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ALIMENTARI, AMBIENTALI E FORESTALI



Regione Toscana



# GESTIONE DEI BOSCHI, ECONOMIA CIRCOLARE, VALORIZZAZIONE AREE MARGINALI: IL RUOLO DEI TANNINI DI CASTAGNO NELLA SALUTE DELLE PIANTE IN VIVAIO

11 Aprile 2025

Pistoia Nursery Campus – Vivai Vannucci

Prof.ssa Stefania Tegli PhD

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Stefania Tegli  
Pistoia Nursery Camp - 11 aprile 2025







Editorial

## Key Challenges in Plant Pathology in the Next Decade

Nian Wang,<sup>1,†</sup> George W. Sundin,<sup>2</sup> Leonardo De La Fuente,<sup>3</sup> Jaime Cubero,<sup>4</sup> Satyanarayana Tatineni,<sup>5</sup> Marin T. Brewer,<sup>6</sup> Quan Zeng,<sup>7</sup> Clive H. Bock,<sup>8</sup> Nik J. Cuniffe,<sup>9</sup> Congli Wang,<sup>10</sup> Thierry Candresse,<sup>11</sup> Thomas Chappell,<sup>12</sup> Jeffrey J. Coleman,<sup>3</sup> and Gary Munkvold<sup>13</sup>

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**XXI century**  
in global changes scenario



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# Climate change impacts on plant pathogens, food security and paths forward

Brajesh K. Singh<sup>1,2</sup>✉, Manuel Delgado-Baquerizo<sup>3,4</sup>, Eleonora Egidi<sup>5</sup>, Emilio Guirado<sup>5</sup>, Jan E. Leach<sup>6</sup>, Hongwei Liu<sup>7</sup> & Pankaj Trivedi<sup>8</sup>

## Abstract

Plant disease outbreaks pose significant risks to global food security and environmental sustainability worldwide, and result in the loss of primary productivity and biodiversity that negatively impact the environmental and socio-economic conditions of affected regions. Climate change further increases outbreak risks by altering pathogen evolution and host–pathogen interactions and facilitating the emergence of new pathogenic strains. Pathogen range can shift, increasing the spread of plant diseases in new areas. In this Review, we examine how plant disease pressures are likely to change under future climate scenarios and how these changes will relate to plant productivity in natural and agricultural ecosystems. We explore current and future impacts of climate change on pathogen biogeography, disease incidence and severity, and their effects on natural ecosystems, agriculture and food production. We propose that amendment of the current conceptual framework and incorporation of eco-evolutionary theories into research could improve our mechanistic understanding and prediction of pathogen spread in future climates, to mitigate the future risk of disease outbreaks. We highlight the need for a science–policy interface that works closely with relevant intergovernmental organizations to provide effective monitoring and management of plant disease under future climate scenarios, to ensure long-term food and nutrient security and sustainability of natural ecosystems.

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## Sections

### Introduction

### Climate change and plant diseases

### Climate change, the plant microbiome and disease

### Paths forward

### Conclusion and future perspectives

## About Climate Change



- Climate change threatens all elements essential for life, such as water, food, health, environment and land. This is a dramatic scenario whose most obvious symptom would be the change in weather conditions; more heat waves, storms and floods caused by melting glaciers.



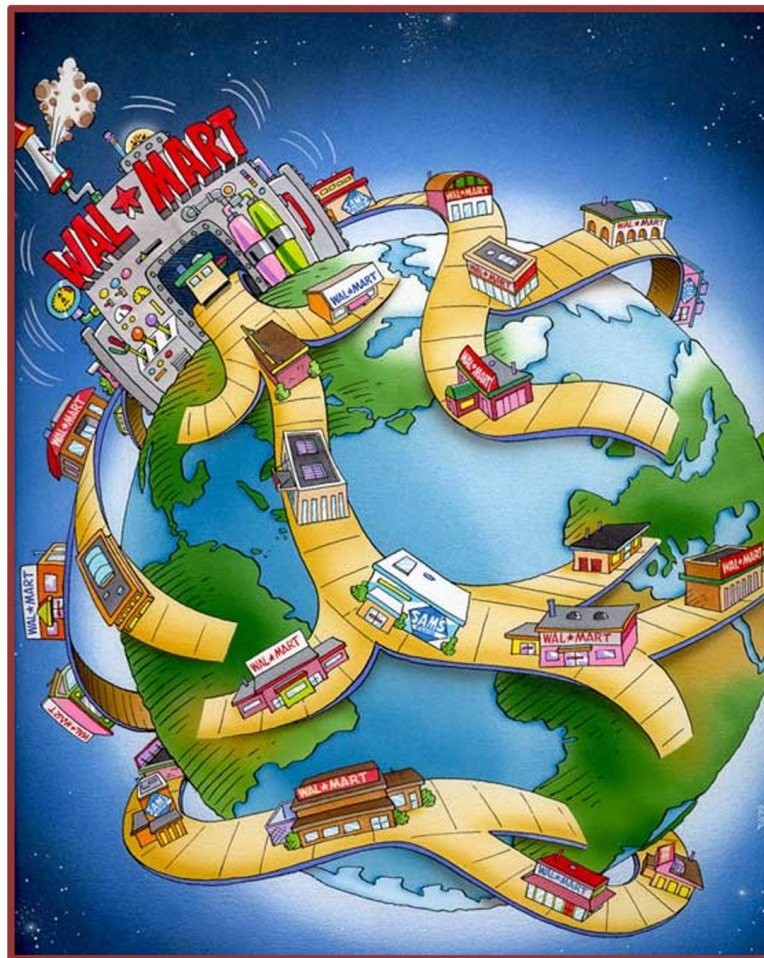
# GLOBAL CHANGES



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# EPIDEMIE e CAMBIAMENTI GLOBALI

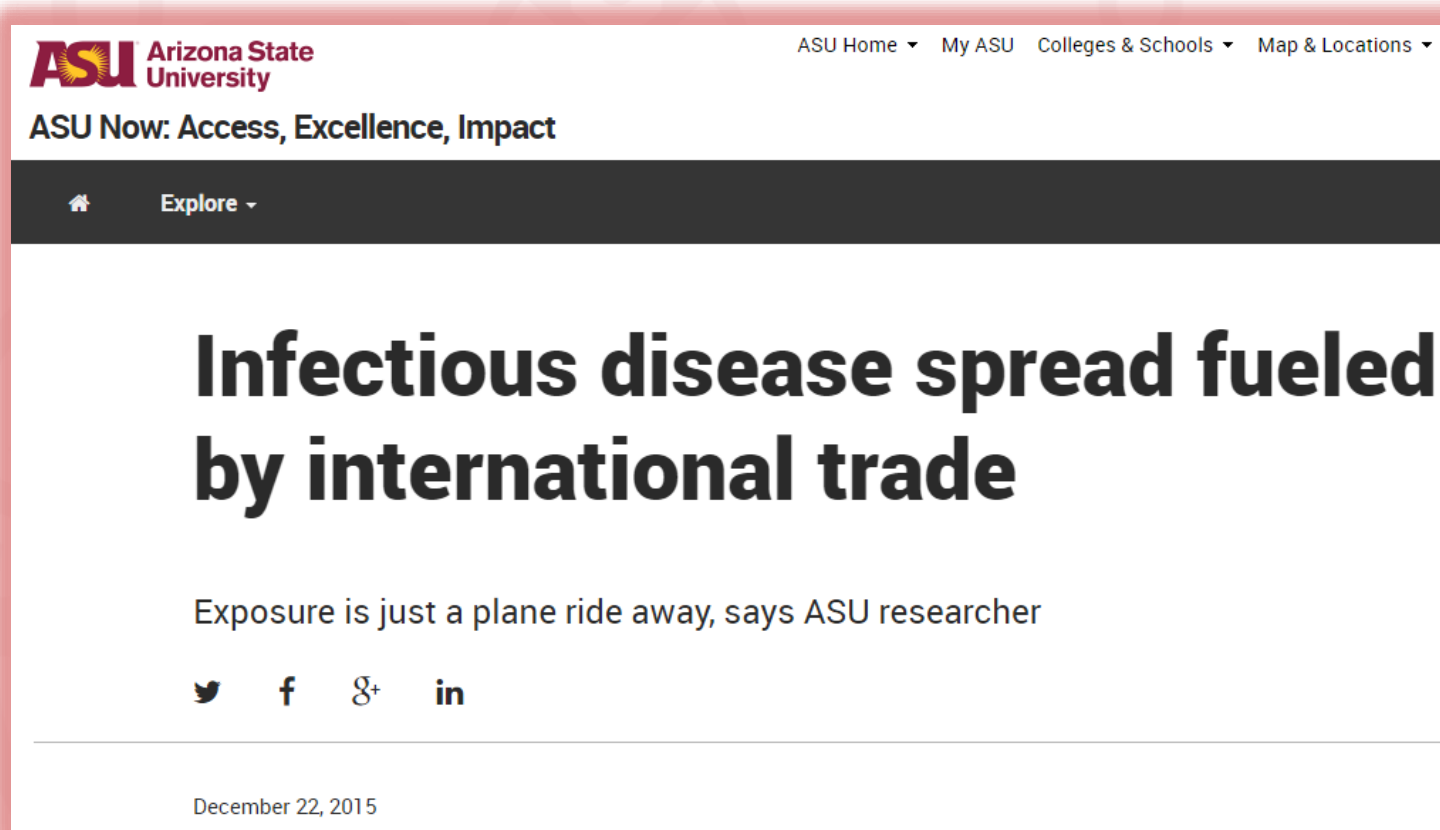


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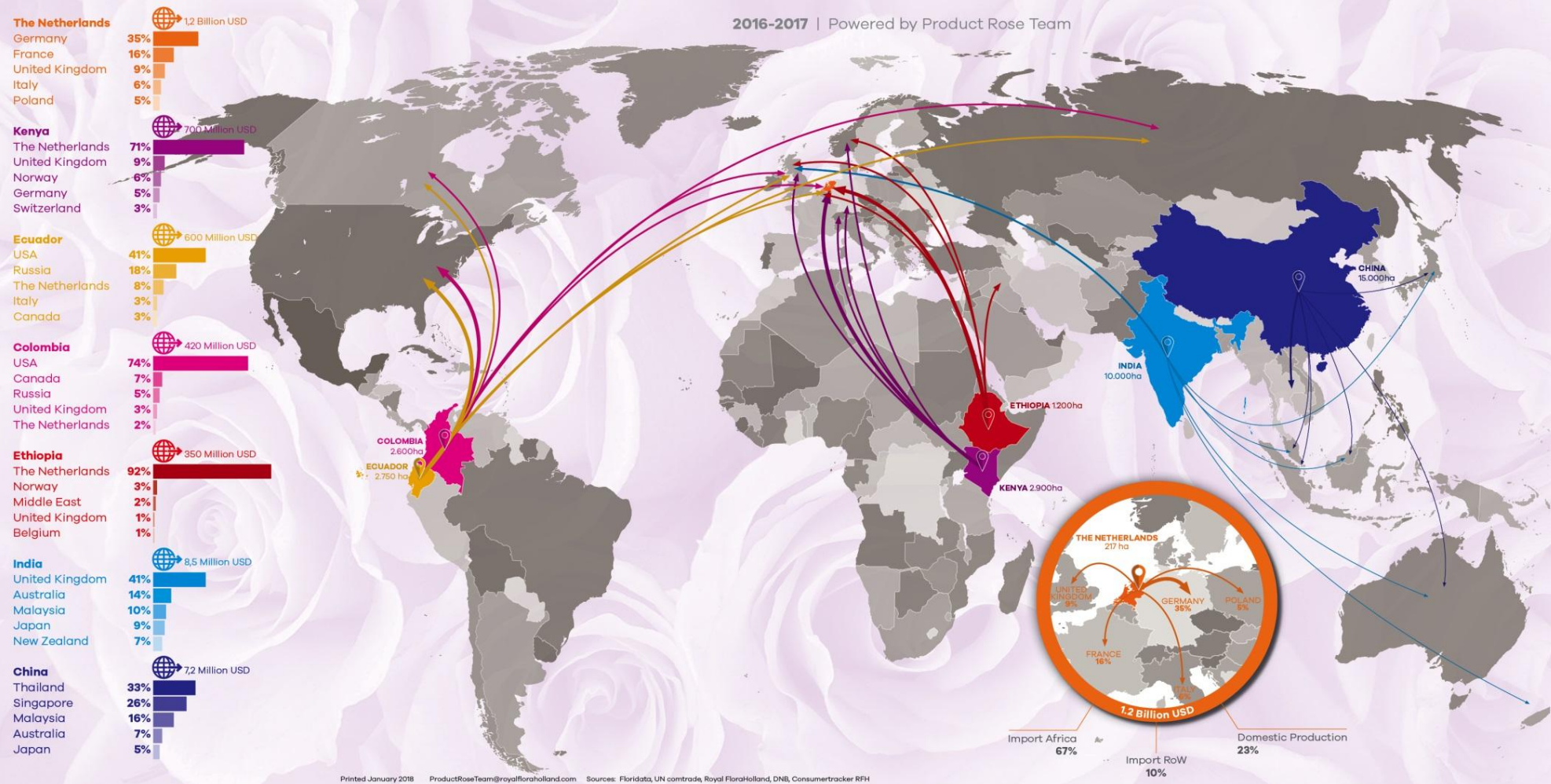
# I PATOGENI NON RISPETTANO LE FRONTIERE!!!





