Plant BioProTech Symposium - 19th November 2019 - Session 1

New insight into free-oxylipins roles, a potential for biocontrol agents

Presented by Estelle Deboever

PhD Student - Molecular Biophysics at Interface Laboratory

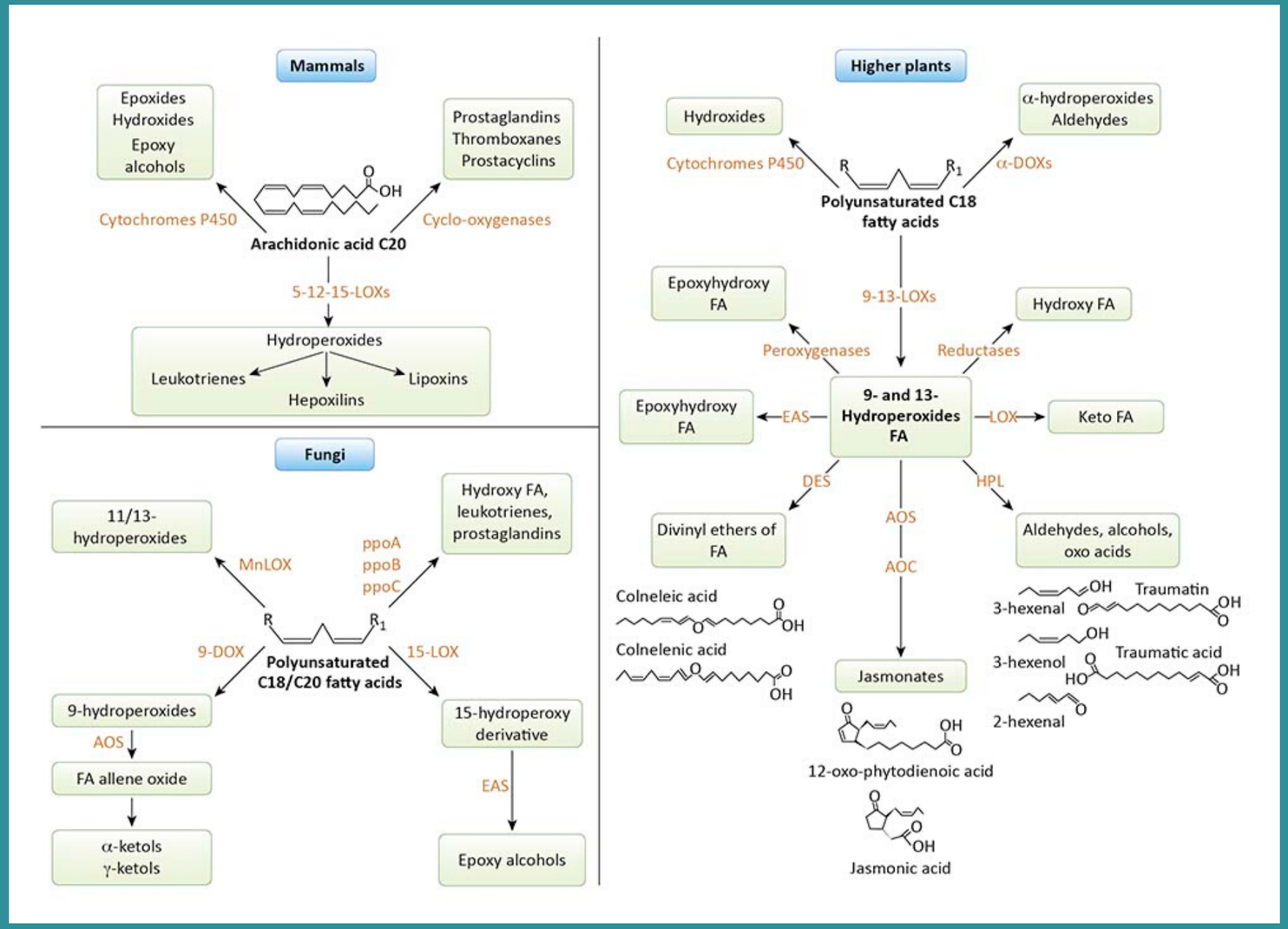
Inside Oxylipins

Definition - Synthesis - Properties

Oxylipin basics

OXYLIPIN

- Large class of lipid metabolites derived from the oxidation of PUFAs
- Found in almost all organims
- Free forms or esterified to phospholipids/galactolipids/etc



Deboever *et al.* (2019, in press) *Trends in Plant Science*

Oxylipin basics

SIGNATURES

(a)biotic stresses = specific oxylipin signatures

INTERACTIONS

PPM lipid composition = important in interaction with PO ?

