Journée Scientifique BASC 28 janvier 2021

Axe “comprendre et gérer la dynamique de la diversité biologique”

Evofungi (2013-2016)

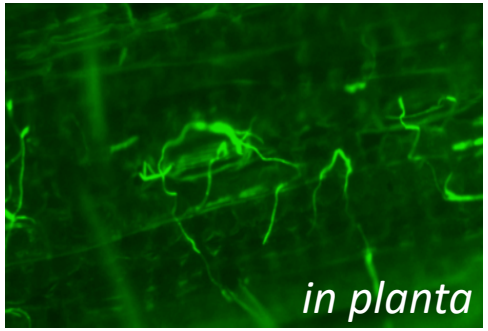
Partner 1: Anne GENISSEL, UMR BIOGER, INRAE

Partner 2: Arnaud LE ROUZIC, UMR EGCE, CNRS

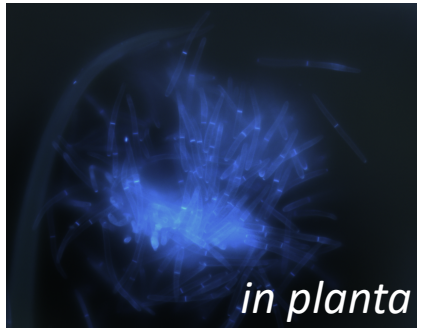
Assessing the evolvability of a pathogenic fungus in the context of global change

- **Context**: Important challenge is to understand the effects of environmental variation on pathogen evolution
- **Questions**: What is the role of phenotypic plasticity in adaptation? Is fluctuating environment a driver of plasticity?
- **Model**: *Zymoseptoria tritici*

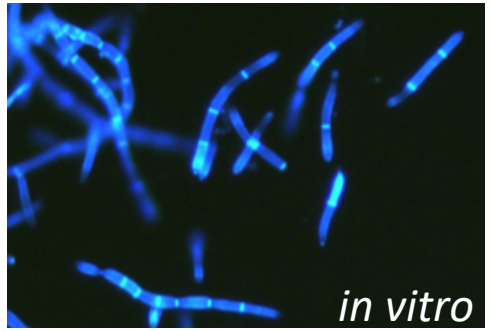
Hyphae on wheat leaf



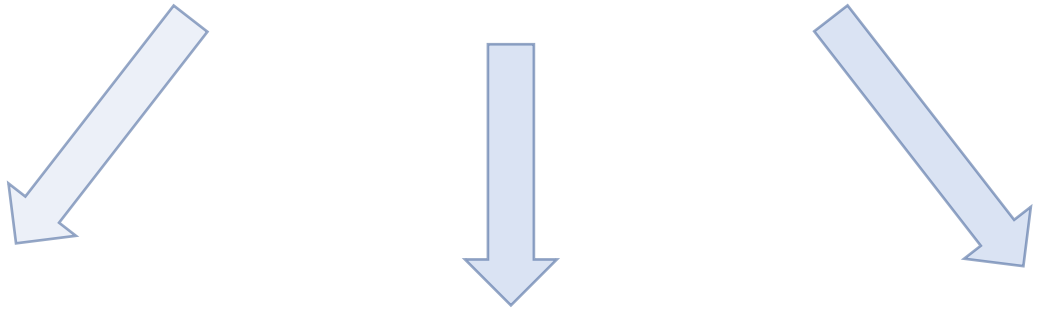
Pycnidia



Micro-pycnidiospores



Evofungi (2013-2016)

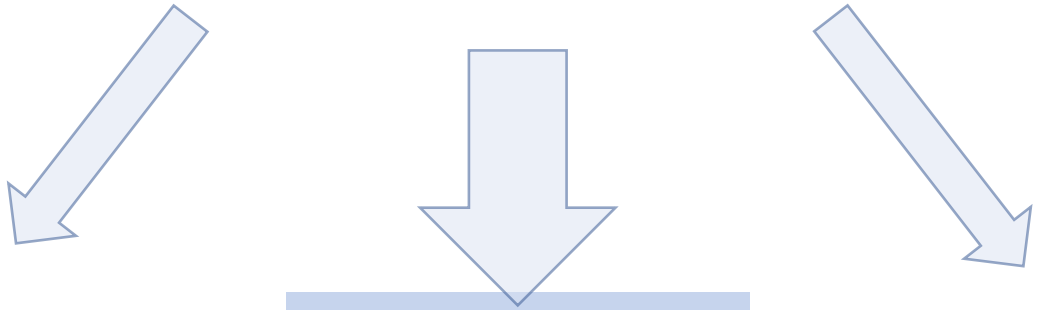


Evofungi (2013-2016)

