Photon
Systems
Instruments

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Photon
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Professional Instruments
for Plant Science, Biotechnology
and Agriculture

Imaging Sensors

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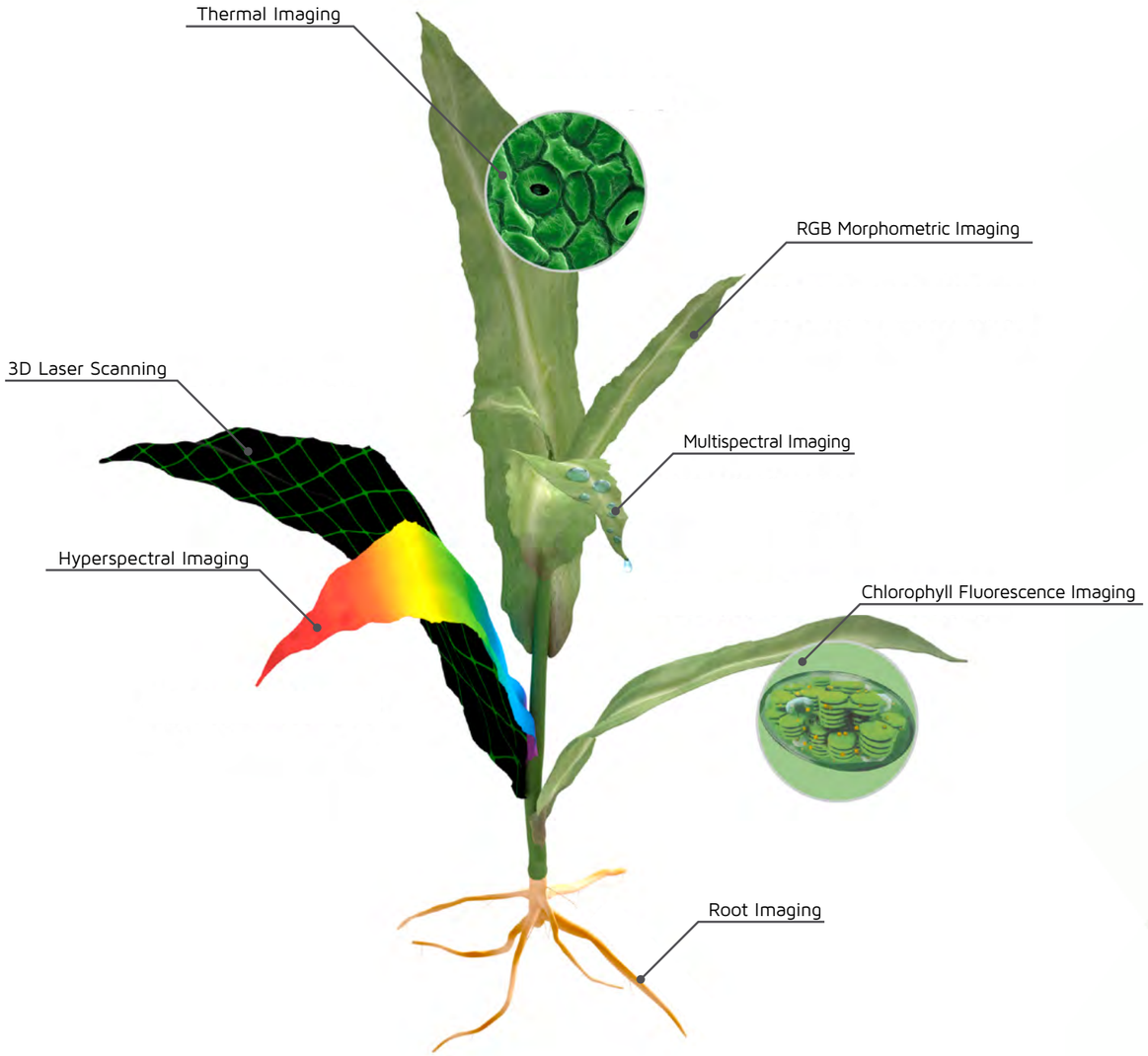
Imaging Sensors

PlantScreen™ Imaging Sensors are complete integrated solutions for non-invasive analysis of plant-specific patterns of light absorption, emission and reflection. The sensors are used for high-throughput automated plant phenotyping and encompass a broad spectral range.

