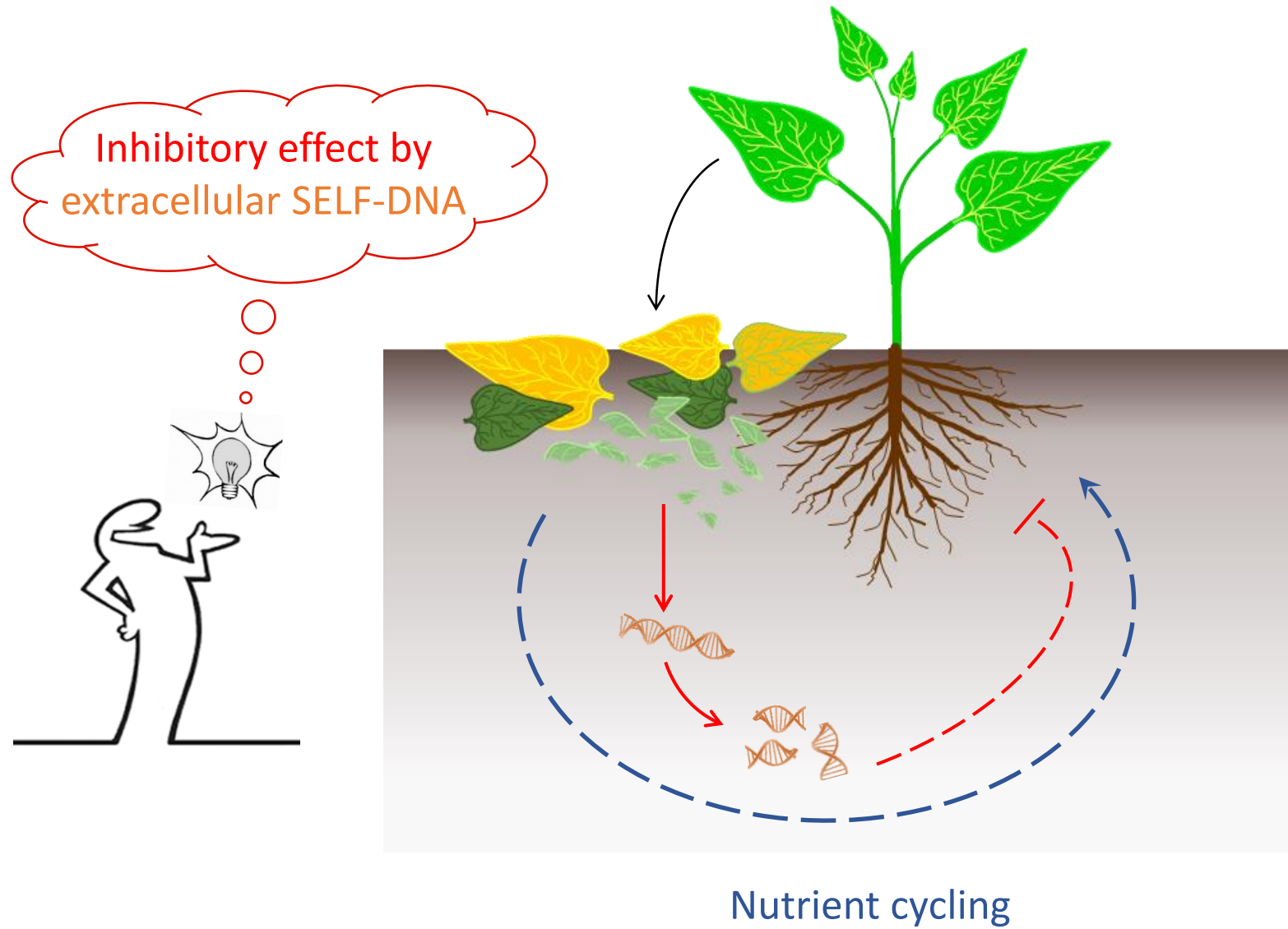




CONTROL

+ Heterologous
DNA

Model idea

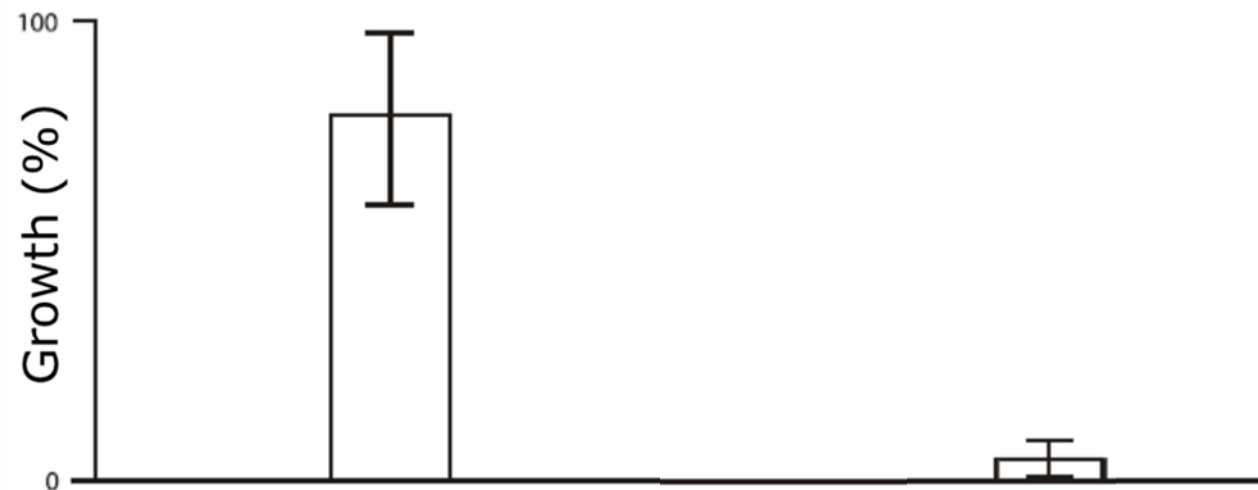


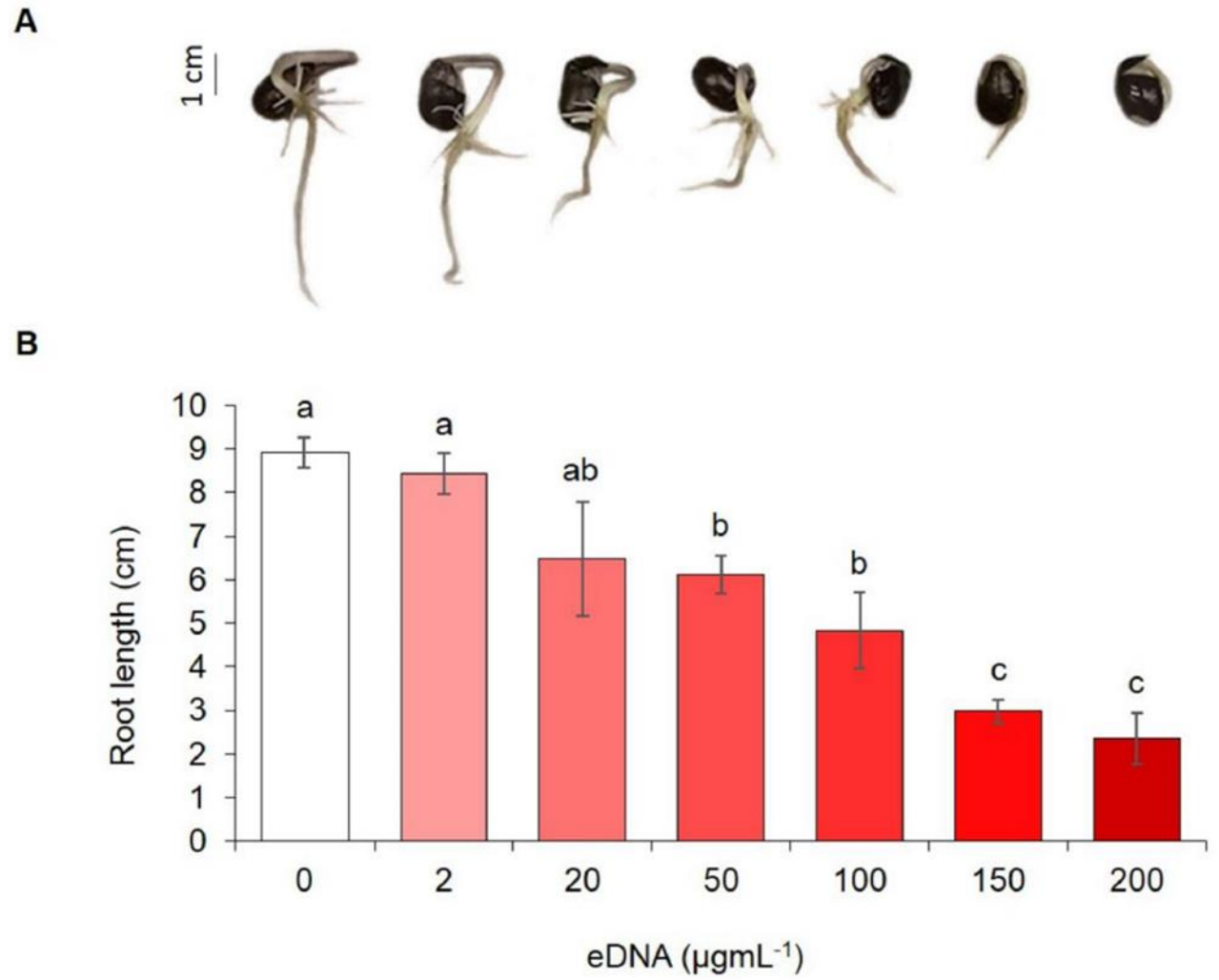
Discovery (1)