PROJECT

- First experimental evolution in fungal pathogen
- Tackle fundamental questions

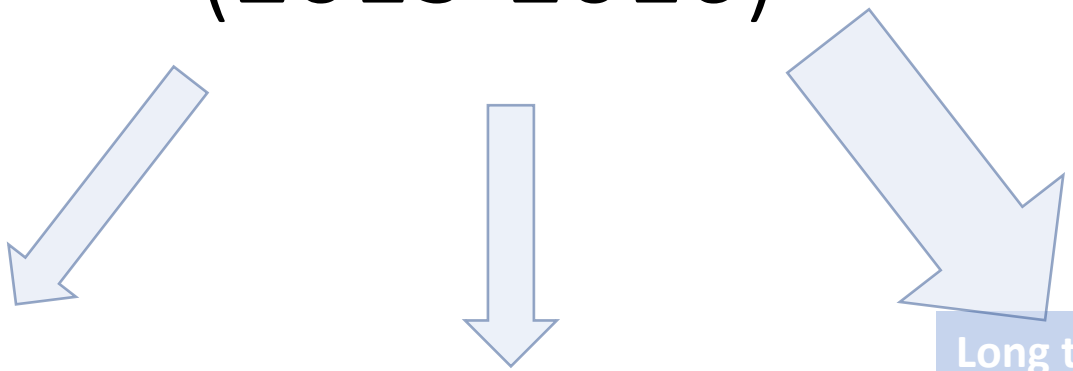
Evofungi (2013-2016)



Short term outcomes

- New collaboration
- Master
- PhD (SEVE)

Evofungi (2013-2016)



Long term outcomes

- Lasting collaboration
- New Research
- ANR proposals

Experimental design for Evofungi

Serial transfers over a year

G0 Gn G500

Cool 17C

fluctuating 17-23C

Warm 23C

Pathogeny

Fitness

RNA seq at 17C & 23C

DNA seq at 17C & 23C

2 clones

3 replicates

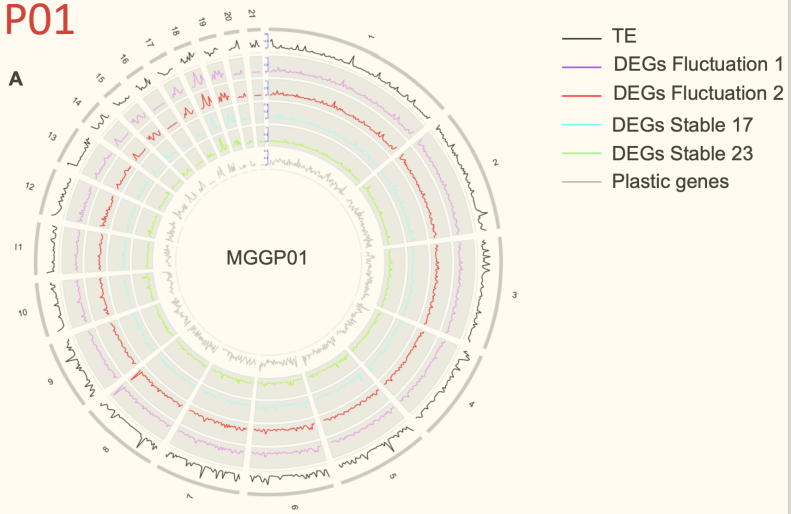
Results and interpretations: A. Jallet's PhD

- Thorough description of **gene expression** variation due to temperature using **Experimental Evolution**

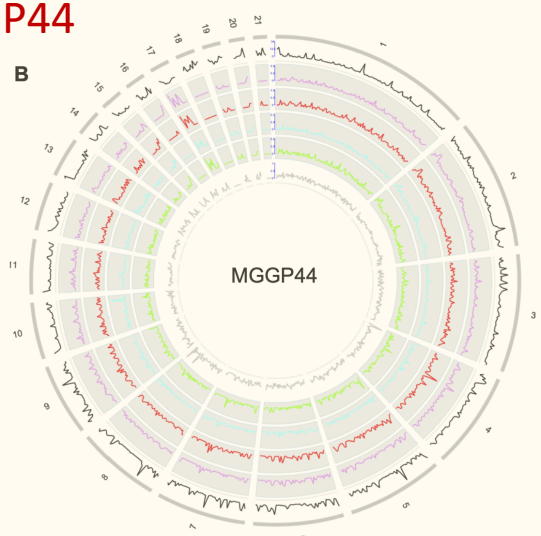
Arthur Jallet, now Postdoc at I. Bravo's lab, Montpellier

