# Des microbes pour soigner et protéger la vigne

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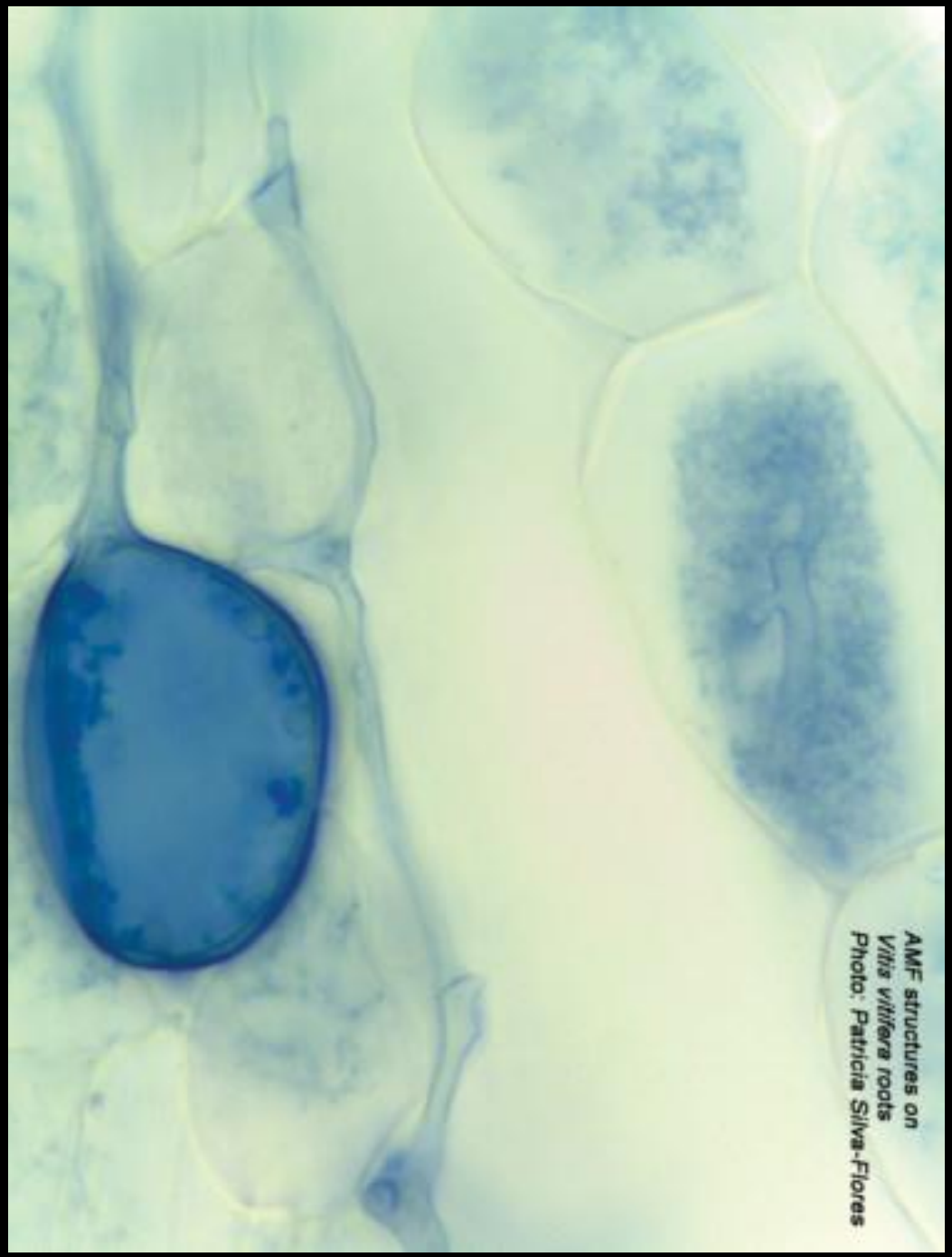
Universités de Gdansk (Pologne) & Kunming (Chine)

# 1

# Exploiter le sol

# Mycorhizes

# Mycorhizes

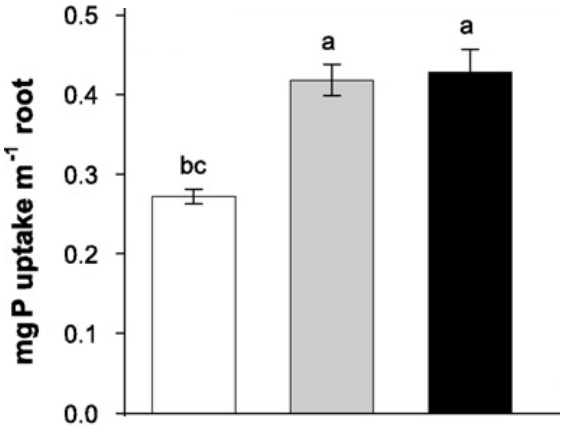


AMF structures on
*Vitis vitifera* roots
Photo: Patricia Silva-Flores

# Mycorhizes

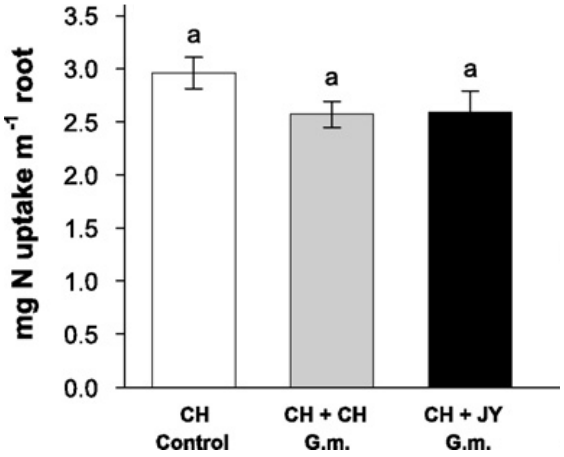
APPLIED SOIL ECOLOGY 36 (2007) 205–215

P




## Sol de CH

N

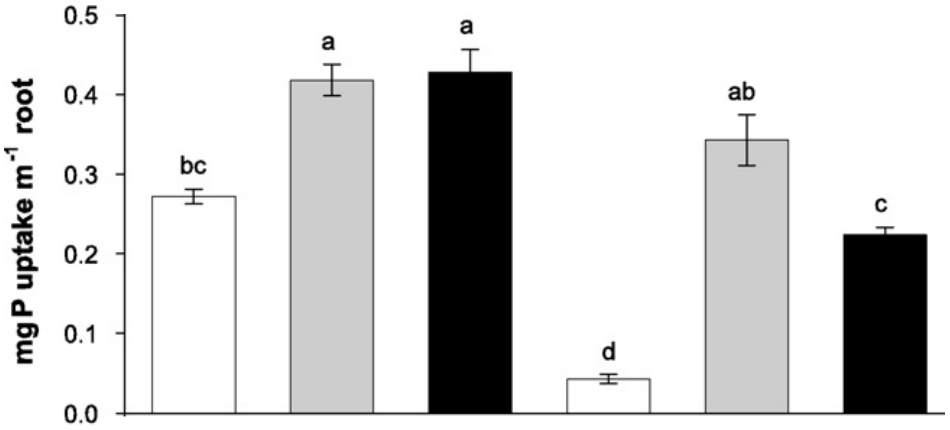



**Sol de deux parcelles CH et JY**

***Glomus margarita*** **issu de**
**CH, en gris**
**JY, en noir**

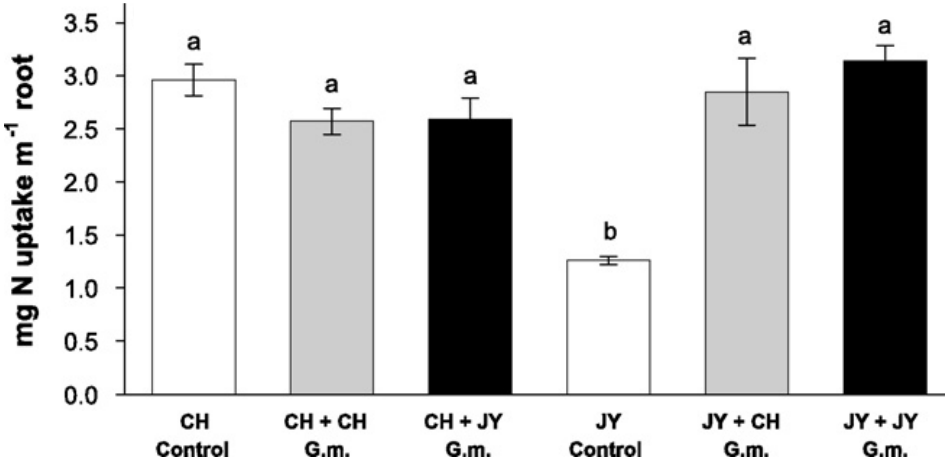
## Pinot noir Orégon

P




Sol de CH  Sol de JY

N




Sol de deux parcelles, CH et JY

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Pinot noir Orégon

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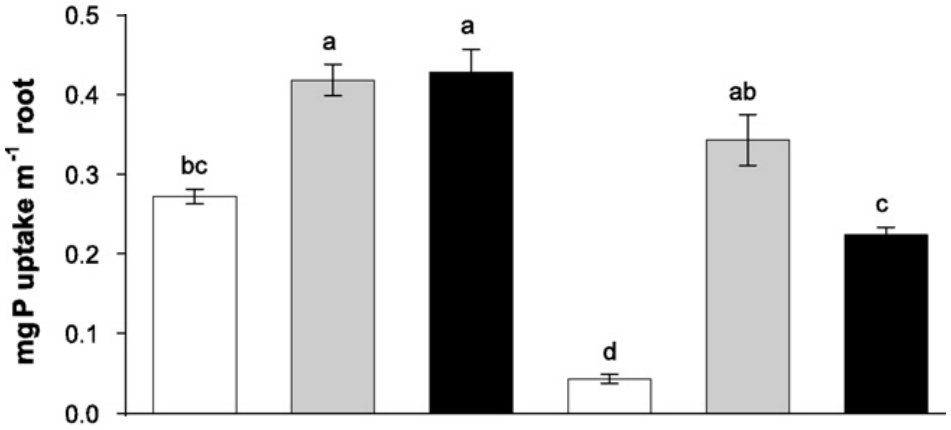
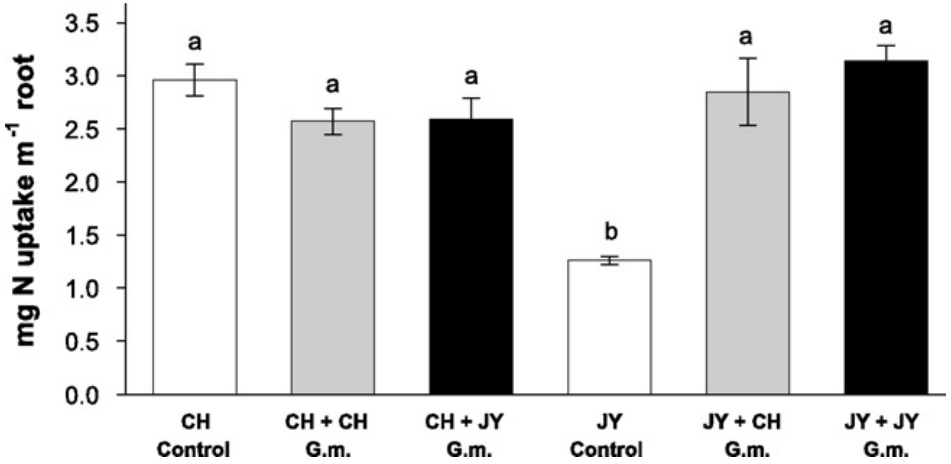



# TERROIR

N




**Sol de deux parcelles, CH et JY**

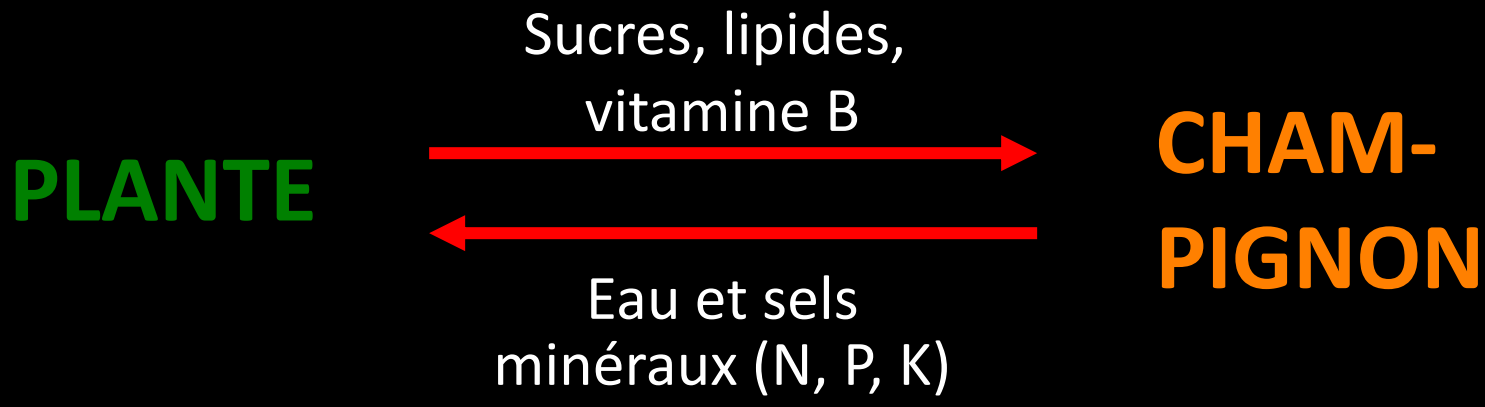
***Glomus margarita*** **issu de**

**CH, en gris**

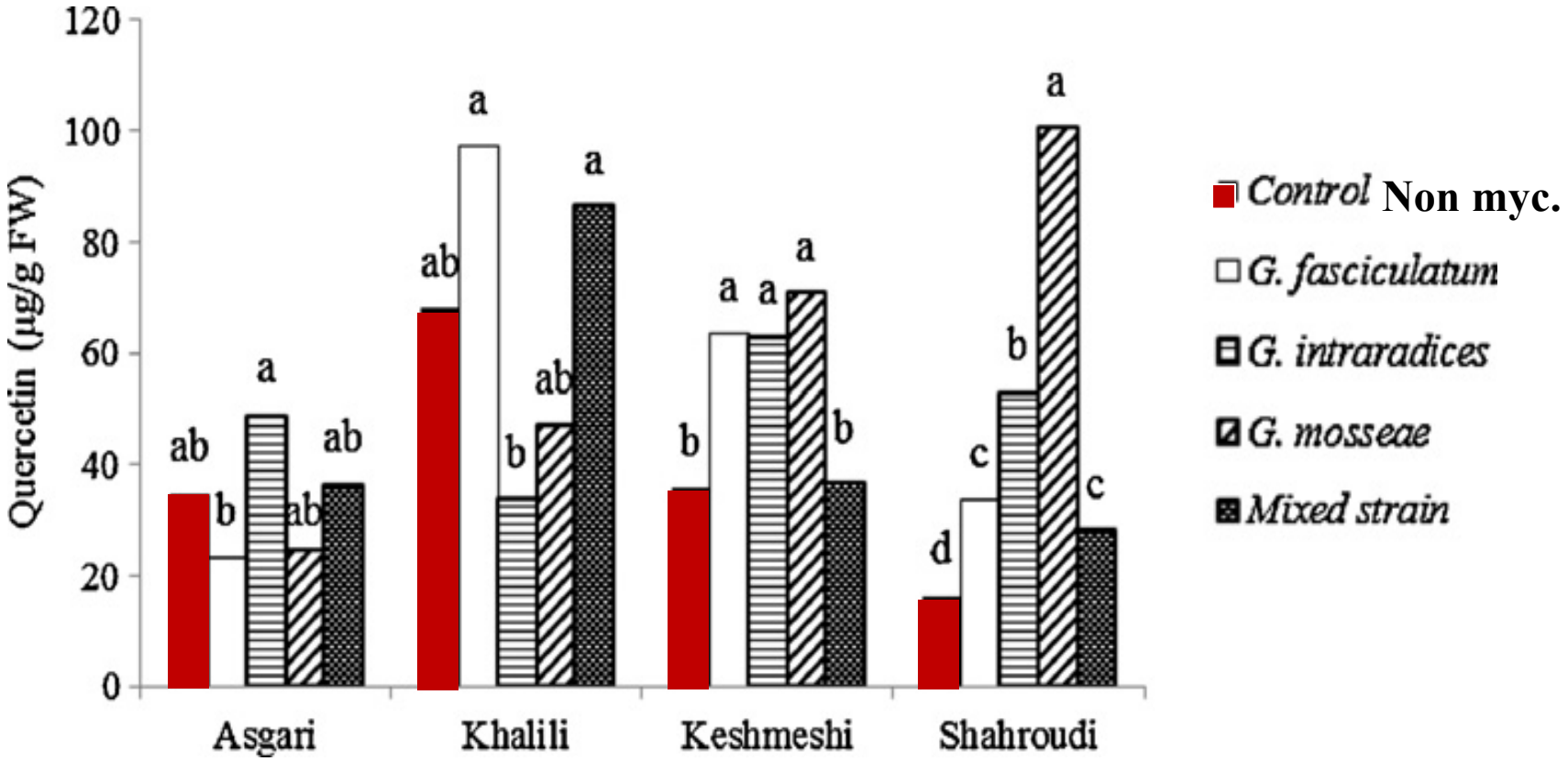
**JY, en noir**

**Pinot noir Orégon**

# LA MYCORHIZE, UNE SYMBIOSE



# Teneur végétative en quercétine de cépages iraniens




Quercetin content of mycorrhizal grape varieties. Means followed by the same letter(s) are not significantly different ($P < 0.05$) as determined by LSD test