# The World of Roses

2016-2017 | Powered by Product Rose Team



14 Feb 2018



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BSPP Retweeted



CABI Invasives @CABI\_Invasives

The #ValentinesDay invasion - the true cost of those imported bouquets [invasiv.es/2EleDH5](https://invasiv.es/2EleDH5)  
#invasivespecies



- Virus or viroid
- Fungi
- Bacteria
- Other groups: nematodes and

Figure 1

First reports of  
East Africa, and



Central America,

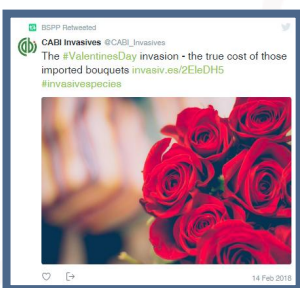
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History  
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# Plant Health Regulation, Regulation (EU) 2016/2031/EU

## KEYWORDS

Global strategy

Increase awareness

Informar

Training

Prevention and Control

**TO BE READY  
For EMERGENCY  
SITUATIONS**



**PREVENTING  
PLANT DISEASES**

bacteria, fungi and viruses



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# *A global surveillance system for crop diseases*

Global preparedness minimizes the risk to food supplies

By **M. Carvajal-Yepes,<sup>1</sup> K. Cardwell,<sup>2</sup> A. Nelson,<sup>3</sup> K. A. Garrett,<sup>4</sup> B. Giovani,<sup>5</sup> D. G. O. Saunders,<sup>6</sup> S. Kamoun,<sup>7</sup> J. P. Legg,<sup>8</sup> V. Verdier,<sup>9</sup> J. Lessel,<sup>10</sup> R. A. Neher,<sup>11</sup> R. Day,<sup>12</sup> P. Pardey,<sup>13</sup> M. L. Gullino,<sup>14</sup> A. R. Records,<sup>15</sup> B. Bextine,<sup>16</sup> J. E. Leach,<sup>17</sup> S. Staiger,<sup>1</sup> J. Tohme<sup>1</sup>**

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Review Article

## Plant pest surveillance: from satellites to molecules

Gonçalo Silva<sup>1</sup>, Jenny Tomlinson<sup>2</sup>, Nawaporn Onkokesung<sup>3</sup>, Sarah Sommer<sup>3</sup>, Latifa Mrisho<sup>4</sup>, James Legg<sup>4</sup>, Ian P. Adams<sup>2</sup>, Yaiza Gutierrez-Vazquez<sup>2</sup>, Thomas P. Howard<sup>3</sup>, Alex Laverick<sup>3</sup>, Oindrila Hossain<sup>5</sup>, Qingshan Wei<sup>5</sup>, Kaitlin M. Gold<sup>6</sup> and  Neil Boonham<sup>3</sup>

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# PESTICIDE ATLAS

Facts and figures about toxic chemicals in agriculture

2022



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Action  
Network  
Europe

<https://eu.boell.org/en/PesticideAtlas>

## Pesticide Atlas

Facts and figures about toxic chemicals in agriculture

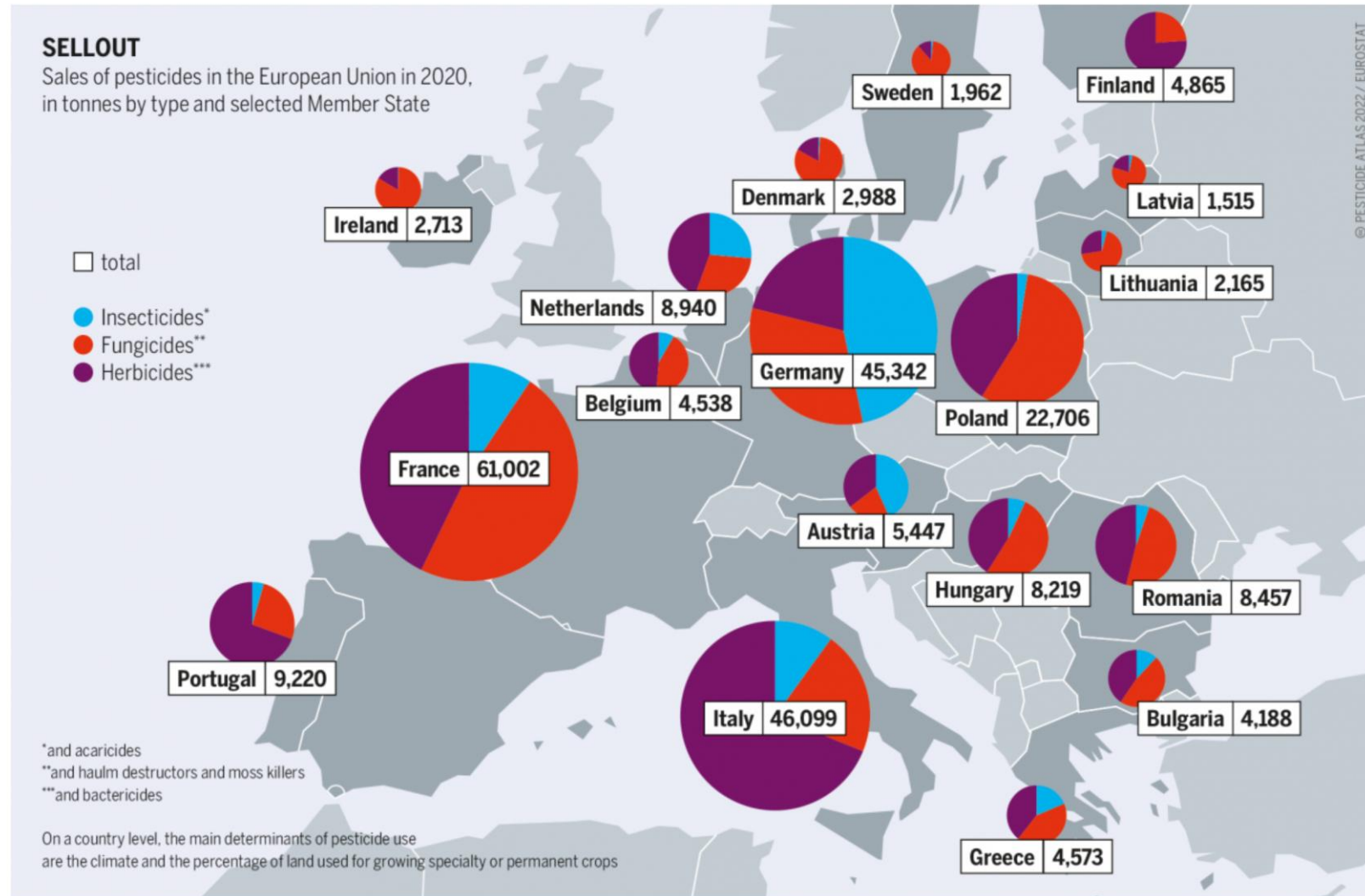
In beer and in honey, on fruit and on vegetables, in grass on playgrounds and even in urine and in the air – traces of pesticides from agriculture can be detected everywhere. That pesticides negatively impact human health, biodiversity, water, and soil is not a new insight by any means. The new and first Pesticide Atlas reveals new facts and data on global pesticide use and trade, its impact on people, their health and biodiversity, and alternative solutions.



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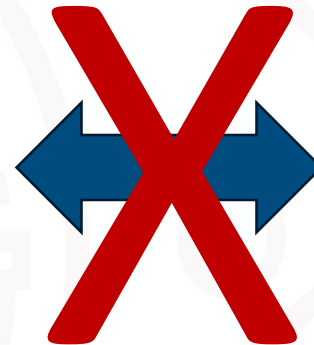
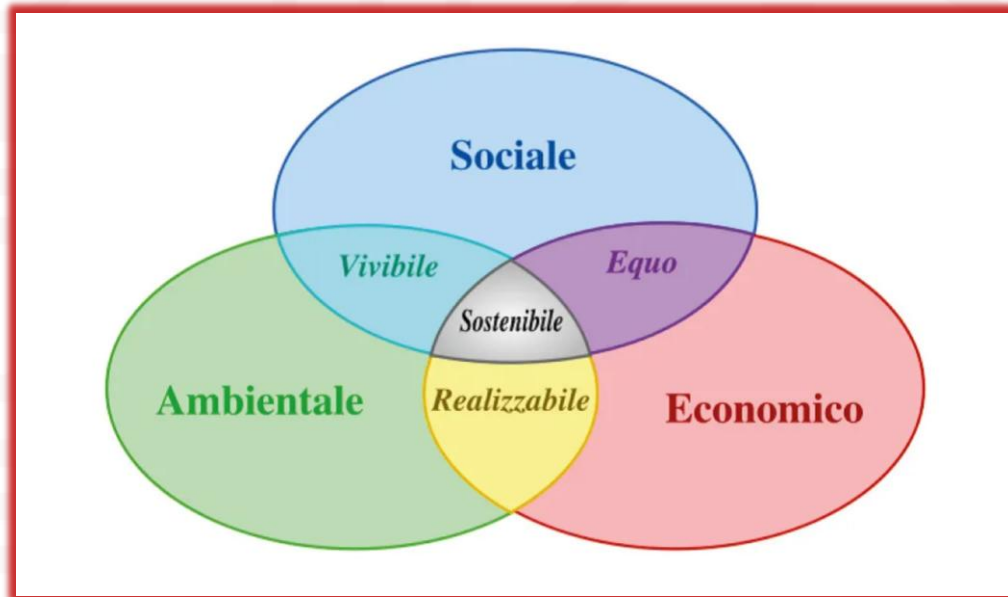
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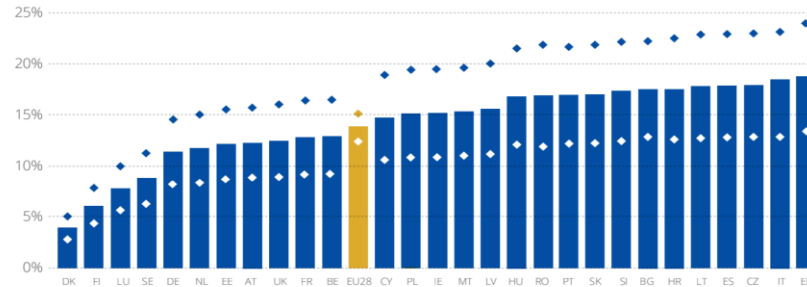


Agricultural land area, crops grown and the climatic conditions as well as national policies play a role in pesticide use. [licence infos](#)





# A proposito di Salute delle Piante e SOSTENIBILITA'!



For the EU as a whole<sup>14</sup>, the estimated total counterfeiting effect amounts to 13.8 % of sales or EUR 1.3 billion. This is a direct estimate of sales lost by legitimate manufacturers of pesticides in the EU each year due to counterfeiting.