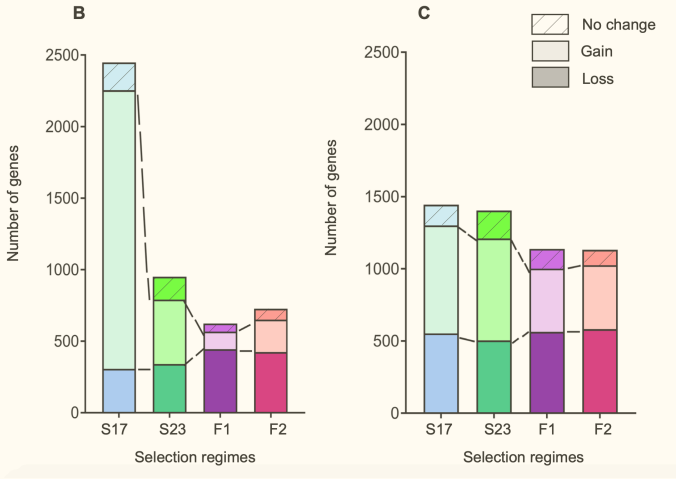
Transcriptome evolution under fluctuations

MGGP01



MGGP44



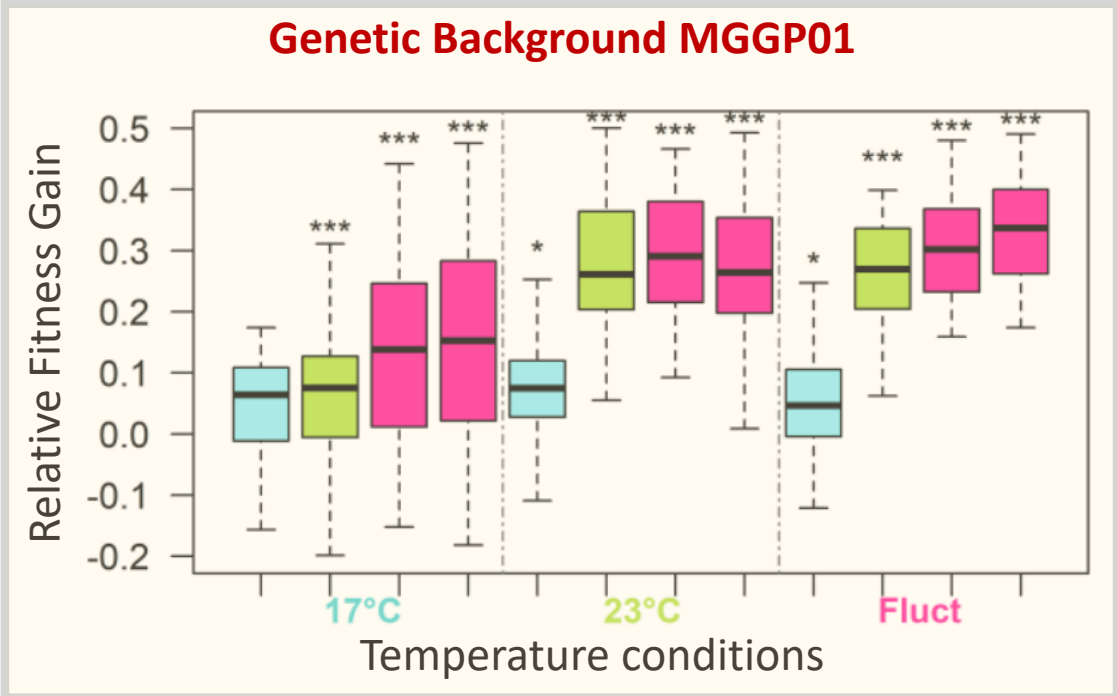


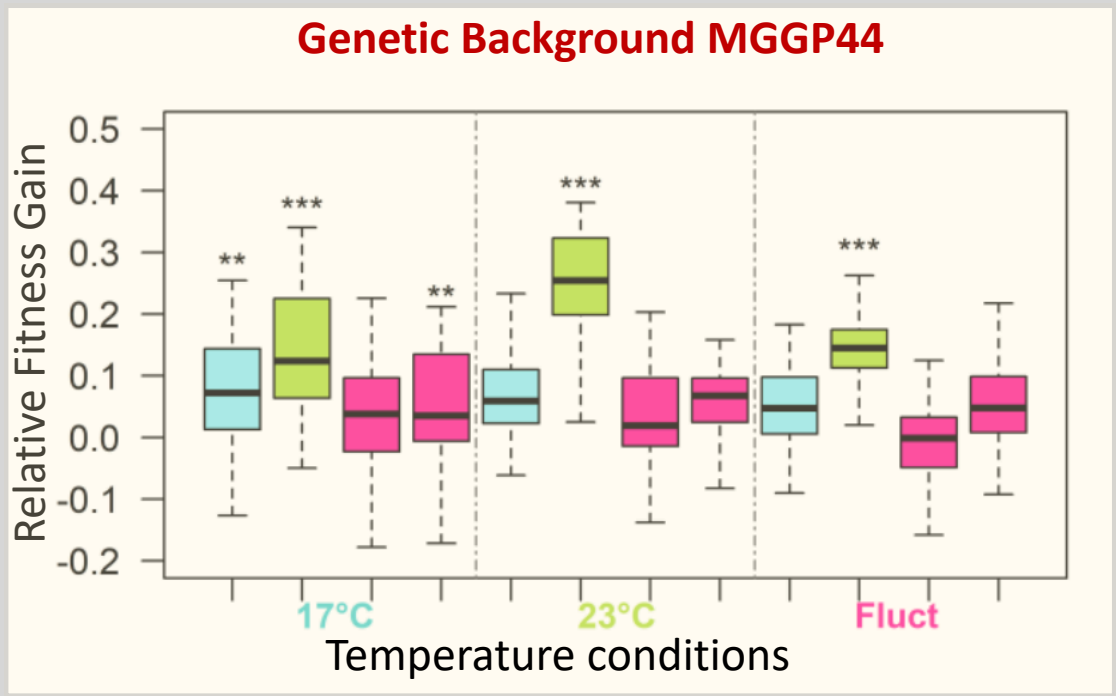
- ~ 10% of transcriptome responded to the fluctuating regime
- often localized in genomic regions enriched in TE