STRUCTURES

- Divinyl-, keto-, and hydroxy- / hydroperoxy- fatty acids = antimicrobial activities
- JA and volatiles aldehydes = signalling

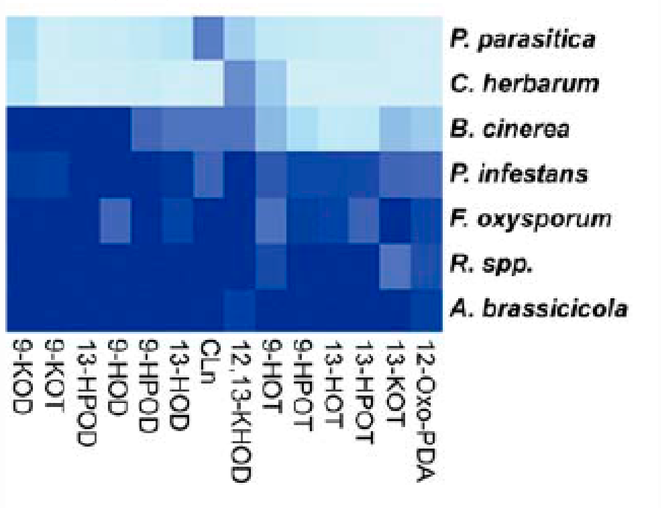
Chemical structure matters

COMMUNICATIONS

Oxylipin pathways = interkingdom communication ?

PO = Plant Oxylipin

Prost *et al.* (2005)



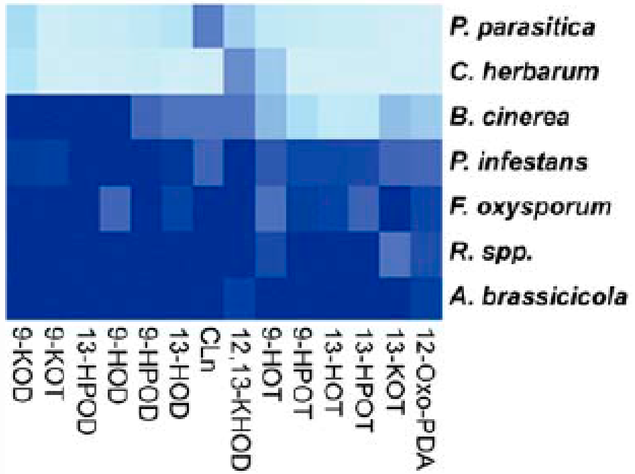
Study of PO

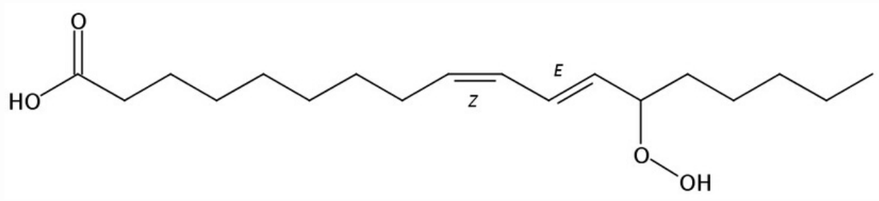
MIND THE GAP

BIOCIDAL / ELICITOR PROPERTIES

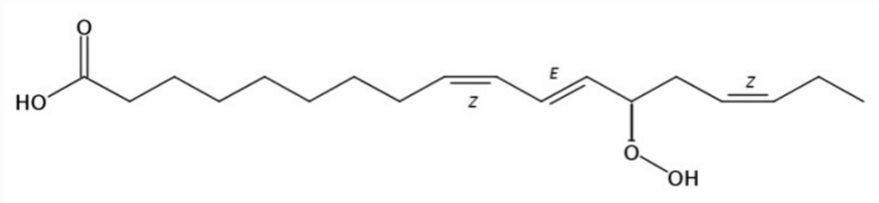
Only *in vitro* results -> *In planta* ?

Prost *et al.* (2005)





