

# TRIANGLE

Project title: Triangular relationships between constitutive defenses, partial genetic resistance and efficiency of plant defense stimulators in apple

Acronym: TRIANGLE

Project duration: 36 months – Start date: 01/11/2017 End date: 31/10/2020

Key-words: basal defenses, constitutive expression, genetic variation, partial resistance, plant defense stimulator, RT-qPCR, genome-wide association mapping, QTL mapping, expression QTL, apple, scab, fire blight

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Summary:

**Context:** Apple is susceptible to numerous diseases and pests that request intensive chemical controls with much concern for human health and environment. Breeding new resistant varieties and/or stimulating plant defenses in commercial orchards are thus major stakes. Especially, increasing the level of basal defenses against a large range of bioagressors instead of focusing on complete resistance against particular ones is a major goal to efficiently decrease the number of treatments. We hypothesize that the constitutive level of basal defenses (i.e., before any induction) is driving the plant capacity to reach a sufficient resistance level to control a pathogen or pest attack, possibly with the help of Plant Defense Stimulators (PDS). The present PhD project will explore the triangular dependencies between constitutive defenses, partial genetic resistance and efficiency of plant defense stimulators in apple scab and fire blight which are two main diseases in commercial orchards. It will partly rely on the RFI-OV-funded project 'PREDIRE' (2016-2019) which aims at exploring the genetic variation of constitutive defenses thanks to expression QTL (eQTL) analysis, and on a supplementary QTL analysis of apple reactivity to PDS. It will also benefit from the 'FALDIM' project ("Formation of Apple- phytoalexins and their detection by laser desorption ionization and related methods") submitted to RFI-OV by SONAS +ResPom. The genomic resources recently developed in apple at IRHS Angers, the germplasm resources present on-site, and the skills of the involved teams in bioanalysis, quantitative genetics and functional analysis of defenses with or without PDS will allow the PhD student to efficiently develop this project.

**Goals:** The PhD student will address three sets of research questions:

- 1- What is the extent of the genetic variation of apple constitutive defenses? Can this variation be used as a predictor for partial genetic resistance to apple scab and fire blight?
- 2- What is the extent of the genetic variation of PDS efficiency in apple? Is this efficiency related to the levels of constitutive defenses and/or partial genetic resistance?
- 3- What are the genetic determinisms of apple constitutive defenses and PDS efficiency? Can we associate these determinisms with partial resistance determinism, candidate genes and possibly metabolites?

**Methodology:**

- Analysis of the constitutive expression of selected defense-related genes thanks to RT-qPCR using consensus primers designed to be conserved over a large core collection of apple cultivars
- Phenotyping of scab and fire blight resistance of the apple cultivars and of a F1 progeny preliminary treated or not by the PDS Bion and further inoculated under controlled conditions (greenhouse)
- GWAS (Genome-Wide Association Studies) and detection of eQTLs in the core collection + QTL analysis in a F1 progeny for apple reactivity to PDS.