Università di Napoli Federico II
Departimento di Agraria

Stato dell’arte sull’uso degli acidi nucleici nel biocontrollo

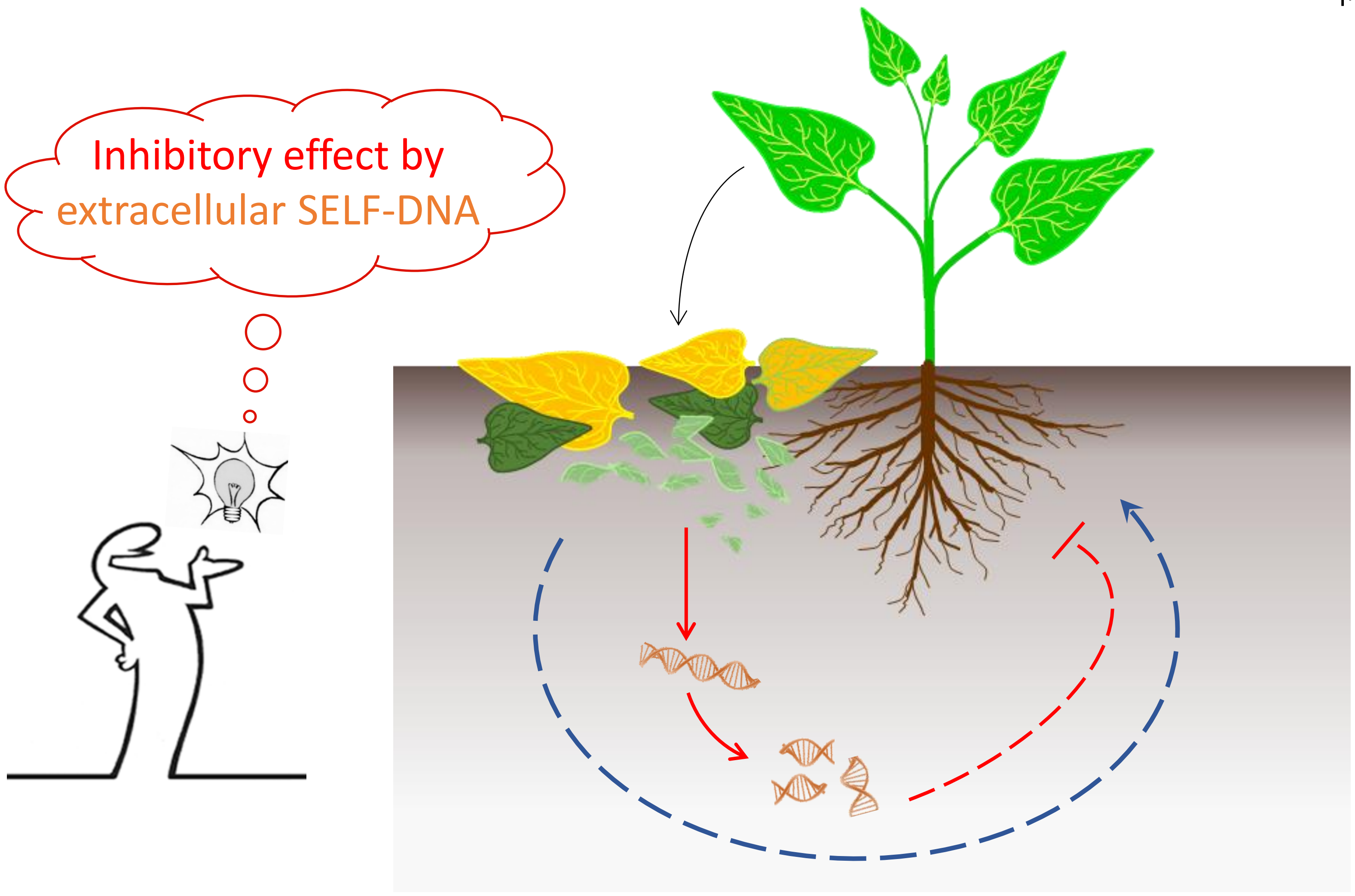
Prof. Stefano Mazzoleni

BIOCONTROL CONFERENCE

Napoli 28 Ottobre 2025

Decomposizione della sostanza organica: un processo chiave nel ciclo dei nutrienti

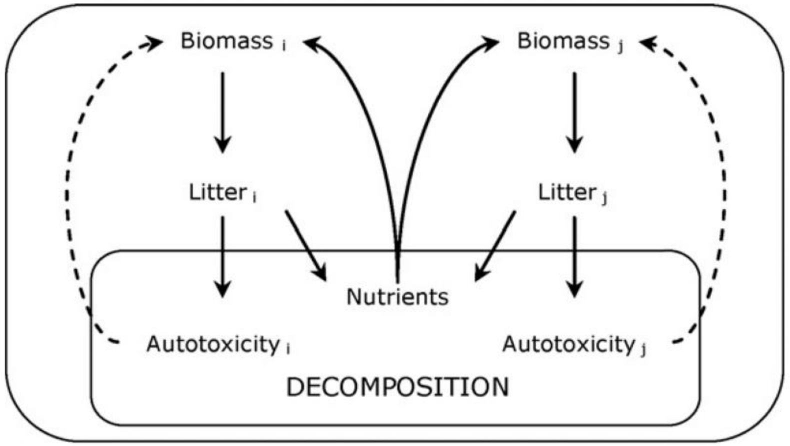
Model idea



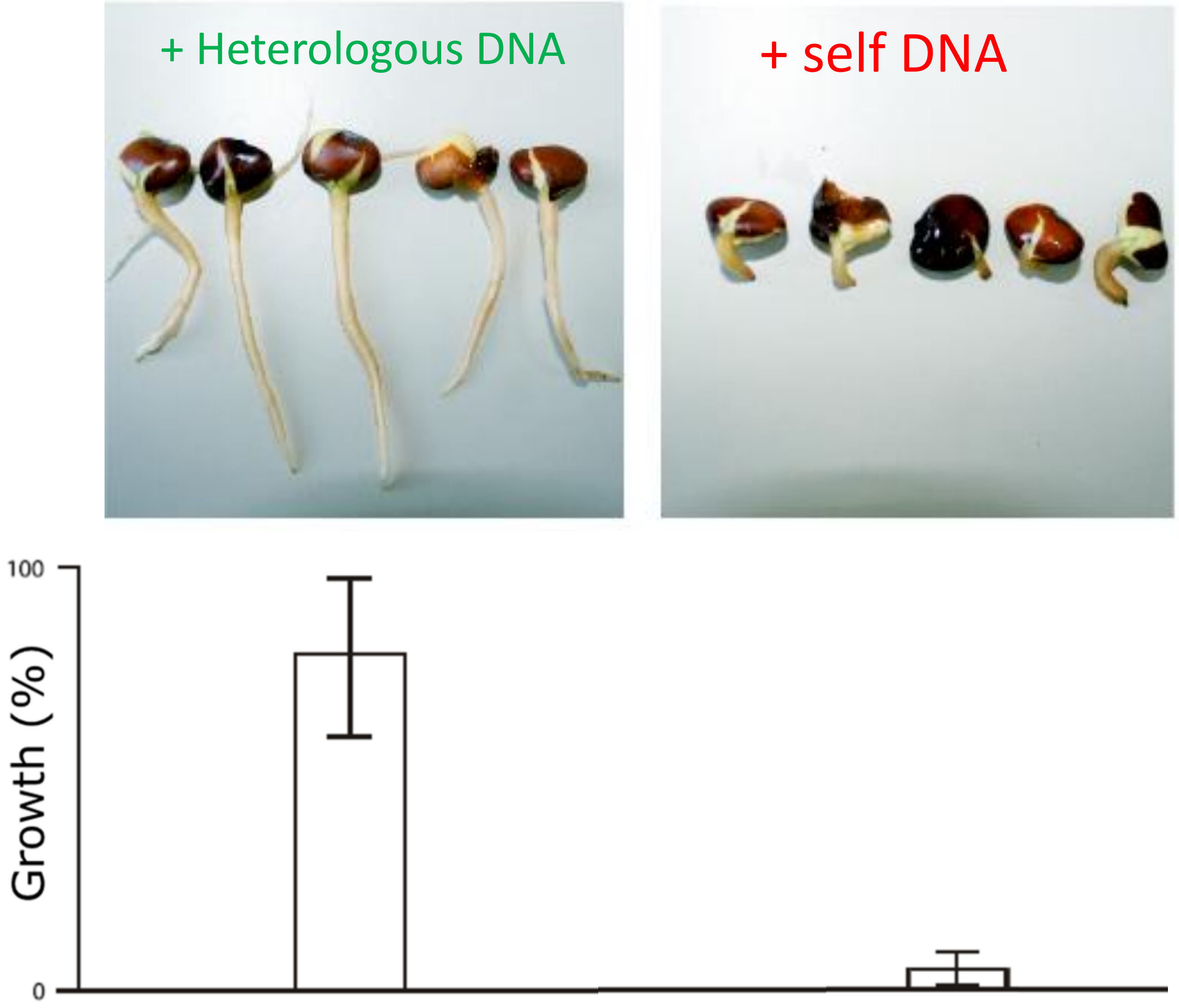
Nutrient cycling and organic matter decomposition

Modelling the effects of litter decomposition on tree diversity patterns

Mazzoleni et al. (2010) *Ecological Modelling*



Inibizione da self-DNA nelle piante: dimostrata in > 30 species

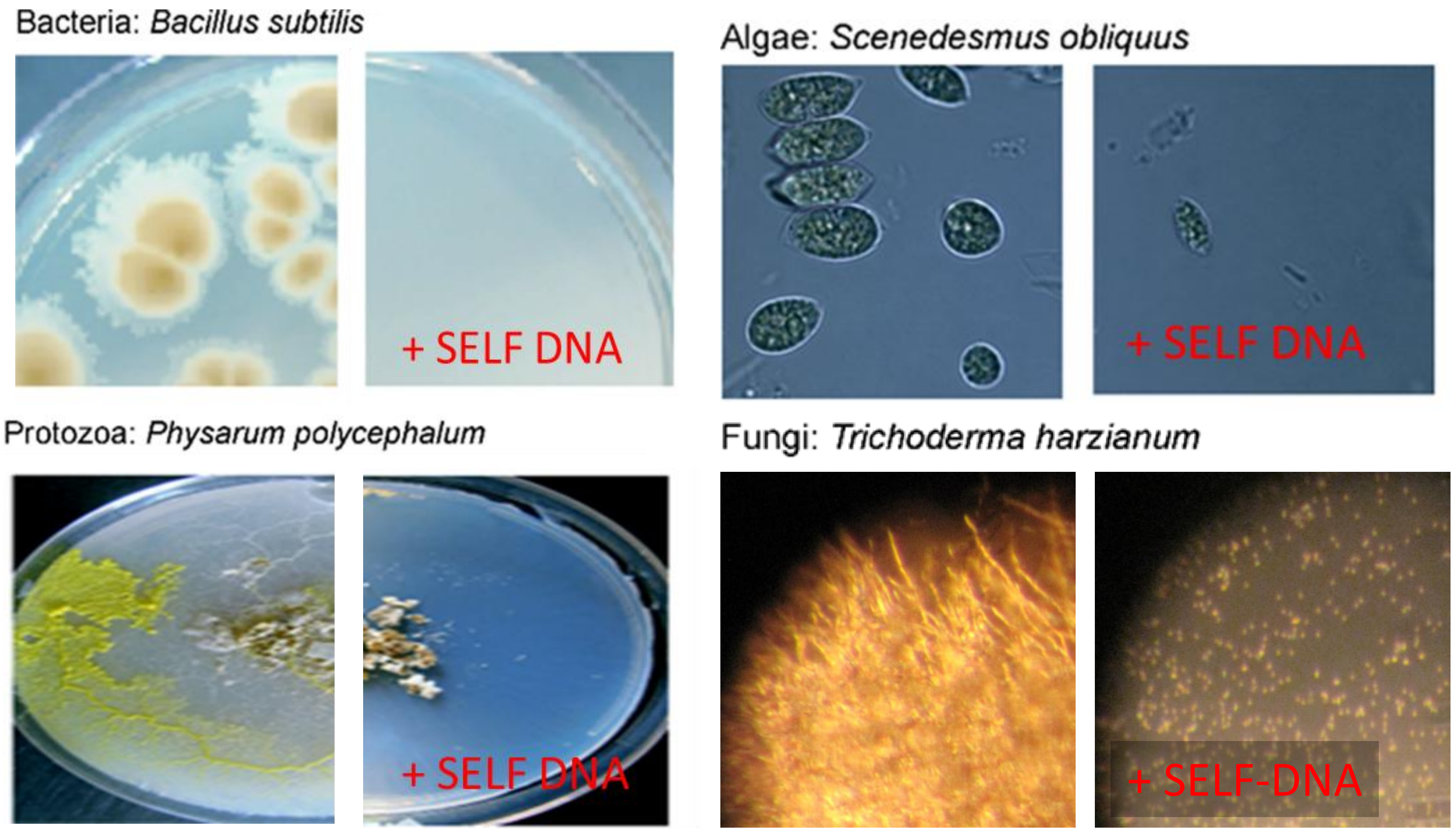


New Phytologist
Research

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

Mazzoleni et al. *New Phytologist 2015 a*

Effetto auto-inibitorio non solo per le piante: **é un fenomeno biologico generale!**



