



Australia's leading plant phenotyping facility,
providing open access to world-class
technology and expertise to accelerate
the development of new and improved crops,
and more sustainable agricultural practice.



Welcome

Accelerate your next plant research project by partnering with the APPF.

Open access to end-to-end plant phenotyping solutions is available across our three strategically located, complementary nodes. We support researchers and agribusinesses tackling the grand challenges of food security and sustainable food production.

Find out more about how we can help accelerate your research.

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Discover more

ACCELERATING DISCOVERY

By measuring how plant performance is influenced by genetic makeup, the growing environment and management practice, phenomics can help tackle the most pressing agricultural challenges.

Phenomics data captured at the APPF enables the more rapid discovery of molecular markers and faster germplasm development, aimed at improving crop yields and resilience of crops to biotic and abiotic stresses such as drought, salinity and pathogen attack.

Advanced APPF technology is supporting the emerging AgTech and Food Innovation arenas

ADVANCING RESEARCH THROUGH THE APPF

The APPF facilitates world-class research and innovation in plant phenomics by:

- providing public and private researchers efficient and affordable open access to state-of-the-art imaging technologies, robotics, sensor networks, data analysis and visualisation tools for plant science and agriculture,
- developing new technologies and capabilities to facilitate innovation in plant science,
- contributing to multidisciplinary and cross-institutional collaborations that address critical challenges in food production,
- promoting scientific partnerships and collaborations between public and private researchers,
- up-skilling scientists and technicians in the use of advanced phenotyping technologies,
- expanding national and international research networks, and
- sustaining Australia's intellectual capability and capacity in plant phenomics.

Changing weather patterns and increasing soil constraints are undermining crop yields worldwide. A transformational advance in agricultural productivity is needed to ensure farmers can grow enough food to meet future demands in a sustainable way.



Partner with us

The technologies and expertise developed by the APPF are world-leading and internationally recognised, making Australia an attractive partner for international collaboration.

As Australia's leading plant phenomics facility our depth and breadth of expertise is unmatched.

WHAT WE OFFER

High-throughput phenotyping

We offer a range of capabilities for high-throughput phenotyping, from model plants to crops. Using automation and the latest camera and sensor technologies, researchers can monitor plant growth and performance at high-throughput to screen large populations of plants for novel genes that improve plant health and increase yield under adverse conditions with less inputs.

Deep phenotyping

Understanding plant physiology and responses to different stresses are essential to identify novel traits that improve stress tolerance. Our cutting-edge sensor technology, combined with the latest developments in image and data analytics, help researchers tease apart the individual components of plant development and stress response.

Field phenotyping

Using both aerial and ground-based phenotyping platforms, APPF technology helps agricultural researchers test crop varieties in the field. Cameras and LiDAR technology are used to identify those lines with promising characteristics for agriculture in the coming decades. Combined with data management and analytical tools, our technology helps researchers make informed decisions about the performance of their plant material in the field.

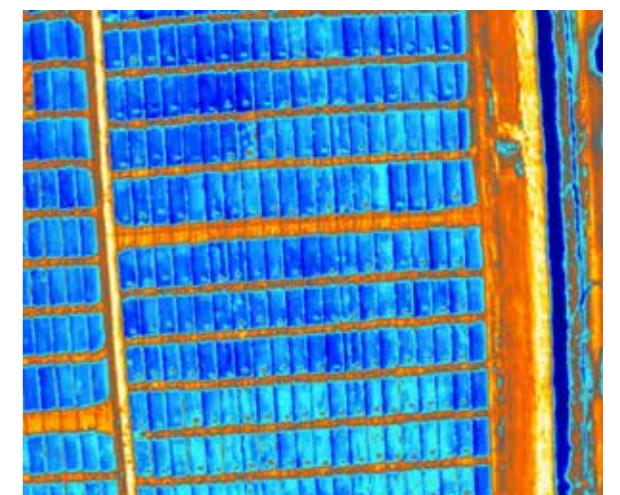
Data management, analysis and visualisation

We offer the full scope of data management, from statistically designed layouts and best practice protocols at the outset through to innovative data management and visualisation tools on completion – all to maximise your results.