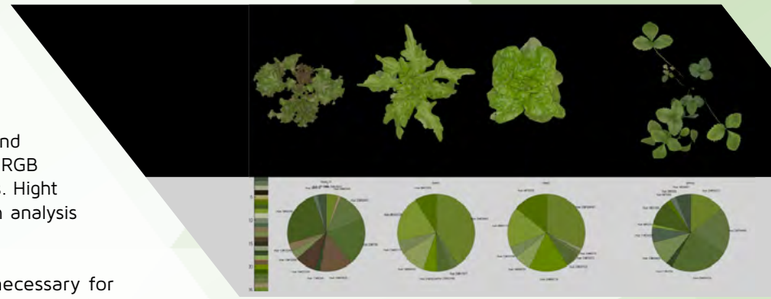
The visible range is monitored by high resolution RGB cameras for structural and colour analysis; hyperspectral cameras monitor plant reflective indices in the visible, near-infrared and short wavelength infra-red ranges, whereas thermal imaging cameras are optimized for leaf temperature and stomatal conductance analysis.

PSI also has a unique range of FluorCam imagers for monitoring kinetic chlorophyll fluorescence for analysis of plant photosynthetic performance. Sensor images can be projected for 3D imaging.



RGB Morphometric Imaging

Wide range number of features linked to plant growth and development can be extracted from digital color RGB Imaging or 3D scanning technology when connected to the automatic software analysis.



A wide range of features linked to plant growth and development can be extracted from digital colour RGB Imaging coupled with automated software analysis. Hight resolution RGB images are acquired for in-depth analysis of plant morphology, geometry and colour.

The homogeneous white LED illumination is necessary for accurate colour representation and allows unique evaluation of plant fitness and discoloration. Industrial high-performance cameras are mounted on a robotic arm together with a light source and are available for the inclusion of novel 3D scanning technology for the high precision morphometric reconstruction of plants.

Key features

- Parameters of static and dynamic analysis
- Plant architecture and morphology
- Plant growth dynamics
- Colour segmentation for plant fitness evaluation
- Developmental processes and stress response analysis
- Top and side view up to 300 cm plant height
- Side view imaging at multiple angles in range 0–360° allows 3D reconstruction from multiple projections
- Line scanning side view mode for large plants or limited space optional
- Homogeneous LED light source

