



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



haute école de viticulture et œnologie  
école supérieure de technicien/ne vitivinicole  
école du vin

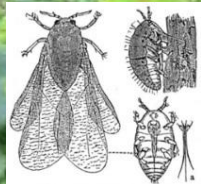


# Grafting, the most sustainable way to control phylloxera over 150 years

<https://hal.science/hal-04744516>

DOI: 10.17180/j3aw-x550

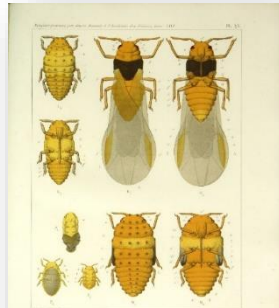
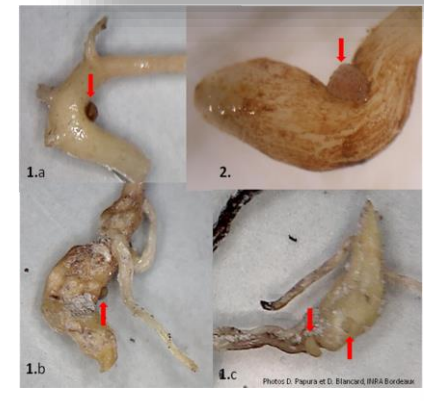
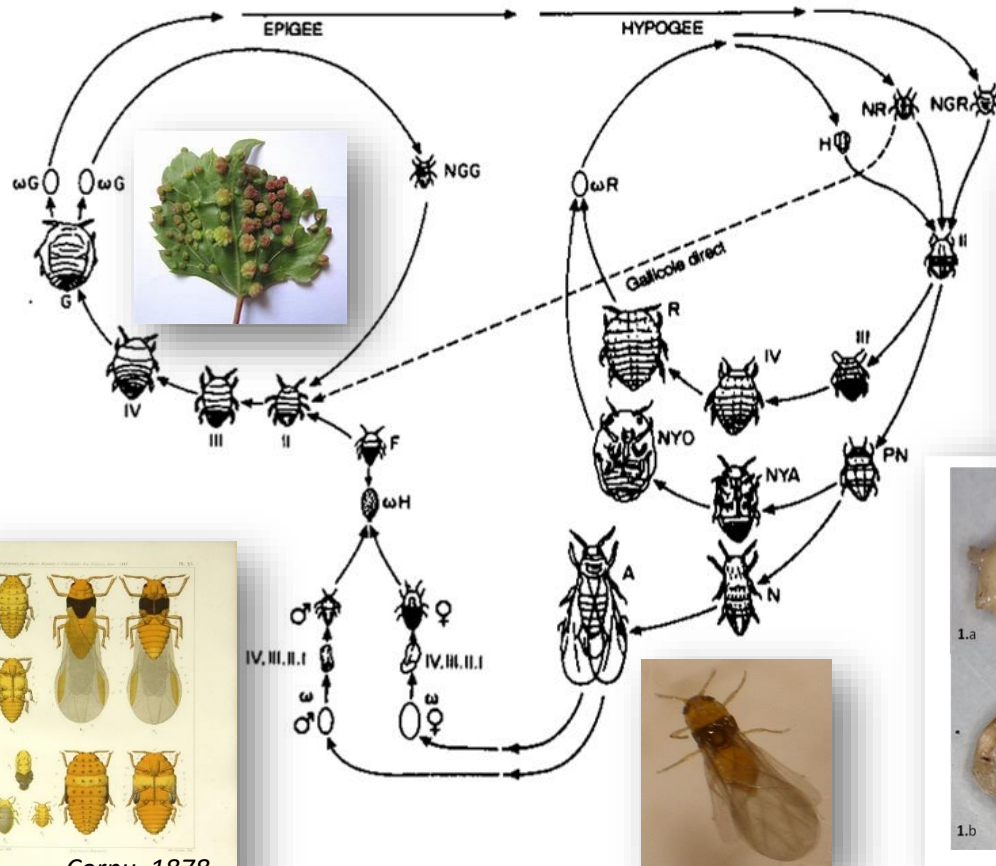
Nathalie Ollat, Olivier Yobrégat, Thierry Lacombe, Markus Rienth, Sébastien Julliard, Maria Lafargue, Jean-Pascal Tandonnet, Jean-Pascal Goutouly, Sarah Jane Cookson, Marina de Miguel, Daciana Papura, Elisa Marguerit