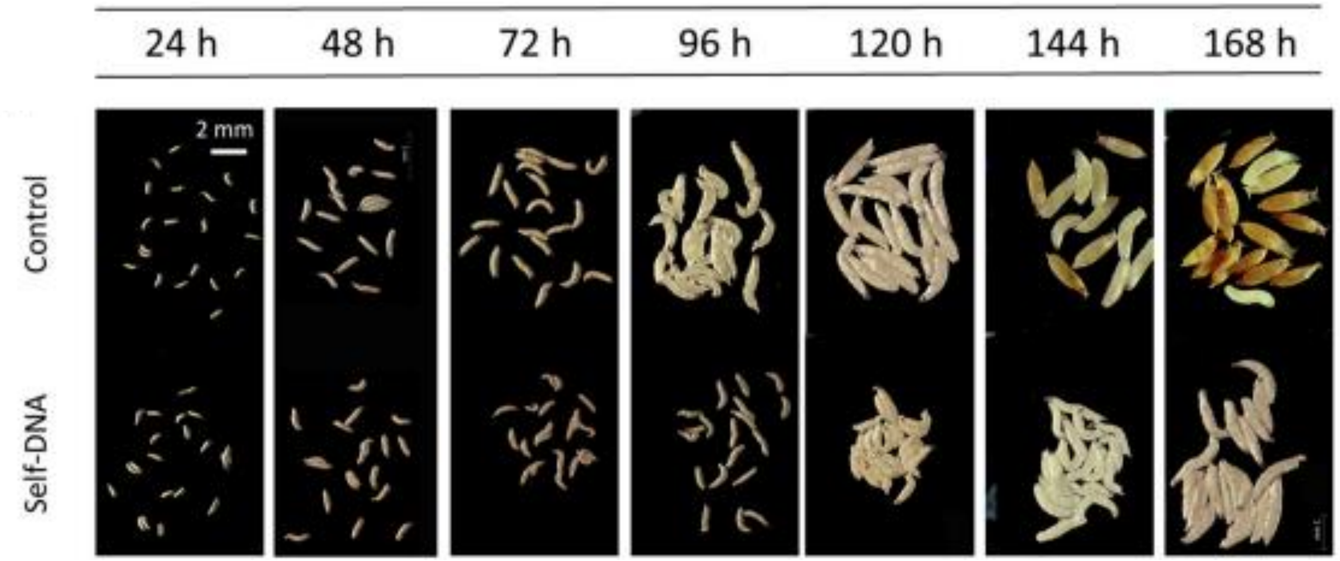
Mazzoleni et al. *New Phytologist 2015 b*

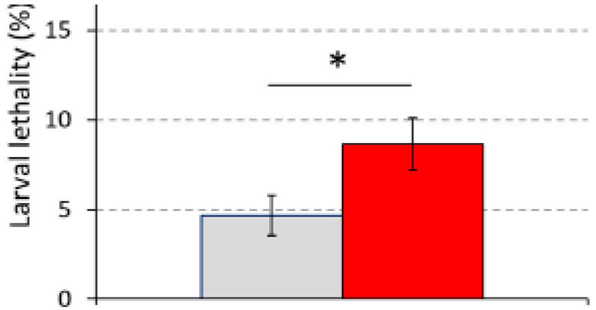
Experimental evidence: studies in model organisms

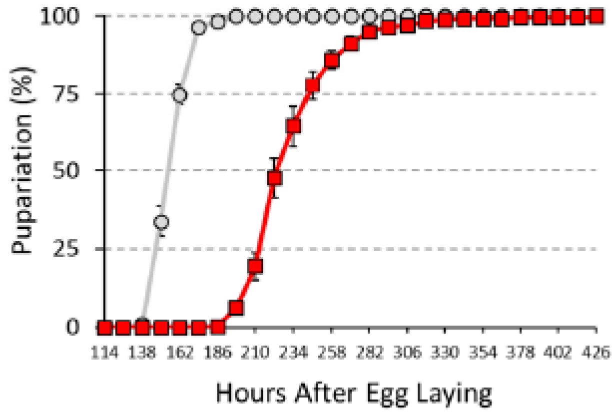
biology MDPI

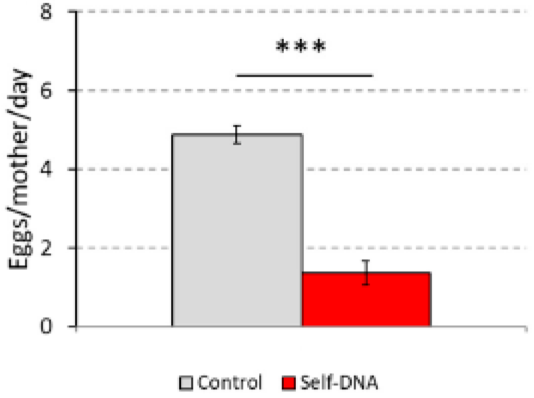
Article

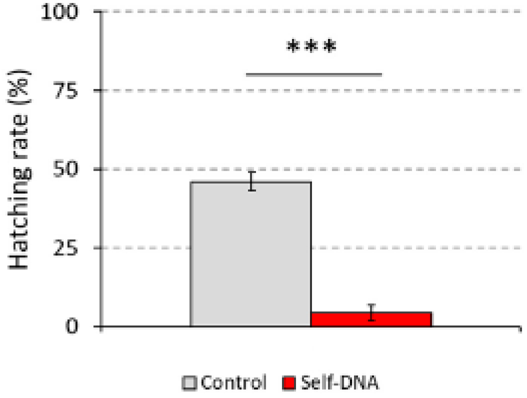
Self-DNA Inhibition in *Drosophila melanogaster* Development: Metabolomic Evidence of the Molecular Determinants









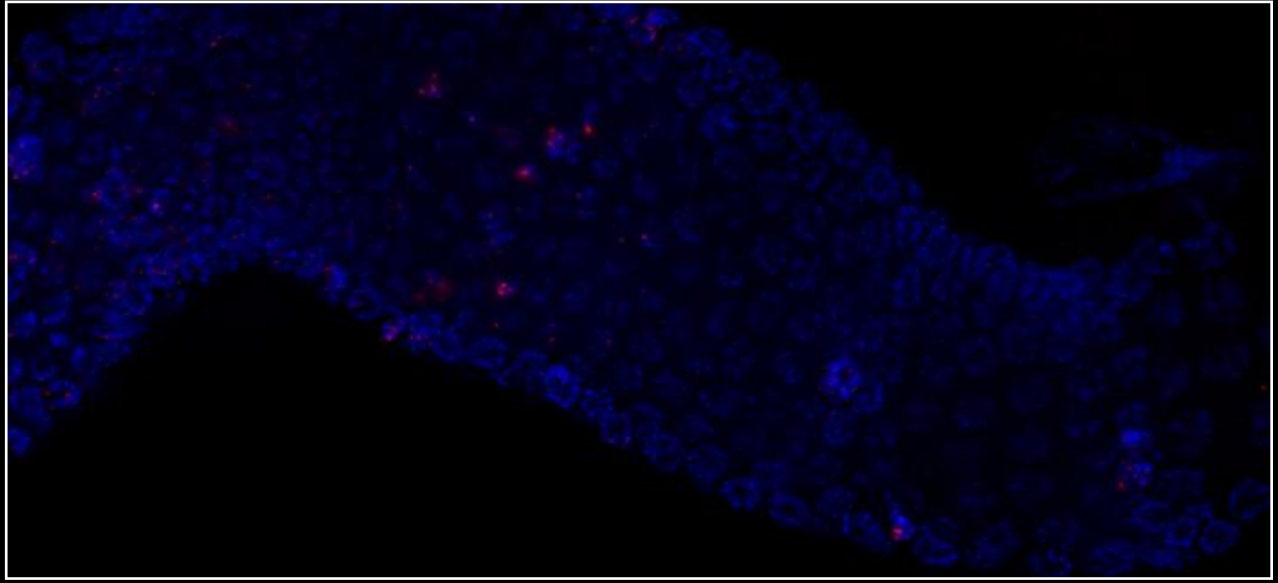


Experimental evidence: studies in model organisms

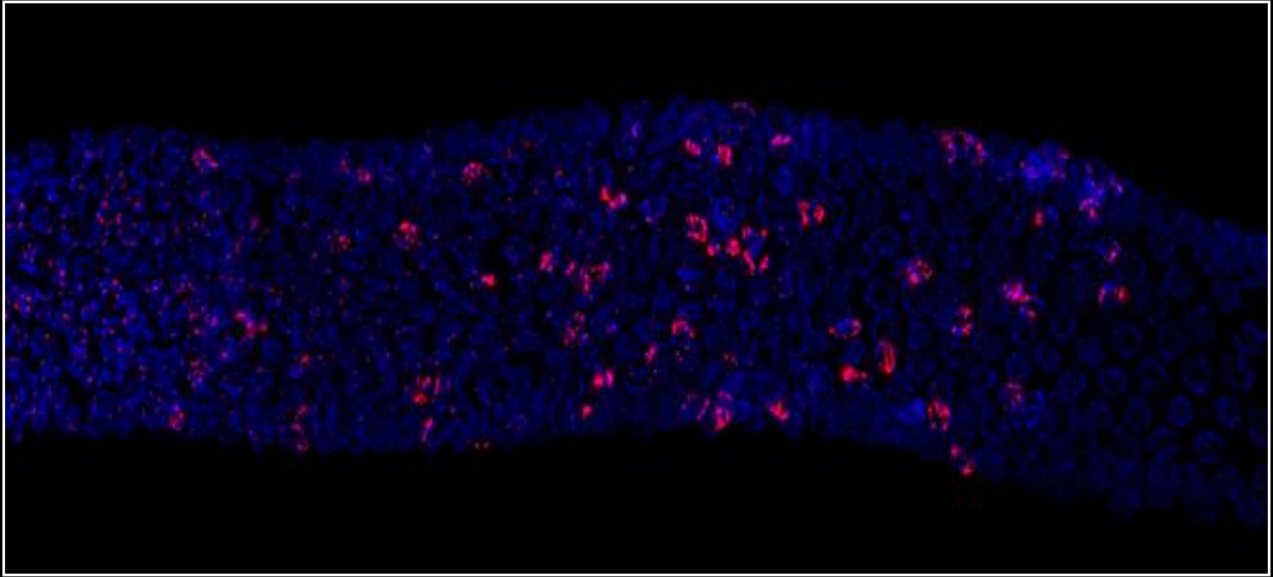

biology
MDPI
Article
Self-DNA Exposure Induces Developmental Defects and Germline DNA Damage Response in *Caenorhabditis elegans*