13-HPOD



13-HPOT

Study of PO

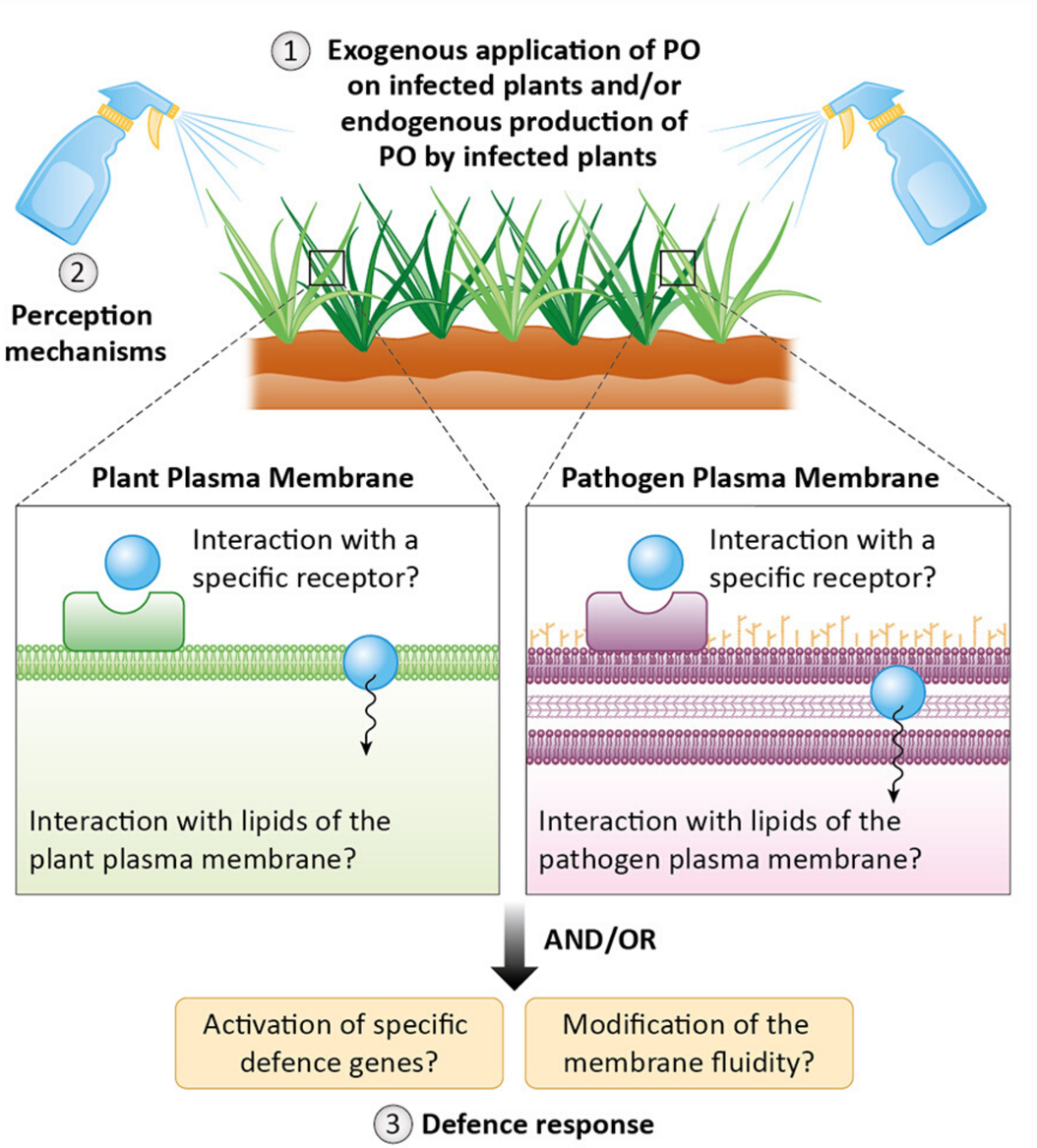
MIND THE GAP

BIOCIDAL / ELICITOR PROPERTIES

Only *in vitro* results -> *In planta* ?

