JÜLICH
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Plant performance monitoring via non invasive image acquisition and processing

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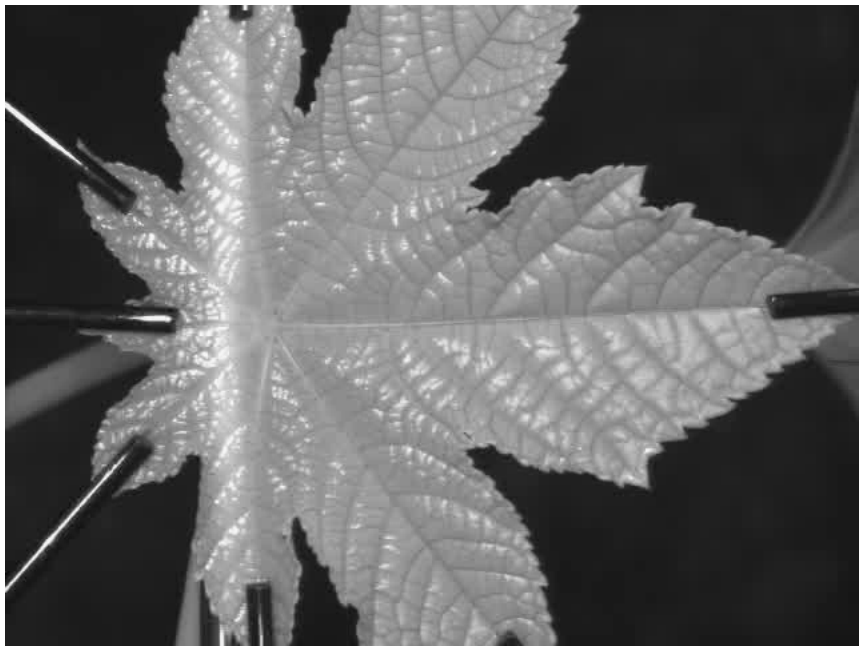
Structure of this talk

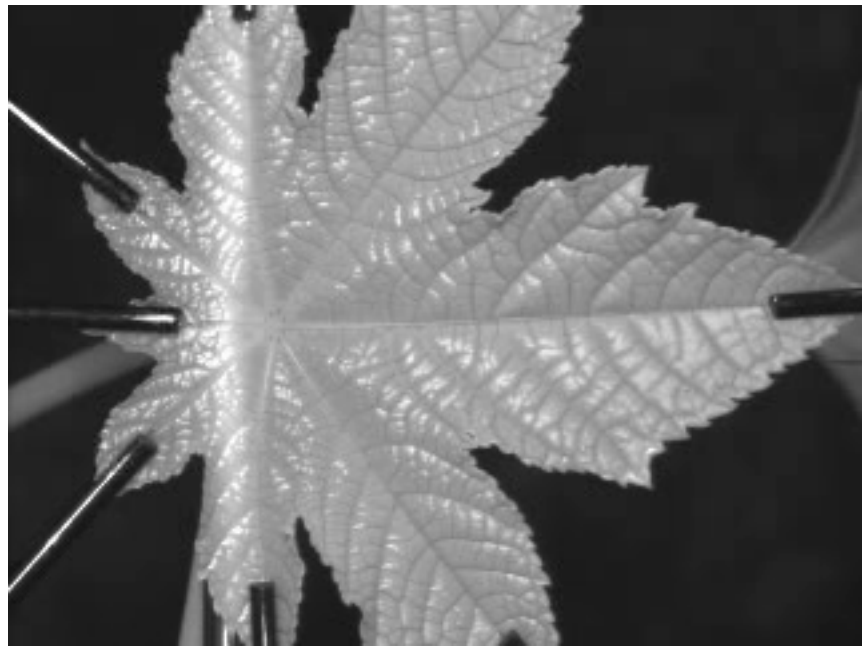
- Plant performance – growth and PS
- Short and long term growth measurement
- Application example: optimized nutrient supply
- Jülich Plant Phenomics Center (JPPC)

diurnal rhythms

diurnal rhythms Castor bean, 24-h-Sequence, acquired in near infrared

Spatial distribution of growth:





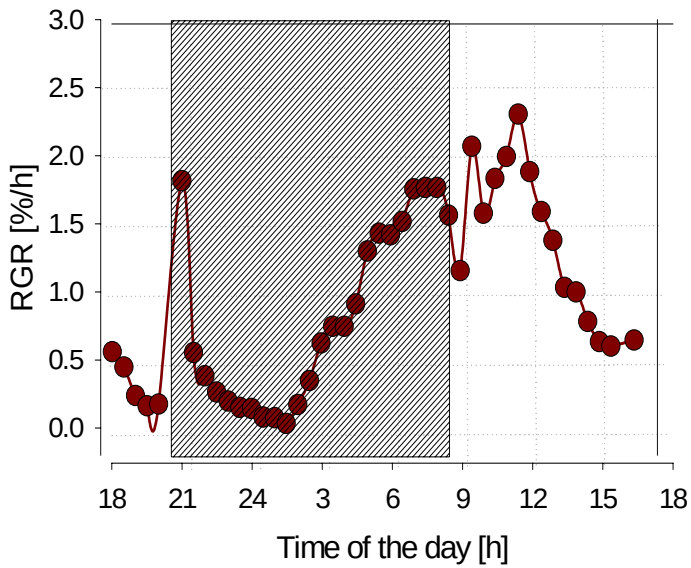
Ricinus 4,5 h 60*45 mm

left: Original images

right: color coded growth images (RGR: ‚relative growth rate')

0 %/h **RGR** 3 %/h

Temporal distribution of growth:

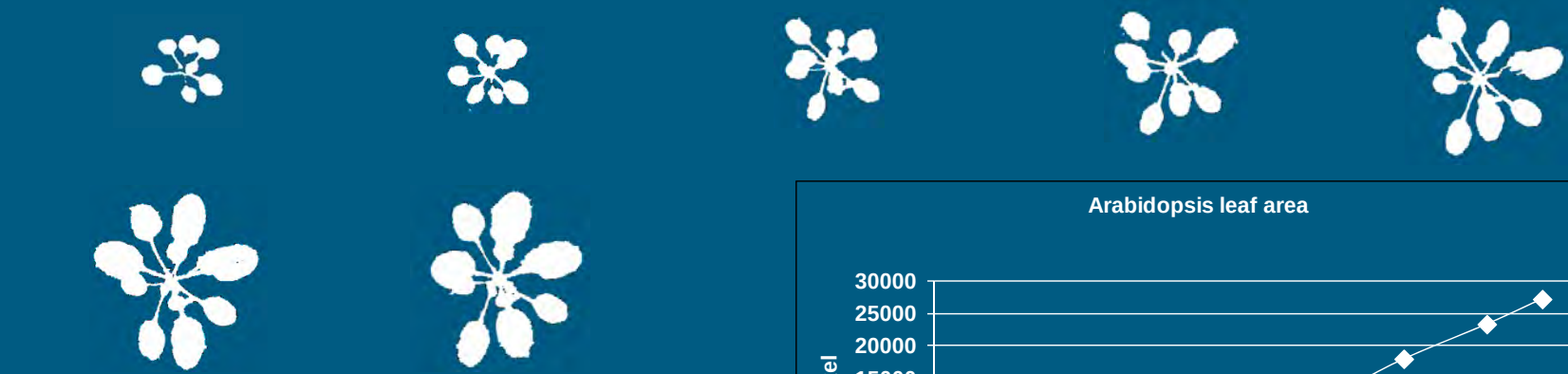


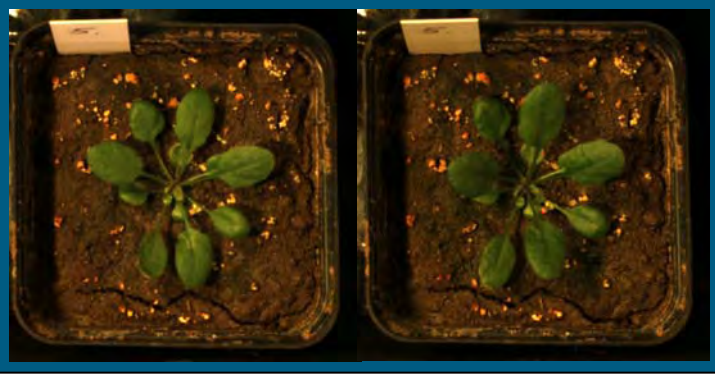
Tobacco 24 h 80*60 mm

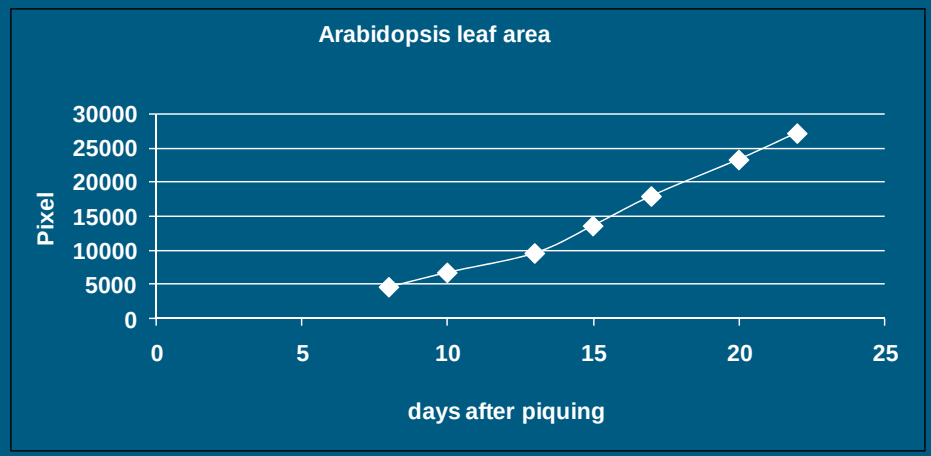
left: original image sequence

right: time course of RGR (24 h)