# Daktulosphairae vitifoliae

## Aerial cycle

## Underground cycle



Cornu, 1878





Still present in vineyards

*Family Estates*

Grafted

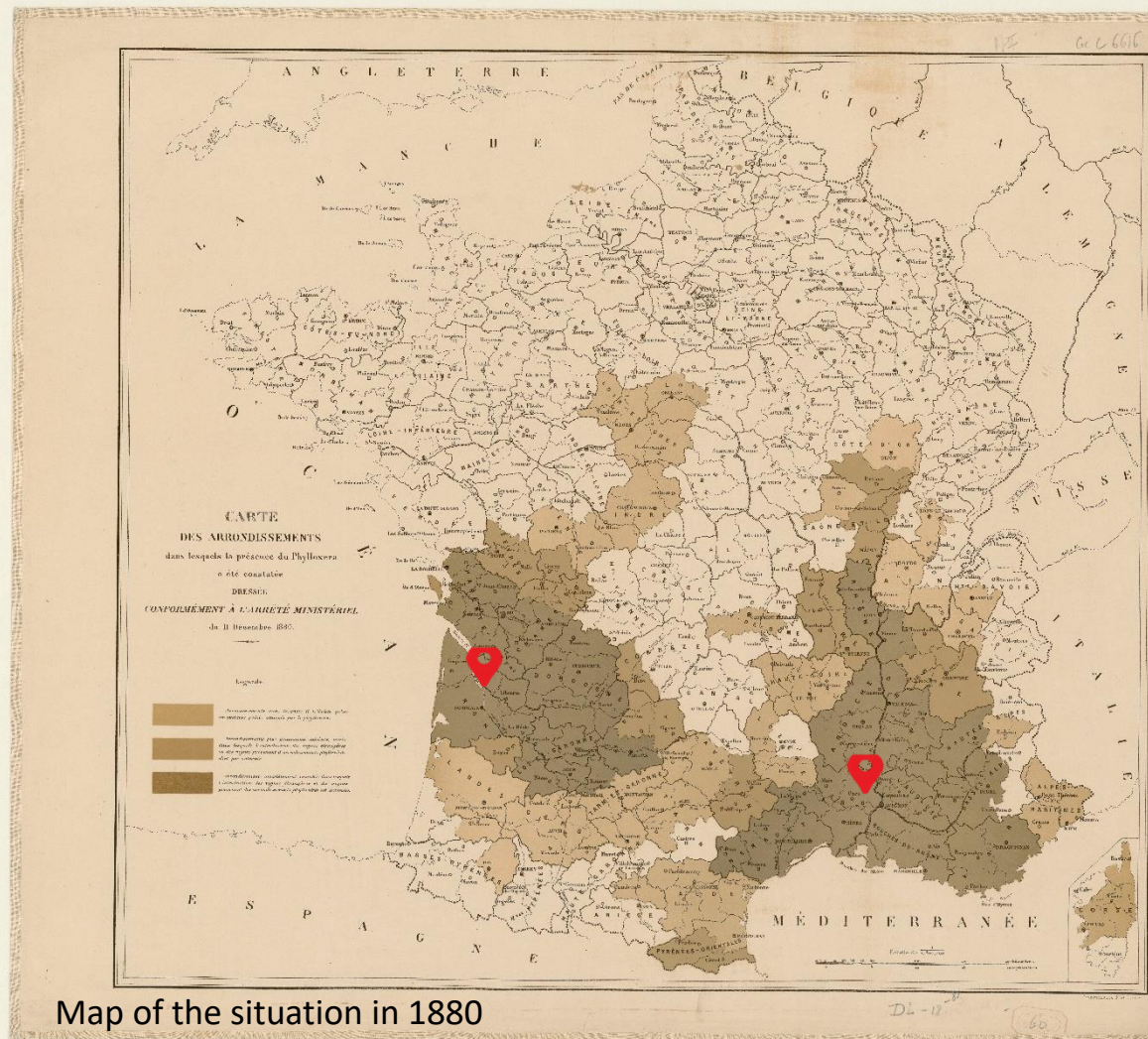
Non grafted

Grafted



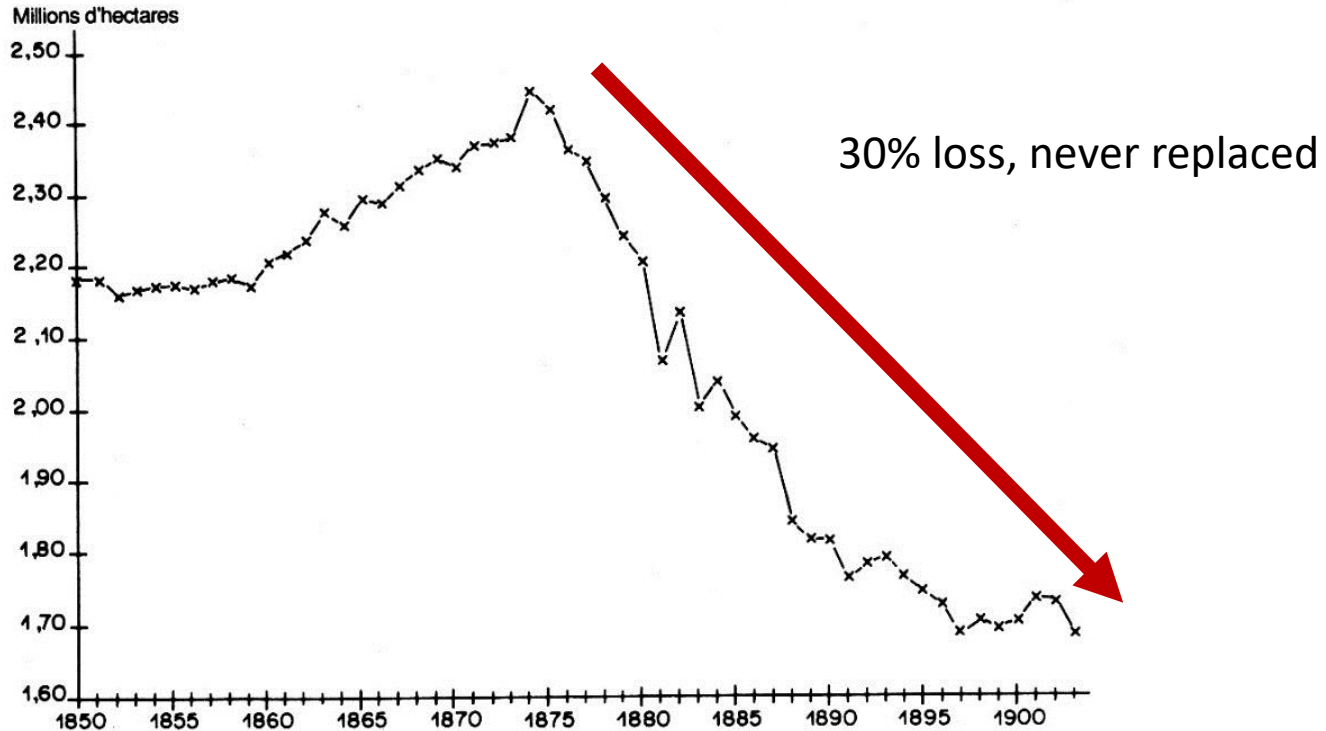
## The epidemic in France

- 1863-1867 : first outbreaks in the South Est and Bordeaux area
- 1868 : discovery of phylloxera in South East of France
- 1880 : 45 administrative departments
- 1887 : 60 departments
- 1894 : 69 departments
- 1900 : all over vineyard regions



