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Poster Communication Abstract – PH.37

OXYGEN DEPENDENT SYNTHETIC CONTROLLERS TO ENHANCE PLANT SURVIVAL UNDER FLOODING AND WATERLOGGING CONDITIONS

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Synthetic biology, cross-kingdom oxygen sensing, flooding, abiotic stresses

Plant synthetic biology is the discipline that aims at the development of new genetic controllers applying engineering principles to the study of plant biology. Depending on their design, such synthetic machineries can exert a dual function: they can track, report and measure a target analyte at the cellular level, or reprogram plant development and metabolism in response to biotic or abiotic stimuli. Excess of water, such as flooding or waterlogging, is among the most adverse conditions that plants can face during their life cycle. Submerged plant tissues experience a drop in oxygen availability, which becomes limiting for aerobic metabolism and gives way to the anaerobic one. Under prolonged stress, only few plant species can survive. These flooding tolerant plants possess unique developmental strategies relying either on fast elongation of shoot tissues to escape form the water layer or arrest of underwater growth to preserve energy. Plants that did not evolve such developmental strategies experience energy crisis and die. In our research, we selected oxygen signaling modules across different kingdoms to design and optimize an orthogonal oxygen-responsive device to be expressed in plants. Through rational combinations of procaryote, mammalian, plant and yeast protein domains, we engineered genetic circuits that generate alternative outputs in an oxygen- dependent manner. This work represents a pioneering effort to combine protein features from different organisms to engineer submergence tolerance traits in plants. It also provides an initial exploration of possible applications for molecular switches based on oxygen availability and paves the way towards its deployment in different research fields.