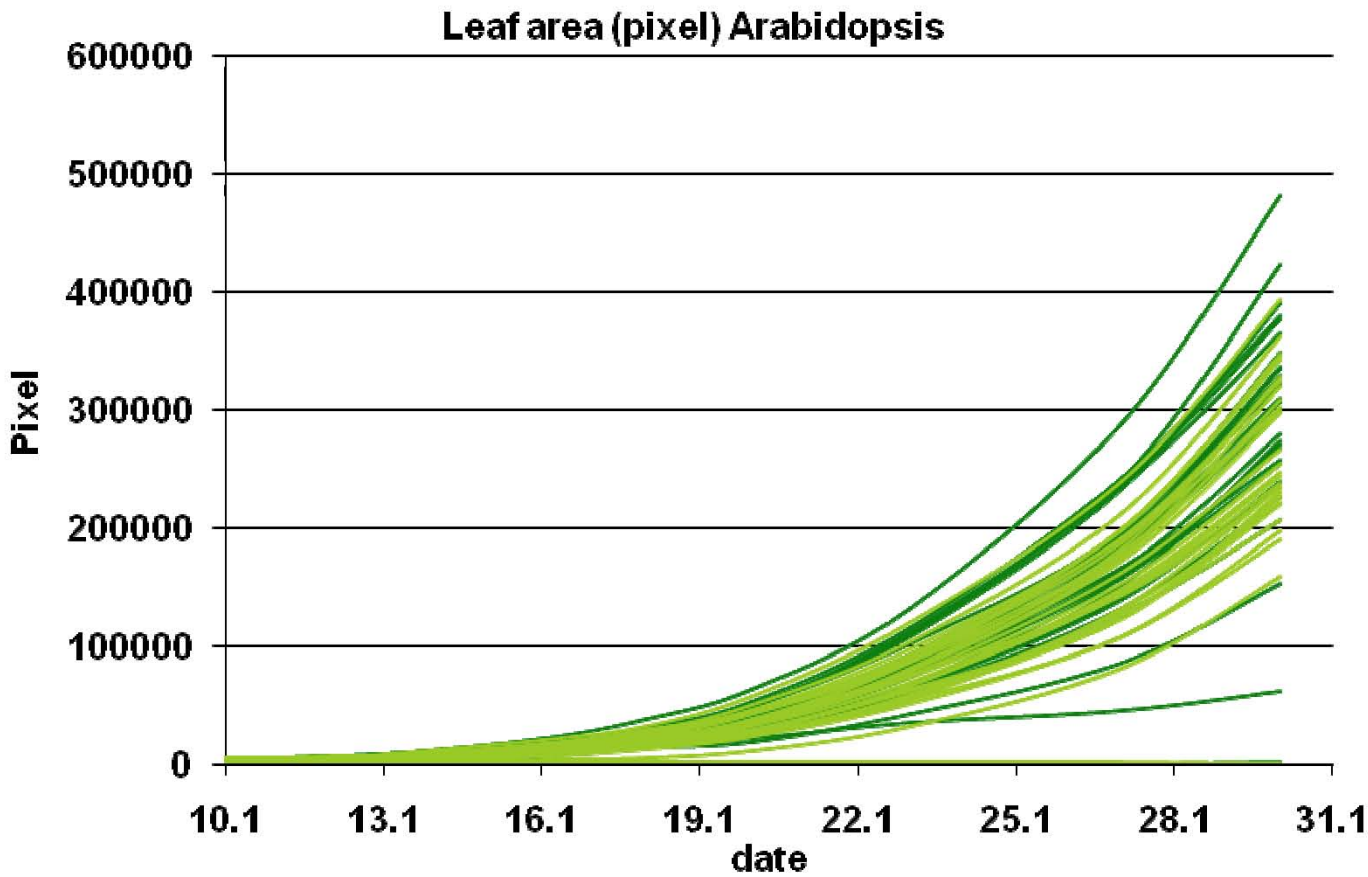
Screening



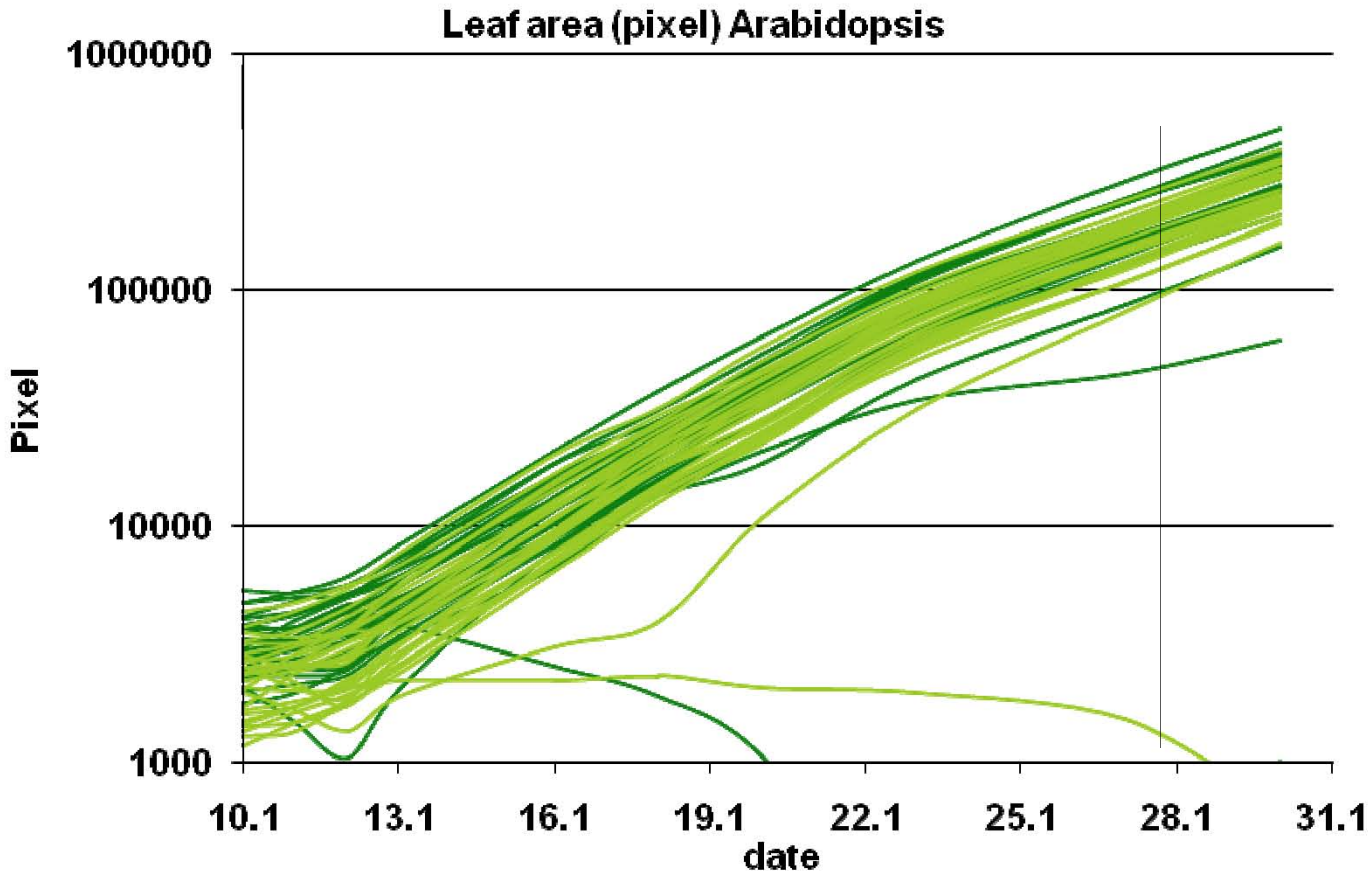



Arabidopsis leaf area
Pixel
30000
25000
20000
15000
10000
5000
0
0
5
10
15
20
25
days after piquing