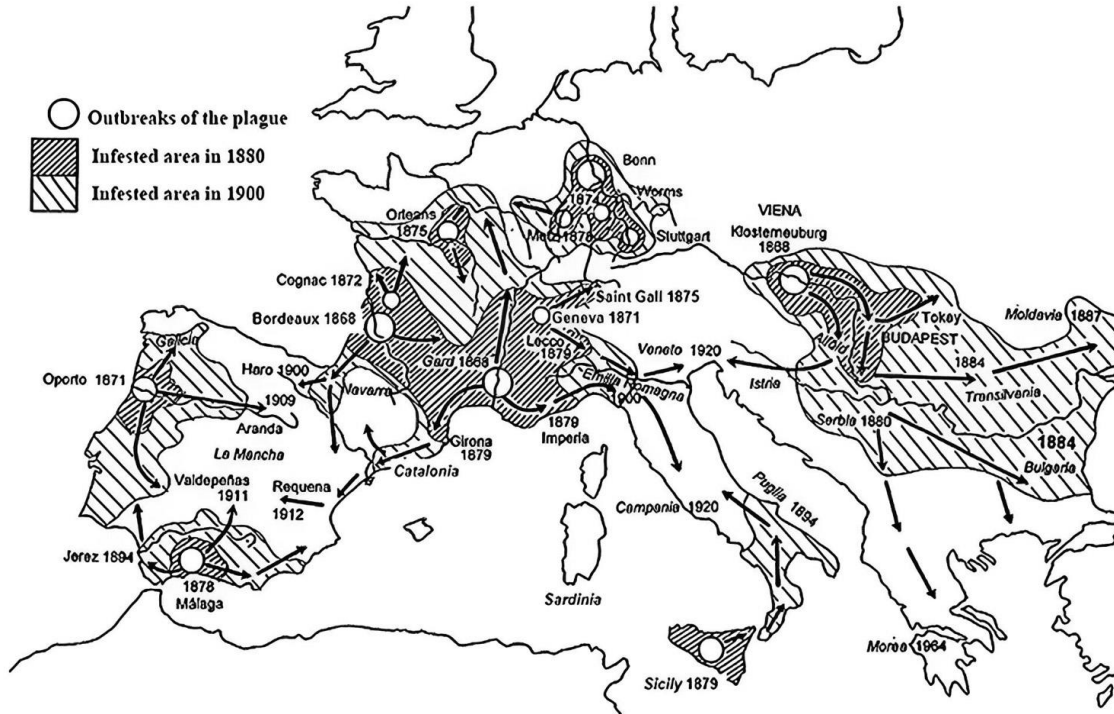
Map of the situation in 1880

## A quick and dramatic decay in France



Area of the french vineyard from 1850 to 1900

# The epidemic throughout the world

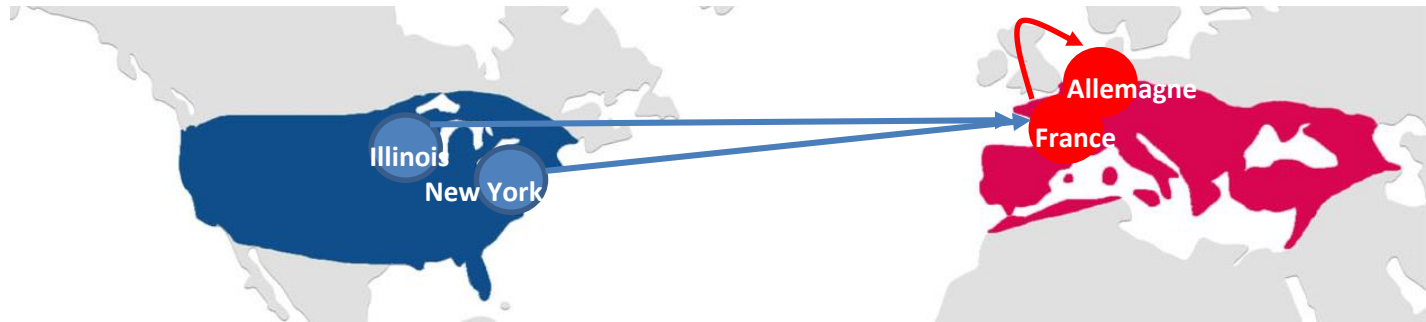
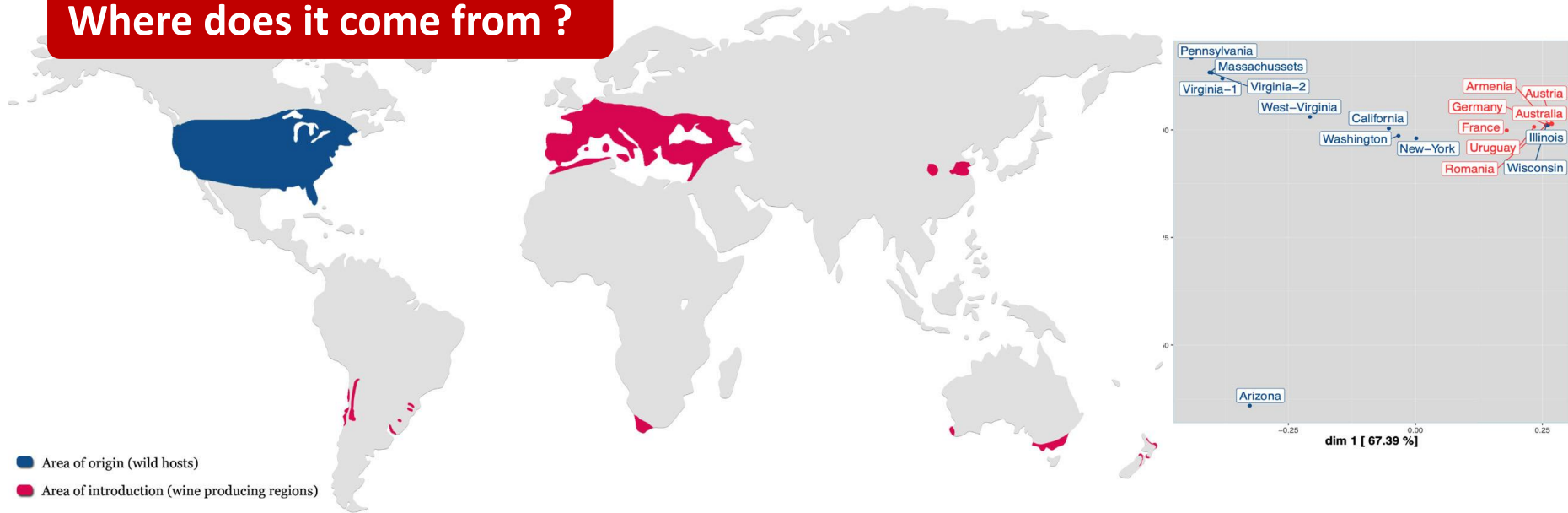


