Lipid remodelling in grapevine as response to downy mildew

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Background

Downy mildew, caused by the obligatory biotrophic oomycete *Plasmopara viticola*, is one of the most devastating grapevine (*Vitis vinifera* L.) diseases worldwide.

We have provided evidences about the role of fatty acids (FA) and lipid signalling in the establishment of the incompatible grapevine-*Plasmopara viticola* interaction[1-4].

Membrane lipids and fatty acids can act as signalling molecules or can be channelled to biosynthetic pathways of other signalling molecules, such as jasmonic acid (JA)[5].

Fatty acid desaturases are key enzymes in lipid metabolism since they are responsible for the biosynthesis of unsaturated fatty acid by adding a double bonds into the acyl chains of glycerolipids[5].

Objectives

Despite the importance of lipid and FA modulation in grapevine defence against downy mildew, no information regarding FA desaturases in *Vitis vinifera* is available to date. Thus, with the present study, we intended to fill the gap regarding FA desaturases involvement in grapevine defence against *P. viticola*.

Results

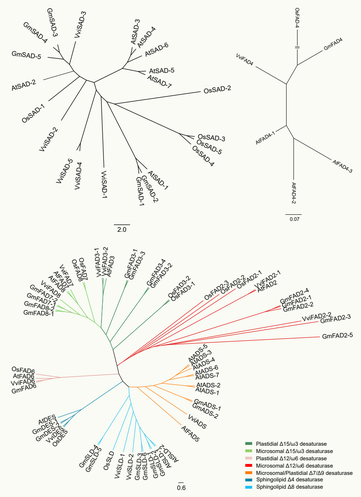

Fig. 1. Maximum likelihood phylogenetic tree of the *Vitis vinifera, Arabidopsis thaliana, Glycine max* and *Oryza sativa* FA desaturase family. (Laureano et al., 2021[4])

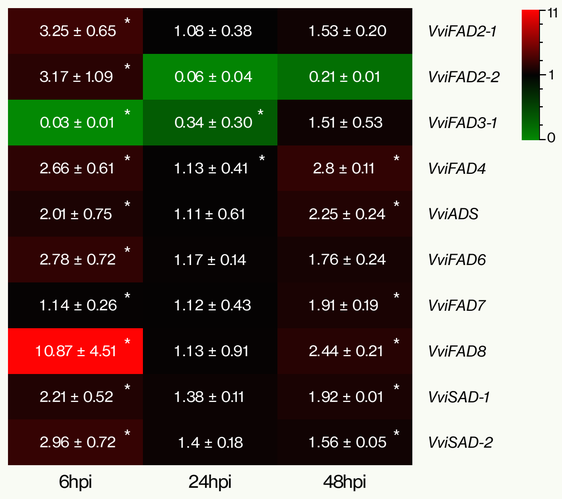

Fig. 2. Expression analysis of FA desaturases' genes of *V. vinifera* cv. Regent leaves upon inoculation with *P. viticola*. Fold-change values are relative to expression in mock inoculated leaves. Asterisks indicate significant differences ($p < 0.05$). (Laureano et al., 2021[4])