- Evolution towards a loss of plasticity under fluctuations

Jallet, Le Rouzic & Genissel, Front. Microb. 2020

Fitness evolution

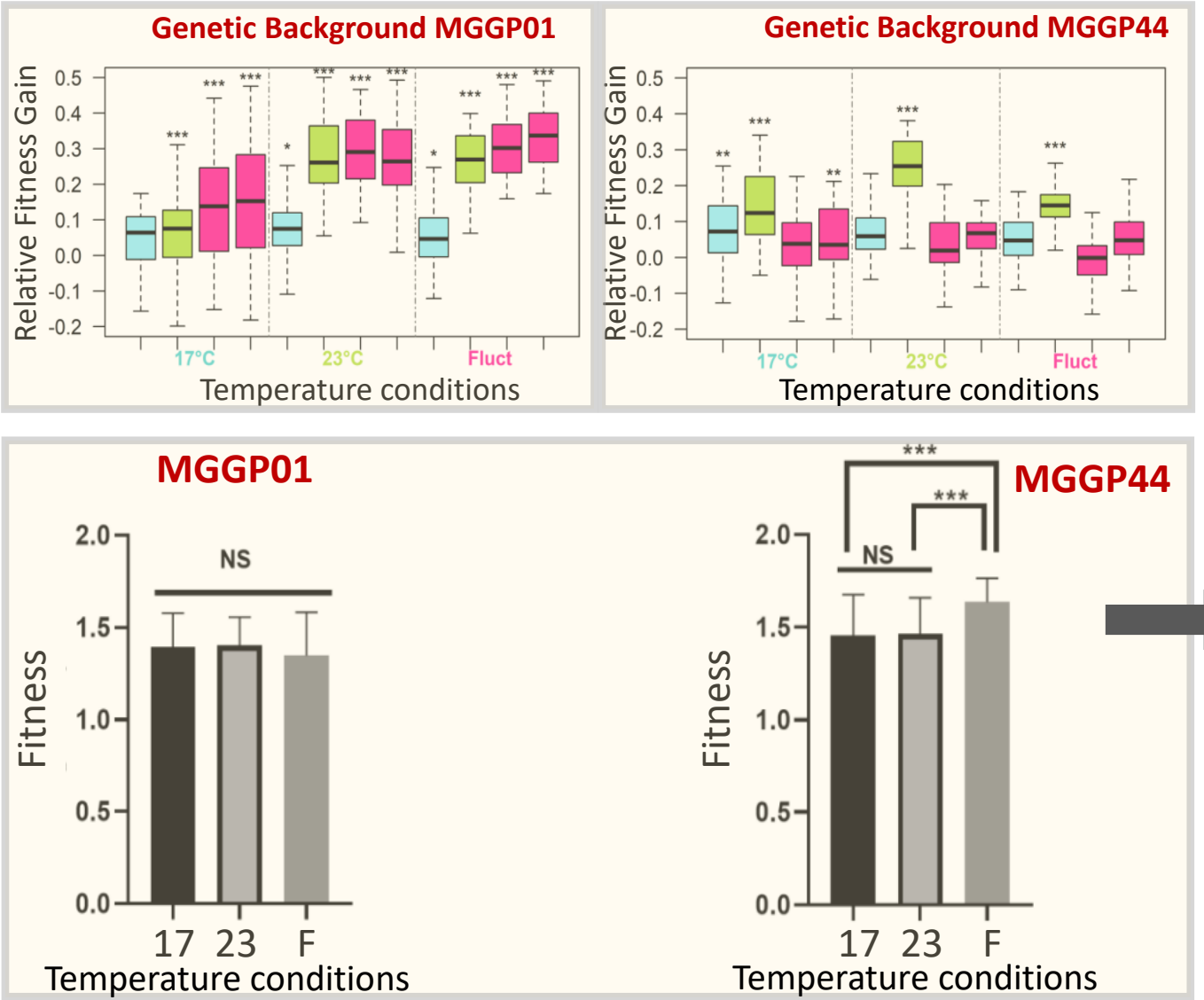




- Evolved generalists: gain of fitness regardless of the condition tested

Jallet et al. in prep

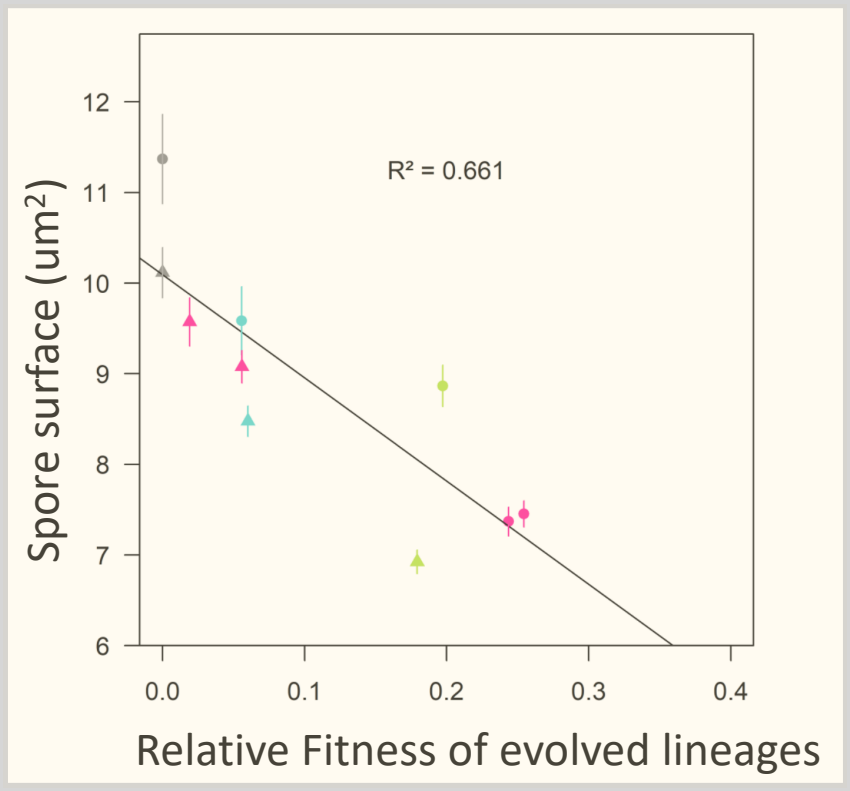
Fitness evolution