@euipo\_EU, 2017

The total direct and indirect effect in the EU of lost sales due to counterfeiting, as an annual average for the period 2009-2014, amounts to EUR 2.8 billion

## Total effects

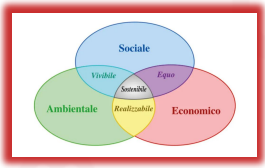
	Sales (million EUR)	Employment(persons)
GERMANY	694	2 902
FRANCE	548	2 295
ITALY	233	826
SPAIN	157	723
UNITED KINGDOM*	128	496
EU-28	2 827	11 686

@euipo\_EU, 2017

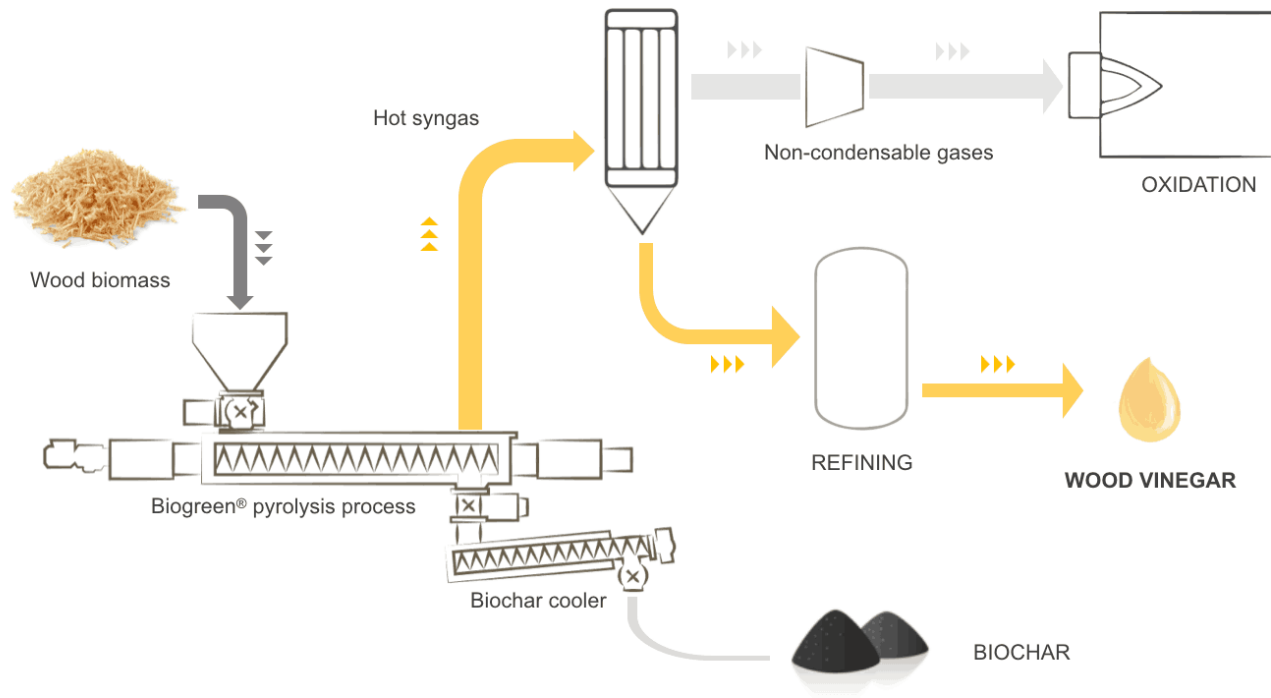


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# ONE Health & Economia circolare!



Da Biogreen, 2020



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## Chestnut wood chips extract

Lab Scale



Pilot Scale





# Chestnut wood chips extract



«34. “Biostimolante delle piante” qualunque prodotto che stimola i processi nutrizionali delle piante indipendentemente dal suo tenore di nutrienti, con l'unica finalità di migliorare una o più delle seguenti caratteristiche della pianta o della rizosfera della pianta:

a) efficienza dell'uso dei nutrienti;

b) tolleranza allo stress abiotico;

c) caratteristiche qualitative;

d) disponibilità di nutrienti confinati nel suolo o nella rizosfera.»;

# Chestnut wood chips extract

Aggiornamento normativo del 09/04/2020

**Decreto Ministeriale nr. 3757 del 09/04/2020** – Modifica del Decreto Ministeriale nr. 6793 del 18/07/2018 recante “Disposizioni per l’attuazione dei regolamenti (CE) n. 834/2007 e n. 889/2008 e loro successive modifiche e integrazioni, relativi alla produzione biologica e all’etichettatura dei prodotti biologici, che abroga e sostituisce il Decreto ministeriale 27 novembre 2009 n. 18354”.

Il 9 aprile 2020 il Ministro Teresa Bellanova ha firmato il Decreto n. 3757 del 09/04/2020 (*c.d. Decreto rotazioni*), con il quale il Ministero delle Politiche Agricole Alimentari e Forestali ha modificato il DM 6793/2018 riguardante alcuni punti dell’articolato, come di seguito specificato:

## **Produzione Vegetale:**

- ha modificato il disposto in materia di rotazioni colturali in agricoltura biologica al fine di armonizzare e chiarire gli aspetti applicativi relativi al ruolo del sovescio e dell’avvicendamento dei diversi cicli colturali nell’ambito delle rotazioni stesse;
- ha rettificato il disposto in materia di **corroboranti**, correggendo il riferimento normativo per la loro immissione in commercio ed inserendo un apposito riferimento all’Allegato 3 che riporta le Linee guida per la presentazione del dossier di richiesta di approvazione di un corroborante;



# Set-up esperimento – Vivaio Vannucci Piante

- Specie vegetale: *Nerium oleander* var. Papà Gambetta
- Usati vasi da 5L
- Irrigazione: 500 mL acqua al giorno, con impianto a goccia
- Trattamento con estratto di castagno e distillati di legno (WV) ogni 2 settimane
- Inoculazione con *Psn23* dopo 1 settimana dal primo trattamento
- Pacciamatura: usato cippato tradizionalmente usato da Vannucci piante

## Trattamenti:

- Controllo negativo (no pacciamatura)
  - Controllo positivo inoculato con *Psn23*
  - WV BioDea
  - WV Nerabiochar
  - Estratto di cippato di castagno
- 5 piante per trattamento



10 piante x trattamento di cui 5 controlli e 5 inoculate con *Psn23*. Diluizioni testate:

- 1:100, 1:250 e 1:500 per BioDea e Nerabiochar
- 1:10, 1:50, 1:100 e 1:500 per l'estratto.





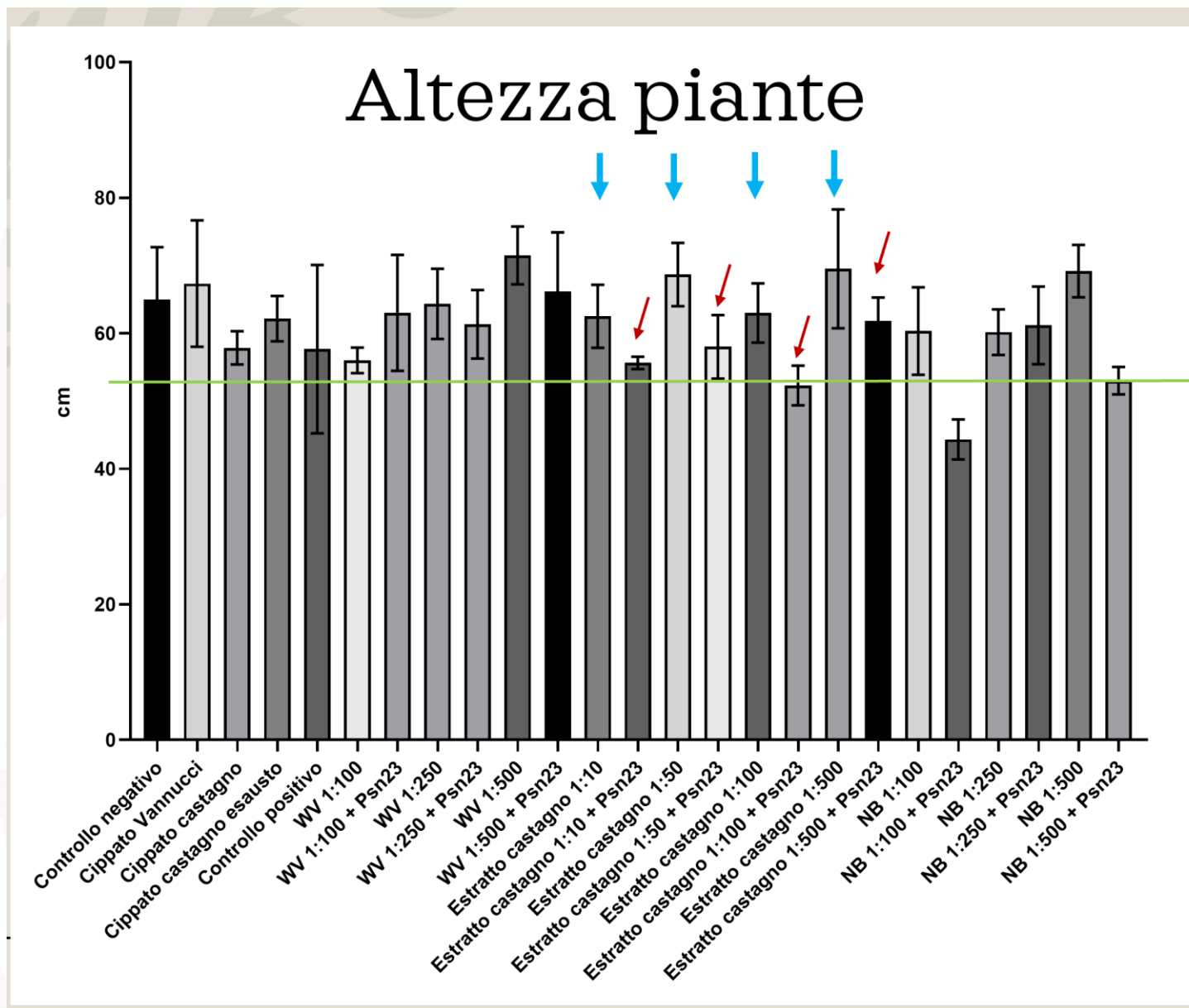


Inoculazione con *Pseudomonas savastanoi* pv. *nerii* Psn23 →  
su ciascuna pianta, sono stati inoculati due rami

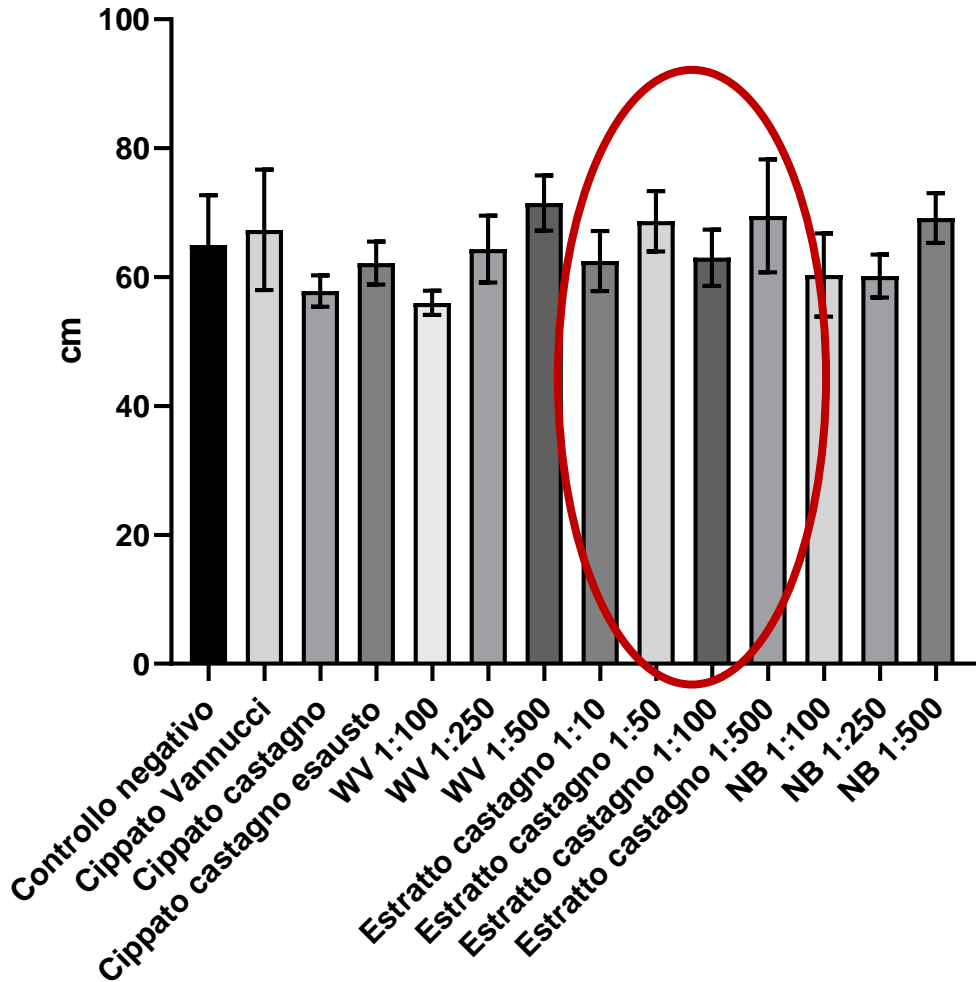
1. Fatto taglio a becco di clarino alla base del ramo
2. Inoculazione con Psn23
3. Chiusura del taglio con parafilm
4. Sullo stesso ramo fatti altri due tagli sterili per verificare movimento del batterio.



