# Plant Mitochondria Research Tackles Food Shortages

**Like many countries across the globe, Australia is facing numerous environmental challenges that have the potential to cripple production of some of the world's most consumed foods. Land salinity is one such problem, where farm and grazing land is lost to increasing levels of salt. According to estimates by Australia's National Land and Water Resources, up to 6.3 million hectares of farmland in Western Australia could be at high risk of developing shallow saline water tables by the year 2050. This poses significant strain on crop production such as wheat, the third most abundant cereal produced in the world.**

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As changes in the environment drastically affect plant growth, which in turn directly impacts food sustainability, in 2011 Professor Harvey Millar's research team at the ARC Centre of Excellence in Plant Energy Biology at The University of Western Australia, embarked on a journey to build a tool to help pinpoint the changes inside plant cells that could impact their growth – in the form of the world's first plant protein monitoring database.

## Building the first plant protein monitoring database

With the help of Agilent Technologies' 1260 Infinity HPLC-Chip/MS System and its powerful OpenLAB software suite, Professor Millar and his team began running assays on thousands of proteins in the model plant Arabidopsis and hundreds of proteins in the major crop plant, wheat. The objective was to set up assays to analyse biochemical pathways and to study where, when, and how specific proteins were lost in genetically modified plant lines and in crops exposed to harsh environments including saline soils.

New results and findings made by the research team are managed by Agilent OpenLAB Enterprise Content Manager and documented in Agilent OpenLAB Electronic Lab Notebook (ELN). The ELN is a next generation electronic lab notebook that automates data capture, organizes results, and greatly improves the team's ability to search and share scientific results and findings. It also ensures intellectual property assets are protected. In essence, the software helps the team manage, store, and retain data from different researchers and also helps them to collaborate more efficiently.

## Targeted protein analyses ensure speed, accuracy and throughput

By establishing an electronic plant protein database, the team was able to conduct targeted protein analysis by repeatedly "dialing up" the mass and fragmentation properties of peptides from proteins in specific biochemical pathways, and across biological samples. In doing so, the analyses were more focused, allowed greater speed and higher throughput, and did not rely on random or chance occurrences which often see specific proteins of interest remaining unidentified in a given experiment.

In addition, this method enabled the team to pin down important biochemical pathways, which were later used in experiments to identify and confirm numerous proteins that have been lost or modified in specific genetically modified plant lines or in plants that have been exposed to harsh environments.

## Mitochondria are key targets for improving plant resilience

Over the years, by leveraging databases and through a combination of proteomics, metabolomics, and transcript analyses in different plant species, Professor Millar's team was able to identify and understand the proteins that make up different parts of the respiration machinery in mitochondria that provide energy for plants to grow - how they are assembled, how they are damaged by environmental stress, and how quickly specific proteins are turned over to make new mitochondria to power the next stage of plant development.

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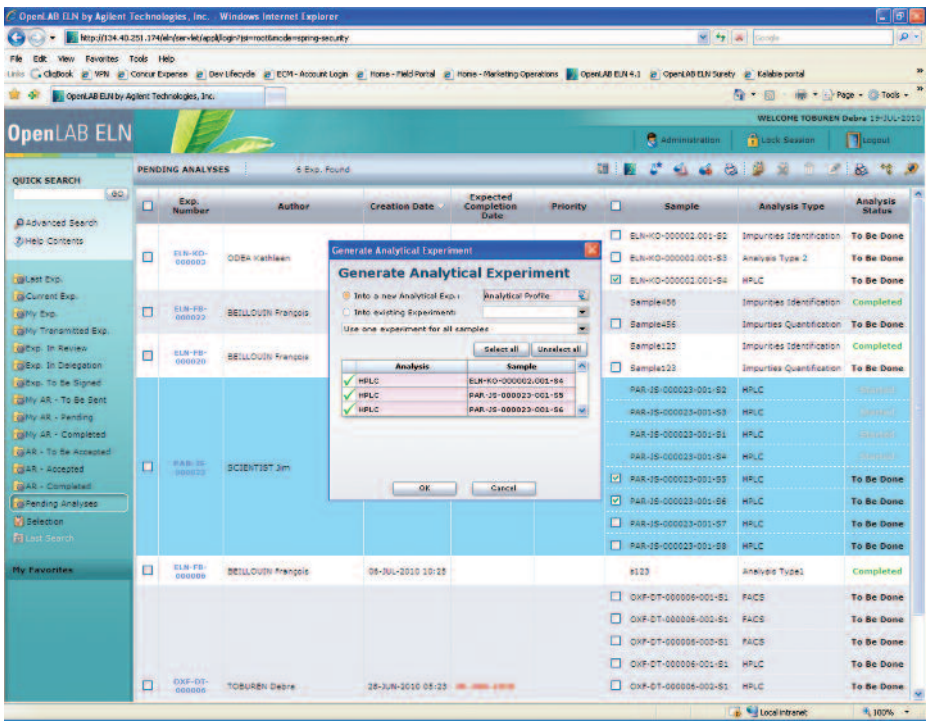