LINK WITH CHEMICAL STRUCTURE

Potential structure-activity relationships



Deboever *et al.* (2019, in press) *Trends in Plant Science*

Study of PO

MIND THE GAP

BIOCIDAL / ELICITOR PROPERTIES

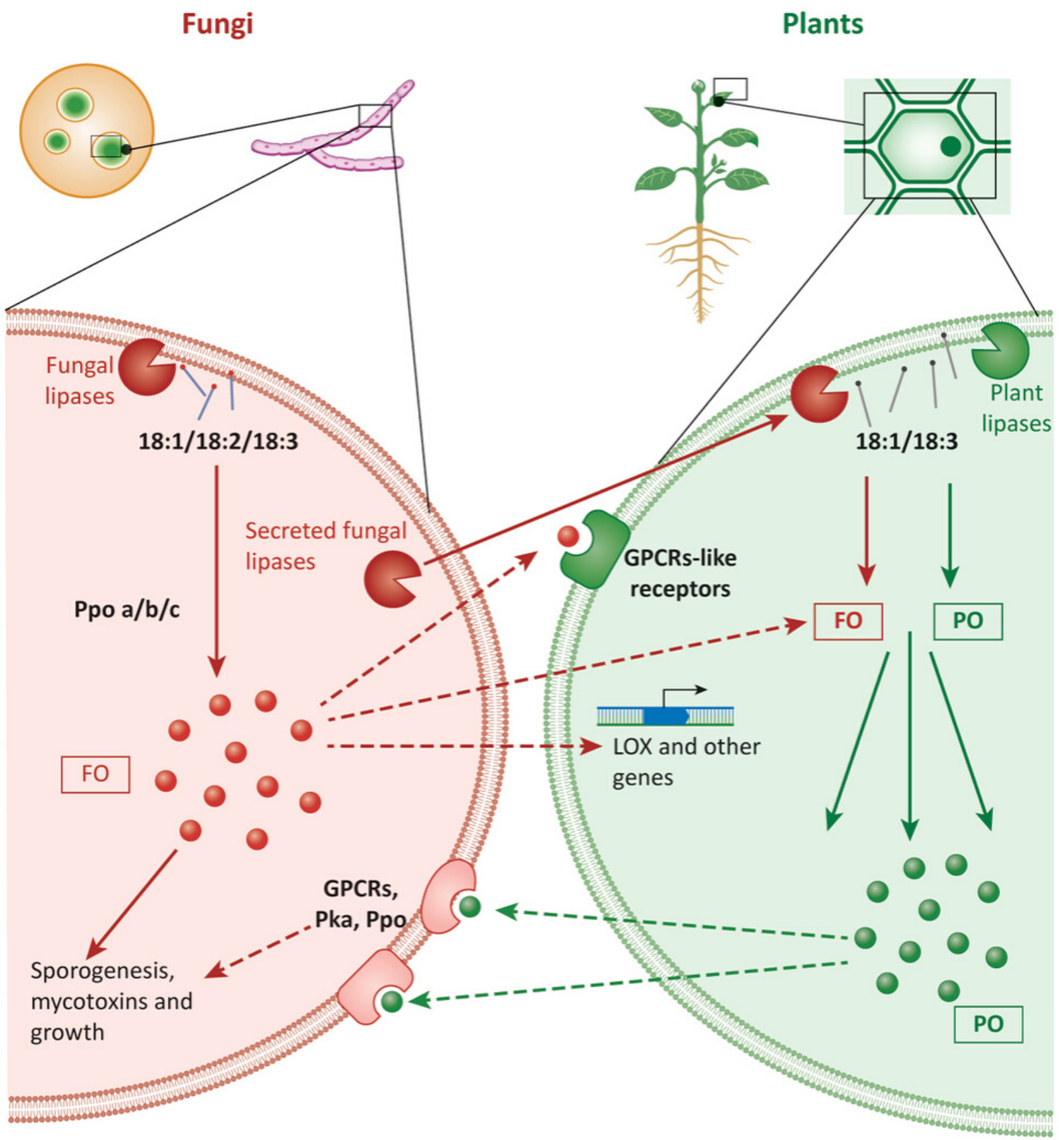
Only *in vitro* results -> *In planta* ?

LINK WITH CHEMICAL STRUCTURE

Potential structure-activity relationships

PLACE OF MEMBRANES IN THIS STORY

If/how POs interact with the pathogen or plant PM



Deboever *et al.* (2019, in press) *Trends in Plant Science*

Study of PO

MIND THE GAP

BIOCIDAL / ELICITOR PROPERTIES

Only *in vitro* results -> *In planta* ?

