Effects of Vine growth and architecture on powdery mildew susceptibility
What do we know about grapevine growth - powdery mildew relationships?

• Correlation between vine vigour and the powdery mildew dynamics and spread
  Calonnec et al., 2009, *Phytopathology* 99:411-422

• The vine growth dynamic impact the disease dynamic for a partially resistant variety
  Valdes et al., 2011, *Crop protection*, 30:1168-1177

• Models are in accordance with these effects
  Burie et al., 2011, *AOB*, 107, 885-95

• Increase of radiance through pruning type increase the tissue resistance
Can we modify the grapevine - powdery mildew relationships with cultural practices?

- Density of plantation,
- Cover-cropping,
- Fertilisation
- Training system, pruning, tinning, topping...

Calonnc et al., 2013, *EJPP* 135
What kind of changes in the host can we expect?

**Vine Growth**

- **Environmental factors**
  - Leaves surface
  - Rate of leaves emergence and shoot growth
  - Leaves density
  - Distribution and location of young leaves
  - Leaves susceptibility

- **Genetic factors**
  - R/S varieties

- **Cultural factors**
  - Fertilisation
  - Irrigation
  - Shoot topping/pruning type
  - Cover-cropping
Effects of vine growth on disease dynamic
Experimental design

• 2 varieties: Merlot and Cabernet-Sauvignon

• 3 root-stock: Ripariat, SO4, 110R

• 2 cultural factors: Weed-control, cover-crop

• 1 shoot inoculated/ treatment
  (variety x root-stock x cultural factor)
Host Variables to assess plant growth

**Plant growth:**

Number of leaves  
Rate of leaves emergence  
*(primary and secondary leaves)* (once a week)  
Length and rate of growth of shoots (once a week)  
Leaves density (1 / season)

**Qualitative measurements of soil and leaves:**

**Soil:** structure and Nitrogen amount

**Leaves:** ratio chlorophyll / flavonol  
*(Dualex®)*. (24 leaves/vine - 1 / season)
At the vineyard or in the laboratory

Leaves physiology

Dualex

Flavonoid = Log

Chlorophylle =

Fluorescence Infrarouge excited Rouge

Fluorescence Infrarouge excited UV

Trans. Infrarouge - Trans. Rouge

Trans. Rouge

NBI = Nitrogen balance index
Disease: Disease incidence and severity on primary and secondary leaves (1x / week)

Disease severity on bunches in July and September

Bunch weight
Predictive Analyses, PLS-PM
Relationships between the different components of the system

Crop management

N in soil  WC - area  CC - area

Vine Physiology

NBI  Chloro  1/Flavo

Disease early

Nb Diseased L pea size  Nb Diseased L shoot topping  Rate of D L emergence

Disease late

Nb L diseased  L severity  B severity

Initial phenological stage

 Nb L flo  Nb L pea size

Shoot early growth

Rate leaves emergence  Shoot length flo  Rate shoot growth
Early dynamics of vine growth do impact disease dynamic of two susceptible varieties at the plant scale
Effects of vine growth on leaf susceptibility
Do the vigour modify the leaf susceptibility?

shoots are sampled on Weed control vs Cover-crop areas
• Measures in semi-controlled conditions:

In the laboratory

- Image analyses for area and shoot length
- Number of leaves (1\textsuperscript{st} and 2\textsuperscript{nd})
- Global leaf area
- Shoot length
- Rate of leaves emergence
5 feuilles de même âge foliaire
3, 8, 10, 17, 29 jours
(croissance, physiologie, sensibilité à la maladie)

Pas forcément les mêmes étages foliaires

Caractérisés pour leur croissance
In the laboratory

- Leaf disks are cut
- Lab axenic conditions
- Inoculation by blowing spores
- Local deposit of spores
- % Infection (t +72 h)
- Sporulation (t +13 j)
- Colony growth
- Sugar
- Water content

Disease

Characterisation
Sugar indicator of sink to source transition

NBI index of vigour

Disease drop at 10 days old leaves

Indicator of ontogenic resistance

Indicator of vigour for old leaves

Leaves that differ for NBI amount are not any more susceptible

Difference of physiology between plots area are mostly expressed for > 10 days leaves resistant to the pathogen!
Conclusion

The cultural management tested do not impact the leaves susceptibility

The effect of vigour on disease reduction is consecutive of the higher rate of susceptible leaves production
## Variables et analyses

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<thead>
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<th>Variables characterizing vine growth</th>
<th>PCA on vine growth</th>
<th>PCA on disease</th>
<th>Mixed model</th>
<th>PLS-Path modelling</th>
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### Variables characterizing disease

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Data analysed: 2009-2010  2009-2010  2010  2010