1865	Portugal
1871	Switzerland
1872	Austria
1873	California
1874	Germany
1875	Australia, Hungaria
1877	Spain
1879	Italy
1880	South Africa, Serbia
1882	Roumania
1885	Algeria
1888	Argentina
1893	Brazil
1898	Greece
1905	Tunisia

## Phylloxera expansion in Europe

(Badia-Miro et al., 2010)

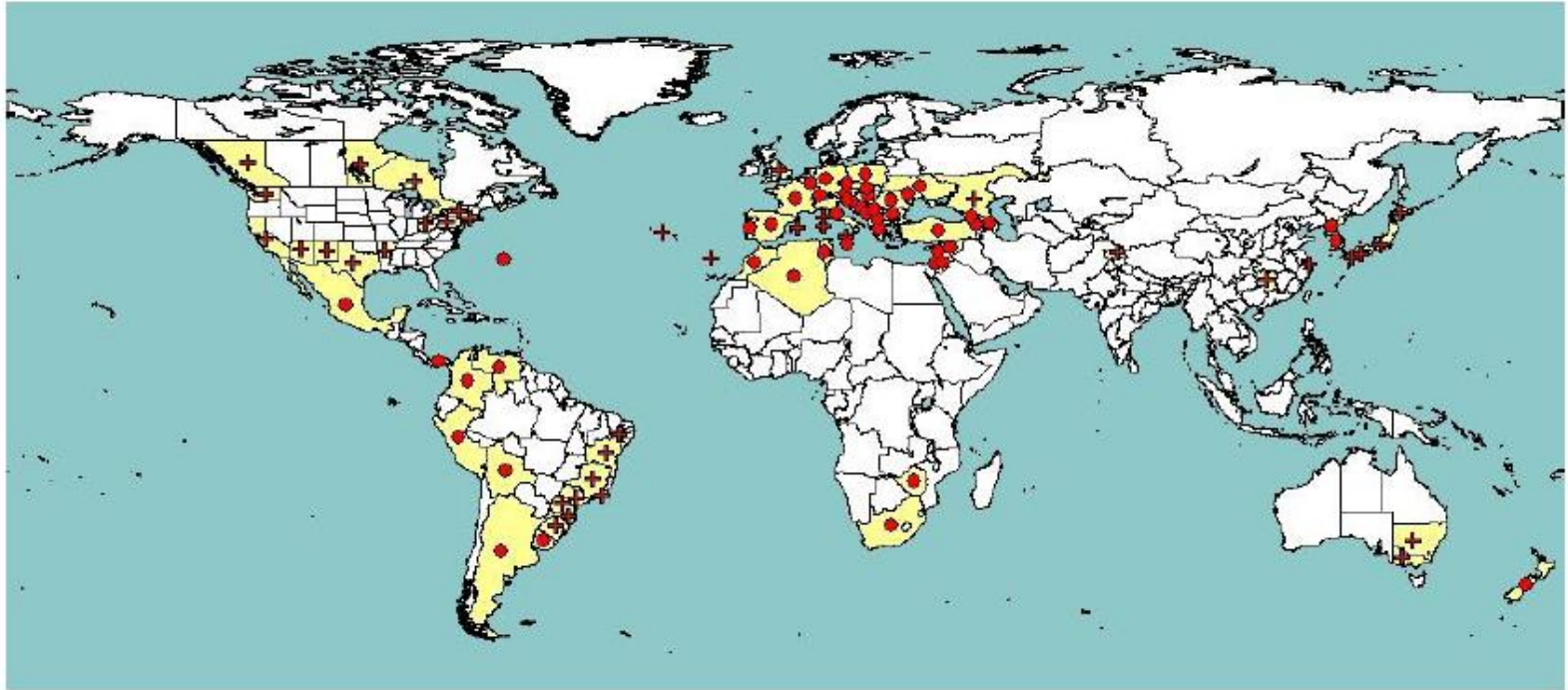
# Where does it come from ?