LINK WITH CHEMICAL STRUCTURE

Potential structure-activity relationships

PLACE OF MEMBRANES IN THIS STORY

If/how POs interact with the pathogen or plant PM

OXYLIPIN COMMUNICATION

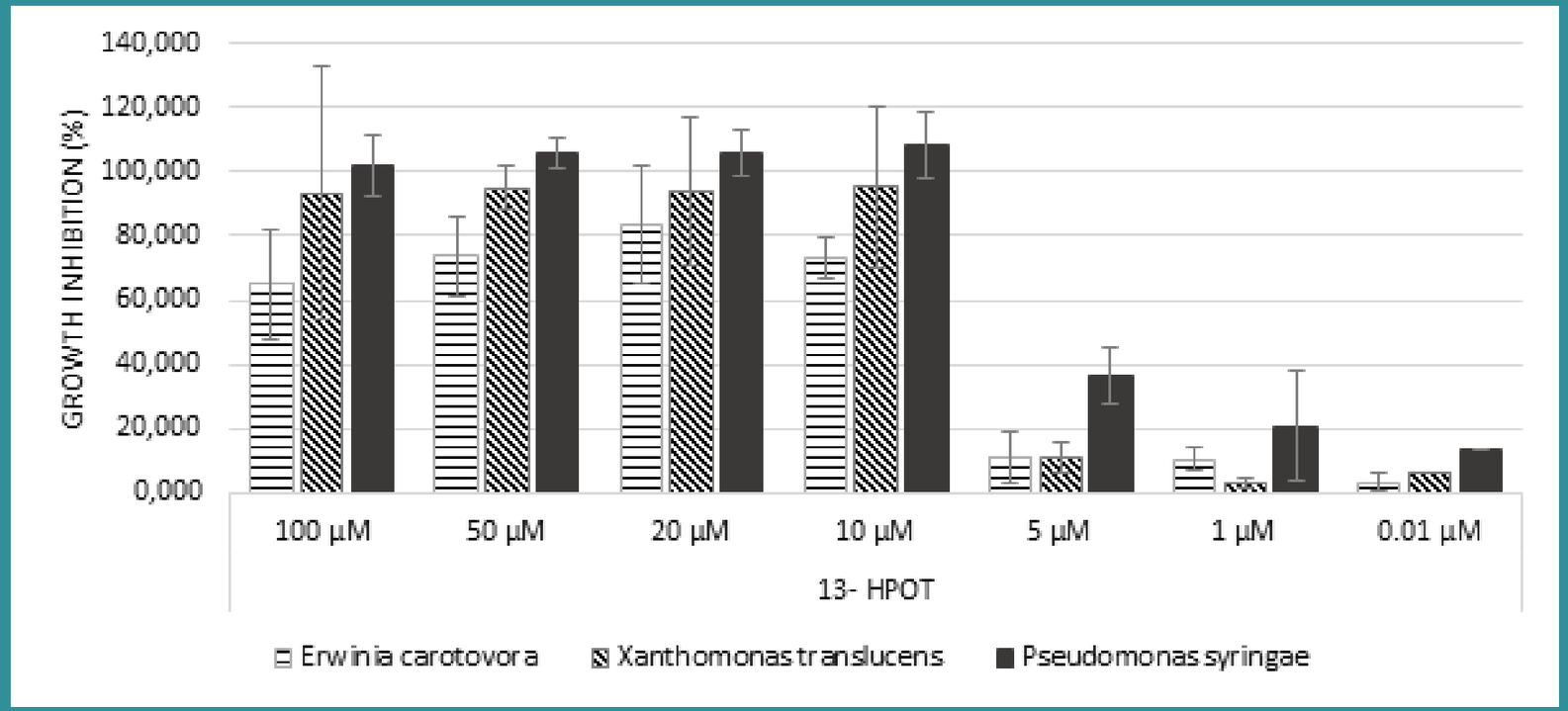
Crosstalk ? Oxylipin "language" ?

Our Research

Results - Conclusions - Perspectives

BIOCIDAL PROPERTIES

- 24 hours *in vitro* tests in 96-wells plats
- Based on Prost *et al.* (2005)
- 3 new bacteria of agronomic interests