Chlorophyll Fluorescence Imaging

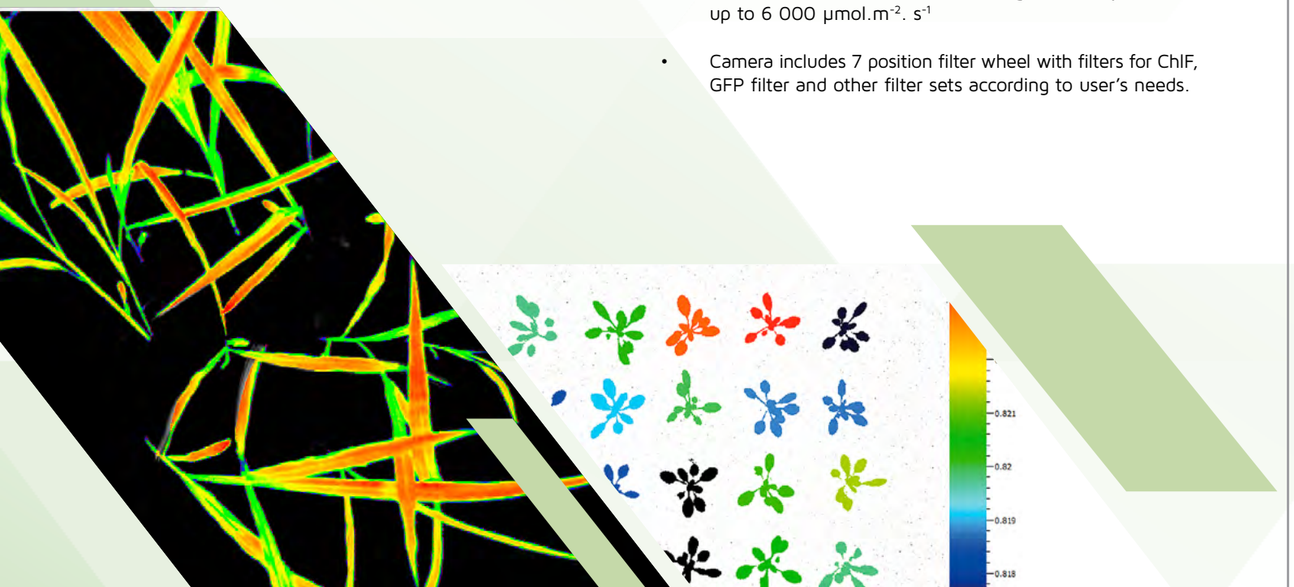
Kinetic Chlorophyll Fluorescence Imaging

Kinetic Chlorophyll Fluorescence Imaging is a very effective non-destructive technique used for rapid measurement of photosystem II (PSII) activity. The advantage of chlorophyll fluorescence over other methods for monitoring plant development and stress is that changes in chlorophyll kinetic parameters often occur well before visible changes are apparent.

Chlorophyll fluorescence is used as a rapid indicator of photosynthetic performance of plants at different developmental stages and/or in response to changing environments. Light curve analysis, quenching analysis, and other parameters are imaged to 2-dimensional maps and used to investigate genetic heterogeneity due to infection, senescence, abiotic stress, or mutation.

Key features

- Non-invasive measurement of photosystems II
- Rapid characterisation of photosynthetic processes within leaves or whole plants
- Sensitive indicator of plant photosynthetic performance at different developmental stages and in response to environment
- Pulse-modulated short duration flashes for accurate measurement of minimal fluorescence (F_0 value) determination
- Two types of actinic lights for light-adapted and quenching analysis
- Saturating light pulse for maximal fluorescence Fm value determination with maximal light intensity up to 6 000 µmol.m^{-2}. s^{-1}
- Camera includes 7 position filter wheel with filters for ChlF, GFP filter and other filter sets according to user's needs.



