Unraveling plant environment interactions is key to identify phenes and ideotypes for improved resource acquisition and crop productivity

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Plants adjust their growth, morphology and metabolism in response to changes of key environmental variables above- and below-ground. Changes in temperature, water, nutrients and light occur simultaneously at widely different spatial and temporal scales and physiological responses very often do not follow simple (linear) relationships. It is a key requirement in plant sciences to analyze complex genotype-environment interactions using a quantitative framework which includes the development of new methodologies to measure plant phenotypes rapidly and in a cost-effective fashion, monitoring of environmental variables at appropriate temporal and spatial scales, and heuristic modelling of responses linked to experimental cycles of new hypothesis and empirical testing. In an applied context to breed a new generation of crops that are resilient to climate change and efficient in exploiting resources, each of these requirements result in specific experimental and technological challenges. Emphasis will be given to non-invasive (imaging and non-imaging) methods are emerging as valuable tools opening new avenues to design powerful phenotypic assays for the identification and selection of useful traits and plant ideotypes to be introduced in breeding programs including root architectural and anatomical traits adapted to low nutrient and water agricultural environments. I will discuss these development based on our experience coordinating national and international plant phenotyping networks.