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MINISTÈRE DE L'ENSEIGNEMENT SUPÉRIEUR, DE LA RECHERCHE ET DE L'INNOVATION
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AGENCE NATIONALE DE LA RECHERCHE
ANR

Vitae - Cultivating the grapevine without pesticides : towards agroecological wine-producing socio-ecosystems

François Delmotte, INRAE / Hervé Hannin, SupAgro

Kick-off meeting, 23 Septembre 2020

Why a project on vine and wine ?

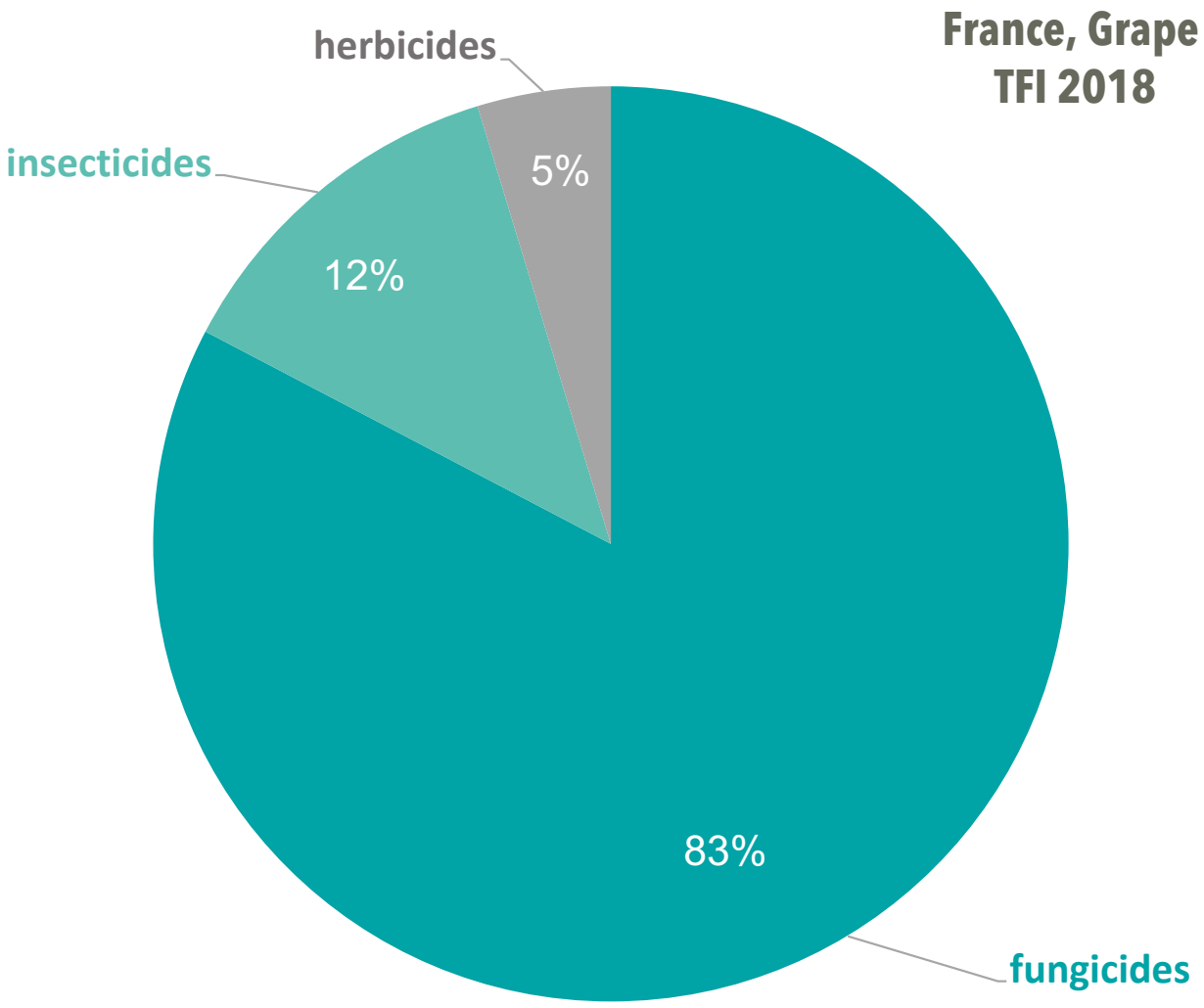
Vine and wine is an important element of French economy and culture