Multispectral Imaging

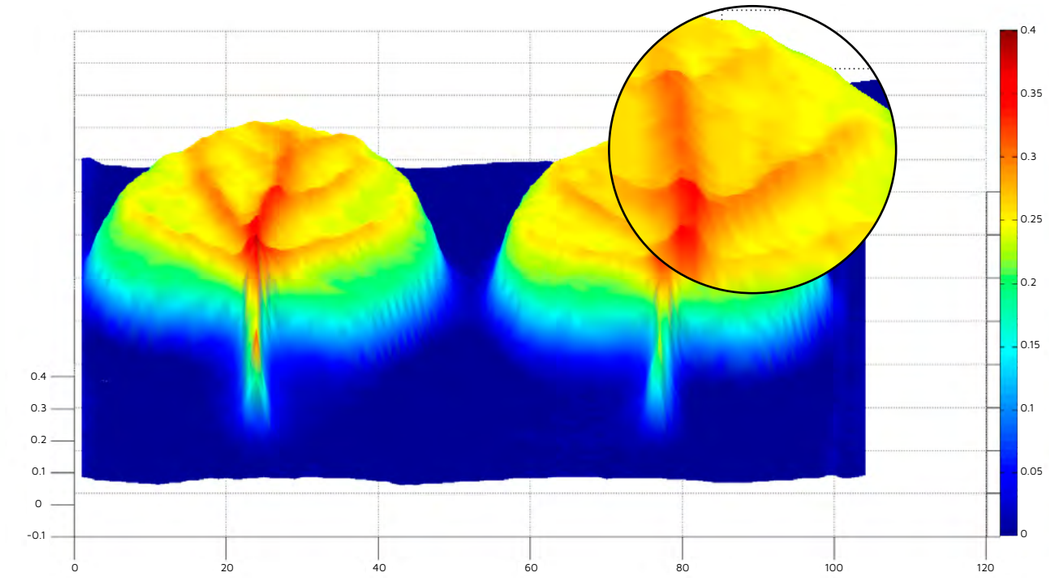
MultiSpectral Imaging

captures data within narrowly-defined wavelength ranges to monitor the water status and biochemical status of plant tissues. For example, PSI has developed an NIR camera with high sensitivity and resolution, and with a special light source, to detect specific NIR water absorbance bands.

The NIR imaging station consists of a camera with an InGaAs sensor to detect light in the near-infrared waveband (900 –1700 nm,). It also has an ultra-homogenous LED light source with two central wavelengths – 940 and 1450 nm.

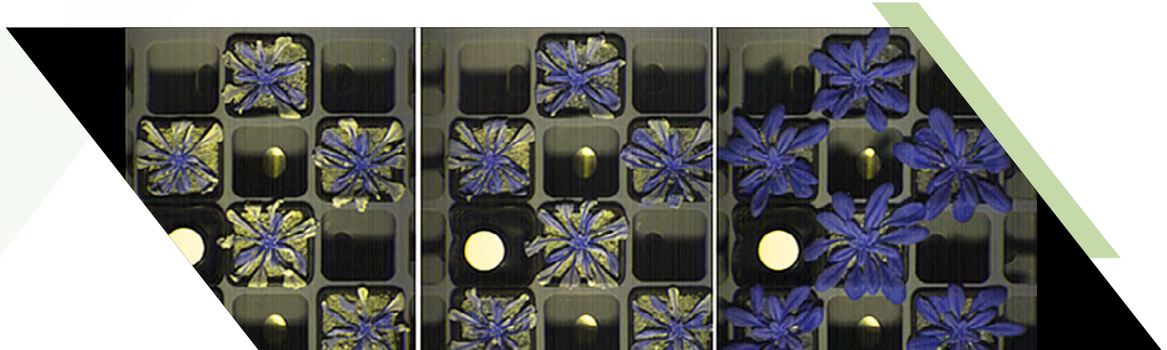
Monitoring the water absorbance peak at 1450 nm, as well as the reference wavelength, eliminates effects of surrounding light and shadow.

Quantification of plant water status is supported with watering and weighting data to assess water use efficiency and response to drought stress This design allows estimation of water content throughout short-term and long-term experimental protocols.