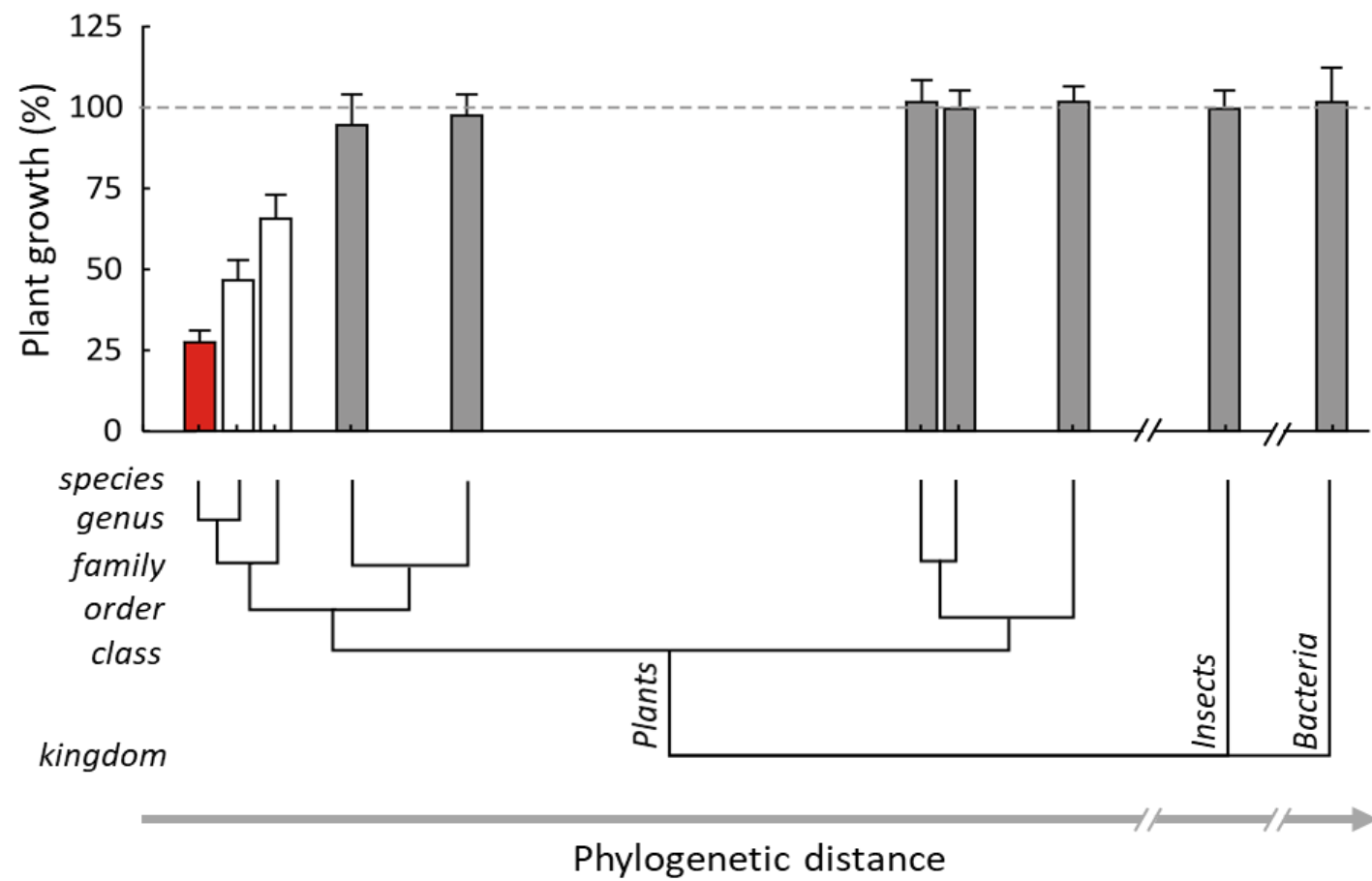
> 30 plant species

Inhibitory and toxic effects of extracellular self-DNA in litter:
a mechanism for negative plant–soil feedbacks?

New Phytologist 2015 a







Discovery (2)

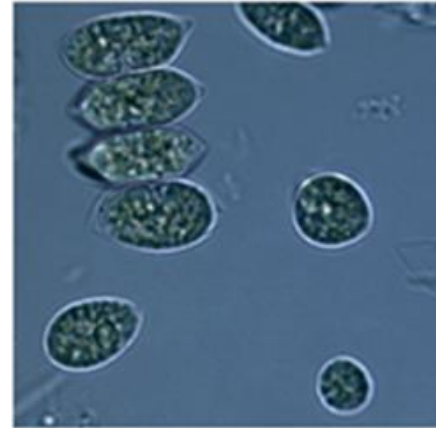
Results published in: [Mazzoleni et al. New Phytologist 2015 b](#)

Inhibitory effect not only for plants: **it is a general biological phenomenon!**

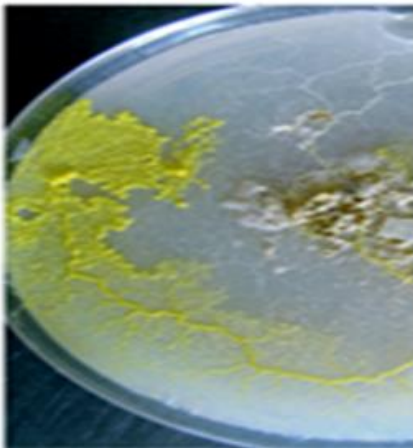
Bacteria: *Bacillus subtilis*



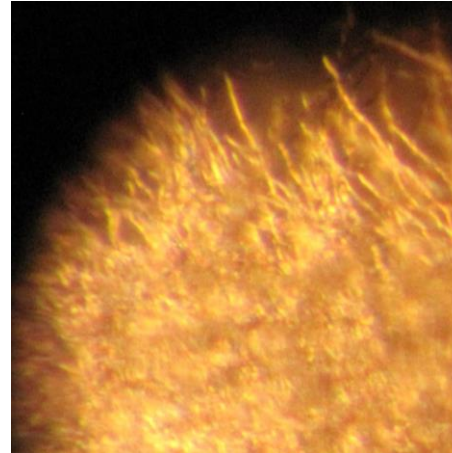
Algae: *Scenedesmus obliquus*



Protozoa: *Physarum polycephalum*



Fungi: *Trichoderma harzianum*

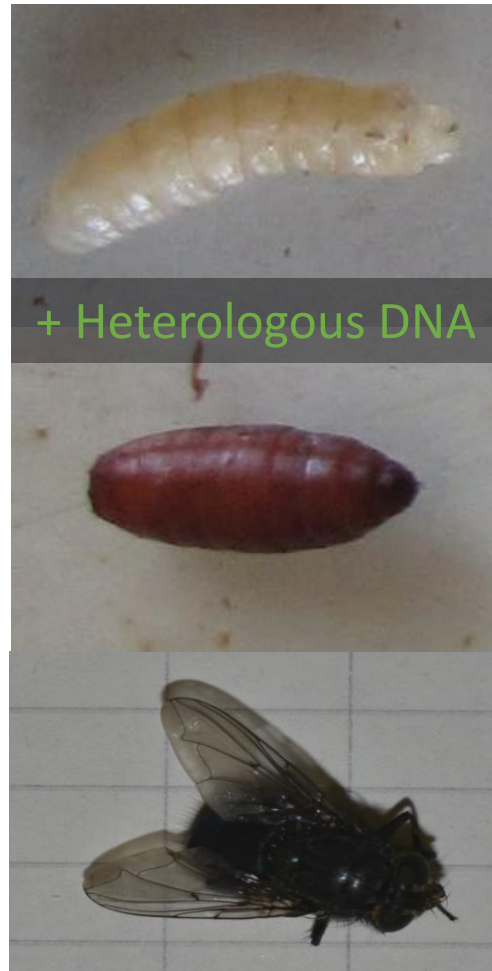


Discovery (2)

Results published in: [Mazzoleni et al. New Phytologist 2015 b](#)

Inhibitory effect not only for plants: **it is a general biological phenomenon!**