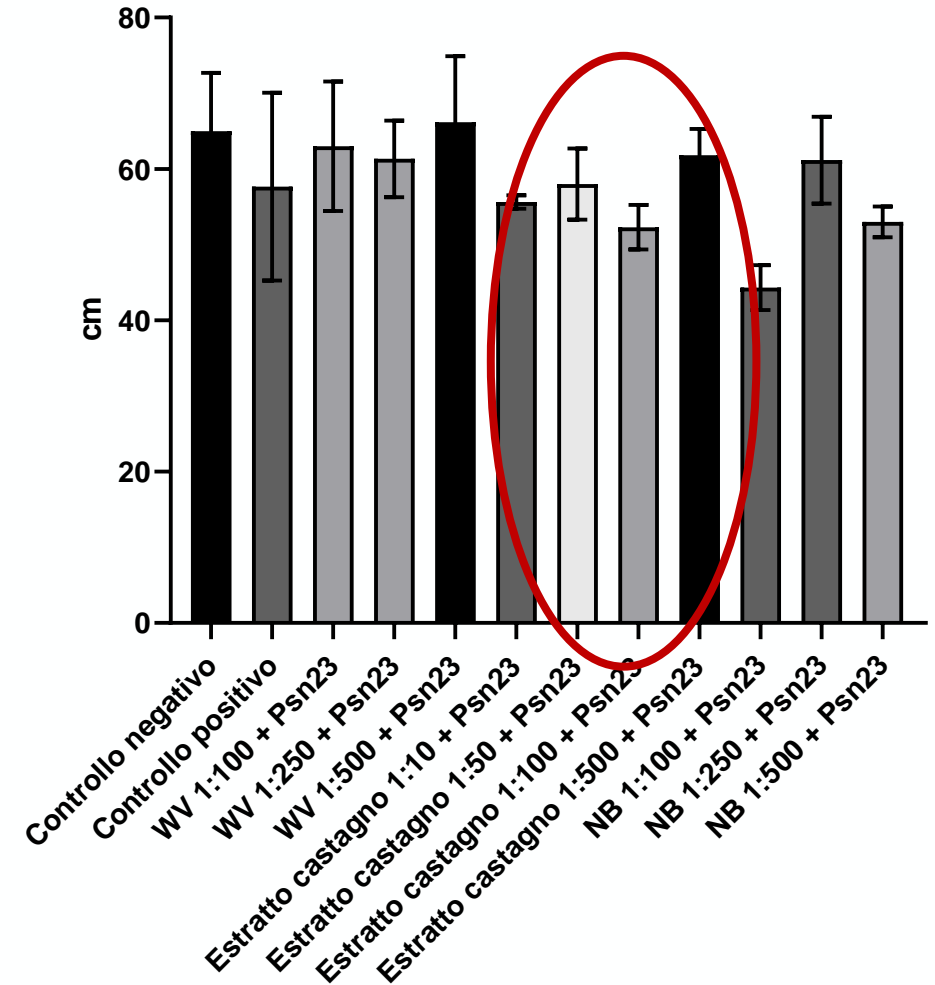




Altezza Piante - Controllo



Altezza Piante - Inoculate





# Tagli inoculati – Pianta 2 – Taglio 1

ECI 500

ECI 100

ECI 50

ECI 10



Controllo positivo



WVI 500

WVI 250

WVI 100



NBI 500

NBI 250

NBI 100



# Campionamento tumori

- ✓ Campionamento delle foglie del penultimo nodo prima della gemma apicale → congelate in  $N_2$  liquido e conservate a  $-80^{\circ}C$  per successiva analisi di espressione di geni correlati alle difese.
- ✓ Misurazione dell'altezza dei rami d'interesse.
- ✓ Analisi dei tumori (se presenti) delle piante inoculate.
- ✓ Campionamento suolo → campioni conservati a  $+4^{\circ}C$ .



1. Tagliata sezione dove precedentemente era stato eseguito il taglio a becco di clarino (sia quelli inoculati sia quelli sterili).
2. Ciascuna sezione è stata divisa a metà, pesata, sminuzzata e incubata in soluzione fisiologica sterile per 24h in agitazione a RT.
3. Per ciascun campione sono stati fatti spot da 5  $\mu L$  su KB nitro50 per verificare la presenza o meno di *Psn23* (analisi microbiologica).



# Analisi attività *in planta* contro Psn23

	Numero tumori														
	Ramo inoculato 1					Ramo non inoculato 3					Ramo non inoculato 4				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Controllo positivo		T	T		T		/	T		T		/	/		/
WV 1:250 + Psn23		T	T		T		/	/		/		/	/		/
WV 1:500 + Psn23		T	T		PT		/	/		/		/	T		/
WV 1:100 + Psn23		T	T		PT		/	/		/		/	/		/
Estratto castagno 1:10 + Psn23	T	T	T	T	T	/	T	T	PT	/	/	/	/	/	/
Estratto castagno 1:50 + Psn23	T	T	T	T	T	/	T	T	/	/	/	T	/	/	/
Estratto castagno 1:100 + Psn23	T	T	T	C	T	/	/	T	/ *	/	/	/	/	/	/
Estratto castagno 1:500 + Psn23	T	T	T	T	T	/	/	/	/	/	PT/PC	/	/	/	/
NB 1:250 + Psn23		T	T		T		/	/		/		/	/		/
NB 1:500 + Psn23		T	T		T		/	/		/		/	/		/
NB 1:100 + Psn23		T	T		T		/	/		/		/	/		/

	Ramo inoculato 2					Ramo non inoculato 5					Ramo non inoculato 6				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Controllo positivo		T	T		PT		/	/		T		/	/		/
WV 1:250 + Psn23		T	T		PC		/	/		PT		T	T		/
WV 1:500 + Psn23		PT	T		PT		/	/		/		/	/		/
WV 1:100 + Psn23		T	T		T		/	/		/		/	/		/
Estratto castagno 1:10 + Psn23	T	T	T	C		T	T	T	/		T	•	T	/	/
Estratto castagno 1:50 + Psn23	T	T	T	T	T	/	/	/	/	/	/	T	/	/	/
Estratto castagno 1:100 + Psn23	T	T	T	T	T	/	T	/	/	/	/	/	T	/	/
Estratto castagno 1:500 + Psn23	T	T	T	T	T	/	/	/	T	T	/	/	PT *	/	/
NB 1:250 + Psn23		C	T		T		/	/		/		/	/		/
NB 1:500 + Psn23		T	T		T		/	/		/		/	/		/
NB 1:100 + Psn23		T	T		T		/	/		/		/	/		/

T = tumore visibile  
 C = cancro visibile  
 PT/PC = possibile tumore/cancro  
 / = assenza sintomi

	Numero tumori											
	Ramo inoculato 1				Ramo non inoculato 3				Ramo non inoculato 4			
	1	2	3	4	1	2	3	4	1	2	3	4
Controllo positivo	T	T	T	T	/	/	/	/	/	/	/	/
WV 1:250 + Pan23	T	T	T	T	/	/	/	/	/	/	/	/
WV 1:500 + Pan23	T	T	PT	/	/	/	/	/	/	T	/	/
WV 1:100 + Pan23	T	T	PT	/	/	/	/	/	/	/	/	/
Estratto castagno 1:50 + Pan23	T	T	T	T	/	T	PT	/	/	/	/	/
Estratto castagno 1:50 + Pan23	T	T	T	T	/	T	/	/	/	/	/	/
Estratto castagno 1:50 + Pan23	T	T	C	/	/	T	**	/	/	/	/	/
Estratto castagno 1:500 + Pan23	T	T	T	T	/	/	/	/	PT/PC	/	/	/
MB 1:250 + Pan23	T	T	T	/	/	/	/	/	/	/	/	/
MB 1:500 + Pan23	T	T	T	/	/	/	/	/	/	/	/	/
MB 1:100 + Pan23	T	T	T	/	/	/	/	/	/	/	/	/

	Ramo inoculato 2				Ramo non inoculato 5				Ramo non inoculato 6			
	1	2	3	4	1	2	3	4	1	2	3	4
Controllo positivo	T	T	PT	/	/	/	/	/	/	/	/	/
WV 1:250 + Pan23	T	T	PC	/	/	/	PT	T	/	/	/	/
WV 1:500 + Pan23	PT	T	PT	/	/	/	/	/	/	/	/	/
WV 1:100 + Pan23	T	T	T	/	/	/	/	/	/	/	/	/
Estratto castagno 1:50 + Pan23	T	T	C	T	/	/	/	/	T	*	/	/
Estratto castagno 1:50 + Pan23	T	T	T	T	/	/	/	/	/	T	/	/
Estratto castagno 1:500 + Pan23	T	T	T	T	/	T	/	/	/	T	/	/
Estratto castagno 1:500 + Pan23	T	T	T	T	/	/	T	T	/	PT	/	/
MB 1:250 + Pan23	C	T	T	/	/	/	/	/	/	/	/	/
MB 1:500 + Pan23	T	T	T	/	/	/	/	/	/	/	/	/
MB 1:100 + Pan23	T	T	T	/	/	/	/	/	/	/	/	/

T = tumore visibile  
C = cancro visibile  
PT/PC = possibile tumore/cancro  
/ = assenza sintomi

## RESEARCH ARTICLE

# Global Analysis of Type Three Secretion System and Quorum Sensing Inhibition of *Pseudomonas savastanoi* by Polyphenols Extracts from Vegetable Residues

Carola Biancalani<sup>1</sup>, Matteo Cerboneschi<sup>1</sup>, Francesco Tadini-Buoninsegni<sup>2</sup>, Margherita Campo<sup>3</sup>, Arianna Scardigli<sup>4</sup>, Annalisa Romani<sup>4</sup>, Stefania Tegli<sup>1</sup>\*

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**Citation:** Biancalani C, Cerboneschi M, Tadini-Buoninsegni F, Campo M, Scardigli A, Romani A, et al. (2016) Global Analysis of Type Three Secretion System and Quorum Sensing Inhibition of *Pseudomonas savastanoi* by Polyphenols Extracts from Vegetable Residues. PLoS ONE 11(9): e0163357. doi:10.1371/journal.pone.0163357

Stefania Tegli  
Pistoia Nursery Camp - 11 aprile 2025



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E TECNOLOGIE AGRARIE,  
ALIMENTARI, AMBIENTALI E FORESTALI





## RESEARCH ARTICLE

Global Analysis of Type Three Secretion System and Quorum Sensing Inhibition of *Pseudomonas savastanoi* by Polyphenols Extracts from Vegetable ResiduesCarola Biancalani<sup>1\*</sup>, Matteo Carboneschi<sup>1\*</sup>, Francesco Taddei-Buoninsegni<sup>1\*</sup>, Margherita Campo<sup>2\*</sup>, Arianna Scardigli<sup>3\*</sup>, Annalisa Romani<sup>4\*</sup>, Stefania Tegli<sup>1,5\*</sup><sup>1</sup> Department of Agrifood Production and Environmental Sciences (DIPPA), Molecular Plant Pathology Laboratory, University of Florence, Via della Lastruccia 10, 50019 Sesto Fiorentino (Florence), Italy, <sup>2</sup> Department of Chemistry "Ugo Schiff", BioElectroLab, University of Florence, Via della Lastruccia 3, 50019 Sesto Fiorentino (Florence), Italy, <sup>3</sup> Consortium I.N.S.T.M., Via G. Galvani 9, 50121 Florence, Italy, <sup>4</sup> Department of Statistics, Computer Science Applications "G. Parenti" (DISA-PHYTOLAB (Pharmaceutical, Cosmetic, Food supplement Technology and Analysis), University of Florence, Via Ugo Schiff 6, 50019 Sesto Fiorentino (Florence), Italy\* These authors contributed equally to this work.  
\* These authors also contributed equally to this work.  
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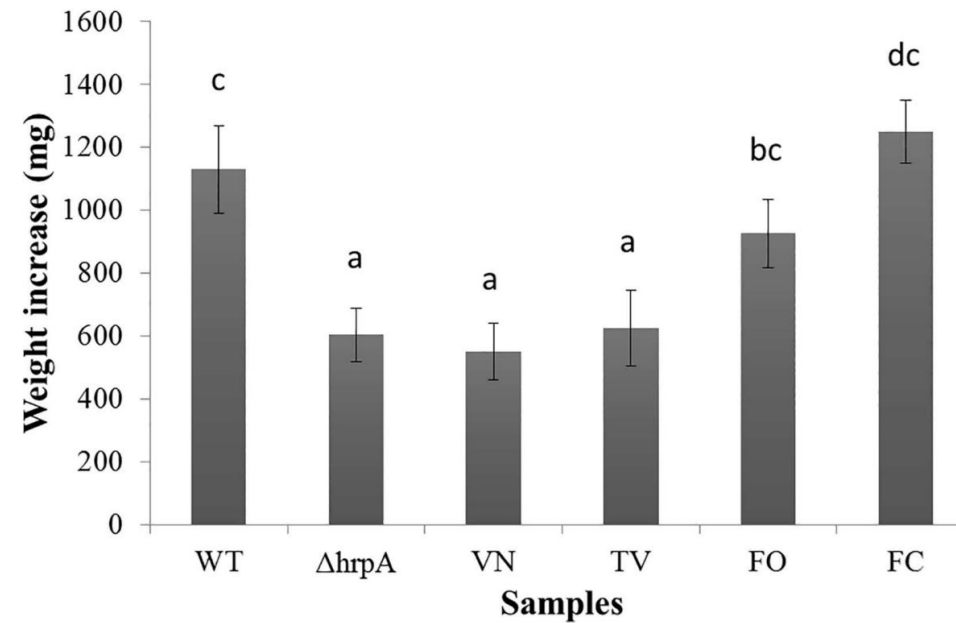
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Citation: Biancalani C, Carboneschi M, Taddei-Buoninsegni F, Campo M, Scardigli A, Romani A, et al. (2016) Global Analysis of Type Three Secretion System and Quorum Sensing Inhibition of *Pseudomonas savastanoi* by Polyphenols Extracts from Vegetable Residues. PLoS ONE 11(9): e0163357. doi:10.1371/journal.pone.0163357