*Industrial Crops and Products* 38 (2012) 160–165

# Mycorhizes et stabilité du sol

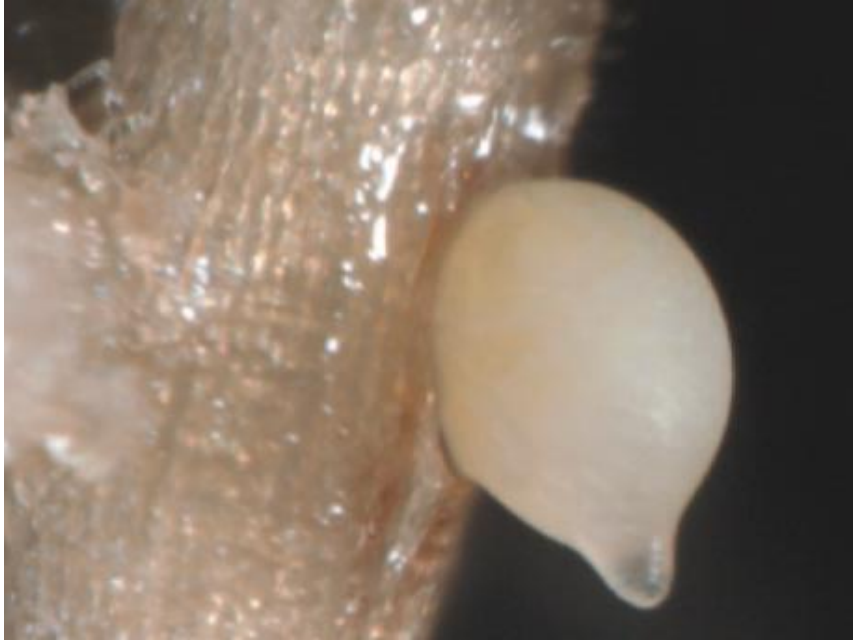
# 2

# Se défendre !


Court-noué

# Court-noué

**sur les attaques du nématode *Xiphinema index***

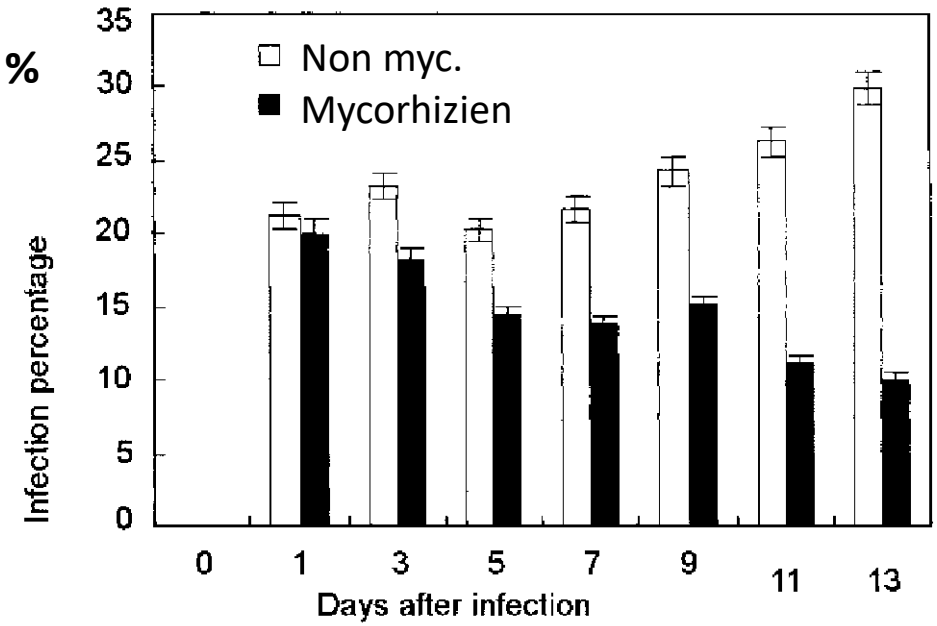


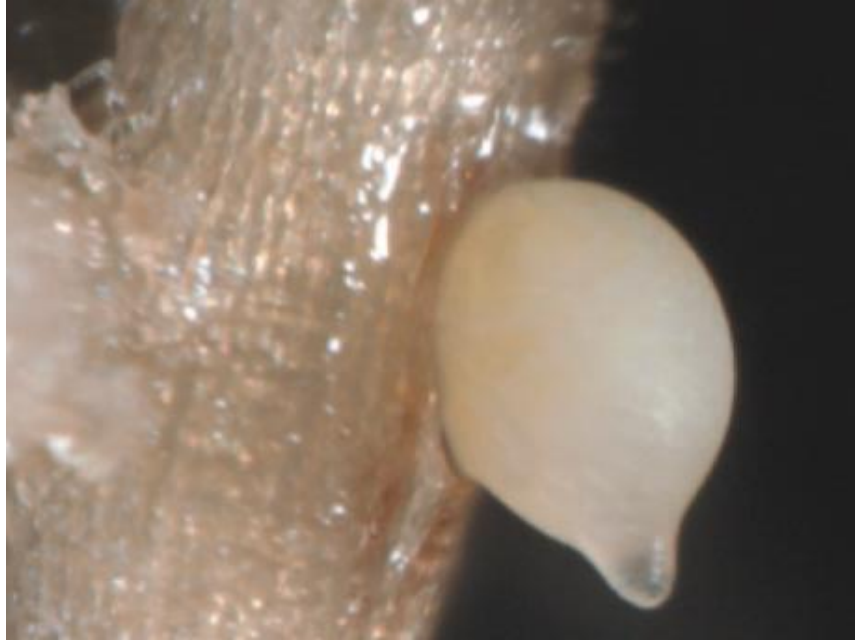
**Effet de *Rhizophagus intraradices***

**sur les attaques du nématode *Xiphinema index***

***Vitis amurensis***

*Plant Cell Physiol.* 47 (2006): 154–163



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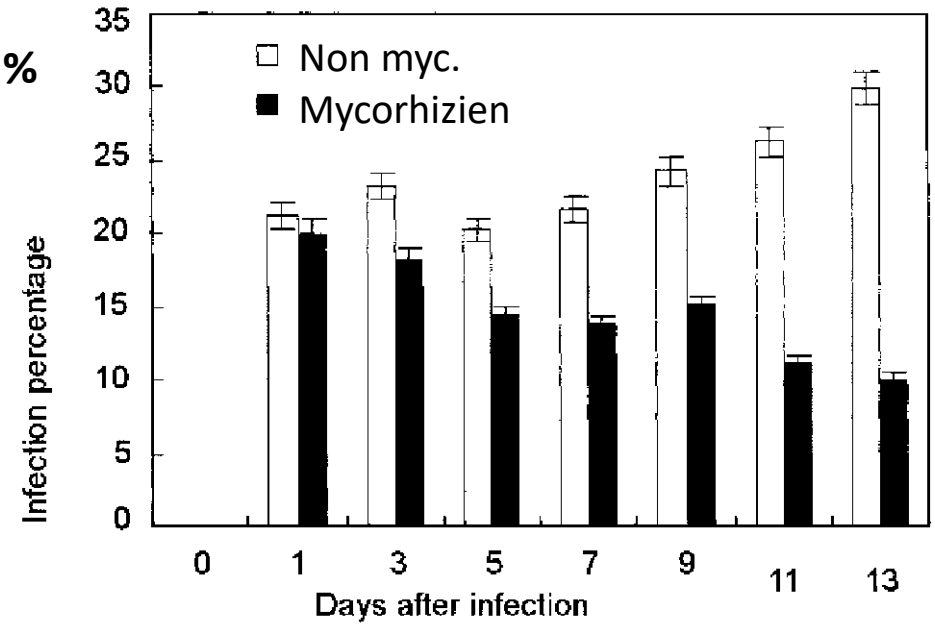