Animalia: *Sarcophaga carnaria*



+ Heterologous DNA



+ SELF-DNA



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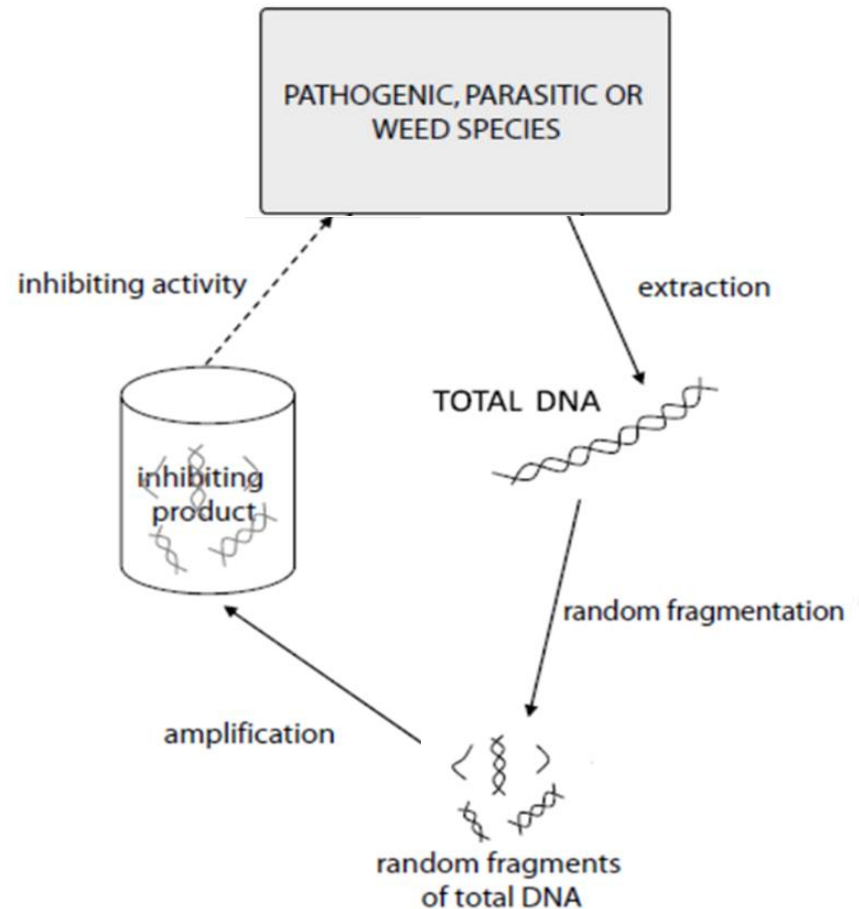
Team

FOUNDING TEAM



Innovative concept

Harmful organisms can be controlled by the exposure to their own DNA



PATENT COOPERATION TREATY

From the RECEIVING OFFICE

To: IANNONE Carlo Luigi
TIBURZI Andrea
SANTI Filippo
GITTO Serena
BANCHETTI Marina
PERRONACE Andrea
BURCHIELLI Riccardo
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DI CERBO Mario
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PCT
NOTIFICATION OF RECEIPT OF PAPERS
PURPORTING TO BE AN INTERNATIONAL
APPLICATION

(PCT Administrative Instructions, Section 301)

Date of mailing (day/month/year): 1 JUL 2013

Applicant's or agent's file reference	IMPORTANT NOTIFICATION
PCT28230	Date of receipt (day/month/year)
International application No. PCT/IT 2013/000193	10 JUL 2013
Applicant: NO SELF S.R.L.	
Title of the invention: COMPOSITION COMPRISING NUCLEIC ACIDS OF PARASITIC, PATHOGENIC OR WEED BIOLOGICAL SYSTEMS FOR INHIBITING AND/OR CONTROLLING THE GROWTH OF SAID SYSTEMS AND PROCESS FOR THE PREPARATION THEREOF	
<p>1. The applicant is hereby notified that this receiving Office has received papers purporting to be an international application on the date of receipt indicated above.</p> <p>2. The applicant's attention is drawn to the fact that these papers have been checked by this receiving Office in respect of their compliance with the requirements of Article 11(1), that is, whether these papers meet the requirements necessary for the recording of an international filing date.</p> <p>3. As soon as this receiving Office has checked these papers, it will inform the applicant accordingly.</p> <p>4. These papers have provisionally been given the international application number indicated above. The applicant is hereby requested to make reference to that number in all correspondence with this receiving Office.</p>	
Name and mailing address of the receiving Office	Authorized officer: L. TAPPA
Facsimile No.	Telephone No. 06 4781 1111

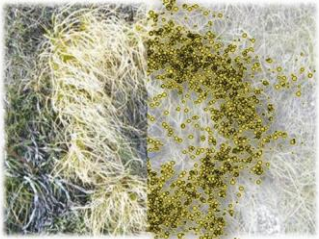
Form PCT/RO/125 (July 1992)

WO2014020624A9

WIPO (PCT)

Worldwide applications

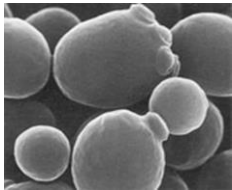
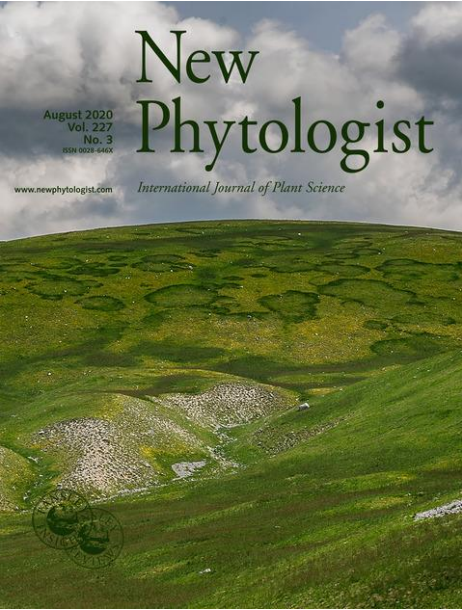
2012 • IT 2013 • CN CA NZ WO CN JP CN DK AU IT EP BR EA
US ES MX EP 2015 • ZA HK 2017 • AU 2018 • JP 2019 •
US



