The '**IPOGEO** - Investigating Plant prOprioception in altered Gravity EnvirOnment'

Plants are sessile organisms that adapt to the non-homogenous distribution of resources by modifying their post-embryonic development through responses called tropisms. Gravitropism, the patterning of postembryonic growth in relation to the gravity vector, is the main determinant of plant architecture through the control of non-vertical organ growth. We have recently shown that all the main components of the root graviresponse, from statolith sedimentation to response, are linked by angle dependence (https://doi.org/10.1073/pnas.2506400122). All the separate theories for root graviresponse (starch/statolith and Cholodny–Went) are, therefore, likely conceptualization of the same mechanism and can be integrated thanks to a cohesive angle dependence framework. This conceptualization allowed us to postulate distinct roles of PINs and columella cell tiers and the existence of time-dependent features in the root graviresponse. Still to clarify is whether the source of these time-dependant qualities is the interaction with other developmental responses, which could become more relevant in altered gravity conditions.

Plant proprioception is the ability of plants to sense their own posture, shape, and movement through internal mechanical signals, such as turgor pressure, wall stress, and bending, allowing them to monitor growth and react to environmental cues. Using mechanisms similar to touch-sensitive cells, plants detect gravity and structural stress to control growth, enabling them to straighten, bend, or flatten leaves. Proprioception is not only a feature of organs, but also at cellular level, where a plant cell adapts cytoskeletal organization, cell wall deposition, protein polarization, and physiology to the new environment.

In the context of the **IPOGEO** project, *A. thaliana* will serve as a model system for investigating how cells and organs respond and adapt to the removal of gravitational constraints. The selected researcher is expected to contribute to the project by assessing changes in morphology, cell wall composition and cytoskeletal organization of wild type and mutant plants grown in simulated and real altered gravity environment. These experiments will take advantage of advanced space simulation and a flight opportunity on board the ISS in October 2026.

By characterizing the signalling pathways for the proprioceptive response, this research will further our understanding of fundamental plant development. Moreover, the project has the potential to identify new targets for crop improvement, representing a valuable contribution to the development of reliable fresh food production systems, both in space and on Earth.