HELIAPHEN : A HIGH-THROUGHPUT PHENOTYPING PLATFORM TO CHARACTERIZE PLANT RESPONSES TO WATER STRESS FROM SEEDLING STAGE TO SEED SET

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ABSTRACT

Characterization of plant morphological and physiological responses is a limiting step to breed crops adapted to drought-limiting conditions. Automation of plant management on a phenotyping platform overcomes it by allowing large scale experimentation with yet accurate and individual plant monitoring. In response to both genetic and eco-physiological experimentation requirements, we developed the HELIAPHEN platform. This unique outdoor platform can host 1300 plants, such as sunflower, in 15L pots. It allows plant growth in climatic conditions similar to field, as well as a precise and automated monitoring of plant water consumption thanks to a prototype robot. Its primary functions are to move autonomously on the 600m² platform, and to treat each pot at its location (including weighing and watering up to a targeted weight). Beyond these functions, the robot takes at each handling, plant images from multiple angles with four cameras, to follow the evolution of morphological traits along with the description of the water status. In addition, a ultrasound radar measures automatically plant height and a laser measures stem diameter at the plant basis. These secondary functions are currently improved with new captors such as a light curtain and a 3D laser in order to reconstitute a 3D representation of the plant. To validate the meaning of the HELIAPHEN outputs, we confirmed the impact of drought stress managed with the robot on seed weight, number and thousand kernel weight (TKW). Furthermore, we observed a correlation between field and HELIAPHEN data for TKW and seed number observed on 45 sunflower hybrids.

Key Words : robot, drought, transpiration, growth, imaging