**DOTTORATO DI RICERCA IN BIOLOGIA CELLULARE E DELLO SVILUPPO**

**XXXIX CYCLE**

**Project proposal for a Sapienza PhD scholarship**

**Main research line**

**Title:** **Impacts of Pectin methylesterase activity on multiple plant-microbe interactions**

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**Summary**

The plant cell wall (CW) is the foremost interface at which interactions between plants and microbes take place. This compartment can be involved in the perception of diverse set of microbial molecules referred to as Microbial/Pathogen Associated Molecular Patterns (MAMPs/PAMPs) through Pattern Recognition Receptors (PRRs) [1]. Plant cells also exploit sophisticated mechanisms of sensing the alteration of CW Integrity [2, 3]. For instance, they can perceive endogenous molecules produced in damaged tissues (the so-called damage-associated molecular patterns, or DAMPs). Typical DAMPs are Oligogalacturonides (OGs), fragments released by the Homogalacturonan (HG), the major component of pectin in the CW[4]. HG is secreted in a highly methyl esterified form to the CW, where it is de-methylesterified by Pectin Methyl Esterases (PMEs), enzymes producing free carboxyl ester groups on pectin backbone releasing protons and methanol. Interestingly, a strong involvement of plant PMEs got discovered during multiple plant-microbe interactions and stresses [5].

PME activity can promote the production/sensing of damage-associated molecular patterns such as oligogalacturonides and methanol, promoting defensive priming in plants. Pathogen recognition receptors such as wall-associated kinases (WAKs) and FERONIA preferentially bind to de-methylesterified pectins. Different plant PMEs are activated in plants upon pathogen attacks. Positive interactions between soil microbiome and plants can promote plant health by influencing growth and tolerance to diseases. Among soil beneficial microbes, arbuscular mycorrhizal fungi (AMF) are pivotal for plant nutrition and stress tolerance. A possible role of PME in plant-soil microbiome interaction was never explored. We will attempt to unravel the role of plant PME activity in CW sensing in plant-microbe interactions. The research foreseen in this project will deepen the knowledge on the contribution of the couple FER-pectin. The main working hypothesis of this proposal is that PME activity contributes to FER binding to de-methylesterified pectin and FER functions during plant immune responses. Moreover, the effect of PME activity on plant-soil microbiome interactions will be defined, including arbuscular mycorrhizal symbiosis.

This project will provide novel knowledge on CW traits to increase the long-term plant resistance to fungal pathogens, avoiding the appearance of resistance phenomena and without negative effects in the ecosystem. Knowledge from Arabidopsis will be transferred to economically important crops resulting in new tools to enable and accelerate plant breeding.Ongoing research relationship with research groups from national and international Universities will provide a stimulating environment as well as an excellent training opportunity for students and research fellows participating in the project.

**References**

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4. Ferrari S, Savatin DV, Sicilia F, Gramegna G, Cervone F, De Lorenzo G. Oligogalacturonides: plant damage-associated molecular patterns and regulators of growth and development. FrontPlant Sci. 2013;doi: 10.3389/fpls.2013.00049.

5. Lionetti V, Cervone F, Bellincampi D. Methyl esterification of pectin plays a role during plant-pathogen interactions and affects plant resistance to diseases. JPlant Physiol. 2012;169:1623–30.

**Pertinent Publications of the proponent (last 5 years)**

1. Coculo D, Del Corpo D, Ozáez Martínez M., Vera P., Piro G, De Caroli M, Lionetti V. Subtilases turn on pectin methylesterase activity for a robust apoplastic immunity. bioRxiv 2022.07.28.501549; doi: https://doi.org/10.1101/2022.07.28.501549
2. Coculo D., Lionetti V. The Plant Invertase/Pectin Methylesterase Inhibitor Superfamily. Front Plant Sci. 2022 Mar 25; 13:863892.
3. Swaminathan, S.; Reem, N.T.; Lionetti, V.; Zabotina, O.A. Coexpression of Fungal Cell Wall-Modifying Enzymes Reveals Their Additive Impact on Arabidopsis Resistance to the Fungal Pathogen, Botrytis cinerea. Biology (2021), 10, 1070.
4. Sciubba F, Chronopoulou L, Pizzichini D, Lionetti V, Fontana C, Aromolo R, Socciarelli S, Gambelli L, Bartolacci B, Finotti E (2020) Olive mill wastes: a source of bioactive molecules for plant growth and protection against pathogens. Biology 9: 450
5. Del Corpo D, Fullone MR, Miele R, Lafond M, Pontiggia D, Grisel S, Kieffer‐Jaquinod S, Giardina T, Bellincampi D, Lionetti V (2020) AtPME17 is a functional Arabidopsis thaliana pectin methylesterase regulated by its PRO region that triggers PME activity in the resistance to Botrytis cinerea. Molecular Plant Pathology 21: 1620–1633. press release https://www.uniroma1.it/it/notizia/un-gene-sconfiggere-la-muffa-grigia-il-nemico-numero-uno-di-oltre-200-specie-di-piante
6. PogorelkoGv, Juvale Ps, Rutter Wb, Hütten M, Maier Tr, Hewezi T, Paulus J, Van Der Hoorn Ra, Grundler Fm, Siddique S, Lionetti V, Zabotina Oa, Baum Tj (2019). Re-targeting of a plant defense protease by a cyst nematode effector. plant journal jun;98(6):1000-1014
7. Mehari, Z., Malacarne, G., Pilati, S., Sonego, P., Engelen, K., Lionetti, V., Bellincampi, D., Vrhovsek, U., Zottini, M., Baraldi, E. And Moser, C. (2019). The molecular dialogue between grapevine inflorescence/berry and botrytis cinerea during initial, quiescent and egression infection stages. Acta Hortic. 1248, 587-594