PhD Thesis Defenses

On **Monday July 29th 2024 at 9.30am** at the classroom **Giuseppe Perrotta**, Via Santa Sofia 100

Ermes Ivan Rovetto (XXXVI cycle)

Will defend his PhD theses titled

European Doctor Candidate

Green solutions and innovative technologies for post-harvest management and safety of food products of the organic and zero-residue citrus production chain

Thesis Abstract

Mediterranean countries, including Spain and Italy, dominate the global fresh citrus fruit trade. The citrus industry in EU Mediterranean countries prioritizes high-quality products like blood oranges, with a focus on consumer health. However, fungal diseases, particularly green mold caused by *Penicillium digitatum*, present significant challenges, resulting in substantial post-harvest losses. Some disease-causing agents are categorized as quarantine or recommended as regulated non-quarantine pests (RNQPs) by the European and Mediterranean Plant Protection Organization (EPPO). Various fungi contribute to post-harvest decay, with some producing mycotoxins that can contaminate fruit or juices. The objectives of this doctoral thesis were as follows: i. Characterize the mycotoxins produced by *Alternaria alternata*, *Colletotrichum gloeosporioides*, and *Penicillium digitatum* in blood orange fruit. ii. Establish a rapid and reliable molecular diagnostic method for in situ detection of the anamorphic fungus *Plenodomus tracheiphilus*, the causal agent of Mal secco disease (MSD) of lemons. iii. Evaluate the effectiveness of *Candida oleophila* as a sustainable alternative to commercial fungicides for post-harvest fruit treatments to prevent green mold incited by *P. digitatum*.

Regarding the first objective, mycotoxins and secondary metabolites produced by *A. alternata, C. gloeosporioides*, and *P. digitatum* in blood orange fruit were analyzed using UHPLC–Q-TOF-MS. Three types of fruit were selected per cultivar: asymptomatic, symptomatic showing necrotic lesions caused by hail, and mummified. Among 47 secondary metabolites identified, 16, 18, and 13 were of *A. alternata, C. gloeosporioides*, and *P. digitatum*, respectively. The metabolic profiles of the peel were similar between hail-damaged and asymptomatic fruit, while the juice of the mummified fruit showed significantly higher levels of specific compounds and mycotoxins (patulin and Rubratoxin B), associated exclusively with the presence of *P. digitatum*.

Consistently with the second objective, a novel diagnostic assay utilizing recombinase polymerase amplification (RPA) technology was developed for detecting *P. tracheiphilus.* RPA assay achieved sensitivity comparable to that of the Real Time-PCR test and even more sensitive in tests on DNA samples obtained through a rapid extraction method, highlighting the potential of RPA in citrus disease management.

Regarding the third objective, the study focused on assessing the effectiveness of the biological control agent *C. oleophila* in managing green mold induced by *P. digitatum* in different stages of the post-harvest supply chain. Results revealed that *C. oleophila* demonstrated notable effectiveness in decreasing the incidence of green mold symptoms. Furthermore, the research has provided insights into the molecular mechanisms of citrus fruit's defensive response to *C. oleophila* treatment.

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