Using fluorescence in the field to detect crop diseases: How we got there

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Protection against grapevine downy mildew

Viticulture in Europe

3,64 Mha
156 MhL (≈15 MT)
60% World production

Crop protection

20 annual sprayings
70 000 T/year = 1,9 G€
21,4 kg active substance/ha
including 19,5 kg/ha of fungicides
70% of losses due to
downy & powdery mildew

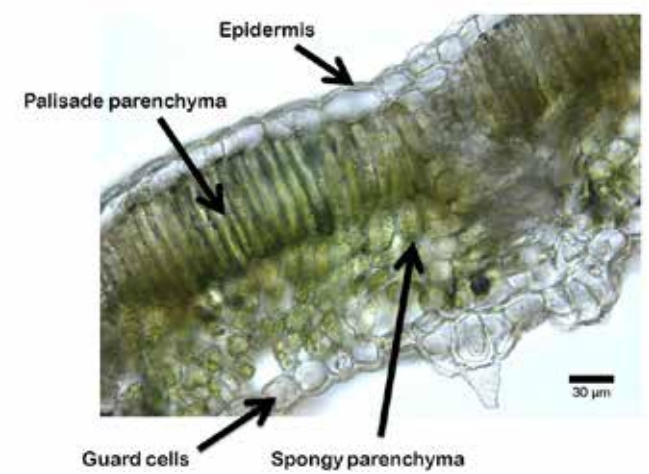
Health

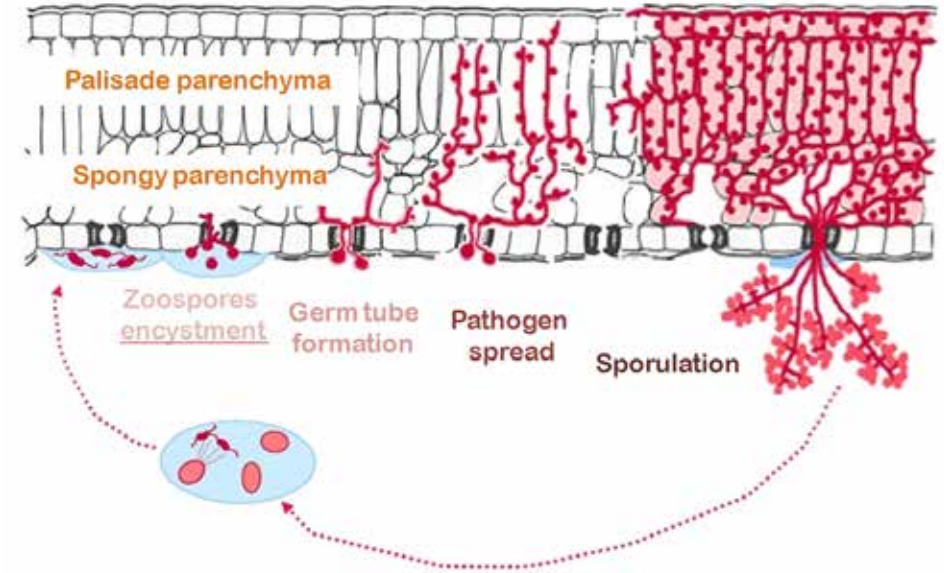
2.5 million vinegrape growers
Pollution by phytochemical treatments
of growers, the environment and the wine

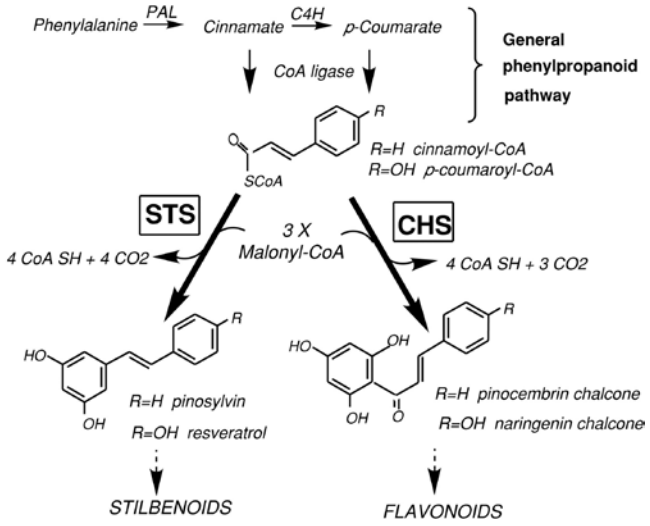
Solutions

IPM (integrated pest management)
Precision agriculture (dose)
Early detection (optical)