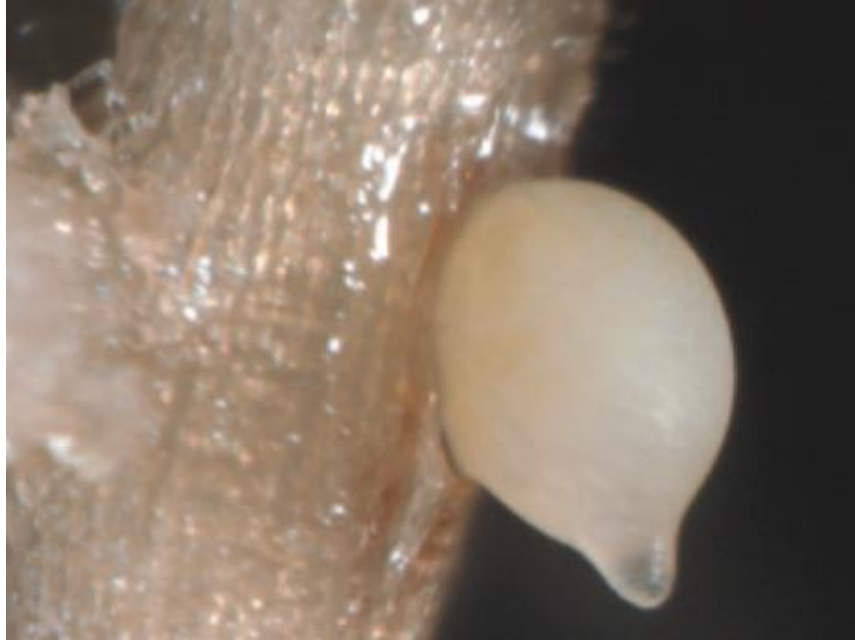

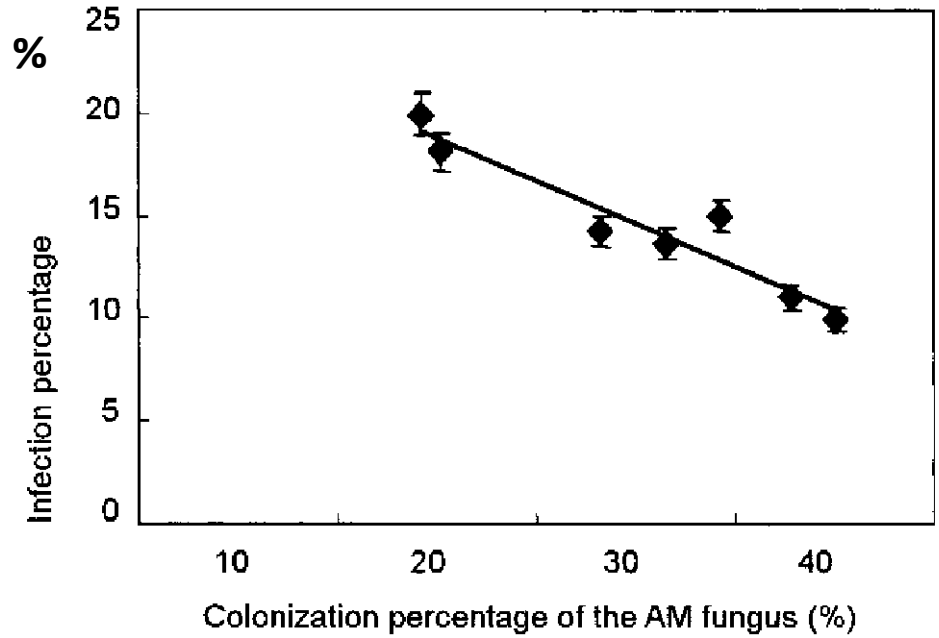


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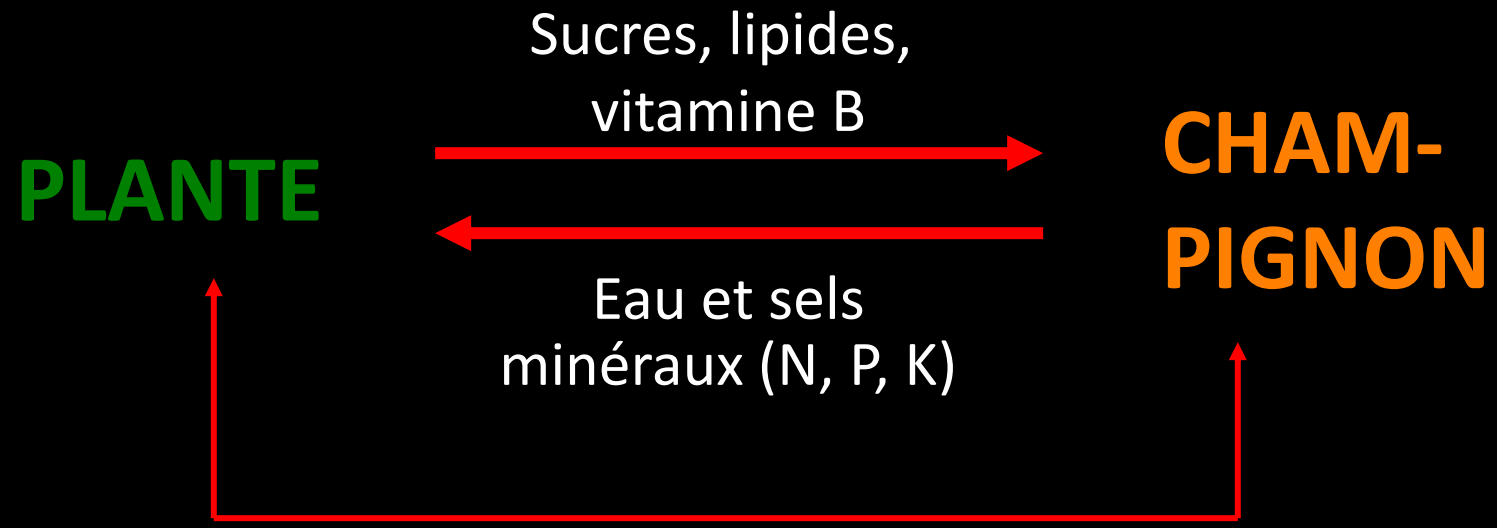
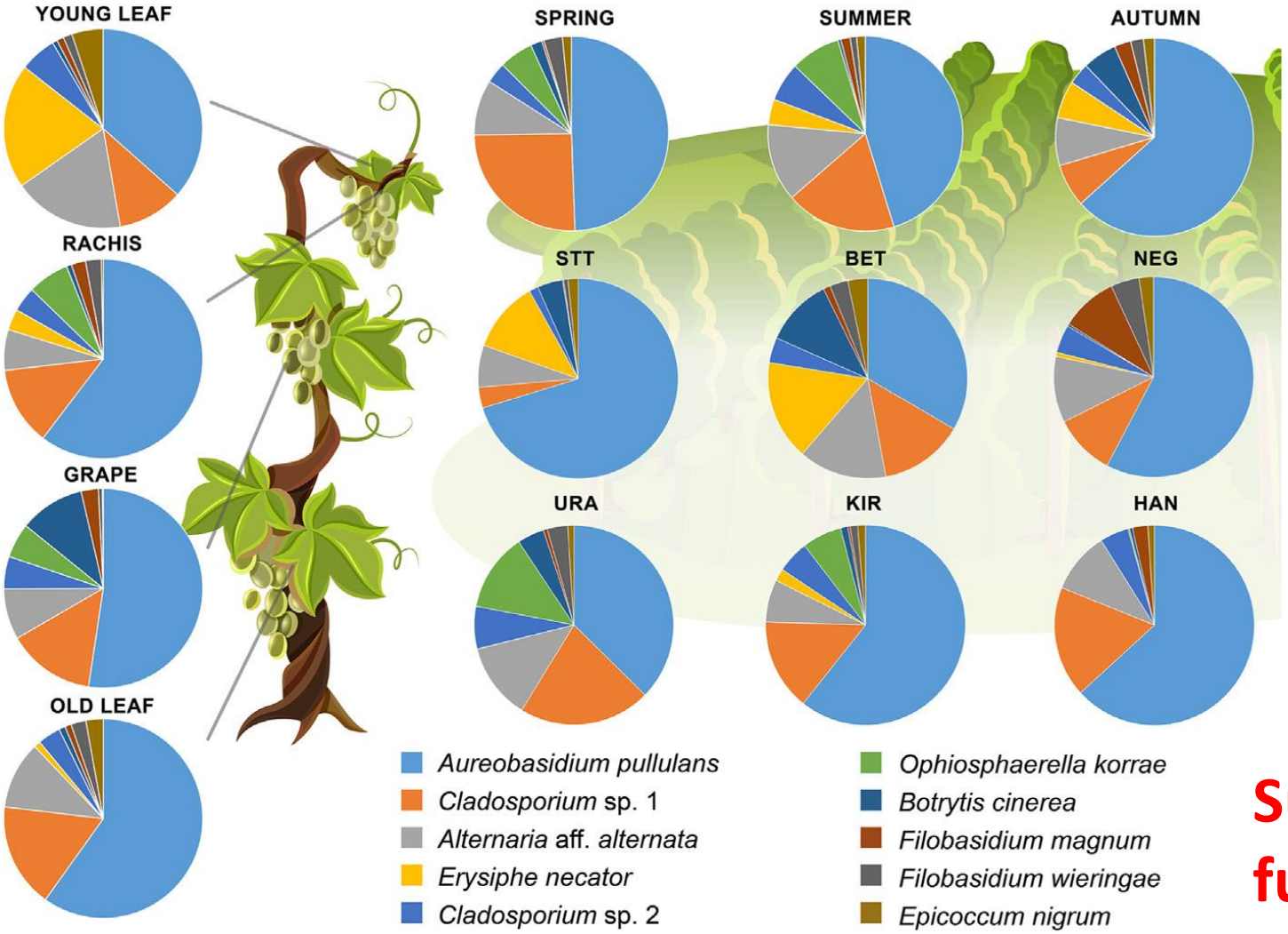
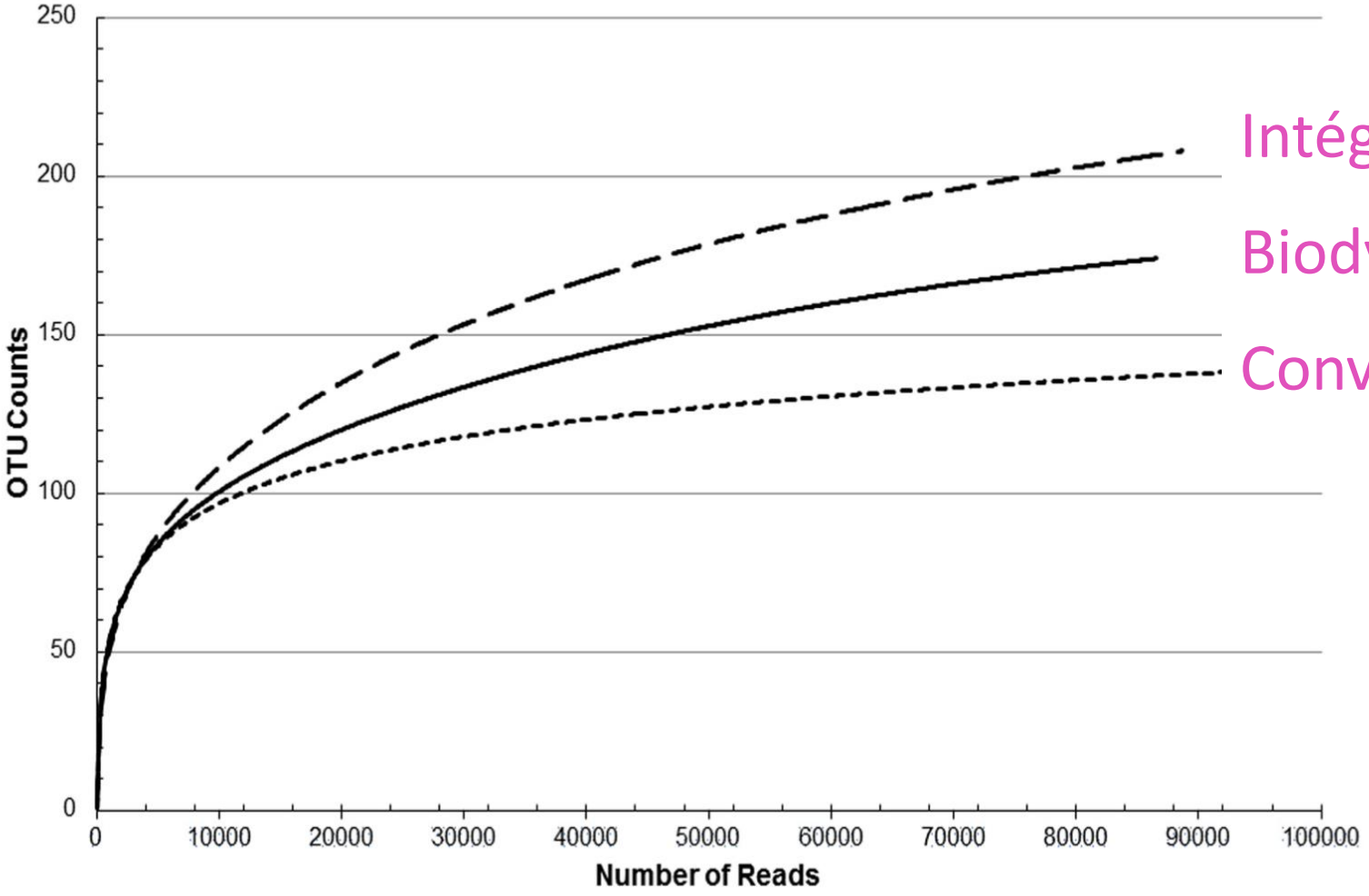





**Sur le furmint**

**Sequence-based Analysis of the *Vitis vinifera* L. cv Cabernet Sauvignon Grape Must Mycobiome in Three South African Vineyards Employing Distinct Agronomic Systems**

# Abondances d'espèces fongiques



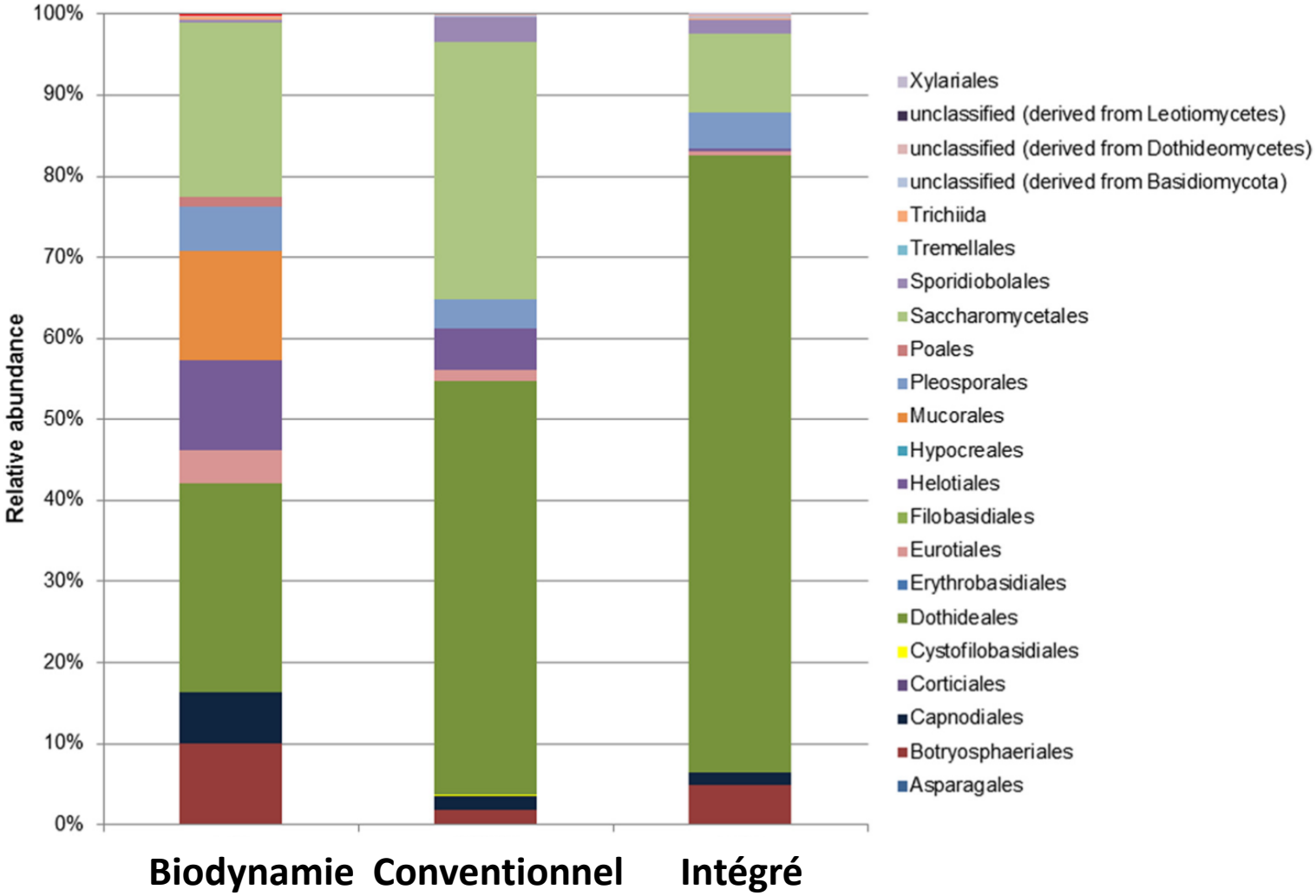

Intégré

Biodynamie

Conventionnel

# Sequence-based Analysis of the *Vitis vinifera* L. cv Cabernet Sauvignon Grape Must Mycobiome in Three South African Vineyards Employing Distinct Agronomic Systems

## Ordres fongiques présents



*Journal of Experimental Botany*, Vol. 61, No. 1, pp. 249–260, 2010
doi:10.1093/jxb/erp295 Advance Access publication 7 October, 2009

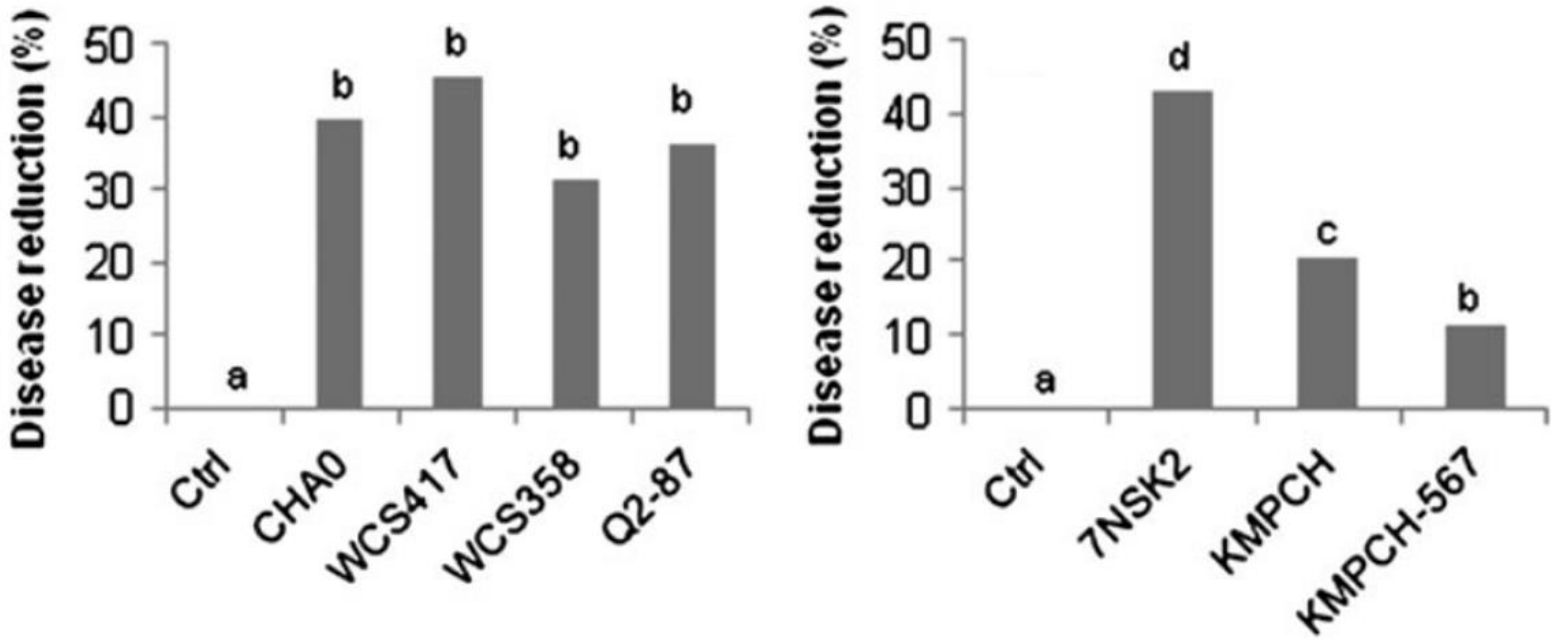
Journal of Experimental Botany
www.jxb.oxfordjournals.org

RESEARCH PAPER

# *Pseudomonas* spp.-induced systemic resistance to *Botrytis cinerea* is associated with induction and priming of defence responses in grapevine

