



# CONNECTIONS

Bioplatforms Australia Quarterly Newsletter | Q1-2011

## PLANT RESEARCH PROPELLED BY HIGH-TECH PHENOMICS FACILITIES

Developing new crop varieties to feed an expanding world population is one of this century's most challenging research imperatives.

Australian scientists are being provided with the capability to take a leading role. Research into innovative high-yielding and disease-resistant crop varieties is driven at two state-of-the-art phenomics facilities in Adelaide and Canberra, collectively known as the Australian Plant Phenomics Facility (APPF).

The APPF, particularly The Plant Accelerator® will make a critical contribution to Bioplatforms Australia's wheat dataset initiative. This program intends to combine existing genomic, proteomic and metabolomic data with new analyses to form a vital resource for the wheat industry. The wheat dataset will directly support the quest to improve wheat varieties for greater crop yields, defence against pathogens and improved grain quality.

## THE PLANT ACCELERATOR®

The Plant Accelerator® offers state-of-the-art plant growth environments and the latest technology in high throughput plant phenotyping.

Digital imaging technologies, high capacity computing and robotics are combined to allow the automated, high throughput, non-destructive measurement of plant growth and function ("phenomics"). This allows the dissection of traits that contribute to, for example, drought and salinity tolerance and this can be carried out for large populations of plants.



Conveyors automatically deliver plants to imaging stations.

The aim is to increase the speed and scale of physiological measurements using controlled growth environments. Over 1km of conveyors can automatically deliver plants to state-of-the-art imaging stations providing a new dimension in plant analysis using infrared and fluorescent based capabilities. The facility reaches a new frontier in genetic studies seeking to elucidate the molecular basis of complex physiological traits. This facility provides increased opportunity to bring a genetic component into physiological studies.

Strategically located at the University of Adelaide's Waite Campus, The Plant Accelerator® provides facility users with access to a critical mass of expertise in plant and soil science including plant biotechnology, cereal breeding, sustainable agriculture, wine and horticulture, and land management.



Plants moving through the bank of digital imaging cameras.

The Plant Accelerator® enables national and international academic and commercial plant scientists to understand and to relate the performance of particular plants to the genetic make-up of those plants which accelerates crop improvement so they are more productive, disease tolerant and can maintain yield on marginal soils.



Plant growth environments are carefully controlled.

## THE HIGH RESOLUTION PLANT PHENOMICS CENTRE

The HRPPC is located in Canberra at CSIRO Plant Industry and the Australian National University.

This Centre focuses on "deep phenotyping" (delving into metabolism



## Lipids play important physiological roles in cells as reflected by the broad range of diseases resulting from the disruption of normal lipid biology

and physiological processes within the plant), and Reverse Phenomics (dissecting traits to discover their mechanistic basis).

Next generation research tools are being developed and applied to probe plant function and performance at medium and high throughput, under growth cabinet conditions and at managed field sites. Recent advances in robotics, imaging and computing are used in applying these technologies and scale them from the single plant to the ecosystem level.

The HRPPC has a broad focus from cereals to dicots and woody perennials at all stages of development offering high throughput technology for the growth and deep phenotyping of small seedlings. The facility boasts the latest 3-D imaging for plant architecture and growth analysis and can delve into plant chemical composition and stress detection. The Centre has also developed a number of new technologies for plant measurement and analysis in the field.

The Phenomobile, a smart golf buggy that measures plant attributes as it is driven over the plot and the Phenonet, a remote smart sensor network based in the field are just two examples.

The Australian Plant Phenomics Facility welcomes Australian and overseas researchers and provides professional consultation in plant phenomics and experimental design together with dedicated bioinformatic support, data management and analysis.

For further information about the facility please visit [www.plantphenomics.org.au](http://www.plantphenomics.org.au)

### ANCESTRY REVEALED

Have you ever wondered where you come from? The Environment Institute, now part of the Bioplatforms Australia consortium, was proud to host a public participation event with the National Geographic's Genographic Project late last year.

More than 300 eager members of the public arrived at Adelaide Central Markets to receive a free DNA kit which was used to identify their deep migratory history going back 60,000 years. These participants were then invited to attend a reveal lecture at the Royal Institution of Australia to hear about their ancient origins from leading researchers in human ancestry.



Celebrity chef Poh Ling Yeow performs a swab test with her seven-year-old nephew Tyler Yeow, to trace her ancestry. Image courtesy of *The Advertiser*, picture by Andrea Laube.

The successful Adelaide experience followed similar programs in New York and Melbourne and included household names such as celebrity chef and artist Poh Ling Yeow and the Adelaide Reds soccer team.

The Genographic Project is a worldwide survey of human genetic diversity and history. Since 2005 over 360,000 people around the world have taken part to create a vast database of human history. Professor Alan Cooper, the Director of the Australian Centre for Ancient DNA (ACAD) is a Principle Investigator with the Genographic Project and is part of the scientific team collaborating with indigenous and traditional groups from around the world to analyse and interpret DNA samples.