αRAD-51

nonself-DNA



self-DNA



Molecular mechanisms

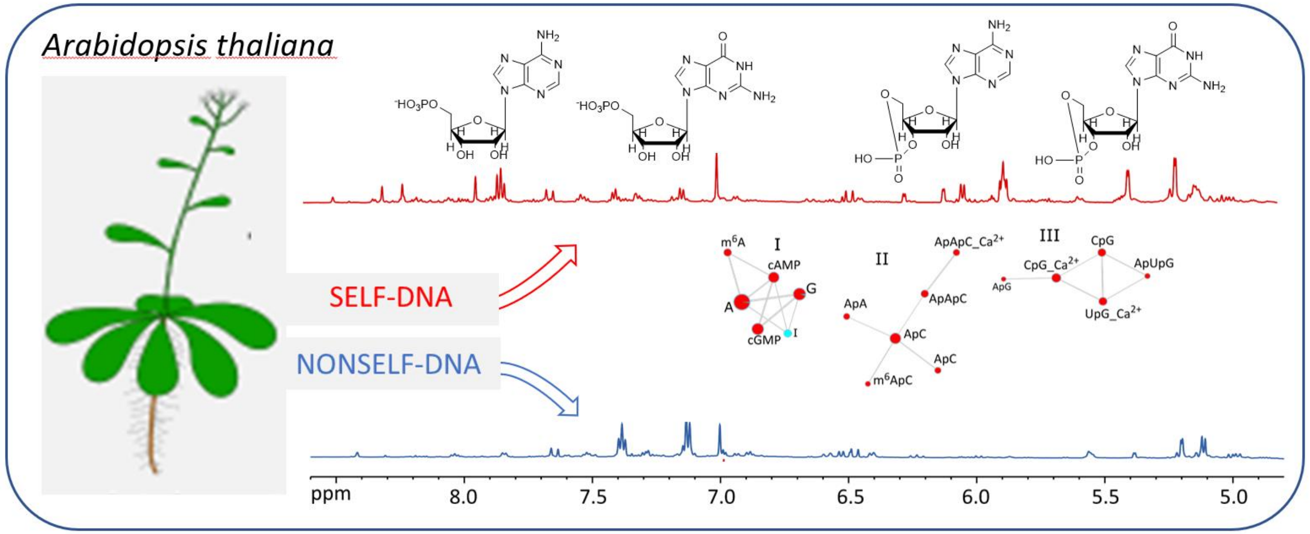
Contents lists available at ScienceDirect

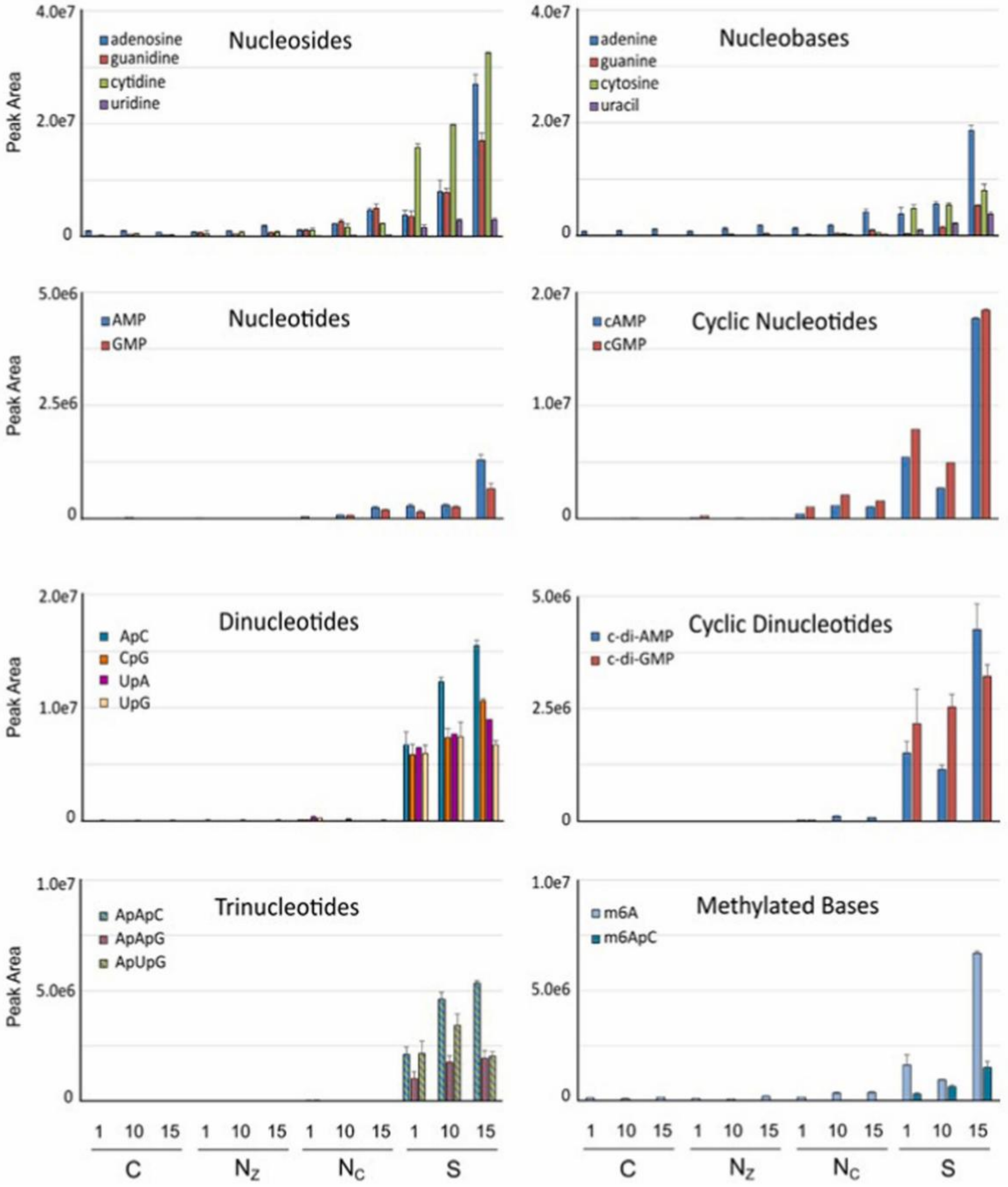
Phytochemistry

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

Metabolomics and molecular networking analyses in *Arabidopsis thaliana* show that extracellular self-DNA affects nucleoside/nucleotide cycles with accumulation of cAMP, cGMP and N6-methyl-AMP

Virginia Lanzotti[a,*], Laura Grauso[a], Alfonso Mangoni[b], Pasquale Termolino[c], Emanuela Palomba[c], Attilio Anzano[a], Guido Incerti[d], Stefano Mazzoleni[a,**]





Molecular mechanisms

epigenomes MDPI

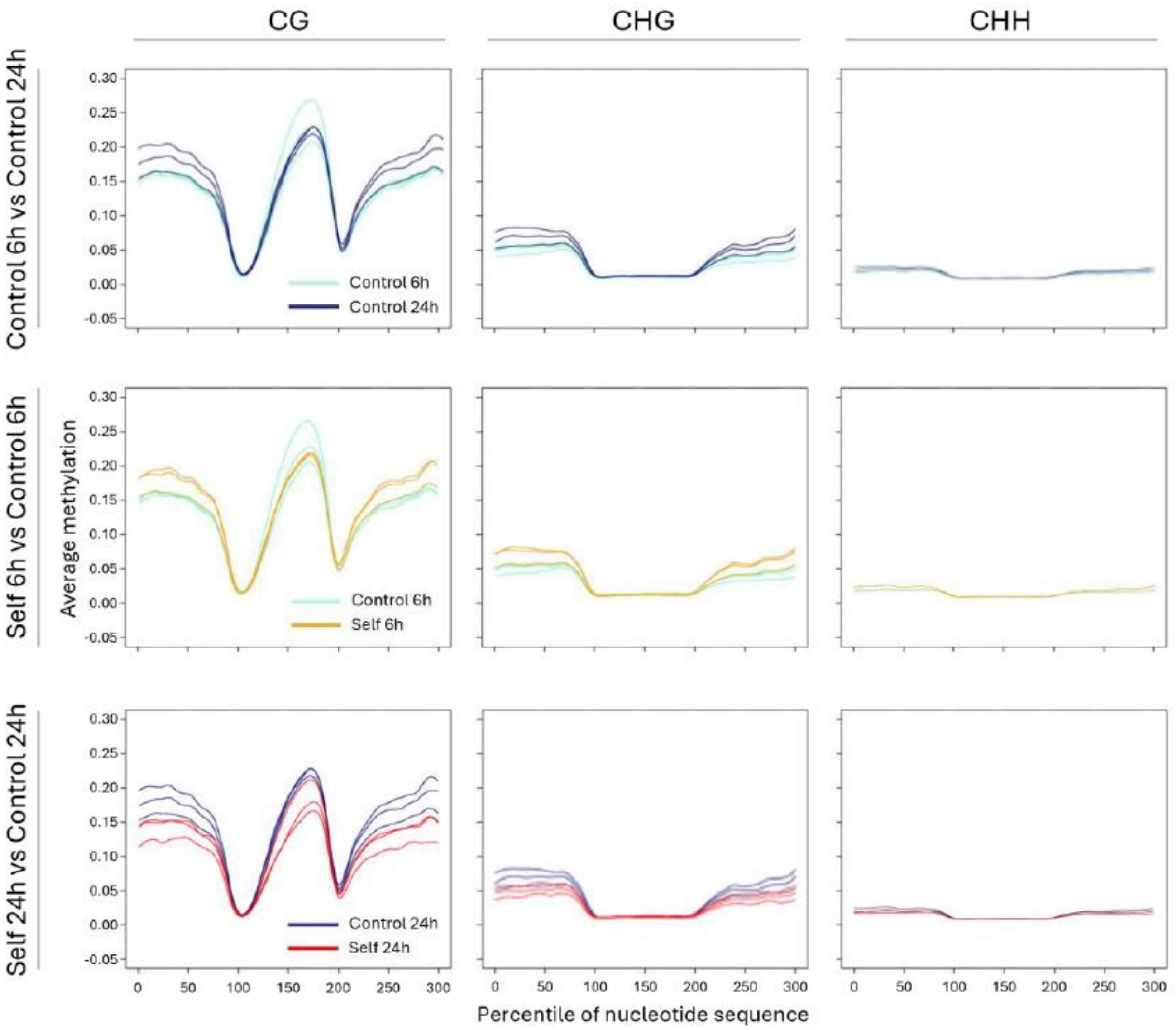
Article

Arabidopsis thaliana Roots Exposed to Extracellular Self-DNA: Evidence of Epigenetic Effects

Alessia Ronchi [1,2], Guido Incerti [1,*], Emanuele De Paoli [1], Speranza Claudia Panico [1], Giovanni Luca Sciabbarrasi [1], Pasquale Termolino [3], Fabrizio Carteni [4], Mariachiara Langella [4], Maria Luisa Chiusano [4] and Stefano Mazzoleni [4,*]

Epigenomes **2025**, *9*, 13

General description	GO term	6h		6-24h		24h	
		E	# DEGs	E	# DEGs	E	# DEGs
Response to stress	response to stimulus		33				55
	response to stress		26				37
	response to abiotic stimulus		20				
	response to chemical		18				
	response to heat		18		7		30
	extracellular region						23
	response to toxic substance						9
	detoxification						8
	cellular response to decreased oxygen levels		8		4		
Response to stress	response to stress		12				
	response to chemical		11				
	cellular response to chemical stimulus		9				
	cellular response to decreased oxygen levels		6				
	cellular response to extracellular stimulus						7
	cellular response to iron ion starvation						4
Transport	zinc ion transmembrane transport		2		2		18
	transition metal ion transmembrane transporter				2		11
	transmembrane transport						8
	inorganic ion transmembrane transport						7
	metal ion transport						6
Photosyntesis associated	plastid envelope						23
	thylakoid						18
	photosynthesis						14
	generation of precursor metabolites and energy						13
	photosynthesis, light reaction						11
	pigment biosynthetic process						6
	photosynthetic electron transport chain						5



Debate and supporting evidence by other teams

6th International Conference on Climate Change 2021 IOP Publishing
IOP Conf. Series: Earth and Environmental Science **824** (2021) 012026 doi:10.1088/1755-1315/824/1/012026

A Review: Is Cinderella's story of self-DNA extracellular effect towards plant growth real?

