LES APPORTS DE LA GÉNOMIQUE À L'AGROÉCOLOGIE

MARDI 27 MARS 2018

AGROPOLIS INTERNATIONAL
MONTPELLIER

AGENCE NATIONALE DE LA RECHERCHE
ANR

MARDI 27 MARS 2018
AGROPOLIS INTERNATIONAL
MONTPELLIER

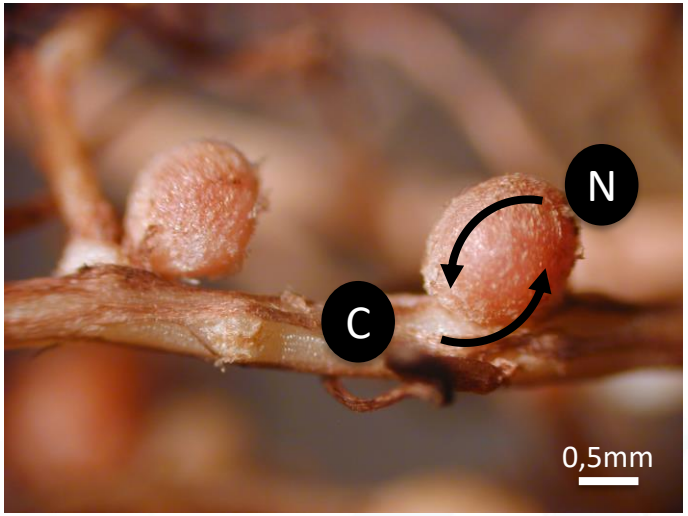
Catherine MASSON-BOIVIN

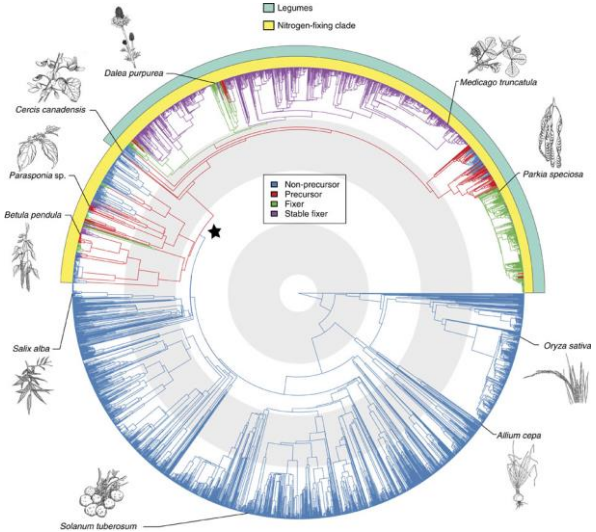
INRA-CNRS

REPLAY

Replaying the evolution of rhizobia: towards a conceptual and practical framework for the design of new nitrogen-fixing plant symbionts