3% of agricultural area

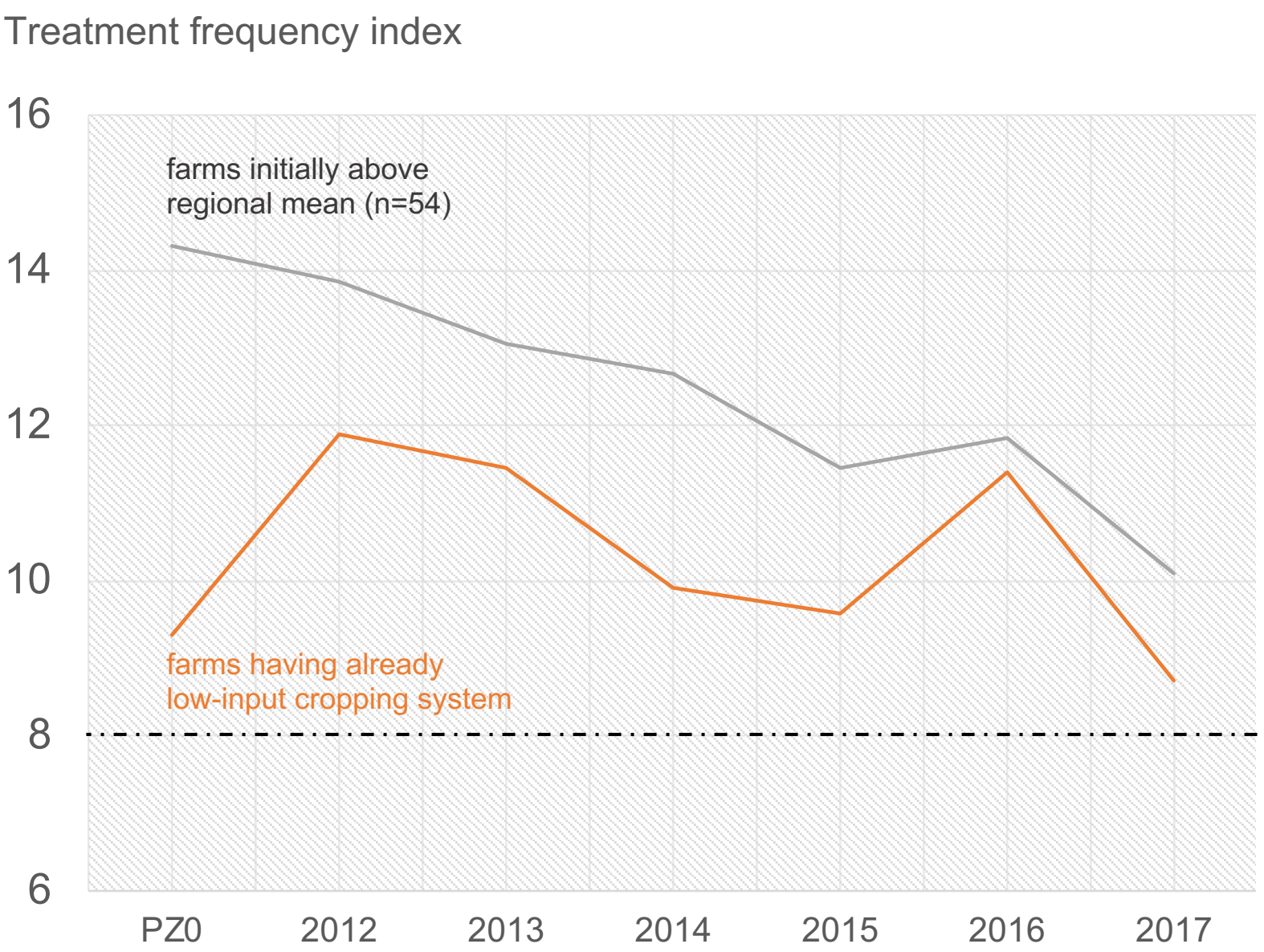
15% of value production

20% of pesticides

Mainly fungicides against powdery & downy mildews



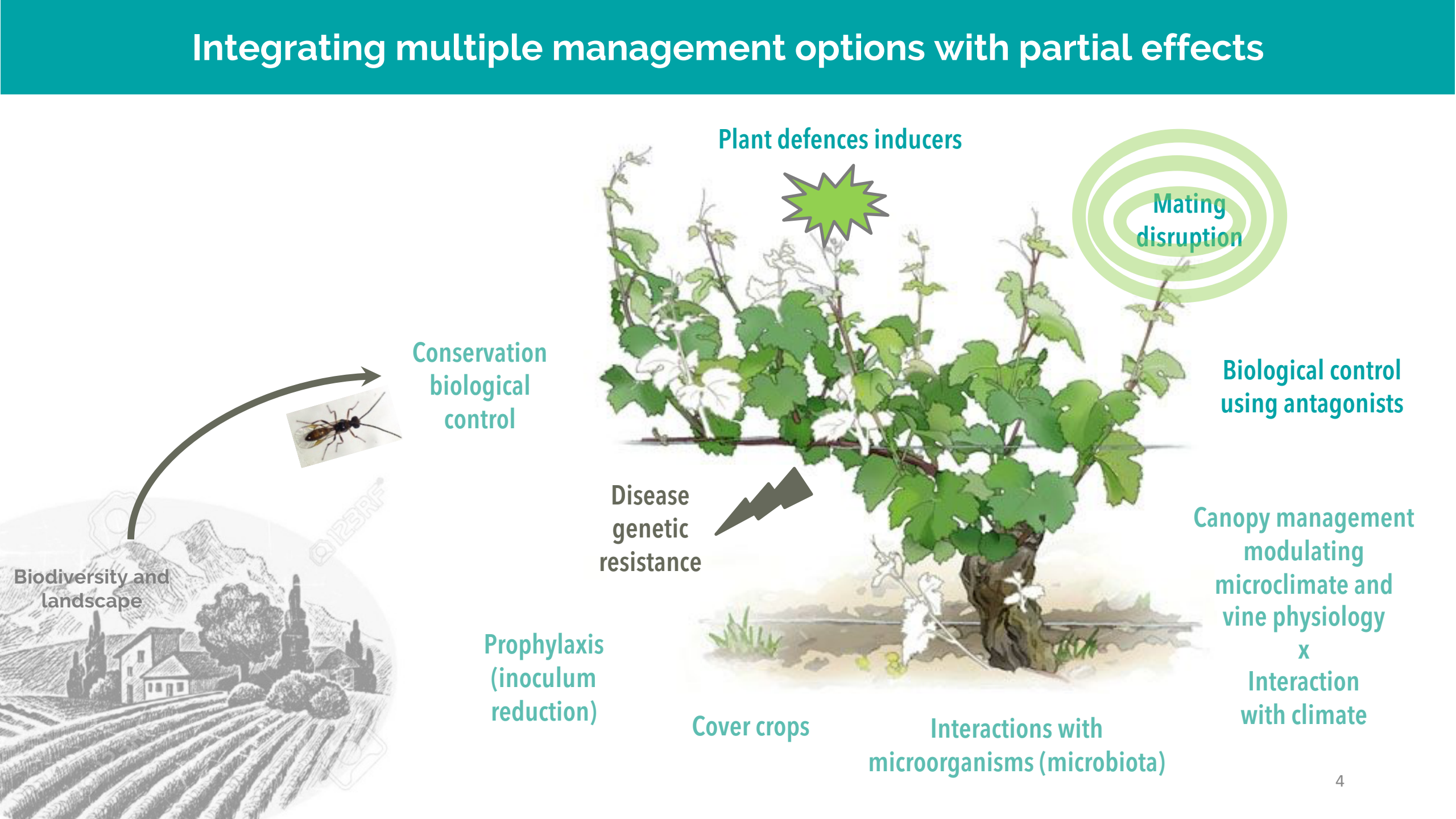
