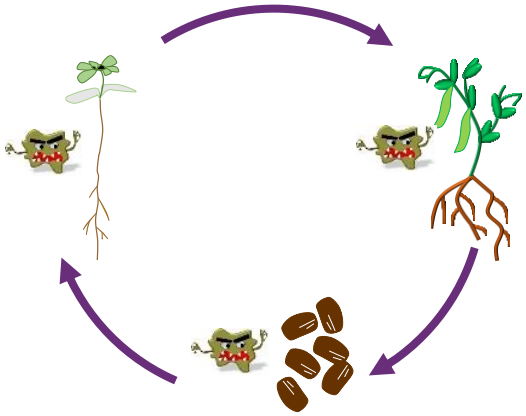
The innovation box of Objectif Végétal

Move closer to academic research to boost your potential of innovation!

n°5

Pathogenic agents transmitted by seeds
What innovative strategies of control?

- Phytopathogenic agents
- Biological control
- Microscopy
- Microbiota
- Metagenomics



- Transcriptomic
- Xanthomonas spp
- Alternaria spp
- Trichoderma spp

Last update: August 2017

Editorial

Hubert Lybeert
Researcher, seed pathology
HM Clause

« Selling a **healthy seed**, free from any disease that may develop from seedling to its harvest stage, is a **major concern of a seed company**. Indeed, the **financial implications** would be disastrous if a pathogen, through this vertical transmission path, would annihilate a crop, or even touch those of the surrounding plots.

Without obtaining **new varieties** that would resist to these parasites genetically, two solutions are available to the seed providers: **disinfection** and **seed treatment**.

Disadvantages and advantages of the two processes intersect rather well and they are very often associated. However, two major elements remain worrying.

1. The use of **"chemical" products** is increasingly regulated, and the permissible uses are increasingly reduced. In this area, **anything that is not allowed is prohibited**.
2. To make a seed perfectly "clean", the whole **seed microbiota** is set aside while it would have a **beneficial action** on its protection and perhaps on the bio-stimulation of the development of the seedling.

Seed producers, and more generally agriculture, need **innovative products that combine efficiency and respect** for human health and the environment. **Bio-control** of pathogens is being studied (plant extracts, bacteria, products derived from bacteria or yeasts ...) ; this is an essential solution for tomorrow. **Genomic research on microflora associated with seeds** should not be left out because of their "upstream" aspect. These two paths to explore are not only solutions for cleaner agriculture, they will bring about a necessary evolution. »

Looking for partners?

Two contacts to support your projects:

COMPANIES

Collaborative & innovative projects

EDUCATION

RESEARCH

Aurore Gauthier, contact to support your R&D projects and to put you through
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Tanegmart Redjala, close interface with the laboratories of the Research Federative Structure Quasav.
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THIS PROJECT IS CO-FUNDED BY THE EUROPEAN REGIONAL DEVELOPMENT FUND

Who work on this topic at SFR Quasav (federative research Structure on Plant quality and health) ?

Emersys team
Emergence, systematics and ecology of plant pathogenic bacteria

FungiSem team
Seed-borne fungal pathogens

ConserTo team
Conservation and Stress tolerance of seeds

SONAS unit
Substances of Natural Origin and structural analogues

Technical platform **Nucleic Analyses**

Technical platform of **Cell Imaging**

Technical platform **Phenotyping of seeds and plants**

Biocontrol agents that block the adaptive mechanisms of pathogens

Phytopathogenic agents face special conditions during their transmission through seeds: chemical stress and physical stress.

Chemical stresses

Defense metabolites (phytoalexins...), ROS →  Aadptive response of the pathogen: detoxification, wall strengthening and phytoalexin rejection.

- Identification of a phytopathogenic **fungal response mechanism** to phytoalexins: **reinforcement of the fungus wall**
- **Discovery of "sensitins"**, molecules inhibiting the strengthening of fungal walls (IRHS-SONAS patent, 2014).

Potential benefit:
Using sensitins for the treatment of seeds and seedlings, in synergy with plant resistance inducers (PRIs).

Physical stresses

Water and osmotic stress due to seed drying. →  Adaptive response of the pathogen: accumulation of Dehydrin like proteins (DLP).

- **FUNHY** project (2014-2016) – *funded by RFI Objectif Végétal* associated with the thesis of **Guillaume N'Guyen** (2012-2015).
- Identification of 2 response mechanisms of phytopathogenic fungi to **water stress**
  - The formation of eisosomes
  - The production of hydrophilins

Nemofy project including the thesis of **Justine Colou** (2016-2019) – *funded by RFI Objectif Végétal*
Study of the molecular factors involved in the transmission of phytopathogenic fungi to seeds (focus on **eisosomes**).

Potential benefit:
Develop strategies to inhibit this adaptive response of the pathogenic fungus.

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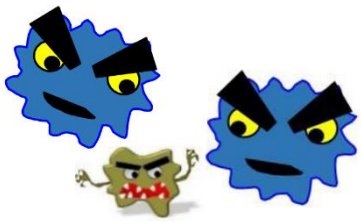
Biocontrol agents antagonistic to phytopathogenic agents



NABUCO project (2015-2018) – *funded by the French Ministery of Agriculture*
Identification of aggressive marine micro-organisms with phytopathogenic fungi.

Potential benefit:
Use these antagonistic agents in biological control on plants and seeds.

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The microbiota of seeds, a biodiversity to be exploited

➔ Microbial communities associated with seeds interfere with the transmission of pathogens.

MetaSEED project (2014-2016) **IRHS** – **HM Clause** – **Vilmorin** – *funded by Région Pays de la Loire*
associated with the thesis of **Samir Rezki** (2014-2017)

Unlike the phytopathogenic fungus *Alternaria brassicicola*, the phytopathogenic bacterium *Xanthomonas campestris pv. campestris* has no significant effect on the composition of the seed microbiota.

