Induced resistance as a tool for sustainable plant protection

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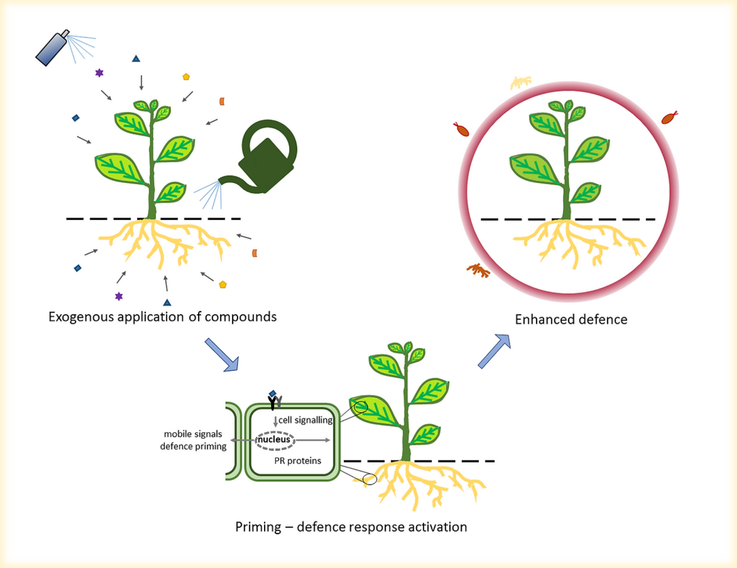
WHY?

- European Commission unveils plan to halve pesticide use and risk in frame of the Farm to Fork strategy — Regulated by EU directive on Sustainable pesticides utilization (2009/128/ES, October 21, 2009).
- The pesticides should be replaced with safe and sustainable alternatives.

HOW?

- Exploitation of biopesticides and semio-chemicals
- Exploitation of integrated crop protection measures
- **Exploitation of compounds capable of inducing plant resistance, i.e. resistance inducers**

Principle of induced resistance



WHAT DOES INDUCED RESISTANCE MEAN?

- Pre-treatment with resistance-inducing compounds either directly activates plant immune system or primes plants to stronger and quicker response to pathogen attack.

WHAT IS THE ORIGIN OF THE INDUCERS?

- Compounds of pathogen origin, e.g. cell wall components, extracellular polysaccharides, pathogen-secreted molecules.
- Substances of natural origin, e.g. plant extracts, biowaste-derived hydrolysates, animal protein hydrolysates, algae extracts.

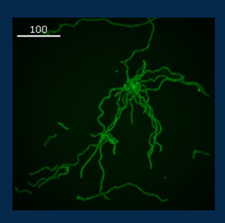
WHAT WE ARE FOCUSED ON?

- We are searching for biobased compounds activating plant immunity mechanisms.

PATHOSYSTEMS

Leptosphaeria maculans

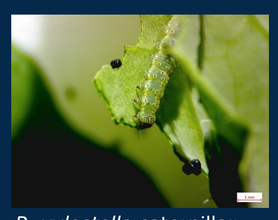
The causal agent of blackleg disease on *Brassica* crops



Plutella xylostella

Diamondback moth
Insect herbivore of *Brassica* spp.

P. xylostella caterpillar



P. xylostella caterpillar

P. xylostella adult

Extent of consumed leaf tissue and changes in plant attractivity to caterpillars in the 4th instar are evaluated.

Blumeria graminis

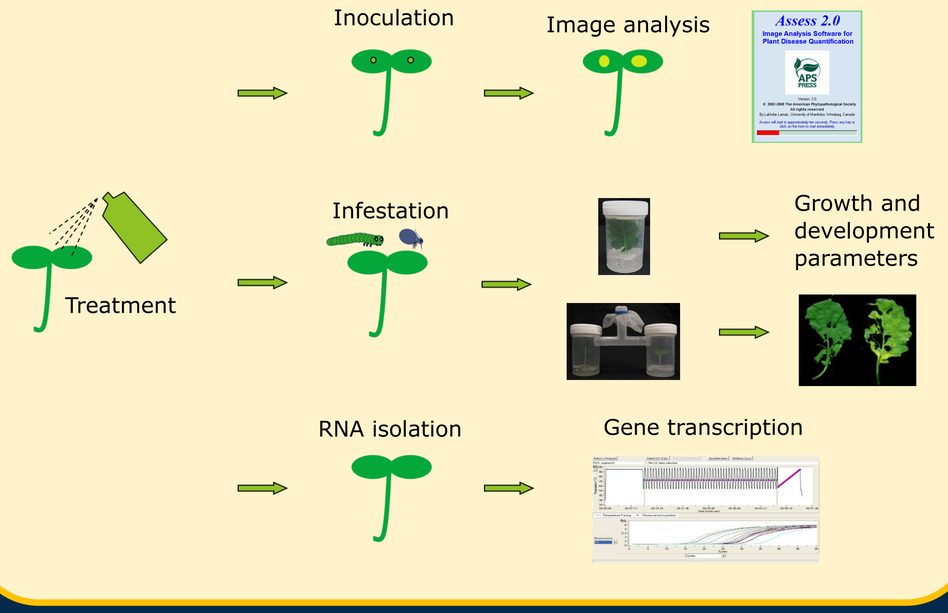
Powdery milldew
barley

Besides resistance induction, the compounds may also interfere with spore germination and appresorium formation.