R Purnamasari[1], U Sudadi[2] and D A Santosa[2,3*]
[1]Soil Science Study Program, Graduate School, IPB University
[2]Department of Soil Science and Land Resource, Faculty of Agriculture, IPB University
[3]Biotechnology Center, Institute for Research and Community Empowerment, IPB University

Abstract. Research related to the extracellular self-DNA effect in plants has been widely conducted during the last decade. Researchers reported the impact of extracellular self-DNA inhibition on plant growth, assuming that extracellular self-DNA could enter plant tissue and thus stimulate an inhibitory response. Environmental conditions have a big role to play in supporting this inhibition, especially with the significant climate changes that have occurred in recent years. Climate changes such as rainfall, humidity, light intensity, and air temperature have a positive effect on the decomposition process of plant litter. Especially if there is a significant climate change accompanied by a monoculture cropping pattern will further trigger the accumulation of extracellular DNA. Dissolved DNA concentration in the soil with the probability of occurrence of the self-DNA effect is directly proportional. Although several studies have confirmed the inhibitory results, self-DNA's mechanism can enter plant tissue and stimulate an inhibitory response has not been widely discussed. It has sparked debate regarding the actual effect of self-DNA and the extent of its potential to inhibit plant growth. Therefore, this paper intends to collect various hypotheses and research results regarding self-DNA's impact on plant growth and reconstruct more comprehensive assumptions regarding the effect of self-DNA, its inhibitory potential, and its ecological implications in agriculture. Exhaustive assumptions about self-DNA are expected to be the basis for generating new research designs that include new variables that have not been considered in previous research.

biology

Review

Extracellular DNA: Insight of a Signal Molecule in Crop Protection

Ireri Alejandra Carbajal-Valenzuela [1], Gabriela Medina-Ramos [2,*], Laura Helena Caicedo-Lopez [1], Alejandra Jiménez-Hernández [1], Adrian Esteban Ortega-Torres [1], Luis Miguel Contreras-Medina [1], Irineo Torres-Pacheco [1] and Ramón Gerardo Guevara-González [1,*]

[1] C. A. Biosystems Engineering, Campus Amazcala, Autonomous University of Queretaro, Carr. Chichimequillas-Amazcala Km 1 S/N, C.P., El Marques, Querétaro 76265, Mexico; jancarval@hotmail.com (I.A.C.-V.); inglauraclo23@gmail.com (L.H.C.-L.); ale.jhtsu@gmail.com (A.J.-H.); adrianesotorres@gmail.com (A.E.O.-T.); mcontreras.uaq@gmail.com (L.M.C.-M.); irineo.torres@uaq.mx (I.T.-P.)
[2] Molecular Plant Pathology Laboratory, Polytechnic University of Guanajuato, Cortazar 38496, Mexico
* Correspondence: gmedina@upgto.edu.mx (G.M.-R.); ramonggg66@gmail.com or ramon.guevara@uaq.mx (R.G.G.-G.); Tel.: +52-1-461-441-4300 (G.M.-R.); +52-1-442-192-1200 (ext. 6093) (R.G.G.-G.)

Biology **2021**, *10*, 1022.

plants

Article

Extracellular DNA as a Strategy to Manage Vascular Wilt Caused by *Fusarium oxysporum* in Tomato (*Solanum lycopersicum* L.) Based on Its Action as a Damage-Associated Molecular Pattern (DAMP) or Pathogen-Associated Molecular Pattern (PAMP)

Alejandra Jiménez-Hernández [1,†], Ireri Alejandra Carbajal-Valenzuela [1,†], Irineo Torres-Pacheco [1], Enrique Rico-García [1], Rosalía V. Ocampo-Velazquez [1], Ana Angélica Feregrino-Pérez [2] and Ramón Gerardo Guevara-Gonzalez [1,*]

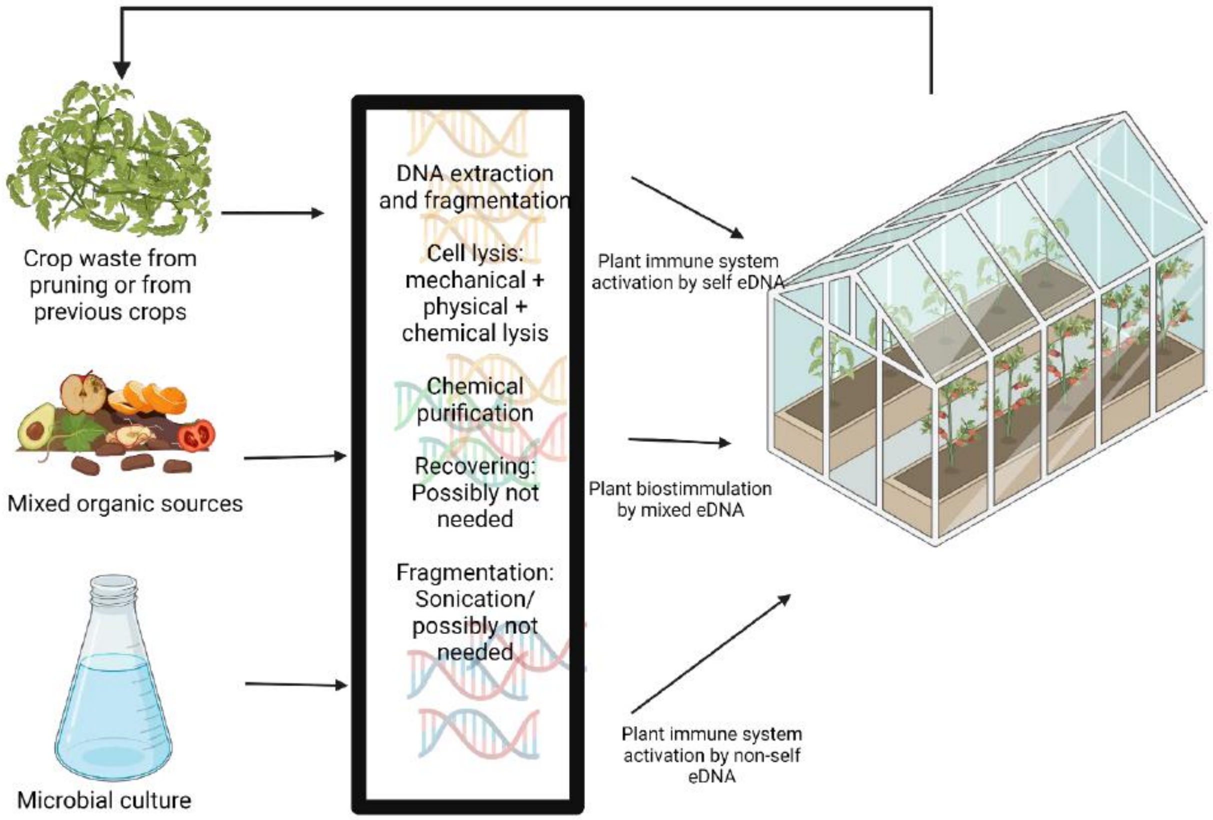


Figure 1. A proposed system of eDNA as an agriculture treatment with circular economy agricultural eDNA treatments.

frontiers in Plant Science

ORIGINAL RESEARCH
published: 26 July 2021
doi: 10.3389/fpls.2021.686121

Extracellular Fragmented Self-DNA Is Involved in Plant Responses to Biotic Stress

Francesca Barbero[1], Michela Guglielmotto[2], Monirul Islam[3†] and Massimo E. Maffei[3]*

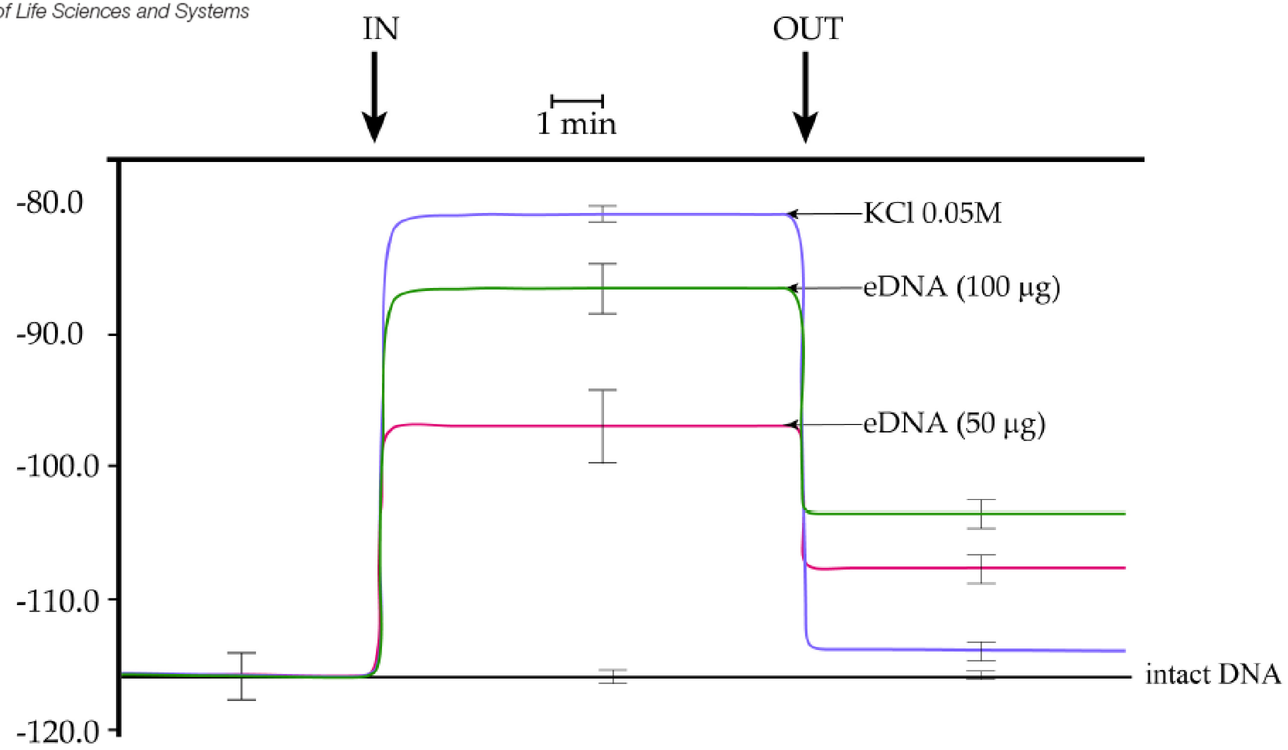
[1] Department of Life Sciences and Systems Biology, University of Turin, Turin, Italy, [2] Neuroscience Institute of Cavalieri Ottolenghi Foundation, University of Turin, Turin, Italy, [3] Plant Physiology Unit, Department of Life Sciences and Systems Biology, University of Turin, Turin, Italy