With current practices, a glass floor have been reached...



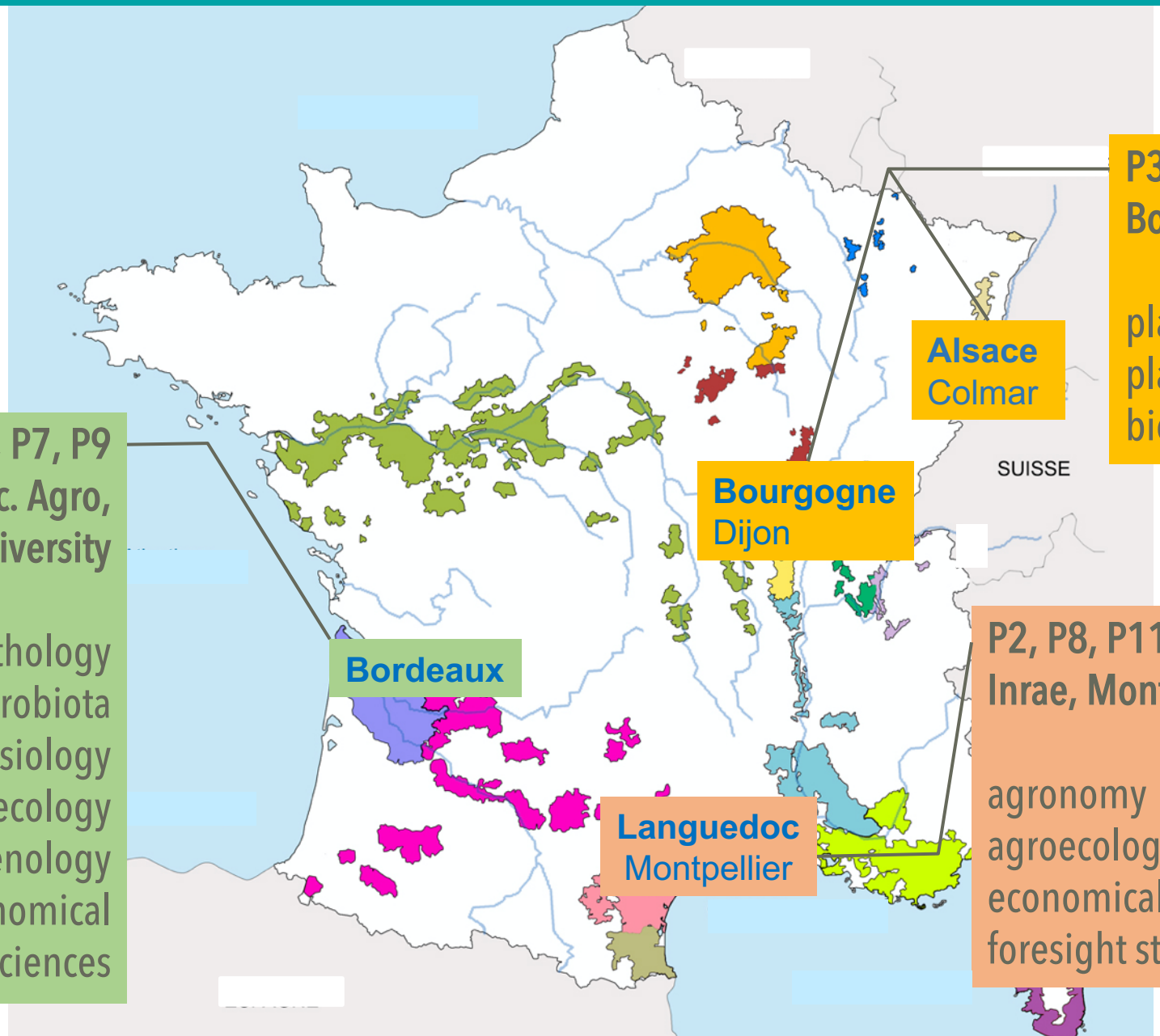
ÉCOPHYTO DEPHY Réseau de Démonstration, Expérimentation et Production de références sur les systèmes économes en phytosanitaires