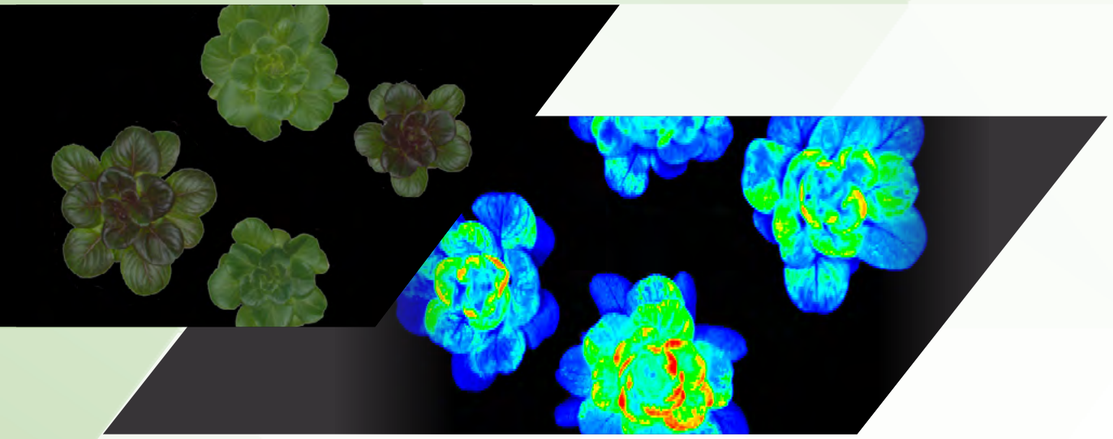


Key features

- Study of relative water content in plants and plant tissues
- Spectral range covers wavelength from 900 to 1,700 nm
- Homogenous illumination source
- Top view configuration
- Automatic calibration steps with reference object
- Programmable measuring protocols
- Automatic analysis of defined parameters



Hyperspectral Imaging



Hyperspectral Imaging technology

provides 3-dimensional hyperspectral data sets of plants on a pixel by pixel basis in the spectral range from 350 to 2,200 nm. Using a hyperspectral camera with image analysis software, plant reflective indices can be visualized across the entire surface of the imaged samples.

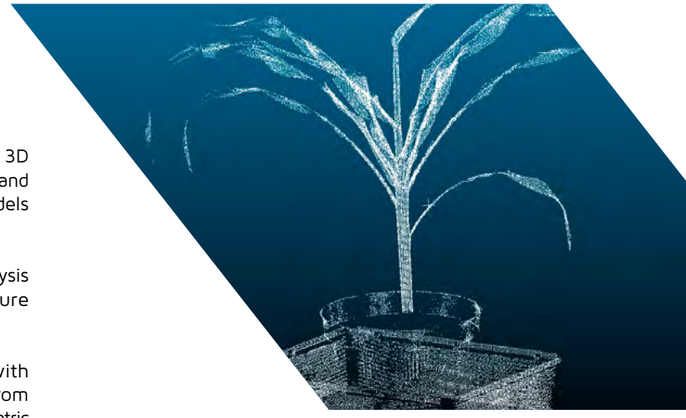
These indices may be correlated with numerous physiological conditions, as well as with the biochemical status of the plant or leaf with respect to pigment composition, nitrogen content, water status or cell structure.

Two versions of hyperspectral cameras are available, VNIR - from UVA to near-infrared wavelengths and SWIR - sensitive in short-wavelength infra-red region can be combined in one hyperspectral module to acquire spectral profiles from 350-2,200 nm.

Key features

- Pixel-by–pixel continuous spectral profile
- Extended spectral range covers wavelength from 350 to 2,200 nm
- Imaging of different vegetative indices
- Study of pigment composition
- Seed quality analysis
- Broad-band light source specifically design for plat measurement
- Top and side view configuration possible
- Automatic calibration steps with reference object
- Programmable measuring protocols
- Automatic analysis of defined parameters

3D Laser Scanning



The PlantScreen 3D Laser Scanner

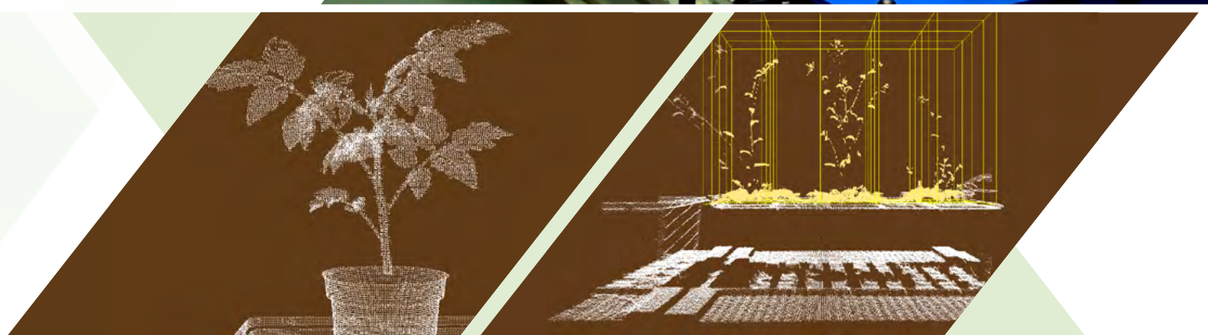
is designed to acquire detailed point-cloud data for precise 3D reconstruction. With the use of multiple angle side scanning and top scan, PlantScreenTM software creates precise 3D models of individual plants or canopy profiles.