International Journal of *Molecular Sciences*

Article

Extracellular Self-DNA (esDNA), but Not Heterologous Plant or Insect DNA (etDNA), Induces Plasma Membrane Depolarization and Calcium Signaling in Lima Bean (*Phaseolus lunatus*) and Maize (*Zea mays*)

Francesca Barbero [1], Michela Guglielmotto [2], Andrea Capuzzo [3] and Massimo E. Maffei [1,*]



biologia plantarum
an international journal for experimental botany
BIOLOGIA PLANTARUM (2023) 67: 9-18
DOI: 10.32615/bp.2022.037

Extracellular self-DNA induces local inhibition of growth, regulates production of reactive oxygen species, and gene expression in rice roots

T. O. S. TJIA[1], K. MEITHA[1,*], P. SEPTIANI[1], R. AWALUDIN[1], and D. SUMARDI[1]

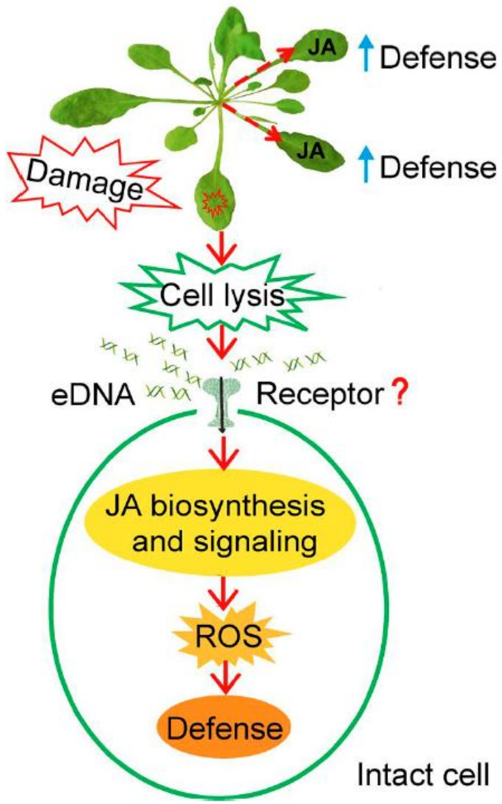
School of Life Sciences and Technology, Bandung Institute of Technology, Bandung, 40116, Indonesia

https://doi.org/10.1093/plphys/kiad252
PLANT PHYSIOLOGY 2023: 192: 2233–2234
Plant Physiology®

It’s not you, it’s me: Extracellular self-DNA signals through the jasmonic acid pathway

Guadalupe L. Fernández-Milmanda[1,2,3,*]

1 Assistant Features Editor, Plant Physiology, American Society of Plant Biologists, USA
2 Department of Plant Biotechnology and Bioinformatics, Ghent University, 9052 Ghent, Belgium
3 VIB, Center for Plant Systems Biology, 9052 Ghent, Belgium



Postharvest Biology and Technology 200 (2023) 112306

ELSEVIER

Contents lists available at ScienceDirect

Postharvest Biology and Technology

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

Extracellular self-DNA induced a PTI-related local defence against *Rhizopus* rot in postharvest peach fruit

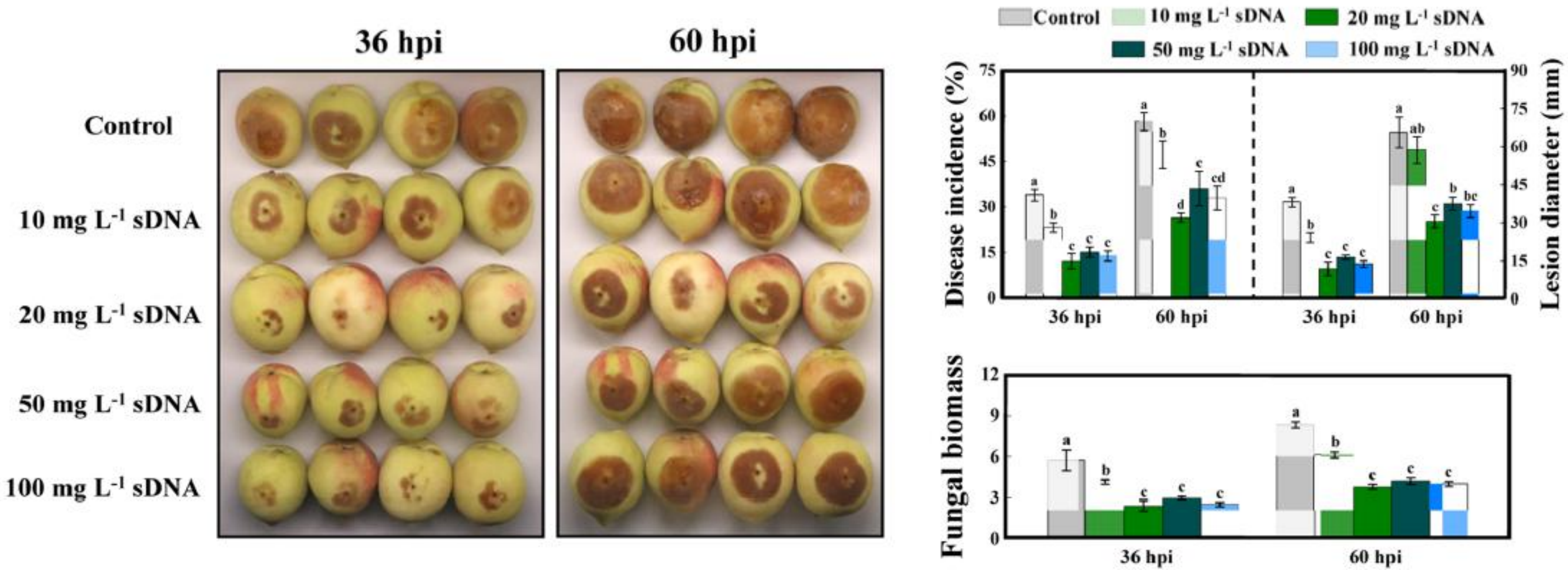
Chunhong Li [a,b,c], Kaituo Wang [a,b,c,*], Yanyu Zou [a,b,c], Changyi Lei [b], Zongxiang Chen [d], Yonghua Zheng [c]

[a] Laboratory of Fruit Function and Disease Management, Department of Public Health and Management, Chongqing Three Gorges Medical College, Chongqing 404000, China

[b] College of Biology and Food Engineering, Chongqing Three Gorges University, Chongqing 404000, China

[c] College of Food Science and Technology, Nanjing Agricultural University, Nanjing 210095 Jiangsu, China

[d] Chongqing Customs Technology Center, Chongqing Customs, Chongqing 401147, China

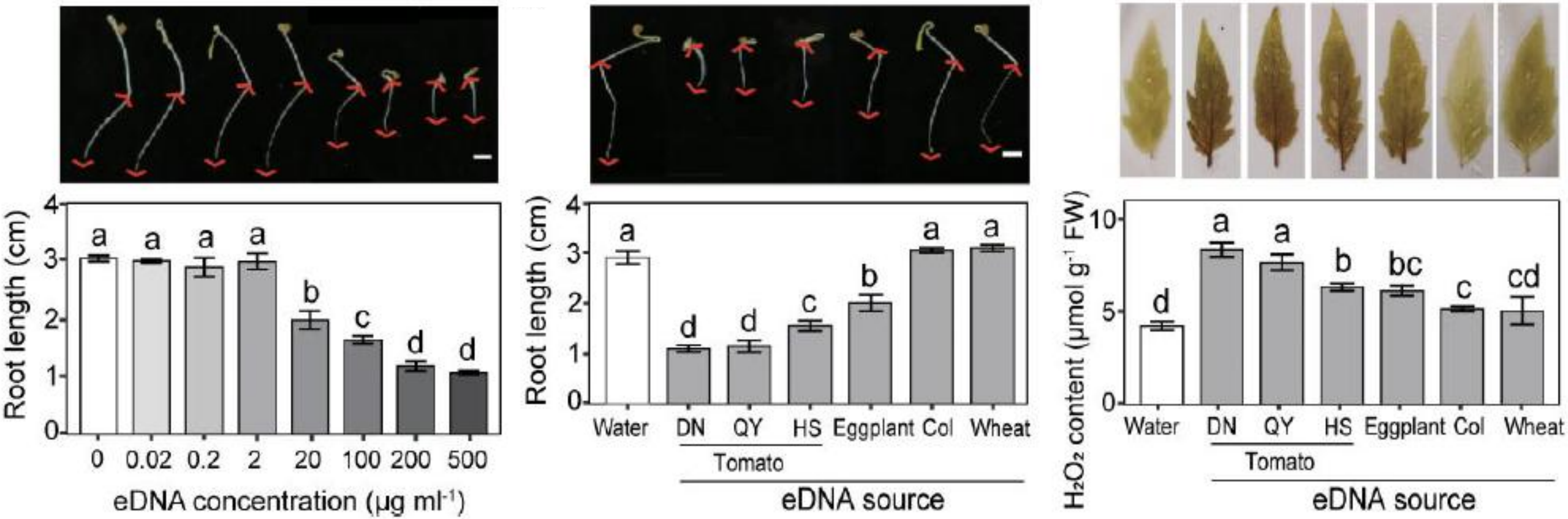


https://doi.org/10.1093/plphys/kiad195 PLANT PHYSIOLOGY 2023: 1–17

Plant Physiology®

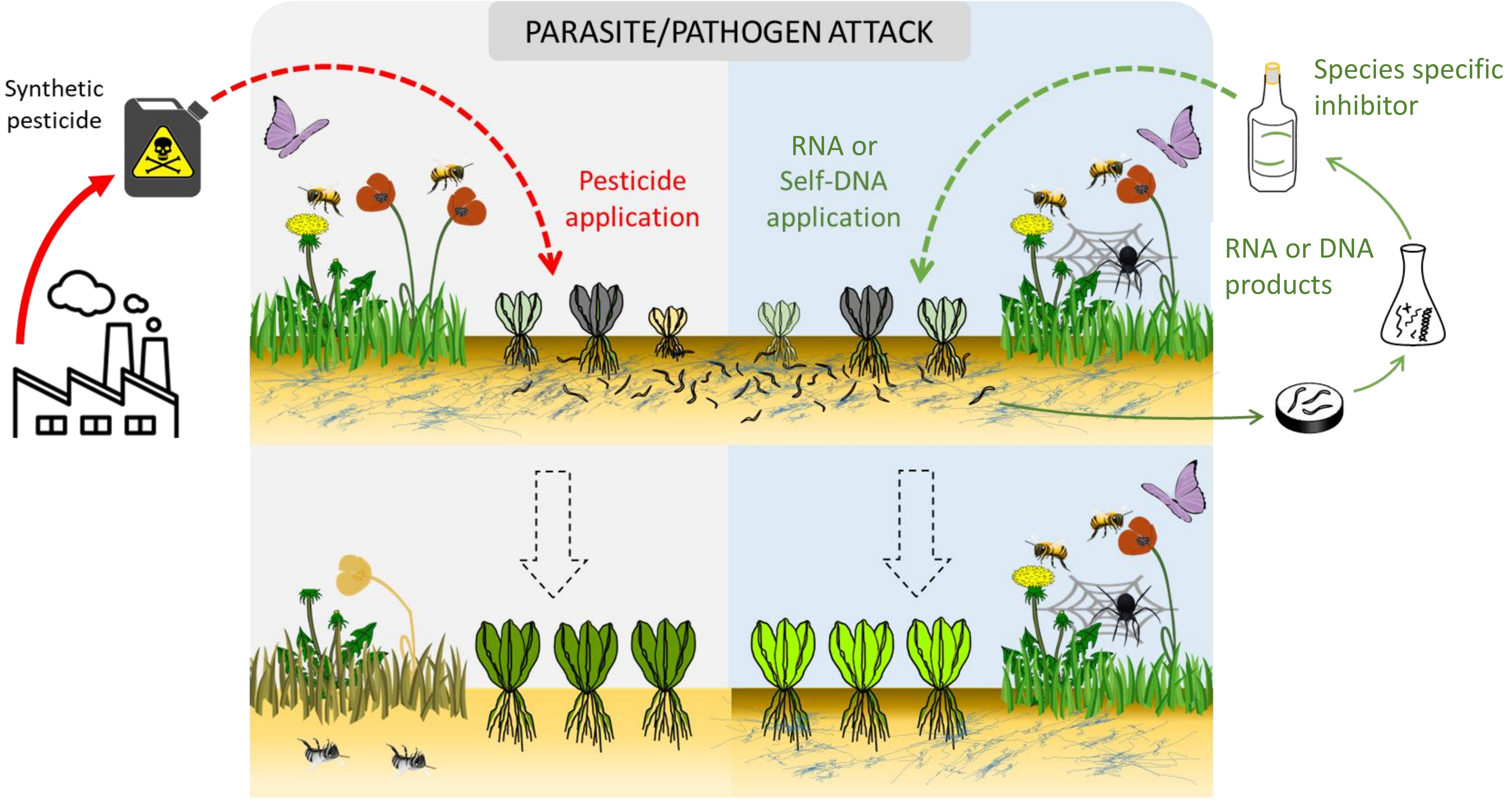
Plant extracellular self-DNA inhibits growth and induces immunity via the jasmonate signaling pathway