“ glass floor ” for pesticides reduction French wine-producing regions

Integrating multiple management options with partial effects



A large consortium for an integrative proposal



P1, P4, P5, P6, P7, P9
Inrae, Bordeaux Sc. Agro, Bordeaux University

plant pathology
microbiota
plant physiology
agroecology
oenology
consumers & economical sciences

P3, P10, P13
Bourgogne University, Inrae

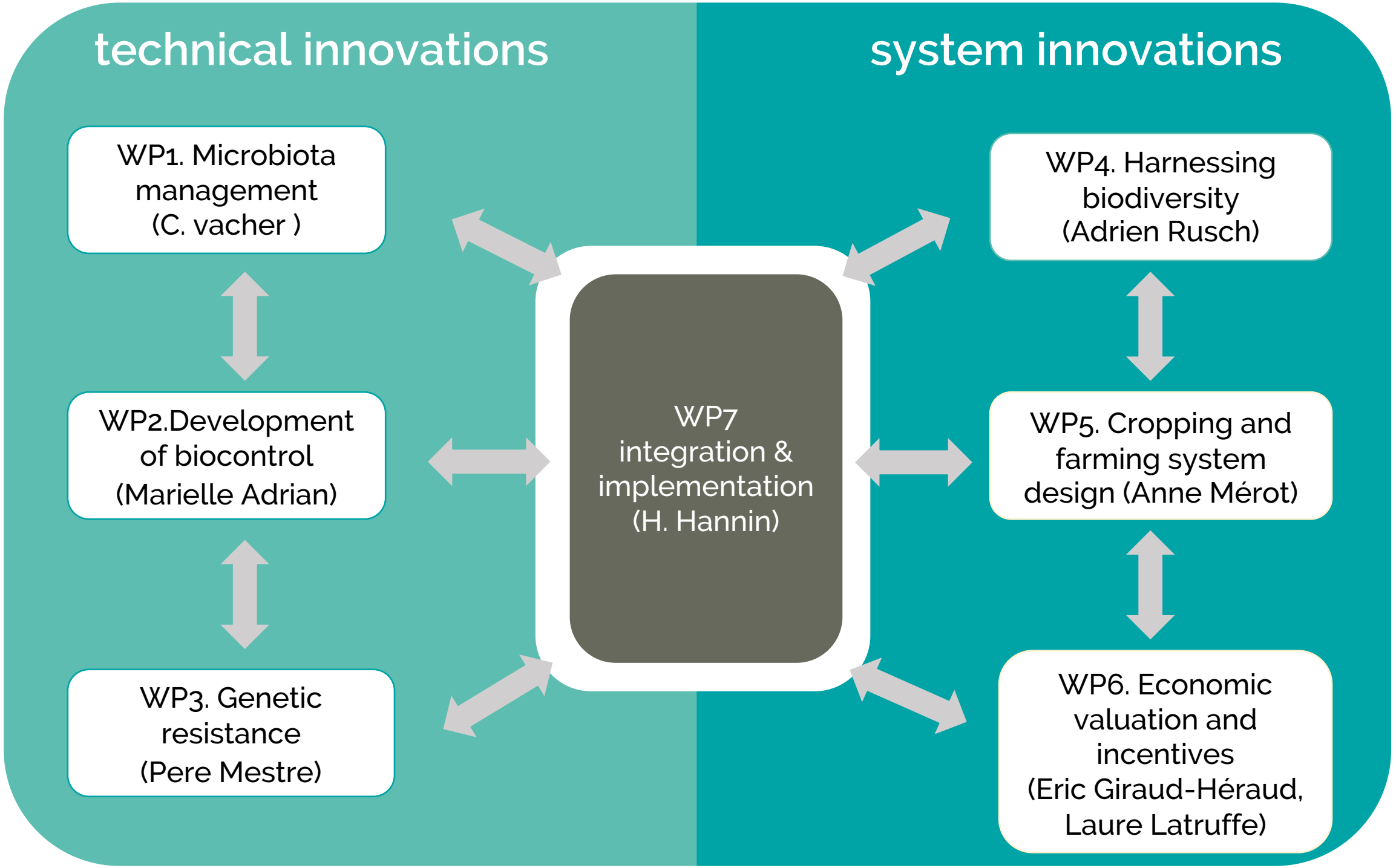
plant breeding
plant-pathogen interactions
biocontrol