Rispe et al., 2018



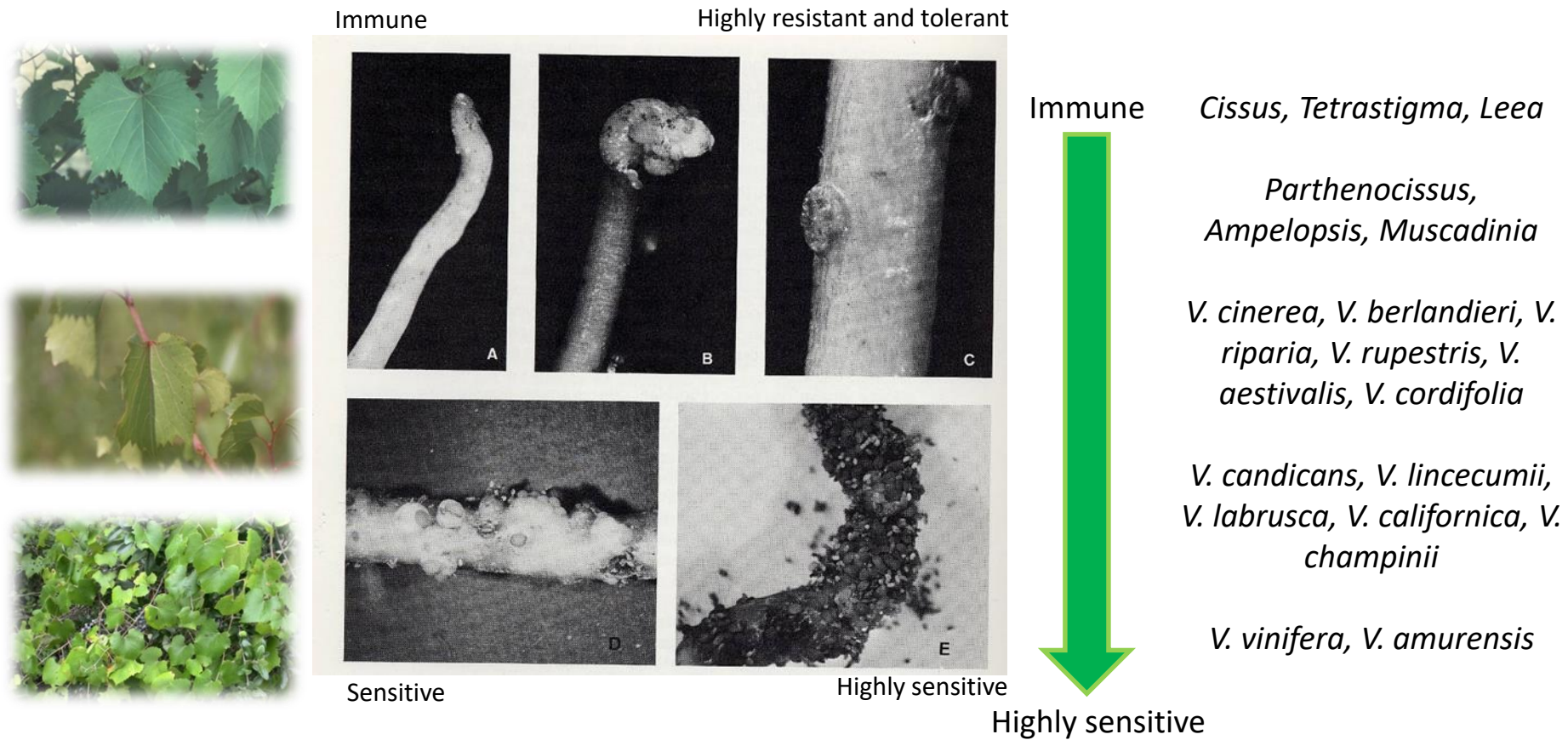
## Actual situation



**Figure 1:** Global distribution of *Daktulosphaira vitifoliae* (extracted from EPPO PQR (2014, version 5.3.1) accessed on 26 March 2014). Red circles represent pest presence as national records and red crosses show pest presence as sub-national records.



# The North American solution



# Phylloxera resistance can be inherited

Millardet, 1877

- **Several resistance genes in most species**

Some heterozygosity

Partial dominance in some species (*V. berlandieri*, *V. cinerea*, *V. rubra*, *M. rotundifolia*)

Boubals, 1966

- **Sensitivity genes in several species**

Some heterozygosity, excepted in *V. vinifera* (homozygote)

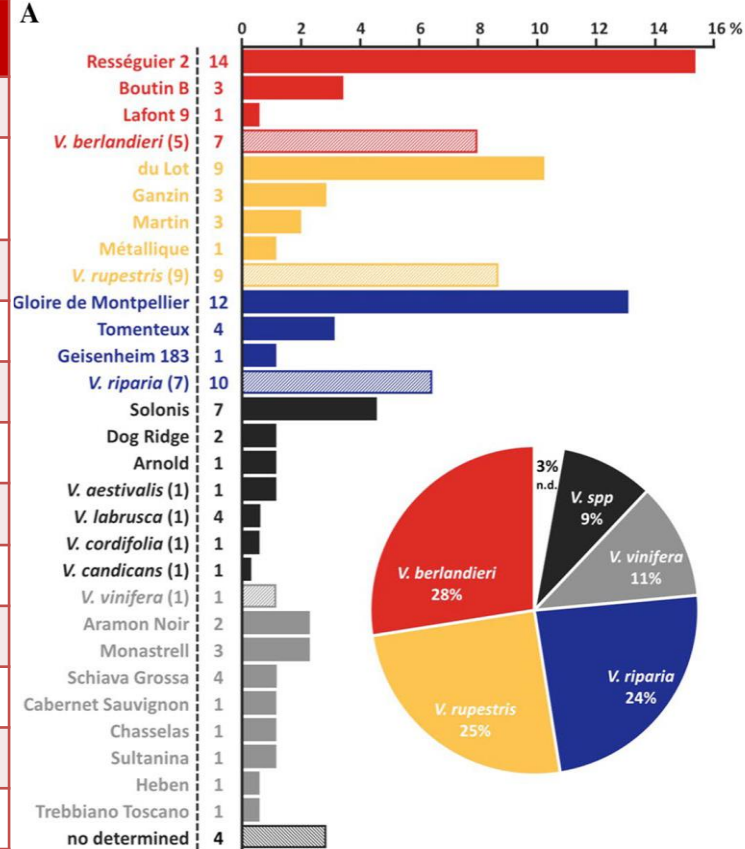
Partial dominance in some species (*V. riparia*, *V. rupestris*, *V. labrusca*, *V. monticola*, *V. cordifolia*, *V. candicans*)