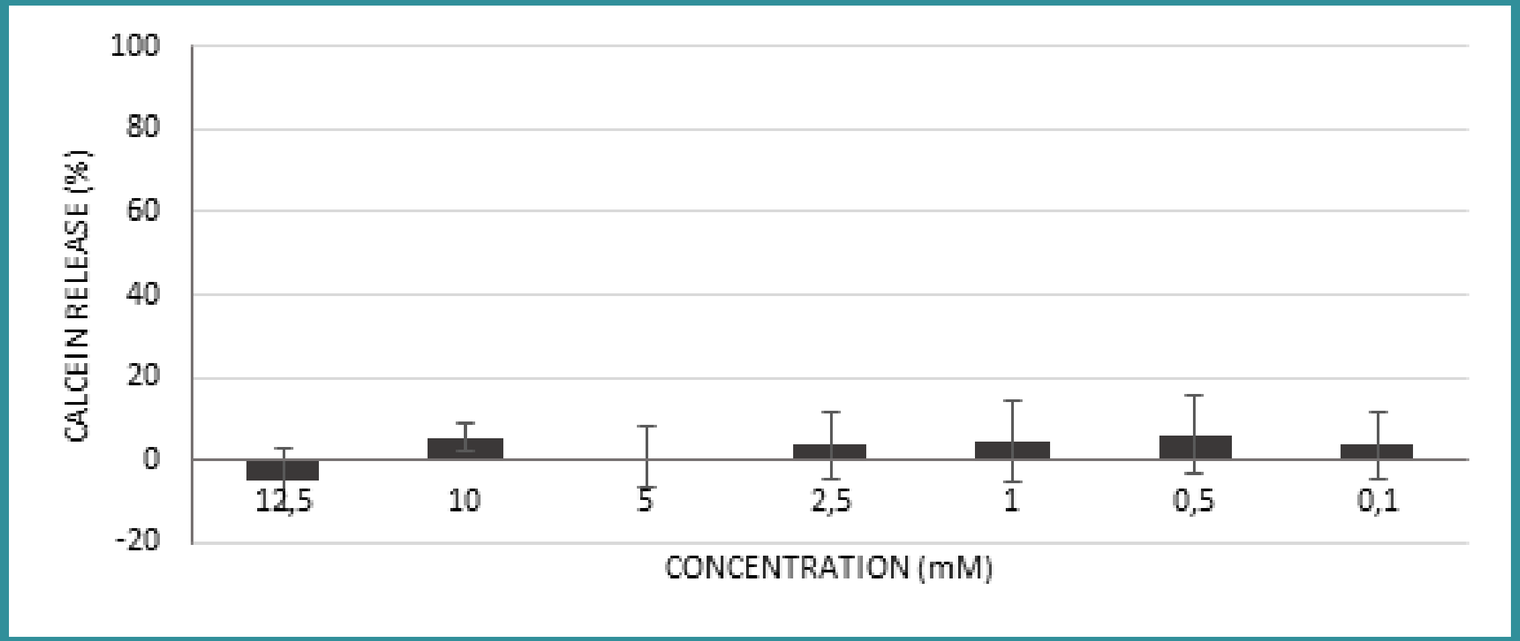


Strong dose effect

In planta ?

BIOCIDAL PROPERTIES

- Calcein released
- Biomimetic membranes mimicking *Pseudomonas* sp. inner membranes :
  - palmitoyl oleyl phosphatidylethanolamine (POPE)
  - palmitoyl oleyl phosphatidylglycerol (POPG)
  - cardiolipin (CL)

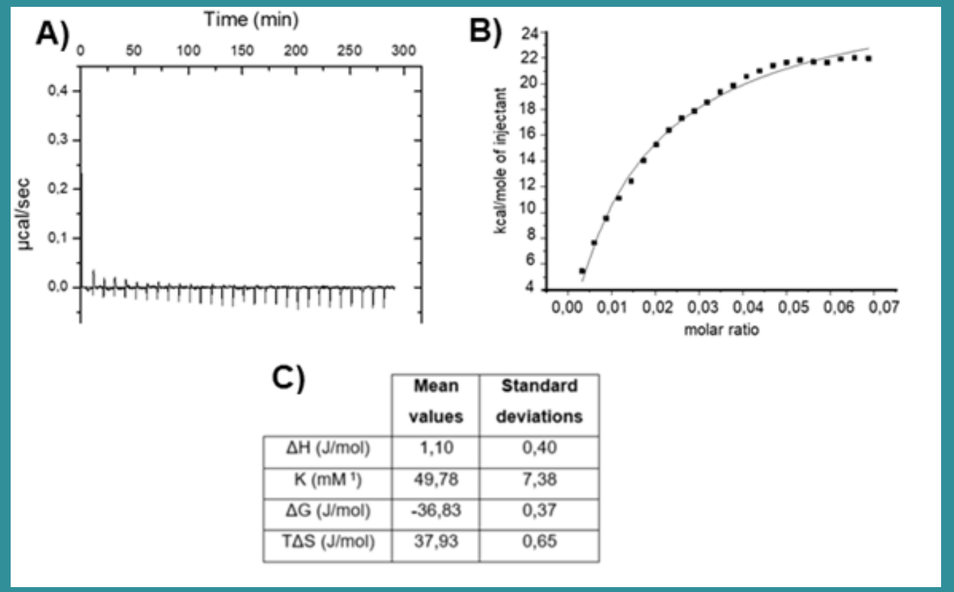


No permeabilizing effect

Mode of action ? Lipid interaction ?

