Anti-oomycete activities of 5 essential oils against 3 genotypes of *Phytophthora infestans* the agent of potato late blight

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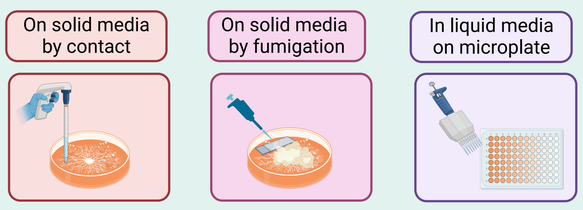
INTRODUCTION

Phytophthora infestans is the oomycete causing late blight disease which represents by far the major pathology on potato crop. Specific attention has been brought towards new genotypes that have emerged in European agroecosystems. Some of them have shown resistance to commonly-used fungicides whereas others recently caused severe damaged due to high virulence.
Facing the decrease in efficiency of synthetic pesticides and the damages they cause on soils and water while harming biodiversity, new alternatives for pest management must be encouraged.
Given that context, plant secondary metabolites have become in the past decades widely studied for numerous application in the agronomic field. Among them, essential oils which are complex hydrophobic mixtures of volatile organic compounds, are gaining interest as biopesticides for plant protection.

MATERIAL & METHODS

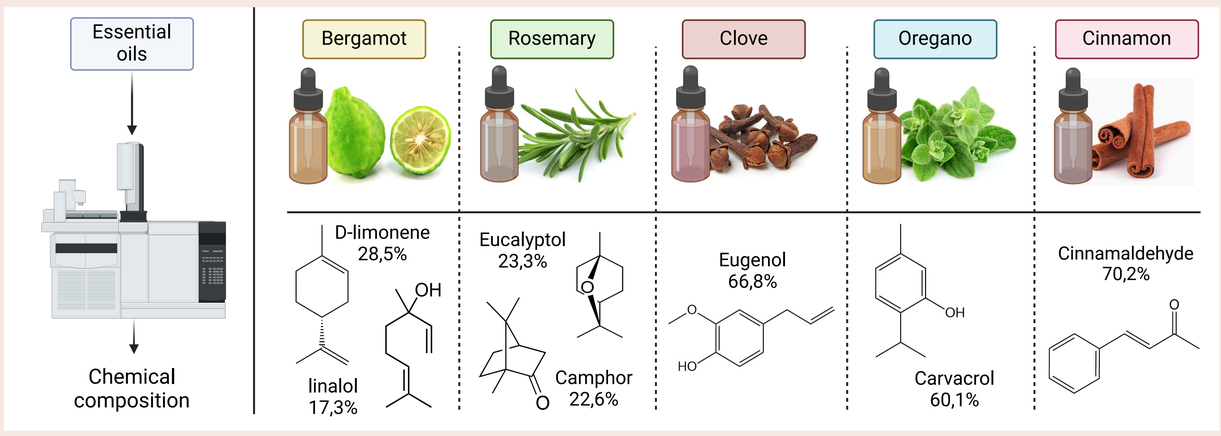
This work aimed at screening on 3 different genotypes of *P. infestans* (EU-13-A2; EU-36-A2 & EU-37-A2) the anti-oomycete potential of 5 essential oils : bergamot (*C. bergamia*), rosemary (*R. officinalis*), oregano (*O. vulgare*), clove (*S. aromaticum*) and Ceylan cinnamon (*C. zeylanicum*). Their **chemical composition** was analyzed by GC-MS.
The inhibition of **mycelium growth** was evaluated on a range of concentrations both by **contact** (0; 0.02; **0.1**; 0.5; 2.5 µL/ml) and by **fumigation** (0; 0.01; 0.05; 0.25 & **1** µL/ml air) on V8-agar media in Petri dish (n=3). Relative inhibition of mycelium growth at one specific concentration is here expressed compared to controls. These experiments were carried out three times.
The inhibition of **spores germination** was tested on microplates in liquid media (n=6). Median inhibitory concentrations (IC_{50}) were then calculated.