Traits	Crosses	Chromosomes	Name of loci or genes	Reference
Leaves	Multispecies	LG14	Rdv3	Clark et al., 2018; Yin et al., 2022
Roots	<i>V. cinerea</i>	LG14	Rdv2	Smith et al., 2018
	<i>V. cinerea</i>	LG13	Rdv1	Zhang et al., 2009, Frommer et al., 2022
	<i>M. rotundifolia</i>	LG7, 3, 10	Rdv6,7,8	Rubio et al., 2020
	<i>V. riparia</i>	LG14		Tandonnet, unpublished

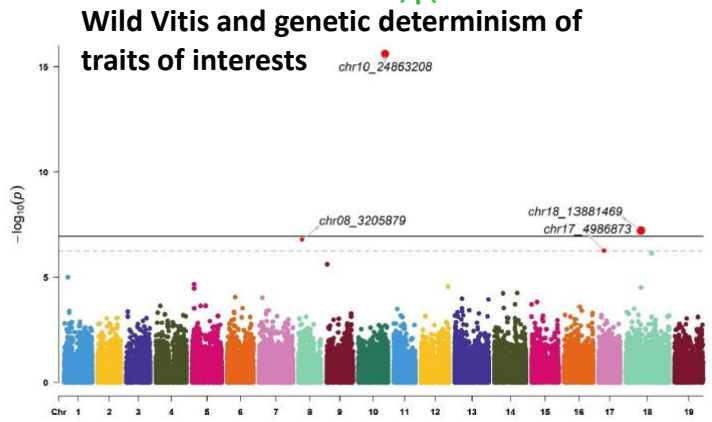
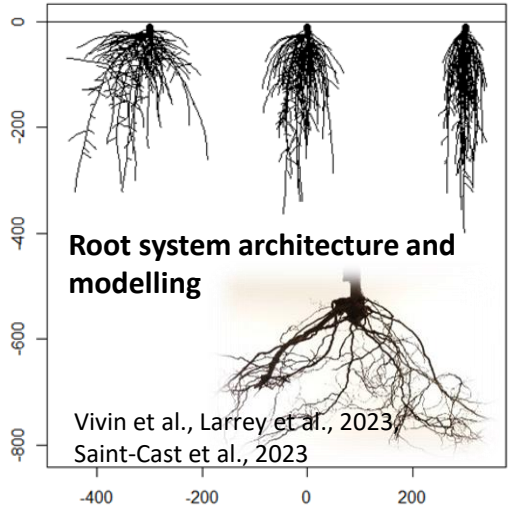


# Rootstock breeding

Year	
1870	First attempt to graft <i>V. vinifera</i> on « american vines »
1874	First studies by Millardet of american species and show up <i>V. riparia</i> resistance to phylloxera
1879	Show up of <i>V. rupestris</i> resistance
1882	Crossing between <i>V. berlandieri</i> and <i>V. vinifera</i> to create 41B
1900	Kober 5BB, 125AA, 140Ruggeri, 1103Paulsen, Dog ridge, Ramsey
1920	Hybridization for 110R and 99R
1930th	SO4 and Binova
1970th	Fercal and Georgikon28
1980th	Gravesac
2007	USDA RS-3, RS-9
2010	GRN1, 2, 3, 4, 5
2011	Registration of Nemadex Alain Bouquet
2014	M serie

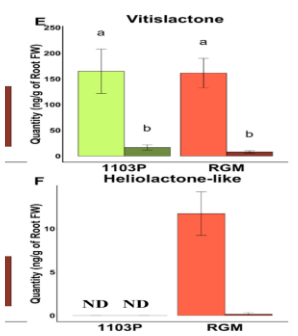
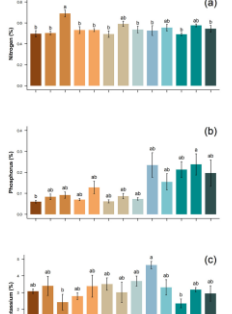


# New era for Vitis and rootstock studies

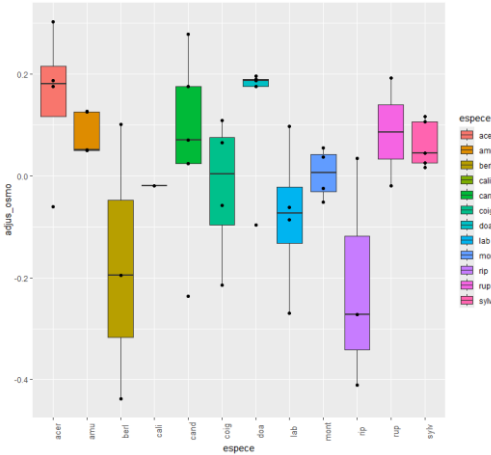


Marguerit et al., 2012; Tandonnet et al., 2018; Rubio et al., 2020; Blois et al., 2023; de Miguel, unpublished

## Mineral nutrition and interactions with soil microorganisms



Gautier et al., 2020; Morel et al., 2024  
Lailheugue et al., 2023; 2024



## Deeper characterization of existing rootstocks



Recherche

Préparation à la saisie - Saisie de traitements - Saisie de données

**Guide global du système d'information**

Entrer des données d'une expérimentation, aidez-vous de ce schéma et du menu guide (onglet en haut à gauche).  
Le schéma se lit de gauche à droite et vous êtes représenté par le symbole

commencer, créez le projet auquel se rattache l'expérimentation, puis l'expérimentation [guide expérimentation](#)  
définissant le matériel végétal, en décrivant votre site expérimental et les objets étudiés (ceps, groupe ou partie de cep  
finissez les traitements appliqués, associez les aux objets mesurés et définissez les variables que vous allez saisir  
Vous pouvez alors saisir vos données. [comment commencer](#)

de projet [Préparation à la saisie](#) [Saisie de données](#) [Saisie de traitements](#) [Saisie de résultats](#)