Xingang Zhou,[1] Huan Gao,[1,2] Xianhong Zhang,[1] Muhammad Khashi u Rahman,[1] Stefano Mazzoleni,[3] Minmin Du[4,*] and Fengzhi Wu[1,*]



NUOVO SCENARIO PER IL BIOCONTROLLO IN AGRICOLTURA: Acidi nucleici?

Past *versus* Future



frontiers in Plant Science
REVIEW
published: 13 August 2020
doi: 10.3389/fpls.2020.01237

Key Mechanistic Principles and Considerations Concerning RNA Interference

*Petr Svoboda**
Institute of Molecular Genetics of the Czech Academy of Sciences, Prague, Czechia

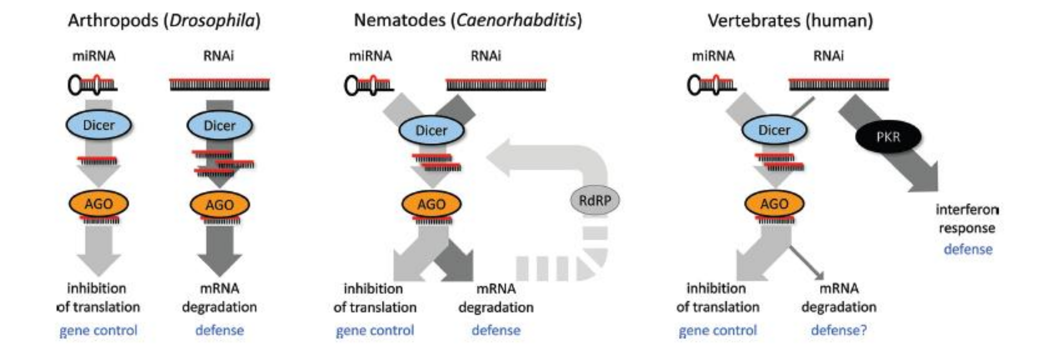


FIGURE 2 | Different scenarios of co-existence of RNAi and microRNA (miRNA) in different species.

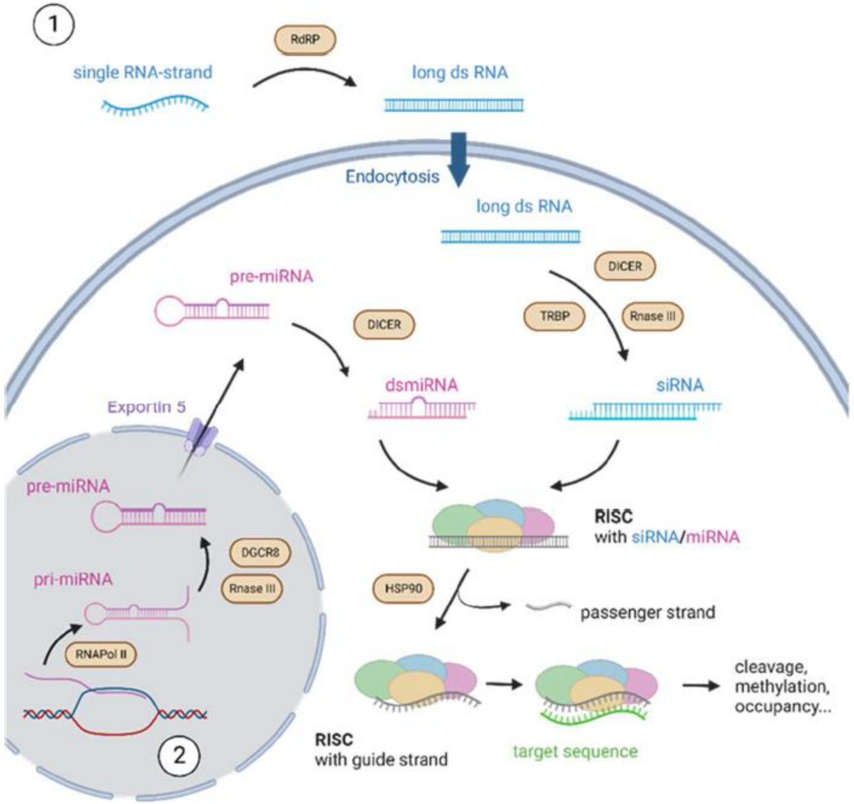
Micromachines 2023, *14*, 1321
MDPI

Review

Basic Principles of RNA Interference: Nucleic Acid Types and In Vitro Intracellular Delivery Methods

Marie Isenmann [1,2], Martin James Stoddart [1,2], Rainer Schmelzeisen [1], Christian Gross [1], Elena Della Bella [2,†] and René Marcel Rothweiler [1,2,*,†]

1 Department of Oral and Maxillofacial Surgery, Faculty of Medicine, University of Freiburg, Hugstetterstrasse 55, 79106 Freiburg, Germany
2 AO Research Institute Davos, Clavadelerstrasse 8, 7270 Davos, Switzerland



