

Press release – 17th August 2020

## Grapevine downy mildew: researchers identify a group of genes involved in its sexual reproduction

Mildews are pathogens responsible for many destructive plant diseases: potato blight, downy mildew of soybean, grapevine downy mildew, etc. Researchers from INRAE, the CNRS, and Paris Saclay University have identified the group of genes responsible for the sexual reproduction of grapevine downy mildew. These genes had never been identified in oomycetes—eukaryotic organisms closely related to brown algae<sup>1</sup>. The discovery was only possible thanks to a technical achievement that allowed researchers to cross grapevine downy mildew strains with each other. This is a major advance in the understanding of sexual reproduction in oomycetes, and, at a larger scale, in plants and fungi. Additionally, it could open new avenues to fight grapevine downy mildew by disrupting its sexual reproduction phase, essential to the development of the disease. The study was published on 14th August 2020 in *Current Biology*.

### What are “mating types”?

“Mating types” are self-incompatibility systems that promote outcrossing in plants, fungi and oomycetes. The gametes from two individuals—carrying a copy of each chromosome—only fuse into an egg or zygote if they are of opposite sexual types. How does this recognition take place in mating types? In potato blight, for example, phytol, a terpene common in plants, is modified and transformed into a hormone, which is then emitted into the environment. The opposite mating type individual perceives the signal, modifies the hormone and releases it to signal its presence to the other. Unlike plants and fungi, the genes involved in this process had not yet been identified in oomycetes.

### The discovery: determinism of mating type locus identified in grapevine downy mildew

In their study, researchers from INRAE, the CNRS, and Paris Saclay University identified the locus<sup>2</sup> determining mating type in grapevine downy mildew. This is the first description ever of this locus in an oomycete. By associating genomic variations to mating types, identified by crossing a large number of individuals, researchers showed that one mating type (P1) was homozygous (Mat-a/Mat-a), whereas the other (P2) was heterozygous<sup>3</sup> (Mat-a/Mat-b).

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<sup>1</sup> Unlike bacteria (prokaryotes), eukaryotes have a nucleus, which contains the DNA.

<sup>2</sup> Locus: precise location of a gene on a chromosome.

<sup>3</sup> Homozygosity is a condition in which two alleles are identical for a particular gene. The heterozygous state is one in which two alleles are different for a particular gene.

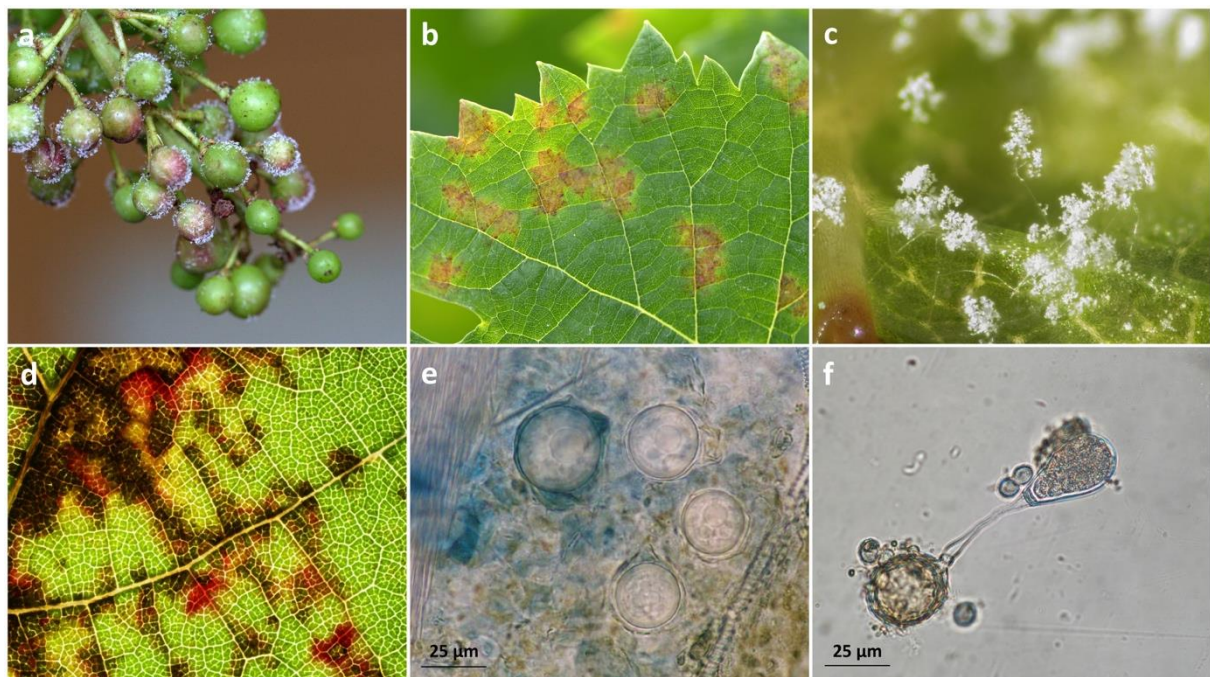
The mating type locus encompasses 40 genes, one of which could encode a hormone receptor.

### A fundamental discovery, and prospects in the fight against downy mildew

These findings have crucial implications in understanding mating type evolution, since they reveal a unique determinism involving an asymmetry of heterozygosity similar to that of sex chromosomes (like the XY system in mammals). This system differs greatly from other mating type systems known in plants, algae, and fungi.

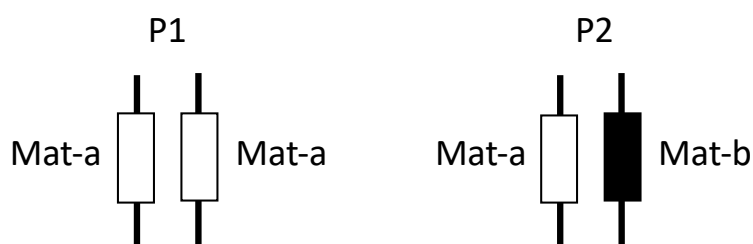
Downy mildew is one of the main diseases affecting grapevine, causing significant losses and requiring over ten fungicide treatments when conditions are favourable. As a result of this discovery, a new method to fight grapevine downy mildew can be envisaged, one that would focus on the sexual phase of the pathogen. Limiting the success of sexual reproduction could help reduce the intensity of epidemics the following year. The goal of the researchers responsible for this study is to develop a process to disrupt the sexual phase, for example, by saturating the environment with hormones specific to the recognition of mating types.

Figure 1: Some images of the grapevine downy mildew cycle (*Plasmopara viticola*)



a- Mildew on bunch of grapes, b- mildew on leaf, c- sporanges on leaf, d- "mosaic" mildew on leaf (autumn), e- oospores (sexual spore), f- germination of an oospore containing motile zoospores

Figure 2: Mating type genetic system on grapevine downy mildew



## Reference

Identification of the first oomycete mating-type locus sequence in the grapevine downy mildew pathogen, *Plasmopara viticola*, Yann Dussert, Ludovic Legrand, Isabelle D. Mazet, Carole Couture, Marie-Christine Piron, Rémy-Félix Serre, Olivier Bouchez, Pere Mestre, Silvia Laura Toffolatti, Tatiana Giraud, François Delmotte, <https://www.sciencedirect.com/science/article/pii/S0960982220310824>

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