As part of this project ACAD has worked with international collaborators to resolve the longstanding issue of the origins of the people who introduced farming to Europe some 8,000 years ago. A detailed genetic study of one of the first farming communities in Europe reveals marked similarities with populations living in the Ancient Near East (modern-day Turkey, Iraq and

other countries) rather than those from Europe. This overturns current thinking, which accepts that the first European farming populations were constructed largely from existing populations of hunter-gatherers, who had either rapidly learned to farm or interbred with the invaders.

Details of the research can be found at <http://tinyurl.com/farm-origin>.

### METABOLOMICS AUSTRALIA GROWS ITS LIPODOMICS SERVICES

Lipids play important physiological roles in cells as reflected by the broad range of diseases such as cancer, diabetes and infectious diseases resulting from the disruption of normal lipid biology.

With recent advances in liquid chromatography mass spectrometry (LCMS), novel analytical approaches are being undertaken to study lipids which has led to the emergence of lipidomics. Lipidomics is the large scale analysis of lipids in biological systems and involves the identification and quantification of cellular lipids and their interacting partners.

At the University of Melbourne node of Metabolomics Australia, complementary targeted and untargeted analytical approaches for lipid analysis are being developed and applied to a wide range of research projects. The targeted approach involves LCMS-based methods to identify and quantify specific classes of lipids and characterise the complex diversity of lipid species within these different lipid classes. In the untargeted approach, a broad profile of the lipids in a sample is built by measuring their accurate masses. To overcome the challenge of interpreting the very large and complex data sets generated by lipid analysis, bioinformatics expertise has been critical in developing advanced methods and pipelines for processing and visualising the data.



Dr. Thusitha Rupasinghe, Ms. Mala Jayamanne and Dr. Dedreia Tull at the University of Melbourne MA node developing lipidomics methodology. The LC-Triple Quadruple-MS is the “work horse” for targeted lipidomics.

The growing interest in lipidomics is reflected by the increasing number of lipidomics projects undertaken by Metabolomics Australia. An exciting collaboration with the CSIRO on fruit

flies and Mycobacterium is using lipid profiling to understand genetic dysfunction in these model organisms. Another CSIRO collaboration is seeking to increase health-promoting lipids in crop plants.

Also on the agri-food front, the Australia Wine Research Institute’s ambitious project on wine yeast is being supported with analysis of the phospholipid profile of yeast at its different growth stages. This project is part of a Bioplatforms Australia-wide study aimed at integrating different ‘omics technologies to demonstrate and promote systems biology in Australia.

Lipidomics analysis is also serving a number of projects from academia and the commercial sector in the field of bio-fuel production from microalgae.

Biomedical-related projects are gaining prominence with particular emphasis on eicosanoid lipids which have been implicated in several different

diseases. A project with the Peter MacCallum Institute is investigating the role of eicosanoids in tumorogenesis. Metabolomics Australia is also profiling eicosanoids in muscles following the use of anti-inflammatory drug intervention in response to muscle damage and pain caused by resistance exercise. Important malaria projects are also underway to combine lipid profiling approaches with targeted lipidomic analysis of phospholipids, isoprenoids and sterols. This analysis aims to understand the role of lipids in malaria infection. Interest in the role of lipids in lung infections is also emerging.

As technological and bioinformatic advances continue, lipidomics will become increasingly critical to biological research and systems biology analysis.

For further information on the lipidomics services offered by Metabolomics Australia please contact Dr Ute Roessner at [u.roessner@unimelb.edu.au](mailto:u.roessner@unimelb.edu.au).

## ‘OMICS CLIENTS INCREASING

A key objective for Bioplatforms Australia is to increase the availability and use of world class ‘omics infrastructure.

Annual usage statistics collected from 2006/07, the year prior to Bioplatforms Australia being established, have been used to monitor access trends and gain feedback on BPA’s access initiatives. So far, the figures paint a positive picture in terms of increased use by both public and private research clients.

Data for 2009/10 represents the third full year of NCRIS funding and confirm an increase in client numbers and revenue. Last year, fee for service clients increased 43 per cent and totaled 76 per cent over the last three years. Figure 1 depicts the acceleration in client numbers since 2006/07, a likely reflection of the expansion in services and some positive momentum as awareness increases.