$$P(\text{establishment}) = \frac{\alpha}{1 + \beta \cdot e^{\gamma \cdot T}}$$

126

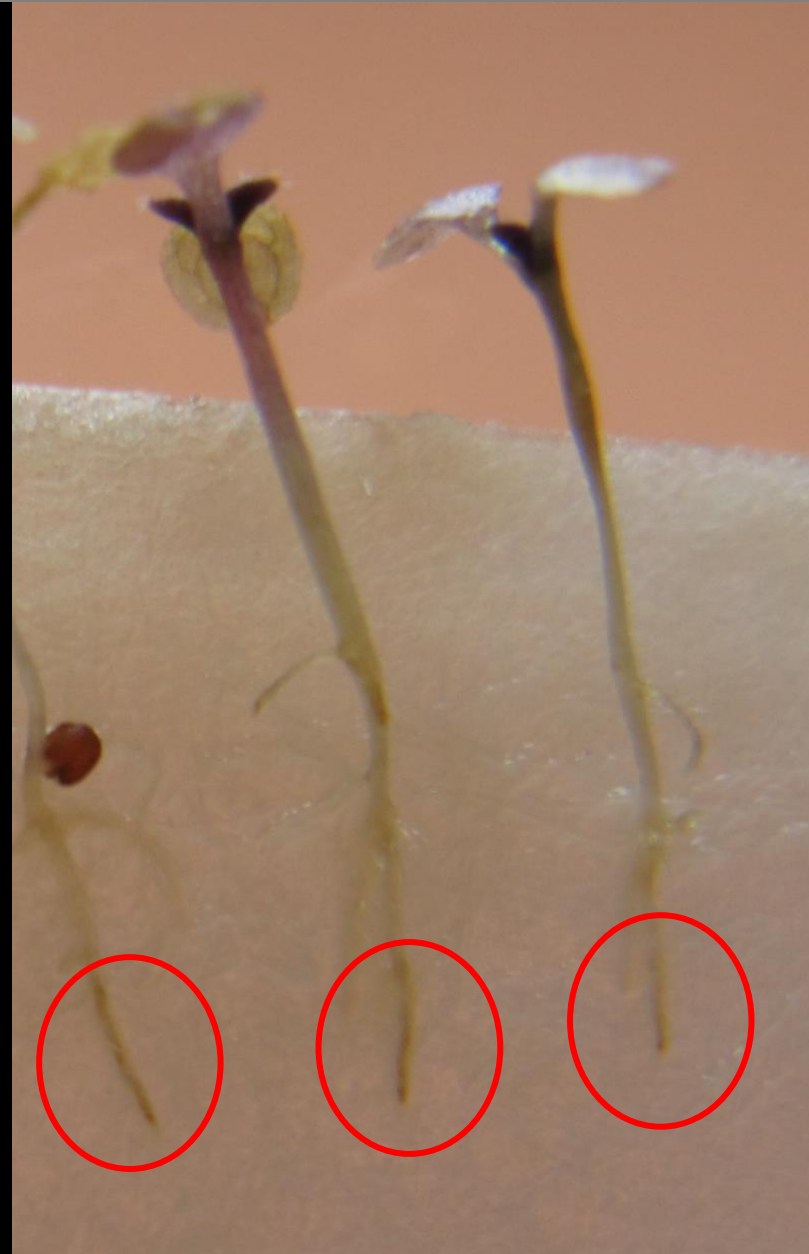
SEPTEMBER 2017



Nonself-DNA



Self-DNA



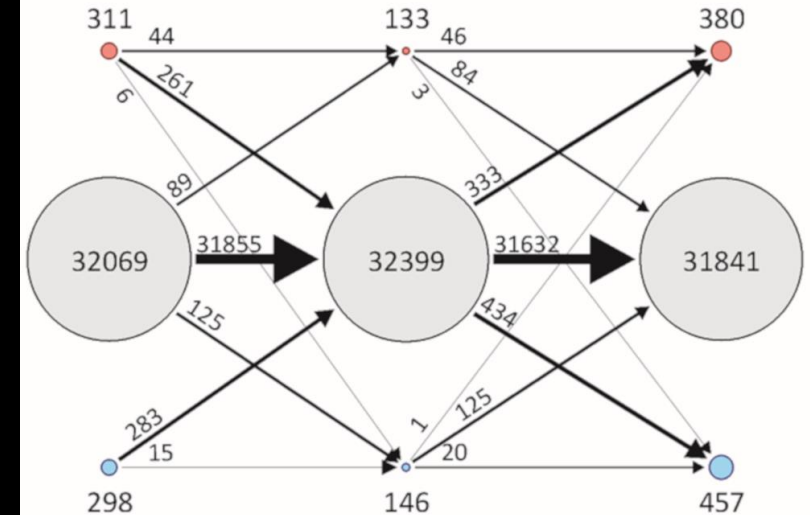
Studies on model organisms: *Arabidopsis thaliana*
(Chiusano et al. submitted *Frontiers in Plant Science*)

INHIBITION TEST (seed soaking)

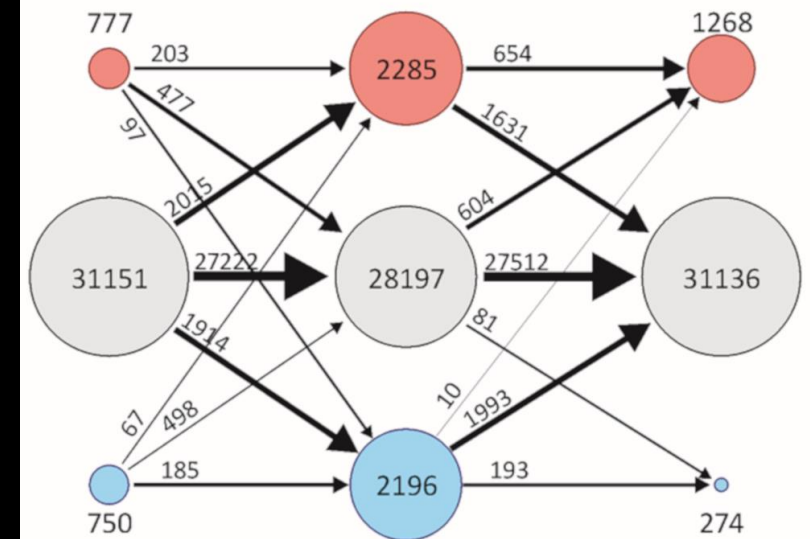


Studies on model organisms: *Arabidopsis thaliana*
(Chiusano et al. submitted *Frontiers in Plant Science*)