**Bas W. M. Verhagen[1,*], Patricia Trotel-Aziz[1], Michel Couderchet[1], Monica Höfte[2] and Aziz Aziz[1,†]**

## Dégâts de botrytis sur les feuilles




## Souches de *Pseudomonas* (*fluorescens*, *putida* ou *aeruginosa*)

*Journal of Experimental Botany*, Vol. 61, No. 1, pp. 249–260, 2010
doi:10.1093/jxb/erp295 Advance Access publication 7 October, 2009

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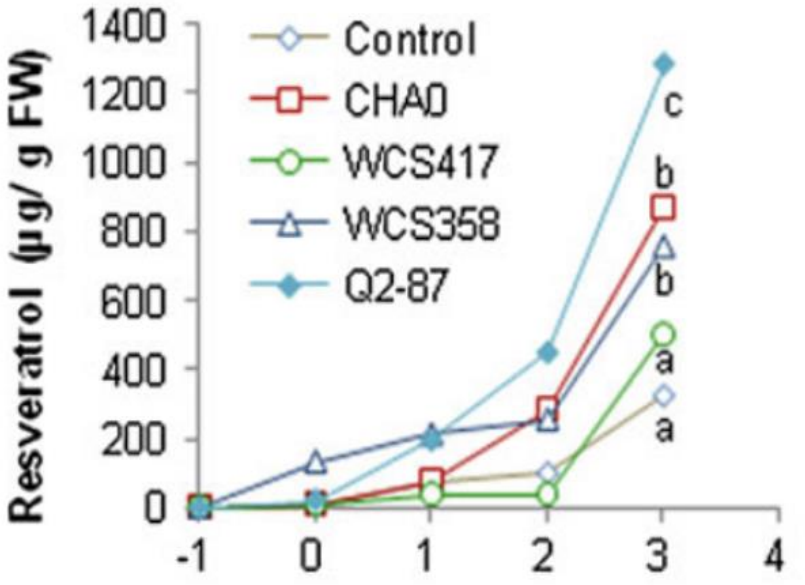
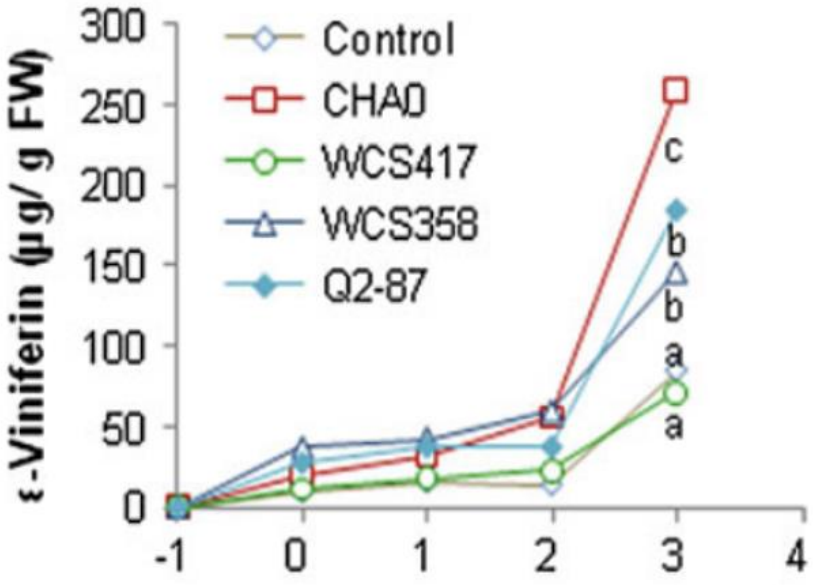
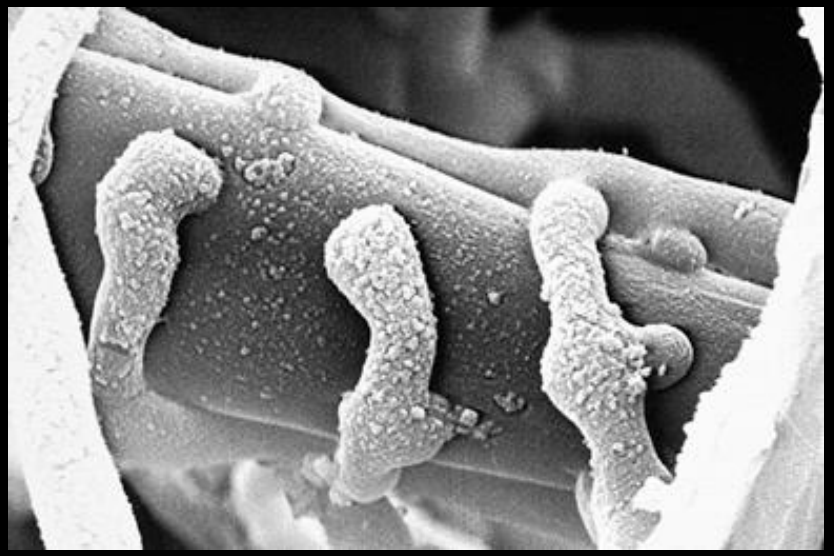
**Bas W. M. Verhagen[1,*], Patricia Trotel-Aziz[1], Michel Couderchet[1], Monica Höfte[2] and Aziz Aziz[1,†]**

## Induction de phytoalexines foliaires

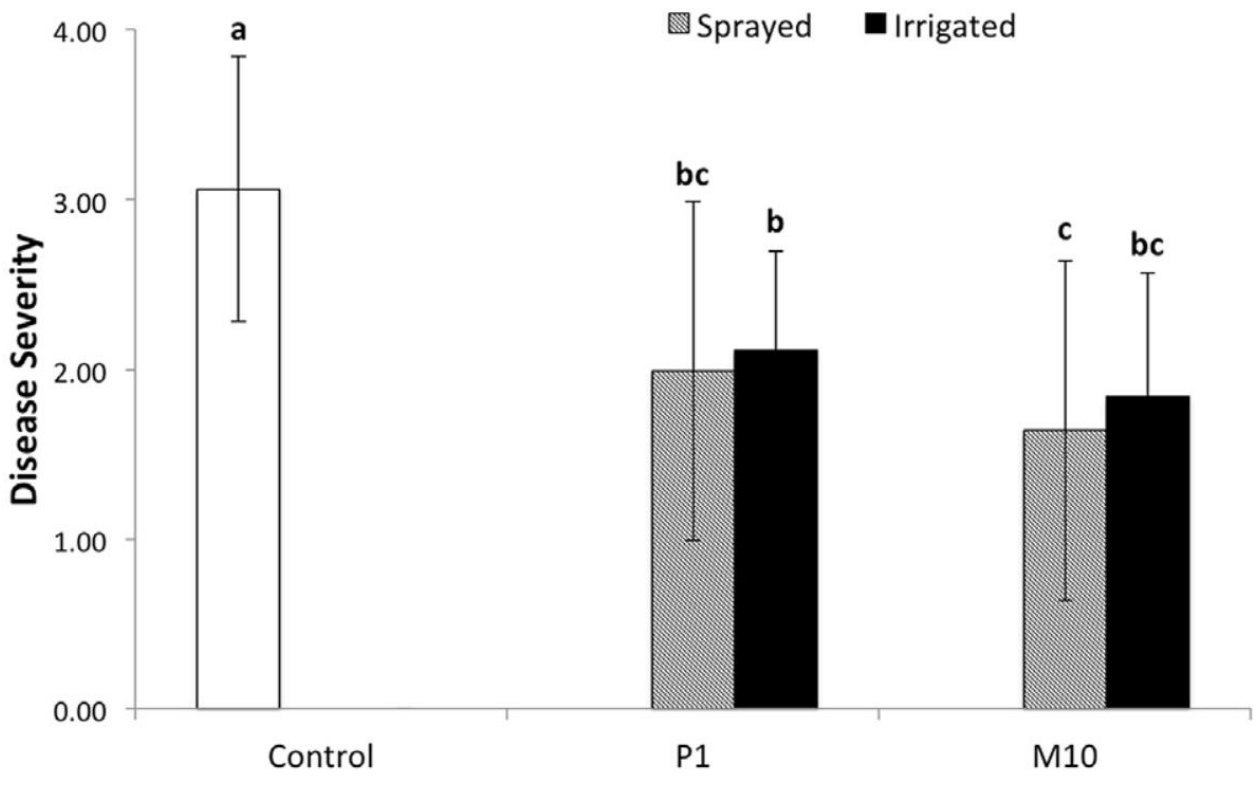


# *Trichoderma*



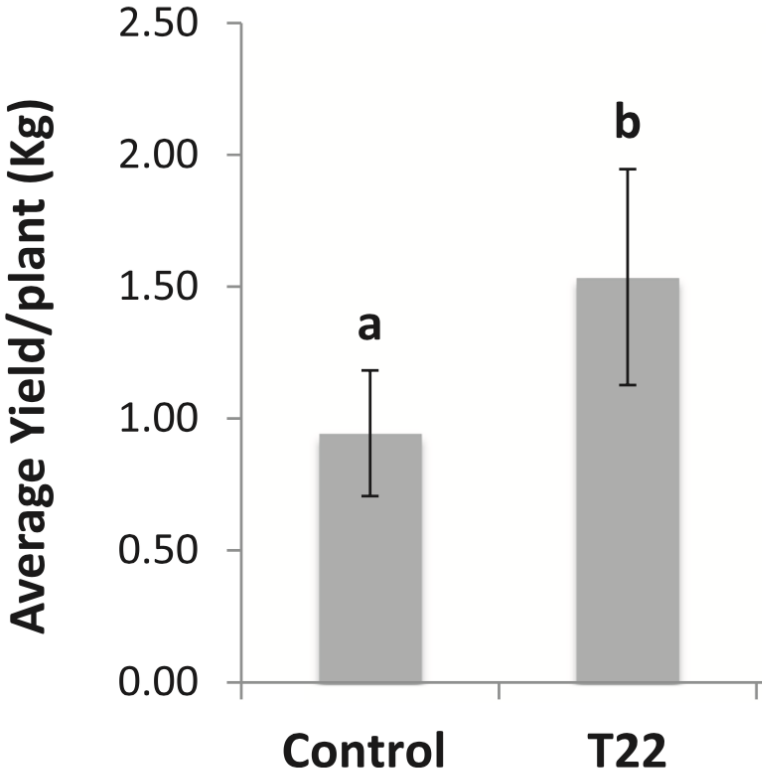
# *Trichoderma* contre l'oïdium




Disease control of a sprayed or a drenched spore suspension of *T. atroviride* P1 and *T. harzianum* M10. Control: $H_2O$ treated. Bars indicate disease severity levels on grape leaves affected by powdery mildew. Different letters on the bars indicate significative differences according to LSD test ($p \leq 0{,}01$).

*Crop Protection* 92 (2017) 176-181

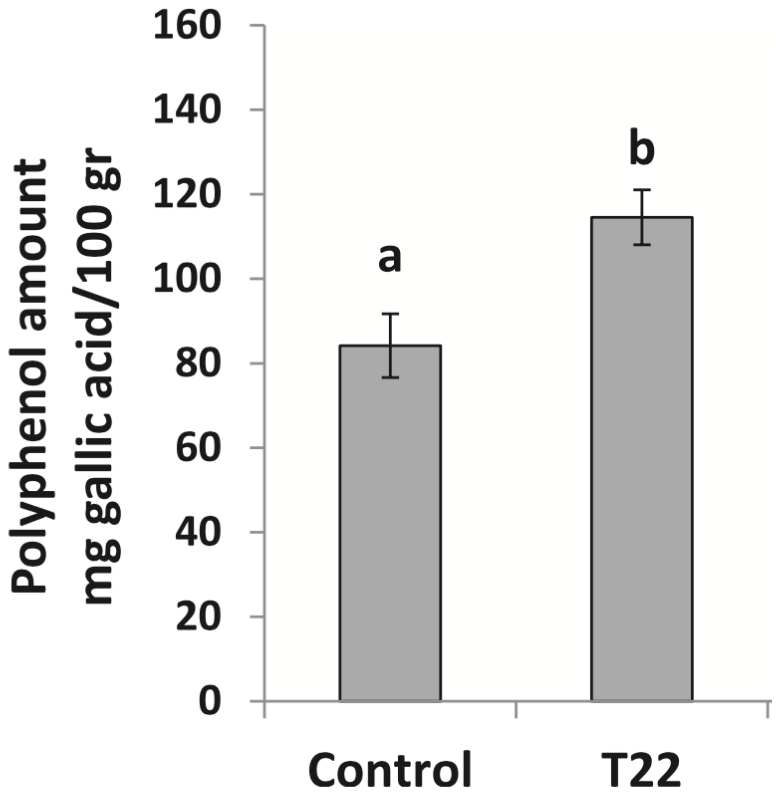
# *Trichoderma* contre l'oïdium




Effect of *T. harzianum* strain T22 (T22) and 6-pentyl-α-pyrone (6PP) treatments on grape yield. Control: $H_2O$ treated. Bars indicated the mean of yield per plant in terms of Kg of grapes produced. Different letters on the bars indicate significative differences according to LSD test ($p \leq 0,05$).

*Crop Protection* 92 (2017) 176-181

# *Trichoderma* et tannins

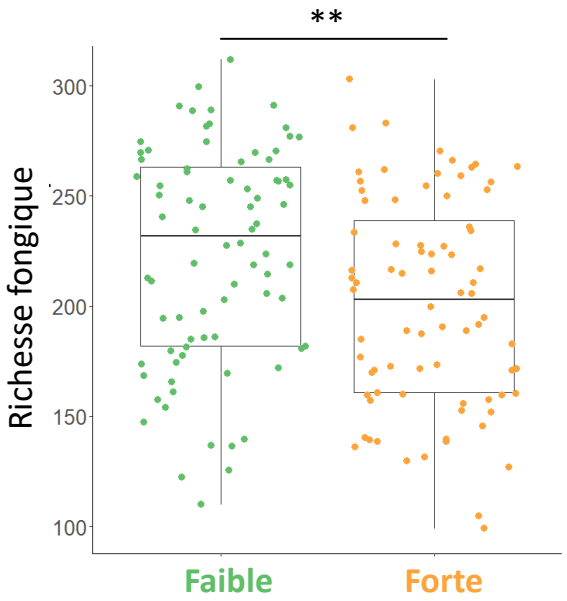



Effect of *T. harzianum* strain T22 (T22) and 6-pentyl-α-pyrone (6PP) based treatments on grape fruits total polyphenols amount. Control: $H_2O$ treated. Bars indicated the mean of polyphenols amount on 100 gr of products expressed as mg equivalents of gallic acid. Different letters on the bars indicate significative differences

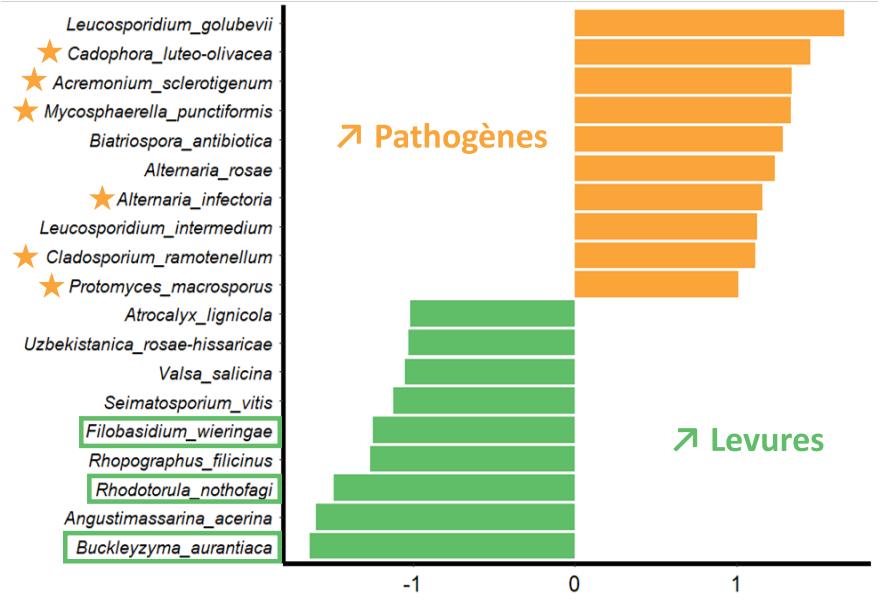
*Crop Protection* 92 (2017) 176-181

# Phyllosphère: les parcelles peu sensibles au mildiou ont un mycobiome foliaire plus riche, avec une plus grande abondance de levures basidiomycètes