Greater fitness under fluctuations

Jallet et al. in prep

Body size matters



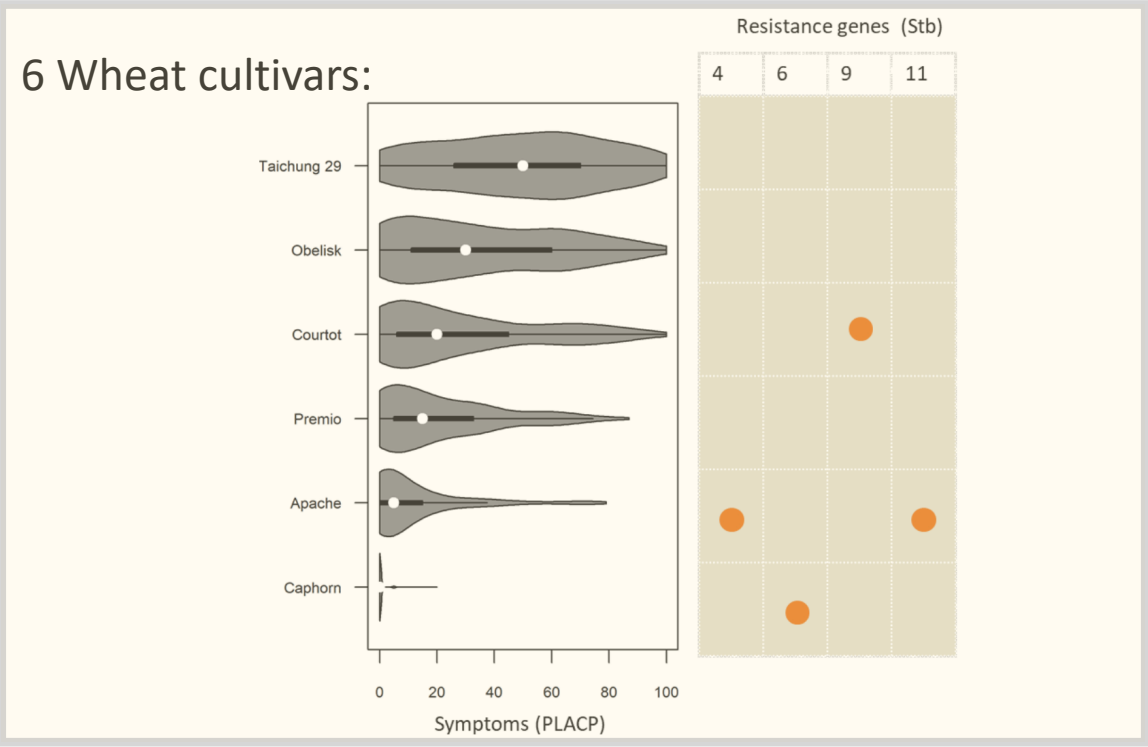
➢ Adaptive evolution with a reduction of spore size

- Is there a common genetic basis or different evolutionary changes led to the same phenotypic evolution?
  ...Some candidates are currently tested

