BIOLOGIE DES ORGANISMES ET DES POPULATIONS

M2 bop - 2009-2010
proposition de stage

Encadrement :

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Titre du stage :

Are plants "smart defenders"? Local vs. systemic induction of defenses against root herbivores in maize

Résumé:

The immune system of plants is highly evolved and plays an important role in plant-insect interactions. Upon attack by herbivores, plants change their metabolism to become more resistant and increase their chance of survival. This also includes the synthesis of volatile compounds that attract natural enemies. While most of the energy is invested in the local response (i.e. in the defense of the attacked tissue), plants often also mobilize their defenses systemically (1). This phenomenon has been interpreted as an anticipative behavior, as attack of one leaf is likely to be followed by an attack on other aboveground parts.

However, this is not true in all cases. Many root herbivores for example do not attack leaves during their development, and it therefore seems counterintuitive that a plant should also start defending its leaves upon root attack. In accordance with this, we do find an induction of defenses systemically in the roots of *Zea mays* upon attack by the beetle *Diabrotica virgifera*, but no classical wound response in the leaves (2). Interestingly however, our preliminary results show that if the plants are mechanically damaged in the roots, they seem to be induces in the leaves as well. This points to a *specific response* of the plant to the root-herbivore, and suggests that if the plant recognizes that it is being attacked in the roots, it actively limits its response to where it is actually effective.

The project aims at answering the question if maize is indeed a "smart defender" as described above. To achieve this, the local and systemic defensive reaction of maize will be characterized after different types of root stress and compared to the "optimal scenario". The experiments will focus on the induction of indirect defenses in the roots and shoots of plants. Behavioural assays with entomopathogenic nematodes (roots) and parasitoids (leaves) will be conducted. The physiological basis for the effects will be elucidated using molecular approaches.

Références bibliographiques :

(1) Long-distance signaling in plant defence
Trends in Plant Science
Volume 13, Issue 6
Jurriaan Ton, Martin Heil

(2) Signal signature of aboveground-induced resistance upon belowground herbivory in maize
The Plant Journal
Early View, Date: April 2009
Matthias Erb, Victor Flors, Danielle Karlen, Elvira de Lange, Chantal Planchamp, Marco D'Alessandro, Ted C. J. Turlings, Jurriaan Ton

Techniques mises en œuvre :

Above and belowground olfactometer assays, volatile collection, GC-MS (liquid/SPME), quantitative PCR, HPLC

Compétences particulières exigées :

The candidate should be interested in the mechanistic basis and behavioral aspects of plant-insect interactions. Motivation to learn and apply a broad range of laboratory techniques (from insect behavior to molecular analysis) is necessary. As we are working with living organisms, the student should be flexible enough to work week-ends and evenings from time to time. English is an advantage, but not mandatory. The project furthermore calls for somebody who can think independently and show a creative approach to problem-solving. The duration of the project is 5-6 months.