A



B



**Fig 1. Pathogenicity test with *Psn23* on oleander explants, following treatment with polyphenolic extracts VN, TV, FO or FC.** Explants from adult oleander plants were inoculated with *P. savastanoi* pv. *nerii* strain *Psn23*, in the presence or absence of the VN, TV, FO or FC extracts (100  $\mu$ M). As negative control the non pathogenic mutant  $\Delta hrpA$  was used. (A) Development of hyperplastic knots at 21 dpi with (from left to right): *Psn23*,  $\Delta hrpA$ , *Psn23*+VN, *Psn23*+TV, *Psn23*+FO, *Psn23*+FC. The symptoms are detectable as swelling at the inoculated end of oleander explants. (B) Normalized weight increase of oleander explants at 21 dpi inoculated with (from left to right): *Psn23*,  $\Delta hrpA$ , *Psn23*+VN, *Psn23*+TV, *Psn23*+FO, *Psn23*+FC. Values are means  $\pm$  SD of nine replicates for each treatment. Different letters indicate significant differences among means at  $P < 0.05$ , according to Tukey's test.

doi:10.1371/journal.pone.0163357.g001

# Go back to lab!



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Stefania Tegli  
Pistoia Nursery Camp - 11 aprile 2025





# Attività antimicrobica?

*Curtobacterium flaccumfaciens* pv. *flaccumfaciens*

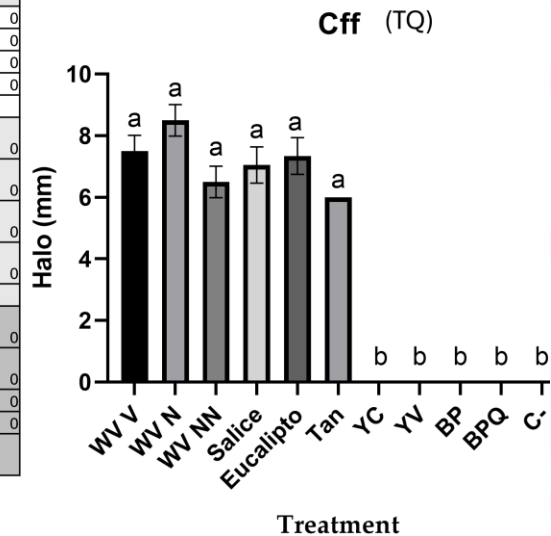
Saggio microbiologico in capsula Petri in LB (valutazioni dopo 4 giorni dall'inoculo)



*Curtobacterium flaccumfaciens* pv. *flaccumfaciens*

Saggio microbiologico in capsula Petri

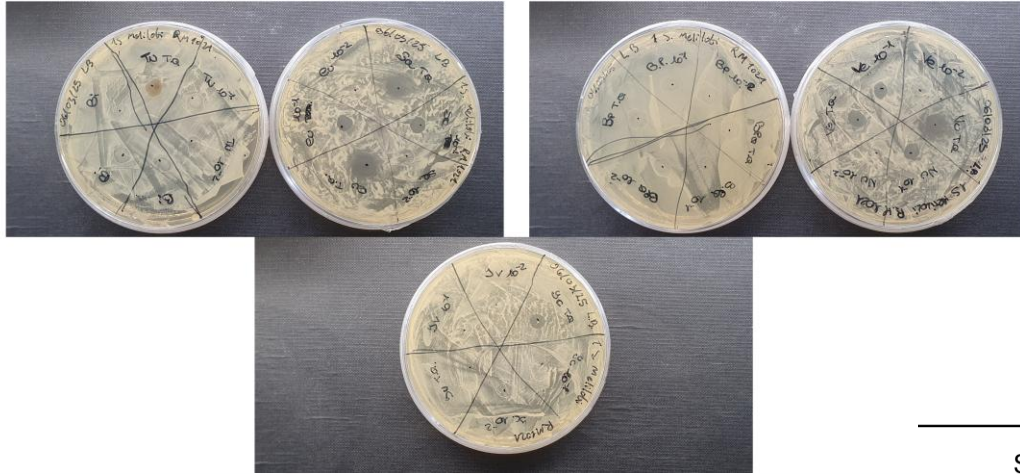
	WV V	WV N	WV NN	Salice	Eucalipto	Tan	YC	YV	BP	BPQ	C-
TQ	7	8	6	8	8	6	0	0	0	0	0
	8	9	7	6.5	8	6	0	0	0	0	0
	8	8	6	7	7.2	6	0	0	0	0	0
	7	9	7	6.7	6.5	6	0	0	0	0	0
					7						
10EXP-1	0	5	0	5 (opachi)	4 (opachi)	0	0	0	0	0	0
	0	5	0	5 (opachi)	4 (opachi)	0	0	0	0	0	0
	0	6	0	5 (opachi)	4.5 (opachi)	0	0	0	0	0	0
	0	4	0	5 (opachi)	5.2 (opachi)	0	0	0	0	0	0
					54.5 (opachi)						
10EXP-2	0	0	0	5 (opachi)	4 (opachi)	0	0	0	0	0	0
	0	0	0	5 (opachi)	4 (opachi)	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
				4 (opachi)	5 (opachi)						



# Attività antimicrobica?

*Sinorhizobium meliloti*

Saggio microbiologico in capsula Petri in LB (valutazioni dopo 4 giorni dall'inoculo)

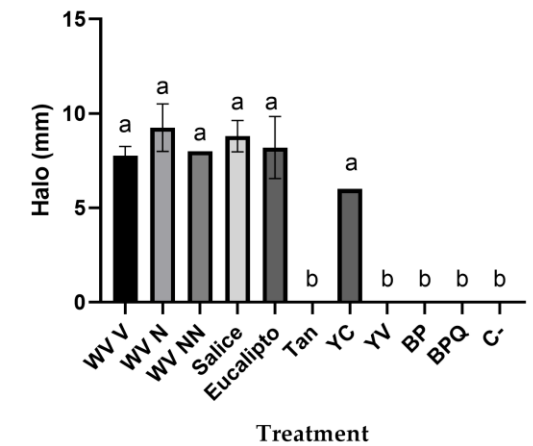


*Sinorhizobium meliloti*

Saggio microbiologico in capsula Petri

	WV V	WV N	WV NN	Salice	Eucalipto	Tan	YC	YV	BP	BPQ	C-
TQ	8	11	8	9	10	0	6	0	0	0	0
	8	8	8	9	9	0	6	0	0	0	0
	8	9	8	8	6						
	7	9	8	10	9						
				8	7						
				7	9						
10EXP-1	7	8	5	6	7	0	0	0	0	0	0
	6	6	4	6	5	0	0	0	0	0	0
	7	7	4	6	5						
	6	7	5	7	7						
				5	6						
				6	5						
10EXP-2	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0						
	0	0	0	0	0						
	0	0	0	0	0						

*S. meliloti* (TQ)



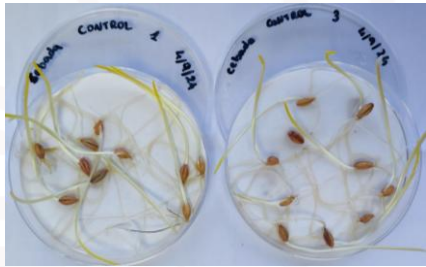


# Attività fitotossica? Erbicida?

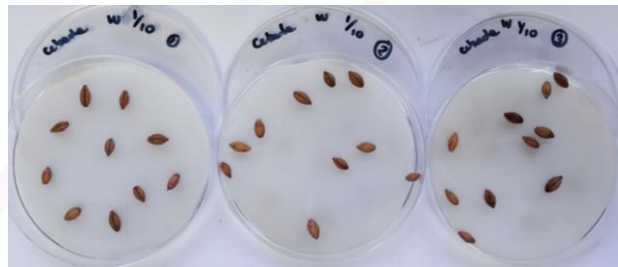
On Barley - Treatments:  
1:10, 1:50, 1:100 and 1:500 dilutions