Self-DNA vs Control



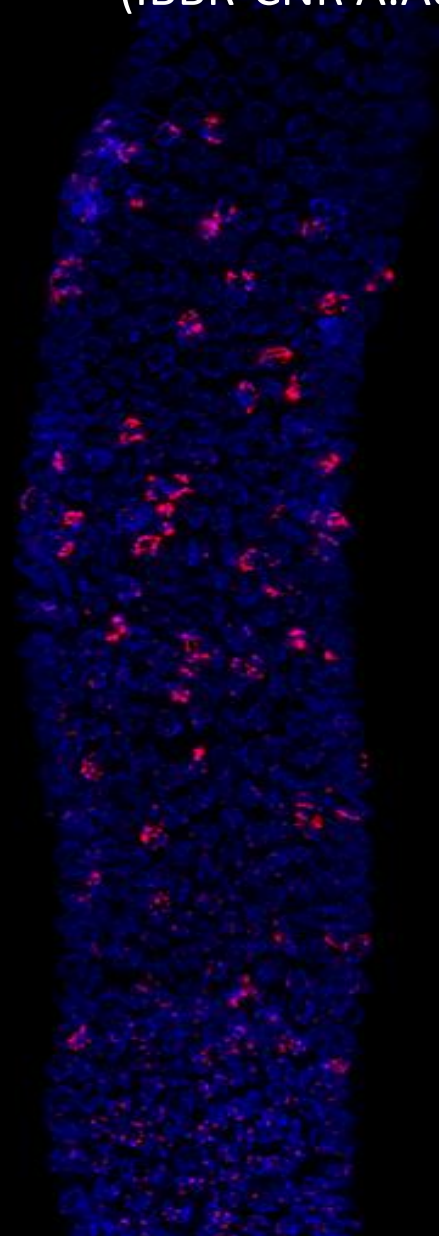
Nonself-DNA vs Control



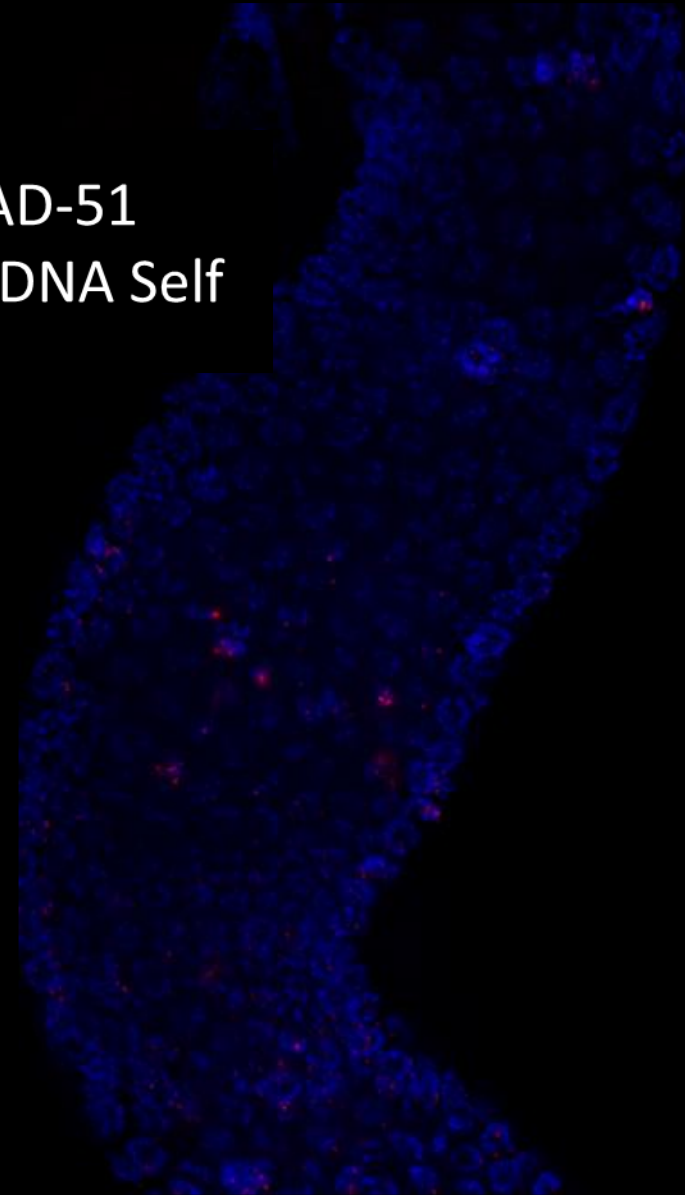
Studies on model organisms: *C. elegans*

(IBBR-CNR A.Adamo, S.Gigliotti, A.Storlazzi)