P2, P8, P11
Inrae, Montpellier SupAgro

agronomy
agroecology
economical sciences
foresight studies

The main 6 goals of Vitae

1. improve the efficiency of existing disease control methods
2. stimulate research for the development of new biocontrol options
3. assess the value-chain from vine to wine of pesticide free cropping systems
4. understand technical and socio-economic ways of transition
5. integrate knowledge and provide transition scenarios
6. create relevant tools to inform public policies and to accompany growers


technical innovations
system innovations
WP1. Microbiota management (C. vacher)
WP2.Development of biocontrol (Marielle Adrian)
WP3. Genetic resistance (Pere Mestre)
WP7 integration & implementation (H. Hannin)
WP4. Harnessing biodiversity (Adrien Rusch)
WP5. Cropping and farming system design (Anne Mérot)
WP6. Economic valuation and incentives (Eric Giraud-Héraud, Laure Latruffe)

Disruptive elements of Vitae proposal

Deploying grapevine disease resistance

Optimizing efficiency and durability of resistance to downy and powdery mildews

(wp3)

- recessive R genes
- identification of Avr genes
- interaction R/Avr
- field evaluation of pathogen populations evolution

Identify resistances to black rot and flavescence dorée
(wp3)

Construct progenitors for future breeding programmes
(wp3)

Assess wine quality & consumers willingness to pay for innovation
(wp6, wp7)

Development of biocontrol solutions

Identify microbial consortia (bacteria, fungi, mycoviruses) that interfere with the major grapevine pathogens

(wp1)

Search for new bioproducts with original mode of action

(wp2)

- plant defense activation
- plant defense de-repression (siRNA)
- disruption of mating-type communication

Assess the interaction between plant physiology and bioproducts effectiveness with the aim to optimize their use in the vineyards

(wp2)

Combining management options

Investigate how multiple agroecological management options - from the field to the landscape - affect trophic networks, pest control services as well as non-intentional effects on bundles of ecosystem functions and services
(wp4)

Understand the functioning and multi-performances of existing viticultural systems in disruption / pesticide use
(wp5)

Assess the overall performance of experimental cropping systems from grape to wine - oenological and economic performance.
(wp7)

Appropriation and dissemination in the specific context of the wine sector

Assess benefits (wtp) and costs for innovative wines and production systems

(wp6)

Identify innovative and sustainable economic and/or regulating incentives to promote vineyard agro-ecological transition and mitigate pesticide use (wp6)

- winegrowers' risk behaviour
- economic alternatives
- insurance contracts granted upon zero-pesticide practices

Develop foresight scenarios for the transition to pesticide-free viticulture

(wp7)

Main strengths of our proposal

- Vitae targets Vine as a strategic crop for a pesticide-free agriculture
- Vitae addresses forefront researches and will manage them into a genuine interdisciplinary approach
- Vitae is highly oriented towards training and transfer
- Vitae builds a new research community