Biologia Futura
https://doi.org/10.1007/s42977-025-00281-3

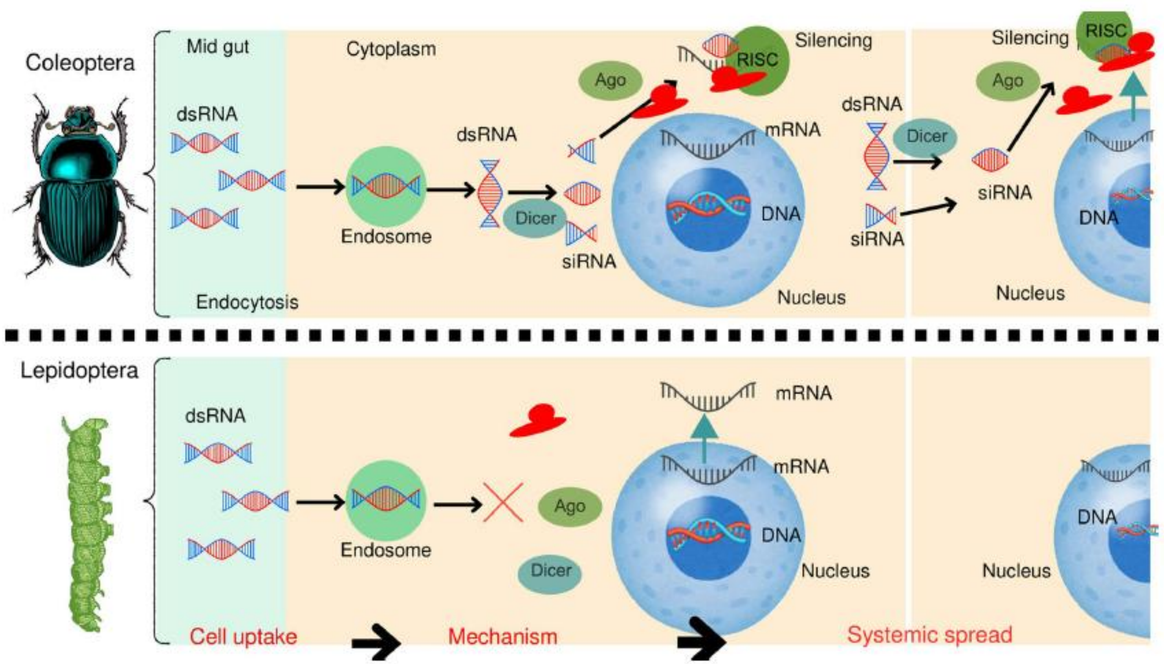
Published online: 19 August 2025

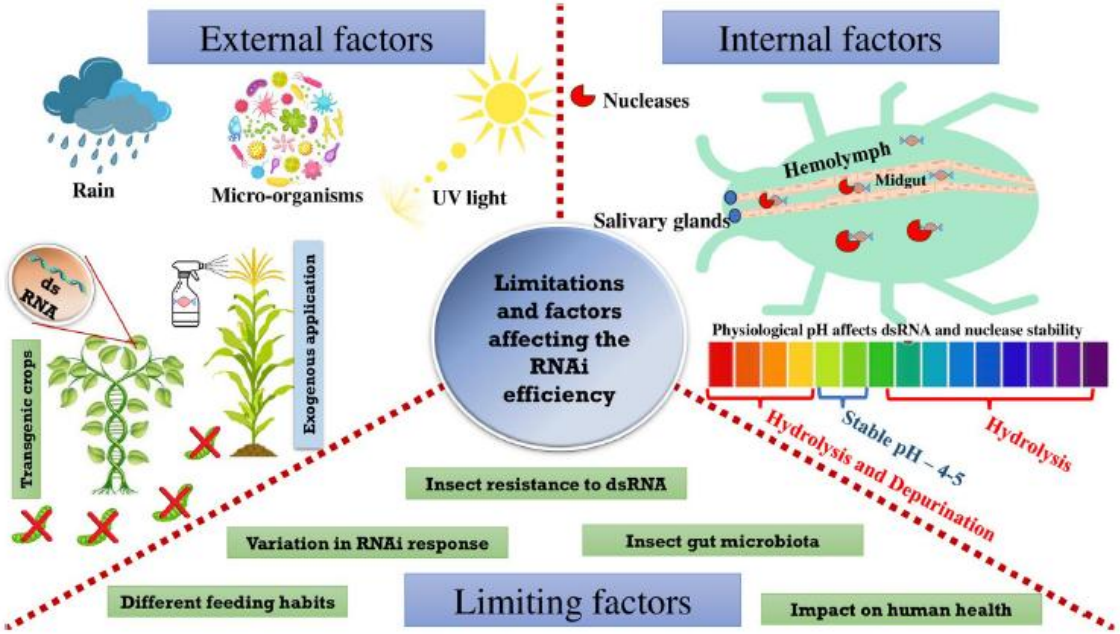
REVIEW

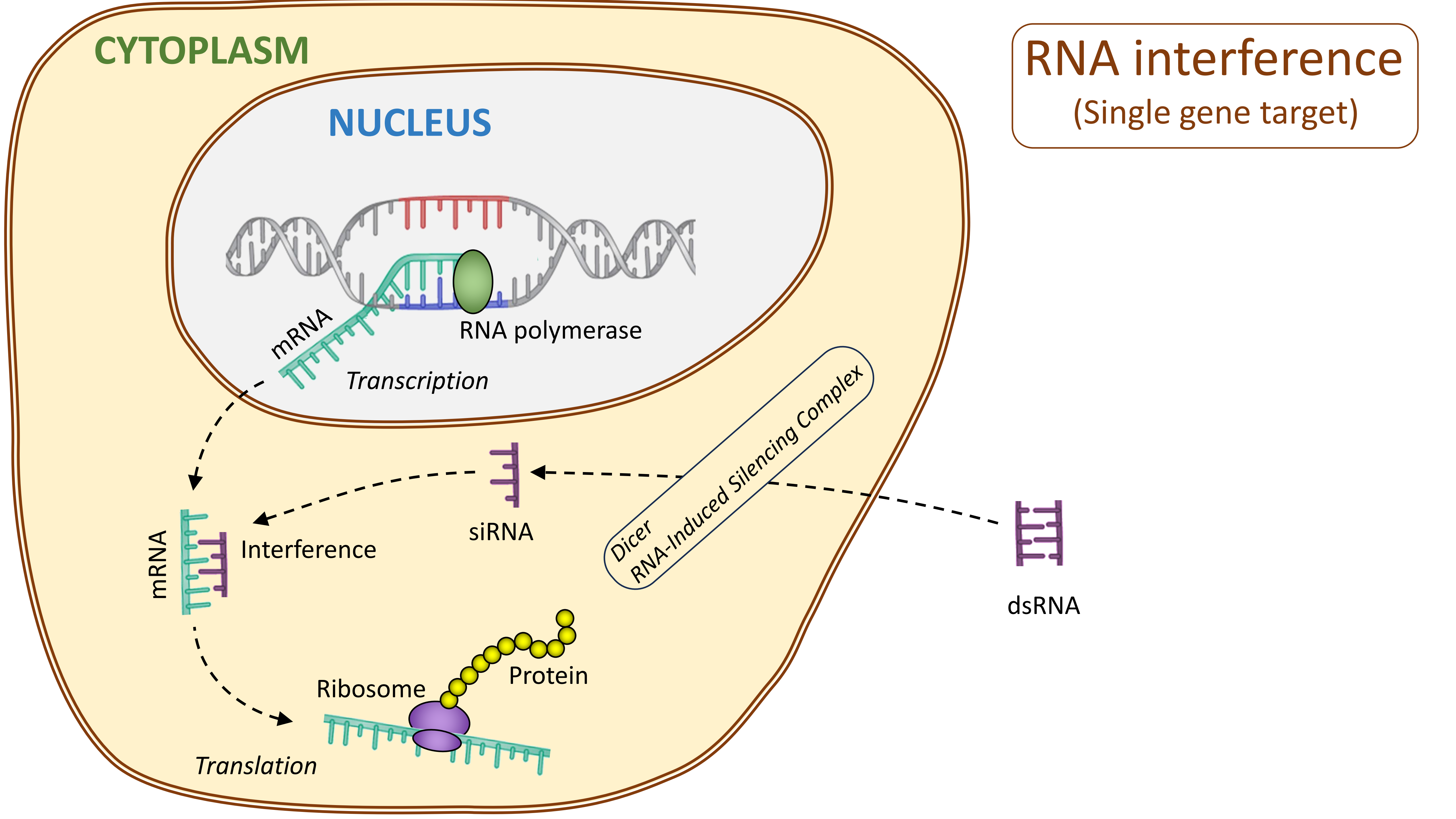
RNA interference (RNAi) for insect pest management: understanding mechanisms, strategies, challenges and future prospects

Deepak Kumar Mahanta[1] · **J. Komal**[2] · **Tanmaya Kumar Bhoi**[3] · **Ipsita Samal**[4] · **Sangeeta Dash**[5] · **Sumit Jangra**[6]

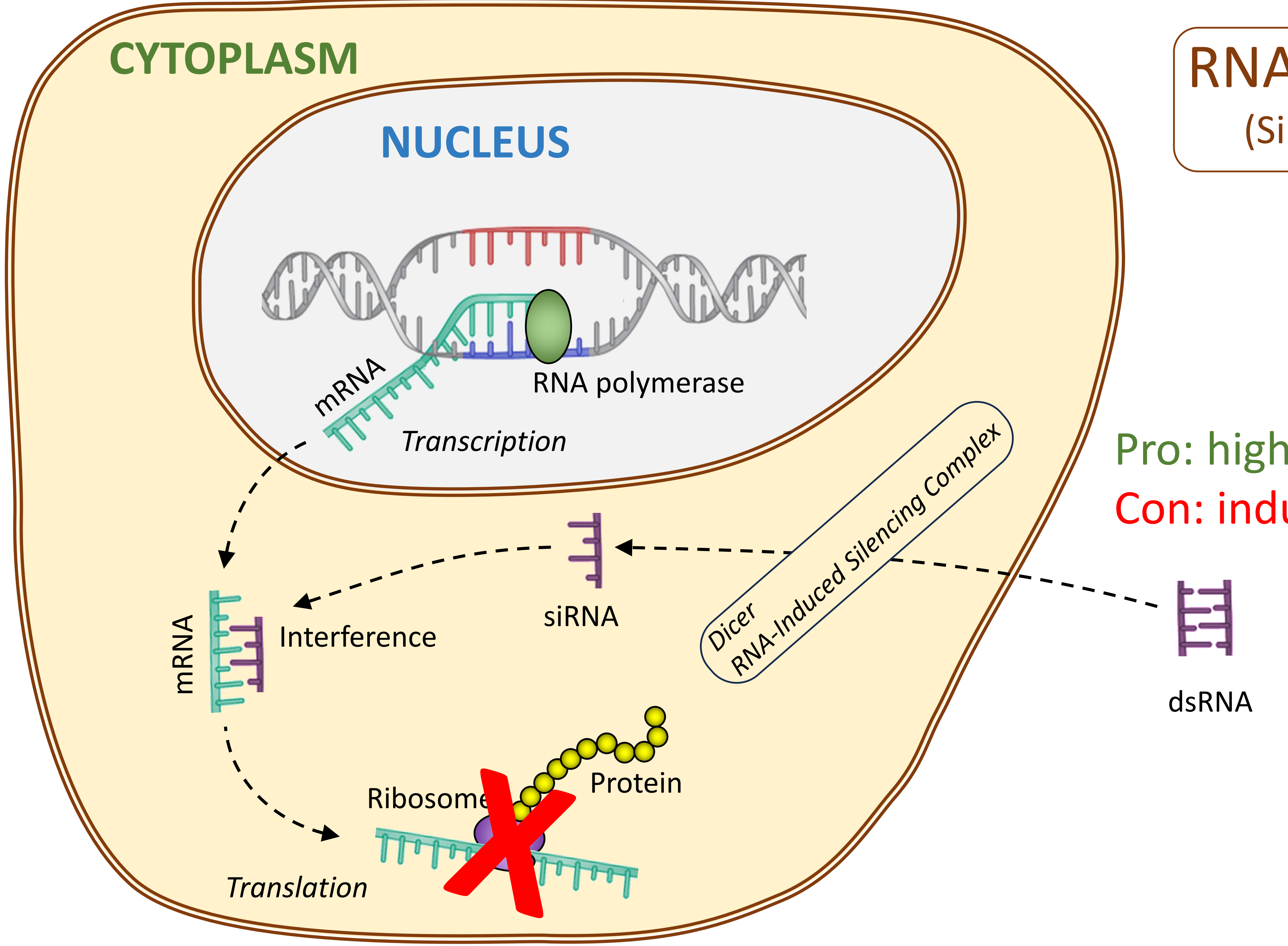
Forest Entomology Discipline, Forest Protection Division,
Indian Council of Forestry Research and Education





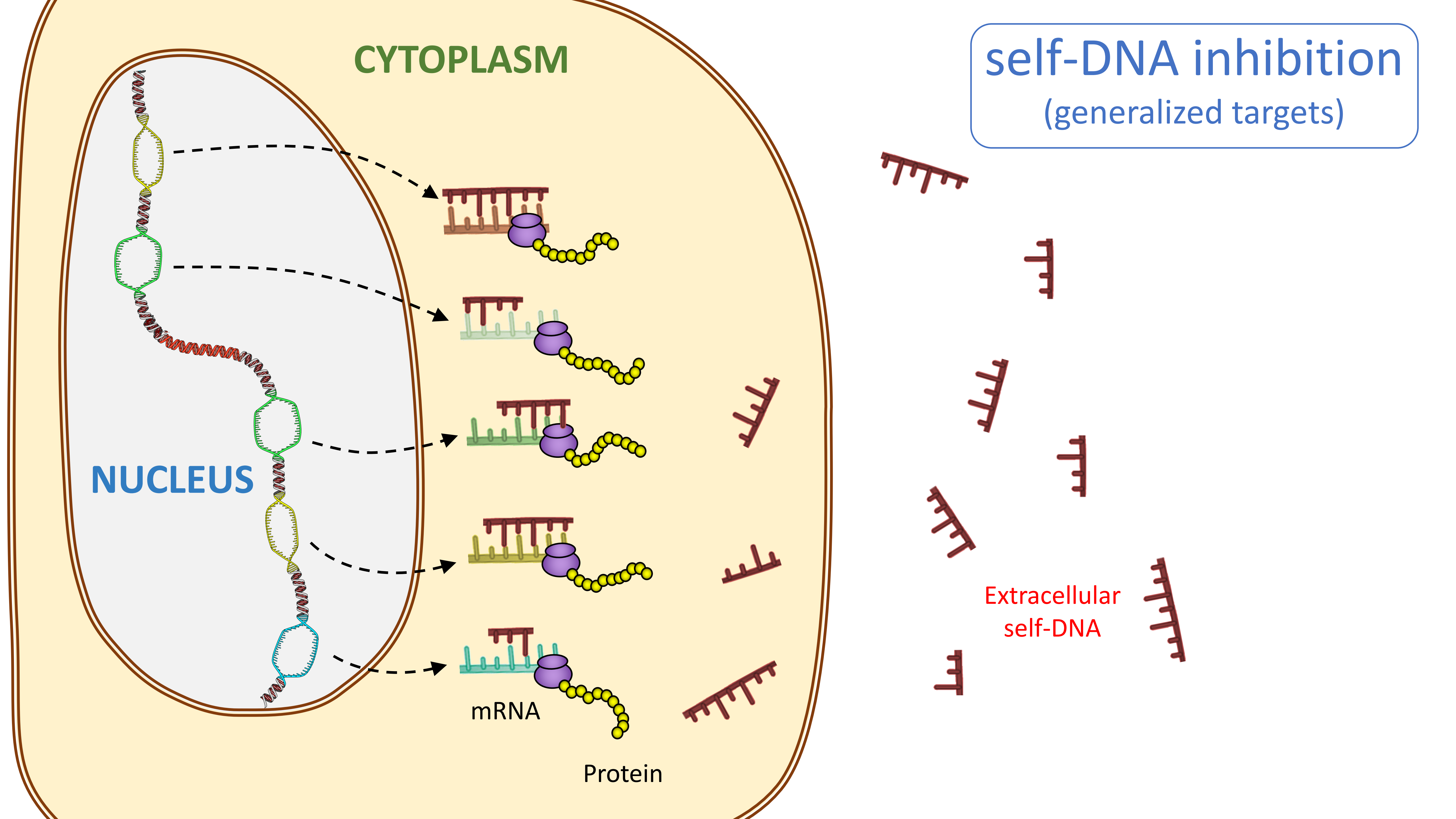

RNA interference
(Single gene target)
CYTOPLASM
NUCLEUS
mRNA
RNA polymerase
Transcription
Dicer
RNA-Induced Silencing Complex
siRNA
dsRNA
mRNA
Interference
Ribosome
Protein
Translation