Microbiote foliaire avant les premiers traitements




Sensibilité de la parcelle au mildiou




Coefficient d'association à la sensibilité

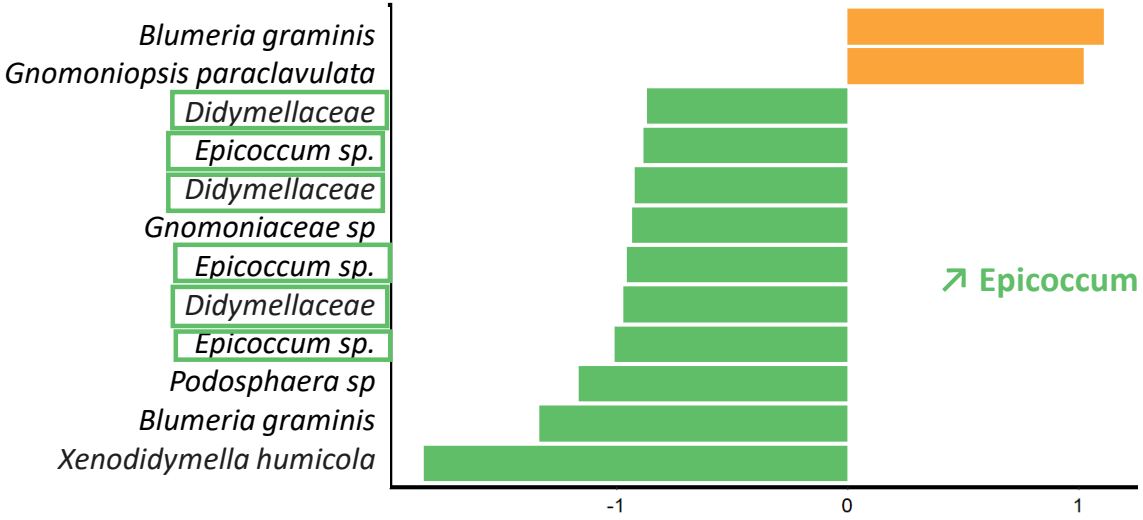
INRAE
Equipe Microbiote, UMR SAVE
10 janvier 24/Paris/Corinne VACHER

vitae
Cultiver la vigne sans pesticides

***Merci à Paola Fournier***

# Endosphère: le genre Epicoccum (Didymellaceae) est sur-représenté dans les parcelles peu sensibles au mildiou

Microbiote foliaire avant les premiers traitements




Coefficient d'association à la sensibilité

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Equipe Microbiote, UMR SAVE
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vitae
Cultiver la vigne sans pesticides

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# 3

# Faut-il inoculer ?

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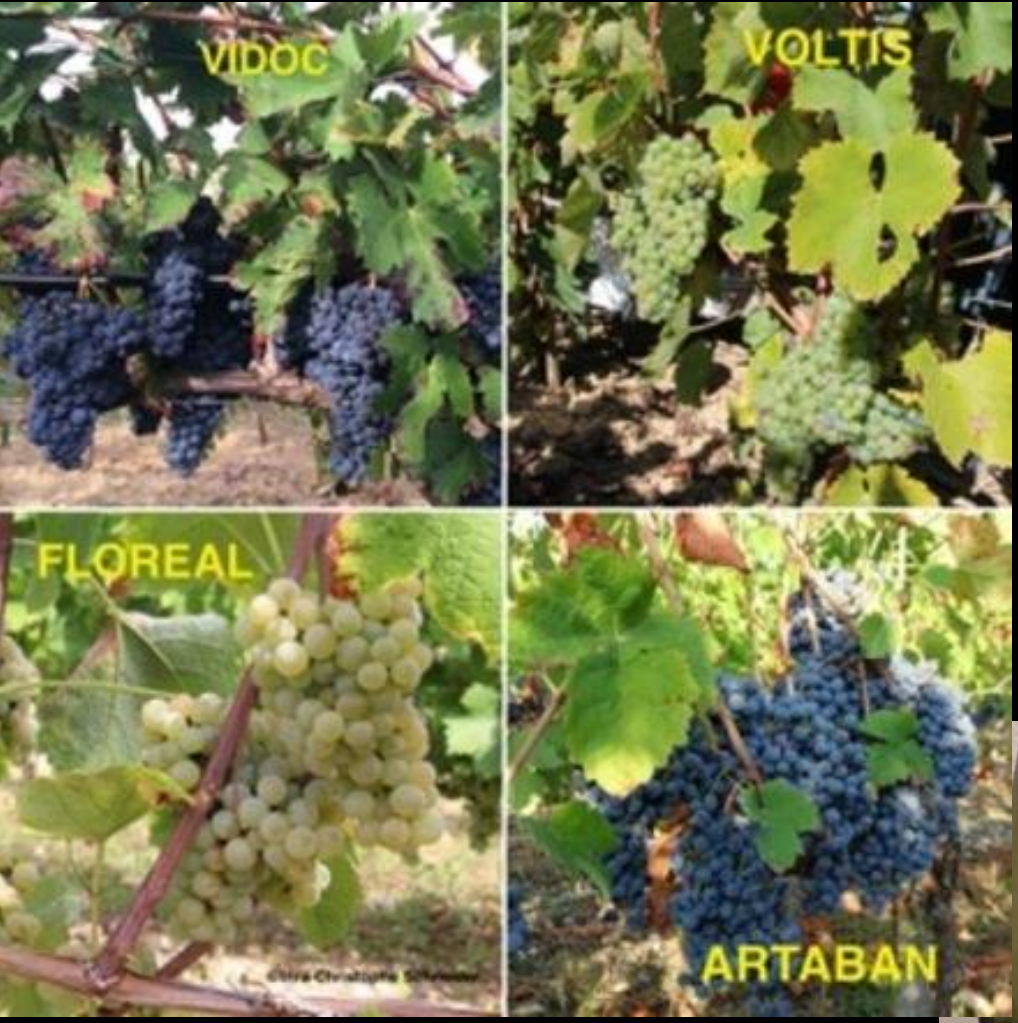
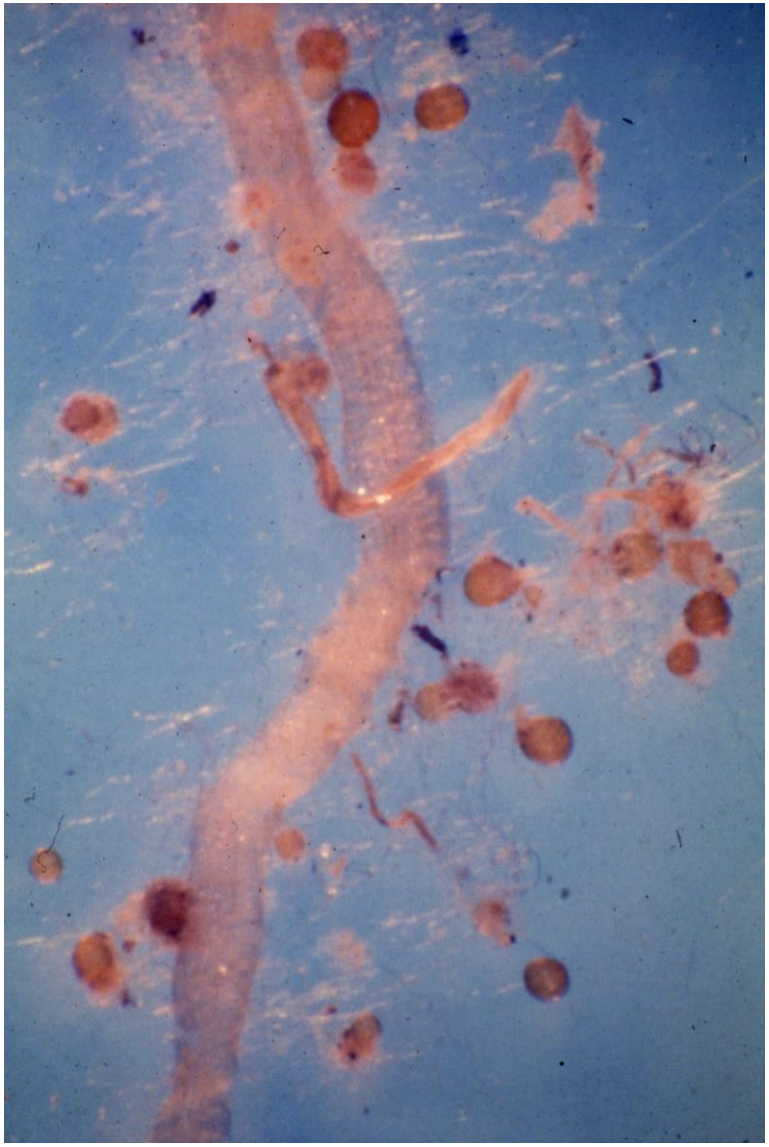
**Pourquoi pas sur les feuilles….**