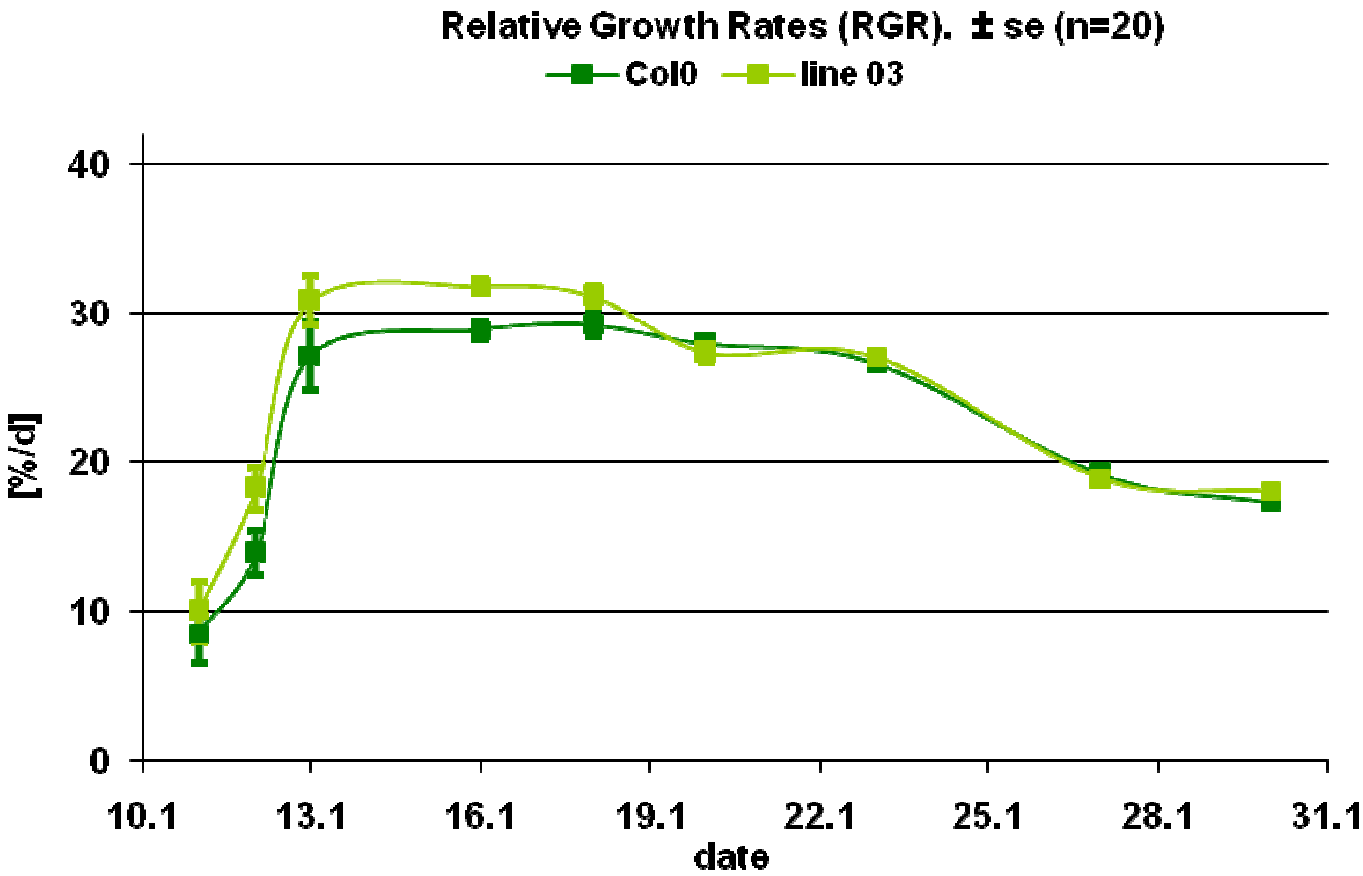
development of total leaf area



development of total leaf area



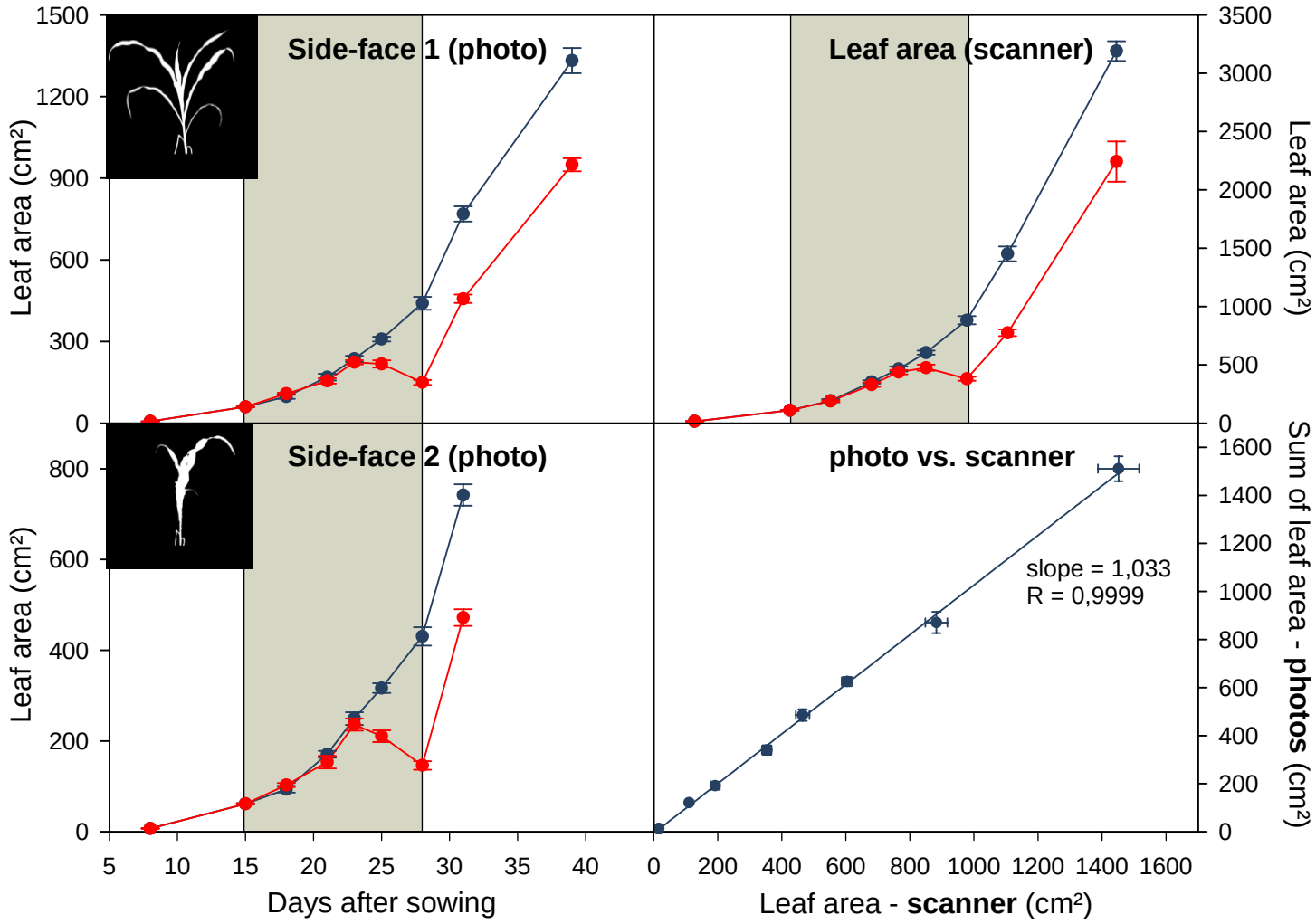
related relative growth rates (RGR)



