Biological control of *Plasmopara viticola* in *Vitis vinifera* by Microbial Volatile Organic Compounds

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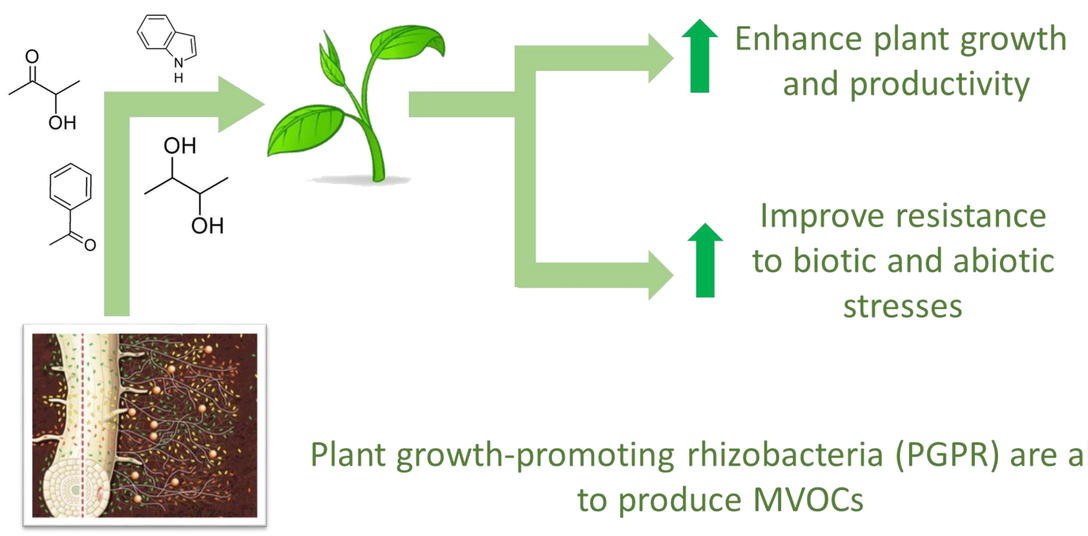
INTRODUCTION

Downy mildew is a grapevine disease caused by *Plasmopara viticola*, which leads to significant losses in wine production. In order to find new and more sustainable solutions for the biocontrol of downy mildew, researchers focused their studies on the microbial volatile organic compounds (MVOCs). Some soil microorganisms, the plant growth promoting rhizobacteria (PGPR), normally emit these MVOC, which act as elicitors of plant responses. The result of this interaction is the induced systemic resistance (ISR), which increases plant defense by means of compounds able to counteract the pathogen attack.



Plant growth-promoting rhizobacteria (PGPR) are able to produce MVOCs

AIM OF THE WORK

Evaluation of MVOC effects

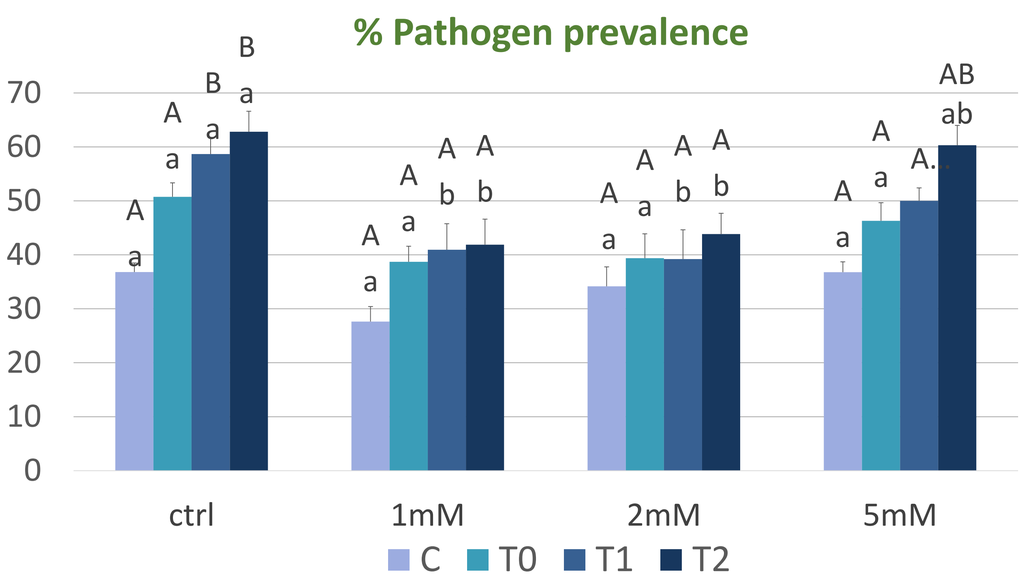
- **on plant ability to enhances secondary metabolism to counteract the pathogen**
- **on plant ability to counteract the prevalence and spread of downy mildew**