Figure 1: Client Numbers by Platform

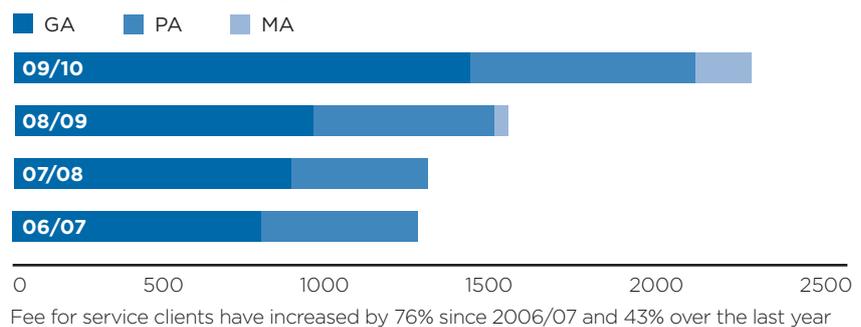
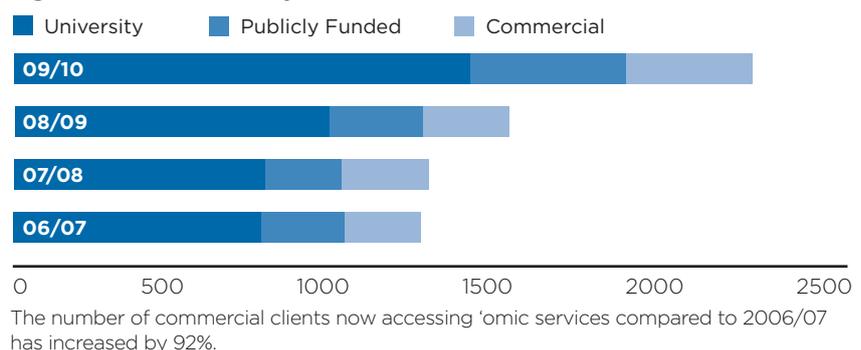


Figure 2: Client Numbers by Sector





## Bioplatforms Australia is pursuing a number of initiatives to broaden access and increase usage of its infrastructure network

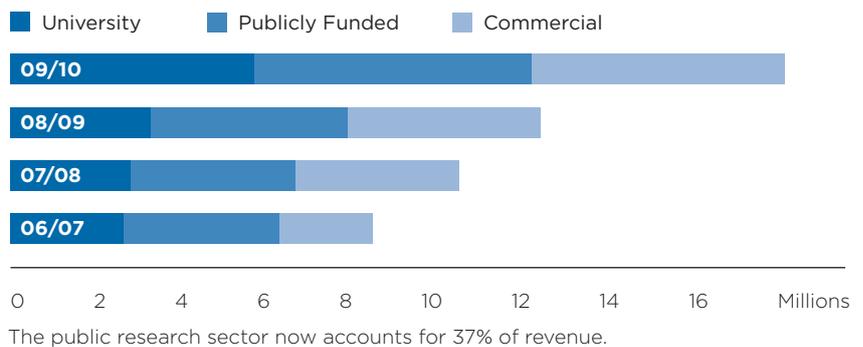
Universities are still the major users of 'omics services, however, commercial interest is growing. Notably, the number of commercial clients accessing 'omics services in the last year increased 92 per cent compared to that recorded in 2006/07.

Research services are predominantly provided to the biomedical/diagnostics sector which account for 62 per cent of clients. Agriculture, food and wine clients account for 33 per cent while environmental clients represent the smallest segment at five per cent. This industry break down changed little last year but data for the last three year shows that the agriculture/food/wine sector has grown by 121 per cent.

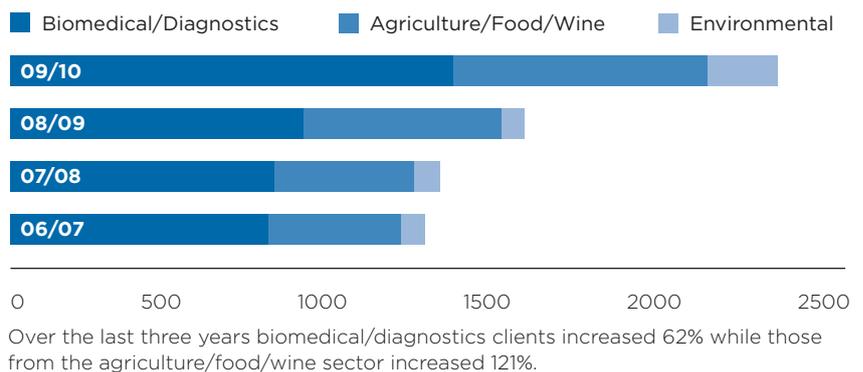
Bioplatforms Australia is pursuing a number of initiatives to broaden access and increase usage of its world class infrastructure network. All facilities are "not for profit" and charge services on a cost recovery basis. Meritorious Australian researchers receive discounted rates and are further encouraged with Access Vouchers providing \$10,000 grants for any 'omics service offered by BPA partners.

BPA regularly attends and sponsors 'omics orientated events, conferences and seminars to showcase platform capabilities to life science researchers. The exciting launch of its datasets initiative will continue to illuminate the potential of 'omics technologies while also creating a brand new resource for all researchers.

**Figure 3: Service Revenue by Sector and Year**



**Figure 4: Client Numbers by Discipline and Year**



## NEW WEBSITE

Metabolomics Australia has launched a new website at [www.metabolomicsaustralia.com.au](http://www.metabolomicsaustralia.com.au).



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