# Les ResDur (résistance durable) de l'INRAE

# Faut-il inoculer ?

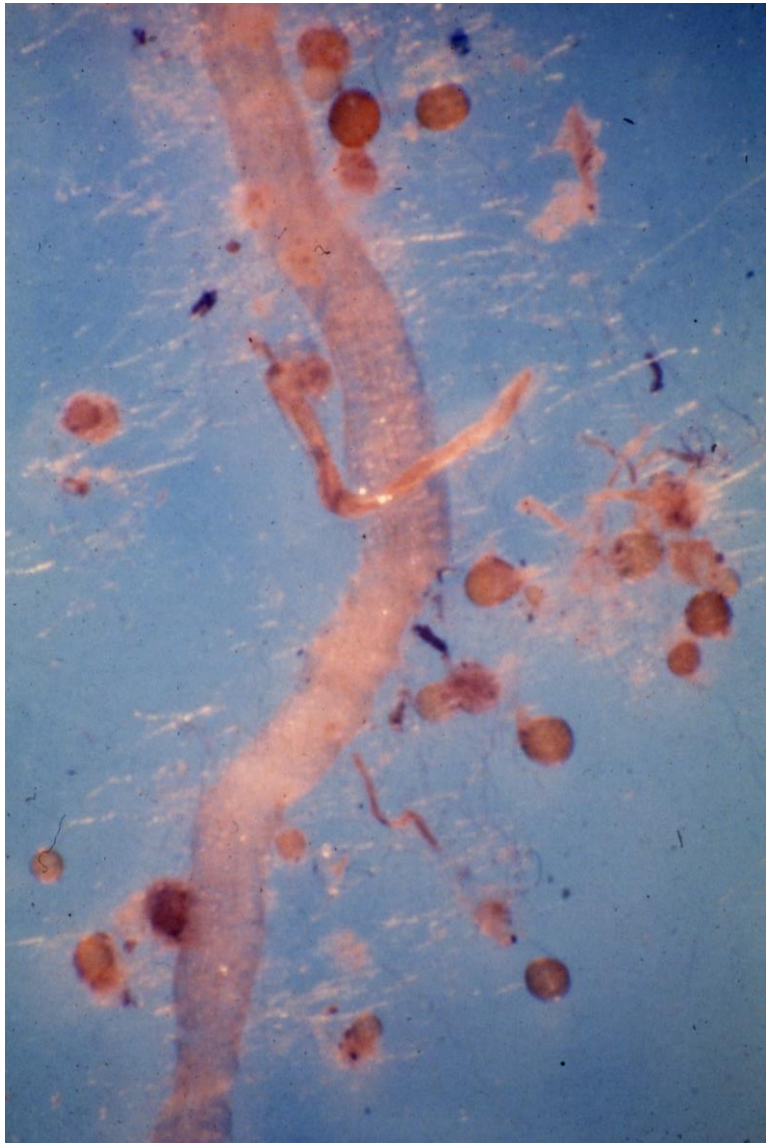


# Faut-il inoculer ?

**Source locale**

**Adaptée au sol**

**Adaptée à la plante**



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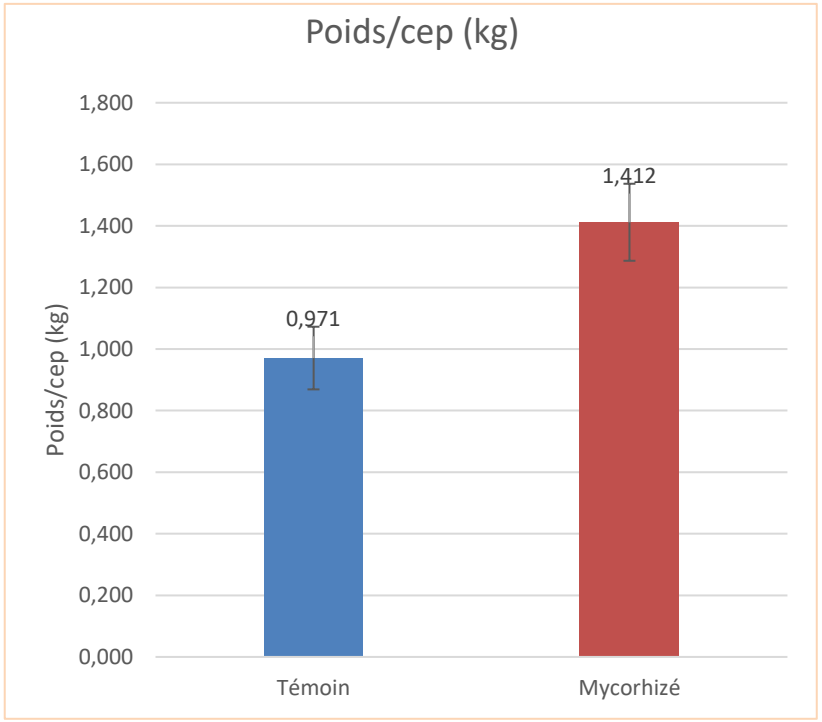
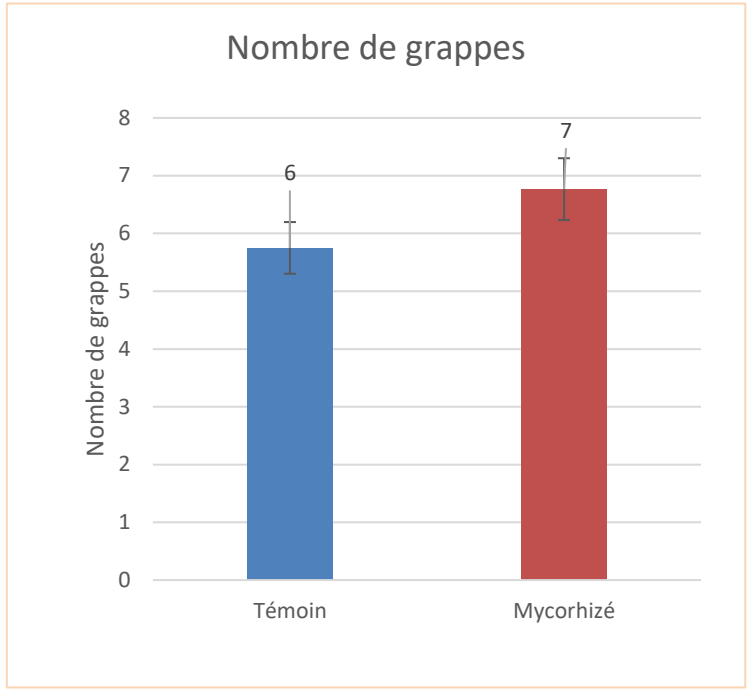
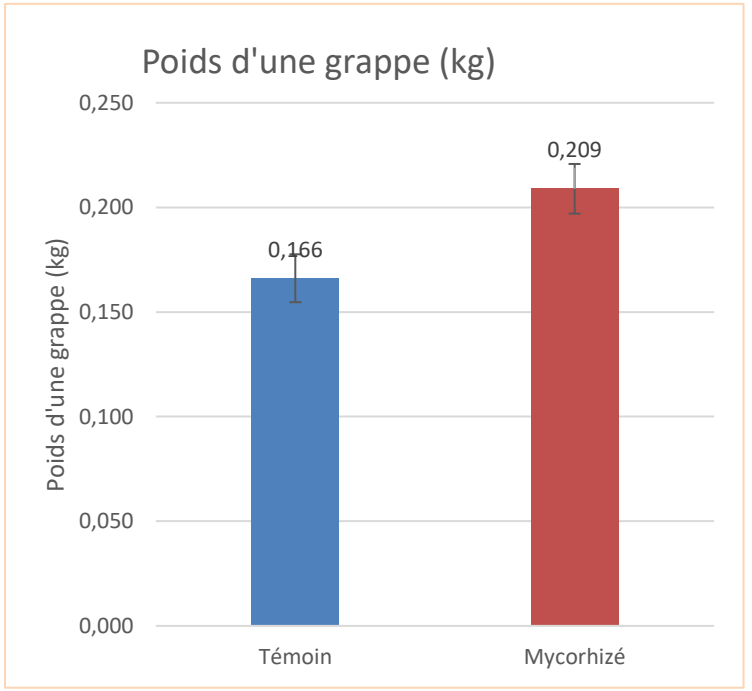
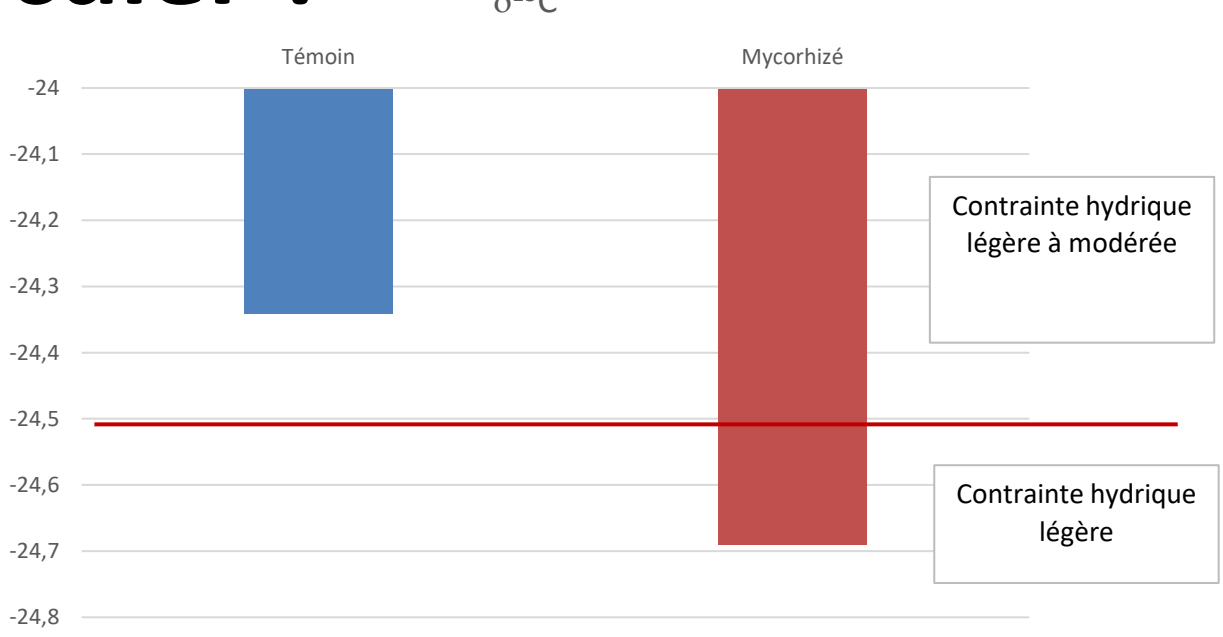



MYCOPHYTO
Cultivons l'équilibre de la nature

# Faut-il inoculer ?




**+ 20%** d'eau dans le sol

**+ 9%** de croissance des racines des jeunes plants

**+ 45%** en rendement

MYCOPHYTO
Cultivons l'équilibre de la nature

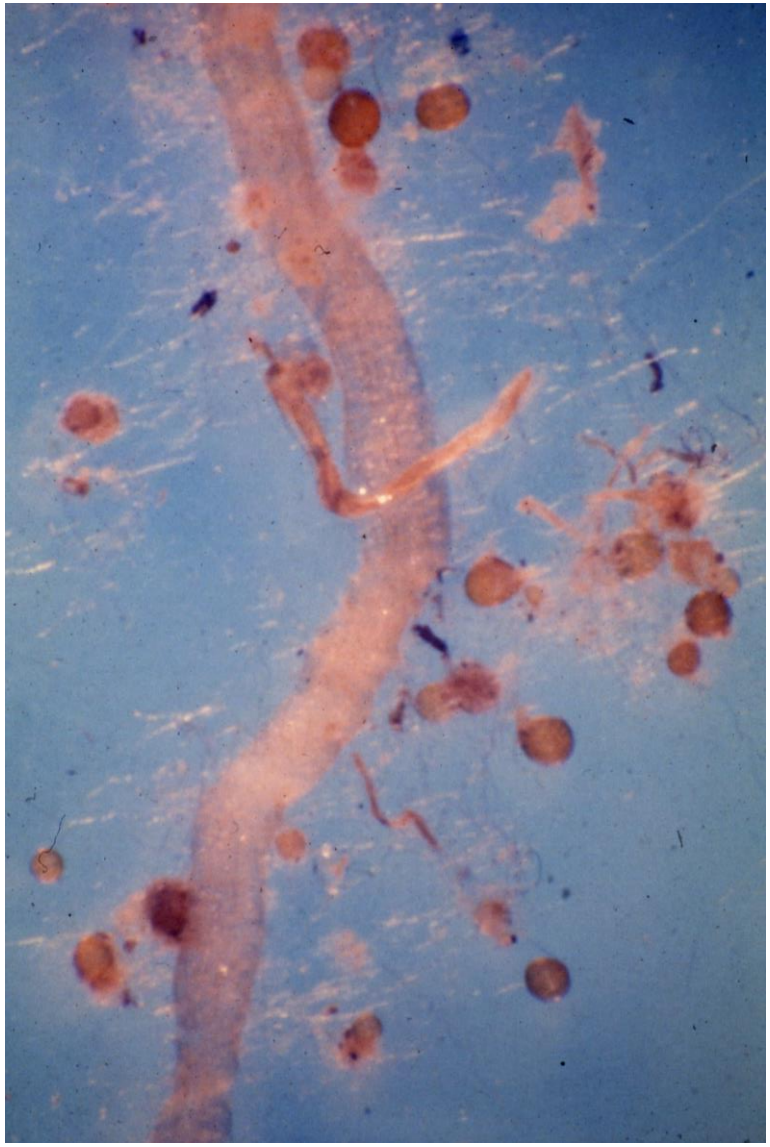
# Faut-il inoculer ?

**Source locale**

**Adaptée au sol**

**Adaptée à la plante**

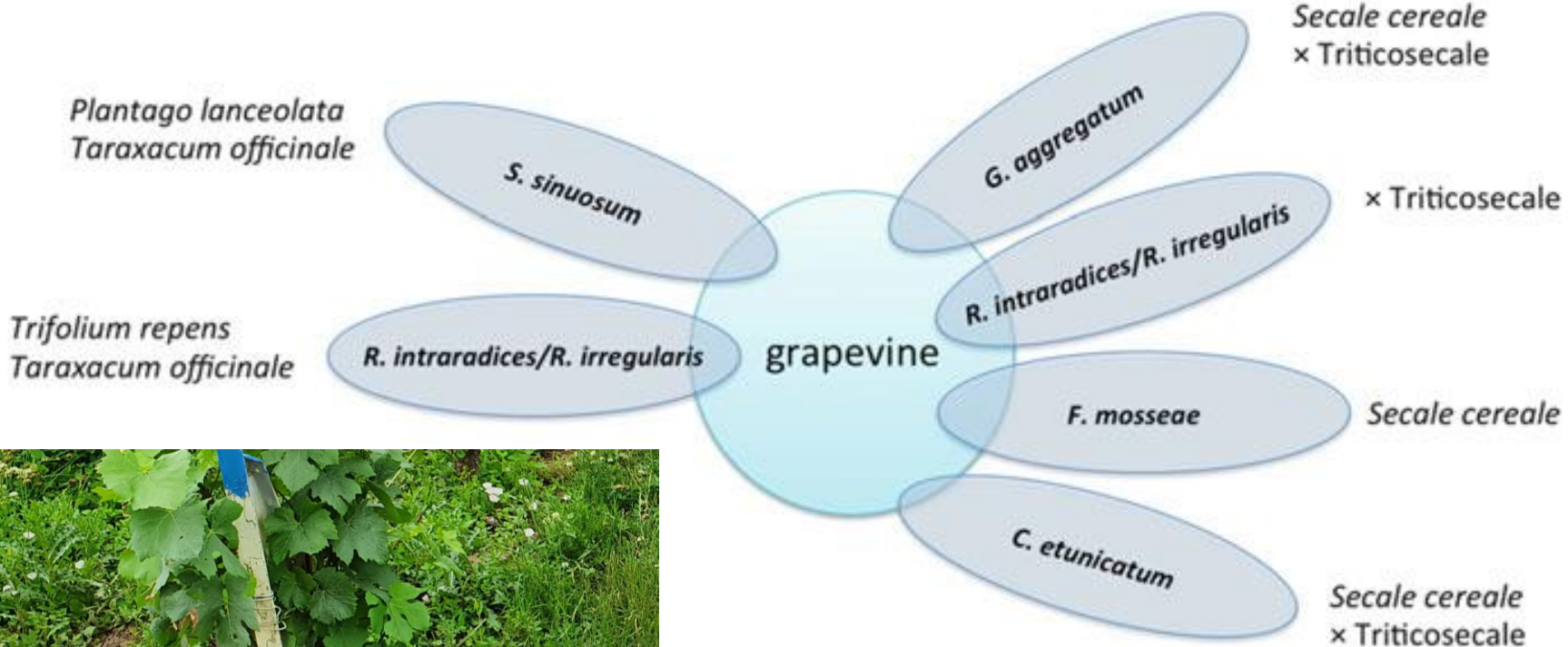
**… et les bons gestes**




Double peine…

**Herbacées spontanées pérennes dominantes (Radic et al., 2012)**

**Semis de couvert (Baumgartner et al., 2005)**



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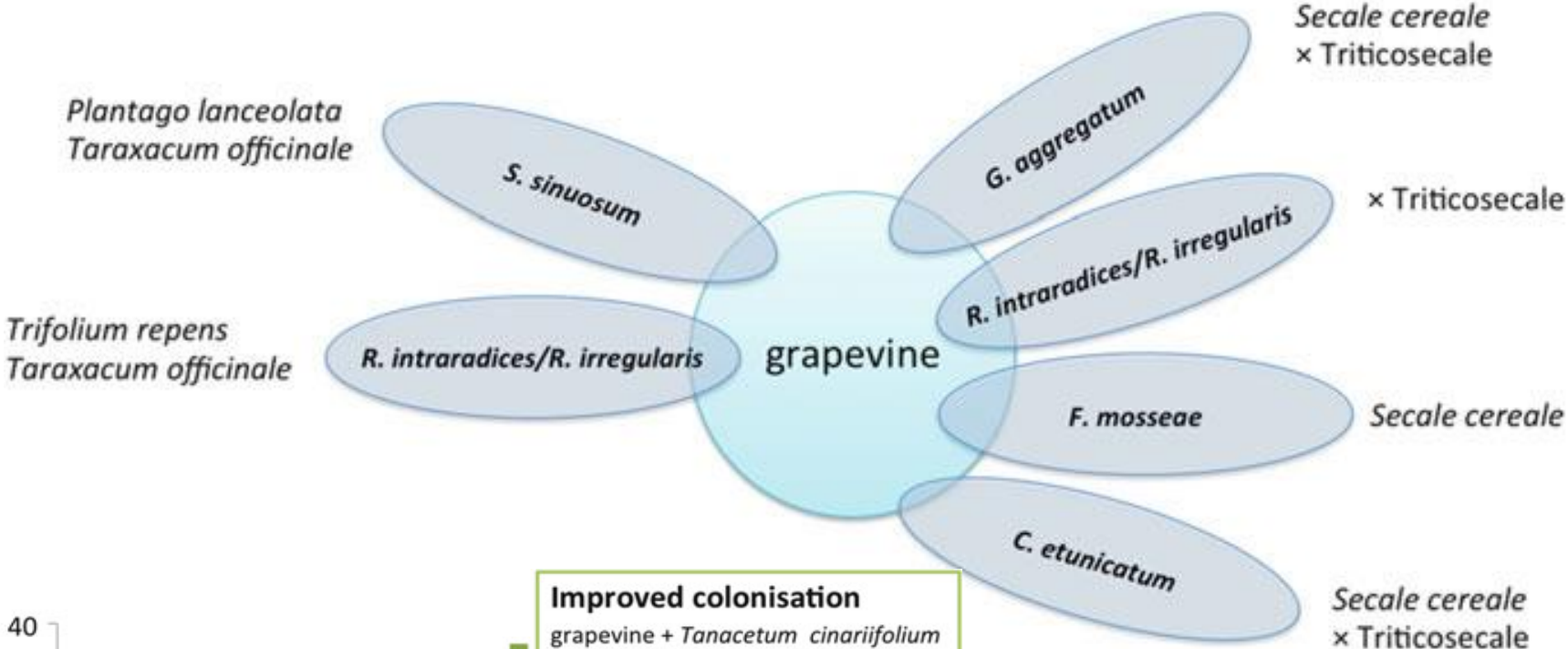
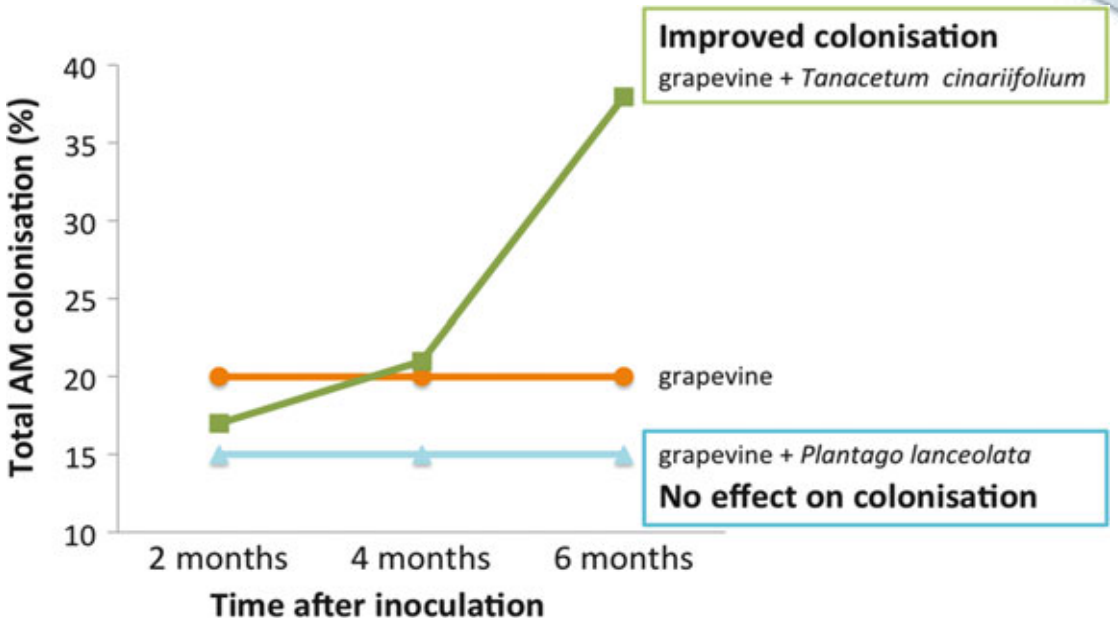