EXPERIMENTAL DESIGN

PLANTS: Grapevine cultivar Merlot, in province of Treviso (Italy).
MVOC TREATMENT: MVOC solution was applied directly on mature leaves at three different concentrations (1, 2, 5 mM), continuously for 10 days.
SAMPLING: First sampling of leaves was performed 4 days post treatment (T1) and the second one 22 days post treatment (T2).
DOWNY MILDEW INFECTION: The infection appeared naturally in the vineyard. The spread and prevalence of secondary downy mildew infection were monitored by Townsend and Heuberger method.
ANALYTYCAL ANALYSIS: Identification and quantification of fatty acids were performed by GC/FID. The quantification of total phenolic compounds, total proanthocyanidins, chlorophylls and carotenoids were performed by spectrophotometer analysis. Identification and quantification of main phenolic compounds by HPLC-MS/DAD.

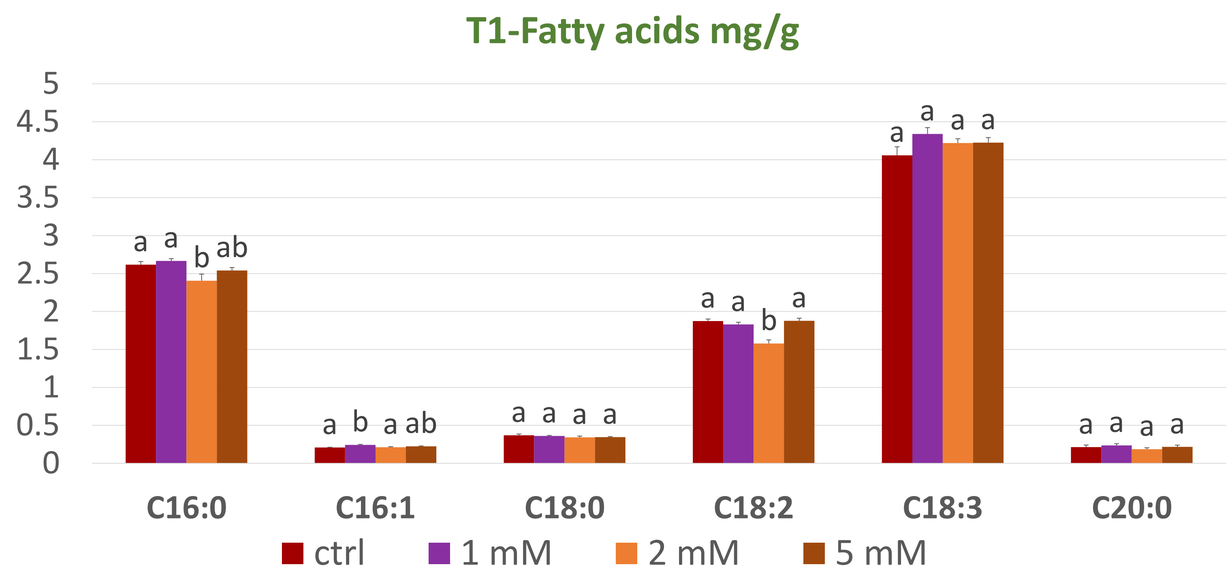
RESULTS

Treatment with MVOC improves plant resistance against *Plasmopara viticola*



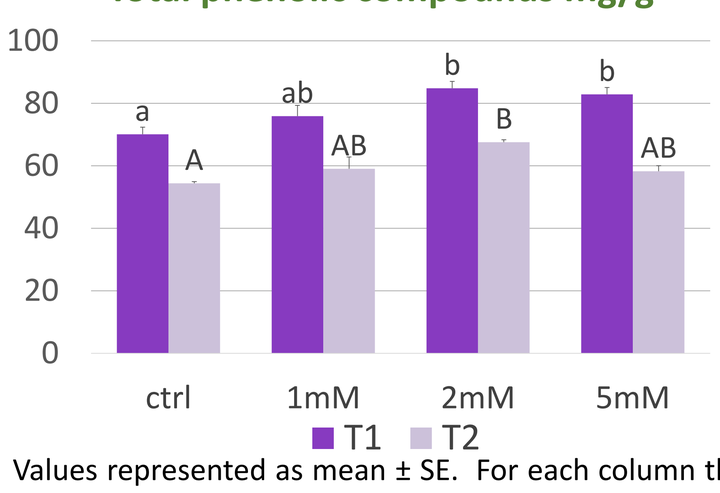
Values are represented as mean ± SE. For each column, the difference in uppercase series letters indicates significant differences between the time within the same treatment. For each column, the difference in lowercase series letters indicates significant differences between the treatment within the same time ($p < 0,05$; Tuckey multiple range test). The times represented are: before treatment (C), at treatment (T0), four dpt (T1) and 22 dpt (T2).