AGENCE NATIONALE DE LA RECHERCHE
ANR

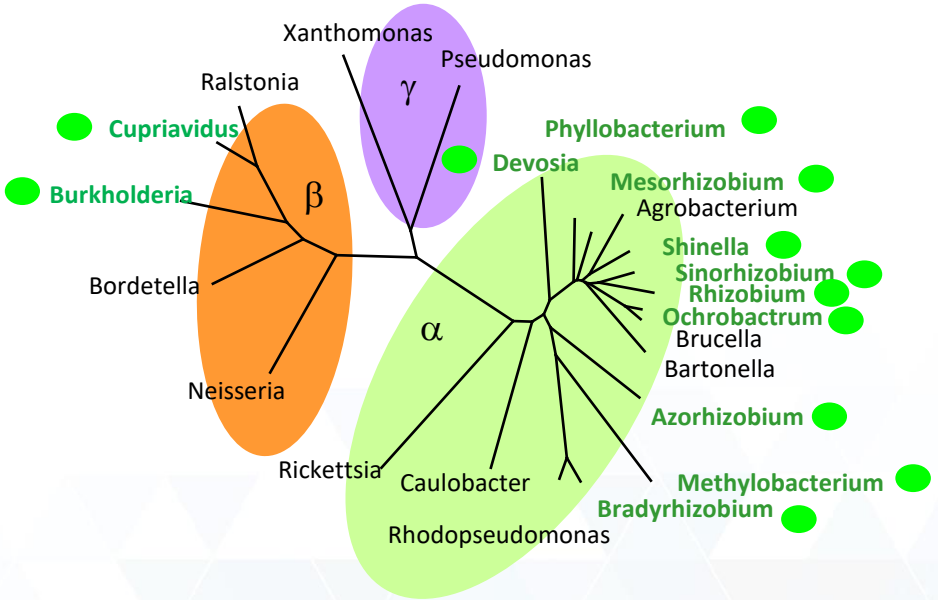

N
C
0,5mm



Symbiotic N2-fixation arose ca. 100 MYA in Angiosperms

Werner et al Nat Com 2014

● Symbiosis genes (*nod-nif*)



Symbiotic N2-fixation have spread to many α- and β-proteobacterial genera

Masson-Boivin et al TIM 2009

AGENCE NATIONALE DE LA RECHERCHE
ANR

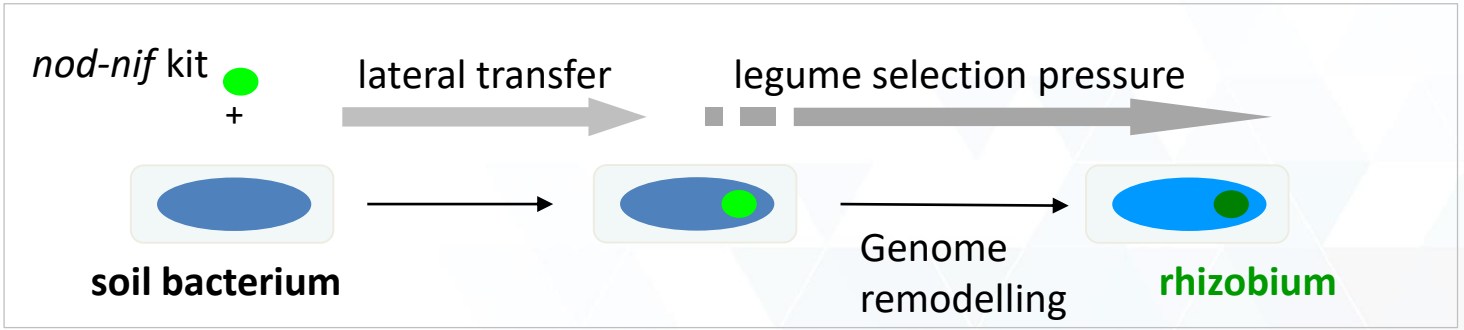
Objectifs

Comprendre les mécanismes évolutifs ayant conduit à l'émergence de symbiotes de légumineuses

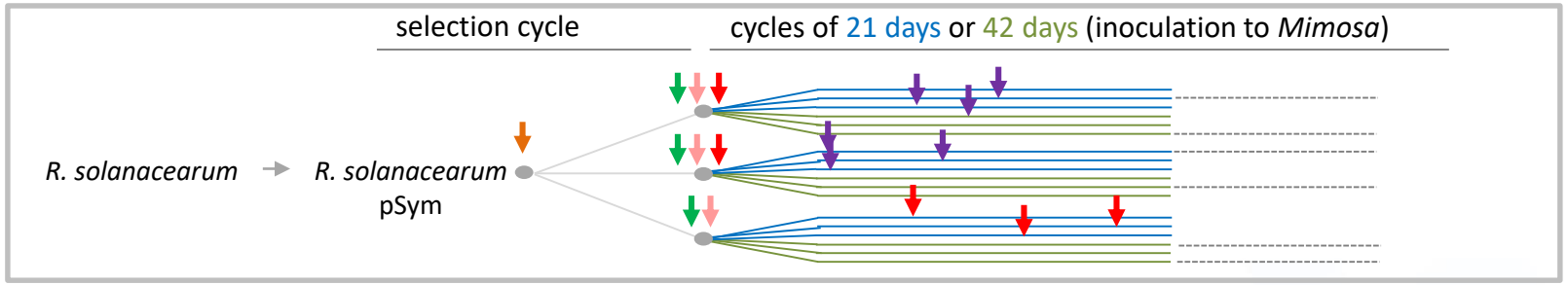
Développer un cadre conceptuel et pratique pour l'évolution de nouveaux symbiotes fixateurs d'azote