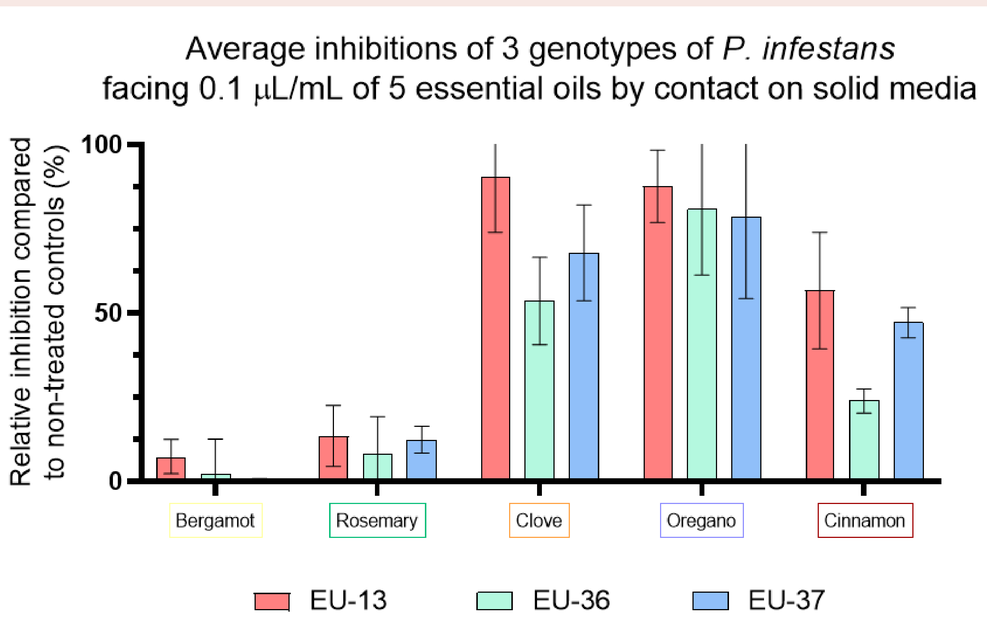


RESULTS

Essential oil chemical profile

The GC-MS analysis revealed for each essential oil the major components and their relative abundance.



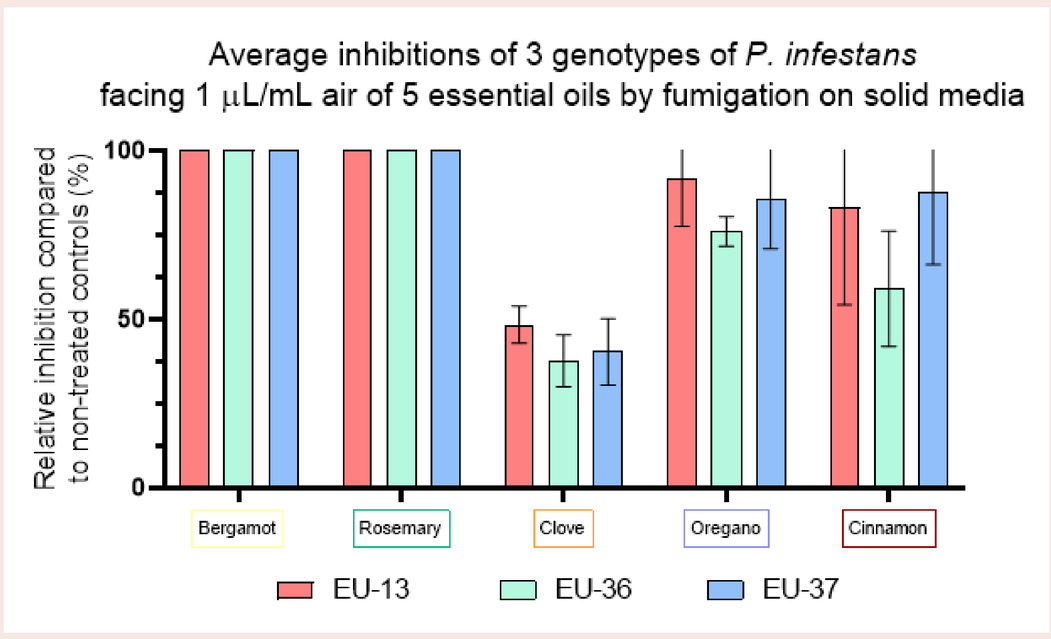


Mycelium growth inhibition by contact

All 5 oils caused total inhibition of the three genotypes at 2.5 µL/mL .
Only clove, oregano and cinnamon held total inhibition at 0.5 µL/mL.
Clove and oregano still showed the highest rates of inhibition at 0.1 µL/mL as presented on the figure on the left.

Mycelium growth inhibition by fumigation

At the highest tested dose of 1 µL/mL of air, only bergamot and rosemary oils allowed total inhibition of all three genotypes by fumigation.
Both those oils contain monoterpenoids which present higher vapor pressure than phenylpropanoids.
This allows better volatilisation and might result in optimal fumigation activity.



Median inhibitory concentrations of 5 essential oils on spores germination of 3 *P. infestans* genotypes in liquid media on microplates

IC_{50} [confidence range] (µL/mL)	Bergamot	Rosemary	Clove	Oregano	Cinnamon
EU-13	10.9 [8.3 ; 14.4]	10.9 [8.8 ; 13.4]	0.5 [0.4 ; 0.6]	1.8 [1.1 ; 2.9]	0.13 [0.09 ; 0.20]
EU-36	1.1 [0.7 ; 1.7]	2.4 [1.2 ; 3.7]	0.1 [0.06 ; 0.14]	0.3 [0.2 ; 0.4]	0.12 [0.05 ; 0.28]
EU-37	4.9 [3.9 ; 6.2]	6.6 [5.3 ; 8.4]	0.4 [0.3 ; 0.6]	0.4 [0.2 ; 0.6]	0.08 [0.05 ; 0.13]

Spores germination inhibition on microplates

Cinnamon oil prevents the best spores germination of all three genotypes followed by clove and oregano oils.
EU-36 seems the most sensitive genotypes since IC_{50} are lower than EU-13 and EU-37.

CONCLUSION & PERSPECTIVES

Essential oils did reveal anti-oomycete activities against the three tested genotypes of *Phytophthora infestans,* among which EU-36 seems the most sensitive. The inhibitory potential toward both mycelium growth and spores germination depends on chemical composition as well as physical properties of essential oils. For those reasons, they could represent an efficient alternative to synthetic pesticides. Meanwhile, *in planta* tests are in progress to confirm those activities on the whole pathosystem. Eventually, optimized formulation will be needed to ensure optimal efficacy of those secondary metabolites despite their physico-chemical nature.

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