- Consultation
- Analysis
- Bioinformatics and biometry
- Data management
- Education and training

Support for long distance studies

A “research hotel” approach provides opportunities for more distantly placed researchers to utilise our facilities, either in person or remotely, through engagement of APPF staff (from applying for quarantine permits through to planting and management of research projects), while mobile equipment is available for field deployment anywhere in Australia.



The open access, world-class capabilities of the APPF have become an essential resource for plant scientists all over the world.

DEDICATED SUPPORT

As one of the first plant phenotyping facilities worldwide, the APPF has been a pioneer in developing and providing plant phenotyping technologies since 2010. Using a multi-disciplinary approach, we have designed and commissioned complex phenotyping platforms for use in controlled environments and in the field; software to facilitate data management, analysis and visualisation; and developed extensive technical experience, to undertake large-scale phenomics studies.

By sharing our resources and knowledge, the APPF enables plant scientists to investigate plant performance at a scale and level of detail not previously possible, accelerating research outcomes to lead to new discoveries, and contributing to Australia's reputation as a world-class leader in innovative agricultural science.

Our team of dedicated, multidisciplinary experts offer complementary skill sets and qualifications in the fields of:

- Plant science and biotechnology
- Mechatronic and agricultural engineering
- Bioinformatics and computational science
- Data management technologies
- Horticulture
- Business development and management

They deliver project design solutions tailored to the specific needs of our facility users, and ensure quality controls are in place and research standards are maintained throughout each project.



STRATEGIC LOCATIONS

The APPF is a complementary network of national research infrastructure platforms, strategically located across three renowned research organisations to benefit from a world-class concentration of expertise in plant biology, spanning from gene discovery to the farm gate. Each node has unique, specialised facilities that interlink to provide a seamless service to users.

- The Plant Accelerator® (TPA) at the University of Adelaide's Waite Campus, Adelaide
- The High Resolution Plant Phenomics Centre (HRPPC) at CSIRO Agriculture and Food, Canberra
- Plant Phenomics Group at the Australian National University, Canberra

We are funded by the Australian Government's National Collaborative Research Infrastructure Strategy (NCRIS) to provide Australian scientists with a competitive advantage, drive cross-disciplinary collaboration and contribute to bridging public research and agricultural business.

ACCESSING OUR CAPABILITIES

Access is affordable and easy. Please use the contact details at the end of this booklet or on our website at www.plantphenomics.org.au to speak with our team and arrange a consultation and quote on your research project.

Who should use our facility?

- Crop scientists and breeders
- Plant geneticists
- Biotechnologists and biochemists
- Soil scientists
- Australian and international researchers
- Academic and commercial researchers



Humanity's greatest challenge is to increase food production by 70% for the more than ten billion people expected to populate the planet by 2050.

Locations

The APPF is a world-leading facility for innovative plant phenomics research to accelerate the development of new and improved crops, and more sustainable agricultural practice.

THE PLANT ACCELERATOR® AT THE UNIVERSITY OF ADELAIDE

The Plant Accelerator® (TPA) is located at the University of Adelaide's Waite Campus, the lead agent of the APPF. Central to the TPA is the first automated high-throughput phenotyping system in Australia, unique in both scale and open-access policy, the system attracts researchers from around the world. Capabilities at our Adelaide node include:

Controlled environment

- **Smartgreenhouses** - The TPA contains four large greenhouses fitted with conveyor systems and imaging stations (LemnaTec Scanalyzer 3D) for the automated, high-throughput, non-destructive phenotyping of plants. This system has a capacity to phenotype up to 2,400 plants per day. Technology includes RGB, steady-state fluorescence and full-range hyperspectral imaging and programmable watering to weight. Possible applications are diverse with respect to the measured traits and plant species studied.
- **The DroughtSpotter greenhouse** - A specialised, LED lit greenhouse fitted with 168 fully automated gravimetric irrigation units.
- **The new Drought and Heat Phenotyping Platform** - the first of its kind in Australia - comprising two controlled environment rooms (CERs) each fitted with a 96-pot DroughtSpotter system. The twin setting enables researchers to undertake experiments under two different climate regimes in parallel, with variables including light quality, humidity, temperature and water stress.
- 34 state-of-the-art greenhouses all certified for GMO, with a number also certified for quarantine work.
- 13 controlled environment growth rooms and chambers including quarantine and GMO certified rooms.