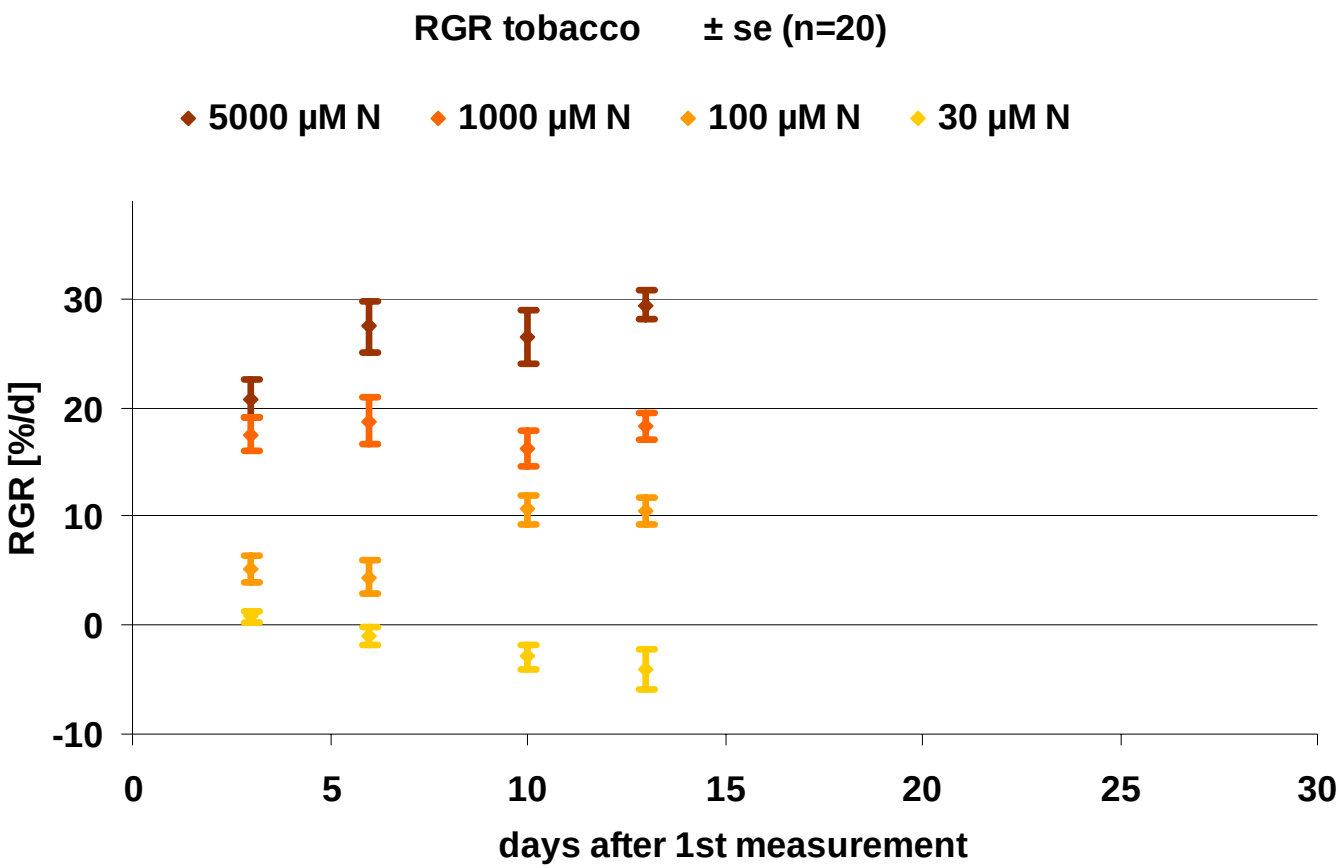
recent and future measurement methods

- Arabidopsis
  - recent: 2-D projected leaf area
  - future: 3-D reconstruction (benefits in leaf angle / overlap)
- tobacco
  - recent: 2-D (small), largest leaf correlation (large plants)
  - future: 3-D reconstruction
- canola, cotton
  - recent: hand measurement
  - future: 2-D projection
- maize, barley
  - recent: rectangular side view
  - future: automated rectangular side view