# Vitiforesterie

**Arbres avec les mycorhiziens de la vigne**
Rosaceae (*Prunus*, *Malus*…)
Liquidambars, noyers, frênes

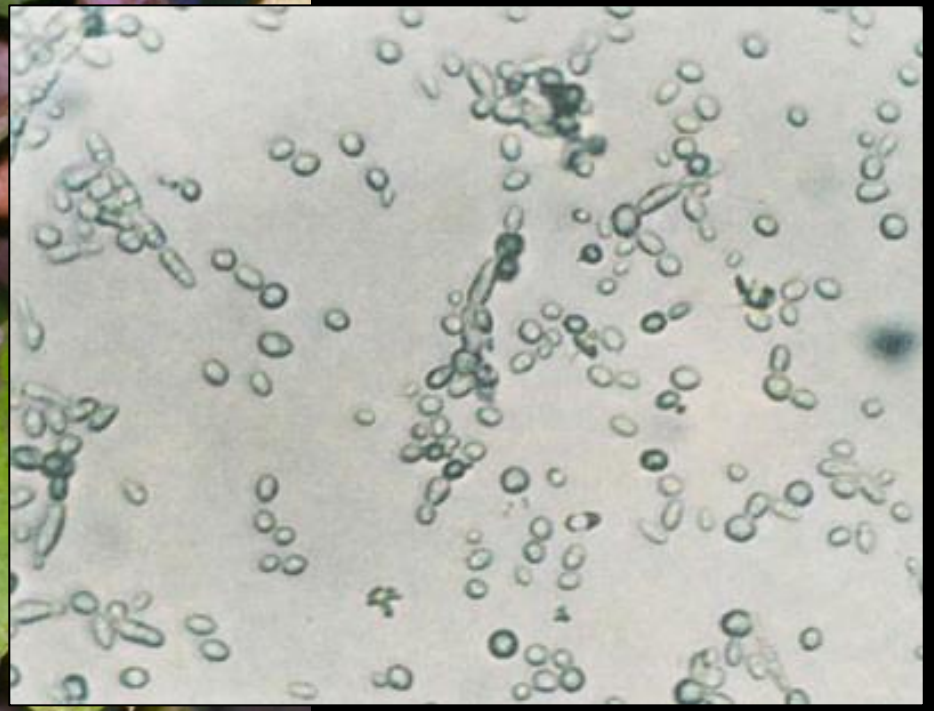
**ou des ectomycorhizes :**
Arbres forestiers (aulnes, chênes, charmes,…)

# 4

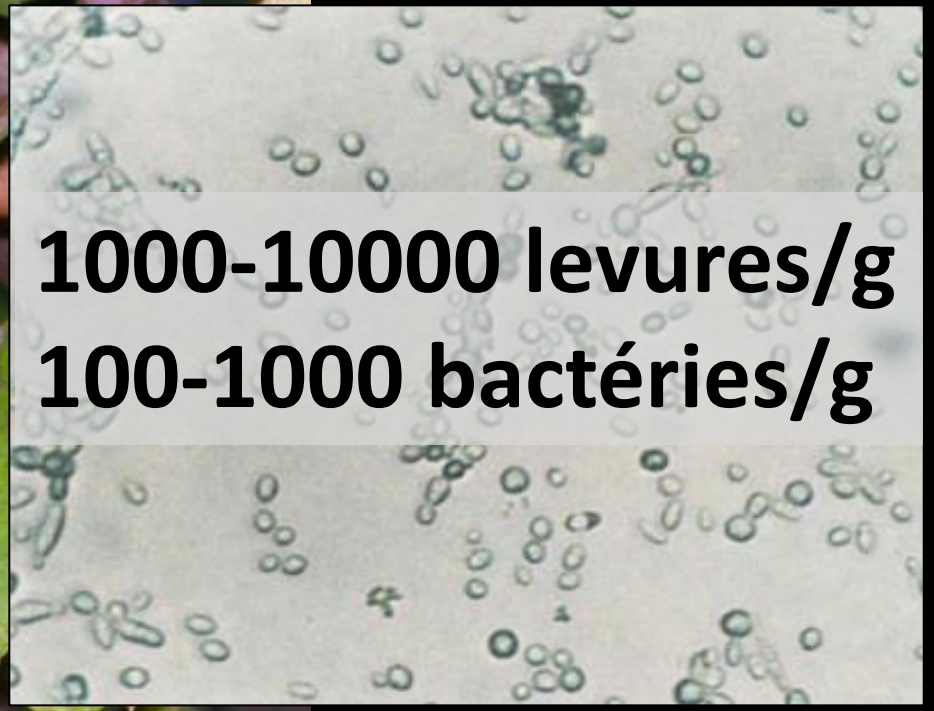
# Préparer le vin

# PRUINE

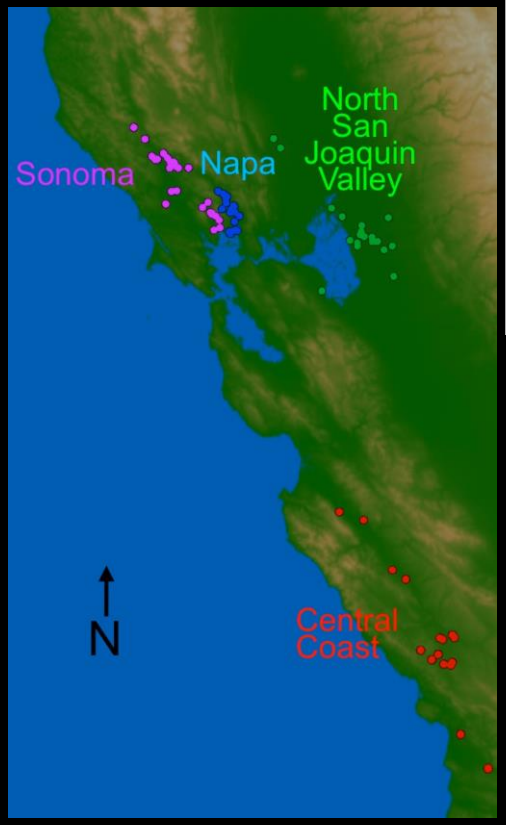
# PRUINE

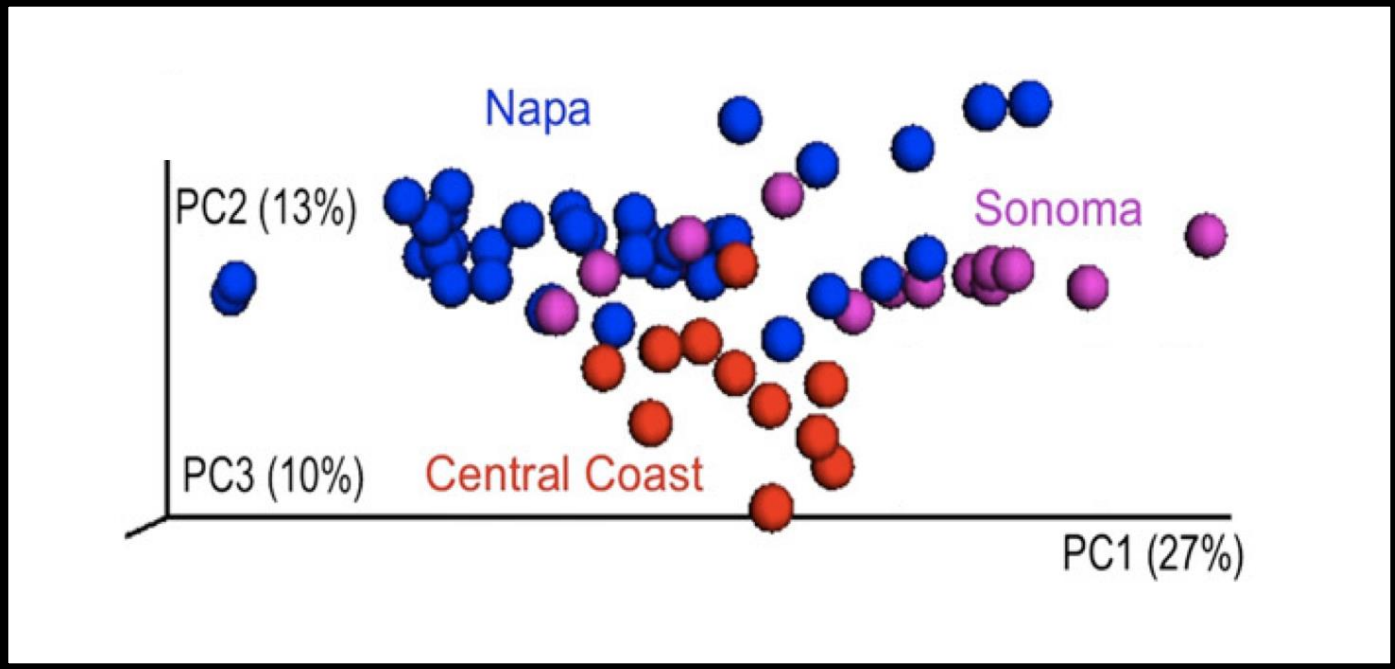


# PRUINE



**1000-10000 levures/g**
**100-1000 bactéries/g**

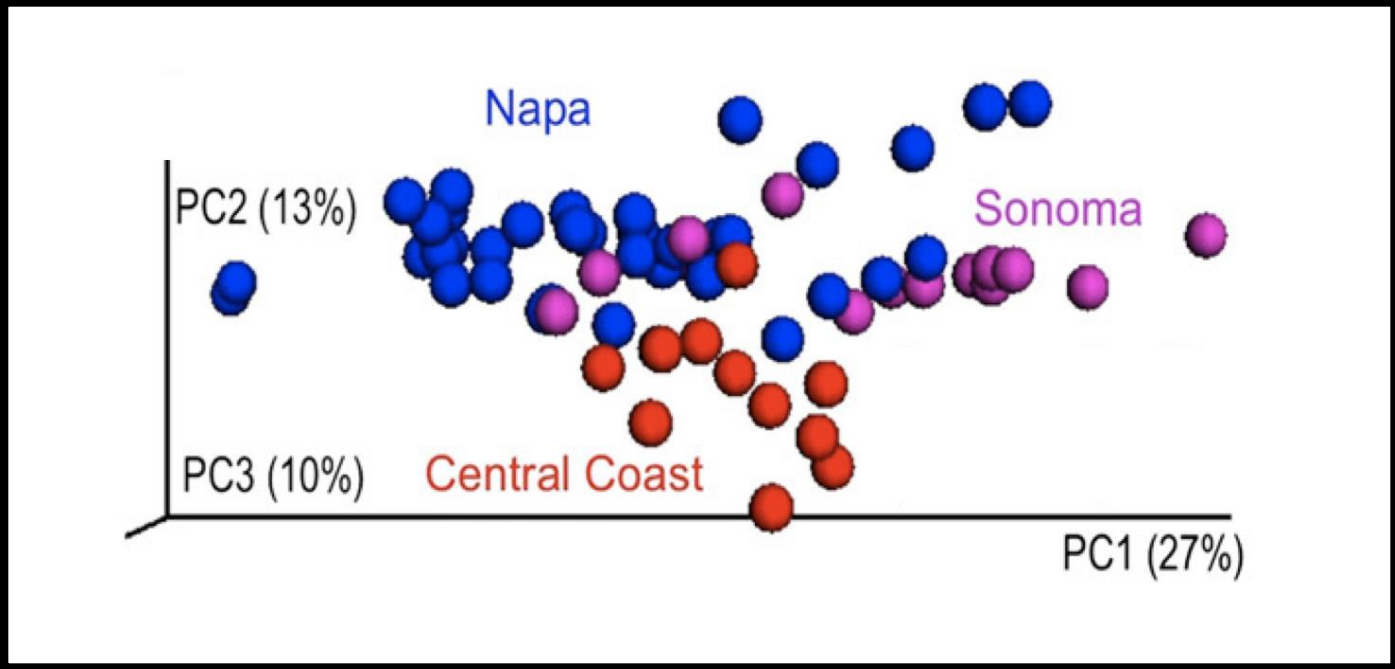


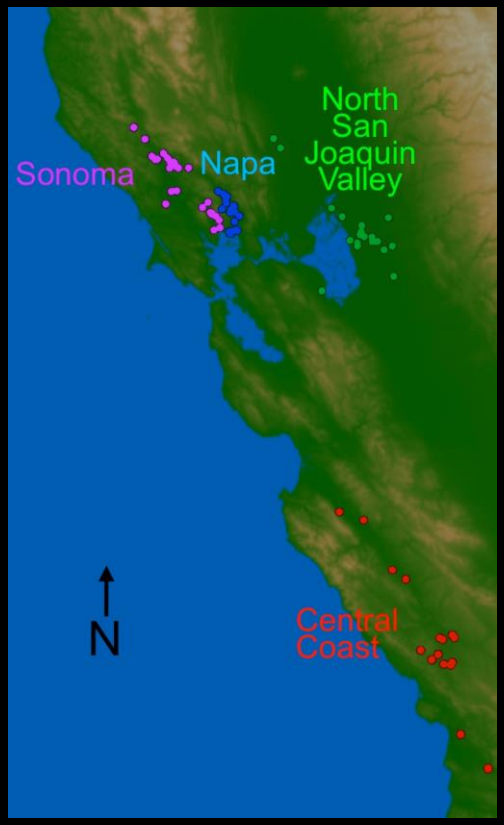




www.pnas.org/cgi/doi/10.1073/pnas.1317377110

# Microbial biogeography of wine grapes is conditioned by cultivar, vintage, and climate

Nicholas A. Bokulich[a,b,c], John H. Thorngate[d], Paul M. Richardson[e], and David A. Mills[a,b,c,1]




# La dimension microbienne du terroir ?

www.pnas.org/cgi/doi/10.1073/pnas.1317377110

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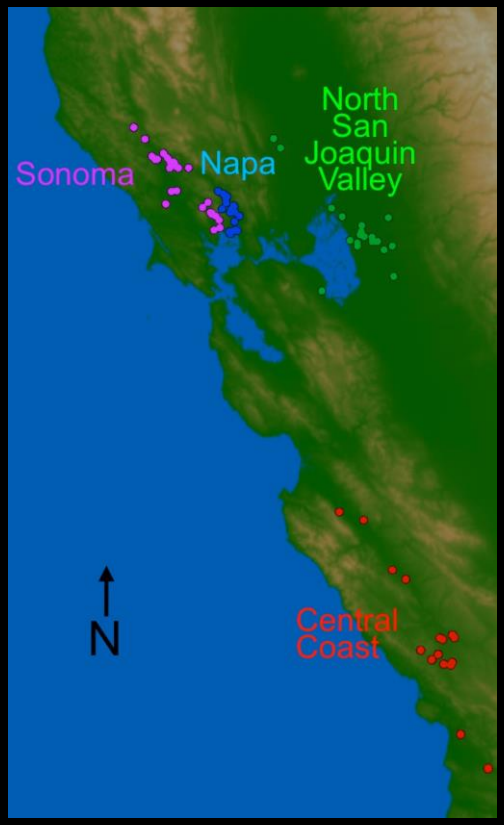