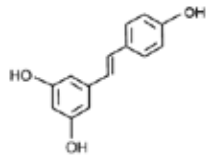
Plasmopara viticola the infection agent of downy mildew

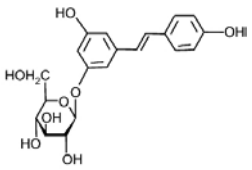


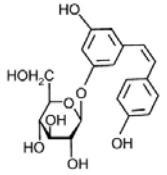


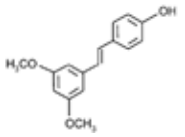


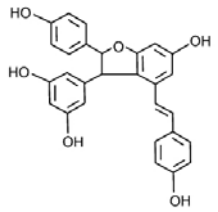
Grapevine phytoalexins
Viniferins, stilbenoids, derivatives of resveratrol

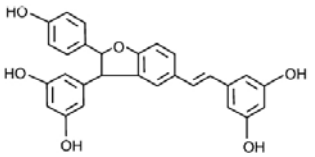

resveratrol


trans-piceid


cis-piceid


pterostilbene

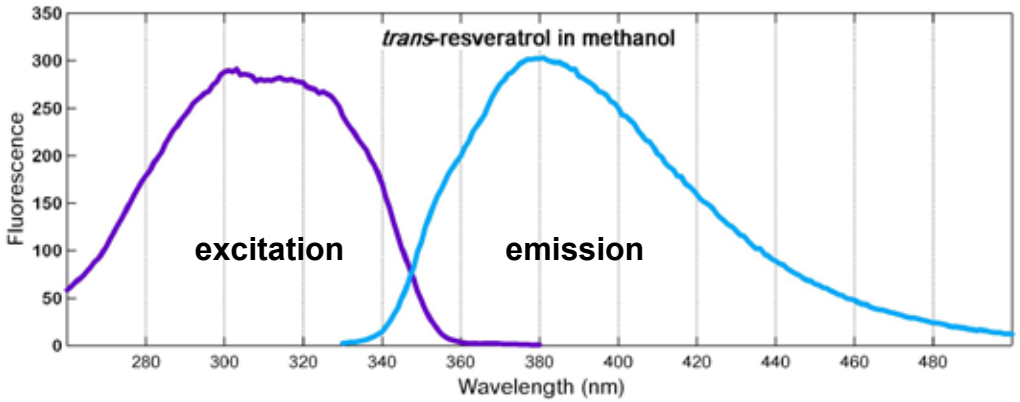

trans-ε-viniferin

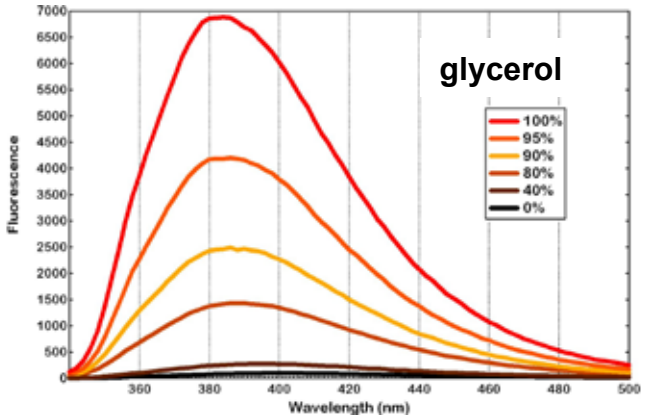

trans-δ-viniferin

Fluorescence of stilbenoids

Bellow et al. (2012) J. Exp. Bot. **63**: 3697

Complete analysis of fluorescence: physico-chemical, microscopic et macroscopic

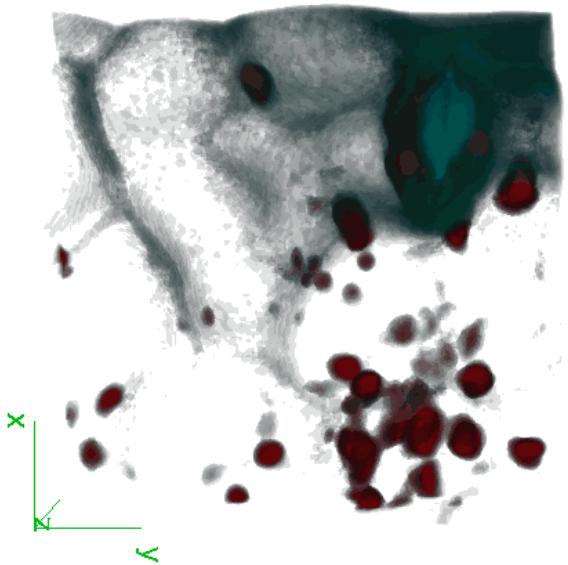


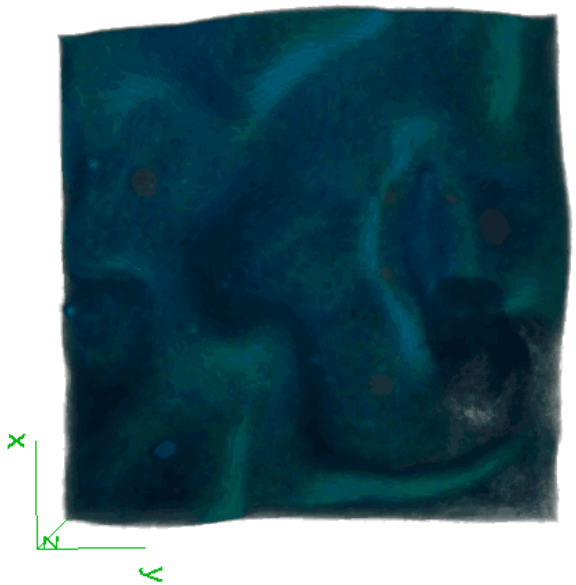


Control