Strategy

Rejouer et analyser l'évolution d'un rhizobium en laboratoire

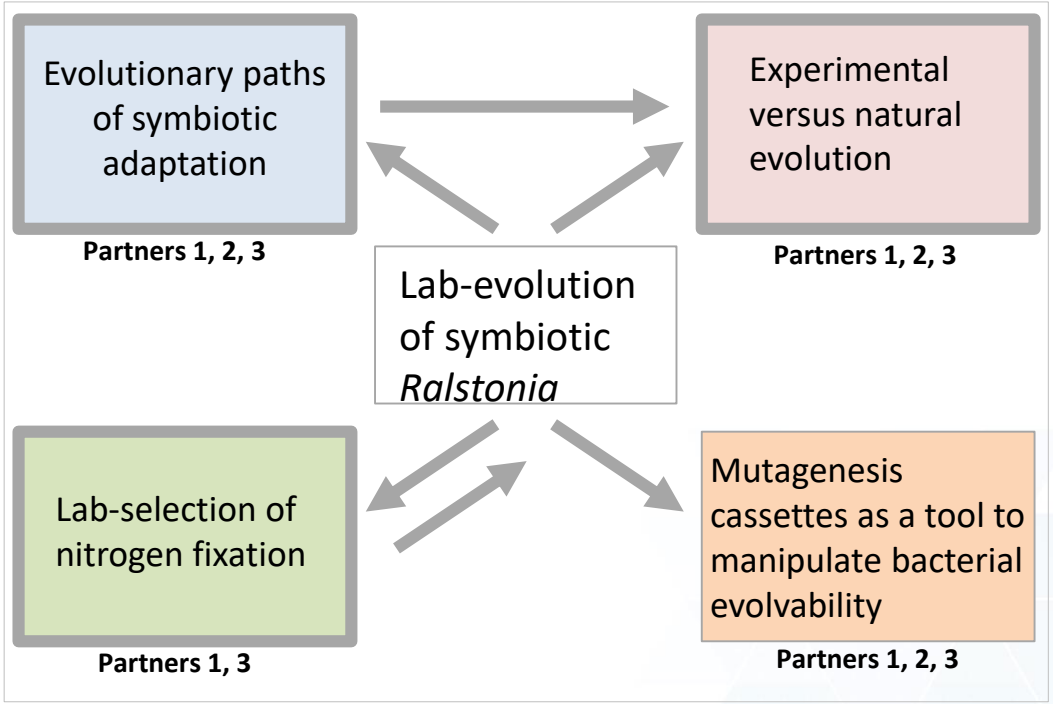


Strategy


selection cycle
cycles of 21 days or 42 days (inoculation to *Mimosa*)
R. solanacearum
R. solanacearum pSym


Infection site
Nodulation
Extracell Infection
Intracell Infection
Nice Infection

Objectifs spécifiques



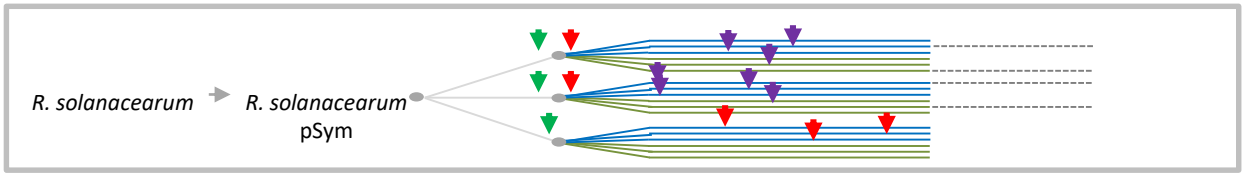
Partner 1
LIPM TOULOUSE)

Partner 2
Institute Pasteur PARIS (E Rocha)

Partner 3
CEA-Genoscope EVRY (S Cruveiller)

