A novel high-throughput method for the 4D morphological phenotyping of germinating seedlings

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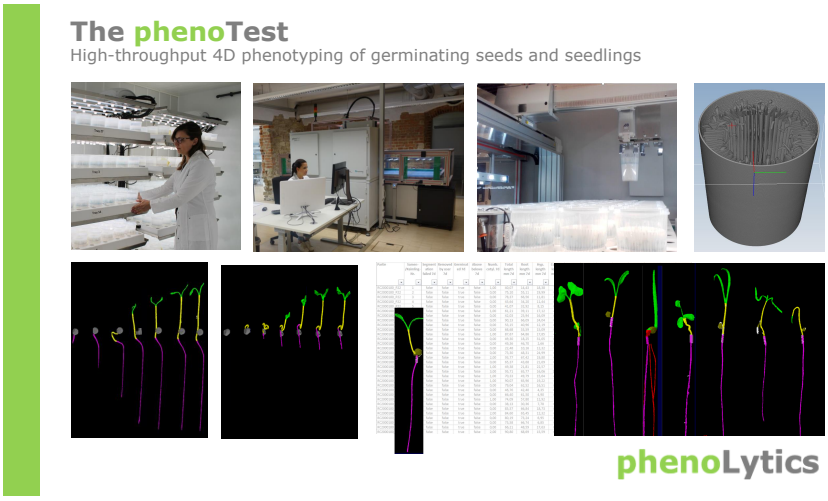
Abstract

In an increasingly digitised and data-driven world, there is a pressing need for globally reproducible high-throughput morphological phenotyping, which provides quantitative and objective data and markers of seed quality to guide analysis and research. Current lab-based methods for morphological phenotyping of germinating seeds still largely rely on visual or 2D-imaging technologies with their respective limitations. Here we present the phenoTest, a novel high-throughput 3D-phenotyping technology that alleviates many of the drawbacks of conventional testing and research methods. Using Xray, 3D-volume image data of individual seedlings grown under highly-standardized conditions are captured. Through an AI-based algorithm, all plant organs can be automatically segmented and measured in 3D, currently outputting 50 seedling datasets per 2 minutes. Individual seedlings can be traced over time across the developmental process without disrupting the germination containers. The process can be run in fully-automated, 24h operation and is industrially validated for multiple years. The phenoTest is universally applicable with customized algorithms for all plants and crops, covering the entire range from fine grasses, vegetables to forestry seeds. The process enables a quantitative, objective and reproducible assessment of morphological seedling traits in 4D which can substitute visual gemination and vigor testing and can be harnessed to optimise processing and breeding. We will share data on the effects of a multitude of factors such as seed treatment, ageing, storage and packaging on the speed and quality of seedling development, and the homogeneity, degree of abnormalities, germination capacity and vigor of seed lots of different crop types.



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