RNA interference
(Single gene target)



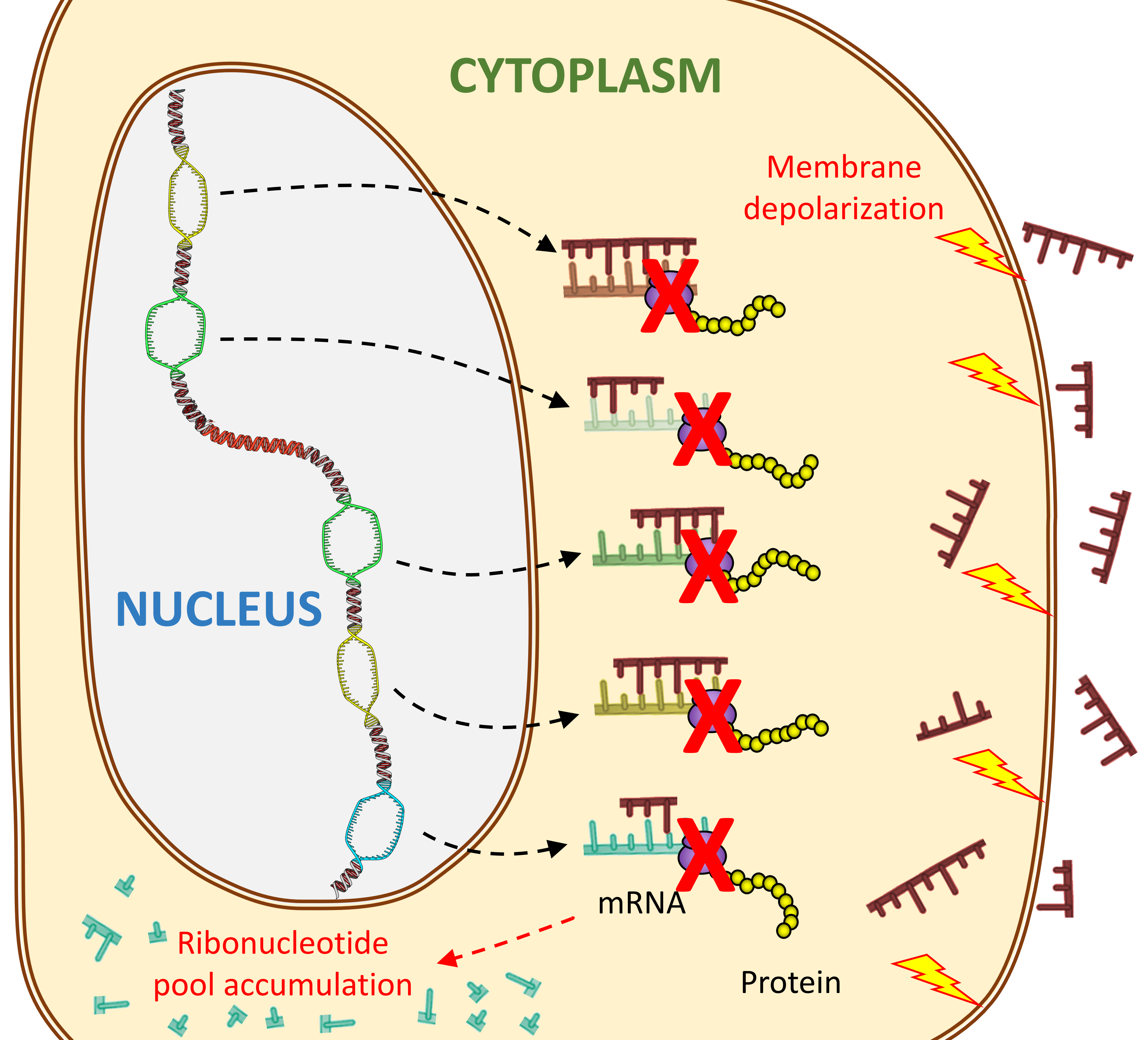
Pro: high precision

Con: induction of resistance



self-DNA inhibition
(generalized targets)
CYTOPLASM
NUCLEUS
mRNA
Protein
Extracellular
self-DNA

self-DNA inhibition
(generalized targets)



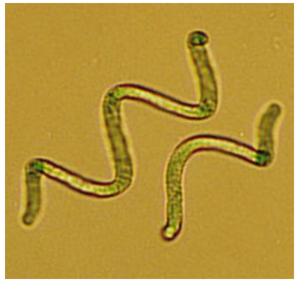
Pro: generalised action
(no resistance)

Con: ?

Uso di acidi nucleici possibile:

- Vantaggi del DNA rispetto al RNA (*AND technology*)
- Problematiche regolatorie

Microrganismi benefici → Biostimolanti → Biocontrollo



Spirulina (*Arthrospira platensis*)

M2M Engineering

syngenta Italia

SC01-SEED

ULTIMO AGGIORNAMENTO: 03.06.2025

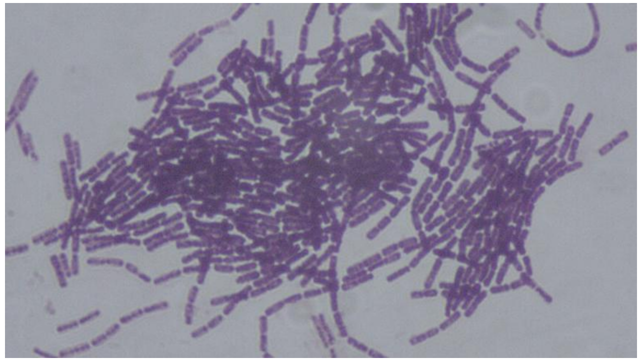
BIOSTIMOLANTI-SPECIALITÀ NUTRIZIONALI, CONCIANTI

NUTRIZIONE DELLE COLTURE

Composizione:	**Formulazione:**
8% Azoto (N) organico	Polvere disperdibile

Trichoderma harzianum

Bacillus thurigensis



Beauveria bassiana

Microrganismi benefici

Biostimolanti | Biocontrollo

+ DNA $_i$ → Biocontrollo + efficace su specie i

«AND Biologicals» technology

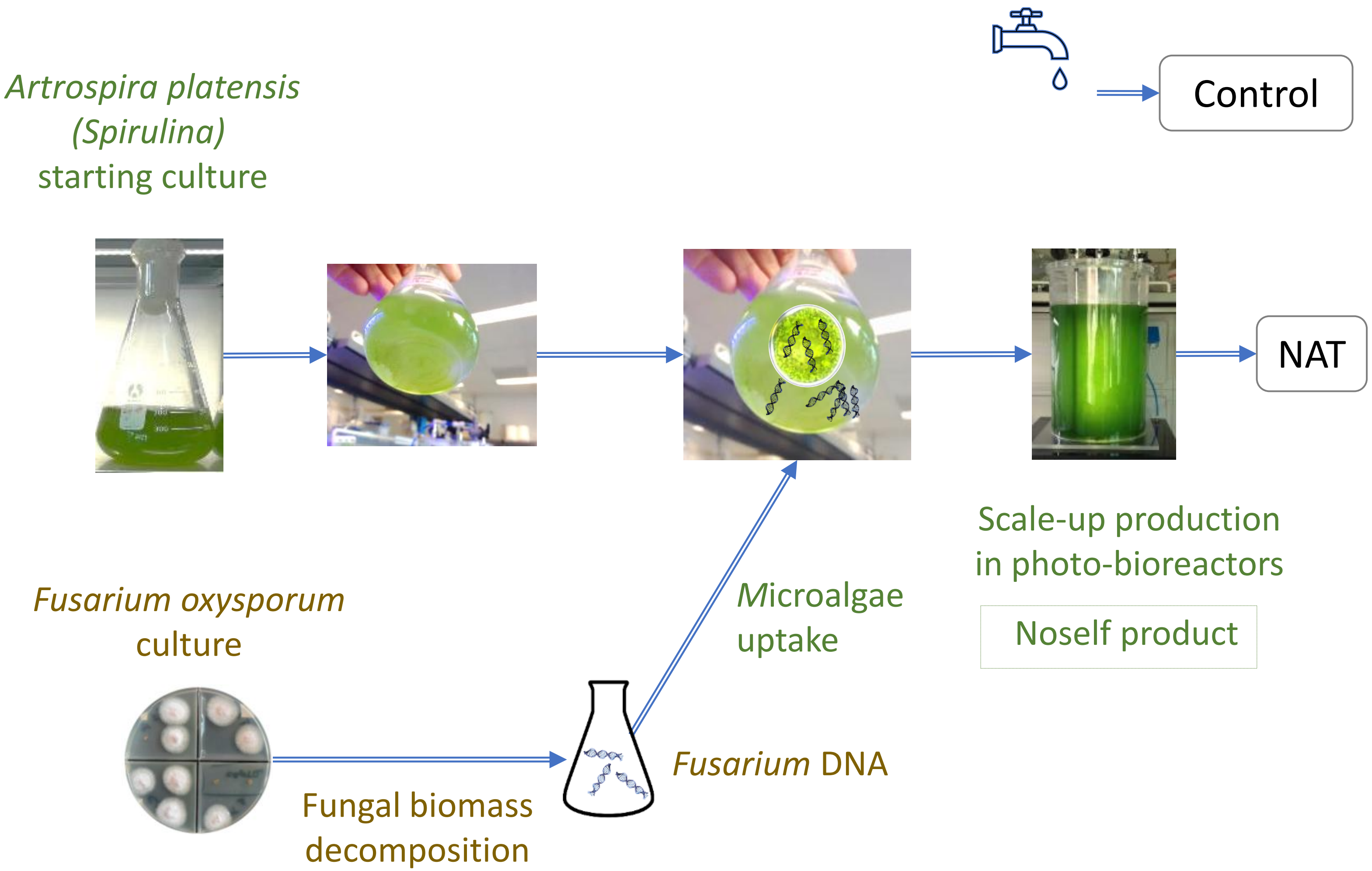
AS NATURE DOES

AND technology

Fusariosi lattuga – esempio di applicazione AND

Fusariosi Lattuga

biocontrol by *Fusarium self-DNA*



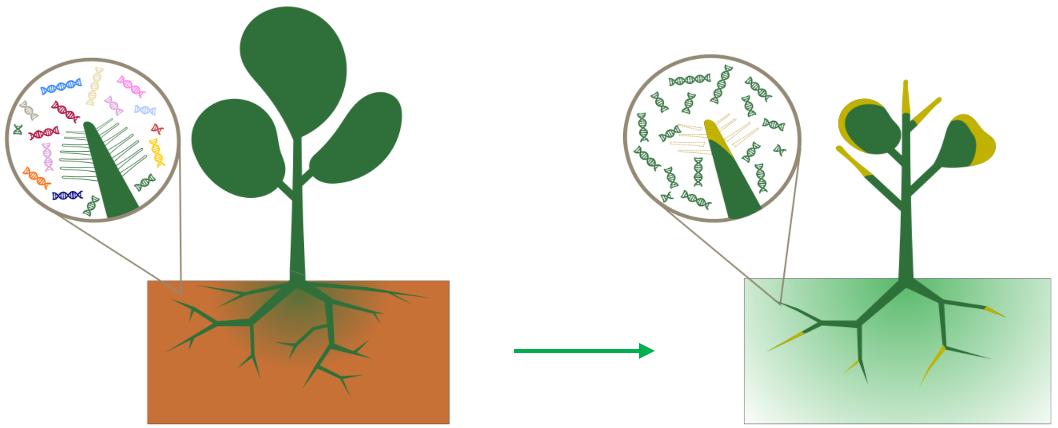
Fusariosi Lattuga

biocontrol by *Fusarium self-DNA*

CONCLUSIONI

Nuova funzione del DNA ambientale

Importanza del bilancio self/noself DNA



:)