α RAD-51
DNA self



α RAD-51
No DNA Self





The Proof of Concept (PoC) for Self-DNA (sDNA) Technology

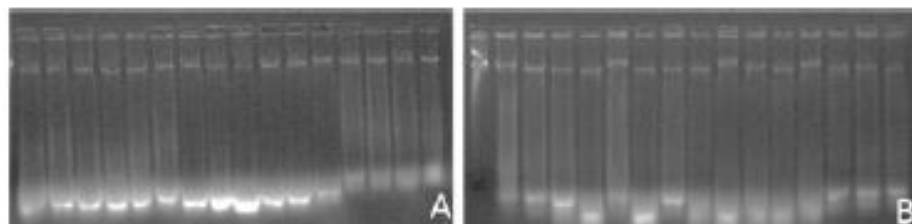
EC&IS RESEARCH GROUP – IRIBB, BOGOR, INDONESIA

IN COLLABORATION WITH

PT EKOTALIS TEKNOLOGI INDONESIA – BOGOR

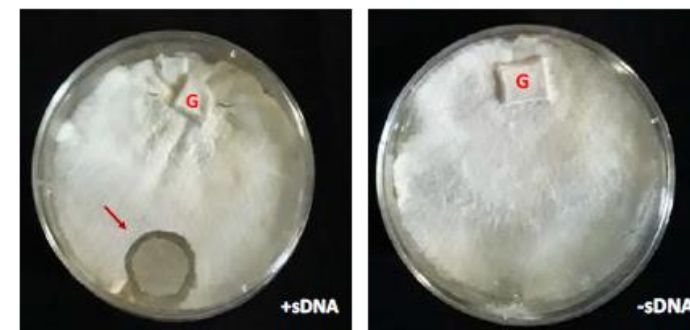
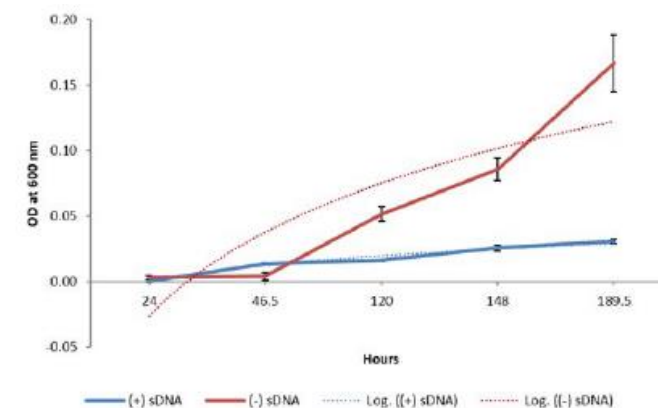
AND BIOPHARMA BV – BERKEL EN RODENRIJS, THE NETHERLANDS

