

Do different combinations of resistance QTLs in grapevine exert differential selection pressures on *Plasmopara viticola* populations?

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Context

Plant. All the traditional varieties used in Europe are very susceptible to downy mildew (*P. viticola*) which causes dramatically damages on leaves and bunches. The French vineyard which represents less than 4% of the cultivated surface, uses 20% of the total pesticides (80% are fungicides), mainly to control downy mildew.

Pathogen. *Plasmopara viticola* is a biotrophic Oomycete specialized on *Vitaceae*. It is native from North America and was introduced in Europe 130 years ago.

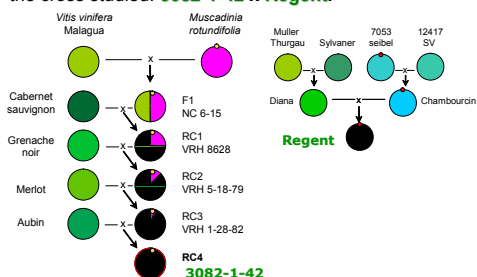
One major goal. Breeding for long-term resistant varieties is an alternative to the intensive application of fungicides.

Strategy. Pyramidize different QTLs of resistance derived from various *Vitis* resistance sources in one variety, to enhance its durability.

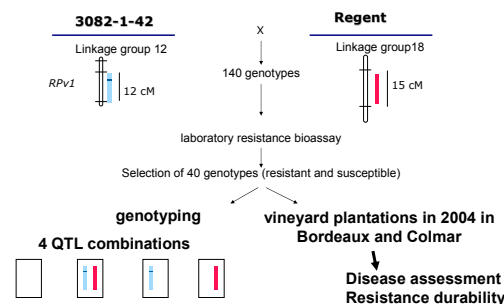
Questions. What is the performance of the different combinations of QTL on controlling the disease on leaves and on bunches? Do different combination of QTLs exert a differential selection pressure on natural *P. viticola* populations?

Experimental design

Genealogy of the **two partially resistant parents** of the cross studied: **3082-1-42 x Regent**.

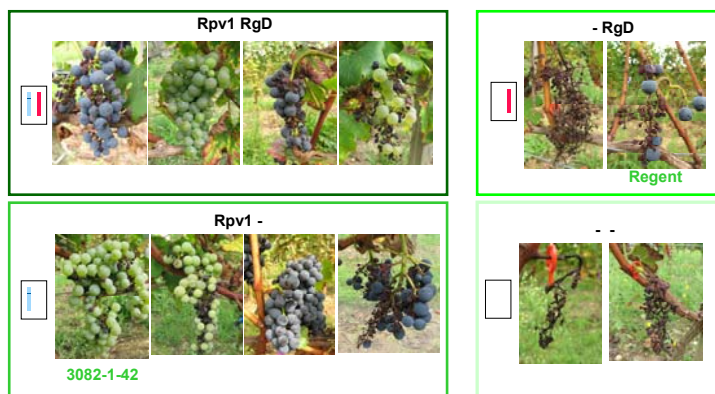


- 3082-1-42 inherited from *Muscadinia* a major QTL of resistance (*Rpv1*), and Regent possessed a QTL of endurance (*RgD*).
- 140 segregants were assessed for disease resistance in a laboratory bioassay.
- 40 genotypes were characterised with molecular markers linked to each QTL.
- Genotypes of the 4 QTL combinations were planted in vineyards at INRA Bordeaux and Colmar (4 plants/genotype) and were assessed in 2007 and 2008 for field disease resistance.

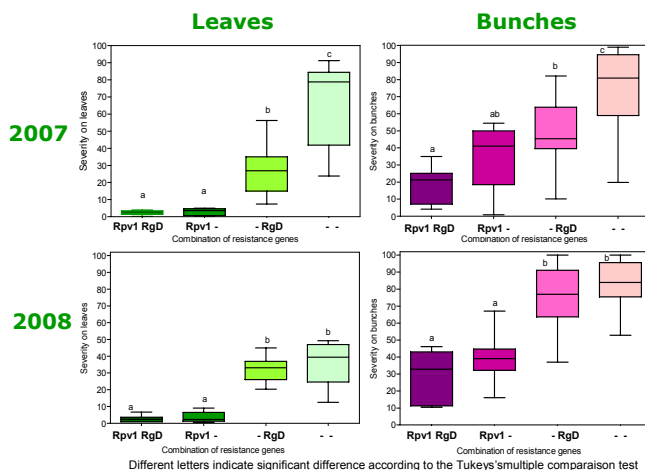


Field assessment

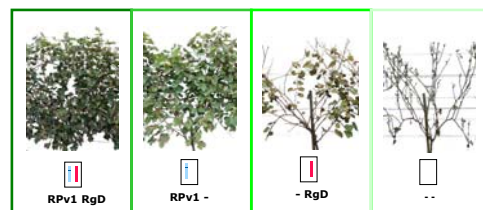
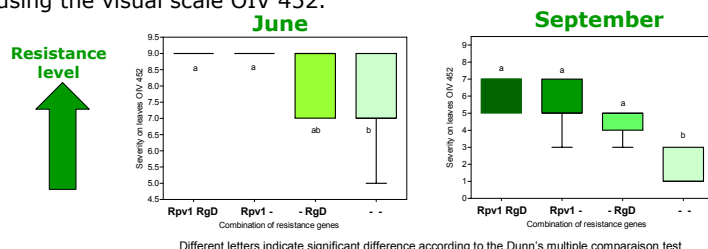
In Bordeaux, disease was assessed in the vineyard at the end of June-July 2007 and 2008. Each vine was characterized for its susceptibility to downy mildew by assessment of severity (% of area with symptoms or destroyed) on leaves and on bunches.



Box-plot for the severity to downy mildew on leaves and on bunches for genotypes, according to their combination of resistance genes



In Colmar, resistance level were assessed on leaves in the vineyard at the middle of June and end of September 2008 by using the visual scale OIV 452.



In June, genotypes having both QTLs (RPv1-RgD) or RPv1 (RPv1 -) were totally resistant against downy mildew. In September, genotypes including RPv1 QTL were less diseased than susceptible genotypes. OIV scale did not allow to discriminate between *Rpv1* and *RgD* combinations.

Conclusion and perspectives

1. The *Rpv1* resistance gene is responsible of a **high level of resistance on leaves** with a low level of variation between genotypes. Resistance from **Regent**, is much **more variable with the genetic background** (genotype effect) and **with the environment** (years effect). **On bunches**, the resistance of genotypes carrying *Rpv1* is of **lesser extent and more variable than on leaves**. There is **no significant positive effect of the association of *Rpv1* and of the QTL of Regent**. The main question now is to determine if genotypes carrying *Rpv1* differ by their resistance expression and/or by the dynamic of ontogenic resistance in bunches.

2. The next step of the project will be to assess **the evolution of the *P. viticola* populations** submitted to the selective pressure of the resistant genotypes. In 2008, 104 isolates were sampled on each combination of QTL in Bordeaux, Colmar and Gödöllő. Each isolate will be tested in bioassays for its aggressiveness and virulence on the resistant genotypes and in term of genetic and genotypic diversity using molecular markers.