Field research

UAV based field phenotyping services are offered in partnership with the Unmanned Research Aircraft Facility (URAF) at the University of Adelaide.

Hyperspectral imaging is offered via a ground-based phenotyping platform, from the air using UAVs in collaboration with URAF, and via manned aircraft in collaboration with Airborne Research Australia (ARA).

Data

TPA provides a suite of analytical tools and tailored support for phenotyping projects in either controlled environments or in the field. Users can visualise, query and filter their data and corresponding images from Smartgreenhouse experiments through Zegami. Our statisticians and biometricians provide experimental design and data analysis, including spatial adjustment and growth analyses.

Expertise at The Plant Accelerator®

TPA is a true service facility, with the team focused on delivering high quality customer support, from initial consultation through to analysis of results.

TPA researchers, with a background in plant physiology and biometry, will provide advice on experimental design and optimal use of technology, backed by a cross-disciplinary team including experts in horticulture, data analysis, mechatronics, software engineering, and statistics.

TPA is certified to undertake quarantine and GMO research and the team can assist with the necessary applications.



HIGH RESOLUTION PLANT PHENOMICS CENTRE AT THE CSIRO

The APPF's CSIRO node, the High Resolution Plant Phenomics Centre (HRPPC), combines expertise in plant science and engineering to develop and build:

- cutting-edge phenotyping technologies to support medium-throughput phenotyping of model and potted plants in controlled environments, and
- novel plant phenotyping solutions to support research experiments at large scale and high-throughput in the field. Field applications include ground and aerial platforms with a capacity of over 250,000 plots p.a. and the first high-resolution plant phenotyping capability for glasshouse/field environments – the Cropatron.

The strong mechatronics and software engineering capability at the HRPPC is driving R&D into cutting-edge phenomics technologies that benefit a range of new industries, e.g. pharmaceuticals. The centre focuses on supporting and refining existing platforms, for example, integrating advanced sensor technologies to measure new traits in new crops and to keep pace with the demand for deeper insight into plant behaviour and function, and innovation to increase capabilities. Our engineers have developed phenoSMART®, a science gateway that provides a national data service for on-demand phenotyping analysis.

Controlled environment

A range of services are available in the controlled environment space, from plant establishment in growth cabinets right through to high resolution imaging of material in our PlantScan, CabScan and TrayScan systems.



Field research

We offer a range of high-throughput field phenotyping services including airborne thermal, multispectral and RGB imaging from our phenoAIR™ system, ground based phenoMobile® Lite LiDAR assessment and ArduCrop canopy temperature measurements.

Data

Our software engineering team offers tailored data analytics solutions for phenotyping experiments. These are delivered through the cloud based phenoSMART® platform as well as data and metadata management through PODD.

