DOTTORATO DI RICERCA IN BIOLOGIA CELLULARE E DELLO SVILUPPO

41° Cycle

Project proposal for a PhD scholarship

Main research line

Title of the research: Role and regulation of the plant TOR/SnRK1 pathways in the trade-off between growth and defense.

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Summary

Plants face challenges from abiotic stresses (drought, salt) and biotic stresses (pathogen attacks) that hinder carbon assimilation and energy levels. The cell wall (CW) acts as a primary defense mechanism, maintaining turgor pressure and defending against pathogens. Stress conditions impact the CW, and CW integrity (CWI) maintenance is vital for survival, involving mechanisms that detect changes in turgor pressure and the breakdown of CW components, which can activate pattern-triggered immunity (PTI). Activation of defense-related responses is costly for the plant, and therefore the balance between growth and defense is essential for plant survival. The antagonistic roles of TOR and SnRK1 kinases play a significant part in regulating this balance. TOR promotes growth when nutrients are abundant, while SnRK1 promotes energy conservation and stress responses under limited resources. TOR activity is linked to reduced pathogen resistance, whereas SnRK1 activity enhances pathogen resistance. Both kinases influence CW composition, suggesting that feedback mechanisms regulate stress responses by adjusting CWI, growth, and immune responses. The project will investigate how TOR and SnRK1 are regulated and how they modulate the growth-defense trade-off under biotic and abiotic stress conditions. Additionally, the project will explore the effects of compromised CWI on TOR and SnRK1 signaling, which may trigger defense responses and reduce growth, and how TOR and SnRK1 modulate CW composition in response to stress conditions. Another objective of the project will be to understand how translation is regulated by stress and how TOR and SnRK1 influence this process.

Pertinent Publications of the proponent (last 5 years)

1. Lorrai L, Erguvan O, Raggi S, Jonsson K, Široká J, Tarkowská D, Novák O, Griffiths J, Jones AM, Verger S, Robert R, **Ferrari S** (2024) “Cell wall integrity modulates HOOKLESS1 and PHYTOCHROME INTERACTING FACTOR4 expression controlling apical hook formation” *Plant Physiology* 196(2): 1562–1578. https://doi.org/10.1093/plphys/kiae370
2. Giovannoni M, Lironi D, Marti L, Paparella C, Vecchi V, Gust AA, De Lorenzo G, Nürnberger T, **Ferrari S.** (2021) “The Arabidopsis thaliana LysM-containing

Receptor-Like Kinase 2 is required for elicitor-induced resistance to pathogens". *Plant Cell & Environment* 44(12):3545-3562. https://doi.org/10.1111/pce.14192

3. Lorrai R, Francocci F, Gully K, Martens HJ, De Lorenzo G, Nawrath C, **Ferrari S** (2021) "Impaired cuticle functionality and robust resistance to *Botrytis cinerea* in *Arabidopsis thaliana* plants with altered homogalacturonan integrity are dependent on the class III peroxidase AtPRX71" *Frontiers in Plant Science* 12:696955. https://doi.org/10.3389/fpls.2021.704958
4. Giovannoni M., Marti L., **Ferrari S**, Tanaka-Takada N. Maeshima M., Ott T., De Lorenzo G., Mattei MB, (2021) "The plasma membrane-associated Ca2+- binding protein PCaP1 is required for oligogalacturonide and flagellin-induced priming and immunity" *Plant Cell & Environment* 44(9):3078-3093. doi: 10.1111/pce.14118
5. Lorrai R, **Ferrari S** (2021) "Host Cell Wall Damage during Pathogen Infection: Mechanisms of Perception and Role in Plant-Pathogen Interactions" *Plants* 2021, 10(2), 399; https://doi.org/10.3390/plants10020399
6. Wang P, Zhou L, Jamieson P, Zhang L, Zhao Z, Babilonia K, Shao W, Wu L, Mustafa R, Amin I, Diomaiuti A, Pontiggia D, **Ferrari S**, Hou Y, He P, Shan L (2020) "Cotton wall-associated kinase GhWAK7A mediates responses to fungal wilt pathogens by complexing with the chitin sensory receptors" *Plant Cell* 32(12): 3978–4001 DOI: https://doi.org/10.1105/tpc.19.00950.