Let's find more resilient trees to reduce the use of phytosanitary products in orchards

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INRAE
GAFL INRA AVIGNON
agropolis fondation Pour la Recherche Agronomique et le Développement Durable

Designing resilient stone fruit trees via integrative phenotyping in low phytosanitary input orchards and Association genetics

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Context:

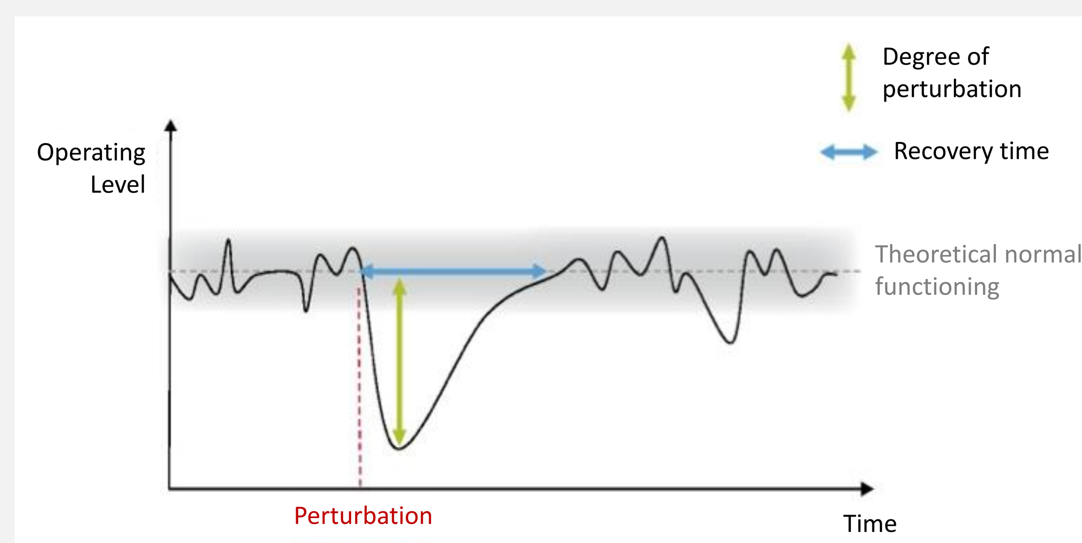
Stone fruit tree orchards suffer from attacks by multiple pests and diseases

Few varieties bear resistance genes and phytosanitary products remain the most effective means of control

There is an urgent societal and environmental demand to reduce pesticides

WE NEED **RESILIENT VARIETIES** i.e. varieties able to cope with biotic perturbations

The mobilization of the diversity of genetic resources is a promising lever to create resilient varieties



Schematic representation of a resilient individual adapted from Toubin et al. 2021

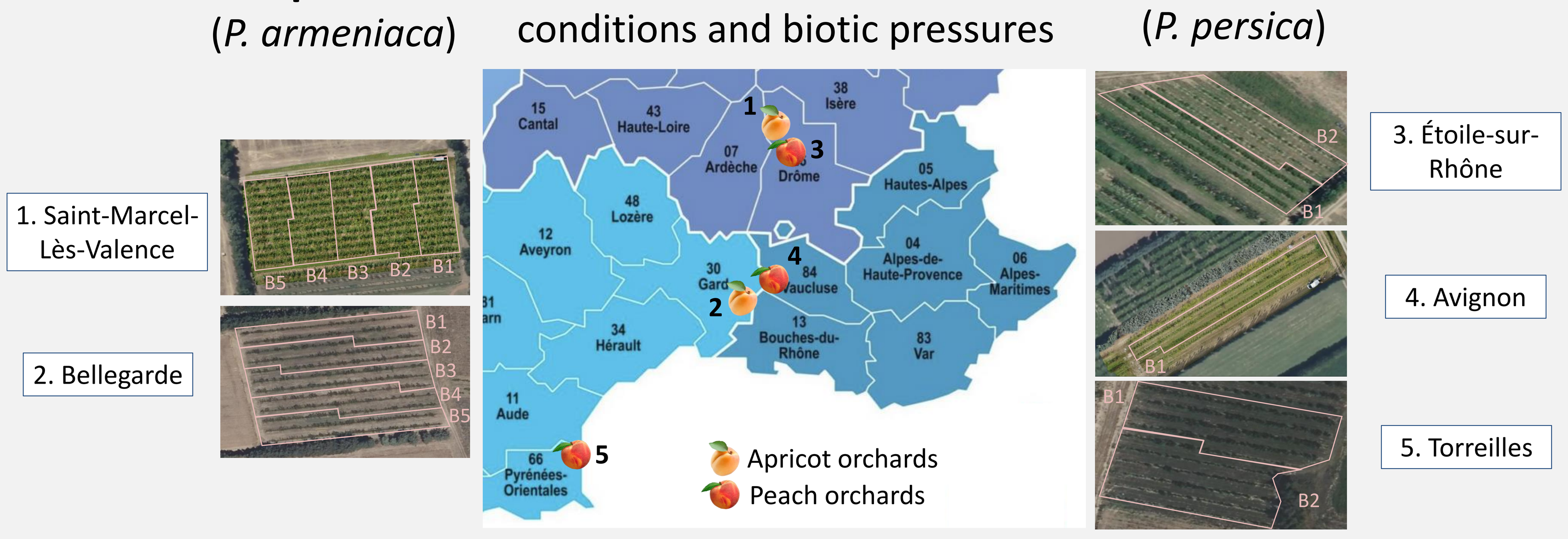
The major objectives are to:

- Uncover the fundamental principles of resilience in stone fruit
- Find genetic markers associated to resilience and resistance/tolerance to major pests and diseases
- Identify potential resilient individuals useful for pre-breeding activities

Experimental design

2 core collections with a large genetic diversity from various geographical origins

Apricot (*P. armeniaca*) | contrasting environmental conditions and biotic pressures | **Peach** (*P. persica*)



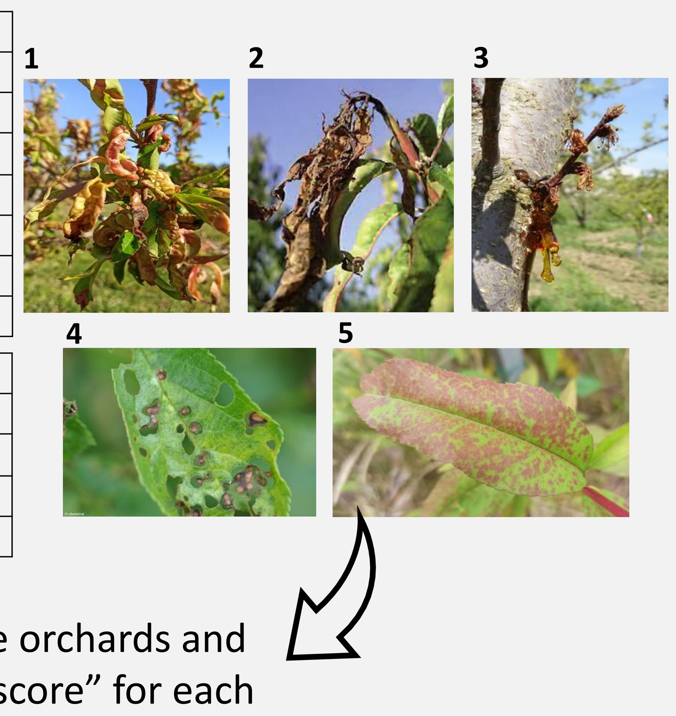
150 unique accessions replicated in 5 blocks planted in 2017 and 2018

206 unique accessions replicated in 1 or 2 blocks planted in 2019

Management method: Low and targeted phytosanitary protection

Observations performed

		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Peach	Leaf curl 1				↔	↔	↔						
Peach	Aphids				↔	↔	↔	↔					
Peach	Shot hole 4					↔	↔	↔	↔				
Peach	Powdery mildew						↔	↔	↔	↔			
Peach	Leafhopper 2						↔	↔	↔	↔	↔		
Peach	Twig dieback							↔	↔				
Peach	Rust 5								↔	↔	↔	↔	
Apricot	Brown rot 3				↔								
Apricot	Bacterial canker				↔	↔	↔						
Apricot	Shot hole 4					↔	↔	↔	↔	↔			
Apricot	Powdery mildew						↔	↔	↔	↔			
Apricot	Rust 5							↔	↔	↔			