Genomic DNA

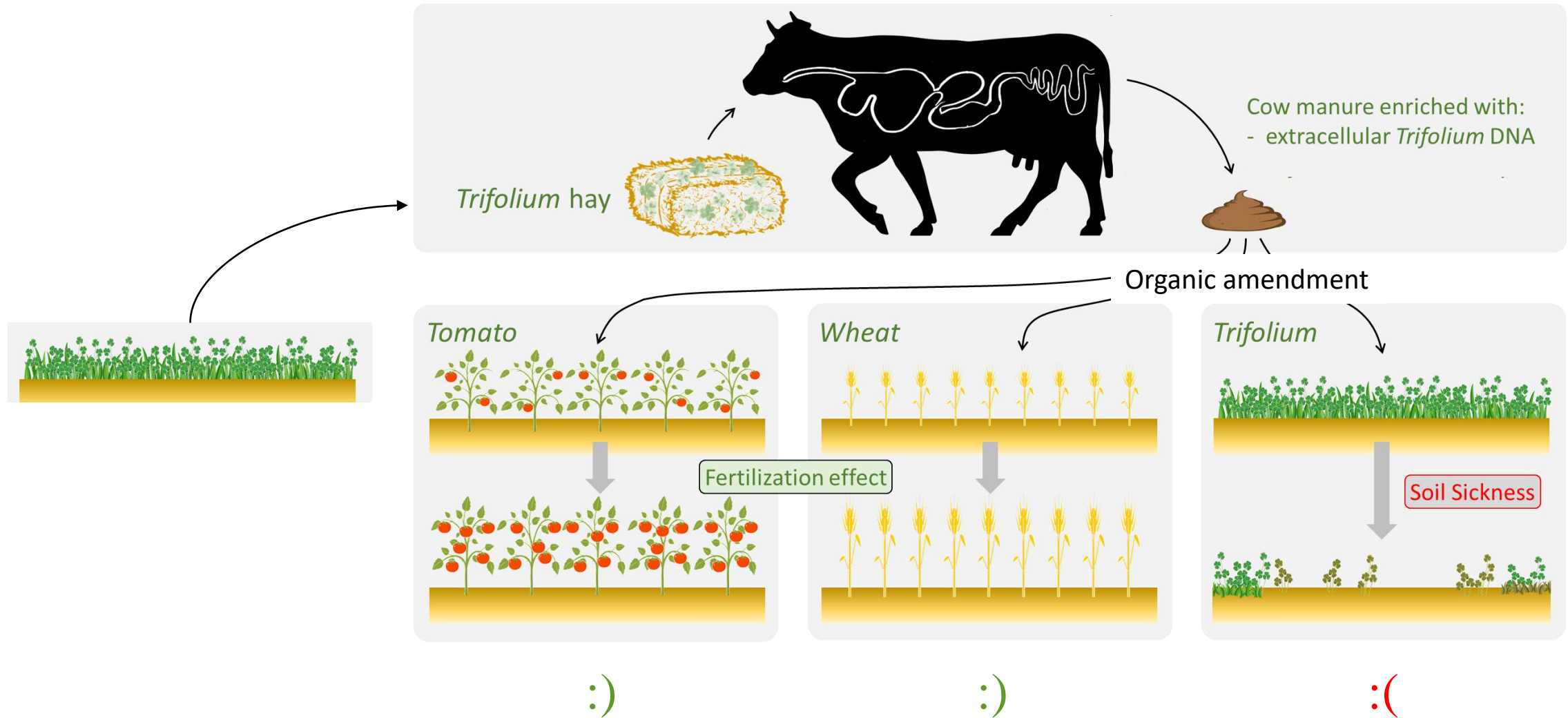


Elaeis guineensis

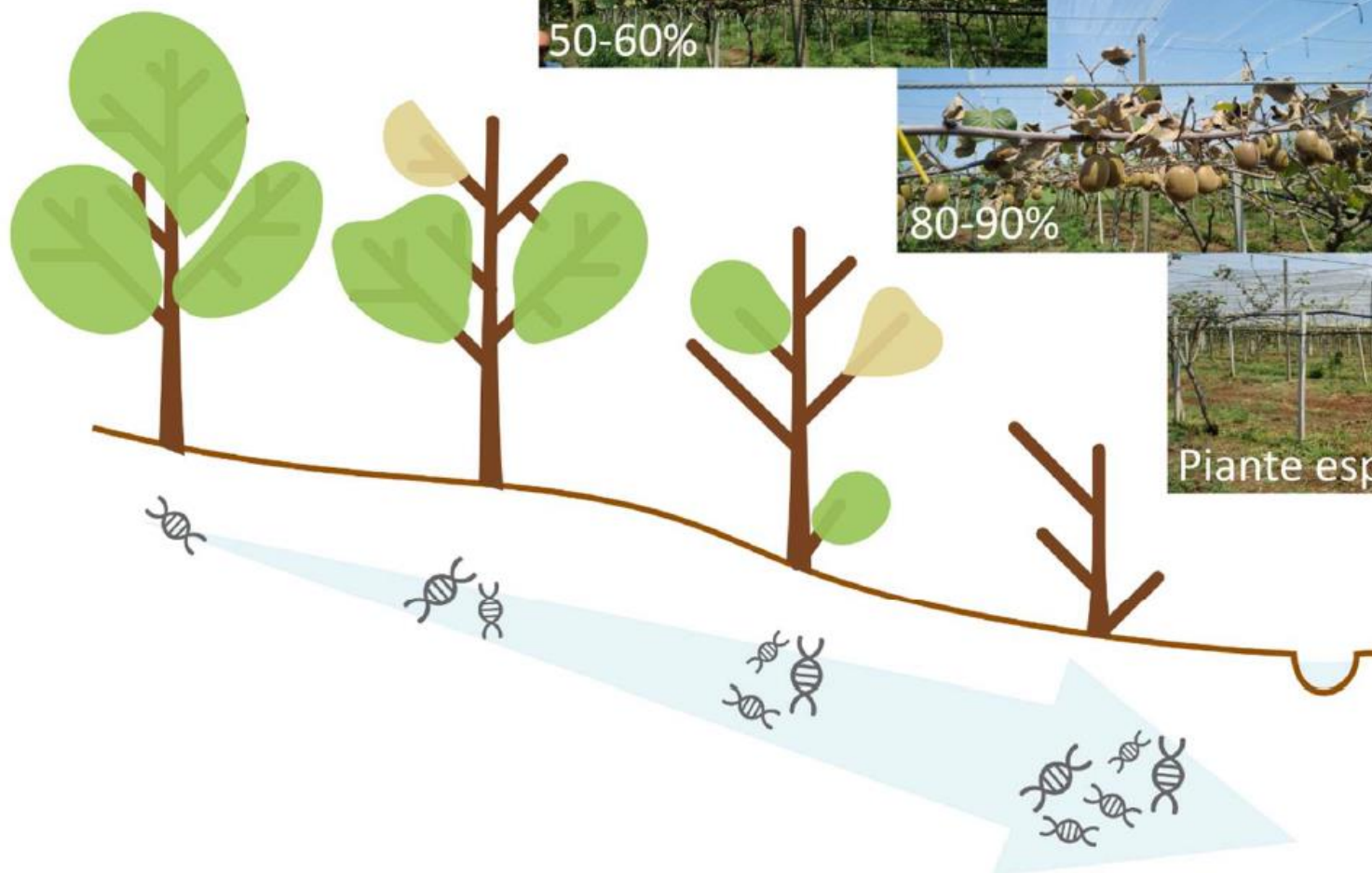
Ganoderma sp.

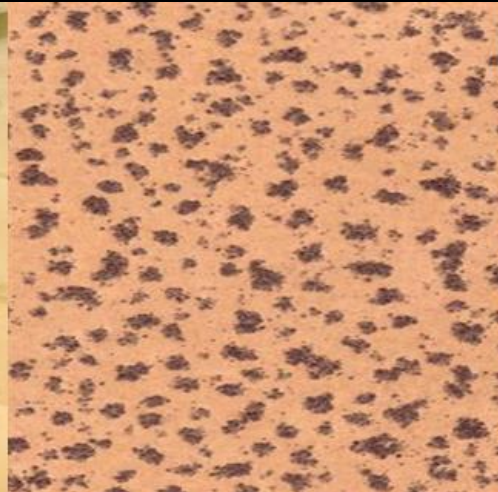
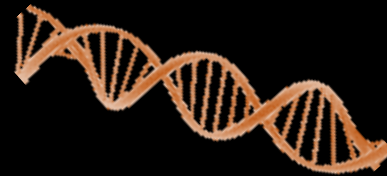


Fertilization with organic matter











Inside-out. The inhibitory effect of self-DNA

Stefano Mazzoleni

24 Febbraio 2021



Main references

Mazzoleni et al. (2014) Inhibitory and toxic effects of extracellular self-DNA in litter: a mechanism for negative plant–soil feedbacks? *New Phytologist* doi: [10.1111/nph.13121](https://doi.org/10.1111/nph.13121).

Mazzoleni et al. (2015) Inhibitory effects of extracellular self-DNA: a general biological process? *New Phytologist*. doi: [10.1111/nph.13306](https://doi.org/10.1111/nph.13306)

Reviews

Cartenì et al. (2016) Self-DNA inhibitory effects: Underlying mechanisms and ecological implications, *Plant Signaling & Behavior*, 11:4, e1158381, DOI: [10.1080/15592324.2016.1158381](https://doi.org/10.1080/15592324.2016.1158381)

Abhayprasad Bhat and Choong-Min Ry (2016) Plant Perceptions of Extracellular DNA and RNA. *Molecular Plant* 9, 956–958. <http://dx.doi.org/10.1016/j.molp.2016.05.014>

Articoli divulgativi

<https://www.freshplaza.it/article/9245017/moria-del-kiwi-e-stanchezza-del-terreno-una-correlazione-oggetto-di-studio/>

<https://www.freshplaza.it/article/9251309/moria-del-kiwi-e-stanchezza-del-terreno-principi-general-per-il-recupero-degli-impianti/>

Riflessioni sulle lobby accademiche :)

Mazzoleni et al. (2021). Mathematical modelling and numerical bifurcation analysis of inbreeding and interdisciplinarity dynamics in academia. *Journal of Computational and Applied Mathematics* 385. <https://doi.org/10.1016/j.cam.2020.113194>