DOTTORATO DI RICERCA IN BIOLOGIA CELLULARE E DELLO SVILUPPO

41th CYCLE
Project proposal for a Sapienza PhD scholarship

Other research line

Title: Investigating the role of a novel H_2O_2 receptor in local and systemic plant immunity triggered by cell wall-derived Damage Associated Molecular Patterns (DAMPs)

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Summary

Plants lack mobile immune cells but possess an advanced innate immune system vital for survival. This system enables cells to recognize danger signals, such as Microbe-Associated Molecular Patterns (MAMPs) and Damage-Associated Molecular Patterns (DAMPs). When activated, the immune response triggers intracellular actions, including defence gene activation, stress hormone accumulation, and systemic signaling to prepare distant tissues against threats. This process, called systemic resistance, involves the transmission of reactive oxygen species (ROS) and Ca^{2+} from the site of detection to unstressed tissues, forming "Ca^{2+} and ROS waves" essential for pre-emptive adaptation to recurring infections. In Arabidopsis, MAMPs/DAMPs recognition leads to cytosolic Ca^{2+} influx and extracellular H_2O_2 (eH_2O_2) production, which are vital for immunity. Recent research on the H_2O_2-induced Ca^{2+} increases 1 (HPCA1) receptor has advanced our understanding of e H_2O_2 perception and Ca^{2+}/ROS wave propagation. However, the systemic roles of ROS and HPCA1 in response to oligogalacturonides (OGs), a class of Cell Wall-Derived DAMPs, remain understudied. OGs, derived from pectin, trigger local defence responses, but their systemic effects are largely unexplored. This project aims to clarify the mechanisms of OG-induced systemic immune responses, focusing on how these CW-DAMPs trigger long-distance signaling and induce systemic resistance against pathogens. Using Arabidopsis as a model, the study will examine HPCA1's role in both basal and OG-induced immunity, contributing to crop protection strategies and sustainable plant immunity, reducing disease-related losses and pesticide use.

Pertinent Publications of the proponent (last 5 years)

1. Bigini, V., F. Sillo, S. Giulietti, D. Pontiggia, L. Giovannini, R. Balestrini and D. V. Savatin (2024). "Oligogalacturonide Application Increases Resistance to Fusarium Head Blight in Durum Wheat." J Exp Bot.
2. Costantini, S., M. Benedetti, D. Pontiggia, M. Giovannoni, F. Cervone, B. Mattei and G. De Lorenzo (2024). "Berberine bridge enzyme-like oxidases of cellodextrins and mixed-linked b-glucans control seed coat formation." Plant Physiol **194**(1): 296-313.
3. Pontiggia, D., S. Giulietti, G. Gramegna, V. Lionetti, R. Lorrai, L. Marti, S. Ferrari, G. De Lorenzo and F. Cervone (2024). Resilience of the plant cell wall and damage-associated molecular patterns (DAMPs) drive plant immunity. Plant Cell Wall: Research Milestones and Conceptual Insight. A. Geitmann. Boca Raton London New York, CRC Press**:** 393-411.
4. Salvati, A., F. Sciubba, A. Diomaiuti, G. P. Leone, D. Pizzichini, D. Bellincampi and D. Pontiggia (2024). "Olive mill wastewater as a source of defense-promoting by-products against microbial pathogens." Plant Stress **14**: 100623.
5. Salvati, A., A. Diomaiuti, F. Locci, M. Gravino, G. Gramegna, M. Ilyas, M. Benedetti, S. Costantini, M. De Caroli, B. Castel, J. D. G. Jones, F. Cervone, D. Pontiggia and G. De Lorenzo (2024). "Berberine bridge enzyme-like oxidases orchestrate homeostatic control and signaling of oligogalacturonides in defense and wounding." bioRxiv.
6. Pontiggia, D., M. Benedetti, S. Costantini, G. De Lorenzo and F. Cervone (2020). "Dampening the DAMPs: how plants maintain the homeostasis of cell wall molecular patterns and avoid hyper-immunity." Frontiers in Plant Science **11**: 613259.
7. Del Corpo, D., M. R. Fullone, R. Miele, M. Lafond, D. Pontiggia, S. Grisel, S. Kieffer-Jaquinod, T. Giardina, D. Bellincampi and V. Lionetti (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**(12): 1620-1633.
8. Wang, P., L. Zhou, P. Jamieson, L. Zhang, Z. Zhao, K. Babilonia, W. Shao, L. Wu, R. Mustafa, I. Amin, A. Diomaiuti, D. Pontiggia, S. Ferrari, Y. Hou, P. He and L. Shan (2020). "The cotton wall-associated kinase GhWAK7A Mediates responses to fungal wilt pathogens by complexing with the chitin sensory receptors." The Plant cell **32**(12).