INRAE
la science pour la vie, l'humain, la terre

université de BORDEAUX

Montpellier SupAgro

UBFC
UNIVERSITÉ BOURGOGNE FRANCHE-COMTÉ

BORDEAUX SCIENCES AGRO

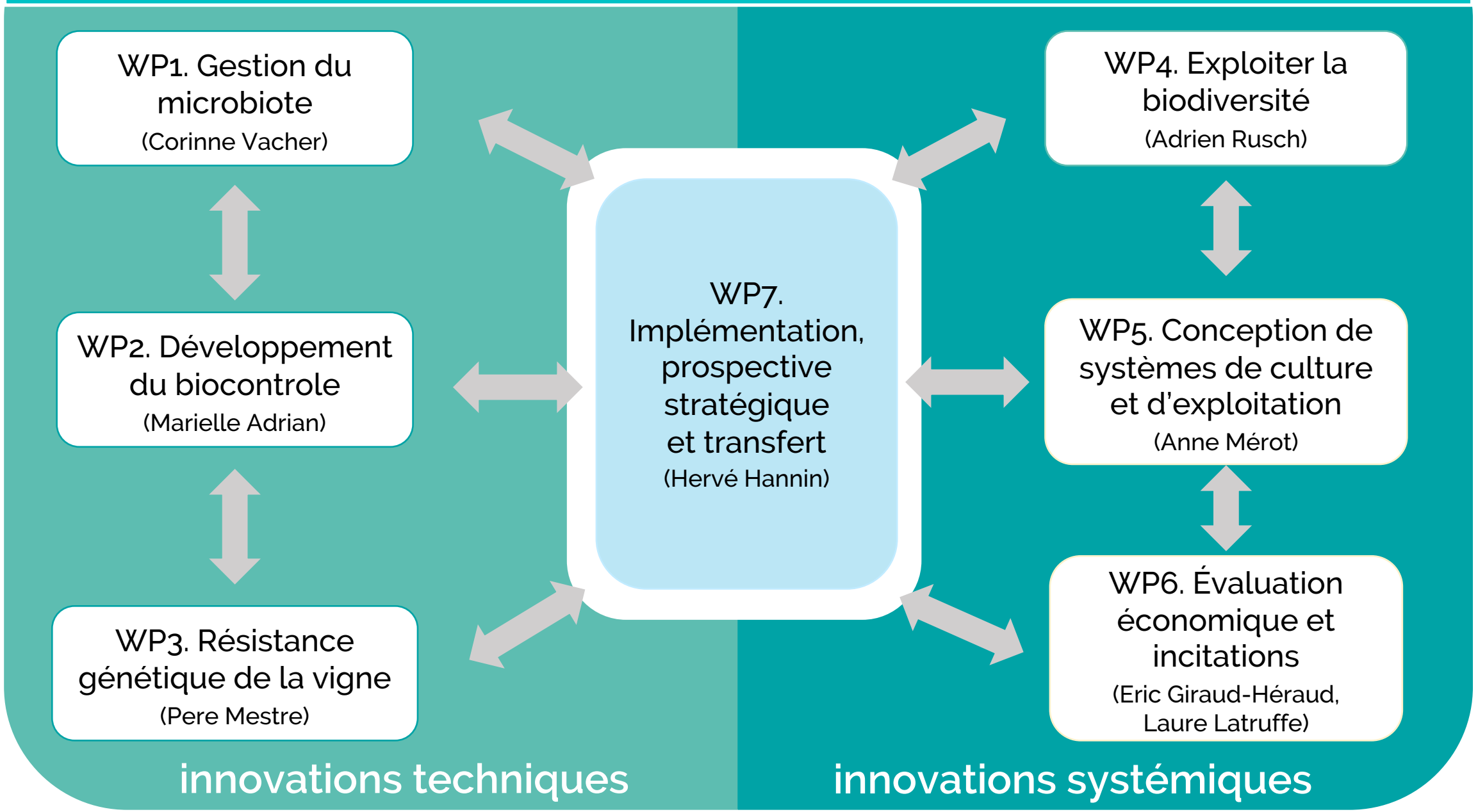
IUVV Institut Jules Guyot

IHEV
Institut des hautes études de la vigne et du vin

ISVV
INSTITUT DES SCIENCES DE LA VIGNE ET DU VIN
BORDEAUX AQUITAINE

VITAE – Cultiver la vigne sans pesticides : vers des socio-écosystèmes viticoles agroécologiques

Coordinateur : François Delmotte — Co-coordinateur : Hervé Hannin



Les pratiques agroécologiques au vignoble

Stimulateurs des défenses de la vigne

Confusion sexuelle

Lutte biologique par conservation

Lutte biologique avec antagonistes

Résistance génétique aux maladies

Conduite de la vigne (architecture, microclimat, physiologie) X Interaction avec le climat

