Qubit PHENOMICS

ADVANCING THE SCIENCE OF PLANT PHENOTYPING AND ENVIRONMENTAL CONTROL

www.qubitphenomics.com

Qubit PHENOMICS

AT QUBIT PHENOMICS WE ARE NOT INTERESTED IN A QUICK SALE OF OFF-THE-SHELF EQUIPMENT. THE NATURE OF RESEARCH IS THAT EVERY PROJECT IS UNIQUE, AND WE TREAT EACH CLIENT AS HAVING DISTINCT REQUIREMENTS. THAT'S WHY WE CONSULT WITH YOU EXTENSIVELY TO ENSURE THAT OUR TECHNOLOGY IS CONFIGURED TO MEET YOUR NEEDS PRECISELY. EVEN IF YOU DON'T ASK, WE'LL PROVIDE THE ANSWERS:

- Will the system do exactly what I need it to do?
- What if my requirements change? Can I alter components?
- Is it adaptable to deal with different species?
- How current is the technology?
- Who am I dealing with, sales people or scientists?
- Will support be maintained after the sale?

Asking the right questions is critical when making decisions about the acquisition of expensive equipment essential to the long term success of your research. And let's face it, plant phenotyping equipment is not simple and it can be expensive. At Qubit Phenomics we expect you to be looking for answers.

OUR TEAM OF OVER 90 PERSONNEL IN NORTH AMERICA AND EUROPE INCLUDES NUMEROUS PHD LEVEL PLANT SCIENTISTS PUBLISHED IN TOP-RANKED JOURNALS. CONTACT US FOR A CONSULATION WITHOUT OBLIGATION. OR BETTER STILL, VISIT OUR NEW PLANT PHENOTYPING CENTER WHERE WE WILL DEMONSTRATE OUR EQUIPMENT AND CONDUCT WHATEVER PROOF OF CONCEPT EXPERIMENTS YOU REQUIRE. THE CENTER IS ALSO AVAILABLE FOR FEE-FOR-SERVICE PHENOTYPING.

PLANT PHENOTYPING WITH PLANT SCREEN

FROM ARABIDOPSIS TO RICE TO MAIZE

Whatever your species of interest, we can design a PlantScreen phenotyping system to fulfill your requirements. Whether it be for the field, the greenhouse, laboratory or the growth room, our plant scientists, engineers and programmers will work with you to ensure that the PlantScreen design meets your immediate requirements, and is configured to provide flexibility as your research evolves.

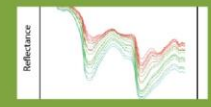
Our conveyor systems deliver plants to imaging stations. Our robotic arm (XYZ) systems bring the imaging stations to the plant. Consult with us to determine which system best meets your needs. We also design and build intelligent greenhouses and growth rooms to house our phenotyping systems, or we can integrate with your existing facilities. Our field-based PlantScreens can be built to scan over a fixed area, or be driven to different locations within the field.

STRUCTURAL ANALYSIS

PlantScreen offers a range of options for morphometric and color analysis, from a 3-camera system with rotating stage to a high resolution scanning system for true 3D reproduction.

Our unique software features include tracking the development and movement of individual leaves.

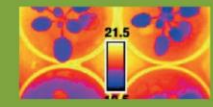
HYPERSPECTRAL IMAGING



Water status, pigment concentrations, N-status and other chemicals of importance may be monitored using our hardware and software to measure the reflectance spectrum of the sample pixel by pixel.

Our hyperpsectral cameras have extremely high resolution to monitor the refective indices of most importance to you.

THERMAL IMAGING

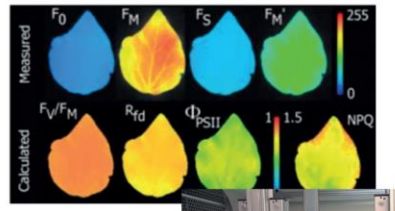


Our systems are designed to eliminate errors that may confound the measurement of thermal heterogeneity in your samples. We measure what is happening in the leaf, not the environment.

