COSMO

Deciphering citrus tolerance determinants to multifactorial stresses by multi-omic ultra-high resolution spatial mapping of plant-microbiota interactions

ABSTRACT

Plants are expected to be subjected to an increasing number of multiple co-occurring biotic and abiotic stresses due to climate change, with critical thresholds for their survival. However, our understanding of plant responses to multifactorial stresses remains limited, which hampers the development of efficient breeding strategies to optimise the adaptation of plants to future climate conditions. Active balancing of stress response trade-offs due to conflicting biotic and abiotic stresses have been shown to be ruled by complex interactions among plant immunity, microbiota and stress tolerance. The key role of plant-microbiota feedbacks on plant signalling pathways was evidenced, but deciphering plant-microbiota interactions remains challenging. Changes in the plant microbiota dynamic can have both beneficial and detrimental effects on host health, depending on the microbes but also on host niche. Consequently, the characterization of in planta microbiota, notably at tissue and cellular levels, is crucial to fully encompass all the biological complexity of microenvironments that sustain plant functioning and tolerance to stresses.
COSMO aims to overcome major barriers to our understanding of plant adaptation to multifactorial stresses by transferring recent developments on ultra-high resolution mapping approaches from developmental and evolutionary biology to plant-microbiota interaction analysis at tissue and cellular levels. The impact should be the resolution of a high spatial mapping of microbiota dynamics associated with gene expression in host tissues, and the identification of tissue-specific plant-microbiota interaction patterns related to plant stress tolerance. COSMO focuses on the plant microbiota of major citrus genetic resources from plant breeding programs for tolerance to either abiotic or biotic stresses affecting Mediterranean cropping systems, i.e. salinity or Phytophthora respectively. The finality is to propose new targets (tissue-specific plant genes × microbial taxa association patterns) for optimising future breeding strategies to mitigate the effects of climate change.

Keywords : Citrus, Compartmentalization, Microdissection, Microbiota, Multifactorial stresses

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GOAL

COSMO aims at unravelling the spatial complexity of plant-microbiota interactions in roots at tissue level and characterized the changes in response to multifactorial stresses. The finality is to identify tissue-

specific plant-microbiota interaction patterns related to plant stress tolerance to propose new targets for efficient breeding strategies. COSMO is at the interface of two innovative research fronts tackling the challenges of in planta microbiota spatial dynamic and plant response to multifactorial stresses associating abiotic (salinity) and biotic (pathogen) factors. In the last few years, changes in plant microbiota dynamic and compartmentalization became as one of the central hypotheses in plant health but roughly assessed at the plant level (i.e. mainly plant organ level). In addition, multifactorial stress-based approaches mainly focus on abiotic stressors, whereas increasing pathogen pressures on plants and vulnerability are predicted due to global change, and important interactions notably between drought or salinity and pathogens were evidenced.