AGENCE NATIONALE DE LA RECHERCHE
ANR

Task1 Evolutionary paths of symbiotic adaptation



Nodulation

Infection +

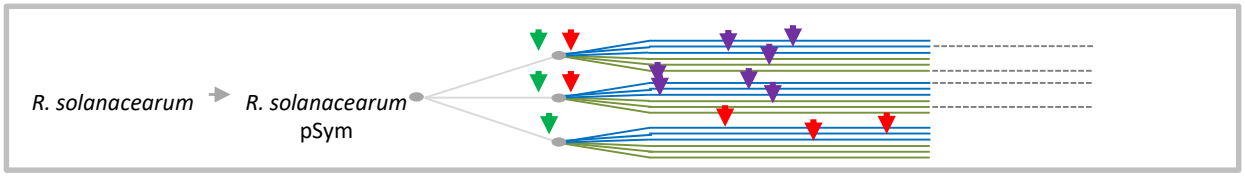
Infection ++

- ✓ Phenotypic shifts
- ✓ Sequencing (Illumina)
- ✓ Genetic reconstruction
- ✓ Phenotype-genotype

Capela et al MBE 2017

AGENCE NATIONALE DE LA RECHERCHE
ANR

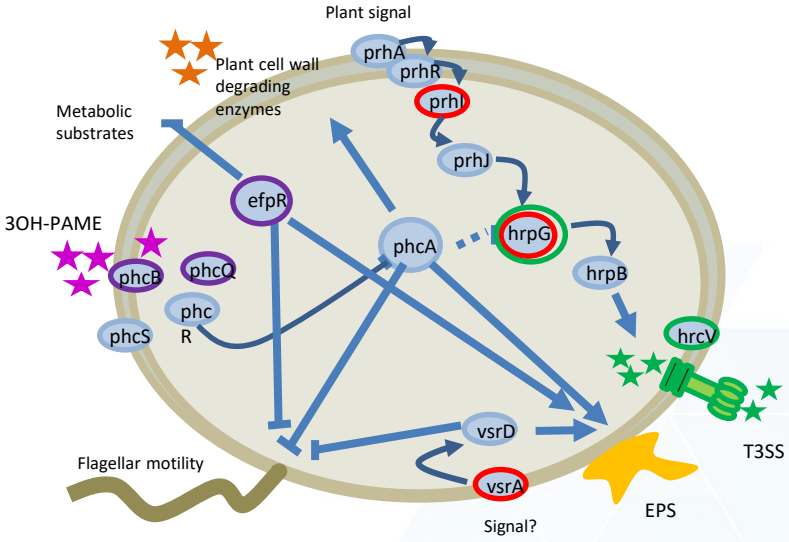
Task1 Evolutionary paths of symbiotic adaptation



