

Development of a mobile, high-throughput, and low-cost plant growth phenotyping system

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Abstract

Plant growth is the product of gene by environment (GxE) interactions during plant development. Effective characterization of plant growth under various conditions provides insight into genetic components of plant development and mechanisms of stress resilience. While the emergence of high-throughput phenotyping facilities provides new avenues to further understand plant development and stress responses, the large costs of such facilities are hindering the study of dynamic growth processes. To democratize high-throughput plant phenotyping, we developed three sets of image-based phenotyping devices utilizing Raspberry Pi computers and low-weight/low-cost materials to continuously monitor shoot and root growth. The process is further automated by our workflows including data collection and statistical analysis. Our devices and workflows are customizable to image a wide variety of plants and tissues. To validate our system, we measured growth of Arabidopsis rosettes, tomato roots, and characterized the relationship between cowpea growth and evapotranspiration. These results demonstrate the variety of applications for Raspberry Pi based phenotyping. Importantly, this low-cost system is ideal for studying the genetics of plant growth and identifying new components of abiotic stress tolerance in a wide variety of species.

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Development of a mobile, high-throughput, and low-cost plant growth phenotyping system

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