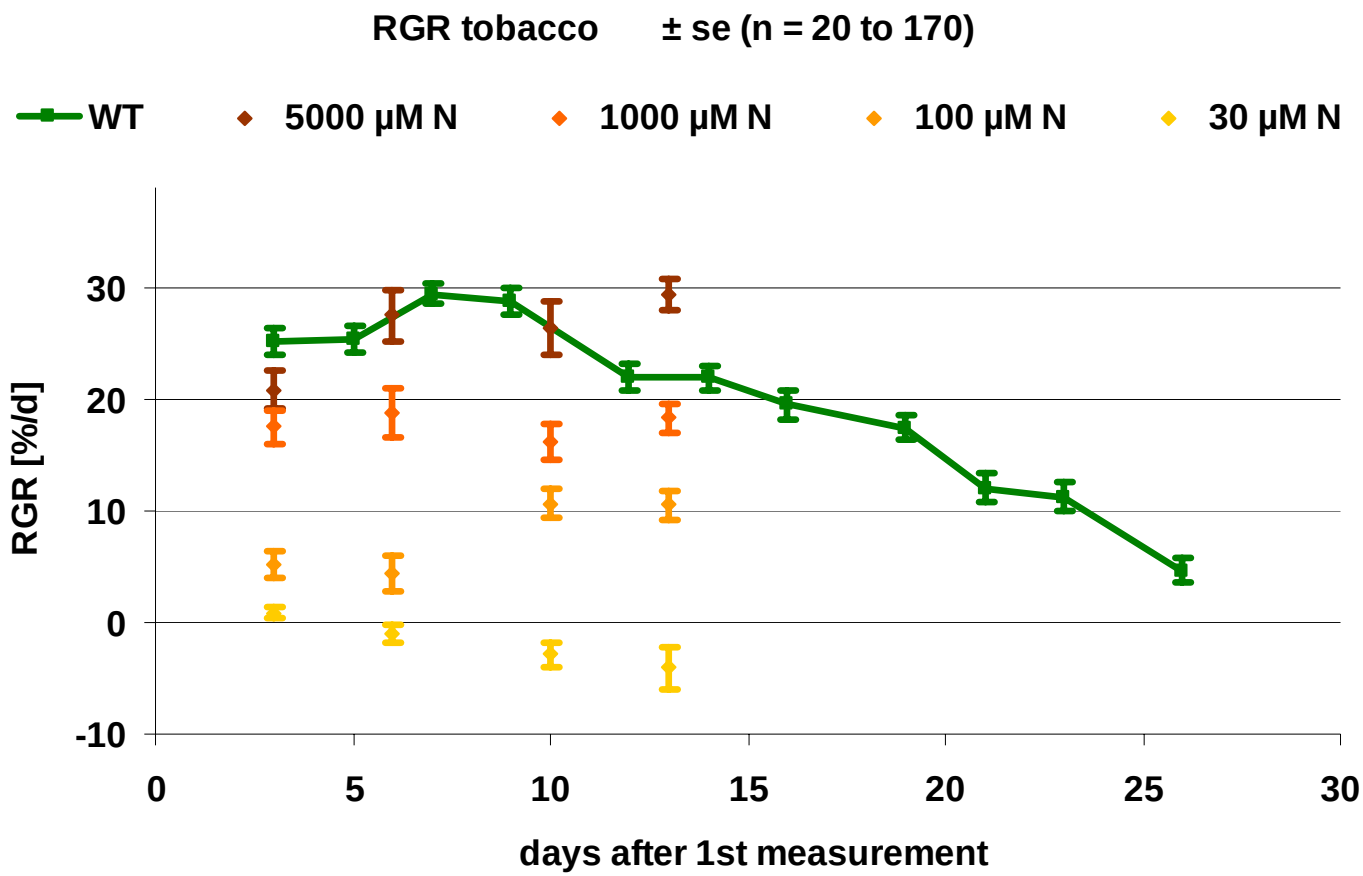
side view correlations



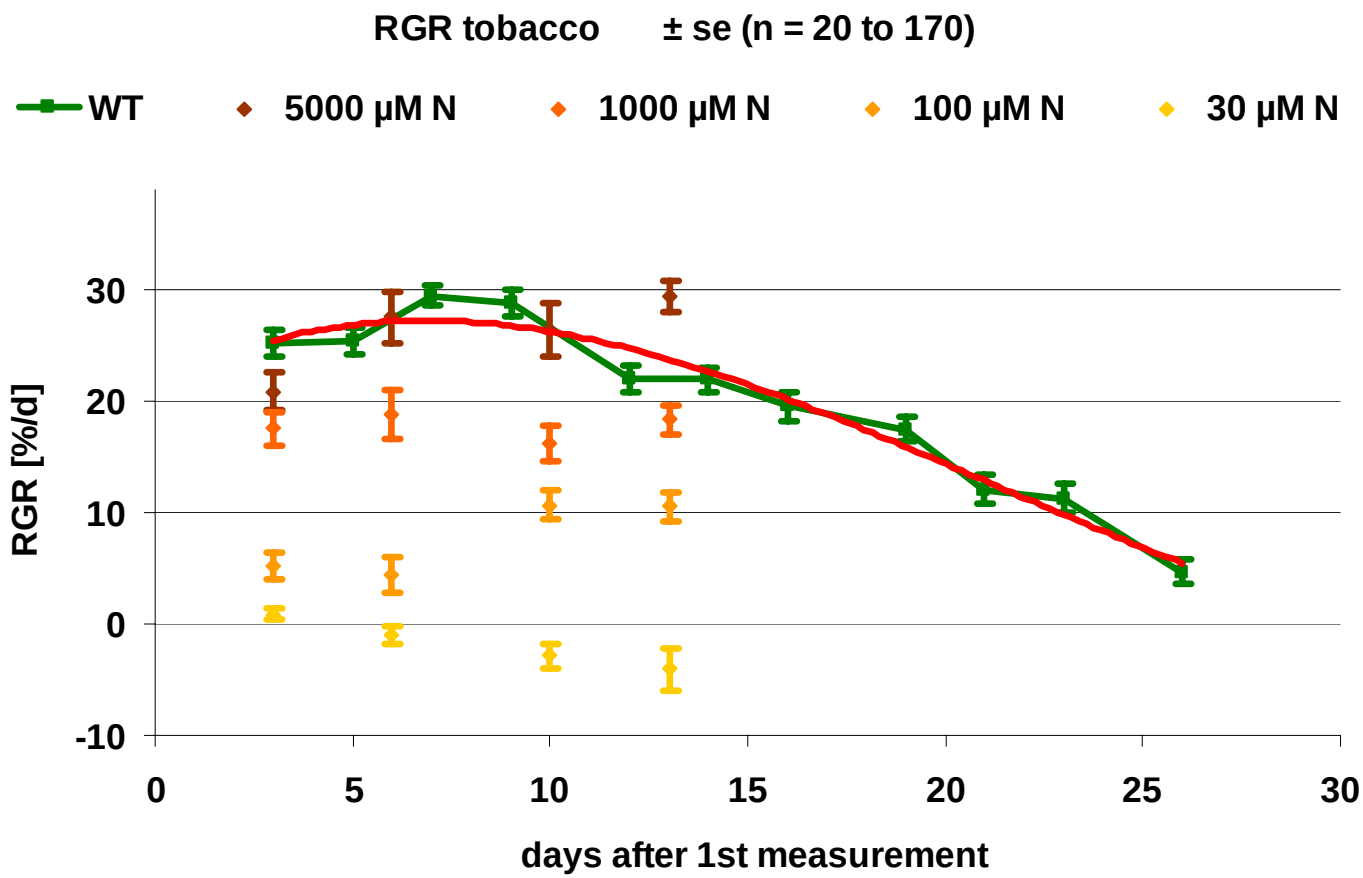
relative growth rates and nutrient supply