Cabernet Sauvignon

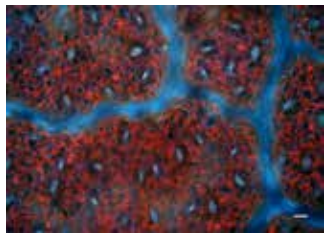
Inoculated



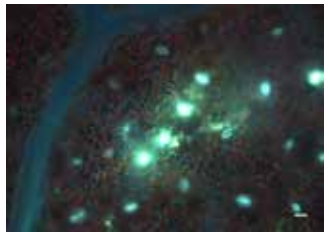


Bellow *et al.* 2012

Autofluorescence



control



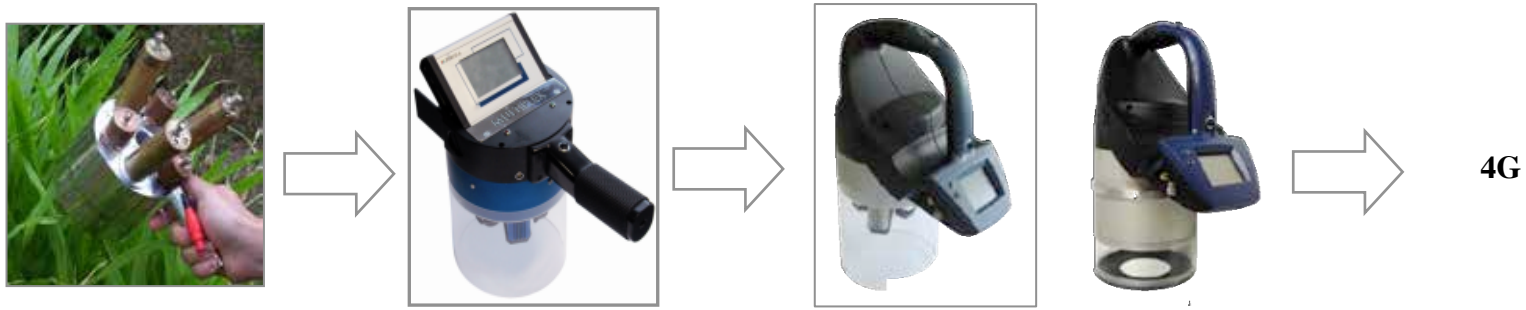
infected

Development of portable field sensors

DUALEX: from 1G to 4 Generation

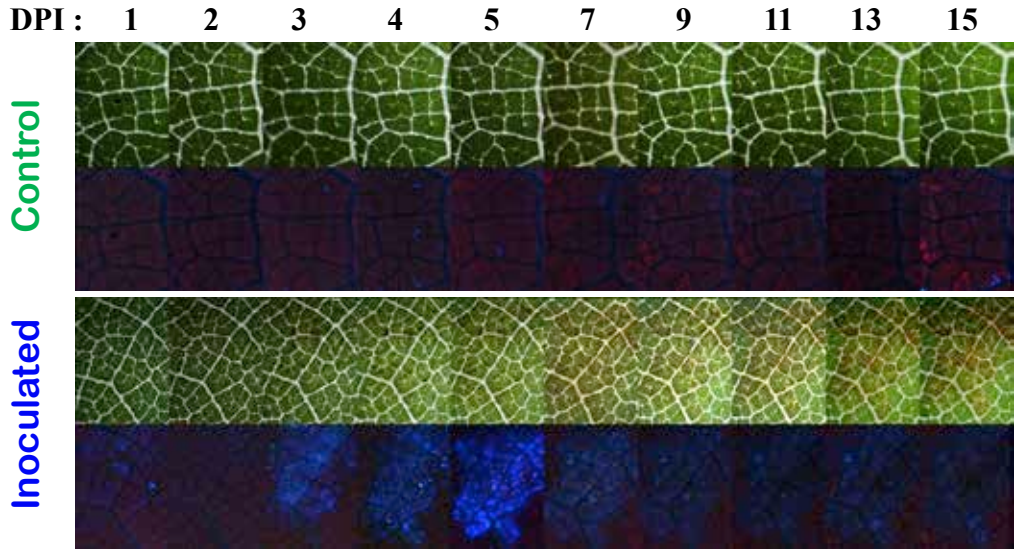
1G Lab 1999 & Field 2000 | **2 G 2003** | **3G, 2005/06** | **4G, 2009**