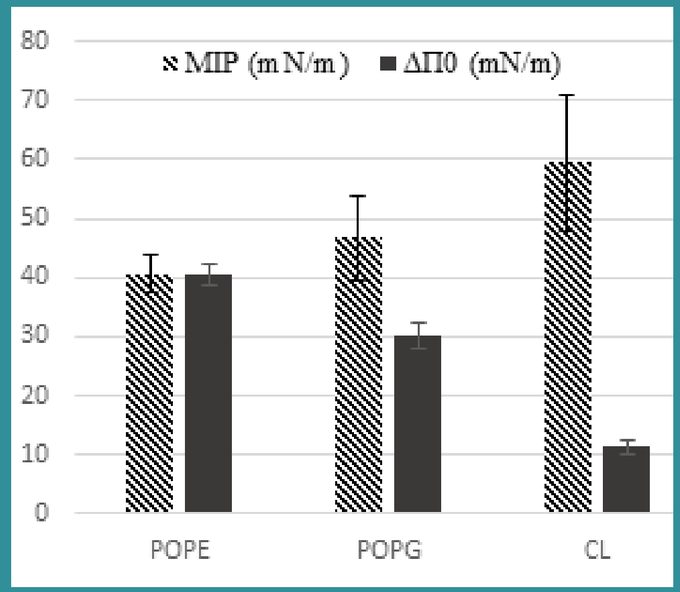
INTERACTION WITH BPM

- Same composition
- Complementary biophysical technics :
  - Isothermal Titration Calorimetry = bilayers
  - Langmuir Through = monolayers



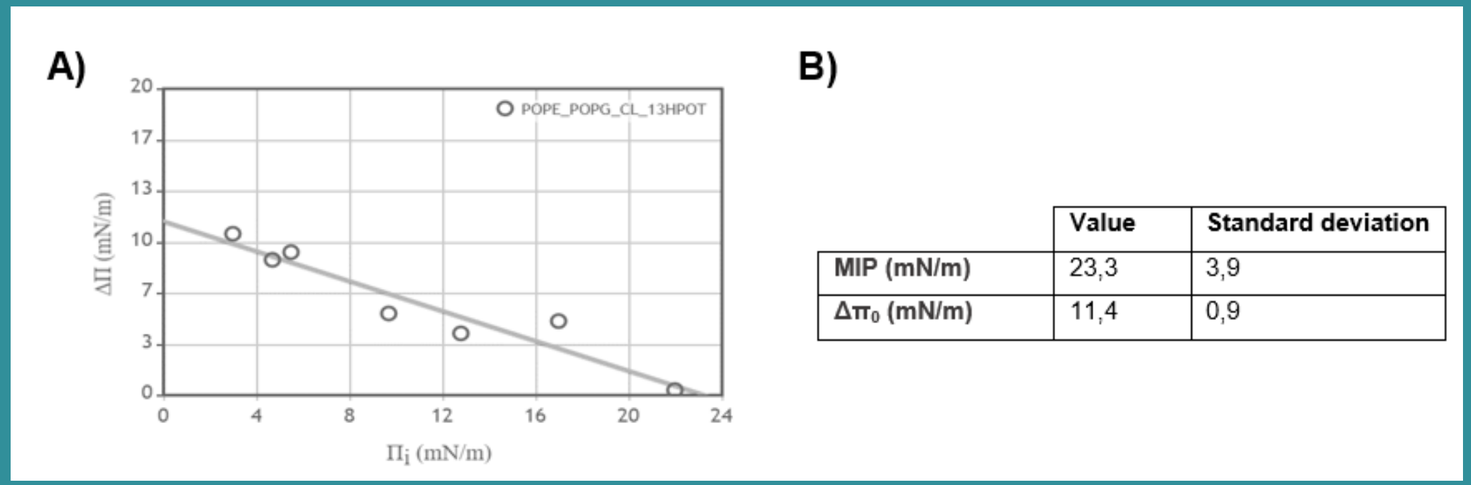
C)

	Mean values	Standard deviations
ΔH (J/mol)	1,10	0,40
K (mM⁻¹)	49,78	7,38
ΔG (J/mol)	-36,83	0,37
TΔS (J/mol)	37,93	0,65



Significant affinity for models

Lipid specificity and changes in lipid phases induced by 13-HPOT ?