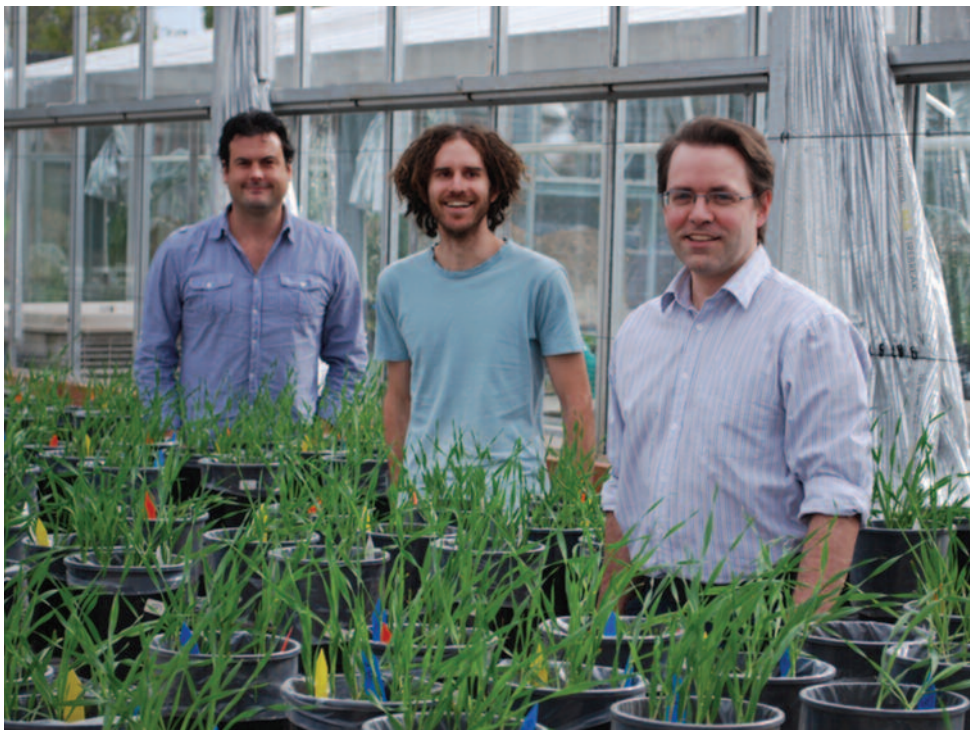

Their research has convinced the team that this organelle is a key target for improving the resilience of plants to grow in changing climates, and to predict how plants will respond to harsh environments.

## Increasing food sustainability in changing environments

Today, the team is studying how respiratory processes vary between plants adapted to different environments across the world, and how the regulation of respiration is being used in nature to control energy generation in plants.

On top of this, the research team is also looking at addressing and tackling looming environmental problems such as the response in rice to low phosphate conditions, as well as the response of wheat to soil salinity. This will have significant agricultural implications as phosphate fertilisers will run out in years to come and many saline regions are losing value as arable land.

Looking forward, Professor Millar is aiming to engage field trial studies for genetically modified crops, as well as continue his research in mitochondria to help plants navigate through the rapidly changing climate and environment.

Professor Millar's work has recently garnered international recognition and he became the first Australian scientist to win the prestigious Charles Albert Shull Award in the United States. The Charles Albert Shull Award recognises outstanding investigations in the field of plant biology by a scientist younger than 45. The Award was created in 1971 to honour a founding father of the American Society of Plant Biologists.

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