

# Plant organ phenotyping enables analysing developmental processes and diurnal changes

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## Background

- Developing organs contribute to growth, reproduction, and recovery processes as well as to responses to the environment
- Organ development comprises changes in size, shape, colour, and physiological properties
- Automated non-invasive monitoring of time-dependent changes enables functional analyses

## Technology for phenotyping of plant organs

### Phenotyping platforms Scanalyzer<sup>HTS</sup> and Scanalyzer<sup>3D</sup>



### Phenotyping platforms for laboratory and greenhouse

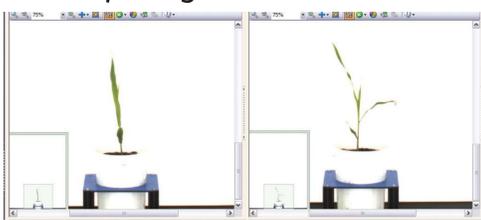
Broad range of **sensors** – e.g. visual light, infrared, near infrared, fluorescence, chlorophyll fluorescence, hyperspectral, laser scanner

**Scanalyzer<sup>HTS</sup>**: Seeds, seedlings, model plants, insects

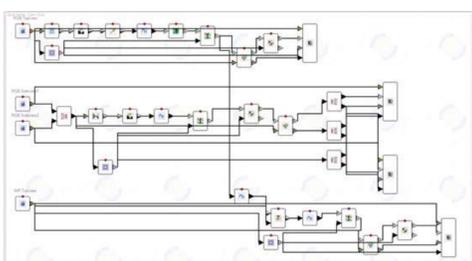
**Scanalyzer<sup>3D</sup>**: wild plants, crops, ornamentals

## Data acquisition and analysis

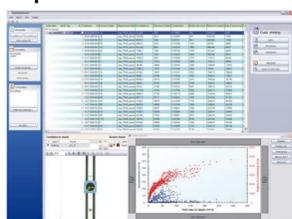
### Sensor/image data



### Data processing



### List of parameters

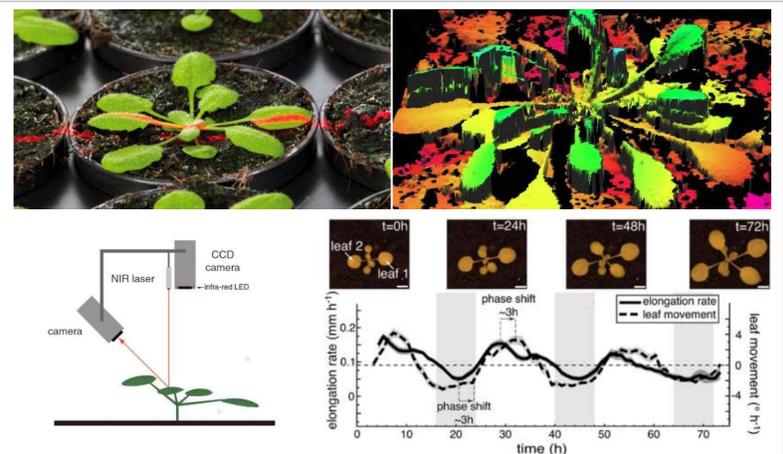


### Biologically relevant information

## Exemplary results

Movement and growth as diurnal processes in *Arabidopsis* leaves; laser scanner measurement in Scanalyzer<sup>HTS</sup>

- Repeated scanning of rosettes during day and night
- 3D models of plants
- Leaf sizes and angles
- Diurnal rhythms of leaf movement and growth



Interplay of leaf growth and movement during day and night. The two diurnal processes occur with a phase shift of 3 hours.

Dornbusch et al. (2012) *Measuring the diurnal pattern of leaf hyponasty and growth in Arabidopsis – a novel phenotyping approach using laser scanning*, *FPB*, 39 (11) 860-869  
Dornbusch et al. (2014) *Differentially Phased Leaf Growth and Movements in Arabidopsis Depend on Coordinated Circadian and Light Regulation*, *Plant Cell*, 26 (10) 3911-3921

### High throughput maize leaf phenotyping; measured with RGB camera in Scanalyzer<sup>3D</sup>



- Analysis of RGB images – different view angles
- Size and shape of whole plant
- Number, size, and geometry of single leaves
- Repeated measurements – time courses

## Conclusion and outlook

- Phenotyping methods give access to dynamic parameters at organ level
- Phenotypic properties and changes correspond to physiological processes and responses to environmental factors
- Combination of size and movement data with other sensor data such as water status, temperature or chlorophyll fluorescence will provide comprehensive insight into organ physiology