## Information system : Silex porte-greffe

Marguerit et al., 2019; Binet et al., 2019, Ollat et al., 2024

Home - Accueil - Vol. 57 No. 2 (2023) OENO One - Original research articles

**ORIGINAL RESEARCH ARTICLES**

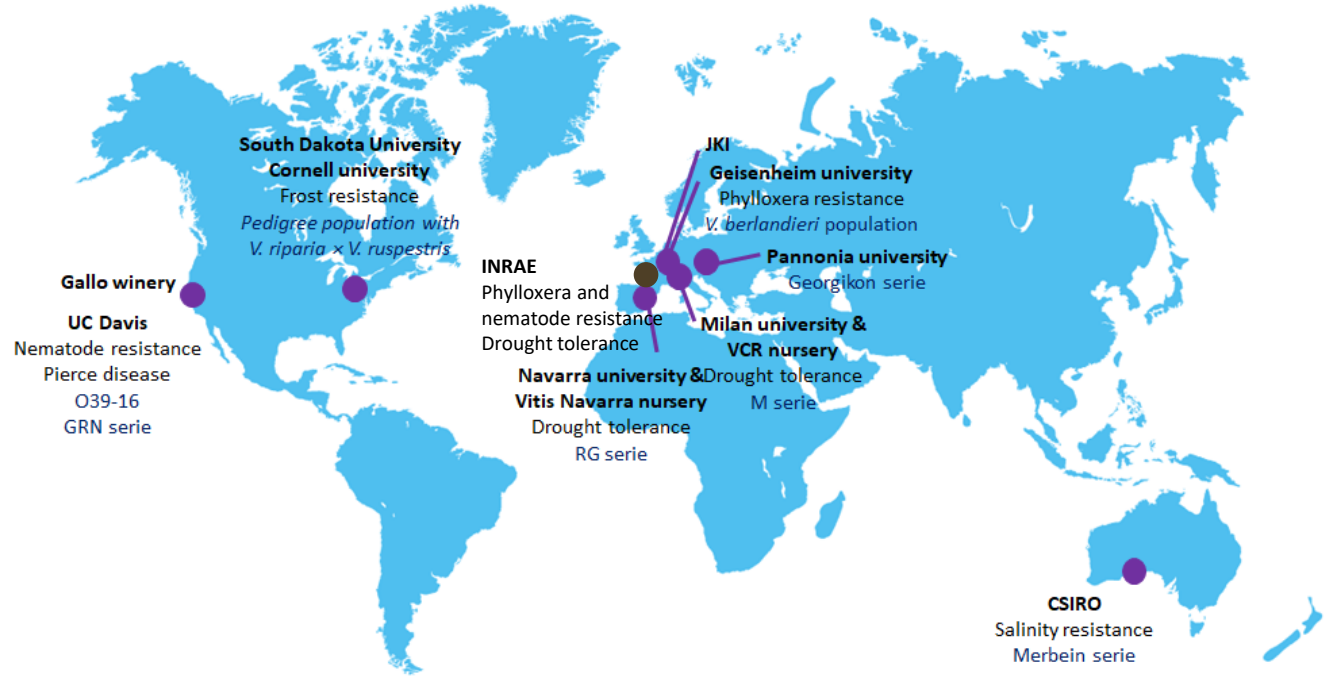
**The role of rootstocks for grape growing adaptation to climate change. Meta-analysis of the research conducted in Spanish viticulture**

This article is published in cooperation with the 22nd GIESCO International Meeting, hosted by Cornell University in Ithaca, NY, July 17-21, 2023.

Luis Gonzaga Santeliciano, Isabel Rekarfe, Nazareth Torres, Mónica Galar, Ana Villa-Llipo, Fernando Visconti, Diego S. Intrigliolo, José M. Escalona, Felicidad Da Hernández, Carlos Miranda  
Vol. 57 No. 2 (2023) OENO One



# Most active rootstock breeding programs in the world



Map established by Marguerit (unpublished)