Treatment with MVOC influences some C16 and C18 profiles



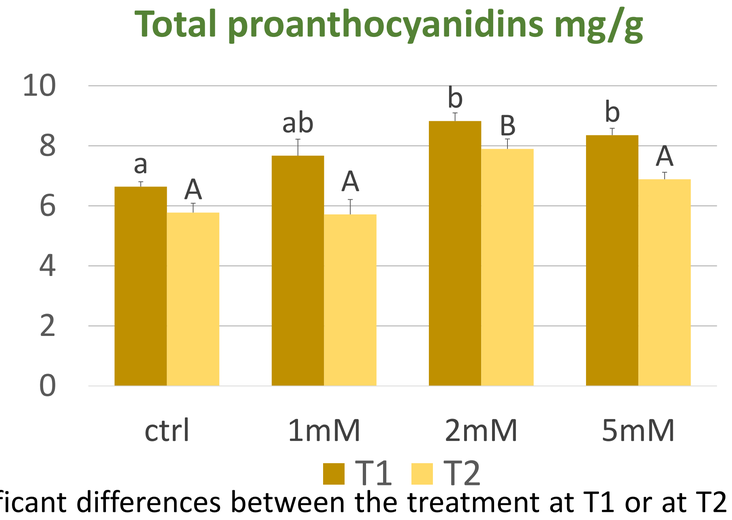
Palmitic acid (C16:0) Palmitoleic acid (C16:1) Stearic acid (C18:0) Linoleic acid (C18:2) Linolenic acid (C18:3) Archidic acid (C20:0)

Values are represented as mean ± SE. For each column, the difference in series letters indicates significant differences ($p < 0,05$; Tuckey multiple range test) between the treatment at T1 sampling.



Treatment with MVOC increases total phenolic compounds and proanthocyanidins synthesis.

The main phenolic compound is quercetin, which is present in two gycosidate forms.



Values represented as mean ± SE. For each column the difference in lowercase or uppercase series letters indicates significant differences between the treatment at T1 or at T2 sampling, respectively ($p < 0,05$; Tuckey multiple range test).

CONCLUSION

- MVOC enhances plant resistance against *Plasmopara viticola;*
- MVOC affects the content of C16 and C18 fatty acids;
- MVOC increases the content of polyphenols, especially flavonoid glycosides and proanthocyanidins, thus improving *V. vinifera* resistance to *P. viticola*.

The use of MVOC represents a sustainable alternative for grapevine pest management