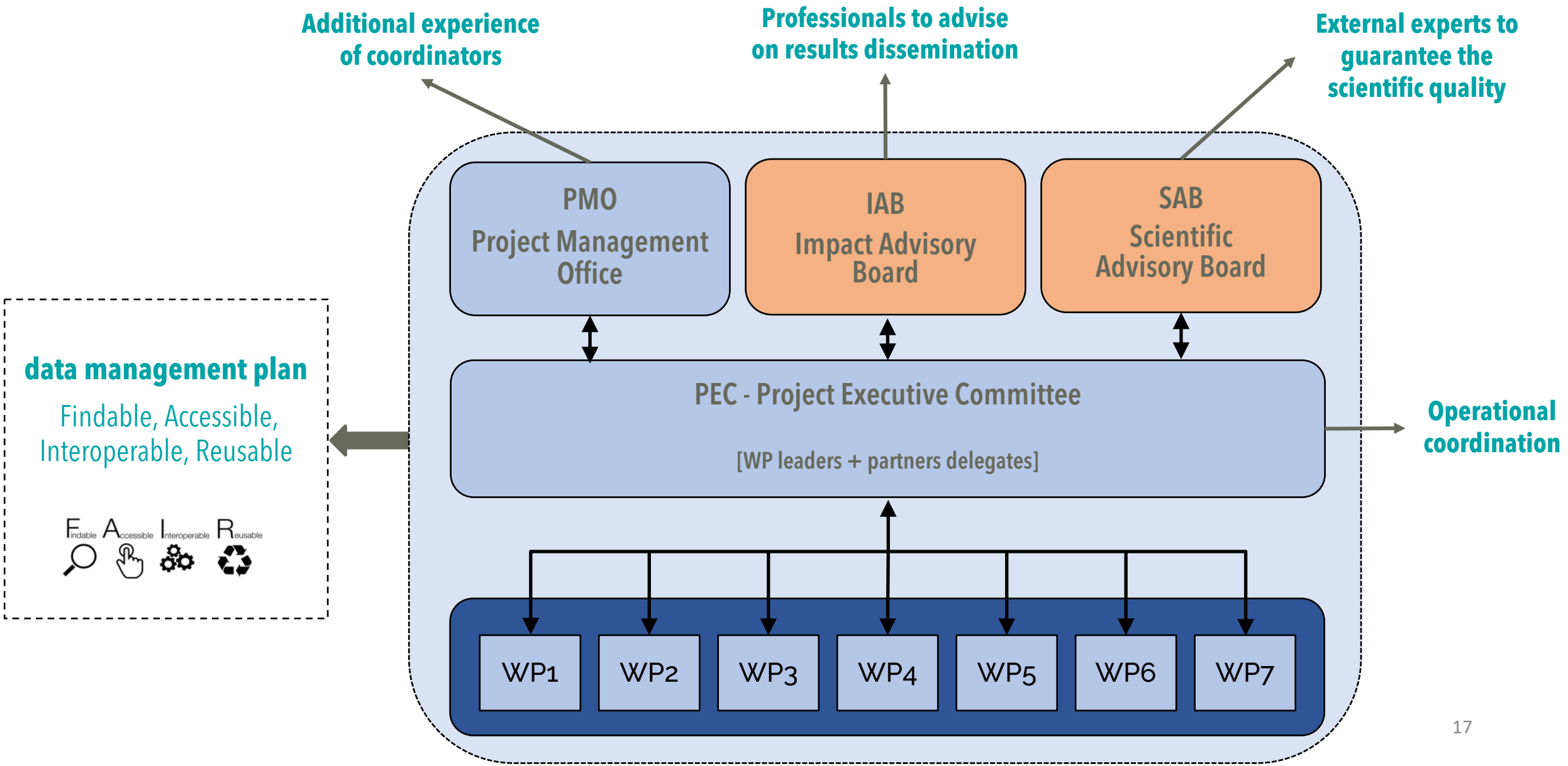
Biodiversité et paysage

Prophylaxie (réduction de l'inoculum)

Enherbement de la parcelle

Interactions avec les microorganismes (microbiote)

Organisation of the management



the end

WP6 - Economic valuation and incentives

Lead L. Latruffe and E. Giraud-Héraud (INRAE-GREThA)

Main questions:

- Measuring wine consumers' expectations on environmental and health improvements in production methods (willingness to pay (WTP) for innovations).
- Identify innovative and sustainable economic and/or regulating incentives to promote vineyard agro-ecological transition and mitigate pesticide use.

Actions:

Task 6.1 Benefits and costs for innovative wine[illegible] and production systems

→ Experimental market concerning:
- wines using resistant varieties
- valuation of biodiversity

Task 6.2 Economic incentives for zero-pesticide production

→
- Assess winegrowers' risk behaviour and its economic consequences
- Compare different economic alternatives
- Insurance contracts granted upon zero-pesticide practices

Ruptures / Innovations:

Improve the methodology to estimate consumers' WTP for wines with radical innovations
Design insurance contracts that are truly operational for zero-pesticide wine growing

WP1 – Microbiota-based disease management

- **Goal**: To identify microbial consortia (bacteria, fungi, mycoviruses) that interfere with the sexual and asexual stages of major grapevine pathogens

- **Actions** / Innovations
  - Compare plant and soil microbiota in sites with low *vs* high frequency
  - Develop microfluidics to quantify accurately target microorganisms
  - Develop culturomics to isolate target microorganisms
  - Model the dynamics of pathogen-microbiota interactions in simplified systems and validate interactions *in planta*
  - Assess the unintended effects of candidate biocontrol agents on fermentative processes
  - Identify the on-field and off-field management options that favor biocontrol (link with WP4)

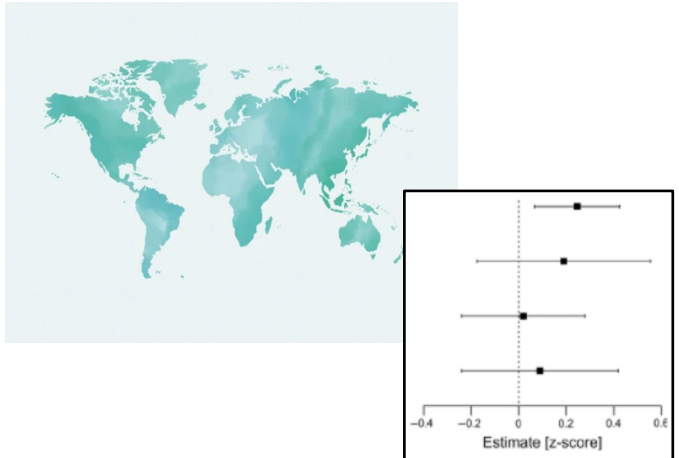
WP4 - Harnessing biodiversity and associated ecosystem services to design multifunctional vineyard cropping systems (A. Rusch)

Objective: investigate how multiple agroecological Mop from the field to the landscape affect trophic networks, pest control services as well as non--intentional effects on bundles of ecosystem functions and services.