Nodulation

Infection +

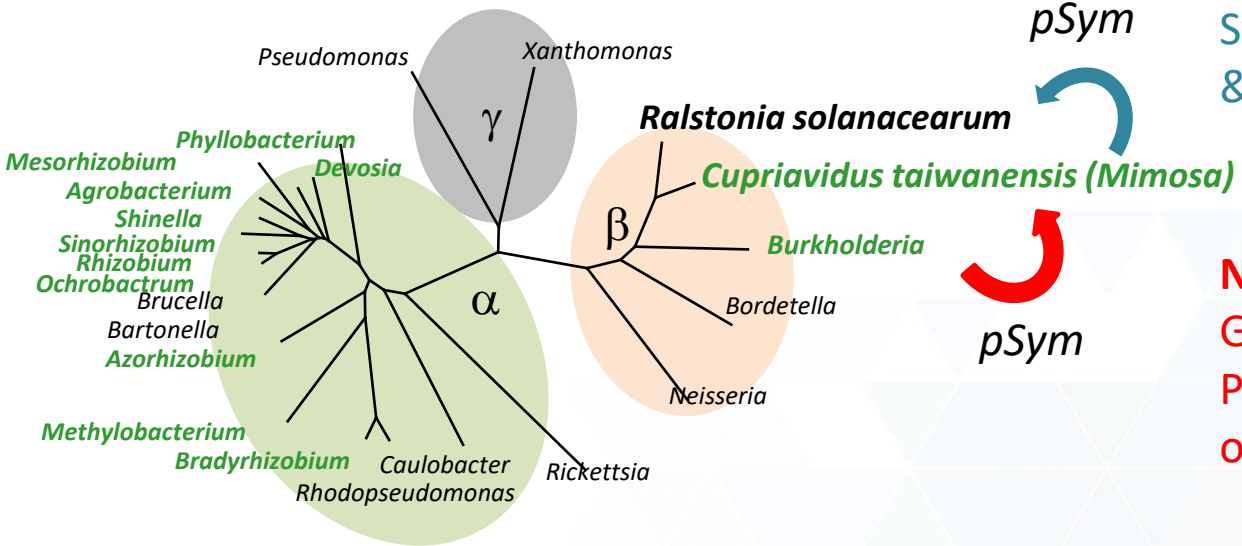
Infection ++



Capela et al MBE 2017

Unpublished data

Task3: Experimental versus natural evolution



pSym

pSym

Lab evolution
Synthetic Biology
& experimental evolution

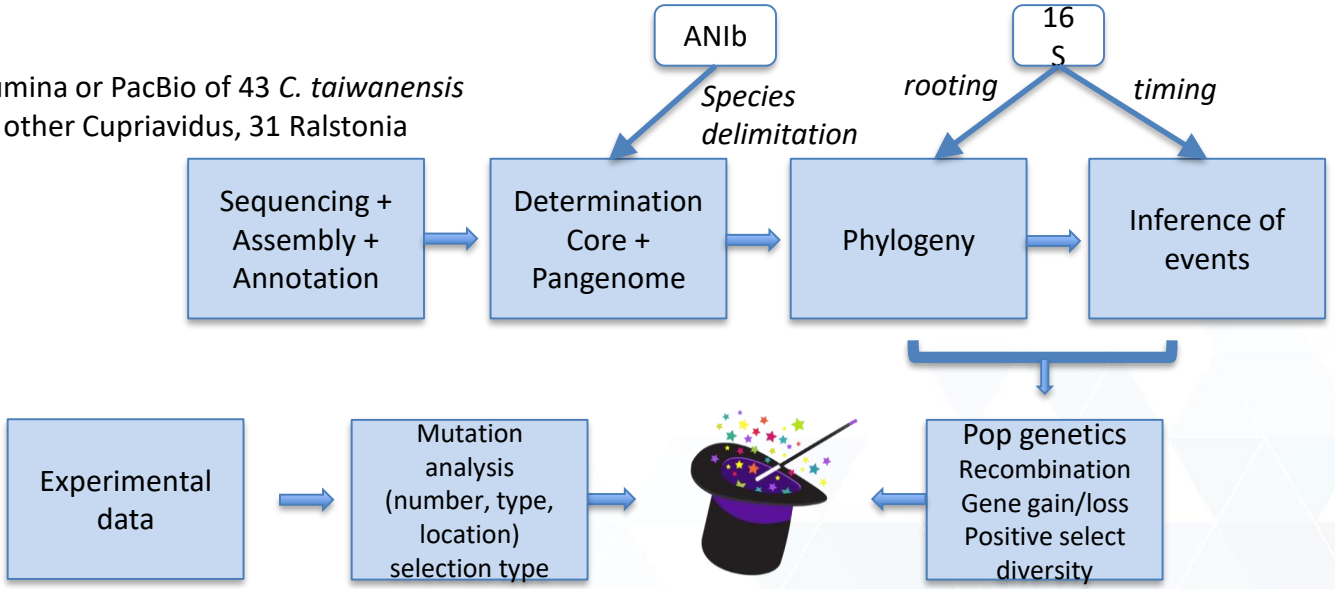
Natural evolution
Genome sequencing
Population genetics
of 58 Cupriavidus