- Pleiotropic effects or direct selection on the trait?

Consequences on disease symptoms

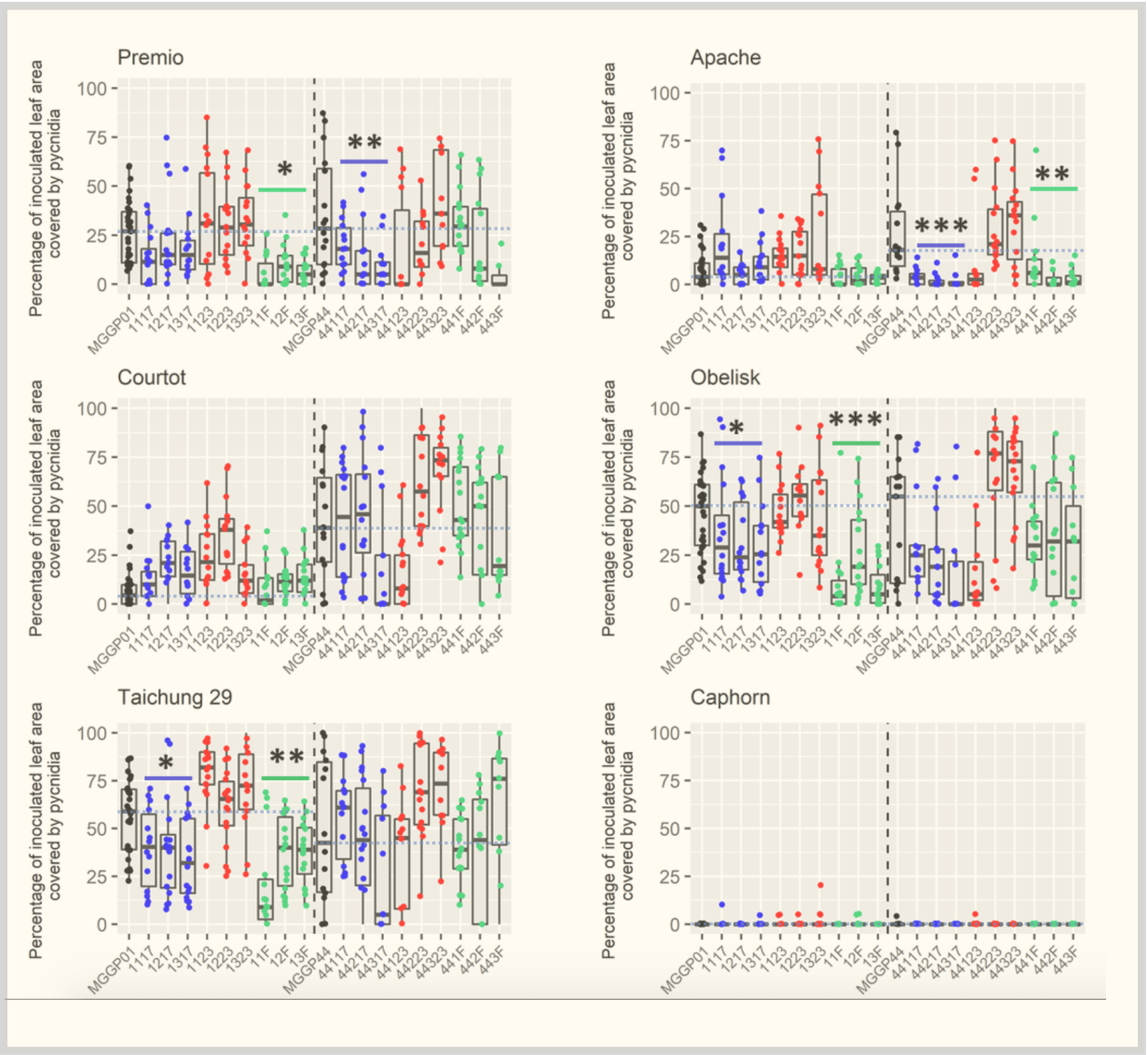
- After a year of evolution with no host we expect that pathogeny may decrease due to relaxed selection pressure
- Are different regimes influencing mutation accumulation and what is their effect on pathogeny?