Using high resolution FLIR cameras, effects of stomatal movement on leaf temperature are clearly visible.

CHLOROPHYLL FLUORESCENCE

PlantScreen is the ONLY phenotyping system that allows for sophisticated quenching analyses using PAM imaging technology. With any other system you cannot measure the critical parameters that provide the swiftest and most accurate indicators for the onset and progression of abiotic and biotic stresses. Measuring Fv/Fm alone may result in poor time resolution of stress kinetics. Plantscreen may be fitted with a rapid camera for detailed OJIP analysis at thousands of frames per second. Slow cameras are inappropriate for such analysis).



THE PLANT SCREEN FAMILY OF PHENOTYPING SYSTEMS

PLANT SCREEN XYZ

The PlantScreen XYZ is a sensor-to-plant system that may be installed in greenhouses or growth rooms. The sensor array may include RGB, 3D Scanning, Chlorophyll Fluorescence, Thermal, NIR and Hyperspectral imaging. The standard imaging area is 80 x 80 cm, for plants of variable height, though other configurations are possible. Petri plates and multi-well plates may also be screened. Qubit Phenomics can provide growth room and greenhouse facilities designed to optimise phenomic screening with the XYZ system, and with our other phenotyping platforms.

PLANT SCREEN MODULAR

The modular Plantscreen is designed for larger plants such as maize and wheat. It integrates with a conveyor to transport plants to modular imaging stations (RGB, 3D Scanning, Chlorophyll Fluorescence, Thermal, NIR and Hyperspectral). An adaptation tunnel pre-equilibrates plants before imaging. Automated watering and weighing is optional. Images may be acquired from the top, side or both. The system may be accommodated in a greenhouse or growth room. Qubit Phenomics builds greenhouses and growth rooms designed to optimise conditions for screening.

PLANT SCREEN SC

Self-contained (SC) PlantScreens are individual cabinets for RGB, 3D Scanning, Chlorophyll Fluorescence, Thermal, NIR and Hyperspectral imaging. They are loaded manually and may be designed for smaller plants and trays (imaging area 35 x 35 cm) or for larger plants and trays (imaging area 80 x 80 cm). The SC systems are attractive to users who wish to build a comprehensive phenotyping system incrementally, since the individual cabinets may be retro-fitted with robotic control, and linked by a conveyor, as the user's research evolves.

PLANT SCREEN FIELD

Qubit Phenomics designs customized phenotyping systems for use in the field. These include large scale, movable gantry systems that may be used to screen an extensive crop area, and smaller scale Transect or Rover systems that may be moved to smaller sites within the field. All systems may include RGB, 3D Scanning, Chlorophyll Fluorescence, Thermal, NIR and Hyperspectral imaging. Systems may be designed to screen most crop species from low-lying plants to mature maize. Fixed gantry systems are also available for use with rain-out shelters etc.

PLANT SCREEN COMPACT

The PlantScreen compact system is designed for smaller plants such as Arabidopsis and Brachypodium. The cabinet may be designed to accommodate 8, 12 or 16 trays (30 x 36 cm) or an equivalent number of pots. Banks of overhead LEDs provide light equilibration. An internal conveyor transports plants in trays or pots to imaging stations (RGB, 3D Scanning, Chlorophyll Fluorescence, Thermal, NIR and Hyperspectral). Automated watering and weighing is included. The system may be attached to an external conveyor for additional capacity.