Based on a calculated mesh model, automated data analysis provides computation of multiple parameters to measure morphological and architectural features of plants.

The depth information from 3D imaging is combined with information acquired from other sensors to project data from chlorophyll fluorescence measurements, or from RGB morphometric analysis, to the 3D model. Systems are customised according to the client's needs.

Key features

- 3D reconstruction of single plant architecture
- Canopy structure profiles for various species for accurate segmentation
- Number of precise morphological parameters automatically calculated
- Projection of data from other sensors to 3D surface model
- Raw data in 3D point-clouds
- Meshed models automatically analysed
- Resolution better than 1mm in X,Y and Z direction
- Top view scanning to determine canopy height and density
- Side view scanning distance is user defined



Root Imaging

Root imaging

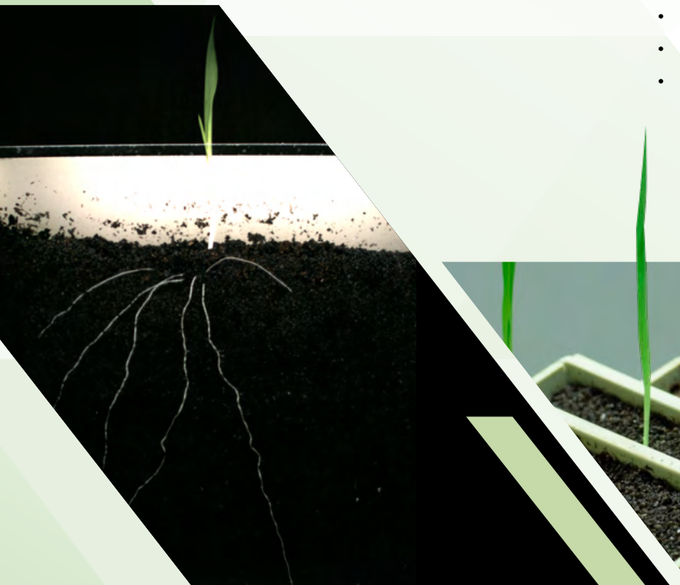
is used to characterize root system architecture. High resolution digital colour images are used for visualization and morphometric analysis of the entire visible root system for detailed root phenotyping related to plant function and yield.

PSI's modular root imaging system consists of a number of rhizotrons that are imaged by a high-resolution monochromatic camera while a homogenous LED light source illuminates the root through the transparent side of the rhizotron box.

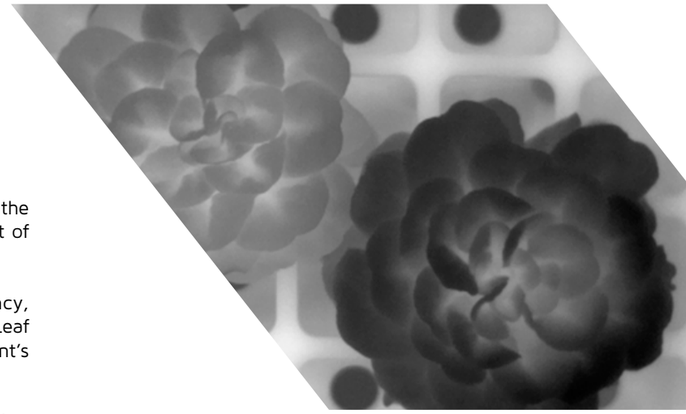
High resolution images allow visualization and morphometric analysis of the visible root system, with automated measurement of various parameters related to root dimension and morphology.