Potential benefit:

Develop more effective treatment products at lower doses, identify disease-resistant varieties.

The genotype of the plant does not significantly influence the composition of microbial communities. On the other hand, the work showed an effect of the production area on the composition of the microbiota.

➔ The genotype of the host plant does not seem to be a good lever to play on the compositions of the seed microbioal communities.

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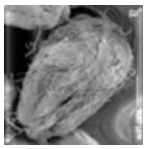
Where and when to bring the treatment ?

What are the factors, in the plant and the fungus, that control the transmission of the phytopathogenic fungus from the seed to the seedling?

➔ Patharaseed project (2014-2016) including the thesis of **Elodie Belmas** (2014-2017) – *funded by Un. of Angers*

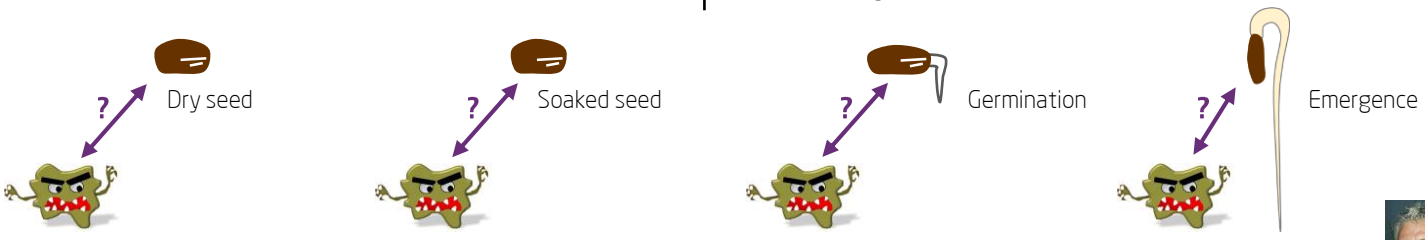
Pathosystem model: *Arabidopsis thaliana* – *Alternaria brassicicola*.



- To identify, by transcriptomic studies, the stages of germination where the seedling defends iitself most and where the fungus is the most aggressive.
- Locate the fungus in the seed during the germination stages (technical platforms **IMAC** and **SCIAM**).

Potential benefit:

Helping agro-suppliers develop more efficient products and apply them at the right time to reduce doses of treatments



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Health and germination, a compromise to be found!

➔ XanthoMed project (2015-2016) – *funded by INRA*

The seeds possess defense capacities against phytopathogenic agents. These defensive mechanisms vary from genotype to genotype, and can impact the acquisition of their germinative quality during their maturation phase.

Triggering of defense mechanisms ?

Development of the seedling ?

➔ BASIS project (2017-2018) – *funded by RFI Objectif Végétal*

- identify seed defense mechanisms,
- understand the physiological and molecular effects of these mechanisms on the germinative quality of the seeds.

Potential benefit:

To obtain seeds capable of defending against the phytopathogenic agents while minimizing the loss of germinative quality.

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OFFERS TO COMPANIES

Examples of topics for collaboration

- **Identifying mechanisms of adaptation of phytopathogenic agents** to the particular conditions prevailing in seeds and seedlings, to develop new biocontrol strategies
- **Looking for biocontrol agents** for seeds and seedlings
- **Developping methods for the detection** of phytopathogenic agents

SUCCESS STORY – the collaborative project DIAPOCAR (2012-2015)

Julie Gombert
FNAMS

« The Diaporthe / Phomopsis fungus causes an umbel disease that affects the production of carrot seeds. The DIAPOCAR project (CASDAR Sélection) involved public research (IRHS and GEVES-SNES), two seed companies (VILMORIN and HM-CLAUSE) and one technical institute (FNAMS). The project has helped deepen knowledge on the fungus and improve the methods of controlling the disease on carrots for seed production. »

Strenghten your R&D team by recruiting a **CIFRE PhD student** (financial support by ANRT and CIR), a **recent PhD graduate** (financial support by CIR) or a **working student** (in contract of professionalization or apprenticeship).

Training for enterprises

- Seed storage and storage
- Plant genetic resources: genetic diversity and valorization
- Plant Genetic Resources: collections management

Catalogue online : agrocampus-ouest/formation-tout-au-long-de-la-vie

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Catalogue online of **Ecole Supérieure d'Agriculture**
› groupe-esa/formation-tout-au-long-de-la-vie

Catalogue online of **Angers University**
› université-angers/formation-continue/Offre-de-formation

or share your needs with us!

Services

Need to know the **aggressiveness** of a microorganism? Need to evaluate the **impact** of a bio-aggressor on **germination** and emergence?
PHENOTIC SEMENCES & PLANTES phenotic@listes.univ-angers.fr

Need to **identify a bacteria**?
Collection of bacteria : cfbp@inra.fr
Cirm

Do you want to **identify a bioagressor** on seeds and evaluate **biocontrol** solutions ?
GEVES contact@geves.fr

Need to **evaluate the biocidal effect** of a product by nephelometry?
Centre R&D : innovation@vegepolys.eu

Patent licencing

WO/2014/012766A1

Potentiating agents for protecting plants from fungal infections

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Objectif Végétal, Research, Education & Innovation in Pays de la Loire is a regional program (2014-2019) established by the Pays de la Loire Regional Council and that involves the teaching and research institutions (Université d'Angers, leader of the program, Agrocampus Ouest, ESA, Inra, Université de Nantes) as well as the international French cluster Végépolys.
Objectif Végétal program mainly aims to reinforce the visibility of the regional centre for education and basic research, to boost translational research and reinforce the processes of economic valorization of research findings, and to develop international partnerships.

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