Application of plant phenotyping technologies for seed, leaf and root productivity traits

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ABSTRACT:

In recent years non- and minimally-invasive technologies for quantitative measurements of plant traits linked to productivity received increasing attention both by the public and private research domains to alleviate the so-called, phenotyping bottleneck'[1]. Concerted actions at the national and international level resulted in a growing research community promoting shared research access to national and international phenotyping platforms and continuing the development of novel methodologies and infrastructure [2, 3]. At our Institute we contributed significantly to shape the research landscape of plant phenomics. In this presentation we will first provide an overview as well as strengths and weaknesses of state-of-the-art phenotyping technologies for selected seed, shoot, and root traits. We will then focus on recent examples of our research highlighting progress and achievements, in particular for: i) single-seed analyses of shape, color, volume, and density and the link of these traits with early plant vigor [4, 5]; imaging of shoot and root architecture in a pre-breeding context [6, 7, 8]; 3D and tomographic reconstructions of plant organs for in-depth analyses of growth and architecture [9, 10]; functional analyses of photosynthetic activity in the lab and in the field [11, 12, 13]. These examples include research contributing to understanding and improving plant water and nutrient productivity for major crops with consideration to species of major interest for Thai agriculture, such as cassava, based on ongoing cooperation with NSTDA. Based on our experience in this research field, we will share in the final remarks the main points learned so far in applying non-invasive technologies both for high-throughput and deep phenotyping as well as emerging research questions that can be tackled by plant phenotyping methodologies. We underlie that one of the key aspects for successful developments in this research field is building multi-disciplinary research teams and collaborative projects encompassing plant biologist and agronomists, bio-physicists and software and hardware engineers.

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