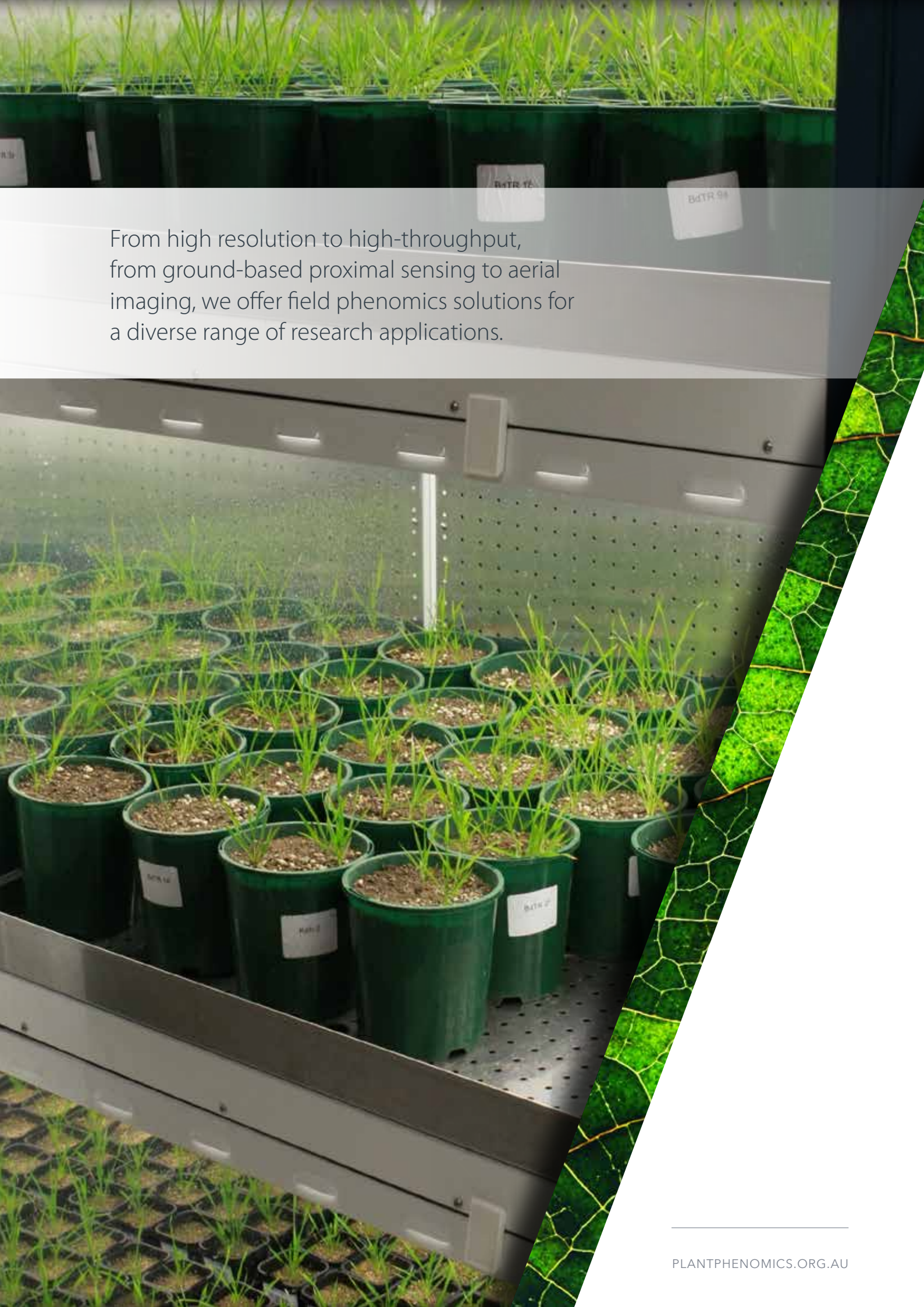
phenoSMART® is a collaborative e-infrastructure platform. This platform allows the user to easily extract information and value from the data collected using phenotyping tools. The architecture of the platform also serves as a base to allow computational tools developed by other research groups across Australia to be made available to others and/or the agribusiness sector.

The PODD system delivers an open source (GNU Affero GPL, v3) and free data management service to capture, manage, secure, annotate, distribute and publish raw and analysed data from phenotyping projects undertaken at the Australian Plant Phenomics Facility. PODD also provides the ability to manage a repository of associated contextual information (metadata) based on standard ontologies (controlled vocabulary) to support data discovery and analysis services.

phenoSMART® and phenoMobile® are registered trademarks of CSIRO in one or more territories in the world.



The APPF team provides tailored support, from experimental design through data management and analytics, to specialised software for data exploration and visualisation.



From high resolution to high-throughput, from ground-based proximal sensing to aerial imaging, we offer field phenomics solutions for a diverse range of research applications.