Questions:

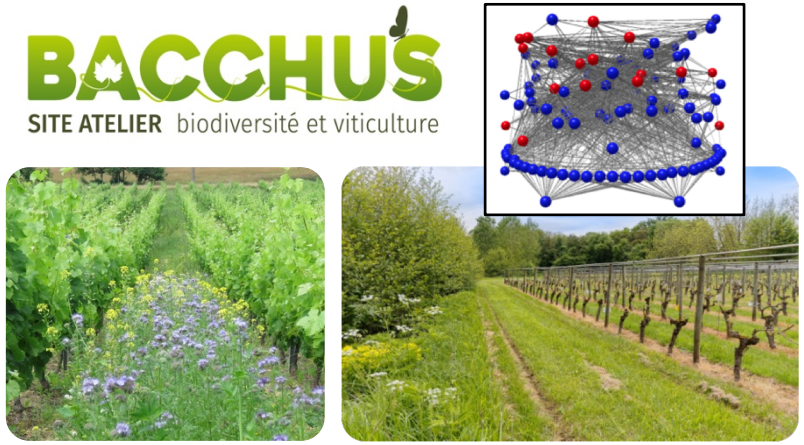
- (Task 4.1) What is the optimal scale and type of management optimizing biological pest control services?
- (Task 4.2) How combined management options affect trophic networks, pest control services and yield losses?
- (Task 4.3) What are the impacts of innovative MOp on bundles of ecosystem services and agroecosystem multifunctionality?

Meta-analysis at the global scale about effects of Mop on pest control services

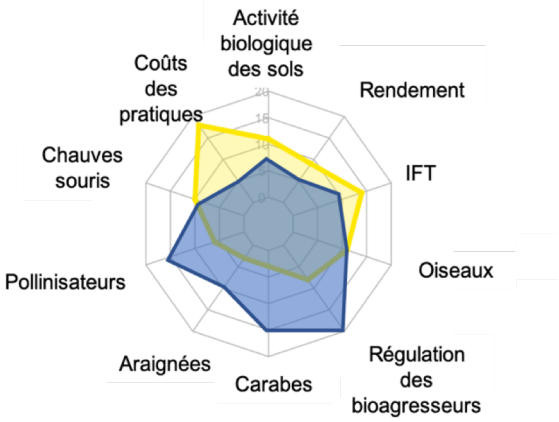


Experimentation about combined MOp in real vineyard landscapes

BACCHUS
SITE ATELIER biodiversité et viticulture



Assesing multifunctionality of innovative agroecosystems



WP3

GOALS

- Optimizing efficiency and durability of resistance to downy and powdery mildews
- Explore genetic resources to search for genes for resistance to black rot and flavescence dorée, to be included in breeding programmes

ACTIONS

- Search for resistance genes to black rot and flavescence dorée: Developing disease resistance evaluation methods, screening of genetic resources, genetic mapping
- Search for recessive resistance genes against downy and powdery mildew
- Identification of *Avr* genes for major genes: GWAS, Effectoromics
- Characterize the interaction between resistance factors and pathogen populations: strain characterization via host range, field evaluation of evolution of pathogen populations
- Constructing resistance progenitors

INNOVATIONS

- Host-range-based system for the biological characterization of downy mildew strains
- Effector-based molecular tool for the monitoring of virulence of downy mildew populations and study of the evolutionary response of pathogen populations
- Disease resistance progenitors containing the newly identified resistance genes introgressed into cultivated genetic backgrounds
- At long term, grapevine varieties combining a high potential of durable resistance to downy and powdery mildew with resistance to black rot and flavescence dorée

WP5 : Innovation systémique et implémentation de systèmes de culture sans pesticide de la parcelle à l'échelle de l'exploitation

Objectifs du WP5 :

- Intégration de leviers en parcelles expérimentales
- Mieux comprendre le fonctionnement et les multi-performances des systèmes viticoles existants en rupture / utilisation pesticides
- Identifier des blocages, freins organisationnels, techniques, des systèmes de travail, oeno à l'implémentation de solutions techniques pour le zéro-pesticide
- Outiller les viticulteurs pour l'accompagnement de leur transition

Actions du WP5 :

- Tâche 5.1 Identifier des combinaisons de leviers implémentés par les viticulteurs en système proches du zero pesticide → *Réseau DEPHY ferme + réseau d'exploitations*
- Tâche 5.2 Quantification des performances agronomiques de parcelles proches du zero pesticide et analyse des processus biophysiques expliquant ces performances → *Réseau de parcelles associées au réseau exploitation T5.1*
- Tâche 5.3 Comprehension des échecs et erreurs dans les processus de reduction des phytos → Réseau d'exploitations décertifiées de l'AB

Rupture – innovations

- Approche systémique
- Approche de conception centrée sur l'implémentation plus que sur la conception de leviers
- Analyse en situation réelle de production de l'echelle parcelle à celle de l'exploitation