# Cutting edge approaches for grafting studies

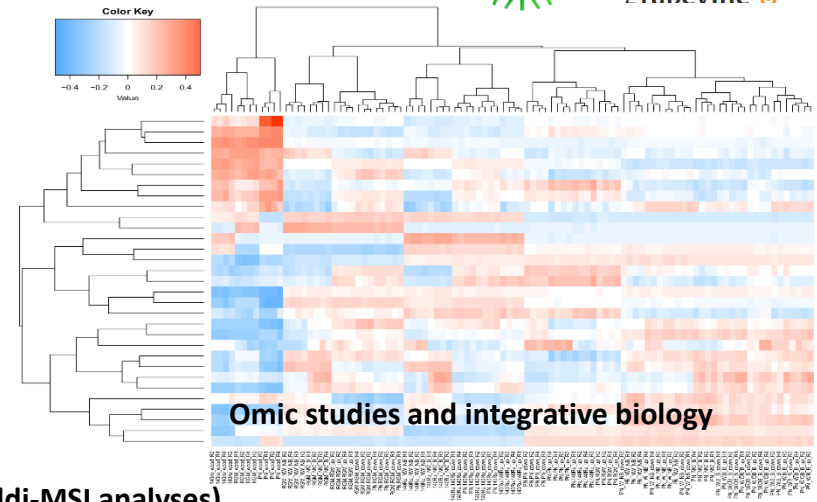


JOURNAL ARTICLE

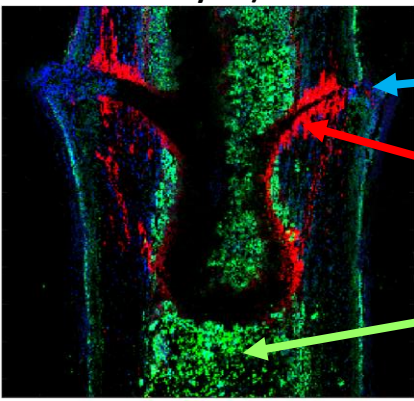
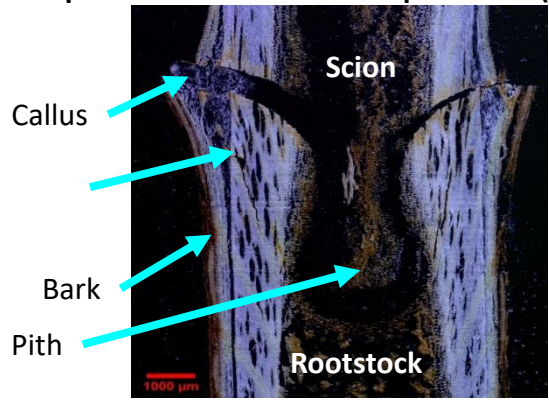
Small RNA populations reflect the complex dialogue established between heterograft partners in *grapevine*

nitti, Sarah Jane Cookson, Emeline Teyssier,

), 2022, uhab067, <https://doi.org/10.1093/hr/uhab067>



## Spatial characterization of processes (Maldi-MSI analyses)

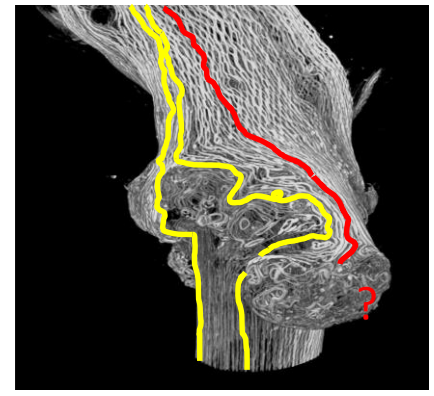


Naringenin

Resveratrol

Catechin/epicatechin

## Spatial reconstruction of grafting zone (RX tomography)



Cookson et al., 2012; 2013; 2014; Prodhomme et al., 2019; Rubio et al., 2022; Loupit et al., 2019; 2022; 2023, Camboue et al., 2024



# Phylloxera is still a threat and grafting is still the most efficient, environmental-friendly practice to live with it !

## New studies are highly necessary

- Diversity of phylloxera biotypes and risks of resistance breakdown
- Genetic determinism of resistance and other traits of interest for rootstocks and new breeding programs
- Biology of phylloxera to understand the risks, the conditions of development and the diversity of symptoms
- Complementary methods of control such as entomopathogen soil fungi : *Metarhizium robertsii*, biocontrol candidate against telluric grapevine pests



Article

Association of the endophytic entomopathogenic fungus *Metarhizium robertsii* with non-grafted grapevine *Vitis vinifera*

Mathilde Ponchon<sup>1,2</sup>, Annette Reineke<sup>3</sup>, Marie Massot<sup>4</sup>, Michael J. Bidochka<sup>5</sup>, Denis Thiéry<sup>1,2</sup> and Daciana Papura<sup>1</sup>

Entomologia Generalis  
Published online August 2024

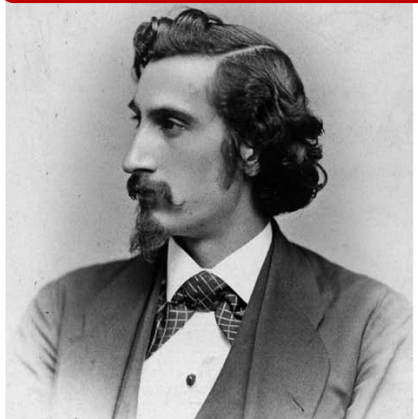
Early Access  
Article

Potential of the entomopathogenic fungus *Metarhizium robertsii* to control radicle grape phylloxera *Daktulosphaira vitifoliae*

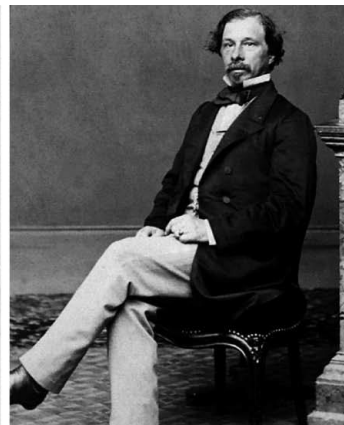
Mathilde Ponchon<sup>1,2</sup>\*, Daciana Papura<sup>1</sup>, Rodrigo López-Plantey<sup>3</sup>, Benjamin Joubard<sup>1</sup>, Manmeet Singh<sup>1</sup>, Karima Rahmani<sup>1</sup>, Annette Reineke<sup>2</sup>, Denis Thiéry<sup>1</sup>



# A tribute to some of the most famous « Phylloxera » actors !



C. V. Riley (entomologist) J.E Planchon (botanist) G. Bazille (grapegrower) F. Sahut (horticulturist) A. Millardet (botanist)



J. Lienchenstein V. Signoret (entomologists) P. Viala (pathologist) L. Ravaz (viticulturist) D. Boubals (geneticist)



Thank you for your attention !



Punch, September 6, 1890 by Edward Linley Sambourne.



Institut Agro Montpellier statue :  
to G. Foex (viticulturist)



**terclimpro**

*Scientific talks dedicated to vine and wine professionals*

**18.02.2025**

*Grand amphithéâtre*  
Bordeaux Sciences Agro, Gradignan

**19.02.2025**

*Espace Edmond & James Grégoire*  
Grégoire Cognac, Châteaubernard

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