

APStress

Deciphering genetic and environmental effects on apple tree responses to water deprivation scenarios

ABSTRACT

In the face of increasing water scarcity, adapting breeding programs to target crops for more efficient water use is crucial. This requires a comprehensive knowledge of the plant physiological responses to drought, including the regulation of water status in plant tissues (by stomatal closure) and the determinants of water-use efficiency (the ratio of carbon gain to water use). These challenging questions have been scarcely studied in perennial crops such as apple tree, yet of major economic importance. The main objectives of the present outbound mobility project were to analyze the dynamics of tree responses to soil water deprivation in two different climatic environments, on the two core collections, located in Montpellier and Bologna, respectively. More precisely, we aimed at screening the tree morphological and eco-physiological responses to a scenario of decreased irrigation from comfort conditions to moderate and severe water stress.

We demonstrated the validity and speed of the IPL as a proxy for net photosynthesis, across watering scenarios, sites and daytime period. We found a wide range of variability for vegetation and water deficit indices derived from multispectral and thermal imaging, as well as canopy cover characteristics. All traits displayed high heritabilities, and the datasets collected through weekly measurements during summers 2017 and 2018 open exciting avenues to decipher genotypic dynamics of responses and GxE interactions. Through clustering procedures, we found several combinations between architectural and functional traits within the 241 varieties observed in Montpellier. We adapted GWAS procedures to identify the genomic regions underlying the variations in the leaf and plant traits. Finally, we studied the fine dynamics of physiological responses to water deficit within a subset of varieties in different field environments as well as on young, potted plants in greenhouse, to identify typologies of behaviours regarding performance of production and efficiency use of water.

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Project leader : Evelyne Costes

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