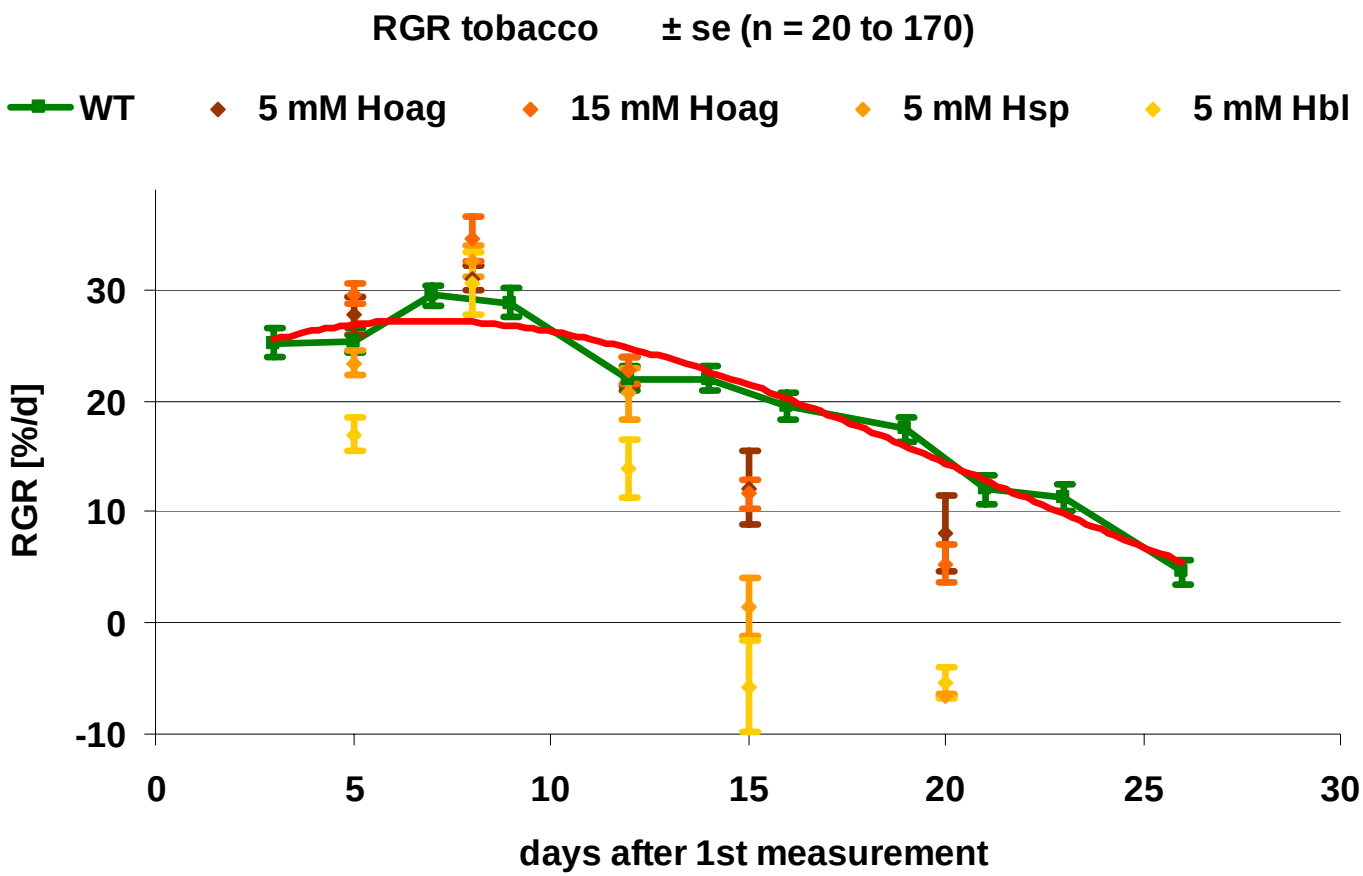
aggregation of 6 greenhouse experiments



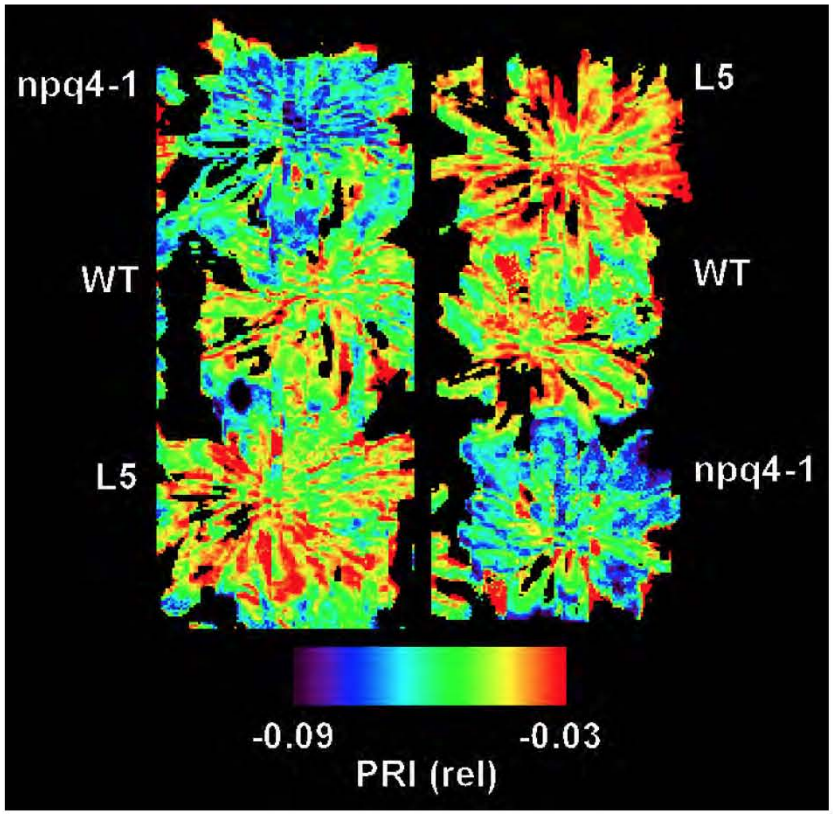
expected development in RGR



rating of alternative nutrient composition



example for photosynthetic efficiency



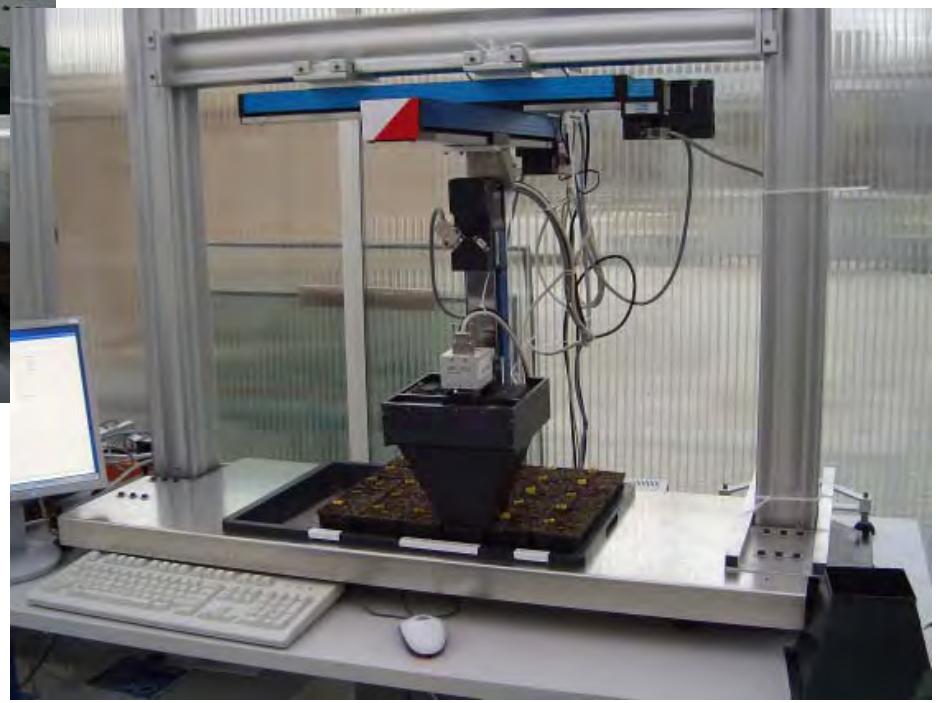
Conclusions

- growth is sensitive for temperature, light, water and nutrients
- passive growth monitoring
- active growth control

- RGR development as growers decision support system

- Photosynthesis – an additional parameter

JPPC – place of growth and analysis



shelf operating system to connect both functions

Acknowledgments

Schurr, Ulrich	Head of the Department
Walter, Achim	Head of the growth & metabolism group
Scharr, Hanno	Head of the programming & algorithms group
Nagel, Kerstin	Scientist

Recent publications:

Chavarria-Krauser, A.; Nagel, K. A.; Palme, K.*; Schurr, U.; Walter, A.; Scharr, H.
'Spatio-temporal quantification of differential growth processes in root growth zones based on a novel combination of image sequence processing and refined concepts describing curvature production'
New Phytologist 177 (2008) 3, 811 – 821

Biskup, B.; Scharr, H.; Schurr, U.; Rascher, U.
'A stereo imaging system for measuring structural parameters of plant canopies'
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Walter, A.; Scharr, H.; Gilmer, F.; Zierer, R.*; Nagel, K. A.; Ernst, M.; Wiese, A.; Virnich, O.; Christ, M. M.; Uhlig, B.; Jünger, S.; Schurr, U.
'Dynamics of seedling growth acclimation towards altered light conditions can be quantified via GROWSCREEN: a setup and procedure designed for rapid optical phenotyping of different plant species '
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Wiese, A.; Christ, M. M.; Virnich, O.; Schurr, U.; Walter, A.
'Spatio-temporal leaf growth patterns of Arabidopsis thaliana and evidence for sugar control of the diel leaf growth cycle'
New Phytologist 174 (2007), 752 – 761

q.v.: http://www.fz-juelich.de/icg/icg-3/Aktuelles/Publikationen