➢ Differential of disease symptoms among wheat genotypes

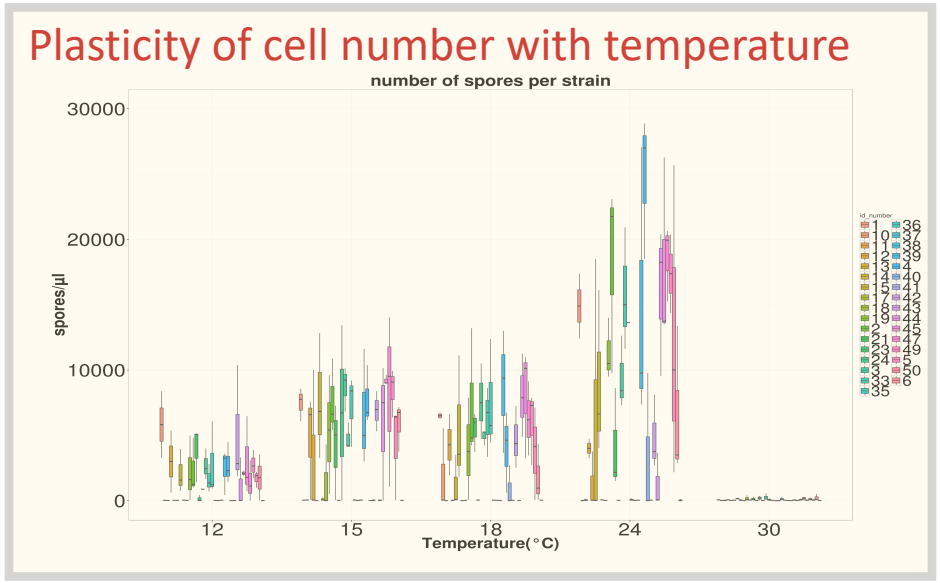
Jallet et al. in prep

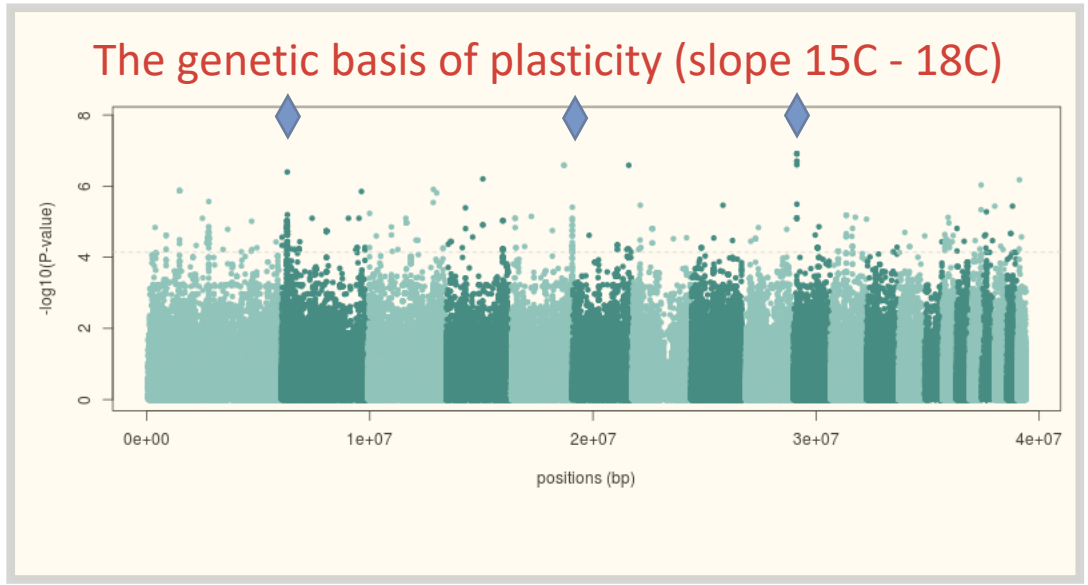
Decrease of disease symptoms in evolved lineages



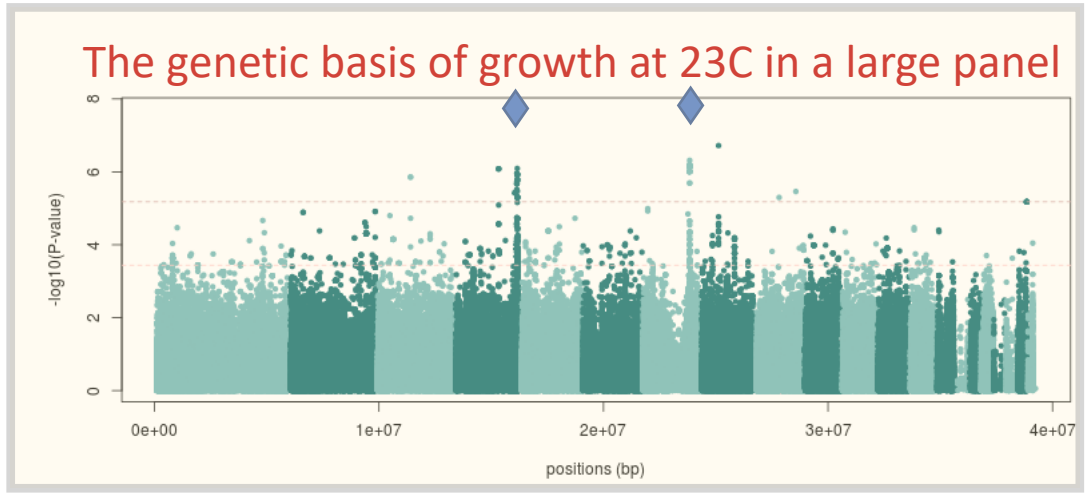
- Some significant decrease of symptoms, no evidence for a link with the selection regime
- No correlation with fitness gain measured *in vitro*
- Trans-lineage segregating mutations in the genome, notably mutations in effector proteins.
- No loss of dispensable chromosomes occurred during the experimental evolution after 500 generations

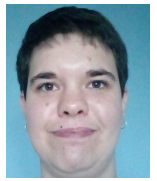
More projects linked to Evofungi: Finding the heritability for the phenotypic plasticity





Maroua Bouzid (2013)



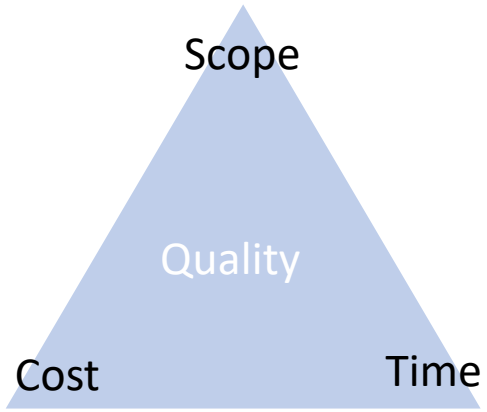


Amandine Bonnet (2015)

- Genetic basis of plasticity is hard to detect
- Need to develop high-throughput and precise phenotyping

Labex Grant: unprecedented stimulus

- Excellent for the establishment of new research
- Positive long term effects



Thank you for attention