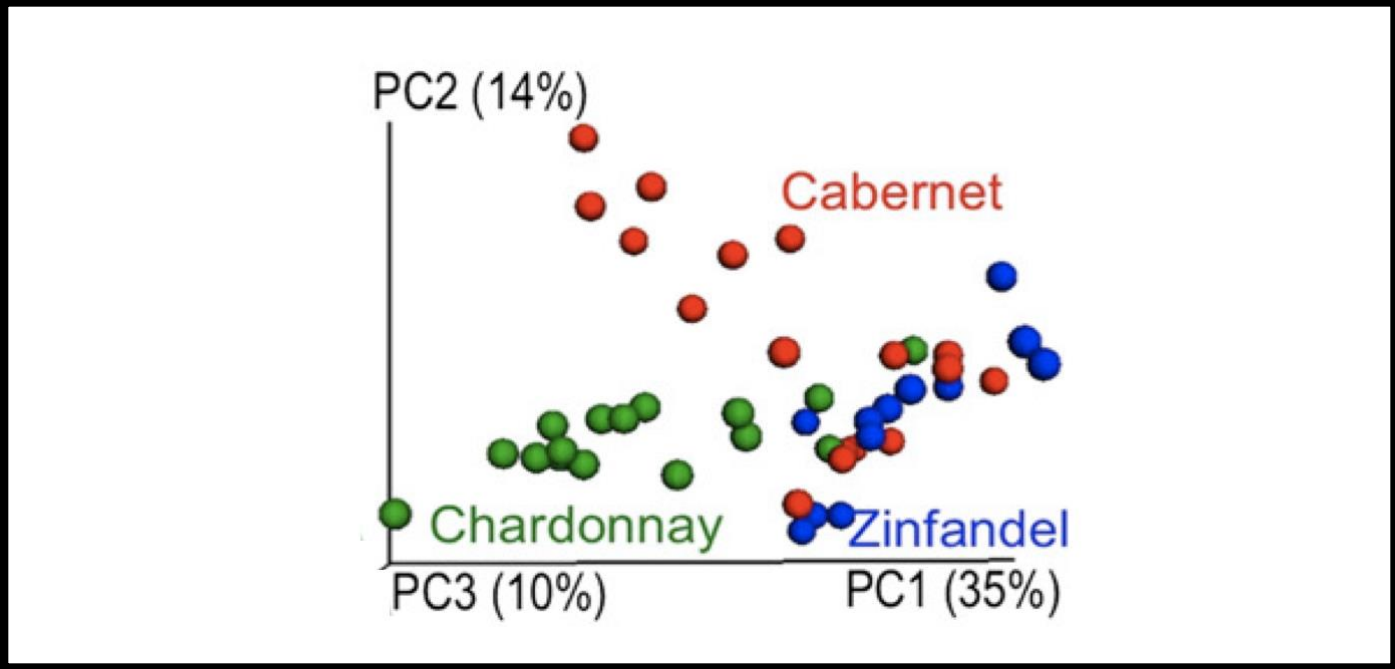


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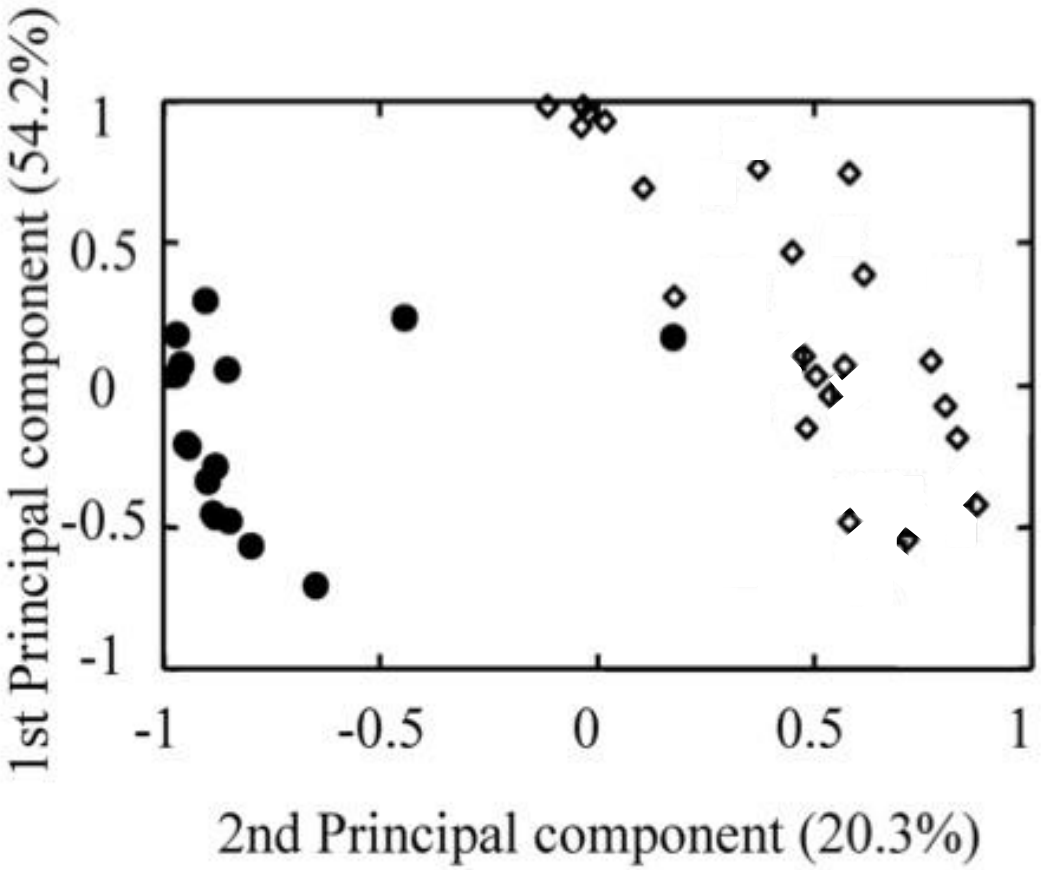
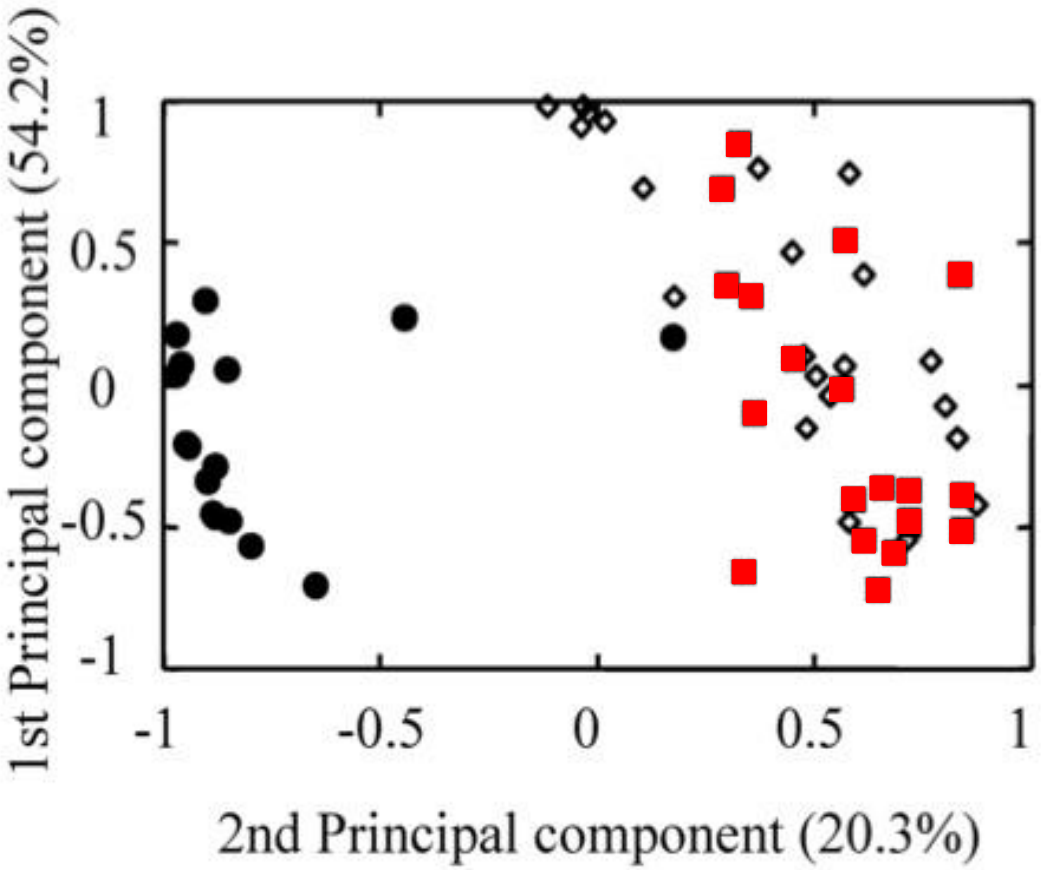



● **Levures de la peau du raisin**

◇ **Levures des surfaces de la cave**

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■ **Levures du moût en fermentation**

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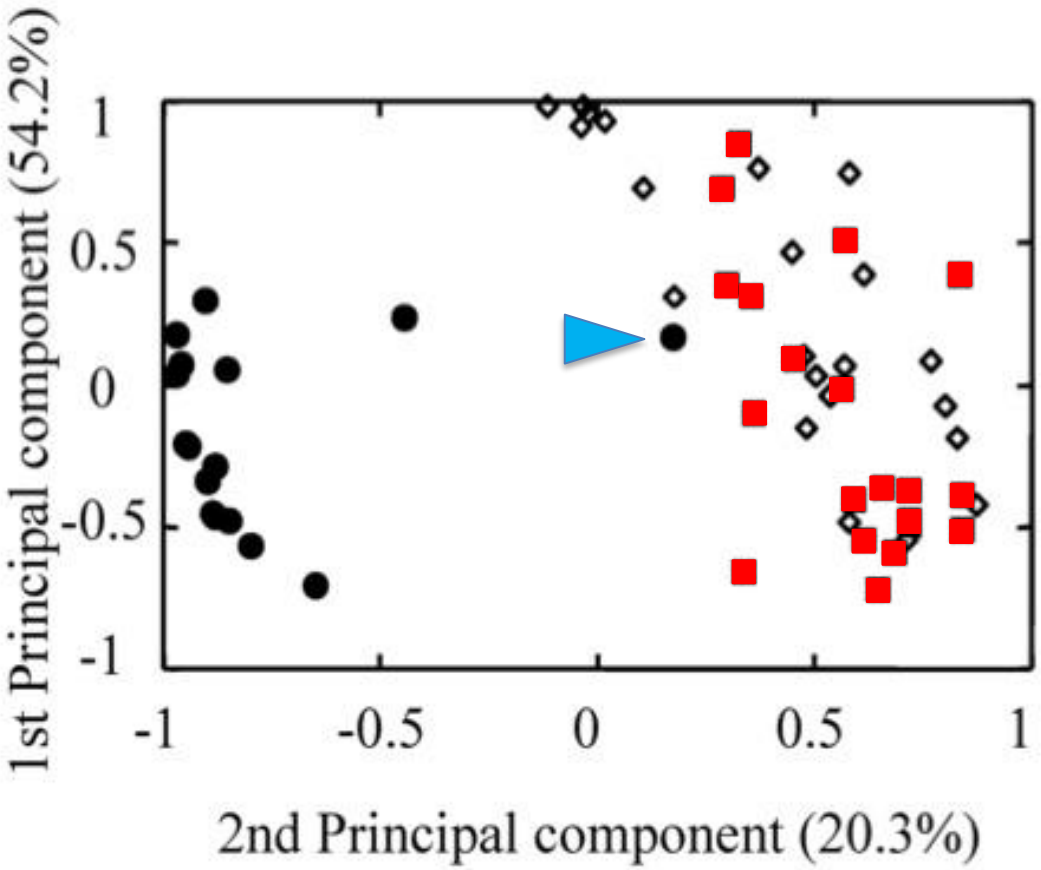


● **Levures de la peau du raisin**

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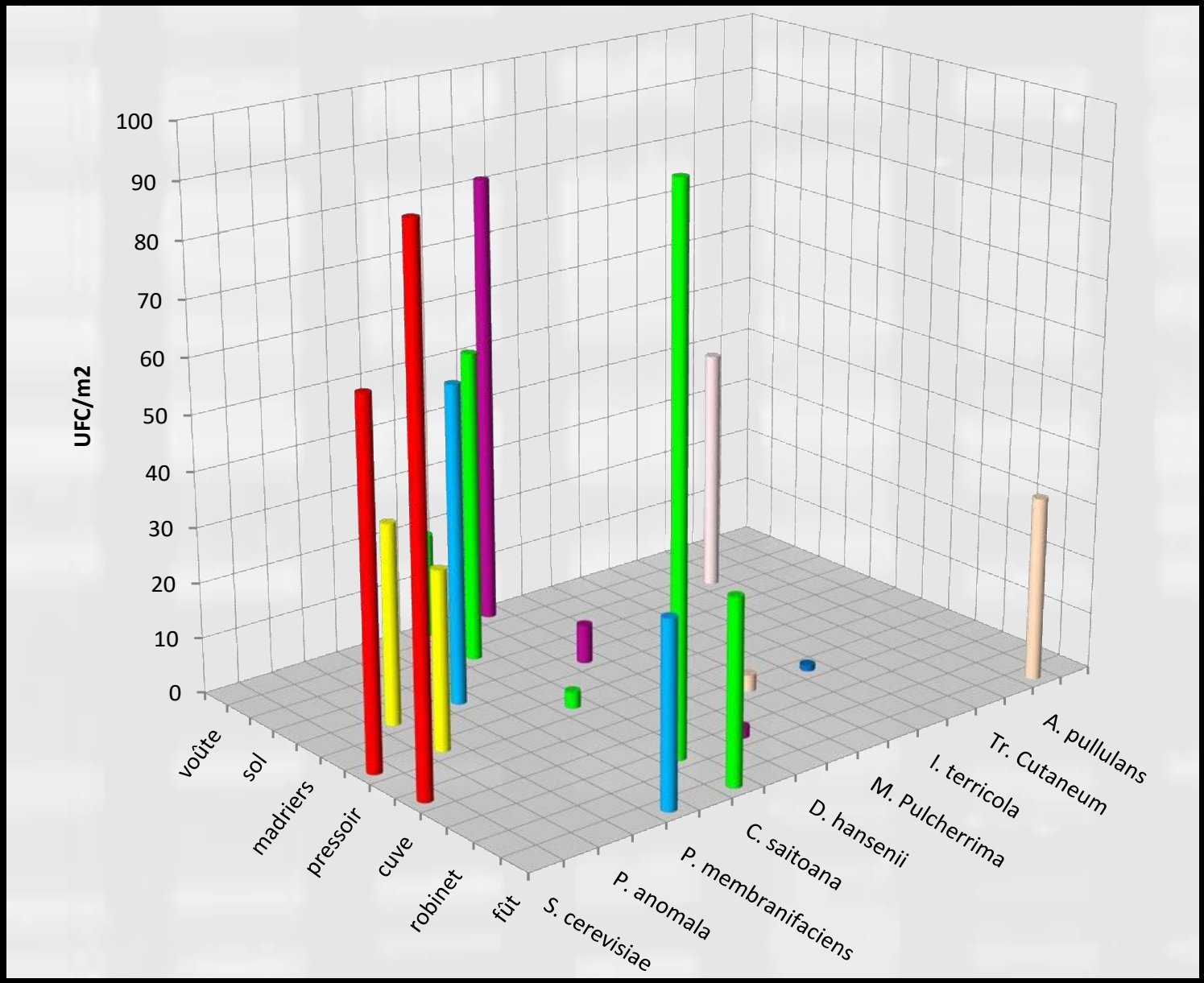
# Un terroir de cave !




**Source :**
**Belin, 1979 in**
**Coarer, IFV**
**Val de Loire**

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