## Treatment dilution 1:10

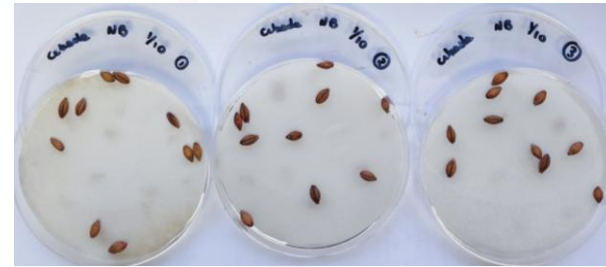
Control



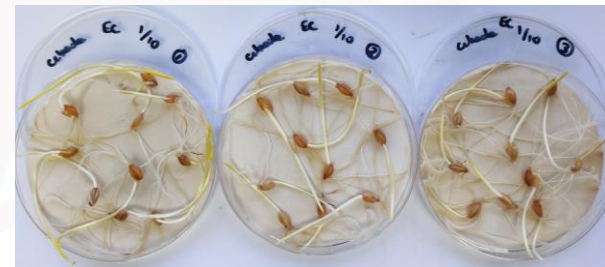
Wood Vinegar Biodea



Wood Vinegar Nerabiochar



Woodchips Extract

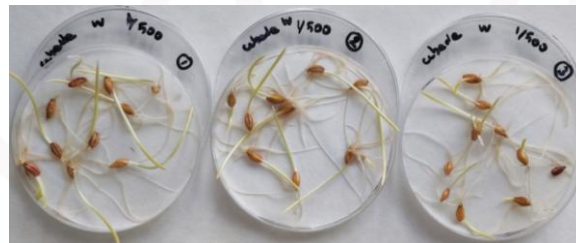


## Treatment dilution 1:500

Control



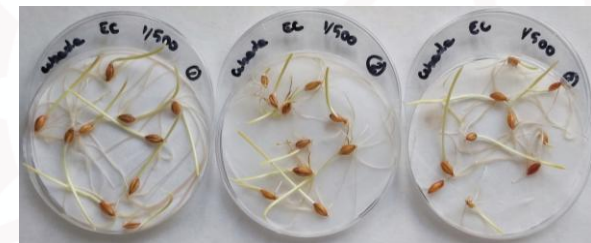
Wood Vinegar Biodea



Wood Vinegar Nerabiochar



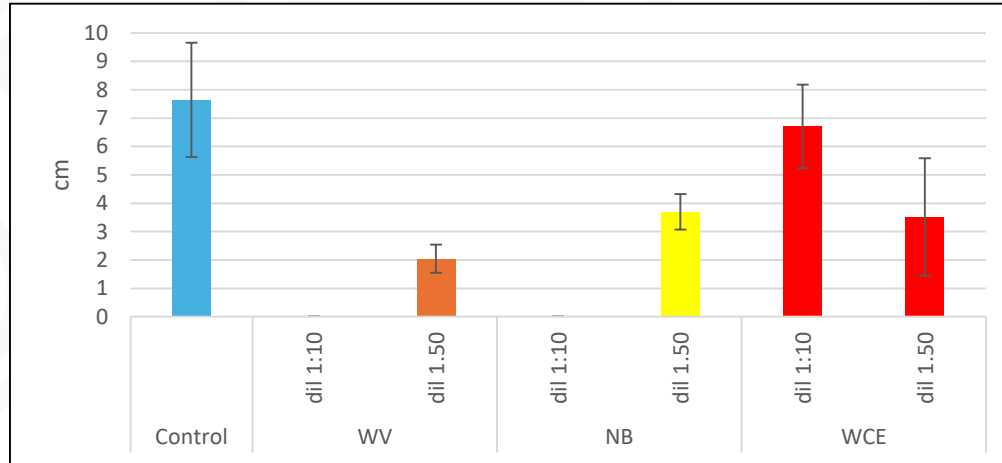
Woodchips Extract



nia  
amp

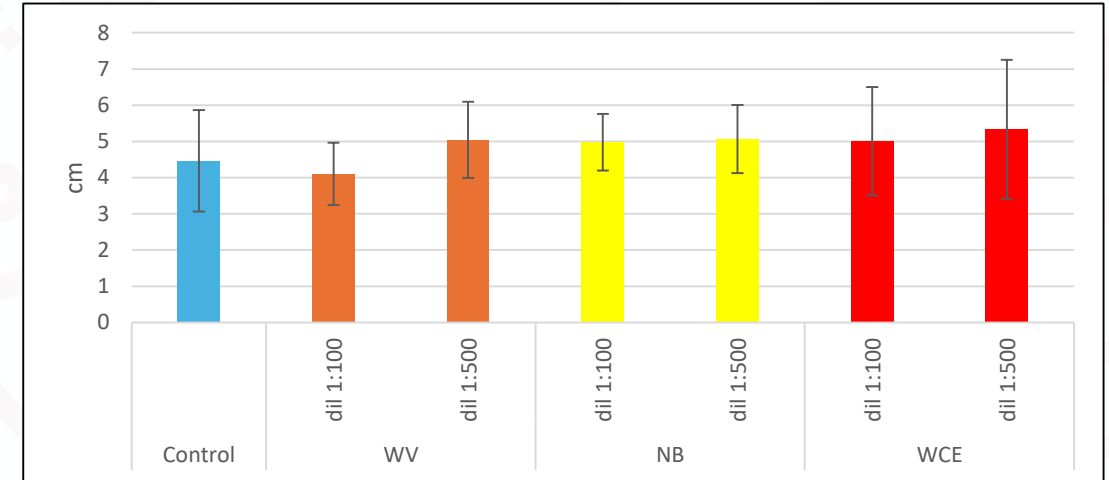
# Attività fitotossica? Erbicida?

Concentrazione 1:10 and 1:50

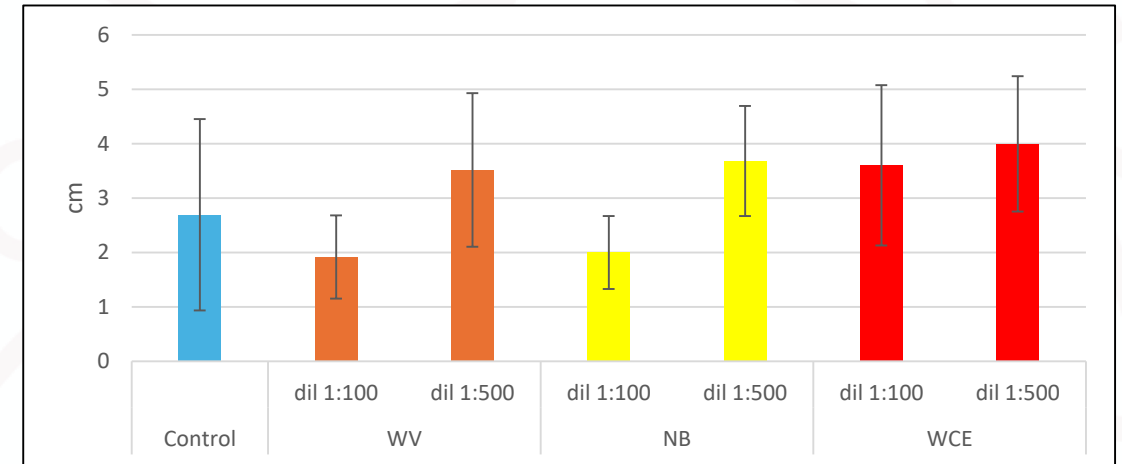
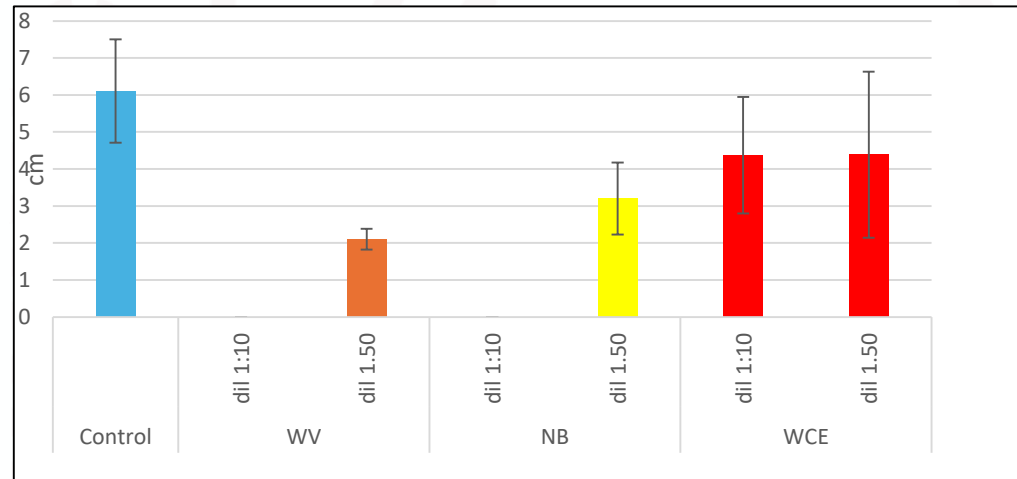