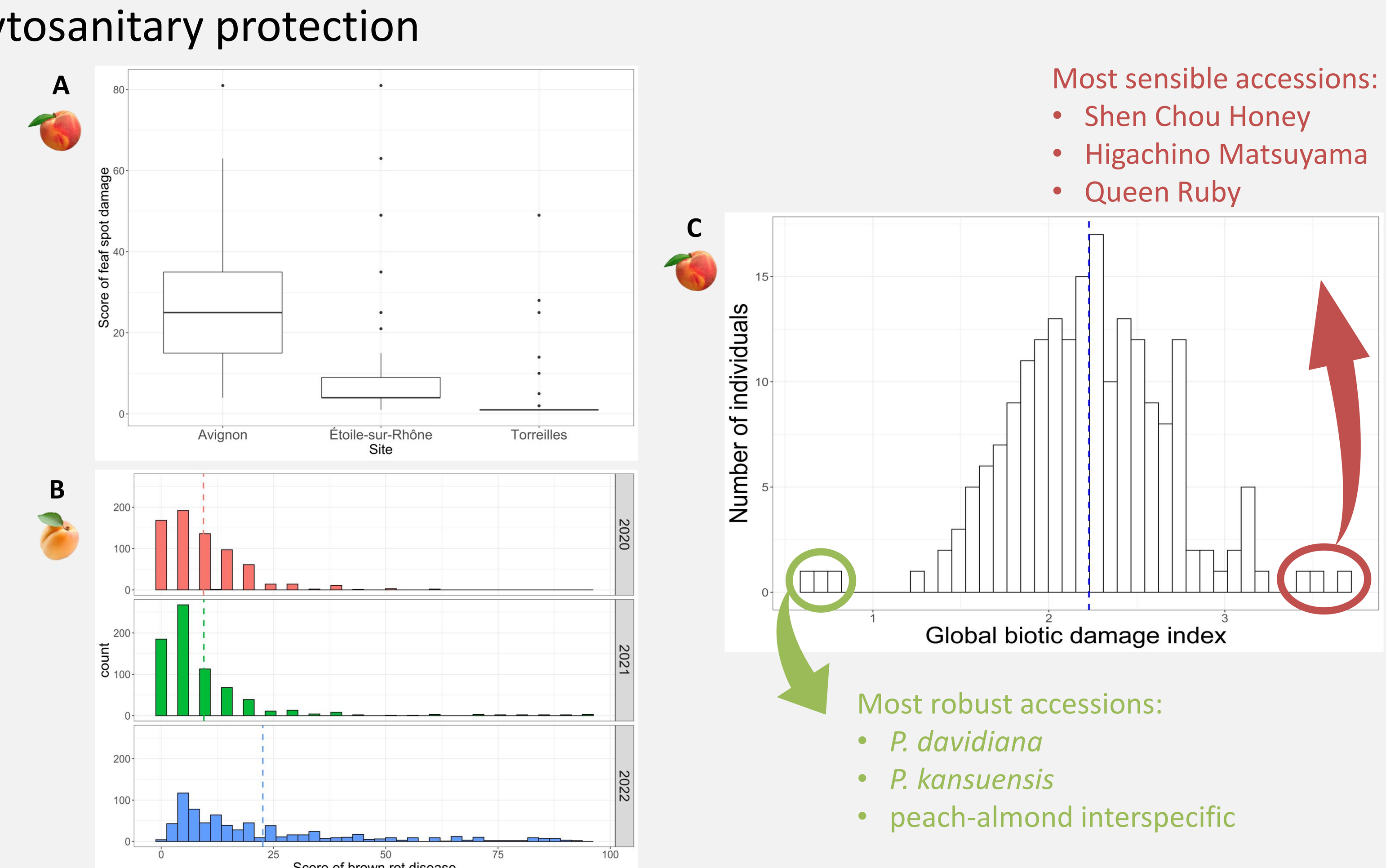


Visual observations in the orchards and attribution of a "damage score" for each pests and diseases observed

Special Thanks to SEFRA and SICA-Centrex experimental research stations, UE AHM and UERI Gotheron from INRAE for the implantation and maintenance of the peach and apricot core collections

Preliminary results

- Broad and differentiated phenotypic response: observed heterogeneity of genotype sensibility to pests and diseases
- Strong effect of the environment: necessity of multi-environment trials
- Identification of more « robust » accessions which seem suited to low phytosanitary protection



(A) Boxplot of leaf spot damage scores in 2021 for the three sites for peach. (B) Histogram of brown rot damage scores in Saint-Marcel-Lès-Valence from 2020 to 2022 for apricot. (C) Histogram of the 2021 global biotic damage index for peach (i.e. sum of the damage score of all the pests and diseases observed for each accession this year)

Perspectives

- Multi-annual and multi-trait analyses: quantifying the annual impact of biotic stresses on tree health
- Studying the interaction between pests and diseases
- Identifying indicators to quantify resilience: vegetative growth, fruit production, photosynthetic activity, etc.
- Develop methods for genome-wide association studies (GWAS)
- Compare resilience traits between peach and apricot: interpretation of biological significance and implications for breeding