Pseudomonas syringe pv. *tomato* *Arabidopsis thaliana*

A model plant for detailed study of compound action mechanism and bacterial pathogen

METHODOLOGY



LOOKING FOR PARTNERS

We can offer:

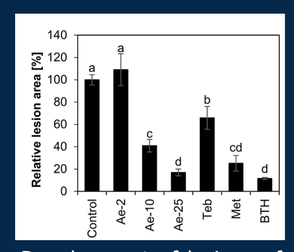
- the testing of compounds for their potential activity to trigger plant defence mechanisms, as well as for their direct antimicrobial activity
- the searching and identification of active compounds

PUBLICATIONS

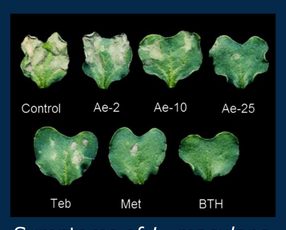
- Burketova L*, Trda L, Ott PG, Valentova O (2015) Bio-based resistance inducers for sustainable plant protection against pathogens. BIOTECHNOLOGY ADVANCES 33: 994-1004.
- Trdá, L. - Janda, M. - Macková, D. - Pospíchalová, R. - Dobrev, P.I. - Burketová, L. - Matušinský, P. (2019) Dual Mode of the Saponin Aescin in Plant Protection: Antifungal Agent and Plant Defense Elicitor. FRONTIERS IN PLANT SCIENCE 10: 1448.
- Jindřichová, B. - Burketová, L. - Montoneri, E. - Francavilla, M. (2018) Biowaste-derived hydrolysates as plant disease suppressants for oilseed rape. JOURNAL OF CLEANER PRODUCTION 183:335-342.
- Nováková, M. - Kim, P.D. - Šašek, V. - Burketová, L. - Jindřichová, B. - Šantrůček, J. - Valentová, O.* (2016) Separation and identification of candidate protein elicitors from the cultivation medium of *Leptosphaeria maculans* inducing resistance in Brassica napus. BIOTECHNOLOGY PROGRESS 32: 918-928.
- Kim PD, Šašek V, Burketová L, Čopíková J, Synytsya A, Jindřichová B, Valentová O. 2013. Cell Wall Components of *Leptosphaeria maculans* Enhance Resistance of *Brassica napus*. JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY 61: 5207-5214.
- Šašek V, Nováková M, Dobrev PI, Valentová O, Burketová L. 2012. beta-aminobutyric acid protects *Brassica napus* plants from infection by *Leptosphaeria maculans* . Resistance induction or a direct antifungal effect? EUROPEAN JOURNAL OF PLANT PATHOLOGY 133: 279-289.
- Věchet,L., Burketová,L., and Šindelářová,M. (2009) A comparative study of the efficiency of several sources of induced resistance to powdery mildew (*Blumeria graminis* f. sp *tritici*) in wheat under field conditions. CROP PROTECTION 28 :151-154.

RESULTS

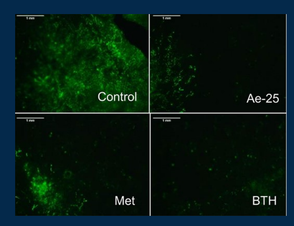
Saponin aescin induces resistance to *L. maculans*



Development of lesions of *L. maculans*.



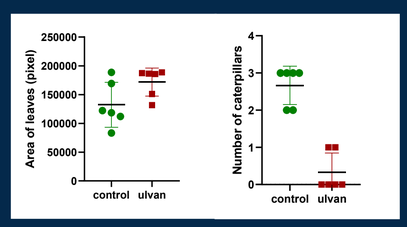
Symptoms of *L. maculans* in cotyledons



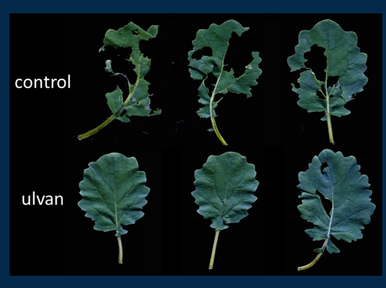
Growth of *L. maculans* hyphae in cotyledons.

Accumulation of hydrogen peroxide after aescin treatment.

Impact of ulvan on *Plutella xylostella* caterpillars´ preference

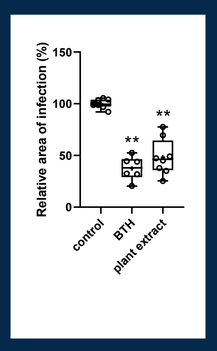


A choice test of ulvan treatment of true leaves of *B. napus* on *P. xylostella* preference.

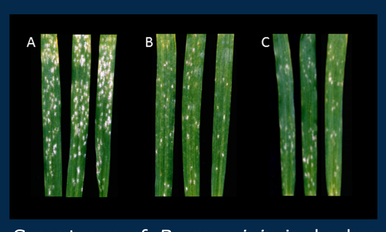


Damage of leaves caused by *P. xylostella* caterpillars after 48 h post infestation.

Plant extract protects barley from *Blumeria graminis* infection



Quantification of symptoms of *B. graminis*



Symptoms of *B. graminis* in barley leaves, A—control; B– BTH; C—plant extract

Prospective strategies:

- Induced resistance
  ⇒ Activation of plant´s immune system
  ⇒ Advantage—nonspecific
- "Green pesticides"
  ⇒ Botanicals, essential oils, algae extract
- Biostimulants
  ⇒ Improving plant fitness