MULTIPLEX: towards 4G



1.5 - 2005 | **2G - 2007** | **3G – 2008 / 2009** | **4G**

Kinetics of the infection



Excitation filter : 340/26
Emission filter : 371 nm long pass

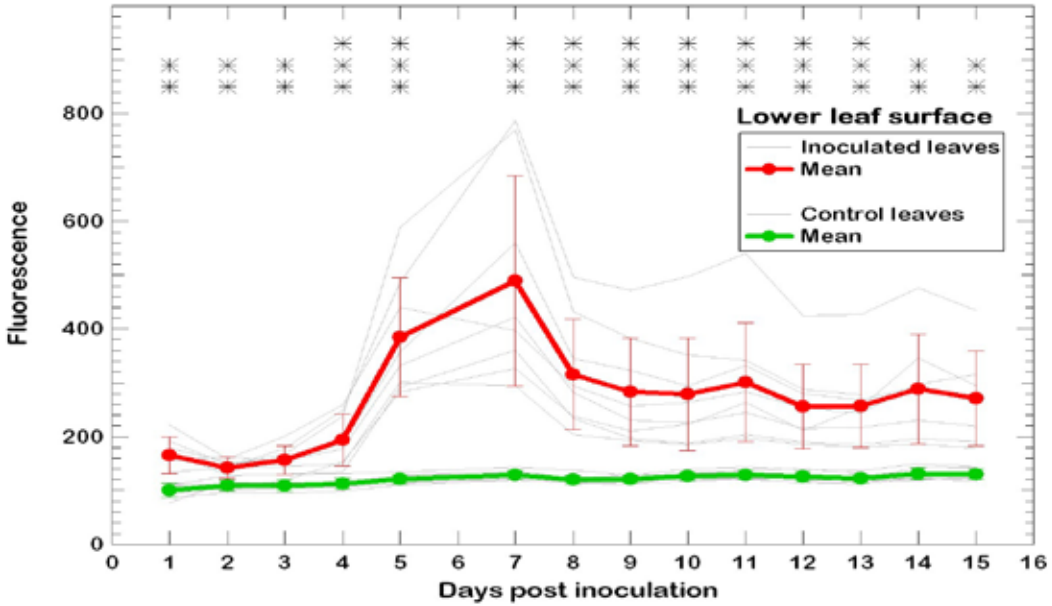
Transmission

Fluorescence UV-visible

Transmission

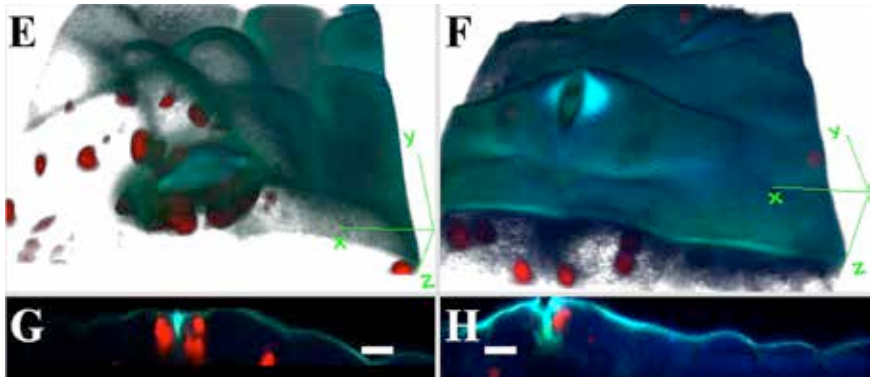
Fluorescence UV-visible

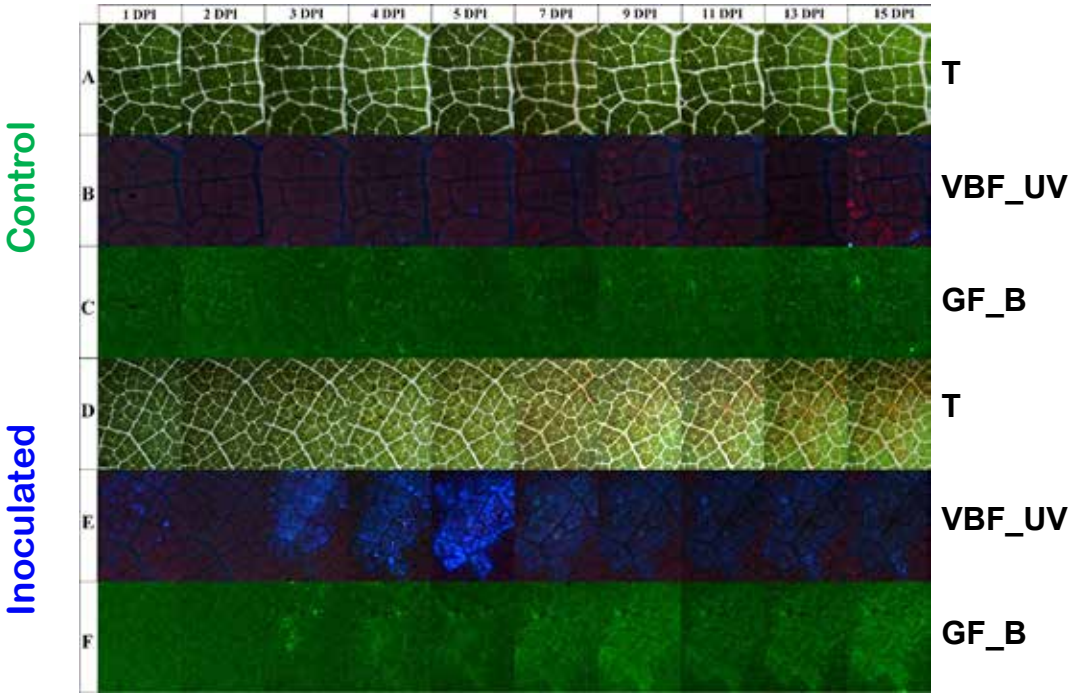
Macroscope Nikon AZ100