Key features

- Non-invasive image acquisition
- Research of root morphology
- Study of root structure respond to changes in environmental conditions
- Identification of genetic variation
- Specific light illumination source
- Modular angle positioning
- Programmable measuring protocols
- Automatic data analysis



Thermal Imaging



Thermal imaging cameras

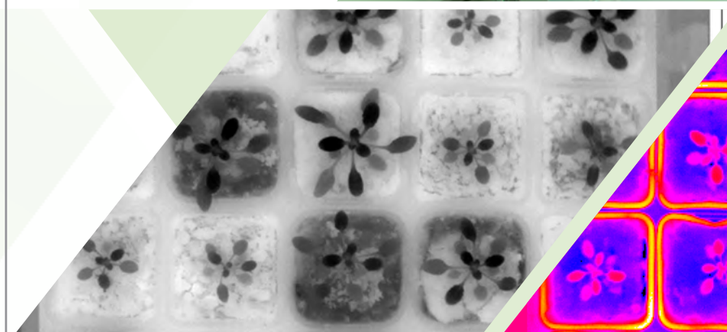
capture information in the long-wavelength infrared part of the spectrum and can be used for non-invasive measurement of leaf and plant temperature.

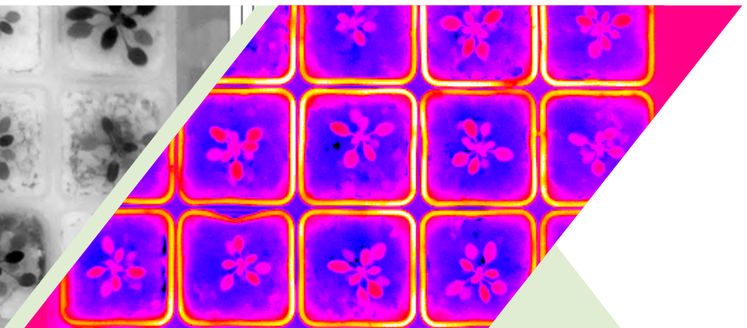
Plant temperature is an indicator of water-use efficiency, which relates to stomatal conductance and transpiration. Leaf temperature assessment is important for assessing a plant's responses to heat load and water deprivation.

Regulation of stomatal aperture to balance the opposing requirements of drought avoidance and self-cooling is critical to the survival of crops under extreme conditions.

Key features

- of plant temperature
- Monitoring stomatal conductance of different plant species
- Early detection of water deficits
- Selection of stomatal or hormonal mutants
- Temporal measurement of infrared radiation emitted by all objects
- High resolution images 1024 x 768 px
- Excellent temperature sensitivity up 20mK
- Highly homogenous LED light panel for active thermal image acquisition
- Top and side view configuration possible
- Programmable measuring protocols
- Automatic data analysis





Research Center

The mission of the PSI Plant Phenotyping Research Center is to provide state-of-art infrastructure for plant cultivation and automated high-throughput phenotyping of a wide range of phenotypic plant traits among various plant species under precisely controlled environmental conditions.

We offer access to cutting-edge instruments and provide professional support by highly-skilled technical and scientific personnel.

All the facilities of the PSI Plant Phenotyping Research Center are available for use by visiting scientists and on a fee-for-service basis for a wide range of phenotyping and plant cultivation experiments.

Realize your ideas

- Perform your own research supported by the PSI scientific team
- Choose a complete phenotyping service performed by the PSI researchers
- Skill development for students - diploma and Ph.D. positions are open

Experience our research facilities

- Automated Plant Phenotyping Systems
- High-End LED based plant
- Modern laboratory (molecular biology, analytics, microbiology)
- Newest PSI instrumentation and technology growth facilities

Previous and current scientific projects

OAK RIDGE National Laboratory

ITALPOLLINA HELLO NATURE!

C. R. HANÁ

University of Zurich[UZH]

CEITEC Central European Institute of Technology BRNO | CZECH REPUBLIC

universitätbonn

CzechGlobe

Mendel University in Brno

APPF Australian Plant Phenomics Facility

KAUST King Abdullah University of Science and Technology