PLANT PHENOMICS GROUP AT THE AUSTRALIAN NATIONAL UNIVERSITY

The APPF's ANU node is part of the ANU Plant Science Division which is a world leader in plant research. In addition to the APPF, ANU Plant Sciences contains two centres of excellence - CoE Plant Energy Biology (PEB) and CoE Translational Photosynthesis (CoETP) as well as the ANU-CSIRO Centre for Genomics, Metabolomics and Bioinformatics.

Services

Our ANU node provides five essential services:

- On-site phenomics and plant growth services - NextGen growth and phenotyping facilities for Australian and international researchers including greenhouses and growth chambers with time-lapse imaging.
- Genomics and bioinformatics, study design and data analysis support - analysis of phenotypic and genomics data and the opportunity to collaborate with world-class researchers in genomics, photosynthesis and bioinformatics.
- Development and streamlining of cross-scale approaches in monitoring for scaling from lab to field, chamber to crop, and forest.
- Research and development of open source hardware and software pipelines and visualisation tools for enabling lower cost high-throughput phenotyping (HTP) and environmental monitoring.
- Collaborative, cross-disciplinary approach to tackling the grand challenges associated with HTP and environmental monitoring.

The ANU node provides the only quarantine approved growth cabinets in Canberra for research purposes. A range of controlled environments are available, capable of high resolution phenotyping of up to 2,000 small plants in custom and climate-simulated growth environments (LED-based). Quantitative phenotypic screening for *Arabidopsis* and similar sized small plants can be conducted including RGB, hyperspectral and fluorescence imaging.

Our shipping container based Growth Capsule systems support dynamic multispectral LED lighting and high-precision environmental controls for growing wheat and other tall crops in high light environments.

Virtual reality

Virtual and augmented reality are the new frontier in scientific visualisation. The APPF ANU node is a leader in the development of systems for visualising phenomics and environmental sensing data and point clouds in virtual and augmented reality (VR and AR).

EcoVR is a virtual reality tool for recreating any forest or field site as a virtual space, where time-lapse sensor and phenomics data can be overlaid on a 3-dimensional model of the landscape. VR and AR represent immense opportunities for revolutionising phenomics and education, and also for industry collaborations to develop new visualisation platforms for precision agriculture. These tools can deliver actionable information to farmers in situ and can be used by the forestry industry to understand how the landscape, environment and genetics interact to impact forest growth.



NCRIS

The National Collaborative Research Infrastructure Strategy (NCRIS) is a Commonwealth funded initiative to support national research infrastructure.

The program comprises nationally significant assets, facilities and services that support leading edge research and innovation, and is accessible to publicly and privately funded users across Australia and internationally.

In May 2018, the Government released the Research Infrastructure Investment Plan (RIIP), its response to the 2016 National Research Infrastructure Roadmap. The plan confirmed the Government's commitment to invest \$1.9 billion under NCRIS to support national research infrastructure (NRI) and secure Australia's research future.

The objectives of the program are to:

- catalyse and support a national network of research infrastructure projects,
- through the network, support high quality research that will drive greater innovation in the Australian research sector and the economy more broadly, and
- empower Australian researchers to address key national and global challenges, and support collaboration between researchers and other end users, such as industry both nationally and internationally.

World-class research infrastructure to underpin greater innovation in the Australian research sector and the economy more broadly



To best address critical challenges in agriculture, we promote multidisciplinary, cross-institutional scientific collaborations between public and private researchers, to drive success for all.

Contact

From model plant to crop plant, we provide state-of-the-art plant phenotyping technology to study your trait of interest in a controlled environment or in the field.

The Plant Accelerator®
at University of Adelaide, Waite Campus

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The cutting-edge technology at the APPF is backed by our wealth of resources, from data management and visualisation tools, directories for experts and technology, publications and case studies, to our world-class expertise in plant phenotyping - discover more with the APPF.

plantphenomics.org.au



plantphenomics.org.au

The Australian Plant Phenomics Facility has three nodes strategically located at



THE UNIVERSITY
of ADELAIDE



Australian
National
University

We are proudly supported by

NCRIS

National Research
Infrastructure for Australia
An Australian Government Initiative