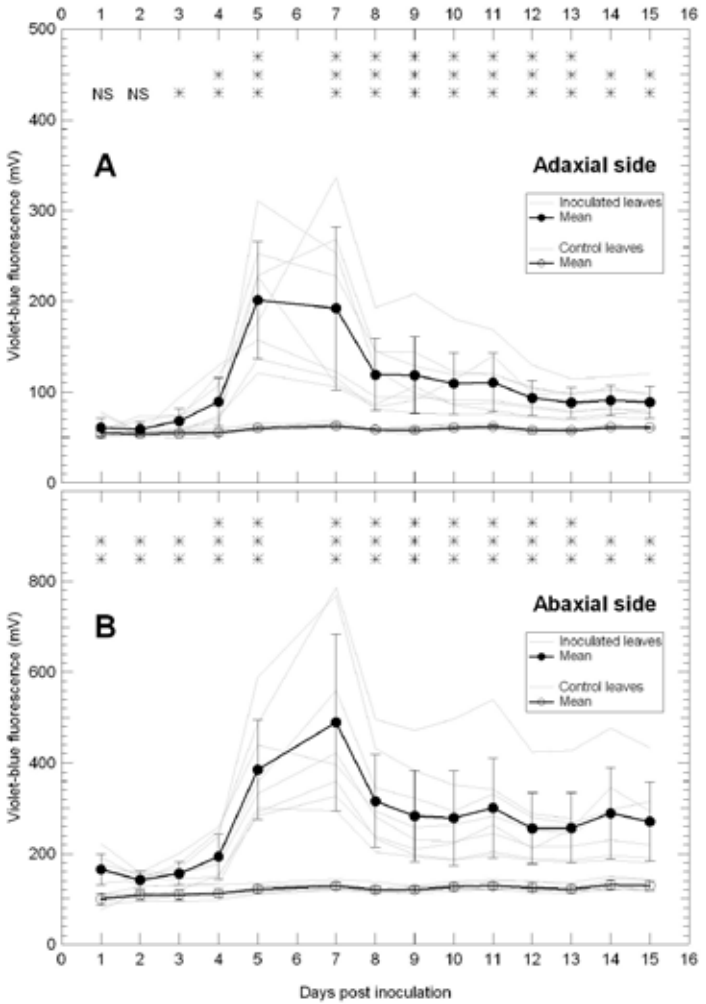


Proximal detection Mx330

Signal present on both leaf sides



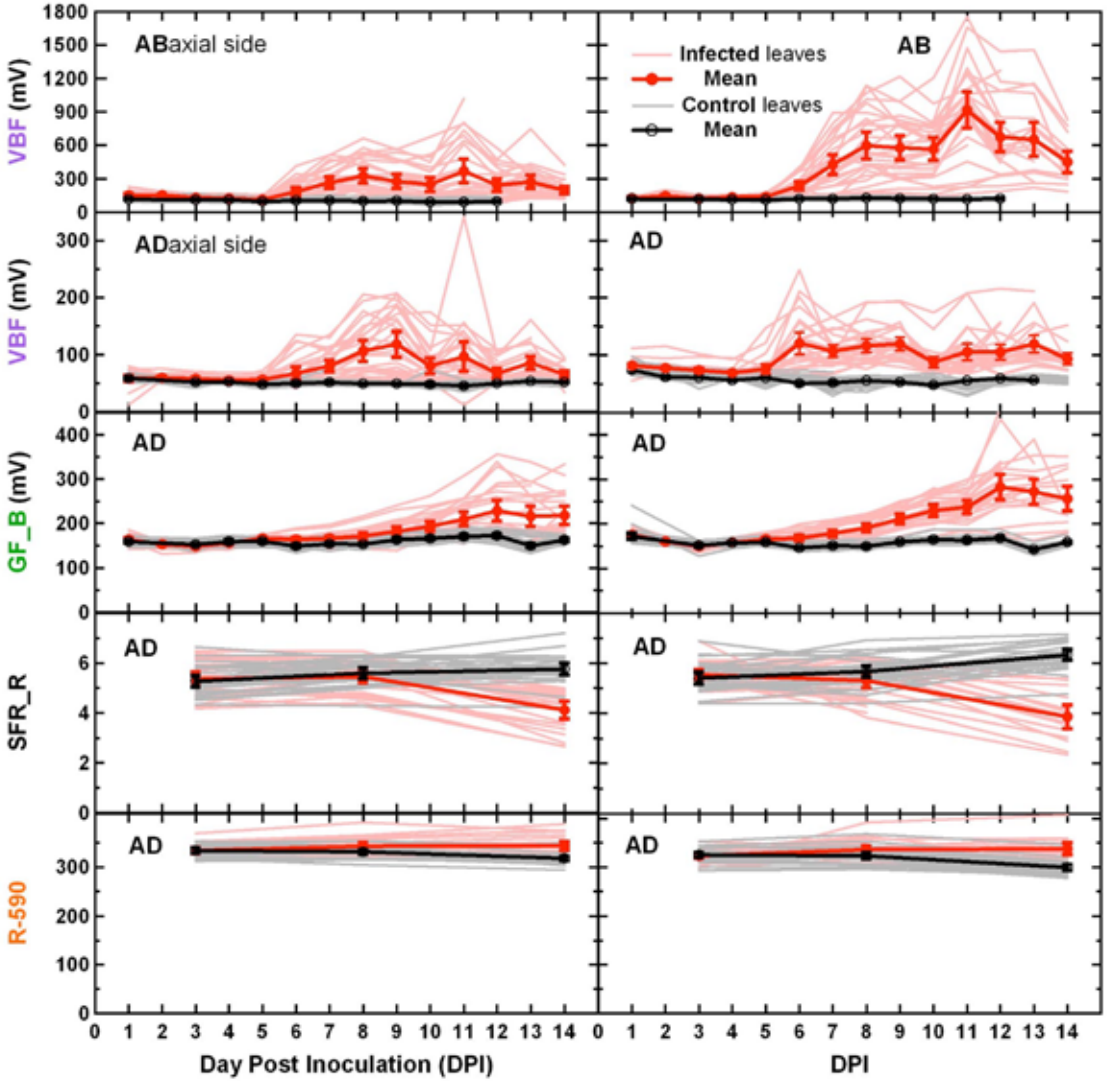




Bellow et al. (2013) J. Exp. Bot. ***64****:333*

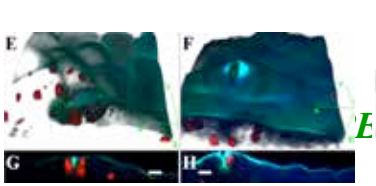
In-field hand-held sensing of downy mildew

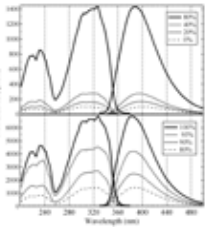
Muscat Ottonel Gewurztraminer

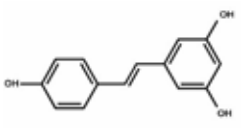


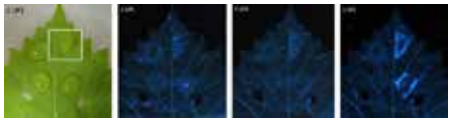
Colmar
Alsace
France

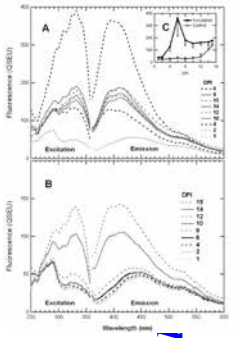
Stilbenes as indicators of downy mildew in grapevine

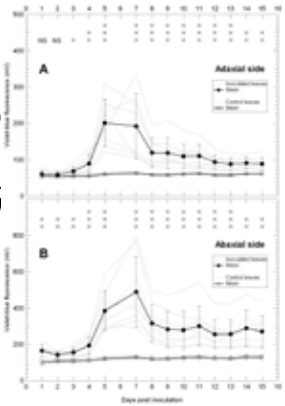












blue fluorescence

induction of stilbene phytoalexins

presence of *Plasmopara viticola*

Multiplex 330 UV-B induced VBF

field scouting hot spots

downy mildew (pesticide spraying)