PLANT SCREEN SC

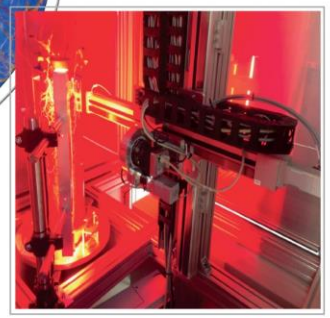
PLANT SCREEN FIELD

PLANT SCREEN COMPACT

ROOT IMAGING WITH RHIZOCAB

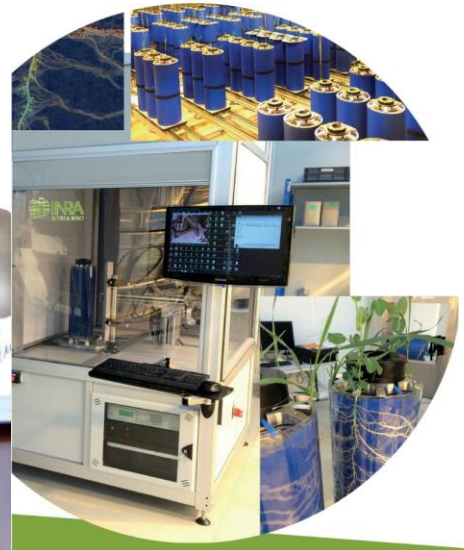
Section of a nodulated root of *Pisum sativum* imaged in the Rhizocab

Developed at INRA (Dijon), the Rhizocab root imaging system is a unique, non-invasive and innovative device that allows visualization of 100% of root biomass while maintaining root function, morphology and root-microbe interactions. The Rhizocab may be integrated with Qubit Phenomic's PlantScreen modular phenotyping system to provide a comprehensive picture of root and shoot characteristics for a broad range of monocots and dicots.



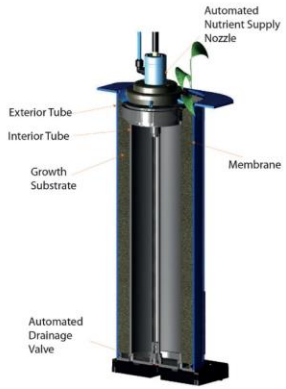
Rhizotubes may be delivered by conveyor, or loaded automatically, into the Rhizocab imaging cabinet. The Rhizotube is rotated to obtain a complete scan of the root system using a side mounted 6 Megapixel camera. The Rhizotube is illuminated in sequence with red, blue and green light via an LED light source, to provide ultra high definition colour images. The camera may be moved automatically on a linear motor to zoom in on a specific area of the root to provide images at even higher definition.

The Rhizotube is a cylindrical rhizotron that consists of two concentric tubes. Plants are grown between the outer tube and a plastic membrane, 18 um thick, that allows passage of water, nutrients and microorganisms to the root, but does not allow the root to penetrate to the growth substrate between the mesh and the interior tube. Therefore, the entire root system is visible for imaging. A light shield surrounds the rhizotube during plant growth to prevent the establishment of algae.

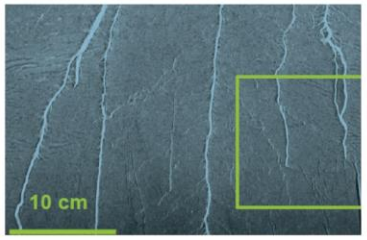


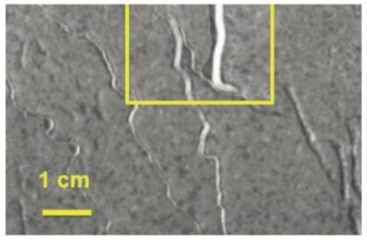
Plants grown in Rhizotubes have root systems that are similar in structure, respond to changes in environmental conditions, and show similar plant microbe-interactions to plants grown in pots. Equivalence has been shown in numerous species. For more on this see:

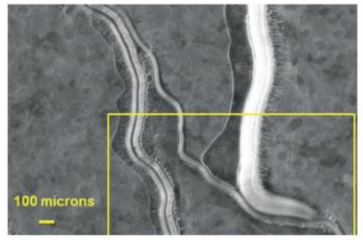
RhizoTubes as a new tool for high throughput imaging of plant root development and architecture: test, comparison with pot grown plants and validation. Jeudy, C. et al. 2016 Plant Methods 12:31