	Value	Standard deviation
MIP (mN/m)	23,3	3,9
$\Delta\pi_0$ (mN/m)	11,4	0,9

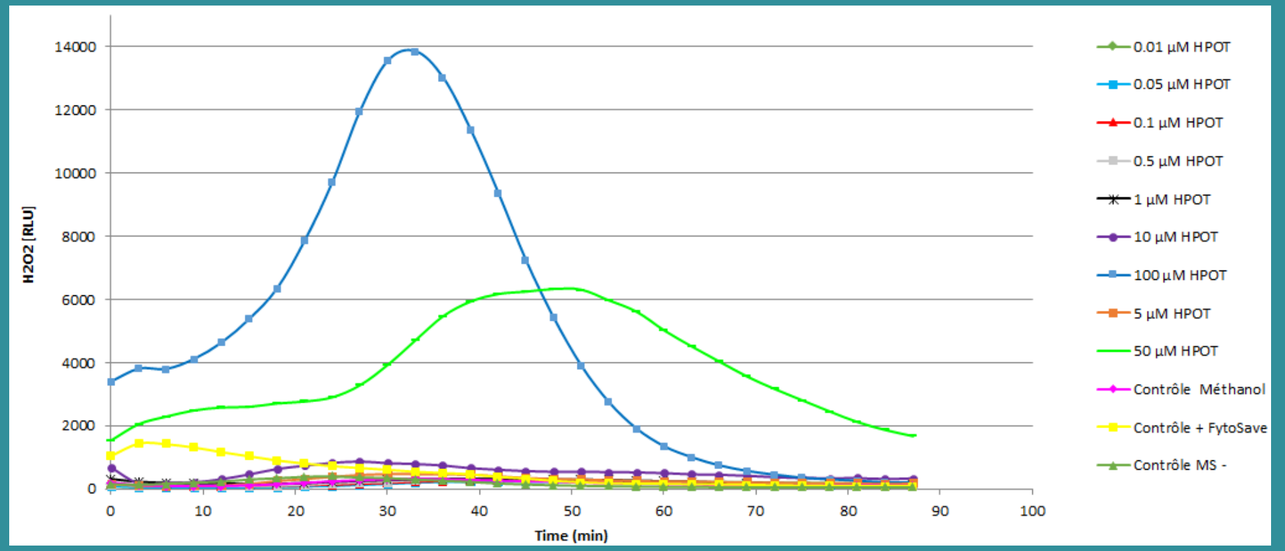
ELICITOR PROPERTIES

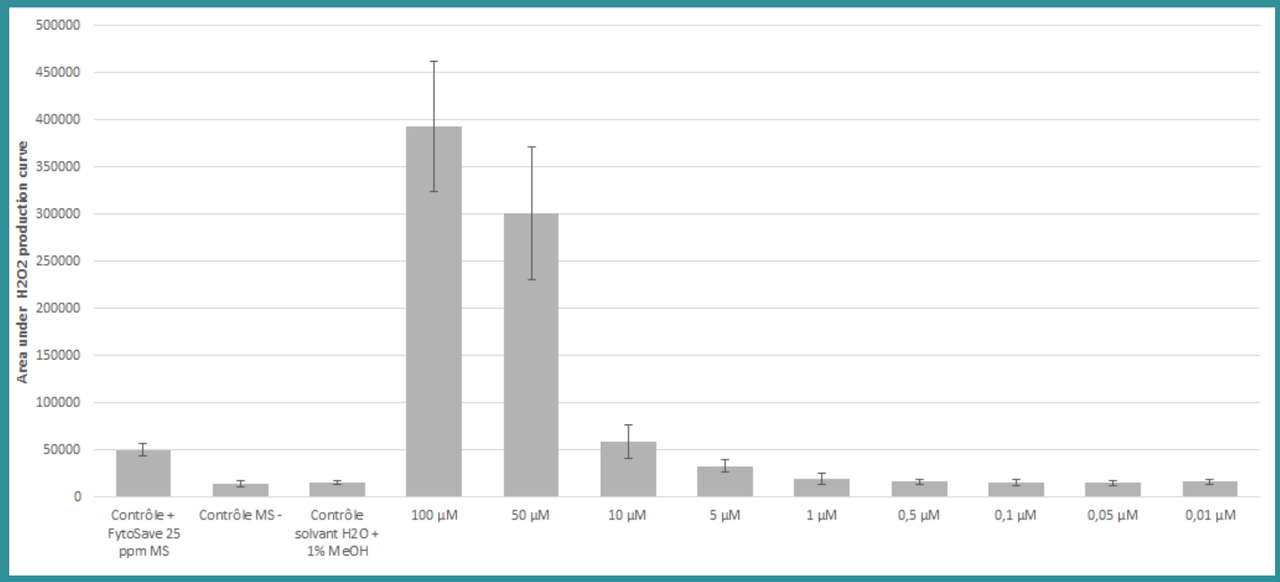
- ROS experiments :
  - *Arabidopsis thaliana* cells
  - H2O2 production after application
  - 1h30 measurement

Window of production = 20 to 50 min after application

Efficacity = up to 5 µM

In planta ?





PERSPECTIVES

OXYLIPINS AS BIOCIDES

Oxylipins show potential as a direct biocidal agent against several bacteria of agronomic interest

OXYLIPINS AS ELICITORS

Oxylipins appear to be inducing ROS production when applied to plants, suggesting their potential role as elicitor

OXYLIPINS AND MEMBRANES

Results seem to indicate that the biological properties of oxylipins are related to their ability to interact with biological membranes and more particularly the lipid part

Thank you for your attention !

estelle.deboever@uliege.be

LIÈGE université
Gembloux
Agro-Bio Tech

LBioMi

@LBMI_Lab

https://www.gembloux.ulg.ac.be

fnrs
LA LIBERTÉ DE CHERCHER