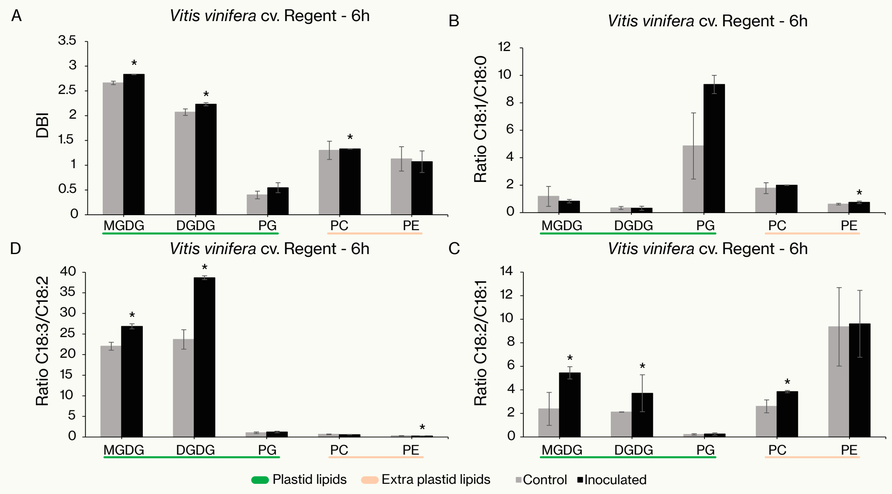

Fig. 3. Fatty acid related parameters of major leaf lipid classes of *V. vinifera* cv. Regent mock control and inoculated leaves with *P. viticola* at 6 hours. Values correspond to average values ± standard error, n = 5; Asterisks indicate significant differences ($p < 0.05$). (Laureano et al., 2021[4])

- Characterizion of FA desaturases gene family in *V. vinifera*, for the first time.

***V. vinifera* cv Regent (tolerant to downy mildew) response to *P. viticola*:**

- Up-regulation of FA desaturases genes.
- Chloroplastidial FA desaturases present a higher fold-change.
- Plastid lipids are higly affected.
- Galactolipids (MGDG and DGDG) have their content in unsaturated FA increased.
- High accumulation of C18:3.

Conclusion

In the first hours of grapevine-*P. viticola* interaction:

- Regent shows an increase of the expression of genes encoding FA desaturases acting on galactolipids, the major lipids of chloroplast membranes.
- Reenforcing these evidences, a progressive FA desaturation in galactolipids was also observed, culminating in an increase in C18:3 content.
- C18:3 is the percursor of JA, which have been identified as a key player in grapevine defece against downy mildew[2].

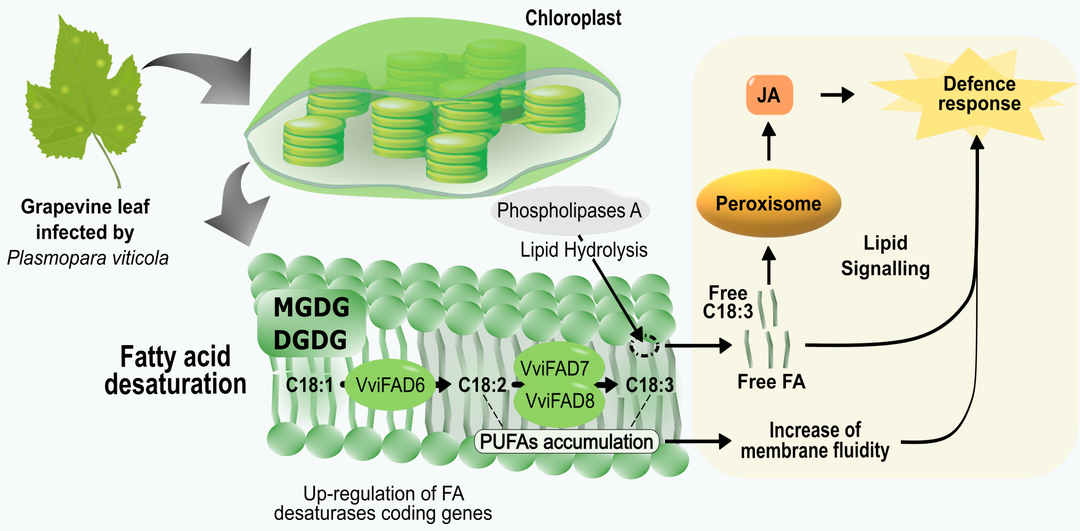

Fig. 4. Fatty acid remodelling in *V. vinifera* cv. Regent as response to *P. viticola*. (Laureano et al., 2021[4])

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Acknowledgements

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