AGRO

PI *'ULTURE*

Mapping and zoning of leaf cover in viticulture

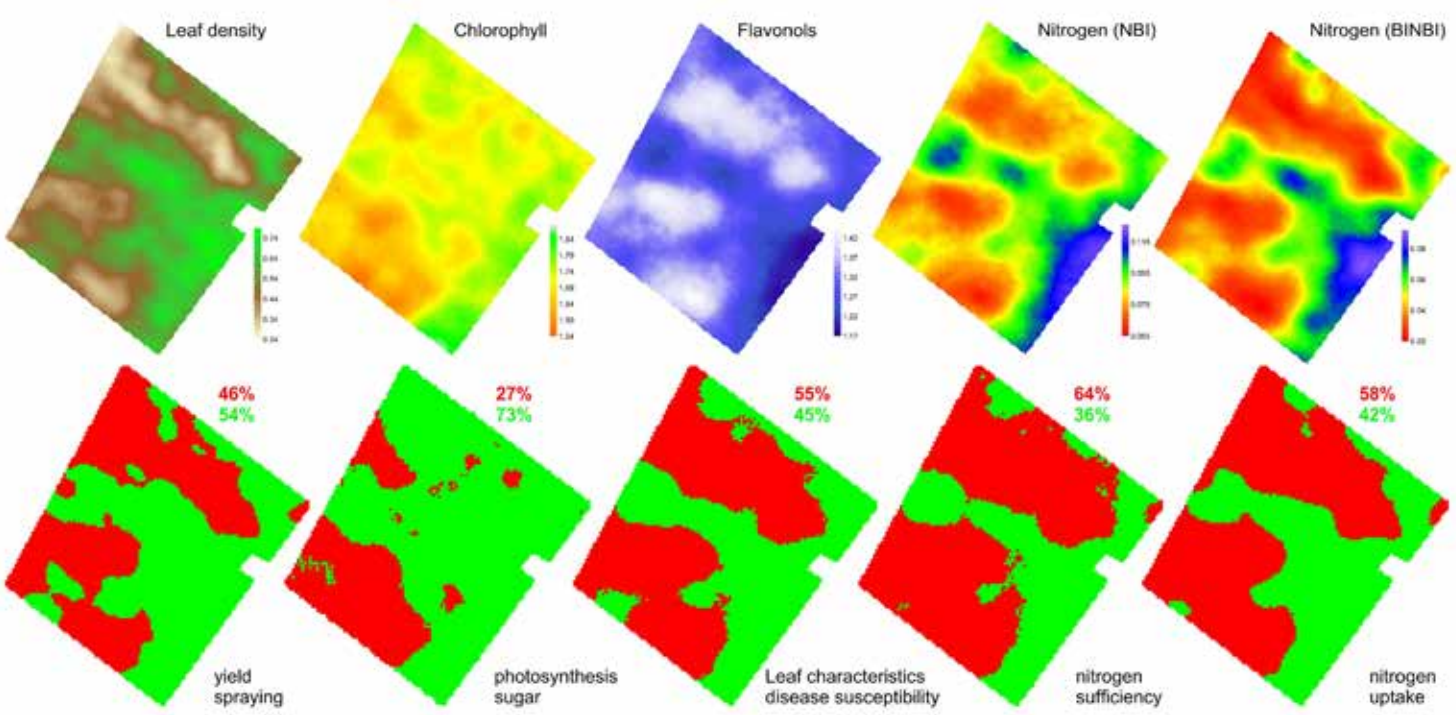
NFI

Chl

Flav

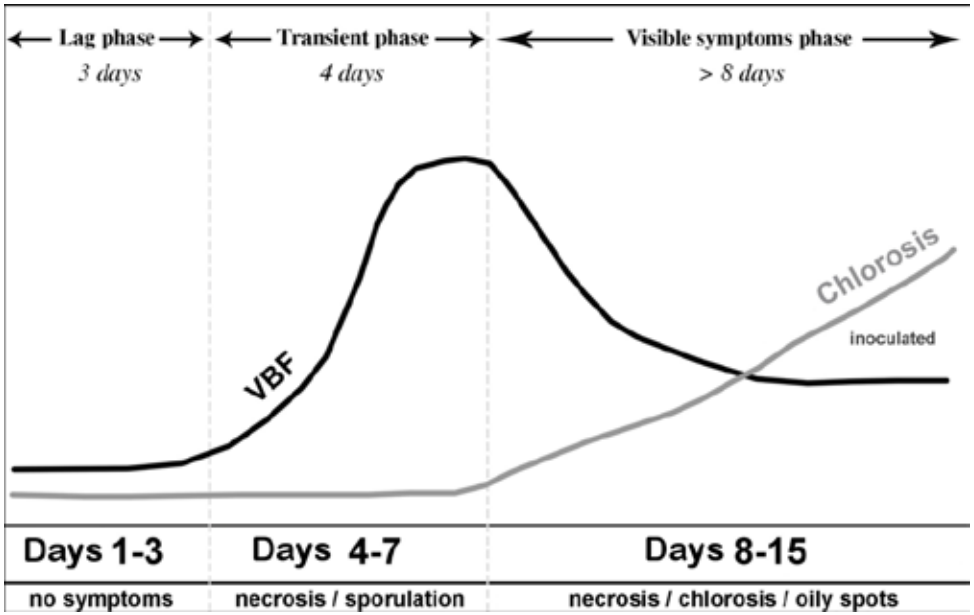
Chl/Flav

NFI*Chl/Flav



Phytoalexins as disease markers

Mounted Multiplex for hot-spot detection



Grapevine
stilbenoids

Peanut
stilbenoids

Sunflower
coumarins

Other crops Phytoalexins

Plant Biospectroscopy team

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