Ipocotile

Concentrazione 1:100 and 1:500

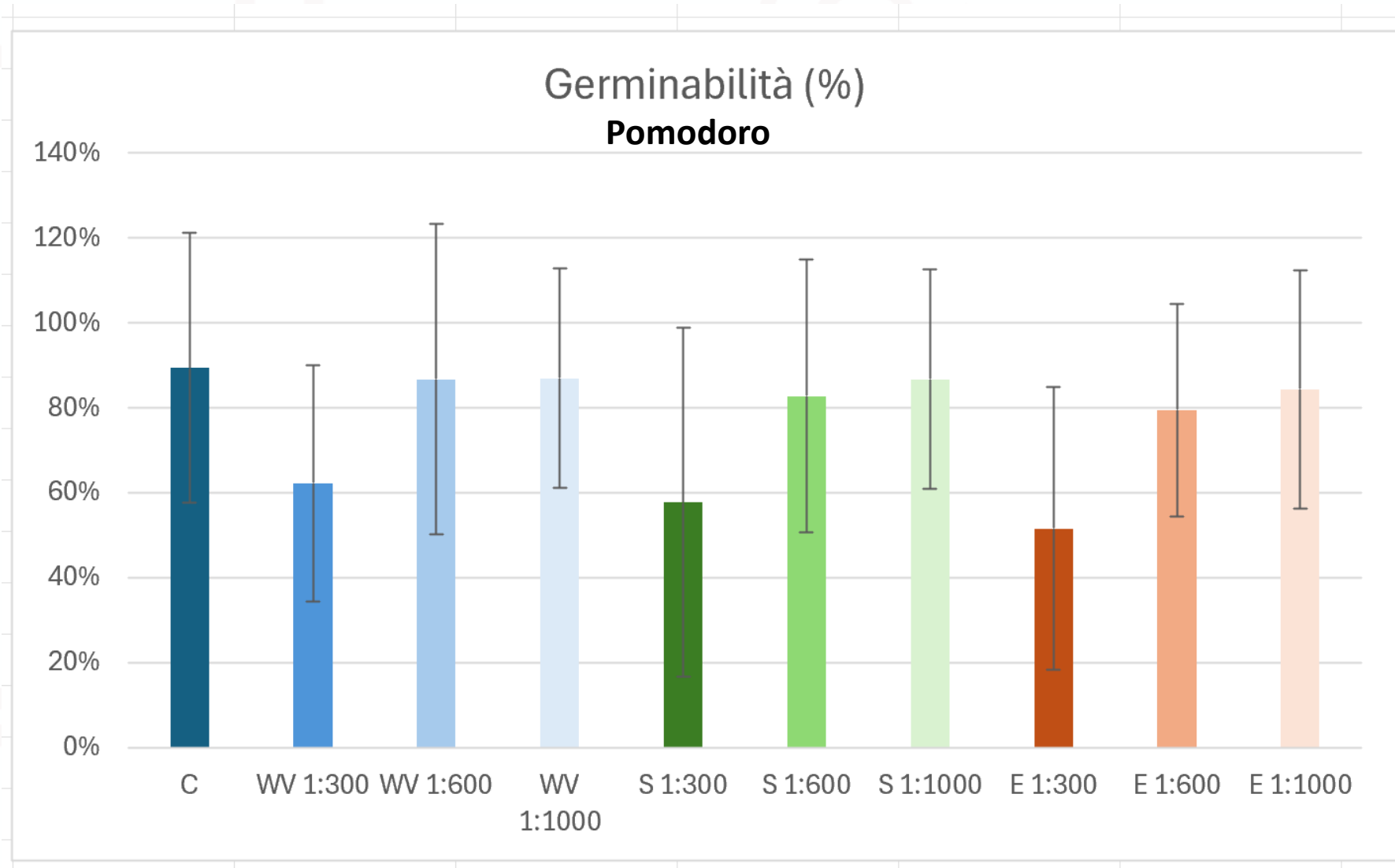


Epicotile

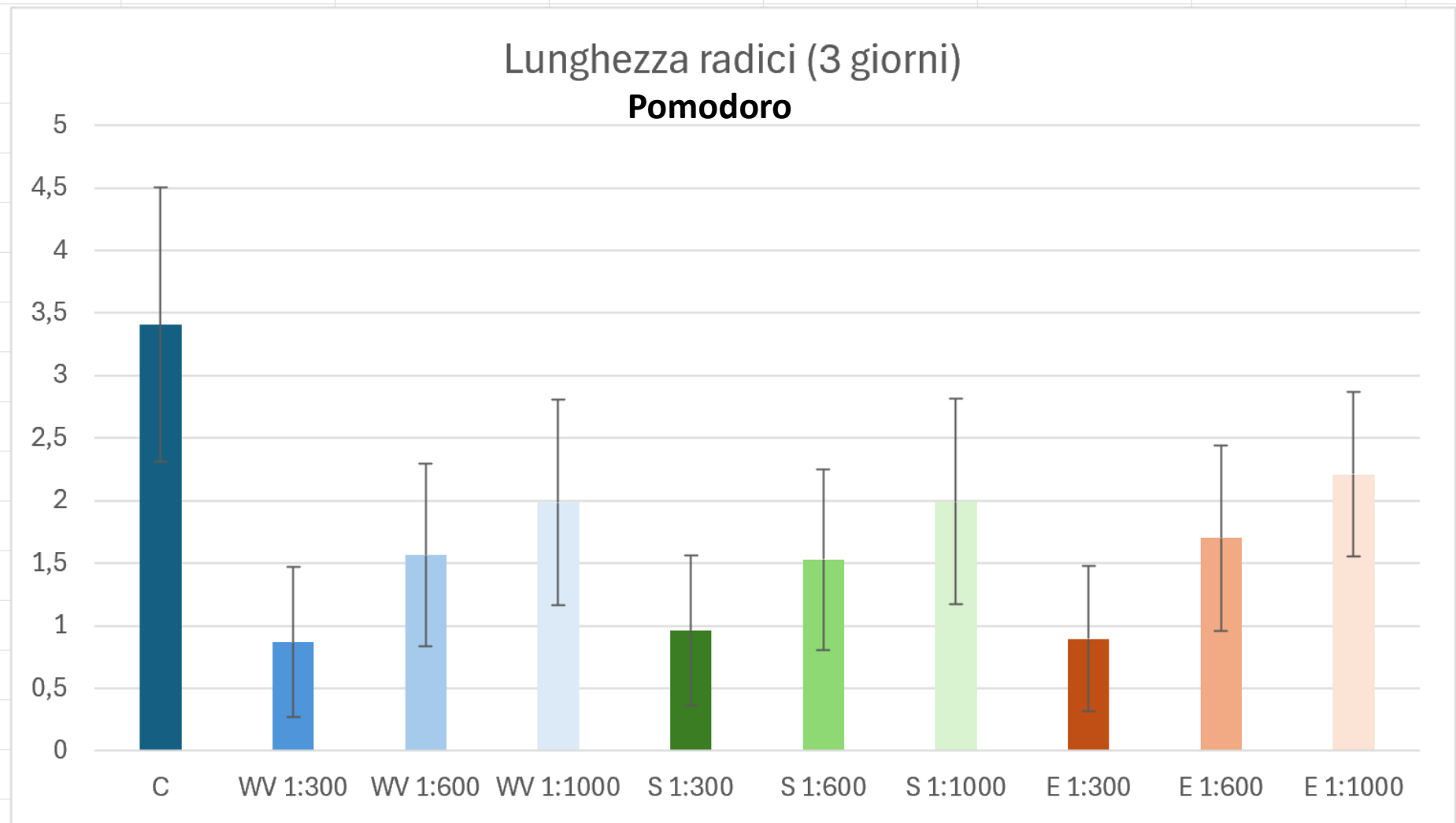




# Attività fitotossica? Erbicida?

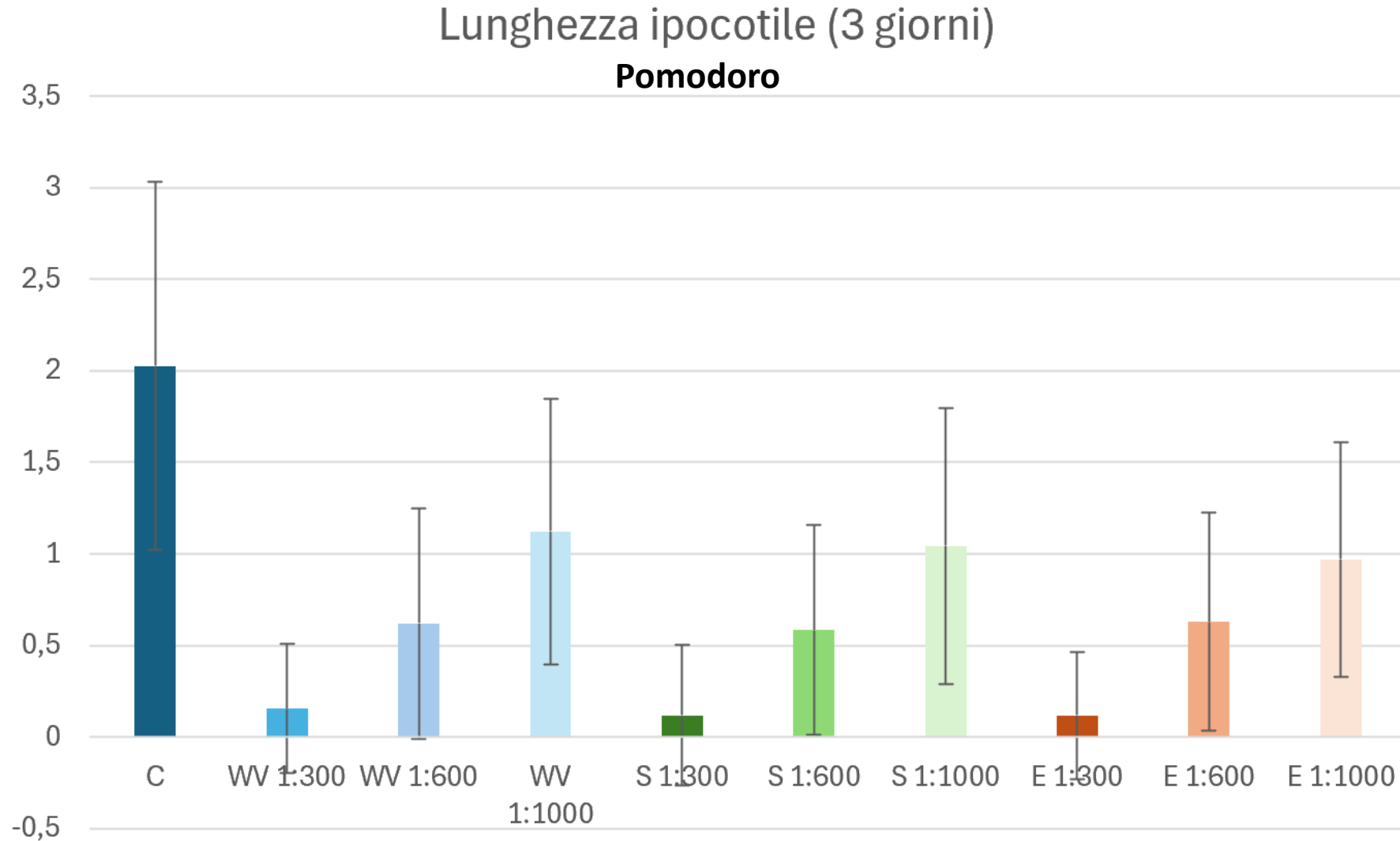


# Attività fitotossica? Erbicida?



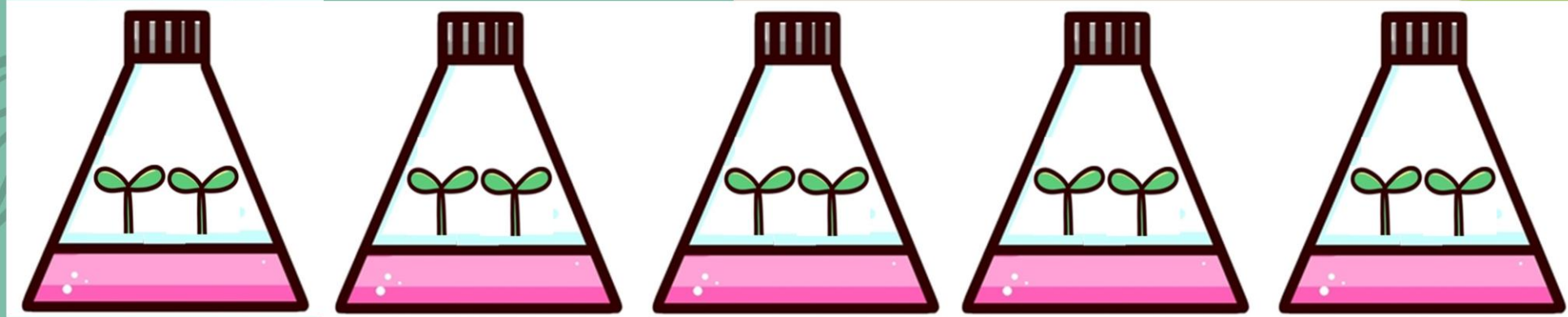


# Attività fitotossica? Erbicida?



# Attività fitotossica? Erbicida?

Test *in vitro*



Controllo

Ecc 1:10

Ecc 1:100

Ecc 1:1.000

Ecc 1:10.000



Estratto  
di cippato  
di castagno

Tabacco var. Burley white  
(*Nicotiana tabacum*)  
2 piante per Magenta



# Attività fitotossica? Erbicida?

30 days post treatment



Controllo

Ecc 1:10

Ecc 1:100

Ecc 1:1.000

Ecc 1:10.000



Estratto  
di cippato  
di castagno

# Attività biostimolante? Corroborante?

Esperimenti su lattuga con stress idrico e salino



Control stress idrico



Estratto castagno 1:100 stress idrico

Stress idrico

Stress salino



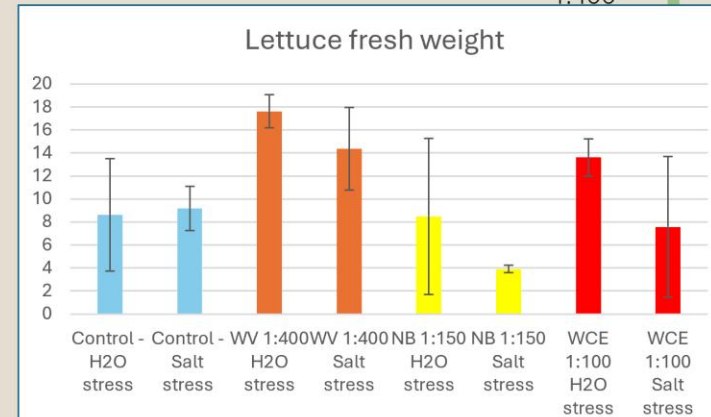
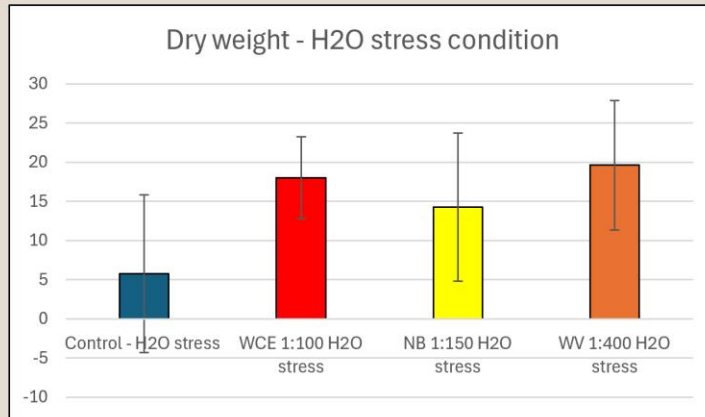
Control Fert

Agri Algae

WV Biodea 1:400

Woodchips Extract 1:100

WV Nerabiochar 1:150

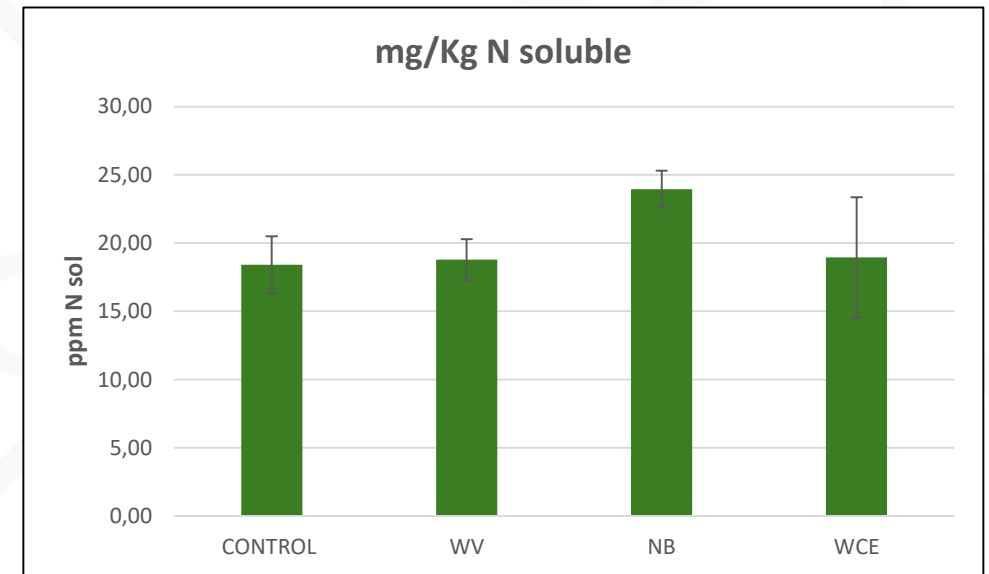
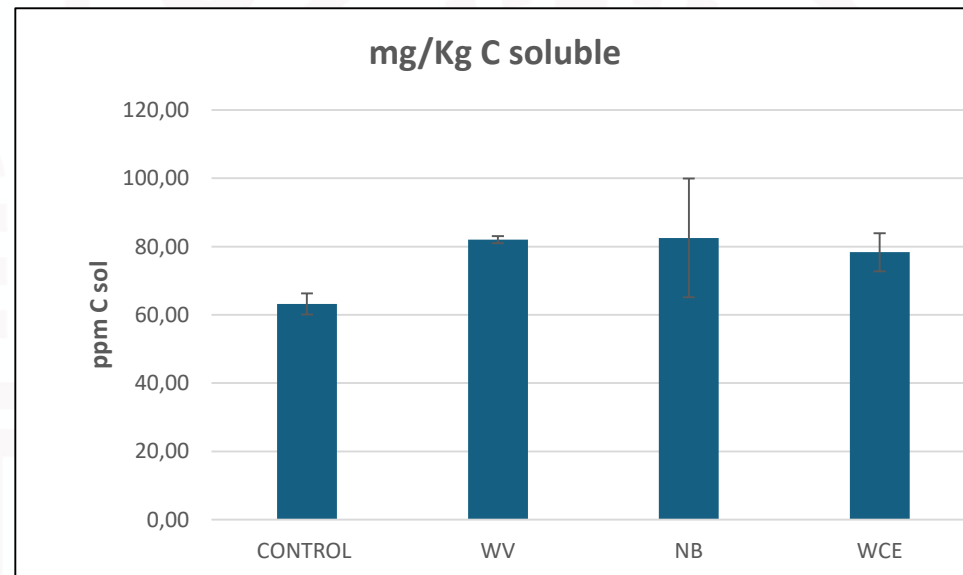
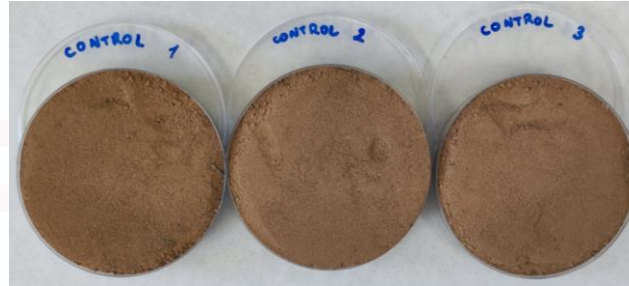