AGENCE NATIONALE DE LA RECHERCHE
ANR

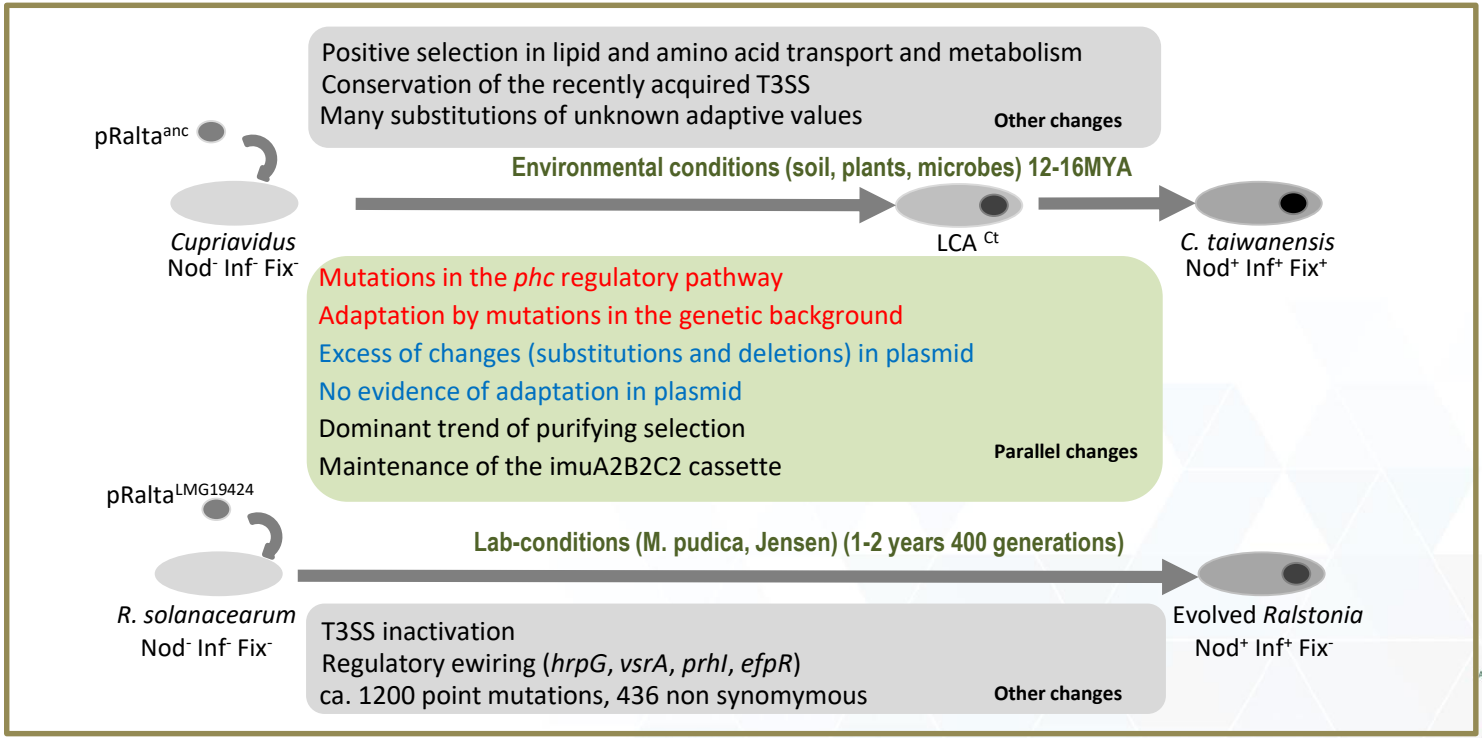
The two processes differed in fundamental points

	Experiment	Natural evolution
genus	*Ralstonia*	*Cupriavidus*
lifestyle	pathogen	saprophyte
conditions	simplified and controlled	complex and changing
time span	1-2 years	12-16 MY
mutualism	no	yes

Illumina or PacBio of 43 *C. taiwanensis*
15 other Cupriavidus, 31 Ralstonia



Task3: Experimental versus natural evolution



Clerissi et al, in revision

Impacts

A fundamental research project.

A better understanding of the evolution of rhizobia

Exploring pathogenesis-symbiosis relationships and transition

Exploring strategies for plant-mediated selection experiments

LIPM Toulouse

Delphine Capela

Marta Marchetti

Benoit Daubech

Jacques Batut

Tang Mingxing

Caroline Raboin

Lukas Brichet

Collaborations

Camille Clerissi

Eduardo Rocha, Institut Pasteur Paris

Stéphane Cruveiller, Genoscope Evry

Olivier Bouchez, GeT Plage, Toulouse

Cécile Pouzet, Imaging platform, Toulouse

Philippe Remigi, Massey University

Chaitanya Gokhale, Max Planck Ploen