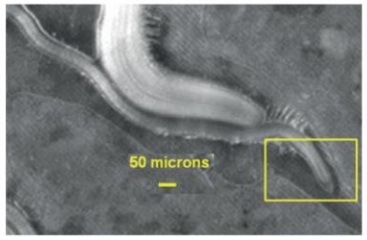


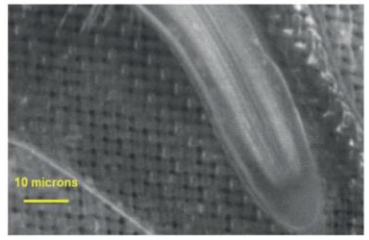
THE RHIZOCAB ALLOWS FOR EXTREMELY HIGH IMAGE RESOLUTION SHOWN BY THE ZOOM SEQUENCE BELOW FOR MAIZE ROOTS. SUCH RESOLUTION ALLOWS FOR DETAILED MORPHOMETRIC ANALYSIS OF THE THINNEST ROOTS AND THE VISUALIZATION OF PLANT-MICROBE INTERACTIONS. RESOLUTION RANGES FROM 42UM PER PIXEL AT 600 DPI TO 7UM PER PIXEL AT 3600 DPI.





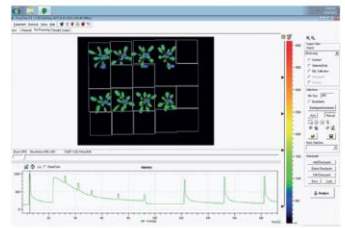




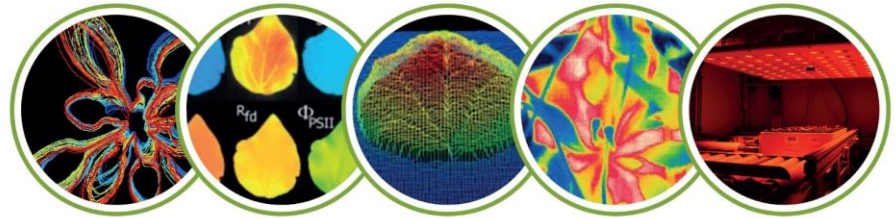


SOFTWARE AND SERVICE

Qubit Phenomic's phenotyping platforms are supplied with all the software and computer equipment required to operate the systems, collect and store data, and do whatever image analyses are required. We provide protocols for the most commonly used screening procedures, but the user may create and save their own protocols easily. Our team of programmers is always available to advise and assist in every aspect of operation and analysis.



Each imaging station is controlled by independent protocol editors. Masks may be applied to select and overlay images. Data are displayed as images, graphically and numerically. Numerous image manipualtion tools are available. Data base software may be integrated with existing databases.



FEE FOR SERVICE PHENOTYPING.

We now offer comprehensive phenotyping services at the new state-of-the-art PSI Phenotyping Center in the Czech Republic. Plant-to-sensor and sensor-to-plant systems are available in our greenhouses and growth chambers. Our plant scientists are available for plant cultivation, protocol development, conducting short and long term experiments and data analyses, all in a secure environment.

....AND AN INVITATION

We are proud of our PlantScreen systems, and would like to show them in action. Please consider a visit to our Phenotyping Center and our manufacturing facility. We'd be pleased to demonstrate our equipment and prove our plant science expertise.

Qubit PHENOMICS

info@qubitphenomics.com
Toll Free: 888-262-2219 (N.A.) or
613-384-1977 (International)
1573 John Counter Blvd. Kingston
Ontario, Canada K7M 3L5

IF YOU WANT THE BEST IN PLANT PHENOTYPING EQUIPMENT, DO THE RESEARCH. AFTER ALL, IT'S YOUR RESEARCH AT STAKE