# E cosa accade al suolo?

Treatments:

- WV 1:25
- NB 1:25
- WCE 1:10



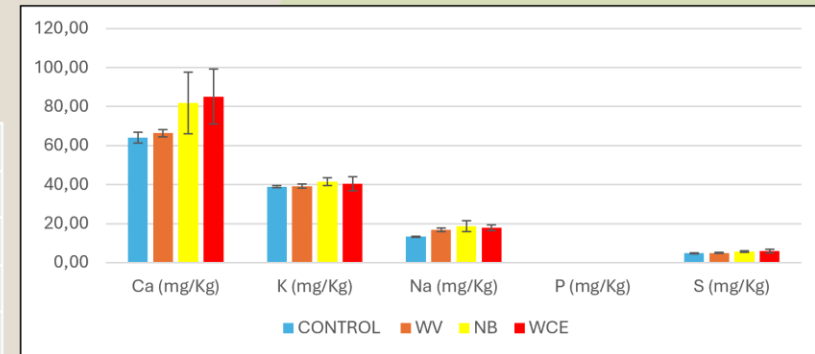


# E cosa accade al suolo?

## Analisi elementi solubili nel suolo

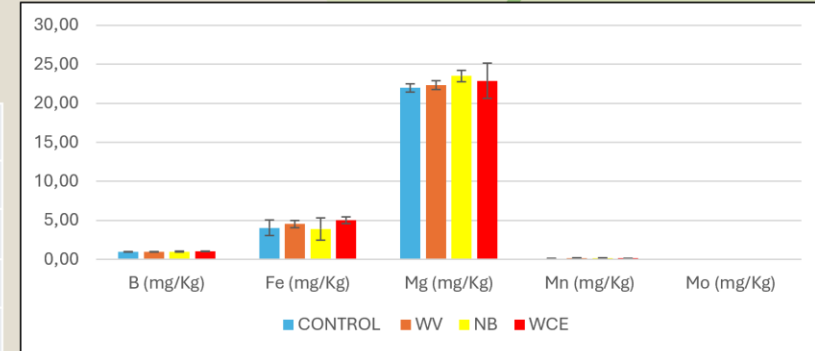
### Macronutrienti

Treatments	Ca (mg/L)	Desv	K (mg/L)	Desv	Na (mg/L)	Desv	P (mg/L)	Desv	S (mg/L)	Desv
CONTROL	64,04	2,88	38,89	0,54	13,29	0,24	<0,01	/	4,79	0,35
WV	66,31	1,92	39,23	0,98	16,85	0,85	<0,01	/	4,96	0,22
NB	81,83	15,80	41,55	1,92	18,64	2,69	<0,01	/	5,71	0,32
WCE	85,07	13,99	40,39	3,59	17,91	1,55	<0,01	/	5,91	1,00



### Micronutrienti

Treatments	B (mg/L)	Desv	Fe (mg/L)	Desv	Mg (mg/L)	Desv	Mn (mg/L)	Desv	Mo (mg/L)	Desv
CONTROL	0,99	0,01	4,04	1,00	21,99	0,52	0,13	0,01	<0,01	/
WV	1,01	0,02	4,54	0,47	22,31	0,56	0,19	0,02	<0,01	/
NB	1,00	0,06	3,90	1,42	23,52	0,73	0,17	0,03	<0,01	/
WCE	1,02	0,03	5,04	0,45	22,89	2,26	0,16	0,02	<0,01	/

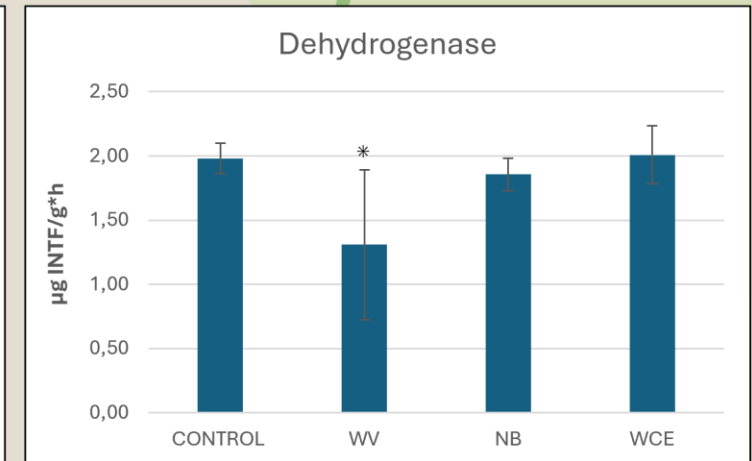
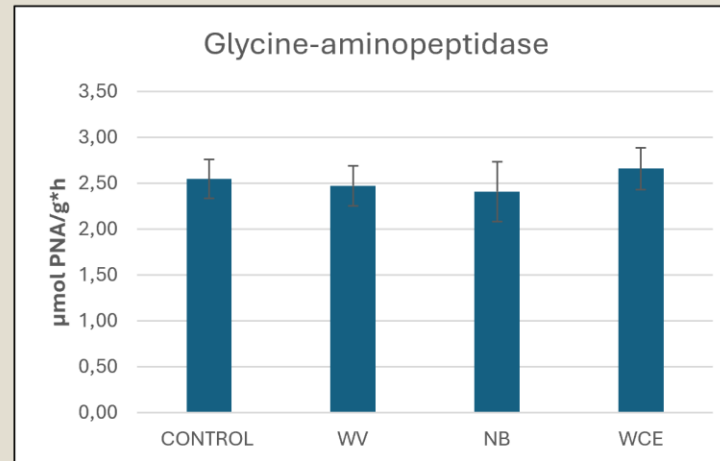
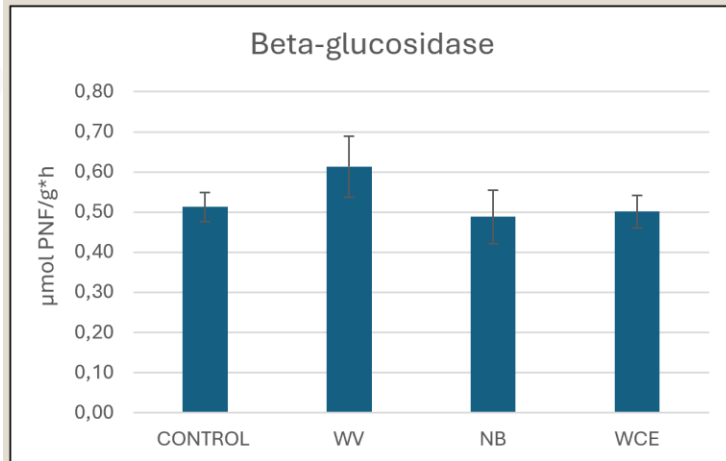
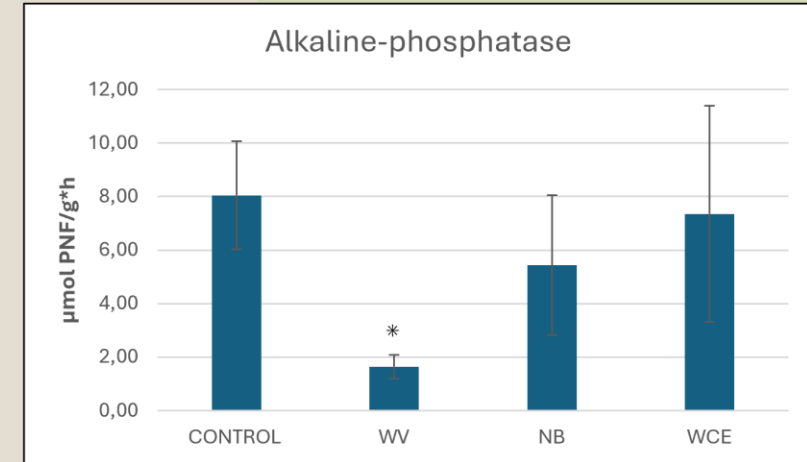
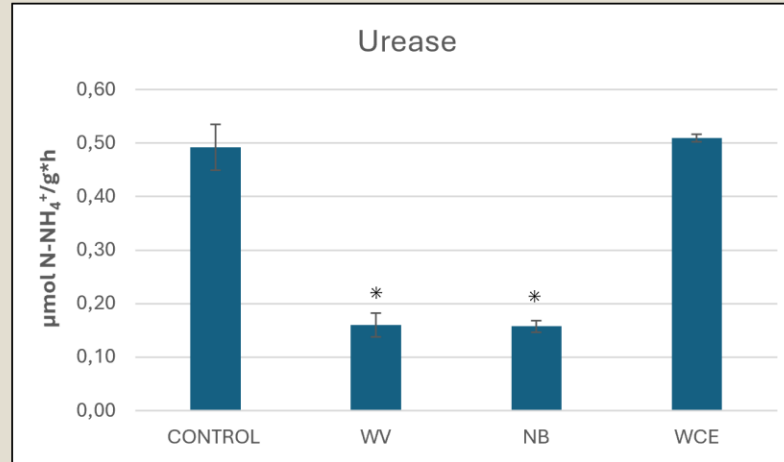


### Metalli pesanti

Treatments	As (mg/L)	Desv	Cd (mg/L)	Desv	Cr (mg/L)	Desv	Cu (mg/L)	Desv	Ni (mg/L)	Desv	Pb (mg/L)	Desv	Zn (mg/L)	Desv
CONTROL	<0,01	/	<0,01	/	<0,01	/	<0,01	/	<0,01	/	<0,01	/	<0,01	/
WV	<0,01	/	<0,01	/	<0,01	/	0,05	0,00	<0,01	/	<0,01	/	<0,01	/
NB	<0,01	/	<0,01	/	<0,01	/	0,04	0,01	<0,01	/	<0,01	/	<0,01	/
WCE	<0,01	/	<0,01	/	<0,01	/	<0,01	/	<0,01	/	<0,01	/	<0,01	/

# E cosa accade al suolo?

Attività  
enzimatiche  
del suolo



# CONCLUSIONI...

- 1) **NO** attività antimicrobica (salvo tq/ no concentrazioni compatibili con trattamenti)
- 2) **SI/NO** attività fitotossica / erbicida / anti-germinazione  
**MA** specie-specifica
- 3) **SI** attività di «recovery» da stress idrico su peso secco pianta
- 4) **NO** attività di difesa da patogeni emibiotrofi
- 5) **NO** impatto negativo su vitalità» e attività enzimatiche del suolo



# Prospettive future...

- 1) Verifica attività antimicrobica «al bruno»
- 2) Verifica attività su fisiologia della pianta per trattamenti «al bruno»
- 2) Ottimizzazione attività fitotossica / erbicida / anti-germinazione con verifica della specie-specificità
- 3) Ottimizzazione in vivaio dell'uso per «recovery» da stress idrico e stress...?
- 4) Verifica attività in vivaio su vitalità» e attività enzimatiche del suolo
- 5) Ottimizzazione trattamenti sinergici con O3



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Regione Toscana



# GRAZIE per l'attenzione!

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Laboratorio di Patologia Vegetale Molecolare

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